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By Authority of J.E. Haddeson

JH. Wells-4-28-94

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700 Area File
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#12 - L. Squires
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#16 - W. E. Jordan
#17 - C. P. Kidder-700 File
#18 - C. N. Gross

January 11, 1946

COPY 1 OF 1

100 AREAS
January 1 through January 7

This Document consists of
5 Pages No. 1 of 5
Copies Series 1

Physics

B Pile

The B Pile has operated at its assigned power level, 25 MW below rated level, during the past except for 10 hours on January 3. During the week a further reduction in level of 27 MW was made under a production test to determine power coefficients and the calibration of A control rod. The discharge of 31 tons of high concentration material during the extended shutdown beginning December 11 reduced the excess reactivity of the B Pile to 27 ih. In the course of the production test the excess reactivity varied between 15 and 41 inhours because of transients.

Gas losses have averaged 1360 cu.ft./day. The gas purity is now 98.5%. It has been found that an indication of 98% gas purity on the 0-2% air scale corresponds to an indication of about 94% purity on the 0-100% air scale of the gas analyzer. Calibration check points support the accuracy of the 0-2% air scale.

D Pile

The operating level of D Pile remained at 25 MW below rating.

The rate of gain in excess reactivity during equilibrium operation has been about 1.8 inhours/day. While somewhat higher than rates of gain observed during the past several months of operation, rates of comparable magnitude have been observed for limited periods previously. The reason for this increase in the rate of gain is not yet understood.

Power coefficients have now been determined from data obtained after the reduction in level on December 30. They are as follows:

Overall power coefficient, C_o = 0.22 ih/MW
Metal " " , C_m = -0.21 "
Graphite " " , C_g = 0.43 "
Graphite relaxation period, 50 minutes.

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The decreased in the overall power coefficient is believed to be just within experimental error of the present accepted value, 0.25 ih/MW. However, the reversal of the trend in this coefficient may be real; a lower value was also observed at F during the past week.

During periods of equilibrium operation for the week the following temperature data were obtained:

Average, 10 hottest tubes in 0.240-inch zone	41.7 °C
Average inlet water temperature	8.3 °C
Average temperature rise (10 hottest tubes)	33.4 °C
Average flow in the central tubes	20.09 gal./min.
Effective central tubes	1273

Using J. A. Wheeler's equation relating effective central tubes with perfect flattening, which states that the number of effective central tubes is $971 \cdot \frac{830 F}{T}$, the increase from 1218 effective central tubes before the poison change to the current figure of 1273 represents an increase of 48 inhours in the perfect flattening of the pile. This amounts to about 70% of the 70 inhours of poison added during the shutdown of December 31, 1945, as described in last week's report. The total amount of poison in the pile according to present methods of calculation is also 70% effective when compared with the effective central tubes converted to perfect flattening.

When equilibrium operation was attained on January 3, the rods were compensating for 76 inhours of excess reactivity, indicating that the additional poison was worth 65 inhours instead of the expected 70 inhours. The increased rate of long term gains mentioned earlier would account for 2 inhours of this discrepancy. The agreement is considered quite good.

The following table compares temperature moments observed following the poison change with those predicted on the basis of the relations described in "Procedure for Improving Temperature Distribution via Rods and Columns" by J. A. Wheeler and R. L. Monagus.

<u>Temperature Moment</u>	<u>Predicted and Observed Temperature Changes</u>				
	<u>Before Change</u>	<u>Due to Poison</u>	<u>Due to Rods</u>	<u>Predicted</u>	<u>Observed</u>
Vertical Dipole	-1.8%	-1.3%	4.7%	1.6%	0.1%
Horizontal Dipole	-1.4	-3.1	0.5	-4.0	0.7
Horizontal Quadrupole	-6.9	6.8	0.6	0.5	-0.9
Diagonal Quadrupole	-1.8	0.7	2.0	0.9	1.2
Monopole	-3.1	-2.6	-0.4	-6.1	-4.4

The observed temperature moments are considered good to about 2%; therefore, the agreement between predicted and observed moments is good except for the case of the horizontal dipole. No explanation for this particular discrepancy is known.

F Pile

On January 1 the power level of the F Pile was dropped to 25 MW below rating from its previous rated level. Rod A was in a favorable position to make a determination of the reactivity coefficients at that time. The data, although not too reliable because of difficulty in making the rapid level change, does however indicate

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an upper limit of -0.21 ih/MW for the metal coefficient. An overall coefficient of 0.20 ih/MW was obtained. Although this is a decided drop from the value 0.31 ih/MW obtained on October 9, there appears to be no reason to question the accuracy of either result. These results mean that there has been a decrease in the graphite coefficient from 0.32 to 0.41 ih/MW. However, there are no other indications that any curing has taken place in the graphite; graphite temperatures remain high and the periods long. No explanation has been found for these results. Until the coefficients are remeasured the former value of 0.31 ih/MW will be accepted for the overall coefficient.

The unit was shut down on January 3 for the discharge of 129 tubes of metal. The bulk of these tubes had already been discharged once before. This large push from a region of high neutron intensity caused only a slight decrease in the reactivity. It was impossible to measure the exact amount because of several rod configuration changes which occurred during the day before shutdown. It does not appear that there is any serious discrepancy between the changes observed at this push and the semi-theoretical curve of metal gains being developed from shutdown data.

At the shutdown of January 3 the zero point of the Thermohm Power Recorder was reset. It had been set, at a previous shutdown, to read zero after the pile had been down for several hours. It now appears that an appreciable amount of radioactive heat was being developed at that time. The power as indicated by the thermometer located in A sample room was used in resetting the zero. After this readjustment the Thermohm Power Recorder now indicates, at operating levels, a level only about 1 MW lower than the level indicated by the A sample room thermometer. Previous to this readjustment the discrepancy was in the neighborhood of 5 to 6 MW.

General

Following is a summary of the present reactivity states of the piles:

<u>Reactivity Absorbed by</u>	<u>Reactivity, ih</u>		
	<u>B</u>	<u>D</u>	<u>F</u>
Xenon	464	476	481
Permanent poison columns	326	266	236.
Bismuth	16	16	0
Rods	27	82	84
C ₀ W	-61	-37	-70
Reactivity of cold clean pile	772	793	731

The cold, clean reactivities are to be compared with 794, 734, and 711 reported for the respective piles on November 23: each unit is operating at 25 MW below rating. Values of 0.27 , 0.25 , and 0.31 ih/MW are used above for the overall coefficient, C_0 . The figure for B Pile permanent poison includes 5 ih for the lead column changed December 24. Permanent poison changes, which together with power level changes affect the xenon content, have been made after November 23, at B on December 4 and at D on December 31.

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Further investigation of corrosion in the vertical thimbles at B Pile has brought out a reasonably complete picture of this phenomenon. Drastic corrosion and perforation appear to occur only in the presence of liquid water. Scale formation occurs to a relatively minor extent on the dry walls of the thimbles. Several mechanisms probably contribute to the corrosion. The dry scale contained small amounts of nitrate and nitrite, presumably produced by reaction of aluminum with oxides of nitrogen. It contained a large amount of hydrated aluminum oxide and a trace of ammonium ion. This is tentatively ascribed to the formation of aluminum nitride by reaction with active nitrogen, followed by hydrolysis of the nitride to the hydrated oxide plus ammonia. The formation of aluminum nitride is known to be catalyzed by lithium, which was also found in the scale. Lithium is known to be present in the water which was used in the hydraulic test of certain thimbles during startup, and its presence may account for the greater amount of scale in those particular thimbles.

Analyses of the moisture content of the carbon dioxide used in purging continue to indicate that this gas is substantially dry. The piping arrangement of the third safety device appears to be such that significant amounts of water could not have entered the thimbles subsequent to the hydraulic test. The borescoping of the thimbles at D and F is expected to provide additional data.

The ratios of the breaking and crushing strength of irradiated graphite from the B Test Hole of B Pile over unexposed graphite appear to have reached maxima of 3.6 and 2.8 respectively, at an exposure of 120 MW-days/C.T. and to have decreased slowly to values of 2.1 and 2.3, respectively, at 640 MW-days/C.T. The data are tabulated below:

<u>Exposure (MW-days/C.T.)</u>	<u>Ratio, Final/Initial</u>	
	<u>Breaking Strength,</u> <u>B/B₀</u>	<u>Compression Strength</u> <u>C/C₀</u>
7.6	1.3	1.2
19	1.5	1.9
27	1.9	2.2
43	2.0	2.7
120	3.6	2.8
212	2.9	2.4
251	2.7	2.7
326	2.4	2.5
640	2.1	2.3

Data on material from the B Test Hole at D are as follows: At 200 MW-days/C.T., $B/B_0 = 2.6$, $C/C_0 = 2.7$; at 641 MW-days/C.T., $B/B_0 = 2.3$, $C/C_0 = 2.8$. These results would suggest that the trend noted at B may not be real; the possible errors in these measurements are known to be large.

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Water, Corrosion, and Engineering

Process Water Control and Pressure Drop

The iron content of the process water averaged 0.013, 0.007 and 0.012 ppm at B, D and F Areas, respectively. The rates of pressure drop increase for these areas were 0.24, 0.30 and 0.38 lbs./sq.in./day, respectively.

Slug Inspection

An attempt was made to cut through a blistered slug using an underwater lathe at F. The base metal machined satisfactorily until a groove about one-eighth inch deep was reached. After this point, the tool no longer removed metal. This was due, in part at least, to the tool feed mechanism slipping. This mechanical condition was corrected and a new cutting tool installed in the lathe. The cutting edge of the carbide-tipped tool that was removed was found to be very badly worn. Another cut was made using the new tool. In this case the rate of machining became very slow after a groove about one-eighth inch deep was reached, indicating that the base metal is very hard. A band around the blistered piece about 1-inch wide was then cut down to a depth of about one-sixteenth inch. Preliminary observations, using the horescope and the binocular telescope, failed to reveal any unusual condition on the freshly exposed surfaces. A more detailed examination will be made of the cut surfaces using the new underwater viewer which has just been installed at B. Additional machining tests are to be made on other blistered and swollen slugs and further attempts are to be made to cross-section a slug.

The slug manipulator at D has been removed from the pit, overhauled and reinstalled in such a way that it may now be removed and installed without draining the pit.

Orifice Distribution

There have been no orifice changes at any area since August, 1945. Additional reports on this subject will be issued only as changes are made.

Roof Level - Top Shield Movement

The center of the roof at B is continuing to rise at a rate of about 0.1 inch/month. The total movement since start-up now exceeds 1 inch. Comparable motion is observed at stations near the side shields, midway between the charge and discharge faces, but no motion has been observed at stations located near the end shields.

At D fewer stations are provided and the data are more scattered, but the same general trend is observed as at B.

Consideration is being given to peering through an empty water tube at the top and bottom of the D Pile to ascertain whether the movement is in the graphite or outside of the graphite.

W E Jordan
W. E. Jordan, Chief Supervisor
100-300 Technical

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