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June 1, 1943

WEEKLY PROGRESS REPORT - TECHNICAL DIVISION
FOR PERIOD ENDING MAY 29, 1943

100 and 300 Areas

Hood Worthington

The need for further development work on coatings for slugs was highlighted in a dropping test with steel slugs of the size to be used at W. When these were dropped about three feet on one another, there was a good deal of bouncing and many of the slugs landed on the circular edge at either end. The resulting concentrated blow was damaging. When one slug struck another that was wrapped with aluminum sheet, the soft metal was sometimes cut and always stretched. Even when allowance is made for the cushioning effect of water, the low elasticity of uranium as compared with steel, and the tight fit of die-drawn jackets, there remains enough evidence of future trouble to make us wish for a coating that is bonded to the underlying metal.

R. B. Mears of the Aluminum Company was here for a day to discuss the corrosion of aluminum. He was strongly in favor of the use of Alclad with 72S on top of 2S. Fabrication of tubes of this material is on our program. Mears told of experiences with water corrosion of aluminum that showed that oxygen could be harmful, probably by causing depolarization. This lends support to our decision to deaerate.

Compensation for excess multiplication factor was discussed with Babcock, Drew, and Wheeler. The most favored method of taking care of an excess deliberately left in the design is by dishing and by leaving certain tubes empty. With the field narrowed to these alternatives, temperature distributions in the pile can be computed and transmitted to the Design Division for an analysis of the resulting expansions and stresses. Before this choice was made, the limits of the field were laid out in a discussion with Drew, Lockhart, McKenna, and Wesstrom, so that the performance of the tube sheet and end shields under the contemplated extremes might be explored. Before deciding how to compensate for additional multiplication factor that may prove to be available in our present design, we shall await the quantitative results of an exponential pile experiment which should be available this week.

H. Worthington - Cont'd.

Trapnell of the Design Division has shown us two types of indicators for monitoring the flow of water to the pile tubes that are outstanding in simplicity. In one, the needle of a pressure gauge is replaced by a perforated disc located in front of a series of lights. The perforations uncover the lights as the pressure reaches the predetermined range. In the other, a graduated cylinder is used in place of a needle. The scale is illuminated from behind and viewed through a narrow opening. The scale is colored. Either is capable of giving a reading of pressure as well as a light signal. Electric pressure switches are still needed to set off alarms and drop safeties.

Fermi brought from Chicago the results of shield tests at the Argonne. With his help the shield was defined. It consists of the following parts after 74 cm. of dead graphite (1) 8" of steel (2) a gap of 4" on the ends only (3) 2.5" of steel (4) six sets of alternations consisting of 4.25" of masonite lofting board of bulk density 1.3 and 3.75" of steel, and (5) a sealing sheet. With the indicated split, 2300 kw. will be removed in (1) and 9 kw. in the rest of the shield, principally in (2). The principal difference between this shield and that previously set up is in (1) which was formerly 2 3/8" thick and removed 300 kw. The increase arises from an underestimate of the role of gamma-rays. Shield cooling must be recomputed. Fermi was strongly of the opinion that boron was not needed in the thermal shield. The new arrangement was transmitted to the Design Division verbally. They have been studying the shield as a structure, and now favor a cubical shell because of the reliability and simplicity with which it can be built.

The results of a discussion of the 300 Area test pile with the Argonne personnel have been transmitted in writing to the Design Division. Additional information furnished by Stabler and Montgomery are being studied for their application to the test pile design. This work is being taken on by M. H. Wahl.

K. G. Jones

Jackets

Final arrangements have been made for the Aluminum Co. to jacket Site X slugs at New Kensington. As a result of last week's meeting at the plant, a new list of specifications and procedures is being made up by C. J. Veith. Tolerances on machined slugs and on jacket wall thickness have been approved by Chipman, Whitaker and the Engineering Department.

A furnace has been purchased for the hydrogen test at 300°C. It is a gas carburizing type made by Heir-Duty Co. and should be ideal for this test. C. E. Daniels is to try to persuade the Aluminum Co. to set up the test at New Kensington under our supervision. After the mortality rate is established, the Site X people will be approached again on the advisability of installing the furnace at Clinton for all future testing.

Chicago should receive a group of jacketed slugs from New Kensington this week for their experimental work.

Wolverine Tube Co. continues its work on developing a more suitable method of closure. Creutz is investigating other possibilities also, since it is not expected that the present jacket and closure will be adequate for Site W slugs.

K. G. Jones - Cont'd.

C. R. Johnson is having Chantland start development work on jacketing 1.34 x 8" slugs at New Kensington. These will be needed for Site X water tubes. During the writer's visit to Chicago next week, this question will be discussed with Chipman as will also the need for 1.34" dies at B & T. These will probably be made by Russell at Battelle during the experimental stage.

Tubing

Ten good tubes with unequal ribs have been extruded at B & T and shipped to Wolverine for drawing. Wolverine is now working on these and as soon as they are satisfied, B & T will go ahead on the other 40 tubes. This should assure us of 50 tubes very shortly.

Corrosion

R. B. Mears of the Aluminum Co. has finally been cleared. He visited Wilmington during the week. A meeting was held with interested parties including J. P. Howe of Chicago, and it was decided to check the potentials between aluminum and various alloys. Samples for Mears and Howe were obtained at the Experimental Station in time for them to take along. Results will be discussed on June 8 at Chicago with Mears, Howe, Kidder and other interested parties.

Graphite

The purity of graphite has become a serious problem and considerable time is to be devoted to this in the near future. Part of the week was spent in reading reports and obtaining a background for this work.

Casting

During the week, a trip was made to the Dye Works with W. R. Huey to obtain information on the melting and casting process as used at this location. A report is to be written to supplement the blueprints received from Kirst. This will be incorporated into the Site X manual.

T. B. Drew

Substantially the entire week has been given to the computation of the thermal gradients and conditions of water flow in the bowed or dished pile. These calculations are well along and should be completed during the week. Preliminary results were made available to the Engineering Department in order that they might begin the analysis of stresses due to thermal expansion. Kuniansky is assisting with the associated boiling disease calculations.

One day was devoted to the discussion of shielding with Fermi and others of the Technical Division.

A little work was done on the problem of the transient behavior of the pile following the sudden interruption of water flow. This is the next major problem on the docket.

S. Kuniansky

Pressure drop calculations were made for various flows of 5°C. water in the central tube with minimum clearance to determine a safe minimum upstream pressure to prevent boiling in the tube. The case of a bowed pile was assumed with the center 17.3' of the tube filled with regular slugs which were bounded on each side by 5.6' of undersized dummy slugs (going to the inner edge of the thermal shield) and 5.25' of twist drills or the equivalent with an assumed resistance per foot of only 20% that of the active slugs. The dimensions of the tube and contents as obtained from Drawing S-155952 and T. B. Drew were as follows: tube I.D. = 1.549"; active slug O.D. = 1.380", dummy slugs O.D. = 1.206" and largest tolerable size of tube ribs (see Drawing S-155952). For these conditions, the peak pressure drop for boiling conditions was 135 lbs./sq. in. Allowing for a 50 lbs./sq. in.margin of safety and atmospheric pressure discharge, an upstream header pressure of 200 lbs. should be sufficient. For the nominal water rate of 2.6 lbs./sec. to give a maximum water temperature of 65°C, the pressure drop through the tube alone was 118 lbs./sq. in.requiring an upstream header pressure of 133 lbs. if the tube discharged at atmospheric pressure.

The effect of the bowed pile with the use of undersized dummy slugs is such that the central tube will probably not be the limiting tube as regards the upstream header pressure necessary to prevent boiling in the tubes and also to supply sufficient cooling water. The reason for this, of course, is the fact that the resistance of the dummy slugs per unit length is only about 1/9 that of regular slugs and the effect of the greater length of regular slugs in tubes further out from the center (also the use of 20°C water) might overbalance the smaller heat load. Further calculations for other tubes are contemplated when sufficient information is available.

C. P. Kidder

Detailed design and preparation of blueprints for the CMX water treating facilities continues. Preliminary architectural prints are being modified slightly before issuing them to field construction.

In order to expedite the delivery of deaerators, it has been necessary to alter the construction material from stainless clad steel to rubber lined steel.

Six inch tees are to be included in the cold and hot treated water lines to permit the installation of corrosion test coupons. This will assist in the development of quantitative values for various metals and alloys.

A list of equipment requirements for the experimental water laboratory has been submitted to the Design Division.

Arrangements are being made by Mr. Simon of the Manufacturing Division to obtain the additional technical personnel required for the Hanford water tests.

Mr. Mears of the Aluminum Company was in Wilmington on May 26 to discuss corrosion of aluminum by water. The meeting was attended by J. P. Howe of Chicago and several members of the Manufacturing and Technical Division. The probable effect of the numerous variables on the corrosion resistance of aluminum was presented by Mr. Mears. The desirability of potential determinations for various metals and alloys in Columbia River water was pointed out and arrangements were made to develop such data at Chicago and at New Kensington.

W. M. Coons

The list of operating and maintenance equipment for C. P. Kidder's project has been completed. Personnel at the Experimental Station were consulted on these requirements.

A list of photographic equipment will be submitted after further talks at the Station and at Milton H. Hill, Inc.

200 Area

L. Squires

Waste disposal for the Hanford separation plants was discussed with the Manufacturing Division, May 24. It currently has been agreed to neutralize all wastes in the canyon in order to achieve better control and to facilitate equipment maintenance. It is believed that the neutralized slurry can be jetted from the canyon to the disposal tanks without plugging or settling in the lines. It is planned to test the flow and settling characteristics of the various neutralized slurries at Chicago next week.

A semiworks wet fluoride run was closely followed at Chicago on May 25 to May 27, with Greager and Acken. The character of the LaF_3 precipitates at various stages in the process was observed. In all cases where the precipitate was in an acid medium, it settled readily under gravity (as much as 1 inch per minute) giving a clear supernatant and could be easily removed from the wall of the centrifuge bowl by slurrying with water. The cake, after treatment with NaOH, became extremely gummy, adhered tenaciously to the centrifuge bowl, and required mechanical scraping for removal. The caustic treated cake readily dissolved in the zirconium complexing solution, however, and no difficulty is expected in operating the caustic modified zirconium coupling.

The results of the current experimental comparison of the wet fluoride and bismuth phosphate processes will be reviewed at Chicago 6/1 and 6/2 and will be summarized to form the basis for the selection on June 7 of the final process.

M. F. Acken

In Chicago June 1

James A. Collins

During the past week a review has been made of the corrosion tests evaluating the corrosiveness of the process liquors and slurries of the wet fluoride and bismuth phosphate extraction processes in order to compare the limitations of each with respect to corrosion. Major Sapper was contacted and requested to secure release of a quantity of "KLW" in the form of electrical cable and sheets to us from the Army and Navy.

Tests have been completed at the Experimental Station evaluating acid resistant bricks submitted by Washington Brick and Lime Co. and Gladding McBean & Co. (two West Coast manufacturers). The results of these tests indicate that it will be possible to secure on the West Coast acid resistant brick for the fume disposal stack at Hanford Engineer Works.

James A. Collins - Cont'd.

A memorandum was prepared to L. Squires considering the resistance of 18-8-S stainless steel to concentrated sulfuric acid.

O. H. Greager

The greater part of the week was spent in Chicago observing a semiworks run on the modified wet fluoride separation process, and collecting information for the forthcoming critical comparison of this method with the bismuth phosphate method. Complete data are now available for the last semiworks phosphate run, and incomplete but significant results have been obtained for the current fluoride run.

Bismuth Phosphate - Semiworks C-19

C-19 represents the first complete semiworks run on all active hex carried through by this process. The third decontamination cycle was carried out in the laboratory because of the small volumes remaining at this stage. Yield and decontamination factors are as follows:

	Yield, %		Decontamination, B		Decontamination, γ	
	Cycle	Cumulative	Cycle	Cum.	Cycle	Cum.
Extraction	100	100	17.5	17.5	14.	14.
1st Decontamination	85	85	89.	1560	53.	740
2nd Dec.	88	75	34.3	53,500	(too low	
3rd Dec. (lab.)	97	73	41.	2.2×10^6	(for counting	

Filtration was used in this run in place of the usual centrifuging, and there are indications of possible yield loss due to irreversible adsorption on the carbon filter plate. However, the yields and decontamination factors above compare favorably with previous wet fluoride runs in the semiworks, although yields in both cases have not been up to laboratory levels.

C-19 differed from earlier phosphate procedures in the use of hold-back carriers for extraction, and addition of Fe^{++} with H_2O_2 for more positive reduction. To insure complete carrying from the reduced solution, bismuth ion was increased to 1 mg./cc. and H_3PO_4 to 0.6M for theproduct precipitation step.

Modified Wet Fluoride - Semiworks C-20

This run incorporated the most recent modifications in the process, namely (1) preliminary precipitation of zirconium phosphate and barium sulfate in the extraction step, and (2) coupling of cycles with NaOH metathesis plus a reduced amount of zirconium complexing agent. The reduced zirconium was expected to improve yields and also permitted $K_2Cr_2O_7$ oxidation in the decontamination cycle, where persulfate and argentic silver had been required previously.

Early analytical results indicate that product yields have been quite good, showing an overall recovery of 90% through two cycles. Decontamination has been disappointing, however, as the over-all factor for two cycles was only 1300 for betas and 1520 for gammas. Corresponding laboratory runs have shown factors of 10^4-10^5 through the same steps, and the cause of this discrepancy has not yet been determined.

F. S. Chambers

A memorandum was prepared describing disposal of 8-day I_{131} at W. It has been pointed out by Miss Way that the "long lived" I_{129} which has a fission yield of 0.26 may also have some bearing on operation of the stack. If the energy and half life of this material are not soon established, however, its handling will have to be worked out during operation at X.

It is planned to discuss with the Metallurgical Laboratory the possibility of neutralizing waste solutions with a mild alkali in an attempt to avoid the formation of precipitates. This would be extremely desirable for both plants since plugging of the waste lines can only be guaranteed when the solutions are clear.

Physics, Instrumentation and 100 Area Control

D. F. Babcock

The blueprints for Site X pile were reviewed. The results of this study (which is continuing) will be reported next week.

An inadequacy was discovered in the mathematical theory which predicts the number of control rods required for a pile to give a given change in k. This shortcoming is being corrected by Wheeler and Gast. As soon as this mathematical part is complete, the control system for W can be specified.

Calculations by Miss Way indicated that argon was perhaps the worst impurity for introducing radioactivity into the helium stream. This calculation could not be made, however, with any surety because of the inadequacy of the experimental data. Miles agreed to ask Metallurgical Laboratory to fill in this gap.

The question of how the excess k that will be built into a W pile can best be utilized was considered with Wheeler. This very complex subject will be summarized this week.

P. A. Dahlen

Calculations were made for Wheeler on the effect of delayed neutrons on the effectiveness of a control rod immediately after it was inserted into the pile. These calculations will be completed next week.

C. W. J. Wende

Estimates of the activities induced in control rods and dummy slugs were reported in a memo to D. F. Babcock on May 25, 1943. The handling of spilled metal was discussed from the shielding standpoint in a memo to C. N. Gross on May 27.

Work in progress includes a review of blueprints on the Site X pile and additional calculations on the shield of the Site W pile.

John A. Wheeler

Bowing of the face of the water cooled pile to compensate 1/2% excess multiplication

John A. Wheeler - Cont'd.

factor has been translated into realizable terms. The pile is divided into five zones, as follows:

Zone	Number of Slugs Per Column	Number of Columns
Red	26	328
White	28	304
Blue	30	288
Yellow	32	290
Green	34	290
	Total	1500

The power distribution corresponding to this bowing has been calculated and will be reported in a memorandum.

The structure of the shield for the water cooled pile was reviewed with Dr. Fermi and other members of the Technical Division here on May 28.

Special problems in determining the effectiveness of control rods have been analyzed jointly with Paul Gast. With him a general method has been developed to determine the size of the circular control rod equivalent to a bar or sheet of absorbing material.

P. F. Gast

The drawings for the pile at X were reviewed for the purpose of determining the degree of control to be expected from the shim rods and also from the safety rods. The results will be reported when the calculations have been checked.

Calculations are also in progress to determine the spacing of control rods in a lattice for various degrees of control and various diameters of rods.

R. M. Girdler

Work on instrument problems continued.

J. N. Wilson

Work on instrument problems continued.

K. Way

An addition to the chart of radioactive and stable elements was constructed and a good deal of time was spent in looking up original sources to help clear up doubtful points for all regions of the chart. It now extends from mass number 78 to mass number 145 and is very nearly ready for reproduction.

[redacted]

K. Way - Cont'd.

Indications are that Iodine ^{129}, marked by the Coryell group as "long-lived", may have a lifetime of the order of a number of days and thus cause trouble in the stack gas. It does not seem probable, however, that there will be any other long-lived iodines, kryptons, xenons, or bromines than those already reported. I^{129} might be long-lived but since I^{126} has not been found in fission products, it probably will not be found either.

Clinton

W. E. Kirst

Water Treatment at X

Final details prior to design of the equipment were settled with the Design Division during the month. A list of special laboratory equipment for water analysis not available at X was furnished to W. Kay. The indications are that the ribbed aluminum tubes will be available in time to be built into the pile.

Visit to Site X

Two days were spent becoming familiar with the status of construction. Construction of all portions of the plant is under way. Graphite finishing is being started this week and testing will begin on the 29th. It is expected that all testing can be completed by early July and that the graphite portion of the pile will be finished shortly after the middle of July. The separation plant and the waste disposal tanks may not be finished before August 1, but this will not hold up preliminary pile operation now scheduled for the first week in August. A much more accurate forecast can be made in 3 or 4 weeks.

Site X Manual

It is hoped that this can be issued complete by June 15 or as soon thereafter as binders can be obtained.

W. A. Denbrock

Work continued on drawings for Site X Operating Manual.

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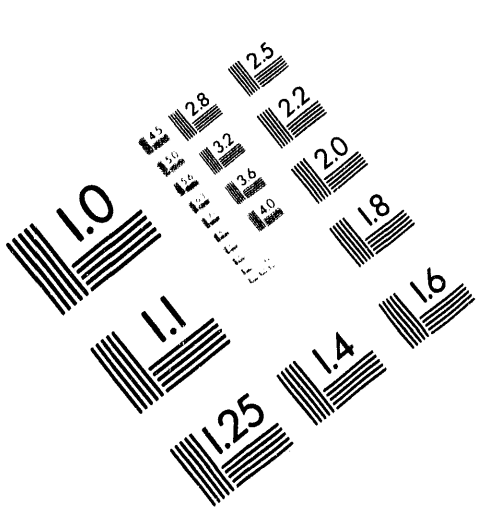

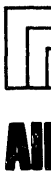

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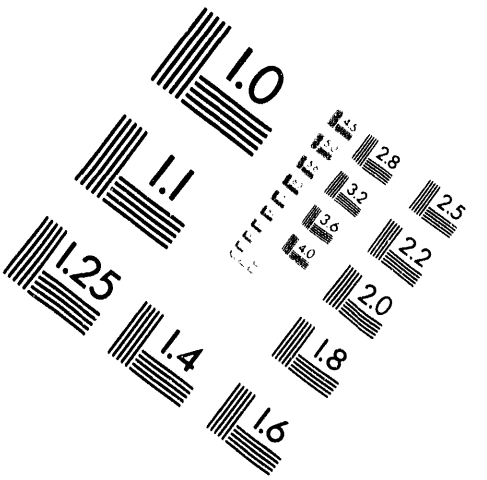

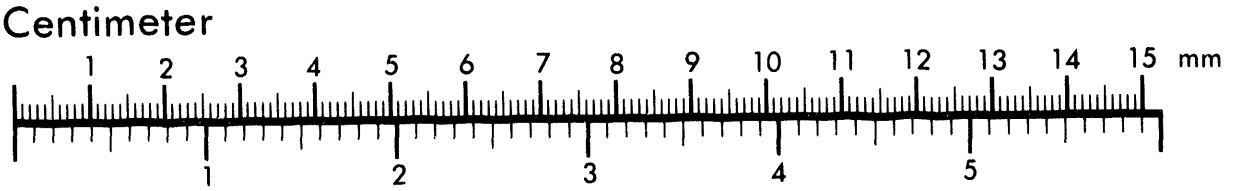

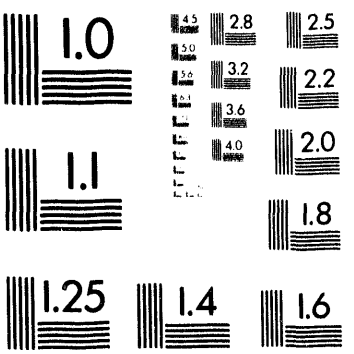

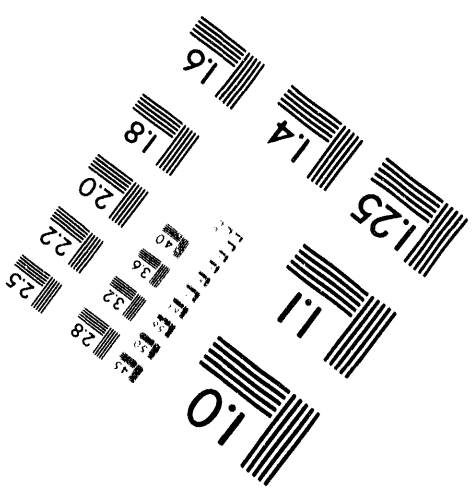

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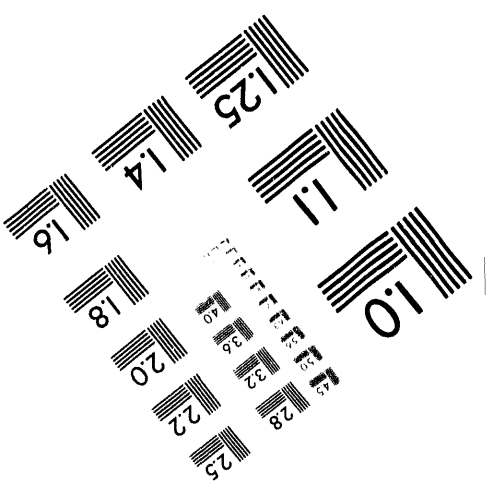

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