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EXPLOSIVES DEPARTMENT—TNX

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- 3 - W. O. Simon
- 4 - W. O. Simon - 700 File
- 5 - W. E. Kirt
- 6 - S. J. Bugbee-B. H. Mackey
- 7 - P. W. Crane - 300 File
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JULY 26, 1944

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EXPLOSIVES TNX
TECHNICAL DIVISION, HANFORD
WEEKLY REPORT FOR PERIOD ENDING JULY 25, 1944

Hood Worthington

On July 17 the status and program for CMX were discussed by Graves, Worthington, and Kidder with Simon, Notman, and Bugbee. It was pointed out that the immediate objective of finding suitable water conditions for start-up had been approached as closely as appears possible with our present equipment and information as to the requirements. We are in a position to suggest a water composition that we should not expect to be corrosive or to build a film rapidly, and we have means available for removal of such films as may occur. Analytical methods have been proved and developed. Pressure drops have been measured with alternative loadings. The movements of slugs have been observed with corrective measures devised. It therefore appears that most of the CMX personnel can be turned over to operations for the start-up, and returned to CMX thereafter if a new set of objectives is laid out on the basis of experience with the first pile.

As yet we have only imperfect information on the effect of demineralization. Our program cannot be considered complete without this information, which ideally should be available at the start-up of 105-B so that the start-up of D will not find us unprepared. Kidder agreed to study how to fit experiments on demineralization into the schedule before the start of B.

A memorandum has been issued collecting suggestions from the Technical Division men on engineering aspects of start-up. The items have been gone over in detail with Crane, Miles, and Kanne, and in some instances with M. H. Smith.

W. K. Woods

Classification changed to

UNCLASSIFIED

(Insert appropriate classification)

Revised by authority of see attached file record card Date May 20, 1944 (8 weeks)

I. May 29 - June 10 3/24/49 by C. J. Banick, AED CO Date March 24, 1949

(Signature of persons making change and verifying the information)

Vacation

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C. J. Banick
J. Banick, AED Class Officer

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MASTER

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II. June 12 - June 24

Results of slug classification methods were analyzed from a dimensional standpoint; it was noted that by relaxing the maximum diameter of Class B slugs from 1.445" to 1.450", 91% of the current production would fall into Classes A and B as far as diameter was concerned. At this time no proper measurements of warp were being taken.

With T. B. Drew recommendations were made to dispense with the current caliper procedure and to substitute two "use" tests. One of these proposed tests involved measuring average diameter by measuring the pressure drop resulting from the flow of a known quantity of air through the annulus formed when the slug to be tested was inserted in a short length of standard ribbed tubing; the second test proposed to measure the combined effect of out-of-round, warp, and welding bead, by rotating the slug between two parallel plates separated by a specified distance. These proposals are presented in a memorandum to Worthington dated June 28, 1944.

Currently, we know of no action taken on the proposal to measure average diameter by measuring pressure drop. However, the parallel plate tester has been constructed and put in use by the Technical Department (not yet by Production). Contrary to our early optimistic beliefs, it was found that warp was not confined to variation in the coating thickness but was in at least some cases actually due to bowing of the slug proper. Thus, several slugs which had appeared to be Class A as a result of caliper measurements were degraded to Class C when it was found that they were so badly warped that they would not pass the plate test. It appears that further relaxation of maximum diameter (as measured by plate test) will be required.

With T. B. Drew, discussion sessions on temperatures in the pile were conducted for the benefit of operating trainees at 100-B. These meetings occurred on June 22 and 24. The 200-W Area was visited on June 23. Drew and the writer studied prints of the proposed Pilot Laboratories for the 100 Areas, and discussed our comments with CMX for transmittal to Wilmington.

An attempt was made to subject the Frost Test to mathematical analysis in order to be able to predict in advance the result of considered changes in procedure. However, no method was developed which was not so extremely laborious that the time required for solution to a specific case would be unjustifiably large.

III. June 26 to July 8

Analysis of current CMX data was undertaken with the objective of establishing allowable variations in pressure drop in W-tubes due to film formation. Results were rather discouraging. In general, a plot of the percentage increase in pressure drop versus the reciprocal of the scale conductance yielded substantially straight lines, but the slope of these lines varied

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over wide limits, and no correlation between this slope and the conditions of the tests could be obtained. It appears that under some conditions scale with a conductance as low as 5000 c.h.u./(hr.) (sq. ft.) ($^{\circ}\text{C}$) might be formed accompanied by a pressure drop increase of only 1 lb./sq. in., whereas under other conditions the pressure drop may increase by 5 or 6 lbs./sq. in. without a seriously thick scale formation. This situation is confused somewhat by the fact that at CMX only the average coefficient for a 7-foot length of tube is being measured and the film formed in this long a zone may be subject to wide variation in uniformity.

At the request of Kanne, the print files at 700 and at Hanford were consulted and an analysis made of the pressure drop to be expected with flow of cooling water through the control rods. For flow of 10 g.p.m. of water a pressure drop of 43 lbs./sq. in. is anticipated through the 1-1/2" and 1" piping, the hose reels, and the rod proper, but excluding the orifice. Hence, it was concluded that the drop safety scram circuit should be set to operate if and when the water pressure to the control rods fell to about 15 lbs./sq. in., corresponding to roughly a 50% reduction in water flow.

At CMX, results of tests in the capillary tubes were examined. The data indicated that inordinately thick films were being formed (intentionally) and it was suggested that since films this thick could never be approached in the plant it would be wiser to devote more detailed attention to films only a few mils thick.

At CMX, current attempts to analyze heat transfer phenomena by means of tube-wall thermocouples were studied. With a 10-foot tube data obtained from thermocouple installations appeared so suspicious that CMX was not encouraged to report the results. An installation in the 3rd jacket of one of the 40-foot tubes gave far more rational results. In this case the thermocouples are used only to localize the measurements to a small section of the tube, but are not being used in an attempt to make the heat transfer measurements independent of variation in steam-side conditions. As scale is formed the water temperature entering the 3rd jacket falls and the wall temperature increases. A value is assumed for the "clean" water film heat transfer coefficient and the initial heat flux is computed, based on the thermocouple reading and the water temperature; it is assumed that the heat flux past the thermocouple varies directly as the difference in temperature between the steam and the wall couple, and the "dirty" water-side coefficient is based on this revised flux. For the test studied, the scale resistance indicated locally by the thermocouple was in substantial agreement with the scale resistance indicated by overall performance of the jacket.

During the period, tests were inaugurated using a standard inlet nozzle connected to a glass tube, and the behavior of the slugs at various water rates was observed visually. Results of this study, indicating conditions under which there is danger of slugs "chattering" in the tubes, and recommendations to minimize the danger of such chattering have been presented in a memorandum, Kidder and Woods to Worthington, July 20, 1944.

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IV. July 10 to July 22

At the request of Crane, calculations were made of the number of slugs which would have jacket temperatures in excess of various values, for various proposed loading arrangements. Guided in part by these results, it has been decided to use an initial loading consisting of about 800 tubes, 32 slugs per tube. For this loading, assistance was given L. Marshall in methods for calculating the jacket temperature of any slug, for use in "zoning" the pile to accommodate the various grades of slugs.

Engineering aspects of start-up were discussed with Gast and transmitted to Worthington informally.

Assistance was given J. Marshall in analyzing the feasibility of determining the temperature coefficient (on k) for the metal for the case where the pile is preheated uniformly to 50°C followed by the sudden admission of cold water, all at negligible power production. It was calculated that the metal would cool at a rate 40 or 50 times as great as the graphite, and hence that it was feasible to change the metal temperature and note the effect on k before the graphite temperature had changed significantly.

Miscellaneous flow rate or pressure drop calculations have been made, or other calculations checked by the writer. These include flow of helium from storage, and flow of water through the sampling lines at the discharge face of the pile. Gross was advised to anticipate a pressure recovery of about 10 lbs./sq. in. between the pressure monitors and the inlet to the tube, based on results obtained at SMX.

A standard discharge nozzle was fastened to the outlet end of the glass tube used in the above-described chattering tests, and the pressure drop from the nozzle to the atmosphere was measured for various flow rates and various loading arrangements. It was observed that either lead slugs or perforated aluminum slugs moved toward the outlet port, partially blocking it and increasing the pressure drop in the order of 5 or 6 lbs./sq. in. at 20 g.p.m. While the effect on the flow rate is not large, it is considered highly desirable to eliminate this potential irreproducibility if pressure drop measurements are to be in any way indications of film formation. A method which has proved satisfactory with the glass tube equipment is to use a special stainless steel slug in the outlet nozzle, equipped with a 1" diameter spindle which protrudes past the outlet port. With this arrangement, a cylindrical lead slug would be required downstream adjacent to the stainless steel slug for pushing reasons. A 1.32" diameter spindle and perforated aluminum slugs did not prove satisfactory. A detailed report is in preparation.

V. Program

On July 26 the proposed loading of the discharge nozzle is to be checked on CMX Tube 1 during an inspection shut-down. This test will maintain actual tube geometry and will investigate higher flow rates than were obtainable with the glass equipment. Further studies of pressure drop versus heat transfer coefficient will be made, using current CMX data, in an attempt to get a correlation between slope of the curve and characteristics of the water.

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C. W. J. Wende

Evacuation procedures in the event of a catastrophe in the 100-B Area were discussed with W. E. Rapp during a visit to that Area on July 19, 1944. The simplest and most generally applicable formula appeared to be: (a) When the wind is from the west, assemble behind Bldg. 190 and depart by the western road, (b) When the wind is from the east, assemble by the eastern gate, thereby taking advantage of the shielding provided by the heavy wall at the discharge face of the pile, and depart by the eastern road. A more detailed discussion of possible events which might require evacuation of the Area will be submitted later.

On the same visit, problems of radiation monitoring during start-up were discussed with L. K. Wyatt. Since the Health Physics group under Parker is not expected to be up to full strength by the time of start-up, Operations plans to set up a patrol group to handle most of the routine monitoring. It was agreed that the writer will prepare a memo summarizing these points in the pile area which will require radiation survey, and will give a talk on radiation problems to members of 100 Area Operations during the coming week.

Instruments for start-up monitoring were discussed with Overbeck and other members of his group. Surveys will be conducted with Lauritsen electrosopes and Victoreen survey meters which the instrument people expect to have ready prior to start-up. Beckmann survey meters will also be used if they arrive in time. A fast neutron meter is under construction, but its use will be limited by its lack of portability.

The location of a conduit line in one of the helium sampling chambers prevented installation of the specified amount of lead shielding. This chamber was inspected with Wyatt and Trapnell and found to be adequately shielded by the reduced amount of lead.

The 200 Area was visited on July 20, 1944 with F. A. Otto. The crane cab, and particularly the shielding of periscopes and ventilating ducts, was inspected in some detail. The steel frames of the transfer casks have arrived on the site but were not available at the time of this visit. It is planned to inspect them next week.

At the request of Operations, the writer plans to visit the operating areas at frequent intervals to acquire familiarity with the plant and to discuss radiation problems with operating personnel.

John A. Wheeler

Tests for slug leaks will not be less severe with water in the autoclave than with steam, and have a considerable chance to be more decisive, especially if a wetting agent is added to the water, according to a memo, Wheeler to Worthington, July 24. This report takes into account the effect of capillary forces on (1) rate of flow of liquid through small channels and (2) critical pressure for condensation of steam to water.

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Detection of increased film drop via temperature rise of slugs, either through expansion of metal columns or through loss in k , will be complicated and perhaps unworkable on a continuing basis owing to alterations in expansion coefficient and temperature coefficient of k due to irradiation, according to a letter, Wheeler to Simon, July 26. A measurement of either type is, however, feasible on an instantaneous basis by re-establishing the zero point; for example, by removing the film with oxalic acid. In other words, one may only be able to tell that the patient required an operation for film removal by having actually made the operation and noted its effect.

Means to test the safety rod system during loading were analyzed with Weil, Marshall, and Gast. Gast is preparing a detailed report on this question.

P. F. Gast

At Bradford's request calculations were made on the sensitivity to be expected from three types of ion chambers proposed for monitoring air activity near the tolerance level. A large chamber (about 1 cubic meter) through which the air passes at atmospheric pressure, or a 10 liter chamber into which the air is compressed at 1500 lbs./sq. in. will each give workable currents.

Consideration has been given to the problem of testing the safety rods on an 800 tube pile in such a way that their adequacy for handling a 1500 tube pile is assured. Wheeler has suggested the use of "curtains" of rods, a row of rods extending completely across the pile. Since there are five such curtains there are 20 distinct combinations of these curtains. The curtain type of geometry is susceptible to rather exact calculation and the 20 combinations provide a k "scale" extending from 0 to 3.75%. The k values cluster most thickly in the region from 1.0 to 2.5%. One of the combinations in this region is expected to be sufficient to hold the dry 800 tube pile. If the predicted combination, or a weaker one, holds the 800 tube pile then the adequacy of the system for larger piles will be assured. Calculations are still in progress on the k of various curtain combinations in the region from 1 to 2.5%.

TECHNICAL DIVISION
HOOD WORTHINGTON

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