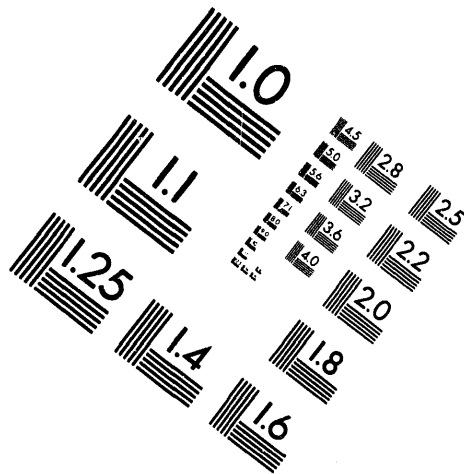
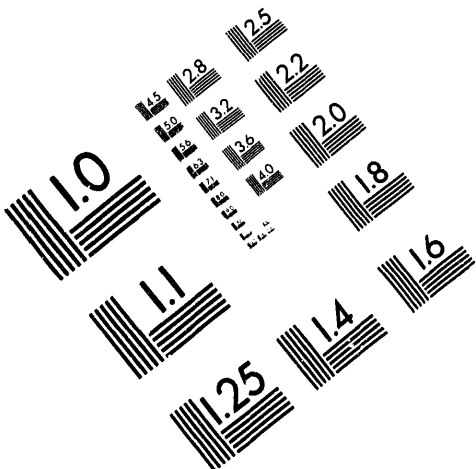




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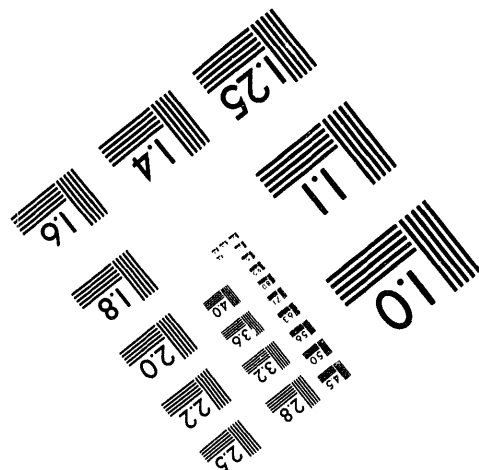
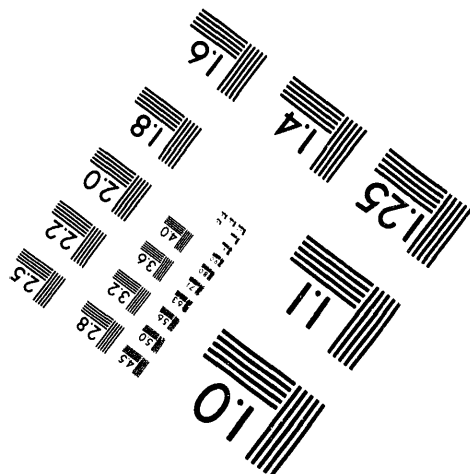
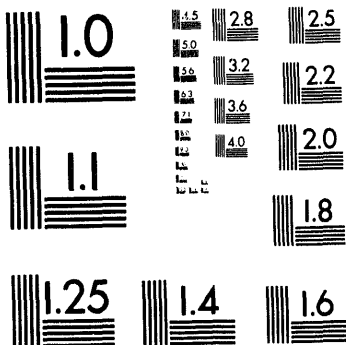
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1.	<u>C. J. Ebnick</u>	<u>AED CO</u>	<u>2/26/89</u>
	Name	Title	Date
2.	<u>J. W. R...</u>	<u>ADD</u>	<u>3/26/89</u>
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June 15, 1943

Reviewing  
Official:

C. J. Ebnick

C. J. Ebnick, AED Class Officer

**M E M O R A N D U M**

Date

3/26/89

WEEKLY PROGRESS REPORT - TECHNICAL SECTION  
FOR PERIOD ENDING JUNE 12, 1943

300 and 100 Areas - Hood Worthington

Hood Worthington

During the past two weeks the drawings of the X pile were reviewed, including those of the control rod system which bear on the rods for the 300 Area test pile. Operation of the safety rod dropping mechanism was inspected at Wilmington Shops. Dropping was rapid, and deceleration was smooth at the end of the stroke, which was closely reproducible. The drawings for the W pile have been reviewed twice.

Methods of constructing the shield with a view to using a minimum of critical facilities were discussed with Burns. The shield was again discussed in the joint Engineering Department-TNX Design Status meeting on June 5. A suggestion to support the inner layers of the biological shield, in which the most heat is developed, from the outer layers is being studied in an effort to minimize motion of the end shields under temperature changes. Otherwise the sequence and size of layers is fixed. Certain properties of Masonite must be uncovered before we can be sure of its mechanical performance: in particular, the coefficient of thermal expansion, the thermal conductivity and the effect of moisture need to be found, and the density must be checked. The latter is important because samples of a material having a nominal density over 1.3 turned out to have one of 1.21, which would require a thicker biological shield.

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**MASTER**



Hood Worthington (Cont'd.)

During a trip to Chicago, Wahl was introduced to the Argonne personnel, along with M. H. Smith and C. N. Gross of the Manufacturing Division. While they familiarized themselves with the apparatus, our most recent drawings were reviewed with Zinn, Anderson, Marshall and Woods, They had already been gone over with Wigner's men the day before.

The increase in radioactivity in the water caused by the presence of a failed coating was discussed with Wigner and Wollan. Data from CC680 by Coryell will be used to calculate the effect quantitatively.

K. G. Jones

Chicago - June 8 and 9

✓ A meeting on the corrosion of aluminum by Columbia River water was held at the Metallurgical Laboratory on Tuesday. All the Chicago staff interested in this problem were present together with R. B. Mears, Zay Jeffries, C. P. Kidder, and the writer.

A major part of the meeting was given over to a discussion of Mears' and Howe's results on potential measurements of various alloys in Hanford water. Briefly, the data obtained indicate that 72S will protect 2S at 70°C. Zinc and plain carbon steel would also be protective, while the stainless steels, copper and graphite cause the attack to take place on the 2S.

For laboratory corrosion tests by Mears and Howe, the following water composition was agreed upon as representing an ideal, obtainable analysis.

Starting with distilled water	
pH	- 6.5 (Mears)
Cl	- 1 p.p.m. ✓
O <sub>2</sub>	- .04 p.p.m.
HCO <sub>3</sub>	- 5 p.p.m.
CO <sub>2</sub>	- 3 p.p.m.
Na	- 0-1 p.p.m.
Heavy metals	- less than .1 p.p.m.
H <sub>2</sub> O <sub>2</sub>	- 10 <sup>-4</sup> mols per liter

✓ Dr. Jeffries suggested that since Mears was now familiar with the entire corrosion problem, the Aluminum Co. be given a couple of weeks to think over the situation in the light of their past experience and present to us a possible solution.

K. G. Jones (Cont'd.)

New York - June 11

✓ A meeting on graphite purity was held in New York on Friday at the offices of National Carbon Co. Those present were: Wilker, Nolan, and Hamister of National Carbon Co.; Doan and Boyd of Chicago; and Graves, Veith and the writer from Du Pont.

After a detailed discussion of graphite purity and the various difficulties involved in obtaining such purity values as we desire, Mr. Wilker agreed to do the following:

1. Investigate the possibility of obtaining coke having a lower vanadium content. A list of manufacturers can be obtained from the W.P.B. Chicago will cooperate on the rather large amount of analytical work involved.
2. Check the Barrett Co. to see whether or not they have analyses for boron content on their pitch. It is Wilker's opinion that the pitch will account for the boron and the coke for the vanadium.
3. They will make furnace charges with high, medium and low vanadium by picking suitable coke and send bars to Chicago for analysis and test.

It is Mr. Wilker's opinion that the vanadium content can be appreciably lowered by a suitable selection of coke. This alone would be of considerable value, even though the boron content were not changed. He was somewhat doubtful about the value of changing the type of pitch used, since the density would be lowered. We are to let him know how low a figure we can accept for density, providing impurities such as boron and vanadium can be lowered appreciably.

During the afternoon, Hamister, Veith and the writer discussed specifications on the graphite bars. Arrangements were made for Veith to meet Hamister in Clarksburg, W. Va. on June 16 to complete the final inspection details.

Wilmington

✓ Extrusion of X material at Columbus is progressing according to schedule, but C. E. Daniels feels that a second source of supply would be advisable. He has contacted Revere Brass & Copper Co. in Detroit and their representative will be here next week to discuss the matter. Revere's extrusion capacity is quite large and they have horizontal presses available.

K. G. Jones (Cont'd.)

✓ Machining is being done at two shops. Daniels reports that quite a number of slugs are being held back at Hamilton, Ohio because they are badly grooved. Evidently a chip can catch under the tool and gouge the slug deeply at times. Since these would not clean up, a number of them have been accumulated for further inspection. It is planned to visit Hamilton with Daniels next week to determine how many of these can be used.

✓ Degassing will start at Warren, Ohio on June 16. The procedure finally adopted is as follows:

1. Containers (steel pipe) made by Copperweld Steel Co. will be packed with 40 to 60 rods.
2. The vessel will be sealed and flushed out with argon until an Orsat analysis for oxygen shows that 95% argon is present.
3. The container or containers will then be heated in one of Copperweld's furnaces to 550-600°C. for 6 hours. Argon will be swept through the container during heating.

T. B. Drew

The calculations of temperature distributions in the flat ended and in the dished pile have been substantially completed except for revising the shield cooling problems to agree with the revised figures for heat evolution. Much of the detailed computation has been handled by Woods, and the boiling disease questions have been covered jointly by Woods and Kuniatsky. It is expected that all this material can be assembled and issued during the coming week.

With Wheeler, a more detailed calculation than we had heretofore made, was carried out to check Allison's estimate of the effect of using aluminum slugs in the reflector. In agreement with Allison, it was found that the effect on the reflector was not particularly serious. Allison had estimated that an additional 3 T. of metal would compensate for the decreased effectiveness of the reflector.

A memorandum was issued to point out that the water distributing orifices at the pile inlet must be followed by at least a 5" straight way if impingement corrosion is to be minimized.

Several discussions were held with Osterloh concerning the operation of water pressure accumulators as standby equipment in the event of pump failure. The related boiling disease studies have been turned over to Woods.

The effect of lateral heat flow in the graphite on the temperature distribution in the X pile was discussed with Lockhart and Jebens.

T. B. Drew (Cont'd.)

Obviously the chief effect is that a portion of the heat generated in the center actually shows up in the outer cooling passages. It seems unlikely that the temperature of the metal will be significantly affected.

The primary work in prospect is:

1. The Columbia River dilution problem, which it is planned to take up next week since the Army has shown interest in having the answer.
2. The pile transient problem.

W. K. Woods

Drew had previously prepared plots of the heat distribution in the bowed pile; comparable plots have been prepared for the flat-ended pile.

Heat transfer coefficients have been predicted for the central tube of the pile and have been used to predict temperature gradients in the metal as a function of tube length, for operation at 250,000 kw. The following maximum temperatures were predicted:

	<u>Bowed Pile</u>	<u>Flat-ended Pile</u>
Maximum Jacket Temperature	74°C.	72°C.
Maximum Average Metal Temperature	210°C.	202°C.
Maximum Axial Metal Temperature	320°C.	307°C.

The bowed pile has a somewhat higher apparent activity at the center resulting from the assumption that 0.5% k can be absorbed by bowing; if this additional k is not available, the pile cannot be bowed.

A plot of water rate versus pile radius, with lines of constant temperature rise, has been prepared for the flat-ended pile and is to be used (together with a similar plot previously prepared by Drew for the bowed pile) to facilitate specification of the water distribution in the pile. It is believed that the refrigerated water should flow through a smaller number of tubes at a higher water rate rather than using the same water rate in all tubes.

The curve of pressure drop versus flow rate for the central tube, minimum clearance, of the flat-ended pile is being recalculated by Kuniatsky and the writer for the case of water saturated with air at 5° C. and 400 lbs./sq. in. ga. This curve should provide a basis for specifying the maximum allowable air content in the water in an accumulator. Present calculations indicate that this much air causes at most a 20% increase in the pressure drop at a

W. K. Woods (Cont'd.)

Flow rate of 3.0 lbs. of water/sec. It has also been shown that this ~~amount~~ air causes a decrease of only about 1% in the amount of water flowing through the pressure reduction nozzles and that the ~~critical~~ flow velocity for the air:water mixture is at least ~~at least~~ 4 times as large as the desired flow velocity in the ~~nozzles~~.

W. K. Woods

### Flow of Water in the Bowed Pile

The ~~study~~ of the flow of water in the bowed pile has been completed and a ~~memorandum~~ memorandum written. As stated in last week's report, there are ~~special~~ egg and ring slugs extending from the inner edge of the ~~thermal~~ out to 8 inches beyond the outer edge of the biological shield ~~and~~ undersized dummy slugs in the reflector portion of the tube ~~and~~ also replacing the active slugs removed to effect shorter active ~~slugs~~ cylinders. For the dummy slugs, the frictional pressure drop ~~is~~ 7% and the kinetic pressure drop 23% that of an equal length ~~of~~ regular slugs. The total pressure drop for the egg and ring ~~slugs~~ was assumed to be 20% that of an equal length of regular ~~slugs~~. Calculations were made for five different tubes, one ~~one~~ from each length tube that is nearest the center of the pile ~~and~~ hence with the greatest heat load of tubes of that particular ~~length~~. For the case of the tubes with minimum clearance complete ~~pressure~~ pressure drop vs. flow rate curves were obtained, this being ~~the~~ limiting case for both the boiling disease and exit water temperature ~~for~~ for nominal flows. In addition, results were obtained ~~in~~ the ~~case~~ case of tubes with nominal clearance for only non-boiling ~~conditions~~. The inlet water temperature to the central tube was assumed ~~to~~ be 5°C., and 20°C. water was arbitrarily assumed to start ~~at~~ the first tube from the center of greater length than the ~~central~~ tube.

~~Limiting~~ results were as follows:

(1) ~~Maximum~~ inlet header pressure to suppress boiling

~~The~~ maximum pressure drop for the boiling cases was 150 lbs./  
~~sq.~~ in. for the central tube, and for suppression of boiling  
~~The~~ inlet header pressure of 200 lbs./sq. in gage is recommended.

(2) ~~Exit~~ cooling water temperature

~~The~~ maximum exit water temperature was 68.5°C. from the  
~~the~~ first tube out from the center, i.e., the first tube to  
~~which~~ which 20°C. water is added. This exit temperature was  
~~the~~ the flow rate resulting from the use of a nozzle picked  
~~to~~ as to give a 65°C. exit temperature from the central tube.



3. No definite statement could be obtained concerning the utilization of the various grades of graphite in the pile other than the poorest grade should be utilized in the reflector. Thus a distribution similar to that employed at X and West Stands will be followed for the 300 Test Pile.
4. During metal testing the average change in control rod position is of the order of 2 mm. although occasionally a variation as great as 17 mm. has been observed. Since the rod position must be measured very precisely to obtain a true effect on k, it is believed desirable to decrease the k value of the control rod by a factor of 5 or 10. The size of these proposed rods is being calculated. A counter proposal has been received to operate the pile at a k of 1.001 with a control rod having a k value of 1.0015; this should increase the control rod movement for a given effect by a factor of 3.
5. A limited number of graphite tests indicated that the cross section sensitivity of the test is  $0.4 \times 10^{-27} \text{ cm.}^2 / \text{atom/inhour}$ . At the point where these tests were run, 2 cm. change in rod position corresponded to one inhour. Insufficient tests have been made to show the variation of graphite purity and density as a function of position in the graphitizing pile. Testing of aluminum is just getting under way so results should be forthcoming in the near future.

#### 200 Area - L. Squires

##### L. Squires

Flowsheets for the bismuth phosphate extraction and decontamination processes were prepared and revised at Chicago in collaboration with Smith's group after consultation with the Chemical and Process Development groups. The flowsheets were submitted to the Manufacturing and Design Division June 10.

A feasible method of waste disposal for the phosphate process has apparently been developed based on the use of  $\text{Na}_2\text{CO}_3$  to neutralize waste metal solution. The carbonate ion complexes the uranium and prevents the precipitation of solids even at  $\text{pH} = 11$  in the presence of phosphate ion. Neutralization of the by-product and decontamination wastes appears straight forward. A waste disposal flowsheet is being prepared and will be submitted to Manufacturing next week.

The canyon layout required for operation of either the bismuth phosphate or wet fluoride processes was worked out with the Manufacturing Division. It was found that the phosphate process would require 34 cells and that the fluoride process could be operated in this layout (with the addition of perhaps 2 waste

L. Squires (Cont'd.)

neutralizers) with a somewhat reduced allowance for spare equipment. Details are covered in a memorandum to file:

Preliminary experiments were made on the solution rate of the Al-Si brazing alloy currently being used as a hot-dipped coating on the metal slugs. It was found that this composition dissolved very slowly and incompletely in both dilute and concentrated HNO<sub>3</sub> and concentrated caustic solution. This behavior will seriously interfere with the metal dissolving step of the extraction process as now operated if hot-dipped coatings are used. Further work is under way.

Work in progress at the present time includes the following:

1. A process description and equipment requirements for the phosphate process are being prepared in report form. These will summarize the process chemistry, operating variables, equipment performance, as well as pertinent physical and corrosion data.
2. The corrosion data for critical points in the phosphate process are being checked under conditions specified in the recent flowsheet. The evaluation of the effect of various annealing conditions on the corrosion resistance of 25-12 welds is also under way.
3. Preparation of a waste disposal flowsheet based on the current experimental program.
4. The current experimental program at Chicago will be followed. In particular, a practical bulk reduction step to follow the decontamination step must be worked out promptly, so that the design of the so-called recovery building can proceed.

M. F. Acken

The first part of the week was spent at Chicago where conditions governing the operation of the bismuth phosphate process were reviewed at a conference attended by members of Sutton's, Smith's, and Seaborg's groups. Assistance was given in the preparation and checking of process flowsheets.

J. A. Collins

Vacation period.

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O. H. Greager

Assistance was given Squires and Acken in preparation of Site W flowsheets on the bismuth phosphate separation process.

Preliminary consideration was given to layout and shielding requirements for a "hot" separation semi-works at W, to operate on a 15-lb. of metal (two slugs) basis.

F. S. Chambers

It has been proposed that the uranium slugs be bonded to the aluminum cans with Brazing Alloy 13 (aluminum + 13% silicon). Consequently a few experiments were made at the Metallurgical Laboratory to determine the effect of this alloy on the coating and metal solution steps.

A specimen immersed in 10%  $\text{HNO}_3$  plus Hg, the proposed coating dissolving solution, lost only 40% of its weight after 1 hr. and 20 minutes of boiling. With 60%  $\text{HNO}_3$ , 20% was lost in 1 hr. and 50 min., and with 10% NaOH, the loss was 29% (1 hr. 50 min.) In all cases, the decrease in size of the specimen was very slight and the final solution contained a black precipitate, probably silicon.

It is probable that HF would have to be employed in the coating solution step if this alloy is used.

Waste Disposal

It was originally proposed to improve the neutralization characteristics of the phosphate process metal waste solution by giving it a wet B process by-product precipitation. It was believed that the addition of fluoride ion would permit neutralization to a pH = 6-7 without metal precipitation.

Tests made at the Metallurgical Laboratory during the past week indicated that this treatment would do little good as long as phosphoric acid was present. Untreated waste starts to precipitate at acidities higher than pH = 0, forms a thick gel at pH = 0.5 (which, however, breaks up on further neutralization) and is completely precipitated at pH = 6. The treated samples started to precipitate at pH = 1-2, with precipitation about 75% complete at pH = 4, and 90% at pH = 6.

It was found, however, that phosphate metal waste can be neutralized and dissolved by an excess of soda ash solution with only the traces of cerium and lanthanum added as hold-back carriers in the extraction step remaining as gelatinous solids.

F. S. Chambers (Cont'd.)

It is proposed to make this neutralization by adding waste to a soda ash slurry since under these conditions foaming and intermediate precipitate formation are minimized. Approximately 300 gm. of 58% soda ash are required to treat one liter of waste.

It was also observed that the soluble complex salt formed in this process is destroyed by the addition of either fluoride ion or caustic soda. Consequently, neither a lanthanum fluoride treatment to decontaminate the waste metal nor partial neutralization with caustic appears desirable. A study is now being made, however, in which the decontamination obtained by  $ZrPO_4$  and  $BaSO_4$  treating, centrifuging, neutralizing, and complexing, followed by removal of the lanthanum and cerium alkaline precipitates will be determined.

✓ A disposal flowsheet for Site W is being prepared.

Physics, Instrumentation, and 100 Area Control - D. F. Babcock

D. F. Babcock

✓ The control rod system for W was discussed with the Manufacturing Division. Design is now making preliminary studies of this problem. It is hoped that their studies will have progressed far enough so that Chicago can be given a preview of our plans on the next Chicago trip (about June 16).

✓ With Gast, Dahlen, and Wheeler curves were developed showing the rate of heat production during an emergency shutdown of a pile. These data will be used by Drew and Woods to calculate the water temperatures during this shutdown period.

C. W. J. Wende

✓ Arrangements have been made for frequent informal discussions of shielding problems with Handforth and Fletcher of the Design Division so that the shielding of various devices may be reviewed as the design progresses. Formal reports will be issued when the final drawings are completed. Millett is maintaining contact with this work for the Manufacturing Division. A number of items bearing on the design of the crane cab and exit labyrinths of the Site W separation plant were handled in this way during the past week.

On the basis of Fermi's experimental data, it was roughly estimated that the present laminated pile shield at W would pass about 0.02 r/8hr. of gammas and would be safe for neutrons by a factor of the order of 30. These figures refer to the solid shield. A butt joint at the top edges of the shield might, however, be unsafe by a factor of 1000. Calculations on various other types of joints are being made.

C. W. J. Wende (Cont'd.)

The detection of coating failure in the pile by immersing a counter in the effluent water was discussed with Bugbee, and it was found that the failure of all coatings in a single tube would not be detectable in the total effluent until about two hours after exit from the pile, but would be detectable at once in the effluent from the defective tube. This result suggests that samples should be taken of the water from a reasonably small number of tubes, such as the twenty or so tubes connected to each header.

John A. Wheeler

With P. F. Gast, a memo was issued during the week on the power distribution in the Clinton pile in various cases when the pile is loaded in rectangular array. Similar calculations are in progress for the case of the rectangular pile loaded in a circular pattern.

The mean free path of the thermal neutron in graphite is of the order of 1". When the dimensions of a control rod are large in comparison with this quantity, a relatively simple treatment of its effectiveness, relative to a circular control rod, turns out to be possible. Under this condition, a strip of material of width,  $2a$ , which is completely opaque to thermal neutrons has the same effectiveness as a control rod of radius  $a/2$ . When a number,  $n$ , of such strips intersect at equal angles, then the radius of the equivalent circular control rod is  $a/2^{1/n}$ , according to the results of calculations completed during the past week.

Production of polonium from bismuth by insertion of bismuth slugs in the center of the Hanford pile raises the question, how great will be the dosage experienced by an individual handling one of these slugs? There is no nuclear gamma radiation to contend with, but the beta particles in traversing the bismuth give off electromagnetic radiation in a small number of instances. The dosage on this account is higher than the tolerance value, according to preliminary estimates, but falls off to a safe level in a few half lives of the radioactive product, Ra E, responsible for the beta rays. One recent reference in the German literature, located by Miss Way, indicates, however, that associated with this relatively short-lived five-day activity there may be a sixty day isomeric transition. If this transition is an inevitable result of the capture of slow neutrons by bismuth, and not due to some impurity in the experimental samples, then a real problem may arise in handling the activated bismuth.

K. Way

Data were collected and calculations made for various charts for Dr. Wheeler's manual.

K. Way (Cont'd.)

Mr. Snell writes that preliminary measurements indicate that the capture cross section of argon for slow neutrons is about  $0.5 \times 10^{-24} \text{ cm}^2$ . This means that a duct 2 ft. in diameter in the He circulation system would need to be shielded by about 18" of concrete. A more accurate value of the cross section will be sent in a few days.

A memorandum on dosage due to gamma rays released by slow neutrons in body was completed. The slow neutron dosage at various distances from a pile is given as a function of the number of slow neutrons leaking out of the pile.

J. N. Wilson (Report for 4 weeks ending June 12, 1943)

The past four weeks have been spent mostly in Chicago learning about D. C. amplifiers and helping to test the Harvey amplifier sets which were ordered by the company for use in the 200 Area of Site X. It has been determined that these sets will meet the specifications of the 200 operators but that they are not as good as the present Chicago circuits; this was the expected conclusion when these sets were ordered. A full scale deflection with 0.5 r/8 hours can be obtained within  $\pm 5\%$  and it is expected that this accuracy can be improved by further work.

Some assistance was given to the organization of the Instrument Group at Site W. Now that this group has been set up, further work on the Harvey sets will be turned over to them. It was arranged that three additional Micro-Max recorders would be available for this work.

It was shown that compression fittings could not be used with the present Copolene coaxial cable. Any unrelieved stress in the cable lowered the resistance to such an extent as to make the cable unusable. Experimental work was thus instigated in Chicago to solve this problem if possible. Jim Collins is obtaining a coaxial cable of a new substance which may solve the difficulty.

It was found that no alpha chambers or glass GM tubes had been ordered for use at Site X. Specifications are being worked out and orders placed as quickly as possible.

Offner Electronics Co. in Chicago was approached on the request of S. J. Bugbee as to supplying the necessary Scaler circuits for Site W. A satisfactory model can be obtained if immediate orders are placed. The circuits have to be made before September because of Offner's commitments to the Air Corps will take all his facilities after that.

A visit was made to the General Electric Company with Weller of the Metallurgical Laboratory to approve the design of their first ionization chamber (tube ZA 571). Information as to the urgency of orders on this item was transmitted to S. J. Bugbee.

P. F. Gast

In conjunction with Wheeler, a calculation was made on the distribution of heat in the pile at X for various amounts of metal arranged to form a rectangle in the pile. A memorandum on this subject has been issued.

A calculation was made on the degree of control achieved by a single cylindrical boron rod in the 300 Area pile.

R. M. Girdler

The period between May 26 and June 12 was spent in Chicago during which time 8 of the 13 Harvey-built amplifiers were put in operating condition. A number of minor changes were made which improved the voltage regulation, but the zero point was still subject to drift. The amount of zero shift between high and low grid resistance was reduced by the use of guard rings under the tube socket and resistance selector switch but under the best conditions amounted to 20% of full-scale deflection.

Extended runs with ion chambers were not completed because of the unavailability of recorders and chambers of the proper type.

Clinton

W. E. Kirst

Vacation period

W. A. Denbrock

Assistance as given W. E. Kirst in the preparation of drawings for the Site X operating manual.

**DATE  
FILMED**

**8/24/94**

**END**



