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March 2, 1945

To: J. W. Crane, Superintendent
Technical Department

From: Wood Washington, 100 Technical

MONTHLY REPORT - FEBRUARY, 1945

Physics Section

Effect of Pile Operation on Properties of Graphite - 107-1-P

Test samples were removed from the B hole of 107-2 on February 22. This set included one casing of regular samples, one of transverse cut samples which will be measured and rechecked in about two weeks, and a group of four samples for measurement of elastic properties by Chicago. A porous column was also changed. The samples have not yet been tested. Seven samples from the previous shipment of January 15, were sent to Chicago.

A series of tests was started to determine the rate of temperature change at the effects of exposure. The annealing of the thermal and electrical resistance at different temperatures was followed as a function of time. The annealing reached equilibrium values which layed on the temperature. The approximate equilibrium values are given in the following table.

ANNEALING OF MEASURED GRAPHITE

Annealing Temperature	Thermal Resistance		Electrical Resistance	
	1 day	100 days	1 day	100 days
75°	1 day	100 days	1 day	100 days
100°	1 day	100 days	1 day	100 days
125°	1 day	100 days	1 day	100 days
150°	1 day	100 days	1 day	100 days
175°	1 day	100 days	1 day	100 days
200°	1 day	100 days	1 day	100 days

Time tested

Residual effect at equilibrium after heating, per cent

100

100
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5

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It is seen that below about 100° the annealing of these properties during the period of the tests is small. The tests are being continued. Further measurements are being made on the annealing of the stored energy. The results suggest that the method of measurement of this property gives a low value for the energy content.

Consideration of the history of the 107-B and 107-D piles showed that the widely different results obtained from similarly located thermocouples at these sites could be explained by their different exposure time and the consequent changes in thermal conductivity of the graphite around them. The ratio of the temperature rise above local water temperature to the power level was taken as a measure of the thermal resistance. If these ratios for the thermocouples at 107-D are extrapolated to the same exposure time as at 107-B they agree within about 15%. Furthermore, the analysis showed that at least until the thermocouple 850 located at the center of the unit read about 100°C, the ratio varied with exposure at the same rate as that of the thermal resistance of the test pile samples. Inasmuch as the test pile operates at about 175°, this results in the more recent annealing tests reported above.

The B test pile of 107-D was charged with fourteen cans containing standard sets of samples. These samples will be exposed at pile temperatures. A group of samples received from Chicago was prepared for charging into 107-D at its next scheduled shutdown. A lead collar for transporting purpose samples was designed. A special ring and thermocouple was designed and placed into B hole of 107-D to read sample temperatures.

Activity of Pile Discharge Water - 107-D

The following is a revised breakdown of the decay curve of normal discharge water which applies to both 107-B and 107-D units.

Relative Activity		Discharge Water		Relative Activity	
Normal	107-D	107-B	107-D	Normal	107-D
1.0	1.0	1.0	1.0	1.0	1.0
2.4 min.	2.4 min.	2.4 min.	2.4 min.	2.4 min.	2.4 min.
16 min.	16 min.	16 min.	16 min.	16 min.	16 min.
8.6 hours	8.6 hours	8.6 hours	8.6 hours	8.6 hours	8.6 hours
14.8 h	14.8 h	14.8 h	14.8 h	14.8 h	14.8 h
Less than .05	Less than .05	Less than .05	Less than .05	Less than .05	Less than .05
Less than .05	Less than .05	Less than .05	Less than .05	Less than .05	Less than .05

The known short-lived activity, 16 (sec.) has been cancelled out in making the tabulation. By relative amount in the above table is meant the relative proportions of the various activities assuming these to be proportional to the activities as measured by a beta counter. This assumes equal particle energies and similar modes of disintegration. This may have led to low values for the contribution of the unidentified 16-minute activity if, as experiments indicate, the decay is by K-electron capture.

It is believed that the manganese activity results from the corrosion of the aluminum, as does the Al^{+++} , and from solution of the manganese present as impurities in the water treating chemicals, ferric and lime. The sodium component is introduced as a constituent of the raw river water and of the additives, sodium silicate and sodium aluminum. The high corrosion of the water constituents could be due to a temporary hold-up of a fraction on the film surface within cooling tube. The mean hold-up time has been estimated to be of the order of 100 minutes. The element responsible for the 16 minute activity has not been identified. Absorption measurements indicate that the decay is by K-electron capture. The absorption coefficient suggests an element near the middle of the periodic table. Although chemical separation methods have been used to establish the long lived emitter, still work on this short-lived activity has not been possible to date. Some of the emitters, chemical or physical, has indicated the presence of fission products in greater amounts than are within the error of the measurements.

The absolute activity of the retention basin exit water, when the entire basin is used, has been measured to be $(3.0 \pm .2) \times 10^{-11}$ curies/cc/water. Being an average distribution curve obtained from the literature this activity is equivalent to .015 mR/hr./m². The activity of the exit water varies linearly with the power level.

To determine the extent and rate of elution of the retention basin exit water by the river flow, samples of river water were taken on February 23 from points in the immediate vicinity and also a considerable distance downstream of the river discharge pipe of 107-B. The following relative activities were found:

Point Sampled		Relative Activity	
Basin exit	About 25' beyond end of discharge pipe and at depth of 10' (bottom)	100	
About 50' beyond end of discharge pipe and at surface		90	
About 70' beyond end of discharge pipe and at surface		18	
About 1000' downstream, at surface		Less than 1	

The activities listed are maximum activities for the regions sampled. The selection of maximum activity samples was made visually possible by the simultaneous discharge of deep red process water from the sedimentation basin of the filter plant. The near surface samples were taken at the point where this colored liquid reached the surface in eddies roughly 5 feet in diameter. The turbulence of the flow in the river was quite violent so that the colored eddies reached the surface at points that shifted about rapidly within a circle of about 20 ft. diameter. The coloration was clearly visible as a channel 10 to 20 yards wide for a distance greater than about one-half mile. The downstream sample was taken at the estimated center of this channel.

The activity per kilogram of power level of the retention basin inlet and exit water of 107-B and 107-D was determined to be practically the same. Differences that have arisen between the areas can be attributed to differences in the amount of film deposits in the two units. Correction for the greater activity (16%) of the 107-B retention basin monitor and the longer decay time before reaching the basin at 107-B, 1.0 instead of 2.0 minutes at 107-D, brings the relative activities into agreement if the comparison is made during equal film conditions such as existed at the beginning of their operation.

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Detection of Jacket Failure by Water Monitoring - 103-4-P

Methods of improving the existing beta activity monitoring system were investigated. To facilitate interpretation of the pattern obtained when the Beckman outputs are in opposition, Micromax recorders were connected to give a continuous record of one Beckman of each bucking pair. This new record will make it possible to determine whether an unbalanced condition is the result of a high activity of one header, such as would result from a jacket failure, or to a low activity of the other bucking header, as could result from a reduced flow in its sampling line.

Various methods of increasing the stability of the flow rate in the sampling lines were examined and tested. These included relocation, or elimination of certain control valves, and increase in diameter of sections of the sampling system. The exact reasons for the slow trends in some lines and the relatively sudden changes in others were not discovered. Film formation and erratic behavior of the automatically operated valves are believed to be major factors.

The possibility of supplementing activity monitoring by spot checks involving chemical procedures was discussed with the chemical group. Outlines of several procedures for concentrating those activities which would be introduced by jacket failure, are being prepared by them for our testing.

Assistance was given the B area Operations group in their survey of the decay of samples taken from the individual headers. A design of water annulus chamber for making similar surveys at 103-D and 103-F was recommended.

Several instances of surges in the Pile Building exit water activity at B and D were investigated. It is believed that in each case the abnormal activity resulted from such factors as change in amount of film or change in amount of chemical additive, instead of jacket failure.

The decay curves of the water samples taken during the comparison of the delayed neutron and beta activity monitoring methods have been analyzed. When correction is made for the normal water activity which is present, the decay of the irradiated uranyl nitrate samples, during the 3.5 hour period examined, corresponds closely to that predicted by the Borst-Wheeler curves. The analysis shows that if a reading 10% higher than normal is observed on a Beckman of the monitoring system, due to failure of a slug which has been in the pile for about one month, an activity three times that of normal exit water may be expected after three hours of decay. Percentage differences between normal water samples due to normal operating fluctuations will remain approximately constant. These results confirm belief that an analysis of the decay curve will provide a good method of establishing the presence or absence of a jacket break.

Flattening of Power Distribution by P-columns

Suitable arrangement of lead (L) and lead-cadmium (P) dummies in a tube makes it possible to adjust its poisoning power between 7 in and 68 in. This possibility for adjustment has important consequences for the optimum use of P columns. Three goals can now be more closely approached:

1. Maximum ratio for the effective number, N_{eff} , of tubes in the pile) 1.0, for the ratio between total heat input and output of the hottest tube.

2. Flexibility in the poison pattern to allow for

(a) displacement of the maximum of the heat production by changing position of the central rod and minor variations in the quality of the metal charged into the pile.
(b) improvement in the multiplication factor of the core of 200 in 100 day intervals, taken up in the main by P-columns.

3. Conservation of heavy metal. Heavy metal should not be discharged until it has 100 days of irradiation or more.

The solution of the poisoning problem must nearly meeting the listed requirements calls for:

1. A lattice of tubes free of heavy metal for all, or nearly all, of the 100 day interval.

2. Progressive strengthening of the poison in those tubes at intervals dependent upon the schedule of heavy metal discharge. For a pile following the 100-day program of fortuitously discharges, this strengthening may be made as follows:

(a) Strengthen the central P-column about 30 in at times of discharging nearest the 27th of successive months. Change none, or only one or two, of the other P-columns at these times.
(1) Once each month, about the 10th day, weaken the central P-column and raise the strength of all the surrounding P-tubes. If the heat distribution has begun to develop hot spots, compensate this effect by strengthening some of the outer P-tubes more than others.

3. When the program of discharge reaches the neighborhood of the poison pattern, as for example every 100 days, then at no cost in heavy metal a complete change in the lattice may be made, if desirable.

Neutron-physical reasoning behind these conclusions may be briefly summarized:

1. Poisoning by two or three well separated P-columns costs of the order of 10 to 100 tubes in the value of N_{eff} due to hot spots on the ring of maximum activity which make this single P-pattern. Consequently the poison should be either well concentrated or well distributed.

2. Concentration of the poison in the center of the heat distribution, either as one tube, or as several contiguous columns, gives very nearly as high a value of N_{eff} as optimum flattening so long as less than 100 in must be compensated. For stronger central poisoning the loss becomes appreciable: 13 tubes for 150 in, and 23 tubes for 200 in. These losses are great enough to make it worth while to distribute the poison among numerous properly spaced tubes.

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3. A still stronger reason against concentration of the poison in one locality is the magnitude of the loss if that position is wrongly chosen. Thus an error of one lattice unit in the location of 115 in of poison costs 50 effective central tubes. The loss doubles for double the displacement. There is opportunity to avoid such losses with a multi-column pattern.
4. A single ring of P columns gives nearly the optimum flattening so long as the total strength is less than 250 in and so long as the radius of the ring is properly chosen. If it is too small, some production in the inner region is lost. If the circle is too large, the central tube comes limiting and the loss in N_{power} is heavy. To err on the side of a too small radius is safer than the opposite tendency.
5. Conservation of heavy metal argues against continual expansion of the radius of the poison circle as the reactivity of the pile increases over a 100 day interval. It is more practical to hold constant the size of the ring. Then one must find another means to keep in balance the outputs of the tubes inside and outside the circle. The obvious solution is a single P column of controllable strength at the center of the ring. Such a column serves as guarantee against a central hot spot. Then it becomes feasible to give the poison circle at the beginning of a 100 day period the full diameter believed to be most suitable for the end of the 100 day period. This is the plan of poisoning now believed to be most suitable.

Starts have been made at 100-B and 100-F towards testing and applying the philosophy of poisoning just outlined. At 100-F the initial requirement of the P-pattern is flexibility, to take care of the possibility that the center of reactivity of the unit is either higher or lower than expected. This requirement has been met by inserting a 7 column poison pattern, consisting of two squares with coincident corners. If the center of reactivity lies where expected, the two anti-coincident corners may be weakened or replaced with heavy metal. There will then be left a circle of 4 P-columns, with a fifth poison channel at its center. If the center of the reactivity is either high or low, only one of the two squares may be left in the pile.

At 100-B a single P-column is in use to compensate the reactivity available for the two week period beginning February 24. Examination of the neutron distribution around it will reveal the degree of off-centeredness of the heat distribution. Thus it should be possible to say before the end of the two week interval where to center the poison circle suggested for insertion at that time.

Pile Constants

With 100-B approaching the 35-alug basis used at 100-D and 100-F, it is becoming possible to use for all three units the same conventional set of constants for computation of xenon poisoning. The word "conventional" is in order because of the amount of direct formation of xenon has not yet been determined accurately and can only be estimated. Six per cent direct formation is believed to be the

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most reasonable and on the basis of computed flattening corrections, the following definitions, equations, and constants have been offered for use:

- $s = 0.06$, fraction of all Xe-135 which is not formed via long lived I-135.
 λ , decay constant of xenon, $0.0749/\text{hr.}$
 λ_i , decay constant of iodine, $0.1027/\text{hr.}$
 L , loss in overall reactivity due to Xe, expressed in inhours.
 M , inhours of Xe equivalent to mother iodine.
 F , inhours of flattening due to F-columns (rod A not included in F)
 ΔX , sum of rates of direct and indirect formation of xenon, in inhours per hour
 $A = 4.23 (1 - F/1600) \text{ in/MW}$
 $B = 3.81 \times 10^{-3} (1 - F/1600) \text{ per MW}$, fractional increase in effective decay constant of xenon per unit power level, due to burn-up.
 $I_{eq} = \Delta X / (1 + \lambda M) \text{ inhours}$, equilibrium poison in W megawatt pile.
 $M_{eq} = A(1 - s) \lambda W / \lambda_i \text{ inhours}$, equilibrium value of mother

Transient equations:

$$\frac{dM}{dt} = -\lambda M + A(1 - s) \lambda W$$

$$\frac{dL}{dt} = \lambda M - L(1 + \lambda M) + \Delta X$$

A day to day calculation has been made of the reactivity of the cold pile; i.e., the reactivity held by the xenon poison and the control rods less that which would be lost by running at substantially no water temperature rise. Both 105-B and D have gained an average of 2 inhours per day of operation over the past month. These gains are in agreement with predictions which take into account the formation of product at the expense of destruction of 235, the destruction of boric in the graphite and the direct formation of probable fission products of large neutron absorption cross-section.

The following reactivity coefficients and graphite temperature relaxation periods have been calculated from data obtained at shutdowns of the piles between February 15 and 22:

	<u>105-B</u>	<u>105-D</u>
Overall power coefficient	+ 0.17 in/MW	+ 0.12 in/MW
Metal Coefficient	- 0.25 in/MW	- 0.26 in/MW
Graphite Coefficient	+ 0.42 in/MW	+ 0.38 in/MW
Graphite period from reactivity	27 min.	26 min.
Graphite period from thermocouple	260	---
	49 min.	

Daily determinations of the metal coefficient have shown no significant trend during the past month.

Charging and Calibration of 105-F

A measurement in the 30% pile of borings taken from the vertical rods installed in

of samples from 105-B and D. The thermal neutron flux along a line at right angles to the tubes at their midpoint was found to be 47.7 cm. when the helium thermometer was 90° from, in agreement with similar measurements at 105-B and D.

The loading of the central zone, 22 tubes wide, was monitored with indium foils placed in a thin rod slot. The number of loaded tubes at which the reaction would begin could be predicted from the activity of the foils and a comparison of the activities obtained at 105-B and D at various stages of the loading. With only 150 tubes loaded (about 7 layers) the critical size predicted by this means was 16.7 layers. When the loading reached 16.8 layers, the unit reacted with a period of 65.3 seconds, corresponding to an excess reactivity of 39.8 inches, indicating the true critical size to be 16.49 layers corresponding to a loading of 69.69x10⁻⁶. This is 1.7x10⁻⁶ cm⁻²(42 inches) greater than found at 105-B. A detailed analysis of the placement of the graphite rods in the packing and their quality as measured by 305 tests predicted an increase of 8.3x10⁻⁶ cm⁻².

With the unit dry and 2003 tubes loaded the following observations were made:

1. All horizontal rods out; vertical rods 15, 20, 26, 33 out; excess reactivity very close to zero (critical).

2. Vertical rod 21 removed; excess reactivity 84 inches.

At 105-D it was observed that with vertical rods 15, 20, 26, 33, 27, 31, 34 out, the excess reactivity amounted to 90 in. Thus, assuming that, in the case of 105-B, rods 27 and 34 (each) have approximately the same activity as 21, we obtain a net increase in reactivity of 7 over B of 272 - 90 = 162 inches. This was considerably more than expected on the basis of a detailed analysis of the differences in packing material and heavy metal alloys and is probably accounted for by the fact that the large concentration of vertical rods in the central region of the unit so affects the neutron distribution that the white zone of the packing, which represents a large improvement over B, is much more heavily weighted than for the normal operating conditions which was the basis used for the calculations. Evidence for this conclusion is provided by the observations made with water in the unit.

With the wet unit the following results for the vertical rod tests were obtained:

1. All horizontal rods out; vertical rods 24, 23, 27, 31, 30, 18, 17, 22, 26, 32 in; excess reactivity less than zero.

2. Vertical rod 32 removed; excess reactivity 38.4 inches.

3. Critical condition obtained by inserting vertical rods 10 and 34 part way; vertical rod 26 removed; excess reactivity 97.9 inches.

At 105-B an excess reactivity of 68 inches was measured for the situation: all horizontal rods out; vertical rods 24, 23, 27, 31, 30, 18, 17, 22 in. Thus, the observed improvement in cold reactivity of 7 over B amounts to about

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(97.5 + 35.4) - 62 = 73 hours. This compares to a calculated expected improvement of about 65 hours, based on the previously mentioned analyses of peaking and lag differences between the two units. Here again, a difference, though not as large as in the dry situation, is to be expected due to the presence of the vertical rods. This gives a total cold reactivity of the 105-F unit of between 655 and 665 hours.

For operation at 225 MW it is calculated that permanent poisoning of about 150 hours is required, in addition to 25 hours in rod A. The following tubes were loaded with a partially poisoned (one poison, three lead and absorbing) columns: 3024, 2171, 2171, 2174, 2171, 2171, and 1574. It is the intention to readjust this poison pattern at a later date in the light of information obtained when equilibrium is reached at the high power level.

For start-up of the cold unit it was found necessary to load tubes 3576, 3586, and 1266 with fully poisoned columns in order to withdraw all vertical rods, horizontal rod No. 2 and part of regulating rod A. The critical position of rod A was observed to be at 17 1/4 inches, with No. 2 completely withdrawn.

Assistance to Operations

The Physics Group of the Technical Department has continued to cover two of the three daily shifts. The expected critical rod configurations after shutdowns have been calculated for the guidance of the R-Department in scheduling the work during a shutdown and planning the start-up. The effect of shim rods in the pile during the rise to power on the temperature distribution has been analyzed and suggestions for avoiding local high temperatures suggested. A chapter for the "Technical Manual" describing the reactivity transients, neutron poisoning and power coefficients, is being prepared.

Blanket - Polonium

A preliminary schedule for the synthesis of polonium has been drawn up as a basis for planning blanket reactivity requirements and handling schedules. Plans have been made for defining the requirements for safe handling of leached blanket slugs by means of measurements on slugs to be leached from 105-F next month. Equipment is being assembled for stripping the aluminum core from some of these slugs prior to shipping for an assay of the polonium content which will furnish a basis for locating the tubes to be changed with blanket.

Inserting Section

Effect of Electric Power Failure on Operation of Pile Unit

Analysis of experimental data on (1) decrease in water pressure supplied to 105-F unit, as a function of time following power failure to the motor-driven high-head pumps, and (2) decrease in exit water temperature from two selected tubes at 105-F,

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as a function of time following power failure to pumps, indicated that an approximately concurrent failure of both electric and steam power did not represent a hazardous condition provided that the steam supply could be maintained for about one minute (or longer) following power failure. After one minute the activity level has dropped to the point where flow from the high-head tanks is adequate to remove the heat. Based on these results, it should not be necessary to bring the unit down voluntarily whenever B.F.A. declares that a critical power situation exists.

Charging Pattern for F File

The effectiveness of the perforated aluminum dummies in reducing the frictional resistance of the tubes was reviewed. Considering a column of solid slugs, it was estimated that if two jacketed lead slugs were replaced with two adjacent perforated dummies the resultant effect on flow rate would be trivial, for the reduced wall traction would be largely offset by the resulting dissipation of kinetic energy. For a given overall pressure drop across the 0.240 inch orifice and the tube, each additional perforated dummy substituted in the same series of adjacent perforated dummies would increase the flow by about 0.5%. Based on this reasoning, it was proposed to the F Department that the two adjacent perforated dummies at either end of the active column be eliminated, and, if necessary, that further reductions in the use of perforated dummies be made in such a manner as to eliminate groups of only one or two perforated dummies in the tube loading.

The 105-F unit was started up using 14 perforated dummy slugs in each tube equipped with 0.240 inch orifices and no perforated dummy slugs in the remaining tubes. Satisfactory flow rates were obtained. However, a combination of high header pressures (375-380 lbs./sq.in.), low inlet water temperatures (6°C), and low power levels resulted in undesirably high Fanellit readings for those tubes which were equipped with 0.175 inch orifices. In order to minimize the frequency of screws by the Fanellit units, the F Department changed the operating range of the units connected to tubes having 0.175 inch orifices.

Helium Purification P.T.- 105-25-F

A satisfactory conclusion to the problem of accumulation of oxides of nitrogen in helium purification units seems to have been reached. Samples of activated charcoal taken from #2 purification unit at 115-D after 100 hours of operation have been analyzed for oxides of nitrogen using the method developed by the Analytical Group. The total amount retained by the 1000 lbs. of activated charcoal in the unit was calculated to be less than 0.01 lb. equivalent NO_2 . Presumably, most of the oxides of nitrogen in the gas entering the adsorbers are removed from the activated charcoal during the normal regenerations or during the room-temperature evacuation made at the start of a run. The F-Department has been advised of these findings so that the former 100 operating hour ceiling placed on the purification units can be removed. However, it has been suggested that the units be subjected to a 2-hour room-temperature evacuation at least every 100 operating hours, and that the activated charcoal of one of the units be analyzed again after 1000 operating hours.

Investigation of Free Fall Methods of Discharging Slings - Problem Assignment 2-2

A study of discharging slings from operating units by free fall has been developed through experiments on mock-up equipment. The equipment involved consists of three parts: (1) a discharging attachment to receive ejected slings from the tube and initiate free fall into the basin, (2) a catch chamber, integral with the discharging fixture, which collects the oily effluent from the tube and directs it into a sewer line through a special manifold collector tube on the discharge line, and (3) a modification of the standard mattress plate to cushion the impact of the sling on striking the discharge chute. This arrangement permits operating personnel to set up to push any number of tubes on a given row at one time, and then actually push two or more tubes simultaneously.

The discharging attachment consists of a horizontal open trough extending 9" beyond the end of the discharge nozzle and attached directly to it. The inletmost ending from the tube is caught in the bottom section of the fixture and connected to a discharge manifold through a short length of rubber tubing. The sling takes a slow tumbling fall from the end of this fixture and strikes the water at a random angle with respect to the surface.

The manifold trough for catching the oily effluent water is made of aluminum tubing 3"x4" in cross-section and long enough to extend across the back face of the unit. In use it is supported by means of brackets welded on the bottom frame which rest on a row of discharge nozzles below the row being pushed. A second set of brackets permit it to be hung from the elevator while being carried from row to another. The trough is slotted at the top to admit the free end of the short rubber tube leading from the discharge fixture. The lower end of the trough is shaped like a funnel and discharges into openings in a vertical pipe at the side of the unit which carries the effluent off to the main chamber.

The mattress plates used are standard plates (horizontal laminated neoprene type) connected to a 1/8 inch thick stainless steel plate) overlaid by two 1/4 inch thick sheets of neoprene. Since it is necessary to lower the mattress plates about 10 inches down the incline of the pit, the free fall discharge, a full width neoprene covered metal extension is provided for each plate. The covering neoprene sheet, mounted above, are fastened at the top of this extension and reach 6 inches beyond the lower end of the mattress. The plates are supported by a bracket at the upper end.

The above described equipment was used to discharge material at 100-2 on February 22. A pushing rate of ten to twelve tubes per hour was realized. No difficulty was experienced with the discharge attachments or the inletmost removal system. With the exception of one mattress plate, which was incorrectly fastened and came loose, the modified plates functioned satisfactorily. Based on these results it is planned to continue free fall discharges of material from the 2 pits using this equipment. Further development will be in the direction of improved discharging machines, improved methods of lubrication, and better facilities for setting discharging slings.

Use of a Lubricant in Charging Tubes - 107-17-2

Mock-up tests indicated that the inletmost carried by entering slings, pre-aligned in oil, is not sufficient to provide adequate initial lubrication of the outgoing

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slings. It is concluded that only those methods which keep lubricant present throughout the tube whenever the slag column is pushed are satisfactory from the standpoint of minimizing rib wear.

Laboratory tests were run on a number of proposed alternate lubricants, including the following:

1. Calol Soluble Oil (A-60), the present plant lubricant
2. Turaco Soluble Oil "B" (A-60)
3. Textile Softener #3 (Du Pont)
4. Hydromite
5. Shell Virgo Oil - 20W
6. Duponol "C"
7. Glycerine

All of these, with the exception of glycerine, produced a cloudy emulsion when mixed with water. All, except glycerine, reduced the wet alumina-alumina sliding coefficient of friction by a factor of more than 50% when used as 1 to 4% emulsions. It is concluded that changing from the present plant lubricant is not justified at this time.

Ventilation Surveys - 105-14-P

The twelve-foot water seal recommended for the 1 inch drain line from the 105-D third safety device proved to be inadequate during the screw on February 15. Active gas from the thickies blew the seal and entered the charge face area. Approval has been given to increase this seal to 30 feet, and provide a siphon-breaker in the line.

Process Temperature Measurements - 105-23-P

Analysis of temperature readings taken on the B and D piles when operating at about 250 MW with nominal 2000 tube loading brings out the following points:

1. No overheating of the shields on either unit is indicated.
2. Graphite temperatures at B continue to run higher than at D as shown by central thermocouples such as 170, for which the readings are 100° and 98°C respectively, and 260, for which they are 125° and 102°C. A large part of this difference is due to the difference in exposure, as discussed in the Physics Section.
3. All the thermocouples in the pile at D appear to be operating satisfactorily with the exception of No. 17, which was broken during installation. This couple is located in the rear face thermal shield.
4. The status of thermocouples in the B pile is as follows:
 - (a) eighteen of the twenty-six couples located in the graphite appear to be functioning properly.
 - (b) seven of the nine couples located in the biological shield are satisfactory.
 - (c) two of the three couples located in the thermal shield are satisfactory.
 - (d) all five couples located in the side structural sections are unreliable.

Movement of Shields - 105-15-P

No excessive shield movements were observed during the month for operation up to 270 MW at both B and D. Vertical rise of the top center of the D rear shield was 0.285 inch, which is in line with previously reported values. A recheck of the 105-B rear shield instruments during the recent shutdown revealed the following:

1. The previously reported shifts (0 - 30 mils) of the B rear shield during operation at 170 - 180 MW actually occurred, since the instrument calibrations had not changed.
2. Very little permanent set of the rear shield was indicated, as shown by the fact that the instrument zeroes agreed closely with those observed during previous shutdowns.

Downcomer Test at F Area - 105-24-P

Performance tests were made on the baffled downcomer at 105-F prior to start-up of that unit. It was found that the water entrained air at all flow rates, although the quantity entrained did not exceed 300 cu.ft./min. This compares with 4000 to 5000 cfm entrained in the downcomer at B and D Areas. The behavior of the entrained air in the pressure sewer was very erratic. At steady normal operating flow, the entrained air was carried by the water in a uniform manner, had little tendency to collect into large slugs, and seldom backed up into the downcomer. At lower flow rates there was a tendency for air to collect into large bubbles, resulting in violent splashing at the inlet chamber of the retention basin. Also at times the entrained air would back up into the downcomer as shown by pressure surges and exhaust of air out of the vent line. Rapid changes in water flow usually were followed by period of erratic performance lasting 5 to 20 minutes. However, the fluctuations remained within permissible limits. The maximum blow-back of entrained air from the sewer into the downcomer due to flow changes was not enough to disturb the flow of water from the unit, or cause water to flow out the vents.

The floor of the shed over the diversion gates at the inlet to the retention basin was removed to prevent personnel from entering and being splashed by active water.

Observations were made following the tripping of one, two, three, and all electric process water pumps, and during a simulated complete power failure. Also the flow was varied using a procedure which could be followed in dropping from full flow to discharge flow and for carrying out the reverse operation.

On the basis of the above tests it has been suggested that:

1. The roof of the pile building adjacent to the downcomer and riser vents be considered as a red danger area when the unit is running.
2. The shed over the retention basin inlet be classed as a yellow danger area, when the pile is operating.
3. The reduction in water flow prior to discharging metal be made as evenly as possible over a period of at least 20 minutes to minimize undesirable condition in the downcomer and pressure sewer.

er and Corrosion Section

film formation

Following the January 26 purge, a new base point for pressure drop was selected on January 29 for 100-B Area. By February 23, the increase above the base was 16.6 lb./sq.in. The average rate of increase for the period was .61 lb./sq.in. (day), but the rate of increase has been increasing and the current rate of increase is approximately 1.5 lb./sq.in. (day).

The rate of increase in pressure drop at the 100-B Area has been erratic but low and averaged .17 lb./sq.in. (day) for the month. The total increase above the December 28 base is 9.2 lb./sq.in.

A pre-startup purge was carried out at the 100-A Area. 100 ppm of sulphur were used at the full flow rate of 30,000 gpm for a two-hour period. The 4 inch cross header screens adjacent to the B Area plugged sufficiently to cause a marked reduction in flow through this line. Inspection of the screens revealed considerable foreign material which undoubtedly contributed to the plugging. Another test must be made with clean screens to determine the plugging possibility under this more normal condition.

Flow Laboratory data have not shown correlation with unit data with respect to film formation and the Laboratory at 100-B was shut down on January 31. The Laboratory at 100-D is still being operated in a further attempt to secure such correlation and also to permit some experimental work to be done by both the Engineering and the Water and Corrosion Sections. It is not planned to operate the 100-A Flow Laboratory.

Corrosion and Inspection

Corrosion tube 2378 was also changed from the 100-B unit on February 22, but results are not yet available.

Tube 0661 at 100-A was damaged while loading due to foreign material which severely scratched the interior surface. The extent of the damage was observed with the borecope and it was decided to replace the tube.

Pieces damaged on December 20 were examined at 800-B storage basin on February 3. Numerous pitting and pits were observed which were typical of the corrosion of aluminum in contact with stainless steel in 7.9 M water containing no aluminum. It was difficult to estimate the depth of the pits but in general they appeared to be shallow and there was no evidence of penetration to the heavy metal.

Process Water Control

No continued improvement in control of the iron content of process water at 100-B has been noticed. Results have ranged from 0.02 - 0.06 ppm and have averaged about 0.04. It has been shown that usually a period of high iron results in a greater pressure drop increase for that period than would otherwise have been expected.

[REDACTED]
W. W. Crane

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March 2, 1945

At 100-D, the control of iron content has continued excellent. At present, a value of 0.02 ppm is seldom exceeded.

Initial results of iron analyses at 100-F Area filter plant have been good although somewhat higher than at 100-D. Most results have been in the .02 - .03 ppm range. However, iron pickup in this Area continued to be much higher than in the other Areas.

Control of pH, silicate and dichromate addition has been satisfactory in all Areas.

No dichromate reduction has been detected in any instance.

ZW
E. W. Worthington, Chief Supervisor
100 Area Technical

EW:mv1

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