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OCTOBER 9, 1946

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To: File

From: P. F. Gast

100 AREAS. TECHNICAL ACTIVITIES REPORT - PHYSICS
SEPTEMBER 1946

D File - E. B. Montgomery -

Summary

The Pine unit was down four times during the month. These were all regularly scheduled shutdowns. Times down vary from 16.9 hours to 19.2 hours. A total of 33.4 tons of metal was discharged. The galvanometer chamber in experimental hole "A" was replaced. One Special Request was discharged and three tubes have been loaded with Special Request samples. A new bismuth column has been established. Some difficulty has been experienced with high temperatures of both tube exit water and graphite following startup. On one occasion the normal operating level was exceeded for a short period of time.

Details

The galvanometer chamber in "A" experimental hole became defective and was removed. The chamber was short-circuited and it was suspected that moisture had caused the short. The chamber used as a replacement had such a low sensitivity that it was inserted farther into the hole at the next shutdown. After the next start-up this chamber also gave spurious readings and is to be replaced at the next opportunity. The original chamber is being tested for moisture. When the "A" hole was first opened, and the chamber removed, a moist, brownish slurry was discovered. This slurry also contained some pieces of material which looked like aluminum oxide.

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On September 5th the shim pump control switch stuck in the out position. This caused a rise in the power output. This condition lasted long enough for the power to rise to 350 MW but not long enough for the unit to scram. This switch has since been replaced with a more sturdy one.

After each of the startups during this month the power level has been reduced to lower the temperature of the graphite or the exit water. This is usually necessary about two hours after the unit is at normal operating level. These conditions last two to four hours. After the 9-24-46 startup it was necessary to lower the level to 225 MW. because of the exit water temperature of Tube 3887. After this was done, an effort was made to alter the distribution of exit water temperatures by changing the rod configuration. Several changes were made which resulted in a prolonged distortion of temperatures. The graphite temperature of two sample points eventually rose over the operating limits. It is probable that the temperature difficulties would have righted themselves sooner had the standard rod withdrawal order been maintained.

The status of poison, special request, bismuth and dummy tubes as of September 30, 1946 is as follows:

<u>Tube</u>	<u>Date Charged</u>	<u>Charge</u>	<u>Nominal 1h</u>	<u>Effective 1h</u>
3169	8-6-46	13-2	21	
3179		3L-2P	30	
2666		2L-2P	14	
2682	9-17-46	15-4 & 5	52	
2374		1L-1P	46	
2066		2L-1P	34	
2082	8-6-46	15-3	41	
1569		2L-1P	34	
1579	9-3-46	15-4	36	
1474		3L-1P	27	
3276	9-3-46	15-4	23	
			<u>396</u>	<u>292</u>
2669	6-25-46	25-3	7	
1866	7-2-46	19	7	
			<u>14</u>	<u>10</u>
0980		Bismuth	7	8
1976		Bismuth	7	4
2088		Bismuth	7	4
2788		Bismuth	7	4
3880		Bismuth	7	4
			<u>35</u>	<u>21</u>
0174		All Lead	7	0.6
4674		All Lead	7	0.6
2461		All Lead	7	0.6
2496		All Lead	7	0.6
				<u>2</u>

Total Effective inhours 326

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Reactivity Status of the D Pile

The reactivity status at the beginning and at the end of this report period is as follows.

Amount	in rods	53	8-26-46 inhours eff.	53	inhours eff.
	"F" col. of "P" pattern	208	" "	165	" "
	Spec. Req. in "P" pat.	85	" "	128	" "
Absorbed	Other S. R. Tubes	10	" "	10	" "
	Bismuth	15	" "	20	" "
	Lead dummy	2	" "	2	" "
	In xenon	497	" "	497	" "
	In power coefficient	-77	" "	-77	" "
	Total cold clean reactivity	794	" "	798	" "

F Pile - U. M. Staebler -

Summary

Calculations of the power level of the F Pile for various times during August and September indicate that the true operating level has been about five per cent lower than previously thought. This condition arises from the fact that the inlet temperature for the Thermohm Power Indicator used for pile control is taken from the B - C crossheader where the water is slightly cooler than average during times when the refrigeration units are in use. Refrigeration was introduced gradually starting on May 6, 1946.

No unusual reactivity effects were noted in connection with the charging or discharging of Special Request material during the month.

Local graphite relaxation periods in the vicinity of three central thermocouples have been studied. Central graphite has an average relaxation period of about 78 minutes after an exposure of 1000 megawatt days per central ton of metal. An effort is being made to reconcile the period measured for central graphite with the period for the whole pile determined by reactivity means in connection with changes in the power level. The increase in the average period as measured by reactivity changes has been 75 per cent as large as the change in the period for central graphite based on actual temperature measurements.

The temperature moments of an operating pile vary within a range of plus or minus 30 per cent of normal during the interval following a startup when large amounts of reactivity must be absorbed by the horizontal rods. Since the large deviations occur within a relatively short period, it is estimated that the calculated exposure of an individual tube normally would be in error by not more than three per cent if only equilibrium conditions are used in the calculation.

The F Pile had no net change in cold, clean reactivity during the month.

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Details

Power Level

The following table summarizes calculations of the power level of the F Pile at approximately one week intervals for the past two months.

<u>Date</u>	<u>Flow</u>	<u>Outlet Temperature</u>	<u>Average Inlet Temperature</u>	<u>Temperature Rise</u>	<u>Power</u>
7-29-46	32,230 gpm	38.65 C°	16.15 C°	22.50 C°	191.1 MW
8-6-46	32,170	38.75	16.21	22.54	191.1
8-13-46	31,935	39.60	16.54	23.06	194.4
8-20-46	31,930	39.10	16.76	22.34	188.0
8-27-46	31,925	40.07	17.30	22.77	191.5
8-29-46	32,386	39.65	17.44	22.21	189.5
9-4-46	32,050	39.60	17.37	22.43	189.4
9-10-46	32,010	39.70	16.94	22.76	192.0
9-24-46	31,835	37.65	15.07	22.58	189.4
				<u>Average</u>	<u>190.7</u>

The flows given in the above table were taken from the Railey instruments with proper correction for the loop header flow and the horizontal rod cooling water. The outlet temperature was taken from a line into "A" sample room which has previously been shown to give a sample whose temperature agrees well with the temperature of the water at the inlet to the retention basin. The average inlet temperature is an average of the temperatures of the four risers weighted according to water flow.

Reliable outlet water temperatures were not available for the period immediately before and after the beginning of refrigeration on May 8, 1946, but available data indicate agreement to plus or minus one per cent between calculated power and the thermohm instrument prior to the use of refrigeration. There appears to have been a gradual deviation after the start of refrigeration up to the minus five per cent stated above. A gradual drop would be expected inasmuch as the amount of refrigeration was increased gradually as needed.

This correction to the operating level of the pile will not affect the exposures calculated for Special Request samples, since they are determined by means of the temperature rise of the water in adjacent tubes. A correction should be applied to graphite exposures and production figures.

An adjustment is provided in the Thermohm Power Indicator to correct for this condition, but no correction has been made because of the fact that it is planned to discontinue refrigeration early next month.

Special Requests

The charge and discharge of Special Request material during the month

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is summarized below:

<u>Date Charged</u>	<u>Tube</u>	<u>Special Request No.</u>	<u>Material</u>	<u>Nominal ih</u>	<u>Date Discharged</u>
9-4-46	2374	15-4	*Li F	56	--
5-2-46	1565	9-3	Be O	7	* 9-25-46
	1565	7	Yp237		
	1565	16-1	95 Oxide		
	1565	10-A	Sm		

Reactivity changes noted in connection with these charges were in agreement with the assigned nominal values and the current shadowing corrections.

Graphite Relaxation Periods

The following local graphite relaxation periods have been determined from thermocouple readings following recent shutdowns.

<u>Date</u>	<u>13 G</u>	<u>14 G</u>	<u>16 G</u>	<u>Accumulated MD</u>
7-17-46	77 minutes	77 minutes	73 minutes	108,198
7-24-46	72 "	72 "	72 "	109,470
7-31-46	80 "	80 "	79 "	110,804
8-23-46	84 "	78 "	77 "	115,864
9-4-46	89 "	78 "	76 "	117,057
	80 "	77 "	75 "	112,300

The local periods noted above, check well with those observed for the D Pile after a comparable exposure, although it has been pointed out previously that the graphite power coefficient is increasing at a more rapid rate at F than at D.

The graphite relaxation period, as measured by the reactivity changes associated with lowering of the graphite temperature following a change in the power level, is about 60 minutes at present. The comparison of this average figure with the more directly measured central period is being studied in an effort to obtain a better understanding of the effect of graphite exposure and temperature on pile reactivity. Thus far, it has not been possible to associate the two results satisfactorily but further work is in progress.

Temperature Moments

Temperature maps of the F Pile are taken each shift during the twenty-four hours following a startup and once each day thereafter. These maps have been used to determine the range of the pile's temperature moments as the horizontal rods are moved through the standard insertion and withdrawal order during this period of changing reactivity. The procedure for determining these temperature moments is described in Document #7-2654, "Procedure For Improving Temperature Distribution via Rods and

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Columns", J. A. Wheeler and R. L. Monagus to W. E. Jordan, September 27, 1945. Eleven maps following the shutdown of September 4 and September 11 were used in the analysis. These data are not sufficient to draw accurate conclusions as to the effects of the rods on the temperature moments. The results would undoubtedly be dependent upon recent pile history and local xenon distribution although, in most cases, results for similar conditions were in good agreement.

Temperature moments during this startup period deviate from equilibrium moments by up to 30 per cent, plus or minus. This includes horizontal rods in the pile, compensating for as much as 280 inhours of reactivity.

Reactivity

The reactivity of the pile at the beginning and at the end of this report period is summarized in the following table:

	8-28-46	9-30-46
	55 inhours	67 inhours
Amount held in rods	436 "	436 "
Amount held in xenon	191 "	161 "
Amount held in poison columns		
Amount held in Special Requests -		
Within the poison pattern . . .	121 "	150 "
Outside the poison pattern . .	16 "	15 "
Amount held in Bi columns	16 "	16 "
Amount held in dummy columns	7 "	7 "
Amount held in power coefficient . . .	-76 "	-76 "
Total cold, clean reactivity	775 "	775 "

The above comparison indicates no net change in the cold, clean reactivity for the month.

General Physics - H. A. Fowler -

Production Test 105-1-P - Radiation Effects on Graphite

One set of transverse cut graphite samples exposed 188 MD/CT (39 MD/CT in the "B" Test Hole 105 B and 149 MD/CT in the "B" Test Hole 105 F) were measured for dimensional changes. The average increase in length was 0.16% which is in good agreement with previous measurements. These graphite samples were cut from known positions in the same graphite bar and it was found that the electrical and thermal resistivity was highest at the center of the bar, and lowest for those at the edges. A comparison of the initial electrical resistance with the increase in length is given in the following table:

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<u>Rox10⁴ ohm-cm.</u>	<u>% Increase In Length</u>
11.22	0.182
10.94	0.170
10.94	0.163
10.26	0.140
10.23	0.140
9.95	0.145

Annealing tests on the change in thermal conductivity were made on parallel cut graphite exposed 200, 836, and 1007 MD/CT in the "B" Test Hole 105 D. The samples were annealed so that the temperature of the samples never exceeded the annealing temperature due to the release of stored energy. Annealing proceeded for sufficient time so that no further removal of the effect was observed at the annealing temperature. The tests indicate that the greater the graphite exposure, the less readily the effect is removed. The per cent of the change in thermal conductivity removed after annealing is given in the following table:

ANNEALING OF THERMAL CONDUCTIVITY - % EFFECT REMOVED

<u>Exposure</u> <u>LD/CT</u>	<u>Annealing Temperature - °C</u>				
	<u>100</u>	<u>125</u>	<u>150</u>	<u>200</u>	<u>400</u>
200	12.7	38.0	52.5	62.5	77.5
836	0	4.9	19.4	29.4	43.0
1007	0	0	6.8	17.0	31.4

Production Test 105-64-P - Corrosion Of Aluminum Thimbles.

Four aluminum pieces were exposed in the "B" Test Hole 105 F in the reflector near the thermal shield at a point where the deposition on the horizontal rods appears to be most severe. The test pieces, dimensions 12" x 0.375" x 0.0125", were exposed to the following atmospheres: (1) carbon dioxide, (2) building air, (3) humidified building air, and (4) the helium atmosphere of the Test Hole. The samples were exposed from 7/24/46 to 9/11/46. The following changes in the test pieces were observed:

<u>Atmosphere</u>	<u>Visible Changes</u>	<u>Change in Weight</u> <u>Grams</u>
Helium	None	None
Carbon Dioxide	Very Slight Corrosion	+ 0.0014
Building Air	Badly Corroded	+ 0.0129
Humidified Building Air	Very Badly Corroded	+ 0.0194

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