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PILE ENGINEERING - GROUP IDETAILS - W. K. Alexander

Inspection and measurements of the metal exposed on Production Test 105-119-P indicate the following:

1. Rolled, lead-dipped slugs do not blister, but do contract lengthwise and expand diametrically.
2. Rolled, triple-dipped slugs blister slightly but are much more stable dimensionally.
3. Gamma-extruded, lead-dipped slugs blister badly but are quite stable dimensionally.
4. Gamma-extruded, triple-dipped slugs blister, but are quite stable dimensionally.
5. Out-gassing and type of metal do not appear to have any real effect on the behaviour of the slugs.
6. The average length and diameter changes are directly proportional to the exposure of the slugs.

Production Test 105-124-P indicates that straightening, outgassing, and the portion of the rod from which the slug came have no real effect on the dimensional stability of the metal. It further confirmed the findings of Production Test 105-119-P that the methods of metal fabrication and canning are the two important factors.

Dimensional measurements were taken on the rolled, triple-dipped metal from Production Test 105-91-P which had previously been inspected for blistering. This was done to obtain more data on this type of metal since it is the type being currently produced. These data indicate that this type of metal presents a good compromise in behavior between blistering tendency and tendency toward dimensional changes.

Parts I, II, and III of Production Test 105-173-P, Supplement A, were carried out at the F Pile during the month. The data indicate that after two hours down time the total rate of heat output of the pile is approximately four MW. It was demonstrated that at this time 3500 gpm is sufficient to cool the pile without exceeding a ten degree rise in any tube. After three hours down time the heat output is down by 1/3 and 2000 gpm is sufficient to cool the pile.

It has recently become apparent that some of the vertical safety rods at both the D and F Piles are not going in all the way when the rods are dropped. Borescopic examination at F revealed the cause to be accumulated rust and scale in the bottom of the thimbles. About a dozen such cases have been noticed at both D and F Piles. Some of the rods remain out so far that the bottom limit switch is not contacted. This condition is being corrected by cleaning the thimble with vacuum equipment. Borescopic examination of two of the original thimbles at B Pile indicated only a negligible amount of this material.

Two tubes, 1973-D and 1160-F, were found to be stuck due to badly distorted pieces. Several others were hard to punch but were not considered stuck.

Tube No. Exposure Day# MD/Tube Type O.K. Bl. Mod. Rpt. Warp Dia. Length Corrosion Mills/mo. Ave. Max.

P. T. 91

1670-F	172	26.2	Type H	0	0	0.011	0.002	8.682	
1671-F	172	26.2	Triple-Dipped						
1672-F	172	26.2	Previously Reported						
1673-F	172	26.2							
1674-F	172	26.2							
1675-F	172	26.2							
1676-F	172	26.3							
1677-F	172	26.2							

P. T. 119

1968-D	223	35.6	Group 1	28	1	0	0.025	0.014	8.555
1968-D	223	36.7							
1979-D	223	35.6	Group 3	30	0	0	0.026	0.017	8.537
1568-D	187	29.6	Group 1	41	4	0	0.018	0.011	8.615
1973-D	187	30.8	2	30	3	0	0.013	0.009	8.644
2172-D	173	28.3	3	38	0	0	0.016	0.009	8.620
2174-D	173	28.3	4	5	17	0	0.008	0.003	8.685
2175-D	173	28.3	5	11	17	0	0.006	0.003	8.691
2376-D	173	28.3	6	11	4	0	0.007	0.003	8.679
2667-D	187	29.9	7	0	11	9	0.010	0.001	8.695
2670-D	187	30.6	8	1	13	9	0.011	0.003	8.694
2868-D	187	20.1	9	0	7	14	0.011	0.003	8.702
2872-D	187	30.8	10	3	19	0	0.008	0.003	8.712
			11	9	15	0	0.009	0.003	8.712
			12	1	23	2	0.009	0.004	8.706

P. T. 119 - Supplement A

From 27 tubes	Normal (25 MD)	20	0	0	0.016	0.009	8.614
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HW-10160
HW-10160

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INSPECTION DETAILS (continued)

Tube No.	Exposure		Type	Blistering			Warp	Dia. (inches)	Length	Corrosion Mills/mo.		
	Days	HD/Tube		CR	SL	Ext.				Ave.	Max.	
P. T. 124												
1267-F	162	24.1	A	0	6	14	0	0.010	0.002	8.702	---	---
1762-F	162	24.1	B	0	1	18	0	0.013	0.003	8.687	---	---
1785-F	162	24.1	C	0	5	15	0	0.011	0.002	8.694	---	---
1864-F	162	25.4	D	0	4	15	1	0.013	0.003	8.696	---	---
1883-F	162	25.4	F	0	2	17	1	0.012	0.003	8.678	---	---
2086-F	162	24.1	G	0	4	16	0	0.016	0.002	8.687	---	---
2184-F	162	25.4	H	0	4	16	0	0.012	0.001	8.648	---	---
2263-F	162	25.5	J	0	1	19	0	0.013	0.003	8.682	---	---
2553-F	162	25.5	K	15	5	0	0	0.020	0.011	8.570	---	---
2584-F	162	25.5	L	17	3	0	0	0.021	0.007	8.627	---	---
2964-F	162	25.4	M	18	2	0	0	0.020	0.007	8.615	---	---
2983-F	162	25.4	N	17	3	0	0	0.023	0.007	8.615	---	---
3165-F	162	25.5	O	16	4	0	0	0.021	0.006	8.626	---	---
3182-F	162	25.5	P	16	4	0	0	0.014	0.007	8.614	---	---
3472-F	162	25.5	S	14	6	0	0	0.023	0.011	8.565	---	---
3475-F	162	25.5	T	14	6	0	0	0.019	0.010	8.592	---	---
P. T. 73												
3580-F	371	50	Four Inch	15	103	10	0	---	---	---	0.04	0.06
3670-F	371	50	Four Inch	---	---	---	---	---	---	---	0.04	0.07
1578-D	166	25	Corr.	4	27	1	0	---	---	---	0.04	0.06
2688-F	165	25	Corr.	6	25	1	0	---	---	---	0.03	0.04
3356-F	301	25	Corr.	2	29	1	0	---	---	---	0.03	0.06

* See P. T. 124 for explanation of these groups.

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DETAILS - C. P. CabellVan Stone Flange Corrosion

The hot flow laboratory was operated at 97° C on the hot side for two weeks because of a defective recorder. The recorder was repaired and the temperature reduced to normal. Inspection of the specimens showed the following:

All tests below have two weeks exposure at 97° C hot side and 50° cold side plus the time shown.

- A. Zinc gaskets only. 14 weeks at 90° - 50° slight pitting on inside periphery of zinc gaskets. No pitting on Van Stone.
- B. Magnesium gaskets (special high grade). 5 weeks at 90° - 50° C. Pronounced corrosion on 50° C washer. Corrosion on 90° washer partly covered by hard scale. No pitting on flanges.
- C. 2-S aluminum washers. 23 weeks at 90° - 50°. Washers and flanges in excellent condition. Cold side bright and shiny.
- D. Controls (asbestos gaskets). 23 weeks at 90°-50°. No corrosion on flanges.

Teflon and "MFT-10 methyl-flex" were tested for possible use for Van Stone gaskets. They held 400 psi water pressure satisfactorily, but exhibited excessive cold flow after one week under load. The cold flow of the MFT-10 was less than that of the Teflon.

Segmental Discharge

The new "segmental pull" equipment devised by the writer was demonstrated successfully to representatives of the "P", Technical, Project Engineering, Maintenance and Instrument Divisions, and to AEC officials, in the F Flow Laboratory and on the B Pile. These tests indicated the need for minor modifications to the oil-feed system. These modifications have now been made.

The equipment consists of a 50 ft. spring steel tape 1/2" wide by 1/32" thick, a reel mounted on the charge head, a spinal tip-off, and a gripper slug. The tape is fed through from the front face to the rear, where the gripper slug is attached and positioned below the tip-off. The tube is discharged with the tape and gripper slug in place. The tape is then wound on the reel by hand, pulling the slug column back. The tape is then pulled to the rear face, the gripper removed, and the tape wound back to the front face.

Tests are scheduled in June to determine the radiation problems which may be encountered in using this equipment. However, the spring-steel spline was used three times in connection with operating emergencies on the piles during the month, and experienced negligible contamination.

Future work on the segmental-pull development will consist of improving the operational aspects of the equipment and reducing time requirements. A large-scale test program on the piles is anticipated.

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DETAILS - B. A. Rohrbacher

Nine specimens of Al process tube were anodized under carefully controlled conditions using different electrolytes and exposure times. The Al specimens were $\frac{1}{2}$ " strips covered by several inches of electrolyte. The potential was applied between the specimen and a carbon electrode.

When 3% chromic acid was used as an electrolyte during anodizing the current flow slowly increased from .030 amp. to .073 amp. at approximately 48 volts during the 45 minute period. With an 8% oxalic acid electrolyte the voltage was immediately reduced to approximately 36 volts to keep the current flow under .5 amp. (arbitrary maximum for this specimen size), and to eliminate excessive heating of the solution. After 35 minutes the voltage was reduced to approximately 30 volts for the same reason.

When boric acid was used (5% boric acid in solution with 5% sodium tetraborate) the opposite effect was observed. After 3 minutes of anodizing the current was less than 10 milliamps and slowly decreased to approximately 1 milliamp in 45 minutes. This indicated that a non-conducting coating was being formed on the Al surface during anodizing. Although thin, this coating may have considerable protective value.

Flow cup tests are being planned to measure potential and current when these specimens are coupled to a stainless steel electrode.

Seven Mg and Al alloys are being prepared for sacrificial anode tests.

A considerable number of slug measurements were made this month. The results will be reported by W. K. Alexander.

DETAILS - C. W. DotsfordGraphite Allocation to DR

Graphite has been allocated for approximately 65% of the DR File. The following objectives have controlled the allocation procedure to date: 1) a proper distribution of graphite quality in various zones of the unit to guarantee maximum reactivity, and 2) segregation of graphite types in each of the various color zones of the unit in a sufficiently large number of layer groups to permit a long range study of radiation effects at various intensities on each type of graphite.

The following table shows a breakdown of the location of graphite types, the average quality of the graphite released to date, and the proposed distribution in the unreacted portion of the DR File.

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C O L O R Z O N E

Layer	<u>Red</u>		<u>Blue</u>		<u>White</u>		<u>Green</u>	
	Type of Graphite	Average Δ ih	Type of Graphite	Average Δ ih	Type of Graphite	Average Δ ih	Type of Graphite	Average Δ ih
1-25	CS	- 0.02	CS	+ 0.127	KC	+ 0.281		
26-45	KC	- 0.13	KC	+ 0.116	KC, KF & CS	+ 0.286	KCF	0.885
79-102	CS	- 0.02	CS	+ 0.127	CS	+ 0.217		
46-65) pro-	CS & KS		KS & CS		KS		KCF & CHF	
66-78) posed	KS		KS		KS		KCF & CHF	

The average quality of the white zone material in the 79-102 layer groups is lower than the average obtained in the other white zones. There will be no loss of reactivity however for the material used in the region would have had to be used if indiscriminate mixing of types was followed.

The minimum quality of the white zone material is the same for all types of graphite used; however, in the case of the KC graphite the quality range above the minimum exceeded that of CS which resulted in a higher quality average.

The green zone in the DR Pile was increased 35% by encroachment into the white zone boundary and will result in an estimated increase of 70 in hours. The change was made as a result of a shipping forecast which showed that there would be a deficit of white zone material and an excess of green zone material inventory at the proposed completion date of machining for the DR Pile.

DETAILS - H. W. Ritchey

Van Stone Flange Corrosion

The theory was advanced that mechanical defects may initiate the pitting type of corrosive attack encountered in flanges on the piles. In order to test this theory, 71 flanges were made using a variety of combinations of annealing and mechanical forming techniques and were examined for flaws at the General Electric Works Laboratory at Schenectady. A detailed description of this work appears in the report dated May 28, 1948 entitled "Trip to Schenectady, May 10-13".

The flanges were examined using "Zyglo", a fluorescent oil. Specimens are first soaked in this oil, the excess then removed by washing, and the oil which seeps from cracks back to the surface is detected by examination under violet light. Flaws were found on the faces of ten of the flanges examined, most of which could be suspected of being serious enough to initiate pitting of the flange when used on a pile. A number of other flaws were found in locations not susceptible to corrosion.

No correlation was obtained between these defects and the techniques used in formation of the flange. Apparently most of the defects which were observed on the flange faces were of a nature which could be attributed to areas of weak bonding of the Alclad layer. It is possible, however, that the vigorous de-oiling caused some flaws to be missed in the examination, and the test will be repeated using different procedures.

H. W. Ritchey
H. W. Ritchey

PILE ENGINEERING - GROUP II

Replacement of Pile He Atmosphere with CO₂ - S. S. Jonas

The helium purity at the D Pile was maintained at 75% during the month. The amount of CO₂ at operating conditions varied from 12 to 24% depending upon the amount of air leakage into the Pile. This leakage was abnormally high during the far side rear neoprene seal replacement. It required two weeks to raise the CO₂ concentration from 12 to 27% while keeping the He concentration at 75%. The consumption of CO₂ during the month was slightly less than that computed from the gas analyses, as shown in the following table. This indicates no excess CO₂ used during the month.

ADDITION OF CO₂ TO THE He ATMOSPHERE OF THE 100-D PILE

Period	Volume Gas Added			Aver. % CO ₂		CO ₂		CO ₂	
	CO ₂	He	Total	Orsat Anal. of Pile Gas	In Make-Up Gas	Accountable Addition	Unaccountable Addition		
	(Std. Cu. Ft.)					(Std. Cu. Ft.)		Period	Total
Jan. 27 -									
May 2	63,560	174,940	238,500			32,210		21,600	21,240
May 3-9	3,190	10,604	13,794	24	23.2	3,350		160	21,190
May 10-16		26,800	26,800	10		2,680		2,680	18,210
May 17-23	6,010	11,760	17,770	16	33.8	3,800		2,130	20,070
May 23-30	2,770	15,000 21,180	17,770	20	15.6	4,750		1,980	21,000

* Approximate figure, assuming average value with excess due to leak of He in He system.

There was no significant increase in expansion or stress on the D Pile shielding that could be attributed to the CO₂ experiment.

Cork Removal - T. W. Gore - S. S. Jonas

Removal of the cork strip between the far side and concrete wall at the D Pile permitted a 1/4" outward tilting of the shield along the discharge face after two weeks operation as shown in the following table.

MOTION OF FAR SIDE SHIELDING AT D
AFTER REMOVAL OF CORK SEAL

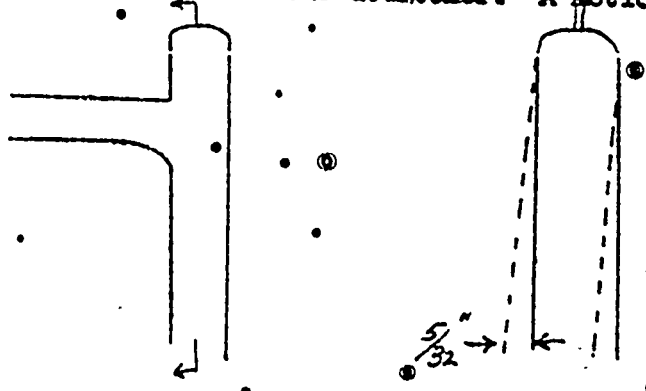
Type of Motion	Instrument		Ref. Date	Motion From Ref. Date to 1948			
	Type	Elev. ft.		May 4	May 10	May 14	May 28
<u>Pile Shut-Down</u>							
1. Separation of Far Side from the Rear Face	EMI	41	1-22-48	0.03	0.04	0.14	0.27
	EMI	35	6-1-46	0.08	0.04	0.13	0.26
	EMI	30	6-1-46	0.00	0.01	0.05	0.14
	EMI	21	1-22-48	-0.03	0.02	0.02	0.06
2. Separation of Far Side from the Top	Arms Gauge	43	2-3-48	0.515	0.490	0.464	0.537
3. Strain on Retaining Brackets	Strain Gage East West		3-9-48	(microinches per inch compression)			
				214 50	323 -17	201 57	203 50

In addition, micrometer brackets were installed on the I level side of the concrete wall. These indicated a 0.020 inch outward tilting after cork removal before startup. Measurements have not been taken during operation because of radiation hazard.

At the F Pile measurements of micrometer brackets since removal of the cork between the top and concrete indicate an upward lifting of the top of 0.062 inches at the far side, 0.012 inches at the center, and 0.038 inches at the near side.

Downcomer Tests - T. W. Gore

Measurements were made of the motion of the B downcomer at 350 lb. header pressure. A measuring gauge which would measure only the maximum movement of the downcomer was placed at the base of the downcomer. A motion of 5/32 of an inch was measured.

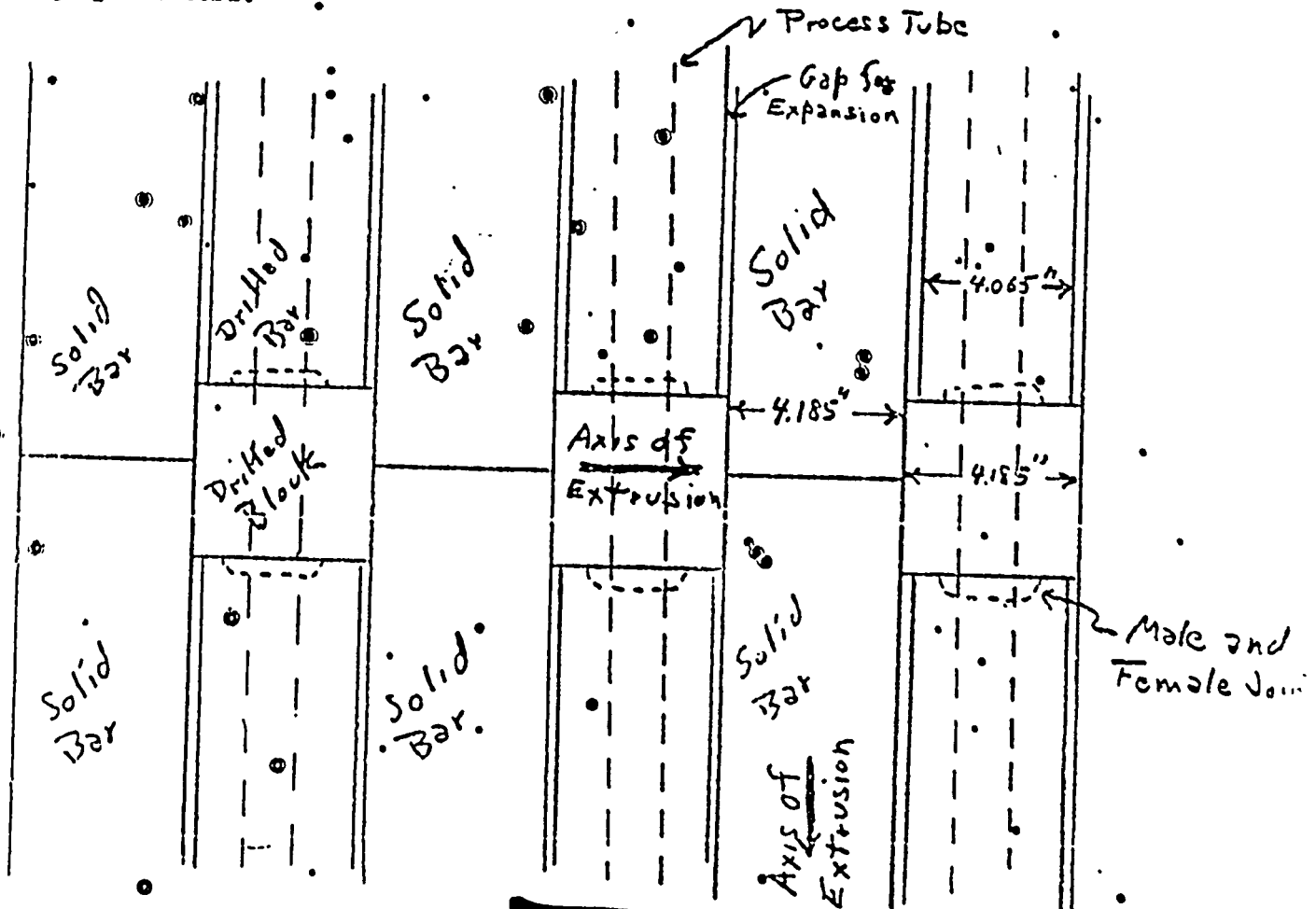


At 200 lb. header pressure this motion was 3/32 of an inch. At 100 lb. header pressure this motion was less than 1/32 of an inch.
 The downcomer support brackets are loose and in need of repair.

Measurements of suction in downcomer ducts at the F Pile as taken by the P Division before each startup do not indicate any distortion or plugging of the baffle system since the inspection of November 29, 1945. An inspection of the inside of the downcomer cannot be made until the old dome which was cut off at the time of installation of a "soft spot" has been removed. An removal of this dome will require about 200 man hours and may involve some radiation hazard due to flame cutting of contaminated material, the inspection does not appear justified unless there is some change in the gage readings or unless the dome is removed for other reasons.

Graphite Block Design for H Pile - J. T. Carleton

The use of undersized process tube blocks for H Pile has been recommended by the Technical Division to minimize adverse effects of graphite expansion. This has met with opposition from the Construction Department because of the time involved in spacing the tube blocks laterally during assembly. An alternative was worked out whereby the tube blocks in the pile would be alternately 4 1/4" and 4" long. The 4" blocks are to be cut so that the axes of extrusion are horizontal and perpendicular to the process tubes. Since the graphite does not expand in the direction of extrusion, these small blocks will be 4.185" in the dimension perpendicular to the process tubes and a laterally rigid structure will result. The following sketch illustrates this. Arrows show direction of extrusion of the raw graphite bars.



Beta Experiment, S. R. 79 - J. B. Lambert - J. C. Chatton

Beta slug No. B-5 was charged into tube 1481-F and started on May 1. Referring to a graphite temperature of 250° , the power generation in the uranium was calculated to be 42.5 watts on May 6. (A value of 250° for graphite temperature on April 20 is probably more accurate than 253° which was previously reported. The graphite was at 253° on March 12.) Referring to the same graphite temperature on May 11, the power generation appeared to have dropped to 37 watts. This was not expected and is attributed to interpretation of insufficient data. The ambient graphite temperature could not be measured, and had to be deduced from previous runs without uranium. If the graphite temperature were assumed to have dropped to 240° on May 11, the power generation would calculate to be 42.5 watts. The temperature of neighboring tubes was one degree higher on May 11 than on the sixth, so the drop in graphite temperature must be accounted for otherwise.

It is reasonable to suppose that the annealing caused by the elevated temperatures may be causing a decrease in graphite temperature in the region of the beta slug. This annealing should take place in a few days. The graphite has been at approximately 250° for the following periods:

SLUG NO.	FROM	TO
D-4	8 PM March 6	6 AM March 7
D-4	4 PM March 7	9 PM March 15
D-6	11 PM April 11	6 PM April 25
B-5	7 AM May 1	5 PM May 1
B-5	11 PM May 1	11 PM May 11
None	May 13	May 18
None	May 20	May 25
B-1	3 AM May 27	1 PM May 27
B-1	8 AM May 28	1 PM May 28
B-1	7 PM May 28	11 AM May 30

There is some basis for believing that the graphite is being annealed and the temperature going down. On March 10 and 12 the inlet water temperature was 5° , the outlet temperature of the neighboring tubes was 44° , and the graphite temperature 253° . On April 20 the inlet water was 9.3° , the outlet of neighboring tubes was 46.5° , and the graphite temperature 250° C. That the graphite temperature should have dropped 10° between May 6 and May 11 seems hardly probable, however.

Resistance to ground dropped to 400 ohms at the end of the run. This measurement was made at 175° , 45 minutes after the unit was down. A measurement 12 hours later at the same temperature showed that the resistance had recovered to a value of 23,000 ohms.

The slug was discharged without trouble on May 12, and is being stored for decay before opening.

Slug No. B-1 was charged on May 26, and has satisfactorily followed the capricious operation of F. Apparently it will take approximately 70 days at power for full-time irradiation of this slug (5% fission).

When the heating coil and its cable were disconnected from the control circuit, a steady DC voltage to ground was measured. This was highest when the temperature of the pile was changing rapidly (start-up and shut-down; up to 0.06 volts), and disappeared as the pile became steady. The reason for this voltage is not known, but similar voltages may cause errors in pile thermocouples which are isolated from ground.

A request has been repeated for as many as four irradiations proceeding simultaneously, and equipment is being prepared for two more tubes at present.

WKW:bb

W. K. Woods

W. K. Woods