NOTICE

CERTAIN DATA CONTAINED IN THIS DOCUMENT MAY BE DIFFICULT TO READ IN MICROFICHE PRODUCTS.

TO : Files, Operations Division (THRU) R. P. Godwin, I. L. Lind and Donald G. Sturges

, 1952

FROM : K. F. Paulovich KFP

SUBJECT: 100 AREAS MONTHLY REPORT - JANUARY 1952

SYMBOL: ODP:KFP

PILE OPERATION

General

The maximum operating level attained in any one day during the month of January 1952 by each of the piles, and the corresponding equivalent percentage of the power level index, are as follows:

	B	D	DR	F	H
MWD	525	500	550	545	587
Percent	263	250	275	273	294

H pile established an individual new maximum operating level during the month. January 5 marked the occurrence of a new maximum of 2649 MWD for simultaneous five-pile total production, and a new maximum of 2670 MW for simultaneous five-pile combined power level. Despite the occurrence of twenty ruptured slugs during the month, total production for January was 62,515 MWD (104.2 percent of forecast).

In the past whenever an abnormal condition in the Panellit pressure monitoring system has resulted in an alarm, the pile operator has been forced to correct the condition and reset the Panellit trip within 20 seconds or manually shut the pile down by means of the #2 safety circuit (which actuates the horizontal rods only). Effective January 16 this operating procedure was modified at all piles. The operator must now correct the condition and reset the Panellit trip within 10 seconds or manually shut the pile down by means of the #1 safety circuit (which actuates all rods). The time delay period was reduced because calculations indicate that at the present power levels the aluminum slug jackets will begin to melt in less than 20 seconds after a complete loss of cooling water. (The 20 second

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time delay was originally based on a power level of 300 MW). The 10 second time delay procedure will remain in effect until an automatic 3-second time-delay relay, similar to the installation presently being tested at B pile (P.T. 105-502-E), can be incorporated in the #1 safety circuit at all piles.

In order to prevent uncontrolled boiling of water in pile process tubes, limitations on tube power output and water temperature rise have been established to insure sufficient header pressure to sweep out any steam formed. In the past these limitations varied only with header pressure and orifice size and were based on a conservative amount of film buildup, a 20°C inlet water temperature, and on the elevation of the top row of process tubes. In order to obtain more efficient utilization of the present header pressures, while still maintaining operational safety, revised temperature rise (boiling disease) limitations were made effective on January 30. The new temperature rise limits are based on actual film buildup (as indicated by Panellit pressure), actual inlet water temperature, and actual vertical location of the process tube, in addition to the header pressure and orifice size. In essence, this results in a separate temperature rise limit for each individual process tube. It is estimated that the revised limits will permit a 3-4 percent increase in power level at DR and H piles, currently operating on boiling disease limitations. This was evidenced by substantial power level increases at both DR and H piles at months end.

B Pile

During January B pile was shut down five times because of the following ruptured slugs:

Tube No.	Shutdown	Started to Power
2582	4:05 A.M., January 6	8:47 A.M., January 8
3688	5:32 P.M., January 10	5:58 P.M., January 10
2961	11:10 P.M., January 16	2:31 A.M., January 18
2669	6:49 A.M., January 25	7:12 A.M., January 25
0860	5:34 P.M., January 25	7:27 P.M., January 26

It was possible to immediately discharge process tubes 3688 and 2669 with the charging machine and resume operations within the scram recovery period. During the outage caused by the ruptured slug in tube 2582, the metal discharge for the month of January was accomplished. In addition, the #6 horizontal control rod thimble, which had been discovered leaking last month, was replaced and the #6 HCR was reinstalled. The rod was returned to service during the subsequent poison push outage.

On January 14 the 3-second time-delay relay setup in the Panellit pressure monitoring system was tied into the #2 safety circuit (P.T. 105-502-E). During the remainder of the month no unnecessary automatic pile shutdowns were caused by this installation.

When the metal column containing a ruptured slug in process tube 2961 could not be discharged with the charging machine, the slugs downstream of the ruptured slug were flushed out with 300 psi water pressure. Following this, excessive radioactivity readings prohibited rear face entry and led to the discovery that four slugs had been flushed onto the 20' catwalk. Apparently, due to the forward location of the ruptured slug (15th slug from the front), the last few downstream slugs flushed out had sufficient momentum to reach the catwalk. After considerable difficulty and time expended, two slugs were remotely washed into the basin with a high pressure fire hose and two slugs were remotely pushed into the basin with a long pipe.

On January 14 the #4 horizontal control rod was taken out of service so that its electrical drive system (originally installed to experimentally check the operation of H pile rods) could be replaced with a standard hydraulic drive mechanism. The electrical drive equipment was removed, decontaminated, and shipped to 189-D on January 23 for use on the horizontal control rod mockup. Installation of the hydraulic drive system was completed during the outage caused by the ruptured slug in process tube 0860. However, the #4 HCR was not returned to service when it was discovered that the rod could not be withdrawn from the pile properly because of faulty electrical wiring. This condition will be corrected during the next shutdown.

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D Pile

The following four ruptured slugs caused the shutdown of D pile during January:

Tube No.	Shutdown	Started to Power
0864	7:00 P.M., January 13	7:27 P.M., January 13
2462	11:22 P.M., January 15	11:48 P.M., January 15
0787	8:55 A.M., January 27	12:36 P.M., January 28
2777	6:08 A.M., January 30	6:28 A.M., January 30

It was possible to discharge three (0864, 2462, and 2777) of the four ruptured slugs with the charging machine and immediately resume operations within the scram recovery period. In order to remove the ruptured slug in tube 0787, it was necessary to remove the rear gunbarrel and push the process tube out the rear face with 27 upstream slugs still in the tube.

During the shutdown initiated on January 24 to conduct the January metal discharge (postponed from January 17) the D test hole thimble and assembly were removed as a unit. The test hole contained a faulty power-indicating ionization chamber (used in conjunction with the control room galvanometer setup). A new thimble and ionization chamber assembly were installed in the test hole. Upon startup, however, it was discovered that the ionization chamber should be inserted further into the unit to increase its sensitivity. An alternative ionization chamber located in the bottom of the pile is being utilized until the D hole chamber can be made useable. During the discharge outage an initial check of the #9 HCR, which has been binding of late, indicated that a new graphite track was needed. This repair work was postponed until the next available shutdown, and the rod was temporarily returned to service.

On January 29 the B horizontal control rod (#3) became badly lodged in the pile. Attempts to manually force the rod out of the unit were abandoned in order to prevent damage to the rod and guide. An effort to return the rod to service will be made during the next shutdown.

During the latter part of the month, it was discovered that the 60" reinforced concrete process water effluent line was leaking badly adjacent to the 107 retention basin entrance. Excavation

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in the vicinity of the leak exposed several serious circumferential cracks in the concrete pipe. At months end excavations were being made at two other locations in the line to determine whether the cracking is local in nature or exists the entire length of the line, necessitating extensive corrective measures.

DR Pile

On January 3 a loose junction was detected on the cold junction compensator in the Brown equipment which monitors the outlet water temperature of individual process tubes. It was discovered that because of this condition the Brown monitor was indicating erroneously high outlet water temperatures (approximately 4°C per tube) and effecting a needless reduction in pile power level (approximately 30 MW). Apparently this situation had existed since November 6, when the Brown instrument was last serviced, and was responsible for the reduced power levels of DR pile during November and December. Upon correction of the condition, it was possible to immediately increase the power level of DR pile to 550 MW before encountering water leak difficulties (3673).

During December DR pile was shut down for the following five ruptured slugs:

Tube No.	Shutdown	Started to Power
1471	10:10 P.M., January 3	10:40 P.M., January 3
3763	3:08 P.M., January 7	4:53 P.M., January 9
0978	8:52 P.M., January 11	1:15 P.M., January 12
1560	12:17 P.M., January 16	3:52 A.M., January 18
2076	3:02 P.M., January 28	3:35 P.M., January 28

It was possible to discharge process tubes 1471 and 2076 with the charging machine and resume operations within the scram recovery period.

On January 7 a loss of reactivity was noted, followed by high effluent water activity readings on 37 1/2 rear crossheader. Upon shutdown a ruptured slug, which apparently had swollen sufficiently to split the process tube and allow water to enter

the pile graphite, was located in process tube 3763. The metal column was backseated both from the rear and the front, but it proved impossible to flush out the downstream slugs with 395 psi water pressure. It was decided to transfer the slugs upstream of the ruptured slug to an adjacent process tube by means of the twin transfer cask. However, the twin transfer cask slipped off the high-lift during unloading operations, necessitating repairs and causing additional delay. When finally put into service, considerable difficulty was experienced with the cask and its use was ultimately abandoned when the cask spline broke off in the process tube.

It was then decided to push the process tube, with its entire charge of 64 slugs, out the rear face. The rear gunbarrel was removed to permit this, and the rear 8' section of process tube was remotely cut off with a torch. As the remainder of the tube was pushed out, it broke off in sections under the weight of the metal column. After some difficulty a new rear gunbarrel was installed, along with a new process tube, and the tube was recharged with metal.

After two unsuccessful startup attempts and the discharge of a total of 12 temporary poison columns, the pile was started to power at 1:23 P.M. on January 9, only to be scrammed 2:37 P.M. due to lack of scrammable control rod. Four additional temporary poison columns were charged and continued operations were finally resumed at 4:53 P.M. on January 9. An equilibrium power level of 150 was obtained, with 30 gallons of water being collected at the CO_2 driers on January 10 (no water collected in drip legs). From the startup performance it was estimated that over 1000 gallons of water were present in the pile graphite in the vicinity of process tube 3763 (equivalent to about 250 inhours).

Following the outage required to remove the ruptured slug from process tube 0978, two unsuccessful startup attempts and the discharge of a total of nine poison columns were required before continued operations were resumed at 1:15 P.M. on January 12. During the subsequent few days the DR pile reached a maximum power level of 300 MW, with a maximum of 23 gallons of water being extracted by the CO_2 driers on January 15.

During the shutdown caused by the ruptured slug in process tube 1560, the January metal discharge (postponed from January 15) was accomplished. A third improved charging machine (installed

on January 15), which can be elevated pneumatically to charge a second row of process tubes without raising the front face elevator, was employed satisfactorily during the discharge. In addition, a total of 14 process tubes in the upper near quadrant of the pile were checked for freedom of movement in the graphite. All moved freely, indicating that external galvanic corrosion of aluminum tubes in the presence of wet graphite had not yet caused binding of the tubes in the cold zone.

At the conclusion of the outage, three attempted startups and three poison pattern adjustments involving 6 temporary poison columns were necessary before the pile was started to power at 12:10 A.M. on January 18, followed by a scram due to insufficient control of excess reactivity. After charging three additional temporary poison columns, continued pile operation was finally resumed at 3:52 A.M. on January 18. The power level was gradually increased to a maximum of 400 MW, which was maintained for the remainder of the month. However, the water collection rate at the CO_2 driers averaged only approximately 20 gallons per day, for a total of only 366 gallons extracted since January 7.

In view of the extremely slow rate of water extraction, and in order to prevent excessive external corrosion of the aluminum process tubes resulting in additional water leaks in the upper near quadrant of the pile, it may be necessary to shut DR pile down for a few days in the near future. An attempt will then be made to heat up and dry out the cold portion of gtaphite by recirculating hot water through the process tubes. This can be accomplished by utilizing the recirculation equipment at DR to inject 8500 lbs./hr. of 225 psi steam into 2000 gpm of effluent water before returning it to the front face of the pile. This system will effectively double the residual heat (fission) in the pile.

During the outage caused by the ruptured slug in process tube 3763, investigation of the B hole leakage indicated that it was resulting from a bent flange and improper gasket seating. This situation was remedied and additional lead shielding was installed until the new B hole assembly installation can be completed at the next available shutdown.

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H Pile

A new maximum power level of 590 MW and a new maximum production rate of 587 MWD were achieved on January 31. The appreciable increase in power level at the end of the month resulted from revised water temperature rise (boiling disease) limits.

With the exception of the scheduled metal discharge on January 24, the H pile operated the entire month without incident at an equilibrium power level of 570 MW. During the discharge outage it was possible to remove two of the three cesium samples ledged in the B test hole facility. As a result of this, the level became highly contaminated making it difficult to operate the P-13 equipment upon startup. Also during the outage two new shields (consisting of iron, paraffin, boron, and cadmium components) were placed around the BF_3 proportional counter tubes installed on #23 rear crossheader. This was done to increase the reliability of the delayed neutron monitoring equipment (P.T.-105-446) in indicating ruptured slugs by reducing the neutron background.

F Pile

Six ruptured slugs caused the shutdown of F pile during January as follows:

Tube No.	Shutdown	Started to Power
2585	12:10 P.M., January 11	12:45 P.M., January 11
1166	6:00 A.M., January 12	9:25 A.M., January 13
2562	12:22 P.M., January 17	1:44 A.M., January 19
2082	7:44 P.M., January 26	12:02 A.M., January 28
0770	8:24 A.M., January 30	3:53 A.M., January 31
0666		

It was possible to discharge only process tube 2585 with the charging machine and resume operations within the scram recovery period.

During the outage caused by the ruptured slug in process tube 1166, gross spread of contamination occurred on the rear face when the process tube started to steam after the slugs downstream of the ruptured slug were flushed out with 75 psi water

pressure. Extensive decontamination of the rear face with chromic acid, Duponal, and water was required before startup at 9:25 A.M. on January 13. Insufficient control rod for turn-around caused the pile to be shut down from 12:47 P.M. to 4:53 P.M. for the addition of 6 poison columns.

The January metal discharge (scheduled for January 18) was accomplished during the outage caused by the ruptured slug in process tube 2562. The 4' section of #7 HCR thimble, which broke off in the pile during removal operations last month, was extracted and the control rod channel was temporarily blocked off with shielding. In addition, the graphite burnout samples were removed from process tube 2777, and new graphite samples were inserted in tubes 2682 and 2777. In conjunction with the exposure of these new burnout samples under P.T.-105-435, the maximum pile graphite temperature limit at F pile has been increased to 450°C.

Several Van Stone flanges were checked for tightness and splits during the 2082 outage. After the ruptured slug was removed from process tube 0770, a second ruptured slug was discovered in tube 0666 while inspecting additional rear Van Stone flanges. In addition, a new thimble was installed for the #7 HCR and the rod was returned to service during the outage.

During January the amount of water collected in the CO_2 driers at F pile gradually decreased from approximately 40 gals./day to an average of 5-10 gals./day. No water was collected in the drip legs. It is believed that essentially all the water originating from leaking process tubes in the lower far quadrant has now been removed from the pile.

A temporary increase in Panellit pressure, indicating the buildup of film in the fringe zones, was noted at F pile during the first week in January. This was accompanied by a decrease in process water flow and a gradual increase in Fe concentration. It is not known whether this condition has been due to the incorporation of activated silica in the process water treatment on December 28, or due to plugged screens caused by a purge of the pile on the same date. During the latter part of the month a slight increase in Panellit pressure was again noted for fringe zone tubes.

RUPTURED SLUGS

Twenty instances of in-pile uranium slug failures occurred during January, bringing the total number to date to 127. The attached table presents all data available at months end regarding these twenty ruptured slugs. It was possible to successfully discharge eight of these ruptured slugs with the charging machine and resume operations within the scram recovery period. Four group 8 slugs were included in the slug failures during January, bringing the total number to date to fourteen.

PRODUCTION TESTS

435 - Graphite Burnout and Transport

Graphite samples exposed to controlled atmospheres of N_2, CO, CO_2 and (95% CO_2 + 5% CO) were removed from process tube 2777 during the January 18 discharge at F pile. The samples were originally scheduled to be maintained at a nominal temperature of 410°C. However, due to the extended water leak difficulties experienced at F pile during the exposure period, the samples were actually subjected to extremely erratic temperature conditions. Consequently, it is doubtful whether consistent data will be obtained when the samples are analyzed after a suitable decay period.

Process tube 2777 (controlled atmospheres) and tube channel 2682 (pile atmosphere) were also recharged with new graphite samples during the January 18 outage. These samples are scheduled to be maintained at the highest equilibrium temperature obtainable (probable about 425°C) without exceeding a maximum pile graphite temperature of 450°C.

473 - Alum and Activated Silica Water Treatment

The alum and activated silica water treatment, which was initiated at F area on December 28, has increased the length of filter runs from 12 hours to 32 hours. The filters, which were designed for a capacity of 2.6 gpm/sq. ft. (1156 sq. ft.) and which reached a maximum of 2.8 gpm/sq. ft. with the former ferric sulfate treatment, are currently operating at a maximum of 4.45 gpm/sq. ft. with the alum and activated silica treatment. Only eight of the twelve filters at F area are now required to filter the process water for F pile. Further

reduction is limited only by the 5000 gpm hydraulic capacity of the filter system and not by the capacity of the filters proper. It is anticipated that this marked increase in filter capacity will not be materially reduced during the high turbidity period of the Columbia River this spring.

502E - Automatic Time-Delay Relay for Panellit System Alarm

The Microflex mechanical 3-second time-delay relay setup installed in the Panellit pressure monitoring system at B pile was tied into the #2 safety circuit on January 14. At months end the 3-second time-delay relay installation was operating satisfactorily and had caused no unnecessary automatic pile shutdowns. When it became necessary to shut B pile down on January 25 because of a ruptured slug (0860), the operation of the time-delay relay system was successfully checked. When the gauge was tripped for one second, no scram resulted; but when the gauge was tripped for three seconds, the pile was scrammed with the #2 safety circuit.

It is planned to tie the three-second time-delay relay into the #1 safety circuit during the next available shutdown at B pile. If this arrangement functions equally satisfactorily, a time-delay relay installation similar to the one at B pile will be incorporated in the #1 safety circuit of the other piles. Work is also in progress on the development of a time-delay relay which operates on the principle of magnetic flux decay. This type relay possesses the advantage of no moving parts and would be more fail-safe than the mechanical type.

PROCESS DEVELOPMENTS

Critical Y Power Condition

On January 22 a meeting was held to discuss the possibility of revising the operating procedure for critical Y power conditions (loss of backup electrical facilities) in an attempt to reduce pile outage time. The 35 critical Y power conditions (exclusive of individual area conditions) which have occurred on the Hanford and BPA systems since startup in 1944 are as follows:

	Hanford		BPA	
	Short (less than 25 min. duration)	Long	Short	Long
Operational errors	1	1	3	0
Equipment failures	4	3	3	1
Lightning	0	0	1	7
Transmission Line Failures	2	6	1	0
System Overload	0	0	1	1
	7	10	9	9

This includes four critical Y power conditions which occurred during 1951. Wooden pole fires caused two Hanford critical Y conditions; one operational error and one low voltage condition resulted in two BPA critical Y conditions.

Bonding of dead-end pole structures has eliminated all dead-end wooden pole fires in the Hanford system. Consequently, it is felt that the current program of binding all tangent wooden pole structures (to be completed in February) should completely eliminate the major cause of Hanford critical Y conditions.

It was agreed that in those instances of critical Y power conditions not involving serious voltage and/or frequency fluctuations when the balance of the Hanford and BPA systems are functioning satisfactorily, the exposure to complete loss of power is not greater than under the present critical W condition (planned removal of backup electrical power). Hence, it was decided to recommend a revision to the present critical Y operating procedure which will allow the piles to continue operation on an alert basis during these special power conditions.

Water Quality

Tests have been initiated in the 105-D flow laboratory to study the effect of process water pH on film formation and slug corrosion. Filtered process water minus sodium dichromate is being employed to obtain data at 65°C and 90°C with pHs of 6.2, 6.7, 7.2, and 7.7. These data will permit the selection of the optimum pH for filtered process water without sodium dichromate.

External Process Tube Corrosion

Examination of the process tubes removed from the lower far quadrant of F pile (location of recent water leak difficulties) has led to the following observations:

(1) A film of external corrosion products (mainly iron and aluminum oxides) was observed on that portion of the process tubes located in the rear gunbarrel and extending as far as 6 1/2' into the graphite. Pitting attack was observed under the corrosion products with a maximum pit depth of 29 mils.

(2) Beyond 14-15' from the rear face, the tubes were free of external corrosive attack.

(3) Cracking and pitting attack was observed on all Van Stone flanges.

Laboratory tests supporting the examination of process tubes from F pile revealed the following:

(1) 2S Al corrodes sacrifically to graphite at temperatures from 20°C to 78°C. This anodic tendency increases with temperature.

(2) 2S Al coupled to graphite in tap water at room temperature suffers pitting attack.

(3) 2S Al coupled to graphite in boiling tap water corrodes at a greater rate (weight loss basis) than at room temperature, but no pitting occurs.

Galvanic couples of 2S Al and graphite are being tested at several temperatures to determine at what temperature pitting attack ceases and general corrosion commences.

3 Encl.
1. Comparative Pile Performance
2. Pile Outage
3. Tabulation of Ruptured Slugs

PAULOVICH/ww

Distribution:
Cy 1 - Addressee
2 - K. F. Paulovich

PILE OUTAGE - JANUARY 1952
(Hours)

	B	D	DR	F	H	Total
Metal Discharge	21.4	41.7		16.8	12.0	91.9
Ruptured Slug Removal	80.0	30.9	107.9	92.6		311.4
Reactor Maintenance	2.0			7.5	7.2	16.7
Production Tests (except P-13)				4.5	1.5	6.0
Special Irradiations	8.0			2.0	3.5	13.5
Total Hours	111.4	72.6	107.9	123.4	24.2	439.5

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COMPARATIVE PILE PERFORMANCE

PILE	B	D	DR	F	H	TOTAL
Initial Startup Design Power Level	9-26-44 250	12-17-44 250	10-3-50 250	2-25-45 250	10-20-49 400	
Days Since Startup	2684	2602	485	2532	834	
Maximum Power Level Attained to Date (MW)	525	515	560	555	590	2745
Maximum Power Level During Month (MWD)	525	500	550	545	587	
Average Operating Level During Month (MW)[1]	440	462	361	451	559	457
~~Percent of Design Power Level[2]~~						
Outage Hours During Month	111.4	72.6	107.9	123.4	24.2	439.5
Time Operated Efficiency (%)[3]	85.0	90.2	85.5	83.4	96.7	83.2
MWD Produced During Month Plutonium	11,598	12,926	9,565	11,651	16,775	62,515
~~[redacted]~~						
MWD Discharged During Month Plutonium	10,662	15,196	13,519	12,054	10,150	61,581
~~[redacted]~~						
MWD In Unit Plutonium	74,273	71,611	76,548	66,996	81,271	370,699
~~[redacted]~~						
Tons of Metal Discharged During Month	18.70	24.43	23.96	21.20	16.68	104.97
Tons of Metal Charged During Month	18.44	24.43	24.34	21.32	16.69	105.22
Tons of Metal In Unit	244.35	243.47	245.61	233.21	245.89	1212.53
Average ~~Product~~ Discharge Concentration (MWD/T)	570	622	564	569	609	587

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PILE	B	D	DR	F	H	TOTAL
Scheduled Shutdowns	0	1	0	0	1	
Carbon Dioxide Concentration (%)[4]	98.0	95.0	96.4	87.2	90.8	
Highest Graphite Temperature Recorded During Month (°C)	378	382	324	411	368	
Outlet Water Temperature (°C)[2] ~~(Average of 10 Hottest Tubes in Central Zone~~	59.9	54.7	42.8	59.0	55.5	
Inlet Water Temperature (°C)[2]	7.0	4.9	4.3	4.0	4.2	
Process Water Flow (gpm)[2]	36,432	37,590	40,216	36,721	42,644	
Maximum Effluent Water Activity (mrep/hr During Month	10.8	8.8	9.2	12.2	10.9	

1) Average Operating Level = $\frac{\text{MWD X 24}}{\text{Hours Operated}}$

~~2) Percentage of Design Power Level = Average MWD / Days in Month (Design MWD)~~

3) Time Operating Efficiency = $\frac{\text{Hours Operated}}{\text{Total Hours}}$

4) Months End Data

2) Average of Last 5 Days of Equilibrium Operation

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TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstance Shutdown and R
108	1471-DR	1) 4-12-51 2) 5-9-51 3) 1-3-52	239	374		584	525			61	.1	High exit water a Discharged with c machine - Resumed in scram recovery
109	2582-B	1) 2-23-51 2) 4-3-51 3) 1-6-52	278	348	5.9	589	525			1858	3.5	High effluent wat - Metal column di with 350 psi wate and hydraulic jac
110	3763-DR	1) 4-23-51 2) 5-9-51 3) 1-7-52	243	362	6.1	537	550	48	52	6537	11.9	Loss of reactivit exit water activi stuck, resulting tube - Entire met discharged in sec process tube - Re barrel removed.
111	3688-B	1) 2-5-51 2) 2-19-51 3) 1-10-52	325	269		523	400	20-25		29	.1	High exit water a Discharged with c machine - Resumed in scram recovery
112	2585-F	1) 3-8-51 2) 4-11-51 3) 1-11-52	275	304	5.9	497	545	42	66	26	.04	High exit water a Discharged with c machine - Resumed in scram recovery

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TABULATION OF RUPTURED URANIUM SLUGS

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		61	.1	High exit water activity - Discharged with charging machine - Resumed operations in scram recovery period.	Cap failure.	MRG 4-12-51 Truck 12 &	
		1858	3.5	High effluent water activity - Metal column discharged with 350 psi water pressure and hydraulic jack.	Cap failure.	ZRG 2-23-51 Truck 1 &	
48	52	6537	11.9	Loss of reactivity and high exit water activity - Slug stuck, resulting in split tube - Entire metal column discharged in sections of process tube - Rear gun-barrel removed.	End cap separated from slug.	ZRG 4-23-51 Truck 5 &	
20-25		29	.1	High exit water activity - Discharged with charging machine - Resumed operations in scram recovery period.	Small crack in can at base of end cap.	MRG 2-5-51 Truck 4 &	
42	66	26	.04	High exit water activity - Discharged with charging machine - Resumed operations in scram recovery period.	End cap bulged - Split around base of cap and down side of can sidewall.	MRG 3-8-51 Truck 6 &	

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TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstance Shutdown and R
113	0978-DR	1) 6-23-51 2) 7-16-51 3) 1-11-52	179	349	6.6	426	150	44	46	100	.7	High exit water Aft section of pi deribbed to perm
114	1166-F	1) 4-17-51 2) 5-8-51 3) 1-12-52	249	401	7.2	454	545	48	63	1470	2.7	High exit water Metal column dis with 75 psi wate and charging mac face contaminate
115	0864-D	1) 1-9-51 2) 4-18-51 3) 1-13-52	270	318		478	500			54	.1	High exit water Discharged with machine - Resume in scram recover
16	2462-D	1) 4-3-51 2) 4-18-51 3) 1-15-52	272	342		550	500			44	.1	High exit water Discharged with machine - Resum in scram recove
117	1560-DR	1) 4-11-51 2) 5-9-51 3) 1-16-52	252	353	7.6	520	300	30	29	530	2.0	High exit water Downstream sect process tube de permit removal.

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TABULATION OF RUPTURED URANIUM SLUGS

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
44	46	100	.7	High exit water activity - Aft section of process tube deribbed to permit removal.	Split originating at bottom of can and extending almost entire length of can.	ZRG 6-23-51 Truck 6 & Group 8 Slug	
48	63	1470	2.7	High exit water activity - Metal column discharged with 75 psi water pressure and charging machine - Rear face contaminated.	End cap off - Portion of exposed end of slug missing.	ZRG 4-17-51 Truck 1 &	
		54	.1	High exit water activity - Discharged with charging machine - Resumed operations in scram recovery period.	Crack at base of end cap extending 3/4 circumference of can.	ZRH 1-9-51 Truck 3 &	
		44	.1	High exit water activity - Discharged with charging machine - Resumed operations in scram recovery period.	Split extending 1/2 way around cap base and 1/2 way down side of can	MRG 4-3-51 Truck 2 &	
30	29	530	2.0	High exit water activity - Downstream section of process tube deribbed to permit removal.	Uranium split failure.	MRG 4-11-51 Truck 9 &	

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TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstance Shutdown and F
118	2961-B	1) 4-5-51 2) 5-16-51 3) 1-16-52	245	247	3.9	487	500	15	13	1190	2.4	High exit water a Slug stuck, remov section of proces 4 slugs flushed o face catwalk.
119	2562-F	1) 2-27-51 2) 4-11-51 3) 1-17-52	281	359	7.0	508	500	22	20	207	.44	High exit water a Downstream sectio cess tube deribbe permit removal.
120	2669-B	1) 4-28-51 2) 5-16-51 3) 1-25-52	254	342	5.4	564	520			21	.04	High effluent wat - Discharged with machine - Resumed within scram recc
21	0860-B	1) 12-26-50 2) 2-7-51 3) 1-25-52	352	249	5.4	511	520	35	37	1329	2.7	High exit water Aft section of deribbed to per
122	2082-F	1) 4-14-51 2) 5-8-51 3) 1-26-52	263	386	6.5	476	540	48	60			High effluent wat - Aft section of tube deribbed to removal.

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TABULATION OF RUPTURED URANIUM SLUGS

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Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
5	13	1190	2.4	High exit water activity - Slug stuck, removed in section of process tube - 4 slugs flushed onto rear face catwalk.	Cap failure.	ZRG 4-5-51 Truck 2 &	
	20	207	.44	High exit water activity - Downstream section of process tube deribbed to permit removal.	Wedge-shaped split extending completely through slug.	MRH 2-27-51 Truck 1 &	
		21	.04	High effluent water activity - Discharged with charging machine - Resumed operations within scram recovery period.	Cap failure.	MRG 4-28-51 Truck 9 & Group 8 Slug	
	37	1329	2.7	High exit water activity - Aft section of process tube deribbed to permit removal.	Two horizontal splits on opposite sides of can extending almost full length of slug.	MRG 12-26-50 Truck 10 &	
	60			High effluent water activity - Aft section of process tube deribbed to permit removal.	End cap separated from slug - Portion of exposed end of metal missing.	MRG 4-14-51 Truck 10 &	

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TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances Shutdown and Re
123	0787-D	1) 2) 3-7-51 3) 1-27-52	326	291	6.2	461	305	28	27	71	.3	High effluent wate - Slug stuck - Tub out rear with upst in tube - Rear gui removed.
124	2076-DR	1) 4-30-51 2) 6-6-51 3) 1-28-52	236	356		537	400			40	.1	High exit water ac Discharged with ch machine - Resumed within scram recov
125	2777-D	1) 2) 5-23-51 3) 1-30-52	252	335		524	400					High exit water ac Discharged with ch machine - Resumed within scram recov
126	0770-F	1) 8-23-51 2) 9-18-51 3) 1-30-52	134	354	6.9	218	330	43	51			High exit water ac Metal column disch with hydraulic jac difficulty.
127	0666-F	1) 1-23-51 2) 2-21-51 3) 1-30-52	343			496	330					Discovered during for 0770 while in rear Van Stone fl Discharged with c machine

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TABULATION OF RUPTURED URANIUM SLUGS

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
28	27	71	.3	High effluent water activity - Slug stuck - Tube pushed out rear with upstream slugs in tube - Rear gunbarrel removed.	Not yet examined.		
		40	.1	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period	Cap failure	MRC 4-30-51 Truck 6 & Group 8 slug	
				High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period	Not yet examined.		
43	51			High exit water activity - Metal column discharged with hydraulic jack without difficulty.	Slug split diagonally into two separate pieces.	124.T B-2 8-23-51 & Group 8 Slug	
				Discovered during outage for 0770 while inspecting rear Van Stone flanges - Discharged with charging machine	Cap failure.	ZRH 1-23-51 Truck 10 &	

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STANDARD FORM NO. 64

Office Memorandum • UNITED STATES GOVERNMENT

TO : Files, Operations Division (THRU) R. L. Plum, I. L. Lind and Donald G. Sturges

DATE: March 7, 1952

FROM : K. F. Paulovich KFP

SUBJECT: 100 AREAS MONTHLY REPORT - FEBRUARY 1952

SYMBOL: OOP:KFP

PILE OPERATION

General

The maximum operating level attained in any one day during the month of February 1952 by each of the piles, and the corresponding equivalent percentage of the power level index, are as follows:

	B	D	DR	F	H
MWD	542	525	560	575	602
Percent	271	263	280	288	301

All five piles established individual new maximum operating levels during the month. February 24 marked the occurrence of a new maximum of 2704 MWD for simultaneous five-pile total production, and a new maximum of 2785 MW for simultaneous five-pile combined power level. Despite the occurrence of 17 ruptured slugs during the month, total production for February was 61,020 MWD (106.7 percent of forecast). This represents a new per diem maximum production of 2104 MWD/day.

During the month an automatic 3-second time-delay relay similar to the equipment successfully tested at B pile (P.T.-105-502-E) was installed at all piles in the Panellit pressure monitoring system and tied into the No. 1 safety circuit. At months end only one automatic Panellit scram had occurred (at H pile on February 20) and it would have been necessary under the former 20-second manual scram system.

B Pile

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A new maximum power level of 545 MW was first attained on February 2, with a new maximum production rate of 542 MWD achieved on February 29.

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The significant increase in power level at B pile during February resulted from poison pattern adjustments during the January 25 outage, revised delta temperature limits, and a 10°C reduction in the graphite temperature indicated by thermocouple 13 G. In the past, this thermocouple has consistently indicated an excessively high graphite temperature when compared with data from adjacent VSR thimble thermocouples and calculated graphite conductances. Consequently, it was arbitrarily decided to reduce by 10°C the graphite temperature reading of thermocouple 13 G, which has been and still is limiting the power level of B pile. It is anticipated that additional poison pattern adjustments during the first shutdown in March will result in the pile operating primarily on boiling limits at an increased power level.

During the shutdown initiated on February 5 for the February metal discharge, the automatic 3-second time-delay relay setup in the Panellit pressure monitoring system was removed from the #2 safety circuit and incorporated in the #1 safety circuit. The #22 vertical safety rod thimble was removed and another pile thermocouple-equipped thimble was installed in VSR channel #22. The faulty electrical wiring of the #4 horizontal control rod was remedied and the HCR was returned to service.

During the outage, performance tests were also conducted on one of the 230' head, 10,000 gpm process water pumps located in 183-B before representatives of du Pont, Gibbs and Hill, and Allis-Chalmers. In addition, a leaking thermocouple well in D riser was repaired and a sturdier rear face catwalk shield was installed. The pile was started to power at 10:18 P.M. on February 6. After reaching a power level of 110 MW while purging at 350 psi, the pile was scrammed at 10:33 P.M. because of momentarily low process water pressure. After unsuccessfully investigating the cause of the low water pressure trip and checking several vertical safety rods which stuck during the scram, operations were finally resumed at 11:47 P.M. on February 6.

B pile was shut down three times during February because of the following ruptured slugs:

Tube No.	Shutdown	Started to Power
1090	3:05 A.M., February 3	3:32 A.M., February 3
4186	11:42 P.M., February 12	2:13 A.M., February 14
4283	3:08 A.M., February 16	3:31 A.M., February 16

It was possible to immediately discharge process tubes 1090 and 4283 with the charging machine and resume operations within the scram recovery period. During the outage caused by the ruptured slug in process tube 4186, the front and rear Van Stone flanges on approximately 25 process tubes were inspected for pitting corrosion. Also, an attempt to install a new process tube in channel 2961 (January rupture) was unsuccessful because of binding in the front gunbarrel.

On February 28, 255 cubic feet of helium were introduced into the CO_2 pile atmosphere system at B pile in order to experiment with the detection of pile gas leakage by means of He leak detection equipment. The addition of He to the pile atmosphere resulted in a slight loss of reactivity, a slight decrease in graphite temperature, and a slight decrease in the percentage of CO.

D Pile

A new maximum power level of 525 MW was first reached on February 11 and a new maximum production rate of 525 MWD was established on February 12.

The increase in power level at D pile was due to poison pattern adjustments, revised delta temperature limits, and a 10°C reduction in the graphite temperature indicated by thermocouple 14 G. In the past, this thermocouple has consistently indicated an excessively high graphite temperature when compared with data from adjacent VSR thimble thermocouples and calculated graphite conductances. Consequently, it was arbitrarily decided to reduce by 10°C the graphite temperature reading of thermocouple 14 G, which has been limiting the pile power level.

During the scheduled metal discharge conducted on February 15, an unsuccessful attempt was made to remove the tip of the B horizontal control rod (which became lodged in the pile on

January 29) from its thimble. The badly damaged control rod was sawed off flush with the face of the unit, and a blank flange and temporary lead and masonite shielding were placed over the thimble. It is planned to remove the lodged rod tip and thimble as a unit during the next available shutdown. Several Van Stone flanges were inspected during the outage and process tube 4055 was discharged prematurely when a high rear pigtail reading indicated a possible ruptured slug.

Only one ruptured slug caused the shutdown of D pile during February, as follows:

Tube No.	Shutdown	Started to Power
1057	5:10 A.M., February 18	6:15 A.M., February 19

During the outage resulting from the ruptured slug in tube 1057, process tube 1971 was discharged with the charging machine when a high rear pigtail reading was noted, indicating a suspected ruptured slug. However, at months end a ruptured slug from tube 1971 had not yet been discovered in the basin. An automatic 3-second time-delay relay was installed in the Panellit pressure monitoring system and tied into the #1 safety circuit during the outage, but was not bypassed until February 22. In addition, a new process tube was installed in channel 0557 and several Van Stone flanges were inspected.

The D pile was shut down from 6:59 A.M. to 7:05 A.M. on February 19 when a low pressure Panellit alarm would not reset in 10 seconds because of a faulty gauge (0557).

Additional excavations along the 60-inch reinforced concrete process water effluent line indicated that the pipe was not leaking between the pile and the vent, but was leaking along the entire length of line between the vent and the retention basin. Consequently, it will be necessary to replace this section of the concrete effluent line (approximately last 500 feet) with a steel pipe as soon as possible.

During February high air activity readings were experienced in the storage basin area of D pile. Increased air flow through the storage area resulted in only a slight decrease in the activity. The condition is apparently being caused by backup from the D-DR effluent tie-in, because whenever DR pile is not operating, the activity disappears. The same situation existed temporarily in the spring of 1951.

DR Pile

A new maximum power level of 575 MW was achieved on February 24, due primarily to the revised boiling disease limitations made effective on January 30 and to the removal of essentially all the water in the upper near quadrant of the pile graphite.

The following six ruptured slugs caused the shutdown of DR pile during February:

Tube No.	Shutdown	Started to Power
1774	6:50 A.M., February 2	5:43 A.M., February 3
1875	7:53 A.M., February 7	7:54 A.M., February 8
1871	5:10 P.M., February 14	5:35 P.M., February 14
1058	5:06 A.M., February 15	7:12 A.M., February 17
2064	2:49 A.M., February 21	2:20 A.M., February 22
1860	7:45 P.M., February 25	6:31 P.M., February 26

It was possible to discharge only process tube 1871 with the charging machine and resume operations within the scram recovery period.

During the outage caused by the ruptured slug in process tube 1774, the orifices of 24 process tubes in the upper near quadrant of the pile (cold wet zone resulting from the failure of process tube 3763 in January) were reduced from .285" to .140", along with the associated Panellit gauge changes, in an effort to heat up the surrounding graphite by reducing the cooling water flow. In addition, several rear and front face Van Stone flanges were inspected. After one unsuccessful startup attempt and the discharge of three tubes (two solid Al, one P-10), the pile was started to power at 5:48 A.M. on February 3. However, it was necessary to shut the pile down from 7:58 A.M. to 9:45 A.M. to charge three temporary and one permanent poison columns, and again from 12:35 P.M. to 2:03 P.M. on February 4 to discharge three temporary poison columns before continued operations were resumed.

The DR pile was manually scrammed with the No. 1 safety circuit at 12:37 P.M. on February 5 when a Panellit pressure monitor alarm caused by gauge oscillation could not be reset within 10 seconds. Operations were resumed in 6 minutes.

During the outage caused by the ruptured slug in tube 1875, the metal discharge for the month of February was partially accomplished. A new flange was welded on the B test hole thimble, the thimble was pressure tested, cooling water piping was connected, and the B hole installation was completed. The pile was started to power at 7:54 A.M. on February 8. However, it was necessary to shut the pile down from 10:28 A.M. to 11:45 A.M. to charge four temporary poison columns and again from 4:45 P.M. to 6:18 P.M. on February 9 to discharge these four poison columns before continued operations were resumed.

When the ruptured slug in process tube 1058 could not be moved after the downstream slugs had been flushed out, the rear gun-barrel was removed and the process tube was pushed out the rear face with the remaining 22 slugs in the tube. The single channel experimental setup for Project Bluenose (P.T.-105-507-A) was installed in process tube 3577 to accurately determine the total integrated exposure of a process tube containing a normal metal loading. The orifices in the special .140" zone (24 tubes in the upper near quadrant) were replaced with .285" orifices, inasmuch as the outlet water temperature of these tubes became limiting on February 11 and necessitated a reduction in pile power level from 510 MW.

The remainder of the February metal discharge was also conducted during the 1058 outage. After approximately 2/3 of the slugs in process tube 3379 had been normally discharged, the metal column stuck in the tube with a slug situated on the discharge tipoff. The slug on the tipoff was flushed into the basin. Nevertheless, excessive radioactivity readings were still experienced in the rear face area, due partially to six other process tubes with rear caps removed preparatory to discharge. It was decided to utilize the services of the tool dolly for the first time. It was possible to remove the tipoff from tube 3379, backseat the metal charge, and cut off the rear pigtail with the tool dolly before difficulty was encountered with the discharge elevator. Because of a short in the control circuit, the elevator began to creep slowly upward when the emergency stop button was not continuously held down. This upward movement broke a hydraulic hose coupling on the tool dolly, rendering it temporarily useless. The remaining slugs in tube 3379 were discharged with a long push pole, which contaminated the charge elevator upon removal into the work area. Process tube 3379 was then replaced with a new tube and charged with regular metal. Pile startup was delayed an additional hour because of a temporary discrepancy of two slugs in the cold metal inventory in the work area.

After unsuccessfully attempting to discharge the ruptured slug in process tube 2064 with the charging machine, it was noted that the outlet water temperature began to rise rapidly. The cooling water flow through tube 2064 was increased sufficiently above 60 inches to reduce the outlet tube temperature. The front and rear caps were then put on the tube again. Shortly thereafter excessively high activity was noted in the rear face area, with readings of 75R experienced at the labyrinth exits. The downstream dummies had apparently been flushed out of the tube by the increased water flow prior to replacing the tube caps, thereby allowing part of the metal column to subsequently wash down against the rear cap. A spline was inserted 41'-10" into the process tube from the front face and the slugs were pulled from the rear cap toward the front. The rear cap was once again removed from the tube. After the free downstream slugs were flushed out and the rear gunbarrel was removed, process tube 2064 was pushed out the rear face with the remaining upstream slugs in it. The tube channel was blanked off with grooved steel dummies inserted in it and temporary shielding installed. During the 2064 outage an automatic 3-second time-delay relay was installed in the Panellit pressure monitoring system and tied into the No. 1 safety circuit.

After the slugs downstream of the ruptured slug in tube 1860 were flushed out with 400 psi water pressure, the process tube was pushed out of the rear face of the pile with the upstream slugs still in the tube, without removing the rear gunbarrel. Process tube 1860 was replaced with a new tube and charged regular. During the outage an unsuccessful attempt was made to repair some of the inoperative graphite thermocouples. Thermocouples 11, 12, 13, 14, and 15 G were traced back to the junction box. It was felt that these thermocouples, and possibly all the graphite thermocouples, might be repaired if the sealing wax were melted and the box detached from the unit. This work will continue at the next available shutdown.

The water collection rate at the CO_2 driers averaged approximately 20 gallons per day during February, bringing the total amount of water extracted from the pile graphite since January 7 (failure of process tube 3763) to 845 gallons. By months end the cold wet zone in the upper near quadrant of DR pile had effectively disappeared.

H Pile

A new maximum power level of 605 MW was first attained on February 25 with a new maximum production rate of 602 MWD achieved on February 26. The appreciable increase in power level resulted from the revised delta water temperature limits made effective January 30 and poison pattern adjustments accomplished during the February 18 outage.

The H pile was shut down (manually with No. 1 safety circuit) from 4:07 A.M. to 4:18 A.M. on February 12 when a Panellit pressure monitor alarm caused by a defective gauge (1180) could not be reset in 10 seconds, and again from 1:50 A.M. to 2:20 A.M. on February 16 when a Panellit alarm caused by a faulty relay could not be reset in 10 seconds. The automatic time-delay relay (installed February 18) scrammed H pile at 6:54 P.M. on February 20 when a Panellit alarm caused by a faulty relay would not automatically reset in 3 seconds. Operations were resumed in 12 minutes.

Two ruptured slugs caused the shutdown of H pile during February, as follows:

Tube No.	Shutdown	Started to Power
2180	12:02 P.M., February 2	12:07 P.M., February 3
3465	3:50 P.M., February 15	4:23 P.M., February 15

It was possible to discharge the ruptured slug in process tube 3465 with the charging machine and resume operations within the scram recovery period.

A rapid loss of reactivity, indicating a probable process tube leak, occurred at H pile at 9:00 A.M. on February 2. The power level of the pile was maintained as high as possible while taking a temperature traverse and collecting other data which would assist in locating the leak. A rear face pigtail survey conducted after shutdown indicated a ruptured slug in process tube 2180, which could not be discharged with the charging machine. The rear gunbarrel was removed and the process tube was pushed out with the entire metal column in it. Examination of the process tube indicated that it had failed at the point of the slug rupture. After inserting a new rear gunbarrel, a new process tube was installed and charged with regular metal.

Approximately 80 gallons of water per day were extracted from the lower far quadrant of H pile during the week following startup. During this period the power level was gradually increased until an equilibrium level of 590 MW was reached on February 8. The water collection rate at the CO_2 driers then decreased substantially until it became negligible on February 15 after a total of 597 gallons had been extracted.

During the scheduled metal discharge conducted on February 18, 134 process tubes in the central .285" zone of H pile were charged with 8" slugs. In addition, the usual 24" of solid Al dummies just downstream of the uranium slugs were replaced with perforated dummies in all process tubes charged, in order to increase the delta water temperature limits in these tubes by 3-4 percent. An automatic 3-second time-delay relay was installed in the Panellit pressure monitoring system and tied into the No. 1 safety circuit. Several tubes in the vicinity of process tube 2180 (which had failed on February 2) were checked for freedom of movement in the graphite. All moved freely, indicating that external galvanic corrosion of the aluminum tubes in the presence of wet graphite had not resulted in binding of the tubes.

Another unsuccessful attempt was made to discharge the cesium and samarium samples lodged in the B test hole facility. Also, during the outage the front and rear Van Stone flanges of approximately 25 process tubes were inspected. Efforts to test the tool dolly failed when the tool dolly could not be moved onto the discharge elevator because of difficulty with the power supply to the driving motor. At months end work was in progress to remedy this situation.

F Pile

A new maximum power level of 575 MW was first achieved on February 8, with a new maximum production rate of 575 MWD established on February 9. The significant increase in power level was due to operation with a 450°C maximum graphite temperature limit (P.T.-105-435) and revised delta water temperature limits.

During the first week of February the water extracted from F pile by the CO_2 driers averaged approximately 10 gallons per day. However, on February 10 and 11 the water collection rate

increased to 23 and 58 gallons per day respectively, indicating that one or more process tubes was leaking. Consequently, the pile was shut down at 12:30 P.M. on February 11 to investigate the source of water leakage. Essentially all process tubes in the lower half of the pile (rows 1 through 22) were individually subjected to a hydrostatic pressure test (350 psi water pressure for 1 minute). It was possible to pressure test 40-50 tubes/hour by utilizing the new type process tube testers instead of the old type pigtail testers (9-12 tubes/hour). The pressure testing program indicated that the following six process tubes (five located in the lower far quadrant) were leaking:

0285	0690
0386	0990
0486	1251

In discharging the metal column in these leakers, considerable difficulty was encountered with process tube 0990. Only the downstream dummies would flush out with 400 psi water pressure. The metal column was backseated and the aft section of the process tube was deribbed. A maximum force of 5000 pounds was exerted on both the front and rear with a hydraulic jack before the metal charge broke loose. All six of the leaking process tubes were blanked off as air tubes.

During the above outage the February metal discharge was accomplished. In addition, several Van Stone flanges were inspected and a rear face contamination study was made. Removal and examination of several rear face nozzles indicated that the beta radiation was originating from material on the surface of the nozzle studs and in the stud holes.

Following startup at 10:05 A.M. on February 14, the water extracted from F pile by the CO_2 driers remained essentially constant at approximately 10 gallons per day, as the power level was gradually increased to an equilibrium level of 565 MW on February 21.

F pile was manually scrammed with the No. 1 safety circuit at 4:23 P.M. on February 15 when a Panellit pressure alarm could not be reset within 10 seconds. The alarm was caused by a short in row 35 which occurred while instrument personnel were working on the Pannelit board. Recovery was effected in 9 minutes.

The following five ruptured slugs caused the shutdown of F pile during February:

Tube No.	Shutdown	Started to Power
1685	7:55 P.M., February 15	8:31 P.M., February 15
0772	7:00 P.M., February 16	7:26 P.M., February 16
3690	2:36 A.M., February 17	7:17 A.M., February 18
1886	5:17 P.M., February 27	5:50 P.M., February 27
3873	2:44 A.M., February 28	March

It was possible to immediately discharge process tube 1685, 0772, and 1886, with the charging machine and resume operations within the scram recovery period.

High rear face radiation levels were encountered while deribbing the aft section of process tube 3690 to permit removal of the ruptured slug and metal column. In replacing the tube, it was possible to only partially push out the process tube. Hence, the section of process tube extending out the rear face was ripped off and the tube was blanked off. An automatic 3-second time-delay relay was installed in the Panellit pressure monitoring system and tied into the No. 1 safety circuit during the outage. In addition, a new process pump motor was installed in the 190 building to replace one that had burned out (No. 11). During startup the No. 12 VSR broke off approximately 7 feet from the upper end of the safety rod. The parted section of the VSR dropped back into the thimble, but did not puncture the thimble. The section of safety rod was removed from the thimble with little difficulty and the remainder of the VSR was tied out of service. Startup of the pile was delayed approximately two hours to accomplish this.

F pile was shut down at 2:44 A.M. on February 28 because of a ruptured slug in process tube 3873. In flushing out the slugs downstream of the ruptured slug, one slug was inadvertently flushed onto the 20-foot catwalk. After several unsuccessful attempts, the slug was remotely forced into the basin by means of a long pole and high water pressure. The excessive rear face contamination and air activity which resulted made it difficulty to derib the aft section of the process tube and remove the ruptured slug.

As a precautionary measure to prevent additional process tube leakage in F pile, it was also decided during the outage to discharge the metal in 39 process tubes located in the lower far corner of the pile (rows 1 through 9, tubes 83 through 94) and blank off the tubes, with a resultant small loss in pile reactivity. However, it was possible to normally discharge (charging machine) only 23 of the 39 process tubes, with the metal column being stuck in the following 16 tubes:

0136	0388	0590	0794
0286	0389	0688	0894
0287	0390	0694	0991
0288	0392	0793	0994

When individually subjected to a hydrostatic pressure test, 3 of these 16 stuck tubes also proved to be leaking (0991, 0688, 0388). By exerting a maximum force of 2500 pounds with a hydraulic jack, it was possible to discharge the metal column in only 6 of these process tubes (0136, 0287, 0390, 0590, 0688, 0794).

When the metal column in approximately 30 process tubes surrounding the fringe of the original 39 tubes was backseated, five additional stuck charges were discovered (0687, 0788, 1090, 1091, 1092). However, when the metal column in approximately 100 process tubes in each of the 3 other corners of F pile was backseated, no stuck charges were encountered. This indicated that the condition was restricted to the lower far corner of the pile. By exerting a maximum force of 15,000 pounds, it was possible to discharge with extreme difficulty the metal column in all stuck tubes except the following six:

0286	0991
0288	0994
0894	1092

These six resisted all pushing and backseating efforts at 15,000 pounds.

After discharging process tube 0688 (leaker), a solid aluminum probe was run through the tube and a restriction was noted approximately 33 feet from the front. Borescoping of the tube indicated that the ribs and the top of the tube were badly distorted at the restriction. Splining from the front indicated

that a similar restriction also existed approximately 30 feet from the front of the other stuck tubes. An unsuccessful attempt was also made to locate the leak in 0688 by pressure testing the tube in sections.

The rear gunbarrel was removed from process tube 0991 and a thin wall gunbarrel fabricated from sheet metal was inserted. After the downstream dummies were extracted with considerable difficulty, the metal column was loosened and discharged by alternately pushing and backseating the charge with a maximum force of 40,000 pounds.

After the rear gunbarrel of process tube 1092 was removed, forces of 24,000 pounds caused the process tube to fail about 100 inches from the rear Van Stone, pushing the tube 4 inches out the rear face. A C-type gunbarrel was installed and the metal column was discharged with forces up to 2500 pounds, along with the rear 8-foot section of process tube.

It was possible to flush out only 8 downstream dummies from tube 0994. It was discovered that the downstream dummy pattern of these tubes included 3 lead dummies, which had become somewhat distorted by the high backseating faces employed. A total of 42 upstream slugs were then transferred from 0994 to an adjacent tube by means of the twin transfer cask before difficulty was experienced with the cask. At forces of 32,000 pounds, no movement of the metal column was possible. However, after replacing the rear gunbarrel with a larger one, the remaining 22 slugs were discharged with forces of 30,000 pounds along with the rear 8 feet section of process tube, which had failed.

The rear gunbarrel of process tube 0894 was removed and a sheet metal gunbarrel was installed. After splining and drilling out the distorted downstream aluminum and lead dummies, forces of 22,000 pounds would not loosen the charge. Unequal movements of the metal column and the process tube indicated that the tube was probably parted at two locations. Twelve slugs were splined out the rear, while pushing from the front. This was abandoned when forces of 52,000 pounds were reached. Steel dummies were inserted in the rear and the tube and charge were forced 45 inches toward the front with a maximum force of 9,000 pounds. The protuding front section of process tube was cut off and the steel dummies in the rear were removed, preparatory to cutting off the last 9 feet of process tube and pushing again from the front. As of March 7 work was still in progress

on this tube, with the stuck charges in process tube 0296 and 0288 still to be discharged.

A visual examination of 24 slugs discharged from some of the stuck tubes showed deep ribs made on most of the slugs, plus an additional deep scratch about 1/4 inch wide on the top of the slugs. Internal measurements made in process tubes 1092, 0991, and 0694 after discharge indicated that the horizontal diameter of these tubes had increased more than .050" and the vertical diameter had decreased more than .030" at the restriction point (approximately 30 feet from the front Van Stone flange).

RUPTURED SLUGS

Seventeen confirmed instances of in-pile uranium slug failures occurred during February, bringing the total number to date to 144. The attached table presents all data available at months end regarding these 17 ruptured slugs. It was possible to successfully discharge seven of these ruptured slugs with the charging machine and resume operations within the scram recovery period. Nine group 8 slugs were included in the slug failures during February, bringing the total number to date to twenty-three.

During the month twenty Hanford irradiated slugs were shipped to the Westinghouse laboratories in Pittsburgh for further examination. The group included four normal slugs, eight ruptured slugs, and eight slugs normally discharged but exhibiting blistering, weld corrosion, or other abnormalities. These slugs will be examined and photographed in air, both with and without the aluminum jackets. It is expected that the program will be completed by the end of March.

PROCESS DEVELOPMENTS

Because of the extremely favorable results (increased filter capacity, negligible film formation, reduced effluent water activity, and reduced rear face contamination) obtained to date with the experimental alum and activated water treatment in progress at F pile, it has been recommended that the equipment necessary to utilize the alum and activated silica treatment be installed in the C pile filter plant. With this treatment it is estimated that 100,000 gpm of process water could be supplied to the pile with the present filter plant (62,000 gpm design capacity).

The tests conducted in 189-D to check the corrosive effect of process water heavy metal ions (copper, lead, silver, tin, and chromium) on 2S and 72S aluminum were completed in February. Results indicate that the 2S aluminum (cans) experiences uniform corrosion attack while the 72S aluminum (process tubes) experiences pitting corrosion attack.

An extensive program has been initiated to evaluate the extent to which process tube Van Stone flanges are suffering pitting type corrosion. Front and rear Van Stone flanges are routinely being inspected during all pile outages, particularly at F and H piles. It is planned to actually measure the maximum pit depth on the Van Stone flanges of 100 process tubes at each of these two piles. At months end the front and rear Van Stone flanges on thirty-seven tubes at F pile and twenty-two tubes at H pile had been examined. Preliminary results indicate that the extent of the pitting corrosion is not as serious as was originally expected.

It has become standard practice at all piles, whenever a ruptured slug cannot be discharged after the downstream slugs have been flushed out and the tube deribbed, to push the process tube out the rear face (if possible) with the remaining upstream slugs in the tube, rather than use the twin transfer cask to transfer the upstream slugs to an adjacent process tube. It has been possible to utilize this method frequently at DR and H piles, where the process tubes have not yet become severely distorted due to graphite expansion.

Effective with the metal discharge at H pile on February 18, the 24 inches of solid aluminum dummies normally positioned just downstream of the metal column have been eliminated and will be replaced with perforated aluminum dummies in all process tubes charged in the future. This will permit an increase in delta water temperature limits, resulting in a 3-4 percent increase in power generation in all process tubes so charged.

Subject to final approval, the pile operating procedure for critical Y power conditions has been revised in an effort to reduce pile outage time. Whenever a critical Y power condition originates, all piles will start to shut down gradually. The electrical dispatcher will have ten minutes to notify the piles of the cause and seriousness of the critical Y power condition. In those instances not involving serious voltage and/or

frequency fluctuations when the balance of the Hanford and BPA systems are functioning satisfactorily, the piles will return to equilibrium power level and operate on an alert basis. This corresponds essentially to an extended critical W power condition (planned removal of backup facilities for a maximum of two hours).

Preliminary exponential data (dry buckling) obtained with a 7 1/2-inch lattice spacing and measured with BF_3 counters agree with the curve interpolated between the 7", 8", and 8 3/8" lattice spacing points. At months end, data were being obtained with indium foils in an effort to explain past discrepancies between indium foil and BF_3 counter measurements.

X-ray pictures taken both before and after 4" and 8" slug columns were backseated in the pressurized C and D machine (189-D) indicated that the slugs were cocked both vertically and horizontally in the process tube, causing them to bind and resist backseating forces. In order to obtain more data on this situation, a representative of Industrial X-Ray Engineers is scheduled to make extensive radiographs of the C and D metal column during the week of March 3.

PRODUCTION TESTS

313-2M - Eight Inch Uranium Slugs

During the metal discharge conducted at H pile on February 18, 134 process tubes in the central .285" zone were charged with eight inch slugs. This represents the first substantial charge of eight inch slugs into any of the piles. (Only two process tubes at DR pile and three tubes at H pile had been charged with eight inch slugs prior to this.) The uranium metal used in the eight inch slug is 1.332" diameter x 8.40" long, canned by the triple-dip process. The canned length of the slug is 8.93" long with an outside diameter the same as the 4-inch slugs (1.438"). The aluminum jacket has a nominal .175" bottom, a thicker cap (.350") and a thicker wall (.045") than the four-inch cans. Thirty-two eight inch slugs were charged into each process tube, making the metal column 7 1/2" longer than the present metal stringer of 64 four-inch slugs.

453 - Sodium Dichromate Elimination

It was decided to prematurely discharge the sodium dichromate elimination process tubes at H pile (2376 and 2275) at a nominal concentration of 400 MWD/T. It was felt that corrosion data obtained from slugs exposed to a concentration of 400 MWD/T would be just as reliable as data obtained from slugs exposed to the originally planned concentration (600 MWD/T). Also it was felt that the test data should be analyzed as soon as feasible in order to immediately eliminate the addition of sodium dichromate to the process water, if the results so indicate, or initiate additional tests. Hence, all four experimental tubes will be discharged during the first March outage at H pile. At that time the concentration of the metal in the two filtered water tubes will be about 410 MWD/T, and that of the metal in the two control tubes will be about 525 MWD/T.

3 Encl.
1. Comparative Pile Performance
2. Pile Outage
3. Tabulation of Ruptured Slugs

PAULOVICH/ww

Distribution:
Cy 1 - Addressee
2 - K. F. Paulovich

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PILE OUTAGE - FEBRUARY 1952
(Hours)

	B	D	DR	F	H	Total
Metal Discharge	20.5	29.6	20.0	15.0	16.0	101.1
Ruptured Slug Removal	27.3	25.1	132.1	59.5	24.6	286.6
Reactor Maintenance	3.0				11.0	14.0
Process Tube Water Leaks				72.7		72.7
Panellit Failures		0.1	0.1	0.1	0.9	1.2
Process Water Pressure Fluctuation	1.2					1.2
Special Irradiations	3.0				5.0	8.0
TOTAL HOURS	55.0	54.8	152.2	147.3	57.5	466.8

[redacted]

FEBRUARY 1952

COMPARATIVE PILE PERFORMANCE

PILE	B	D	DR	F	H	TOTAL
Initial Startup Design Power Level	9-26-44 250	12-17-44 250	10-3-50 250	2-25-45 250	10-20-49 400	
Days Since Startup	2713	2631	514	2561	863	
Maximum Power Level Attained to Date (MW)	545	525	575	575	605	2825
Maximum Power Level During Month (MWD)	542	525	560	575	602	
Average Operating Level During Month (MW)[1]	490	478	380	512	558	483.6
~~Percent of Design Power Level~~[2]						
Outage Hours During Month	55.0	54.8	152.2	147.3	57.5	466.8
Time Operated Efficiency (%)[3]	92.1	92.1	78.1	78.8	91.7	86.6
MWD Produced During Month Plutonium	13,098	12,768	8,610	11,710	14,834	61,020
~~Tritium~~						
MWD Discharged During Month Plutonium	11,208	10,356	8,784	6,597	13,720	50,665
~~Tritium~~						
MWD In Unit Plutonium	76,163	74,023	76,374	72,109	82,385	381,054
~~Tritium~~						
Tons of Metal Discharged During Month	18.82	16.80	15.43	11.91	22.45	85.41
Tons of Metal Charged During Month	18.69	16.68	15.55	10.54	22.53	83.99
Tons of Metal In Unit						1,211.11
Average ~~Discharge~~ Concentration (MWD/T)	595.5	616.4	569.3	553.9	611.1	593.2

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PILE	B	D	DR	F	H	TOTAL
Scheduled Shutdowns	1	1	0	0	1	
Carbon Dioxide Concentration (%)[4]	97.0	93.1	94.9	93.6	87.8	
Highest Graphite Temperature Recorded During Month (°C)	380	380	320	442	378	
Outlet Water Temperature (°C)[2] ~~(Average of 20 Hottest Tubes in Central Zone~~	62.4	57.1	55.6	70.8	57.9	
Inlet Water Temperature (°C)[2]	4.2	6.5	4.1	3.8	4.2	
Process Water Flow (gpm)[2]	36,180	38,180	40,780	37,513	41,700	
Maximum Effluent Water Activity (mrep/hr During Month	10.8	10.2	9.8	11.1	9.6	

1) Average Operating Level = $\frac{\text{MWD X 24}}{\text{Hours Operated}}$

~~2) Percent of Design Power Level = Average MW = Total MWD / Design MW (Days in Month) (Design MW)~~

3) Time Operating Efficiency = $\frac{\text{Hours Operated}}{\text{Total Hours}}$

4) Months End Data

2) Average of Last 5 Days of Equilibrium Operation

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TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances Shutdown and Re
128	1774-DR	1) 4-30-51 2) 6-6-51 3) 2-2-52	241	346	6.4	554	450	45	47	897	2.0	High exit water ac Aft section of prc deribbed to permit
129	2180-H	1) 7-6-51 2) 8-8-51 3) 2-2-52	178	362	6.3	441	590	47	48	1039	1.7	Rapid loss of reac caused shutdown - slug located by re survey - Rear gunl removed - Pushed out with metal co - Process tube ru point of ruptured
130	1090-B	1) 2-26-51 2) 3-21-51 3) 2-3-52	258	258	3.4	437	540			116	.21	High exit water Discharged with machine - Resume in scram recover
131	1875-DR	1) 5-3-51 2) 6-6-51 3) 2-7-52	246	334	6.8	553	450	33	31	960	2.1	High effluent wa - Aft section of tube deribbed to removal.
132	4186-B	1) 4-5-51 2) 5-16-51 3) 2-12-52	272	264		353	520			961	1.85	High exit water Discharged with jack and chargin

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TABULATION OF RUPTURED URANIUM SLUGS

Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
45	47	897	2.0	High exit water activity - Aft section of process tube deribbed to permit discharge.	Uranium split failure	MRH 4-30-51 Truck 9 & Group 8 slug	
47	48	1039	1.7	Rapid loss of reactivity caused shutdown - Ruptured slug located by rear pigtail survey - Rear gunbarrel removed - Pushed process tube out with metal column in tube - Process tube ruptured at point of ruptured slug.	Can failure.	MRG 7-6-51 Truck 12 & Group 8 slug	
		116	.21	High exit water activity - Discharged with charging machine - Resumed operations in scram recovery period.	End cap failure	MRG 2-26-51 Truck 12 &	
33	31	960	2.1	High effluent water activity - Aft section of process tube deribbed to permit removal.	Uranium split failure.	MRH 5-3-51 Truck 4 & Group 8 slug	
		961	1.85	High exit water activity - Discharged with hydraulic jack and charging machine.	End cap failure	ZRG 4-5-51 Truck 1 &	

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TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances Shutdown and Re
133	1871-DR	1) 5-9-51 2) 6-6-51 3) 2-14-52	253	417	7.6	550	500			21	.04	High exit water act Discharged with cha machine - Operation in scram recovery p
134	1058-DR	1) 4-5-51 2) 10-15-51 3) 2-15-52	123	290	5.5	185	500	21	16	1717	3.46	High exit water ac Flushed out 43 slu stream of rupture gunbarrel removed process tube cont remaining metal o face.
135	3465-H	1) 6-6-51 2) 8-8-51 3) 2-15-52	191	390		514	585			70	.12	High exit water a Discharged with c machine - Resumed within scram reco period.
136	1685-F	1) 7-17-51 2) 8-30-51 3) 2-15-52	169	362		309	450			93	.20	High exit water a Discharged with c machine - Resumed within scram reco period.
137	4283-B	1) 4-28-51 2) 5-16-51 3) 2-16-52	276	190	3.8	357	450			15	.02	High exit water ac Discharged with ch machine - Resumed within scram recov

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TABULATION OF RUPTURED URANIUM SLUGS

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
)		21	.04	High exit water activity - Discharged with charging machine - Operations resumed in scram recovery period.	End cap off.	ZRG 5-9-51 Truck 4 & Group 8 slug	
21	16	1717	3.46	High exit water activity - Flushed out 43 slugs downstream of rupture - Rear gunbarrel removed - Pushed process tube containing remaining metal out rear face.	Uranium split failure.	MRH 4-5-51 Truck 10 &	
5		70	.12	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period.	End cap failure - Slug surface pimpled and pitted.	ZRH 6-6-51 Truck 9 & Group 8 slug	
0		93	.20	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period.	Diagonal split running entire length of slug, penetrating can on one side.	MRH 7-17-51 Truck 1 & Group 8 slug	
)		15	.02	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period.	Can split partially around base of cap and down side of slug.	MRG 4-28-51 Truck 5 & Group 8 slug	

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TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstance Shutdown and R
138	0772-F	1) 4-16-51 2) 5-8-51 3) 2-16-52	284	404		492	450			72	.13	High exit water ac Discharged with ch machine - Resumed in scram recovery
139	3690-F	1) 3-30-51 2) 9-18-51 3) 2-17-52	152	291	6.2	206	570	29	28	1122	1.98	High exit water a Aft section of pi deribbed to permi
140	1057-D	1) 1-29-51 2) 3-7-51 3) 2-18-52	348	304	5.7	497	385	21	18	531	1.37	High exit water a Aft section of pi deribbed to perm
141	2064-DR	1) 5-29-51 2) 6-26-51 3) 2-21-52	240	393	7.4	510	530	21	18	1019	2.05	High exit water a Slug stuck - Proc pushed out with slug and upstrea tube.
142	1860-DR	1) 4-2-51 2) 5-9-51 3) 2-25-52	292	341	7.3	510	500	29	24	984	1.97	High effluent wa - Downstream slu out at 400 psi - slug and upstrea removed in proce

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TABULATION OF RUPTURED URANIUM SLUGS

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		72	.13	High exit water activity - Discharged with charging machine - Resumed operations in scram recovery period.	End cap off - Slug split 1 inch back from cap end - Slug surface pitted.	MRH 4-16-51 Truck 2 &	
29	28	1122	1.98	High exit water activity - Aft section of process tube deribbed to permit removal.	Two longitudinal splits, 180° apart, entire length of can sidewall - Slug swollen.	MRH 3-30-51 Truck 6 &	
21	18	531	1.37	High exit water activity - Aft section of process tube deribbed to permit removal.	Uranium split failure.	MRH 1-29-51 Truck 7 &	
21	18	1019	2.05	High exit water activity - Slug stuck - Process tube pushed out with ruptured slug and upstream pieces in tube.	Split on one side of slug.	MRG 5-29-51 Truck 1 & Group 8 slug	
29	24	984	1.97	High effluent water activity - Downstream slugs flushed out at 400 psi - Ruptured slug and upstream pieces removed in process tube	Split failure.	ZRH 6-2-51 Truck 12 &	

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TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstance Shutdown and I
143	1886-F	1) 4-14-51 2) 5-8-51 3) 2-27-52	295	404		549						High exit water a Discharged with c machine - Recover scram recovery pe
144	3873-F	1) 8-17-51 2) 9-18-51 3) 2-28-52	163	351	6.3	299		46	53			High exit water a Aft section of pr deribbed to permi - Extensive rear contamination.

TABULATION OF RUPTURED URANIUM SLUGS

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
				High exit water activity - Discharged with charging machine - Recovered within scram recovery period.	End cap detached - Wedge-shaped portion of metal and can separated from exposed end of slug.	MRG 4-14-51 Truck 10 &	
46	53			High exit water activity - Aft section of process tube deribbed to permit removal - Extensive rear face contamination.	Slug split longitudinally and around cap.	120T 8-1-51 Truck 7 & Group 8 slug	

Office Memorandum • UNITED STATES GOVERNMENT

TO : Files, Operations Division (THRU) R. L. Plum, I. L. Lind and Donald G. Sturges

DATE: April 3, 1952

FROM : K. F. Paulovich KFP

SUBJECT: 100 AREAS MONTHLY REPORT - MARCH, 1952

PILE OPERATION

General

The maximum operating level attained in any one day during the month of March 1952 by each of the piles, and the corresponding equivalent percentage of the power level index, are as follows:

	B	D	DR	F	H
MWD	560	530	562	535	594
Percent	280	265	281	268	297

B and D piles attained individual new maximum operating levels during March, and B, DR, and H piles established individual production records for the month. March 26 marked the occurrence of a new maximum of 2734 MWD for simultaneous five-pile total production. Despite an extended 15 day outage at F pile and the occurrence of 10 ruptured slugs during the month, a new maximum total production of 66,884 MWD (109.3 percent of forecast) was achieved in March. This also represents a new per diem maximum production of 2,158 MWD/day.

A critical Y power condition resulting from the loss of several generators at Grand Coulee Dam necessitated the shutdown of all operating piles (B, D, DR, and H) beginning at 12:59 P.M. on March 14. Stabilization of power conditions on the BPA system permitted all piles to resume operations within the scram recovery period, with an average outage time of 39 minutes.

B Pile

A new maximum power level of 560 MW was first attained on March 9, with a new maximum daily production of 560 MWD achieved on March 10. The increase in power level resulted

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principally from poison pattern adjustments made during the March 1 outage. A new maximum monthly production of 15,289 MWD was established at B pile in March.

A critical Y power condition resulting from the loss of several generators at Grand Coulee Dam caused the shutdown of B pile from 12:59 P.M. to 1:32 P.M. on March 14.

During the month of March, B pile was shut down twice because of the following ruptured slugs:

Tube No.	Shutdown	Started to Power
3686	3:45 A.M., March 1	6:02 A.M., March 2
3694	1:57 P.M., March 3	7:08 A.M., March 4

It was possible to immediately discharge process tube 3686 with the charging machine, but the attempt to resume operations within the scram recovery period was unsuccessful. During the subsequent outage the metal discharge for March was accomplished and another attempt was made to replace process tube 2961 (January rupture). After removing the front and rear gun-barrels and broaching the graphite channel, installation of a new tube proved impossible when the tube stuck approximately eight feet from the rear face. The tube was removed, bayonets and steel dummies were placed in the front and rear of the channel, and neutron shielding was installed on the front face. It was not possible to locate the ruptured slug removed from process tube 3686 among all the slugs discharged into the basin chutes.

Before it was possible to remove the ruptured slug in process tube 3694 (extreme fringe of pile), it was necessary to flush out 25 downstream slugs with 400 psi water pressure and derib the aft section of the process tube. The tube was blanked off as an air tube, with steel dummies and neutron shielding installed in the front. A rear face pigtail survey failed to indicate any additional ruptured slugs in row 36 of process tubes.

On March 7 the A horizontal control rod became inoperable on high speed because of difficulty in the differential gear box. Correction of the difficulty was completed during pile operation and the A horizontal control rod was returned to normal operation on March 12.

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On March 10, 126 cubic feet of He were introduced into the CO_2 pile atmosphere system at B pile in order to experiment with the detection of pile gas leakage by means of He leak detection equipment. The addition of helium to the pile atmosphere resulted in a slight loss of reactivity and a slight decrease in graphite temperature.

Excessive effluent water activity was experienced at B pile during the latter part of March because of high film buildup during a 28-day period of continuous operation at a nominal power level of 545 MW, and because of abnormal river water turbidity resulting from the removal of the cofferdam used in the construction of the 181-B river pump house addition.

D Pile

A new maximum power level of 530 MW was first reached on March 25 and a new maximum daily production of 530 MWD was established on March 26. The increase in power level at D pile resulted from poison pattern adjustments and the discharge of three process tubes, which were limiting temperature-wise, during the March 19 outage.

A critical Y power condition resulting from the loss of several generators at Grand Coulee Dam caused the shutdown of D pile from 1:01 P.M. to 1:42 P.M. on March 14.

Four ruptured slugs caused the shutdown of D pile during March, as follows:

Tube No.	Shutdown	Started to Power
2765	9:07 P.M., March 5	9:35 P.M., March 5
0984	9:47 A.M., March 7	10:13 A.M., March 7
1256	11:13 A.M., March 11	11:41 A.M., March 11
0456	8:35 A.M., March 27	1:30 P.M., March 28

It was possible to immediately discharge process tubes 2765, 0984, and 1256 with the charging machine and resume operations within the scram recovery period.

On March 6 the CO_2 consumption at D pile increased from approximately 6,000 to 9,000 cubic feet per day. An extensive check of the rear face, inner rod room, and top of the pile indicated that the leakage was originating from the inner rod room. In

addition, binding was periodically experienced with the No. 8 horizontal control rod between March 6 and March 12, at which time it finally became stuck at a position approximately 175" in the pile. It was possible to force the No. 8 HCR outward until only the rod tip remained lodged in the unit. Cooling water was left on the control rod until shutdown removal operations could be initiated.

During the scheduled metal discharge conducted on March 19, an unsuccessful attempt was made to completely remove the No. 8 HCR from the pile with moderate forces (excessive forces were not employed in order to avoid damaging the rod). Because of high activity readings at the No. 8 HCR rod tip, it was decided to reconnect the high speed drive gear and run the No. 8 HCR partially into the unit, in order to attain a better time limit for work on B horizontal control rod. The step plug of "B" HCR was removed and the thimble, including the lodged rod tip, was remotely pulled into a can and taken to the burial ground. The thimble was broken into two sections while pulling it into the can. A new thimble was installed and gas leakage discovered around the step plug and flange during pressure testing was corrected. The B horizontal control rod was then reassembled and returned to normal operation. The No. 8 HCR removal operation was postponed until the next available shutdown.

During the discharge outage internal bore measurements were taken along the length of graphite channels 0787, 3366, and 1964. These three channels, the tubes of which had previously been removed because of ruptured slugs, were returned to air channel status. The bore measurements indicated that portions of graphite channels 0787, 3366, and 1964 was elleptical in cross section, with the major axis in the horizontal plane. Also, three du Pont uranium fission chambers were installed in process tube 1972 to determine the effect of radiation on their capacity to monitor neutron flux distribution. (P.T. 105-528-SR).

During the outage caused by the ruptured slug in process tube 0465, the No. 8 horizontal control rod was withdrawn from the unit after removing the gate assembly and the first section of graphite track. A pressure test of the thimble indicated that it was leaking badly. A hydrostatic test of the control rod indicated that the rod was also leaking at the tip section. The buildup of corrosion products had apparently distorted the rod tip section and caused it to bind in the unit. A blank

flange, along with lead and paraffin shielding, was installed over the thimble opening in the inner rod room. The No. 8 horizontal control rod was left with the tip section situated in the sandwich wall to allow it to cool radioactively. It is planned to renovate the rod tip section prior to the next shutdown, at which time the thimble will be replaced and the No. 8 HCR returned to service. Upon startup only slight neutron scattering was observed in the outer rod room.

During the 0465 outage at D pile, a new water-cooled assembly was installed in A test hole, pressure tested, shielded, and made available for normal service. In addition, a vertical traverse was conducted on process tubes 4453, 4494, and 4674 and several front and rear Van Stone flanges were inspected for corrosion.

DR Pile

With the exception of a critical Y power outage (March 14) and a scheduled metal discharge (March 21), DR pile operated the entire month without incident at an equilibrium power level of 550 MW, thereby establishing a new maximum monthly production (15,669 MWD) for any one pile.

A critical Y power condition resulting from the loss of several generators at Grand Coulee Dam caused the shutdown of DR pile at 1:06 P.M. on March 14. Despite a delay in startup until 1:59 P.M. because of difficulty in withdrawing No. 12 and No. 33 vertical safety rods, a successful recovery was effected.

During the scheduled metal discharge conducted on March 21, 86 process tubes in the central .285" orifice zone of DR pile were charged with eight-inch slugs (the first substantial charge of eight-inch slugs into DR pile under PT 105-313-2M). Three improved charging machines, capable of servicing two process tubes in the same vertical row without elevator adjustment, were employed during the metal discharge. However, considerable difficulty was experienced with the two end machines shorting out because of wet micro-switches. It is planned to remedy this condition and again check the operational efficiency of three charging machines during the April discharge at DR pile.

Process tubes 3561 (located in the wet zone of the upper near quadrant) and 1265 (located below the wet zone) were removed from the pile. Preliminary examination indicated that both these tubes had undergone considerable external galvanic corrosion in the presence of wet graphite similar to that occurring on F pile process tubes. During the shutdown the carriage axle of the tool dolly was also straightened, returning the tool dolly to working condition. In an effort to reduce the lag of the effluent water beta monitoring equipment at DR pile, the sample water flow from the rear cross-headers was increased from about 300 cc/min to approximately 1400 cc/min. This effectively reduced the cycle time of the system from 40 to 8 minutes.

The water collection rate at the CO_2 driers gradually decreased from approximately 10 gallons per day at the beginning of the month to a negligible amount by mid-March.

H Pile

A new maximum monthly production of 15,359 MWD was established at H pile during March.

A critical Y power condition resulting from the loss of several generators at Grand Coulee Dam caused the shutdown of H pile from 1:08 P.M. to 1:37 P.M. on March 14.

The following three ruptured slugs caused the shutdown of H pile during March:

Tube No.	Shutdown	Started to Power
0975 3665	3:08 A.M., March 3	7:43 A.M., March 5
3565	8:09 P.M., March 27	3:52 A.M., March 29

In removing the ruptured slug from process tube 0975, 36 slugs downstream slugs were flushed out with 400 psi water pressure, the rear gunbarrel was removed, and the process tube containing the remainder of the metal column was then pushed out with moderate forces. A new gunbarrel and process tube were installed and the tube was charged with eight-inch slugs. A rear face pigtail survey led to the discovery of a second ruptured slug in process tube 3665, which was discharged without difficulty with the charging machine.

The four process tubes (2275, 2276, 2376, 2377) involved in the sodium dichromate elimination tests (PT 105-453) were also discharged during the shutdown. The process tubes were removed from the pile, cut into sections, and taken to 111-B for corrosion examinations. After installing four new process tubes in the unit, special water injection equipment (PT 105-509-A) was incorporated in process tube 2376.

During the 0975 shutdown the metal discharge for March was conducted. This included charging eight-inch slugs into 140 process tubes (PT 105-313-2M), with only perforated Al downstream dummies. The tool dolly was also run onto the discharge elevator for functional testing, but the brake would not release consistently, making it necessary to return it to the tool dolly room and remove the motor brake for repairs.

A rapid loss of reactivity occurred at H pile at 7:30 P.M. on March 27. Temperature data indicated that the top near quadrant was the coldest section of the pile. A check of the Panellit gauges in this quadrant showed that process tube 3565 was 15 pounds below normal. The temperatures of graphite thermocouples 36G and 37G (below tube 3565) dropped rapidly. These data all pointed to the fact that substantial amounts of water were leaking into the graphite from process tube 3565. After the pile was shut down at 8:09 P.M., process tube 3565 was discharged without difficulty with the charging machine. No indication of reactivity was obtained when all the control and safety rods were withdrawn at 8:30 P.M. When hydrostatically tested process tube 3565 would not hold pressure, indicating that it was leaking as the result of the ruptured slug discharged. Process tube 3565 was then pushed from the unit in 6-foot sections.

During the shutdown 14 process tubes located below 2180 (February water leakage) were checked for freedom of movement in the graphite. All tubes except one (0777) were loose in the graphite. An unsuccessful attempt was also made to charge quartz capsules containing graphite specimens and various gases into process tube 0776 to obtain additional data on gas-graphite reactions (PT 105-504-E). In addition, 48 process tubes located on the far side of the pile were discharged and charged with eight-inch slugs.

After an unsuccessful startup attempt and the discharge of three temporary poison columns (1271, 1972, 2878), continued operations were resumed at 3:52 A.M. on March 29. Following startup, the water collection rate at the CO_2 driers increased to a maximum of 134 gallons/day on March 30, and then decreased appreciably. By the end of the month, a total of 262 gallons had been extracted from H pile.

A second effluent water crib was excavated at H area during March and utilized to advantage during the 3565 outage.

F Pile

On March 7 work was in progress on the removal of stuck charges from process tubes 0286, 0894 and 0288 (See February Monthly Report).

Considerable difficulty was encountered in removing the three lead dummies from the rear of process tube 0286. Initial back-seating attempts had expanded the lead dummies over the process tube ribs and distorted the rear section of the tube. After removal of the downstream dummies, alternate pushing and back-seating forces up to 40,000 pounds moved the metal column a maximum of sixteen inches. The rear gunbarrel of process tube 0286 was removed and a sheet metal gunbarrel was installed. With a maximum force of 15,000 pounds exerted on the front, it was then possible to push out the metal column and a eleven-foot rear section of the process tube.

The rear gunbarrel of process tube 0894 was removed and a sheet metal gunbarrel was installed. After splining and drilling out the distorted downstream aluminum and lead dummies, forces of 22,000 pounds would not loosen the charge. Unequal movements of the metal column and the process tube indicated that the tube was probably parted at two locations. Twelve slugs were splined out the rear, while pushing from the front. This was abandoned when forces of 52,000 pounds were reached. Steel dummies were inserted in the rear and the tube and charge were forced 45 inches toward the front with a maximum force of 9,000 pounds.

A front section of the parted process tube (approximately 17 feet) was pulled out the front face into a burial can. A 13 foot section of split (3/4 inch slot in top) sheet metal tube was then installed in the front of channel 0894. After discharging and deribbing process tube 0893, 8 upstream slugs were transferred with considerable difficulty from 0894 to 0893

by means of the twin transfer cask. The ninth slug, which had been upset on one end, became lodged in the transfer cask. It was necessary to remove the cask to the storage basin and remotely push the slug out.

It proved impossible to spline any additional slugs into the transfer cask, both with and without the split tube section in the front of the channel. Alternate pushing and backseating forces up to 40,000 pounds moved the metal charge a maximum of 74 inches. The steel dummies were then splined out the rear of tube 0894. The rear section of process tube was drilled out with a drill slightly larger than the tube diameter to a depth of approximately fifteen feet. After cleaning the Al chips and graphite dust from the rear of the channel, alternate pushing and backseating forces up to 20,000 pounds moved the charge a maximum of 90 inches. The rear end of the channel was again cleared with a large drill and 7 downstream slugs were splined out the rear. It was then possible with forces of 25,000 pounds exerted on the front to push out the remainder of the metal charge along with two short rear sections of process tube.

The rear gunbarrel was removed from process tube 0288 and an oversize C-type gunbarrel was installed. A maximum force of 40,000 pounds exerted on the front of the metal column resulted in no movement. After 7 slugs were splined out the rear, alternate pushing and backseating forces up to 40,000 pounds moved the charge a few inches. Seventeen of 20 steel dummies were removed from the rear of the tube and the rear section of process tube (approximately 8 feet) was cut off adjacent to the last steel dummy and removed. An attempt was made to cut the tube ribs around the remaining 3 steel dummies with a hollow saw. After cutting out the ribs under the last 2 dummies, the hollow saw broke. Only part of the hollow saw could be removed with a magnet, spline, and hook.

After discharging and deribbing process tube 0287, 49 upstream slugs were transferred from 0288 to 0287 by means of the twin transfer cask. The metal column was moved forward 12 inches by exerting forces of 39,000 pounds on the rear, permitting two more slugs to be transferred to 0287. The last steel dummy was then removed from the rear by drilling and tapping. The rear end of the tube channel was drilled out with a drill slightly larger than the diameter of the process tube to a depth of approximately eleven feet, at which point the drill struck a solid object. After flushing out the chips, graphite dust, and pieces of process tube with water, a steel rod was inserted in the rear of the channel and the charge was backseated two inches with a 39,000 pound force. The split C type gunbarrel,

which was beginning to draw together, was removed from the rear of 0288 and replaced with the sheet metal gunbarrel from 0894. It was then possible to push out the process tube and the remainder of the metal charge with maximum forces of 18,000 pounds.

After the stuck metal charges in process tubes 0991, 1092, 0994, 0286, 0894, and 0288 had been completely removed, a program of backseating was instituted. All metal columns on the bottom five horizontal rows of process tubes (rows 01 through 05) and in the far five vertical rows of process tubes (tubes 92 through 96) were backseated. The metal columns in approximately 100 process tubes adjacent to the area of stuck charges in the lower far corner of F pile were also backseated. This latter group completed the backseating of all process tubes located below row 15 and to the far side of row 81. Several reluctant charges were discovered in this program (0281, 0986, 1293, 1295, 1396) but all were discharged without difficulty. In addition, approximately 40 process tubes located below tube 2863 ~~1885~~ were checked for freedom of movement in the graphite. The majority of process tubes found loose in the graphite during the December 1951 testing program were still free.

and approximately 25 process tubes located below tube 1885

In order to further investigate the cause of the extensive sticking of metal columns in the lower far corner of F pile, startup was postponed several days to obtain internal bore measurements (process tubes and graphite channels), graphite samples, sections of process tubes, and to sectionally pressure test several leaking tubes. Measurements of the internal diameter of 4 process tubes which had contained stuck charges (0389, 0694, 0991, 1092) and 4 process tubes which had contained normal charges (1591, 2058, 2358, 2991) were obtained before the bore measurement equipment failed. A solid cylindrical probe of 1.490 inches diameter was passed through process tube 0660 (lower near corner), but a 1.500-inch diameter probe could not be inserted.

When process tubes 0389, 0694, 0991 and 1092 (stuck charges) could not be removed from the pile by normal methods using forces up to 11,000 pounds, a newly developed internal tube splitter was utilized to advantage. The tubes were longitudinally split from rear to front along a horizontal plane by pulling the tube splitter through the process tubes with moderate forces. The split tubes were then pulled out the front face with relative ease into a burial can. An examination of a section of process tube 1092 revealed that

corrosion products on the tube exterior were so extensive that chips an inch square in area could be flaked off. Process tubes 2058 and 2358 (charges not stuck) were pushed from the pile by conventional methods using forces up to 5000 pounds. The internal diameter of these 6 graphite channels (0389, 0694, 0991, 1092, 2058, 2358) were measured along with graphite channels 0284, 1290, 2696, which had been similarly checked in December 1951. Graphite mining samples were obtained from channels 0389, 0694, 0991, 1092, 2058, 2358 and graphite core samples were obtained from channel 1092. Also, several sections of process tubes removed from the lower far corner of the pile were retained for further examination. Sectionalized pressure testing of process tubes 0388 and 0688 (leakers) indicated that the tubes were apparently leaking at a point approximately nine feet from the rear Van Stone flange.

All of the 51 process tubes in the lower far quadrant which had been discharged during the extended outage (bringing the total number of process tubes now out of service at F pile to 156) were buttoned up as air tubes, with steel dummies and neutron shielding (lead, cadmium, paraffin) installed on the front face. This resulted in a loss of approximately 45 inhours in reactivity.

Before startup, a new tip section was installed on #12 VSR and the vertical safety rod was returned to service. Also, the graphite burnout samples exposed to pile atmosphere in tube channel 2682 (PT 105-435) were removed, and the March metal discharge was accomplished.

At 9:30 P.M. on March 15, operations were resumed at F pile. A radiation survey of the lower far corner of the pile front face indicated that excessive readings were originating from process tubes 1090 and 4674. This situation was corrected during the subsequent poison push when additional grooved steel dummies were inserted in the front of these tubes. Also, high CO_2 consumption following startup led to the discovery of several leaks originating from the front face connections of tubes in the lower far quadrant.

Following startup, the water collection rate at the CO_2 driers averaged 25 gallons/day as the power level of F pile was increased to 515 MW on March 19. From then until the end of

March the water extraction rate gradually decreased to about 10 gallons/day, as an equilibrium power level of 535 MW was maintained.

One ruptured slug caused the shutdown of F pile during March, as follows:

Tube No.	Shutdown	Started to Power
1080	9:10 A.M., March 17	9:54 A.M., March 17

It was possible to immediately discharge process tube 1080 with the charging machine and resume operations within the scram recovery period.

Information obtained at F pile during the extended March shutdown indicates that the phenomenon of stuck charges is presently restricted to the lower far corner of the pile (area of continued water leakage during the past few months). It was not possible to normally discharge the stuck charges, which had been in the pile an average of 23 months, because of a restriction in the process tube approximately 9 feet from the rear Van Stone flange. Bore measurements showed that the process tubes and graphite channels were elliptical in cross section (horizontal major axis) for about 4 feet upstream of the rear gunbarrel. Preliminary observations indicate that the reduction in cross section of the process tubes and graphite channels resulted from the buildup of corrosion products, principally aluminum oxide. Analysis has indicated that the corrosion products contain as much as 15 percent water, which contributes to the continuation of the corrosion mechanism. Hence, it appears that water from process tube leakage remains in the cold graphite zone just upstream of the rear gunbarrel. External galvanic corrosion of the Al process tubes in the presence of wet graphite leads to the buildup of aluminum oxide corrosion products. This buildup is of sufficient magnitude around the lower half of the process tube to reduce the vertical diameter to the point where the metal columns cannot be discharged. Work is in progress to investigate the possibility of using 63S Al, anodized Al, or protective coatings in conjunction with process tube replacements at F pile.

RUPTURED SLUGS

Only ten instances of in-pile uranium slug failures occurred during March, bringing the total number to date to 154. The attached table presents all data available at months end regarding these ten ruptured slugs. It was possible to successfully discharge four of these ruptured slugs with the charging machine and resume operations within the scram recovery period. Six Group 8 slugs were included in the slug failures during March, bringing the total number to date to 29.

An analysis of ruptured slug data, based on approximately 1500 process tubes charged with Group 7 metal and approximately 700 process tubes charged with Group 8 metal in the .240" and .285" orifice zones, has recently been completed. Preliminary results indicate that the rupture frequency of both Group 7 and Group 8 metal increases exponentially with concentration (MWD/T), the Group 8 metal being superior to the Group 7 metal by a factor of 2.5. The rupture rate of Group 7 slugs also increases exponentially with tube power, with the uranium split failures exhibiting a much higher rate than the can and cap failures. The rupture frequency of Group 8 slugs, however, decreases with tube power for all types of failures. Additional Group 8 ruptured slug data are needed to substantiate these preliminary conclusions.

Eight ruptured slugs of the 20 Hanford irradiated slugs shipped to the Westinghouse laboratories in Pittsburgh during March have been examined and photographed in air. To date WAPD examinations have merely confirmed Hanford observations.

Work on a lead glass cave in the 111-B building was completed during the month. This will permit ruptured slugs to be examined and photographed at close range in air. It is planned to take colored photographs of five ruptured slugs in each of the seven basic classifications of failures (HW-23351). By months end, four ruptured slugs had been photographed and examined. It is anticipated that cutoff equipment will soon be available for use in sectioning ruptured slugs into wafers for detailed metallurgical examinations.

PRODUCTION TESTS

435 - Graphite Burnout and Transport

Graphite samples exposed to pile atmosphere at F pile were removed from tube channel 2682. The samples had been maintained at a nominal temperature of 430° C for an exposure period of

approximately 6 weeks. Preliminary analysis of the samples indicates that they experienced a burnout rate of only 2%/1000 days. From this information it appears that the exponential graphite burnout phenomenon is not as sensitive to temperature as was originally thought. Hence, it may be possible to relax the graphite temperature limit at all piles to as high as 410°C, if these data can be substantiated.

453 - Sodium Dichromate Elimination

During the March 3-4 outage at H pile, the two sodium dichromate elimination process tubes (2275 and 2376) and the two control tubes (2276 and 2377) were prematurely discharged at approximate concentrations of 400 MWD/T and 525 MWD/T, respectively. All four process tubes were removed from the pile, cut into sections, and transported to 111-B for corrosion examinations. Preliminary data indicate that the elimination of sodium dichromate resulted in a slightly higher rate of general corrosion on the first few upstream slugs and a considerably lower corrosion rate on the remainder of the metal column. The slugs subjected to dichromate-free water exhibited a slightly lower rate of film formation, but an appreciably higher weight of film formation, indicating possibly a different type of film. A spectrochemical analysis of the slug corrosion products is in progress.

504E - Study of Gas - Graphite Reactions

In order to obtain additional inpile data on gas-graphite reactions, aluminum-jacketed quartz capsules containing graphite specimens and various gases (carbon dioxide, carbon monoxide, helium, oxygen, nitrogen, hydrogen, and water vapor) are scheduled to be exposed in a central zone process tube at H pile.

The quartz capsules (1" dia. x 18" long.) are enclosed in an inner Al tube (1.45" dia.) which rests on the process tube ribs. This results in a dry but water-cooled installation, similar to that already in operation in tube 1684-B. The initial experiments to be conducted at water temperatures with CO, CO_2 and graphite samples, were scheduled to begin at H pile on March 28. However, difficulty was experienced in installing the test channel equipment in process tube 0776 and effecting a water tight seal. Hence, the installation will be accomplished during the next available shutdown in April.

506A - Pile Atmosphere Leak Detection

Besides being a radiation hazard, the cost of carbon dioxide gas that is lost through pile atmosphere leakage is considerable. Work is in progress at B pile to develop a method of locating and eliminating pile atmosphere leaks by the addition of small quantities of helium to the pile atmosphere and the use of He leak detection equipment. It is planned to add 1 percent helium (approximately 250 cubic feet) to the CO_2 atmosphere at B pile and maintain this percentage for several weeks. To date, however, helium has been introduced into the pile atmosphere system only twice (255 cubic feet on February 28 and 126 cubic feet on March 10), primarily in an effort to check the Consolidated He leak detector and external sampling system. Each addition of He has resulted in a slight loss of reactivity and a slight decrease in graphite temperature.

509A - G.E. Dew Point Recorder

In an effort to determine whether sensitive moisutre analytical techniques can be utilized to locate the position of small process tube leaks, water injection equipment was installed in an empty process channel (2376) at H pile during the March 3-4 outage. Tests are in progress, utilizing both existing Foxboro Dew Cell equipment and a G.E. automatic Dew Point recorder, to determine the effect of pile gas flow rates and humidities on tube leak detection. Water injection tests (5 gal/day rate for 2 hrs.) with both high(0° F dew point) and low (-20° F dew point) gas humidities at low gas flows (700 cfm) have shown that it is extremely difficult with both the Foxboro and G.E. instruments to determine which rear face plenum chamber is the first to experience a moisture increase, because of an appreciable radial component of gas flow. With a high gas flow (2500 cfm) and high humidity, it is possible to detect which one of the 10 rear face plenum chambers is initially affected. High gas flow and low gas humidity tests are yet to be conducted, as well as a duplicate set of tests with a water injection rate of 25 gal./day. It is hoped that high gas flow and low gas humidity conditions will allow the detection of moisture at individual rear face sample points (10 per plenum chamber).

528R - Fission Chamber Life Test

During the March 19 discharge outage at D pile, three du Pont uranium fission chambers were installed in a wet process tube (1972) to determine the effect of radiation on their capacity to monitor neutron flux distribution. Each of the fission chambers is .5" dia. x 3.6" long and contains 10 grams of natural uranium. They are enclosed in a perforated Al cylinder designed to allow cooling water to flow over the chambers. One fission chamber was damaged during installation. The other two chambers agreed exceptionally well and indicated without lag minute power fluctuations of the pile for approximately one week. At that time one of the chambers began to gradually diverge and finally failed on March 31 because of insulation failure in the pile. Three additional du Pont uranium fission chambers will be installed in a second wet process tube at D pile during a future shutdown.

PROCESS DEVELOPMENTS

Proposed pile and water plant modifications at DR and H (C-482) are in the process of being completely revised. The original project called for the revision of 190 process pumps at DR and H to provide a pump discharge pressure of 525 psi, and modification of the front piping system to withstand 475 psi working pressure. However, higher boiling disease limits can be obtained either by enlarging the outlet fittings or increasing the header pressure. A recent re-evaluation has indicated that higher boiling limits can best be obtained by the former method, with a smaller increase in operating expense than that associated with front face and pumping modifications. The revised proposal consists of enlarging the tube outlet fittings and pigtails at DR and H piles to a minimum I.D. of 5/8" and 1", respectively. This will permit power level increases of 15 percent at DR and 30 percent at H through higher boiling disease limits. However, only approximately half of this production increase can be realized initially because of current graphite temperature limitations.

Extensive radiographs of metal columns in the pressured C and D machine (189-D) were obtained during the week of March 3 by representatives of Industrial X-Ray Engineers. X-Ray pictures were also taken of metal columns charged in 108-D utilizing

normal pile charging equipment and techniques. Data obtained indicate that slugs charged under normal conditions do not experience cocking in the process tube. Only slugs charged under pressure in the pressured C and D machine were observed to be cocked vertically and horizontally, both before and after backseating. These data nullify the possibility that some of the current slug ruptures may be caused by local hot spots resulting from the cocking of slugs in the process tubes.

The inspection of front and rear Van Stone flanges at F and H piles (50 process tubes each) has indicated that less than half of the Van Stone flanges have experienced any pitting corrosion. A minimum wall thickness of 30 mils was measured on those few Van Stone flanges experiencing severe pitting corrosion. It is planned to routinely inspect the Van Stone flanges on an additional 50 process tubes each at F and H piles, in order to obtain sufficient data tc evaluate the extent of Van Stone flange corrosion.

A flapper nozzle assembly, designed to permit the charge and discharge of temporary poison columns during pile operation, has successfully been tested in 108-D under simulated operating conditions. It is planned to test the flapper nozzle assembly at B pile in the near future on a production test basis.

Preliminary results of an investigation of annular, internally-cooled uranium slugs appear very encouraging, both from the standpoint of reactivity and heat transfer considerations. Power recovery possibilities with various configurations of annular, internally-cooled slugs are currently under study by heat transfer personnel.

3 Encl.
1. Comparative Reactor Performance
2. Pile Outage
3. Tabulation of Ruptured Slugs

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Distribution:
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PILE OUTAGE - MARCH, 1952

	B	D	DR	F	H	Total
Metal Discharge		16.5	29.5	8.0	13.6	67.6
Ruptured Slug Removal	43.1	30.3		0.7	54.7	128.8
Stuck Charge Removal				301.9		301.9
Production Test (except P-13)				3.0	13.5	16.5
Reactor Maintenance		18.8	8.0	46.0	2.5	75.3
Power Interruption	0.5	0.7	0.9		0.5	2.6
Special Irradiations			3.5	2.0		5.5
Total Hours	43.6	66.3	41.9	361.6	84.3	598.2

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COMPARATIVE REACTOR PERFORMANCE - MARCH, 19[redacted]

REACTOR	B	D	DR	F	H	TOTAL
Initial Startup	9-26-44	12-17-44	10-3-50	2-25-45	10-20-49	
Design Power Level (MW)	250	250	250	250	400	
Days Since Startup	2744	2662	545	2592	894	
Maximum Power Level Attained to Date (MW)	560	530	575	575	605	2845
Maximum Power Level During Month (MWD)	560	530	562	535	594	
Average Operating Level (MW)[1]	524	448	536	496	559	514
Total Reactor Outage Hours	43.6	66.3	41.9	361.6	84.8	598.2
Time Operated Efficiency (%)[2]	94.1	91.1	94.4	51.4	88.6	83.9
MWD Produced - Plutonium	15,289	12,660	15,669	7,907	15,359	66,884
MWD Discharged - Plutonium	8,126	12,163	20,852	9,514	22,529	73,184
MWD In Reactor	83,326	74,520	71,191	70,502	75,215	374,754
MWD In Reactor Basin						99,929
Tons of Metal Charged	13.55	19.68	33.62	13.03	38.78	118.66
Tons of Metal Discharged	13.80	20.05	33.62	19.05	38.47	124.99
Tons of Metal In Reactor						1204.78
Tons of Metal In Reactor Basin						170.41
Tons of Metal In 103 Storage						64.67
Average Discharge Concentration (MWD/T)	589	606	620	500	585	585
Scheduled Shutdowns	0	1	1	0	0	
Carbon Dioxide Concentration (%)[3]	98.0	95.2	98.3	98.0	90.0	
Highest Graphite Temperature Recorded (°C)	380	381	319	435	368	
Outlet Water Temperature (°C)[4]	64.4	59.6	57.5	61.8	58.2	
Inlet Water Temperature (°C)[4]	7.0	8.3	6.8	7.1	6.7	
Process Water Flow (gpm)[4]	35,084	38,168	41,188	36,875	42,422	
Maximum Effluent Water Activity (mrep/hr)	14.6	12.0	12.9	14.7	9.5	

1) Average Operating Level = $\frac{\text{MWD Produced} \times 24}{\text{Hours Operated}}$

2) Time Operated Efficiency = $\frac{\text{Hours Operated}}{\text{Total Hours In Month}}$

3) Months End Data

4) Average of Last Five Days of Equilibrium Operation

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TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances Shutdown and Re
145	3686-B	1) 2) 8-30-51 3) 3-1-52	211	306		345	545			976	1.80	High exit water ac Discharged with ch machine - Attempt within scram recov failed.
146	0975-H	1) 2) 9-25-51 3) 3-3-52	160	448	9.3	412	595	27	24	1459	2.45	High exit water ac Flushed out 36 slu 400 psi water pres Rear gunbarrel re Process tube push remaining slugs i
147	3665-H	1) 8-31-51 2) 9-25-51 3) 3-3-52	160	428	8.2	429	595			32	.05	Discovered during ar e by means of h pigtail reading - with charging mac
148	3694-B	1) 1-5-51 2) 1-23-51 3) 3-3-52	405	177	3.7	327	545	39	49	648	1.19	High exit water a 25 downstream slu out with 400 psi pressure - Aft sc process tube deri permit removal.
149	2765-D	1) 7-7-51 2) 7-22-51 3) 3-5-52	225	362	6.8	477	515			678	1.31	High exit water a Discharged with c machine - Resumed within scram recc

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TABULATION OF RUPTURED URANIUM SLUGS

Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		976	1.80	High exit water activity - Discharged with charging machine - Attempt to recover within scram recovery period failed.	Unable to locate ruptured slug in basin chutes	Group 8 slug	
7	24	1459	2.45	High exit water activity - Flushed out 36 slugs with 400 psi water pressure - Rear gunbarrel removed - Process tube pushed out with remaining slugs in it.	Cap failure.	Unable to read end cap data because of condition of cap. Group 8 slug	
		32	.05	Discovered during 0975 outage by means of high rear pigtail reading - Discharged with charging machine.	Uranium split longitudinally, almost entire length of slug	125T 8-31-51 Truck 3 & Group 8 slug	
	49	648	1.19	High exit water activity - 25 downstream slugs flushed out with 400 psi water pressure - Aft section of process tube deribbed to permit removal.	Slug badly blistered - Wedge-shaped portion of can and metal missing below end cap.	MRG 1-5-51 Truck 6 &	
		678	1.31	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period.	End cap failure	MRG 7-7-51 Truck 10 & Group 8 slug	
		[redacted]					

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TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances Shutdown and Re
150	0984-D	1) 4-3-51 2) 4-18-51 3) 3-7-52	324	333	5.9	587	515			542	1.05	High exit water a Discharged with c machine - Resumed within scram reco
151	1256-D	1) 4-3-51 2) 4-18-51 3) 3-11-52	328	259	5.6	468	515			678	1.31	High exit water a Discharged with c machine - Resumed within scram reco
152	1080-F	1) 8-21-51 2) 9-18-51 3) 3-17-52	181	362		298						High exit water a Discharged with c machine - Resumed within scram reco
153	0465-D	1) 4-6-51 2) 5-23-51 3) 3-27-52	309	280	5.7	397	530	25	26			High exit water a Aft section of pi deribbed to permit
154	3565-H	1) 8-30-51 2) 9-25-51 3) 3-27-52	184	413	8.1	497	570					Rapid loss of pi ty - Discharged ing machine - Pr leaking at locat ruptured slug.

[redacted]

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21 25

TABULATION OF RUPTURED URANIUM SLUGS

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		542	1.05	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period.	End cap failure	MRG 4-3-51 Truck 2 &	
		678	1.31	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period.	End cap failure	MRG 4-3-51 Truck 5 &	
				High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period.	Deep rib marks on slug surface - Slug split longitudinally on both sides - Cap end of slug slightly bulged	176-H 8-21-51 Truck 3 & Group 8 slug	
25	26			High exit water activity - Aft section of process tube deribbed to permit discharge.	Cap failure.	MRH 4-6-51 Truck 5 &	
				Rapid loss of pile reactivity - Discharged with charging machine - Process tube leaking at location of ruptured slug.	Can sidewall failure	125-T 8-30-51 Truck 3 & Group 8 slug	

[redacted]

STANDARD FORM NO. 64

[redacted]

Office Memorandum • UNITED STATES GOVERNMENT

TO : Files, Operations Division (THRU) R. L. Plum, and Donald G. Sturges

DATE: May 5, 1952

FROM : K. F. Paulovich KFP

SUBJECT: 100 AREAS MONTHLY REPORT - APRIL, 1952

SYMBOL: OP:KFP

PILE OPERATION

General

The maximum operating level attained in any one day during the month of April 1952 by each of the piles, and the corresponding equivalent percentage of the power level index, are as follows:

	B	D	DR	F	H
MWD	548	540	562	534	575
Percent	274	270	281	267	288

D pile attained an individual new maximum operating level during April and established an individual production record for the month. Despite the occurrence of sixteen ruptured slugs during a 30-day month, a new maximum total production of 68,932 MWD (113.4% of forecast) was achieved in April. This also represents a new per diem maximum production of 2,298 MWD/day.

On April 18 the addition of 1.8-2.2 ppm of sodium dichromate to inhibit Al corrosion was eliminated from the process water treatment at all piles except F. The elimination of sodium dichromate at F pile was postponed until the April 25-27 outage so that two process tubes (0874, 1162) containing weighed slugs for the purpose of obtaining slug corrosion data with alum-activated silica-sodium dichromate treated process water could be discharged before modifying the water treatment. The decision to eliminate sodium dichromate was based on in-pile data obtained from two dichromate-free process tubes discharged from H pile during Match (P.T.-105-453). These data indicated that the elimination of sodium dichromate reduced slug corrosion by a factor of approximately two, with no significant difference in film formation or type of corrosion experienced.

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During April the effluent water activity at all piles, and particularly F pile, consistently exceeded the established maximum of 10 mrep/hour, and necessitated considerable dilution with filtered water at 1904 before discharging the 107 retention basin water to the Columbia River. Analyses of the effluent water indicated that the activity was due to short-lived manganese isotopes. The increase in manganese is believed to be due to an increase in manganese content in the influent Columbia River water and/or an increase in manganese content discovered in the last shipment of lime employed for process water pH control. The effluent water activity is greater at F pile because of the different process water treatment employed, i.e., alum-activated silica coagulation with lime added after, instead of preceding, filtration. Unsuccessful attempts were made at F pile during the month to reduce the effluent Mn activity by increasing the chlorine addition and by raising the pH of the treatment.

B Pile

During the shutdown initiated on April 1 for the April metal discharge, a rear face pigtail survey revealed that the readings of process tubes 0885, 0886, 0966, and 0989 were higher than surrounding tubes. The charges in these four tubes were backseated and the rear section of the tubes and nozzles were swabbed out. However, no conclusive evidence was obtained and the suspected process tubes were not discharged. During the outage an unsuccessful attempt was made to pull the B test hole facility from its thimble, making it necessary to remove the assembly and thimble as a unit. A new thimble was installed with a steel plug, blank flange, and shielding in place until the test hole installation could be completed during a subsequent outage. Upon startup a radiation survey indicated that the temporary neutron shielding around B test hole was inadequate, making the entire far side of the pile and part of the work area a danger zone.

During the month April, B pile was shut down six times because of the following ruptured slugs:

Tube No.	Shutdown	Started to Power
2489	8:57 P.M., April 4	9:21 P.M., April 4
3653	3:42 P.M., April 6	5:17 P.M., April 7
4086 } 4056 }	12:03 P.M., April 15	1:42 P.M., April 16
1371	6:25 A.M., April 23	9:32 A.M., April 24
0386	12:55 P.M., April 29	1:32 P.M., April 29

It was possible to immediately discharge process tubes 2489 and 0386 (extreme fringe of pile) with the charging machine and resume operations within the scram recovery period.

After flushing out 17 downstream slugs with 350 psi water pressure and deribbing the aft section of the process tube, the metal column in tube 3653 could not be loosened with pushing and backseating forces of 8000 pounds. It was necessary to transfer 43 upstream slugs to process tube 3652 with the twin transfer cask, and then push out the process tube containing the rupture and three remaining slugs. During this outage the temporary shielding around the B test hole was rebuilt with additional paraffin and masonite blocks, making it possible to release the front face and work area from danger zone status after startup.

The possibility of a water leak became apparent at B pile on April 10 when water began to accumulate in the exit drip leg. In order to accelerate moisture extraction, the CO_2 gas flow through the pile was increased to 1040 cmf on April 14 by increasing the steam head to the drier and blower turbines. When B pile was shut down on April 15 because of high effluent water activity, a rear face survey revealed high pigtail readings on tubes 4086 and 4056. It was possible to discharge process tube 4086 without difficulty with the charging machine. After flushing out 21 downstream slugs with 400 psi water pressure and deribbing the aft section of process tube 4056, the metal charge could not be pushed with forces of 7000 pounds. Thirty-nine upstream slugs were transferred to tube 4057 and the process tube, containing the rupture and three additional slugs, was pushed out in sections. The section of process tube 4056 containing the ruptured slug appeared to have a small hole in the tube. This observation was confirmed when the water leakage disappeared following startup. A new process tube was installed in channel 4056, and two additional steel plugs were inserted in the B test hole thimble to supplement the temporary shielding during this outage.

Before it was possible to remove the ruptured slug in process tube 1371, it was necessary to flush out sixteen downstream slugs and derib the aft section of the process tube. During this shutdown the installation of a new water-cooled facility in B test hole was completed and made available for operation. In addition, the metal discharge scheduled for May was accomplished and new process tubes were installed in channels 1371, 3652, and 3653 (April ruptures).

D Pile

A new maximum power level of 540 MW was first reached on April 4, with a new maximum daily production of 540 MWD established on April 5. A new maximum monthly production of 14,566 MWD was established at D pile in April.

Three ruptured slugs caused the shutdown of D pile during April, as follows:

Tube No.	Shutdown	Started to Power
3088	1:37 P.M., April 2	2:10 P.M., April 2
0855	8:48 A.M., April 7	8:00 P.M., April 8
4060	11:40 P.M., April 29	12:05 A.M., April 30

It was possible to immediately discharge process tubes 3088 and 4060 with the charging machine and resume operations within the scram recovery period. Following the 3088 recovery, D pile was scrammed at 2:45 P.M. on April 2 because of failure of the #32 VSR clutch. The vertical safety rod was tied out of service and operations were resumed again at 2:51 P.M.

An abnormally high Panellit pressure led to the discovery of the ruptured slug in process tube 0855. After flushing out 29 downstream slugs and deribbing the aft section of the process tube, it was possible to push out the remainder of the metal column with forces of 4000 pounds. During the shutdown, the #8 HCR thimble was removed, a new thimble was installed, and the #8 horizontal control rod (the tip section of which had been replaced on April 3-4) was reassembled and installed in the unit. The necessary cooling water and drive connections were completed and the #8 HCR was returned to service. In addition, the metal discharge for April was accomplished during the 0855 outage. Startup was delayed momentarily when #11 and #19 vertical safety rods dropped back into the pile. The rods were tied out of service and repaired during the subsequent poison push outage.

Considerable binding of the #2 horizontal control rod was experienced at D pile during the early part of April. Consequently, during the week of April 21 the #2 HCR was completely withdrawn from the pile, the control rod was disconnected, and the tip section was remotely pulled into a can and transported to the burial ground. The #2 HCR was then reassembled with a new tip section, pressure tested, and made ready for installation. During the first available shutdown in May, it is planned to return the #2 HCR to service after installing a new thimble.

DR Pile

During the scheduled metal discharge conducted on April 10, 250 process tubes were charged with eight-inch slugs under PT-105-313-2M. Three improved charging machines, with new micro-switches installed, were employed during the metal discharge. However, one machine was damaged during charging and temporarily put out of service. Hence, a valid check of the operational efficiency of three charging machines was again not obtained. During the shutdown the experimental setup installed in process channel 3577 (Project Bluenose, P.T.-105-507-A) was discharged at an approximate concentration of 135 MWD/T. A second identical setup was installed in 3577 in an effort to duplicate the data obtained with the first channel.

Only one ruptured slug caused the shutdown of DR pile during April, as follows:

Tube No.	Shutdown	Started to Power
2192	3:17 P.M., April 23	10:48 P.M., April 24

After flushing out 48 downstream slugs, it was necessary to remove the rear gunbarrel before process tube 2192 could be pushed out with the remaining slugs in it. A new rear gunbarrel and new process tube were installed in 2192, along with 1180, and the tube was recharged with metal.

During the 2192 outage, 36 process tubes located in and below the wet zone of the upper near quadrant were checked for freedom of movement in the graphite. All tubes were free except 2560, which appeared to be stuck and could not be moved from either the front or the rear.

Startup was delayed approximately 12 hours when several crossheader screens became plugged during the pre-startup purge, making it necessary to inspect and clean all crossheader screens. During this period process tube 3588 was discharged with the charging machine because of a high rear pigtail reading. However, at months end a ruptured slug had not been located from this tube.

H Pile

The water collection rate at the CO_2 driers decreased from seventeen gallons/day on April 1 to normal conditions on April 6, making a total of 320 gallons extracted from H pile following the water leak in 3565 during March.

H pile was shut down twice during April because of the following ruptured slugs:

Tube No.	Shutdown	Started to Power
3088	5:43 A.M., April 12	11:32 P.M., April 13
3681	8:58 A.M., April 14	11:19 P.M., April 14

It was possible to immediately discharge process tubes 3681, 3161, and 3162 (ruptured suspects) with the charging machine on April 14 and resume continued operations. A ruptured slug was confirmed in process tube 3681, but not in tubes 3161 or 3162.

A dew point increase and excessive effluent water activity from #29 rear crossheader resulted in the detection of a ruptured slug and water leak in process tube 3088. After fourteen downstream slugs were flushed out with 400 psi water pressure, the metal column could not be moved with forces of 2500 pounds. It was necessary to remove the rear gunbarrel before the process tube, containing the ruptured slug and remaining slugs, could be pushed out in sections. A new rear gunbarrel and new process tube were installed and the tube was recharged with metal. During the 3088 outage, the April metal discharge was conducted, with 190 process tubes being charged with eight-inch slugs. In addition, process tube 0777, which appeared to be stuck in the graphite during March, was checked again for freedom of movement and found to be free.

Upon resuming operations, the water collection rate at the CO_2 driers decreased from a maximum of sixteen gallons/day to a normal rate on April 18. A total of 58 gallons were extracted from H pile following the water leak in process tube 3088.

On April 10 and 11 two uranyl nitrate injections were made into process tube 2369 to obtain delayed neutron monitoring data under P.T.-105-446.

H pile was scrammed at 8:37 P.M. on April 17 because of a faulty Panellit connection. Recovery was effected in sixteen minutes.

F Pile

The following three ruptured slugs caused the shutdown of F pile during April:

Tube No.	Shutdown	Started to Power
4287	6:14 P.M., April 4	6:42 P.M., April 4
2493	9:33 P.M., April 6	10:09 P.M., April 6
2659	8:37 P.M., April 28	9:18 P.M., April 28

It was possible to immediately discharge all three process tubes (4287, 2493, and 2659) with the charging machine and resume operations within the scram recovery period.

During the shutdown initiated on April 7 for the April metal discharge, a ruptured slug was discovered in process tube 0562 by a routine rear pigtail survey and discharged without difficulty. Graphite burnout samples exposed to controlled atmospheres of CO, CO_2, and (95% CO_2+5% CO) were removed from the front of process tube 2777 during the shutdown, thereby concluding PT-105-435. A temporary graphite temperature limit of 410°C was made effective at F pile until the graphite burnout test data can be summarized and evaluated. A total of 429 process tubes located in rows 12 through 19 were checked for freedom of movement in the graphite. 145 process tubes were found to be stuck, 24 of which had previously been free. However, 25 process tubes which had previously been stuck were now loose. In addition, the metal columns in 132 process tubes located in the lower far corner (below row 15 and to the far side of column 81)

were successfully backseated. The front and rear Van Stone flanges of approximately 30 process tubes were inspected, and process tube 0379 was discharged and isolated as an air tube because of excessive Van Stone flange pitting.

F pile was scrammed at 11:10 A.M. on April 19 because of abnormally high Panellit pressure on process tube 0378. The tube was discharged without difficulty and recharged with solid Al dummies. It was discovered that the pressure increase was caused by a rubber gasket from a process tube hydrostatic leak tester which was lodged in the end of one of the perforated Al dummies. Apparently the gasket had been inadvertantly left in the rear of the process tube during the leak testing program conducted in February. If the pile had not been automatically scrammed by the three-second time-delay relay setup recently installed in the Panellit pressure monitoring system, the slug jackets might have melted in process tube 0378 because of the restriction in cooling water flow. Operations were resumed at 11:56 A.M.

In order to improve the water collection at the CO_2 driers, the gas atmosphere flow at F pile was increased from 1800 cfm to 3000 cfm on April 3. This was accomplished by employing three driers and two blowers in the gas system, and by increasing the steam pressure to the drier and blower turbine drives (the 150 psi inlet rating of the turbines had not been fully utilized previously). The increase in gas flow temporarily increased the water collection rate at the CO_2 driers from about ten gallons/day to a maximum of nineteen gallons/day, before gradually decreasing to a normal three gallons/day rate on April 21. On April 22 the CO_2 gas flow was returned to normal.

However, the water extraction rate began to increase appreciably during April 23-25, and F pile was shut down at 2:05 P.M. on April 25 to investigate the possibility of additional process tube leaks. All process tubes in the lower half of the pile (rows 1 through 23) were individually subjected to a 350 psi hydrostatic pressure test. Two leaking process tubes (0463, 0889) were discovered, discharged with maximum forces of 2000 pounds, and isolated from the cooling water system. In addition, the metal column in 123 process tubes located in the lower far corner (below row 15 and to the far side of column 82) were successfully backseated. Seventy-six process tubes which had been checked for freedom of movement in the graphite on April 7 were rechecked and no significant change was observed.

During the outage the metal discharge scheduled for May was accomplished, and three process tubes (3874, 3974, 1371) with leaking nozzle gaskets were investigated and repaired. In addition, two process tubes (0874, 1162) containing slugs earmarked for obtaining slug corrosion data with the alum-activated silica-sodium dichromate water treatment were discharged (P.T.-105-503-E). Sodium dichromate was eliminated from the water treatment at F pile, and 6 process tubes (0874, 1162, 2369, 2377, 2676, 3871) were charged with weighed slugs for obtaining slug corrosion data with the alum-activated silica treatment without dichromate.

Following startup at 1:26 P.M. on April 27 the water collection rate at the CO_2 driers averaged thirteen gallons/day for the remainder of the month.

An unsuccessful attempt was made at F pile to reduce the abnormally high effluent water activity (due to increased manganese content) by increasing the chlorine addition. Also, the pH of the alum-silica-dichromate treated process water was increased from 7.3 to 7.7 on April 21 in an effort to eliminate the manganese. However, this resulted in increased Fe concentration and accelerated film buildup on the slugs. It was necessary to reduce the pH from 7.7 to 7.5 and finally back to 7.3 again before the film formation returned to normal.

RUPTURED SLUGS

Sixteen instances of in-pile uranium slug failures occurred during April, bringing the total number to date to 170. The attached table presents all data available at months end regarding these sixteen ruptured slugs. It was possible to successfully discharge eight of these ruptured slugs with the charging machine and resume operations within the scram recovery period. Eight Group 8 slugs were included in the slug failures during April, bringing the total number to date to 37.

PROCESS DEVELOPMENTS

A series of four tests were recently completed at H pile in which the 105 Bailey flowmeters were checked against the rate of drop of filtered water level in the 190 storage tanks. These

drop tests indicated that, after investigation and accounting for all intermediate water leakage and useage, approximately 5 percent more cooling water is flowing through H pile than indicated by the 105 flowmeters. It is being recommended that the flow meters at H pile be corrected accordingly, which will result in a paper increase in power level of approximately 25 MW. It is also being recommended that the 190 drop tests be adopted as a standard means of checking pile cooling water flows. It is planned to perform 190 drop tests at B, D, DR, and F piles in the near future to check the possibility of similar errors.

A review of all graphite burnout data available to date, particularly that recently obtained from samples exposed at 430°C in channel 2682-F, has led to a recommendation that the maximum graphite temperature be relaxed from 380°C to 410°C at all piles. At this temperature it is estimated that the graphite burnout rate would be only 1.8%/1000 days. The recommendation has essentially been approved by management and should be made effective early in May. F pile is currently operating with a temporary graphite temperature limit of 410°C, following the conclusion of P.T.-105-435.

The existing corrosion limit on pile power levels is currently undergoing revision. Instead of a maximum outlet water temperature of 80°C for all process tubes, the revised corrosion limit will be based on a uniform allowable slug corrosion of 6 mils (assuming a minimum canwall thickness of 10 mils and a maximum scratch depth of 4 mils). This will result in an outlet water temperature limit of approximately 95°C in the central zone and a limit in the neighborhood of 75°C in the fringe zone, due to differences in exposure period. Correlation of slug corrosion data obtained to date has indicated that the corrosion is a function of slug surface temperature and slug power generation. Consequently, the revised corrosion limits will also be based on tube power generation. In addition, data recently obtained from slugs subjected to dichromate-free cooling water at H pile have indicated that the elimination of sodium dichromate reduced slug corrosion by a factor of approximately two. The new corrosion limits will be increased 25 percent to take partial advantage of the elimination of sodium dichromate at all piles during April. Hence, the new corrosion limits established on dichromate-free

corrosion data will be based on outlet water temperature and/or tube power generation, whichever is limiting. These revised limits, which are scheduled to go into effect at all piles in May, should not necessitate any pile power cutbacks during the summer months. The existing maximum outlet water temperature of 80°C has already become limiting at all piles and would require power reductions if continued in effect.

Tests in progress at H pile to determine the effect on film formation of low iron concentration in ferric sulfate treated process water were concluded during April. For two purge periods the iron concentration of the process water at H pile was decreased from a normal content of .015 ppm to an average of .005 ppm, by increasing the ferric sulfate coagulant from 3 ppm to approximately 12-15 ppm. This resulted in a considerable reduction in film formation, as measured by the decrease in process water flow at constant power level. With normal Fe concentration (.015 ppm) a 133 gpm decrease per day was experienced. With .005 ppm Fe concentration, the decrease/day was 50 gpm and 23 gpm for the two test periods respectively.

Slug corrosion data obtained to date with 65°C and 95°C filtered water in the 105-D flow laboratory has indicated that considerable pitting corrosion is experienced at pHs of 6.2, 6.7, and 7.2. Corrosion data obtained with the recirculation setup in the 105-F flow laboratory have indicated that corrosion rates with total solids concentrations of 6 ppm and 12 ppm are considerably less than corrosion losses experienced in the piles (filtered water has approximately 90 ppm total solids). The corrosion rates with the 12 ppm water were lower than with the 6 ppm water, contrary to expectations.

All television equipment required for the experimental rear force monitoring system have arrived. Construction of a mockup structure simulating the rear face of a pile is in progress at 189-D to check the operation of the television camera and viewers.

PRODUCTION TESTS

435 - Graphite Burnout and Transport

Graphite burnout samples exposed to controlled atmospheres of CO, CO_2, and (95% CO_2 + 5% CO) were removed from the front of process tube 2777 during the April 7 discharge at F pile to conclude PT-105-435. The samples had been maintained at a nominal temperature of 430°C for an exposure period of approximately 2 months. Upon removal it was discovered that the CO and (95% CO_2 + 5% CO) samples had been allowed to run dry during the test, thereby making data from these samples unreliable. The graphite exposed to a CO_2 atmosphere is presently undergoing analysis.

446 - Delayed Neutron Monitoring

On April 10 and 11 two uranyl nitrate injections were made into process tube 2369 to obtain additional data with delay neutron monitoring equipment. Uranyl nitrate was injected at a constant rate until an initial indication was obtained with the beta monitoring equipment, at which time the delayed neutron monitoring indication had increased 25 fold, demonstrating its sensitivity. Data obtained with a second delayed neutron monitoring system installed in the sample room revealed that the high neutron background previously obtained with the chambers located on #23 rear crossheader was due in part to photo neutrons originating from a N^{16}-D_2O reaction. The tests also demonstrated that the uranyl nitrate hangs up in the process tube and is subjected to more than a two second exposure in the pile, as originally thought.

505E - Irradiation of Glass Balls (Ball 3X System)

During the April 10 discharge at DR pile, graphite ~~timing~~ mining process channel 2577 was charged with a specially constructed graphite "boat" containing six 3/8" dia., Al-coated glass balls intended for use in the ball 3X safety system. It is planned to subject the glass balls to neutron bombardment for one month to determine the resultant gamma-ray activity and radiation damage.

3 Encls.
1. Comparative Reactor Performance
2. Pile Outage
3. Tabulation of Ruptured Slugs

PAULOVICH/ww

Distribution:
Cy 1 - Addressee

REACTOR OUTAGE - APRIL, 1952

	B	D	DR	F	H	Total
Metal Discharge	24.7		26.4	24.9	18.8	94.8
Ruptured Slug Removal	79.4	30.0	21.7	2.3	25.4	158.8
Stuck Charge Removal				2.9		2.9
Production Tests	2.5			7.7		10.2
Reactor Maintenance		8.9	11.2	72.1		92.2
Removal of Restriction in Process Tube				0.8		0.8
Panellit Failure					0.3	0.3
Plugging of Crossheader Screens			12.2			12.2
Total Hours	106.6	38.9	71.5	110.7	44.5	372.2

KFP
3-25-52

COMPARATIVE REACTOR PERFORMANCE - APRIL, 52

REACTOR	B	D	DR	F	H	TOTAL
Initial Startup	9-26-44	12-17-44	10-3-50	2-25-45	10-20-49	
Design Power Level (MW)	250	250	250	250	400	
Days Since Startup	2774	2692	575	2622	924	
Maximum Power Level Attained to Date (MW)	560	540	575	575	605	2855
Maximum Power Level During Month (MWD)	548	540	562	534	575	
Average Operating Level (MW)[1]	452	513	532	496	562	513
Total Reactor Outage Hours	106.6	38.9	71.5	110.7	44.5	372.2
Time Operated Efficiency (%)[2]	85.2	94.6	90.1	84.6	93.8	89.7
MWD Produced - Plutonium	11,573	14,566	14,375	12,594	15,824	68,932
MWD Discharged - Plutonium	16,311	6,423	21,291	22,225	14,399	80,649
MWD In Reactor	78,588	82,663	64,275	60,871	76,640	363,037
MWD In Reactor Basin						123,144
Tons of Metal Charged	26.47	10.29	35.76	37.95	24.60	135.07
Tons of Metal Discharged	26.96	10.66	34.37	38.45	23.83	134.27
Tons of Metal In Reactor						1205.58
Tons of Metal In Reactor Basin						205.28
Tons of Metal In 103 Storage						95.98
Average Discharge Concentration (MWD/T)	605	603	619	578	604	601
Scheduled Shutdowns	1	0	1	1	0	
Carbon Dioxide Concentration (%)[3]	98.0	97.4	96.9	97.7	92.2	
Highest Graphite Temperature Recorded (°C)	369	380	315	445	365	
Outlet Water Temperature (°C)[4]	66.6	62.8	60.9	63.2	61.7	
Inlet Water Temperature (°C)[4]	10.9	10.9	10.7	10.6	10.9	
Process Water Flow (gpm)[4]	36,378	38,740	40,828	36,565	42,990	
Maximum Effluent Water Activity (mrep/hr)	15.4	10.8	12.2	21.4	15.0	

1) Average Operating Level = $\frac{\text{MWD Produced} \times 24}{\text{Hours Operated}}$

2) Time Operated Efficiency = $\frac{\text{Hours Operated}}{\text{Total Hours In Month}}$

3) Months End Data

4) Average of Last Five Days of Equilibrium Operation

80

[redacted]

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No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances Shutdown and Re
155	3088-D	1) 8-2-51 2) 8-22-51 3) 4-2-52	224	291	5.4	439	520			40	.08	High exit water a Discharged with c machine - Resumed within scram reco
156	4287-F	1) 4-16-51 2) 5-8-51 3) 4-4-52	332	231	4.3	329	535			52	.097	High exit water a Discharged with c machine - Resumed within scram reco
157	2489-B	1) 7-17-51 2) 8-14-51 3) 4-4-52	234	357	6.5	469	465			57	.12	High exit water Discharged with machine - Resume within scram rec
158	3653-B	1) 1-5-51 2) 1-23-51 3) 4-6-52	439	149	2.6	365	465	47	54	1185	2.54	High exit water a Unable to move me after flushing ou stream slugs - Tr 43 upstream slugs with twin transfe Pushed out tube rupture and 3 re
159	2493-F	1) 4-14-51 2) 5-8-51 3) 4-6-52	334	263	5.3	465	525	41	45	61	.12	High exit water Discharged with machine - Resume within scram rec

[redacted]

TABULATION OF RUPTURED URANIUM SLUGS – APRIL, 1952

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		40	.08	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period	End cap failure.	MRH 8-2-51 Truck 2 & Group 8	
		52	.097	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period	End cap failure.	MRG 4-16-51 Truck 4 &	
		57	.12	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period	End cap failure.	MRH 7-17-51 Truck 9 & Group 8	
47	54	1185	2.54	High exit water activity - Unable to move metal column after flushing out 17 downstream slugs - Transferred 43 upstream slugs to 3652 with twin transfer cask - Pushed out tube containing rupture and 3 remaining slugs	End cap off - Longitudinal split thru center of slug.	MRG 1-5-51 Truck 5 &	
41	45	61	.12	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period.	End cap failure.	MRH 4-14-51 Truck 9 & (P.T.-105-103)	

TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstance Shutdown and F
160	0855-D	1) 12-8-50 2) 1-16-51 3) 4-7-52	447	256	5.5	471	535	35	37	1349	2.52	Abnormally high P pressure - Aft se process tube deri permit removal.
161	0562-F	1) 8-8-50 2) 9-28-50 3) 4-7-52	558	248	5.8	559	535			52	.097	Discovered during outage by rear pi - Discharged witho culty after backs 1000 pounds.
162	3088-H	1) 8-25-51 2) 9-25-51 3) 4-12-52	200	378	6.4	496	575	48	55	1191	2.07	High effluent wat and dew point inc slugs flushed out psi pressure - Ne remove rear gunba out tube & remaini Tube leak at rupt
163	3681-H	1) 8-31-51 2) 9-25-51 3) 4-14-52	202	396	5.2	529	575			124	.22	High exit water a Discharged with c machine - Resumed within scram recov
164	4086-B	1) 6-14-51 2) 7-28-51 3) 4-15-52	262	297	5.3	374	505			19	.037	High exit water a Discharged with c machine - Unable t because of rupture

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TABULATION OF RUPTURED URANIUM SLUGS

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
35	37	1349	2.52	Abnormally high Panellit pressure - Aft section of process tube deribbed to permit removal.	End cap off	MRG 12-8-50 Truck 2 &	
		52	.097	Discovered during discharge outage by rear pigtail survey - Discharged without difficulty after backseating with 1000 pounds.	End cap off.	MRG 8-8-50 Truck 1 &	
48	55	1191	2.07	High effluent water activity and dew point increase - 14 slugs flushed out with 400 psi pressure - Necessary to remove rear gunbarrel to push out tube & remaining charge - Tube leak at rupture.	Uranium split failure.	167-T 8-25-51 Truck 1 & Group 8	
5		124	.22	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period.	Slug split diagonally into two pieces	ZRG 8-31-51 Truck 9 & Group 8	
5		19	.037	High exit water activity - Discharged with charging machine - Unable to start up because of rupture in 4056.	End cap failure.	MRH 6-14-51 Truck 11 & Group 8	

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TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances Shutdown and Re
165	4056-B	1) 4-28-51 2) 5-16-51 3) 4-15-52	335	3.6	186	358	505	43	44	946	1.89	High exit water acti Unable to move metal after flushing out 2 stream slugs - Trans upstream slugs to 4 twin transfer cask · out tube containing 3 remaining slugs.
166	1371-B	1) 6-11-51 2) 7-11-51 3) 4-23-52	287	6.3	373		540	48	60	1046	1.94	High exit water act Aft section of proc deribbed to permit
167	2192-DR	1) 2) 10-15-51 3) 4-23-52	191			307	545			998	1.83	High exit water ac Flushed out 48 dow slugs - Rear gunba removed - Tube and slugs pushed out.
168	2659-F	1) 10-22-51 2) 12-5-51 3) 4-29-52	145			262	355			45	.13	High exit water ac Discharged with ch machine - Resumed within scram recov
169	0386-B	1) 1-5-51 2) 1-23-51 3) 4-29-52	462				555			36	.065	High exit water ac Discharged with ch machine - Resumed within scram recov
170	4060-D	1) 2-12-51 2) 3-7-51 3) 4-29-52	419			617	520			13	.025	High exit water ac Discharged with ch machine - Resumed within scram recov

TABULATION OF RUPTURED URANIUM SLUGS

Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
3	44	946	1.89	High exit water activity - Unable to move metal column after flushing out 21 downstream slugs - Transferred 39 upstream slugs to 4057 with twin transfer cask - Pushed out tube containing rupture & 3 remaining slugs.	End cap off - Wedge-shaped portion of slug detached below cap base.	MRG 4-28-51 Truck 5 & Group 8	
	60	1046	1.94	High exit water activity - Aft section of process tube deribbed to permit removal.	Can sidewall failure - Wart-like swelling on side at failure.	ZRG 6-11-51 Truck 11 & Group 8	
		998	1.83	High exit water activity - Flushed out 48 downstream slugs - Rear gunbarrel removed - Tube and remaining slugs pushed out.	End cap missing - Slug disintegrated into about 10 pieces.	End cap data not legible.	
		45	.13	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period	Slug split longitudinally	173-U 10-22-51 Truck 6 & Group 8	
		36	.065	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period	End cap failure.	MRG 1-5-51 Truck 2 &	
		13	.025	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period	Slug blistered considerably - End cap off - Two longitudinal cracks in can - Pinhole in can near crack.	MRG 2-12-51 Truck 6 &	

Office Memorandum — UNITED STATES GOVERNMENT

TO : Files, Operations Division (THRU) R. E. Plum and Donald G. Sturges

DATE: June 6, 1952

FROM : K. F. Paulovich

SUBJECT: 100 AREAS MONTHLY REPORT - MAY 1952

PILE OPERATION

General

The maximum operating level attained in any one day during the month of May 1952 by each of the piles, and the corresponding equivalent percentage of the power level index, are as follows:

	B	D	DR	H	F
MWD	550	555	570	578	520
Percent	275	278	285	289	260

D pile attained an individual new maximum operating level during May and D, DR and F piles established individual production records for the month. Despite the occurrence of 12 ruptured slugs and wet graphite difficulties at H pile, a new maximum total production of 72,601 MWD (115.4% of forecast) was achieved in May. This also represents a new per diem maximum production of 2,342 MWD per day.

The maximum graphite temperature limit was relaxed from 380°C to 410°C at B, D, DR, and H piles on May 21. Inasmuch as the maximum outlet water temperature of 80°C necessitated appreciable power level cutbacks at B, D, and F piles during May, a temporary outlet water temperature limit of 35° was made effective at all piles on May 29, until new corrosion limits based on dichromate-free process water can be established. The revised corrosion limits should be put into effect during June.

339 process tubes at DR and H piles were charged with 8-inch slugs (P.T.-105-313-2M) during May. This brings the total now in DR and H piles to 1209 process tubes, or 39% of the 100,000 8-inch slugs scheduled to be charged. 8-inch slugs are scheduled to be charged into the lower two-thirds of B, D, and F piles beginning in June.

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B Pile

During the month of May, B pile was shut down four times because of the following six ruptured slugs:

Tube No.	Shutdown	Started to Power
3088-1 3088-2	1:23 P.M., May 3	1:51 P.M., May 3
2470 2062	1:30 P.M., May 4	3:18 P.M., May 5
3278	4:55 P.M., May 13	5:25 P.M., May 14
2461	11:58 A.M., May 19	12:38 P.M., May 19

It was possible to immediately discharge process tubes 3088 and 2461 with the charging machine and resume operations within the scram recovery period.

After flushing out 21 downstream slugs, the metal column in tube 2470 was discharged with a maximum force of 2000 pounds without oil lubrication. A new process tube was installed and recharged with metal. An abnormal increase in Panellit pressure led to the discovery of a second ruptured slug in process tube 2062 during the same outage. After flushing out 48 downstream slugs, the metal column in tube 2062 could not be loosened with forces up to 6000 pounds. It was necessary to transfer seven upstream slugs to process tube 2061 with the twin transfer cask and remove the rear gunbarrel before the tube containing the remaining slugs could be pushed out. A new process tube and gunbarrel were installed and the tube was recharged with metal. An examination of process tube 2062 revealed a small hole in the tube in the vicinity of the ruptured slug, accounting for a slight increase in the moisture removal rate at B pile on May 3 and 4.

On May 13 it was possible to immediately discharge suspect process tube 3178 with the charging machine. However, electrical difficulties with the discharge elevator delayed startup attempts until 5:57 P.M., at which time it was impossible to recover. Examination of the metal column discharged from 3178 revealed no ruptured slug. A rear pigtail survey indicated that process tube 3278 was also reading high. Consequently, the metal column in process tube 3278 was discharged with the charging machine. Process tubes 3178 and 3278 were both recharged with regular metal. During the outage approximately 70 process tube orifices and the corresponding Panellit gauges were changed. In addition, a new process tube was installed in channel 2961 and recharged with regular metal.

A temporary discrepancy in metal inventory on May 15 was resolved on May 16 when two missing slugs were found on a maintenance high lift.

B pile was scrammed at 1:59 P.M. on May 15 when the No. 4 Beckman was inadvertantly by-passed while attempting to calibrate the No. 1 Beckman. Recovery was effected in three minutes.

During the shutdown initiated on May 27 for the May metal discharge and a Rala shipment, a facility for charging and discharging a poison column during pile operation was installed on tube 1277 and successfully tested (PT-105-1-MR).

D Pile

A new maximum power level of 555 MW was first reached on May 14, with a new maximum daily production of 555 MWD established on May 15. The power level increase at D pile during May was attributable to improved graphite lattice conductance and the return to service of the #2 horizontal control rod. A new maximum monthly production of 15,370 MWD was established at D pile in May.

Three ruptured slugs caused the shutdown of D pile during May, as follows:

Tube No.	Shutdown	Started to Power
4265	10:09 P.M., May 1	10:35 P.M., May 1
2981	7:04 A.M., May 29	7:36 A.M., May 29
4185	1:10 A.M., May 30	1:36 A.M., May 30

It was possible to immediately discharge all three process tubes (4265, 2981, 4185) with the charging machine and resume operations within the scram recovery period.

The D pile was shut down on May 5 to conduct the metal discharge for the month of May. During this outage an attempt to remove the No. 2 horizontal control rod thimble resulted in the thimble breaking into two sections and damaging the transport can, making it necessary to substitute another can before the thimble removal could be completed. The graphite channel was vacuumed and the step plug installed. Considerable difficulty was encountered while inserting the thimble and the thimble was damaged in going through the step plug. This required abandoning the thimble and installing a new thimble. A gas seal was made with considerable

difficulty, a full length traverse was made, the graphite was installed, the thimble was pressure tested, and the No. 2 horizontal control rod was returned to service before startup.

During the latter part of May, considerable difficulty was encountered with the No. 5 horizontal control rod binding in the pile. On May 21 the installation of a front face crossheader pressure monitoring system was completed at D pile except for individual Panellit gauges. While awaiting delivery of the Panellit gauges, a Heise gauge is temporarily being utilized to obtain individual crossheader pressure data.

During the month the excavation of an extension to the common D-DR effluent water crib was started in order to increase the flow of contaminated effluent water through the existing crib.

DR Pile

With the exception of two Panellit scrams and the scheduled metal discharge, DR pile operated the entire month without incident at an equilibrium power level of approximately 560 MW. A new maximum monthly production of 16,475 MWD was established at DR pile in May.

DR pile was scrammed at 5:00 P.M. on May 7 due to a leaking Panellit gauge (1071). Operations were resumed in five minutes. The DR pile was scrammed again at 1:53 A.M. on May 13 due to a second leaking Panellit gauge (2961). Recovery was effected in nine minutes.

During the scheduled discharge initiated on May 15, the metal column in process tube 1871 was discharged because of a high rear pigtail reading. However, examination of the charge revealed no ruptured slug. During the outage, the graphite boat containing six 3/8" diameter Al-coated balls intended for use in the ball 3X safety system were discharged from channel 2577 after an irradiation period of one month.

In addition, uranium impregnated graphite samples were charged into channel 2764 for North American Aviation under PT-105-543-SR. Two process tubes containing a total of 31 8-inch slugs (PT-105-313-2M) were discharged for examination after an exposure of approximately 330 MWD/T. No unusual slug characteristics were observed. The pile was started to power at 4:53 P.M. on May 16. However, at 10:40 P.M. it was necessary to shut the pile down

because of insufficient control rod for turn-around. Six additional temporary poison columns (0781, 1288, 1264, 3762, 3983, 4071) were charged and continued operations were resumed at 12:01 A.M. on May 17.

F Pile

A new maximum monthly production of 15,765 MWD was established at F pile in May.

Only one ruptured slug caused the shutdown of F pile during May, as follows:

Tube No.	Shutdown	Started to Power
0564	9:14 A.M., May 24	9:44 A.M., May 24

It was possible to immediately discharge the ruptured slug in process tube 0564 and resume operations within the scram recovery period.

F pile was shut down five times because of Panellit scrams during May. The pile was shut down at 11:37 P.M. on May 4 because of an incorrect pressure trip setting on gauge 1586. Recovery was effected in 15 minutes. The pile was scrammed at 7:20 P.M. on May 5 and again on 1:22 A.M. on May 6 because of a pressure trip on Panellit row 15. The exact difficulty was not determined and operations were resumed in 15 and 9 minutes respectively. F pile was scrammed again at 3:11 A.M. on May 6 because of a low pressure trip on gauge 1583. Examination revealed that the gauge had a pin point leak due to corrosion at the point where the pressure inlet was brazed to the Bourdon tube. The faulty gauge was replaced and operations were resumed at 3:15 A.M. F pile was also scrammed at 2:31 P.M. on May 20 when a single-strand circuit jumper failed while changing several Panellit gauges, thereby shorting out the Panellit board. Operations were resumed at 2:44 P.M.

The water collection rate at the CO_2 driers decreased from 10 gallons per day on May 1 to a normal rate of 4 gallons per day on May 8, making a total of 112 gallons extracted from F pile following the removal of leaking process tubes 0463 and 0889 on April 23-25.

An attempt was being made at months end to locate the excessive leakage (approximately 8000 cu. ft./day) of CO_2 pile atmosphere which has existed at F pile since the major shutdown in early March by employing the helium leak detection equipment used at B pile under PT-105-506-A.

H Pile

The following two ruptured slugs occurred at H pile during the month of May:

Tube No.	Downtime	Started to Power
3261	8:53 A.M., May 16	9:08 A.M., May 18
2789	11:30 P.M., May 19	7:53 P.M., May 21

During the scheduled outage initiated on May 12 to conduct the metal discharge for May, it was discovered while charging process tube 1559 that the near charging machine was damaging the slugs. The slugs from this tube were removed and new slugs were charged with the other charging machine. Inasmuch as it was not known when this condition began, several slugs were splined out from the front of process tubes on crossheader No. 7 and inspected. It was discovered that these slugs were only slightly scratched and were allowed to remain in the process tubes. The near charging machine was adjusted and operated satisfactorily during the remainder of the charging operation. During the outage the front and rear Van Stone flanges of approximately sixty process tubes were examined. No deep corrosion pits were noted.

In addition, a 1.45" diameter aluminum tube enclosing aluminum-jacketed quartz capsules containing graphite specimens and various gases was installed in process tube 0776 in order to obtain additional in-pile data on gas-graphite reactions (P.T.-105-504-E). The experimental tube set up satisfactorily leak tested and put into operation.

During the discharge outage an attempt to check the operational characteristics of the hot water recirculation system at H pile was delayed approximately four hours when an unmarked blank in the return line adjacent to the bottom of the near front riser could not be immediately located. However, a satisfactory test was conducted from 5:00 P.M. to 8:30 P.M. on May 12. However, water hammer encountered in shutting down the steam injector resulted in a steam leak at the injector flange, which was believed at first to be a gasket leak. However, it was subsequently discovered that the steam injector was actually cracked. At the conclusion of the shutdown, the 15 unbonded 8-inch enriched uranium Al alloy slugs exposed in process tube 0674 since November 21, 1951, were discharged (P.T.-105-502-A). A reactivity decrease of 7-8 inhours was noted, comparing favorably with the 8-9 inhour increase observed when the enriched column was charged.

H pile was shut down at 5:23 A.M. on May 16 because of the loss of pressure on the P-13 circulation system resulting from a recirculation pump failure. Operations were resumed at 5:56 A.M. After reaching a power level of approximately 400 MW a loss of reactivity (approximately 75 inhours) caused H pile to be shut down at 8:53 A.M. on May 16. Because of low graphite temperatures, a water leak was suspected in the near top portion of the pile. The rear pigtails on the near side of rows 1 through 30 were surveyed without a positive rupture indication. The thimble of the P-13 recirculation equipment was satisfactorily pressure tested twice. The metal columns in approximately 30 process tubes located in rows 22 through 31 and columns 57 through 60 were satisfactorily backseated. All process tubes in rows 39 down through 32 were individually subjected to a hydrostatic pressure test from the near extremity of the pile to and including vertical column 71.

It was discovered that process tube 3261 was leaking and could not be backseated. The rear gunbarrel was removed and the process tube was pushed out containing the entire metal discharge. A new flexible rear gunbarrel was installed with difficulty and a new process tube was recharged with metal. Examination of the column indicated that 3261 contained a ruptured slug in the vicinity of a large hole in the process tube. After replacing the cracked steam injector with a duplicate model from DR pile, the hot water recirculation system was started at 5:12 A.M. on May 17 and successfully employed for the first time to uniformly heat up the wet graphite in any pile. Tolerable radioactivity readings were experienced in the valve pit and on the front face of the pile. After removing a total of 84 gallons, H pile operations were resumed at 9:08 A.M. on May 18. However, after attaining 200 MW it was necessary to shut H pile down again at 11:30 P.M. on May 19 because of insufficient reactivity due to wet graphite resulting from the rupture of tube 3261. During the shutdown a rear pigtail survey indicated an additional ruptured slug in process tube 2789, which was easily discharged with the charging machine. The hot water recirculation equipment was utilized again starting at 5:45 P.M. on May 20 and the pile was started to power at 7:58 P.M. on May 21, after removing 238 gallons of water.

At 1:15 A.M. on May 23, H pile was scrammed due to a low pressure trip on Panellit gauge 3868. Operations were resumed at 1:27 A.M.

After reading 400 MW H pile was scrammed again at 4:40 P.M. because of a low pressure trip on Panellit gauge 4676. The pile was unable to recover because of insufficient reactivity. The hot water recirculation system was used again beginning at 7:05 P.M. and continuing only until 5:10 A.M. on May 24, in order to allow the reactor to cool off slowly. During this outage, the water injection equipment installed in process channel 3276 in conjunction with gas moisture determinations conducted with the G.E. dew point recorder (P.T.-105-509-A) was discharged and recharged with regular metal. All control rods were withdrawn at 2:25 P.M. on May 24 but no indication of reactivity was obtained. It was necessary to discharge the poison in process tubes 3390, 2878, and 1480 before continued operations could be resumed at 8:54 P.M. on May 24. The moisture removal rate at the CO_2 driers gradually decreased during the remainder of the month from a maximum of 113 gals./day on May 27 to 10 gals./day on May 31, bringing the total water collected to date from the 3261 leak to 986 gallons.

RUPTURED SLUGS

Twelve instances of inpile uranium slug failures (including two ruptured slugs in the same process tube, 3088-B) occurred during May, bringing the total number to date to 182. The attached table presents all data available at months end regarding these twelve ruptured slugs. It was possible to successfully discharge seven of these ruptured slugs with the charging machine and resume operations within the scram recovery period. Nine Group Eight slugs were included in the May slug failures, bringing the total number to date to 46.

PROCESS DEVELOPMENTS

The hot water recirculation system employed at H pile during May consists of a 12-inch line which returns 2000 gpm of effluent water from the top of the rear riser to a pump and steam injector (rated at 40,000 pounds per hour) in the valve pit and then to the top of the near front riser. During the operation of the recirculation system, approximately 30,000 pounds per hour of 225 psi steam were injected into the system in order to control the pile heating. This reduced steam injection resulted in considerable vibration of the system and caused two pressure gauges to snap off during operation. By adjusting the steam injection so that the water temperature downstream of the injector was 85°C, it was possible to uniformly heat up the pile

in approximately three hours. At equilibrium operation, the maximum outlet water temperature and the graphite temperature were stabilized at approximately 30°C and 70°C respectively. While initially utilizing the system during the May 17 outage, a cooler prior to the driers was inadvertently operated and 35 gallons of water were condensed out flooding the driers.

It was possible to remove approximately 3 to 4 times as much moisture from the pile atmosphere with the hot water recirculation system as was possible to remove during pile operation with the present CO_2 drier system using a maximum gas flow of 4000 cfm. The dew point of the recirculated water was only a few degrees below the outlet dew point, further indicating the inadequacy of the drier capacity. It appears that a condenser located prior to the driers could be advantageously used to remove gross amounts of moisture, leaving the final moisture removal to the driers during pile operation. The hot water recirculation equipment had never been tested or used prior to this month because major water leaks in the past have occurred at considerably lower pile power levels and the external galvanic corrosion of Al process tubes was not understood. It has been recommended that the design of the existing hot water recirculation system be improved and incorporated in C pile.

It is possible to immediately raise the power level of H pile to 400 MW upon startup and then gradually increase to equilibrium. This can be accomplished because H pile has 15 horizontal control rods involving approximately 630 inhours. B, D, DR, and F piles have only nine horizontal control rods (about 350 inhours) and it is necessary during startup to reduce the level from 350 MW to 150 MW during the transient period. With present operating levels, B, D, DR, and F piles need approximately 150 inhours additional control. Installation of equipment for charging and discharging poison columns during pile operation similar to that satisfactorily testing at B pile during May can provide this required control. This would effect a three to four percent production increase by the following means:

1. Reduction of minimum down time.

2. Extension of scram recovery period.

3. Poison pattern adjustment during operation.

4. Elimination of poison push outages.

5. High level startup limited only by temperature considerations.

Efforts are now in progress to install poison addition equipment on approximately six process tubes at each of B, D, DR, and F piles.

Four-inch experimental glass filters run in parallel with the gravity feed filters at F area indicate that higher filter capacities (estimated at 6 gpm/sq. ft.) are obtainable with the alum-activated silica water treatment by employing filters consisting essentially of all Authrafilt. Consequently, one process filter at F pile is being converted to an essentially all Authrafilt filter (only 9" of sand) for experimental testing purposes.

Corrosion data obtained from slugs discharged from F pile last month indicate that slug corrosion with alum-activated silica water with dichromate is only 1/6 that of ferric sulfate water with dichromate and 1/3 that of ferric sulfate water without dichromate. During the present high turbidity period, the amounts of alum and activated silica required for process water treatment has remained essentially constant, whereas the amount of ferric sulfate at the other piles has increased by a factor of four. On this basis, alum process water treatment should result in a lower annual operating expense despite the fact that it is more costly than ferric sulfate.

PRODUCTION TESTS

505-E - Irradiation of Glass Balls (Ball 3X System)

During the May 16 discharge outage at DR pile, the graphite boat containing six 3/8" diameter aluminum coated balls intended for use in the Ball 3X Safety System were discharged from process channel 2577 after an irradiation period of one month. Examination of the glass balls indicated that at least two of the six balls had completely melted.

509-A - General Electric Dew Point Recorder

During the May 23 outage at H pile, the water injection equipment installed in process channel 2376 was discharged. Tests run earlier in the month, in which the gas flow was increased from 700 cfm to 4000 cfm while injecting water at a rate of 15 gallons per day, indicated that it was possible to detect the rear face plenum chamber which first experienced a moisture increase as well as to determine the vertical moisture variation in that prticular plenum chamber. Consequently, it appears that the G.E. automatic Dew Point recorder is capable of detecting moisture at an individual rear face sample point (10 per plenum chamber).

1-MR - Poison Column Control During Operation

During the May 27 discharge outage at B pile, a facility for charging and discharging a poison column during pile operation was installed on process tube 1277 and its operational feasibility was satisfactorily demonstrated. The equipment consists of special front and rear nozzles containing ball valves, a hydraulic charging tube capable of operating at high inlet pressures, and a remote means of hydraulically controlling the rear nozzle valve. Upon startup on May 28, but before the pile power was cut back to 150 MW during turn-around, forty-five 6-inch lead-cadmium poison slugs (approximately ten inhours) were charged into tube 1277. It required 15 minutes to charge the poison column. Following turn-around the lead-cadmium poison slugs were replaced with perforated aluminum dummies in approximately thirty minutes without incident. During the charge of the poison column during operation, the cooling water flow was maintained at 7 gpm in order to obtain adequate cooling, but not wash the slugs out the rear nozzle.

PAULOVICH/ww

Distribution: Cy 1 - Addressee

Encl.
1. Comparative Reactor Performance
2. Reactor Outages
3. Tabulation of Ruptured Slugs

REACTOR OUTAGE - MAY, 1952

	B	D	DR	F	H	Total
Metal Discharge	21.2	29.0	13.0		19.5	32.7
Reactor Maintenance		20.4	5.0		28.8	54.2
Special Irradiations	5.0		4.0		3.0	12.0
Ruptured Slug Removal	51.9	1.3		0.5	120.9	174.6
Panellit Failure			0.3	0.7	0.2	1.2
Inadvertant Beckman Operation	0.1					0.1
P-13					0.6	0.6
Total Hours	78.2	50.7	22.3	1.2	173.0	325.4

KFP
3-25-52

COMPARATIVE REACTOR PERFORMANCE MAY, 1952.

REACTOR	B	D	DR	F	H	TOTAL
Initial Startup	9-25-44	12-17-44	10-3-50	2-25-45	10-20-49	
Design Power Level (MW)	250	250	250	250	400	
Days Since Startup	2805	2723	606	2653	955	
Maximum Power Level Attained to Date (MW)	560	555	575	575	605	2870
Maximum Power Level During Month (MWD)	550	555	570	520	578	
Average Operating Level (MW)[1]	467	532.	548	509	506	513
Total Reactor Outage Hours	18.2	50.7	22.3	1.2	173.0	325.4
Time Operated Efficiency (%)[2]	99.5	93.2	97.0	99.8	76.7	91.3
MWD Produced - Plutonium	12,947	15,370	16,475	15,765	12,009*	72,566*
MWD Discharged - Plutonium	12,754	18,378	7,612	60	17,995	56,799
MWD In Reactor	78,781	79,655	73,138	76,576	70,654	378,804
MWD In Reactor Basin						114,653
Tons of Metal Charged	21.39	30.59	12.56	0	30.95	95.49
Tons of Metal Discharged	21.20	30.36	12.67	.12	30.43	94.78
Tons of Metal In Reactor						1206.29
Tons of Metal In Reactor Basin						191.00
Tons of Metal In 103 Storage						160.02
Average Discharge Concentration (MWD/T)	602	605	601	500	591	599
Scheduled Shutdowns	1	1	1	0	1	
Carbon Dioxide Concentration (%)[3]	98.0	98.0	97.8	97.8	94.3	
Highest Graphite Temperature Recorded (°C)	381	392	303	391	389	
Outlet Water Temperature (°C)[4]	66.7	66.6	63.5	65.2	62.3	
Inlet Water Temperature (°C)[4]	13.5	13.7	13.3	13.7	13.6	
Process Water Flow (gpm)[4]	36,528	39,096	41,644	37,026	43,478	
Maximum Effluent Water Activity (mrep/hr)	15.5	11.2	10.5	17.6	10.3	

1) Average Operating Level = $\frac{\text{MWD Produced} \times 24}{\text{Hours Operated}}$

2) Time Operated Efficiency = $\frac{\text{Hours Operated}}{\text{Total Hours In Month}}$

3) Months End Data

4) Average of Last Five Days of Equilibrium Operation

* Does not include 35 MWD of 15 enriched slugs discharged from H Pile.

Slug Power (Kw) / Concentration MWD/T / Nominal Power Level / Position in Tube

ABLATION OF RUPTURED LITHIUM-ALUMINUM (P-10)

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Concentration of End Slugs (MWD/T)	Nominal Pile Power Level	Position In Tube*	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)		Circumstances Shutdown and Rem
171	4265-D	1) 4-3-51 2) 4-18-51 3) 5-1-52	379	265	4.5	550	510			13	.025	High exit water a Discharged with c machine - Resumed within scram recc
172	3088-B-1	1) 6-8-51 2) 7-11-51 3) 5-3-52	297	308	5.9	570	550		29 (Includes 3088-B-2)		.052	High exit water Discharged with machine - Resume within scram rec
173	3088-B-2 (second rupture in tube)	1) 6-8-51 2) 7-11-51 3) 5-3-52	297	308	5.9	570	590		29 (Includes 3088-B-1)		.052	High exit water Discharged with machine - Resume within scram rec
4	2470-B	1) 8-1-51 2) 9-12-51 3) 5-4-52	266	368	7.1	580	550	43	56	460	.837	High exit water Flushed out 21 slugs - Maximum 2000 lbs. requi out remainder o without oil lub
175	2062-B	1) 11-16-51 2) 1-6-52 3) 5-4-52	109	359	5.9	274	550	16	18	1047	1.904	Abnormal increa lit pressure le covery during 2 Flushed out 48 slugs to 2061 - rear gunbarrel remaining slugs With 6000 lbs.

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TABULATION OF RUPTURED LITHIUM-ALUMINUM (P-10) SLUGS MAY, 1952

Position in Tube*	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)		Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
0			13	.025	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period.	End cap failure - End cap separated from slug.	MRG 4-3-51 Truck 6 &	
0			29 (Includes 3088-B-2)	.052	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period.	End cap failure - Crack running around 1/2 circumference at cap base.	ZRA 6-8-51 Truck 1 & Group 8	
			29 (Includes 3088-B-1)	.052	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period.	Can sidewall failures - Hole in can sidewall near slug bottom.	ZRA 6-8-51 Truck 1 & Group 8	
0	13	56	460	.837	High exit water activity - Flushed out 21 downstream slugs - Maximum force of 2000 lbs. required to push out remainder of charge without oil lubrication.	Uranium split failure - Cap end of slug broken into five fragments.	XRG 8-1-51 Truck 7 & Group 8	
30	16	18	1047	1.904	Abnormal increase in Panellit pressure led to discovery during 2470 outage - Flushed out 48 downstream slugs to 2061 - Removed rear gunbarrel - Tube and remaining slugs pushed with 6000 lbs.	Uranium split failure - Can split longitudinally on both sides. slugs - Transferred 7 upstream	Z-127-B 11-16-51 Truck 5 & Group 8	

[redacted] DEC

TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstance Shutdown and R
176	3278-B	1) 9-15-51 2) 10-10-51 3) 5-13-52	216	361	6.3	480	535			1410	2.563	High exit water a Discharged witho culty with chargi - Unable to recov of electrical dif with discharge el following dischar suspected metal 3178.
177	3261-H	1) 9-1-51 2) 9-25-51 3) 5-16-52	234	312		542	565			4286	7.586	Loss of pile rea Rear gunbarrel r Process tube and metal charge pusi Large hole in pr at location of r slug.
178	2461-B	1) 9-22-51 2) 11-2-51 3) 5-19-52	199	309	6.5	441	550			40	.073	High exit water Discharged with machine - Resume within scram rec
179	2789-H	1) 8-25-51 2) 9-25-51 3) 5-19-52	238	356		565	565			18	.032	Discovered by re survey during ou remove water fro (3261) - Dischar difficulty with machine.

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TABULATION OF RUPTURED URANIUM SLUGS

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		1410	2.563	High exit water activity - Discharged without difficulty with charging machine - Unable to recover because of electrical difficulties with discharge elevator following discharge of suspected metal column in 3178.	End cap failure.	ZR-97 9-15-51 Truck 1 & Group 8	
		4286	7.586	Loss of pile reactivity - Rear gunbarrel removed - Process tube and entire metal charge pushed out - Large hole in process tube at location of ruptured slug.	Can sidewall failure.	U-131-G 9-1-51 Truck 3 & Group 8	
		40	.073	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period.	End cap failure.	Z-100-B 9-22-51 Truck 8 & Group 8	
		18	.032	Discovered by rear pigtail survey during outage to remove water from graphite (3261) - Discharged without difficulty with charging machine.	End cap failure.	MRG 8-25-51 Truck 1 & Group 8	

[redacted]

TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances Shutdown and Re
180	0564-F	1) 4-14-51 2) 5-8-51 3) 5-24-52	382	278	5.5	481	510			26	.051	High exit water a Discharged with c machine - Resumed within scram reco
181	2881-D	1) 10-11-51 2) 11-29-51 3) 5-29-52	182	360	4.5	445	540			37	.068	High exit water a Discharged with c machine - Resumed within scram reco
182	4185-D	1) 4-3-51 2) 4-18-51 3) 5-30-52	408	280	5.6	604	540			29	.053	High exit water a Discharged with c machine - Resumed within scram recc

TABULATION OF RUPTURED URANIUM SLUGS

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		26	.051	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period.	End cap off - Side of can torn open at cap end, extending 3/4" along side.	MRG 4-14-51 Truck 10 &	
		37	.068	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period.	End cap failure.	Z-190-G 10-11-51 Truck 8 & Group 8	
		29	.053	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period.	End cap failure.	MRH 4-3-51 Truck 9 &	

STANDARD FORM NO. 64

Office Memorandum • UNITED STATES GOVERNMENT

TO : Files, Operations Division (THRU) R. L. Plum DATE: July 3, 1952
and Donald G. Sturges

FROM : K. F. Paulovich

SUBJECT: 100 AREAS MONTHLY REPORT - JUNE 1952

SYMBOL: OP:KFP

PILE OPERATION

General

The maximum operating level attained in any one day during the month of June 1952 by each of the piles, and the corresponding equivalent percentage of the power level index, are as follows:

	B	D	DR	H	F
MWD	547	579	560	569	525
Percent	274	290	280	285	263

D pile attained an individual new maximum operating level during June and established an individual production record for the month. June 1 marked the establishment of a new maximum of 2738 MWD for simultaneous five-pile total production. Despite the occurrence of ten ruptured slugs and process tube water leakage difficulties at both F and H piles, a total production of 70,772 MWD (116.4 percent of forecast) was achieved in June. This represents a new per diem maximum production of 2,359 MWD per day.

A uniform maximum outlet water temperature limit of 90° C for all process tubes was approved by the Reactor Process Committee on June 27 and should become effective at all piles early in July.

Curved "banana" type tip-offs, requiring no lubricating oil hose drains, have for use been adopted at all piles during discharge.

Files

July 3, 1952

Initial charges of eight-inch slugs were made into the lower two-thirds of B, D, and F piles during June. At months end a total of 2055 process tubes had been charged with eight-inch slugs at all five piles. This represents 66 percent of the 100,000 eight-inch slugs scheduled to be charged under PT-105-313-2M. 48% of the metal in H pile and 29% of the metal in DR pile now consists of eight-inch slugs.

Work continued at all piles on the installation of a front face crossheader pressure monitoring system, for use in accurately determining operating "boiling disease" limits.

B Pile

During the month of June B pile was shut down for the following two ruptured slugs:

Tube No.	Shutdown	Started to Power
1392 4378	10:38 P.M., June 24	7:44 P.M., June 27

After flushing out 24 downstream slugs with 400 psi water pressure, the metal column in tube 1393 could not be pushed or backseated with a maximum force of 7000 pounds. It was necessary to derib the aft section of the process tube before the charge could be loosened with a force of 4000 pounds. The process tube was replaced and charged with eight-inch slugs. During the outage, several process tube orifices and the corresponding Panellit gauges were changed. While charging 127 process tubes located in the lower two-thirds of the pile with eight-inch slugs, considerable difficulty was experienced with the new charging machine head employed with eight-inch slugs, and continued adjustment was necessary to complete the discharge.

During the metal discharge, the metal column in process tube 4378 could not be routinely discharged. A high rear pigtail reading indicated the possibility of a ruptured as well as a stuck slug. This was subsequently confirmed. While attempting to backseat the charge with a maximum force of 8000 pounds, the rear Van Stone flange was sheared off and the process tube was stretched almost two inches. Forty downstream slugs were flushed out and twenty-two upstream slugs were transferred to tube 4379 by means of the twin transfer cask. Process tube 4378 was then pushed out with the ruptured slug in it. A new process tube was installed and recharged with metal.

Upon startup on June 27, the facility for charging and discharging a poison column during pile operation was utilized to charge 45 six-inch lead-cadmium poison slugs into process tube 1277 before turn-around. Following turn-around, the lead-cadmium poison slugs were replaced with aluminum dummies. Following the subsequent poison push outage on June 28, process tube 1277 was again charged and discharged with poison slugs during pile operation without incident.

During the June 24 outage the raw water export line adjacent to the 151 substation, which had ruptured during hydrostatic testing of the C pile tie-in, was repaired and returned to service.

D Pile

A new maximum power level of 585 MW was maintained for 7 1/2 hours on June 16, with a new maximum daily production of 579 MWD also established on June 16. The significant power level increase at D pile during June resulted from process tube orifice changes and poison pattern adjustments accomplished during the June 10 discharge outage. A new maximum monthly production of 15,614 MWD was established at D pile in June.

Only one ruptured slug caused the shutdown of D pile during June, as follows:

Tube No.	Shutdown	Started to Power
3292	10:55 A.M., June 4	11:21 A.M., June 4

It was possible to immediately discharge the ruptured slug in process tube 3292 with the charging machine and resume operations within the scram recovery period.

During the scheduled discharge initiated on June 9, 139 process tubes located below row 32 were charged with eight-inch slugs. Approximately 25 process tube orifices and the corresponding panellit gauges were also changed. Prior to the discharge outage the No. 5 horizontal control rod, which had been binding in the pile during May, was pulled out of the unit and dismantled. In doing so the rod tip was broken into two sections about four feet in front of the rod rack. The thimble, containing the broken rod tip section, was removed from the pile during the discharge outage and buried. After considerable difficulty was experienced in removing sections of graphite track and cast iron thermal shielding, the graphite channel was beveled and vacuumed, and a new thimble was installed and pressure tested satisfactorily. A new rod tip section was installed and the No. 5 horizontal control rod was returned to service.

During the outage, it was discovered that the No. 2 horizontal control rod had a water leak at the point where the rod tip and rod rack are joined together. Investigations revealed that the water couplings between the rod tip and the rod rack were rubbing badly due to improper positioning. The misalignment was corrected and the No. 2 HCR water leak repaired.

Following startup on June 11, the Panellit pressure on process tube 3681 increased abnormally. A check for a possible ruptured slug during the subsequent poison push outage was negative. During the last half of the month, the outlet water temperature of process tube 4486 was unexplainably 10° C higher than the exit temperature of surrounding tubes, while the Panellit pressure remained normal. Because of the existing corrosion limit (85° C), process tube 4486 proved to be a severe limitation on power level at D pile during the latter part of June.

DR Pile

With the exception of the scheduled metal discharge on June 16, DR pile operated the entire month without incident at an equilibrium level of approximately 555 MW. During the shutdown outage, the No. 31 vertical safety rod was removed from the pile and a steel wire was installed in the No. 31 VSR thimble for obtaining neutron flux distortion data in the vicinity of various types of poison tubes (bismuth, lithium, thorium). The No. 31 VSR was tied out of service and adequate shielding was installed in the thimble opening. In addition, four process tubes (0882, 0884, 1086, 3289) were charged with Sylvania powdered metallurgy slugs under PT-105-313-4M.

An extensive check for increased CO_2 gas loss at DR pile during June failed to locate the origin of the leakage. However, on June 29 it was determined that the CO_2 was probably escaping from the rear face of the pile.

The extension to the common D-DR effluent water crib was completed during June, providing improved drainage of contaminated effluent water.

F Pile

The following two ruptured slugs caused the shutdown of F pile during June:

Tube No.	Shutdown	Started to Power
2584	11:50 A.M., June 17	12:33 P.M., June 17
0967	4:32 P.M., June 17	4:55 P.M., June 17

It was possible to immediately discharge both process tubes (2584, 0967) with the charging machine and resume operations within the scram recovery period.

On June 4 four-hundred cubic feet of helium were introduced into the CO_2 pile atmosphere in a second unsuccessful attempt (first on May 27) to locate the excessive CO_2 leakage at F pile by means of helium leak detection equipment.

On June 3 an indication of moisture in the pile gas was noted on the experimental silicagel columns connected to the rear plenum chambers. But the temperature traverse data, pile reactivity, and Panellit pressures all remain normal. On June 4, however, the outlet dew point began to increase, a gradual loss of reactivity was experienced, and an appreciable increase in water collection was noted. Consequently, the pile was shut down at 11:50 A.M. on June 4 to investigate additional process tube water leakage. All process tubes in rows 1 thru 35 plus a few in row 36 were individually subjected to a 350 psi hydrostatic pressure test (1445 total). One leaking process tube (3573) was discovered and discharged without difficulty. Sectional pressure testing of process tube 3573 indicated that the tube was leaking at a point approximately 10 feet from the rear nozzle. The process tube also proved to be stuck in the graphite channel. The tube was set up as an air tube with grooved steel dummies and cadmium-paraffin front face shielding.

In addition, 72 process tubes (24 centered around process tube 1588, 24 centered around 2991, 12 centered around 0565, and 12 centered around 0574) were checked for freedom of movement in the graphite. All process tubes checked proved to be stuck in the graphite except 3193. The charges in 79 process tubes adjacent to the air tube section in the lower far corner of F pile were backseated. All metal

columns backseated satisfactorily except 0888 and 0989. By splining, it was determined that the charges in both these tubes were sticking at a point 10' 4" from the rear nozzle, or 31' 9" from the front Van Stone flange. It was necessary to utilize maximum forces of 20,000 pounds in alternate pushing and backseating attempts before the charges in 0888 and 0989 could be discharged. After installing grooved steel dummies and front face shielding on these tubes, the pile was started to power at 1:10 A.M. on June 7.

The water collection rate at the CO_2 driers gradually decreased from a maximum of 23 gallons/day on June 8 to a normal 4 gallons/day rate on June 19. A total of 150 gallons of water was extracted from F pile following the leakage of process tube 3573.

F pile was shut down at 8:05 P.M. on June 9 to discharge the metal columns in process tubes 4172 and 3876 because of abnormally high exit water temperatures on these tubes. Defective thermocouples were apparently the cause of the excessive outlet temperatures. The pile was started to power again at 8:35 P.M.

An increase in the water collection rate to 18 gallons/day on June 22 resulted in F pile being shut down at 8:05 P.M. to investigate another process tube water leak. An initial moisture indication was noticed on the silicgel columns connected to the rear plenum chambers, but temperature traverse and Panellit pressure data remained normal and no reactivity loss or drip leg accumulation was experienced. A total of 344 process tubes located in rows 1 through 9 plus the far half of rows 10 through 12 were individually subjected to a hydrostatic pressure test. Process tube 0887 was found to be leaking. Sectional pressure testing of process tube 0887 indicated that it was leaking between 10 and 11 feet from the rear nozzle. The tube was discharged, grooved steel dummies were inserted, and the tube was blanked off with front face shielding.

A total of 152 process tubes (25 centered around process tube 3573, 21 centered around 3287, and 32 centered around 1957, 18 centered around 0757, and 56 centered around 1689) were checked for freedom of movement in the graphite. Approximately 60 process tube which had formerly been loose in the graphite channels were found to be stuck. The metal columns in a total of 141 process tubes located in rows 4, 5, 6 and adjacent to the air tube section in the lower far corner were backseated. All charges backseated successfully except that in tube 0485, which required a maximum force of 3000 pounds to discharge before establishing it as an air tube.

The June metal discharge and a Rala shipment were conducted during the outage. A total of 245 process tubes below row 32 were charged with eight-inch slugs. During the normal metal discharge a total of four process tubes (1089, 1194, 0586, and 3552) could not be discharged routinely with the charging machine. Forces of 1000 to 4000 pounds were required to discharge the metal columns in these tubes. All four tubes were established as air tubes. Examination of the metal column from fringe tube 3552 revealed a warped "banana" type slug.

During the outage air channels 2058, 2358, 2777, and 2682 were broached, new process tubes were installed, and the tubes were charged with metal. The thermocouple stringer located in process tube 2167 was discharged, the graphite channel was broached, and a new tube was installed and charged with metal.

An attempt to remove an abandoned KAPL creep experimental setup from air tube 1077 proved unsuccessful. After disassembling the front and rear nozzles, the charge could not be moved from the rear. It was necessary to drill and tap three front grooved steel dummies in order to remove them. In attempting to pull out the next two steel dummies with a hook, several feet of radioactive thermocouple cable came out. The cable was cut off and placed in a lead cave. In doing so, the control room, monitor room, office, corridors, and work area became contaminated, necessitating extensive building decontamination measures. When no additional front steel dummies could be removed from tube 1077, the blank flange and paraffin shielding were replaced on the front face.

The No. 8 horizontal control rod, which had been binding during the early part of June, was removed from the reactor and disconnected. The thimble was pressure tested and discovered to be leaking. The tip section of the No. 8 HCR was removed and buried. A blank flange and steel shielding were placed over the thimble opening. A new thimble will be installed in the pile and the No. 8 horizontal control rod will be repaired and returned to service at the next available shutdown.

By pumping a red acetone-soluble dye into process tube 3573 (discovered leaking on June 6) it was possible to locate and mark the leak while the process tube remained in the pile. The process tube was then pushed out and the 8' section of tube with the external leak indication was transported to 111-B for detailed examination. The graphite channel was broached and vacuumed and a new process tube was installed and charged with metal.

During the extended outage several fringe tube orifices and the corresponding Panellit gauges were changed. In an attempt to reduce the CO_2 gas leakage from the rear face, cemented keys were installed on the dummy rear gunbarrels in the lower far corner. Two process tubes (2676, 3871) were discharged to obtain corrosion data with alum-activated silica water treatment without dichromate (P.T.-105-503-E).

Following startup at 9:00 A.M. on June 26, the moisture collection rate at the CO_2 driers averaged about eight gallons/day for the remainder of the month.

H Pile

The water collection rate at the CO_2 driers decreased from 17 gallons/day on June 1 to a normal 4 gallon/day rate on June 5, bringing the total amount of water collected from the 3261 process tube leak (May 17) to 1031 gallons.

The following five ruptured slugs occurred at H pile during the month of June:

Tube No.	Downtime	Started to Power
1778	5:31 P.M., June 6	6:10 P.M., June 6
2758, 2683, 3063	10:12 P.M., June 6	6:19 P.M., June 8
1170	9:40 P.M., June 10	12:53 A.M., June 12

It was possible to discharge the metal columns in process tubes 1778 and 2583 with the charging machine and resume operations within the scram recovery period on June 6. Examination of the slugs revealed one ruptured slug from process tube 1778.

Following the 1778 outage, water leak indications were noticed during startup and an abnormally high Panellit pressure was observed on process tube 2683. The graphite temperatures on the far side of the pile decreased and a gradual reactivity loss was experienced prior to shutdown at 10:12 P.M. on June 6 because of high exit water activity.

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After flushing out 29 downstream slugs, the metal column in process tube 2758 could not be loosened with forces of 2000 pounds. The process tube containing the remaining upstream slugs was pushed out of the pile. The process tube, which had been pressure tested satisfactorily, was replaced and recharged with metal. After flushing out nine downstream eight-inch slugs, it was possible to discharge the remainder of the metal column in process tube 2683 with a maximum force of 2000 pounds. When subjected to a hydrostatic pressure test the tube was found to be leaking. A new process tube was installed and recharged with metal. The ruptured slug in tube 2683 was the initial eight-inch slug (group 9) failure.

During the 2758-2683 outage the June metal discharge, including 185 tubes of eight-inch slugs, was accomplished. The metal column in process tube 3063 could not be discharged normally. After the process tube was satisfactorily pressure tested, the tube containing the entire metal column was pushed out of the pile. A new process tube was installed and charged with metal.

High exit activity indications resulted in the shutdown of H pile on June 10. The metal column in process tube 1170, located by a high rear pigtail activity, could not be pushed with the charging machine. The process tube was hydrostatically pressure tested and was found to be leaking. The metal column could not be loosened with forces of 3000 pounds. After flushing out nine downstream eight-inch slugs and removing the rear gunbarrel, the process tube containing the remainder of the metal column was pushed out of the pile. The rear gunbarrel was replaced and a new process tube was installed and recharged with metal. During the outage the eight-inch (group 9) slugs in ten process tubes were discharged for inspection (1175, 1176, 1178, 1179, 1278, 1279, 1281, 1072, 0972, 0973).

Eighteen slugs out of the 320 slugs discharged and inspected were sent to 111-B, along with process tube 1170 and the ruptured eight-inch slug, for detailed examination. No unusual surface defects were noted during the preliminary inspection.

Following startup on June 12, the water collection rate at the CO_2 driers gradually decreased from a maximum of 75 gallons/day on June 13 to a normal rate on June 27. A total of 864 gallons of water were extracted from the two process leaks (2683, 1170) caused by Group 9 eight-inch slug ruptures.

At months end pile power level was limited at H pile to approximately 530 MW because of a hot region surrounding permanent graphite mining channel 2577.

RUPTURED SLUGS

Ten instances of in-pile uranium slug failures occurred during June, bringing the total number to date to 192. The attached table presents all data available at months end regarding these ten ruptured slugs. It was possible to successfully discharge four of these ruptured slugs with the charging machine and resume operations within the scram recovery period. Four Group 8 slugs were included in the June slug failures, bringing the total number to date to fifty. In addition, two Group 9 slugs (eight-inch slugs with thicker can wall) also failed. In each case the ruptured Group 9 slug resulted in a process tube leak.

PROCESS DEVELOPMENTS

In an effort to detect moisture in the CO_2 atmosphere at F pile, a glass tube containing Desigel (silica gel containing cobaltous chloride) has been connected to each one of the ten rear face plenum chambers. When moisture is picked up by the silica gel the cobaltous chloride causes a change in color from blue to red. Each tube has a nichrome wire coil surrounding it for regenerating the Desigel. In each of two instances of process leakage at F pile during the month (June 4 and June 22) the silica gel columns connected to the rear plenum chambers gave an initial indication of moisture in the pile gas approximately 24 hours before any other indications. However, it was not possible to determine the exact location of the moisture. Ninety Desigel columns are now being fabricated for installation on each of the rear plenum chamber sample lines. It is expected that the installation will be completed during July. It is hoped that it will be possible to secure an early indication and an accurate location of moisture in F pile gas with this setup.

During June one gravity feed filter at F area was converted from a bed of 20 inches of anthrafilt and 10 inches of sand to a bed consisting of 27 inches of anthrafilt and 3 inches of sand. The anthrafilt filter was put into service on June 16 in order to obtain performance data under conditions of high level water turbidity. It was possible to obtain a filter capacity of 5.2 gpm/sq. ft. with the experimental filter. This filter capacity represents a two-fold increase in the original 3000 gpm design capacity.

Installation of the in-pile water quality facility at D pile is essentially complete. A production test is being submitted for the substitution of aluminum sulfate for ferric sulfate as the coagulating agent in the process water treatment at D pile. In this way in-pile PH tests can be initiated with alum (no activated silica) treated water. The in-pile facility, consisting of five experimental tubes and one control tube, is expected to be put into service during June concurrent with the use of alum at D pile.

The installation of the Flexowriter automatic tube outlet water temperature recording facility was completed at B pile during June. It is possible with the automatic recorder to scan the outlet water temperatures of the complete pile from left to right and from top to bottom and prepare a typewritten temperature map in an average of 15 minutes, depending on the pile flattening. This represents a considerable improvement over the present manual temperature map preparation requiring two to three hours. The Flexowriter facility types all normal outlet temperatures in black ink and all abnormal temperatures in red ink. Consequently, it will be possible during pile startup or during process tube leakage investigations to obtain a temperature traverse of the entire pile in 15 minutes with abnormal areas outlined in red.

During the June 22-26 outage at F pile, a red tetra-bromo dye dissolved in acetone was pumped into process tube 3573 (discovered leaking on June 6) in an effort to locate and identify the leakage point while the complete process tube remained in the pile. The procedure proved successful and it was possible to supply the Pile Technology Group with an eight-foot section of process tube 3573 with an external red area marking the leakage point. This should permit a better examination and evaluation of process tube leakage, inasmuch as it has not been possible to conclusively locate previous process tube leaks when examined.

PRODUCTION TESTS

1-MR Poison Column Control During Operation

The facility for charging and discharging a poison column during pile operation which is installed on process tube 1277 was successfully operated twice at B pile during June. Following startup on June 27, 45 six-inch led-cadmium were charged into process tube 1277 before turn-around and displaced with aluminum dummies following turn-around. Following the subsequent poison push outage on June 28, process tube 1277 was again charged and discharged with poison slugs during pile operation without incident. Less than 30 minutes were required for charging or discharging the poison column. The third charge of poison slugs occurred at a higher power level (400 MW) than the previous two charging operations.

503-E - Alum-Activated Silica Water Treatment

During the June 22-26 outage at F pile the weighed slugs in process tubes 2676 and 3871 located in the .240 orifice zone were discharged at an approximate concentration of 175 MWD/T. The slugs were air-weighed and preliminary results indicate that the corrosion rate of slugs exposed to process water treated with alum-activated silica without sodium dichromate is approximately equal to that experienced with ferric sulfate without dichromate water. This is a higher corrosion rate than was anticipated and this corresponds to approximately half the corrosion rate experienced with ferric sulfate with dichromate process water. However, it is believed that the corrosion rate is high because of the low concentration of the metal columns discharged. It is expected that the corrosion rate will be lower with the metal columns discharged from the other four corrosion tubes (0874, 1162, 2369, 2377) after longer exposures.

313-4 M - Sylvania Powdered Metallurgy Slugs

During the June 16 discharge outage at DR pile, 48 slugs fabricated at Sylvania from powdered uranium by hot pressing techniques were charged into four process tubes (0882, 0884, 1086, and 3289) in order to evaluate any detrimental effects of irradiation on slugs prepared by powder metallurgy.

Enclosure: 1. Comparative Reactor Performance
2. Reactor Outages
3. Tabulation of Ruptured Slugs

PAULOVICH/slc

Distribution: Cy 1 - Addressee

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REACTOR OUTAGE - JUNE, 1952

	B	D	F	DR	H	Total
Metal Discharge	15.0	17.0	22.0	17.9	19.1	91.0
Reactor Maintenance		17.5	6.6	4.6		28.7
Production Tests			21.2			21.2
Special Irradiations	2.0	5.0	16.5	4.0		27.5
Ruptured Slug Removal	55.7	0.4	0.9		53.0	110.0
Process Tube Water Leakage			75.4			75.4
Stuck Charge Removal			10.4			10.4
Investigation of High Temperature Tubes			0.5			0.5
Total Hours	72.7	39.9	153.5	26.5	72.1	364.7

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COMPARATIVE REACTOR PERFORMANCE - JUNE, 195

REACTOR	B	D	DR	F	H	TOTAL
Initial Startup	9-26-44	12-17-44	10-3-50	2-25-45	10-20-49	
Design Power Level (MW)	250	250	250	250	400	
Days Since Startup	2835	2753	636	2683	985	
Maximum Power Level Attained to Date (MW)	560	585	575	575	605	2900
Maximum Power Level During Month (MWD)	547	579	560	525	569	
Average Operating Level (MW)[1]	524	551	546	461	532	525
Total Reactor Outage Hours	72.7	39.9	26.5	153.5	72.1	364.7
Time Operated Efficiency (%)[2]	89.9	94.5	96.3	78.7	90.0	89.9
MWD Produced - Plutonium	14,130	15,614	15,767	10,884	14,377	70,772
MWD Discharged - Plutonium	16,994	14,362	9,955	25,381	14,684	81,376
MWD In Reactor	75,917	80,907	78,950	62,079	70,347	368,200
MWD In Reactor Basin						164,854
Tons of Metal Charged	27.65	23.62	15.60	44.65	25.63	137.15
Tons of Metal Discharged	27.40	23.27	16.31	43.53	25.36	135.87
Tons of Metal In Reactor						1207.57
Tons of Metal In Reactor Basin						275.21
Tons of Metal In 103 Storage						202.28
Average Discharge Concentration (MWD/T)	620	617	610	583	579	599
Scheduled Shutdowns	0	1	1	0	0	
Carbon Dioxide Concentration (%)[3]	98.0	98.0	95.1	98.0	91.5	
Highest Graphite Temperature Recorded (°C)	385	390	330	400	386	
Outlet Water Temperature (°C)[4]	71.6	69.6	64.8	67.9	61.6	
Inlet Water Temperature (°C)[4]	15.6	15.6	15.1	14.4	15.5	
Process Water Flow (gpm)[4]	36,470	39,782	42,050	36,851	43,446	
Maximum Effluent Water Activity (mrep/hr)	11.7	9.3	10.4	14.0	9.8	

1) Average Operating Level = $\frac{\text{MWD Produced}}{\text{Hours Operated}} \times 24$

2) Time Operated Efficiency = $\frac{\text{Hours Operated}}{\text{Total Hours In Month}}$

3) Months End Data

4) Average of Last Five Days of Equilibrium Operation

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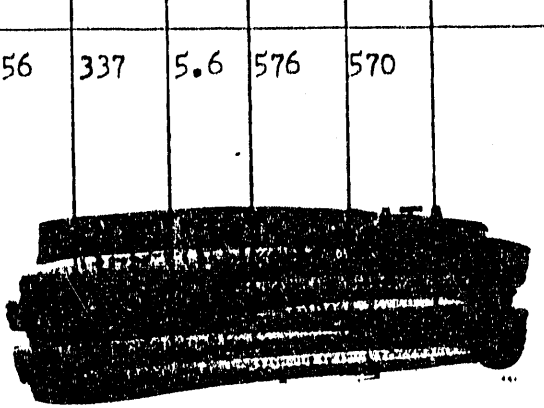
TABULATION OF RUPTURED URANIUM SLUGS -

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstance Shutdown and R
183	3292-D	1) 4-3-51 2) 4-18-51 3) 6-4-52	413	255	5.0	616	555			71	.13	High exit water s Discharged with c machine. Resumed within scram reco
184	1778-H	1) 12-29-50 2) 11-20-51 3) 6-6-52	199	401	7.6	504	570			41	.072	High exit water s Discharged with c machine. Resumed within scram reco
185	2758-H	1) 8-25-51 2) 9-25-51 3) 6-6-52	255	311	6.7	503	570	34	38	431	.76	High exit water a Flushed out 29 do slugs. Metal colu not be loosened w of 2000 lbs. Tube maining charge pu
186	2683-H	1) 1-25-52 2) 2-17-52 3) 6-6-52	112	376	13.3	266	570	23	57	659	1.16	High exit water s Flushed out 9 dow slugs. Remaining pushed with force lbs. Process tube rupture.
187	3063-H	1) 8-25-51 2) 9-25-51 3) 6-8-52	256	337	5.6	576	570			177	.31	Would not dischar during 2758-2683 Process tube & en column pushed out



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TABULATION OF RUPTURED URANIUM SLUGS - June, 1952

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		71	.13	High exit water activity- Discharged with charging machine. Resumed operation within scram recovery period	End cap failure	MRG 4-3-51 Truck 1 &	
		41	.072	High exit water activity. Discharged with charging machine. Resumed operation within scram recovery period.	Uranium split failure	MRG 12-29-50 Truck 1 &	
34	38	431	.76	High exit water activity. Flushed out 29 downstream slugs. Metal column could not be loosened with forces of 2000 lbs. Tube and remaining charge pushed out.	Uranium split failure	8-25-51 Truck 10 & Group 8	
23	57	659	1.16	High exit water activity. Flushed out 9 downstream slugs. Remaining charge pushed with forces of 2000 lbs. Process tube leak at rupture.	Can sidewall failure--1" diameter hole in can sidewall 1" below cap end located on rib mark.	A-660 1-25-52 Truck 11 Group 9	
		177	.31	Would not discharge normally during 2758-2683 outage. Process tube & entire metal column pushed out.	Uranium split failure.	G 8-25-51 Truck 9 & Group 8	

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TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances Shutdown and Re
188	1170-H	1) 2) 3-3-52 3) 6-10-52	99	379	13.4	230	570	23	56	1379	2.42	High exit water a 9 downstream slug out. Rear gunbarr Process tube and of charge pushed tube leak at rupt
189	2584-F	1) 6-1-51 2) 7-12-51 3) 6-17-52	341	322	4.0	683	525			61	.12	High exit water a Discharged with c machine. Resumed within scram reco
190	0967-F	1) 8-22-51 2) 9-18-51 3) 6-17-52	275	322	5.5	516	525			49	.09	High exit water a Discharged with c machine. Resumed within scram reco
191	1392-B	1) 2-6-51 2) 12-7-51 3) 6-24-52	200	273	5.6	291	540	40	63	945	1.75	High exit water a Flushed out 24 do slugs. Could not l charge with maxim 7000 lbs. Aft sec process tube deri maining slugs dis with force of 400
192	4378-B	1) 3-14-51 2) 4-3-51 3) 6-26-52	450	259	5.1	641	540	23	32	1119	2.07	Could not be rout charged during 13 Metal column coul loosened with max of 8,000 lbs. Flu downstream slugs. 22 upstream slugs twin transfer cas pushed out with

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TABULATION OF RUPTURED URANIUM SLUGS

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
23	56	1379	2.42	High exit water activity. 9 downstream slugs flushed out. Rear gunbarrel removed. Process tube and remainder of charge pushed out. Process tube leak at rupture.	Can sidewall failure. Hole in can sidewall similar to 2683.	Group 9	
		61	.12	High exit water activity. Discharged with charging machine. Resumed operations within scram recovery perio	End cap failure. Hole in center of end cap.	MRH 6-1-51 Truck 8 & Group 8	
		49	.09	High exit water activity. Discharged with charging machine. Resumed operations within scram recovery perio	Uranium split failure	B-124-T 8-22-51 Truck 9 & Group 8	
40	63	945	1.75	High exit water activity. Flushed out 24 downstream slugs. Could not loosen charge with maximum force of 7000 lbs. Aft section of process tube deribbed. Remaining slugs discharged with force of 4000 lbs.	Can sidewall failure	MRG 2-6-51 Truck 10 &	
23	32	1119	2.07	Could not be routinely discharged during 1392 outage. Metal column could not be loosened with maximum force of 8,000 lbs. Flushed out 40 downstream slugs. Transferred 22 upstream slugs to 4379 with twin transfer cask. Process tube pushed out with remaining slugs.	Uranium split failure.	MRH 3-14-51 Truck 4 &	

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Office Memorandum [redacted] UNITED STATES GOVERNMENT

TO : Files, Operations Division (THRU) C. L. Robinson DATE: August 4, 1952
and Donald G. Sturges

FROM : K. F. Paulovich

This Document consists of 19 Pages No. 1 of [redacted] Series

SUBJECT: 100 AREAS MONTHLY REPORT - JULY 1952

SYMBOL: OP:KFP

[redacted]

PILE OPERATION

General

The maximum operating level attained in any one day during the month of July, 1952 by each of the piles, and the corresponding equivalent percentage of the power level index, are as follows:

	B	D	DR	F	H
MWD	558	598	575	547	558
Percent	279	299	288	274	279

D pile attained an individual new maximum operating level during July and DR pile established a new individual production record for the month. July 28 marked the establishment of a new maximum of 2746 MWD for simultaneous five-pile total production. Despite the occurrence of 13 ruptured slugs and process tube water leakage difficulties at F pile, a new maximum total production of 73,337 (108.8% of forecast) was achieved in July. This represents a new per diem maximum production of 2366 MWD per day.

A uniform maximum outlet water temperature limit of 90° C for all process tubes became effective at all piles on July 11.

At month's end a total of 2738 process tubes had been charged with eight-inch slugs at all five piles. This represents 87% of the 100,000 eight-inch slugs scheduled to be charged under PT-105-313-2M. 15.8%, 15.8%, 29.2%, 20.5% and 59.3% of the charges in B, D, DR, F, and H piles, respectively, now consist of eight-inch slugs.

The July monthly production at H pile was increased 5% (742 MWD) in order to correct for erroneous cooling water flow rates. This resulted from a series of four tests recently completed at H area in which the 105 Bailey flow meters were checked against the rate of drop of filtered water level in the 190 storage tanks. These

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drop tests indicated that, after investigating and accounting for all intermediate water leakage and usage, 5% more cooling water was actually flowing through H pile than indicated by the 105 flow meters. Effective August 1 the flow meters at H pile will be corrected accordingly to provide accurate power level measurements. It is planned to perform 190 drop tests at the other piles in the near future to check the possibility of similar errors.

B Pile

During the month of July B pile was shut down for the following 5 ruptured slug indications:

Tube No.	Shutdown	Started to Power
1793	6:20 P.M., July 2	6:51 P.M., July 2
1292	3:30 P.M., July 6	4:05 P.M., July 6
1791	10:10 P.M., July 20	10:45 P.M., July 20
0858	3:38 A.M., July 21	4:13 A.M., July 21
Crossheaders $8\frac{1}{2}$, $12\frac{1}{2}$	1:48 P.M., July 22	2:17 P.M., July 22

It was possible to immediately discharge process tubes 1793, 1292, 1791, and 0858 with the charging machine and resume operations within the scram recovery period. A rear face pigtail survey of crossheaders $8\frac{1}{2}$ & $12\frac{1}{2}$ on July 22 resulted in no positive indication of a ruptured slug and operations were resumed without discharging any process tubes.

During the scheduled outage initiated on July 23 for the July discharge, all far side crossheader screens were replaced and several process tube orifices and corresponding Panellit gauges were changed. While charging process tube 2867 it was discovered that the near charging machine was damaging the slugs. It was found by splining that the slugs charged into tubes 2867 and 2868 had been badly scarred, and these tubes were discharged and recharged. A check of the slugs previously charged with the machine into tubes 2958, 2954 and 2951 revealed that these slugs were only slightly damaged and were not discharged. At the conclusion of the July discharge the cold metal inventory was one slug high, indicating that one process tube had apparently been charged one slug short. Several hours were spent attempting to locate the short metal column by splining newly charged tubes from both the front and the rear. However, the pile was started to power at 4:37 A. M. on July 25 when the discrepancy could not be resolved. Approximately 60 newly charged process tubes which had not been checked were tagged for investigation at the next available opportunity.

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After reaching a power level of 300 MW, B pile was scramed at 5:04 A. M. on July 25 because of low pressure Panellit scram on row 26. When nothing abnormal could be detected, the pile was started to power at 5:11 A. M. After reaching a power level of 66 MW, B pile was scramed again at 5:24 A.M. when the pressure on tube 2666 decreased abnormally and the outlet temperature increased to 92° C. It was discovered that the P-10 charge in tube 2666 had been replaced with a regular metal column but that the smaller .140" orifice had not been enlarged accordingly. Process tube 1579 similarly had a small orifice. Consequently the orifices in process tubes 1579 and 2666 were changed from .140" to .240" and operations were resumed at 6:35 A. M. An abnormally high Panellit pressure on process tube 1579 necessitated the replacement of the front nozzle and orifice assembly during the subsequent poison push outage.

B pile was scramed at 12:47 P. M. on July 26 due to the failure of the wire connection to the Mercoid on Panellit gauge 1055. The gauge was replaced and recovery was effected in 12 minutes.

D Pile

A new maximum power level of 600 MW was achieved at D pile on July 23, with a new maximum daily production of 598 MWD established on July 24. The significant power level increase at D pile during July resulted primarily from the adoption of the 90° C maximum outlet water temperature limit.

Three ruptured slugs caused the shutdown of D pile during July, as follows:

Tube No.	Shutdown	Started to Power
3971	1:13 A.M., July 5	1:50 A.M., July 5
0482	12:56 P.M., July 16	12:20 P.M., July 18
3769	9:48 P.M., July 28	10:18 P.M., July 28

It was possible to immediately discharge the ruptured slug in process tubes 3971 and 3769 with the charging machine and resume operations within the scram recovery period. However, after reaching a power level of 365 MW following the 3971 startup, it was necessary to shut D pile down again at 2:43 A. M. because of insufficient reactivity to recover.

During the subsequent outage the metal discharge for July was accomplished. A check of the cone screen and the thermocouple in process tube 4486 (abnormally high outlet water temperature during the latter part of June) revealed nothing irregular. The tube was discharged and recharged and the temperature returned to normal upon startup. During the outage approximately 15 process tube orifices and the corresponding Panellit gauges were changed. Special pigtails were installed on process tubes 2170 and 3472, which will be utilized for securing in-pile water quality pH data under PT-105-509-E. Process tubes 2170 and 3472 were charged with solid aluminum dummies, to check the operation of the experimental setup for a period of one month before weighed slugs are charged.

Following startup the Panellit pressure on water quality experimental tube 3472 gradually increased to the extent that a purge of this tube for 25 minutes during operation was necessary on July 11 to return the system to normal. On July 11 process tube 2170 was switched to process water due to pump difficulties in the flow laboratory.

After flushing out 25 downstream slugs with 400 psi water pressure, the metal column in tube 0482 could not be loosened with a force of 6000 pounds. Preparatory to transferring the upstream slugs, considerable difficulty was experienced in removing front steel dummies used in pushing attempts. Visual inspection of the inner surface of the process tube revealed a buildup of corrosion products approximately 1/16 to 1/8 inch in thickness along the section of tube located in the front gun barrel. This restricted passage of the dummies to the point that they would not remain on the spline. The corrosion products were buffed off with a stiff wire brush and the steel dummies were easily removed. 38 upstream slugs were then transferred to process tube 0483 by means of the twin transfer cask. After forces of 6000 pounds would not move the process tube, the rear gun barrel was removed and the tube containing the ruptured slug was pushed out. A dummy gun barrel was installed in the rear and grooved steel dummies, a blank flange, and neutron shielding were installed in the front. During the 0482 outage approximately 25 additional process tube orifices and the corresponding Panellit gauges were changed and a supplementary metal discharge was conducted. Also, the metal column in process tube 0576 was discharged because of a high rear pigtail reading but no definite slug rupture was located.

Pressure buildup on water quality tube 2170 necessitated purging this process tube during operation following startup on July 18. On July 20 half of the 183 Filter Plant began to use alum instead of ferric sulfate as a coagulating agent. On July 24 the other half of the 183 Filter Plant was also converted to alum. This was done under PT-105-508-E in order to supply alum-treated process water for the

in-pile pH tests to be conducted under PT-105-509-E. On July 25 the flow laboratory water supply to 3472 failed, requiring the tube to be supplied with process water.

During startup following the 3769 rupture the magnetic clutches on vertical safety rods number 10 and number 18 would not hold the rods out of the pile. These 2 VSR were tied out of service and the pile resumed operations with 3 vertical safety rods out of service (#20 VSR, which is experimentally equipped with a C-type sphincter gas seal, is also currently tied out of D Pile).

DR Pile

With the exception of a Panellit scram on July 25 DR pile operated the entire month of July without incident at an average power level of 560 MW. A new maximum monthly production of 17,358 MWD was achieved at DR pile in July.

The Panellit scram occurred at 10:37 A. M. on July 25 when the Panellit pressure on tube 4453 exceeded the low pressure trip while the pile was being purged during operation at 350 MW. Operations were resumed in 11 minutes.

During the metal discharge on June 16 a temporary poison column was inadvertently left in process tube 1087. This has resulted in a slight flux distortion and power level reduction at DR pile during the past 6 weeks. It is planned to correct this situation during the metal discharge outage scheduled early in August.

H Pile

The following three ruptured slugs caused the shutdown of H pile during July:

Tube No.	Shutdown	Started to Power
3189	1:34 A.M., July 5	3:55 P.M., July 6
2677	4:51 P.M., July 7	6:36 P.M., July 7
4460	7:40 P.M., July 18	8:10 P.M., July 18

It was possible to discharge the metal column in process tubes 2677 and 4460 and resume operations within the scram recovery period. The metal column in 2677 could not be discharged with the charging machine. However, it was possible to discharge the metal column with a maximum force of 2500 pounds in sufficient time to recover after an outage of one hour and forty-five minutes. The metal column from 2677 had been charged under PT-105-503-A (continuously rolled uranium).

A rear pigtail survey on July 18 indicated that both process tubes 4360 and 4460 were reading high. Consequently both tubes were discharged but it was possible to locate a ruptured slug in the metal charge of 4460 only.

An indication of excessive effluent water activity at 12:20 A. M. on July 5 was followed immediately by such water leak indications as loss of reactivity, increase in gas pressure, and moisture in rear plenum chamber gas samples. However, it was not possible to locate the source of water leakage with a temperature traverse or Panellit pressure survey before the pile was shutdown at 1:34 A. M. A rear pigtail survey indicated that process tube 3189 contained a ruptured slug and hydrostatic pressure testing of the tube indicated that it was also leaking. After flushing out 19 downstream slugs the process tube and remaining charge could not be pushed with forces of 8000 pounds. It was necessary to remove the rear gun barrel before the tube, containing the upstream slugs, could be pushed out and replaced.

During the 3189 outage the metal discharge for July was accomplished, including 31 process tubes charged with 8-inch slugs under PT-105-313-9M, (simulated Fernald uranium). A charge of 32 8-inch slugs was discharged from process tube 0961 and after installing special front and rear face connections, tube 0961 was charged with solid aluminum dummies for the purpose of checking out the operation of the experimental cooling water recirculation setup (PT-105-506-E). Sufficient maintenance was also done on the P-13 equipment so that it could operate on recirculation following startup.

During the 3189 shutdown an attempt was made to charge approximately 30 tubes with only one rear face entry by reducing the cooling water flow to only 2000 gpm instead of the usual 20 inches of water. The test proved unsuccessful because the excessive water pressure washed out the downstream aluminum dummies. Also, installation of effluent water sample lines from rear crossheaders 21 and 23 was completed for ruptured slug detection experimentation.

The water collection rate at the W_2 driers decreased from a maximum of 72 gallons/day on July 7 to a normal 4 gallon/day rate on July 14, bringing the total amount of water collected from the 3189 process tube leak to 185 gallons.

H pile was shut down at 4:13 P. M. on July 6 due to failure of the P-13 water supply caused by a loss of pressure while attempting to switch recirculation pumps. Operations were resumed at 5:00 P. M. with the P-13 setup still on recirculation.

It was necessary to shut H pile down again at 10:45 A. M. on July 8 to permit the P-13 equipment to be switched from recirculating to process water because of oil pump difficulties. During the outage process tube 1583, containing PT-105-503-A metal, was discharged because of an abnormally high exit water temperature. The metal columns from 1583 and 2677 (rupture), both containing metal charged under PT-105-503-A, were set aside for further inspection. Operations were resumed at 11:55 A. M.

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Due to pump difficulties process tube 0961 was taken off of recirculation and placed on process water on July 9. A uranyl nitrate solution was injected into process tube 2369 on July 10, 14, and 21 in order to obtain additional data on ruptured slug detection utilizing delayed neutron, gamma ray spectrometer, and C-pile beta monitor systems.

The final shipment of J slugs from H pile to Arco for U-235 separation was accomplished on July 7.

A scheduled outage was initiated at H pile at 11:59 P. M. on July 14 so that temporary repairs could be made to the East retention basin to prevent water leakage into the West retention basin in order that permanent repairs could be accomplished in the West retention basin during pile operation. After isolating the East retention basin approximately 8 holes (some as deep as 6 feet) located in the sloping walls of the southeast corner of the East basin first bay were grouted with a total of 56 cubic yards of concrete. In addition, the center line expansion joints extending from the East wall to the center partition and from the inlet end to the first bay wall were cleaned out and replaced employing high temperature asphalt filler. During the outage, graphite mining samples were obtained from process channel 2677 and both the P-13 equipment and the 0961 recirculation loop were returned to recirculating service. A high rear pigtail reading resulted in tube 1488 being discharged as a ruptured suspect. However, examination of the metal column revealed no ruptured slug.

On July 18 it was necessary to switch the 0961 recirculating loop to process water because of abnormal pressure buildup. On July 21 it was necessary to shut H pile down at 7:10 P. M. so that the P-13 equipment could be switched once again to process water because of a surge tank leak in the recirculating system. Operations were resumed at 7:42 P. M. On July 23 a high pressure Panellit trip on recirculation experimental tube 0961 resulted in the shutdown of H pile at 5:29 P.M. The high pressure resulted from plugging of the line between the rear nozzle and the -12 level. H pile was started to power at 5:45 P. M.

At months end an effort was being made to repair the West retention basin at H pile during pile operation. Several holes located on the sloping sides of the separating wall and the inlet end of the first bay were being grouted with concrete. It appears that the first bay of the West side of the retention basin is not as severely underminded with voids as was the East side of the basin.

In order to compensate for the discrepancy recently discovered in the 105 Bailey flowmeters by means of 190 drop tests, a straight 5% (742 MWD) was added to the July monthly production at H pile. Effective August 1 the cooling water flow through H pile will be corrected to obtain actual power level and production data.

F Pile

The following three ruptured slugs caused the shutdown of F pile during July:

Tube No.	Shutdown	Started to Power
0560	5:33 A.M., July 3	5:55 A.M., July 3
3773	3:07 A.M., July 29	3:34 A.M., July 29
3684	2:53 A.M., July 31	3:14 A.M., July 31

It was possible to immediately discharge all three process tubes (0560, 3773 and 3684) with the charging machine and resume operations within the scram recovery period.

The F pile was shutdown at 9:24 P. M. on July 7 because of an increase in water collection rate accompanied by a change in color in the silica gel columns connected to the rear plenum chambers. A total of 337 process tubes (far half of row 01 through 07, all of rows 08 through 13) were individually subjected to a hydrostatic pressure test before process tube 0867 was discovered to be leaking about 12 feet from the rear Van Stone flange. In addition, the metal charges in 71 process tubes adjacent to the lower far air tube section (rows 01 through 12, column 78 through 96) were backseated successfully with the exception of the columns in 0586 and 0787. The charge in 0787 was loosened with a maximum force of 3500 pounds. After discharging, process tube 0787, was established as an air tube. It was discovered that the column in 0586 could not be initially backseated because it was completely full of 8-inch perforated aluminum dummies. Process tube 0586 was discharged with the charging machine and also established as an air tube.

During the outage the metal discharge for July was accomplished. In addition the leaking thimble for the number 8 horizontal control rod was removed from the pile and buried. A new thimble was installed, the graphite track was replaced, the step plug was inserted, and the number 8 HCR was reassembled. After satisfactorily pressure testing the new thimble, the #8 HCR was returned to service.

Acetone soluble red dye was utilized to dye stain leakers 0867 and 0486 (air tube for several months). It was not possible to move process tube 0486 with a maximum force of 12,000 pounds. A process tube splitter was attached to the rear of the tube and pulled toward the front splitting the rear 14 feet of the tube. The front gun barrel was removed and the process tube was pulled out the front of the pile. It was possible to push out process tube 0867 without difficulty. The rear Van Stone flange and dye-marked sections of process tubes 0867 and 0486 were saved for further detailed examination. Adequate shielding was installed on channels 0486 and 0867, which were set up as air tubes.

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The F pile was shutdown again at 1:38 P. M. on July 11 to investigate a sudden increase in water collection rate. A total of 1485 process tubes were individually subjected to a pressure test (rows 01 through 36) before it was discovered that process tube 3670 was leaking at approximately 9 feet 3 inches from the rear Van Stone flange. The point of tube leakage was marked by using the red dye method and the tube was pushed out of the rear with a force of only 1,700 pounds. The red dye marked section of process tube and the front and rear Van Stone flange sections were saved for further inspection. The channel was broached and a new process tube was installed and recharged.

In order to install inpile thermocouple calibration of equipment PT-105-510-A, it was necessary to probe tubes 0890, 0891, 0892, 0990, and 0789 with a solid 8-inch aluminum dummy before a free channel was obtained. The probe hung up at approximately 30 feet from the front of all tubes except 0789, in which the thermocouple setup was installed. During the outage special thermocouples were charged into the thermal shielding cooling tubes located adjacent to process tube rows 25 and 26 on the far side (PT-105-515-A). In an effort to determine the location of the excessive gas leakage at F pile a survey of the inner rod room was conducted. It appeared that the gas leakage was originating from the number 7 horizontal control rod. During the outage several rear face thermocouples were replaced. Following the subsequent poison push F pile was shutdown from 6:44 P. M. to 7:35 A. M. on July 14 because of an undetermined Panellit scram.

On July 18 an increase in moisture collection and outlet dew point was experienced at F pile. However, no water accumulated in the drip legs and temperature traverse data remained normal. It was necessary to shut F pile down at 1:57 A. M. on July 19 to investigate a sudden increase in water collection rate. All process tubes in the entire pile were individually subjected to a 350 psi hydrostatic pressure test. It was found that process tubes 1475, 3668, and 3883 were leaking. Sectionalized pressure testing of these three process tubes indicated that 1475 was leaking at a point approximately 17 feet from the rear Van Stone flange, 3668 at a point approximately 12 feet from the rear Van Stone flange, and 3883 approximately 8 feet from the rear Van Stone flange. The metal columns in leaking tubes 1475, 3668, and 3883 were discharged and the identity of the metal in each tube was maintained for further examination of the slugs. The metal charges in a total of 84 process tubes located in the lower far corner of F pile were successfully backseated.

The point of leaking of the 3 leakers was dye stained and process tubes 3883 and 3668 were discharged in 3 foot sections without difficulty. It was necessary to remove the rear gun barrel and exert forces of 3,500 pounds before process tube 1475 could be pushed out of the rear. Channels 3883 and 3668 were broached and new process tubes were installed and recharged with regular metal. Channel 1475 was established as an air tube with a gun barrel plug in the rear end neutron shielding on the front.

During the outage gas leak investigations in the inner rod room indicated that the number 7 horizontal control rod was definitely the source of the CO_2 gas leakage. However, the thimble could not be pressure tested because the rod was too radioactive to remove from the pile. Consequently, the number 7 rod was kept in the "out" position during the latter part of the month so that it would be sufficiently cool radioactively to be pulled from the pile during the first available outage in August to permit pressure testing of the #7 HCR thimble.

An examination of the slugs discharged from process tubes 3773 and 3684 (July ruptures) revealed that several slugs in each charge were extremely severely pitted over the entire slug surface. Several pitted slugs from each tube were saved for detailed inspection.

By months end a total of 843 gallons of water had been collected at the CO_2 driers from leaking process tubes 0867, 3670, 1475, 3668, and 3883. The water collection rate, which reached a maximum of 81 gallons/day on July 15, gradually decreased to a 10 gallons/day rate on July 31.

RUPTURED SLUGS

Thirteen instances of inpile uranium slug failures occurred during July, bringing the total number to date to 205. The attached table presents all data available at months end regarding these 13 ruptured slugs. It was possible to successfully discharge 10 of these ruptured slugs with the charging machine and resume operations within the scram recovery period. Eight group 8 slugs were included in the July slug failures, bringing the total number to date to 58. No group 9 slug failures (8-inch slugs) occurred during July.

PROCESS DEVELOPMENTS

A three dimensional survey of two Brookhaven concrete shield mockups conducted in 189-D to detect voids with different types of pours has been completed. Measurements were made by positioning a radium source and a G-M detector in adjacent process tube sleeves. Results have indicated that the standard density variation is not large for the various types of aggregates poured by both the conventional and Prepakt methods. The deviation in density for the Brookhaven concrete averaged about 5%.

A proposal to add the head from the 183 pumps to that of the 190 pumps by by-passing the 190 storage tanks has been shown to be both physically possible and economically attractive. At present the discharge from the 183 10,000 gpm pumps is reduced from 75 psi to 20 psi before going to the 190 storage tanks. If the 190 tanks were by-passed and the 70 psi water was pumped directly to the 190 turbine driven pumps, an annual savings of approximately $120,000 in steam consumption would result.

At present the limiting factor in the water plant capacity at H pile is the capacity of the filter plant with ferric sulphate as a coagulant. If alum is substituted as a coagulating agent, as is expected in the near future, the filter plant will no longer be the limiting factor. By running the turbine driven primary pumps at full throttle, the 190 pumps are capable of supplying 65,000 gpm of filtered water to the pile, with a resultant increase in steam consumption. The limiting factor at the H pile water capacity using alum-treated water would be the 183 pumps, which were designed for a maximum flow of 55,000 gpm. Recent tests have shown that they can supply as much as 59,000 gpm. Consequently, with alum treated water almost 60,000 gpm flow would be available at H pile without further pump additions in the event that additional water were needed for pile enrichment.

To date the following seven leaking process tubes at F pile have been dye marked and the leaking sections have been saved for further examination:

3573	3668
0867	3883
0486	1475
3670	

A detailed inspection at 108-B of the leaking sections of process tubes 3573, 3670, 3668, 3883, and 1475 has revealed a complete lack of external corrosion in the vicinity of the leaks. However, in each of these tubes internal pits or cavities, of sufficient depth to penetrate the process tube, have been observed approximately 10 to 12 feet from the rear Van Stone flange. It is believed that this internal cavitational attack is due to a local reduction in the cooling water annulus. This causes a high velocity, low pressure region, in which the alternate formation and collapse of vapor bubbles results in a series of cavities in the process tube. This reduction in cooling water annulus might possibly be caused by cocked slugs, process tube distortion due to graphite expansion, or badly blistered slugs. It has been calculated that a reduction in the cooling water annulus to 10 mils which is sufficient to cause this phenomenon, can be obtained by cocking the slugs only .8 of a degree. This cavitation phenomenon has occurred in all tubes examined at the downstream section of the metal column, where the cooling water temperature is a maximum.

This same phenomen has also been observed in two process tubes used in tests in the 105-D flow laboratory. In both cases, the water temperature was 95° C and the process tubes developed leaks in a period of approximately 12 days. In one tube, raw water was used, and in the other, ferric sulfate treated process water was employed. Attempts

are now being made to duplicate this phenomenon in the 105-D flow laboratory. In addition, several slugs located near the leak in process tube 3668-F have been observed to be badly pitted on one side. Likewise slugs from the downstream end of process tubes 3773 and 3684 (July ruptures at F pile) have been extremely severely pitted over the entire slug surface. This seems to indicate that some of the slugs in the downstream region (same vicinity as process tube leaks) are also undergoing some form of cavitational attack. Tests in the 108-D building have indicated that under normal charging procedures and pressure (30 psi) no slug cocking has been observed by x-ray studies. However, it has been shown that slug cocking is possible with the standard pile charging procedure if the maximum pressure of the charging machines (90 psi) is approached.

In order to minimize the possibility of slug cocking, no metal columns in the piles will be backseated in the future with forces exceeding 600 pounds. Also, all slugs will be charged into the piles with the end caps facing the same direction. It is planned to further investigate this cavitation problem by examining slugs and process tubes removed from both F and other piles, as soon as facilities at 108-B will permit.

PRODUCTION TESTS

506-E - Recirculation of Cooling Water

In order to determine the feasibility of recirculating pile cooling water, an experimental recirculation loop employing steam condensate was installed in process tube 0961 during the July 5 outage at H pile. Process tube 0961 was initially charged with solid aluminum dummies for the purpose of checking the operation of the equipment for approximately one month. The recirculation equipment consists of two parts, a water plant and a recirculation loop. The water plant (located in the outer rod room) consists of a steam condenser cooled by filtered water and six storage tanks. The recirculation loop (located on the -12 level) consists of 2 retention tanks (each providing 40 minutes hold up time), 2 heat exchangers used for cooling, a high pressure operating pump (26 gpm at 400 psi), and a low capacity shutdown pump (4 gpm at 100 psi). It is the purpose of the tests to obtain data on corrosion rates, film formation rates, effluent activity, and water damage due to radiation. At the conclusion of the operational shakedown period, tube 0961 will be charged with weighed and numbered uranium slugs, which will be exposed for a sufficient period to obtain satisfactory data.

508-E - Alum Coagulated Water at D Pile

On July 20 half of the 183-D filter plant began to employ alum instead of ferric sulphate as a coagulating agent in the process water treatment. On July 24 the other half of the 183-D filter plant was converted to alum. This was done in order to supply D pile with alum-treated process water for inpile corrosion tests at low pH under PT-105-509-E.

509-E - Effect of Low pH Alum Water on Pile Operation

During the July 5 outage at D pile an inpile experimental setup to evaluate the effect of low pH, alum-treated process water on pile operation was installed. The test will use existing equipment in the 105-D flow laboratory to furnish low pH, alum-treated water to 5 process tubes to obtain corrosion, film formation, and effluent activity data. Because of insufficient excess activity at D pile only 2 of the 5 process tubes (2170 and 3472) were charged with solid aluminum dummies for the purpose of checking the operation of the equipment. During an August shutdown these two tubes will be recharged with weighed metal slugs and process tubes 2171, 2570, and 3571 will be charged with aluminum dummies for a similar one month shakedown period, at which time they will be recharged with weighed metal slugs. A sixth tube (2070) will be supplied with process water through the regular front face crossheader and will be used as a control tube. It is planned to obtain data at pHs of 7.0, 7.3 and 7.65. The tubes will be discharged at concentrations of 200, 400 and 600 MWD/T.

510-A - Effect of Irradiation on Thermocouples

In order to determine the effect of pile irradiation on the calibration of thermocouples, an aluminum-clad steel thermocouple slug was installed in graphite channel 0789 during the July 11 outage at F pile. Two sizes of iron-constantau and chromel-alumel thermocouples are enclosed in the steel slug, which is filled with lead. An electric heater is mounted on the steel container to melt the lead in order to check the voltage of the thermocouples versus the melting point of lead. It is planned to check the voltage of each thermocouple every 15 days for a period of one year, at which time a calibrated thermocouple will be inserted into the thermocouple slug to check the calibration of the irradiated thermocouples at temperatures up to 500° C.

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515-A - Shield Temperatures Without Cooling Water

During the July 11 outage at F pile special thermocouples were installed in the far side thermal shield cooling tubes adjacent to process tube rows 25 and 26. These thermocouples are located next to three existing thermocouples in the biological shield. The flexible connectors on the front of the thermal shield cooling tubes adjacent to process rows 22 through 28 were removed and replaced with valved connectors containing an orifice for measuring the cooling water flow. It is the purpose of the test to determine the temperatures which result in the various shield components when cooling water is shut off from selected adjacent and alternate thermal shield cooling tubes during pile operation. To date, the flow has been shut off from one thermal shield cooling tube only. It was observed that the thermal shield temperature increased to a maximum of 116° C and the biological shield temperature increased to a maximum of 79° C in the non-cooled section.

3 Enclosures:
1. Comparative Reactor Performance
2. Reactor Outages
3. Tabulation of Ruptured Slugs

PAULOVICH/slc

Distribution:
Cy. 1 - Addressee

	B	D	DR	F	H	Total
Scheduled						
Metal Discharge	39.0	14.7		15.6	5.8	75.1
Maintenance	3.0	5.0		7.5	25.0	40.5
Production Tests	4.7			7.0	2.8	14.5
Special Production	3.0				2.5	5.5
Unscheduled						
Ruptured Slug Removal	2.3	63.0		1.2	25.5	92.0
Process Tube Water Leak				86.2		86.2
Stuck Charge Removal				2.4		2.4
Panellit Failure	0.2					0.2
Rupture Suspect	0.5					0.5
Improper Orificing	1.3					1.3
Improper Panellit Gauge			0.2			0.2
P-13					1.5	1.5
Total Hours	53.3	82.7	0.2	185.6	69.6	391.7

HW-SECURITY INFORMATION SECRET

HW-FP
3-25-52

COMPARATIVE REACTOR PERFORMANCE JULY, 1952

REACTOR	B	D	DR	F	H	TOTAL
Initial Startup	9-26-44	12-17-44	10-3-50	2-25-45	10-20-49	
Design Power Level (MW)	250	250	250	250	400	
Days Since Startup	2866	2784	667	2714	1016	
Maximum Power Level Attained to Date (MW)	560	600	575	575	605	2915
Maximum Power Level During Month (MWD)	558	598	575	547	553	
Average Operating Level (MW)[1]	494	540	560	486	554	529
Total Reactor Outage Hours	53.3	82.7	[illegible]	185.6	69.6	391.7
Time Operated Efficiency (%)[2]	92.8	88.9	[illegible]	75.1	90.6	89.5
MWD Produced - Plutonium	14,216	14,889	17,358	11,301	15,573*	73,337*
MWD Discharged - Plutonium	18,906	18,723	0	10,321	16,635	64,585
MWD In Reactor	71,227	77,073	96,308	63,059	69,285	376,952
MWD In Reactor Basin						160,989
Tons of Metal Charged	31.61	31.32	0	18.10	28.55	109.58
Tons of Metal Discharged	31.11	30.98	0	18.31	28.36	108.76
Tons of Metal In Reactor						1208.39
Tons of Metal In Reactor Basin						268.91
Tons of Metal In 103 Storage						192.54
Average Discharge Concentration (MWD/T)	608	604	0	564	587	594
Scheduled Shutdowns	1	0	0	0	0	
Carbon Dioxide Concentration (%)[3]	98.0	98.0	98.0	94.3	95.0	
Highest Graphite Temperature Recorded (°C)	368	402	333	394	392	
Outlet Water Temperature (°C)[4]	71.9	73.1	68.7	72.2	64.1	
Inlet Water Temperature (°C)[4]	18.3	18.1	17.9	18.3	18.0	
Process Water Flow (gpm)[4]	37,818	39,474	41,958	37,239	49,385	
Maximum Effluent Water Activity (mrep/hr)	14.7	10.9	11.7	12.3	10.8	

*Includes 5% (742MWD) Adjustment

1) Average Operating Level = MWD Produced ÷ 24 / Hours Operated

2) Time Operated Efficiency = Hours Operated / Total Hours In Month

3) Months End Data

4) Average of Last Five Days of Equilibrium Operation

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TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstance Shutdown and R
193	1793-B	1) 1-31-51 2) 9-12-51 3) 7-2-52	294	259	4.8	408	505			74	.15	High exit water a Discharged with c machine-Resumed o within scram reco
194	0560-F	1) 4-16-51 2) 5-8-51 3) 7-3-52	422	214	5.2	454	525			68	.13	High exit water a Discharged with c machine-Resumed o within scram reco
195	3971-D	1) 12-5-51 2) 1-25-52 3) 7-5-52	162	336		373	565			1318	2.33	High exit water a Discharged with c machine--Unable t in scram recovery
196	3189-H	1) 2) 11-20-51 3) 7-5-52	228	330	6.1	586	525	45	54	959	1.83	High exit water s Flushed out 19 do slugs--Couldn't p tube with 8000# f Removed rear gunb Pushed out tube w maining charge in

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TABULATION OF RUPTURED URANIUM SLUGS - July, 1952

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		74	.15	High exit water activity-Discharged with charging machine-Resumed operations within scram recovery period	End cap failure	MRH 1-31-51 Truck 8 &	
		68	.13	High exit water activity-Discharged with charging machine-Resumed operations within scram recovery period	End cap failure	MRG 4-16-51 Truck 4 &	
		1318	2.33	High exit water activity-Discharged with charging machine--Unable to recover in scram recovery period.	End cap failure	MRH 12-5-51 Truck 6 & Group 8	
45	54	959	1.83	High exit water activity-Flushed out 19 downstream slugs--Couldn't push out tube with 8000# force--Removed rear gunbarrel--Pushed out tube with remaining charge in it.	Can sidewall failure	Group 8	

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TABULATION OF RUPTURED URANIUM SLUGS -

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstance Shutdown and F
197	1292-B	1) 2-8-52 2) 3-2-52 3) 7-6-52	126	255		179	505			86	.17	High exit water Discharged with machine--Resumed within scram rec
198	2677-H	1) 1-12-52 2) 1-24-52 3) 7-7-52	165	427	8.9	436	525			74	.14	High exit water Forces of 2500 l to removed charg operations withi recovery period.
199	0482-D	1) 4-5-51 2) 5-23-51 3) 7-16-52	420	258	5.4	576	595	39	60	1682	2.83	High exit water Flushed out 25 d slugs--Transferr stream slugs to twin transfer ca rear gunbarrel-- tube containing slug.
200	4460-H	1) 3-7-51 2) 4-4-51 3) 7-19-52	471	242		489	550			65	.13	High exit water Discharged with machine--Resumed within scram rec

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TABULATION OF RUPTURED URANIUM SLUGS - July, 1952

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		86	.17	High exit water activity-Discharged with charging machine--Resumed operations within scram recovery period	End cap failure	MRB 2-8-52 Truck 1 & Group 8	
		74	.14	High exit water activity-Forces of 2500 lbs. required to removed charge--Resumed operations within scram recovery period.	Uranium split failure	ZRG 1-12-52 Truck 3 & (P.T.-105-503-A Group 8	
39	60	1682	2.83	High exit water activity--Flushed out 25 downstream slugs--Transferred 38 upstream slugs to 0483 with twin transfer cask--Removed rear gunbarrel--Pushed out tube containing ruptured slug.	Uranium split failure	MRH 4-5-51 Truck 1 &	
		65	.13	High exit water activity-Discharged with charging machine--Resumed operations within scram recovery period	Uranium split failure	ZRI 3-7-51 Truck 5 &	

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TABULATION OF RUPTURED URANIUM SLUGS *

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstance Shutdown and R
201	1791-B	1) 4-6-51 2) 12-7-51 3) 7-20-52	226	276	4.8	410	510			90	.18	High exit water a Discharged with c machine--Resumed within scram reco
202	0858-B	1) 4-28-51 2) 5-16-51 3) 7-21-52	432	243	6.0	621	510			90	.18	High exit water a Discharged with c machine--Resumed within scram reco
203	3769-D	1) 3-15-52 2) 5-6-52 3) 7-28-52	83	367	6.3	213						High exit water a Discharged with c machine--Resumed within scram recc
204	3773-F	1) 10-1-51 2) 12-5-51 3) 7-29-52	237	398	7.8	479	550			133	.24	High exit water a Discharged with c machine--Resumed within scram reco
205	3684-F	1) 12-5-51 2) 1-18-52 3) 7-31-52	195	372		383	550			79	.14	High exit water a Discharged with c machine--Resumed within scram recc

[redacted]

TABULATION OF RUPTURED URANIUM SLUGS * July 1952

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		90	.18	High exit water activity-Discharged with charging machine--Resumed operations within scram recovery period	End cap failure--Slug surface badly blistered	MRG 4-6-51 Truck 11 &	
		90	.18	High exit water activity-Discharged with charging machine--Resumed operations within scram recovery period	Uranium split failure--Slug surface badly blistered	MRG 4-28-51 Truck 5 & Group 8	
				High exit water activity-Discharged with charging machine--Resumed operations within scram recovery period	End cap failure	MRG 3-15-52 Truck 4 & Group 8	
		133	.24	High exit water activity-Discharged with charging machine--Resumed operations within scram recovery period	End cap failure--Slug surface severely pitted	MRG 10-1-51 Truck 2 & Group 8	
		79	.14	High exit water activity. Discharged with charging machine--Resumed operations within scram recovery period	End cap failure	MRH 12-5-51 Truck 3 & Group 8	

STANDARD FORM NO. 64

Office Memorandum — UNITED STATES GOVERNMENT

TO : Files, Operations Division (THRU) C. L. Robinson and Donald J. Sturges

DATE: September 4, 1952

FROM : K. F. Paulovich

SUBJECT: 100 AREAS MONTHLY REPORT - AUGUST 1952

This Document consists of 15 Pages No. 1 of [redacted] Copies, Series [redacted]

[redacted]

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General

The maximum operating level attained during the month of August, 1952 by each of the piles, and the corresponding equivalent percentage of the power level index, are as follows:

	B	D	DR	F	H
MWD	565	530	593	550	620
Percent	283	290	292	275	310

B, DR, and H piles attained individual new maximum operating levels during August, and H pile established a new individual production record for the month. August 1 marked the establishment of a new maximum of 2804 MWD for simultaneous five-pile total production, and a new maximum of 2820 MW for simultaneous five-pile combined power level. Total production for August was only 66,352 MWD (98.4% of forecast). This resulted from the occurrence of 13 ruptured slugs, nine of which required minimum downtime outages, and water leak difficulties at B, D and F piles.

The practice of diluting effluent process water at 1904 was terminated on August 25 at all piles upon the recommendation of the Radiological Sciences Dept. In addition, the operating immersion dose-rate limit of 10 mrep/hr was relaxed to 15 mrep/hr. Gamma radiation will be monitored continuously and spot beta measurements will be made to insure accurate total dose-rates and proper beta/gamma ratios.

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At month's end 57% of the 200,000 8" slugs scheduled to be charged under PT-105-313-2M had been charged into the 5 piles. 26%, 22%, 44%, 25% and 66% of the charges in B, D, DR, F, and H piles, respectively, now consist of 8" slugs.

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B Pile

A new maximum power level of 565 MW and a new maximum daily production of 565 MWD were established at B pile on August 1.

During the month of August B pile was shutdown for the following two ruptured slugs:

Tube No.	Shutdown	Started to Power
0274	2:42 P. M., 8/2	6:18 P. M., 8/3
3764	10:06 P. M., 8/4	11:17 A. M., 8/6

It was possible to immediately discharge suspect metal columns in process tubes 0274, 0374, and 0375 with the charging machine on August 2. Operations were resumed at 3:22 P. M. but it was necessary to shut the pile down again at 3:45 P. M. due to insufficient reactivity for continued operations. Examination of the three metal columns revealed a ruptured slug from process tube 0274 only. During the outage replacement of all front crossheader screens was completed.

After flushing out 30 downstream slugs from process tube 3764, alternate front and rear forces of 7000 pounds would not move the remainder of the charge. After transferring 32 upstream slugs to process tube 3765 with the twin transfer cask, the tube broke into two sections while unsuccessfully attempting to push the tube out with forces of 15,000 pounds. The rear gun barrel was removed and the rear 21 foot section of process tube containing the rupture and one other slug was pushed from the pile. The channel was then buttoned up front and rear and established as an air tube.

On August 13 the moisture collection rate at the CO_2 driers increased to 38 gal/day and there to 86 gal/day on August 14. Consequently B pile was shutdown at 5:00 A. M. on August 15 to investigate the source of the water leakage. Prior to shutdown, the Flexowriter automatic tube outlet water temperature recording facility was employed to advantage in locating the wet zones of the pile. A total of 659 process tubes were individually subjected to a hydrostatic pressure test before tube 2660 was discovered to be leaking. Sectionalized pressure testing of tube 2660 indicated that it was leaking somewhere in the last 5 feet. In addition, it was discovered that process tubes 3293, 2252, and 0569 were all leaking at the rear Van Stone flange. The two rear 3 foot sections of process tube 2660 and the rear Van Stone flange sections of tubes 2252, 3293 and 0569 were saved for examination. After discharging process tubes 3293, 2252, 0569, and 2660, new process tubes were installed and recharged with metal.

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Following the August 15-16 outage the water collection rate at the CO_2 driers increased to a maximum of 62 gal/day on August 19 and then gradually decreased to a normal rate by August 31. A total of 378 gallons were collected from the leak in process tube 2660.

The B pile was shutdown from 1:23 P. M. to 1:42 P. M. on August 22 due to an electrical power failure caused by C pile tie-in work at 151-B. Installation of new relays required some rewiring of the existing 230 kv relays. While doing this the power supply failed momentarily because one relay was not set properly.

On August 28 a scheduled outage was initiated to conduct the August metal discharge.

D Pile

Two ruptured slugs caused the shutdown of D pile during August as follows:

Tube No.	Shutdown	Started to Power
0460	7:05 A.M., 8/13	12:45 P.M., 8/14
1568	1:55 A.M., 8/18	9:27 A.M., 8/19

On August 5 an abnormal increase in water collection rate at the CO_2 driers indicated a possible process tube leak. No indications were obtained from temperatures traverses, reactivity changes, or graphite temperature data. However, a continued increase in the exit dew-point and condensate collection resulted in the shutdown of D pile at 12:00 noon on August 7. Starting from the top of the pile 600 process tubes were hydrostatically tested before discovering that process tube 3175 was leaking at a point approximately 8' 4" from the rear Van Stone flange. A red dye was pumped through the tube to mark the leakage point and the tube was then removed and replaced. Severe internal cavitational attack was noted around the process tube ribs at the point of leakage.

During the outage, the August metal discharge was conducted. In addition, process tube 2170 was replaced and the tube was charged with weighed slugs and replaced in the Panellit scram circuit. A borescope of process tube of 3472 indicated considerable buildup of corrosion products in the tube. However, borescoping of tube 3473 also indicated corrosion products to a lesser extent. The tube was charged with weighed slugs and replaced in the Panellit scram circuit. Special front and rear nozzles were installed on process tubes 2171, 2570, and 3571. The tubes were charged with

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numbered solid aluminum dummies and removed from the Panellit scram circuit. These 5 process tubes (2170, 3472, 2171, 2570, 3571) are tubes being utilized under PT-105-509-E to obtain inpile water quality data with low pH, alum treated water.

After resuming operations at 3:06 P. M. on August 10 the water collection rate decreased from a maximum of 35 gal/day on August 11 to a normal rate on August 21. A total of 153 gallons were extracted from D pile following the water leak in process tube 3175.

After flushing out the slugs downstream of the rupture in process tube 0460, the charge was backseated with a force of 3500 lbs. The metal column was then discharged with a charging machine and the tube was pushed from the pile and replaced. During the outage the du Pont uranium fission chamber installed in process tube 1972 (PT-105-528-SR) was removed and the tube was recharged with regular metal. The dummy gunbarrel in tube 0482 was removed and a new rear gunbarrel was installed along with a new process tube. Several orifice and Panellit gauge changes were also made during the outage.

After flushing out the downstream slugs from process tube 1568, the remaining metal column could not be backseated with a force of 6000 lbs. 41 upstream slugs were then transferred to tube 1569 with the twin transfer cask. It was necessary to remove the rear gunbarrel before the process tube and ruptured slug could be pushed from the pile with a force of 7500 lbs. A new rear gunbarrel and process tube were installed and the tube was charged with solid aluminum dummies. Examination of the rupture indicated that it was one of four 7" graphite receptacle pieces charged on July 16, 1952 under PT-105-269.

On August 24 an increase in the moisture collection rate at the CO_2 driers to 27 gal/day indicated another process tube leak. However, no indications were obtained from reactivity, graphite, or temperature traverse data. D pile was shutdown at 4:28 A. M. on August 25 to locate the water leakage. Starting from the top of the pile a total of 1414 process tubes were hydrostatically pressure tested before it was discovered that tube 1692 was leaking. It was possible to remove the tube with forces of 4000 lbs. Sections of the process tube were saved for further examination.

Following startup at 8:10 A. M. on August 26 the moisture collection rate at the CO_2 driers increased to a maximum of 33 gal/day on August 28 and then gradually decreased to a normal rate by August 31. A total of 125 gallons were collected from the leak in process tube 1692.

Files

September 4, 1952

DR Pile

A new maximum power level of 535 MW and a new maximum daily production of 533 MWD were established at DR pile on August 29. With the exception of two Panellit scrams and a scheduled metal discharge on August 5, DR pile operated the entire month of August without incident at an average power level of 5[illegible] MW.

DR pile was shutdown from 10:14 P. M. to 10:28 P. M. on August 5 and again from 5:46 A. M. to 5:55 A. M. on August 25 because of a faulty relay on Panellit row number 22.

During the August 5 discharge outage, flux foils were removed from VSR number 31 and the vertical safety rod was reassembled and returned to service.

A survey of the rear face revealed that approximately 15 rear bellows were leaking CO_2 gas. These bellows were repaired and following startup the excessive CO_2 gas leakage at DR pile decreased considerably. During the outage, several process tube orifices and the corresponding Panellit gauges were also changed.

F Pile

The following 9 ruptured slugs caused the shutdown of F pile during August:

Tube No.	Shutdown	Started to Power
4063	2:37 P. M., 8/6	4:05 P. M., 8/9
3581	1:00 P. M., 8/12	1:27 P. M., 8/12
0872	8:46 A. M., 8/13	7:20 A. M., 8/16
3467	8:53 A. M., 8/18	1:34 P. M., 8/19
3791	8:22 P. M., 8/24	12:43 A. M., 8/26
1967	8:02 P. M., 8/29	9:29 P. M., 8/29
3879	5:50 P. M., 8/30	6:12 P. M., 8/30
3592	7:40 P. M., 8/31	7:58 P. M., 8/31

It was possible to discharge the metal columns in process tubes 3581, 1967, 3879, and 3592 with the charging machine and resume operations within the scram recovery period.

F pile was shutdown at 2:37 P. M. on August 6 to investigate an abnormal increase in moisture collection rate. A rear pig tail survey indicated that process tube 4068 was reading excessively high because of a ruptured slug. After flushing out 5 downstream slugs the metal column could not be backseated or frontseated with a maximum force of 5000 lbs. The process tube was pressure tested and was found to be leaking. Considerable difficulty was encountered while transferring 53 upstream slugs to process tube 4067 with the twin transfer cask. It was necessary to clean out corrosion products found in the front of the process tube and to fabricate a special thin slug soline before the transfer operation could be completed. A sample of the corrosion products was retained for analysis. After removing the rear gunbarrel it was possible to push the process tube containing the ruptured slug from the pile with a force of 4000 lbs. An examination revealed a hole in the process tube in the location of the ruptured slug. A new rear gunbarrel was installed, but a new process tube lodged in the graphite channel after 35 feet had been inserted. Consequently the channel was blanked off as an air tube.

During the outage of 4068 a backseating program in the lower far corner of F pile revealed that 2 process tubes (0686 and 0983) of 61 tubes checked could not be backseated with a 600 lb. force. It was necessary to utilize 2500 lbs. force in discharging process tube 0988 and 5000 lbs. in discharging tube 0686. These two tubes were established as air tubes. In addition, the number 7 HCR thimble was satisfactorily pressure tested during the outage. However, it was discovered that the first section of the rod tip was damaged. Consequently, a new rod tip was installed and the number 7 horizontal control rod was returned to service. Process tubes 3373 and 3684 (July ruptures) were removed with maximum forces of 5000 lbs. The dummy rear gunbarrel plug from process tube 1475 was removed and a new rear gunbarrel was installed. Three new process tubes were installed in these channels and charged with regular metal.

Following startup at 4:05 P. M. on August 9 the moisture collection rate at F pile increased to a maximum of 43 gal/day on August 11 and then decreased to a normal collection rate by August 20, bringing the total water collection from the leak in process tube 4068-F to 171 gallons.

F pile was shutdown from 12:50 P. M. to 1:26 P. M. on August 11 to discharge process tubes 2471 and 3386 because of abnormally high

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exit water temperatures which were seriously limiting pile power level. It was subsequently discovered that the excessive temperatures resulted from defective thermocouples. Examination of the metal columns from these tubes revealed several severely pitted slugs.

After flushing out 21 downstream pieces from process tube 0872 a maximum force of 5000 lbs. would not loosen the charge. A high activity reading in the discharge area indicated that a total of 8 slugs had been flushed onto the catwalk. These were remotely pushed into the storage basin chutes with a long pole. A continued high activity reading on the rear face indicated that a slug had become cocked in the temporary flushing nozzle. After considerable difficulty the slug was removed from the nozzle with spline and vacuum equipment from the "fly's eye" viewer. After pushing the process tube 5 inches out of the pile with a force of 5000 lbs., it was possible to remove 2 more slugs. After decontaminating the rear face and deribbing the aft section of the process tube, it was possible to discharge the remainder of the metal column with a force of 3000 lbs. A new process tube was installed and charged with metal.

During the 0872 outage the metal discharge for August was conducted and a pressure test of the number 4 HCR thimble indicated that it was leaking. The thimble was blanked off and adequate shielding was installed. Process tubes 3769 and 3768 were borescoped and recharged with metal.

After shutting down the pile because of high exit water activity and an abnormal Panellit pressure and temperature on process tube 3467, it was possible to flush out only one downstream slug. When the charge could not be loosened with a force of 5000 lbs., 62 upstream slugs were transferred with the twin transfer cask. The tube could not be pushed out with a maximum force of 23,000 lbs. After removing the rear gunbarrel it was possible to push out the process tube containing the ruptured slug with a maximum force of 8500 lbs. The tube was blanked off as an air tube.

It was possible to discharge the metal column in process tube 3791 with the charging machine. However, subsequent high activity readings in the rear face area indicated that 3 slugs had lodged on the 0 foot level catwalk. The slugs were flushed off the catwalk without difficulty but operations could not be resumed within the scram recovery period. During the outage the charges in 66 process tubes in the lower far corner of F pile were backseated. The charge in tube 0385 proved to be stuck and required a force of 2500 lbs. to discharge the metal column. In addition the charges in tubes 0280, 1190, and 1391 were somewhat reluctant to backseat-

ing and were also discharged. These 4 tubes were established as air tubes. New process tubes were installed in channels 3873 and 0867 and the tubes were charged with regular metal. An attempt to broach channel 4086 and install a new process tube proved unsuccessful.

During the month it was necessary at F pile during the various outages to replace a total of 17 exit water temperature thermocouples. Eight of these indicated no reading and nine indicated a reading higher than the surrounding process tubes. This resulted in considerable difficulty in maintaining outlet water temperatures below the 90° limit without power level reductions.

H Pile

A new maximum power level of 620 MW was attained at H pile on August 20 with a new maximum daily production of 620 MWD established on August 21. The significant power level increase at H pile during August resulted from approximately 25 MW gained due to adjustment of the Bailey flowmeters and from increased boiling limits resulting from no solid downstream dummies aft of the 8" slug metal columns. A new maximum monthly production of 16,899 MWD was achieved at H pile in August.

During the scheduled outage initiated on August 13 to conduct the August metal discharge, stop-gap repairs to the 1st, 5th, and 6th bays of the west retention basin were completed. A total of approximately 10 cubic yards of concrete were used for grouting the voids located. During the outage the P-13 equipment was returned to recirculation status. A special popoff valve was installed on the outlet of recirculation tube 0961 (PT-105-506-E) and the experimental loop was returned to recirculation service. Three special neoprene pigtails were installed on the rear face of H pile for the functional testing of neoprene pigtails for C pile under PT-105-519-A. During startup the H pile was shutdown from 1:39 to 2:20 A. M. on August 14 due to a P-13 instrument relay contact failure.

Only one ruptured slug caused the shutdown of H pile during August.

Tube No.	Shutdown	Started to Power
4055	3:35 P. M., 8/29	4:00 P. M., 8/30

The metal column in tube 4055 was removed with a maximum force of 2500 lbs. After replacing the process tube, the metal discharge scheduled for September was conducted.

RUPTURED SLUGS

Twelve instances of inpile uranium slug failures occurred during August, bringing the total number to date to 217. The attached table presents all data available at month's end regarding these 12 ruptured slugs. It was possible to successfully discharge only 4 of these ruptured slugs with the charging machine and resume operations within the scram recovery period. Nine group 8 slugs were included in the August slug failures, bringing the total number to date to 67. In addition, a failure of a special uranium slug housing a graphite sample (PT-105-269) occurred at D pile during August.

PROCESS DEVELOPMENTS

The simulation of a ruptured slug by injecting a uranyl nitrate solution into process tube 2369 was conducted at H pile on August 1 and 5. Both the delayed neutron and gamma ray spectrometer systems demonstrated good stability. Although the data from these tests and 4 injections conducted during July have not been completely analyzed, it is apparent that the extrapolation of instrument performance from these tests to an actual slug rupture is difficult because of an uncertain uranium exposure time which results from holdup in the tube. This condition makes theoretically calculated extrapolation factors unreliable. Attention is being given to the possibility of simulating a rupture more closely by releasing controlled quantities of highly exposed uranium to the effluent stream.

During the month additional evidence of cavitational attack was discovered on both process tubes and slugs at D and F piles. At D pile, cavitational attack was evident around the ribs of leaking tube 3175. In fact, one rib was completely chewed away at the point of leakage. In addition, the end of the slug located at the leak had been attacked. At F pile, advanced stages of pitting were found on the ruptured slugs located in process tubes 4068, 3581, 3781, along with as many as 5 other downstream slugs in the same tubes. Internal pitting was viewed about 9 feet from the rear Van Stone flange of tube 3878 while borescoping the tube. Two pitted slugs from tube 2471 and 3 pitted slugs from 3386 were found when these tubes were discharged on August 11 because of abnormally high exit water temperatures. Fifteen slugs in tube 0988, which was discovered to be stuck during the backseating program conducted on August 8, were also found to be pitted. In addition to these tubes and slugs at D and F piles, several perforated aluminum dummies discharged from DR pile during the August 5 discharge outage exhibited cavitational pitting around the edge of the perforations. Although all of these slugs and tubes exhibited a

mechanical-type attack due to cavitation, alum-treated process water is being employed at all 3 piles. Consequently, there may be come correlation between this cavitational attack and the lack of film buildup with alum-treated water. An attempt to duplicate the cavitational attack of process tubes in the 105D laboratory obtained during July is now under way. 95° C. alum-treated water is being circulated through a glass process tube over a simulated column of slugs. To date duplication of the pitting on the end of the slugs is being observed, but no turbulence or boiling is visible in that vicinity.

PRODUCTION TESTS

509-E - Effect of Low pH Alum Water on Pile Operation

During the August 7-10 outage at D pile, process tubes 2170 and 3472 were charged with regular weighed slugs and returned to the Panellit scram circuit. Special front and rear nozzles were installed on the 3 remaining tubes (2171, 3571, and 2570) and these tubes were charged with numbered solid aluminum dummies and removed from the Panellit scram circuit. During the next scheduled outage at D pile, these last 3 process tubes will be charged with regular metal slugs to obtain data on the effect of low pH, alum-treated process water. A sixth tube (2070) is being supplied with process water through the regular front-face crossheader and will be used as a control tube.

Enclosure: 1. Comparative Reactor Performance
2. Reactor Outages
3. Tabulation of Ruptured Slugs

PAULOVICH/slc

Distribution:
Cy 1 - addressee

	B	D	DR	F	H	TOTAL
Scheduled						
Metal Discharge	27.3	29.1	24.7	20.0	8.0	109.1
Maintenance	4.0		4.0	11.2	5.9	25.1
Irradiation Tests	.1	15.0	21.1	1.0	1.0	38.2
Special Production	3.7				6.2	9.9
Unscheduled						
Ruptured Slug Removal	67.1	29.6		152.5	24.4	283.6
Process Tube Water Leak	53.8	88.5				142.3
Stuck Charge Removal				14.0		14.0
Power Failure	0.3					0.3
Ruptured P. T. Slug		31.5				31.5
Panellit Failure			0.3			0.3
Discharge Hot Tubes				0.6		0.6
P-13 Instrument					0.7	0.7
Total Hours	160.3	193.7	49.0	209.9	48.4	661.3

COMPARATIVE REACTOR PERFORMANCE - AUGUST 1952

REACTOR	B	D	DR	F	H	TOTAL
Initial Startup	9-26-44	12-17-44	10-3-50	2-25-45	10-20-49	
Design Power Level (MW)	250	250	250	250	400	
Days Since Startup	2,897	2,815	698	2,745	1,047	
Maximum Power Level Attained to Date (MW)	565	600	585	575	620	2,945
Maximum Power Level During Month (MW)	565	580	533	550	620	
Average Operating Level (MW)[1]	482	509	561	440	533	521
Total Reactor Status Hours	149.3	193.7	43.2	239.2	55.4	661.3
Time Operated Efficiency (%)[2]	72.5	74.3	93.4	71.8	93.5	82.2
MWD Produced - Plutonium	11,711	11,667	16,272	8,803	16,899	66,352
MWD Discharged - Plutonium	21,279	14,362	22,379	9,814	14,447	82,283
MWD In Reactor	61,659	73,378	39,710	64,922	71,737	361,306
MWD In Reactor Basin						165,282
Tons of Metal Charged	36.25	25.24	37.94	14.94	24.82	139.19
Tons of Metal Discharged	35.25	24.95	37.51	15.54	24.99	138.24
Tons of Metal In Reactor						1,200.34
Tons of Metal In Reactor Basin						278.41
Tons of Metal In 103 Storage						187.23
Average Discharge Concentration (MWD/T)	604	596	610	569	578	595
Scheduled Shutdowns	1	0	1	0	1	
Carbon Dioxide Concentration (%)[3]	98.0	98.0	96.6	95.3	92.2	
Highest Graphite Temperature Recorded (°C)	364	397	316	396	400	
Outlet Water Temperature (°C)[4]	71.5	74.3	71.0	74.5	69.7	
Inlet Water Temperature (°C)[4]	18.9	19.3	19.1	20.1	18.9	
Process Water Flow (gpm)[4]	38,378	39,758	42,140	37,583	45,726	
Maximum Effluent Water Activity (mrep/hr)	12.4	15.1	12.0	14.0	15.0	

1) Average Operating Level = $\frac{\text{MWD Produced} \times 24}{\text{Hours Operated}}$

2) Time Operated Efficiency = $\frac{\text{Hours Operated}}{\text{Total Hours In Month}}$

3) Months End Data

4) Average of Last Five Days of Equilibrium Operation

[redacted]

TABULATION OF RUPTURED URANIUM SLUGS -

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstance Shutdown and R
206	0274-B	1) 1-31-51 2) 2-20-51 3) 8-2-52	529	133		562	565			988	1.75	High exit water a Discharged with c machine along wit tubes 0374 & 0375 to recover within recovery period.
207	3764-B	1) 12-31-51 2) 6-26-52 3) 8-4-52	39	347	7.5	81	565	34	49	1449	2.56	High exit water a Flushed out 30 do slugs-transferred slugs to 3765 wit transfer cask - t in two sections-r gunbarrel-pushed tube section cont
208	4068-F	1) 12-13-51 2) 1-18-52 3) 8-6-52	201	345	3.0	368	550	59	77	2714	4.93	High exit water a flushed out 5 dow slugs-transferred slugs to 4068 wit fer cask-removed barrel-pushed out rupture in it-prc leak at location
209	3581-F	1) 12-6-51 2) 1-19-52 3) 8-12-52	207	392	4.9	438				17	.03	High exit water a Discharged with c machine-resumer c within scram rec
210	0460-D	1) 2-8-51 2) 3-7-51 3) 8-13-52	525	198	3.7	574	550	45	59	892	1.75	High exit water a Flushed out slug of rupture-backs with 3500 lbs.-c charged with cha Tube pushed out &

TABULATION OF RUPTURED URANIUM SLUGS - August, 1952

	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
5			988	1.75	High exit water activity - Discharged with charging machine along with suspect tubes 0374 & 0375 - unable to recover within scram recovery period.	Uranium Split failure	MRH 1-31-51 Truck 9	
5	34	49	1449	2.56	High exit water activity - Flushed out 30 downstream slugs-transferred 32 upstream slugs to 3765 with twin transfer cask - tube broke in two sections-removed rear gunbarrel-pushed out aft tube section containing rupture.	Uranium split failure	H 12-31-51 Truck 9 & Group 8	
0	59	77	2714	4.93	High exit water activity-flushed out 5 downstream slugs-transferred 58 upstream slugs to 4068 with twin transfer cask-removed rear gunbarrel-pushed out tube with rupture in it-process tube leak at location of rupture.	Uranium split failure	ZRB 12-31-51 Truck 10 & Group 8	
			17	.03	High exit water activity-Discharged with charging machine-resumer operations within scram recovery period.	End cap failure	ZRH 12-6-51 Truck 4 & Group 8	
0	45	59	892	1.75	High exit water activity-Flushed out slugs downstream of rupture-backseated charge with 3500 lbs.-column discharged with charging machi[redacted] Tube pushed out & replaced	Uranium split failure [redacted]	MRG 2-8-51 Truck 9	

TABULATION OF RUPTURED URANIUM SLUGS -

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstance Shutdown and R
211	0872-F	1) 9-10-51 2) 10-26-51 3) 8-13-52	292	389	8.4	563		29	46	1987	3.61	High exit water a Flushed out 21 do slugs-8 slugs flu catwalk-deribbed of tube-removed r charge with 3000
212	3467-F	1) 10-10-51 2) 12-4-51 3) 8-18-52	257	390	2.0	508		63	86	1043	1.89	High exit water a abnormal Panellit & temp.-flushed o stream - couldn't charge with 5000 transferred 62 up slugs - removed r barrel-pushed out rupture with 8500
213	3781-F	1) 10-11-51 2) 12-4-51 3) 8-24-52	263	374	2.4	508	530			1248	2.37	High exit water a Discharged with c machine- 3 slugs catwalk - unable in scram recovery
214	4055-H	1) 3-23-51 2) 4-4-51 3) 8-29-52	513	226		547	620			821	1.33	High exit water a Discharged metal with force of 25

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TABULATION OF RUPTURED URANIUM SLUGS - August, 1952

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
29	46	1987	3.61	High exit water activity-Flushed out 21 downstream slugs-8 slugs flushed onto catwalk-deribbed aft section of tube-removed remainder of charge with 3000 lbs.	Wedge-shaped uranium split	159-U 9-10-51 Truck 8 & Group 8	
63	86	1043	1.89	High exit water activity, abnormal Panellit pressure & temp.-flushed out 1 downstream - couldn't loosen charge with 5000 lbs. force-transferred 62 upstream slugs - removed rear gun-barrel-pushed out tube & rupture with 8500 lbs. force	Uranium split failure	(PT-105-269) 189-H 10-10-51 Truck 11 & Group 8	
		1248	2.37	High exit water activity-Discharged with charging machine- 3 slugs lodged on catwalk - unable to start up in scram recovery period	End Cap failure	158-H 10-11-51 Truck 3 & Group 8	
		821	1.33	High exit water activity - Discharged metal column with force of 2500 lbs.	End cap failure	ZRH 3-23-51 Truck 9 &	

[redacted]

TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstanc Shutdown and
215	1967-F	1) 12-13-51 2) 1-18-52 3) 8-29-52	224	367	43	456	525			18	.03	High exit water a discharged with machine - resume within scram rec
216	3879-F	1) 12-5-51 2) 1-18-52 3) 8-30-52	225	351	5.7	433	525			18	.03	" "
217	3582-F	1) 12-6-51 2) 1-18-52 3) 8-31-52	226	363	4.0	463	525			13	.03	" "

TABULATION OF RUPTURED URANIUM SLUGS

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		18	.03	High exit water activity- discharged with charging machine - resumed operations within scram recovery period.	End Cap failure	G 12-13-51 Truck 7 & Group 8	
		18	.03	" " "	End Cap failure	ZRB 12-5-51 Truck 8 & Group 8	
		13	.03	" " "	End Cap Failure	ZRH 12-6-51 Truck 4 & Group 8	

STANDARD FORM NO. 64

Office Memorandum • UNITED STATES GOVERNMENT

TO : Files, Operations Division (THRU) C. L. Robinson and Donald G. Sturges

DATE: October 3, 1952

FROM : K. F. Paulovich

SUBJECT: 100 AREAS MONTHLY REPORT - SEPTEMBER 1952

SYMBOL: OP:KFP

PILE OPERATION

General

The maximum operating level attained during the month of September, 1952 by each of the piles, and the corresponding equivalent percentage of the power level index, are as follows:

	B	D	DR	F	H
MWD	570	585	580	555	618
Percent	285	293	290	278	309

B pile attained an individual new maximum operating level during September. A new maximum of 2883 MWD for simultaneous five-pile total production was established on September 29, and a new maximum of 2890 MW for simultaneous five-pile combined power level was achieved on September 28. Despite the occurrence of 12 ruptured slugs during a 30-day month, a new maximum total production of 73,680 MWD was attained in September. This represents 126.2% of forecast because B pile was originally scheduled to be shut down during September for the installation of the Ball Third Safety System.

Because of difficulties in procuring new perforated aluminum dummies, a concentrated effort was expended at all piles during September to decontaminate for reuse as much of the inventory of irradiated perforated Al dummies as possible with chromic and oxalic acids plus trisodium phosphate.

B Pile

A new maximum power level of 575 MW was established at B pile on September 8 and a new maximum daily production of 570 MWD was achieved on September 1.

During the month of September, B pile was shut down for the following two ruptured slugs:

Tube No.	Shutdown	Started to Power
0480	9:30 A.M., 9/9	6:33 P.M., 9/10
0574	10:48 A.M., 9/15	2:30 P.M., 9/16

It was possible to immediately discharge process tube 0480 with the charging machine on September 9. Operations were resumed at 10:00 A. M. but it was necessary to shut the pile down again at 10:30 A. M. after reaching a power level of 260 MW due to insufficient reactivity for continued operations. While conducting the September metal discharge during the subsequent outage, a stuck metal column was discovered in process tube 0962 which required 3000 pounds force to discharge. The front section of process tube 3764 (tube broken while removing August rupture) was removed with the use of the process tube splitter. After broaching the graphite channel, a new process tube was installed, satisfactorily pressure tested, and charged with metal. A force of 3000 pounds was required to push process tube 2986 so that a new process tube could be installed and charged with metal.

Following startup, it was necessary to shut B pile down from 9:45 A. M. to 11:22 A. M. on September 11 in order to charge additional temporary poison columns into six process tubes (0873, 1165, 1182, 3678, 3766, 3973) in order to allow increased power level operation. While discharging these temporary poison columns during an outage lasting from 11:50 P. M., September 11 to 2:22 A. M., September 12, the metal columns in process tubes 0987 and 2966 were discharged because of suspected ruptured slugs. However, examination of both metal columns revealed no ruptured slugs.

After flushing out thirty downstream slugs from process tube 0574, a force of 3600 pounds was required to loosen the charge. The process tube was replaced and charged with metal. During the 0574 outage a supplementary September metal discharge was conducted and process tube 0962 was pushed with a maximum force of 5500 pounds. A new process tube was installed and charged with metal. In addition, the differential thermohms for both the outlet water temperature and the pile power level systems were replaced because of erratic operation prior to the shutdown.

However, on September 29 the thermohm power level indicator went out of service again, requiring that the pile be operated with calculated power level measurements. At month's end the installation of the front face crossheader Panellit pressure monitoring system was complete except for calibrating the Panellit gauges, connecting the system into the annunciator panel, and remedying a few leaks in the system.

D Pile

Only one ruptured slug caused the shutdown of D pile during September, as follows:

Tube No.	Shutdown	Started to Power
0365	2:12 A.M., 9/8	3:59 P.M., 9/10

After flushing out 17 downstream slugs the metal charge in tube 0365 could not be loosened with a maximum force of 6000 pounds. Forty-five upstream slugs were transferred to process tube 0364 with the twin transfer cask and the tube containing the two remaining slugs was pushed with a maximum force of 11,000 pounds. A new process tube was installed and recharged with metal. Examination of the metal column from tube 0365 (excluding the ruptured slug) did not reveal any evidence of cavitational pitting.

During the 0365 outage the metal discharge for September was accomplished. In addition, the solid aluminum dummies in process tubes 2171, 2570, and 3571 were replaced with 4-inch weighed slugs and these tubes were returned to the Panellit scram system (PT-105-509-E). Before charging with weighed slugs, process tube 2570 was replaced and process tube 2171 was borescoped. In addition, three duPont uranium fission chambers were charged into process tube 1364 to determine the effect of radiation on their capacity to monitor neutron flux distribution (PT-105-528-SR). However, two of the three chambers became defective shortly after startup, just as the first set of three fission chambers had done previously in process tube 1972.

D pile was shut down from 6:13 P. M. to 6:31 P. M. on September 21 because of a faulty Panellit gauge in row 12.

Beginning on September 8, considerable binding was experienced with the #7 horizontal control rod. Consequently, on September 29 the #7 HCR was pulled from the pile and preparations were in progress at month's end to replace the rod tip section and thimble during the next scheduled outage early in October.

DR Pile

One ruptured slug (the first since April 23) caused the shutdown of DR pile during September.

Tube No.	Shutdown	Started to Power
2574	4:42 A.M., 9/6	4:10 A.M., 9/8

After flushing out 23 downstream slugs it was possible to discharge the metal column in process tube 2574 with a maximum force of 3000 pounds. A new process tube was installed and recharged with metal. During the 2574 outage the September metal discharge was conducted. In addition, process tube 3178 was pushed from the pile with a maximum force of 8000 pounds and a new tube was installed and charged with metal. Sections of both process tubes 2574 and 3178 were saved for further examination. During the shutdown two tubes of metal from PT-105-313-6M (Alpha canned slugs from rods salt bath beta heat treated at Lackawanna) were discharged at a concentration of 100 MWD/T. In addition, five thorium slugs were charged into process tube 2773 under PT-105-516-A.

DR pile was shut down from 3:52 A. M. to 4:05 A. M. on September 16 because of a low pressure trip on Panellit gauge 1551. The pile was shut down from 5:12 A. M. to 5:33 A. M. on September 22 because the Bourdon tube in Panellit gauge 2888 ruptured. DR pile was shut down for a third Panellit scram from 1:52 A. M. to 2:03 A. M. on September 24 because of ruptured capillary tube.

F Pile

The following five ruptured slugs caused the shutdown of F pile during September:

Tube No.	Shutdown	Started to Power
2365	1:53 A.M., 9/4	6:11 A.M., 9/5
0567	1:04 A.M., 9/12	11:04 P.M., 9/13
0868	8:15 A.M., 9/16	1:57 P.M., 9/17
3966	6:20 P.M., 9/19	6:47 P.M., 9/19
2181	5:04 A.M., 9/20	5:37 A.M., 9/20

It was possible to discharge the metal columns in process tubes 3966 and 2181 with the charging machine and resume operations within the scram recovery period.

After flushing out 23 downstream slugs, the metal column in process tube 2365 could not be moved with a maximum force of 5000 pounds. Following the transfer of 39 upstream slugs to process tube 2366 by means of the twin transfer cask, the metal charge was loosened with a maximum force of 6000 pounds. The process tube itself was pushed from the pile with a force of 5000 pounds and a new tube was installed and charged with metal. During the 2365 outage the #4 horizontal control rod thimble was removed from the pile. After two feet of graphite channel had been chipped and vacuumed, an attempt to install a new thimble proved unsuccessful when the thimble was damaged during insertion. Consequently, a step plug, blank flange, and shielding

were installed in the thimble entry. In addition, the metal columns in a total of 45 process tubes located in the lower far corner of F pile were successfully backseated using a maximum force of 600 pounds during the outage.

It was possible to discharge the metal column in 0567 with a charging machine and resume operations at 1:35 A. M. on September 12. However, after reaching a power level of 319 MW it was necessary to shut the pile down again at 3:10 A. M. because of insufficient reactivity for continued operation.

During the subsequent outage, a new #4 HCR thimble was installed and the horizontal control rod was reassembled and returned to service. While conducting the September metal discharge, considerable difficulty was experienced with both charging machines and repeated adjustments were required to prevent scratching of the slugs. On several occasions it was necessary to spline out charged slugs to check whether they had been damaged during charging. Approximately 8 faulty thermocouples were repaired and a new rear gunbarrel and process tube were installed in 3467 during the shutdown. Also, process tube 3582 was pushed with a maximum force of 3000 pounds and a new tube was installed.

During the poison push outage following the 0567 shutdown, process tube 3378 was discharged because of a suspected ruptured slug. Examination of the metal column revealed no ruptured slug, but five downstream slugs exhibited considerable cavitational attack.

At 400 psi water pressure it was possible to flush out only the downstream dummies in process tube 0868. The metal column could not be backseated with a maximum force of 5000 pounds. While transferring 61 upstream slugs to process tube 0869, considerable splining difficulty was encountered. When a maximum force of 11,000 pounds would not push the process tube containing the 3 remaining slugs, it was necessary to remove the rear gunbarrel before the tube could be pushed from the pile. Considerable rear face air borne contamination resulted during the operation.

The metal columns in both process tubes 2180 and 2265 were discharged with the charging machine on September 20 because of high rear pigtail readings. However, only one ruptured slug from process tube 2181 was discovered in the two metal columns along with a total of seven slightly pitted slugs from both tubes.

H Pile

Three ruptured slugs caused the shut down of H pile during September, as follows:

Tube No.	Shutdown	Started to Power
3460	1:20 P.M., 9/13	2:01 P.M., 9/13
2984	3:26 P.M., 9/17	1:25 P.M., 9/19
3577	4:02 A.M., 9/27	4:38 A.M., 9/27

It was possible to discharge the metal column in 3460 with the charging machine and resume operations within the scram recovery period.

After flushing out 16 downstream slugs, the metal column in 2984 could not be moved with a force of 3000 pounds. After pushing the process tube and the remaining slugs 14 feet with a maximum force of 6000 pounds, the process tube stuck. It was necessary to remove the rear gunbarrel before the tube could be completely removed from the pile. A new gunbarrel and process tube were installed and charged with metal. The rupture in tube 2984 was an 8-inch slug (third 8-inch rupture). Examination of the process tube revealed a small hole in the tube between the ribs at the location of the 8-inch ruptured slug.

During the outage an experimental neoprene pigtail was removed from the rear of process tube 0980 (PT-105-519-A). In addition, graphite samples (PT-105-504-E) were discharged from process tube 0776 and an attempt was made to charge a second set of graphite samples into the inner Al tube. However, inspection of the inner Al tube revealed it to be ruptured. Consequently, the non-irradiated samples were discharged and the inner Al tube was removed from the process tube. After satisfactorily pressure testing process tube 0776, the tube was charged with solid aluminum dummies. During the 2984 outage the September metal discharge was conducted and the installation of the front crossheader Panellit pressure monitoring system was completed. In addition, a total of 38 process tubes in the central zone of H pile were charged with 4-inch slugs under the following metal fabrication production tests:

PT-105-313	Type of Slugs	Tubes
4M	Alpha-canned, uranium metal powder metallurgy	4
5M	Triple-dipped, rods finished by cold drawing	10

PT-105-313	Type of Slugs	Tubes
6M	Alpha-canned rods salt bath beta heat treated at Lackawanna	12
9M	Triple-dipped, Fernald evaluation metal	12

During the 2984 outage, a high rear pigtail reading resulted in the discharge of the metal column in process tube 4376. No ruptured slug was located in the charge, but a pressure test of the process tube revealed it to be leaking. The process tube was established as an air tube.

The recirculation cooling water loop in process tube 0961 was switched to regular process water on September 1 because of a bearing failure on the high pressure pump. However, the system was returned to recirculation status on September 9 and operated satisfactorily during the remainder of the month. Also, on September 5 another injection of uranyl nitrate was made into process tube 2369 for simulated ruptured slug detection tests.

On September 24 it was necessary to reduce the power level at H pile because the exit water temperature of process tube 3577 was approximately 6 to 12° C higher than the temperature of adjacent tubes. The Panellit pressure remained normal and an instrument check revealed no faulty components in the temporary monitoring system. On September 27 H pile was scrammed at 4:02 A. M. because of a faulty Panellit gauge on row No. 2. The metal column in process tube 3577 was discharged and recharged with solid aluminum dummies. Inspection of the 32 8-inch slugs from 3577 revealed a small hole in the can sidewall of one slug. This represents the fourth 8-inch slug rupture under the present program of PT-105-313-2M.

H pile was scrammed at 6:15 P. M. on September 11 because of a faulty Panellit gauge on row No. 3 which could not be located before recovery at 6:31 P. M. H pile was shut down again from 1:44 A. M. to 2:00 A. M. on September 12 because of faulty Panellit gauge 0372. A second Panellit scram from 5:13 A. M. to 5:26 A. M. on September 12 resulted in the location of a bad terminal on Panellit gauge 0368 and a short in Panellit gauge 0353.

PRODUCTION TESTS

509-E - Effect of Low pH Alum Water on Pile Operation

During the September 9 outage at D pile, the solid aluminum dummies in process tubes 2171, 2570, and 3571 were replaced with regular 4-inch weighed slugs and the process tubes were returned to the Panellit scram

system. Prior to charging, process tube 2570 was replaced with a new tube and process tube 2171 was borescoped. In addition, a column of weighed 4-inch slugs was charged into regular process tube 2070, which will be used as a control tube. With all five process tubes (2170, 3472, 2171, 3571, and 2570) charged with weighed slugs, the inpile experimental tests to evaluate the effect of low pH, alum-treated process water on pile operation were initiated. Corrosion, film formation, and effluent activity data will be obtained at pHs of 7.0, 7.3, and 7.65.

504-E - Study of Gas - Graphite Reactions

During the September 18 outage at H pile, the quartz capsules containing graphite specimens which had been exposed to CO and CO_2 gases at water temperatures were discharged from the inner aluminum tube. After charging new graphite samples it was discovered that the inner aluminum tube was ruptured. Consequently, the non-irradiated samples were discharged and the inner aluminum tube was removed. After pressure testing, process tube 0776 was charged with solid aluminum dummies. The study of inpile gas-graphite reactions will continue after replacement of the inner aluminum tube.

516-A - Effects of Irradiation on Thorium Slugs

The charging of five thorium slugs into process tube 2773 during the September 7 outage at DR pile completed the charging of 45 rolled and 45 extruded 6 1/2-inch unbonded thorium slugs into the piles. It is the purpose of these tests to evaluate the effects of increased exposures (up to 1000 MWD/AT), as well as the irradiation effects on extruded thorium slugs. The first columns of thorium slugs irradiated to high concentrations will be discharged during October.

PROCESS DEVELOPMENT

An informal request for $19,000 has been submitted to the A & B Committee for the installation of equipment for the charging and discharging of poison columns during pile operation on 18 process tubes at B pile. The operational feasibility of this facility was recently demonstrated at B pile with equipment installed on process tube 1277. Upon approval it is estimated that between 3 to 4 months will be required for material procurement and installation.

In conjunction with a study to evaluate the production gains possible through the relaxation of the present 600 MWD/T ± 5% concentration in order to vary discharges and dampen reactivity cycles, it has been

shown that the average discharge concentration has a much more pronounced effect on the isotopic ratio of plutonium 240 to plutonium 239 than the range of discharge concentrations employed to obtain a specific average concentration.

It has been suggested that it might be extremely attractive to utilize the excess filter capacity at the present piles (employing aluminum sulfate) to provide part of the filter plant capacity required for the K piles. If new lines connecting the KE-KW, D-DR, and B-C areas were constructed and tied into the present export water system, it would be possible to transport over 200,000 gpm excess filtered water to K areas as follows:

F	27,000 gpm
H	40,000 gpm
D-DR	60,000 gpm
B-C	86,000 gpm
	213,000 gpm

By doing this it would be necessary to construct only one filter plant at K area, with a substantial decrease in capital costs.

During September the delayed neutron monitoring equipment was modified so that it monitored a sample of water from the near downcomer, representing half of H pile effluent water. When two ruptured slugs (3460 and 2984) occurred at H pile during the month, the ratio of signal to background of the delayed neutron monitoring equipment was 2 to 3 times as great as that with the beta monitoring equipment. This was obtained in spite of the fact that the water sample from the offending cross-header had been diluted by a factor of 23 before reaching the delayed neutron monitor. At month's end duPont scientilation counter and filter equipment was being connected to effluent sample lines at H pile for testing with future injections of uranyl nitrate (PT-105-523-A).

Additional evidence of cavitational pitting attack on slugs discharged from F pile was obtained during September. Ruptured slugs 0868 and 2181 exhibited cavitational pitting, and slugs from the downstream end of ruptured columns 2365, 0868, and 2181, plus transfer tube 2366, showed varying degrees of cavitational pitting. In an effort to evaluate the causes and conditions necessary for cavitational attack an extensive program has been formulated, a large portion of which is already underway. The program consists of the following:

1 - Investigations of the effect of ferric sulphate versus alum sulphate and sodium dichromate versus no dichromate water treatment in the 50-tube mockup. Tests will also investigate the effect of temperature, velocity, static pressure, film formation, and mechanical obstructions.

2 - Visual studies of the cavitational phenomenon in a glass process tube mockup.

3 - Induction heater tests to determine the effect of hot slug surfaces with various mechanical obstructions.

4 - Submerged jet impingement tests and rotating disc tests to investigate the influence of water treatment, temperature, velocity, types of metal and film formation. Included will be high frequency interupted jet tests which will provide a mechanical analogue of cavitation in which bubble collapse will be simulated by impact forces.

5 - Two dimensional nozzle studies of high temperature cavitation including pressure, temperature, and velocity variations.

6 - Slug cocking tests incorporating the effect of process tube bowing, weld overhangs, and blistered slugs.

7 - Investigation of the effect of alum, ferric sulphate, sodium dichromate, and purging on the growth of front process tube barnacles or corrosion products. This will include the examination of a substantial number of pile process tubes to determine the status of front tube corrosion and the examination of a representative series of process tubes before and after pile purges.

8 - Examination of all leaking process tubes and pitted slugs to determine the type and frequency of cavitational attack, and the examination of ordinary process tubes and slugs for comparison.

9 - The determination of the effect of alum, ferric sulphate, dichromate and purging through full scale pile process water tests. It is planned to leave H and B piles on ferric sulphate treatment without dichromate and with purging. C and DR piles will utilize alum and sodium dichromate treatment plus purging. F will continue with alum treatment without dichromate but purging will be initiated. D pile will continue with alum treatment and no purging, but the addition of sodium dichromate will be initiated. In this way it is planned to evaluate the optimum water treatment from the standpoint of cavitational attack for K pile water plant designs.

RUPTURED SLUGS

Twelve instances of inpile uranium slug failures occurred during September, bringing the total number to date to 229. The attached table presents all data available at month's end regarding these 12 ruptured slugs. It was possible to successfully discharge only 4 of these ruptured slugs with the charging machine and resume operations within the scram recovery period. Seven group 8 slugs were included in the September slug failures, bringing the total number to date to 74. In addition, the third and fourth group 9 slug failures (8-inch slugs) occurred during September at H pile.

Enclosure: 1. Comparative Reactor Performance
2. Reactor Outages
3. Tabulation of Ruptured Slugs

PAULOVICH/slc

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HFP
3-25-52

COMPARATIVE REACTOR PERFORMANCE SEPTEMBER 1952

REACTOR	B	D	DR	F	H	TOTAL
Initial Startup	9-25-44	12-17-44	10-3-50	2-25-45	10-20-49	
Design Power Level (MW)	250	250	250	850	400	
Days Since Startup	2927	2845	728	2775	1077	
Maximum Power Level Attained to Date (MW)	575	600	585	575	620	2955
Maximum Power Level During Month (MWD)	570	585	580	555	618	
Average Operating Level (MW)[1]	521	565	539	488	591	542
Total Reactor Outage Hours	65.0	65.0	51.3	107.8	48.1	337.2
Time Operated Efficiency (%)[2]	91.0	91.0	92.9	85.0	93.3	90.6
MWD Produced - Plutonium	14,230	15,412	15,045	12,447	16,546	73,680
MWD Discharged - Plutonium	3,650	17,705	21,409	13,903	14,377	76,044
MWD In Reactor	67,239	71,585	83,346	62,566	73,906	358,642
MWD In Reactor Basin						181,156
Tons of Metal Charged	15.33	30.23	35.76	23.01	24.61	128.94
Tons of Metal Discharged	14.68	29.57	36.13	23.06	24.78	128.22
Tons of Metal In Reactor						1210.06
Tons of Metal In Reactor Basin						304.18
Tons of Metal In 103 Storage						171.89
Average Discharge Concentration (MWD/T)	589	599	593	603	580	593
Scheduled Shutdowns	0	0	0	0	0	
Carbon Dioxide Concentration (%)[3]	97.0	98.0	93.0	93.8	94.1	
Highest Graphite Temperature Recorded (°C)	360	395	335	407	402	
Outlet Water Temperature (°C)[4]	73.6	74.7	69.7	74.5	69.4	
Inlet Water Temperature (°C)[4]	19.0	19.4	19.2	19.6	19.5	
Process Water Flow (gpm)[4]	38,862	40,012	42,262	38,112	45,852	
Maximum Effluent Water Activity (mmcp/hr)	14.4	13.0	11.5	11.3	13.7	

1) Average Operating Level = $\frac{\text{MWD Produced} \times 24}{\text{Hours Operated}}$

2) Time Operated Efficiency = $\frac{\text{Hours Operated}}{\text{Total Hours In Month}}$

3) Months End Data

4) Average of Last Five Days of Equilibrium Operation

REACTOR OUTAGES, SEPTEMBER, 1952

	B	D	DR	F	H	TOTAL
Scheduled						
Metal Discharge	5.3	30.3	30.9	21.9	1.1	89.5
Maintenance			4.5	30.8	7.0	42.3
Production Tests	4.0	15.0	1.5	0.5	4.5	25.5
Special Production	0.6		3.0	2.0	9.9	15.5
Unscheduled						
Ruptured Slug Removal	55.1	19.4	10.5	52.6	24.5	162.1
Panellit		0.3	0.9		1.1	2.3
Total Hours	65.0	65.0	51.3	107.8	48.1	337.2

TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstanc Shutdown and
218	2365-F	1)10-10-51 2)12-5-51 3)9-4-52	274	365	7.9	557	535	40	61	1076	2.01	High exit water a Flushed out 23 do slugs--Transferre stream slugs. Pus remaining charge force of 6000 lbs
219	2574-DR	1)11-5-51 2)12-24-51 3)9-6-52	257	394	8.0	596	580	41	60	324	.56	High exit water a Flushed out 23 do slugs--Loosened r charge with force
220	0365-D	1) 2)3-28-51 3)9-8-52	530	204		583	580	47		548	.94	High exit water a Flushed out 17 do slugs--Transferre stream slugs to C tube & remaining with maximum forc lbs.
221	0480-B	1)1-31-51 2)9-12-51 3)9-9-52	363	252	4.8	503	565			1097	1.94	High exit water Discharged with machine--Unable t within scram rec

TABULATION OF RUPTURED URANIUM SLUGS * September, 1952

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
40	61	1076	2.01	High exit water activity--Flushed out 23 downstream slugs--Transferred 39 upstream slugs. Pushed out remaining charge with maximum force of 6000 lbs.	Can sidewall failure.	MRB 10-10-51 Truck 5 & Group 8	
41	60	324	.56	High exit water activity--Flushed out 23 downstream slugs--Loosened remaining charge with force of 3000 lbs	Can sidewall failure	196-U 11-5-51 Truck 5 & Group 8	
47		548	.94	High exit water activity--Flushed out 17 downstream slugs--Transferred 45 upstream slugs to 0364--Pushed tube & remaining 2 slugs out with maximum force of 11,000 lbs.			
		1097	1.94	High exit water activity--Discharged with charging machine--Unable to recover within scram recovery period.	End cap failure	MRH 1-31-51 Truck 3 &	

TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstance Shutdown and R
222	0567-F	1) 12-7-51 2) 1-19-52 3) 9-12-52	237	294	4.0	340	540			54	.10	High exit water a Discharged with c machine--Unable t within scram reco
223	3460-H	1) 12-6-51 2) 1-24-52 3) 9-13-52	233	355		483	610			245	.40	High exit water a Discharged with c machine--Resumed within scram reco
224	0574-B	1) 3-26-51 2) 11-2-51 3) 9-15-52	318	294	6.4	580	565	34	51	1271	2.24	High exit water a Flushed out 30 d slugs--Loosened charge with 3600
225	0868-F	1) 12-7-51 2) 1-27-52 3) 9-16-52	233	384		431	540	64		2456	4.56	High exit water Necessary to tran stream slugs to 0 remaining 3 slugs with maximum forc lbs.--Rear gunbar
226	2984-H	1) 2-7-52 2) 3-6-52 3) 9-17-52	195	402		505	605	16		673	1.11	High exit water Flushed out 16 d slugs--Force of moved tube 14'-- gunbarrel--Pushe remaining charge in process tube at rupture locat

TABULATION OF RUPTURED URANIUM SLUGS

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		54	.10	High exit water activity--Discharged with charging machine--Unable to recover within scram recovery period.	End cap failure	MRH 12-7-51 Truck 10 & Group 8	
		245	.40	High exit water activity--Discharged with charging machine--Resumed operations within scram recovery period.	Can sidewall failure	ZRG 12-6-51 Truck 8 & Group 8	
34	51	1271	2.24	High exit water activity--Flushed out 30 downstream slugs--Loosened remaining charge with 3600 lbs force.	Uranium split failure	MRG 3-26-51 Truck 11 &	
64		2456	4.56	High exit water activity--Necessary to transfer 61 upstream slugs to 0869--Tube & remaining 3 slugs pushed out with maximum force of 11,000 lbs.--Rear gunbarrel removed.	Can sidewall failure	MRG 12-7-51 Truck 11 & Group 8	
16		673	1.11	High exit water activity--Flushed out 16 downstream 8" slugs--Force of 6000 lbs moved tube 14'--Removed rear gunbarrel--Pushed out tube & remaining charge--Small hole in process tube between ribs at rupture location.	Can sidewall failure--Hole about 1" diameter in can.	MRB 2-7-52 Truck 2 & Group 9	

TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstance Shutdown and
227	3966-F	1) 10-11-51 2) 12-5-51 3) 9-19-52	289	370		505	540			54	.10	High exit water Discharged with machine--Resumed within scram rec
228	2181-F	1) 12-13-51 2) 1-18-52 3) 9-20-52	246	375		506	540			54	.10	High exit water Discharged with machine--Resumed within scram rec
229	3577-H	1) 4-15-52 2) 5-13-52 3) 9-27-52	137			376	610			95	.15	Abnormally high temperature. Dis charging machine operations withi recovery period.

TABULATION OF RUPTURED URANIUM SLUGS

Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		54	.10	High exit water activity--Discharged with charging machine--Resumed operations within scram recovery period.	End cap failure.	MRB 10-11-51 Truck 3 & Group 8	
		54	.10	High exit water activity--Discharged with charging machine--Resumed operations within scram recovery period	End cap failure	MRH 12-13-51 Truck 4 & Group 8	
		95	.15	Abnormally high exit water temperature. Discharged with charging machine--Resumed operations within scram recovery period.	Can sidewall failure	MRG 4-15-52 Truck 2 & Group 9	

STANDARD FORM NO. 64

Office Memorandum • UNITED STATES GOVERNMENT

TO : Files, Operations Division (THRU) L. Robinson and Donald G. Sturges

DATE: November 5, 1952

FROM : K. F. Paulovich

SUBJECT: 100 AREAS MONTHLY REPORT - OCTOBER 1952

SYMBOL: OP:KFP

PILE OPERATION

General

The maximum operating level attained during the month of October, 1952 by each of the piles, and the corresponding equivalent percentage of the power level index, are as follows:

	B	D	DR	F	H
MWD	600	575	585	558	630
Percent	300	288	293	279	315

B and H piles established individual new maximum operating levels during October. October 28 marked the occurrence of a new maximum of 2904 MWD for simultaneous five-pile total production, and a new maximum of 2910 MW for simultaneous five-pile combined power level. With the occurrence of only 11 ruptured slugs, only 4 of which required minimum downtime outages, total production for October was 77,587 MWD (114.3 percent of forecast). This represents a new per diem maximum production of 2,503 MWD per day.

At months end the following percentage of metal in each of the piles consisted of 8" slugs (PT-105-313-2m):

	B	D	DR	F	H
Percent	36.4	42.0	69.9	33.4	65.4

During October 48 outlet water temperature thermocouples failed, primarily at F and H piles. Approximately 33 hours of outage time was required to repair or replace these defective thermocouples.

B Pile

A new maximum power level of 600 MW was established at B pile on October 27 and a new maximum daily production of 600 MWD was achieved on October 28. The significant increase in power level resulted from poison adjustments and orifice changes accomplished during the October 14 outage, plus changes in operating control rod configurations. The 600 MW maximum power level was limited by boiling disease limitations.

During the month of October B pile was shut down for the following 4 ruptured slugs:

Tube No.	Shutdown	Started to Power
0680	10:59 A. M., 10/2	11:24 A. M., 10/2
3054	3:10 P. M., 10/6	3:34 P. M., 10/6
3892	8:05 P. M., 10/13	5:52 P. M., 10/15
0862	2:51 A. M., 10/29	7:00 A. M., 10/30

It was possible to discharge the metal columns in process tubes 0680 and 3054 with the charging machine and resume operations within the scram recovery period.

The metal column in process tube 3892 could not be moved with a force of 2500 pounds. After flushing out 46 downstream slugs, it was not possible to loosen the remainder of the charge with a maximum force of 8000 pounds. After transferring 2 upstream slugs to process tube 3891 with the twin transfer cask, difficulty was encountered with the third slug, which lodged in the cask. When a spline was inserted in an attempt to free the third slug and push it back into the process tube, the slug stuck at the front gunbarrel flange. With difficulty, the spline was removed and the third piece was pushed back into the process tube. By exerting a force of 6000 pounds, it was possible to push the process tube 55 inches out the rear of the pile. After cutting off the protruding section of tube and removing the rear gunbarrel, the remaining portion of the process tube containing the rest of the slugs was pushed out with a maximum force of 2000 pounds. The rear gunbarrel was reinstalled, but it proved impossible to install a new process tube because of a bent front gunbarrel. Consequently, the tube was established as an air tube with steel dummies and neutron shielding on the front face.

During the 3892 outage the metal discharge for October was accomplished. In addition, the #9 horizontal control rod was removed from the pile and a hydrostatic pressure test confirmed a leak in the #9 HCR thimble. A blank flange and neutron shielding were installed over the #9 HCR

opening in order to permit subsequent replacement of the thimble. One radioactively "hot" P-10 poison slug scheduled to be charged into process tube 3476 was discovered to be ruptured and was replaced with a 5-inch perforated dummy in the poison column. The ruptured P-10 slug was removed for burial. During the discharge shutdown, ten experimental front face caps with short (1-inch) inserts were installed under PT-MR-105-4.

The metal column in 0862 could not be loosened with a force of 2500 pounds. After flushing out 5 downstream slugs, the remaining metal column could not be moved with a maximum force of 8000 pounds. It was necessary to remove the rear gunbarrel before the process tube and remaining slugs could be pushed out with a force of 7500 pounds. A new rear gunbarrel and process tube were installed and charged with regular metal. During the 0862 outage, 35 additional special front face caps with short inserts were installed during the supplementary October discharge conducted.

Following startup, it was necessary to shut B pile down from 9:15 A. M. to 12:30 P. M. on October 30 to charge temporary poison in order to allow increased power level operation with #9 HCR rod out of service. This was followed by a shutdown from 1:25 P. M. to 2:10 P. M. on October 30 to install a larger orifice on tube 1382, which was limiting power level. The temporary poison columns were discharged during an outage lasting from 4:47 A. M. to 6:22 A. M. on October 31.

On October 8, one percent of helium (approximately 200 cubic feet) was added to the CO_2 atmosphere at B pile in an attempt to locate CO_2 leakage by means of helium leak detection equipment. Similar additions of helium were made on October 13 and October 23. No leaks were discovered originating from the top of the pile or from the horizontal control rod thimbles. However, while checking several rows of process tubes, it was discovered that the front face bellows on tubes 0270, 0460, 0469, 4190 and 4682 were leaking by various degrees.

On October 22 high 105-B background readings were traced to effluent vapors originating from the surge breaker outside the building, indicating that it had been broken during the recent construction work on the 105-B and 105-C effluent connection. Stop gap repairs to the junction box were made.

D Pile

Two ruptured slug indications caused the shutdown of D pile during October as follows:

Tube No.	Shutdown	Started to Power
2084	2:28 P. M., 10/16	2:54 P. M., 10/16
Crossheader 42 1/2	7:46 P. M., 10/19	8:20 P. M., 10/19

It was possible to discharge the metal column in process tube 2084 with the charging machine and resume operations within the scram recovery period. It was not possible to definitely locate a suspect rupture on October 19.by a pigtail survey of rear crossheader 42 1/2.

During the scheduled outage initiated on October 1 for the discharge of metal, the thimble for the #7 horizontal control rod was pressure tested satisfactorily. After replacing considerable graphite track, a new control rod tip section was installed and the #9 HCR was reassembled and returned to normal service. During the discharge outage special tubing was connected from the rear nozzles of process tubes 0491, 1694, 2374, 2587 and 2792 to an existing spare line in the sample room in order to determine the effect of power level on the radioactivity of effluent alum treated cooling water. Also, a special thermocouple assembly was installed in process tube 1383 to obtain data or central slug temperatures, uranium thermal conductivity, and rates of slug temperature rises after cooling water shut-off (PT-105-411-P).

On October 20 a water leak was discovered in the inner rod room, apparently coming from the #4 horizontal control rod. The #4 HCR was temporarily removed from service and satisfactorily pressure tested. On October 21 a hydrostatic pressure test of the #7 horizontal control rod revealed that it was the source of the water leak. Consequently, the #7 horizontal control rod was removed from service and pulled into the outer rod room. Examination revealed a leak located at the welded junction between the rod rack and the rod tip section. The leak apparently resulted from a very poor Heliarc weld. The top and bottom plates were removed and the leaking tubing was rewelded along with the welds on the other two tubes. After satisfactorily pressure testing the control rod, the #9 HCR was placed back in the inner rod room pending investigation during the next available shutdown of binding difficulties.

On October 28 a leak was noted on process tube 3961 where the front pigtail connection was welded to the crossheader. D pile was shut down at 6:05 P. M. on October 29 for a supplementary metal discharge, originally scheduled for early in November. The #7 HCR was returned to service and the leaky front pigtail on tube 3961 was replaced. An unsuccessful attempt was made to install special front pigtails on tubes 1382 and 1384 under PT-105-411-P. Excavation around the leaking joint in the effluent line nearest the retention basin revealed that the joint had slipped out of line. To repair the leak concrete was poured around the lower two thirds of the line, the upper section was grouted, and the excavation was backfilled to the top of the effluent line.

Following startup, it was necessary to shut D pile down from 10:36 A. M. to 12:52 P. M. on October 31 to charge temporary poison in order to allow increased power level operation. This was followed by a Panellit scram lasting from 2:48 P. M. to 3:12 P. M. on October 31. D pile was shut down again from 11:37 P. M. on October 31 to 2:18 A. M. on November 1 to discharge the temporary poison columns.

DR Pile

With the exception of the October metal discharge outage initiated on October 15, DR pile operated the entire month of October without incident, at an average power level of 566 MW.

During the October 16 discharge outage, the special column of slugs in process tube 3577 (Project Bluenose, PT-105-507-A) was discharged because of failure of the Potter flow meter. The special front and rear face nozzles and equipment were removed from tube 3577 and installed on tube 3674. A new metal column of 64 4-inch slugs was charged into process tube 3674 for an exposure of 600 MWD/T. Removal of the orifice and cone screen of process tube 3577 revealed that the cone screen was partially plugged with small particles of metal. During the shutdown two tubes (3275 and 3583) of 4-inch slugs fabricated from rods salt bath beta heat treated at Lackawanna (PT-105-313-6M) were discharged. Also, one tube (3289) of 4-inch slugs fabricated by uranium metal powdered metallurgy (PT-105-313-4M) was discharged. In addition, 5 thorium slugs plus 28 regular 8-inch slugs were discharged from tube 3483 as part of the program to evaluate the effect of irradiation on thorium slugs (PT-105-516-A).

During the discharge outage the rear gunbarrel of 3188 was removed and a new rear gunbarrel was installed. After broaching the graphite channel and reaming the front gunbarrel, a new process tube was

installed, pressure tested, and charged with 8-inch slugs. While discharging ANL-172 from process tube 1167, it was noted that the tube was excessively corroded and contained a heavy deposit of hard film. The special nozzles were removed from process tube 1167 and the tube was charged with solid aluminum dummies. Before startup, process tubes 1167, 2574, 3179 and 3188 were all hydrostatically tested satisfactorily.

F Pile

The following 6 ruptured slug indications caused the shutdown of F pile during October:

Tube No.	Shutdown	Started to Power
0866	1:44 P. M., 10/4	2:10 P. M., 10/4
1779	7:16 A. M., 10/6	9:40 A. M., 10/8
3971	11:12 A. M., 10/15	5:28 P. M., 10/16
1479	4:45 P. M., 10/19	5:12 P. M., 10/19
Crossheader 24 1/2	6:53 P. M., 10/21	7:29 P. M., 10/21
3965	7:18 A. M., 10/30	7:57 A. M., 10/30

It was possible to discharge the metal columns in process tubes 0866, 1479 and 3965 with the charging machine and resume operations within the scram recovery period. No suspect rear pigtail could be located on rear crossheader 24 1/2 on October 21.

It was possible to loosen and discharge the metal column in process tube 1779 with a maximum force of only 2000 pounds. Because of indications of water leakage in the upper sections of the pile prior to the 1779 shutdown, it was decided to hydrostatically pressure test portions of the pile. After individually pressure testing a total of 812 process tubes (rows 30 up thru 46, rows 1 up through 5) it was discovered that process tube 0585 was leaking. After discharging 0585 with the charging machine, the tube was dye stained in order to locate the leakage point. A tube cutter was pushed 14 feet in from the front face with a maximum force of 12,000 pounds before the cutter failed. After running another cutter in 4 feet from the rear face with a force of 3,000 pounds, tube removal attempts were abandoned and tube 0585 was established as an air tube. The front 14 foot and rear 4 foot split sections of the process tube were removed and saved for detailed examination.

During the 1779 outage the metal columns in a total of 60 process tubes located in the lower far corner of F pile were successfully backseated with a maximum force of 600 pounds with the exception

of tube 0383. A force of 1000 pounds was required to backseat the charge in 0383. Consequently, the metal column was discharged and the tube was established as an air tube. During the shutdown process tube 1064 was satisfactorily pressure tested and charged with metal. Six thermocouples were installed and 54 new thermocouple leads were run from the control room to the rear face. In addition, a suspected restriction in the 107-190A effluent line (large volumes of water were noted escaping from the man hole near the outlet end of the 107 retention basin on October 5) was investigated during the shutdown. Several miscellaneous objects (saw horse, basin planks, pieces of plywood) were removed from the 107 manifold and the situation was remedied.

On October 10 the exit water temperature of process tube 4480 was observed to be considerably higher than that of surrounding tubes, while the Panellit pressure remained normal. Consequently, F pile was shut down from 2:10 P. M. to 3:01 P. M. on October 10 to discharge tube 4480 and recharge it with solid aluminum dummies. It was discovered that a defective thermocouple was the cause of the abnormally high effluent water temperature.

On October 10 the installation of 90 silica gel moisture indicators connected to the rear face plenum chamber sample lines was completed and put into service. During the remainder of the month the moisture indicators operated satisfactorily.

After flushing out 4 downstream slugs the metal column in process tube 3971 could be neither pushed or backseated with a maximum force of 5000 pounds. Fifty-nine upstream slugs were then transferred to tube 3970 with the twin transfer cask. It was possible to loosen and discharge the ruptured slug with a force of 12,000 pounds. After removing the rear gunbarrel the process tube was pushed out with a force of 5000 pounds and the channel was established as an air tube. Portions of the process tube were saved for examination. During the 3971 outage an inspection of the front section of several process tubes revealed extremely bad barnacle growth in most of the tubes. In addition, process tube 0383 was split from rear to front with the tube splitter employing forces less than 5000 pounds. The front 6-foot section of the process tube was removed from the pile, cut off, and saved for examination. Tube 0383 was then returned to its status as an air tube.
On October 23 a water leak was observed at the front of process tube 3360 due to a split nut on the nozzle end of the front pigtail. F pile was shut down from 10:08 A. M. to 10:35 A. M. on October 23 to replace the cracked pigtail connector on tube 3360. The split pigtail connector was sent to the 300 Area for metallographic examination.

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November 5, 1952

H Pile

A new maximum power level of 630 MW was first attained on October 27, with a new maximum daily production of 630 MWD achieved on October 28. A new maximum monthly production of 17,776 MWD was achieved at H oile in October.

Only one ruptured slug caused the shutdown of H pile during October as follows:

Tube No.	Shutdown	Started to Power
4474	8:37 P. M., 10/15	9:32 P. M., 10/15

It was possible to discharge the metal column in 4474 with the charging machine and resume operations within the scram recovery period.

During the shutdown initiated on October 19 to accomplish the October metal discharge, the recirculation system installed in tube 0961 was tested because of pressure variations experienced during operation. When the orifice and cone screen were removed it was found that the cone screen was full of small concrete particles necessitating the replacement of the cone screen. Because of these difficulties the replacement of tube 0961 and the charging of uranium slugs into the cooling water recirculation setup was cancelled in order to obtain another month's shakedown operation.

During the outage an experimental neoprene pigtail was removed from the rear of process tube 3774 and a new neoprene pigtail was installed. Approximately 20 defective thermocouples were replaced. An inspection of the horizontal control rods indicated that corrosion products had built up under the #1 and the #3 HCRs indicating possible tip section leakage. It is planned to check this further during the next available shutdown. Process tube 4376 was replaced with a new tube and sections of the old tube were saved for examination.

During the discharge outage a water sampling line was connected from the far rear riser to the far sample room in order to perform operational tests on slug rupture detection instrumentation developed by duPont (PT-105-523-A). Also, one set of irradiated aluminum corrosion samples were discharged from the Z test hole and replaced with a new set of samples in order to evaluate the effect of neutron flux on aluminum corrosion under PT-105-510-E.

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On October 22 lagging on P-13 pipes, which had become oil soaked from a leaking P-13 pump, ignited and resulted in an oil fire. The fire was quickly extinguished by portable CO_2 fire extinguishers. The operating temperature of the P-13 facility was reduced below the oil flash point to 300° F, in order to minimize further possibility of fire until all the oil had vaporized.

During October work continued on cutting all electrical cables and connections to the tool dolly and installing disconnect junctions in all lines so that the tool dolly at H pile can be disconnected and removed without delay or difficulty for use at C pile.

On October 8 a leak test of the East retention basin indicated that it was still losing effluent water at a rate of approximately 3,000 gpm.

C Pile

The acceptance of C pile by the Reactor section of Manufacturing was originally scheduled for October 10. However, considerable difficulty was experienced with the ball 3X valves located beneath the reactor. During acceptance tests it was discovered that when the ball valves were partially opened a few of the balls would prevent further opening or closing of the valves. Hence, it was necessary to remove all the ball 3X valves for modification. This consisted of installing a skirt to prevent the balls from getting between the ball and the valve housing. Following that, additional difficulty was encountered in making the modified ball valves gas tight. Also, considerable difficulty was encountered in making the balls roll down the slightly inclined chute to the bucket elevator for return to the top of the reactor. All of the ball 3X valves had been modified, reinstalled, and tested satisfactorily, and 50 out of 85 acceptance tests had been completed by month's end. On November 4, at the completion of all acceptance tests, the C reactor was accepted and charging of metal for dry critical determinations was begun.

RUPTURED SLUGS

Eleven instances of inpile uranium slug failures occurred during October, bringing the total number to date to 240. The attached table presents all data available at month's end regarding these 11 ruptured slugs. It was possible to successfully discharge seven of these ruptured slugs with the charging machine and resume operations within the scram recovery period. Seven group 8 slugs were included in the October slug failures, bringing the total number to date to 81.

An examination of accumulated ruptured slug data has indicated that 4 ruptured slugs occurred on each of 6 individual crossheaders at DR pile during the November, 1951 - February, 1952 period. This is much above the statistical distribution of ruptures obtained in the other piles. It might possibly be an indication that, in the effort to quickly discharge a ruptured slug within the scram recovery period, the reduction in cooling water flow has resulted in boiling in other tubes on the same crossheader. This could conceivably have resulted in subsequent ruptured slugs on the same crossheader. As a matter of fact on several occasions, such as during the removal of the rupture in 3892-B on October 14, steam has been observed spurting out the rear of a process tube containing a ruptured slug with reduced cooling water flow.

An inspection of slugs discharged from F pile has continued to reveal that a majority of the downstream slugs exhibits varying degrees of cavitational pitting. During October the ruptured slugs in tubes 3971 and 1479 were severely pitted, and several downstream slugs in tubes 0866, 0585, 1779, 3971 and 1479 also showed evidence of cavitational pitting. In one instance, a slug from rupture tube 1479 was so badly pitted that spots of the AlSi layer were visible on the can sidewall.

PROCESS DEVELOPMENTS

On October 10 the installation of the silica gel moisture indication system was completed at F pile and put into service. The installation consists of 90 glass tubes containing Desigel (silica gel containing cobaltous chloride) each of which is connected to one of the gas sample lines originating in the rear face plenum chamber. When moisture is picked up by the silica gel the cobaltous chloride causes a change in color from blue to red. Each tube has a nichrome wire coil surrounding it for regenerating the silica gel. It is hoped that the installation of this 90 tube indicator will permit both an early indication and an accurate location of moisture in the F pile gas atmosphere.

It is planned to hydrostatically pressure test the front face risers at the various piles to a maximum of 750 psi during the scheduled ball 3X outages. This is being scheduled to determine if the present risers will withstand a working pressure of 500 psi, so that in the event it is decided in the future to increase the working pressure above the present 400 psi the exact pressure limitations of the existing risers will be known. Plastic jackets and associated strain gauges will be located at critical spots on the risers, so that as the riser pressure is increased an indication of stresses developed will be known at all times during the test to prevent actual rupture.

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DECLASSIFIED

November 5, 1952

During October an inspection of the front sections of several process tubes at B, D and F piles was conducted in an effort to evaluate front tube corrosion and barnacle growth. Preliminary checks indicate that the front tube barnacle growth is considerably more advanced at F pile, where cavitational pitting of slugs has been experienced, than at B or D piles.

Examination of several thorium slugs discharged from D pile during the October 2 discharge outage at an exposure concentration of 800 MWD/T has shown that there is evidence of burned spots at various points on the unbonded cans. This represents the initial results from thorium slugs irradiated to high concentrations under PT-105-516-A.

Single columns containing materials having low neutron capture cross section tend to increase the local thermal neutron flux. As a result higher rates of power generation occur in the immediate adjacent regular metal columns. In the past, equilibrium power levels have been seriously limited by tubes surrounding a column of B material, solid aluminum, air, or graphite stringers. Consequently, it has been decided to substitute solid aluminum dummies for a portion of the upstream uranium charge in all tubes immediately adjacent to such columns.

A study has been initiated to see whether the current limit on power level increase during a hot startup (25 MW per minute) can be relaxed from a technical and safety viewpoint. The present limit has resulted in production losses through failure to recover from scrams which could have been avoided with a faster rate of power level increase.

Two hundred 2S aluminum process tubes are currently being anodized at room temperatures by the Columbia Electric Company at Spokane. 150 of these tubes will be used for tube replacement in the lower far corner of F pile during the ball 3X outage scheduled to commence on November 17.

As a temporary measure to conserve perforated aluminum dummies and at the same time consume obsolete solid aluminum dummies, the downstream dummy charge for C reactor will consist of nine 8-inch perforated dummies and five 8-inch solid aluminum dummies. Although this change in the dummy column will lower vapor binding limits approximately 5%, no immediate effect on power level will result since vapor binding considerations will not be limiting at C pile for some time.

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The Flexowriter automatic tube outlet water temperature recording facility at B pile has proven definitely superior to the IBM installations at DR and H piles in rapidly furnishing recorded temperature information. The Flexowriter can produce a temperature map in an average of 15 minutes depending on pile flattening and should aid in the early location of process tube water leaks. Consequently, a project proposal is in preparation for the installation of a Flexowriter setup at D, DR, F and H piles.

PRODUCTION TESTS

MR-4 - Experimental Caps with Short Inserts

During the October 14 outage at B pile experimental front face caps with short (1-inch) inserts were installed on 10 process tubes. On October 29 thirty-five additional caps with short inserts were installed on the following tubes: 2378 thru 2380, 2475 thru 2480, 2275 thru 2280, 2375 thru 2377, 2575 thru 2579, 2675 thru 2680, and 2775 thru 2780. It is the purpose of this test to determine how 1-inch of aluminum compares with the normal 12 inches of aluminum inserted in a front face cap as shielding against gamma activity. Considerable difficulty has been experienced at B pile during discharges because of excessive corrosion product buildup in the normal 12-inch front face inserts. This has resulted in several hours delay in the completion of a normal discharge. Consequently, if the 1-inch inserts being tested provide sufficient front face shielding this charging difficulty can be remedied. Preliminary results from the 45 special inserts charged during October indicate that the 1-inch aluminum inserts are only about half as effective as the normal 12-inch aluminum inserts but still result in workable time limits. However, with the loss of cooling water in a process tube the 1-inch insert will definitely be inadequate shielding.

511-E - Effluent Activity of Alum Treated Water

During the October ? discharge at D pile special tubing was installed which connected the rear nozzles of one process tube in each orifice zone (0491, 1694, 2374, 2587, 2792) to an existing spare effluent sample line. It is the objective of this installation to determine experimentally the effect of pile power level on the radioactivity of effluent cooling water treated with alum and activated silica. It is believed that phosphorus, the rare earths, and fission products are primarily responsible for the activities dangerous as river contaminants. The difference between alum-silica water and ferrifloc water in the concentrations

of the elements responsible for these activites is not accurately known. It is planned to take periodic effluent water samples and conduct direct radiochemical analyses in the 200 West Area. It is hoped that an accurate relationship between effluent activity and pile power level can be established.

523-A - duPont Ruptured Slug Detectors

During the October 20 discharge outage at H pile an effluent water sampling line was installed connecting the far riser to the far sample room. It is the purpose of this installation to provide effluent water samples for the operational testing of slug rupture detection instrumentation developed by duPont. The instrumentation designed to detect fission product gamma activity in the effluent water consists of 2 scintilation counters mounted in series on an effluent sample line. One detector views a filter designed to absorb fission products, whereas the second detector operates without a filter as a power level reference. The instrumentation designed to detect and analyze beta activity consists of an ion chamber and circuity designed to determine the effective decay rate of the beta activity. Performance data from these tests will be applicable to the Hanford slug rupture detection problem. On October 3 an injection of uranyl nitrate into process tube 2369 was made to test the sensitivity of the duPont gamma monitor. Inasmuch as the uranyl nitrate is solution, the filter failed to pick up any of the gamma activity.

411-P - Uranium Slug Temperatures

During the October 2 discharge outage at D pile a special thermocouple slug assembly was charged into process tube 1383 in order to obtain data on slug central temperatures, uranium thermal conductivity, and slug temperature rises after shutoff of the cooling water flow. The special thermocouple slug has a central chromel-alumel thermocouple and 2 outer thermocouples. Special equipment was installed on the tube to measure both inlet and outlet water pressures and temperatures.

Enclosure: 1. Comparative Reactor Performance
2. Reactor Outages
3. Tabulation of Ruptured Slugs

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COMPARATIVE REACTOR PERFORMANCE OCTOBER 1952

REACTOR	B	D	DR	F	H	TOTAL
Initial Startup	9-25-44	12-17-44	10-3-50	2-25-45	10-20-49	
Design Power Level (MW)	250	250	250	250	400	
Days Since Startup	2958	2876	759	2806	1108	
Maximum Power Level Attained to Date (MW)	600	600	585	575	630	2990
Maximum Power Level During Month (MWD)	600	575	585	558	630	
Average Operating Level (MW)[1]	532	550	566	494	604	550
Total Reactor Outage Hours	83.1	82.1	43.2	88.1	37.0	334.5
Time Operated Efficiency (%)[2]	88.8	89.0	94.2	88.2	94.9	91.0
MWD Produced - Plutonium	14,643	15,171	16,520	13,477	17,776	77,587
MWD Discharged - Plutonium	16,452	22,413	22,261	1,386	16,557	79,069
MWD In Reactor	65,430	64,343	77,605	74,657	75,125	357,160
MWD In Reactor Basin						204,226
Tons of Metal Charged	26.97	37.00	36.69	1.89	27.12	129.67
Tons of Metal Discharged	27.10	37.51	36.04	2.76	27.31	130.72
Tons of Metal In Reactor						1209.01
Tons of Metal In Reactor Basin						341.38
Tons of Metal In 103 Storage						346.45
Average Discharge Concentration (MWD/T)	607	598	618	502	606	605
Scheduled Shutdowns	0	2	1	0	1	
Carbon Dioxide Concentration (%)[3]	98.0	98.0	98.0	95.4	97.4	
Highest Graphite Temperature Recorded (°C)	384	393	336	402	410	
Outlet Water Temperature (°C)[4]	74.1	72.6	67.0	70.0	67.9	
Inlet Water Temperature (°C)[4]	16.5	16.9	15.5	16.8	15.8	
Process Water Flow (gpm)[4]	39,048	39,030	43,064	37,733	45,818	
Maximum Effluent Water Activity (mrep/hr)	14.7	14.3	11.8	14.5	12.4	

1) Average Operating Level = $\frac{\text{MWD Produced} \times 24}{\text{Hours Operated}}$

2) Time Operated Efficiency = $\frac{\text{Hours Operated}}{\text{Total Hours In Month}}$

3) Months End Data

4) Average of Last Five Days of Equilibrium Operation

REACTOR OUTAGES - OCTOBER 1952

	B	D	DR	F	H	TOTAL
Scheduled						
Metal Discharge	13.0	45.1	26.6		21.3	106.0
Maintenance	6.3	13.0	10.6		11.1	41.0
Production Tests	3.4	22.6	4.8	0.5	4.7	36.0
Special Production			1.2			1.2
Unscheduled						
Ruptured Slug Removal	60.4	0.4		57.2	0.9	118.9
Process Tube Water Leak				24.0		24.0
Stuck Charge Removal				4.5		4.5
Ruptured Pigtail				0.5		0.5
Suspected Ruptured Slug		0.6		0.6		1.2
Discharge of Hot Tube				0.8		0.8
Panellit Scram		0.4				0.4
Total Hours	83.1	82.1	43.2	88.1	38.0	334.5

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TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances Shutdown and Re
230	0680-B	1) 4-6-51 2) 12-7-51 3) 10-2-52	300	323	6.3	543	560			116	.21	High exit water ac Discharged with ch machine-Resumed op within the scram r period.
231	0866-F	1) 10-6-51 2) 12-5-51 3) 10-4-52	304	380	5.0	542	555			181	.32	High exit water a Discharged with c machine-Resumed o within scram reco
232	1779-F	1) 10-16-51 2) 12-5-51 3) 10-6-52	306	384	7.3	626	555			905	1.62	High exit water ac Metal column loose max. force of 2000
2.	3054-B	1) 2-1-51 2) 9-12-51 3) 10-6-52	390	196	3.7	539	560			46	.08	High exit water ac Discharged with ch machine - Resumed within scram reco
234	3892-B	1) 2-1-51 2) 9-12-51 3) 10-13-52	397	158	2.8	493	565	18	25	915	1.62	High exit water ac Flushed out 46 dow slugs-transferred slugs to 3891 with transfer cask-remo gunbarrel-pushed t remaining slug out max. force of 6,0

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TABULATION OF RUPTURED URANIUM SLUGS OCTOBER, 1952

Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		116	.21	High exit water activity - Discharged with charging machine-Resumed operations within the scram recovery period.	End cap failure	MRG 4-6-51 Truck 4 & Group 7	
		181	.32	High exit water activity- Discharged with charging machine-Resumed operations within scram recovery period.	End cap failure	MRG 10-6-51 Truck 7 & Group 8	
		905	1.62	High exit water activity- Metal column loosened with max. force of 2000 lbs.	Uranium split failure	MRH 10-16-51 Truck 1 & Group 8	
		46	.08	High exit water activity - Discharged with charging machine - Resumed operations within scram recovery period.	End cap failure	MRG 2-1-51 Truck 2 & Group 7	
18	25	915	1.62	High exit water activity- Flushed out 46 downstream slugs-transferred 2 upstream slugs to 3891 with twin transfer cask-removed rear gunbarrel-pushed tube and remaining slug out with max. force of 6,000 lbs.	Uranium split failure	MRH 2-1-51 Truck 2 & Group 7	

TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances Shutdown and R
235	3971-F	1) 12-5-51 2) 1-18-52 3) 10-15-52	271	378	4.1	513	550	60	79	987	1.80	High exit water ac flushed out 4 down slugs - transferre stream slugs to 39 transfer cask-remo gunbarrel-loosened slug with mx. forc lbs. - pushed tube 5,000 lb. force
236	4474-H	1) 2-21-52 2) 3-3-52 3) 10-15-52	223	231	3.6	359	615			201	.33	High exit water ac Discharged with c machine - resumed within scram reco
237	2084-D	1) 3-28-52 2) 5-6-52 3) 10-16-52	163	392	6.0	424	570			52	.09	High exit water a Discharged with c machine - resumed within scram reco
238	1479-F	1) 12-8-51 2) 1-18-52 3) 10-19-52	275	389	5.2	567	550			39	.07	High exit water ac Discharged with c machine - resumed within scram reco
239	0862-B	1) 4-6-51 2) 12-7-51 3) 10-29-52	327	311	2.7	606		59	77			High exit water a flushed out 5 dow -couldn't loosen force of 8,000 l rear gunbarrel-pu and remainder of [redacted] with ma

TABULATION OF RUPTURED URANIUM SLUGS

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
60	79	987	1.80	High exit water activity - flushed out 4 downstream slugs - transferred 59 upstream slugs to 3970 with twin transfer cask-removed rear gunbarrel-loosened rupture slug with mx. force of 12,000 lbs. - pushed tube out with 5,000 lb. force	Can sidewall failure	MRG 12-5-51 Truck 5 & Group 8	
		201	.33	High exit water activity- Discharged with charging machine - resumed operations within scram recovery period.	End cap failure	MRG 2-21-52 Truck 1 & Group 8	
		52	.09	High exit water activity - Discharged with charging machine - resumed operations within scram recovery period.	End cap failure	ZRH 3-28-52 Truck 9 & Group 8	
		39	.07	High exit water activity - Discharged with charging machine - resumed operations within scram recovery period.	End cap failure	ZRH 12-8-51 Truck 5 & Group 8	
59	77			High exit water activity - flushed out 5 downstream slugs -couldn't loosen charge with force of 8,000 lbs. - removed rear gunbarrel-pushed out tube and remainder of metal column [redacted] with max. force of 7,500 lbs.	End cap failure	MR 4-6-51 Truck 4 & Group 7	

[redacted]

TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MED/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstance Shutdown and
240	3965-F	1) 10-11-51 2) 12-5-51 3) 10-30-52	330	346	6.4	586						High exit water a Discharged with c machine - resumed within scram reco period.

[redacted]

TABULATION OF RUPTURED URANIUM SLUGS

Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
				High exit water activity - Discharged with charging machine - resumed operations within scram recovery period.	End cap failure	MRG 10-11-51 Truck 3 & Group 8	

STANDARD FORM NO. 64

Office Memorandum • UNITED STATES GOVERNMENT

TO : Files, Operations Division (T'RU)
C. L. Robinson and Donald G. Sturges

DATE: December 4, 1952

FROM : K. F. Paulovich

SUBJECT: 100 AREAS MONTHLY REPORT - NOVEMBER 1952

SYMBOL: OP:KFP

PILE OPERATION

General

The maximum operating level attained during the month of November 1952 for each of the piles, and the corresponding equivalent percentage of the power level index, are as follows:

	B	C	D	DR	F	H
MWD	590	600	570	605	550	630
Percentage	295	300	285	303	275	315

C, DR, and H piles established individual new maximum operating levels during November, and D pile established a new individual production record for the month. November 30 marked the occurrence of a new maximum of 2,960 MWD for simultaneous 5-pile total production, and a new maximum of 2,970 MW for simultaneous 5-pile combined power level. Total production for November was 73,312 MWD (114.4 percent of forecast) with C pile operating and F pile down for installation of the ball 3X system. This total production includes 41 MWD attributable to enriched U-235 burnout at C and H piles.

Only six ruptured slugs occurred during November, five of which required minimum downtime outages.

At month's end the following percentage of metal in each of the piles consisted of eight-inch slugs (PT-105-313-2M):

	B	C	D	DR	F	H
Percent	41.9	43.3	42.2	76.8	34.6	70.7

During November a total of 880 six-inch 4 1/8 percent U-235 aluminum alloy slugs were charged into C and H reactors.

00185

B Pile

During the month of November, B pile was shut down for the following three ruptured slugs:

Tube No.	Shutdown	Started to Power
0387	2:53 A. M., 11/3	4:51 A. M., 11/4
0373	9:26 A. M., 11/10	8:32 P. M. 11/11
4488	10:11 A. M., 11/20	2:24 P. M., 11/12

After flushing out 26 downstream slugs in process tube 0387, an attempt to push the remaining metal column with a maximum force of 5,000 pounds failed. The tube containing the remaining charge was pushed out the rear and a new tube was installed and charged with eight-inch slugs. During the outage, the #9 horizontal control rod tip was removed. In removing the thimble, the thimble cap was broken off and remained in the control rod channel at the cast iron blocks. The broken piece of thimble was pushed back into the pile because it was too hot radioactively to handle. After chipping the graphite and installing the step plug, an attempt to install a new thimble failed when the thimble bound in the step plug. The new thimble was removed, shielding was installed at the step plug, and the installation of the #9 horizontal control rod thimble was postponed until the next available outage.

During the 0387 shutdown, the C - B safety circuit tie-in was completed. Also, an inner tube to be used to irradiate graphite samples under PT-105-403-P was installed in process tube 3461. Tests with reduced water flows were conducted in order to determine shielding effectiveness of the short front face cap inserts under shutdown conditions (PT-MR-105-4).

B reactor was shut down on November 10 because of an increase in Panellit pressure and outlet water temperature on process tube 0373. After flushing out four downstream slugs, the process tube and remaining charge was pushed from the unit and a new process tube was installed and charged with metal. Graphite samples were charged into the dry inner tube located in process tube 3461 (PT-105-403-P). During the 0373 outage, the broken end of the #9 horizontal control rod thimble was pushed to the rear of the channel. After removing two inches from the end of the new thimble for clearance purposes, the new thimble was installed. The horizontal control rod was reassembled and pressure tested, but the rod was not returned to service because the rod tip was found to be binding at 160 inches.

The November metal discharge was conducted during the shutdown and a new rear gunbarrel and process tube were installed in air tube 3892. An inspection of the front section of several process tubes on crossheader 34 1/2 revealed that barnacle growth at B pile was as bad and extensive as that at F pile, despite the difference in water treatment.

On November 15 one unirradiated slug was discovered under the front face elevator indicating that one process tube had been charged short during 0373 outage.

After flushing out only the downstream dummies in process tube 4488, the rear gunbarrel was removed and the process tube containing the entire metal column was pushed with a maximum force of 7,500 pounds. The rear gunbarrel was replaced and a new process tube was installed. Binding of #9 horizontal control rod was found to be due to misalignment of roller guides and a slight warp in the rod. After aligning the guides no binding was evidenced and the #9 horizontal control rod was returned to service. An investigation located the process tube which had been charged one piece short during the 0373 outage. The one slug was added to the metal column correcting the cold metal inventory. The BPA electrical power was cut off from 10:20 A. M. to 11:15 A. M. on November 21 to conduct power failure acceptance tests at C pile. The test was continued until 1:40 P. M. in order to obtain steam consumption data for B and C areas. Operations were resumed at B pile at 2:24 P. M.

C PILE

C pile was turned over to Operations at 10:00 A. M. on November 4 and initial charging for dry critical determinations began at 12:05 P. M. Dry critical determinations were made with all control rods removed from the pile, a pile atmosphere of air, a rear dummy pattern consisting of 4 solid and 10 perforated 8-inch aluminum dummies, and no cooling water admitted to the process tubes. The neutron flux monitoring during the criticality tests was accomplished by means of four BF_3 proportional counter chambers located in C test hole and process tubes 2073, 2375 and 2192, and four ion chambers located in B and D test holes and process tubes 2161 and 2188 and connected to the Beckmans. An apparent dry critical loading was reached at 9:00 A. M. on November 5 with a central cylindrical loading of 312 tubes. However, it was discovered that the BF_3 chamber located in C test hole had been inadvertently positioned at the center of the pile instead of near the reflector, thereby affecting the critical size. When the BF_3 chamber was withdrawn to its correct position, the 312 tube loading became super critical and it was necessary to shut the pile down with VSR #38. Twenty tubes around the fringe of the dry critical loading were discharged and recharged two at a time. Actual dry

critical loading occurred at 2:38 P. M. on November 5 with 305 tubes charged. A few tubes were then charged beyond dry critical in order to run a radial flux traverse through C test hole and a longitudinal flux traverse through process tube 2174 after gold foils had been irradiated to calibrate instrumentation.

Cooling water (crossheader pressure of 75 - 90 psi) was then admitted to those process tubes charged in the dry critical loading. In order to determine wet critical with a dry reflector, water was admitted to additional tubes only as they were charged during the wet critical loading. Process tubes 2075 and 2174 were each charged with 44 enriched C slugs. A wet critical loading was reached at 8:00 P. M. on November 7 with 534 process tubes loaded with normal metal and 2 tubes charged with C metal. The enriched metal was discharged from tube 2174 and a second wet critical loading was reached at 3:30 A. M. on November 8 with 576 tubes charged with normal uranium and one tube charged with C slugs. The enriched metal was discharged from 2075 and a third wet critical loading without enrichment was reached at 4:48 P. M. on November 8 with 619 process tubes charged with normal uranium. A few additional tubes were charged to make the loading slightly super critical and radial and longitudinal flux traverses were run through C test hole and process tube 2174, respectively. Loading of process tubes continued until a 25 second period was obtained with 670 wet tubes charged.

At this point a series of danger coefficient measurements were made in order to determine the effect on reactivity of various tube configurations. Danger coefficient measurements were taken with process tube 2174 charged with the following:

1. 64 standard 4-inch slugs in wet tube.
2. 50 5-inch hollow receptacle slugs (standard O. D.).
3. Empty dry tube.
4. Solid Al dummies in dry tube.
5. 64 4-inch hollow slugs, core and annulus dry.
6. 64 4-inch hollow slugs, wet core, dry annulus.
7. 64 4-inch hollow slugs, wet core, wet annulus.
8. 43 6-inch bismuth slugs in wet tube.
9. Partial column of 6 thorium slugs centered with Al dummies.
10. 35 solid 8-inch Al dummies in wet tube.
11. Water in empty process tube.

In addition, reactivity measurements were obtained with the graphite stringer used for flux traverses inserted in C test hole and with a long thimble installed in B test hole.

[redacted]

At the completion of these reactivity measurements the tubes charged beyond wet critical were discharged again and CO_2 was admitted to the pile atmosphere. Difficulty was experienced initially with the CO_2 purging because of a restricting PRV in the system. However, after installing a temporary bypass a CO_2 purity of 90% was reached at 11:00 A. M. on November 11, resulting in an 180 inhour gain in reactivity.

In addition to monitoring the reactivity transient during the CO_2 purge, additional danger coefficient measurements were obtained with a CO_2 atmosphere and the following configurations in tube 2187:

1) Regular metal in wet tube.
2) 43 6-inch bismuth slugs in wet tube.
3) Partial column of 6 thorium slugs centered with 15 Al dummies in wet tube.
4) 43 thorium slugs in wet tube.
5) 64 lithium-Al slugs in wet tube.
6) 43 poison (lead-cadmium) slugs in wet tube.
7) Cluster of 4 wet tubes (2086, 2087, 2188, 2187) with 43 6-inch bismuth slugs each.
8) 43 6-inch bismuth slugs in 2187 only.
9) 35 8-inch solid Al dummies.

Measurements were also taken with a horizontal control rod of special rod tip design inserted into HCR channel #5 with the following cooling water configurations:

1) Completely dry.
2) Core wet, annulus dry.
3) Core dry, annulus wet.
4) Completely wet.

At this point cooling water was supplied to all the process tubes and the balance of the reactor was charged with metal. The header pressure was then raised to an operating level of 410 psi, in order to conduct full scale reactor tests to determine the effectiveness of the horizontal rods, vertical rods, and the ball 3X system.

On November 15 fifteen process tubes of temporary poison and 14 process tubes of enriched C metal (5 kg, 20 slugs/tube) were charged, as follows:

Poison		
3889	3366	3869
3879	3374	3382
2774	2785	1189
2174	2185	1566
1583	0970	0976

C Metal		
0766	0773	0780
1060	1086	1459
1489	3359	3389
3760	3786	4066
4073	4080	

The C reactor was started to power at 1:45 P. M. on November 18 and operation was maintained at 5 MW until 4:31 P. M., at which time C reactor was scrammed for the recalibration of Panellit gauges, adjustment of instruments, and work on the HCR and VSR rods and miscellaneous equipment. Operations were resumed at 11:15 P. M. and after maintaining a power level of 10 MW for several hours to check instrument calibrations and sensitivity, the power level was increased to 100 MW at 10:30 A. M. on November 19. A radiation survey of the building indicated that additional shielding was needed on the E, H and K test holes before power level could be raised. C pile was shut down from 3:50 P. M. to 4:02 P. M. and again from 4:45 P. M. to 5:00 P. M. on November 20 because of Panellit system difficulties. After fabricating and installing additional paraffin shielding over test holes E, H and K. the power level was raised to 250 MW at 2:00 P. M. on November 20. Operation at 250 MW revealed that neutron beams were originating from the T seams of the far side shielding on the X-1 and X-2 levels.

C pile was shut down from 12:44 A. M. to 12:59 A. M. and again from 2:37 A. M. to 2:45 A. M. on November 21 because of Panellit difficulties. The pile was scrammed again at 8:22 A. M. on a simulated power failure test which constituted part of the pumping plant acceptance tests. After pushing 8 tubes of temporary poison, operatinn was resumed at 4:15 P. M. At 5:05 A. M. on November 22 the power level was increased in 20 MW increments with a 15 minute wait between each increment until 400 MW was reached at 7:25 A. M. However, it was necessary to shut C pile down from 3:15 P. M. to 4:18 P. M. due to low CO_2 gas purity resulting when pressure was reduced on the B pile gas system. C pile was shut down from 9:00 A. M. to 9:27 A. M. on November 23 because of low voltage on the BPA system. The relay which caused the scram was discovered to be over sensitive and scheduled for replacement.

Power surges originating in the BPA system caused C pile to shut down from 2:56 P. M. to 3:17 P. M. on November 26 and again from 2:18 A. M. to 2:27 A. M. on November 27. After operating C pile at 500 MW from 9:05 A. M. on November 24, in order to obtain equilibrium temperature traverse data for evaluating the effect of the initial 5 kg enrichment, the power level was increased to 600 MW on November 28. This represents the maximum power level achieved at C pile during November, with a maximum daily production of 600 MWD established on November 29. C pile was shut down at 6:00 A. M. on December 1 in order to charge the remaining 5 kg of enrichment into 14 process tubes. During the shutdown additional shielding fabricated in the F area maintenance shops was installed on the T seams of X-1 and X-2 levels. A check of the inner rod room and the ball 3X valves in an effort to locate CO_2 leakage revealed no sizeable leaks. Operations were resumed at 8:45 P. M. on December 1 with a power level of 625 attained by 10:00 P. M.

It is planned to increase the power level at C pile at a rate of 30 MW every 3 days until an arbitary limit is reached which is based on a maximum 4-inch and 8-inch slug can-end (.175") temperature calculated to prevent localized boiling between slugs. It is estimated that this will occur at a maximum tube power generation of 600 kw/tube or a pile power level of 800 MW.

D PILE

With the exception of two short-duration scrams, D pile operated the entire month of November without incident at an average power level of 558 MW. A new maximum monthly production of 16,655 MWD was achieved at D pile in November.

D pile was shut down from 3:47 A. M. to 4:12 A. M. on November 23 because of a loose connection on Panellit gauge 1278. Difficulty was encountered in inserting the #4 horizontal control rod during the scram. An investigation revealed that the #4 horizontal control rod would not move in either direction with the shim pumps alone. Consequently, the #4 horizontal control rod was withdrawn from the unit on November 24 and preparations were started for repair of the control rod during the next available shutdown.

D pile was shut down from 2:59 P. M. to 3:15 P. M. on November 26 due to a power surge originating in the BPA system.

On November 20 four experimental water quality process tubes (2170, 2171, 2570, 3472) were purged at full pile power level in order to reduce the increased Panellit pressure on these tubes (PT-105-509-E).

DR PILE

A new maximum power level of 605 MW was established at DR pile on November 8, and a new maximum daily production of 605 MWD was achieved on November 9.

One ruptured slug caused the shutdown of DR pile during November as follows:

Tube No.	Shutdown	Started to Power
0768	8:44 A. M., 11/14	3:18 A. M., 11/15

After flushing out 23 downstream slugs in process tube 0768, the tube and the remaining slugs were pushed out of the pile. A new tube was installed, pressure tested, and charged with eight-inch slugs. Inasmuch as the ruptured slug in 0768 was both pitted and blistered, sections of the process tube were saved for detailed examination.

On November 11 a shutdown was initiated at DR pile to conduct the metal discharge for November. An inner tube was installed in process tube 2488 with special front and rear connections as part of the one-tube ink facility system and associated equipment was installed in the inner and outer rod rooms (PT-105-529-A). However, when the installation of the system was completed operational tests indicated that water could not be circulated through the system because of a restriction in the outlet drain line. Efforts are in progress to permit revision of the outlet piping system during the next shutdown.

During the discharge outage an attempt to remove process tube 3278 proved unsuccessful. The 20 foot section of tube lodged in the process channel could not be removed because the tube section was badly battered on the upstream end. Consequently, the tube was reestablished as an air channel with steel dummies, blank flange and neutron shielding on the front. In addition, the front section of process tubes 2451, 2457, 2462, 2489, 1167 was inspected for front tube corrosion.

During November a power level reduction of 10 MW resulted when the discharge pressure from the 190 pressure pumps was reduced from 435 psig to 425 psig to comply with the established maximum discharge pressure.

F PILE

F pile was shut down with only one ruptured slug during November, as follows:

Tube No.	Shutdown	Started to Power
1172	6:36 P. M., 11/6	7:11 P. M., 11/6

It was possible to discharge the metal column in process tube 1172 with the charging machine and resume operations within the scram recovery period. During the discharging operation, several downstream dummies were ejected by steam after the rear cap had been removed from the process tube. The ruptured slug in tube 1172 was not pitted, but several other downstream slugs in the process tube were badly pitted.

It was necessary to shut F pile down from 9:45 A. M. to 10:07 A. M. on November 4 to charge 15 cadmium-lead poison slugs into tube 3484 in order to alleviate a hot spot seriously restricting power level.

F pile was shut down at 5:15 A. M. on November 16 to initiate a scheduled thirty-day outage for the installation of the ball 3X system. While conducting the November metal discharge on November 16, the metal column in three process tubes (0584, 0685, and 0786) could not be discharged with a maximum force of 2,500 pounds. After oiling, maximum forces of 2,000, 3,500 and 6,000 pounds were required to discharge the metal columns in tubes 0786, 0685 and 0584, respectively. Several columns of excess temporary poison were charged into F pile for the duration of the extended outage.

An abnormal rate of water collection in both the front and rear drip legs on November 17 indicated a process tube water leak. After hydrostatically pressure testing a total of 219 process tubes and systematically isolating individual crossheaders from the water system, it was discovered that tube 3189 was leaking because the rear Van Stone flange had broken away from the remainder of the tube. It was possible to discharge tube 3189 with the charging machine, but efforts to push the tube resulted in the tube parting into two sections when a force of 5,000 pounds was applied. Inas-

much as the pile would not be in operation for several weeks, the hot water recirculation system was started at 9:30 P. M. on November 19 in an attempt to remove the moisture from the graphite during the shutdown. 65°C - 70°C hot water was recirculated through F pile until the exit gas dew point readings indicated that the majority of the moisture had been removed from the pile. After removing a total of 118 gallons of water the hot water recirculation system was shut down at 11:50 P. M. on November 21. Process tube 1993, which was previously suspected of leaking was pressure tested on November 21 and also found to be leaking. Tube 1993 was discharged and removed without difficulty.

At month's end a total of 82 process tubes in the lower far corner of F pile had been removed out of the 150 tubes scheduled for removal. It was possible to remove a maximum of 11 tubes/shift by splitting the tubes from rear to front with tube splitting equipment, pushing the process tubes out the rear of the pile, and cutting them into short 2 - 3' sections for examination and/or burial. A total of 66 new anodized 2S Al process tubes had been installed at month's end in the lower far corner, after broaching and cleaning the tube channels and reaming the front and rear gunbarrels.

After draining and flushing, the liquid borax 3X tanks were disconnected and removed from the top of F pile. The vertical safety rod guide cables and wenches were then disconnected. After removing the VSR limit switches and bumper assemblies, the vertical safety rods were removed in order to modify the tip and upper sections for use with the ball 3X system. Considerable difficulty was encountered in the removal of the vertical safety rod thimbles with the special thimble chute erected to carry the thimbles from the top of the unit directly into an outside burial pit. Some of the rollers would not turn, causing the paper wrapped thimble sections to stick while sliding down the chute. The thimble sections were finally disposed of down the chute by attaching them to a dolly. While removing those vertical safety rods upon which additional graphite thermocouples had been installed, some of the thermocouple wire remained in the VSR channels. The wire was tamped into the bottom of the thimble holes prior to inserting the lower "flower pots" connections. The slots in the graphite and masonite were then reamed for installation of the new VSR step plugs. At month's end work was in progress in filling cracks and seams greater than 1/4" in the VSR channels and cleaning the channels prior to installation of the ball 3X equipment.

The old downcomer was isolated from the water system after the water flow had been reduced to a 2,000 gallon per minute shutdown flow. The old downcomer was removed and buried and at month's end 3 of the 6 sections of the new downcomer had been completely installed at F pile.

00194

Exploratory holes drilled in the East retention basin after extensive cleaning measures indicated that there were few voids requiring grouting. At month's end, work was in progress in installing a new expansion joint at the foot of the sloping sides and replacing all existing expansion joints. Following this, a waterproofing compound containing iron fillings will be applied to the gunite sloping sides. The West basin is being cleaned in order to be ready for similar repairs at the conclusion of the East basin work early in December. During the retention basin repairs, the 2,000 gallon per minute shutdown flow through F pile is being pumped directly to the emergency earth crib.

Because of the difficulty in obtaining waterproof connectors from the vendor, work on replacing process tube thermocouples at F pile has temporarily been postponed. It is hoped that the connectors will arrive sufficiently early in December to permit the installation of the replacement thermocouples during the ball 3X outage at F pile.

During the ball 3X outage, the #6 HCR was withdrawn from F pile because of excessive binding and the control rod tip section was removed. Upon pressure testing, the #6 HCR thimble was found to be leaking and the thimble was removed and buried.

H PILE

A new maximum power level of 640 MW was established on November 30. This power level increase resulted from the charging of 10 kg of enriched uranium in the fringe zone of H on November 25, coupled with the establishment of a temporary maximum graphite temperature limit of 430°C until the helium system is ready for use. At that time the 430°C graphite temperature limit will be reduced to 410°C again and a small percentage of helium will be introduced into the CO_2 pile atmosphere.

Only one ruptured slug caused the shutdown of H pile during November, as follows:

Tube No.	Shutdown	Started to Power
0571	9:52 A. M., 11/15	9:32 A. M., 11/17

After discharging the metal column in process tube 0571 with a maximum force of 2,500 pounds the tube was recharged with 8-inch

slugs. However, the green metal was discharged again and the process tube was removed when the rear pigtail reading failed to decrease below 6 R. A new process tube was installed and recharged with 8-inch slugs.

During the 0571 outage, the aluminum dummies in cooling water recirculation tube 0961 (PT-105-506-E) were discharged and the special fittings disconnected. The tube was pushed four feet out the rear of the pile with forces up to 6,000 pounds and then stuck. The protruding 4-foot section was cut off at the rear and the remainder of the tube was removed by splitting it longitudinally. Sections of process tube 0961 were saved for further examination. Steel dummies, blank flange and neutron shielding were installed, and tube 0961 was temporarily established as an air channel. In addition, the solid aluminum dummies in process tube 0776 were discharged and a new inner tube charged with graphite samples was installed in tube 0776 (PT-105-504-E). During the outage the November metal discharge was conducted.

H pile was shut down from 9:08 P. M. to 9:18 P. M. on November 9 because of a faulty Panellit relay on Row No. 2. During the scram the A horizontal control rod would not go all the way into the pile. Also, a check of abnormally large CO_2 losses on November 10 (3,000 cubic feet per shift) revealed that the leakage was apparently originating from a hole in the A horizontal control rod thimble. Consequently, during the 0571 outage the A thimble was pressure tested and found to be leaking badly. The rod tip was also discovered to be out of alignment. A gas seal and paraffin-lead shielding were temporarily installed over the thimble opening.

H pile was shut down at 12 midnight on November 24 in order to charge the first group of enriched slugs (10 kg) for fringe zone enrichment. Twenty process tubes were charged with C metal and approximately 100 orifice and panellit gauge changes were made to accommodate the enriched fringe loading. During the scheduled outage a new process tube was installed in channel 0961 and the recirculating system was returned to operation with a charge of 32 8-inch slugs. An attempt to remove the C hole thimble proved unsuccessful because of the buildup of corrosion products between the step plug and the thimble. The gas seal and shielding were replaced and the thimble removal was postponed. In addition, it was discovered that two tool dolly cables had been damaged by movement of the discharge elevator, making the tool dolly inoperable.

Following startup, it was necessary to shut down H pile from 12:04 P. M. to 1:08 P. M. on November 26 in order to repair the near high tank check valve which failed to close after functional testing during the scheduled shutdown.

At month's end installation of the B pile Flexowriter automatic tube outlet temperature recording facility in the monitoring system at H pile was in progress in order to permit rapid temperature traverse maps to be used with the experimental fringe zone enrichment program.

RUPTURED SLUGS

Six incidents of inpile uranium slug failures occurred during November bringing the total number to date to 246. The attached table presents all the data available at month's end regarding these six ruptured slugs. It was possible to successfully discharge only one of these ruptured slugs with the charging machine and resume operations within the scram recovery period. Three Group 8 slugs were included in the November slug failures, bringing the total number to date to 84. In addition, the fifth Group 9 slug failure (8-inch slug) occurred during November in H pile.

PROCESS DEVELOPMENTS

It was first thought that the front tube barnacle growth at F pile might be caused by the lime which was added for pH adjustment after filtration. However, laboratory experiments do not bear out this theory. A check on barnacle growth in the front of process tubes at B pile where the lime is added with the ferric sulphate prior to filtration, has revealed that it is as serious as that observed in F pile. Laboratory experiments have indicated that barnacle growth is negligible with 2 ppm of sodium dichromate added to the water continuously. Intermittent additions of sodium dichromate, however, do not reduce the barnacle growth. In addition, impurities lodged on the internal surface of the process tube, such as bits of graphite, act as nuclei and result in excessive and rapid barnacle growth. A production test is being formulated in an attempt to investigate the possibility of removing the existing front tube barnacles by means of chromic or oxalic acid injections into one pile crossheader.

The danger coefficient measurements taken at C pile using 5-inch hollow receptacle slugs with the standard 1.35 inch uranium O. D. and a 5/8 inch I. D. showed a 5 inhour per column loss in a small wet pile, indicating a loss of the order of 4% ΔK in a fully loaded pile. Especially fabricated hollow slugs with a 1.39" O. D. in order to half the outer annulus flow and with a 9/16 inch I. D. annulus showed a loss of approximately 1 inhour per column in the small wet pile, or of the order of 1% ΔK in the large pile. This indicates that the reactivity limitations imposed by hollow slugs can be compensated for by enrichment should their mechanical properties be demonstrated to be superior.

The C pile horizontal control rod design consists of canned walls containing cadmium which are centered in a circular thimble through which cooling water flows. The outer water annulus was originally 1/8" but due to concern regarding the shadowing effect resulting from neutron back scattering the annulus was reduced to 1/16" in the present C pile rods. Consequently, a special tip section which had the 1/8" annulus and necessary fittings to obtain various wet and dry annulus configurations was fabricated for tests during C pile startup. The special tip was placed in the #5 HCR channel and both wet and dry annulus configurations were checked. The total effect of the outer 1/8" annulus appeared to decrease the strength of the control rod by only 3%.

Eleven central vertical safety rods, 11 horizontal control rods and 9 VSR channels filled with boron steel balls were each sufficient to hold the wet fully loaded C pile sub critical.

PRODUCTION TESTS

MR-4 - Experimental Caps With Short Inserts

During the 0387 outage at B pile, tests were conducted to determine the shielding effectiveness of the front face caps with short inserts with reduced cooling water flow. A 30 minute test was run on rows 9 and 10 and a one hour test was run on row 25 in which the rear caps were removed from tubes with short inserts and the cooling water flow was reduced to 20 inches of water. However, the upstream section of the process tube remained full of cooling water under these conditions and the shielding effectiveness of the short inserts proved adequate. With loss of cooling water in the front of a process tube, the short inserts would definitely be inadequate shielding.

509-E - Effect of Low pH Alum Water on Pile Operation

Purging of the 5 experimental tubes (2170, 3472, 2171, 3571 and 2570) at full pile power level has been authorized at D pile because a more rapid film buildup has been experienced with these tubes than with regular process tubes. The purging will be done whenever the film buildup in these tubes increases to the extent that the Panellit pressure approaches the upper trip limit. On November 20 a purge of these tubes at full pile power level was conducted and the Panellit pressures were reduced 5 to 15 psi. If the power level were reduced to the established limit of 350 MW before the purging of these tubes, considerable production losses would result.

529-A - Ink Facility

A one tube ink control facility was installed at DR pile during the November 12 discharge outage. The supplementary control facility consists of makeup equipment, recycle equipment, gas separating equipment, and the control element. The control element consists of two concentric tubes with one end of the larger tube sealed off. The potassium tetraborate solution flows through the inner tube to the sealed end and returns through the annulus formed by the two tubes. The entire element is inserted in process tube 2488 and cooled by the normal flow of process water. The solution enters and leaves through a special nozzle installed on the rear face. The process solution will be continuously recycled at 2 gpm through the control element by means of recycle equipment located in the inner rod room. Makeup equipment located in the outer rod room will be used to change the concentration of the solution by pumping either filtered water or 10% potassium tetraborate solution to the recycle system. The gas separator will provide a liberating surface for the entrained gases which are formed during irradiation. It is mounted on the rear face directly above the control tube. The gases will be bled to the building discharge ventilating duct for dilution.

After the ink facility system was completely installed it was found that water could not be recirculated because of a restriction in the outlet drain line. It is planned to correct this situation so that inpile recirculation of water can be initiated at the next shutdown at DR for checking the operational and mechanical aspects of the system before adding potassium tetraborate solution. The purpose of the test is to obtain data on the following:

1 - Gas generation rates, gas composition and their effect on recirculation.

2 - Radioactivity buildup in the control system, recycling equipment, and drainage effluent.

3 - Corrosion of the 2S aluminum control element.

4 - Total control strength of the test facility and its effect on pile reactivity and temperature distribution.

528-A - Alteration of Two C Pile HCR

At present the excess reactivity maintained during pile equilibrium operation for scram recovery is usually held in two long and two

short control rods for optimum control of the temperature distribution. Because the horizontal rods enter the near side of the pile the far side has a tendency to become more limiting unless counteracted by the flattening pattern. Consequently, the two rods most commonly used for long rods (#5 and #11) were modified at C pile so as to contain no cadmium poison cans in the near half of the control rod. A check will be made to see if the equilibrium horizontal temperature distribution can be balanced with the horizontal control rods alone with this system.

Enclosure:
1. Comparative Reactor Performance
2. Reactor Outages
3. Tabulation of Ruptured Slugs

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00200

COMPARATIVE REACTOR PERFORMANCE NOVEMBER, 1952

REACTOR	B	C	D	DR	F	H	TOTAL
Initial Startup	9-26-44	11-18-52	12-17-44	10-3-50	2-25-45	10-20-49	
Design Power Level (MW)	250	650	250	250	250	400	
Days Since Startup	2988	13	2906	789	2836	1138	
Maximum Power Level Attained to Date (MW)	600	600	600	605	575	640	3620
Maximum Power Level During Month (MWD)	590	600	570	605	550	630	
Average Operating Level (MW)[1]	496	400	558	559	519	597	536
Total Reactor Outage Hours	95.9	17.3	2.9	64.4	355.8	79.5	615.8
Time Operated Efficiency (%)[2]	86.7	94.2	99.6	91.1	50.6	89.0	84.2
MWD Produced - Plutonium	12,902	4,664	16,665	15,259	7,881	15,900	73,271*
MWD Discharged - Plutonium	9,743	0	0	21,066	6,512	23,457	60,778
MWD In Reactor	68,589	4,664	81,008	71,798	76,026	67,568	369,653
MWD In Reactor Basin							194,506
Tons Of Metal Charged	17.02	251.55	0	34.04	.25	37.39	340.25**
Tons Of Metal Discharged	16.94	.13	0	34.19	13.45	39.81	104.52
Tons Of Metal In Reactor							1,444.74
Tons Of Metal In Reactor Basin							327.78
Tons Of Metal In 103 Storage							121.04
Average Discharge Concentration (MWD/T)	575	0	0	616	484	589	582
Scheduled Shutdowns	0	0	0	1	1	1	
Carbon Dioxide Concentration (%)[3]	98.0	95.0	98.0	97.0	Reactor Down	98.0	
Highest Graphite Temperature Recorded (°C)	392	302	410	338	400	410	
Outlet Water Temperature (°C)[4]	68.6	43.2	66.1	60.9	69.1	62.1	
Inlet Water Temperature (°C)[4]	10.3	9.1	10.9	10.9	13.7	11.1	
Process Water Flow (gpm)[4]	38,110	65,175	38,920	42,716	37,535	46,056	
Maximum Effluent Water Activity (mrep/hr)	16.7	9.6	13.5	11.0	13.9	14.8	

* MWD accrued to Pu production, does not include 41 MWD attributed to U-235 burnout.

** Does not include 880 pieces of C metal.

00201

1) Average Operating Level = $\frac{\text{MWD Produced} \times 24}{\text{Hours Operated}}$

2) Time Operated Efficiency - $\frac{\text{Hours Operated}}{\text{Total Hours In Month}}$

3) Months End Data

4) Average of Last Five Days of Equilibrium Operation

[redacted] DECLASSIFIED

REACTOR OUTAGES - NOVEMBER, 1952

	B	C	D	DR	F	H	TOTAL
Scheduled							
Metal Discharge	0	0	2.3	23.7	0	14.4	40.4
Maintenance	17.6			7.6		1.5	26.7
Production Tests	1.3			11.5		38.1	50.9
Special Production				1.5		0.2	1.7
Flattening Adjustment					0.4		0.4
Ball 3X Installation					354.8		354.8
Unscheduled							
Ruptured Slug Removal	77.0			20.1	0.6	24.0	121.7
Panellit Scram		0.9	0.4			0.2	1.5
Power Surge		0.8	0.2				1.0
Maintenance		14.6				1.1	15.7
CO_2 Purge		1.0					1.0
Total Hours	95.9	17.3	2.9	64.4	355.8	79.5	615.8

[redacted] - NOVEMB

TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (KW)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstanc Shutdown and
241	0387-B	1) 2-27-51 2) 3-21-51 3) 11-3-52	593	171	3.6	512	540	38	58	1371	2.55	High exit water increase in Panel - Flushed out 26 slugs - couldn't column with 5000 Pushed out tube ing charge togeth
242	1172-F	1) 10-22-51 2) 12-5-51 3) 11-6-52	337	402	7.8	699	500			13	.03	High exit water Discharged with machine - resume within scram rec
243	0373-B	1) 2-1-51 2) 9-12-51 3) 11-10-52	425	116	0.9	588	570	60	53	1272	2.25	Increase in Panel and exit water t Flushed out 4 do slugs - couldn't metal column - p tube and remainin together
244	0768-DR	1) 2-27-52 2) 4-25-52 3) 11-14-52	203	322	6.5	487	370	41	55	264	.71	High exit water Flushed out 23 slugs - pushed and remaining c
245	0571-H	1) 4-5-52 2) 5-12-52 3) 11-15-52	187	327	12.5	397	625			753	1.2	High exit water Force of 2500 l to discharge me

[redacted]

[redacted] - NOVEMBER, 1952

TABULATION OF RUPTURED URANIUM SLUGS

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
38	58	1371	2.55	High exit water activity and increase in Panellit pressure - Flushed out 26 downstream slugs - couldn't move metal column with 5000 lbs. - Pushed out tube and remaining charge together.	Uranium split failure	MRH 2-27-51 Truck 1 & Group 7	
		13	.03	High exit water activity - Discharged with charging machine - resumed operations within scram recovery period.	End cap failure	MRB 10-22-51 Truck 7 & Group 8	
60	53	1272	2.25	Increase in Panellit pressure and exit water temperature - Flushed out 4 downstream slugs - couldn't loosen metal column - pushed out tube and remaining charge together	Uranium split failure	MRH 2-1-51 Truck 2 & Group 7	
41	55	264	.71	High exit water activity - Flushed out 23 downstream slugs - pushed out tube and remaining charge	Slug separated into several pieces.	ZRG 2-27-52 Truck 10 & Group 8	
		753	1.2	High exit water activity- Force of 2500 lbs. required to discharge metal column.	Can sidewall failure.	MRH 4-5-52 Truck 2 & Group 9	

[redacted]

[redacted]

TABULATION OF RUPTURED URANIUM SLUGS.

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (Kw)	Concentration (MWD/T)	Nominal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (kWD)	Assigned Operating Production Loss (Days)	Circumstance Shutdown and
246	4488-B	1) 2-18-52 2) 3-2-52 3) 11-20-52	263	153	1.7	229	570	9	15	923	1.6	High Panellit pre alarm - Flushed stream dummies b slugs - removed barrel - pushed and entire metal with maximum for 7500 lbs.

[redacted]

[redacted]

TABULATION OF RUPTURED URANIUM SLUGS

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	Reference
9	15	923	1.6	High Panellit pressure alarm - Flushed out downstream dummies but no slugs - removed rear gunbarrel - pushed out tube and entire metal column with maximum force of 7500 lbs.	Compound cap failure	MRG 2-18-52 Truck 5 & Group 8	

[redacted]

STANDARD FORM NO. 64

Office Memorandum

UNITED STATES GOVERNMENT

TO : Files, Operations Division (THRU)
C. L. Robinson and Donald G. Sturges

DATE: January 2, 1953

FROM : K. F. Paulovich

SUBJECT: 100 AREAS MONTHLY REPORT - DECEMBER 1952

SYMBOL: OP:KFP

PILE OPERATION

General

The maximum operating level attained during the month of December 1952 for each of the piles, and the corresponding equivalent percentage of the power level index, are as follows:

	B	C	D	DR	F	H
MWD	590	734	590	600	419	672
Percentage	295	367	295	300	210	336

C and H piles established individual new maximum operating levels during December, and B, C and H piles established new individual production records for the month. December 31 marked the occurrence of a new maximum of 3526 MWD for simultaneous 6-pile total production, and a new maximum of 3580 MW for simultaneous 6-pile combined power level. With the occurrence of only 3 ruptured slugs, a new maximum total production of 87,040 MWD (111.9% of forecast) was attained in December, with F pile down almost the entire month for the installation of the ball 3X system. This total production includes 359 MWD attributable to enriched U-235 burnout at C and H piles. A new per diem maximum plutonium production of 2796 MWD/day was established during December.

At month's end the following percentage of metal in each of the piles consisted of eight-inch slugs (PT-105-313-2M):

	B	C	D	DR	F	H
Percent	42	43	49	83	46	73

On December 3 the 3-second time-delay relay in the Panellit system at C and H piles was reduced to 1 second because of operation of these reactors above a power level of 650 MW. The 3-second time-

2105

delay relay had been established to prevent the slug jackets from melting with a stoppage of cooling water flow in the process tube in which heat is being generated at a maximum rate at a pile power level of 600 MW. On December 23 the 1-second Panellit time-delay relay was reduced to zero at C and H piles in the interest of increasing the degree of protection afforded by the Panellit system. On December 26 the 3-second time-delay relay at B, D, DR and F piles was also eliminated from the Panellit system. The time delay is only normally zero inasmuch as there is inherent in the instrumentation a fraction of a second lag. As a result of removing the time delay feature in the Panellit system, nine Panellit scrams were experienced at B, C and H piles in December due to fluctuating Panellit pressures.

After seven 8-inch slugs were ejected from process tube 2484 at B pile as a result of steam generation caused by insufficient cooling water immediately after shutdown, it was decided on December 26 not to attempt to remove any more ruptured slugs in time to resume operations within the scram recovery period. In the future a minimum down time will be taken to remove all ruptured slugs, and cooling water will not be reduced on the suspected tube until it has sufficient time to cool adequately. With the reduced frequency of ruptures experienced during the last two months, this precautionary measure should not result in appreciable production losses.

Investigations are being initiated to determine exactly when and to what extent the cooling water can be reduced on a process tube, and to study methods of remotely removing the rear cap of a process tube while maintaining an increased cooling water flow.

During the latter part of December, the bulk storage of liquid carbon dioxide under high pressure was begun at all pile areas to replace the gaseous CO_2 cylinder storage system. By the end of December the installation of earthquake detection equipment was completed at F pile, essentially completed at H pile, and in progress at B, D and DR piles.

B PILE

A new maximum monthly production of 15,718 MWD was achieved at B pile in December.

During the month of December, B pile was shut down for the following two ruptured slugs.

Tube No.	Shutdown	Started to Power
0272	10:53 P. M., 12/8	11:23 P. M., 12/8
4190	9:00 A. M., 12/22	6:55 P. M., 12/24

206

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It was possible to immediately discharge process tube 0272 with the charging machine and resume operations within the scram recovery period.

B pile was shut down from 11:02 A. M. to 11:07 A. M. on December 10 due to the malfunction of the #3 Beckman circuit when the #3 Beckman was removed from bypass following instrument standardization. B pile was shut down from 10:42 P. M. to 10:47 P. M. on December 17 because of a faulty jumper connection while repairing a Panellit gauge on row #46.

B pile was shut down from 1:24 A. M. to 1:29 A. M. on December 19 because of a power surge on the #1 Beckman. A survey of the entire Panellit board revealed that one tube (4190) was experiencing an unusual pressure increase. Continuous monitoring of the Panellit pressure and outlet temperature of tube 4190 during the subsequent few days indicated that the pressure of 4190 was gradually increasing without an increase in temperature. B pile was finally shut down at 9:00 A. M. on December 22 because of the rapid increase in Panellit pressure on tube 4190. It was decided to discharge tube 2484 along with tube 4190 in order to charge temporary poison in an effort to change the flattening pattern. Following the withdrawl of personnel from the rear face and prior to attempting the discharge of tube 4190, the Brown temperature monitor indicated an increase in exit temperature on tube 2484, which had been valved down to a cooling water flow of 70 inches along with tube 4190. The valve on cross-header on 23 1/2 was cracked open gradually but the resulting steam formation ejected a total of seven 8-inch slugs from the rear of tube 2484. Four of the slugs lodged on the 10' catwalk, one dropped into the discharge chutes, one landed on thefar side discharge elevator apron, and one was subsequently discovered lodged in a rear pigtail.

A wooden plow fastened to a wooden hinged extension handle was fabricated and the 4 slugs were remotely pushed from the 10' catwalk. A shovel and 35' of guide pipe sections were fabricated and the slug on the far side elevator apron was pushed into the discharge chutes by remotely guiding the pipe and shovel with a rope from the 30' far lead room. Considerable difficulty was experienced in locating the last missing slug. Radiation surveys made with a probe hung from the 30' lead room by means of a cable and with a probe attached to the discharge elevator indicated that the approximate location of the missing slug was below row 10. The slug was finally observed lodged between the rear pigtails of tubes 0384 and 0383 by scanning with the fly's eye periscope. The slug was removed by means of a long pole with a hook on the end remotely maneuvered from the 10' catwalk.

After flushing out twenty 4-inch downstream slugs from process tube 4190, it was impossible to move the remainder of the metal column with a maximum force of 8000 pounds. The process tube containing the remaining 44 slugs was pushed from the pile and a new process tube was installed.

At month's end extensive preparations were in progress at B pile for the installation of the ball 3X system during the outage scheduled to begin on January 5. The South 107 retention basin had been pumped dry and cleaned to permit retention basin repairs during the ball 3X outage. The pump sump installation in the South basin was completed on December 12.

C PILE

A new maximum power level of 740 MW was established at C pile on December 9 and a new maximum daily production of 734 MWD was achieved on December 26. A new maximum monthly production of 19,686 MWD was achieved at C pile in December.

During a scheduled outage initiated on December 1 the remaining 5 kg of enrichment were charged into 14 process tubes. During the shutdown, additional shielding which was fabricated in the F area maintenance shops was installed on the T seams of X-1 and X-2 levels. A check of the inner rod room and the ball 3X valves in an effort to locate CO_2 leakage revealed no sizeable leaks.

C pile was shut down from 12:50 P. M. to 1:03 P. M. on December 3 because of a low pressure trip on Panellit gauge 0374. When the Panellit pressure continued to drop, the pile was shut down from 2:33 P. M. to 2:57 P. M. in order to install a new .240 orifice. Following startup, however, the Panellit pressure continued to be abnormally low.

C pile was shut down at 10:14 A. M. on December 15 due to the malfunction of a relay in the 151 substation. The power failure was corrected immediately but the 3X balls dropped into the #26 VSR channel when the #26 VSR did not drop completely into the unit within the 4.5 second time-delay relay period. C pile could not resume operations within the scram recovery period because of considerable difficulties encountered in removing the 3X balls from the #26 VSR channel and returning them to the hopper. During the outage the drop time for the #26 VSR was checked 3 times and found to average 3.5 seconds. The time-delay relay in the Panellit system, which had been reduced from 3 seconds to 1 second on December 10 because of pile operation above 650 MW, was checked and the time delay period was found to be 0.6 seconds. In addition, a series of flow and pressure tests were conducted on the process water system at 300, 400, 500 psi and full flow pressures. It was

the purpose of these tests to obtain actual flow-pressure operating data. Operation of eight 190 pumps at full flow resulted in a maximum pressure of 490 psi, and operation of nine 190 pumps at full flow resulting in a maximum pressure of 537 psi.

A total of 27 front face caps and process tubes on row 25 were inspected for corrosion. No front tube corrosion was evident and the ribs appeared in excellent condition. No corrosion buildup was noted on the front face shielding inserts. In addition, it was discovered that 3 small pieces of metal were restricting the outlet from the front crossheader to the pigtail on tube 0374. After removal of the restricting pieces, the Panellit pressure on tube 0374 returned to normal. After buffing and lubricating #26 VSR, C pile resumed operations at 4:35 A. M. on December 16.

C pile was shut down from 5:51 A. M. to 6:00 A. M. on December 17 due to an unexplained power surge which tripped the #2 Beckman circuit. The regulated voltage increased to 60.34 cps, followed by a momentary return to normal, and then dropped to 59.64 cps.

During the early part of December the power level at C pile was increased at a rate of 30 MW every 3 days. It was planned to increase the power level until a maximum tube power generation of approximately 600 kw per tube, established in order to prevent localized boiling between slugs, was reached. However, on December 19 it was arbitrarily decided to limit the power level at C pile to a maximum tube power generation of 525 kw per tube until initial discharges have been made at C pile and sufficient irradiated slugs inspected to warrant another 75 kw per tube increase.

C pile was shut down from 3:47 A. M. to 9:35 P. M. on December 20 when a bushing on the 13.8 kv ground transformer at the 151 substation shorted out. A critical Y power condition existed from 3:54 A. M. to 7:25 P. M. During the outage all ball 3X valves were exercised and lubricated and several process tubes were leak tested in an attempt to locate possible water leakage indicated earlier in the month. It was subsequently discovered that the water leak indications were due to air leakage into the sampling lines through the quick disconnects.

C pile was shut down from 3:33 A. M. to 4:41 A. M. on December 21 when an adjacent gauge was shorted out while Panellit gauge 0382 was being repaired. During the scram the #24 VSR failed to go into the unit more than 2 feet when the gas seal boot seized the rod. Consequently, the 3X balls dropped into the #24 VSR channel when activated by the slack cable trip. The 3X balls were retrieved without difficulty.

[redacted]

On December 23 the one-second time-delay relay in the Panellit system was reduced to nominally zero in order to increase the protection afforded by the Panellit system. A check revealed that the actual time lag in the Panellit scram circuity was approximately 1/12 of a second.

C pile was shut down from 1:49 P. M. to 2:53 P. M. on December 23 due to a power surge originating in the BPA system. The 3X balls again dropped from the #24 hopper. One hour was required to retrieve all the balls from the VSR channel. On December 24 it was decided to bypass the faulty relay contacts on the #24 and #26 vertical safety rods so that the 3X balls would not drop under normal scram conditions. Only extremely low water pressure and the earthquake detector will release the balls from these two hoppers until the difficulty is remedied. This leaves 37 hoppers for use in the ball 3X system at C pile at present, which is approximately 3 times the number of channels required to maintain the pile subcritical while wet.

D PILE

One ruptured slug caused the shut down of D pile during December as follows:

Tube No.	Shutdown	Started to Power
3156	11:36 P. M., 12/12	12:08 A. M., 12/13

It was possible to immediately discharge the ruptured slug from process tube 3156 with the charging machine and resume operations within the scram recovery period.

During the outage initiated on December 3 to conduct the December metal discharge, special valved rear pigtails were installed on process tubes 1382, 1383, and 1384, in order to check slug temperature rises following the stoppage of cooling water flow subsequent to pile shutdown (PT-105-411-P). After considerable difficulty the tip section of the #4 HCR was removed and a new rod tip was installed. After repairing a water leak at the junction of the control rod and rod rack, and satisfactorily pressure testing the thimble, the #4 HCR was returned to operation with no subsequent binding experienced.

In addition, the #6 HCR was removed from the pile and a pressure test of the control rod indicated a small water leak at the tip end of the rod. Pressure test of the thimble indicated that the thimble was leaking also. Both the thimble and graphite track showed considerable evidence of corrosion product buildup. Approximately 17 feet of graphite track were removed before the hole was blanked off and shielded

with lead, masonite, and paraffin. It is planned to replace the #6 HCR thimble during the next available outage.

Process tubes 2161 and 2182 were removed and after broaching the channels, graphite thermocouple stringers were installed under PT-105-514-A. In addition, a similar graphite thermocouple stringer was installed in C test hole for correlating graphite temperatures measured with both Cr-Al and Fe-Co thermocouples along all three axis of the reactor.

During the latter part of the month the rod tip section of the #6 HCR was disconnected from the rod rack and removed. On December 13 new delta temperature limits for the inpile water quality process tubes (PT-105-509-E) were made effective. Binding was experienced with both the #7 HCR and #9 HCR during the month.

DR PILE

With the exception of the scheduled metal discharge outage initiated on December 7, DR pile operated the entire month of December without incident, at an average power level of 572 MW.

During the discharge outage process tubes 2663 and 2687 were removed from the pile employing maximum forces of 3500 pounds. New process tubes were installed, pressure tested, and charged with metal. An attempt to remove the process tube in 3276 proved unsuccessful because the tube was badly battered. Tube 3276 was reestablished as an air tube.

While installing a new drain line for the ink facility system (PT-105-529-A) a minor explosion occurred at 10:30 A. M. on December 8 while drilling a 1/4" hole into the rear face gas separator. Apparently the explosion was due to a small amount of hydrogen remaining in the tank, which ignited because of a drilling spark. The 6-inch X 6-foot separator tank was not ruptured but the ends were bulged slightly. The new drain line installation was completed and leak tested satisfactorily, and the ink facility system was placed into operation recirculating filtered water. The ink facility operated satisfactorily for the entire month of December and it is planned to begin the recirculation of the potassium tetraborate solution early in January.

F PILE

At the beginning of December three of the six section of the new downcomer had been installed at F pile, approximately 40% of the repairs to the East retention basin had been completed, a total of 82 process tubes had been removed from the lower far corner, and work was in progress locating and filling cracks greater than 1/4 inch in the VSR channels.

The last section of the new downcomer was installed on December 3. After completing the tie-in of the downcomer inlet line, the water system was returned to normal on December 22 and full flow was established at on the new downcomer in order to conduct acceptance tests. On December 23 the water pressure was increased from 75 psi to 400 psi in 3 minutes and then decreased from 400 psi to 75 psi in 3 minutes with no significant effects observed in the new downcomer. It was possible to raise or lower the process water pressure as fast as possible without water backup in the downcomer.

By December 13 a total of 150 process tubes in the lower far corner of F pile had been replaced. This included all those originally scheduled except three (0983, 0887, and 0891), from which battered segments of process tubes could not be removed. Subsequently, on December 22 it was possible to remove the tube section in channel 0988 with considerable difficulty and a new process tube was installed.

Tubes 0887 and 0891 were blanked off and established as air tubes. All new tubes installed in the lower far corner were successfully subjected to a hydrostatic pressure test prior to startup.

During the early part of December considerable difficulty was experienced with the filling of seams in the VSR channels with a graphite-sodium silicate compound. Reboroscoping of the VSR channels after filling of the seams indicated that the filling compound had worked its way out of the seams in some channels, despite the fact that the filled seams had been heated to 200°F with the heaters lowered into the channels. Consequently, it was decided on December 13 to continue with the ball 3X installation without refilling approximately 13 known cracks. Bushings were placed in the thermal shield and VSR step plug holes. Doweled holes were drilled and utilized for locating and installing the new VSR step plugs and ball 3X hoppers. The ball recovery system, consisting of an air pump, shielded hopper, cyclone filter, and associated cooling water piping, air lines, and electrical system, was installed on top of the pile. The VSR sphincter seal water and gas piping was connected, and the VSR bumper assemblies, limit switches and associated electrical system were installed. By December 18 all of the vertical safety rods and guide cables were installed and the acceptance test program, consisting of the test operation of hopper gates, vertical safety rods, ball 3X time-delay relays, and 3X ball recovery system, was begun. By December 25 all acceptance tests had been successfully conducted and the installation of the ball 3X system was complete with the exception of locating and reducing CO_2 gas leakage.

The retention basin repairs were completed by December 17 and accepted on December 22. Subsequent flow tests indicated that the leakage in the repaired West basin was negligible.

On December 15 a metal discharge was conducted. Seven process tubes (1073, 1266, 1284, 2662, 3466, 3484, and 3773) were removed and graphite thermocouple stringers were installed in the process tube channels to replace the VSR thimble graphite thermocouples which were removed during the ball 3X installation. CO_2 gas pressure was established on the pile on December 19 and an 8-hour leak test conducted on December 20 at a pressure of 2 1/2 inches indicated that the gas leakage was between 600 and 700 cubic feet per hour. Each ball 3X hopper was leak tested and all front and rear face bellows were checked. After repairing all detectable leaks, two additional 8-hour gas leakage tests conducted on December 21 indicated a gas leakage of approximately 400 cubic feet per hour. On December 21 the gas pressure was removed from the pile in order to permit the withdrawal of the vertical safety rods in order to make the VSR tips gas tight.

Gas pressure was restored to the pile on December 25, after replacing a leaking sphincter seal on #19 VSR. A complete check of the front and rear faces of the pile, of the inner rod room, of the X levels, of the top of the pile, and of the 115 building gas system and valving, indicated no unusual large sources of gas leakage. A gas loss test conducted at 2 1/2 inches on December 25 indicated a loss of approximately 350 cubic feet per hour. On December 26 the final test of dropping and retrieving balls in one VSR channel (#36) was conducted. It was discovered that the vacuum hose lacked a few inches of reaching the bottom of the channel. Consequently, it was necessary to remove approximately 15 balls from the bottom of the channel with a magnatic fixture. A borescoping of all seams in VSR #36 indicated that no balls were lodged in the cracks.

Because of difficulty in obtaining waterproof connects from the vendor, the replacement of the rear face process tube thermocouples (other than 120 associated with the new process tubes installed in the lower far corner) was not accomplished at F pile during the 3X outage. However, all front face crossheater screens were replaced and the earthquake detector system was installed during the extended shutdown. In addition, the #6 HCR thimble was replaced and the horizontal control rod was returned to service.

On December 27 the excess temporary poison was discharged with a CO_2 gas leakage of approximately 200 cubic feet per hour, F pile resumed operations at 5:10 P. M. on December 27. The pile was shut down from 5:14 to 5:40 P. M. because of an improper trip setting on the #4 Beckman during startup. F pile was shut down again at 6:17 P. M. because of low Panellit pressure on gauge 0380. When withdrawing the vertical safety rods after this scram, the #28 VSR stuck in a position approximately 3 feet out of the reactor. The winch would not raise the VSR and it was necessary to force the rod

from the pile. Upon removal it was noted that scoring marks approximately 1/8 inch wide existed on the rod starting about 3 feet from the bumper ring for a total length of about 6 feet. Consequently, the #28 VSR was tied out of service. A series of drop tests was conducted on the remaining vertical safety rods. All vertical safety rods were satisfactorily run in and out of the pile under power 5 times and scrammed 3 times. After investigating and repairing faulty electrical circuity between the Panellit and safety systems, F pile was started to power at 6:25 A. M. on December 28.

The pile was shut down from 11:13 A. M. to 8:38 P. M. on December 28 to conduct additional VSR tests. All vertical safety rods were again run in and out under power 5 times and scrammed 3 times. The rods were pulled out of the unit and individually inspected closely. It was found that each rod was scored and scratched badly almost the entire length of the rod from 8 feet below the bumper ring to that part of the rod at the top of the hopper. The scratches were approximately 1/64 inch deep, and caused by misalignment of the step plugs. During this outage, four process tubes of temporary poison were discharged and work on the Panellit system was conducted.

F pile was shut down again at 5:40 A. M. on December 29 to charge temporary poison columns and to locate excessive gas leakage. A high reading on top of the unit indicated that the #37 VSR sphincter seal might be leaking. The #37 VSR seal was removed and found in excellent condition. However, it was observed that the step plug was badly scored on both sides. A new seal was installed and the #37 VSR was returned to service. Two process tubes (0984, 3884) were charged with temporary poison and F pile was started to power at 4:29 P. M. on December 29. A CO_2 leakage test conducted shortly after startup indicated the consumption rate was approximately 150 cubic feet per hour.

F pile was shut down from 2:54 A. M. to 7:04 A. M. on December 30 to discharge the poison columns in process tubes 0984 and 3884. During the outage a check of the top of the pile indicated gas leakage between the #14 and #20 VSR.

H PILE

A new maximum power level of 675 MW was established at H pile on December 8, and a new maximum daily production of 672 MWD was achieved on December 9. A new maximum monthly production of 17,895 MWD was achieved at H pile in December.

H pile was shut down from 6:43 A. M. to 7:03 A. M. on December 13 because of a faulty Panellit gauge (0383). On December 21 a scheduled outage was initiated to conduct the metal discharge for December and to charge 15 additional tubes with enriched C slugs, making a total of 35 tubes charged to date. During this outage the C test hole thimble was removed from the pile with considerable difficulty and after probing, vacuuming and traversing the test hole channel, a graphite thermocouple stringer was installed in order to monitor the temperature of the reflector and shielding during the fringe enrichment program. Process tubes 0562 and 0579 were removed from the pile in order to obtain graphite mining samples under PT-105-512-E.

The time-delay relay in the Panellit system, which had been reduced from 3 seconds to 1 second on December 3, was again reduced to zero during the discharge outage. An inspection of the upstream portion of 28 process tubes indicated that the tubes were in relatively good condition with small amounts of corrosion present. During the outage approximately 250 process tube orifices were enlarged and the corresponding Panellit gauges were changed and recalibrated in order to accomodate the additional 10 kg of enrichment charged. The tip sections of "A" HCR was removed and buried during the shutdown, but the replacement of the leaking thimble was postponed to the next available shutdown. Operations were resumed at 10:04 P. M. on December 23. The pile was scrammed from 11:16 P. M. to 11:30 P. M. on December 23 due to a faulty Panellit gauge (1652).

H pile was shut down from 3:12 A. M. to 3:51 A. M. and from 11:21 P. M. to 11:31 P. M. on December 25 and again from 10:26 A. M. to 10:45 A. M. on December 27 because of widely fluctuating pressures on Panellit gauges 4256, 3096, and 4563, respectively. These Panellit scrams were a direct result of eliminating the time delay feature from the Panellit system in order to increase the protection afforded by the system.

During December the three-stage compressor and several leaking valves in the helium system were repaired and a carload of helium was unloaded, so that at month's end helium could be added to the CO_2 atmosphere manually. It is planned to manually adjust the helium added to the pile atmosphere until sufficient operating data has been obtained in order to utilize automatic proportioning equipment in the gas system.

On December 17 the installation of the Flexowriter automatic tube outlet temperature recording facility in the monitoring system at H pile was completed to permit rapid temperature traverse maps with the experimental fringe zone enrichment.

RUPTURED SLUGS

Only 3 instances of inpile uranium slug failures occurred during December, bringing the total number to date to 249. The attached table presents all the data available at month's end regarding these 3 ruptured slugs. It was possible to successfully discharge 2 of these ruptured slugs with the charging machine and resume operations within the scram recovery period. All 3 December slug failures were group 8 slugs, bringing the total number to date to 87.

PRODUCTION TESTS

514-A - Thermocouples In Process Channels

During the December 3 discharge outage process tubes 2161 and 2182 were removed from D pile and graphite thermocouple stringers were installed in the broached process channels. It is planned to obtain the following data with this installation:

a - Temperature limits for permanent channel thermocouples.

b - Effect of thermocouple wire size and composition on temperature readings.

c - Relative front to rear graphite temperature and lattice conductance distribution.

d - Correlation of lattice continuance data with HCR configuration.

e - Intersecting graphite temperature distributions along 3 piles axes (process tube, C test hole, and VSR thimble thermocouples).

Each tube contains both chromel-alumel and iron-constantan thermocouples in both 26 and 30 wire gage sizes.

Preliminary results indicate that wire gage size has negligible effect on the thermocouple temperature readings. However, the iron-constantan thermocouples read as much as 10% higher than similarly located chromel-alumel thermocouples. This phenomenon has also been in evidence at C pile where both types of graphite monitoring thermocouples were installed. The graphite temperatures indicated by the channel stringers are 50°C higher than adjacent C test hole and VSR thermocouple readings. It is

planned to utilize data from this installation for correlating graphite temperatures indicated by permanent channel thermocouples with the present burnout temperature limit of 410°C.

529-A - Ink Facility

During the discharge outage conducted at DR pile on December 7, a new drain line was installed on the ink facility system previously inserted in process tube 2488. A minor explosion occurred while drilling a hole into the rear face gas separator, but the separator tank was not ruptured and it was possible to complete the installation of the drain line. The explosion occurred when a small amount of oxygen remained in the tank and ignited because of a drilling spark. The ink facility was placed into operation with the inpile recirculation of filtered water for checking the operational and mechanical aspects of the system. The ink facility operated satisfactorily for the remainder of December and it is planned to begin the recirculation of the potassium tetraborate solution early in January.

516-E - Corrosion Product Removal From Process Tubes

On December 23 during the extended ball 3X outage at F pile, process tubes 0572, 0573, 0574, and 0575 were isolated from the cooling water system and an attempt was made to flush the tubes with a 5% chromic acid solution in order to remove the barnacles located in the front sections of F pile process tubes. This first attempt was unsuccessful because of corrosion attack on the mild steel mixing tank while heating the acid solution. However, on December 24 these four tubes were successfully purged with a 5% chromic acid solution for 30 minutes at a flow rate of 2 gpm. The acid solution was at a temperature of 60°C and a pH of 0.3. The barnacle growth in the front of the process tubes was visually inspected before and after the acid flush. Removal of the barnacles appeared to be very successful on the second attempt except for a narrow ribbon on the top of two process tubes, indicating that these two tubes were probably not flowing full of acid solution. The metal columns on these four process tubes were then discharged and inspected and appeared to be in no worse condition than other slugs discharged from F pile.

Enclosure: 1. Comparative Reactor Performance
2. Reactor Outages
3. Tabulation of Ruptured Slugs

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COMPARATIVE REACTOR PERFORMANCE DECEMBER, 1952

REACTOR	B	C	D	DR	F	H	TOTAL
Initial Startup	9-26-44	11-18-52	12-17-44	10-3-50	2-25-45	10-20-49	
Design Power Level (MW)	250	650	250	250	250	400	
Days Since Startup	3019	44	2937	820	2867	1169	
Maximum Power Level Attained to Date (MW)	600	740	600	605	575	675	3795
Maximum Power Level During Month (MWD)	590	734	590	600	419	672	
Average Operating Level (MW)[1]	553	686	561	572	342	624	556
Total Reactor Outage Hours	52.4	54.3	50.3	52.5	678.1	55.4	943.1
Time Operated Efficiency (%)[2]	91.5	92.7	91.9	92.9	5.9	92.5	71.4
MWD Produced - Plutonium	15,718	19,686	15,982	16,478	922	17,395	86,681*
MWD Discharged - Plutonium	1,070	38	14,743	22,233	16,425	19,617	74,116
MWD In Reactor	83,237	24,312	82,247	66,053	60,523	65,846	382,218
MWD In Reactor Basin							190,339
Tons Of Metal Charged	1.89	.93	23.27	35.93	49.37	29.97	141.36**
Tons Of Metal Discharged	2.13	1.78	24.20	35.53	26.07	33.15	122.86
Tons Of Metal In Reactor							1463.24
Tons Of Metal In Reactor Basin							320.58
Tons Of Metal In 103 Storage							90.79
Average Discharge Concentration (MWD/T)	502	21	609	626	630	592	603
Scheduled Shutdowns	0	1	1	1	0	1	
Carbon Dioxide Concentration (%)[3]	94.0	94.0	97.2	97.6	90.5	96.2	
Highest Graphite Temperature Recorded (°C)	405	360	398	337	354	438	
Outlet Water Temperature (°C)[4]	63.7	48.7	65.4	612	--	56.9	
Inlet Water Temperature (°C)[4]	7.4	6.3	8.2	8.2	--	8.1	
Process Water Flow (gpm)[4]	37,840	64,878	38,672	42,708	--	47,346	
Maximum Effluent Water Activity (mrep/hr)	14.3	8.1	14.9	11.5	13.0	14.6	

* MWD accrued to Pu production, does not include 359 MWD attributed to U-235 burnout

** Does not include 730 slugs of C metal.

1) Average Operating Level = $\frac{\text{MWD Produced} \times 24}{\text{Hours Operated}}$

2) Time Operated Efficiency - $\frac{\text{Hours Operated}}{\text{Total Hours In Month}}$

3) Months End Data

4) Average of Last Five Days of Equilibrium Operation

[redacted]

REACTOR OUTAGES - DECEMBER, 1952

	B	C	D	DR	F	H	TOTAL
SCHEDULED							
Metal Discharge	[illegible]	2.0	29.5	26.9		19.5	30.9
[illegible]		12.	2.3	[illegible]		[illegible]	30.1
Production Tests			[illegible]	1[illegible].7		2[illegible].1	[illegible]
Special Production				2.0		0.2	2.2
Ball 3X Installation					678.1		678.1
UNSCHEDULED							
Ruptured Slug Removal	2[illegible].5		0.5				26.0
Panellit Scrams	0.1	1.8				1.6	3.5
Beckman Scrams	0.1						0.1
Electrical Power Failure	0.1	37.7					37.8
Irradiated Metal In Discharge Area	33.6						33.6
TOTAL HOURS	62.4	54.3	60.3	52.6	678.1	55.4	963.1

[redacted]

[redacted]

TABULATION OF RUPTURED URANIUM SLUGS

No.	Tube	Date 1) Canned 2) Charged 3) Ruptured	Days in Pile	Tube Power (KW)	Slug Power (Kw)	Concentration (MD/T)	Normal Pile Power Level	Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstanc Shutdown and
247	0272-B	1) 2-7-52 2) 3-2-52 3) 12-8-52	281	209	4.6	318	585			106	.18	High exit water Discharged with machine. Resumed within scram rec
248	3156-D	1) 2-16-52 2) 3-18-52 3) 12-12-52	269	269		502	580			111	.19	High exit water Discharged with machine. Resumed within scram rec
249	4190-B	1) 12-17-51 2) 10-29-52 3) 12-22-52	54	203	3.6	80	560	18	18	786	1.40	Abnormal increas pressure. Flushe downstream slugs loosen remainder column with maxi of 8000 lbs. Pu process tube and 44 slugs.

[redacted]

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TABULATION OF RUPTURED URANIUM SLUGS

Position in Tube From Front	Local Water Temp. (°C)	Assigned Operating Production Loss (MWD)	Assigned Operating Production Loss (Days)	Circumstances of Shutdown and Removal	Observations of Slug	End Cap Data	References
		106	.18	High exit water activity. Discharged with charging machine. Resumed operations within scram recovery period.	Compound cap failure	ZRH 2-7-52 Truck 3 & Group 8	
		111	.19	High exit water activity. Discharged with charging machine. Resumed operations within scram recovery period.	End cap failure	ZRG 2-16-52 Truck 2 & Group 8	
18	18	786	1.40	Abnormal increase in Panellit pressure. Flushed out 20 downstream slugs. Couldn't loosen remainder of metal column with maximum force of 8000 lbs. Pushed out process tube and remaining 44 slugs.	Compound cap failure	MRG 12-17-51 Truck 1 & Group 8	

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7/9/92