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Higher Power Levels

The reactivity and temperature limitations of going to power levels greater than 275 MW have been considered. Calculations have been based specifically on the D Pile with 40 per cent carbon dioxide in its atmosphere. A summary of these limitations is given below.

Level (MW)	Residual Flattening	Down Times		(Reduced Level)
		Min.	Max. (Nom.)	
275 MW	450 in	17.6 hrs.	24.0 hrs.	29.0 hrs.
325	400	13.5	19.6	24.6
350	375	19.1	19.6	23.7
400	325	20.3	---	22.3
450	285	21.6	---	21.6

The values in the above table are based on the assumption that 70 inhours will be held in control rods under equilibrium operating conditions and no metal discharged during the shutdown. The 70 inhours in control rods will allow recovery from a 30 minute scram through most of the range of power levels considered. A change in this value will shift both minimum and maximum down times about one hour for every 15 inhours but will not make a significant difference in the margin between minimum and maximum down times. An average metal discharge (an effective 4% of the pile) will decrease the minimum and maximum down times about three-fourths of an hour but again does not add significantly to the margin between them.

It is apparent from the above table that operation at 325 to 350 MW is practical from a reactivity standpoint even for the present piles if operation for 12 to 20 hours following each shutdown is limited to about

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one-half the nominal power. Operation at 400 MW or more (if possible by other considerations) would require extended shutdowns and use of supplementary poison columns at each start-up.

Operation above 350 MW does not look feasible without changes in orifice patterns, an increase in water flow, or a relaxation of water temperature limitations.

An extrapolation of measured values for the radiation from water at the exit of the retention basin gives a value of about 3.8 mr/hr ($\beta + \gamma$) for operation at 400 MW with both sides of the basin in use.

Reduced Pile Size vs Power Level

Previous calculations of the possible operating level of the D Pile if reduced in size (number of tubes loaded) did not give proper allowance for the limitations imposed by water temperature limitations. It would be necessary to use part of available reactivity to flatten the temperature distribution to remain within limits on exit water temperature. The following table is based on a maximum water temperature of 70°C from the hottest tube of a cylindrically loaded pile.

<u>No. Tubes</u>	<u>Allowable Power Level</u>	<u>Residual Flattening</u>
20004	275 MW	410
1800	275	360
1700	275	300
1600	260	275
1400	220	200
1200	175	120
1000	125	35

It was assumed in these calculations that 50 inches would be held in the control rods during equilibrium operation for the purpose of screen recovery.

Symposium on Power Coefficients

The Pile Physics Group met in three sessions of a symposium on power coefficients and xenon equations during the month. These meetings were prompted by the realization that the values now used in calculating corrections for xenon poison and overall power coefficients will not explain all operating data.

There has been a gradual deviation between measured values of the overall power coefficient and the apparent average value of this coefficient obtained from start-up data. This deviation has increased in magnitude with increased accumulated exposure and increased graphite temperature. Attempts to explain observed data have been directed chiefly along two lines, (1) there is noticeable difference in the cross section of xenon for neutrons of different energies (σ increases as temperature increases over the range of pile operation), and/or (2) there is a decrease in the true temperature coefficient of the graphite with an increase in graphite temperature over the range of temperatures encountered.

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It has not been possible to give a satisfactory explanation for all observations with either of the above mentioned interpretations. For example, a variation in xenon cross section with neutron energy does not explain the apparent drop in the measured value of the overall power coefficient (ih/MW) with the addition of carbon dioxide and consequent increase in graphite temperature. A variation in graphite temperature coefficient (ih/°C) with graphite temperature will not explain the change in the value of the apparent overall power coefficient with change in length of the shutdown from which it is determined.

Data from 13 selected start-ups from shutdowns ranging from 16 to 27 hours long have been analyzed as points on a xenon decay curve to evaluate the constants for the xenon equations. The results of this analysis indicate that a unit operating at 275 MW with 320 inhours of flattening and a central graphite temperature of 220°C loses over 10% more reactivity due to the xenon poison than the currently accepted equations give. This same physical amount of xenon appears to be only about 75% as effective as a neutron absorber when the pile temperature is reduced to "room temperature." The overall power coefficient derived from this analysis is 0.85 ih/MW. Data from a standard type power coefficient test were treated by means of these revised xenon equations and yielded a value of 0.8 ih/MW for the overall power coefficient. Low level, or in-fine coefficient tests give a value of 0.9 to 1.0 ih/MW for a comparable total exposure so there is evidence of a consistent overall power coefficient to fit these various operating conditions if the xenon equations are changed. A xenon cross section of 3.25 megabarns for the thermal neutrons of the "hot pile" compared to 2.7 megabarns for the thermal neutrons of the "cold pile" would be necessary to obtain the derived equations.

Analysis of other operating data, including that obtained from the shutdown of the B Pile in March, 1946, is continuing in an effort to check the validity of revisions to the xenon equations.

Data from all three operating areas have been collected to plot ih/°C vs graphite temperature. The integral of the best curve for these points gives values of total inhours due to the graphite temperature coefficient as a function of change in graphite temperature. Since the effect of the metal temperature coefficient is fairly constant it may be subtracted from the total inhours due to the graphite temperature coefficient obtained by the above integration and the difference is the expected net effect of a power (or temperature) change. Values for the apparent average overall power coefficient obtained by the above analysis are about 50% greater than those observed from start-up data. This observation is taken as further evidence that both xenon and power coefficient effects are greater than now assumed.

Tests on New Vertical Rods

About 20 vertical safety rods from each of the three operating piles are being replaced with new stainless steel rods as designed for the B Pile. Fifteen rods have been replaced at B, 10 at D and 17 at F. Tests on the effectiveness of these rods are being made after they are installed. These tests have taken several forms including (1) comparison of reactivity period with rod in to period with rod out but part of "A" rod in, and (2) comparison of dropping period after rod is inserted to rising period before rod insertion. Values for individual rods will be reported when the work is more nearly complete.

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Metal Quality Studies

A more detailed study of results obtained by W. A. Kattner in tests on selected porous uranium has made it possible to give better estimates of the gains to be achieved by segregation on the basis of porosity after the pickling process.

A reactivity gain of 10 inhours would be expected if the very porous material is remelted and cast as "B" material. This would require remelting about 4% of total production.

A gain of 9 inhours would be expected if each pile is divided into three zones and metal is changed according to its porosity.

Process Tube Ion Chamber Status

The fourth process tube ion chamber failure took place in the F Pile on February 23. All of those included in the original installation in September, 1948, have now failed. Tests in the E Test Hole of the F Pile demonstrated that bakelite and paper-base bakelite retained physical shape after lucite had completely disintegrated. Irradiations of bakelite, quartz, and other insulating materials have been started in the B Hole of the F Pile to determine to what extent these materials change in electrical resistivity as well as physical strength under pile radiations. Two of the remaining three chambers in the F Pile have partial paper-base bakelite insulation, but the third has complete lucite insulation. The Instrument Division has designed a new chamber with only aluminum and quartz as structural or insulating materials in the region of high radiation intensity. Delivery of the first chambers of this new design is expected about April 15, meanwhile tests will be run on the combined output of the large chambers under risers 5 and 8 to determine their usefulness in case of another series of failures of the process tube chambers.

Reactivity Balance

The reactivity balance of each of the operating piles at the beginning and end of this report period is given in the following table:

	<u>B Pile</u>		<u>D Pile</u>		<u>F Pile</u>	
	<u>1-31-49</u>	<u>2-28-49</u>	<u>1-31-49</u>	<u>2-28-49</u>	<u>1-31-49</u>	<u>2-28-49</u>
In rods	81 ih	99	70 ih	71 ih	56 ih	
In xenon	526	519	489	482	503	501
In Special Requests						
Inside P Pattern	145	185	268	281	135	162
Outside P Pattern	20	15	10	5	21	21
In bismuth	120	120	120	135	112	112
In P Columns	0	0	17	17	39	75
In Plant Assistance	0	0	35	30	0	0
In dummy tubes	0	0	3	12	28	33
Corrections for SR-52	0	0	0	0	- 14	0
Corrections for C ₀	-130	-130	-150	-161	-160	- 179
	(25%CO ₂)	(25%CO ₂)	(40%CO ₂)	(40%CO ₂)	(25%CO ₂)	(40%CO ₂)
Gross, clean reactivity	762	803	862	872	771	790

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The above table shows net gains of 46 inhours for the B Pile, 10 inhours for the D Pile, and 19 inhours for the F Pile. The large gain indicated for the B Pile appears to be partly due to errors connected with large changes in poison columns, and to the fact that there were relatively small discharges of metal during the month.

The increase in product concentration in metal in the pile appears to have been responsible for reactivity gains averaging about 20 inhours per pile during the month.

EXPERIMENTAL PHYSICS GROUP - J. M. West

Graphite Testing

(A) Purified - Non-Experimental

The results of routine functional tests on purified graphite during February are summarized in Table I.

TABLE I

PURIFIED GRAPHITE

<u>Type</u>	<u>No. of Heats</u>	<u>Average dih (purity)</u>	<u>Effective dih</u>			<u>Density</u>		
			<u>Ave.</u>	<u>Max.</u>	<u>Min.</u>	<u>Ave.</u>	<u>Max.</u>	<u>Min.</u>
GHF	72	.907	.907	1.01	.70	1.640	1.677	1.618
CSHF	6	.905	.903	1.01	.83	1.639	1.650	1.633
CSF	24	.950	.950	.99	.85	1.640	1.661	1.624

The purity of GHF dropped slightly from last month's average. The density is essentially unchanged. CSF improved in purity and dropped a small amount in density. The CSHF results are typical.

Individual GHF bars continue to vary more in purity than CSF bars. Some of the process changes which were put into effect about the last of January are expected to improve the consistency but no functional tests (except on weekly express samples and experimental heats) have been made on GHF produced since that time.

(B) Experimental Purification

With a constant manifold gas pressure relative flow measurements were made on each gas line of the furnace in which heat GHF-1050-X had just been processed. Sample bars were selected for functional testing from positions where the flow rates were unusually high or very low. Results of these flow measurements and functional tests are shown in Table II.

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TABLE II
GAS FLOW VS. PURITY

<u>Position</u>	<u>Flow</u>	<u>Layer Sampled</u>	<u>dih Purity</u>	<u>Position</u>	<u>Flow</u>	<u>Layer Sampled</u>	<u>dih Purity</u>
1	110	Top	.55	32	100	-	-
2	180	-	-	33	110	-	-
3	70	Bottom	.93	34	140	-	-
4	160	-	-	35	110	-	-
5	180	-	-	36	140	-	-
6	broken	-	-	37	80	-	-.0
7	120	-	-	38	180	-	-
8	0	T	.89	39	0	T	.88
9	130	-	-	40	220	-	-
10	0	B	.93	41	110	-	-
11	150	-	-	42	150	-	-
12	80	-	-	43	150	-	-
13	160	-	-	44	140	-	-
14	260	T	1.02	45	160	-	-
15	160	-	-	46	120	-	-
16	60	-	-	47	150	-	-
17	170	-	-	48	50	-	-
18	140	-	-	49	190	-	-
19	80	-	-	50	broken	-	-
20	260	B	1.00	51	broken	-	-
21	100	-	-	52	240	B	.97
22	190	-	-	53	170	-	-
23	140	-	-	54	220	-	-
24	120	-	-	55	broken	-	-
25	150	-	-	56	90	-	-
26	50	-	-	57	160	-	-
27	60	T	.90	58	500*	T	.93
28	50	-	-	59	160	-	-
29	340	B	1.01	60	150	-	-
30	160	-	-	61	130	B	.97
31	240	-	-				

* This line had an oversize orifice.

The average dih (purity) for the five bars above gas lines with flow rates above 200 was + .986, as contrasted with + .872 for the average of seven cases with flow rates below 200. The writer believes that this difference is significant and that it would have been greater if the relative flow rates throughout the run were the same as they were measured to be at the end of the run. No information is available about the condition of these gas lines before the run began. The quality of a given bar is also influenced by the gas flow on either side as well as immediately underneath.

In experimental heat GHF-1082-X, eight adjacent gas lines were deliberately plugged to determine how far away from starved areas a decrease in purity could be observed. The results are shown in Table III.

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TABLE III

GAS FLOW VS. PURITY - HEAT GHT-1082-X

<u>Position</u>	<u>Orifice</u>	<u>dih (Purity)</u>		<u>Position</u>	<u>Orifice</u>	<u>dih (Purity)</u>	
		<u>Bottom</u>	<u>Top</u>			<u>Bottom</u>	<u>Top</u>
25	Open	.90	.63	31	Plugged	.57	.12
26	Open	.93	.50	32	Plugged	.77	.53
27	Plugged	.81	.52	33	Plugged	.85	.46
28	Plugged	.77	.34	34	Plugged	.95	.85
29	Plugged	.57	.12	35	Open	1.02	.86
30	Plugged	.47	.11	36	Open	1.01	.85

The results on GHT-1082-X show that a given bar is influenced by the gas flow in neighboring positions as well as immediately underneath. Bars from the top layer are consistently less pure than those from the bottom. The top layer is clearly more sensitive to purifying gas flow variations than the bottom layer. Both bottom and top layers are purer on one end of the series than on the other. This trend will be investigated further.

Heat GHT-1048-X was processed at a peak temperature of 2750° C instead of the usual 2500° C. Freon was added at the normal rate but for a longer time because of the longer heating period required to reach the higher temperature. The total amount of Freon added was 435 lbs. as compared with the standard amount of 290 lbs. No gas was added at position 31, because the optical pyrometer for temperature measurement was inserted at this point. At the end of the run, the gas feeder lines at positions 1, 2, 60, and 61 were observed to be almost, if not completely, plugged. Twelve sample bars were selected for functional tests, with results as shown in Table IV.

TABLE IV

PURIFICATION AT 2750° C

<u>Position</u>	<u>Layer</u>	<u>Orifice</u>	<u>dih (purity)</u>	<u>Position</u>	<u>Layer</u>	<u>Orifice</u>	<u>dih (purity)</u>
1	T	plugged	.85	35	T	Ok	1.01
2	B	plugged	.96	40	B	Ok	.97
8	T	Ok	1.05	50	T	Ok	.97
20	B	Ok	.97	55	B	Ok	1.00
31	T	Ok	1.04	60	T	Plugged	.97
31	B	Ok	.99	61	B	Plugged	.91
Average -							.974

The average dih (purity) for the six bars which showed no visual evidence of plugging was + .995, while the other six bars averaged + .953. The high purity of bars from position 31 shows the strong influence of neighboring positions.

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It is clear that the higher temperature and increased Freon in heat GEF-1048-X produced graphite of significantly higher purity than is normally produced by the standard procedure. By making use of recently acquired knowledge about how to minimize plugging of gas lines, by using larger orifices in end positions, and by not deliberately plugging any lines, it should be possible to produce GEF with an average diH (purity) of about ± 1.00 , by this procedure. More time and more power would be required per heat, however.

As agreed in conferences at Morganton recently, twenty-five heats have been made on which no flushing gas was used. Functional test results have been made only on a weekly express shipment from this series. The results are shown in Table V.

TABLE V
OMISSION OF NITROGEN FLUSHING

<u>diH Purity</u>				
<u>Heat</u>	<u>Bar 3-T</u>	<u>Bar 15-B</u>	<u>Bar 61-B</u>	<u>Average</u>
1070	.96	.96	.98	.967
1071	.73	.86	.54	.710
1072	.96	.99	1.09	1.013
1073	.20	.87	.63	.567
1074	.87	.85	.99	.903
1075	.97	.99	.94	.967
Average	.782	.920	.862	.855

More data will be needed before the effect of nitrogen flushing on purity can be evaluated. The results in Table V are typical of weekly express shipments. Since these weekly shipments include bars from near the ends (3-T and 61-B), the averages are usually below the averages for the entire heats.

Another series of twenty-five heats have been made in which the amount of CCl_4 was doubled during the heating phase ($1000 \rightarrow 2000^\circ \text{C}$) and from which nitrogen flushing was omitted. Functional test results on a weekly express shipment from this series are shown in Table VI.

TABLE VI
DOUBLED CCl_4 - NO FLUSHING

<u>diH Purity</u>				
<u>Heat</u>	<u>Bar 3-T</u>	<u>Bar 15-B</u>	<u>Bar 61-B</u>	<u>Average</u>
1099	.95	.98	.98	.970
1100	.86	.87	.99	.937
1101	1.05	1.06	.99	1.033
1102	.82	.58	.86	.753
1103	.95	.97	1.00	.973
1104	.97	.98	1.01	.987
Average	.933	.907	.972	.937

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The results in Table VI are better than those which are usually obtained on weekly express shipments. It is encouraging to note that bars 3-T and 61-B are considerably better than usual. This may be due to the use of larger (3/64 instead of 1/32 inch) orifices in positions 1, 2, 60, and 61 rather than to the increased CCl_4 feed. All that can be said at present is that the first returns look good.

A series of heats has been made without nitrogen flushing and with the amount of Freon doubled. The time during which the Freon was added was increased from 5 to 6 hours. Two weekly express shipments from this series have been tested, with results as shown in Table VII.

TABLE VII

DOUBLED FREON - NO FLUSHING

Heat	<u>Δ ih (Purity)</u>			
	<u>Bar 3-T</u>	<u>Bar 15-B</u>	<u>Bar 61-B</u>	<u>Average</u>
1125	.96	.77	1.04	.923
1126	.97	.13	1.06	.720
1127	.91	.85	.74	.833
1128	1.04	.69	1.00	.910
1129	1.02	.53	.91	.820
1130	.89	.54	.88	.770
1157	.83	.74	1.03	.867
1158	1.03	.91	.78	.907
1159	1.04	.78	1.05	.957
1160	.98	.63	.87	.827
1161	.94	.70	1.07	.903
1162	<u>.97</u>	<u>.76</u>	<u>.96</u>	<u>.857</u>
Average	.965	.669	.949	.861

The results in Table VII are definitely unusual. Bars 3-T and 61-B are ordinarily inferior to bar 15-B. The high quality of end bars relative to central ones indicated that residual chlorine might be responsible for the low Δ ih values on central bars. When bar 15-B of heat 1126 and bars 3-T, 15-B, and 61-B of heat 1128 were analyzed for chlorine content (by the pile activation method) they were found to contain about 15, 0, 10, and 3 ppm, respectively. There can be little doubt that the low Δ ih values are largely due to residual chlorine.

This residual chlorine is probably due more to the increased time of addition of Freon rather than to the higher rate of feed. This theory is supported by the functional test results on GXT heats 1018-X, 1019-X, and 1020-X, which were treated with double the usual amount of Freon, but for the same period of time, and which gave average Δ ih (purity) values of + .965, + .932, and + .851, respectively.

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Although all of the factors connected with increased Freon feed have not been evaluated, it is obvious that poorer graphite results when the Freon is doubled, the time of addition is increased, and no flushing is done. Standard procedure for the immediate future will involve the usual amount of Freon (290 lbs.) added over a period of 5 hours and followed by helium flushing.

A test has been made to determine whether there are consistent variations in quality of low purity GWF bars from one end to the other. Eight 4-ft. bars were cut into 1-ft. sections. The eight sections from the ends of the bars adjacent to the gas inlet tubes were tested together, the next eight sections together etc., with results as follows:

<u>Section</u>	<u>Aih (purity)</u>	<u>Remarks</u>
1	.24	inlet end
2	.07	
3	.38	
4	.16	

The purity of these poor quality GWF bars apparently varies in a random manner. If any differences do exist between the two ends of the bars, they are masked by larger variations due to other causes.

Functional tests are being made on experimental blocks of molded lampblack which have been purified at various temperatures. The Aih (purity) values on blocks which were purified at 2000° C and 2250° C were - .85 and + .02 respectively. A sample which was purified at 2500° C will be tested later.

(C) Unpurified

Because of the urgency of tests on GWF heats no CS heats were tested during February.

Rare Earths in Graphite

Functional tests have been made on samples of molded graphite containing various rare earth elements. From the functional test results, the known amounts of the elements added, and their absorption cross sections, it is estimated that more than half of the samarium, gadolinium, and dysprosium were removed by the gas baking and graphitization. These samples have been returned to Morganton for "F" processing. The main purpose of this treatment is to determine whether gadolinium and dysprosium are removed by the "F" process. It is already known that europium and samarium are removed.

Absorption Cross Section of Magnesium

The absorption cross section of a common commercial magnesium was compared with 28 aluminum in the Test Eilo. The samples used weighed about 1½ lbs. The cross section of the magnesium was found to be 74% as great as the 28 aluminum. Estimated absolute values of absorption cross section were 0.17 and 0.23 for magnesium and 28 aluminum, respectively.

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After the test on the commercial magnesium had been completed, it was learned that mercury had been spilled on the magnesium some time before. The value of 0.17 barns should, therefore, be considered as an upper limit for readily available magnesium. Uncontaminated "pure commercial" magnesium is now on hand and will be tested soon.

Water Activity

Calculations have been made on the radioactivity of recirculating water of a composition specified by Giffels and Valot, Inc. This water differs from that on which calculations were made previously in that it is to be made by a combination of demineralization and condensation methods, and contains less sodium. The details of these calculations are given in a separate document, (HW-12470, R. L. Dickman to File, Feb. 16, 1949).

Since September, 1948, the cooling water for the 105-B pile has contained only about one-half as much sodium silicate as was added in the D and F areas. A marked decrease in both the Na^{24} (14.8 hr.) and Mn^{56} (2.6 hr.) activities has occurred at B since then. The drop in Na^{24} was expected, but the cause of the Mn^{56} decrease is not known with any degree of certainty. It is believed that the gradual decrease in Mn^{56} resulted from the higher pH at the filter plant in B area. Since the pH of the water as it enters the piles must remain the same, and since sodium silicate raises the pH, any decrease in sodium silicate feed must be preceded by an increase in the pH of the water at the filter plant.

Pile Shielding

(A) Vertical Rod Guides for D-R

Results of radiation measurements outside the A test hole of the F Pile with an old (B, D, and F Piles) type vertical rod guide and with a new type (D-R Pile) guide in the hole were reported last month. In view of the high fast neutron flux through the D-R guide, it was decided to fill two of the spiral grooves with polythene. When this was done, the fast neutron intensity dropped from 1350 to 60 nram./hr. The maximum gamma intensity dropped from 35 to 12 mrc./hr.

The polythene obviously did a lot of good. Two of the grooves in all D-R rod guides have already been filled with polythene, and, in view of these test results, will be considered satisfactory from the radiation standpoint. Further details will be given in the final report on the production test (P.T. No. 105-225-P).

Radioactivity of Titanium

A sample of commercial titanium sheet about 1/16 inch thick has been irradiated in the third slot of the E test hole of the F Pile. Measurements of radioactivity were made as a function of decay time. The estimated half lives and intensities, together with probable sources of the observed activities, were as follows:

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TABLE VIII

RADIOACTIVITY OF TITANIUM

<u>Half Life</u>	<u>Probable Reaction</u>	<u>Saturated Activity per gram * at a Distance of 6 Inches</u>	
		<u>Beta (mrep/hr.)</u>	<u>Gamma (mr./hr.)</u>
6 min.	$Ti^{50}(n,g) Ti^{51}$	< 10,000	0
2.6 hrs.	$Mn^{55}(n,g) Mn^{56}$	8,800	1100
~14 hrs.	$Na^{23}(n,g) Na^{24}$ $Cu^{63}(n,g) Cu^{64}$	480	4
~4 1/2 hrs.	$Ti^{48}(n,p) Sc^{48}$	290	32
long 2-3 mo.	$Fe^{58}(n,g) Fe^{59}$ $Ti^{50}(n,g) Ti^{51}$	590	87

*

If the irradiation had been made in the center of the pile, the intensities would have been about 10 times as great.

The probable sources of the observed half lives were deduced from the results of a spectrochemical analysis which showed the following impurities:

Aluminum	Trace (< 0.01%)
Copper	Trace
Iron	Moderate (0.01 to 1%)
Magnesium	Trace
Manganese	Moderate
Silicon	Trace to moderate

This titanium isn't too bad for a control rod material from the radioactivity standpoint. It would be much more satisfactory if the manganese and copper (and sodium, if any) were removed, however. Efforts are being made to obtain purer metal.

Critical Mass Experiments

Plans are being made for a series of experiments to determine the critical mass of plutonium under a variety of conditions. A delegation of Hanford technical men visited Los Alamos for the purpose of picking up information about somewhat similar experiments which have been done there.

Because of the desirability of doing the experiments in a location which can be abandoned in case of serious contamination, an isolated tract house has been tentatively selected for a control room. A small experimental building will be built at a distance of 200 feet from the control house.

Plans for the experiments have advanced far enough to be turned over to the Design Division as soon as the Project is approved. Through conversations with the Instrument Division, tentative plans for the types and quantities of instruments have also been agreed upon.

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GRAPHITE GROUP - A. A. Johnson

Heat of combustion values obtained by the 300 Area Analytical group on graphite mined from 3169-F at the location of the ruptured SR-15 piece under P.T. No. 105-237-P indicate an average stored energy of 500 cal./gram. Comparisons between samples along the bore are inconclusive because of wide variations in check determinations. Portions of these samples have been sent to the National Bureau of Standards for Stored Energy Measurements. Sykos stored energy will be run here.

Considerable recovery in c-axis was observed for samples placed in an empty process tube at ambient pile temperature. After 1.5 years samples previously irradiated 1110 MD/CT and 446 MD/CT recovered 62 and 50%, respectively. Most of this recovery occurred during the first year.

Further work on boron containing graphites have shown that an acceleration factor of about 5 can be obtained for samples with 10 mg. of boron per gram of graphite. Arrangements have been made to have National Carbon extrude 10 bars of graphite containing boron.

The effective flux along the length of the B test hole at 105-F was monitored by observing the change in electrical resistance that resulted from one week's exposure. The results show that for at least 100 inches on each side of center, the effective neutron flux is constant except for a variation of approximately 10 percent which is periodic and corresponds to the lattice spacing. Poison columns one and one half lattice units away from the test hole have practically no effect on the flux.

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