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HW-10548

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July 19, 1948

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This document consists of

12 pages. No. 3
13 copies. Series A

100 AREAS TECHNICAL ACTIVITIES REPORT - ENGINEERING

JUNE, 1948

COPY 1 OF 1

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PILE ENGINEERING - GROUP IDETAILS - W. K. AlexanderSlug Blistering and Corrosion

Routine inspection of regular metal and corrosion pieces this month gave no unusual results. Two tubes of four-inch rolled lead-dipped slugs were inspected at 50% normal concentration to see if the dimensional changes this metal undergoes were having any effect on the cans. This was prompted by the recent failure of one of these slugs at the F Pile. There were no signs of any kind of can distortion or failure.

Two corrosion tubes were loaded in the B Pile prior to the start-up.

Four tubes of alpha-rolled and alpha-extruded metal were loaded at 100-F Area on Production Test 105-191-P. This metal was measured for length, diameter, and warp and was weighed in two liquids for density measurements.

Listed below in tabular form are the inspection data for the month:

Tube No.	Type	Exposure		Blistering				Penetration Rate		
		MD	Days	O.K.	Sl.	Mod.	Ext.	Ave.	Max.	Mils/mo.
3052-F	Regular	25	588	1	29	2	0	--	--	
2178-D	Regular	25	150	5	27	0	0	--	--	
2669-D	Corr.	25	152	5	26	1	0	0.05	0.08	
2173-D	Reg. 4"	13	77	These slugs were not inspected for blistering but were inspected for can failure.						
	Rolled									
2773-D	"	13	77							

Also discharged but not inspected were the final 11 tubes of four-inch pieces on Production Test 105-75-P.

The weighing of the 8" pieces in tetra-bromo-ethane in the presence of water proved to be quite difficult. The most difficult part was to prevent drops of water clinging to the slug and being carried into the heavy liquid. These drops of water have buoyant effect on the slugs which was quite appreciable. The coefficient of expansion of the heavy liquid seems to be quite large and a standard slug was weighed in the liquid at temperatures ranging from two to twenty ° C to obtain a correction curve for the expansion effect.

DETAILS - C. W. BotsfordGraphite Allocation to DR Pile

Graphite has now been allocated for 87% of the DR pile. There is a sufficient amount of tested graphite to meet the red and blue zone requirements for the unit. The shipping rate of the green material is in excess of requirements.

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Difficulty is being encountered, however, in obtaining sufficient quantity of white zone material without downgrading the quality limitation. The unpurified KS material which is currently being received has provided no white zone quality material. Due to this quality drop a deficit of 4000 white zone bars is expected, necessitating several changes in scheduling in order to prevent downgrading.

There were 1400 bars of purified graphite with a Δh of less than + 0.80 which were of lower purity than the green zone material. Those bars were placed in the white zone, but were scheduled only for use in specific block details which touch the green zone and thus effectively increased the green zone.

All of the KC graphite remaining at Morganton, totaling some 1000 bars, are being sent to Hanford and should be white zone material.

The surplus graphite from the 105-F unit is being tested and it is expected that from 800 to 1000 bars will be satisfactory for the white zone.

The graphite shipping schedule and prompt graphite testing program has enabled the 101 operation to proceed at maximum speed throughout with no shutdown due to material shortages.

Slug Molding

An attempt was made to mold exposed uranium slugs using "Dupli-Coeloid" molding powder, but the results were unsatisfactory. The molding compound adhered excessively to the slug and prevented removal of the slug from the mold. It was hoped that this material would be satisfactory since it does not require heating and was slow setting. "Dentacol", which requires heating, is the best molding compound tested to date.

DETAILS - C. P. Cabell

Segmental Discharge

Segmental discharge was successfully conducted on two pile tubes, 1881-F and 2863-F, during the month. Each tube was segmentally-discharged twice, for a total of four successful operations.

No undue contamination was experienced during these tests. Removal of perforated dummies from the front of the tubes presented no serious contamination problem, and contamination of rear-face equipment was not excessive. It was found, however, that the contamination picked up by the gripper slug and cord was enough to require frequent changing of gloves, and improved methods of handling this equipment will be developed.

Earlier in the month the reliability of the equipment was unintentionally demonstrated. In a test on tube 1866-F, the gripper slug was placed on the tape upside down, and the tape broke when efforts were made to pull the column back. The tube was then discharged without incident by pushing from the front. This occurrence demonstrated that the "reel and spline" segmental discharge system is practically fool-proof, and that accidents, failures, or operating errors are not likely to result in serious consequences.

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For more precise evaluation of beams encountered during segmental discharge, H. I. is planning film tests in order to establish time limits.

Tests on a six-inch stainless steel slug, 1.490 $\pm$ 0.003" diameter, showed that such a slug, when positioned in the front nozzle, allows no detectable beam to escape from a tube containing no water or other shielding slugs, and loaded with active slugs ready for discharge. Scattered radiation was found to be about 5 mr/hr.

A careful investigation by the Instrument Development Division disclosed that there is no practical method of counting the slugs as they are discharged. Experience with the segmental discharge equipment indicates that a precise separation can be made.

Corrosion of Van Stone Flanges

At a meeting attended by representatives of the P Division, Technical Engineering and Statistics, a program for inspection of Van Stone flanges was established and recommended to the P Division. The program is as follows:

- A. Inspect half the flanges on the DR type tubes in the piles every 8 months.
- B. Inspect flanges on 60 tubes per face per pile per year, as follows:
 - 1. 20 "old" Van Stone flanges in the 0.140" zone. It is felt that from this data we can predict performance in other zones.
 - 2. 20 Van Stone flanges in the 0.140" zone and 20 Van Stone flanges in the 0.240" zone, said flanges being of the group formed during the recent repair program.

DETAILS - R. A. Rohrbacher

Anodizing of Al Process Tube Specimens

Specimens were cut from an Alclad aluminum process tube in half-inch strips and then anodized. Solutions of chromic, boric, and oxalic acid were used as electrolytes and three specimens were anodized in each electrolyte for periods of 5, 15, and 45 minutes.

Open circuit potential measurements were made with a glass-electrode voltmeter between anodized Al specimens and a S.S. electrode of the same surface area. The above electrodes were approximately 1/2" apart in flowing process water at inlet water temperature. Although the open circuit potentials of the anodized specimens were higher than the control (unanodized) specimen at the start of the test, all the specimens had approximately the same potential after 24 hours. These measurements indicate some degree of porosity or conductivity of the anodized specimens.

Current measurements in corrosion cells showed that anodizing aluminum, using the above methods, did reduce the galvanic current, but did not stop pitting of the Al. The table below shows the correlation between calculated weight loss by corrosion of Al and observed pitting.

CORRELATION BETWEEN CALCULATED WEIGHT
LOSS BY CORROSION OF AL AND OBSERVED PITTING

<u>Speciment</u> (type)	<u>Length of Test</u> (days)	<u>Ave. Current</u> (micro-amps)	<u>Calc. Loss</u> (mg.)	<u>Observed Pitting</u>
Control	19	7.9	1.21	{ 2 large pits
Chromic**	19	1.9*	.29	5 small pits
Boric**	12	4.1*	.62	1 small pit
Oxalic**	12	4.4*	.67	1 med. pit
				6 very small pits

* In all cases with anodized specimens no measurable current flowed during the first several hours of the experiment.

** Anodized for 45 minutes.

Control specimen - unanodized
Chromic - 3% chromic acid solution
Boric - 5% boric acid with 5% sodium tetraborate
Oxalic - 8% oxalic acid solution
Small pit - less than 1 m.m. in diameter
Medium pit - about 1 - 1.5 m.m. in diameter
Large pit - several square m.m. in area

Microscopic examination of the above specimens showed the following: The control specimen was found to be the worst in this group as regards pitting. The two large pits covered several square m.m. and penetrated the Alclad. There was some indication of preferential corrosion. The specimens anodized with chromic and boric solutions both had one pit, the latter penetrating the Alclad. The specimen anodized with oxalic acid showed very small pits hardly distinguishable from surface flaws on the metal. The coating in this case could not be easily scratched. This is of interest since a soft, easily scratched coating is undesirable.

Plans have been made to continue the study of anodizing in order to find a suitable protective coating. This work will include various preliminary treatments as well as sealing after anodizing.

Experimental Mg and Al Alloys

Five Mg and two Al alloys are being tested in a tri-metallic corrosion cell. The alloys were placed between Al and S.S. electrodes in flow cups. The corrosion current was calculated from the potential drop across a 100-ohm resistor connected to each electrode. The other ends of the resistors were shorted together. To date the Mg alloys have acted as sacrificial anodes to protect the Al, but in the cells containing the Al alloys both the Al and Al alloys were anodic to the S.S. The above test on these experimental alloys is continuing.

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Flow Laboratory Modifications

Plans have been made to increase the number of tubes in the 100-D Flow Laboratory. Twelve "short" tubes will replace the four "long" tubes so that additional nozzle assemblies will be available to test various Van Stone protective methods such as anodizing, using a metal gasket as a sacrificial anode, and various protective coatings. Water flow to the tubes will be a series - parallel system whereby three tubes in a line will be connected in series. A "long" tube can be re-installed by removing the intervening nozzle assemblies.

H. W. Ritchey
H. W. Ritchey

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PILE ENGINEERING - GROUP IIDowncomer at B Pile - T. W. Gore

A circular hole 18 inches in diameter was cut in the side of the B downcomer for the purpose of removing the bottom 5 feet of baffle. It was found that the vertical section of the baffle had torn loose. A visual inspection of the inside of the downcomer pipe and cushion chamber showed that:

1. The baffle had progressively torn loose along the sides. The bottom 7 feet of the baffle was not continuously welded. (see sketch)

2. Scratches on the inside of the pipe showed that the baffle plate had inscribed an arc at the base of the baffle of $19\frac{1}{2}$ inches on one side and 8 inches on the other side before tearing loose at the top of the vertical section. These scratches were not serious enough to warrant any repair to the pipe itself.

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3. The top 7 feet of baffle was bent in a slight arc indicating that a more efficient design may have been realized by use of a stream-lined section. At five feet from the bottom two horizontal tears approximately 6 inches long on one side and 14 inches on the other reduced the strain thereby keeping the bottom section flat.
4. The baffle and walls of the downcomer had only a slight brownish film on them with no appreciable evidence of erosion.

The damaged condition of the cushion chamber indicated that the baffle had been in the cushion chamber for a considerable length of time. Sketch shows position of baffle and damage done to cushion chamber.

The bottom center and plate was broken in half and wedged in the bottom, holding the torn bottom plate in position.

All the stainless steel plates in the cushion chamber were loose because no precaution had been taken to prevent nuts from backing off the 3/4 inch anchor bolts.

Several large circumferential cracks in the 42 inch concrete sewer line were found. Similar cracks were also found at the entrance of 107 basin.

The downcomer support brackets were shimmed solidly and bolted securely on the supporting beams. Measurements made at 350 lb. header pressure before and after repair resulted in a decrease of the motion at the bottom of the downcomer from 5/32 of an inch to 3/64 of an inch. A noticeable decrease of amplitude of vibration at the top of the downcomer was also observed. Three semi-circular 3 foot sections of 1/4 stainless steel plate were welded on the outside of the downcomer pipe. Observations will be made in the future as to the strength this imparts to the system.

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Downcomer at D Pile

The 12 inch breather line was removed on the downcomer at D Area revealing that the baffle had also failed. Further investigation of this system will be made at the time of the DE tie-in with the process sewer line.

The possible reason for failure of the B and D Areas' baffle design is that large volumes of air are entrained in the system. This sets up pressure fluctuations which caused irregular surges in the water flow to the baffle system. These surges overstressed the baffle system causing failure of the baffle.

A possible clue as to the failure at D Area may have occurred in December, 1945 when a 4 inch crack was found in the downcomer pipe at the top of the baffle system. The location of the crack indicates the reason for the tear now that we know the baffle has failed.

Annealing of Pile Graphite - J. T. Carleton

A heater supplied by Pittsfield to anneal the graphite surrounding a process hole failed during test in an assembly of graphite machined to simulate the pile. J. T. Carleton went to Pittsfield to expedite delivery of more heaters as described in detail in Document HW-10294. Attempts to fabricate a heater at Hanford have not been successful.

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P. T. No. 105-168-P - Replacement of Pile He Atmosphere with CO₂ - S. S. Jones

The helium purity was maintained at 76% during the month with a nominal carbon dioxide concentration of 25%. As shown in Table I, all of the carbon dioxide currently being added to the system can be accounted for and there is no excess consumption of gas at this time.

TABLE I - Addition of CO₂ to the Pile Atmosphere

Period	Volume Gas Added			Average % CO ₂		Accountable Addition of CO ₂ , Volume	Total Unaccountable Addition of CO ₂ since 1/27/48 Volume
	CO ₂	He	Total	Orsat Anal.	In Make-Up Gas		
Jan. 27 to May 31	80,290	245,230	325,510	--	--	59,290	21,000
May 31 to June 6	2,300	10,190	12,490	22	18.4	2,870	20,430
June 6 - 13	4,520	10,220	14,740	21	30.7	2,720	22,230
June 13 - 20	3,160	13,340	16,500	24	19	4,210	21,180

A further analysis of the C-14 concentration in the circulating gas atmosphere of the F Pile was made on June 16th. This showed a C-14 concentration of 1.63×10^{-3} micro curies per liter of Pile gas, the helium purity being 93%. This is considerably lower than has been reported before. This may be due to the lower concentration of air in the Pile gas.

Unit Motion

- The outward motion of the rear edge of the far side shield continued but at a slower rate. It has now moved a maximum of 0.36 inches since the far side cork seal was removed.

TABLE II - Motion of Far Side Shielding at D, After Removal of Cork Seal

Type of Motion	Instrument		Reference Date	Motion From Ref. Date to			
	Type	Elev. (ft.)		June 2	June 6	June 10	June 24
1. Separation of Far Side from the Rear Face	B. M. I.	41	1-22-48	0.28	0.28	0.29	0.36
		35	1-22-48	0.26	0.26	0.26	0.27
		30	1-22-48	0.13	0.14	0.13	0.14
		21	1-22-48	0.05	0.03	0.06	0.04

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Type of Motion	Instrument		Reference • Date	Motion From Ref. Date to			
	Type	Elev. (ft.)		June 2	June 6*	June 10	June 24
						-----1948-----	
						(inches)	
2. Separation of Far Side From the Top	Ames Gauge Mic. Brac.	43 Center 43 Front	2-3-48 2-3-48	0.59 -- 0	-- --	-- Horizontal- Vertical-	0.65 0.22 0.20
				(micro inches per inch)			
3. Strain on Retaining Brkts.	Strain Gauge	East West	3-9-48	223 22	212 20	208 4	237 25

* Readings taken during Pile Shut-Down

WR Lewis
W. R. Lewis

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Beta Experiment - J. B. Lambert - J. C. Chatten

Prepared and fabricated equipment for installation of two additional Beta Experiment tubes. Selected 0865-F for the next additional tube to be charged for this purpose. New tube was installed and left as air tube till charge is ready. R-79 B6 received from Schenectady. Shipped R-79 B2 and 3 coils of R-79 cable back to Schenectady. Estimated by Carson that 195 days will be required in 0865-F for 10% fission.

Filter papers from 1481-F were counted twice during month on June 19 and June 29. Iron activity found on all papers in both checks. A short lived component of very low total activity found on paper #1 during counting of June 29, 1948 was unidentified. Operation of the experiment was not interrupted because of this component since a similar activity was found once before, on a non-SF run of the equipment. Power operation of 1481-F has continued normally as planned during the month. No significant drop in ground resistance was noted as in the case of B-5.

Equipment is being assembled in 212-N for opening B-5, which is at present stored in a cask at F.

Cask Opening - J. C. Chatten

Successfully opened R40-4, pieces #1, #7, #8. Capsules were placed in cask #3 for shipment. Swabbed capsule receptacle of pieces #7 and #8 and prepared swabs (packed) for shipment to Schenectady. These swabs will be used for evaluation of the R40 Experiment.

Slug Annealing - J. C. Chatten

Preparations are underway to heat soak a distorted piece at 500° C to determine if any degree of slug annealing can be effected by this process. It is planned to do this work in the vicinity of one of the water basins. A muffle furnace has been fitted with a temperature indicator and variac on 15 foot leads for remote temperature control. Plans are not complete on the procedure. Measurements using Alexander's slug calipers will be made before and after each period of heat soak.

New Technical Building, 300 Area - J. C. Chatten

It was estimated that \$105,000 would be required to equip the Pile Technology facilities in the new Technical Building in 300 Area on basis of space requirements planned.

Ruptured Slug - J. C. Chatten

Results of the investigations into the causes of this failure will be reported by L. D. Turner of the Metallurgical Laboratory.

W. K. Woods

W. K. Woods

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