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Date

AUGUST 30, 1944

EXPLOSIVES-TNX

TECHNICAL DIVISION, HANFORD

WEEKLY REPORT FOR PERIOD ENDING AUGUST 29, 1944

Hood Worthington

We have been following the progress of tests on the slugs closely. Current production shows 0.1% failure in autoclave test at 40 hours, as compared with 2% before August 14. This radical improvement has been the occasion for meetings to review the initial loading of pile B and production for D, in which we have participated. The trend is toward as little use of production before that date as possible. Kidder's autoclave gave one failure of an unautoclaved slug in 80 hours at 250 lbs. per sq. in. and 95°C, out of roughly 200 each of autoclaved and unautoclaved slugs, and has now been running fourteen days. Babcock and Wheeler will study the subject of testing in an effort to improve the test.

We have discussed with Hilberry the significance of the storing of potential energy amounting to several hundred calories per gram in the graphite in the form of atomic displacement resulting from bombardment. This phenomenon is mentioned in a letter of Wigner to Allison, July 20, which came to TNX, Wilmington, on August 21, and to us August 28, and also in Project Council Information Meeting (Physics Research) CS-2066, which was issued August 22 and reached us August 29. It had been our plan to allow the progress of the Wigner effect to cause the graphite temperature to rise by lowering its thermal conductivity. It appeared improbable that we could cure the condition by applying external heat, since the helium system was long since abandoned as a means of heating or cooling the graphite, and since the biological shield would not be likely to withstand such temperatures, either because of decomposition of the HD-128 or because of warping. There was, however, a possibility that heat could be generated and distributed by running the pile dry for a brief time. Handling a release of even 100 calories per gram by this means is not an attractive prospect, as the temperature would rise perhaps an additional 200°-300°C in the regions in which it occurred.

D. F. Babcock

Five drafts of Operating Standards for the 100 Area (prepared by the Technical Department) were reviewed and returned to Crane with our comments. The review job is now up to date. No new drafts are expected for a week or more.

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Reviewing G. Bonick 3/24/89
Official

MASTER

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The problem of detecting failures in slug jackets was discussed with Simpson and members of the Technical Department. The question of the source of the large background count obtained by Simpson when experimenting in this subject at the Clinton pile was discussed in detail but no new clues were developed. It was agreed that Simpson would do additional experimental work aimed at unraveling this uncertainty.

C. W. J. Wende

The observation that lead dummy slugs at the inlet end of a tube may mushroom when subjected to the stress of discharging requires consideration of alternative loading schemes. A number of possible alternatives were discussed with members of the Technical Department and summarized in a letter to W. O. Simon on 8-28-44. The scheme which is most satisfactory from the standpoint of shielding uses one iron slug in the thermal shield and two lead slugs near the outside of the biological shield. The remainder of the space is filled by perforated aluminum dummies. The lead slugs will be fished out before the charging machine is set in place. Provision must be made either to keep the tube filled with water during this operation or to remove the slugs while the operator stands to one side of the nozzle. The tube will then be pushed in the usual manner. The Technical Department is at present investigating the extent of mushrooming and means of removing the lead slugs at the inlet end.

The monitoring of delayed neutrons in the exit water was discussed with J. A. Simpson and data on the expected gamma background were supplied to him. In addition to his work on the detection of coating failure, Simpson plans to obtain quantitative data on the neutron background outside the shield of the Clinton pile. Some preliminary measurements indicated that this background is relatively high, but its origin is at present uncertain.

J. A. Wheeler

Reclaimed slugs containing 0.09 lb. less heavy metal than normal slugs will contain more Al and Si and give a reactivity lower by 0.07%. This alteration translated into a loss of production about 2% via decreased opportunity for poisoning and flattening, and in this sense is equivalent to a cost of 1 day in every 50.

A proposed arrangement for measuring the temperature of a special central heavy metal slug in 105-B was reviewed with D. Loomis. All slugs are aluminum on the downstream side of the selected one. For this reason the heavy metal in the sample piece receives an extra large neutronic end bombardment. In the absence of protection this slug will rise in temperature about 30 per cent above what is normally considered the hottest slug in the pile and may be liable to early failure. Consequently it is now intended to replace the immediately adjacent aluminum slug with one containing a suitable alloy of cadmium and lead. The difficulty of precise calculation of the neutron distribution near the revised arrangement means that the interpretation of the

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observed thermocouple reading may be in error from 5% to 10% either way. The factor of proportionality should however be independent of time.

Latest available information on the rate of corrosion of heavy metal is listed in a teletype, Brugman - Draley to Worthington - Wheeler, August 25, and is summarized here for the purpose of reference:

Corrosion Rate in $\text{mgm}/\text{cm}^2 \text{ hr}$

	20°C	50°	60°	70°	80°	90°
Distilled water nearly saturated with air	0.001	0.005	0.011	0.012	0.2	0.7
$1 \times 10^{-5} \text{ N H}_2\text{O}_2$ nearly saturated with air	0.002	0.005	0.007	0.015	0.3	0.6
Distilled water saturated with hydrogen				0.4		1.0
Distilled water saturated with oxygen				0.003		1.1
Distilled water saturated with nitrogen				0.25		
W water saturated with hydrogen		0.06		0.3		
Distilled water containing 700 ppm sulfate				0.08		

This information was requested in connection with the slug failure problem. To raise a serious blister, roughly 500 mg of heavy metal should corrode over a space of the order of 1 cm^2 . The total corrosion will reach $500 \text{ mg}/\text{cm}^2$ in distilled water at 90°C in 700 hours on the basis of the tabulated figures. At an autoclave temperature of 170°C the corrosion rate extrapolates to a figure of the order 20 to $500 \text{ mgm}/\text{cm}^2 \text{ hr}$, corresponding to failure times of the order 1 hr to 25 hrs. The agreement in general magnitude between these estimates and the observed failure times suggests that metal corrosion may be the dominant mechanism determining rate of failure. To the extent that this conclusion is correct, it is appropriate to consider as the primary criterion for slug zoning the temperature in the heavy metal where it will be under attack during failure; that is, the temperature at a depth below the surface of the order of 20 mils.

P. F. Gast

Wheeler is currently calculating the control to be expected from safety rod "curtains" by a different method of approach from that used by the writer in obtaining the values reported in a memorandum to Simon (8-14-44). That report contained two types of results: (1) For certain curtain combinations an exact calculation could be made. A recheck of these results has uncovered some slight errors, but, at the time of writing it appears that the final values will not differ importantly from those previously reported. These values are higher than those currently obtained by Wheeler by about 0.1% of k. (2) For certain types of curtain combinations it was necessary to resort to estimates because of the complexity of the calculations involved. Wheeler has suggested a method for checking the accuracy of these estimates, and such checks are now in progress.

The size of the final differences remaining in the results obtained by the two different methods may give an indication of the reliability of the predictions regarding the action of the safety system in the 1500 tube pile.

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Recent results, reported by Chicago (CC-1805), indicate that 60 mols of stable noble gases will be produced as fission products by 100 days operation of a 250 MW pile. This amounts to an average of 25 cc's of gas at N.T.P. in each heavy metal slug. It is thus conceivable that pressures sufficient to rupture the aluminum jacket may be created. In the case of the Clinton pile (1 MW, 35 tons of metal) the pressures developed by these gases if they all collected in the space between the slug and the can (approx. 90 lbs/sq. in) would not produce any easily noticed effects.

T. B. Drew

Analysis of the data from the acceptance leakage test of the pile B envelope has been carried further and a memorandum has been prepared. The free volume of the pile as calculated from the data is 13,500 cu ft. This is to be compared with 16,000 cu ft. as estimated from the blueprints (TRX-PG-17, p.40). Of this latter figure 13,800 cu ft is the volume attributed to the pores of the graphite and Masonite while 2,200 cu ft is the calculated volume of the ducts and plenum chambers. The leakage data, taken at their face value, therefore, indicate the total volume of those pores which connect freely with the plenum chambers to be 11,300 cu ft or 82% of the total pore volume as estimated from the blueprints.

Miscellaneous assistance has been given members of the Technical Department in connection with flow and heat transfer calculations.

A preliminary study of the heating of heavy metal slugs during their submersion in the successive molten metal baths of the canning process has indicated that variations on the order of 1 sec or less in the time of dip in the various baths may cause large variations in the temperature distribution in the slug when it reaches the can.

W. K. Woods

Final tests with solid aluminum dummies in a W-tube were conducted on August 21, using the "electric needle" technique to detect motion of the pieces. The only time chattering was observed occurred when an aluminum dummy was located too close to the inlet nozzle. With lead slugs at either end of the column in the tube proper and standard stainless steel slugs in the outlet nozzle no movement was detected at flow rates below 10 g.p.m.; at higher flow rates definite but rather erratic and irreproducible movement was observed, involving a shifting of the pieces when the flow rate was changed.

It is quite probable that the slug motion described above will not occasion serious erosion difficulties, and erratic variation in pressure drop across the aluminum-filled tubes will not be objectionable. Hence, in the initial loading, if there are a relatively small number of aluminum-filled tubes connected to the chilled water header, it is believed that very minor risk is involved by leaving the 0.240 inch orifices in place and permitting full flow of water through these tubes. Even this minor risk need not be taken in the outer tubes and it is recommended that the flow rate should be reduced to below 10 g.p.m. in the 700 or 800 tubes connected to the unchilled header.

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Rather than change the orifices, this reduction in flow can easily be obtained during the early stages of operation by reducing the pressure in the unchilled water header to, say, 90 lbs/sq. in. In the event that a few active tubes are served by the unchilled water header, the heat generation in these tubes will be so small that adequate flow rates will still be obtained with the reduced header pressure.

The flow laboratory at 105-B was put in operation during the week. Poor agreement in performance of the two tubes under supposedly identical conditions was finally traced to the presence of a block of wood trapped in the 4-inch manifold and partially blocking the opening from the manifold at the point of connection of one of the pig-tails.

Discussions have been held with Technical Department relative to obtaining data from the unit. In addition to obtaining hourly readings of the pressures on a limited number of tubes, consideration is being given to the possibility of covering the Panellit board photographically at less frequent intervals. If feasible, a photographic record would provide an instantaneous reading for a large number of tubes, would reduce the possibility of error in recording the data, and would reduce the labor involved in obtaining the data. It is hoped that by following gradual changes in Panellit readings pile shut-downs may be anticipated and the trouble remedied before automatic dropping of the safety rods takes place.

TECHNICAL DIVISION
HOOD WORTHINGTON

Hood Worthington

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