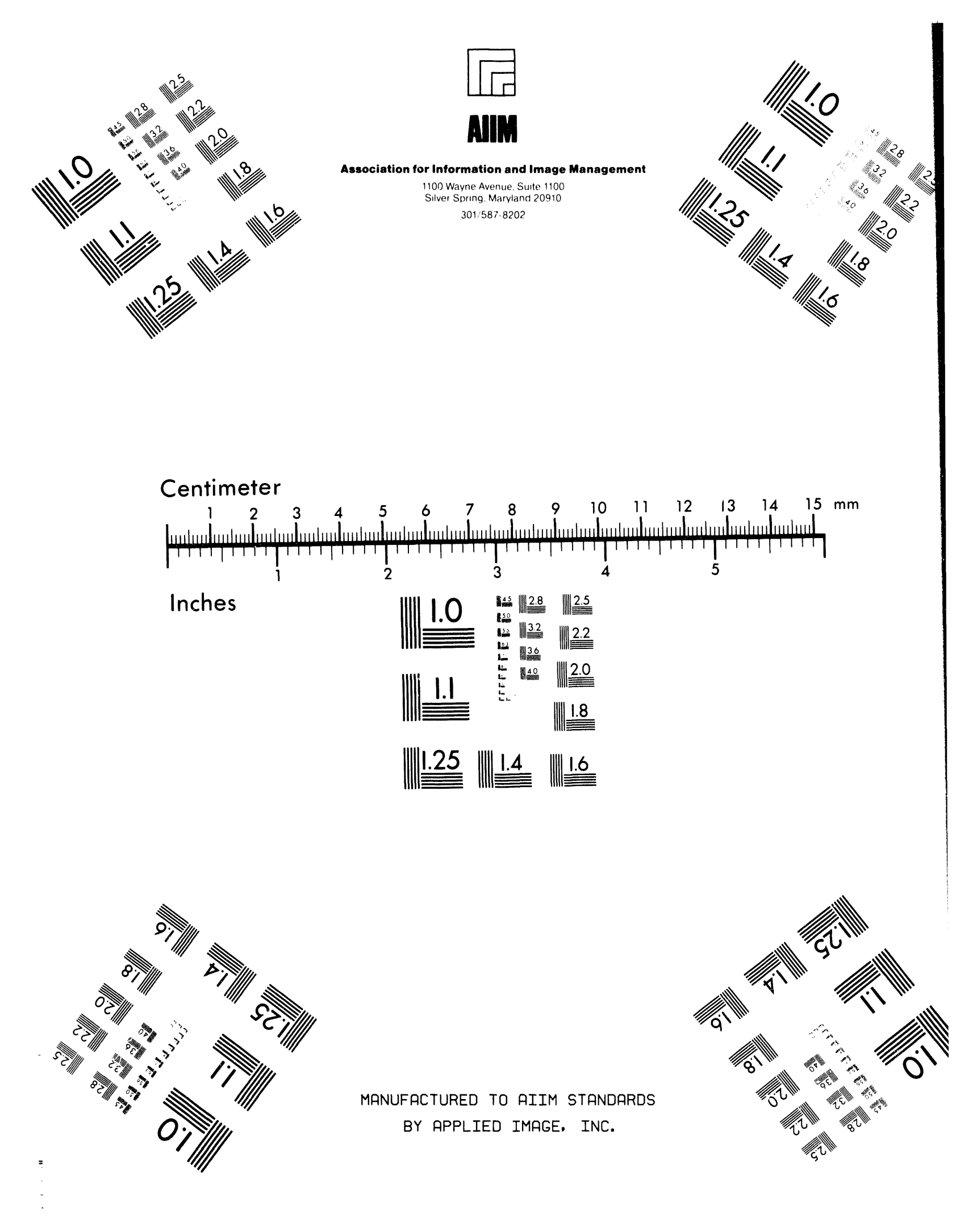
AIIM
Association for Information and Image Management
1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301/587-8202
Centimeter
Inches
MANUFACTURED TO AIIM STANDARDS
BY APPLIED IMAGE, INC.

1 of 1

HW-25054

HW-25054

[redacted]

This document consists of 32 pages. Copy No. 10 of 61 copies. Series A

Page 10 is Restricted
Pages 7, 11 + 26 are Inc

TECHNICAL ACTIVITIES REPORT

MECHANICAL DEVELOPMENT STUDIES - JULY 1952

COPY 1 OF 1, SERIES "A"

By

W. K. Alexander

Pile Engineering Sub-Unit
PILE TECHNOLOGY UNIT

Due to film deterioration, portions of this document may be illegible.

August 12, 1952

[redacted]

1946. Its [redacted] disclo-
[redacted] to
[redacted] person is prohibited.

[redacted]

1.	F. W. Albaugh - F. J. Leitz
2.	J. A. Ayres
3.	J. J. Cadwell
4.	T. W. Hauff
5.-6.	K. H. Kingdon - KAPL
7.	E. P. Lee
8.	W. M. Mathis
9.	G. E. McCullough
10.	V. D. Nixon
11.	W. I. Patnode
12.	P. H. Reinker
13.	G. M. Roy
14.	W. L. Schalliol
15.	W. K. Woods
16.	AEC-HOO - Attn: D. G. Sturges
17.	300 Files
18.	700 Files
19.	Pink Copy
20.	Yellow Copy
21.	O. H. Greager
22.	J. H. Warren - J. T. Baker
23.	W. R. Lewis
24.	R. O. Mehann
25.	V. D. Donihee
26.	F. A. R. Stainken - H. T. Wells
27.	C. W. Botsford
28.	J. A. Haaga
29.	R. G. Clough
30.	E. J. Filip
31.	S. L. Nelson
32.	D. S. Lewis
33.	P. F. Gast
34.	J. W. Ozeroff
35.	E. A. Eschbach - H. L. Mars
36.	L. P. Bupp - R. M. Fryar
37.	A. B. Carson
38.	J. C. Chatten
39.	P. A. Johnson
40.	R. L. Dickeman
41.	M. W. Carbon
42.	H. L. Henry
43.	J. F. Music - H. F. Zuhr
44.	J. M. Atwood - M. Lewis
45.	E. C. Pitzer - R. A. Rohrbacher
46.	E. C. Wood - J. W. Richiss
47.	J. R. Wolcott
48.	B. R. Elder
49.	J. H. Snyder
50.	R. T. Jaske

[redacted]

51.	E. L. Reed
52.	D. L. Peterson - T. F. Robinson - H. S. Davis
53.	C. H. Goldthorpe - H. Harty
54.	W. J. Morris - R. W. Vivian - R. C. Lovington
55.	G. E. Wade - J. M. Roberts
56.	R. E. Johnson - R. V. Dulin - J. P. Cooke
57.	R. E. Schilson - P. M. Jackson - J. M. Rector
58.	C. D. Emmons - E. G. Dosskey
59.	W. K. Alexander
60.	Extra
61.	Extra

[redacted]

TABLE OF CONTENTS

[redacted]

TABLE OF CONTENTS (CONTINUED)

[redacted]

I. PILE CONTROL

A. HORIZONTAL ROD SEALS - ROUND ROD - R. E. Johnson

Future pile design indicates that it would be desirable to eliminate the horizontal rod thimbles because of the reactivity they absorb and the temperature limits they impose on pile operation. This elimination creates a need for a suitable gas seal around the rods. Such a seal has been under development for the C Pile.

Sphincter Seal

A total of 80,000 cycles on the horizontal rod sphincter seal was completed without a failure although the "Hydrograph" was almost completely worn from the surface of the rod section. See Figure 1. The long continued ease of running must be attributed to the excellent coat of lubricant retained on the sphincter boot as shown in Figure 2, and to the polishing effect which the "Hydrograph" had on the cycling rod. Because of the findings of the above test, a check run was made using a clean surfaced rod and a "Hydrographed" boot. At 3000 cycles the frictional force became excessive for the cycler, and therefore any possibility of using Hydrograph on the boot only was judged unwise. Flaking of the "Hydrograph" may cause a contamination problem and is the chief disadvantage of this seal. The average leak rate from pressure loss calculations was .01 cubic feet of gas per hour at 80°F and 20 inches of water pressure.

Rubber Washer Seal

A new type unlubricated seal utilizing sealing washers made of 1/16 inch neoprene gasket sheet is being tested. Figure 3 shows various seal combinations that have been tried. Type 1 provided a very good seal but had too much frictional resistance for continuous operation on the cycler. Type 2 leaked considerable gas during cycling probably because the washers were not sufficiently rigid without the backup washers as used in the Type 1 design. Type 3 leaked somewhat however the frictional resistance was reduced considerably over that obtained in the Type 1 design. Type 4 shows great promise in its ability to seal a rod. A total of 50,000 cycles has been completed with very good wear resistance and with practically no gas leakage. Indications are that this seal may be more suitable for 105-C than the present sphincter seal.

Undoubtedly other washer seal designs are as suitable and perhaps better suited than the Type 4 design for their are numerous variables present, such as, washer material, its hardness, thickness, and length, types of back-up washers, and number of washers necessary.

[redacted]

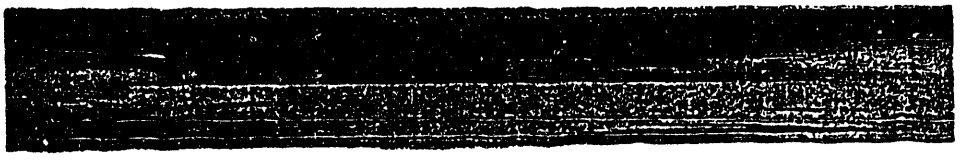

FIGURE 1

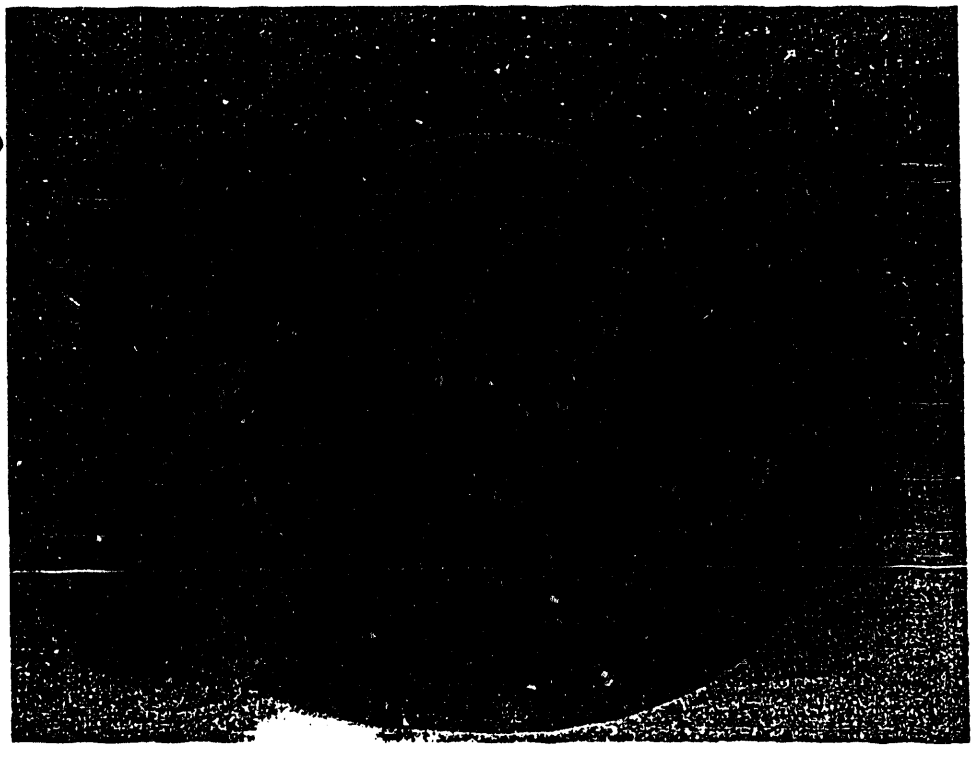

FIGURE 2

RUBBER WASHER SEALS

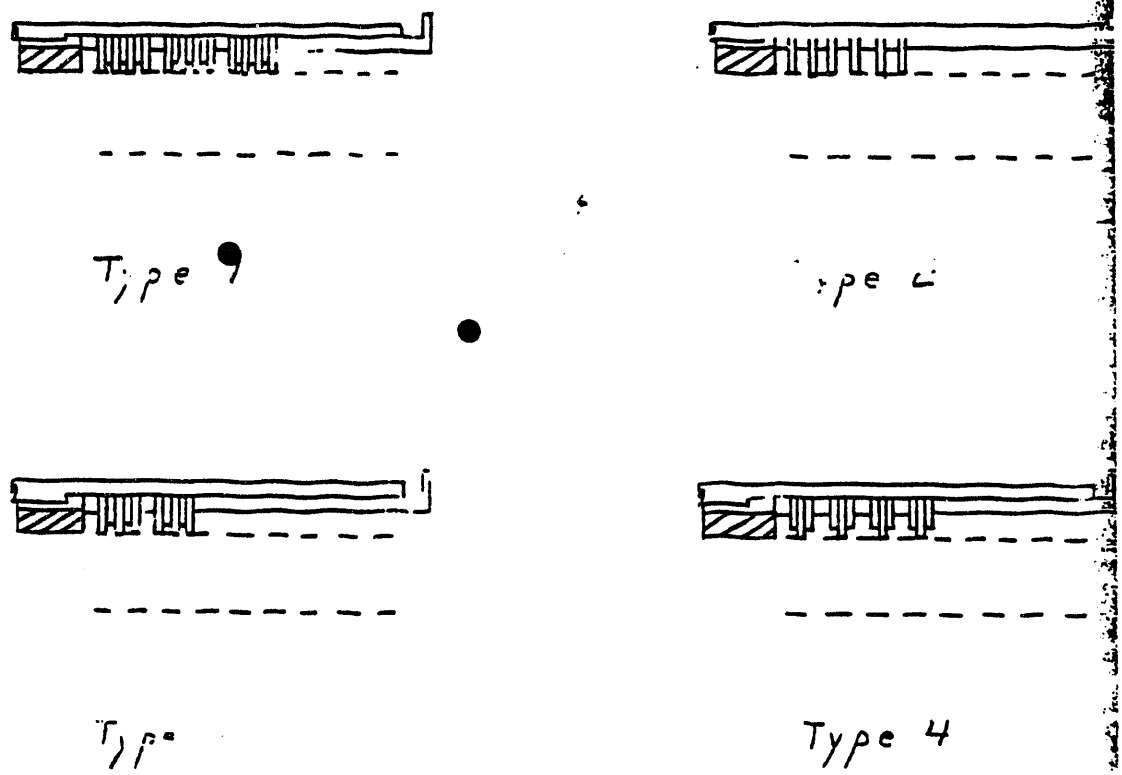

FIGURE 3

B. HORIZONTAL ROD MOCKUP: DESIGN TEST NO. 5 - R. E. Johnson

The overall horizontal rod mockup program consists of several phases. The first phase is a functional and life test of the 105-C rod prototype equipment under conditions of both startup and anticipated stages of graphite growth. The second phase utilizes the facility for development of a rod conversion program to eliminate the rod problem now present in the existing reactors. The third phase will be for the development of future rod designs.

Functional testing of the C Pile Horizontal Rod under startup conditions has been completed. It may be stated that on an overall basis the system has performed satisfactorily. An error in the positioning limit switch (P-8439) leaves the rod tip 6" closer to the graphite at the "full out" position than is shown on operating diagram P-8522. If necessary this may be corrected by using a 6" limit switch extension. Along with the startup tests the requested electrical drive tests are being performed. Figure 4 shows a view of the two drive units and the graphite end of the mockup. The time of insertion was determined to be 44 seconds under normal drive full speed and 7 seconds under scram. The required data have been obtained although tests are being run to determine an inexpensive way of slowing down the emergency drive. The horizontal rod system is no longer to be used as a scram system, however the original scram drive is to be kept as a stand-by rod driving system. It appears that adding a series resistance to the scram drive electrical circuit may accomplish this end. When this procedure has been definitely established, testing under graphite growth conditions will begin.

The mockup was utilized in determining the best method of application and the optimum thickness of "Hydrograph" lubricant to be used on the rod. The results are summarized in a letter to J. C. Wood, July 21, 1952. Two painted coats of polished "Hydrograph" are recommended. Figure 5 shows a few of the wear spots from testing.

By means of an RMJ air sampler a relative indication of the amount of "Hydrograph" loss was obtained. A small amount of graphite dust collected from under the seal over a half hour of continuous rod operation indicated that contamination may be a problem within the inner rod room of 105-C. Various means of diminishing this problem will be attempted.

Upon using the mockup, several construction mistakes were found. The 120 volt selenium battery charger had not been properly altered to charge a 240 volt bank. The bank itself, which was obtained from the rod system at 100-B, was two batteries short in number.

C. HORIZONTAL ROD CONVERSION - PRESENT PILES - J. M. Roberts

The problems connected with the horizontal rods in the older piles and the necessity for their conversion is covered in detail in HW-23216. The

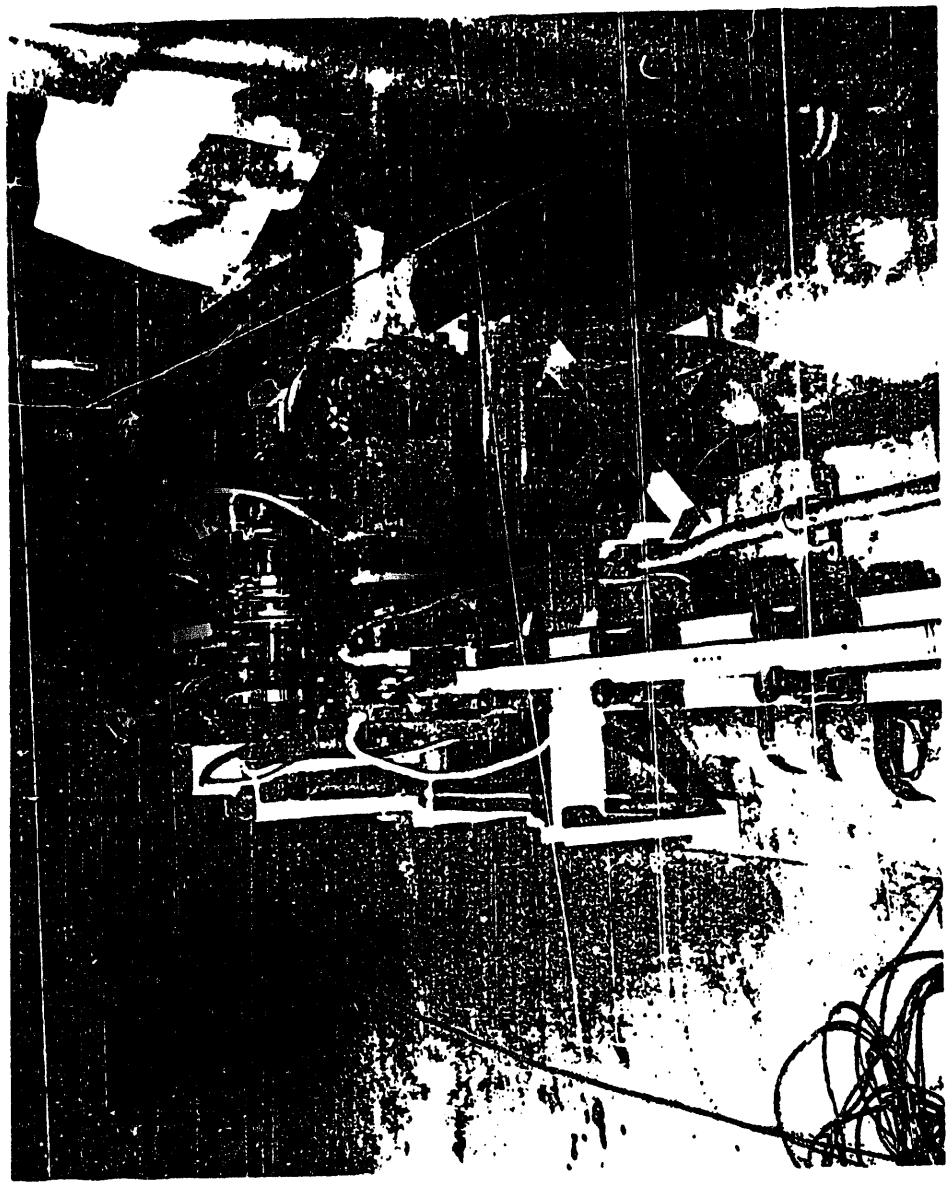

FIGURE 4

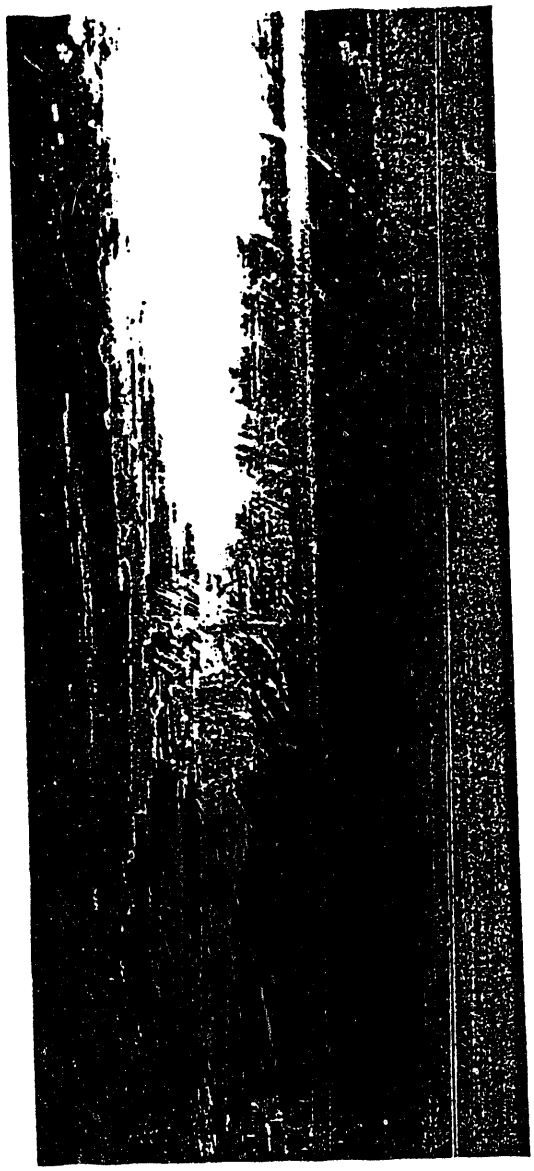

FIGURE 5

proposed conversion consists of an external thimble between the pile face and the barricade wall with a seal at the barricade wall. The seal operates with an oil lubricant on the inactive rear section of the rod which is made of steel. The rest of the system is built around this basic conversion idea.

The design is nearly completed and should be ready soon for the mockup stage in the 189-D Building. Of course, the actual mockup may be delayed until the tests are completed on the C Pile horizontal rod.

The success of a new type seal employing rubber washers with undersized holes on the C Pile horizontal rod (figure 3) has given promise of similar success for the rectangular shaped rod which is necessary on the older piles. It may be desirable on the rectangular rod to reduce the pressure drop across the washers by using a pressure balancing mechanism. A design for a seal housing to permit extensive testing has been completed and is being fabricated at the present time.

Should this type seal prove practical for a rectangular shaped rod the entire conversion would reduce itself to a new main gate with an attached seal plus a new smooth-surfaced rod tip. The main gate for the external thimble design was purposely designed for use with a seal in case one was developed. Therefore all that remains for the seal type conversion is the selection of a new rod tip. This could consist of a slight modification of the present tip where a smooth continuous shell would be substituted for the plates over the tubes, or it could be a complete departure from the accepted method in which an attempt would be made to improve the inhour strength of the rod. This will require some study to determine whether a new design should be attempted at this date or whether the more definite approach should be taken where only a slight modification is necessary.

Both of the conversions - seal and external thimble - will be carried simultaneously until one or the other is deemed satisfactory for a pile installation.

D. BALL 3X PRESENT PILES - P. M. Jackson

Work on this assignment includes the study of various components necessary for the installation of the Ball 3X System.

Work done on the Ball 3X Sphincter Seal is given in detail under the title "Effect of Sphincter Seal and Lubrication On VSR Drop Time". Design Test No. 11, by P. M. Jackson.

A completely modified crack filler has been received and testing will begin very soon. The filler has undergone numerous changes to insure reliable operation. The reservoir has been increased in size so that it will contain more mix, and it has been made replaceable in order to speed up the

[redacted]

filling operation. The outlet holes have been increased in number and size in order to permit easier flow of the material. The crack locator has been adjusted so that a more reliable hole survey can be made and guides have been added to prevent the filler machine from revolving during operation.

A demonstration of its operation will be given within a week.

E. FUNCTIONAL TEST OF C PILE V.S. ROD AND BALL 3X SYSTEM; DESIGN TEST NO. 6 - C. D. Emmons

The purpose of the test is to determine the operating characteristics of the Vertical Safety Rod and Ball Safety System for C Pile.

During the past month the V.S.R. System was installed and the rod displacement time curve was obtained. See Figure 6. This curve was obtained for two conditions, the first was with no pressure on the sphincter seal and the other was with 6 feet of water pressure on the seal. A table of the results is shown below.

TABLE I

Total Rod Drop Distance	ROD DROP TIME - SECONDS	
	6' Head On Seal	0' Head On Seal
30½'	2.97	2.78
24½'	1.825	1.73

During the last six feet of rod travel the winch hydraulic brake is applied. The total lifting time of the rod with the C Pile winch was measured to be 20.7 seconds.

The C Pile Ball 3X System is presently in the process of being installed.

A full charge of balls was placed in the C Pile Hopper. The ball level was within 8 inches of its top surface; the weight of the charge was 1400 pounds, and the number of balls in the hopper was approximately 175,000.

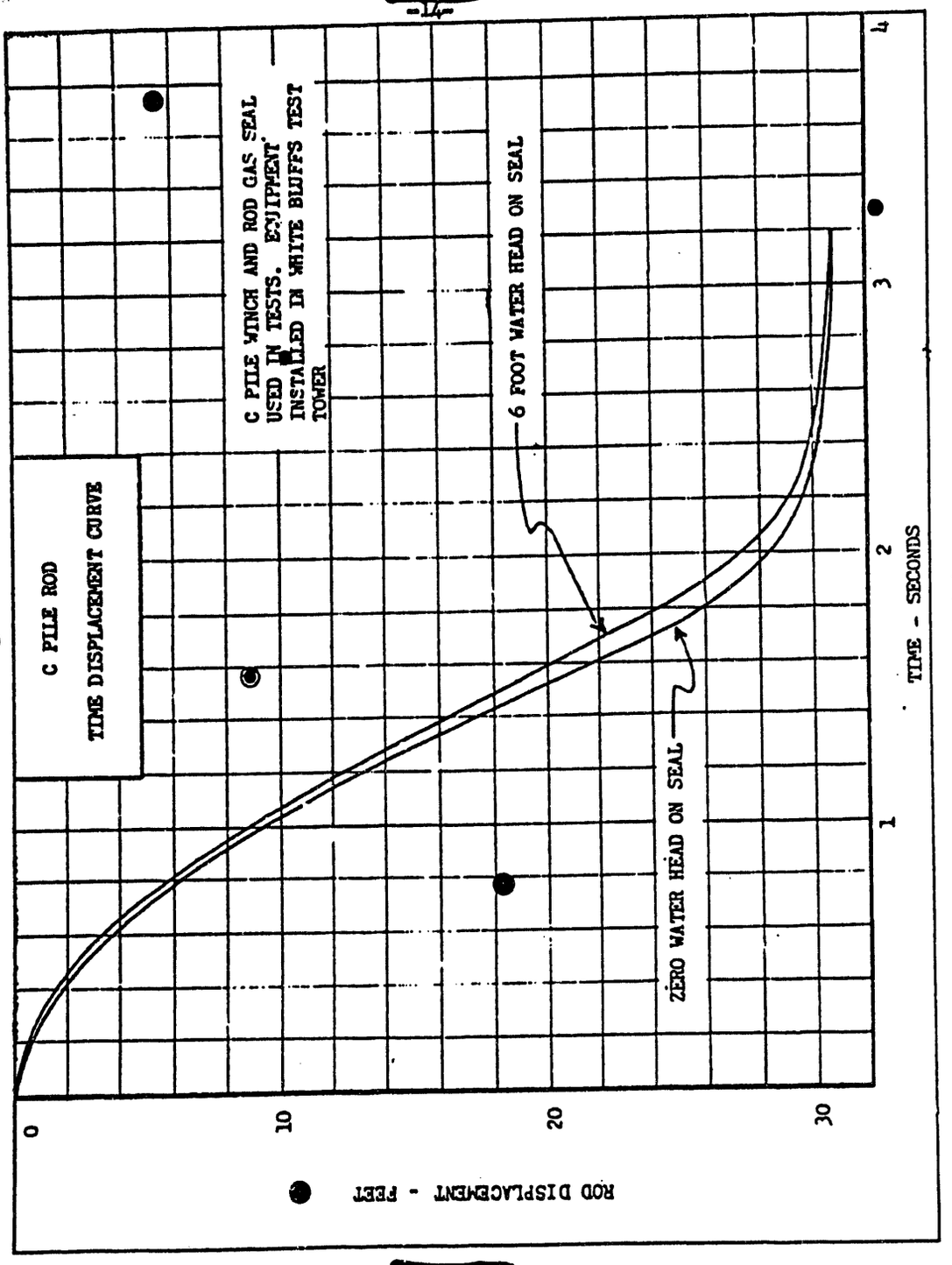

FIGURE 6

F. EFFECT OF SPHINCTER SEAL ON V.S.R. DROP TIME; DESIGN TEST NO. 11 - P. M. Jackson

To prevent the atmosphere surrounding the pile from becoming unduly contaminated with pile gasses, seals must be provided on all openings from which gasses might escape. Such a seal is necessary on all vertical safety rods that are not provided with thimbles. The sphincter seal has been designed for this application.

The last shutdown at 105-D occurred during the 4th of July weekend, and therefore the work scheduled was postponed until the next shutdown. This work consists of altering the apparatus for measuring the volume of gas leakage so that a more positive leakage value can be obtained.

It has not been possible to measure the minute quantity of gas which the Kanne Chamber indicates is escaping.

G. INK FACILITY - J. M. Roberts

This project consists of a one-tube mockup to be installed on the pile for checking out the feasibility of using potassium tetra-borate solution as a supplementary control medium. The development work has advanced to the actual installation of a test facility on DR-Pile.

A meeting of all concerned parties was called recently by Project Engineering Unit for the purpose of scheduling all work which must be done during normal shutdown periods. It was felt that about 16 hours would be required to lay the drain line which must pass from the inner rod room through the ventilator duct under the rear face and out the side of the building to the underground storage tanks. It was not known exactly what time limits could be expected, but it was felt that at least six shutdowns would be required for the job. The next shutdown would be used to plan the operations, take an RMU survey, and look over the situation generally, leaving five shutdowns for the actual installation. Since there will be no July shutdown, the earliest completion date will be January or February 1953 unless some additional time is made available by extended shutdowns for ruptures. No work is planned during the ball [redacted] installation since all the maintenance personnel will be busy elsewhere at that time.

The instruments are scheduled for a September delivery and will be installed as a unit while the drain-line work is being done. The cycling and solution mock-up equipment in the inner and outer rod rooms will be pre-fabricated as much as possible beforehand and moved into position while the other work is going ahead.

Some concern has been expressed that the hydrogen peroxide formed by the boron (n,α) reaction would be detrimental to the system. However, it

was the opinion of the corrosion group that the peroxide would actually help to inhibit the corrosion of the aluminum by the potassium tetraborate solution.

H. HORIZONTAL ROD SEAL - RECTANGULAR ROD - W. E. Cawley - J. M. Roberts

It would be desirable to remove the horizontal rod thimbles from the existing pile for two reasons:

1. The thimbles absorb reactivity.
2. Due to growth of the pile graphite, the thimbles are somewhat deformed which causes the rods to stick.

It is proposed to eliminate the internal thimbles by developing a dependable gas seal to be mounted on the side wall of the pile. Since the old piles were designed for rectangular rods, there is not enough clearance with present conditions for insertion of a round rod. Therefore, a new rod cross-section is proposed which is elliptical in shape. This modification was necessary to make possible the design of a gas seal.

During the past month an assembly was designed to test the proposed seals. This new seal testing assembly will be used in conjunction with the seal cycle-testing machine in building 189-D. Several different seal designs have been proposed and will be tested as soon as the housing is fabricated.

J. BF_3 CONTROL - W. E. Cawley - J. M. Roberts

It has been estimated that a period of eight to ten minutes is required with the presently planned ink facility in order to integrate fully a change in concentration throughout the system. This limits its use to supplementary control. A second disadvantage is the fact that zero control is limited to a tube full of water. Obviously a gas control with variable pressure would not have either of these disadvantages. However, in selecting a suitable gas with a high cross section and suitable stability the search narrows to BF_3 and Xe^{131}. Since the cost of Xe^{131} would be prohibitive, BF_3 was singled out for further development.

To determine the feasibility of developing such a control system, the characteristics of BF_3 must be ascertained. A thorough search of the literature indicated that no BF_3 has ever been subjected to irradiation in a pile at high flux densities. As a consequence, samples are being prepared by the Pile Services Group for irradiation tests. Some 2S aluminum coupons were placed in some of the containers to determine what reaction occurs between the BF_3 and aluminum when subjected to pile conditions. The aluminum coupons were accurately weighed and

will be reweighed after exposure. Also the BF_3 gas will be analyzed by a mass spectrometer before and after the samples are placed in the pile.

BF_3 gas is not corrosive when it is kept dry. If, however, any moisture is allowed to come in contact with the gas, it is expected that corrosion will occur. Therefore, it is desirable to have some tests run on this gas to determine the rate of corrosion for a given amount of moisture per unit volume of BF_3. With this information it will be possible to determine the amount of moisture that can be tolerated in the system. Corrosion tests are being prepared by the Corrosion Group.

Considerable thought has been given to possible systems for controlling the pressure of the BF_3. The three most promising are as follows:

1. The first system consists of a pump for evacuating the control tube which is pressurized from a tank through a suitable control valve. Here the flow is continuously recycled. The burnout can be held down by maintaining a large volume in the pressure tank. The corrosion and mechanical problems are numerous in this type system, however.

2. The second system consists of a small vertical tube roughly 1/2 inch in diameter and two feet long externally connected to the control tube. This small vertical tube is then submersed to various levels in liquid nitrogen to condense out any portion of the BF_3 desired to give the control densities. The vapor pressure of BF_3 at $-154^{\circ}C$ is 5 mm which makes the method quite feasible since the temperature of liquid nitrogen is $-195^{\circ}C$. The advantage here is the simplicity of the entire system. The BF_3 can be highly purified and thoroughly dried before introducing it into the sealed system and it should remain dry and pure indefinitely. The trouble with this system is the fact that the total volume should be held small to conserve nitrogen and yet held high to extend the burnout period. The burnout period at 100 psia is roughly 300 days for a full process tube assuming continuous use with the capture rate continuing at the initial rate throughout this period. Under these conditions it would be necessary to replace the gas every six months. The liquid nitrogen evaporates quite rapidly presenting another problem. Some means of assuring a continuous supply is required. The cost of liquid nitrogen is only $.30 per liter which is not prohibitive. Considerable development would be necessary to produce a sensitive control from such a method of pressure control.

3. The third method uses water absorption to remove BF_3 from the system along with a pressure tank for introducing BF_3. The volumetric absorption of BF_3 in water is 1000 to

[redacted]

1 at 760 mm pressure. The tube would be pressurized from the tank and evacuated by water absorption with a provision for introducing helium for zero control. The burnout problem would be eliminated altogether, but the corrosion problems connected with the water absorption are most serious. No pump would be necessary and if the corrosion could be isolated outside the pile this method might prove to be the best in the end.

The study will be continued until a definite program can be outlined or until the preliminary tests rules out the use of BF_3 as a control medium altogether.

K. TEST OF ALUMINUM COATED BORON GLASS BALLS - DESIGN TEST NO. 16 - C. D. Emmons

A series of tests is being run on aluminum coated boron glass balls to determine their feasibility for use in the Ball 3X Pile Systems.

The impact properties of the balls after being held at 500°C for one hour and then cooled to room temperature was determined by dropping them through the graphite stack 50 times. After approximately 20 drops the aluminum coating began to flake off and upon completing the test approximately ten per cent of the balls had lost a large portion of this protective coating. No apparent damage was caused to the glass itself. The test was repeated with balls heated to 600°C and the same results were observed.

L. STUDY OF BORON COATING OF CONTROL RODS - J. H. Rector

The boron coating for the control rods of the older piles was applied by a powder flame spray method. Experience has shown that in some conditions the coating does not adhere to the aluminum tubing. In view of these facts and possible new designs for controls it is desirable to improve or develop a new coating procedure or method which will give better service from a standpoint of heat transfer and bond strength. A powder metallurgy process of pressing and sintering the boron coating will be tested.

The powder materials of Al, B, B_2O_3 and B_4C have been received. The dies for pressing the samples will be completed shortly. Tests will begin as soon as the equipment can be set up.

M. CONTROL ROD CHANNEL BLOCK REMOVAL - J. H. Rector

Recent replacement of horizontal control and shim rods and thimbles has required the removal of all or part of the graphite channel blocks for the first few feet of the opening to permit sufficient clearance for the new thimble replacement. If all of the graphite channel blocks were removed

[redacted]

it would improve conditions for present control rod thimble replacement and the additional 11/16" height of the opening would also facilitate application of the proposed replacement control rods for the B, D, and F Piles. Present operations for removing the blocks involve a "chiseling" technique which is quite cumbersome.

A machine incorporating two milling cutters of the slitting saw type has been designed and is being fabricated. The machine is scheduled for completion 9-1-52. The graphite for the mock-up in 189-D Building, upon which it will be tested, is scheduled for completion by the same date. Tests should begin in September.

The print numbers for the design include SK-1-1026, SK-1-1027 Sheets 1 and 2, and SK-1-1034.

N. IN PILE TEST - GLYPTAL - BORON - CONTROL ROD TUBE COATING - J.M. Roberts

The Power and Maintenance Unit has developed a method of applying a mixture of glyptal and boron powder to a control tube to produce a resilient coating with a tight bond to the aluminum. Since it is quite easy to apply, the cost will be greatly reduced over that of the conventional metal-spray process. To determine its feasibility for horizontal control rod use, an in-pile test of the coating for radiation damage was initiated. The test has been delayed until a third sample using Armstrong cement and boron powder could be prepared. The tests should start shortly.

P. RADIATION DAMAGE - HORIZONTAL ROD MATERIALS - J. M. Roberts

Samples of 2S plates and alloy bolts obtained from both the active and inactive zones of a horizontal rod will be tested for stress-strain characteristics and surface hardness to determine the long term radiation effects to the materials. The delivery of the pieces to 111 B Building was held up by transportation difficulties, delaying the start of the tests. Therefore, little progress can be reported this month.

Q. PILE ATMOSPHERE STUDY - R. V. Dulin

A study is being made of the effect on pile operation of reducing the pressure of the pile atmosphere. A preliminary determination of the amount of gas entrained in the graphite, and its effect on attaining a reasonable vacuum, is necessary before a full scale test can be undertaken, however.

To this end, a vacuum tank is being made which will hold 9 graphite bars. A vacuum pump will be attached and the empty tank evacuated to a low pressure (1 mm Hg abs.) After noting the pressure rise (if any) over a 24 hour period the graphite bars will be placed in the tank and the tank pumped down again. After another 24 hours the pressure rise will again be read, and from this rate of leakage of air from the graphite may be

determined. A plot of the absolute pressure versus time will be made for each case, also.

R. LINEAR MOTOR - W. E. Cawley - J. M. Roberts

It is possible that a linear motor could be developed to position the horizontal rods. The advantages to be gained by use of this type of device include elimination of the need for an outer rod room since the linear motor stator would be located in the inner rod room. Also the rods could be moved into the pile at a very high speed in case of a scram. Correspondence has been instigated with the Land Equipment Division, General Electric Company at Schenectady Works. Preliminary correspondence indicates that a rod drive of this type may be quite feasible.

II. SHIELDING

A. BROOKHAVEN CONCRETE WATER RETENTION TEST - R. C. Lovington

As assistance to the Shielding Program of the Physics Group, a water-retention test is being conducted in the 189-D laboratory to determine the water-retention characteristics of Brookhaven concrete as a function of temperature and time.

This test has continued during the past month. No change in weight has occurred since the last report. Readings are now being taken once a month.

B. X LEVEL SHIELD - G. E. Wade

The purpose of this project is to devise a method of charging and discharing samples from the "B" and "D" test holes that will overcome present difficulties encountered in using the gatling gun.

Some preliminary sketches of a revised gatling gun are now being prepared. When these are finished they will included in a report describing the advantages and operation of the new system.

C. AGGREGATE SURVEY - H. Harty

In order to determine what ore materials are available as aggregate in a high density concrete, inquiries are being sent to various mining institutions and companies. Present inquiries concern the Chromite deposits in Montana, and the water retention minerals available in California.

[redacted]

D. DISTORTION AND STRESS IN THE BIOLOGICAL AND THERMAL SHIELDS OF B, D, AND F PILES - C. Warren

Gradual increase in the power levels of B, D, and F Piles have caused increasing concern about the possible effects of higher power levels on the biological and thermal shields of these piles. In an attempt to predict what restrictions, if any, the shields might impose on power levels, an analytical study was made of the stress conditions in the biological and thermal shields of B, D, and F Piles. The study did not include the possible effects of radiation damage to the masonite component of the shields.

In a previous Technical Activities Report it was stated that the power level of B, D, and F Piles can be increased to at least 700 MW without adverse stress or distortion effects on the shields. This figure was computed on the basis of a calculated allowable temperature differential across the side biological shields of 200C. A more complete study of the temperatures that may exist in the shields at higher power levels has now been made, and it appears that the 700 MW value can safety be increased to 800 MW.

A report which provides a discussion of the factors considered in this study of the shields will be issued soon.

E. STUDIES OF HIGH DENSITY CONCRETES FOR BIOLOGICAL SHIELDS - C. Warren

During the past month space in the east end of the 189-F Building was allocated to the Pile Technology Unit for the installation of a laboratory to study high density concretes for shielding. The laboratory which is planned will contain the equipment necessary to fabricate concrete specimens for physical testing along with certain special testing equipment which can be used only for concrete testing.

An outline of a program to study and develop high density concretes for shielding purposes has been prepared. The outline contains a discussion of materials that should be tested, tests that should be conducted on those materials, and the testing equipment required.

F. THERMAL SHIELD SIDE CAST IRON HANGER UNIT STRENGTH TEST: DESIGN TEST NO. 17 - C. D. Emmons

It has been proposed that the side cast iron thermal shield blocks be hung on the side wall instead of stacking them one on top another. The purpose of this test was to determine if such a design was feasible, by actually running a strength test on two banger units designed by Process Engineering.

A mock-up of a side shield hanger was constructed with provisions for applying the load under three conditions. The load was applied (1) midway between the two adjacent hangers with the cast iron shielding

[redacted]

block as close to the hanger as possible; (2) midway between the two adjacent hangers with the cast iron shielding block 7/8 inches from the hanger; and (3) directly above one hanger with the shielding block 7/8 inches from the hanger. The maximum amount of movement measured was 0.100 inches and this was with a force of 40,000 pounds applied to the center of the block. The weight of one block is approximately 4000 pounds and it is therefore felt that the hanger design is adequate.

III. PROCESS TUBE ASSEMBLY

A. RADIAL CREEP TEST OF ZIRCONIUM TUBING; DESIGN TEST NO. 2 - C. D. [redacted]

The final report on the "Radial Creep Test of Zirconium Tubing" was issued July 14, 1952, Document number HW-24969.

B. PIGTAIL FLEXURE TESTS; DESIGN TEST NO. 3 - R. E. Schilson

The pigtail flexure tests refer to tests made on all newly developed pigtails, whether they are designed for new piles or for replacement on present piles. It is necessary to run actual flexure tests to determine whether a particular pigtail design is satisfactory, because of the difficulty, or impossibility of predicting stresses in such an irregular shaped object.

In the flexure tests, the ability of the pigtails to withstand the [redacted] and contraction forces imposed by the process tube during the start-up and shutdown operations of a pile is tested on a specially built testing machine. In this way the life expectancy of a particular type pigtail may be determined.

The pigtail flexure testing machine has been modified to permit testing of the double-loop, 1-inch, stainless steel pigtail for the RDA-DC-3 program, and tests are now underway. The pigtail has been flexed without failure ± 1/2 inch for 7200 cycles while an internal pressure of 600 psig was applied to it.

After completion of this test, the machine will be modified to permit testing of a 3/4 inch, aluminum pigtail for DR replacement.

A final report is now being written covering all tests on pigtails for the "C" pile development program.

C. PROCESS TUBE RIB SPACING AND WIDTH - R. V. Dulin

There are several factors which suggest that the present 90° angular spacing of the ribs in the process tube may not be the optimum position for process tube design. Also advantages can be obtained if a narrower tube rib can be used.

[redacted]

One of the most serious conditions arising from the present rib spacing is the galling of the slugs. With the advent of charging and discharging machines which will operate at full power output, this galling may be increased. It seems probable that gouging could be reduced by relocating the process tube ribs at some lesser angular distance apart thereby reducing the slug sliding friction forces present. Other advantages of placing the ribs closer together would be:

1. Lower pushing forces required in charging operation.
2. Less galling of slug cans thus fewer aluminum chips which are a contamination and radiation hazard on the rear face of the pile.
3. Longer tube rib life and a smoother rib.
4. Less tendency for slugs to wedge between the ribs and become stuck.

Test apparatus has been designed to establish a comparison between various angular positions of the tube ribs. This is to be done by placing two aluminum bars, with the edges machined to the contour of tube ribs, in an adjustable assembly capable of simulating any number of rib positions from 90° on down to 15°. A hydraulic cylinder will be used to measure the force required to push a 15 to 20 foot column of slugs along the ribs.

A study will also be made of the effect of process tube rib width on galling and also on pushing forces. If it is possible to reduce the width of the tube rib, two desirable improvements might be gained:

1. Better heat transfer characteristics, since the area of the slug can exposed to water flow would be increased.
2. Smaller aluminum cross-section in the pile, resulting from a smaller volume of aluminum in the process tube.

Design of the test facilities have been completed and drawings are being prepared.

D. TAPER BORE GUNBARREL DEFLECTION: DESIGN TEST NO. 7 - R. E. Schilson

The taper bore gunbarrel deflection test was undertaken to obtain the deflection characteristics of the gunbarrels designed to be used with the taper bore, which is a tapered tube that performs the same function as the B-tube and doughnut assembly in present piles. That is, it affords shielding around the gunbarrel where it passes through the biological shield, and, at the same time, allows for deflection of the gunbarrel, which is caused by graphite growth forcing the graphite entry block to tilt and rise. In this test, the effect of the slope and rise of the graphite entry block on the gunbarrel and process tube are determined, particularly the deflection curves of the gunbarrel.

The final report will be written as soon as the analysis of the test data is finished.

[redacted]

E. CREEP TESTS - IRRADIATED PROCESS TUBES - R. E. Schilson

Because of the present trend to higher power levels and, consequently, the higher inlet header pressures needed, this test was inaugurated to determine the effect of pile radiation on the ability of the process tubes to withstand the higher water pressures that may be encountered. The necessary information will be obtained by measuring the increase in the circumference of process tubes which were used in one of the reactors. These tubes will be subjected to internal pressures up to 1000 psi at a temperature of 100°C. At the same time identical tests will be conducted on non-irradiated process tubes.

Work on this project will continue when the specially designed electric furnace is completed.

IV. PILE OPERATING EQUIPMENT

A. PRESSURIZED C & D MACHINES - J. P. Cooke

The primary purpose of this test is to determine the feasibility of charging and discharging slugs under normal water flow conditions, and thus eliminate pile shutdowns for charging. The principal obstacles encountered to date in this experimental program have been cocked slugs and galling and siezing of slugs in process tubes. A certain amount of "bowing" or localized" column bending" seems to occur even in a straight tube, though in a bent tube force of 600-800 pounds seems to be capable of lifting a slug column of 9 to 10 feet in length off the track and up against the top of the tube.

Tests with a standard charging machine have indicated that charging forces of 700 to 800 pounds will cause cocked slugs in a straight tube and forces of 600 to 700 pounds will cause this trouble in a badly distorted tube. This leads to speculation as to whether the charging force necessary to free a charge of slugs in an operating pile might not at the same time leave a few cocked slugs in the next pile charge. Cocked slugs have not been observed however if they were charged into a straight or a badly distorted tube according to standard charging procedures.

The relationship which appears to exist between total charging force and cocked slugs may possibly impose limits to the length of process tubes in future piles if some means cannot be found to reduce the friction factor between slug and tube. Current proposals along this line are:

1. Anodizing a hard coating on either the slugs or tube interior (or both). Anodized slugs will be completed about August 1, in the setup at 108-B and equipment is currently being installed in 189-D for anodizing the interior of the process tube.

2. Make the tube tracks out of some material other than aluminum - possibly a special cross-section tempered glass rod, fiberglass, or a combination of both crimped into a suitably extruded grooved track section. Samples of various possible glass materials are being procured for study.

3. It is possible that a lubricant might be found which could be mixed with the process water in the tube being charged, and which

   a. Would not pick up a long-lived activity, nor cause contamination build-up of an oily, scummy, or greasy nature in the 107 basins.

   b. Would not be too expensive in the large volumes that would be required.

Investigation of lubricants has therefore been deferred on the basis that the difficulties connected with their possible use are such that they should be considered as a last resort.

B. UNPRESSURIZED CHARGING MACHINE: DESIGN TEST NO. 1 - W. J. Morris

This project was established to determine the operating characteristics of the unpressurized charging machine and its discharge assembly and to evaluate reliability and simplicity of operation. The system was designed originally to be used for "Postum Charging", a continuous side-loaded charging-discharging operation for special request material. Testing has been directed toward adapting this system to the charge and discharge of piles with process metal while the pile is in operation. Document HW-25006, "Terminal Report, Pile Technology Unit Design Test Number 1, Unpressurized Charging and Discharging System" by W. J. Morris, July 22, 1952, has been issued.

In the testing of both the unpressurized and pressurized continuous charging systems, slugs were found to lie in various cocked positions when charged at flow conditions. The development of a workable continuous charging and discharging system depends upon the elimination of the problem of slug cocking. A process tube with a lucite window 6" long and covering 210° of the circumference has been developed to allow observation of the slugs moving through the tube. Strain gauges are used on the lucite window to keep the stresses within a working limit. Figure 7 shows the lucite window and the attached strain gauges. When charged at 25 gpm, the slug moves through the process tube at a speed of roughly 10 feet per second. Pictures of the slug moving by the window are being made with an Eastman High-Speed Camera. High-Speed motion picture photography (1000 - 3000 frames per second as compared with slow-motion pictures 64 to 128 frames per second) reveals details of rapid movement which are undetected by the eye. A series of four reels of film have been taken and are presently being developed. It is planned to study the following conditions by this method:

[redacted]

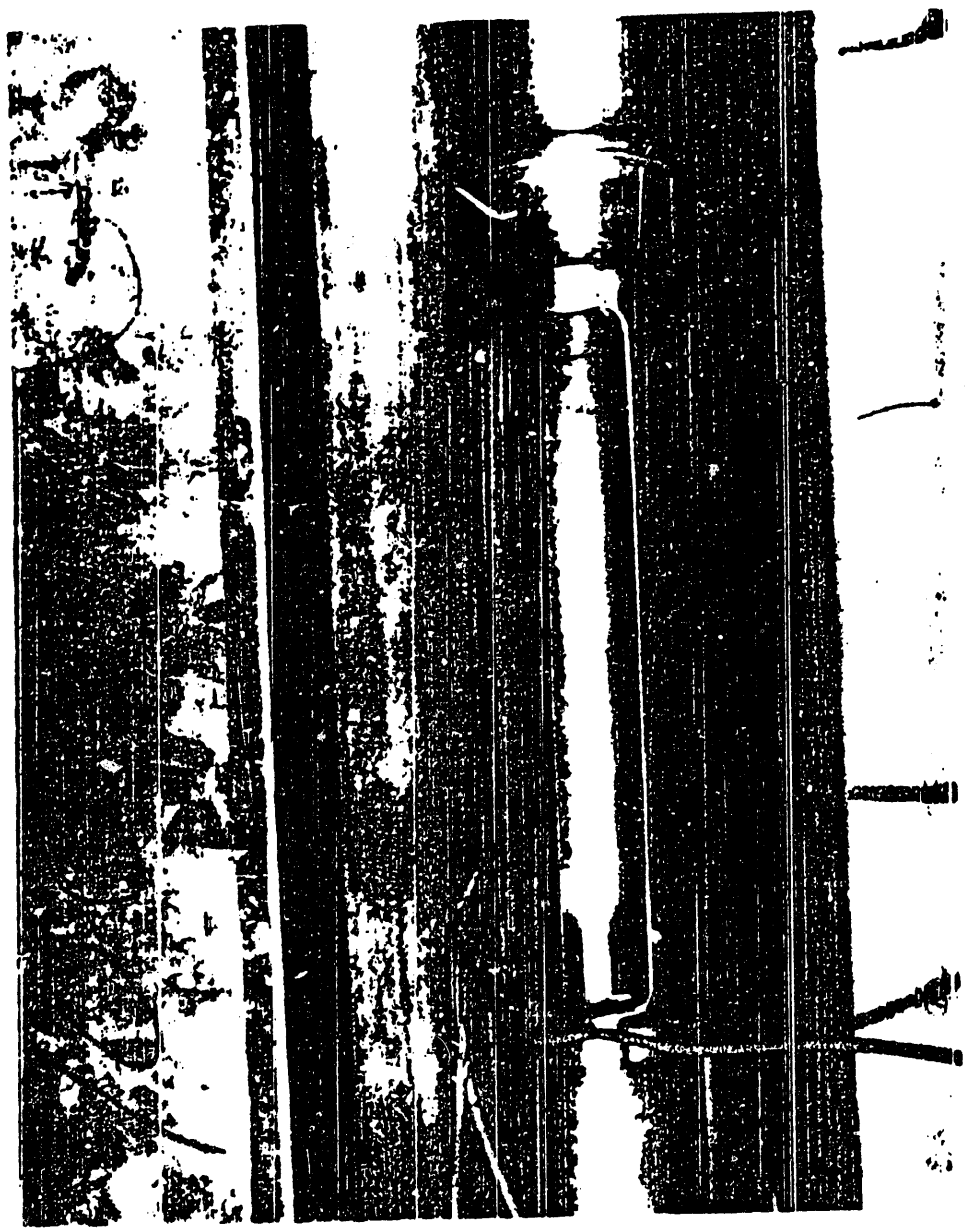

Figure 7

1. The movement of slugs rifling down a process tube at full flow conditions.
2. The effect of various flow rates on the movement of the slugs.
3. The effect of slugs hitting the column of previously charged slugs.

C. REAR FACE MONITORING BY TELEVISION - W. J. Morris

The lack of visual contact between the front elevator and rear elevator, or the control room and rear face, has seriously handicapped certain pile operations. It was decided that a closed circuit television system with two remotely controlled cameras mounted on the rear elevator would be the most flexible viewing arrangement. The monitor would be located in the control room with auxiliary viewers located at any desired site.

The mechanical design for remote control of the camera has been completed and actual construction was started this month. Fabrication of the camera carriage is about 30% complete. Delivery of the small fractional horsepower positioning motors has been delayed, but they are expected by August 1, 1952.

All electrical drawings will be completed this month.

Testing of the equipment will begin in about 6 to 8 weeks.

D. IN-PILE PROCESS TUBE PRESSURE TESTER - R. W. Vivian

This tester is being designed to speed up and improve the accuracy of in-pile process tube pressure testing, possibly for future routine testing of process tubes.

The design uses a rubber seal, expanded by a pressure source greater than the pressure used to test the process tube. This differs from the presently used tester, which uses a gasket expanded by mechanical pressure. The new tester will test several tubes at once.

E. PROCESS TUBE OD GAUGE - J. H. Rector

The possibility of process tubes being deformed in shipment or project transfer to job location requires an inspection for these defects. A gauge is needed for rapid and accurate inspection of process tube outside diameter before installation in the pile.

A ring gauge was designed as per print H-1-3546 and fabricated. However the original size was 0.003" over the maximum process tube diameter and when tested this gauge did not meet the requirements. A new gauge is being fabricated to the maximum process tube outside diameter.

[redacted]

F. CASK STANDARDIZATION - R. E. Johnson

The completed design is intended to provide a standardized group of shipping casks for test and process pieces. The cask design will be made available to off-site atomic energy installations.

No progress can be reported this month.

G. SLUG AIR WEIGHER - R. W. Vivian - R. C. Lovington

The slug air weigher is being designed and fabricated for use in the irradiated fuel element examination program at 105-B viewing basin. The air weigher will determine the slug jacket weight loss due to corrosion.

Design of the weigher is shown on prints SK-1-975, Sheets 1 through 24. Upon completion of the fabrication process, it will be tested in a viewing facility mock-up.

H. P-13 REMOVAL - W. J. Morris - R. C. Lovington

This project has as its object the preparation of equipment for the removal and burial of the P-13 pressure assembly located in H-Pile. At present there is no facility provided for removing the assembly either upon completion of tests or on an emergency basis. The principal difficulty to be encountered in this operation is the extreme activity level which will be present as a result of the irradiation of the unit. A system of removal has been devised which is believed to offer a high degree of reliability, and is the basis of a Project Proposal.

The Project Proposal and cost estimates were revised the early part of this month to incorporate several suggestions made by Technical supervision. Circulation of the proposal for approval is now almost complete, and it is hoped that the final signatures will be obtained in time to present the proposal at the July meeting of the Appropriations and Budgets Committee.

J. SLUG IDENTIFIER - R. C. Lovington

At the request of the Process Control and Analysis group, Mechanical Development is investigating various methods which might be used to determine the exact location of the slugs in the process tubes. At the present time, little, if anything, is known regarding the orientation of the slugs in a particular tube. The batch-type system of discharge, especially in the case of a rupture, does not allow the analysis group to properly correlate data which may help explain the reasons for the slug failure.

The method which has been proposed consists of a new slug numbering system which will give each slug a separate number. A record would be made of the slug numbers immediately prior to charging by photographing the boxes of slugs as they are handed to the charging operator.

[redacted]

This investigation has continued during the past month. Several standard automatic indenting lettering machines have been located which can be readily adapted for use in the proposed system.

K. SLUG BREAKER - R. W. Vivian - R. C. Lovington

The slug breaker is being designed and fabricated for use in the fuel element examinatior program at the 105-B viewing basin. The breaker will test the fracture strength of irradiated slugs as well as to give a surface which can be inspected for grain size and orientation.

Design of the breaker is carried on prints SK-1-1030,Sheets 1 and 2. At present it is in the shop being fabricated.

L. HIGH SPEED FLUX MONITORING - R. E. Schilson

It is desirable to know the front to rear flux curve in the piles for various reasons. This information may be obtained by measuring the gamma activity of slugs discharged from the reactors but present methods of doing this are so slow and tedious as to make it impractical. Therefore, this project is being undertaken to develop a possible method of measuring the gamma flux of individual slugs, automatically, as they are being discharged.

During the past month, no progress was made on this project because of work on other projects.

M. SLUG CLEANER - R. W. Vivian - R. C. Lovington

The slug cleaner is being constructed for use in the irradiated fuel element examination program at the 105-B viewing basin. The cleaner is used to remove the film build-up on the slug before the slug is weighed. The design is an extension of the one in present use, modified to process slugs at a greater rate. At present it is in the shop being fabricated.

N. CO_2 LEAK DETECTOR - W. E. Cawley - J. M. Roberts

It is proposed to develop a CO_2 leak detector which will indicate the volume of CO_2 leaking past a given point. Such a detector will be extremely useful as long as a CO_2 pile gas atmosphere is used. Several systems for accomplishing this result are under consideration.

V. PILE RENOVATION

A. PROCESS TUBE ASSEMBLY DISTORTION TEST - PRESENT PILES - C. E. Wade - R. V. Dulin

The purpose of this test is to study the limits of graphite growth and the resultant process tube distortion that will prevent the charging and discharging of slugs and thus curtail pile operations.

During the past month all testing on the nine-tube mock-up was finished. The data are now being organized and correlated and a report on the findings will be issued in the near future.

Two conclusions can be drawn from the test results at this time. First, replacement of gunbarrels will offer no particular problem in the forseeable future providing some type of guide for the gunbarrel is used. Second, bending of the process tube in the gunbarrel will not limit the passage of four-inch slugs under any conditions of graphite growth that might occur in the near future.

B. GRAPHITE MINER - J. H. Rector

Experience and tests of various technical groups indicate it may be desirable to rebore or overbore the graphite tube blocks in the older piles to improve operating conditions and efficiency. Preliminary study of this project indicates the basic design should incorporate an external electric power source, Selsyn motor type remote cutter diameter control of the machine from the front elevator. The drafting of such a machine is now in progress.

C. PROCESS TUBE REPLACMENT - P. M. Jackson

A winch arrangement is needed to pull new process tubes into the unit during tube replacement. Present replacement techniques are manual and quite cumbersome. The design criteria has been set at 500 pounds pulling force at a speed of 30 fpm. Various types of drives and cable arrangements are being studied in order to secure the most effective winch. At present, information on various air motor drives is being secured from the vendors.

Previous tests have indicated that the pulling mandral, used successfully in the 305-A Building for several months, will be quite adequate. The nylon covered cable appears to be well suited for the puller as the contamination from the smooth nylon is much less than uncovered steel cable. A block and tackle arrangement for the pulling cable has been abandoned since it is nearly impossible to obtain a cable or group of cables with sufficient capacity that could be pulled over a 1 1/2" sheave.

[redacted]

VI. POWER RECOVERY

A. POWER RECOVERY - FUEL CONFIGURATION - C. Warren - G. E. Wade

The purpose of this project is to determine the feasibility of an internally cooled slug as a pile fuel configuration that would permit the recovery of a reasonable amount of power from graphite-uranium piles.

The equipment needed to test this type of slug has been outlined, but some difficulty is being experienced in procurement. The instruments for measuring temperature and strain are not readily available. Also delivery of the stainless steel needed for the heater element and the simulated slugs will be delayed six months by the steel strike.

A theoretical investigation of the stress problems encountered in a split hollow slug is being made. This investigation is intended to supplement data which will be obtained in the tests. Briefly, the problem is to derive relationships which will make it possible to predict the performance of an internally cooled split hollow slug under test and/or pile conditions. Two cases are being considered for temperature distribution through the slugs:

a. The temperature distribution in the slug is assumed to be due to heat flowing from the external surface of the slug to a cooling tube in the center. This case is analogous to the test which is planned.

b. The temperature distribution in the slug is assumed to be due to uniform heat generation within the slug, the slug being cooled by a cooling tube in the center. This case roughly simulates the temperature distribution that would exist in a pile slug.

B. IN-PILE CREEP TEST - J. M. Roberts - R. E. Schilson

Very little information is available as to the effect of irradiation on the creep of metals. Tests that have been run depended upon measuring devices whose reaction to irradiation is likewise unknown. It is desirable therefore to develop a creep tester in which a direct method of creep measurement is used. This tester consists of a rack and pinion which operates a cam and breaker point system. Each time a signal is received regardless of its magnitude it is known that a definite calibrated amount of creep has occurred. The temperature and load on the specimen are maintained constant by submersing the specimen in a condensing steam bath of known pressure.

The design will be turned over to the instrument shops to build as soon as the prints are available from reproduction.

[redacted]

DATE
FILMED
10/25/94
END