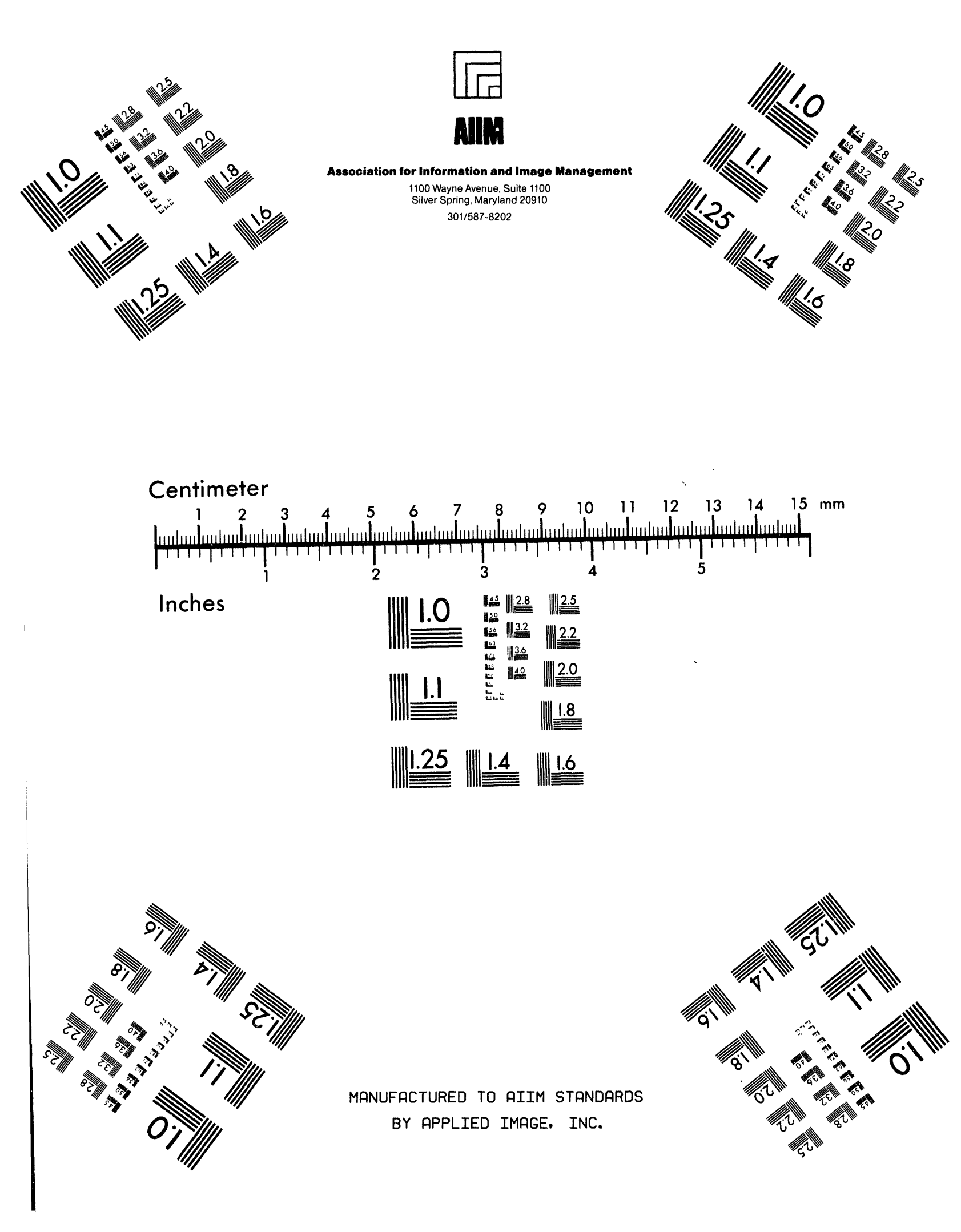
AIIM
Association for Information and Image Management
1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301/587-8202
Centimeter
Inches
MANUFACTURED TO AIIM STANDARDS
BY APPLIED IMAGE, INC.

1 of 1

1. A.B.Greninger
2. C.W.J.Wende
3. U.K.Staebler
4. E.B.Montgomery
5. H.A.Fowler
6. P.F.Gast
7. W.K.Woods
8. W.D.Coolidge - 300
9. 700 File
10. Pink Copy
11. Yellow Copy

This Document Consists of 10 Pages

No. 11 of 11 Copies. Series A

COPY 1 OF 1, [redacted]

December 11, 1946

100 AREAS TECHNICAL ACTIVITIES REPORT - PHYSICS NOVEMBER 1946

D Pile - E. B. Montgomery -

Summary -

The 105-D Pile was down on November 5 and November 26 for regularly scheduled shutdowns. At both shutdowns, the pile was down for nearly twenty-four hours (effective time down). Two scrams occurred during the month, one on November 4 and one on November 29. Both of these were of short duration. Five Special Request 15 tubes were discharged and recharged with Special Request 15. On November 1 a regular coefficient test was run for 5 hours at 221 MW. All refrigeration of processed water has been discontinued. Some 13 inhours of reactivity were gained during the month. Vertical rod thimbles, 10 through 22, have been pressure tested. All of these were satisfactory. A monthly foil irradiation was made at 100-B. No significant changes were noted.

Details -

Coefficient Test

On November 1 the level was dropped from 250 MW to 221 MW and held for 5 hours. Then the level was raised to 250. During the rise the unit was levelled at 245.5 for a few minutes before going

up to a level of 248 MW. This change in level made it difficult to evaluate the latter half of the test. The values obtained for the coefficients were as follows:

Overall Coefficient, C_O	-	0.37 ih/MW
Graphite Coefficient, C_G	-	0.64 ih/MW
Metal Coefficient, C_M	-	0.26 ih/MW
Relaxation Period, T	-	57 minutes

Apparent Change in Poison Tube

On September 3rd, Tube 3274-D was charged with Special Request 15-4. After the startup the temperature traverse showed the temperature of this tube to be approximately the same as that of a standard metal tube. The temperature of 3276-D was low and it was believed that Request 15-4 had been loaded into 3276. On November 5, when 3276-D was discharged it was found to contain regular heavy metal. The thermocouple leads from 3274-D and 3276-D were mixed and the Special Request had been in 3274-D.

Monthly Foil Irradiation at 100-B

The two foils irradiated in Tube 1363-B gave an average nv of 107.0 neutrons per $cm.^2$ per second. This is slightly higher than last month, but is to be expected as it is within the experimental error and the gas purity is higher (99.1%). This gives a value of 1.42% k below critical.

Special Requests

The following is a summary of the charging and discharging of Special Requests in the D Pile during November:

Date	Tube	Special Request Discharged	No. Pieces	Special Request Charged	No. Pieces	ih Nom.
11-6-46	3274-D	15-4	12	15-9	12	23
11-6-46	1579-D	15-4	23	15-8	23	36
11-26-46	2374-D	15-5	34	15-9 and 10	(21,15-9 and 13,15-10)	46
11-26-46	2666-D	15-5	31		31	44
11-26-46	2682-D	15-4 and 5	36(14,15-4) (22,15-5)		36	48

Reactivity Status

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

	10-31-46	11-30-46
Amount in Rods	51	64
Absorbed in Special Requests (All in reg. "P" Pattern)	302*	302
Bismuth Tubes	34	34
Lead Dummy	2	2
Xenon	497	497
	886	899
	-92**	-92
	794	807

Total gains for the month are 13 inhours. This is to be expected as operation was continuous for five weeks, interrupted by only one shutdown during this time.

* This value of 302 was reported last month as 308 ih, the higher value being based on an earlier estimate of the value of a full column of LiF slugs as being 68 ih nominal. A later value of 60 ih nominal is found to be more correct. For the purpose of evaluating monthly gains the same value is used in both cases.

** This value of the contribution of the overall coefficient was gained from the coefficient test of November 1st. It too, should be used for gains calculation instead of the value of 77 ih given in the last monthly summary. The value of 77 ih resulted from the last previous coefficient test.

F Pile - U. P. Staebler

Summary -

A Production Test was performed to determine the reactivity power coefficients of the F Pile at low power levels and with practically no xenon poison remaining in the pile. The following results were obtained:

Coefficient	From Rise 0.2 to 36 kW	From Drop 36 to 0.4 kW	Average
Metal, C_M	-0.31 ih/MW	-0.35 ih/MW	-0.33 ih/MW
Graphite, C_G	1.24 "	1.29 "	1.26 "
Overall, C_O	0.93 "	0.94 "	0.93 "
Relaxation Period	62 minutes	75 minutes	--

A rod calibration of A Rod obtained in connection with the test gives an overall strength of 106 inhours with Rods 2, 4, and 5 out, R at 134" out and 6 temporary poison columns in the pile. The coefficient results indicate non-linearity of the metal coefficient with power. They further show that the graphite coefficient under the conditions of the test is about twice that measured by means of the usual coefficient test. This difference in the graphite coefficient is believed to be due to the de-

pondence of xenon cross-section upon neutron energy which must partially cancel the large graphite coefficient observed in this test. The observed difference in graphite relaxation period as determined from the two sets of data has not been explained.

Additional experience in the use of temporary poison columns during an extended shutdown of the pile was obtained during the month. The average strengths of the six temporary poison columns used in connection with the extended shutdown which began on November 4, was slightly less than in most previous cases. The dependence of the column effectiveness with normal average water temperature rise in the particular tubes agrees well with earlier data. The effectiveness seems to depend upon the cube of the temperature rise.

Four new bismuth columns were charged during the month and six tubes were charged with LiF, replacing "P" pieces or other LiF columns. Reactivity changes noted in connection with these changes in poisoning material were not all in good agreement with expectations but it has not been possible to assign the responsibility for the disagreement to any particular cause.

The pile had not yet returned to xenon equilibrium following the shutdown of November 27 at the end of the month, but conditions just prior to this shutdown indicate a loss of one inhour since October 31, 1946. An observed loss of two inhours since June 25, 1946, is in good agreement with the change predicted by Document No. 7-4207, "Metal Quality Considerations in Pile Operation", Staebler to C. M. Gross, based on the average quality of metal production during this interval.

Details

Xenon Free Coefficient Test - Production Test #105-78-P - Supplement A.

This test consisted of the following steps:

1. Critical rod conditions were established with A Rod at 100 inches out. This brought Rods 2, 4, and 5 out, and B to 134 inches out.

2. A Rod was calibrated by means of 4 periods. These were taken with A Rod set at 140", 170", 200", and all out.

3. The power level was raised to 36 MW in less than 2 minutes and held constant at that level for five hours.

4. The power level was dropped to 0.4 MW and critical rod positions observed for 15 hours.

The time and magnitude of the turn-around point during the final critical condition measurements made it possible to reconstruct the xenon curve back to the point of the drop from 36 MW. It was then possible to

[redacted]

calculate values for the xenon constants A and s, where A is a function of xenon cross-section and s is the percent of xenon formed directly with fission. Values for B, X, and I were assumed to be correct as now used. On this basis the following values were obtained:

$$A = 4.77 \qquad s = 0.045$$

If the value of B, corrected for flattening, is taken as 0.00300 instead of 0.00312 as given by present methods, values of A = 4.87 and s = 0.083 are obtained. The above values for A include the correction for flattening.

The periods obtained in the calibration of A Rod indicated a strength of 2.1 times the accepted calibration based on xenon equations. In analyzing the Production Test it was necessary to take exception to this calibration curve in the region from 100 inches out to all in. It was found that use of the originally constructed calibration curve in this region led to poor graphite relaxation periods and general discord between the two sets of data. Since this region of the curve was not backed by periods it was recalibrated by extrapolation of the graphite period determined by the region which was backed by periods. Tabulation and discussion of the values obtained for the reactivity power coefficients and the graphite relaxation period has been covered in the summary of this report. A more detailed report of this test is in preparation.

Temporary Poison Columns

The following six tubes were charged with full poison columns for the duration of the extended shutdown beginning on November 4, and remained in the pile during the first 18 hours of operation following the shutdown: 3662-F, 3685-F, 2089-F, 1989-F, 1162-F and 1185-F. The average poisoning effectiveness of these columns was evaluated at 3 points. The results are summarized below.

Event	Total ih	ih/Column	Rods
Critical before rise to power after extended shutdown	151	25.1	A,9,2 in, 7 @ 160"
Critical after 6 columns were discharged	109	18.3	A in, 9 about 180"
At 180 MW after 6 columns were discharged	135	22.5	A in, 9 about 180"

The above values are slightly less than most of those previously reported for similar rod conditions, but the difference is probably due to the differences in locations.

Further study of the dependence of poison column effectiveness on

[redacted]

local flux has been made in connection with these six tubes. Earlier work on this problem is reported in Document No. 7-4560, "Pile Control - Temporary Poison During Extended Shutdown of D, June 17 to June 20, 1946", U.K.Staebler to File. The equation given in Document No. 7-4560 should have been written

$$\text{inhours} = 7 + 61(\Delta T/48)^X$$

since seven inhours of the nominal value of a poison column is due simply to the absence of metal. Data following the shutdown of June 17 at D and November 4 at F have been reviewed on the basis of the above equation to evaluate X. ΔT in this equation is the temperature rise in the tube under rod conditions similar to those at which its effectiveness as a full poison column has been evaluated. The temperature rise of a central tube in an unflattened pile operating at 250 MW would be 48°C. (See Document No. 7-4560) This figure should be corrected for different power levels. Various evaluations of X are summarized below.

	Rods	ΔT	ih	X
6-17-46	A, 9, 2 in 7 @ 200"	32.7°C.	27.3	2.9
100-D	A, 9, in 2 @ 30"	32.0	26.5	2.8
	A @ 43"	31.5	24.8	2.9
11-4-46	A, 9, 2, in 7 @ 160"	26.5	25.1	3.3
100-F	A in 9 @ 180"	24.7	22.5	3.1

In order to get the values of X to agree with the assumption that the strength of the poison column varies with the square of the temperature rise it would be necessary to change the other factors of the equation by amounts greater than one would consider them to be in error. For instance, a value of 57°C. would have to be assumed for the temperature rise in the central tubes of an unflattened pile operating at 250 MW. Consideration is being given to a review of similar data for other cases where temporary poison columns have been used in order to obtain additional confirmation or disproof of the above results.

Special Material

The following table summarizes the charging and discharging of material covered by the Special Request Program.

		Discharged			Charged		
Date	Tube	S.R. No.	Material	Nom. ih	S.R. No.	Material	Nom. ih
11-5-46	3169-F	-	2L-3P	51	15-7-8	LiF	34
	2374-F	15-4	LiF	56	15-8	LiF	48
11-27-46	1474-F	15-5	LiF	30	15-9	LiF	29
	1569-F	15-5	LiF	45	15-9	LiF	34
	2082-F	15-5	LiF	45	15-9	LiF	36
	2682-F	15-5-6	LiF	45	15-9	LiF	36

Tubes 3082-F, 1682-F, 1666-F, and 3266-F were charged with bismuth for the first time during the shutdown of November 4.

A comparison of expected and observed reactivity changes in connection with the shutdowns of the month is given below.

Date	f_3	Δih Nom.	Δih Eff.	Δih Metal	Δih L.T.	Δih Total	Observed
11-4 to 7	6.9%	-2	2	-6	3	-1	-13
11-20	3.7	0	0	-3	3	0	4
11-27	4.6	-30	22	-4	3	21	-

Reactivity

The reactivity of the F Pile at the beginning of the month and at the last point of xenon equilibrium is summarized in the following table, along with the poison effectiveness at the end of the month.

	10-31-46	11-27-46	11-30-46
Amount held in rods	46 inhours	47 inhours	--
Amount held in xenon	427 "	427 "	--
Amount held in poison columns . .	54 "	17 "	17 inhours
Amount held in Special Requests .			
within the poison pattern . .	261 "	281 "	260 "
outside the poison pattern .	15 "	15 "	15 "
Amount held in Bi columns	16 "	41 "	41 "
Amount held in dummy columns . .	12 "	2 "	2 "
Amount held in power coefficient.	-76 "	-76 "	--
Total cold clean reactivity . . .	755 "	754 "	

The above tabulation indicates a loss of one inhour for the month and a loss of two inhours since June 25, 1946. It is of interest to compare this loss with that to be expected on the basis of the known quality of metal charged into the piles during this interval and the expected graphite gains. Document No. 3-5092, "Weighted Monthly d ih Averages", Butler to Staebler, gives the average monthly d ih values for 305 tests from January through October, 1946. The weighted average of ΔK% for metal tested since June was determined to be -0.11. Figure 1 of Document No. 7-4207 predicts a net reactivity loss of one inhour for this average quality of metal being charged over the period being considered. The agreement between observed and predicted reactivity changes is further indication of the total magnitude of the graphite gains to be expected.

General Physics - H. A. Fowler

Two sets of samples were removed from the "B" Test Hole of the F Pile November 4, 1946 having the following exposure histories:

(1) 39 MD/CT in B Pile, plus 316 MD/CT in F Pile - Total 355 MD/CT.

(2) 899 MD/CT in B Pile, plus 316 MD/CT in F Pile - Total 1215 MD/CT.

Samples were also machined from graphite removed from the No. 9 Thimble of the D Pile after 1054 MD/CT exposure at ambient pile temperatures. The following results were obtained on these samples:

Exposures MD/CT	Type Samples	Place Exposed	Stored Energy Cal/gm.	K_o/K	R/R_o	B/B_o	C/C_o	Dimensional Change %
355	Transverse	"B" Test Hole	-	18.8	4.1	-	-	0.30
1215	Parallel	"	90	39.4	4.9	1.7	2.3	-
1054	Transverse	No. 9 Thimble	36	19.6	3.7	-	2.2	0.28

The stored energy curve for the 1215 MD/CT graphite showed the loss in the peak of the energy spectrum observed for high exposure capsule samples. However, these samples had originally been partially annealed due to the 75°C. temperature of the "B" Test Hole, B Pile. The 316 MD/CT exposure in the Test Hole of the F Pile (35°C.- 40°C.) is sufficient to saturate the stored energy in the low temperature region of the stored energy spectrum for a sample not previously exposed. No data are available to determine whether the stored energy will rebuild in an annealed piece the same as for an unexposed piece. The stored energy spectrum in the region of the loss in peak is very similar to the spectrum of highly exposed capsule samples.

The stored energy of the graphite removed from the No. 9 Thimble showed considerable thermal annealing. The stored energy spectrum indicates the temperature of the graphite was approximately 150°C. during exposure.

The thermal conductivity ratio, 39.4, is in good agreement with the calculated value 40.1. The value 40.1 is calculated from data obtained on samples removed from the "B" Test Hole of the D Pile. Since K_o was lower for the 1215 MD/CT samples than for the samples used to calculate the ratio 40.1, the value 39.4 should be lower than the calculated value. The ratio K/K_o varies as a function of K_o. The ratio 18.8 for the 355 MD/CT transverse cut sample is in good agreement with previous results obtained for transverse cut samples. The graphite from the No. 9 Thimble showed considerable thermal annealing of the conductivity effect.

The cross breaking strength is still decreasing. The variation of the cross breaking strength ratio, B/B_o, with exposure is given in the following table:

[redacted]

Exposure MD/CT	B/Bo
0	1
120	3.6
251	2.7
326	2.5
640	2.1
1215	1.7

The crushing strength of graphite, C/Co, varies with exposure in the same way as the cross breaking strenth. The variation of the crushing strength with exposure is given in the following table:

Exposure MD/CT	C/Co
0	1
120	2.9
251	2.7
326	2.5
640	2.4
1215	2.3

The values obtained for dimensional changes are not in good agreement between samples removed from the "B" Test Hole of the D Pile and the "B" Test Hole of the F Pile. The rate of expansion is linear with exposure for samples removed from the same test hole, but the rate of expansion varies between test holes. Laboratory tests do not show any annealing of the expansion at 75°C., the temperature of the test hole of the D Pile. The only significant difference is that the samples in the D Pile were exposed in air and the sample in the F Pile were exposed in helium. The expansion of the graphite from the No. 9 Thimble is much lower than would be expected from the exposure and the ambient temperature of the graphite.

J. M. West

A visit was made to the Argonne Laboratory during the period of October 30 to November 6, for the purpose of obtaining information about uranium reactivity testing and Request No. 15 processing. Details of the metal testing procedure are being used in setting up a similar testing program in the 305 Test Pile at H.E.W. The oscillating system used in connection with the P-9 Pile at Argonne was also investigated with a view toward the eventual possibility of using a setup such as this for reactivity tests on small samples of uranium. Details of the Argonne process for preparation of lithium slugs and extraction of

product in connection with the Request No. 15 irradiation program are to be considered, along with other factors, in reaching a decision about the advisability of taking over the entire Request 15 program at H.E.W.

A special graphite test stringer has been prepared and installed in the 305 Test Pile for testing samples from castings supplied by the uranium producing companies. A calibration has been made with iron wire of known cross-section to determine the relation between the reproduction factor of the test samples and the reactivity of the pile. Six lots of samples which were previously tested at Argonne have been received at H.E.W. and given preliminary tests with this setup. Full scale testing awaits preparation of small samples of metal for determining the effect of weight variations on reactivity. It is also planned to determine, and if possible correct, the causes for the very erratic results which have been obtained in reactivity tests on H.E.W. type slugs with the Test Pile during recent months.

Paul F. Gast

P. F. Gast
100 Technical

PFG/lh

DATE
FILMED
7/12/94

END