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CS-1465

Copy 27 A

Metallurgical Project

A. H. Compton, Project Director

* * *

Metallurgical Laboratory

S. K. Allison, Director

* * *

Technical Division

Chas. M. Cooper, Division Director

SPECIAL REREVIEW FINAL DETERMINATION Class: <u>U</u>	Reviewers	Class.	Date
	<u>KAW</u>	<u>U</u>	<u>03/30/82</u>
	<u>JRP</u>	<u>U</u>	<u>03/30/82</u>

TECHNICAL DIVISION PROGRAM AUTHORIZATIONS

Copies of program authorizations covering the authorized research and development activities of the Technical Division are bound in this report.

As further authorizations are issued they will be forwarded to holders of this report.

This document is
PUBLICLY RELEASABLE

Henry Keger
Authorizing Official

Date 10-27-10

Received: March 16, 1944

Issued: April 7, 1944

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List of
PROGRAM AUTHORIZATIONS

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2	Ether Extractions as a Portion of a Separation Process	281 ML 59-2b
3	A Life Test on a Slurry Pumping System	126 ML 55-2
4	Preliminary Development of a Slurry Evaporator	261 ML 55-1
5	Corrosion of Aluminum in Water-Cooled Pile	124 ML 51-1
6	Slug Handling Studies	171 ML 51-7
7	Fluid-Film Heat Transfer in Water-Cooled Pile	122 ML 51-8
8	General Research & Development Studies	390 ML 51-S
9	Coatings Process Development (for Site w)	154 ML 54-3
10	Thermopile for Radiation Detection	135 ML 56-2
11	General Optical Design	390 ML 56-5
12	Service in Optics to Site X & Site w	136 ML 56-4
13	Evaporation Techniques	132 ML 56-3
14	Tests on "w" Slugs with Internal Heating	124 ML 51-17
15	Semi-works Investigation of Concentration Methods	211 ML 51-16
16	Thermal Contact of Graphite Layers	122 ML 51-10
17	Exploratory work and service	390 ML 54-5
18	Corrosion Studies, A. Aluminum Alloys	124 ML 54-4a
19	Corrosion Studies, B. Film Problems	124 ML 54-4f
20	Corrosion Studies, C. Electrochemical Measurements	124 ML 54-4d
21	Coatings Research, A. Mechanically applied Jackets	154 ML 54-3k
22	Corrosion Studies, D. Tuballoy and Alloys	391 ML 54-4e
23	Design & Experimentation on a Borescope for Inspecting Ribbed Tubes when Water is Flowing through Tubes, in the 100 Area, Site w	136 ML 56-6
24	Design & Experimentation on an Under Water Periscope for Use in Storage Basin or Sorting Basin - 100 Area Hanford	136 ML 56-7
25	Semi-works Solution of Heavy Metal & Preparation of UNH Solutions for the Chemistry Division	201 ML 51-14
26	Detection of Leaking Aluminum Tube	173 ML 51-18
27	Coatings Research, B. Precoats	154 ML 54-3d
28	Coatings Research - Alternative Methods, C. Soldering & Brazing	154 ML 54-3e

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List of Program Authorizations - contd.

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29	Coatings Research, D. Thick Coats of Aluminum-Silicon Alloy #13	154 ML 54-3b
*30	Coatings Research, E. Seam welding	154 ML 54-3L
31	Coatings Research, F. Testing	154 ML 54-3j
32	Design of Plastic Optics for Canyon Periscopes	236 ML 56-1b
33	Design Studies of Ether Extraction for Hanford Scale of Operation	281 ML 59-2b1
34	Status of Separations Processes	285 ML 59-4
35	Design of a Smoke Generator	226 ML 59-2d
36	Metallurgy of Product	215 ML 54-7
37	Refractories for Melting & Casting	215 ML 54-10
38	Design of a Submerged Reactor for Installation in the Metal Storage Canal at Hanford	207 ML 59-2e
39	Study of Defects in W-Slug Metal	155 ML 54-5g
40	General Assistance & Design Studies	390 ML 59-8

*- Reissued as File Serial No. 42

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FINDING LIST
(Arranged according to Problem Number)

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390 ML 54-S	17		
390 ML 56-5	11		
390 ML 59-S	40		
391 ML 54-4e	22		

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PROBLEM NUMBERING SYSTEM

Consider a typical number:

136 ML 56-1a

136 indicates general class of work, e.g. pile instrumentation - optical instruments. The code is supplied by Dr. Hilberry's office.

ML indicates work is being done at Metallurgical Laboratory, Chicago.

56 indicates Division 5 (Technology), Section 6 (Optics)

1a indicates problem designation within section.

Technical Division Section Numbers

1. Engineering Development
2. Metallurgy
6. Optics
9. General Engineering

* * *

The File Serial Number is useful for filing purposes and to key to the appropriate program authorization related material (program review, "part 2" extensions of program authorization, closing status report) which may be issued at a later date. For example, the first supplement to program authorization, file serial 10, will be marked "CS-1465, F.S. 10, Supplement A."

* * *

Priority Rating of Problems of Technical Division

The classification of the problems with respect to relative importance is indicated below:

- A - Main line work
 - B - Alternate
 - C - Research
-
- 1 - Needed immediately
 - 2 - Needed in near future
 - 3 - Future

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UNCLASSIFIEDAbbreviated Code used for Assignment of
Problem Numbers

<u>Code</u>	<u>Subject</u>
100	File Characteristics
110	Control of Reacting Units
120	Cooling of Reacting Units
130	Instrumentation
140	Protection (Health)
150	Materials (Const. and Process)
160	Activation Investigations
170	Operations Studies
180	Process Design
200	Extraction and Decontamination
210	Concen. Purif. and Prod. Rec.
220	Wastes
230	Instrumentation
240	Protection (Health)
250	Materials (Const. and Process)
260	Recovery of Activated Mat.
270	Operations Studies
280	Process Design
300	Nuclear Physics
310	General Physics
320	Radiation ("Photo") Chem.
330	Nuclear Chemistry
340	Product Chemistry (Chem. and Phys. Prop.)
350	General Chemistry
360	General Biology
370	Clinical Investigations
380	Metallurgical Studies
390	Miscellaneous

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 1

Problem No. _____
Date November 23, 1943
Priority A-3

PROGRAM AUTHORIZATION

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CS-1465 File Serial 1
This document consists of 1
pages and 0 figures.
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Series A
Issued to: _____

Title: Use of Lucite for Optical Prisms.

Objective:

To make use of Strain Free and Optically Homogeneous Lucite for certain optical parts exposed to Radiation.

Present Status:

It is definitely known that suitable Lucite can be obtained. Also, it is known that with sufficient care small optical parts can be molded free from strain. A skilled scientist has been retained for a period of three months to carry out this limited program. There is available to us a certain amount of technical information collected by governmental agencies, but the development of the techniques required has not been carried sufficiently far in any one outside organization.

Proposed Program:

To perfect the technique of making flat optical surfaces in Lucite, using Ryerson Laboratory Optical Shop facilities. To develop a technique of molding small Lucite prisms in a matrix made of suitable optically flat materials.

Reason for Proposed Work:

In the use of scanning instruments two possible substitutes for glass prisms are (a) metal mirrors, (b) Lucite or other plastic prisms. The use of metal mirrors is attended by rather serious operational difficulties which increase the cost of an instrument or else decrease its usefulness.

A more extended program than the one proposed would involve the use of Lucite for lenses also. Although it is not considered desirable to initiate such a program at this time, the information procured in the program on prisms of Lucite would be of value in a program on lenses.

Remarks:

Review Date 3/31/44
Man-Months Authorized 3-4
Estimated Special Equipment Cost \$500.00
Estimated Completion Date March 31, 1944
Estimated Man-Months to Complete 3-4

Submitted by Georgi S. Menikoff

Approved by _____

Authorized by: Chas. M. Cooper
SK Allison

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 1

Problem No. 136-ML-56-1a

Date March 31, 1944

Priority A-3

FINAL REVIEW

Title: Use of Lucite for Optical Prisms.

Supplement A

CS-1465-File Serial #1

This document contains 1 Pages
of Text and 0 Pages of Figures.

This is Copy 27 of 45 Series A

Issued to: Clinton

Closing Status: Subsequent to the starting of this work, access to secret reports of N.D.R.C. and conferences with them later made it plain that Lucite is not a suitable material for optical prisms. However, the work begun was continued, with limited time, so that the general technique of polishing plastics could be studied. It is considered advisable to terminate this as a separate authorization.

Reports: G.S.M.-M.U.C. #69

Total Man-Months Expended 1.3

Supervisor Responsible N. F. Bardsley

Section Chief Georgios M. M. M.

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Program Authorization

Title: Ether Extractions as a Portion of a Separation Process

CS-1465 File Serial 2
This document consists of 1
pages and 0 figures.
Copy No. 27 of 100 copies.
Series A
Issued to

Objective:

- (1) To demonstrate in semi-plant equipment the mechanical feasibility of ether extraction as a method of separating product from uranium solutions.
- (2) To carry out ether extractions required by the Chemistry Division in preparing special concentrates of product and fission products.
- (3) To evaluate ether extraction as a method of effecting decontamination.

Present Status:

Experiments have shown that an aqueous solution of product in the oxidized form may be separated from fission products and uranium by extraction with ether in a counter current extractor. The yield of product averages 95% and is decontaminated by a factor ranging from 50 - 100. Experiments have indicated that radiation at 50 x "W" levels for 15 min. has no effect on the carrying of product at X concentration and in the time indicated above no effects of radiation on the solution have been detected. Furthermore the effects, if any, of radiation on the solvent should not be a limiting factor as the contact time can be reduced to a safe value by proper design of the equipment. The process has been successfully coupled to the BiPO₄ process.

Space now assigned to the Semi-Works Group in the West Stand is available for installation of the necessary equipment. An adequate ventilation system is installed and operating in this area. Personnel of the Semi-Works Group will be able to carry out the experimental work.

Proposed Program:

It is proposed that an extraction process be designed by the General Engineering Section and set up and operated by the Engineering Development Section in order to demonstrate the mechanical feasibility of such a process. It is anticipated that some chemical experiments will be required from time to time. Details of the program are as follows:

- (1) Obtain and install equipment typical of full-scale plant design for continuous ether extraction of product from uranium solutions.
- (2) Demonstrate within 2 months the mechanical and chemical feasibility of the ether extraction processes on a semi-plant scale.
- (3) Carry out all large scale ether extractions required by the Chemistry Division for special investigations.
- (4) Following conclusion of Item #2 above, use the equipment to evaluate ether extraction as a method of decontamination.

Reason for Proposed Work:

This process may offer an attractive alternative to the present extraction step in the BiPO₄ process. The objective of the proposed work is to confirm these findings on a semi-works scale using equipment capable of being installed and operated in an actual plant.

Review Date January 15, 1944

Man-Months Authorized 12

Estimated Completion Date 3/15/44

Estimated Man-Months to Complete 18

Supervisor Responsible J. O. Maloney

Submitted by J. O. Maloney
C. E. Kircher

Approved by: Chas. W. Cooner

Noted by T.R.H. Noted by J.E.M.

Authorized by S. K. Allison

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PROGRAM AUTHORIZATION(PART II)

Title: Ether Extraction as a Portion of a Separation Process.

Objective: The principal objective of Part II of this program is to continue the work initiated under the first authorization. The work proposed consists, in a broad sense, of demonstrating the chemical and mechanical feasibility of ether extraction as a method of separating product from uranium and fission products.

Progress (Part I) and Present Status: In discussing the progress, the objectives of Part I must be listed.

- (1) To demonstrate in semi-plant equipment the mechanical feasibility of ether extraction as a method of separating product from uranium solutions.
- (2) To carry out ether extractions required by the Chemistry Division in preparing special concentrates of product and fission products.
- (3) To evaluate ether extraction as a method of effecting decontamination.

Twelve man-months were authorized to accomplish this program.

Under the time authorized a complete continuous ether extraction system has been designed, constructed, and operated in a preliminary manner. Although not operated entirely by remote control, it is perfectly feasible to do so. The chemical problems of separating the product from the uranium have not been completely worked out as yet and as such represent a portion of the future work.

A batch ether extraction system has been designed and construction essentially completed. It will be used to prepare product and fission product concentrates.

An evaluation of the ether extraction process is about 75% complete and will be finished and issued during the coming month. A complete review of all the pertinent chemical information will be included in this report. Chemical batch experiments indicate that decontamination factors for two cycles are essentially the same.

Proposed Program: It is proposed that the continuous and batch equipment be operated for the purpose for which they were constructed. Details of the program are as follows:

1. Operate the continuous counter current equipment to produce a decontaminated product and by successive cycles determine the decontamination factors obtainable.
2. Obtain the necessary physical and chemical information incidental to (1) above.
3. Collect sufficient data on the continuous unit to permit large scale design.
4. Obtain information pertinent to the recovery of uranium by ether extraction.
5. Operate the batch system to produce a product concentrate.

CS-1465 File Ser. #2
Supple. A Part II
This document consists
of 1 page of text and
0 pages of figures.
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F. S. 2

Page 2

Reason for Proposed Work: This process may offer an attractive alternative process to the present process at several points. Knowledge of the possibilities of such a process is believed to be justified.

Reports on Part 1: CN-1353, CN-1491, CN-1584, CC-1264, CC-1364

Next Review Date July 15, 1944
Man-Months Authorized (Part II) 30
Man-Months Used (Part I) 13-1/2

Estimated Completion Date July 15, 1944
Estimated Man-Months to Complete 30

Supervisor responsible J. B. Tepe

Noted by G. I. Sea Gorg
T R Haggins

C. E. Kishner
Submitted by J. O. Maloney

Approved by G. E. Kidd

Chas M Cooper

Authorized by A. B. Vernon 4/29

MUC-EWB-95

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 2

Problem No. 281-ML-55-2b
Date October 12, 1944
Priority B-1

PROGRAM AUTHORIZATION(PART III)

Part III

Title: Ether Extraction as a Portion of a Separation Process

Objective: The objective of Part III of this program is to prepare final reports covering the experimental work carried out under Parts I and II.

CS-1465 F. S. #2, Supple. B
This document contains 1
pages of text.
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Series A
Issued to: Clinton
(R. L. Sloan - pers.)

Progress (Parts I and II) and Present Status: A stainless steel continuous counter-current ether extraction system, capable of treating about 1 gal/hr. of aqueous feed, was constructed in the west stands semi-works. Fifteen experimental runs were made using the extraction system described. Although the mechanical feasibility of this type of operation was demonstrated, the chemical feasibility of the process was not wholly proved.

A stainless steel batch solvent extraction apparatus was also constructed in the semi-works. The equipment has been successfully employed to recover dectn-taminated uranyl nitrate from waste solutions from the continuous solvent extraction equipment.

At present the only work which is being done on this program is the preparation of a report covering data on the physical properties of aqueous and ether solutions of uranyl nitrate. It is not known when active experimental investigation of this problem can be resumed. The semi-works data which have been collected up to the present time are not sufficient to serve as the basis for the design of a full-scale plant.

Proposed Program: It is proposed to prepare and issue several reports including a brief review of the fundamental laboratory work which has been done on ether extraction and an evaluation of the ether extraction separation process, and a final report on the program including the results of all semi-works runs of the continuous and batch systems.

Reason for Proposed Work: Since it is not planned to do additional experimental work on this problem, the results obtained to date should be recorded for use by workers on similar investigations which are either now under way or which might be initiated in the future.

Reports on Parts I and II: CN-1353, CN-1491, CN-1584, CC-1264, CC-1364, CN-1751, CN-1787, CN-1953.

Next Review Date January 1, 1945
Man-Months Authorized (Part III) 3
Man-Months Used (Parts I and II) 44
Estimated Completion Date Dec. 1, 1944
Estimated Man-Months to Complete 3

Written by A. B. Tepe
Approved by C. D. Malone
Chas M Cooper
H. B. Verman

Group Leader Responsible A. B. Tepe

Authorized by H. B. Verman

Received: October 25, 1944

Issued: OCT 30 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

Problem No. 281-ML-55-2b
Date December 22, 1944

File Serial 2

FINAL REVIEW

Title: Ether Extraction as a Portion of a Separation Process

Closing Status: A continuous countercurrent semi-works ether extraction system for partially extracting and decontaminating product was constructed and operated through the cooperative efforts of the Engineering Development and General Engineering Sections. A program of fundamental chemical investigation was conducted simultaneously by Chemistry Section C-1. Although considerable valuable information was collected during the period of active investigation, all of the objectives were not accomplished before it was necessary to terminate the program because of a critical man-power shortage.

The successful completion of fifteen semi-works runs of duration up to 27 hours is interpreted as indicating the mechanical feasibility of the operation. Product yields and decontamination factors as high as 95% and 10-fold respectively were obtained in some runs. Sufficient data were not collected to prove the chemical feasibility of the operation and to serve as the basis for full-scale design.

Since there is little indication that active experimental investigation can be resumed in the near future, the program is being closed at this time. A final report in which the results of laboratory and semi-works investigation are described is being issued.

Reports: CC-1264, CC-1364, CN-2492.

CS-1465 F.S. #2

Supple C

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of 1 page of text.

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Series A

Issued to: Clinton Lab.
Route to Mr. D. Whitaker

Man-Months Expended: 46

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B. Tepe
Group Leader

J. O. Maloney
Section Chief

Chas. M. Cooper
Division Director

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial No. 3 Problem No. 126 LL 55-2
Date December 2, 1943
Priority C2

PROGRAM AUTHORIZATION

CS-1465 File Serial 3
This document consists of 1
pages and 0 figures.
Copy No. 27 of copies.
Series A
Issued to:

Title: A life test on a slurry pumping system.

Objective: To determine life expectancy information on centrifugal pumps, for homogeneous slurry piles.

Present Status: Preliminary plans for homogeneous slurry piles incorporate pumping systems whose life under operating conditions is unknown. Recent work with commercial pump manufacturers has developed a promising design of a modified standard pump. This problem has been under extensive study for six months.

Proposed Program: To install one modified commercial vertical centrifugal pump in a recirculating oxide slurry system. To operate this system without maintenance until some failure becomes apparent. It is also proposed to follow the particle size and composition of the slurry.

Reason for Proposed Work: The useful life of a homogeneous pile will probably depend on the useful life of a pumping system operating without maintenance. The information from this work will provide a basis for future design and experimental work and will utilize the considerable work recently put on this problem without an appreciable increase in the effort already expended.

Remarks: The cancellation of the work on the slurry systems presents an opportunity to carry on a long time experiment without holding up a design group.

Review Date March 1, 1944
Man-Months Authorized 3
Estimated Completion Date July 1, 1945
Estimated Man-Months to Complete 5

Supervisor Responsible

Submitted by F. R. Ward

Approved by H. C. Vernon

H. C. Bellas

Authorized by S. K. Allison

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University of Chicago
Metallurgical Laboratory
Technical Division

Problem No. 126-ML-55-2
Date, April 1, 1944
Priority C-2

File Serial 3

PROGRAM AUTHORIZATION (PART II)

Title:

Life Test on Slurry Pumping System.

Objective:

To determine life expectancy information on centrifugal pumps, for homogeneous slurry piles.

Progress (Part I) and Present Status:

The stainless steel vertical centrifugal Taber Pump intended for use in this test has been received and its supports have been installed. The circulating pipe and auxiliary apparatus have been designed and orders placed.

In the meantime a "practice" run on a standard horizontal pump has been completed, yielding interesting information on the change in particle size and viscosity of the UO_3 -water slurry with pumping time. In spite of improvements to the system after the first, unsuccessful run, difficulty is still encountered in frothing and in settling out of the particles at the relatively low velocities employed in this practice test.

Proposed Program:

Another practice run will be made after further improvements to the system to minimize foaming and settling difficulties. Following this, the small pumping system will be available for other tests which may be requested by Section C-IV of the Chemistry Division.

The Taber Pump installation will be completed for operation by May 1, if possible. During the long-term test, samples will be taken for particle size measurement if this variable is to continue under investigation, although the major effort will be directed toward operation of the pump without maintenance of any kind.

Reason for Proposed Work:

The useful life of a homogeneous pile will probably depend on the useful life of a pumping system operating without maintenance. The information from this work will provide a basis for future design and experimental work and will utilize the considerable work already put on this problem.

Reports on Part I:

None.

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Next Review Date - July 1, 1944
Man-months Authorized (Part II) - 7
Man-months Used (Part I) - 3
Estimated Completion Date - July 1, 1945
Estimated Man-months to Complete -
Supervision Responsible - R. N. Lyon

Submitted by:

A. C. Miller

Approved by:

C. E. KitchinChas M Cooper

Authorized by:

Samuel K Allison

The examination of particle size in
the slurries is to be done on a piece-
work basis, arranged after expiration
of the regular contract April 30 1944.

IUC-LWB-94

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial No. 3

Problem No. 126-ML-55-2
Date, March 4, 1944

PROGRAM REVIEW

Title: Life Test on Slurry Pumping System

CS-1465 File Serial 3 This document
consists of 1 page and 0 figures.
Copy No. 27 of 44 copies.
Series A Issued to: Clinton

Present Status: In connection with studies leading to the design of a P-9 homogeneous slurry pile, work was undertaken by the Engineering Development Section in December for the purpose of determining the life expectancy of a centrifugal slurry pump. The investigation was turned over to this Section upon discontinuance of active studies on P-9 pile design, with responsibility for development of analytical procedures for the slurry assigned to Section C-V of the Chemistry Division.

The program proposed in the subject authorization is: (1) to install a modified commercial, vertical, centrifugal pump in a recirculating oxide slurry system and (2) to operate this system without maintenance until some failure becomes apparent. It was also proposed (3) to follow the particle size and composition of the slurry. A review date of March 1 was set, with 3 man-months of time authorized.

At the time the Program Authorization was issued, equipment had been set up by the P-9 Pile Design Section for a "practice run" on UO_3 - water slurry, using a standard water pump, and the test had been started. Its purpose was to develop sampling methods and other experimental techniques before undertaking operation of the proposed stainless steel pumping system. During this time the Chemistry Division was to work with the Illinois Institute of Technology in developing a method of measuring particle size of the UO_3 so that any changes could be observed during the progress of pumping tests.

Since approval of the above authorization, approximately two man-months of time have been expended in completing the practice run and in completing the design and ordering parts for the final stainless steel system. The surprisingly high settling rate of the UO_3 employed led to rapid caking on the bottom of the storage tank in the "practice system", so that the solids content of the circulated slurry decreased to 16% of the initial value. Changes have been made in the system to prevent this from happening, and to improve the sampling method, and the equipment is ready to be started again. The electron microscope has been found capable of yielding particle photographs for counts, and the method can now be tried for adequately following trends in particle size during a pumping test. The parts of the stainless steel system have been ordered and should be received early in April.

Since the authorized amount of time has not been completely expended, a progress report on this study and an additional program authorization will not be submitted until April 1.

Reports: None

Notebooks:

Issued to

H. F. Carey
R. Bradt

No.

100-B
255-B

Man-Months Used

2

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Supervisor Responsible

H. W. Bell

(Please file in booklet under Program authorization as first supplement to file serial 3)

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MOC-EWB 337

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and 0 figures. No. of 10 copies
Series A.

University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 3

Problem No. 126-ML-51-2
Date: December 14, 1944
Priority C-3

FINAL REVIEW

Title: A Life Test on a Slurry Pumping System

Closing Status: The objective of operating a modified pump to obtain information useful in predicting and improving the life expectancy of such a pump in a P-9 homogeneous slurry pile has not been reached. A stainless steel pumping system was designed and the parts fabricated. The system includes a 1000 gpm vertical Tabor pump with a special rotary seal and a control device to maintain the slurry level in the pump below this seal, together with the necessary recirculating lines, sampling devices, hold-up tank, flow meter and other auxiliaries. Because of the volume of other problems of higher priority, the above equipment was never completely assembled for test. The parts are on storage at the Armory.

Several "practice runs" using a standard horizontal pump handling UO_3 in water were made to obtain information on slurry sampling methods and to develop other experimental techniques applicable to the large stainless steel pumping system. These runs were also made as a service to the Chemistry Division who were interested in following the change in viscosity, particle size, etc. of the slurry as pumping proceeded.

Since the Technical Division is disbanding no further work on this problem will be carried out under the above authorization.

Reports: None.

Notebooks: 100-B, 777

Total Man-Months Expended - 6.2

CS - 1465 F.S. #3

Supple C

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Series A.

Issued to: Clinton (R. L. Dwyer, Jr.)

Group Leader Responsible

Section Chief

Division Director

Report received: December 29, 1944

Issued: JAN 3 1945

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial No. 4

Problem No. 261 ML 55 1
Date December 3, 1943
Priority C2

PROGRAM AUTHORIZATION

CS-1465 File Serial 4
This document consists of 1
pages and 0 figures.
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Title: Preliminary development of a slurry evaporator.

Objective: To determine if a proposed system of P-9 and product recovery incorporating this equipment is a practicable method of attack on the Plant Problem.

Present Status: Detailed designs have been completed to the point where construction may begin. The subject of P-9 recovery from slurries is a difficult one and has been under consideration by numerous groups for the past six months.

Proposed Program: Procure and install the equipment shown on LZD 130 (and its associated auxiliaries) and make a sufficient number of operating runs to determine its operating characteristics.

Reason for Proposed Work: When the problems of slurry piles are undertaken again, the information from this work will allow a more intelligent attack on the problem of P-9 and product separation.

Remarks: Successful operation of this test unit would allow the same equipment to be used to recover the 4 tons of P-9 to be used in the exponential experiment.

Review Date April 1, 1944
Man-Months Authorized 3

Estimated Completion Date 9/1/44
Estimated Man-Months to Complete 10

Supervisor Responsible

Submitted by F. R. Ward

Approved by H. C. Vernon

H. M. Bellas

Chas. M. Cooper

Authorized by S. K. Allison

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University of Chicago
Metallurgical Laboratory
Technical Division

Problem No. 261-ML-55-1
Date, April 1, 1944
Priority C-2

File Serial 4

PROGRAM REVIEW

Title:

Preliminary Development of a Slurry Evaporator.

Progress and Present Status:

Because of the greater urgency of other studies no progress has been made in obtaining the proposed slurry evaporator for operating tests. A definite program has resulted, however, from discussions with the interested parties.

Program for Balance of Authorization:

Expected increase in manpower will permit progress to be made in procuring and testing the evaporator as originally proposed.

Reports:

None.

Man-months Expended - 0.1

Next Review Date - July 1, 1944

Supervision Responsible: R. N. Lyon

Section Chief - C. E. Kircher

C. E. Kircher

Supplement A
CS-1465-File Serial #4
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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 4

Problem No. 261 ML 55-1
Date: December 30, 1944
Priority C-2

FINAL REVIEW

Title: Preliminary Development of a Slurry Evaporator

Closing Status: The objective and proposed program of constructing and operating a particular evaporating system for a sufficient length of time to determine its characteristics were not carried out. A few preliminary discussions were held, but no material progress has been made. The large volume of work of higher priority made it impossible to spend much time on this problem.

Since the Technical Division is being disbanded, no further work on this problem will be carried out under this authorization.

Reports: None

Notebooks: 755-B

Total Man-Months Expended - 1

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Issued to: Winter Lab.

Route to: R. L. Davis, per

Group Leader Responsible R. N. Lyon

Ass't Section Chief R. N. Lyon

Division Director Chas. M. Cooper

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PROGRAM AUTHORIZATION

Title:

Corrosion of Aluminum in Water-Cooled Pile

Objective:

- (1) To complete a high-spot evaluation of the effect of deaeration, water temperature, and velocity on corrosion rate of aluminum slug-jackets and outer tubing; (2) to find the causes of scale and film formation in tests at "W" and means of prevention; and (3) to run corrosion tests as required on special jacket types and end closures.

Present Status:

Studies have been made of the effect of variables in water analysis on the corrosion rate, e.g. chloride, peroxide, and Calgon content, and pH, as well as the effect of internal heating of the slug. The effect of perforation of the jacket on swelling of the slug and the corrosion of steel and iron pipe and fittings have also been investigated. Progress Report CE-973 has been issued.

Proposed Program:

- (1) In view of the urgency of the film problem at Hanford, the corrosion equipment at Site "B" has been modified to simulate more closely the arrangement of test apparatus at CMX and an investigation of the causes and prevention of film formation will be made.
- (2) During the progress of study (1), revised corrosion apparatus will be set up at Site "B" to permit more exhaustive tests of the effect of velocity, temperature, and deaeration on aluminum corrosion.
- (3) Apparatus already set up will be expanded in size for general service work on corrosion of slug jackets.
- (4) Studies will be made of galvanic corrosion of dissimilar metals at the ends of the tubes if laboratory tests in the Metallurgy Section show a need for them.

Reason for Proposed Work:

Corrosion through a slug jacket would result in swelling of the slug and seizing in the ribbed tube, making it difficult to remove the slug and perhaps the tube from the pile. Pitting through the ribbed tubing would release water into the graphite of the pile. Corrosion of aluminum in the pile must therefore be held to a minimum.

The high heat transfer coefficients needed for cooling the slugs require that no appreciable scale be formed on the aluminum jacket.

Remarks:

These studies occupy a position intermediate between the laboratory studies of the Metallurgy Section and the long-term confirmatory tests by CMX by virtue of their involving short-term tests under widely varying conditions on specimens of "W" geometry.

Review Date 3/1/44
Man-Months Authorized 40 tech. & 10 non-tech.
Estimated Completion Date 9/1/44
Estimated Man-Months to Complete 100 tech. & 50 non-tech.
Supervisor Responsible R. D. McCrosky

Submitted by PTM^c Crosby
Approved by H. S. Bellas
Charles M. Cooper
Authorized by James H. Atkinson

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University of Chicago
Metallurgical Laboratory
Technical Division

Item No. 124-ML-51-1
Date April 1, 1944
Priority A-1

File Serial 5

PROGRAM AUTHORIZATION (PART II)

CS-1465 File Serial 5
Part II. This document
consists of 2 pages of
text and 0 pages of
figures. Series A.
Issued to: 27-Clinton

Title:

Corrosion of Aluminum in Water-Cooled Pile.

Objective:

- (1) To complete a high-spot evaluation of the effect of deaeration, water temperature, and velocity on corrosion rate of aluminum slug-jackets and outer tubing;
- (2) To find the causes of scale and film formation in tests at "W" and means of prevention; and
- (3) To run corrosion tests as required on special jacket types and end closures.

Progress (Part I) and Present Status:

- (1) A revised arrangement of equipment for studying the corrosion of aluminum has been designed and is now being constructed.
- (2) Deposition of hydrated iron oxide films on the walls of the "W" annulus has been found dependent upon ferric and ferrous iron content, temperature, water velocity, type of anion present and time permitted for coagulation of the sol. These effects have been measured by observation of the film thickness, pressure drop, and heat transfer coefficients, and the results are being incorporated in a progress report to be issued during April.

Special tools and techniques have been developed in the course of this work, including an electrical contact micrometer for measurement of film thickness, apparatus for studying electrophoretic effects, etc.

- (3) A stainless steel system for water recirculation has been set up containing 45 feet of "W" tubing for corrosion testing of special slugs to be submitted by the Metallurgy Section.

Proposed Program:

- (1) The revised apparatus for corrosion tests on aluminum in the "W" geometry will be completed. An evaluation will then be made of the effects of deaeration, temperature, and velocity of water on the corrosion of aluminum.
- (2) Film studies will be continued with the objective of learning the mechanism of formation. Particular attention will be paid to the effect of various anions in the water, and of time and turbulence effects. Much of this work will be done in a glass system to avoid pick-up of iron by corrosion. A compact unit containing an externally heated Al tube, followed by a glass section, will be employed to observe film-forming tendencies of water samples withdrawn from various points in present large scale system.

(3) Corrosion tests will be run on special slugs to be submitted by the Metallurgy Section.

Reason for Proposed Work :

Brief tests here and at "X" have indicated that Al corrosion rates may be greater at 70° C. than at 95° C., so that a careful survey of the temperature effect, as well as that of velocity and of deaeration, is necessary. It is also desirable that film formation studies be continued to determine the fundamental mechanism, since "W" studies will eventually turn to corrosion problems and since film deposition problems not anticipated now may arise later during operation of the piles.

Reports on Part I:

Progress report on film studies will be issued during April.

Next Review Date - July 1, 1944

* Man-months Authorized (Part II) - 70

Man-months Used (Part I) - 44

Estimated Completion Date - October 1, 1944

Estimated Man-months to Complete - 150

Supervisor Responsible - R. D. McCrosky

Submitted by:

A. C. Dwyer

Approved by:

C. E. Kitcher

Chas M Cooper

Authorized by:

HC Vernon

* 10 men on shift work

6 men on construction and development of apparatus

5 men on analysis, weighing, working up data

3 men on supervision

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Further work under this File Serial number is not contemplated. Please file the original program authorization and all supplements under "Completed Problems" in the back of the Booklet. If you do not hold a complete set of all File Serial numbers, please return the material under this File Serial number to the Information Office, in order to reduce inventory work.

Please attach to "Final Reviews".

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial No. 5

Problem No. 124-ML-51-1
Date, March 7, 1944

PROGRAM REVIEW

Title: Corrosion of Aluminum in Water-Cooled Pile.

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Present Status: (1) An investigation of the causes and prevention of film formation is under way. The effects of Fe^{+3} added to the water and the point of addition have been studied and found of major importance. Cataphoretic effects under an applied difference in potential across the annulus have been found negligible in tests thus far completed. Studies of the addition of Fe^{+2} , and of time, temperature, and turbulence effects must be made in order to gain further insight into the mechanism of the deposition.

(2) Revised corrosion equipment is in the stage of final design with complete installation expected by April 1.

(3) Apparatus for general service work on corrosion of slugs is ready to be installed pending completion of a current test on uncoated tuballoy.

(4) Galvanic corrosion studies are thus far being handled by the Metallurgy Section.

Reports: None.

Notebooks:

Issued to M. J. Szulinski No. 852, 1334

Man-Months Expended: 28

Supervisor Responsible R. D. McCrosky

H. W. Bell

(Please file in booklet of Program Authorizations as first supplement under File Serial 5)

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 5

Problem No. 124-ML-51-1
Date - October 12, 1944
Priority A-1

PROGRAM AUTHORIZATION (PART III)

Title:

Corrosion of Aluminum in Water-Cooled Pils..

Objective:

- (1) To complete a high-spot evaluation of the effect of deaeration, water temperature and velocity on corrosion rate of aluminum slug-jackets and outer tubing;
- (2) To find the causes of scale and film formation in tests at "W" and means of prevention; and
- (3) To run corrosion tests as required on special jacket types and end closures.

Progress (Parts I, II) and Present Status:

Film studies have been brought to a close and further basic work on corrosion of 2S aluminum has been discontinued to make additional manpower available for the long tube cartridge study. The stainless steel recycle system has been and is being used for isothermal corrosion tests on various types of slug jackets and end closures.

Proposed Program:

It is proposed to continue tests using the isothermal unit with particular emphasis on behavior of die-cast slugs and long tube cartridge envelopes. Combined erosion and corrosion tests on various types of aluminum jackets for the long cartridge are also planned. Upon finishing the foregoing it is expected that this study will then be complete and at a date of about Jan. 1, 1945.

Reasons for Proposed Work:

Tests of a full scale nature permit rapid evaluation of possible "W" performance of weld types, surface conditions and envelope materials for enclosing the slugs.

Reports on Parts I and II:

A progress report covering work on film formation is in preparation.

Next Review Date - December 1, 1944
Man-months Authorized (Part III) - 44*
Man-months Used (Parts I and II) - 134*
Estimated Completion Date - January 1, 1945
Estimated Man-months to Complete - 20
Supervisor Responsible - R. E. Larson

Submitted by:

R. E. Larson

Approved by:

A. C. D. Miller

Chas M Cooper

Authorized by:

R. E. Larson

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* Includes 24 man-months over-run above that authorized for Parts I & II.

Received: October 25, 1944; Issued: OCT 30 1944

Part III
CS-1465 F.S. #5, Supple. C
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University of Chicago
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Technical Division

File Serial 5

Problem No. 124-ML-51-1
Date: December 30, 1944
Priority: A-1

FINAL REVIEW

Title: Corrosion of Aluminum in Water-Cooled Pile.

Closing Status: The objectives of this program have been reached. These studies occupied a position intermediate between the laboratory studies of the Metallurgy Section and the long-term confirmatory tests by CMX by virtue of their involving short-term tests under widely varying conditions on specimens of "W" geometry.

The equipment designed for the aluminum corrosion tests permitted either isothermal or internal heating of the specimens. The effects of calgon, pH, sulfite, H₂O₂, temperature, annealing, and several inhibitors on aluminum corrosion were studied. An all iron apparatus was also constructed for obtaining, in quantity, isothermal aluminum corrosion data; but, because of the sudden emphasis on the film studies, this equipment was never used. All film study runs were made using internally heated specimens with demineralized water. A study of the deposition, removal and prevention of ferric, chromic, aluminum, calcium and magnesium films was made with varying water velocities, heat fluxes, added reagents, time lag and concentration of reagents and pH. A stainless steel recycle system was used for isothermal corrosion tests with and without inhibitors on the various types of slug jackets and end closures. These corrosion studies were made on bare tuballoy slugs, Al/Si (single and triple dip) and Zn/Al bonded slugs, unbonded slugs, Al/Si die cast slugs, and 52S and 2S Al drawn cartridges in water at different pH's and with various reagents added.

With the dissolution of the Technical Division, no further work on this program will be carried out under this authorization. Work may be continued, however, by the Metallurgy Division under Program No. 124-ML-54-5; File Serial 55.

Reports: CE-973; CE-2524; CE-2550; CE-2551

Notebooks: 217-B; 852; 1334; 1335;

18-B	333-B	387-B	725	924-B
104-B	334-B	574-B	849-B	944-B
213-B	376-B	575-B	904-B	1334
217-B	379-B	610-B	905-B	1335
269-B	380-B	657-B	912-B	986-B

CS-1465 F.S. #5

Supple D

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Series A

Issued to: *Clinton Lab.*
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Memos: JPH-MUC-230; FF-MUC 172; FF-MUC 143; FF-MUC 199; FF-MUC 218.

Total Man-Months Expended - 145

Group Leader Responsible

Ass't. Section Chief

Division Director

*R. E. Larson**A. N. Lyon**Chas M. Cropper*

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UNCLASSIFIED PROGRAM AUTHORIZATIONS

CS-1465 File Serial 6
This document consists of 1
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Series A
Issued to:

Title:

Slug Handling Studies

Objective:

- (1) To determine the ease of removal of slugs from a full-length "W" tube after long-term exposure to water.
- (2) To render assistance to TNX Division and others on miscellaneous problems involved in the loading and discharging of slugs in the "W" pile.

Present Status:

Investigations have been made and reports submitted of the pushing force required for slug removal from the "X" and "W" piles, the effect of tube curvature on slug removal, the design of discharge chutes, hydraulic conveying of slugs, rib and slug scoring, and other problems connected with unloading the pile.

Proposed Program:

- (1) Exposure of one 44-ft. "W" tube, loaded with slugs, to flow of simulated "W" water for period of about 2 months, followed by observation of pushing force required for discharge of slugs.
- (2) Assistance to TNX when and as required on problems involved in the handling of "W" slugs.

Reason for Proposed Work:

The loading of heavy metal slugs into the pile without excessive wear of the aluminum jackets, and the discharge and transfer of active slugs are major engineering problems outside the field of past experience in materials handling.

Remarks:

Review Date 4/1/44
Man-Months Authorized 3 tech. and
1 non-tech.
Estimated Completion Date 4/1/44
Estimated Man-Months to Complete 3 tech. and 1 non-tech.
Supervisor Responsible R. N. Lyon

Submitted by H. H. Lyon
Approved by H. W. Bellas
Oliver H. Cooper
Authorized by: Samuel R. Allison

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CS-1465
F.S.#6
Supple.A

University of Chicago
Metallurgical Laboratory
Technical Division

File Serial #6

Problem No. 171-ML-51-7
Date, June 15, 1944
Priority A-1

PROGRAM AUTHORIZATION (PART II)

Title: Slug Handling Studies

Objective:

To render assistance to TNX Division and others on miscellaneous problems involved in the design and handling of "W" slugs.

Progress (Part I) and Present Status:

Reports on the slug discharge chute of a "W" pile and cushioning materials for discharging slugs have been issued. Measurement of the force to discharge slugs in a full length "W" pile tube has been completed and a report written. Tests were conducted indicating that redesign of the reverse spiral, lead dummy slugs was necessary.

Proposed Program:

Tests of the pressure drop and general behavior of the new design of aluminum tubular dummy slugs will be completed. Miscellaneous slug handling studies will be undertaken at the request or with the consent of the Division Director.

Reason for Proposed Work:

Site "W" is in need of information regarding adequacy of slug design and handling methods.

Reports on Part I:

CE-1391; CE-1523; Report on force to discharge slugs will be issued during coming month.

Next Review Date, August 1, 1944
Man-months Authorized (Part II), 5*
Man-months Used (Part I), 3.7
Estimated Completion Date, September 1, 1944
Estimated Man-months to Complete, 5
Supervisor Responsible, R. N. Lyon

*Includes ca. 2/3 Man-months Overrun

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R. L. Doan Pers

Submitted by: A. C. Tipler

Approved by: C. E. Kischer
Chas. M. Cooper

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Authorized by: H. C. Vesper 7/6

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 6

Problem No. 171-ML-51-17
Date: December 30, 1944
Priority: A-1

FINAL REVIEW

Title: Slug Handling Studies

Closing Status: These investigations have been concluded. Work has been completed on slug pushing force and abrasion problems for both X and W. Data and proposals for the Hanford and Clinton discharge chutes have been published. Experimental work on dummy slug design has been completed.

Forces of 4 to 8 lbs. per slug were observed in pushing W slugs in ribbed tubing. This was accompanied by minor abrasion. Lubricants or chemical treatment of the jackets did not improve the situation although it is believed that work hardening of the jacket will help. An auxiliary slug track was designed, built and proven adequate.

Spiral dummy slugs were found to buckle and jam while no other slugs showed this tendency. Fluttering of dummy slugs was shown to occur only at the water inlet. The normal 20 ft./sec. water velocity was shown to be sufficient to move slugs in the ribbed tube.

The minimum radius of curvature of the ribbed tube which will permit a slug to pass through was shown theoretically and experimentally to be 16 ft. Experiments showed that a 45° rotation of the ribbed tube was permissible.

Information on other results obtained in this program is given in the reports listed below.

No further work on this problem will be carried out under this authorization.

Reports: CE-856, CE-1391, CE-1523, CE-1210, CE-1274, CT-2504

Memos: SGB-MUC #3; HWB-MUC #6; RNL-MUC #6; HWB-MUC #14; RNL-MUC #19; SGB-MUC #4; RNL-MUC #2.

Notebooks: 122, 532, 711, 777, 1353, 100-B, 115-B, 937-B, 907-B, 58-B.

Total Man-Months Expended - 8

CS-1465 F.S. #6

Supple B

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Ass't Section Chief

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Technical Division

File Serial 7

Prob. No. 122 ML-51-8

Date 1/1/44

Priority A-2

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PROGRAM AUTHORIZATION

CS-1465 File Serial 7
This document consists of 1
pages and 0 figures.
Copy No. 27 of copies.
Series A
Issued to:

Title:

Fluid-Film Heat Transfer in Water-Cooled Piles

Objective:

To determine (1) water-film heat transfer coefficients in the "W" geometry and (2) the variation in jacket temperature opposite the ribs of the outer tubing and on the ends of the slug. Also (3), assistance will be rendered in designing and constructing apparatus for long-term confirmatory studies by CMX.

Present Status:

Preliminary measurements have shown that a water film coefficient of about 7000 B.t.u./(hr.)(sq.ft.)(°F.) will be realized with clean metal surfaces, and that a temperature rise in an unbonded, 20-mil jacket of 6 to 7°C. might be expected. The general features of design of equipment for "W" have been discussed with TNX.

Proposed Program:

- (1) Water film coefficients on clean aluminum tubing will be determined with a higher degree of accuracy in a steam-heated apparatus which has recently been thermally insulated and had other refinements made to permit operation at high heat fluxes.
- (2) Accurate measurements will be made of the temperature rise of the proposed type slug jacket opposite the ribs of the outer tubing and on the ends of the slugs.
- (3) Further assistance will be rendered the TNX Division in constructing equipment for use in tests at CMX.

Reason for Proposed Work:

A major limitation upon power output of the "W" pile will be the corrosion rate of the slug jacket, which is adversely affected by high temperatures. The attainment and maintenance of such high heat fluxes as will be encountered at the center of the pile is a major engineering problem justifying exploratory research in Chicago and confirmatory tests at "W" upon solution of the scaling problem there.

Remarks:

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Review Date 4/1/44
Man-Months Authorized 11 tech.
Estimated Completion Date 4/1/44
Estimated Man-Months to Complete 11
Supervisor Responsible R. N. Lyon

Submitted by H. H. Lyon
Approved by J. W. Bellas
Chas M Cooper
Authorized by: Samuel K. Allison

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University of Chicago
Metallurgical Laboratory
Technical Division

Problem No. 122-ML-51-8
Date, April 1, 1944
Priority A-2

File Serial 7

PROGRAM REVIEW

Title:

Fluid-Film Heat Transfer in Water-Cooled Piles.

Progress and Present Status:

Water-film heat transfer coefficients in the annulus of "w" pile tubes have been determined at a bulk water temperature of 150° F. and various water velocities. Measurement of temperature of the slug jacket opposite the ribs of the outer tubing has been deferred in favor of tests on internally heated slugs. (129-ML-51-17) Equipment for long-term confirmatory heat transfer studies has been built and sent to CMX where tests are in progress. Auxiliary equipment has been furnished upon request.

Thermal conductivity values of magnesia for slug-end insulation have been determined at various bulk densities but it appears that a solid aluminum disc will be employed for end insulation. Slug-end jacket temperature measurements have not been undertaken because the Pashkis Analyzer method being used at Columbia University circumvents the nearly insurmountable difficulties in obtaining the proper heat flux distribution at the end of the slug in heated models.

Program for Balance of Authorization:

Water-film coefficients at lower bulk water temperatures will be determined to correlate coefficient vs. temperature relationship. The increase in slug jacket temperature opposite the outer tube ribs will be measured as the program for study of internal heating permits.

Reports:

Progress report covering a portion of the authorization will be issued during April.

Man-months Expended - 6

Next Review Date - June 1, 1944

Supervision Responsible - R. N. Lyon
Section Chief - C. E. Kircher

C. E. Kircher

R. N. Lyon

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F.S. 7 Supple.B

University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 7

Problem 122-ML-51-8
Date, June 15, 1944
Priority A-2

PROGRAM AUTHORIZATION (PART II)

Title: Fluid-Film Heat Transfer in Water-Cooled Piles

Objective:

To determine the increase in the temperature of the jacket of bonded slugs opposite the ribs of the outer tubing.

Present Status:

Determination of water film heat transfer coefficients has been completed and the thermal conductivity of magnesium oxide (formerly a proposed slug-end insulator) under various degrees of compression has been measured. Development of equipment to determine jacket temperature increase of bonded slugs opposite ribs of the outer tubing is nearly complete.

Proposed Program:

Equipment will be completed and tests runs to determine the increase in temperature of that portion of the slug jacket adjacent to the ribs.

Reasons for Proposed Work:

It is expected that the part of the slug jacket in contact with the ribs may be one of the hottest and, consequently, may limit the maximum water temperature in the pile.

Reports on Part I:

Reports on the water film heat transfer coefficient and the thermal conductivity of magnesium oxide will be issued within the next month.

Next Review Date, October 1, 1944
Man-months Authorized (Part II), 4*
Man-months Used, (Part I), 11.3
Estimated Completion Date, October 1, 1944
Estimated Man-months to Complete, 4
Supervisor Responsible, R. N. Lyon

*Includes 1/3 man-month overrun.

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Submitted by:

Approved by:

Authorized by:

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Received: July 12, 1944 Issued:

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University of Chicago
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Technical Division

File Serial 7

Problem No. 122-ML-51-8
Date: December 30, 1944
Priority: A-2

FINAL REVIEW

Title: Fluid Film Heat Transfer in Water-Cooled Pipes.

Closing Status: Most of the objectives of this program have been reached. The fluid film heat transfer coefficient in W geometry was found to be within reasonable agreement with that calculated by the standard equation for circular pipe, substituting the hydraulic diameter of the system for the diameter term in the equation. Equipment for tests at CMX was designed, constructed, assembled, tested, and shipped to Hanford. Since it was believed that adequate allowance had been made for jacket temperature differences at the tube ribs, no accurate measurement of this temperature difference was made. To assist in calculating slug end temperatures, and to help design work in the reduction of this end temperature, measurements were made of the thermal conductivity of MgO pellets using a specially designed testing device. Some rather unsuccessful efforts were made to duplicate slug end heating using graphite, tungsten, and Nichrome heaters.

No further work on this program will be carried out under this authorization, since the Technical Division has been disbanded.

Reports: CE-2534; CE-2490; CE-2553

Notebooks: 116-B; 754-B; 1037; 1115; 198-B; 711; 656-B; 896; 1036.

Total Man-Months Expended - 13.4

Group Leader Responsible

Ass't Section Chief

Division Director

CS-1465 F.S. #7

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PROGRAM AUTHORIZATION

CS-1465 File Serial 8
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Title:

General Research and Development Studies

Objective:

- (1) To render assistance on engineering problems requiring less than 1 man-month of time by personnel.
- (2) To carry on exploratory studies that might develop into major investigations.

Present Status:

Past studies of this kind have included the method of mounting thermocouples in "X" slugs, calculations of air flow through channels in the "X" pile, slug testing for leaks, exploratory work in thermal contact of graphite layers, etc.

Proposed Program:

Future studies in this program will be undertaken at the request or with the consent of the Division Director.

Reason for Proposed Work:

Past experience has indicated that there are many diverse engineering problems requiring experimental work, most of which require but little time or personnel.

Remarks:

The recent organization of the General Engineering Section in the Technical Division will relieve the Engineering Development Section of the responsibility for many design problems, but there will still be a certain number of small problems requiring experimental work.

Review Date 4/1/44
Man-Months Authorized 4 tech.
Estimated Completion Date 7/1/44
Estimated Man-Months to Complete 4 tech.
Supervisor Responsible R. N. Lyon

Submitted by H. H. Lyon
Approved by H. W. Bellas
Chas. M. Cooper
Authorized by: Samuel K. Allison

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 8

Problem No. 390-ML-51-S
Date, April 1, 1944
Priority A-2

PROGRAM REVIEW

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Title: General Research and Development Studies.

CS-1465 File Serial #8 Supple. A
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Progress and Present Status:

Assistance has been rendered on several engineering problems, none of which required more than one man-month of time by personnel. Work thus far has consisted of determining a method of mounting thermocouples in "X" slugs, calculations of air flow through channels in the "X" pile, testing for leaks in slugs, etc. Exploratory work in such studies as thermal contact of graphite blocks and investigation of methods for determining water leaks in pile tubes were pursued under this study until sufficient background was developed to justify separate Program Authorizations for carrying out specific investigations.

Program for Balance of Authorization:

Future studies under this program will be of like nature and will be undertaken at the request or with the consent of the Division Director.

Reports:

Reports as required will be issued under separate Program Authorizations.

Man-months Expended: 0.03
Next Review Date: September 1, 1944

Supervisor Responsible:

A. N. Lyon

Section Chief:

E. E. Kirschner

MUC-EWB-93

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PROGRAM AUTHORIZATION (PART II)

CS-1465, P.S.# 8 Supple. B

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Series A.

Issued to: Clinton
R. F. Saew - Pres.

Title: General Research and Development Studies

Objective:

The objectives of this program are to render assistance on engineering problems requiring less than one man-month of time and to carry on exploratory studies that might develop into major investigations.

Present Status:

Up to the present time nearly a dozen miscellaneous engineering problems have been handled under this program. A number of these have developed into separate Program Authorizations such as "Detection of Leaking Aluminum Tube" (File Serial 26), "Neutronic Reactor Loading Cartridge" (File Serial 48) and an investigation of methods for detecting blistered slugs in "W" pile tubes.

Proposed Program:

Future studies will be of like nature and will be undertaken at the request or with the consent of the Division Director.

Reason for Proposed Work:

Additional work of this kind no doubt will be required of the Engineering Development Section.

Reports on Part I:

Reports have or will be issued under separate Program Authorizations.

Next Review Date, September 1, 1944
Man-months Authorized (Part II), 10*
Man-months Used (Part I), 7
Estimated Completion Date, October 1, 1944
Estimated Man-months to Complete, 10
Supervisor Responsible, R. N. Lyon

*Includes 3 Man-months Overrun.

Submitted by:

A. C. Miller

Approved by:

C. E. Fisher

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Chas M Cooper

Authorized by:

H. G. Vernon

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Received: July 2, 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 8

Problem No. 390-ML-51-S
Date: December 30, 1944
Priority: A-2

FINAL REVIEW

Title: General Research and Development Studies.

Closing Status: A wide variety of short term problems have been completed, and others have been developed into larger programs with separate authorizations. Problems completed under this authorization include: testing of a leak detection method for the helium system at Hanford, testing the use of steam to remove swollen Hanford slugs, and preliminary development of blister detection methods and of the long tube cartridge. Previous studies had included: method of mounting thermocouples in X slugs, calculations of air flow through X channels, slug testing for leaks, and several others.

Each of these studies has been recorded in one of the reports listed below:

<u>Reports:</u>	CE-2529	CE-2538	CE-2532	CE-2542
	CE-2535	CT-C-2280	CE-2530	CE-2533
	CE-2537	CE-2545	CT-1922	CE-2554
	CE-2547	CE-2536	CE-2548	

Notebooks: 122, 532, 711, 777, 656-B, 907-B, 937-B, 176-C

Total Man-Months - $13\frac{1}{2}$

Group Leader Responsible

Ass't Section Chief

Division Director

CS-1465 F.S. # 8

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PROGRAM AUTHORIZATION

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Title: Coatings Process Development (for Site W)

Objective: To develop a production method for coating "W" slugs,
and to produce about 3000 pieces of final design.

Present Status:

1. Present design involves two aluminum cans soldered together, with inside can soldered to slug. Solder is Sn + 8% Zn.
2. Process has been demonstrated for X-size slugs, except that complete solution of air gap insulator problem is not available.
3. All necessary equipment on hand or scheduled.

Proposed Program: To develop by March 15, this or another process into a production method suitable for Site W.

Reason for Proposed Work: Site W needs a coating method, and the processes can be evaluated properly only by carrying out the operations with full-size "W" pieces.

Remarks: Progress Report is issued every week by K. G. Jones.
(20 men)

Review Date March 15, 1944
Man-Months Authorized 75
Estimated Completion Date May 1, '44
Estimated Man-Months to Complete 125

Submitted by AB Greninger
Approved by J Chipman
Chaston Cooper
Authorized by: Samuel K. Allison

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 9

Problem No. 154-ML-54-3
Date March 15, 1944
Priority A-1

PROGRAM AUTHORIZATION (PART II)

Title: Coatings Process Development (for Site W)

Objective: To develop an improved production method for coating W-slugs.

Progress (Part I) and Present Status:

1. In the period January 1 to April 1, the Al-Si bonding process has been developed to the point where it is believed to be satisfactory for initial Hanford production (which started March 24, 1944).

2. Present design involves a metal slug 8.000" $\pm$ 0.010" long and 1.359 $\pm$.001" diameter, bonded with Al-Si to an aluminum can (0.035" wall thickness), and with a solid aluminum disc about 0.350" thick bonded to each end of the slug. Welding is done with the argon-arc.

3. Gas voids within the bond are readily detected with the "frost test". All finished pieces contain varying amounts of oxide skin within the bond; these oxide layers are a potential source of trouble in pile operation.

Proposed Program: The major objective will be improvement in the quality of the bond. Attempts will be made to perfect all steps in the canning procedure, and to eliminate those which appear undesirable.

Reports on Part I: Progress Reports have been issued every week by K. G. Jones. MUC-KGJ#1 to #31 incl; Also: MUC-PEC#4 to #7, and #28; MUC-EBH#17 and #23; MUC-FF#61 and #64.

CS-1465 File Serial 9, Part II.
Supple. A. This document consists
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36 Series A.
Issued to: Clinton

Next Review Date July 1, 1944
Man-Months Authorized (Part II) 80
Man-Months Used (Part I) 72
Estimated Completion Date Sept. 1, 1944
Estimated Man-Months to Complete 125
Supervisor Responsible K.G. Jones, and
after April 15, Raymond Yancey

Submitted by AB Greninger
Approved by R. M. Yancey
L. C. Brown
Charles C. Jones
Authorized by H. G. Verne

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 9

Problem No. 154 ML 52-1
Date July 1, 1944
Priority A-1

PROGRAM AUTHORIZATION (PART III)

Title: Al-Si Coating Development for Hanford

Objective: To develop a satisfactory coating process for W.

Present Status: A slug canned with Al-Si bonding is in production at Hanford, and the first two piles will undoubtedly use this type of coated slug. From many points of view, the slugs being made both by Hanford production line and by experimental line at Site B are unsatisfactory. The main points of weakness are: (1) Braze line quality (2) Quality of finished welded closure (3) Penetration of Al-Si through Al can (4) Quality of bond, including the bond between Al can and Al-Si.

Although it is believed that almost all of the defective pieces can be eliminated by testing prior to use, there will certainly be some pieces in which water will penetrate to Tu in the pile. The result of this penetration at a reasonably high power level of operation will undoubtedly be swelling of the Al can and possible jamming of the slug in the tube.

Proposed Program: (1) Continuation of Al-Si canning development with particular attention to changes in the present Hanford production system that may result in improving quality of the finished slug; (2) Investigation of cast-on coatings of Al-Si which would be brittle and thus probably not swell, even though water penetrates to the Tu surface; (3) Continuation of tests on finished slugs and the development of new tests particularly for cast-on coatings.

Reason for Proposed Work: Hanford needs the best possible jacketed piece that can be produced.

Reports: Weekly reports, MUC-RWY#33 to 50. Record report, CT-1741 (A-2453) by P. E. Collins and R. W. Yancey

Next Review Date October 1, 1944
Man Months Authorized (Part III) 50
(15 of these are for service work for other sections)
Man Months Used (Part II) 84
Estimated Completion Date Continuing
Estimated Man Months to Complete 12
full time men

Submitted by RW Yancey (by ABG)

Approved by ABG

Chas. M. Cooper

Authorized by Samuel K. Allison

CS-1465 F.S. #9
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File Serial 9

Problem No. 154-ML-52-1

Date 10-1-44

Priority A-1

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to: (R. L. Brown - pers.)

PROGRAM REVIEW

Title: Al-Si Coating Development for Hanford

Progress and Present Status:

The Al-Si canning process has progressed to the extent that only one other experiment remains to complete the development work.

The present status of this program is such that it is possible to can W size slugs which have extremely good bond and have no side-wall penetration of Al-Si alloy. The dimensions are within specifications. The slugs can be welded satisfactorily.

Program for Balance of Authorization:

The remainder of the work involves the canning of a number of slugs using a thick bottomed Al can which has a .25" radius on the I. D. at the bottom of the can.

Reports:

MUC-RWY-33 through MUC-RWY-63.

Man-Months Expended 160

Next Review Date 1-1-45

Group Leader Responsible R. W. Yancey

Section Chief J. H. Chapin

Division Director Chas. M. Cooper

Received: November 7, 1944
Issued: NOV 10 1944

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File Serial 9

University of Chicago
Metallurgical Laboratory
Technical Division

Problem No. 154-ML-52-1
Date December 5, 1944

FINAL REVIEW

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TITLE: ALUMINUM-SILICON CANNING PROCESS DEVELOPMENT *R. L. Dean pers.*

CLOSING STATUS:

At the termination of this program, the status of the work can best be described as follows:

(1) A satisfactory method of canning tuballoy slugs bonded with Al-Si (88%-12%) alloy has been developed.

(2) The hydraulic canning machine which has been used in the development of the coating process is satisfactory in its present design.

(3) Welded closures either testable or non-testable have been developed.

(4) Testing methods for bonded slugs have been devised to give maximum assurance against failure in use.

REPORTS:

MUC-KGJ-1, 2, 3, 4, 5, 6, 8, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 24, 25, 27, 29, 30, 31, 32.

MUC-RWY-33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 67, 68.

MUC-FF-39, 56, 64, 69, 70, 72, 76, 80, 86, 87, 88, 89, 92, 119, 138, 140, 144, 147, 151, 162, 188, 196, 197, 199, 218.

MUC-EC-52, 67, 77, 79, 82.

MUC-DPR-2; MUC-KTP-20; MUC-RGC-1; MUC-MF-4; MUC-EPW-96;
MUC-ABH-1; MUC-EBH-10, 17, 23, 26; MUC-GTS-535; MUC-IHNG-2;

MUC-TDGE-103, 117, 139, 148, 172, 173, 225.

CT-2518.

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(File Serial 9)

MUC-LMF-6, 10, 14; MUC-GY-8; MUC-JED-30; MUC-GEB-450, 452

MUC-CMC-172, 173, 175, 179, 197, 202, 223.

MUC-SKA-403, 638; MUC-EWB-96, 191; MUC-CEK-30, 81; MUC-JC-96;

MUC-ABG-35, 45, 60, 89, 90, 95, 123, 125, 126, 135, 143, 145,
175, 180, 189, 190, 219, 276.

MUC-JPH-164, 165, 172, 177, 197, 199, 201, 202, 216, 230, 242.

MUC-DG-1: MUC-GY-9; MUC-PEC-2a, 3a, 4a, 5, 6, 7, 11, 28.

Total Man-Months Expended 173.6

Supervisor Responsible _____

Section Chief J H Chapin

Division Director Chas M. Coyle

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 10

Problem No. 135 ML-56-2
Date 12/4/43
Priority A-2

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PROGRAM AUTHORIZATION

Title: Thermopile for Radiation Detection:

CS-1465 File Serial 10
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Issued to:

Objective: To construct very sensitive thermopiles by evaporation methods for purposes of neutron detection.

Present Status: Some of these have been constructed. All equipment for their fabrication is on hand, and only details of their construction must be developed. Lack of sufficient personnel and the importance of other work has delayed this program.

Proposed Program: It is planned to continue this work and construct many of these thermopiles coated with both boron and uranium. Various backings and metals should be tried. More personnel will be needed to push this work. Work is aimed at production of a useful device by May 1.

Reason for Proposed Work: There is a great need for more versatile instruments to measure radiations. Such thermopiles as are described here would cover a wide range of intensities with great sensitivity.

Remarks: This program calls for no unusual expenditures for special equipment.

Review Date April 1, 1944
Man-Months Authorized 3
Estimated Completion Date 3/31/44
Estimated Man-Months to Complete 6

Submitted by Georges Monn

Approved by Chas. I. [Signature]
William W. [Signature]

Authorized by: [Signature]

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 10

Problem No. 135-ML-56-2

Date March 15, 1945

Priority A-2

PROGRAM REVIEW

Title: Thermopile for Radiation Detection.

CS-1465 F. S. #10

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Series A.

Issued to: Clinton Lab.

Progress and Present Status: Because of the higher priority of work in optical surfacing and measurements, work has progressed slowly on this program. Sufficient parts are now ready, however, for a test assembly to determine characteristics.

A. L. Down
per

Program for Balance of Authorization: As time and higher priority work permit, final assembly and testing will be carried out and completed, and models built according to Project needs.

Reports: None.

Man-Months Expended 0

Next Review Date June 15, 1945

Supervisor Responsible Peter R. Girardot

Section Chief George S. Mony

Division Director J. C. Stearns

Report received: March 21, 1945

Issued: **MAR 22 1945**

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Technical Division

File Serial 10

Problem No. 135-ML-56-2
Date March 31, 1944
Priority A-2

PROGRAM REVIEW

Title: Thermopile for Radiation Detection.

Supplement A
CS-1465-File Serial #10
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Progress and Present Status: Some of these have been constructed, however, none have been tested. All equipment is on hand and most techniques for producing these have been developed.

Little progress, other than the construction of new templates has been made. This program was delayed because of higher priority of other work and because of the need to first develop the evaporation of boron to coat the hot junctions.

Program for Balance of Authorization: It is planned to construct several of these thermopiles with about 20 junctions on flat mica. Also, an attempt will be made to construct an evaporated thermopile of several hundred or a thousand junctions for monitoring very low intensities.

Reports: None.

Man-Months Expended 0.2

Next Review Date May 15, 1944

Supervisor Responsible Daniel D. Friel

Section Chief Charles M. M...

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Metallurgical Laboratory
Technical Division

File Serial 10

Problem No. 135-MI-56-2

Date June 1, 1944

Priority A-2

PROGRAM REVIEW

Title: Thermopile for Radiation Detection.

Progress and Present Status: Little has been done on this problem since March 31st, because of priority of other work.

Program for Balance of Authorization: Continuation of that stated on March 31st.

Reports: None.

Man-Months Expended 0.4

Next Review Date July 15/44

Supervisor Responsible LSM

Section Chief George S. Monn

MUC-EWB-119

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 10

Problem No. 135-ML-56-2

Date July 15, 1944

Priority A-2

PROGRAM REVIEW

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Issued to: Clinton
B. L. Olson

Title: Thermopile for Radiation Detection.

Progress and Present Status: Because of the priority of service in optics to Sites X and W there has been no manpower available for this program since the last report.

Program for Balance of Authorization: As soon as the major portion of our service to Sites X and W is at such a stage that personnel can be spared for this work it will be started again.

Reports: None

Man-Months Expended 0

Next Review Date Nov. 15, 1944

Supervisor Responsible Manfred Olson
Section Chief Georges. Monk.

MUC-EWB-224

Cue 7/12/44

Received: July 12, 1944

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File Serial 10

Problem No. 135-ML-56-2
Date November 15, 1944
Priority A-2

PROGRAM REVIEW

Title: Thermopile for Radiation Detection.

CS-1465 F. S. 10

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R. L. Doan, Pres.

Progress and Present Status: Because of the priority of service in optics to Site W, and of work in optical surfacing and measurements, there has up until now been no manpower available for this program since the last report.

Program for Balance of Authorization: It will be possible now to proceed with the construction and testing of this type of radiation detector. Work has already been initiated, and is in progress. The group will build several experimental models, determine their characteristics, and design final models according to Project needs.

Reports: None

Man-Months Expended 0

Next Review Date Jan. 15, 1945

Supervisor Responsible

Peter R. Girardot

Section Chief

George S. Monr

Division Director

Charles N. Cooper

Report received: November 30, 1944

Issued:

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University of Chicago
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Technical Division

File Serial 11

Problem No. 390 ML 56-5
Date January 17, 1944
Priority B-1

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PROGRAM AUTHORIZATION

CS-1465 File Serial 11
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Issued to:

Title: General Optical Design.

Objective: To study optical design in relation to Project requirements. To investigate the applications of newer types of optical construction, as with plastics, special mirror surfaces, low reflection coatings, and radiation shielding devices, to the requirements of Project conditions.

Present Status: A distortionless wide angle overall viewer containing a water radiation shield has been devised. A general service scanning periscope has been designed. Several types of length extenders of this periscope have been studied and modeled. Means of baffling radiation for protection of personnel and optical parts have been studied in their relation to optics. A limited amount of lens design work has been carried on, relative to improvement of performance in adopted Project instruments. Effects of radiation on optical materials have been investigated in collaboration with other sections. Investigations of the use of substitute materials such as plastics and mirrors have been started.

Proposed Program: 1. To continue the present study of the use of plastic materials for optical construction. (A-1 priority)

2. To continue those studies of lens design which are expected to improve the performance and usefulness of optical instruments for Project purposes.

Reason for Proposed Work: The novel and peculiar demands made upon optical instruments in the Project are not met by any existing designs. Instruments built thus far have been produced under high pressure and compromises have been adopted in order to get serviceable though not very satisfactory equipment as soon as possible. Admittedly there are many improvements toward greater usefulness, durability, and dependability which could have been made if time for research had been allowed. Also, new requests are still being made for novel instruments, all requiring a certain amount of theoretical study in design. Research is still under way in other agencies outside the Project leading towards a solution of these problems, and cooperation with these groups is established.

Remarks:

Review Date April 1, 1944
Man-Months Authorized 3
No completion date for this work is in sight.

Submitted by George S. Monk
Approved by Charles H. Casper

Authorized by Samuel K. Allison

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PROGRAM AUTHORIZATION (PART II)

Supplement A

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Title: General Optical Design.

Objective: To study optical design in relation to Project requirements. To investigate the applications of newer types of optical construction, as with plastics, special mirror surfaces, low reflection coatings, and radiation shielding devices, to the requirements of Project conditions.

Progress (Part I) and Present Status: Design of a plastic objective for the periscope has been completed, and the first doublet of the erecting system is expected to be complete in two or three weeks.

Work has been resumed on the design of an overall viewer which is to be distortion free. This work has not progressed far enough for a good estimate to be made regarding the amount of time necessary to complete the problem.

A general survey is in progress on means whereby periscopic instruments may be protected against coloration.

Also on the program is a method for obtaining good definition and distortion-free imagery over an extremely wide angle by means of a plurality of overall viewers directed at different angles. This novel instrument has been dubbed the "fly-eye".

Variations of the scanning mirrors in use in New Hot Lab, Site X, are requested, and a small amount of design work is required on these.

Proposed Program: 1. To continue the present study of the use of plastic materials for optical construction. (A-1 priority)

2. To continue those studies of lens design which are expected to improve the performance and usefulness of optical instruments for Project purposes.

Reason for Proposed Work: The novel and peculiar demands made upon optical instruments in the Project are not met by any existing designs. Instruments built thus far have been produced under high pressure and compromises have been adopted in order to get serviceable though not very satisfactory equipment as soon as possible. Admittedly there are many improvements toward greater usefulness, durability, and dependability which could have been made if time for research had been allowed. Also, new requests are still being made for novel instruments, all requiring a certain amount of theoretical study in design. Research is still under way in other agencies outside the Project leading towards a solution of these problems, and cooperation with these groups is established.

Reports on Part I: Comparative Tests of Periscopic "Extenders" - CT-1351.

Next Review Date June 1, 1944

Man-Months Authorized (Part II) 6

Man-Months Used (Part I) 2.5

Estimated Completion Date none

Estimated Man-Months to Complete 10

Submitted by

W. Wallin

Approved by

George M. Moore

Charles E. Coe

Supervisor Responsible *W. Wallin*

Authorized by

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 17

Problem No. 390-ML-56-5

Date June 1, 1944

Priority A-1

PROGRAM REVIEW

Title: General Optical Design

Progress and Present Status: Two projects have been receiving attention under this authorization. Design of an aspheric (distortion free) overall viewer has been completed, and work is in progress of checking the results. Full specifications have been made for the optics of the W borescope.

Program for Balance of Authorization: The work on the overall viewer has assumed that the eye is on the axis of the system. It is proposed that an investigation be made of the effect of decentering the eye.

It is also desired to investigate the possibility of building a borescope entirely of reflectors in order to eliminate parts which will discolor when exposed to radiation.

Man-Months Expended 4-1/2

Next Review Date July 31-1944

Supervisor Responsible

Section Chief

NUC-EWB-117

Supplement B
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Received: June 7, 1944

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PROGRAM AUTHORIZATION (PART III)

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Title: General Optical Design.

Objective: To study optical design in relation to Project requirements. To investigate the applications of newer types of optical construction, as with plastics, special mirror surfaces, low reflection coatings, and radiation shielding devices, to the requirements of Project conditions.

Progress (Part II) and Present Status: Design of a plastic objective for the periscope has been completed, and the first doublet of the erecting system is complete.

On the overall viewer, a distortion-free curve has been found and work is in progress checking the accuracy of the results.

A general survey is in progress on means whereby periscopic instruments may be protected against coloration.

Also on the program is a method for obtaining good definition and distortion-free imagery over an extremely wide angle by means of a plurality of overall viewers directed at different angles. This novel instrument has been dubbed the "fly-eye".

Variations of the scanning mirrors in use in New Hot Lab, Site X, are requested, and a small amount of design work is required on these.

Full specifications have been made for the optics of the W borescope.

Proposed Program: The work on the overall viewer has assumed that the eye is on the axis of the system. It is proposed that an investigation be made of the effect of decentering the eye.

It is also desired to investigate the possibility of building a borescope entirely of reflectors in order to eliminate parts which will discolor when exposed to radiation. Other current design problems will be continued.

Reason for Proposed Work: The novel and peculiar demands made upon optical instruments in the Project are not met by any existing designs. Instruments built thus far have been produced under high pressure and compromises have been adopted in order to get serviceable though not very satisfactory equipment as soon as possible. Admittedly, there are many improvements toward greater usefulness, durability, and dependability which could have been made if time for research had been allowed. Also, new requests are still being made for novel instruments, all requiring a certain amount of theoretical study in design. Research is still under way in other agencies outside the Project leading towards a solution of these problems, and cooperation with these groups is established.

Reports on Part II: None.

Next Review Date Sept. 1, 1944

Man-Months Authorized (Part III) 0

Man-Months Used (Part I & II) 11.1

Estimated Completion Date none

Estimated Man-Months to Complete
(continuing, 2 men full time)

Supervisor Responsible W. Wallin

Submitted by *W. Wallin*

Approved by *Charles M. Cooper*

Authorized by *W. Wallin* 7/6

MUC-EWB-239

AUG 9 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 11

Problem No. 390-ML-50-5

Date August 5, 1944

Priority A-1

UNCLASSIFIED

PROGRAM AUTHORIZATION (PART IV)

Title: General Optical Design.

Objective: To study optical design in relation to Project requirements. To investigate the applications of newer types of optical construction, as with plastics, special mirror surfaces, low reflection coatings, and radiation shielding devices, to the requirements of Project conditions.

Progress (Part III) and Present Status: A general survey is in progress on means whereby periscopic instruments may be protected against coloration.

Also on the program is a method for obtaining good definition and distortion-free imagery over an extremely wide angle by means of a plurality of overall viewers directed at different angles. This novel instrument has been dubbed the "fly-eye".

Variations of the scanning mirrors in use in New Hot Lab, Site X, are requested, and a small amount of design work is required on these.

Full specifications have been made for the optics of the W borescope. A check on the design of the borescope objective has been made.

Proposed Program: The work on the overall viewer has assumed that the eye is on the axis of the system. It is proposed that an investigation be made of the effect of decentering the eye.

It is also desired to investigate the possibility of building a borescope entirely of reflectors in order to eliminate parts which will discolor when exposed to radiation. Other current design problems will be continued.

Reason for Proposed Work: The novel and peculiar demands made upon optical instruments in the Project are not met by any existing designs. Instruments built thus far have been produced under high pressure and compromises have been adopted in order to get serviceable though not very satisfactory equipment as soon as possible. Admittedly, there are many improvements toward greater usefulness, durability, and dependability which could have been made if time for research had been allowed. Also, new requests are still being made for novel instruments, all requiring a certain amount of theoretical study in design. Research is still under way in other agencies outside the Project leading towards a solution of these problems, and cooperation with these groups is established.

Reports on Part III: None.

Next Review Date Sept. 1, 1944
Man-Months Authorized (Part IV) 10
Man-Months Used (Part I, II & III) 19.5
Estimated Completion Date none
Estimated Man-Months to Complete
(continuing, 2 men full time)
Supervisor Responsible G. S. Monk

Submitted by Georges Monor

Approved by Chas M Cooper

Authorized by H. Vernon

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 11

Problem No. 390-ML-56-5

Date Sept. 1, 1944

Priority A-1

PROGRAM REVIEW

Title: General Optical Design.

Progress and Present Status: Most of the work done under this program has been concerned with the design of an objective for borescopes or similar instruments where a wide angle of view and a large depth of field are desired.

Calculations have been compared with experimental setups for a proposed objective design.

Program for Balance of Authorization: It is proposed to continue the work on the borescope type objective as well as to make a further study of the possibility of constructing a borescope using mirrors instead of lenses.

Reports: None.

Man-Months Expended 4

Next Review Date Nov. 1, 1944

Supervisor Responsible G. S. Monk

Section Chief G. S. Monk W. L. Moore R. M. Clark

Division Director Chas. M. Cooper

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University of Chicago
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Technical Division

File Serial 11

Problem No. 390-ML-56-5

Date November 1, 1944

Priority A-1

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PROGRAM REVIEW

Title: General Optical Design.

CS-1465 F. S. 11
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Progress and Present Status: At present wide angle and deep field borescope objectives are not being worked on. A fairly satisfactory design was found to be possible with lenses already in stock. Attention has shifted to the design of Galilean monoculars which have been shown to give great increase in magnification without the loss in definition which usually accompanies the use of a high power eyepiece.

In preparation for survey of possible moulders of large plastic lenses, data on overall viewers up to three feet is being prepared.

Program for Balance of Authorization: It is proposed to continue work on design as emergency problems come up. Some attention is being paid to short length overall viewers because of an indication that these may be requested for the additions to the Clinton Hot Laboratory.

Reports: CP-2170.

Man-Months Expended 3-1/2

Next Review Date Jan. 1, 1945

Supervisor Responsible *George S. Monck*

Section Chief *George S. Monck*

Division Director *Chas. M. Cooper*

Report received: November 30, 1944

Issued: DEC 11 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 11

Problem No. 390-ML-56-5
Date January 1, 1945
Priority A-1

PROGRAM REVIEW

Title: General Optical Design.

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Progress and Present Status: The attention of the Optical Design Group is at present centered on designs of wide angle objectives. In addition, some work is being done on a device for measuring the intensity of fluorescent radiation for the Health Group. Some time is also being devoted to a program of inspection of the plastic lenses which are used for additional borescope parts with a view to improving the definition of those parts yet to be made.

Program for Balance of Authorization: It is proposed to continue work on design as problems arise.

Reports: CP-2170.

Man-Months Expended 28

Next Review Date March 31, 1945

Supervisor Responsible George S. Mark

Section Chief George S. Mark

Division Director Chas M. Cooper

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 11

Problem No. 132-ML-56-3

Date March 15, 1945

Priority A-1

PROGRAM REVIEW

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Series A.

Issued to: Clinton Lab.

R. L. Doan, pers.

Title: Optical Surfacing and Optical Measurements.

Progress and Present Status: Continued experiments in preparations of thick films of metal for the Chemistry Division have shown that a direct method by evaporation of the metal does not give the desired surface characteristics. An indirect method (described under File Serial 62), however, gives satisfactory results.

The group has started design of an improved transmission and reflection measuring instrument to supercede the present model, which is unstable and too insensitive.

Aluminizing of mirrors is maintained as a routine service, with deposition of gold on electrometer reeds and diaphragms continued as required.

Proposed Program: A literature search in progress for alternate methods of preparing thick films will be continued, and such methods fully investigated. The results will be immediately applicable to the preparation of thick films for the Chemistry Division.

Instrument design continues; the neutron detection thermopile will be assembled and tested as time permits. Service jobs in aluminization and other coatings continue, and will be done as required and authorized.

Reports: None.

Man-Months Expended (Part IV) 4.3

Next Review Date June 1, 1945

Supervisor Responsible Peter R. Girardot

Section Chief Georges S. Monk

Division Director J. C. Stearns

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Report received: March 21, 1945

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 11

Problem No. 390-ML-56-5

Date March 31, 1945

Priority A-1

PROGRAM REVIEW

Title: General Optical Design.

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Issued to; Chilton Lab. (B. L. Sloan - Per)

Progress and Present Status: The design of the optical system of a Fluorimeter is near completion. The design of an achromat using spare plastic borescope lenses as one element is nearing completion. Designs of incidental items to current construction have been completed during the past month. The staff of the group is writing reports on the Optical System of the Borescope, and the Plastic Kellner Objective Used in Borescopes.

Program for Balance of Authorization: It is proposed to continue work on design as problems arise.

Reports: CP-2170.

Man-Months Expended 6

Next Review Date June 30, 1945

Supervisor Responsible *J. H. Moore*

Section Chief *George D. Moore*

Division Director *J. C. Stearns*

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PROGRAM AUTHORIZATION

CS-1465 File Serial 12
This document consists of 1
pages and 0 figures.
Copy No. 27 of copies.
Series A
Issued to:

Title: Service in Optics to Site X and Site W.

Objective: To provide for service in Optical Instrument Design, for consultation in other phases of the Project, and for pioneering developments in optics which are essential to the Project.

Present Status: 1. The suitability of many types of instruments to Project purposes have been studied and two most suitable types, the scanning periscope and the overall viewer, selected for concentrated study and design. Models of these in various forms have been constructed. Sources of parts supply have been established. Innumerable services of minor character have been rendered other Project groups.

2. A large periscope has been constructed for the Pile discharge area at X. A periscopic slug inspector box has been designed and is being built. Eight short scanning periscopes have been designed for the new hot lab at X, and are in construction. A model of a special overall viewer is being built for this hot lab. A borescope for X is being constructed on sub-contract with close supervision. A carriage for the borescope is being designed. A special canal periscope is in design for X.

3. Consultations on optics have been held with Operations of Hanford 100 Area and a program of consultations for all Hanford areas is projected.

Proposed Program: 1. To continue the general service program in optics along the lines established and described in item 1 of the Present Status outline.

2. Site X program: To complete the following assignments:
- (a) Construction of the Slug Inspector Box.
 - (b) Construction of the borescope and its carriage.
 - (c) Construction of a canal periscope. An instrument is needed as an immediate temporary substitute for the Slug Inspector Box. A canal periscope of more general adaptability is projected, unofficially, for later construction.
 - (d) Construction of Eight Scanning Periscopes for the New Hot Lab.
3. Site W program: To continue the present arrangement of cooperation and consultation with Operations. To design and supervise construction of optical instruments for W if requested.

Reason for Proposed Work: Optical Instrumentation of Irradiated Areas and for Operational Purposes is Essential to the Project Program.

Remarks: It is expected that requests on hand for specific instruments can all be filled by April 1.

Review Date May 1, 1944
Man-Months Authorized 20
Estimated Completion Date
Estimated Man-Months to Complete
For Requests now on Hand 16
The General Program continues indefinitely.

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Submitted by Georges Mont

Approved by

Authorized by:

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 12

Problem No. 136-ML-56-4

Date May 5, 1944

Priority A-1

PROGRAM REVIEW

CS-1465 File Serial #12 Supple. A
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Copy 22 of 16 Series A
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Title: Service in Optics to Site X and Site W.

Progress and Present Status: Since the authorization of this program, much experimental and design work has been done on optical instruments of the periscopic and overall viewer types. From this work has been developed a highly satisfactory scanning periscope and also an overall viewer design for installation in the Site X Hot Labs. Twelve of the scanning periscopes have been completed or are nearly completed, four of this number having been shipped to the Clinton Laboratories. The overall viewers required for installation at Site X have also been nearly completed. Two of these have been shipped to the Clinton Laboratories.

Recently much work has been done on the borescope and its carriage for use in examining ribbed tubes at Site X.

Several other periscopic instrument designs are under consideration for applications at Site X.

Optical instruments installed at Site X have recently been serviced and experimental work has been done in a study of lens materials.

Designs have been developed for a special type of overall viewer for Site W and of periscopes and a borescope using plastic lenses which may be employed at Site W.

In addition to the above mentioned services a number of smaller services have been rendered other Project groups.

Program for Balance of Authorization: To continue proposed program as outlined under Program Authorization. (CS-1465 File Serial 12)

Reports:

CT-1242 (A-1819)
CT-1351 (A-1890)
CP-1246 (A-1823)
GSM-MUC #85
N-716 (CT)
N-736 (CT)

Man-Months Expended 15

Next Review Date Aug. 1, 1944

Supervisor Responsible William H. McLaughlin

Section Chief George J. Frank

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Priority A-1

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MUC-LEWB-288

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Problem No. 136-ML-56-4

Date October 1, 1944

Priority A-1

CS-1465 F. 5. 12

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W. J. Roan - Pers.

PROGRAM REVIEW

Title: Services in Optics to Site X and Site W.

Progress and Present Status: Under Part II of this program authorization a Viewer-Corner Periscope has been designed and the drawings of it submitted to the Operations Group for approval. Much of the work of assembly and considerable construction work on the W-Borescope was done under this program. Prior to September 6th most of the construction work in connection with the models of the Storage Basin or Sorting Basin periscopes for Site W was accomplished under this program. In addition to the above, a Shelfscope was designed and constructed for the Hot Lab at Site X and preliminary work has been done on a Chemiscope for the same site.

At present, work is being continued on a number of instruments for Site X and Site W and tests and experiments are being performed on improved objectives and eyepieces for Project instruments.

Program for Balance of Authorization: To continue the objective of this program authorization as diligently as possible.

Reports: On Part I - CP-1246, GSM-MUC-35, CP-1684, M-CP-1593, M-CP-1687.
On Part II - None.

Man-Months Expended 34

Next Review Date Jan. 1, 1945

Supervisor Responsible

William H. Kirkle

Section Chief

George J. Munn

Division Director

Chas. M. Cooper

Report received: October 16, 1944

Issued:

OCT 20 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 12

Problem No. 136-ML-56-4

Date June 1, 1945

Priority A-1

PROGRAM REVIEW

Title: Services in Optics to Site X and Site W.

Progress and Present Status: Since April 1, 1945 the second D-A periscope has been completed and supplied to Site X, and the third such instrument is nearly completed.

Three C-A type periscopes have been improved and reconditioned for Site X.

A Chemiscope 15/16 inch diameter has been completed and additional accessories for it have been designed for Site X.

A special mirror mount and two stellite mirrors were constructed and delivered to Site X.

The design of a modified type C-B periscope has been completed for Site X, one instrument is completed and five others are in various stages of completion.

Some optical parts have been supplied to Site W and three dove prisms have been completed and are ready for shipment.

Program for Balance of Authorization: To complete as rapidly as possible those instruments now designed and under construction and to supply such other services as may be needed.

Reports: As in previous Review plus on Part II - CP-2437, GSM-MUC #170.

Man-Months Expended 57

Next Review Date _____

Supervisor Responsible Willard W. Kerkel

Section Chief George S. Moore

Division Director J. C. Stearns

CS-1465 F.S.#12

Sup. F

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B. L. Doan

Report received: June 7, 1945

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File Serial 12

Problem No. 136-ML-56-4

Date January 1, 1945

Priority A-1

PROGRAM REVIEW

CS-1465 F.S. #12

Supple D

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Series A

Issued to

Title: Services in Optics to Site X and Site W.

R. L. Clinton
per

Progress and Present Status: Since October 1st, 1944, two Viewer-Corner Periscopes have been completed and one of them delivered to Site W. The second Viewer-Corner Periscope is ready for delivery and a third one is complete except for the driving motor which has not yet arrived from the manufacturer. The installation of an under-water periscopic viewer for the storage basin at Site W was supervised during October.

During November conferences were held on optical needs at Site X and two types of periscopic instruments were recommended for the 706-D building.

At present the two types of periscopes for the 706-D building are being designed and the assembly and detail drawings are being prepared.

Program for Balance of Authorization: To continue the objective of this program authorization as diligently as possible.

Reports: On Part I - CP-1246, GSM-MUC #85, CP-1684, M-CP-1593, M-CP-1687, CP-1689.
On Part II - CP-2170, CP-2266.

Man-Months Expended 42

Next Review Date April 1, 1945

Supervisor Responsible

William H. H. H. H. H.

Section Chief

George E. M. M.

Division Director

Charles M. Cooper

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 12

Problem No. 136-ML-56-4

Date April 1, 1945

Priority A-1

PROGRAM REVIEW

CS-1465 F.S.#12 Supple E
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Title: Services in Optics to Site X and Site W.

ISSUED TO: Clinton Lab (R. L. Doan Rec)

Progress and Present Status: Since January 1, 1945, the second and third Viewer-Corner Periscopes have been supplied to Site W.

The designs for D-A and D-B type periscopes have been completed for Site X and eight of the D-B instruments have been constructed and delivered. One D-A instrument has likewise been completed and shipped. Three additional D-A periscopes are under construction.

One General Service or C-A type periscope has been completed and delivered to Site X and three of those originally supplied are being overhauled. A special C-B periscope with plastic optical parts has also been constructed and delivered to Site X.

The design of a modified C-B periscope is nearly finished.

Program for Balance of Authorization: To continue the objective of this program as set forth in the program authorization.

Reports: On Part I - CP-1246, GSM-MUC #85, CP-1684, M-CP-1593, M-CP-1687, CP-1680.
On Part II - CP-2170, CP-2266.

Man-Months Expended 50

Next Review Date June 1, 1945

Supervisor Responsible Willard H. McQuinn

Section Chief Robert M. Munn

Division Director J. C. Stearns

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 13

Problem No. 132 ML-56-3
Date 12/4/43
Priority A-1

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PROGRAM AUTHORIZATION

CS-1465 File Serial 13
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Series A
Issued to:

Title: Evaporation Techniques.

Objective: To develop evaporation techniques for preparing films of controlled thickness upon surfaces of ionization chambers and other devices of interest to the Project.

Present Status: Facilities and techniques are now available for preparation of films from the more usual materials. Films of boron adequate for ionization chamber purposes have been prepared but further development is needed to assure success on full scale chambers. Deposition of tubealloy by vacuum evaporation has been demonstrated.

Proposed Program: 1. Complete development of equipment and methods for depositing films of boron on ionization chamber surfaces. Assuming prompt delivery of equipment on order this phase should be completed by April 1. Priority A-1.

2. With B-1 priority studies will continue development of techniques for applying heavy films, and methods of removing these films in the form of foils.

Reason for Proposed Work: Permanent, well bonded boron films of controlled thickness are an essential part of neutron monitoring equipment. Methods at present leave much to be desired as to permanency or control of thickness.

Frequent demands are made on the Optics Section for production of optical surfaces and of other films by evaporation technique.

Remarks: Note that preparation of thermo-piles by these methods is covered by separate authorization.

Review Date: April 1, 1944
Man-Months Authorized 7

Submitted by Georges M. Mow
Approved by

Estimated Completion Date 12/44
Estimated Man-Months to Complete
To Complete the Boron Study 10
The service work continues indefinitely.

Authorized by Samuel K. Allen

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PROGRAM AUTHORIZATION (PART I)

Title: Evaporation Techniques.

Supplement A

CS-1465-File Serial #13

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Objective: To develop evaporation techniques in vacuo for the preparation of mirrors and films of critical metals and particularly to refine the evaporation techniques of boron and uranium for thermopiles and other radiation detecting devices.

Progress (Part I) and Present Status: Methods for coating ionization chambers with boron have been developed and described in a report to be issued in a few weeks. Techniques for the deposition of critical metals and the preparation of high reflecting mirrors have been refined. The evaporation of a heavy film of uranium has not yet been satisfactorily accomplished.

Proposed Program:

1. Develop the evaporation of boron onto small areas of low melting materials particularly onto thermopiles. It is necessary to develop a method of boron evaporation that liberates little heat to the surrounding materials.
2. Develop the deposition of very heavy films of uranium and other critical metals.
3. Develop techniques for the preparation of high quality mirrors.

Reason for Proposed Work:

1. A method of depositing boron on thermopiles and other neutron monitoring instruments is needed.
2. The need for better mirrors for optical systems is becoming increasingly important.
3. Techniques for evaporation of critical metals must be developed to the needs of various sections of the Project.

Reports on Part I: One is to be issued in a few weeks.

Next Review Date June 15, 1944
Man-Months Authorized (Part II) 10
Man-Months Used (Part I) 9
Estimated Completion Date none
Estimated Man-Months to Complete _____

Supervisor Responsible D. D. Friel

Submitted by George S. Monk
Approved by Chas. D. Cooper

Authorized by W. D. Monk

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University of Chicago
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Technical DivisionFile Serial 13Problem No. 132-ML-56-3Date June 21, 1944Priority A-1PROGRAM AUTHORIZATION (PART III)

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Title: Evaporation Techniques.

(Alternate Title: Thin Film Preparation Techniques)

Objective: To develop and standardize techniques for preparing films of desired characteristics upon various surfaces and of various materials as needed by the Project.

Present Status: 1. Satisfactory films can be prepared for mirrors and other uses, and some progress has been made toward standardization.

2. Good non-reflecting surfaces can be prepared, but little progress has been made toward standardization or control.

3. Films of boron and tubealloy can be deposited only with difficulty.

4. Considerable work has been done on the thermopile, but it has not been assembled or tested.

Proposed Program: 1. Refine and standardize the techniques for producing films of desired and uniform characteristics.

2. Continue experimentation with boron and tubealloy films using induction heating.

Reason for Proposed Work: Some mirrors show pinholes and other defects in use, suggesting that we need to refine and standardize our methods to produce consistently coatings of desired characteristics.

The thermopile constructed by evaporated films, though not urgent, should be completed so that its characteristics may be determined.

The use of induction heating may be the solution for the evaporation of recalcitrant metals such as boron and tubealloy.

Remarks: The preparation of thermopiles by these methods is covered by separate authorization.

A portable evaporation unit now under construction must be finished so that the induction heater may be used.

Reports: CP-1738 (A-2450)

UNCLASSIFIED

Next Review Date Sept. 15, 1944Man-Months Authorized (Part III) 10Man-Months Used (Part I & II) 13.3Estimated Completion Date continuingEstimated Man-Months to Complete continuing
1 to 2 men full timeSubmitted by George J. BrownApproved by Chas. M. CooperSupervisor Responsible Manfred G. Brown

MUC-FWB-229

Authorized by H.C. Johnson 7/12Received: JUN 29, 1944
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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 13

Problem No. 132-ML-56-3

Date September 20, 1944

Priority A-1

PROGRAM REVIEW

Title: Evaporation Techniques.

(Alternate Title: Thin Film Preparation Techniques).

Progress and Present Status: The production of satisfactory films for mirrors has been almost completely standardized. Good low-reflection coatings have been made, although work remains to be done to make possible the production of durable films. The deposition of films of boron and tubealloy has not been pursued recently, due to development of other methods of deposition outside the group. Assembly and testing of the thermopiles is in progress, and will be completed by about December 1, barring the intervention of higher priority work.

Program for Balance of Authorization: Continued standardization of techniques, especially of low reflection coating, will be carried out, concurrent with further inquiry into the best materials for such coatings. The thermopile investigation will be completed, and the usual service jobs done as required and authorized.

Remarks: The preparation of thermopiles by these methods is covered by separate authorization. Much of the work in this group is general service work and as such continues indefinitely.

Reports: None.

Man-Months Expended 18.9

Next Review Date November 15, 1944

Group Leader Responsible Peter Girardot

Section Chief Georges Monks

Division Director Charles Cooper

CS-1465 F.S., 13

Supplement C

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File Serial 13

Problem No. 132-ML-56-3
Date November 16, 1944
Priority A-1

PROGRAM REVIEW

CS-1465 F. S. 13
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Series A
Issued To: Clinton
(R. L. Doan - pers.)

Title: Optical Surfacing and Optical Measurements.

Progress and Present Status: No difficulty is experienced in reproducing uniformly satisfactory mirror surfaces and many types of coatings for other uses. The production of low-reflection films has been suspended for the present. Two optical testing instruments have been built and are in operation, while a third is under construction. Progress on a thermopile has awaited completion of more urgent work.

Proposed Program: An investigation into methods of coating mirrors with a tough transparent protective film will be made; the thermopile investigation and optical instruments will be completed. The usual service jobs continue, and will be done as required and authorized.

Reports: CP-2343

Man-Months Expended 22.5

Next Review Date Jan. 15, 1945

Supervisor Responsible Peter R. Gindler

Section Chief George M. Mone

Division Director Chas McCoque

Report received: November 30, 1944
Issued:

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PROGRAM AUTHORIZATION (PART IV)

CS-1465 F.S. #13

Supple E

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1 page of text

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Series A.

Issued to: *Clinton Lab*

(R. L. Dean - pres.)

Title: Optical Surfacing and Optical Measurements.

Objective: To prepare thin film coatings for various Project needs, to develop and standardize techniques for this purpose, and to design, construct, and operate instruments for optical measurements.

Present Status: Two testing instruments, a nodal slide and an aberrations tester, have been constructed and are in use, as well as a shadow box. Assembly and testing of neutron thermometers has not been pursued, due to their low priority.

Aluminizing of mirrors is maintained as a routine service, with deposition of gold on electrometer reeds continued as required.

Experiments to determine the best conditions under which satisfactory thick films of metal may be deposited are proceeding at present for the Chemistry Division.

Proposed Program: 1. Refine and standardize the techniques for producing films of desired and uniform characteristics.

2. Continue service jobs to the Project in any thin film needs.

3. Continue experimentation with thicker films, and work out methods of putting still better films of gold onto electrometer reeds.

4. Assemble and test neutron detection thermopiles.

Reason for Proposed Work: Project needs require services in thin film coatings continuously.

Gold coatings on vibrating reed electrometers are not entirely satisfactory, in that they are not sufficiently durable, suggesting that further refinement of technique is necessary.

Work on the neutron detection thermopile should be completed, and further research into thicker films continued. As the needs of the section demand, optical measuring instruments must be set up and operated.

Remarks: The preparation of neutron detection thermopiles is covered by separate authorization.

Reports: CP-2343

Next Review Date March 15, 1945

Man-Months Authorized (Part IV) 10

Man-Months Used (Parts I, II & III) 28.3

Estimated Completion Date continuing

Estimated Man-Months to Complete two men full-time - continuing.

Supervisor Responsible *P. R. Girardot*

Submitted by *George M. Moore*

Approved by *Chas. M. Cooper*

Authorized by *J. C. Stearns*

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 13

Problem No. 132-ML-56-3

Date June 1, 1945

Priority A-1

PROGRAM REVIEW

Title: Optical Surfacing and Optical Measurements.

Progress and Present Status: Aluminizing and partial aluminizing continues, as well as gold coating, for instrumentation and for Chemistry Division research. Work on heavy films for the same section has been carried on at a reduced rate. Seventy-five percent of the time of the group has been spent in report writing.

Proposed Program: A general report on the progress and work of the group since its inception will be completed shortly, as well as numerous subsidiary reports on specialized problems and operation of apparatus. Aluminizing and gold coating will continue as required.

Reports: CP-2920.

Man-Months Expended (Part IV) 8.6

Next Review Date _____

Supervisor Responsible Peter R. Guardo
Section Chief [Signature]
Division Director J.C. Stearns

CS-1465 F.S.#13

Sup. F

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Series A

Issued: Chilton Lab.

R.L. Doan

Report received: June 7, 1945

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PROGRAM AUTHORIZATION

Title:

Tests on "W" Slugs with Internal Heating

CS-1465 File Serial 14
This document consists of 1
page and 0 figures.
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Issued to: _____

Objective:

- (1) To develop a practical method of internally heating "W" slugs for corrosion studies by CMX, employing high internal temperatures.
- (2) To utilize this device in studies here of the effects resulting from jacket failure and in tests of proposed types of jackets and bonding materials with high internal temperatures.

Present Status:

Internal heating with graphite and tungsten resistors has been found practicable only with short lengths of specimens, and tests have been run indicating rapid failure of slugs having unbonded jackets that were punctured. The suggestion has been made that Calrod or a similar insulated heater be used as a heat source for studies on bonded jackets.

Proposed Program:

With the assistance of the General Engineering Section, an improved design of internally heated slug will be developed and constructed. Units will be made available to CMX for corrosion studies, and other units will be operated at Site "B" to determine rate of undercutting of the bonded jacket of a slug following perforation of the jacket. Tests of the various proposed jackets and bonds will be run at high heat flux.

Reason for Proposed Work:

- (1) The tendency toward formation of iron oxide films on the surface of aluminum slug-jackets and ribbed tubing in "W" water makes it desirable to run tests on internally heated specimens to determine the effect of the heat flux on the film. Steam-heated units are now under construction to assist with this problem, but larger temperature differences between the center of the slug and the water must be duplicated to simulate true conditions.
- (2) Exposure tests on perforated aluminum slug-jackets can be performed with less operating difficulty and on more specimens at one time if the proposed method can be developed.
- (3) The various alternative types of slug jackets and bonds should be tested under severe temperature conditions to assist in selecting the best design for use at "W".

Remarks:

Review Date 4/1/44
Man-Months Authorized 10 tech. and 10 non-tech.
Estimated Completion Date 4/1/44
Estimated Man-Months to Complete As shown
Supervisor Responsible R. D. McCrosky

Submitted by W. H. Bell

Approved by _____

Authorized by Samuel K. Allen

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File Serial 14

PROGRAM REVIEW

Title:

Tests on "W" Slugs with Internal Heating.

Supplement A

CS-1465-File Serial #14

This Document contains 1 Pages

Text and 0 Pages of Figures.

This is Copy 27 of 42 Series A.

Issued to: *Clinton*

Progress and Present Status:

Four methods are under investigation for heating slugs internally at maximum "W"-pile heat flux for (a) undercutting tests on jacket bonds at perforations in the jacket and (b) corrosion tests at "W".

(1) A single slug, drilled through the centers and clamped on the periphery at its ends, is heated with a graphite resistor. A zinc-bonded specimen has been under test 30 hours by this method without signs of undercutting at the jacket perforation.

(2) A tubular slug with monel end caps was jacketed, the caps removed, and the specimen placed longitudinally between two monel tubes through which a graphite resistor was inserted. Difficulty has been encountered in preventing leakage of water through the gaskets.

(3) Tubular slugs mounted upon a steel mandrel are under construction in the Site B Shops preparatory to heating electrically with graphite resistors.

(4) A Besler High-Pressure Steam Boiler has been purchased and is being installed temporarily at Site B for tests there before being shipped to "W" for CMX studies.

Program for Balance of Authorization:

Development of the various electrical heating methods will be continued in an attempt to find a practicable system for use in testing at least 10 slugs at Site B concurrently. Provision will be made for running these tests continuously and for trial operation of the high pressure steam boiler as a source of heat for extensive tests at "W".

Reports:

None.

Man-months Expended - 6

Next Review Date - May 1, 1944

Supervision Responsible - R. D. McCrosky

Section Chief - C. E. Kircher

C. E. Kircher

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 14

Problem No. 124-ML-51-17

Date, June 5, 1944

Priority A-1

Cs-1465--F.S.# 14 Suppl. B

Title:PROGRAM AUTHORIZATION (PART II)

This document contains 2 pages.

Tests on "W" slugs with internal heating.

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Issued to: Clinton-B. L. Bacon
Pres.Objective:

- (1) To develop a practical method of internally heating "W" slugs for corrosion studies by CMX, employing high internal temperatures.
- (2) To utilize this device in studies here of the effect resulting from jacket failure and in tests of proposed types of jackets and bonding materials with high internal temperatures.

Progress (Part I) and Present Status:

Two basic methods, electrical resistance and high pressure steam heating are under investigation for producing heat fluxes of "W" pile magnitude in slugs to determine (a) undercutting at perforations of the jacket and/or bond and (b) corrosion rates under various types of bonding procedures.

(1) A successful electrically heated unit has been developed in which a single slug is bored out longitudinally to receive the graphite resistor. The slug is supported at its ends within a ribbed tube and exposed to water flowing at 20 ft./sec. in the annulus. Tests using this apparatus are being conducted on a shift basis. Further work is being carried out to develop a test unit for mounting several tubular slugs on a steel mandrel.

(2) A Besler high pressure steam generator has been purchased and is being installed at Site B.

Proposed Program:

- (1) Conduct additional internal heating failure tests as prescribed by the Metallurgy Section using the electrical resistance heating method.
- (2) Complete expansion of the number of electrical testing units from the present 3 to a proposed 8 units.
- (3) Complete the development of the electrically heated apparatus which would accommodate several slugs.
- (4) Complete the construction of the high pressure steam test equipment and conduct internal heating tests using same.

Reasons for Proposed Work:

- (1) Failure testing under internal heating conditions appears to approximate closely the actual "W" pile conditions and is, therefore, a valuable guide to adequacy of materials and designs.

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Received: July 3, 1944

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14

- (2) More rapid results are required than can be obtained with three units.
- (3) Successful development of equipment for testing several slugs on a mandrel would permit uniform exposure of the entire slug to heating which is not possible with the present single slug test units.
- (4) Tests with use of high pressure steam will be made to establish the usefulness of this equipment as compared to the electrical apparatus.

Reports:

Metallurgy Section is currently reporting significance of test results. Engineering Development Section will issue during coming month progress report on equipment development.

Next Review Date: August 1, 1944

Submitted by

A. C. Miller

Man-months Authorized (Part II): 60*

Man-months Used (Part I): 27

Approved by

E. E. Kitcher

Estimated Completion Date: 10/1/44

Estimated Man-months to Complete: 60

Supervisor Responsible: A.C. Miller

Chas M. Berger

*Includes 16 man-months overrun.

Authorized by

H. E. Johnson

MUC-EWB-135

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 14

Problem No. 124-ML-51-17
Date: December 30, 1944
Priority: A-1

FINAL REVIEW

Title: Tests on "W" Slugs with Internal Heating.

Closing Status: The objectives of this program have been met. A practical method of heating "W" slugs internally has been developed and has been used here for about 8 months in studies of the effects resulting from jacket failures and in tests of proposed types of jackets and bonding materials as well as corrosion resistant uranium alloys.

In addition an alternative heating method using 1000 to 1500 lb. per. sq. in. steam has been developed.

With the dissolution of the Technical Division, no further work on this program will be carried out under this authorization. Work may be continued, however, by the Metallurgy Division under Program No. 124-ML-54-5; File Serial No. 55.

Reports: CE-2543; CE-2544; CE-2552

Notebooks: 608-B, 711, 116-B, 753, 937-B, 575-B, 1115, 148-C.

Total Man-Months - 66.2

Group Leader Responsible R. E. Larson

Ass't Section Chief H. M. Lyon

Division Director W. M. Cooper

CS-1465 F.S. # 14

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PROGRAM AUTHORIZATION

Problem No. 211ML - 51-16
Date 1/1/44
Priority B-1

CS-1465 File Serial 15
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Title:

Semi-Works Investigation of Concentration Methods.

Objective:

To evaluate on a semi-works scale alternate methods of concentrating products from decontaminated solutions.

Present Status:

At the present time the extraction and decontamination steps of the separations process appear to be feasible and adequate. Less information is available on the concentration step, and therefore more attention should be paid to evaluating main line and alternate methods of effecting product concentration. Working in collaboration with the Engineering Development Section, the Chemistry Division has an approved program (211 MCL 1110) covering the laboratory phases of a semi-works evaluation of the concentration method outlined below.

Facilities are available in the semi-works laboratory to undertake an investigation of the type indicated.

Proposed Program:

Using solutions prepared from "X" metal having a concentration of 40 - 80 micrograms of product per lbs., carry out the standard extraction and decontamination steps. Then concentrate the product by dissolving the bismuth phosphate product precipitate in HCl and carrying the product from the solution by precipitating uranous oxalate or lanthanum fluoride. Minor alterations in the main line concentration procedure requiring investigation will also be checked in the semi-works laboratory.

Reason for Proposed Work:

The concentration method suggested above, in comparison with the proposed plant method, reduces the total number of operations required to effect the same degree of concentration and therefore offers a possibility of higher product yields.

Remarks:

Review Date April 1, 1944
Man-Months Authorized 14
Estimated Completion Date June 1, 1944
Estimated Man-Months to Complete 25
Supervisor Responsible _____

Submitted by E. E. Higdon
Approved by J. J. Pallas
Chas. M. Cooper

Authorized by Samuel K. Allison

Noted by T. R. Rogers
" " H. S. Lister

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 15

Problem No. 211-ML-51-16
Date, April 20, 1944
Priority B-1

PROGRAM REVIEW

Title: Semi-works Investigation of Concentration Methods.

Progress and Present Status:

CS-1465 File Serial #15
Supple. A. This document consists of 1 page of text and 0 pages of figures. Copy 27 of 36 Series A.
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Neoprene lined centrifuge equipment and hard rubber vessels were set up in the Semi-works for carrying out the uranous oxalate-hydrochloric acid and lanthanum fluoride-hydrochloric acid concentration procedures on a scale equivalent to 150 lbs. of uranium.

In these procedures, the bismuth phosphate product precipitate from the decontamination cycle was dissolved in hydrochloric acid and the product carried from this solution with uranous oxalate or lanthanum fluoride. The uranous oxalate procedure has been successfully demonstrated in 12 Semi-works runs, and two lanthanum fluoride runs have been completed with good yields.

The bismuth phosphate product precipitate used in the foregoing runs was prepared using U(IV) for reduction in the decontamination cycle. Since Fe(II) is the present standard reducing agent for the decontamination cycle, it is necessary to demonstrate these procedures in the presence of the amount of iron normally carried with the bismuth phosphate product precipitate.

The work was repeatedly interrupted due to failure of a neoprene "brush-on" coating on the centrifuge equipment, and was temporarily discontinued after all attempts of the Semi-works group to apply an impervious coating using neoprene brush-on compound failed.

Program for Balance of Authorization:

Concentration work will be resumed upon receipt of centrifuge equipment being rubber lined by the Goodrich Company. Approximately six uranous oxalate runs and six lanthanum fluoride runs will be made to determine the effect of iron on these procedures.

Reports: CN-1353, CN-1491, CN-1584.

Man-months Expended: 8
Next Review Date: July 1, 1944

Supervisor Responsible:

R. C. Ryce

Section Chief:

E. E. Kircher

NUC-EWB-92

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Problem No. 211-ML-51-16
Date, July 17, 1944

Title: Semi-works Investigation of Concentration Methods.

Closing Status: An alternate method of concentration was investigated in which the BiPO_4 product precipitate from the final decontamination cycle was dissolved in a small volume of hydrochloric acid. From this solution the product was removed by co-precipitation with a relatively small amount of $\text{U}(\text{C}_2\text{O}_4)_2$ or LaF_3 . Rubber-lined equipment was used throughout because of the corrosiveness of the HCl solutions.

The $U(C_2O_4)_2-HCl$ concentration process was demonstrated to be reliable and efficient on a scale equivalent to 150 lbs. of Clinton metal when $U(IV)$ was used for reduction in the $BiPO_4$ decontamination cycle. The average measured product loss in the effluent solutions following $U(C_2O_4)_2$ precipitation was 1.5%. Two successful semi-works runs were made in which LaF_3 was used as the product carrier from HCl solutions.

Work on this problem was suspended in April to permit work on problems of higher priority. Since laboratory results indicate that the present LaF₃ concentration process produces adequate results, and since this study has demonstrated feasible alternates, the semi-works investigations have been discontinued.

Reports: CN-1353, CN-1491, CN-1584, Notebook 375-B, Group Master Results, Notebook 1329, Group Log Book. A final record report on this study is in preparation. (#CN-2243).

Total Man-months Expended - 8-1/2

Division Director

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Report received: October 16, 1944
Issued:

OCT 20 1944

CS-1465 F. S. 15
Supplement B
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The [redacted] [redacted] [redacted]
[redacted] [redacted] information which
is more restricted than the informa-
tion available in reports of [redacted]
[redacted] these reports are not to show
whereas the [redacted] of the project
of the Base Laboratory, without
special authorization.

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PROGRAM AUTHORIZATION

CS-1465 File Serial 16
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Series A
Issued to:

Title:

Thermal Contact of Graphite Layers

Objective:

To determine the coefficient of heat transfer between horizontal layers of graphite stacked as in the proposed method for the "W" pile.

Present Status:

A steam-bath heat source and a screw press have been constructed for measuring the heat transfer in a vertical direction under any unit stress encountered in the pile. Graphite has been ordered from Hanford.

Proposed Program:

The graphite bars machined to "W" tolerances will be stacked in the proposed criss-cross arrangement to be used at Hanford, using the steam-bath as a base. With heat being absorbed in water tubes at the top of the stack, temperatures will be measured throughout and the vertical heat transfer rates calculated.

Reason for Proposed Work:

Thermal conductivity of the graphite pile may be a determining factor in the maximum power output, and values should be obtained before construction has begun.

Remarks:

Review Date 4/1/44
Man-Months Authorized 3 tech. and 1 non-
tech.
Estimated Completion Date 4/1/44
Estimated Man-Months to Complete 3 tech.
and 1 non-tech.
Supervisor Responsible R. N. Lyon

Submitted by M. H. Lyon
Approved by H. S. Keller
Chas. M. Cooper

Authorized by Samuel K. Allison

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 16

Problem No. 122-ML-51-10
Date: December 30, 1944
Priority: A-2

FINAL REVIEW

Title: Thermal Contact of Graphite Layers.

Closing Status: The objective of this program was reached. A 4 ft. x 2 ft. x 4 ft. high graphite pile was constructed within a screw press capable of exerting up to 43,000 lbs. of compression force. The pile was heated at the bottom by means of a steam oven and cooled by water flowing through pipes in the top graphite layer. Pile temperatures were measured by means of calibrated nickel wire resistance thermometers.

The following coefficients were obtained:

Mean Pressure lbs./sq.in.	Average h.t.c.* Btu/(hr.)(sq.ft.)(°F)	Effective Conductivity of Graphite Btu/(hr.)(sq.ft.)(°F/ft.)
1.7	150	29.5
11.4	184	33.3
20.2	223	36.1
38.1	249	39.2
1.7 (upon release of pressure)	177	32.5

*Graphite to graphite interfacial heat transfer coefficient.

No further work will be done on this problem under this authorization.

Report: CE-2271

Notebooks: 777; 532

Man-Months Expended - 2.5

CS-1465 F.S. #16

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Series A *Clinton Lab.*

Issued to: *(R. L. Dwyer)*

Group Leader Responsible *O. N. Lyon*

Ass't Section Chief *O. N. Lyon*

Division Director *Charles Cooper*

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 17

Problem No. 390 ML-54-S
Date January 3, 1944
Priority _____

PROGRAM AUTHORIZATION

CS-1465 File Serial 17.
This document consists of 1
pages and no figures.
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Series A
Issued to: _____

Title: Exploratory work and service.

Objective: To do miscellaneous exploration work, and perform
service for other sections.

Present Status:

Proposed Program: A limit of one man-month will be made
for any simple service job. Research or
service work requiring more time will be
covered by specific Program Authorizations.

Reason for Proposed Work:

Remarks:

Review Date April 1, 1944
Man-Months Authorized 10

Estimated Completion Date _____
Estimated Man-Months to Complete _____

Submitted by AB Hemenway

Approved by J. Chipman
Chas M Cooper

Authorized by: H.C. Vernon 1/9/44

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PART II

University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 17Problem No. 390-ML-54-SDate April 1, 1944Priority ---PROGRAM AUTHORIZATION(Part II)

CS-1465 File Serial 17. This document consists of 1 pages of text and 0 pages of figures. Series A. Issued to: J. P. Clinton

Title: Exploratory Work and ServiceObjective: To do miscellaneous exploratory work, and to perform service for other sections.Progress (Part I) and Present Status:

1. Work on diffusion of nickel electroplates into tuballoy has progressed to the point where diffusion layers up to 1/8" thick have been obtained.
2. Autoradiography has been shown to be of use in the examination of bonded, aluminum jacketed slugs.
3. Good bonding has been obtained between Al/Si clad aluminum discs and Al/Si hot dipped tuballoy discs by hot pressing at temperatures of approximately 550-600°C. Good bonding has not yet been obtained between cylindrical surfaces.

Proposed Program:

1. Further work on diffusion of nickel electroplates into tuballoy will be carried on under P. A. No. 381-ML-54-6
2. Autoradiography of bonded slugs will be carried on from the standpoint of improving the technique. Work on its use as an inspection method and on the correlation of the results of radiography, frost testing and microscopic examination will be transferred to P. A. No. 154-ML-54-3.
3. Work on hot pressure bonding will be continued in efforts to get complete bonding on cylindrical surfaces.
4. Other exploratory work will be started and general service work for other groups will be carried on as required.

Reasons for Proposed Work:

1. See P. A. No. 381-ML-54-6
2. Radiography is a relatively simple and rapid way of getting some idea of the soundness of the bonding layer.
3. Pressure bonding is a possible alternative to the present canning operation.

Next Review Date June 1, 1944
Man-Months Authorized 10
Estimated Completion Date Continuing
Estimated Man-Months to Complete
Items 1, 2, & 3 only - 6
Supervisor Responsible F. Foote

Submitted by F. FooteApproved by A. B. GreningerAuthorized by W. J. ...

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 18

Problem No. 124 ML - 54 - 4a
Date January 7, 1944
Priority A-1

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PROGRAM AUTHORIZATION

CS-1465 File Serial 18
This document consists of 1
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Copy No. 27 of copies.
Series A
Issued to:

Title:

Corrosion Studies
A. Aluminum Alloys

Objective:

To determine effect of environmental variables in a pile cooling system on corrosion of aluminum alloys, such as may be employed for water tubes or slug jacket assemblies for H.E.W.

Present Status:

The most important variables have been established to be, temperature, pH, Cl^- concentration and velocity. Approximate effect of each understood in case of 2S. 72S has been partially investigated. Investigation of minor variables has been started (see below). CMX at Hanford is prepared to make routine tests under most likely range of operating variables.

Proposed Program:

Determine corrosion rates and pitting on a laboratory scale for aluminum alloys 2S, 72S, 52S, 61S, and 13 under following conditions:

Temp. 70° to 95°C ; pH 3 to 8.5; Cl^- 0 to 4 ppm; velocity 0 to 35 ft/sec.; H_2O_2 0 to 10^{-3} N; Ca^{++} 0 and 20 ppm, Mg^{++} 0 and 6 ppm; HCO_3^- 0 and 20 ppm; SiO_2 0 to 50 ppm*; calgon 0 to 10 ppm; Cu, etc. 0.01 ppm; SO_4^{--} 0 to 80 ppm.

Determine distribution curve for pit depths under conditions:

Temp. 70° and 90°C ; low flow velocity; Cl^- 1 ppm; H_2O_2 conc. 0 and 5×10^{-5} , 10^{-4} and 10^{-3} N; Ca^{++} 20 ppm; Mg^{++} 6 ppm; SO_4^{--} 80 ppm, HCO_3^- 80 ppm; pH - 3, 4, 5, 6, 6.5

*Note: SiO_2 different from water composition would result from use of sodium silicate as an inhibitor. Other inhibitors may be of interest.

Reason for Proposed Work:

2S to be used for slug coating in pile
72S to be used for cladding 2S
52S, 61S, 13 should be considered as materials for tubes and coatings.

Remarks:

This work in general will point out the more useful materials and indicate the practical range of conditions. CMX will then be in position to check actual water operating in actual geometry.

Dr. R. B. Mears of the Aluminum Research Laboratories is a consultant.
Corrosion testing of Al-Si No. 13 coat going on in Grasselli Laboratories.

Review Date April 1, 1944
Man-Months Authorized 15

Submitted by John P. Haire

Approved by Robert M. Campbell

Estimated Completion Date July 1, 1944
Estimated Man-Months to Complete

30

Authorized by Samuel R. Allen

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 18

UNCLASSIFIED

53-1
Problem No. 124 ML - 54-4a
Date April 1, 1944
Priority A - 1

PROGRAM AUTHORIZATION (PART II)

Title: Corrosion Studies
A. Aluminum Alloys

CS-1465 File Serial 18 Part II.
This document consists of 1 pages
of text and 0 pages of figures.
Series A.
Issued to: *27-Clinton*

Objective: To determine effect of environmental variables in a pile cooling system on corrosion of aluminum alloys, such as may be employed for water tubes or slug jacket assemblies for H.E.W.

Progress (Part I) and Present Status: Progress in Part I has been to show more clearly the effects of pH, temperature, Cl^- concentration on the corrosion of 2S aluminum at flow velocities from 0 to 20 ft./sec. Investigation of minor variables SiO_2 and Cu^{++} have been carried out under certain conditions. To date, no significant difference in corrosion can be attributed to Ca^{++} , Mg^{++} or SO_4^{--} .

The present status is that the most important variables have been established to be temperature, pH, Cl^- concentration and velocity. The corrosion of 2S has been measured at several values of each variable within the range listed below. For 72S the same is true, with the tests covering less range and not in as much detail.

Proposed Program: Determine corrosion rates and pitting on a laboratory scale for aluminum alloys 2S, 72S, 52S, 61S and 13 under following conditions:

Temp. 70° to 95° C; pH 3 to 8.5; Cl^- 0 to 4 ppm; velocity 0 to 20 ft./sec.; H_2O_2 0 to 10^{-3} ; Ca^{++} 0 and 20 ppm; Mg^{++} 0 and 6 ppm; SO_4^{--} 0 to 80 ppm; SiO_2 and other inhibitors 0 to 50 ppm; Cu^{++} , etc. under 0.1 ppm.

Determine distribution curve for pit depths under conditions:

Temp. 70° to 90° C; low flow velocity; Cl^- 1 ppm; H_2O_2 conc. 0, 2×10^{-5} , 10^{-4} and 10^{-3} N; Ca^{++} 20 ppm; Mg^{++} 6 ppm; SO_4^{--} 80 ppm; HCO_3^- 80 ppm; pH 4, 5, 6, 6.5, 7.

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Reason for Proposed Work:

2S to be used for slug coating in pile
72S to be used for cladding 2S
52S, 61S, 13 should be considered as materials for tubes and coatings.

Reports on Part I: None written, but one due during month of April.

Remarks: This work in general will point out the more useful materials and indicate the practical range of conditions. CMX will then be in position to check actual water operating at W geometry.

Dr. R. B. Mears of the Aluminum Research Laboratories is a consultant.
Corrosion testing of Al-Si No. 13 coat going on at Grasselli Laboratories.
The estimated completion date given below is not necessarily a real completion date, but an overall review date.

Next Review Date July 5, 1944
Man-Months Authorized (Part II) 15
Man-Months Used (Part I) 11
Estimated Completion Date October 1, 1944
Estimated Man-Months to Complete 30

Supervisor Responsible Joseph E. Draley

Submitted by *Joseph E. Draley*
Approved by *C. B. Drayner*
J. Chipman
Charles M. Cooper
Authorized by *H. J. ...*

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 18

Problem No. 124-ML-53-1 (New)
Date: 124-ML-54-4a (Old)
July 6, 1944
Priority: A-1

PROGRAM AUTHORIZATION (Part III)

Title: Corrosion Studies
A. Aluminum Alloys

CS-1465 F. S. #18
Supplement B Part III
This Document contains
1 page of text. Series A
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Objective: To determine effect of environmental variables in a pile cooling system on corrosion of aluminum alloys, such as may be employed for water tubes or slug jacket assemblies for H.E.W.

Progress (Part I and II) and Present Status: Progress in Parts I and II has been to show more clearly the effects of pH, temperature, Cl^- concentration on the corrosion of 2S aluminum at flow velocities from 0 to 20 ft/sec. Investigation of effects of dichromate, SiO_2 , Cu^{++} , have been carried out under certain conditions. To date, no significant difference in corrosion can be attributed to Ca^{++} , Mg^{++} , or $\text{SO}_4^{=}$.

At present the most important variables have been shown to be temperature, pH, Cl^- concentration, and velocity. The corrosion of 2S has been measured at several values of each variable within the range listed below, and with some materials such as dichromate, Calgon, sodium silicate. The same main variables have been covered for 72S, but less extensively, and in less detail.

Studies to determine pit distribution have proved unfruitful. The statistical systems used did not cause sufficient pitting.

Proposed Program: Determine corrosion rates and pitting on a laboratory scale for aluminum alloys 2S, 72S, 52S, 61S, and 13 under following conditions:
Temp. 70° to 95° C; pH 3 to 8.5; Cl^- 0 to 4 ppm; velocity 0 to 20 ft/sec.
 H_2O_2 0 to 10^{-3} ; Ca^{++} 0 to 20 ppm; Mg^{++} 0 to 6 ppm; $\text{SO}_4^{=}$ 0 to 80 ppm;
 SiO_2 and other inhibitors 0 to 50 ppm; Cu^{++} , etc. under 0.1 ppm.

Determine effect of various agents which may be added at H.E.W. on the corrosion of 2S Al.

Reason for Proposed Work:

2S to be used for slug coating in pile.
72S to be used for cladding 2S
52S, 61S, 13 should be considered as materials for tubes and coatings.

Reports on Parts I and II: None written; the first will be issued in July

Remarks: This work in general will point out the more useful materials and indicate the practical range of conditions. CMX will then be in position to check actual water operating at W geometry.
Dr. R. B. Mears of the Aluminum Research Laboratories is a consultant. The estimated completion date given below is not necessarily a real completion date, but an overall review date.

Next Review Date: October 12, 1944
Man-Months Authorized (Part III) 14
Man Months Used (Parts I & II) 24
Estimated Completion Date: Jan. 1, 1945
Estimated Man Months to Complete: 28

Submitted By: *J. E. Draley*
Approved By: *[Signature]*
Approved By: *[Signature]*

Supervisor Responsible: J. E. Draley

Authorized By: *[Signature]*

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53-2

University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 19

Problem No. 124 ML 54-41
Date January 18, 1944
Priority A-1

PROGRAM AUTHORIZATIONTitle:

Corrosion Studies
B. Film Problems

Objective:

To determine in the laboratory those conditions which cause precipitation on aluminum of films of the type which change pressure drop and heat transfer.

Present Status:

Exploratory work has begun. Analyses show that Fe_2O_3 is the chief formal constituent and is derived from the Fe^{++} content of the solution. SiO_2 and HCO_3^- are of next importance, Al^{+++} can be a contributor. Precipitation of $\text{Fe}_2\text{O}_3 \cdot x \text{H}_2\text{O}$ rapid at 85°C . Tyndallometric methods of measurement have been developed for laboratory studies.

Proposed Program:

Study in the laboratory of factors which determine the rate and completeness of precipitation of $\text{Fe}_2\text{O}_3 \cdot x \text{H}_2\text{O}$, $\text{Al}_2\text{O}_3 \cdot x \text{H}_2\text{O}$ and $\text{SiO}_2 \cdot x \text{H}_2\text{O}$ colloids.

Collaboration with the Engineering Development Section on study of rate of film formation under conditions of geometry and flow approximating Hanford.

Reason for Proposed Work:

To render possible assistance to Hanford by understanding phenomena which may seriously influence rate of power production.

Remarks:

Review Date April 1, 1944
Man-Months Authorized 14
Estimated Completion Date July 1, 1944
Estimated Man-Months to Complete 18

Submitted by: John P. MooreApproved by: W. K. B. [unclear]Authorized by: Samuel K. Allison

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Date: April 1, 1944

Priority: A-1

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PROGRAM AUTHORIZATION (PART II)

CS-1465 File Serial 19 Part II.
This document consists of 1
pages of text and 0 of figures.
Series A.
Issued to: *J. E. Draley*

Title: Corrosion Studies
B. Film Problems

Objective: To determine in the laboratory those conditions which cause or prevent precipitation on aluminum of films of the type which change pressure drop and heat transfer.

Progress (Part I) and Present Status: In glass laboratory systems the effects of iron concentration, turbulence, temperature, pH, and H_2O_2 conc. on precipitation of ferric hydrate were found under certain conditions. Deposition of iron precipitates were studied as well as their inhibition by certain agents; notably waste sulfite liquor, soluble silica, tartaric acid, sodium lignin sulfonate, citric acid, urea, glucose, sulfamic acid. Only the last three were ineffective.

Certain organic compounds are effective inhibitors of hydrate iron oxide precipitation at low inhibitor: iron ratios. Soluble and colloidal silica also afford protection, but at considerably higher ratios.

Proposed Program: Study in the laboratory the conditions under which precipitation of hydrous Fe_2O_3 and alumina take place. Evaluate agents for the inhibition of such precipitation and study the relation between electrophoretic velocity and stability of iron and aluminum oxide colloids.

Reason for Proposed Work: To render possible assistance to Hanford by understanding phenomena which may seriously influence rate of power production.

Reports on Part I: None written, but one due during month of April.

Next Review Date: July 5, 1944
Man-Months Authorized: (Part II) 14
Man-Months Used: (Part I) 11
Estimated Completion Date: October 5, 1944
Estimated Man-Months to Complete: 28
Supervisor Responsible: J. E. Draley

Submitted By: *Joseph E. Draley*

Approved By: *W. B. Greninger*

J. Chipman
Clinton Carpenter
Authorized By: *H. J. Hanson*

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[REDACTED]

124-ML-53-2 (new)
Problem No: 124-ML-54-4f (Old)
Date: July 5, 1944
Priority: A-1

Report received: September 18, 1944
Issued: SEP 28 1944

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PROGRAM AUTHORIZATION

Title:

Corrosion Studies
C. Electrochemical Measurements

CS-1465 File Serial 20
This document consists of 1
page and 0 figures.
Copy No. 27 of copies.
Series A
Issued to:

Objective:

To obtain electrochemical information which will define problems and show means of solution in regard to:

- Contact of different materials of construction in design of operating units at H.E.W.
- Corrosion of bonding and jacketing materials
- Corrosion of tuballoy and its alloys

Present Status:

Potentials against a standard calomel electrode of 316, 416, Pb, Cu, 308, Bi, 2S, 3S, 72S, Zn have been measured in a preliminary fashion at 30°, 70° and 95°C in W water. 72S has been shown to protect 2S at elevated temp. Stainless steel and chrome iron have been shown to be cathodic to 2S and accelerate corrosion. The data at present is inadequate and incomplete. Undercutting of jackets is partially understood and improvements pointed out. Erratic behavior of Tu has been found and reasons indicated.

Proposed Program:

Make careful potential and current measurements with the following couples of materials which are at present under consideration in connection with the water carrying passages of the pile. (Steels, irons, and aluminum alloys)

- 304-304 welded 304-cast iron Cu-416-72S Al 72S Al-2S Al
316-316 " 304-cast steel Cu-420-72S Al
304-316 Cu-416 Cu-416-2S Al
304-416 Cu-420 Cu-420-2S Al
304-420 2S Al-304
72SAl-304
- Bonding materials
Zn-Sn Al-Si (Electroplates involved; also, Cu, Ni, Cr)
Zn-Sn-Al Zn-Ni
Zn
- Tu alloys
Tu-Al Tu-Zn system
Tu-Ni system

Reason for Proposed Work:

Corrosion problems must be evaluated. Potential and current measurements can show effects hard to observe otherwise. Solders may be improved by addition agents indicated by electrochemical studies.

Phase diagrams as well as corrosion of alloys may be partially evaluated by potential measurements.

Remarks:

Work under direction of Dr. R. B. Mears

Review Date April 1, 1944

Man-Months Authorized 7

Estimated Completion Date (1) April 1,

(2) July 1. (3) Indef.

Estimated Man-Months to Complete (1) 9,

(2) 9. (3) Indef.

Submitted by J. H. P. Hume

Approved by [Signature]

Authorized by: [Signature]

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PROGRAM AUTHORIZATION (PART II)

CS-1465 File Serial 20 Part II.
This document consists of 1
pages of text and 0 pages of
figures. Series A.
Issued to: *21-Clinton*

Title: Corrosion Studies
C. Electrochemical Studies

Objective: To obtain electrochemical information which will define problems and show means of solution in regard to:

- Contact of different materials of construction in design of operating units at H.E.W.
- Corrosion of bonding and jacketing materials.
- Corrosion of tuballoy and its alloys.

Progress (Part I) and Present Status: Under Part I, potentials and currents were measured for metals and couples of 2S, 72S Al, 420, 304, and 316 s.s. in simulated Water at room temperature and $\sim 90^{\circ}\text{C}$. Instrument and procurement difficulties have prevented completion of (1) below on schedule. No completely satisfactory electrolyte has been discovered in which to measure potentials of Sn-Zn-Al alloys.

About one third of the necessary potentials have been measured for (1). Certain others are known incompletely. Generally speaking 72S, 2S Al, steels, are listed in order of decreasing anodic properties in the solutions of interest, at temperatures above $\sim 60^{\circ}\text{C}$. At lower temperatures the first two are $\sim$ equal.

Proposed Program: Make careful potential and current measurements with the following couples of materials which are at present under consideration in connection with the water carrying passages of the pile. (Steel, irons, and aluminum alloys).

(1) 304-304 welded	304-cast iron	Cu-416	Cu-416-72S Al
316-316 "	304-cast steel	Cu-420	Cu-420-72S Al
304-316	304-420	2S Al-304	Cu-416-2S Al
304-416	72S Al-2S Al	72S Al-304	Cu-420-2S Al

(2) Bonding Materials

Zn-Sn	Al-Si	(Electroplates involved; also, Cu, Ni, Cr)
Zn-Sn-Al	Zn-Ni	
Zn		

(3) Tu Alloys

Tu-Al, Tu-Ni system, Tu-Zn system

Reason for Proposed Work: Corrosion problems must be evaluated. Potential and current measurements can show effects hard to observe otherwise. Solders may be improved by addition agents indicated by electrochemical studies.

Phase diagrams as well as corrosion of alloys may be partially evaluated by potential measurements.

Remarks: Work under direction of Dr. R. B. Mears.

Report on Part II None written, but one due during month of April.

Review Date: July 5, 1944

Man Months Authorized: (Part II) 7

Man Months Used: (Part I) 7

Estimated Completion Date: (1) May 15,

(2) July 5, (3) September 5

Estimated Man Months to Complete (1) 4,

(2) 4, (3) 5

Supervisor Responsible: J. E. Draley

Submitted By: *Joseph E. Draley*

Approved By: *W. B. Greninger*

Authorized By: *H. V. ...*

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial No: 20 Problem No: 124-ML-54-4d (Old)
Date: July 5, 1944
Priority: A-1

124-ML-53-3 (New)

PROGRAM AUTHORIZATION (Part III)

Title: Corrosion Studies
C. Electrochemical Studies

Objective: To obtain electrochemical information which will define problems and show means of solution in regard to:

- Contact of different materials of construction in design of operating units at H.E.W.
- Corrosion of bonding and jacketing materials.
- Corrosion of tuballoy and its alloys.

Progress (Parts I & II) and Present Status: Under Parts I & II potentials and galvanic currents were measured for metals and couples of 2S, 72S Al, 420, 304, and 316 s.s. in simulated W water. Recent changes in specification of W water have increased the number of experiments to be made and have deferred completion of testing for H.E.W. Data obtained have indicated that 72S will be anodic to 2S Al at a pH 6.5; however, will not completely protect it. Data at pH 7.5 are incomplete and indicate that the corrosion of 2S may be slightly increased by the presence of 72S Al.

Proposed Program: Complete the study of pertinent couples listed for H.E.W. in Authorizations I and II. Other systems will be considered as they become important. 52S Al and 61S will be studied as materials for H.E.W. The use of zinc to cathodically protect the Al-s.s. interface will be considered.

Reason for Proposed Work: Corrosion problems must be evaluated. Potential and current measurements can show effects hard to observe otherwise. Solders may be improved by addition agents indicated by electrochemical studies.

Phase diagrams as well as corrosion alloys may be partially evaluated by potential measurements.

Remarks: Work under direction of Dr. R. B. Mears.

Reports on Part I and II: Progress report for Part I issued as CT-1703.
Supplementary report covering Part II due during July.

Review Date: October 12, 1944
Man Months Authorized(Part III) 6
Man Months Used(Part I & II) 14
Estimated Completion Date: Jan. 1, 1945
Estimated Man Months to Complete: 13

Supervisor Responsible: J. E. Draley

Submitted By: J. E. Draley

Approved By: J. B. Heninger

Authorized By: H. Varian 9/4

Report received: September 18, 1944

Issued: SEP 28 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 21

Problem No. 154 ML 54-3k
Date January 17, 1944
Priority B1

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PROGRAM AUTHORIZATION

Title:

Coatings Research
A. Mechanically applied Jackets

CS-1465 File Serial 21
This document consists of 1
page and 0 figures.
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Series A
Issued to:

Objective:

To provide information for making a slug jacketed with aluminum and operable under Clinton conditions of temperatures in excess of 300°C.

Present Status:

The present method for jacketing Clinton slugs employs a welded aluminum jacket in contact with the tuballoy slug and is believed to be limited by reaction between slug and jacket to about 350°C. Methods have been developed for applying coats which may serve as blocking layers to prevent such reaction.

Proposed Program:

It is proposed to:

- Define more exactly the upper operating temperature limit of the present assembly.
- Employing various blocking layers, attempt the development of an assembly operable at temperatures as high as 600°C.

Reason for Proposed Work:

An increase in allowable operating temperatures from 300 to 500°C would greatly increase the potential power production of Clinton pile.

Remarks:

Complete and adequate testing of successful higher temperature assemblies may require considerably longer periods of time than contemplated in present request.

Review Date April 1, 1944
Man-Months Authorized 1
Estimated Completion date April 1, 1944
Estimated Man-Months to Complete 1

Submitted by J. H. P. Howe

Approved by J. H. Chapman
J. B. Dickinson
W. M. Cooper

Authorized by Samuel K. Allison

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 21

CS-1465 P.S. #21 Supplc. A

Problem No. 154-ML-54-3k

Date June 28, 1944

Priority B-1

FINAL REVIEW

Title:

Coatings Research:
A. Mechanically applied Jackets

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B. L. Brown
Rev.

Closing Status:

The contribution of this group to mechanically applying jackets has been an attempt to develop an undercoating, either hot-dip or electroplate, which would serve as a blocking layer between uranium slugs and aluminum cans thus preventing their interaction at elevated temperatures in the Clinton pile. The need for this work decreased considerably during the last three months, however, so that now it does not appear worth while to continue a separate authorization. Any work in the future on this problem will be reported under electroplating or canning authorizations.

No completely satisfactory blocking layer has been developed. Chromium electroplates appear to be the most satisfactory. Experiments were carried out to determine the amount of hydrogen at the chromium-uranium interface in plated slugs to determine if a separate outgassing procedure is necessary. No additional hydrogen was found at the plate interface over that contained in slug proper.

Reports:

None

Total Man-Months Expended $\frac{1}{2}$

MUC-EWB-232

Supervisor Responsible L. M. Foster

Section Chief A. B. Heininger

Received: July 14, 1944

Issued:

AUG 9 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 22

Problem No. 391 ML 54-4
Date January 17, 1944
Priority B-1

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PROGRAM AUTHORIZATION

CS-1465 File Serial 22
This document consists of 1
page and 0 figures.
Copy No. 27 of copies.
Series A
Issued to:

Title:

Corrosion Studies
D. Tuballoy and Alloys

Objective:

To determine corrosion rates of tuballoy and other alloys under conditions outlined on sheet I as well as in distilled water.

Present Status:

Corrosion rates of tuballoy in distilled water have been determined from room temp. to 100°C. Studies have also been made in distilled water containing H₂O₂ and Cl⁻. Phenomena occur which are not understood. Alloys containing nickel show marked increase in corrosion resistance. Of five other alloys, none showed signs of increase in corrosion resistance.

Proposed Program:

- a. Determination of the corrosion rates of tuballoy from different sources
 1. Room temp. to 150°C.
 2. Cl⁻ 0 to 10 ppm
 3. H₂O₂ 0 to 10⁻³
 4. Inhibitors
 5. Correlation with metallography
- b. Corrosion rates of Ni alloys
as above
- c. Others that may appear promising.

Reason for Proposed Work:

The use of uncoated metal is possible under certain conditions which are indicated to be critical. The behavior of tuballoy is erratic and believed to be influenced by impurities and inclusions. The only chance of using uncoated metal depends on working out metallurgical specifications. Alternative coating methods depend on corrosion resistance of tuballoy alloys.

Remarks:

The alloys are prepared by Metallographic group. In general the work holds a low priority.

Review Date April 1, 1944
Man-Months Authorized 3

Estimated Completion Date July 1, 1944
Estimated Man-Months to Complete 6

Submitted by John P. Howe

Approved by A. Chapman

Authorized by Samuel K. Allen

* 124 ML 54-4a, Jan. 7, 1944

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PROGRAM AUTHORIZATION (PART II)

Title:

Corrosion Studies
D. Tuballoy and Alloys

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CS-1465 File Serial 22 Part II.
This document consists of 1
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Series A.
Issued to: *27-Clinton*

Objective:

To determine corrosion rates of tuballoy and other alloys under solution conditions such as may be encountered in a water-cooled pile as well as in distilled water.

Progress (Part I) and Present Status:

Under Part I, corrosion was determined for Tu-Ni alloys up to 10% Ni in peroxide-chloride solutions at temperatures from 40 to 90°C.

Corrosion rates have been determined in distilled water and in dilute H₂O₂ from room temperature to 90°C. Studies have also been made in chloride-containing solutions. Nickel alloys show marked increase in corrosion resistance. Of several other alloys, none showed signs of significant corrosion resistance.

Proposed Program:

- A. Determination of the corrosion rates of tuballoy from different sources:
1. Room Temperature to 150°C.
 2. Cl⁻ 0 to 10 ppm.
 3. H₂O₂ 0 to 10⁻³N
 4. Inhibitors
 5. Correlation with Metallography
- B. Corrosion Rates of Ni Alloys
as above
- C. Others that may appear promising.

Reasons for Proposed Work:

The use of uncoated metal is possible under certain conditions which are indicated to be critical. The behavior of tuballoy is erratic and believed to be influenced by impurities and inclusions. The only chance of using uncoated metal depends on working out metallurgical specifications. Alternative coating methods depend on corrosion resistance of tuballoy alloys.

Reports on Part I: None written, but one due during the month of April.

Remarks:

The alloys are prepared by Metallographic Group. In general the work holds a low priority.

Next Review Date: July 5, 1944
Man-Months Authorized (Part II): 3
Man-Months Used (Part I): 2
Estimated Completion Date: October 1, 1944
Supervisor Responsible

Estimated Man-Months to Complete 6

Submitted By: *Joseph E. Draley*
Approved By: *J. B. Gleninger*
J. Chipman
Chas M. Carpenter
Authorized By: *H. V. mon*

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial: 22

391-ML-53-4 (New)
Problem No: 391-ML-54-4e (Old)
Date: July 5, 1944
Priority: B-1

PROGRAM AUTHORIZATION (Part III)

Title: Corrosion Studies
D. Tuballoy and Alloys

Objective: To determine corrosion rates of tuballoy and other alloys under solution conditions such as may be encountered in a water-cooled pile as well as in distilled water.

Progress (Part I & II) and Present Status: Under Part I, corrosion was determined for Tu-Ni alloys up to 10% Ni in peroxide-chloride solutions at temperatures from 40 to 90°C.

Corrosion rates have been determined in distilled water and in dilute H₂O₂ from room temperature to 90°C. Studies have also been made in chloride-containing solutions. Nickel alloys show marked increase in corrosion resistance. Of several other alloys, none showed signs of significant corrosion resistance.

Proposed Program:

A. Determination of the corrosion rates of tuballoy from different sources:

1. Room Temperature to 150°C.
2. Cl⁻ 0 to 10 ppm.
3. H₂O₂ 0 to 10⁻³ N
4. Inhibitors
5. Correlation with Metallography

B. Corrosion Rates of Ni Alloys as above

C. Others that may appear promising.

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Supplement B Part III
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Reasons for Proposed Work: The use of uncoated metal is possible under certain conditions which are indicated to be critical. The behavior of tuballoy is erratic and believed to be influenced by impurities and inclusions.

Use of uncoated metal depends on working out metallurgical specifications. Alternative coating methods depend on corrosion resistance of tuballoy alloys.

Reports on Part I and II: An interim report has been written but not published.

Remarks: The alloys are prepared by Metallographic Group.

Next Review Date: October 12, 1944
Man Months Authorized (Part III): 6
Man Months Used (Part I & II): 5
Estimated Completion Date: October 1, 1944
Supervisor Responsible: J. E. Draley
Estimated Man Months to Complete: 6

Submitted By: J. E. Draley
Approved By: A. B. Sheringer
Sheringer

Authorized By: H. J. Brown 9/14

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PROGRAM AUTHORIZATION

CS-1465 File Serial 23
This document consists of 1 page
and no figures. Copy No. 27
of copies. Serial No.
Issued to:

Title: Design and Experimentation on a Borescope for Inspecting Ribbed Tubes
when Water is Flowing through Tubes, in the 100 Area, Site W.

Objective: To eliminate optical difficulties in the use of a borescope in ribbed tubes at Site W.

Present Status: A borescope of standardized commercial optical design is being constructed for use in the W-type tubes at Clinton, the only novel feature on this borescope being an offset eyepiece. It is to be used when no water is flowing through the tubes. Also, in this borescope, there has been no provision to prevent coloration of lenses by radiation, but substitute lens systems are to be ordered to replace those furnished with the borescope, in case coloration is sufficiently troublesome.

Proposed Program: (1) To design lenses and other optical parts of plastics to avoid the severe coloration in glass. The foregoing part of the program is being carried out in cooperation with N.D.R.C., Section 16.1.

(2) To design an objective, a mirror system, and an illuminating system usable with water flowing through the tubes.

(3) To carry out necessary modeling and experimental tests of these novel designs. It is probable that the modeling will be limited to the objective end of the instrument, since modeling of the "extender" part of the system is to be done by N.D.R.C., Section 16.1. Their work is for the purpose of studying the additive scattering anticipated in a long train of plastic lenses.

Reason for Proposed Work: The success of a borescope under these novel conditions cannot be foretold. The extent to which we can adapt plastic optics still has to be studied and the final result may be a compromise solution. A request to proceed with the development of this instrument and keep TNX duPont informed of the results is incorporated in a letter dated January 11th from Tilley-Wahl, Manufacturing Division of duPont, to J. B. Miles.

Review Date April 1, 1944

Man-Months Authorized 2

Estimated Completion Date April 1

Estimated Man-Months to Complete 2

Submitted by George S. Moore

Approved by O. W. Wahl

Authorized by Samuel K. Allen

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 23 Problem No. 136-ML-56-6
Date April 1, 1944
Priority A-2

PROGRAM REVIEW

Supplement A
CS-1465-File Serial #23
This Document contains 1 Pages
of Text and 0 Pages of Figures.
This is Copy 27 of 44 Series A.
Issued to: Clinton

Title: Design and Experimentation on a Borescope for Inspecting Ribbed Tubes When Water is Flowing Through Tubes, in the 100 Area, Site W.

Progress and Present Status: A type-W ribbed tube has been mounted in Ryerson 154 and connections arranged to circulate water through the tube to simulate conditions at Site W. A borescope consisting of a head carrying an illumination system and mirror and the main body containing objective extender and eyepiece lens systems has been constructed and operation tests have been started.

Program for Balance of Authorization: It is planned to test the borescope for different rates of flow of water and different water temperatures and to design the tip of the borescope head to enable it to be used to insert and release a lead plug in the ribbed tubes as a radiation shield. Other problems connected with insertion and operation of the borescope in the pile will be studied.

Reports: None, except weekly reports.

Man-Months Expended 1

Next Review Date June 1, 1944

Supervisor Responsible W. L. ...

Section Chief George ...

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PROGRAM AUTHORIZATION (PART II)

Title: Construction of Borescopes for Inspecting Ribbed Tubes When Water is Flowing Through Tubes, in the 100 Area, Site W.

Objective: To construct at least one complete borescope by July 1st, 1944 and subsequently, sufficient additional parts to give adequate service.

Progress (Part I) and Present Status: The design work of the borescope has been finished, a contract for plastic lenses has been placed, a number of suitable plastic lenses have been accumulated for substitute use and parts are being made in Ryerson Shop as rapidly as possible.

Proposed Program: To assemble one complete borescope by June 15th, or as soon as possible thereafter, containing the following sections:

1. Objective head, 15" long.
2. Extension, 48" long.
3. Five extensions, each 96" long.
4. Cross-arm with eyepiece, focussing lens, and mechanical control.

This first borescope will contain throughout the length which is inserted in the ribbed tube, plastic lenses contracted for from Polaroid, or if these are not finished in time, substitute plastic achromats obtained from Polaroid.

Thereafter, additional heads, extension sections, and cross-arms, will be constructed to a suitable number and in such speed that desired examination of ribbed tubes can be carried on. It is estimated that because of possible coloration, a minimum of ten heads, and sixty extension sections will be necessary. Although two cross-arms are contemplated, present discussions with duPont Operations indicate that more will be needed.

Reason for Proposed Work: Examination of the insides of ribbed tubes at W for defects leading to breakdown is considered vital and necessary.

Reports on Part I: None.

Next Review Date July 15, 1944

Man-Months Authorized (Part II) 10

Man-Months Used (Part I) 2

Estimated Completion Date Sept. 1, 1944

Estimated Man-Months to Complete 22

Submitted by

George S. Monk

Approved by

Charles M. Cooper

Supervisor Responsible G. S. Monk

Authorized by

H. G. Thompson 6/19

MUC-EWB-125

CS-1465 - F. S. #23-Supple. B. Pt. II

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 23

Problem No. 136-ML-56-6

Date March 1, 1945

Priority A-1

PROGRAM REVIEW

Title: Construction of Borescopes for Inspecting Ribbed Tubes When Water is Flowing Through Tubes, in the 100 Area, Site W.

Progress and Present Status: The following parts have yet to be shipped:

1 Cross Arm Cam Adapted to Drive Mechanism.	5 Heads, Circumference View.
4 Cross Arms, Universal	2 Cameras.
27 8-foot Tubing Sections.	5 Gland and Clamp Assemblies.
7 4-foot Tubing Sections.	Quantity Extra Gaskets, Tools and Accessories.
15 Heads, Right Angle View.	1 Drive Mechanism.
	3 Transformers and Connections.

Program for Balance of Authorization: To complete the above work.

Reports: CP-2325.

Man-Months Expended 21

Next Review Date June 15, 1945

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Issued to: Clinton Lab.
R. L. Doan, pers.

Supervisor Responsible Georges. Monk

Section Chief Georges. Monk

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Technical Division

File Serial 23

Problem No. 136-ML-56-6

Date July 15, 1944

Priority A-1

PROGRAM REVIEW

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Issued to: Clinton (R. L. Sloan)
(Rus)

Title: Construction of Borescopes for Inspecting Ribbed Tubes When Water is
Flowing Through Tubes, in the 100 Area, Site W.

Progress and Present Status: The Polaroid Corporation has fulfilled its commitments in regard to time of delivery and quality of workmanship on plastic lenses for the borescope. The shop work is approximately two weeks behind schedule. It is expected that the shop will catch up on its schedule very shortly and the Optics Section will strive to do likewise.

Program for Balance of Authorization: To complete a sufficient number of sections so that replacements of colored lenses can be effected quickly.

Reports: None.

Man-Months Expended 1 *

Next Review Date Sept. 1, 1944

Supervisor Responsible George S. Monr

* More time than this was expended but principally by the Section Chief and weekly rated employees.

Section Chief George S. Monr

MUC-EWB-223

Cmc 7/12/44

Received: July 12, 1944

Issued:

WIC 9 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 23

Problem No. 136-ML-56-6
Date September 1, 1944
Priority A-1

PROGRAM REVIEW

Title: Construction of Borescopes for Inspecting Ribbed Tubes When Water is
Flowing Through Tubes, in the 100 Area, Site.W.

Progress and Present Status: The first complete borescope has been finished and delivered to Site W. Additional cross arms, heads, standard sections and other borescope parts are being constructed and assembled. A new Gear Box and Carriage is being designed to serve as a replacement for the original one shipped with the first instrument.

Program for Balance of Authorizations: To complete a sufficient number of borescope sections so that service of the instrument can be maintained by quick replacement of damaged and expended parts.

Reports: None.

Man-Months Expended 8

Next Review Date Nov. 1, 1944

Supervisor Responsible G. S. Monk

Section Chief G. S. Monk by William W. McChesley

Division Director Chas M Cooper

CS-1465 F.S. #23
Supplement D
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File Serial 23

Problem No. 136-ML-56-6

Date October 1, 1944

Priority A-1

PROGRAM AUTHORIZATION (PART III)

CS-1465 F. S. 23
Supplement E
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Title: Construction of Borescopes for Inspecting Ribbed Tubes When Water is
Flowing Through Tubes, in the 100 Area, Site W.

A. S. Sloan - Sec.

Objective: To send additional parts as authorized to Site W.

Progress (Parts I and II) and Present Status: The borescope has been shipped.
A camera has been constructed and is under test. A blind bore objective for
quicker operation has been completed and is under test for possible improvement.
Additional parts as required are being manufactured.

Proposed Program: To send additional parts, camera, blind bore head, and new
gear box as quickly as they are completed.

Reason for Proposed Work: To fill requests for service.

Reports on Parts I and II: None.

Next Review Date Nov. 20, 1944

Man-Months Authorized (Part III) 10

Man-Months Used (Parts I and II) 12

Estimated Completion Date 2/1/45

Estimated Man-Months to Complete 12

Submitted by *Roy J. Moore*

Approved by *Chas M Cooper*

Supervisor Responsible G. S. Monk

Authorized by *H. B. Gibson* 10/17

Report received: October 16, 1944

Issued: OCT 20 1944

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File Serial 23

Problem No. 136-ML-56-6

Date November 20, 1944

Priority A-1

PROGRAM REVIEW

CS-1465 F. S. 21
Supplement F
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Title: Construction of Borescopes for Inspecting Ribbed Tubes When Water is
Flowing Through Tubes, in the 100 Area, Site W. *(B. L. Swan Pers)*

Progress and Present Status: Since the borescope was sent, the following parts
have been completed and shipped to Site W:

Carriage

Gear Box

Cross-Arm

Camera

6 - 8 ft. standard sections
with dust caps

1 - 4 ft. standard section
with dust cap

A right-angle view mirror head with
water-tight window and 21 cp. bulb
for illumination.

3 - 8 in. lengths of lead-filled tub-
ing for radiation protection.

A transformer and necessary electri-
cal connecting wires.

Some extra supplies of gaskets for
borescope joints, and wrenches for
assembling and operating the borescope.

The new gear box is progressing favorably and a second camera of high speed
is in design.

Program for Balance of Authorization: To complete a sufficient number of bore-
scope sections so that service of the instrument can be maintained by quick re-
placement of damaged and expended parts.

Reports: CP-2325

Man-Months Expended 15

Next Review Date March 1, 1945

Supervisor Responsible *George S. Monk*

Division Director *Chas M. Casper*

Report received: November 30, 1944

Issued:

DEC 11 1944

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[REDACTED]

Date May 9, 1945

[REDACTED]

Closing Status: To enable an observer to view objects submerged in several feet of water with considerable magnification and good resolution two types of Under-Water Periscopes were designed and constructed. One type was a Binocular Under-Water Periscope of such length and weight to be conveniently held in the observer's hands and the other type known as an Under-Water Bar Viewer was a monocular instrument slightly longer than 20 feet which required an auxiliary supporting mechanism. Nine of the binocular instruments, and three of the monocular instruments have been constructed and supplied as well as sufficient spare parts for the monocular instrument to be equivalent to a fourth spare viewer.

Reports: CP-2296, CP-2969.

Man-Months Expended 6½

Group Leader Responsible

Section Chief

Division Director

12

Report received: May 15, 1945
Issued: MAY 17, 1945

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PROGRAM AUTHORIZATION

CS-1465 File Serial 24. This document consists of 1 page and no figures. Copy No. 27 of copies. Series A. Issued to:

Title: Design and Experimentation on an Under Water Periscope for Use in Storage Basin or Sorting Basin - 100 Area, Hanford.

Objective: To design and model such a periscope.

Present Status: As understood at present, the problem presented is identical with that at Site X. For Site X a periscope consisting of three telescopes in juxtaposition and a scanning mirror has been designed. This instrument may have a length of from 11 to 17 feet depending upon the request made. There has also been designed a spherical window of glass or lucite fastened to the objective end of the periscope with its center at the entrance pupil, i.e., the location of the scanning mirror. Preliminary tests with optically inadequate apparatus have been made in the use of such an instrument, but mechanical problems of construction have received no attention thus far. A hastily constructed temporary instrument has been sent to Site X to be used in inspection of slugs at the bottom of the canal and it is hoped that the use of this will help in the final design.

Proposed Program: To continue with the program under way and to keep TNX, duPont informed of the development of the instrument.

Reason for Proposed Work: Informal discussion with staff members of Operations and Research at Clinton have indicated the necessity for an instrument at Site X. Authorization for keeping TNX informed of developments is contained in a letter of January 11th, 1944 from Tilley-Wahl, duPont to J. B. Miles.

Review Date April 1, 1944
Man-Months Authorized 1
Estimated Completion Date April 1st
Estimated Man-Months to Complete 1

Submitted by George S. Mink

Approved by (S)

Authorized by: W. C. Allen

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University of Chicago
Metallurgical Laboratory
Optics Section

File Serial 24

Problem No. 136-ML-56-7

Date March 1, 1945

Priority A-1

PROGRAM REVIEW

Title: Design and Experimentation on an Under-Water Periscope for Use in Storage Basin or Sorting Basin - 100 Area, Hanford.

Progress and Present Status: Since January 1st, 1945 (the last review date) the second and third of three Monocular Under-Water Viewers have been completed and delivered, and a spare instrument constructed. Three Binocular Under-Water Periscopes have been delivered and the remaining six await delivery from the subcontractor. Aside from these six instruments work on this program has been completed.

Program for Balance of Authorization: Delivery of the six binocular instruments and the preparation of a report on the Under-Water Viewer will complete this program.

Reports: CP-2296

Man-Months Expended 6

Next Review Date Apr. 1, 1945

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Supervisor Responsible

Willard H. C. Burke

Section Chief

George E. Moore

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File Serial 24

Problem No. 136-ML-56-7

Date April 1, 1944

Priority A-2

PROGRAM REVIEW

Supplement A

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Title: Design and Experimentation on an Under-Water Periscope for Use
in Storage Basin or Sorting Basin - 100 Area, Hanford.

Progress and Present Status: Urgency of other problems has prevented
any work being done on this particular instrument.

Program for Balance of Authorization: To continue with the program as
proposed to supply design information to Hanford as needed.

Reports: None.

Man-Months Expended 0

Next Review Date June 1-1944

Supervisor Responsible William H. McArthur

Section Chief George D. Moore

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University of Chicago File Serial 24
Metallurgical Laboratory
Technical Division

Problem No. 136-ML-56-7
Date June 1, 1944
Priority A-2

PROGRAM REVIEW

Title: Design and Experimentation on an Under-Water Periscope for Use
in Storage Basin or Sorting Basin - 100 Area, Hanford.

Progress and Present Status: Urgency of other problems has prevented
any work being done on this particular instrument.

Program for Balance of Authorization: To continue with the program as
proposed to supply design information to Hanford as needed.

Reports: None

Man-Months Expended 0

Next Review Date July 1st, 1944

Supervisor Responsible

Section Chief

Willard W. M. Noble

George B. Munn

MUC-EWB-120

Supplement B
CS-1465-File Serial #24
This Document contains 1 Pages of
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Received: June 9, 1944

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Metallurgical Laboratory

File Serial 24

Problem No. 136-ML-56-7

Date July 1, 1944

Priority A-2

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PROGRAM REVIEW

This Document contains 1 Pages of
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is Copy 27 of 36. Series A
Issued to: Clinton

B. L. Sloan Pers.

Title: Design and Experimentation on an Under-Water Periscope for Use in Storage Basin or Sorting Basin - 100 Area, Hanford.

Progress and Present Status: Previous to June 15th very little work was done on this problem; however, since then designs have been developed and models constructed and studied.

Program for Balance of Authorization: To continue with the program as proposed; to supply design information to Hanford as needed and to construct an instrument for use at Hanford.

Reports: None.

Man-Months Expended 1/3

Next Review Date Sept. 1, 1944

Supervisor Responsible

William A. W. Chubb

Section Chief

George S. Moore

MUC-EWB-221

Cmc 7/12/44

Received: July 13, 1944

Issued:

AUG 9 1944

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Technical Division

File Serial 24

Problem No. 136-ML-56-7

Date September 6, 1944

Priority A-1

PROGRAM AUTHORIZATION (PART II)

Title: Design and Experimentation on an Under-Water Periscope for Use in Storage Basin or Sorting Basin - 100 Area, Hanford.

Objective: To design and model periscopes for above applications and to construct these instruments as requested.

Progress (Part I) and Present Status: Two types of periscopic instruments have been designed and modeled for use in the Storage Basin or Sorting Basin - 100 Area, Hanford. One is of binocular form and the other for close inspection of individual slugs and slug defects is of monocular form. Both instruments are under construction and rapid progress is being made toward the completion of the first of several instruments requested.

Proposed Program: To supply instruments of both types in succession to meet the needs for each type of periscope at Hanford and to supply sufficient spare parts for servicing the instruments.

Reason for Proposed Work: Specific needs for these instruments have been indicated and requests made for them.

Reports on Part I: None.

Next Review Date Nov. 1, 1944
Man-Months Authorized (Part II) 4
Man-Months Used (Part I) 1-3/4
Estimated Completion Date Jan. 1, 1944
Estimated Man-Months to Complete 4

Written by W. H. McCook
Approved by G. S. Monk
(Section Chief Responsible)

Group Leader Responsible W. H. McCook

Authorized by H. J. Cooper 99

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Issued: SEP 28 1944

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File Serial 24

Problem No. 136-ML-56-7

Date November 1, 1944

Priority A-1

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PROGRAM REVIEW

CS-1465 F. S. 24

Supplement E

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Series A

Issued To: Clinton (R. L. Doan - pers.)

Title: Design and Experimentation on an Under-Water Periscope for Use in Storage Basin or Sorting Basin - 100 Area, Hanford.

Progress and Present Status: Two types of periscopic instruments have been designed and are under construction, a binocular form for rapid inspection or sorting of slugs and a monocular form for close inspection of individual slugs and slug defects. The first monocular instrument has been completed and delivered to Site W, the second periscope of this form is being assembled and spare parts are also being prepared. The first binocular instrument is expected from the manufacturer in the near future.

Program for Balance of Authorization: To continue the program as proposed, to supply design information to Hanford as needed and to construct instruments and spare parts for use at Hanford.

Reports: None.

Man-Months Expended 2

Next Review Date Jan. 1, 1945

Supervisor Responsible Willard R. McCorble

Section Chief George J. Mow

Division Director Charles M. Cooper

Report received: November 30, 1944

Issued: DEC 11 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 24

Problem No. 136-ML-56-7
Date January 1, 1945
Priority A-1

PROGRAM REVIEW

Title: Design and Experimentation of an Under-Water Periscope for Use in Storage Basin or Sorting Basin - 100 Area, Hanford.

Progress and Present Status: Since the last review date, November 1st, 1944, two additional periscopes of monocular form have been completed except for the final assembly of the objective sections. Binocular Periscopes have also been designed and manufactured. These instruments are expected to be received from the manufacturer in the very near future.

Program for Balance of Authorization: After delivery of the above instruments the remaining work under this program will consist of building spare parts for the monocular instruments.

Reports: CP-2296.

Man-Months Expended 5

Next Review Date March 1, 1945

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Supervisor Responsible Willard W. H. Kerkle

Section Chief George Mason

Division Director Charn Cooper

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Metallurgical Laboratory
Technical Division

File Serial 24

Problem No. 136-ML-56-7

Date April 1, 1945

Priority A-1

PROGRAM REVIEW

Title: Design and Experimentation on an Under-Water Periscope for Use in Storage Basin or Sorting Basin - 100 Area, Hanford.

Progress and Present Status: Since March 1st, 1945 a spare Under-Water Viewer has been shipped and the remaining six Binocular Under-Water Periscopes have been completed. Four of the above mentioned binocular periscopes have been shipped and the two remaining instruments are ready for shipment.

Program for Balance of Authorization: Shipment of the two binocular periscopes and completion of a report on the Under-Water Viewer will constitute final activity under this authorization.

Reports: CP-2296.

Man-Months Expended 6

Next Review Date May 1, 1945

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Supervisor Responsible Walter H. C. Goble

Section Chief Gen. J. M. Mone

Division Director J. C. Stearns

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PROGRAM AUTHORIZATION

CS-1465 File Serial 25. This document consists of 1 page and no figures. Copy No. 27 of copies. Serial A. Issued to:

Title:

Semi-Works Solution of Heavy Metal and Preparation of UNE
Solutions for the Chemistry Division

Objective:

To obtain, store, and dissolve active heavy metal and carry out extraction and/or decontamination cycles on same to produce materials in the quantities required by the Chemistry Division in conducting main line investigations.

Present Status:

Space and equipment have been provided in the West Stands for a Semi-Works unit capable of processing up to 50 lbs. of active heavy metal per batch. This includes a dissolver, processing tank, agitators, transfer pumps, and a centrifuge.

Proposed Program:

To act as a service group for the Chemistry Division by setting up and operating semi-works equipment for processing active heavy metal solutions on a scale required to test main line investigations. This includes the following items:

- (1) Obtain active metal from "X" and other sources as required for Semi-Works operations.
- (2) Prepare active metal solutions in 25 to 40-gal. lots.
- (3) Carry out various separation operations on solutions of active metal to obtain concentrates of product and/or fission products.
- (4) Check efficiency of first line alternative separation processes.

Reason for Proposed Work:

To make it possible for the Chemistry Division to carry out main line investigations requiring the handling of active materials on a scale exceeding the capacity of laboratory facilities and not feasible, from the program standpoint, at Site "X".

Remarks:

Review Date 3/1/44
Man-Months Authorized 18
Estimated Completion Date June, 1944
Estimated Man-Months to Complete 45
Supervisor Responsible

Submitted by E. E. Kirschner
Approved by H. S. Rolles
Chas. M. Cooper

Authorized by: Mc Vernon 2/4/44

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Noted by L. J. S. Noted by TRH

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PROGRAM AUTHORIZATION (PART TWO)

Title: Semi-Works Solution of Heavy Metal and Preparation of UNH Solutions for the Chemistry Division

Objective: To obtain, store and dissolve active heavy metal and carry out extraction and/or decontamination cycles on same to produce materials in the quantities required by (1) the Chemistry Division in conducting main line investigations, and (2) the Technical Division for additional Semi-works programs such as Ether Extraction, Concentration Process Development and Decontamination Investigations.

Progress Made and Present Status: A Semi-works unit capable of processing 20 to 30 lbs. of active heavy metal per batch at a rate of two to four batches per week has been installed in the West Stands. This consists of concrete shielded cells in which a dissolver, a centrifuge, an extraction tank, a by-product precipitation tank, a product precipitation tank, and waste disposal tanks have been installed and individually shielded in such a manner that they can be operated without excessive exposure to radiation. The unit has been in operation for three months during which time about 600 lbs. of active metal containing up to 100 micrograms of product per lb. have been processed. Solution equivalent to about 200 lbs. of metal has been turned over to the Chemistry Division as an aqueous solution of uranyl nitrate. The remainder was dissolved and the solutions were carried through a bismuth phosphate extraction and one decontamination cycle. The resulting bismuth phosphate product precipitate, except for three batches turned over to the Chemistry Division, was used in the Semi-works program for concentration studies.

The current Clinton flowsheet was used in the preparation of the above materials except that U^{+4} was used for prereduction instead of formic acid in twelve runs, and was used for reduction in the decontamination cycle in place of Fe^{+2} in six runs.

Decontamination

Based on these tests, U^{+4} is entirely satisfactory for prereduction. In the decontamination cycle, reduction was essentially complete using U^{+4} but decontamination was not as good as when Fe^{+2} was used.

Current Semi-works Concentration studies, Ether Extraction studies and proposed Decontamination studies will require a great deal of additional metal solution and bismuth phosphate product precipitate. In addition, the Chemistry Division requires a continual supply of solutions from various stages in the process. The manpower originally authorized for this service program has been expended and an additional manpower authorization will therefore be required to continue the program.

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File Serial 25

-2-

Proposed Program: Continue to act as a service group for the Chemistry and Technical Divisions, operating Semi-works equipment for processing active heavy metal solutions on a scale required to test main line investigation. This includes the following items:

- (1) Obtain active metal from Clinton and other sources as required for Semi-works operations.
- (2) Prepare active metal solutions in 10 to 40 gallon lots for Chemistry Division and for use in Semi-works ether extraction studies.
- (3) Carry out extraction and decontamination cycles on solutions of active metal to obtain concentrates of product for further investigations.
- (4) Check efficiency of first line alternative separation processes.

Reason for Proposed Work: To make it possible for the Chemistry Division and Technical Division to continue to carry out main line investigations requiring the handling of active materials on a scale exceeding the capacity of laboratory facilities and not feasible, from the program standpoint, at Clinton.

Reports on Part I:

CN-1491, CN-1353: Notebooks, 1329, 140-B

Next Review Date: July 1, 1944

Man-Months Used (Part I): 34 *

Estimated Completion Date: December 31, 1944

Additional Man-Months to Complete: 90

Man-Months Authorized (Part II): 45

Supervisor Responsible: A. C. Hyde

*Noted by G. J. Seaborg
Noted by T. H. Hogness.*

Submitted by: E. R. Christensen

Approved by: J. E. Kitcher

Chas M Cooper

Authorized by: St Allison

* The overrun of man-months on the authorized time for Part I occurred during the period when the procedure for handling Part II Authorizations was being set up. The authorization requested in Part II is exclusive of the overrun on Part I.

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Part II - This document consists
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Technical Division

File Serial 25

Problem No. 201-ML-51-14
Date August 3, 1944
Priority A-1

PROGRAM REVIEW

Title: Semi-works Solution of Heavy Metal and Preparation of U.W.H. Solutions for the Chemistry Division.

Progress and Present Status: Since the approval of the authorization for Part II of this study, the equipment has been revamped to improve the remote control technique, to decrease recontamination from step to step by careful equipment and piping layout. An additional centrifuge and two additional process tanks have been installed to be used exclusively for a second BiPO_4 decontamination cycle.

In this period, about 500 pounds of active metal have been dissolved containing between 50 and 100 micrograms of product per pound. In addition 64 pounds of Berkeley bombarded tuballoy were dissolved and Np^{237} extracted by co-precipitation with LaF_3 .

Semi-works investigations were completed on the use of NaNO_2 and Pb_3O_4 as alternate pre-reduction and oxidation agents, respectively, for product in the extraction and by-product precipitation steps. Both materials were found to be suitable alternates. A solution of NaOH and NaNO_3 is being used to remove aluminum cans from the Clinton slugs prior to their dissolution. Ammonia and hydrogen concentrations in the dissolved off-gases have been determined during the dissolution of the aluminum cans. The conditions necessary to obtain a minimum hydrogen evolution have not yet been established.

Program for Balance of Authorization: Active metal will be obtained from Clinton as required by the programs of the Chemistry and Technical Divisions, and active metal solutions made. Variations in first line alternative separation processes will be investigated.

Reports: CN-1353, CN-1491, CN-1584, CN-1768, CN-1787, Notebooks 1329, 140-B, 453-B and 692-B.

Man-months Expended (Part II) - 36

Next Review Date - October 1, 1944

Group Leader Responsible

Section Chief

Division Director

CS-1465 F.S. #25

Supplement B

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Report received:

September 1, 1944

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File Serial 25

MUC-EWB 275
Problem No. 201-ML-51-14
Date - August 11, 1944
Priority A-1

PROGRAM AUTHORIZATION (PART III)

Title: Semi-works Solution of Heavy Metal and Preparation of UNH Solutions for the Chemistry Division

Objective: To obtain, store and dissolve active heavy metal and carry out extraction and/or decontamination cycles to produce materials required by (1) the Chemistry Division in conducting main line investigations, and (2) the Technical Division in the Semi-works programs.

Progress (Part II) and Present Status: An additional centrifuge and two additional tanks were installed to decrease recontamination of solutions and to provide separate equipment for a second BiPO_4 decontamination cycle. A total of 838 pounds of active metal containing 50 to 100 micrograms of product per pound were dissolved for use in current semi-works and Chemistry Division programs. In addition, 64 pounds of Berkeley bombarded metal were dissolved for the Chemistry Division and the Np237 extracted by coprecipitation with LaF_3 .

Studies were completed on the use of NaNO_2 and Pb_3O_4 as alternate prereduction and oxidation agents, respectively, for product in the extraction and by-product steps. Both materials were suitable alternates. Other studies were made to determine the composition of the dissolver off-gases while decanning Clinton slugs with NaOH , NaNO_3 solutions.

Proposed Program: Active metal will be obtained from Clinton as required by programs of the Chemistry and Technical Divisions and active metal solutions made. The equipment for a BiPO_4 extraction step and two regular BiPO_4 decontamination cycles will be augmented to provide separate equipment for each step. This will make the semi-works equipment adequate for investigations of a more precise nature. Variations in first line alternative separation processes, developed by the Chemistry Division, will be investigated.

Reason for Proposed Work: Certain main line studies conducted by the Chemistry and Technical Divisions require investigations on the semi-works scale. It is not possible, from a program standpoint, to do this work at Clinton.

CS-1465 F.S. 25
Supplement C
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Report received: September 23, 1944
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Reports on Part II: CN-1353, CN-1491, CN-1584, CN-1768, CN-1787, CN-1953.
Notebooks, 1329, 140-B, 453-B, 692-B.

Next Review Date: November 11, 1944

Man-months Authorized (Part III): 50

Man-months Used: 74

Estimated Completion Date: December 31, 1944

Estimated Man-months to Complete: 130

Group Leader Responsible: C. J. Egan

Written by B. R. Wendrow

Approved by A. M. Brown

A. C. Miller

Chas M. Cooper

Authorized by H. J. Brown 9/18

Noted by:

D. J. Seaborg
J. R. Dugan

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 25

Problem No. 201-ML-51-14
Date, November 30, 1944
Priority A-1

FINAL REVIEW

Title: Semi-works Solution of Heavy Metal and Preparation of UNH Solutions for the Chemistry Division.

Closing Status: Under direction of the Technical Division, 1414 pounds of active Clinton metal, containing 50 to 100 micrograms of product per pound of metal were dissolved. In addition 64 pounds of Berkeley bombarded metal were dissolved for the Chemistry Division, and the Np ²³⁷ extracted by coprecipitation with LaF₃. The active UNH solutions prepared from Clinton metal were used to:

- (a) Provide active solutions for the Chemistry Division in larger quantities than could be prepared in the laboratory.
- (b) Study U^{IV} as a prereduction agent in the extraction step and as a reducing agent in the decontamination cycle.
- (c) Study NaNO₂ and Pb₃O₄ as alternate prereduction and oxidizing agents, respectively, for product in the extraction and by-product steps.
- (d) Prepare solutions for Ether Extraction studies.
- (e) Study decontamination in two BiPO₄ cycles based on the Hanford flow-sheet without scavengers.
- (f) Make preliminary studies on the low acidity modification of the BiPO₄ process.

In the future, the dissolution of active Clinton metal and disposition of the resulting active solutions will be made under the direction of the Chemistry Division.

Reports: CN-1353, CN-1491, CN-1584, CN-1787, CN-1953, CN-2084, CN-2162, CN-2414
Notebooks, 1329, 140-B, 453-B, 692-B, 375-B, 603-B

Total Man-months Expended - 90

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Supple D
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Issued to: Clinton Lab
(R. L. Doan - Pers)

Group Leader Responsible

Section Chief

Division Director

C. J. Eggers

A. C. Tiller

Chas McEwen

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The design of this report is to provide information which is more restricted than the information in the usual report. It is intended for receiving these reports and passing them to other members of the project, even of the same laboratory, without specific authorization.

Report received: December 29, 1944

Issued: JAN 3 1945

~~SECRET~~
UNCLASSIFIED

PROGRAM AUTHORIZATION

Title:

UNCLASSIFIED

Detection of Leaking Aluminum Tube

Objective:

To develop a method and design of apparatus for detecting leaking ribbed tubes in the W pile.

Present Status:

No satisfactory method has yet been developed for locating a leak of water into the graphite of the W pile, although the general area may be indicated by the helium sampling and moisture testing system. It is desirable that a testing procedure be developed that will indicate the position of any leak passing more than one pound of water per hour so that the faulty tube can be replaced.

It has been suggested that this be done after a one-day shut down of the pile by flowing water through suspected tubes at a minimum flow rate and at a pressure less than atmospheric. Helium drawn into the tube would be determined at the discharge end.

Proposed Program:

An orifice will be constructed that leaks one pound of water per hour at the maximum pressure in the tube. An attempt will be made to detect the helium drawn into a simulated W pile tube with water passing through at less than atmospheric pressure. Other possible methods will also be investigated, and the apparatus recommended will be designed with the assistance of the General Engineering Section.

Reason for Proposed Work:

The seriously adverse effect of water on the k of the pile necessitates the development of a rapid and dependable method of determining leaks in the tubes. A formal request for this work has been received from the TNX Manufacturing Division.

Remarks:

Review Date April 1, 1944
Man-Months Authorized 4
Estimated Completion Date April 1, 1944
Estimated Man-Months to Complete 4

Supervisor Responsible R. N. Lyon

Submitted by

H. W. Bellas

Approved by

Chas M. Cameron

Authorized by

J. K. Allison

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 26

Problem No. 173-ML-51-18
Date: December 30, 1944
Priority: A-1

FINAL REVIEW

Title: Detection of Leaking Aluminum Tube.

Closing Status: The objective of this program has been met. A satisfactory device has been developed for the detection at leaking ribbed tubes in the W pile by hydrostatic means. This device was tested at SMX and found to be satisfactory.

No further work will be done on this problem under this authorization.

Report: CE-1809

Notebooks: 711, 777

Total Man-Months Expended - 1.4

Group Leader Responsible

R. N. Lyon

Ass't Section Chief

R. N. Lyon

Division Director

Oliver Cooper

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PROGRAM AUTHORIZATION

Title:

Coatings Research
B. Precoats

CS-1465 File Serial 27

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and no figures.

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Serial A

Issued to:

Objective:

General development of the techniques of electroplating on tuballoy with special emphasis on obtaining one or more precoatings which can be made to adhere firmly and permanently to tuballoy and to a jacketing material while effectively preventing interaction or interdiffusion between tuballoy and jacket materials.

Present Status:

The technique of electroplating on tuballoy has been largely mastered and coats of Cu, Ni, Fe, Cr, and Zn have been prepared which on short time tests have indicated good adherence. Several of these have served as satisfactory bases for other coatings although Cr is the only one at present showing adequate resistance to water.

Proposed Program:

1. Prepare on tuballoy slugs satisfactory barrier layers for jacketing and operation under Clinton conditions but at temperatures up to 600°C.
(Completion estimated by April 1)
2. Develop by electroplating a satisfactory precoat for use with the aluminum-silicon coating materials.
3. Develop the technique of electroplating on aluminum for specific needs that may develop such as on insulating caps.
4. Continue a small program on general tuballoy electroplating.

Reason for Proposed Work:

No way of jacketing Clinton slugs for operation at temperature in the range 400-600°C has yet been developed. No satisfactory undercoat is yet available for use with the Al-Si hot dip coating method (thick coat).

Remarks:

The work is directed by A. G. Gray of the du Pont Electroplating Division. Three men are working in Chicago.

Review Date April 1, 1944

Man-Months Authorized 10

Estimated Completion Date September 1

Estimated Man-Months to Complete

27

Submitted by J. P. [Signature]

Approved by [Signature]

Authorized by: [Signature]

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PROGRAM AUTHORIZATION (PART II)

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CS-1465 File Serial 27 Part II.
This document consists of 1
pages of text and 0 of
figures. Series A.
Issued to: 27-Clinton

Title:

Coatings Research
B. Precoats

Objective:

General development of the techniques of electroplating on tuballoy with special emphasis on obtaining one or more precoatings which can be made to adhere firmly and permanently to tuballoy and to a jacketing material while effectively preventing interaction or interdiffusion between tuballoy and jacket materials.

Progress (Part I) and Present Status:

Considerable emphasis has been placed on the standardization of the pretreatment of tuballoy prior to electroplating as the adherence of any plate depends to a large extent on this treatment.

With the help of the metallographic group diffusion studies on the tuballoy-nickel system are being made in an effort to produce a slug, with a protective alloy coating, which might be used without an aluminum can.

Both chromium and nickel are attractive candidates for blocking agents to prevent or retard interdiffusion between tuballoy and jacket materials.

Proposed Program:

1. Concentrate on chromium as a precoat prior to Al-Si and possibly zinc dips with subsequent canning. (B-2)
2. Continue experiments on tuballoy-nickel interdiffusion compounds (B-2)
3. Evaluate the use of nickel as a intermediary to prevent interdiffusion (B-1) between tuballoy and the aluminum can for use in the Clinton pile.
4. To continue as a service group to other groups.

Reason for Proposed Work:

One or more alternative coating procedures is very desirable to supplement the existing processes.

Electroplating provides a possible means of providing protection to slugs against corrosion fundamentally distinct from hot dip process which have some faults in common.

The need for an electroplating service group has been demonstrated frequently in the past. This need will undoubtedly grow in the near future.

Remarks:

Practically all of the experimental work on electroplating is now being done by the Chicago group.

Reports:

A handbook on electroplating on tuballoy is being compiled by A. G. Gray of the du Pont Electroplating Division.

Next Review Date July 1, 1944

Man Months Authorized (Part II) 12

Man Months Used (Part I) 12

Estimation Completion Date #1 4-#2 10/1; #3 6/1

Estimated Man Months to Complete --

#1 - 6; #2 - 12; #3 - 2

Supervisor Responsible L. M. Foster

Submitted by L. M. Foster

Approved by A. D. Greninger
John P. Howe
A. Chipman
Chas. M. Conner

Authorized by Samuel K. Allen

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 27

Problem No. 154 ML 52-2
Date July 5, 1944
Priority B-1

PROGRAM AUTHORIZATION (PART III)

Title:

Coatings Research, Electroplating

Objective:

General development of the techniques of electroplating on tuballoy.

Progress (Part II) and Present Status:

There is no completely satisfactory method of plating on uranium. It is beginning to appear questionable that any one satisfactory pretreating and plating method can be devised as long as the metal itself differs in structure, purity, etc., from one piece to the next.

Changing the concentration of constituents of the tri-chloroacetic acid pretreatment solutions has markedly improved the results.

Proposed Program:

1. Concentrate on plating methods for uranium, including,
 - (a) Developing new pretreatments
 - (b) Developing entirely new plating methods. (May involve non-aqueous baths).
 - (c) Trying to determine the most platable type of base metal and taking steps, if necessary, to have such metal produced.

Reports:

Quarterly Progress Report CT-1793

Next Review Date October 1, 1944
Man Months Authorized (Part III) 15
Man Months Used (Part II) 24
Estimated Completion Date Continuing
Estimated Man Months to Complete 3 full
time men
Supervisor Responsible L. M. Foster

Submitted L. M. Foster (by ABG)

Approved by W. B. Heninger
Chas. M. Carpenter
J. K. Allison

CS-1465 F.S. #27 Supplement B
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Received: September 5, 1944
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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 27

Problem No. 154-ML-52-2
Date Oct. 31, 1944
Priority A-1

PROGRAM REVIEW

Title: Coatings Research, Electroplating

Progress and Present Status:

A satisfactory procedure for pretreating tuballoy prior to plating has been developed. This involves anodic treatment of the metal in concentrated trichloroacetic acid solution. Practically all of the metals that can be deposited from aqueous solution have been plated on tuballoy. The plate-tuballoy interface is usually rather jagged and somewhat contaminated, however, the adherence and continuity of the plates are good. The nature of the surface of the metal determines to a large extent the degree of imperviousness of the metal deposited.

During the past two months efforts of the group have been directed toward the plating of molybdenum and molybdenum alloys. Nickel-molybdenum alloys containing up to 55% molybdenum have been obtained. Of all the metals investigated diffused Ni-Mo plates (approximately 15% Mo) have shown the best corrosion resistance. None of the molybdenum rich alloys have been diffused as yet. Attempts to plate metallic molybdenum have not been successful. Plates analyzing 90% metallic molybdenum have been obtained. These plates have a metallic luster and chemical analysis indicates that some of the metal is present as such, however, the quantity of the latter has not been determined. Specimens have been submitted for x-ray analysis.

Program for Balance of Authorization:

Attempts will be continued to produce a Mo-Ni alloy richer in Mo than those obtained at present. Work on molybdenum plating will be continued.

Reports:

Quarterly Progress Report CT-1793.

Man-Months Expended 30

New Date 1/1/45

Report received: November 30, 1944

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Supplement C
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Group Leader Responsible *J. M. F. Co.*

Section Chief *J. H. Chapin*

Division Director *Clinton Lab.*

University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 28

Problem No. 154 ML 52-3
Date January 17, 1944
Priority B-1

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PROGRAM AUTHORIZATION

Title:

Coatings Research - Alternative Methods
C. Soldering and Brazing

Objective:

To develop a thoroughly satisfactory method for bonding aluminum jackets to tuballoy when employed in high power water cooled units. (Includes insulation of ends and mechanical developments incidental to production applications.)

Present Status:

A Zn-Sn bonding material and method of application have been developed to yield an adequate bond but are subject to undesirable corrosion by water. Present results indicate a Zn-1.0% Al bond to be mechanically strong and much more corrosion resistant. An Al-Si alloy bond affords best corrosion resistance and good strength but requires further mechanical developments in application.

Proposed Program:

- Continue with principal emphasis at Cleveland the development of an Al-Si bonded-aluminum jacketed assembly for use in high power water cooled piles.
- In cooperation with Grasselli to develop and procure mechanical facilities for setting up in Chicago and operating a pilot production unit for Al-Si bonded assemblies. Operation scheduled for early February, 1944.
- Assist in evaluation of the Zn-Al bond at present under active development in canning process development group.
- Evaluation of other bonding materials and methods as they become of importance.

Reason for Proposed Work:

No completely satisfactory bonding agent and method of application has as yet been adequately demonstrated. Operation of H.E.W. at design power level depends upon solution of this problem.

Remarks:

Nineteen men (7 full time, 12 part time) are working on (a) in Cleveland
Three men are working on (b) in Chicago
Five men are working on (c) and (d) in Chicago

Review Date April 1, 1944

Man-Months Authorized (21 per mo.) 70

Estimated Completion Date July 1, 1944

Estimated Man-Months to Complete 126

Submitted by

John P. Howe

Approved by

W.B. Greninger

Chas M. Cooper

John Chishman

Authorized by

Harold K. ...

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PROGRAM REVIEW

Title:

Coatings Research
C. Soldering, Brazing and Canning

Supplement A

CS-1465-File Serial #28

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Progress and Present Status:

Research on methods of applying protective aluminum jackets to the uranium slugs for the Hanford water cooled pile has yielded two distinct processes which are not in developmental stages. The processes are:

1. Bonding with aluminum-silicon alloy (Alcoa #13) after an initial preparation of the slug by a bronze dip and subsequent removal of the bronze-uranium alloy with molten tin.
2. Bonding with zinc-aluminum alloy (99% Zn, 1% Al)

The Al-Si bond is extremely resistant to corrosion, will withstand high temperatures and consumes a minimum of k. The process is not yet developed to the extent that a sufficiently high per cent of satisfactory slugs can be prepared for the process to be feasible.

The zinc-aluminum bond is somewhat less resistant to corrosion, will not withstand as high temperature as Al-Si and consumes considerable k. The process is considerably simpler, however, and a high per cent of usable slugs can be made. The bonding is much more complete and uniform, dimensional requirements on the slug can easily be met, and, in general, a great deal more is known about the process.

Program for Balance of Authorization:

Future work will be directed toward:

1. Perfecting the zinc bond process and contributing toward research on the aluminum-silicon process.
2. The evaluation of each.
3. The development of new processes.
4. Completion of "feeler" tests and life tests on the bonded slugs.

Remarks:

The greater part of the research work on the Al-Si has been done by the Cleveland group. As of March 1, however, their work has contributed more toward process development and should not be charged against this authorization from this date on. Cleveland man power for the month of March was 22 man months.

Reports

MUC-LMF-14

Man Months Authorized Jan. 17 70
Man Months Expended 28 (16 at Cleveland
12 at Chicago)
Revised Authorization (Chicago only) 15
Next Review Date July 1, 1944

Supervisor Responsible J. M. Foster

Section Chief W. B. Greninger

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PROGRAM REVIEW

Title:

Coatings Research
C. Soldering, Brazing and Canning

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Progress and Present Status:

The zinc bonding process has been carried as far as it seems practical to do so in the laboratory. A mechanized canning unit was constructed which eliminates the need for the various manual operations employed when hot tongs were used. This unit worked very satisfactorily and about 700 W size slugs were canned. About 66% of the slugs canned passed the isothermal frost test. The remainder failed because of entrapped air in the bond.

The obvious solution to this problem was canning in vacuo. A vacuum unit was constructed and tried out on a few slugs. About 80% of these showed considerable improvement over slugs canned at atmospheric pressure. The remaining 20% showed little or no improvement. This is attributed to the fact that frequently the slugs would fail to seat in the can under vacuum. The unit is now in the shop to have a plunger device installed by means of which, the slug can be seated before the vacuum is released.

Program for Balance of Authorization:

The vacuum canning unit will be tried again after the modification mentioned above are completed. Enough slugs will be canned to test the process and determine if a definite improvement in slug quality can be expected from vacuum canning.

The process will be reported on and final operating instructions will be drawn up.

Remarks:

The zinc process is the only bonding process being carried on by this group. All aluminum-silicon work is now in R. Yancey's group under a separate authorization.

Reports:

Record Report on Zinc Bonding in Info. Office. (CT-1757; A-2464)

Man Months Authorized March 31 15
Man Months Expended 12
Next Review Date Oct. 1, 1944.

Supervisor Responsible L. M. Foster
Section Chief A. B. Greiner

MUC-IWB-231

Received: July 31, 1944
Issued: AUG 9, 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 28

154-ML-54-3e (OLD)
Problem No. 154-ML-52-3 (New)
Date Sept. 30, 1944

FINAL REVIEW

Title: Coatings Research - Alternative Methods, C.
Soldering, Brazing, and Canning

Closing Status:

Coatings research resulted in the development of two alternative bonding methods which had attractive features; a bond employing the eutectic Sn-Zn alloy and the other employing Zn plus 1% Al. The Sn-Zn process was given considerable attention at first because of the attractiveness of the low melting point. Several months of work on this process, however, indicated that the corrosion resistance of this bond was not sufficiently good to warrant further development of the process. In December, 1943, a program was initiated to fully develop the zinc bonding process to a point where it might be recommended for production for H.E.W.

By April 1944, a canning machine had been constructed by means of which, about 700 W-size slugs were canned. This showed the feasibility of the process. About 35% of the slugs produced, however, failed to pass the specifications set up for continuity of the bond as determined by the isothermal frost test. Canning in vacuo was visualized as the solution to this problem. During May and June, 1944, a new canning mechanism incorporating vacuum was constructed. After preliminary trials on several hundred slugs, the process was pronounced satisfactory for a production trial.

On September 15, 1944 a new group was organized under the direction of T. J. Armstrong. The group was composed entirely of Du Pont men. The function of this group was to produce a sufficient number of canned slugs to determine if the process was feasible from a production standpoint. Sixteen hundred slugs were received from Hanford for this purpose. By September 28, 800 slugs had been canned at a rate of about 75 per day with a maximum of 100 per day. More than 90% of the slugs met each specification set up, including soundness of weld, dimensions, continuity of bond, soundness of can, etc., with about 85% of the slugs acceptable on all counts.

The remainder of the 1600 slugs are now in process. This run is being made under a new P.A. No. 154-ML-52-3.

Reports:

MUC-LMF-4, MUC-LMF-6, MUC-LMF-14, MUC-LMF-19, MUC-LMF-17, MUC-LMF-134, MUC-ABC-45,
MUC-LMF-113, MUC-CMC-253, CT 2284.

Total Man-Months Expended 46

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Group Leader Responsible L. M. Fowler

Section Chief Cham

Division Director Chas. M. Cooper

Received: November 7, 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 29

Problem No. 154 ML 54-3b
Date January 17, 1944
Priority B-1

PROGRAM AUTHORIZATION

Title:

Coatings Research

D. Thick coats of aluminum-silicon alloy #13 Issued to: _____

CS-1465 File Serial 29
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Objective:

To develop a method for applying to tuballoy slugs thick coats (20-30 mils) of Al-Si alloy adhering with sufficient mechanical strength and possessing adequate corrosion resistance for use in a high power water cooled unit.

Present Status:

Coats of Al-Si alloy #13 have been cast on tuballoy slugs by a rolling process and subsequently machined to proper thickness. To date, means have not been found to prevent the formation of a brittle alloy layer which endows porrosion resistance due to cracking. The properties of the cast metal in the coat have not yet been determined.

Proposed Program:

Proceed with the perfection of the hot dipping and casting techniques. Try out and evaluate precoating technique. Determine the corrosion resistance under conditions of operation at H.E.W. of completed slugs.

Reason for Proposed Work:

Canning methods are complicated and depend on maintaining close tolerances. The proposed method may afford some simplification and remove the dependence on specially made cans still providing protection for tuballoy.

Remarks:

The program is not to be begun until the bonding procedure using Al-Si has been placed in pilot plant operation. Work will proceed in the Grasselli Laboratories.

Review Date April 1, 1944
Man-Months Authorized (13 per mo.) (4 mo.)
52
Estimated Completion Date July 1, 1944
Estimated Man-Months to Complete 52

Submitted by John P. Homan

Approved by W.B. Harrison
Charles E. Cooper
John Chipman

Authorized by: Harold L. ...

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 29

Program No. 154-ML-54-3b

Date April 1, 1944

Priority B-1

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PROGRAM REVIEW

Supplement A

CS-1465-File Serial #29

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Issued to: Clinton

Title:

Coatings Research

D. Thick coats of aluminum-silicon alloy #13

Progress and Present Status:

No change

Program for Balance of Authorization:

Reports: None.

Man-Months Expended none

Next Review Date May 15, 1944

Supervisor Responsible Z. P. Foster

Section Chief A. B. Heninger

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University of Chicago
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Technical Division

File Serial 29

Problem No. 154-ML-54-3b
Date June 28, 1944
Priority B-1

FINAL REVIEW

This Document contains 1 Pages
of Text and 0 Pages of Figure
This is Copy 37 of 36. Serial
Issued to: Clinton

Title:

Coatings Research
D. Thick Coats of Aluminum-Silicon Alloy #13.

Closing Status:

This program was carried on as an alternative method of slug protection for the Hanford pile in the event that aluminum cans could not be satisfactorily applied and welded. Enough pieces were prepared at Cleveland to carry out various tests.

Corrosion test and straight aluminum-silicon hot dipped pieces and bronze-tin-Al-Si hot dipped pieces indicated that they were not satisfactory for Hanford use without considerable more research and development. This program was temporarily suspended because of higher priority work two months ago.

It is very unlikely that this program will be pursued again.

Reports:

None

Total Man-Months Expended 0

MUC-FWB-230

Supervisor Responsible J. M. Foster

Section Chief W. Greninger

Received: July 14, 1944

Issued: AUG 9 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 30
This Authorization is
continued as File Serial
No. 42

Problem No. 154 ML 54-31
Date January 17, 1944
Priority B-2

PROGRAM AUTHORIZATION

Title:

Coatings Research
E. Seam Welding

CS-1465 File Serial 30
This document consists of 1
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Series A
Issued to:

Objective:

To evaluate a method of seam welding a can closure

Present Status:

Seam welded closures were used in canning metal for Clinton. By proper cleaning reasonable perfection of weld is possible. However, the weld is not readily tested for perfection. Moreover, severe pitting corrosion takes place under the fold as ordinarily made. A combination of seam and fusion welds is possible.

Proposed Program:

Seam weld a number of complete bonded slug assemblies from each canning method developed for H.E.W. Critically test the welds under operating conditions as well as more severe conditions. Hold the method as a supplement to the fusion welding process.

Reason for Proposed Work:

The proposed method has been shown to be equivalent to the fusion welding process for unbonded jackets but requires an additional forming operation. As yet bonded jackets have not been satisfactorily closed by fusion welding. It is essential to provide a stand in and supplement for fusion welding.

Remarks:

It is anticipated that final testing will extend beyond time allowed for completion.

Review Date April 1, 1944
Man-Months Authorized 1

Estimated Completion Date July 1, 1944
Estimated Man-Months to Complete 1

Submitted by John P. Howe

Approved by B. B. Channing

Charles M. Crook

John Chisholm

Authorized by: Samuel W. Waller

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 30

Problem No. 154-ML-54-31

Date March 31, 1944

FINAL REVIEW

Title:

Coatings Research
E. Seam Welding

Supplement A

CS-1465-File Serial #30

This Document contains 1 Pages of
Text and 0 Pages of Figures.

This is Copy 27 of 40 Series A.

Issued to: M. D. Whitaker

Closing Status:

The seam welding of slugs at the Aluminum Company for the Clinton pile proved to be unsatisfactory for production. A welding unit was secured for Chicago and welding research was carried to the point where it appeared definite that the obstacles presented by this process could not be overcome in time for Hanford production.

The welder has been removed from the site but is being held by the project for use in an emergency in the event that a satisfactory fusion weld cannot be made.

Reports:

Mr. B. J. Fletcher, Aluminum Company of America, New Kensington, Pa., is familiar with work done at that place.

Work at Site B is not covered by a record report.

Total Man-Months Expended 2

Supervisor Responsible L. M. Fenton

Section Chief W. D. Greening

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 31

Problem No 154 ML 54-31
Date January 17, 1944
Priority A-1

PROGRAM AUTHORIZATION

Title:

Coatings Research
F. Testing

CS-1465 File Serial 31
This document consists of 1
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Series A
Issued to:

Objective:

To develop and evaluate tests for slug assemblies to be used at H.E.W.

Present Status:

Methods are available for testing slug assembly in regard to:

1. Tightness of closure
2. Perfection of bonding
3. Perfection of can
4. Surface cracks in metal
5. Integrity of insulator for ends of slug
6. Corrosion of finished unit.

Proposed Program:

Complete the apparatus for each test, and except for item 6, turn it over to the canning process development group for use in final inspection of canned slugs for H.E.W. Investigate new and alternative methods for inspection of slug and assembly such as the use of supersonic waves, X-radiography for weld perfection, and others.

Reason for Proposed Work:

It is imperative that no defective slug assemblies are placed in a high power unit because one failure can materially reduce the efficiency of the process.

Remarks:

The test for bonding is being developed at M.I.T. and translated to Chicago. It is expected to have work done at the University of Michigan.

Review Date April 1, 1944
Man-Months Authorized 30

Estimated Completion Date Sept. 1944
Estimated Man-Months to Complete 63

Submitted by J. H. P. Horn

Approved by R. B. Greninger

Chas M Cooper

W. H. Chibman

Authorized by: Samuel W. Brown

UNCLASSIFIED

PROGRAM AUTHORIZATION (PART II)

Title:

Coatings Research
F. Testing

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CS-1465 File Serial 31
Part II, Supple. A. This document consists of 1 page of text and 0 pages of figures
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Issued to: *Chilton*

Objective:

To develop and evaluate tests for slug assemblies to be used at H.E.W.

Progress (Part I) and Present Status:

At the beginning of the testing program there were no tests for W-slugs, which had been evaluated. The formulation and evaluation of the tests methods required, necessarily changed with the changes in design of the W-slug; i.e. double jacket to single jacket, insulating end caps to conducting end plugs. The most recent change to the conducting end plug has changed the 'completion' status of the testing program.

The Isothermal Frost Test used upon the bond is being improved and a more critical interpretation is being established. The use of beta-graphs to indicate the character of the bond is being evaluated. The use of the supersonic tests upon the core and the bond appears to become even more important with the knowledge that alpha-rolled cores have much better supersonic transmission than the extruded cores (due, especially, to the lack of voids in the alpha-rolled metal.) Both the reflectoscope and the thru transmission supersonic tests are believed to be the most feasible for the bonding test of the conducting plugs to the wall of the can and to the core. The vacuum bubble test is not as useful as it was formerly in the weld leak test, because of the presence of bonded conducting plugs in the slug ends. The Zyglo tests must be used to reject cans, cores, and caps which have surface defects not seen by visual inspection. X-radiography of the weld will indicate macroscopic porosity only and can be used only as an aid in developing the welding process. Thermal cycling of dummy W-slugs will give information concerning the variation of heat gradients upon specific bond defects.

Proposed Program:

Completion of thru transmission supersonic testing apparatus, installation at Chicago of reflectoscope with trained personnel, evaluation of beta-graphic tests, and completion of the program of thermal cycling will give an evaluation of the bonding tests. The use of the Zyglo test will indicate the surface defects in cans, cores, and caps. The tightness of the fusion weld made upon the bevel of the can wall and the bonded conducting plug can now be made only by visual inspection or by Zyglo to indicate surface defects in the weld.

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Reports on Part I:

Zyglo Report in the Information Office.

Next Review Date July 5, 1944.

Man-Months Authorized (Part II) 33

Estimated Completion Date July 1, 1944

Estimated Man-Months to Complete: 34

Supervisor Responsible L.M.

Submitted By: R.F. Plott *R.F. Plott*

Approved By: *W.B. Greninger*

Authorized By: *H.C. Johnson*

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 32

Problem No. 236-ML-56-1b

Date April 15, 1945

Priority

PROGRAM REVIEW

Title: Design of Plastic Optics for Canyon Periscopes.

Progress and Present Status: No progress has been made since the last review date because of great urgency of other problems. Status is the same as at July 1st Review.

Program for Balance of Authorization: See Review for July 1, 1944.

Reports: None.

Man-Months Expended 0

Next Review Date July 1, 1945

CS-1465 F.S. 32

Sup. G.

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Series A:

Issued: Clinton Lab.

R. L. Doan.

Supervisor Responsible *J. M. M.*

Section Chief *George M. M.*

Division Director *J. C. Stearns*

Report received: May 10, 1945

Issued:

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 32

Problem No. 236 ML 56-1b

Date 1/29/44

Priority A-2

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PROGRAM AUTHORIZATION

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Series A
Issued to:

Title: Design of Plastic Optics for Canyon Periscopes.

Objective: To design plastic substitutes for optical parts now in use in the two canyon periscopes.

Present Status: Plastic achromatic lenses can be made. A general program of redesign in plastics is under way.

Proposed Program: To calculate corrected lenses and other optical parts for those parts in the canyon periscopes which are subject to radiation.

Reason for Proposed Work: A request for this work is contained in a letter from Tilley-Peterson TTK, dated January 25, addressed to Dr. S. K. Allison.

Remarks:

Review Date April 1, 1944

Man-Months Authorized 1

Estimated Completion Date April 1

Estimated Man-Months to Complete 1

Submitted by George M. M...

Approved by Chas. D. C...

Authorized by:

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 32

Problem No. 236-ML-56-1b

Date April 1, 1944

Priority A-2

PROGRAM REVIEW

Supplement A

CS-1465-File Serial #32

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Text and 0 Pages of Figures.

This is Copy 27 of 40 . Series A

Issued to: M. W. Whitaker

Title: Design of Plastic Optics for Canyon Periscopes.

Progress and Present Status: Nothing has been done - see report of
March 1.

Program for Balance of Authorization: See report of March 1.

Reports: None.

Man-Months Expended none

Next Review Date June 1, 1944

Supervisor Responsible _____

Section Chief Georges M. Mow

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 32

Problem No. 236-ML-56-1b

Date June 1, 1944

Priority A-2

PROGRAM REVIEW

Title: Design of Plastic Optics for Canyon Periscopes.

Progress and Present Status: Problem has been turned over to the Design Group, but because of priority of other instrumentation for Site W, little has been done.

Program for Balance of Authorization: See report of March 1.

Reports: None.

Mon-Months Expended 0

Next Review Date July 1, 1944

Supervisor Responsible Whiter Wood

Section Chief George Brown

MUC-IWB-118

Supplement B
CS-1465-File Serial #32
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University of Chicago
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Technical Division

File Serial 32

Problem No. 236-ML-56-1b

Date July 1, 1944

Priority 1-2

PROGRAM REVIEW

This Document contains 1 Pages of
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is Copy 27 of 36. Series A
Issued to: Clinton (B.L. Sloan)
(Piss)

Title: Design of Plastic Optics for Canyon Periscopes.

Progress and Present Status: This work is being done by the design group. At present there is insufficient information concerning the indices of refraction and the dispersions in the glasses used in the canyon periscope and this information is being collected.

Program for Balance of Authorization: Two courses are open to us. One is to discard the present optical system entirely and substitute a suitable plastic system chosen from those available to us at the present time. Another is to design lenses of plastic components to take the place of the individual glass lenses now in use. Our opinion is that the first step would be satisfactory. It would certainly be the most economical of time and effort. On the other hand, some preliminary calculations must be made to see how far we can go in designing plastic duplicates of the present lenses without this form of replacement becoming too involved. As soon as this stage has been reached a report will be forthcoming.

Reports: None

Man-Months Expended 0

Next Review Date Sept. 1, 1944

Supervisor Responsible Georges Monod

Section Chief Georges Monod

MUC-LWB-222

Due 7/1/44

Received: July 12, 1944
Issued:

AUG 9 1944

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University of Chicago
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Technical Division

File Serial 32

Problem No. 236-ML-56-1b

Date September 1, 1944

Priority A-2

PROGRAM REVIEW

Title: Design of Plastic Optics for Canyon Periscopes.

Progress and Present Status: No progress has been made since the last review date because of great urgency of other problems. Status is the same as at July 1st Review.

Program for Balance of Authorization: See Review for July 1, 1944.

Reports: None.

Man-Months Expended 0

Next Review Date Nov. 1, 1944

Supervisor Responsible L. S. Monk

Section Chief L. S. Monk William A. W. Chubb

Division Director Charles M. Cooper

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Report received: September 18, 1944

Issued: SEP 28 1944

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File Serial 32

Problem No. 236-ML-56-1b

Date November 1, 1944

Priority A-2

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R. L. Doan - Dr.

PROGRAM REVIEW

Title: Design of Plastic Optics for Canyon Periscopes.

Progress and Present Status: No progress has been made since the last review date because of great urgency of other problems. Status is the same as at July 1st Review.

Program for Balance of Authorization: See Review for July 1, 1944.

Reports: None.

Man-Months Expended 0

Next Review Date Jan. 1, 1945

Supervisor Responsible *George Monk*

Section Chief *George Monk*

Division Director *Chas. McKee*

Report received: November 30, 1944

Issued:

DEC 11 1944

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File Serial 32

Problem No. 236-ML-56-1b
Date January 1, 1945
Priority A-2

PROGRAM REVIEW

Title: Design of Plastic Optics for Canyon Periscopes.

Progress and Present Status: No progress has been made since the last review date because of great urgency of other problems. Status is the same as at July 1st Review.

Program for Balance of Authorization: See Review for July 1, 1944.

Reports: None.

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Man-Months Expended 0

Next Review Date April 15, 1944

Supervisor Responsible General Munn

Section Chief General Munn

Division Director Charles M. Paeper

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PROGRAM AUTHORIZATION

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CS-1465 File Serial 33
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Issued to:

Title:

Design Studies of Ether Extraction for Hanford Scale of operation.

Objective:

To design equipment suitable for extracting product from the uranyl nitrate solutions from the dissolver.

Present Status:

Semi-works equipment is essentially complete for extracting product from active Clinton metal. During the next month data will be available to permit actual equipment sizes to be estimated.

Proposed Program:

It is proposed to initiate a design program immediately to handle the more general fixtures of this equipment. The principal features to be worked out are those of control.

Reason for Proposed Work:

The ether extraction unit offers good possibilities of

1. Producing a product decontaminated by a 100-fold factor.
2. Recovering uranium sufficiently decontaminated to be re-used.
3. Producing of fission-product concentrate.

Remarks:

Review Date April 15, 1944

Man-Months Authorized 2

Estimated Completion Date 5/1/44

Estimated Man-Months to Complete 4

Supervisor Responsible J. O. Maloney

Submitted by J. O. Maloney

Approved by E. E. Kiser

Chas M Cooper

Authorized by Samuel K Allison

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Technical Division

File Serial 33

Problem No. 281 ML-5-2b1
Date 4/15/44
Priority B-2

PROGRAM REVIEW

Supplement A

CS-1465-File Serial #33

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Issued to: M. E. Whitaker

Title: Design Studies of Ether Extraction for Hanford Scale of
Operations.

Progress and Present Status: The purpose of this program was to design
equipment suitable for extracting product from the uranyl nitrate solutions
from the dissolver.

During the last two months a preliminary sketch was made of the
equipment and operating features of a unit to process 3 tons of metal per
day. It was anticipated that sufficient information would be obtained from
the semi-works operation to permit a logical design to be completed. Un-
fortunately such data are not yet available and it is proposed to wait
until such fundamental information is available before attempting final
design.

Program for Balance of Authorization: As soon as suitable semi-works
operating data are available the design will be studied, modified, and
submitted for comment.

Reports: None.

Man-Days Expended 4

Man-Days Authorized 52

Next Review Date 6/15/44

Supervisor Responsible J. O. Maloney

Section Chief G. E. Kirk

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File Serial 33

Problem No. 281-ML-55-2b1

Date July 15, 1944

Priority B-2

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PROGRAM REVIEW (PART I)

R. S. Doan-Ces.

Title: Design Studies of Ether Extraction for Hanford Scale of
Operations.

Progress and Present Status: No work has been done on this program since the last review was written. The reason the study has been inactive is because the semi-works investigation* of the ether extraction separation process has not been completed. It was originally anticipated that sufficient fundamental information would be made available through the semi-works investigation to permit the design of a separation plant for Hanford to be made with reasonable assurance. At the present time only a preliminary sketch of the equipment required and description of its operating features have been prepared.

*See Ether Extraction as a Portion of a Separation Process - P.A.N. 281-ML-59-2b.
#52

Program for Balance of Authorization: Experimental studies of the extraction and decontamination phases of the ether separation process have been curtailed indefinitely because it is felt that all available manpower must be devoted to the study of urgent problems more closely related to the main-line process. Full-scale ether extraction equipment can not be properly designed with the limited amount of chemical and semi-works data now available. It is quite possible that the work will be resumed after the Hanford plant is in successful operation.

Reports: None.

Man-Days Authorized (Part I) 52

Man-Days Expended (Part I) 4

Next Review Date 9/15/44

Supervisor Responsible *J. B. Tape*

Section Chief *J. S. Maloney*

Completed 9/19/44

Received: July 18, 1944
Issued: AUG 9

NUC-LWB-234

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File Serial 33

Problem No. 281-ML-55-2b1
Date November 11, 1944
Priority B-2

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PROGRAM REVIEW

Title: Design Studies of Ether Extraction for Hanford Scale of Operations

Progress and Present Status: No work has been done on this program since the last review was written on July 15, 1944. The semi-works program (P.A.No. 281-ML-59-2b) which was planned to obtain the data necessary in the full-scale design was terminated before completion, due to a shortage of man-power. At the present time only a preliminary sketch and a description of the equipment required have been prepared. No work is being done.

Program for Balance of Authorization: A final report will be prepared covering the available full-scale design information. The program will be closed out before January 1, 1945.

Reports: None.

Man-Days Expended 4

Next Review Date January 1, 1945 (final)

Group Leader Responsible *J. B. Tye*
Section Chief *J. E. Maloney*
Division Director *Chas. M. Cooper*

Report received: December 2, 1944
Issued: DEC 11 1944

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University of Chicago
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Technical Division

Problem No. 281-ML-55-2B1
Date December 30, 1944

File Serial 33

FINAL REVIEW

Title: Design Studies of Ether Extraction for Hanford Scale of Operation

Closing Status:

This program was authorized to permit the design of a full-scale ether extraction separations plant for Hanford to be made as soon as sufficient semi-works data on which to base the design had been collected. Very little work has been done on this program because when semi-works data were finally obtained such a critical shortage of man-power existed that time could not be devoted to a study of only B-2 priority.

The semi-works program of investigation which was carried out to obtain design data for use in the present program has recently been reviewed in a final report (CN-2492). Sufficient data were not obtained to serve as the basis for a complete Hanford plant design. In fact, a considerable amount of both fundamental laboratory work and semi-works development remains to be done before the feasibility of an ether extraction separations process is demonstrated.

Reports: None.

CS-1465 P.S. #33

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Total Man-Months Expended 4 man-days

Group Leader Responsible *J. B. Tepe*

Section Chief *J. A. Maloney*

Division Director *Chas. N. Cooper*

The data reported is more than sufficient in the receiving them to even of specific information.

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PROGRAM AUTHORIZATION

CS-1465 File Serial 34
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Series A
Issued to:

Title:

Status of Separations Processes

Objective:

To follow all developments on the separation processes and to render bi-monthly accounts on them. These accounts would include flow sheets, evaluations, and recommendations.

Present Status:

On a good many of the processes it is extremely difficult to obtain a complete picture of any separations process from a given report or set of reports.

Proposed Program:

It is proposed to maintain an up-to-date file on all of the separations processes being investigated.

It is proposed to issue a bi-monthly status report on all processes being investigated.

It is proposed to evaluate these processes from an engineering standpoint.

Reason for Proposed Work:

This will fulfill a definite need of the Project for centralized information on the Separations Processes.

Remarks:

Review Date April 1, '44 and bi-monthly
thereafter.

Man-Months Authorized 1

Estimated Completion Date indeterminate

Estimated Man-Months to Complete "

Supervisor Responsible J. O. Maloney

Submitted by J. O. Maloney

Approved by C. E. Kirk

Chas M Cooper

Authorized by Samuel K Allison

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University of Chicago
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Technical Division

File Serial 34

Problem No. 285-ML-55-4

Date May 5, 1944

Priority B-2

CS-1465-F.S.34

Supple A-Pt. II

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JUN 2 1944

R. L. DOWN

PROGRAM AUTHORIZATION (PART II)

Title: Status of Separations Processes

(Down)

Objective: To follow all developments on the separation processes and to render bi-monthly accounts on them. These accounts would include flow sheets, evaluations, and recommendations.

Progress (Part I) and Present Status: A Part II for CN-1017, "Survey of Separation Processes," has been completed and will be issued in the next two weeks. A flow sheet is now being prepared for the BiPO₄ Process as operated at Chicago, Clinton and as proposed for Hanford. ⁴

Proposed Program: It is proposed to pursue actively the evaluation work and during the next three months to bring all of the separation processes up to date.

Status reports will be issued bi-monthly.

Reason for Proposed work: This will fulfill a definite need of the Project for centralized information on the Separations Processes.

Reports on Part I: None issued yet.

Next Review Date September 1, 1944

Man-Months Authorized (Part II) 4

Man-Months Used (Part I) 1

Submitted by J. D. Maloney

Approved by E. E. Kidd

Estimated Completion Date Indefinite

Chas M Cooper

Estimated Man-Months to Complete "

Supervisor Responsible J. B. Tepe

Authorized by H. J. Vernon 17

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File Serial 34

Problem No. 285-ML-56-4

Date July 1, 1944

Priority B-2

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PROGRAM AUTHORIZATION (PART III)

This Document contains 1
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Issued to: Clinton

Title: Status of Separation Processes

Objective: To follow all developments on the separation processes, to maintain an index of the sources of detailed information and to condense the most significant facts and data into summaries for the Technical Division, General Engineering Section files.

Progress (Parts I and II) and Present Status: Reports CN-1017 and CN-1603 which include descriptions, flowsheets and critical evaluations of the main line and several alternate separation processes were prepared on this authorization and have been issued. These reports covered only the period prior to October 1, 1943.

All of the Project literature issued prior to June 1, 1944 which reports on separation process developments has been reviewed, and a summary covering the period October, 1943 to June 1, 1944 is in preparation for the Technical Division files.

Proposed Program: Future developments on the main line and alternate separation processes will be followed closely and work necessary to the accomplishment of the objectives as outlined above will be carried out.

Reason for Proposed Work: This work is needed to facilitate in the Technical Division the handling of special 200-area problems.

Reports on Parts I and II: CN-1017 and CN-1603.

Remarks: Parts I and II called for issuance of critical reports comparing various processes. (See above). Under Part III it is proposed to devote only enough effort to maintain files adequate for work in the Technical Division.

Next Review Date October 1, 1944

Man-Months Authorized (Part III) 4

Man-Months Used (Parts I and II) 5

Estimated Completion Date Indefinite

Estimated Man-Months to Complete One man full time

Supervisor Responsible J.B. Tape

Submitted by J.O. Maloney

Approved by J.O. Maloney

Chas. M. Cooper

Authorized by H.C. Vernon

MUC-EWB-216

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Received: July 12, 1944

Issued: Aug 9 1944

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File Serial 36

285-ML-59-4 Old
Problem No. 285-ML-55-4 New
Date October 1, 1944
Priority B-2

PROGRAM REVIEW

Title: Status of Separation Processes

Progress and Present Status: Reports CN-1017 and CN-1603 which include descriptions, flowsheets, and critical evaluations of the main-line and four alternate separation processes were prepared on this authorization and have been issued. These reports covered only the period prior to October 1, 1943.

A report summarizing the status of development of the various separation processes as of June 1, 1944 has been completed and is available in the General Engineering files. An evaluation of the hexone isolation method compared to the present peroxide isolation method for Hanford has been made.

Program for Balance of Authorization: The General Engineering Section will continue to assemble information on the separation processes in an effort to keep an up-to-date file on them.

Reports: CN-1017 and CN-1603.

Man-Months Expended 4-1/2

Next Review Date January 1, 1945

Written by RE Clark
Group Leader Responsible J.B. Tepe
Section Chief J.P. Maloney
Division Director J.B. Greninger

CS-1465 F. S. 34
Supplement C
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File Serial 34

Problem No. 285-MI-55-4
Date December 30, 1944

FINAL REVIEW

Title: Status of Separations Processes

Closing Status:

CS-1465 F.S. #34
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The objective of this program was to follow all developments on the separations processes and to prepare review reports for the files of the General Engineering Section, Technical Division.

Two review reports were prepared and issued which included descriptions, flowsheets, and evaluations of the main-line and alternate separations processes and covered only the period prior to October 1, 1943. A third report was prepared which contained similar information, but which extended the period covered to June 1, 1944. The latter report is being examined by the interested parties at this time pending a decision as to whether or not it should be issued.

Reports: CN-1017, CN-1603, MUC-TDGE-557.

Total Man-Months Expended 5

Group Leader Responsible B. Tepe

Section Chief J. A. Maloney

Division Director Chas. M. Chapin

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PROGRAM AUTHORIZATION

Title:

Design of a Smoke Generator

CS-1465 File Serial 35
This document consists of 1
page and no figures.
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Series A
Issued to:

Objective:

To design a smoke generator capable of furnishing smoke
in amounts proportional to the stack gas activity.

Present Status:

It is desirable to have some means of showing the manner in
which the stack-gas activity from the separation plants
at W is being distributed over the countryside.

Proposed Program:

It has been proposed that a smoke be used to trace the distribution.
The smoke would be generated by a means similar to one employed by
the armed forces in laying down smoke screens. This smoke consists
of a mixture of hot gases and oil drops.

It is proposed to design a smoke generator whose output is proportional
to the stack-gas activity. It will be necessary to modify the present
armed forces design so a variable and smaller capacity can be obtained.

Reason for Proposed Work:

Requested by C. M. Cooper

Remarks:

Review Date March 15, 1944

Man-Months Authorized 3

Estimated Completion Date April 15, '44

Estimated Man-Months to Complete 4

Submitted by J. O. Maloney

Approved by G. E. Kinn

Chas. M. Cooper

Supervisor Responsible J. O. Maloney

Authorized by Samuel Hillman

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial No. 35

Problem No. 226 ML-55-2d
Date March 18, 1944

PROGRAM REVIEW

Title: Design of a Smoke Generator

CS-1465 File Serial 35
This document consists of 1
page and 0 figures.
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Series A
Issued to: Clinton

Present Status:

A flowsheet with equipment sizes has been made for the smoke generator, which will handle 10, 20, or 30 g.p.h. of Diol 70 oil. It is designed to use fuel oil to heat the Diol 70 oil to 900°F. with necessary controls for temperature, pressure and flow rates of fuel oil, Diol 70, and water.

It is planned to prepare detailed drawings of the equipment, which, with a discussion of the design details, will be submitted to the plant operating personnel.

The need and method of using the smoke generator must be determined in the field, as it is entirely possible that a unit using 10 g.p.h. of oil will be adequate.

Reports none

Notebooks none

Man-Months Expended 1

Man-Months Authorized 3

Written by R.H. Johnson

Supervisor Responsible J.O. Maloney

Section Chief C. E. Kild

(Please file in booklet of Program Authorizations as first supplement to File Serial 35)

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 35

Problem No. 226-ML-55-2d
(226-ML-59-2d)

Date August 28, 1944

FINAL REVIEW

Title: Design of a Smoke Generator

Closing Status:

A report has been written giving the basis for the design of an oil-vapor smoke generator shown on ES-7. Construction of a unit is not contemplated unless requested from Hanford.

Reports:

CE-1994

Total Man-Months Expended 1

Group Leader Responsible R. H. Jephens
Section Chief J. O. Maloney
Division Director Chas M Cooper

CS-1465 F. S. #35, Supple. B
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Received: August 30, 1944

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PROGRAM AUTHORIZATION

Title: Metallurgy of Product

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Objective: (1) To develop methods for reduction, and casting of uranium and plutonium of a high degree of purity.

Present Status: Methods for reduction of uranium on 1-gram scale have been developed and recommended for "Y". This has included development of small non-porous crucibles of BeO and ThO₂. Work on larger scale is in progress.

Proposed Program: (1) Develop alternate methods for reduction of plutonium.

- a. Using uranium and other stand-ins.
- b. On one-gram scale for plutonium.

(2) Develop methods for casting uranium and plutonium of high purity including precision casting.

(3) Determine properties of plutonium and its alloys as requested by "Y".

Reason for Proposed Work: To secure basic Metallurgical information on product.

Remarks: Part of a general program of cooperation with "Y".

Review Date March 25, 1944
Man-Months Authorized 15

Submitted by

Estimated Completion Date Dec. 31, 1944
Estimated Man-Months to Complete 60-70

Approved by

Chas M Cooper

Authorized by

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FINAL REVIEW

CS-1465 File Serial #36 Supple. A
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Title: Metallurgy of Product

Closing

Status: This report is prepared as a metallurgical supplement to the Program Review of 215-ML-54-10, "Refractories for Melting and Casting" and for this reason it covers the research on metal reductions at Chicago since August 1st. The refractory and metallurgical work was done in a single group under Dr. T. T. Magel until his departure for Site Y February 5th. The Ceramics Group was then formed as a separate unit about February 18th. Consequently, there was considerable shifting of personnel and direction during the period covered by this review. There is no intention of covering the work in complete detail at this time, as the program is not finished, but is being subdivided and continued under the following designations:

File Serial No. 50
Title:

Problem No. 215-ML-54-7A
Bomb Reductions of Uranium and Uranium Alloys

File Serial No. 51
Title:

Problem No. 341-ML-54-7E
Measurement of Vapor Pressure of Uranium, Plutonium and Their Compounds

File Serial No. 52
Title:

Problem No. 215-ML-54-7F
Production of Uranium Metal by the Hot Wire Technique

The present status is as follows:

(1) Bomb Reductions:

The conventional bomb reduction of UF_4 with an excess of Ca in the presence of Ca and I_2 as a booster does not result in good slag metal operations on 10 g., 1 g., or smaller scale operations. This difficulty was overcome by the procedure of placing the steel bomb in a graphite centrifuge which also serves as a heater. This was demonstrated to be a marked improvement over stationary bomb reductions giving consistent yields above 90%. The technique was applied successfully to 50 mg. and 10 g. reductions and has been transferred to Y for use on plutonium. Glazed BeO crucibles are preferred.

In stationary bomb reductions a better nugget can be obtained by adding sufficient manganese or zinc chloride to form a 5% alloy with these elements. These impurities can be removed subsequently by distillation during vacuum melting.

The use of UCl_4 instead of UF_4 in stationary reductions often gave poorer yields, but the button obtained was cleaner and under these conditions it does not seem to be necessary to use the Ca and I_2 booster. The use of $CaCl_2$ is also beneficial.

(2) Hot Wire Reductions:

The hot wire technique is being developed as one of the promising methods for obtaining metal of high purity. Uranium is being used as a stand-in. In other applications of this method the metal has been formed below the melting point as a solid wire. With uranium it has been necessary to operate above the melting point and this creates several experimental problems. Side reactions have prevented continuous formation of the metal and a suitable filament material was not known. It has been found that W filaments coated with ThO_2 are suit-

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able and that the reaction is continuous when oxygen is rigorously excluded and UI_4 is supplied in the presence of hydrogen. Good operating conditions maintain the oven at 500°C and the filament at 1500°C with the iodine reservoir at room temperature and the hydrogen flowing at a pressure of 100-200 microns. Deposits of about 300 mg. are obtained but the metal does not drip off of the filament as desired.

(3) Vapor Pressure Measurements:

Vapor Pressures have been measured by the effusion method to yield the following data:

Material	<u>Vapor Pressure in mm of Hg</u>				<u>Heat of Vaporization Calories</u>
	1673°K	1873°K	2073°K	2273°K	
Pu Oxide	2.2×10^{-8}	2.4×10^{-7}	6.1×10^{-6}		101,000
U Oxide (UO_2)		7.1×10^{-5}	4.0×10^{-3}	7.2×10^{-2} /	137,000

The work was done to obtain rough order of magnitude type of information as rapidly as possible, and it definitely needs to be repeated with greater precision.

Reports:

The work carried out under T. T. Magel and L. S. Foster was reported in a series of monthly reports: CK 897, Aug. 28, 1943; CK 963, Oct. 11, 1943; CK 1040, Nov. 6, 1943; CK 1130, Dec. 10, 1943; and CK 1240, Jan. 19, 1944. The work carried out under G. Derge and L. S. Foster was issued in two status reports: CS 1474, pp.31-33, Feb. 29, 1944; and CS 1568, pp.23-24, Mar. 31, 1944.

(1) Bomb Reductions:

T. T. Magel

Notebook numbers - 22-B, 23-B, 96, 97, 120-B, 186, 191-B, 1016
1150

L. S. Foster

Notebook numbers - 1015

(2) Hot Wire Reductions:

T. T. Magel

Same as above

L. S. Foster

Same as above

(3) Vapor Pressure Measurements:

T. T. Magel

Notebook number - 1016

M. Cefola

Notebook number - 795

Total Man-Months Expended: 21 since January 1st

Supervisor Responsible G. Derge

Section Chief J. Chipman

University of Chicago File Serial 37
Metallurgical Laboratory
Technical Division

Problem No. 215 ML 54-
Date January 13, 1944
Priority A-2

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PROGRAM AUTHORIZATION

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Issued to:

Title: Refractories for Melting and Casting

Objective: To investigate various refractories that may be used for reduction and melting of uranium and plutonium of high purity. To prepare refractories for use at Chicago and "Y."

Present Status: Satisfactory 1 gram crucibles of BeO have been prepared. Preliminary studies indicate possibility of using ThO_2 , TiN, ZrN, MgO, CaO, Y_2O_3 .

Proposed Program: Establish a Refractories laboratory for investigation and production of refractories for Chicago and "Y". Prepare crucibles requested by "Y". Undertake development of above refractories in the order named.

Extensive additions to present laboratory facilities will be required.

Reason for Proposed Work: Refractories which will not contaminate pure uranium and plutonium are needed for reduction and casting.

Remarks: Essentially no research or production of refractories is planned at "Y".

Review Date March 25, 1944
Man-Months Authorized 20
Estimated Completion Date 12/31/44
Estimated Man-Months to Complete 120

Submitted by
Approved by J. Chapman

Authorized by Robert K. Allison

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 37

Problem No. 215 ML-54-10
Date April 1, 1944
Priority A-2

PROGRAM REVIEW

Title: Refractories for Melting and Casting

Progress and Present Status:

CS-1465 File Serial #37

Supple. A

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Issued to: Clinton

(1) Production of small BeO crucibles, (Type "C" for Site Y) has been continued, using a slip casting technique, and firing at 1750 - 1850°C in an oxy-acetylene or oxy-propane heated refractory brick kiln, after pre-firing at 1000 - 1200°C in an electrically heated muffle furnace. Larger crucibles of the same type have been produced for use at Chicago.

(2) MgO crucibles have been produced (Type "A" for Site Y) by tamping around a mandril in a graphite mold and firing by induction.

(3) Crucibles of Ti, prepared by dry-pressing commercial TiN, have been successfully fired in vacuo by induction heating, using a shield of Molybdenum. Such crucibles become incandescent and reach a temperature of 2000°C (in vacuo) in a few minutes in a suitable coil of a high frequency induction furnace.

(4) It has been agreed upon to transfer the Ceramics Group to Massachusetts Institute of Technology to take advantage of more adequate laboratory space. The work will be under the direction of Professor F. H. Norton.

Program for Balance of Authorization: Since the group will have been completely transferred by the date of this review, no further work will be done on this authorization.

Reports: A terminal report will be compiled summarizing the previous work and giving in detail the work carried out under this authorization.

Man-Months Expended 8.65

Next Review Date June 1, 1944

Supervisor Responsible L. S. Foster

Section Chief R. B. Heninger

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FINAL REVIEW

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Title: Refractories for Melting and Casting

Issued to: *Chadler (R. L. Dox - Pers.)*

Closing Status: This report will be supplemented by the Final Review of problem number 215 ML-54-7, and summarizes the work since July, 1943. The ceramic work was combined with the metallurgical work in the Pure Metal Group during the major part of this period and was under the supervision of T. T. Magel, Group Leader, until his departure to Site Y early in February, 1944. L. S. Foster served as Associate Group Leader. The Group Authorization for the ceramics work discussed here was issued on January 13, 1944 and on February 17, 1944 the Pure Metal Group was divided into two groups: (1) Pure Metal, G. Derge, Group Leader, and (2) Refractories, L. S. Foster, Group Leader. It was later decided that the work on refractories could be done more effectively at the Massachusetts Institute of Technology and the transfer of the group was completed by April 1, 1944. The work is being continued there under the supervision of Professor F. H. Norton.

During the development period, many refractories were investigated, but attention was ultimately focussed upon three: BeO, MgO and TiN. A method of firing slip-cast BeO crucibles was developed, using a kiln lined with high alumina brick and heated by oxy-acetylene or oxy-propane torches. The crucibles produced were porcelain-like and non-porous. Satisfactory MgO crucibles were produced and fired in graphite molds, using induction heating, but they were more porous. TiN crucibles were dry-pressed and fired in vacuo by induction heating, using a molybdenum cylinder as the heater. The investigation of the refractory problem was barely begun and has been continuing at M.I.T.

Reports: The work carried out under T. T. Magel and L. S. Foster was reported in a series of monthly reports: CK-897, August 28, 1943; CK-963, October 11, 1943; CK-1040, November 6, 1943; CK-1130, December 10, 1943; and CK-1240, January 19, 1944. The work carried out under G. Derge and L. S. Foster was issued in two status reports CS-1474, pp. 31-33, February 29, 1944; and CS-1563, pp. 23-24, March 31, 1944.

A terminal report covering the refractories work was issued on June 1, 1944 and given the number CT-1711 (A-2436)

Total Man-Months Expended:

Between March 1 and April 1: 8.65
Between Jan. 1 and June 1 : 22

Supervisor Responsible: *L. S. Foster*

Section Chief: *A. B. Greninger*

Received: May 24, 1944
Issued: JUN 24 1944

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PROGRAM AUTHORIZATION

OS-1485 File Serial 38. This document consists of 1 pages and no figures. Copy No. 27 of _____ copies. Series A. Issued to: _____

Title:

Design of a Submerged Reactor for Installation in the Metal Storage Canal at Hanford.

Objective:

To design and construct an apparatus suitable for carrying out the various separation process steps in the presence of external radiation. The unit will be designed to process about a liter of material. It will be tested at Chicago and then turned over to the Du Pont Company for final testing at Clinton, prior to installation at Hanford.

Present Status:

Extensive chemical operations in the presence of high beta and gamma activity will be carried out for the first time at Hanford. Facilities should be available at Hanford in order to make studies on a laboratory size scale under full level radiation. By such a method as proposed below it will be possible to divorce the chemical and radiation effects in the event that the process should fail to operate at some point. Although the specific need for such a unit is not yet obvious, it is believed advisable to provide one as insurance.

Proposed Program:

It is proposed to employ the active metal in the 60-day storage basin at Hanford as a source of radiation and to conduct any necessary experiments in the presence of this radiation. The solutions being processed will contain only tracer activity of fission product. The equipment will be so designed that the solution can be removed at any point in the process from the radiation field and operations carried on without shielding.

The problem from this Section's standpoint will consist of designing, constructing, and testing of the equipment. The unit will be capable of operating under water and in the presence of radiation and will permit the extraction and decontamination steps to be carried out.

It will be necessary to consult with the various responsible parties at Clinton and Chicago to determine the chemical experiments to be done and the actual conditions of radiation.

Reason for Proposed Work:

Requested by C. H. Greenewalt.

Remarks:

Review Date April 15, 1944

Man-Months Authorized 2

Estimated Completion Date 6/15/44

Estimated Man-Months to Complete 6

Submitted by J. O. Maloney

Approved by Chas M Cooper

Supervisor Responsible R. H. Johnson

Authorized by H. C. Johnson 7/9/44

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 38

Problem No. 207-ML-55-2e
Date April 15, 1944
Priority A-2

PROGRAM REVIEW

Title: Design of a Submerged Reactor for Installation in the Metal Storage Canal at Hanford.

Progress and Present Status: An apparatus suitable for carrying out the separations process steps in the presence of external radiation has been designed and is being constructed. Radiation calculations have indicated that ionization intensity, in the proposed reactor will be approximately twice that expected in the plant reactors in the 200 Area at W.

The reactor is 5 in. in diameter and 9 in. high with an electric heater on the bottom and cooling water on the sides in a jacket. A Selsyn motor drive is supplied which will have a limited range of variable speed for the agitator. The entire assembly would be placed in an 11 in. diameter 30 in. high cylinder which will have a hose connection extending above the water surface of the storage basin. It is expected that solutions will be added through 347 type capillary tubing.

Orders for the stainless steel and motors have been placed. Some delay is being experienced in obtaining some of the plate. Substitutions will be made if the situation does not clear up shortly. The other miscellaneous materials are being ordered for delivery the last week in April. It is expected that detailed prints will be available May 1 for construction of the units.

A guide for handling the reactor and a control bench are being constructed as auxiliary equipment. Two complete reactors are being built to obtain results in the shortest possible time with control runs on solutions not exposed.

Program for Balance of Authorization: Tests will be made of the feasibility of adding chemicals through 1 and 2 mm. stainless steel tubes at known rates.

Construction of the two units will be completed by June 15, and tested as to feasibility of carrying out the bismuth phosphate extraction and decontamination steps.

Depending on further developments the unit will be shipped to Site X for exploration under the lower radiation level available there. Conditions may be such however, that it would be necessary to use the equipment at Site W before it can be used at Site X.

Reports: February and March Status Reports, TDGE-155 and 187.
Technical Division Drawings, 35, 41, 46, 47, 50 and 51.

Man-Days Expended 61₂

Man-Days Authorized 52

Next Review Date 6 15-44

Supplement A
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Supervisor Responsible R. H. V. Lewis

Section Chief G. E. Kish

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PROGRAM AUTHORIZATION (PART II)

CS-1465-F.S.# 38 Supple. B

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Issued to: *Chilton*

B. H. Adams - Pers.

Title: Design of a Submerged Reactor for Installation in the Metal Storage Canal at Hanford.

Objective: To design and construct an apparatus suitable for carrying out the various separation process steps in the presence of external radiation. The unit will be designed to process about a liter of material. It will be tested at Chicago and then turned over to the Du Pont Company for installation at Hanford.

Progress and Present Status: An apparatus suitable for carrying out the precipitation steps of the proposed separation process in the presence of external radiation has been designed and is being constructed. Radiation calculations have indicated that ionization intensity, in the proposed reactor, will be approximately twice that expected in the plant reactors in the 200 Area at W.

The construction of the reactors has been started, the parts that require welding and polishing have been sub-let to an outside fabricator, while the machining and assembly will be done in the Ryerson Shops. Slow delivery of capillary tubing for the feed lines is delaying completion of the reactors.

The control bench for the reactor has been constructed and is ready for use.

Tests have been made in the laboratory on a liter scale of the de-contaminations that may be expected through the extraction, by-product and product precipitation of the bismuth phosphate process. Tests of the amounts of liquid retained in the capillary feed lines indicate that 1.5 cc. of solution is the maximum that will be retained. This can readily be removed by flushing with 10 cc. of water; hence, it will not be necessary to alter the amount of reactants or the concentration of the solutions used in the tests.

Proposed Program: Complete construction of the reactors.

Carry out at least three complete bismuth phosphate cycles in each reactor through the first product separation by July 15.

Write a report on the work by August 1 and ship the equipment to Site W when requested.

Reason for Proposed Work: Requested by C. H. Greenewalt.

Reports on Part I: February, March, April and May Status Reports.
Technical Division Drawings 35, 41, 46, 47, 50 and 51.

Next Review Date August 1, 1944
Man-Months Authorized (Part II) 4
Man-Months Used (Part I) 1-3/4
Man-Months Authorized (Part I) 2
Estimated Completion Date August 1, 1944

Supervisor Responsible *R. H. Jechens*

Submitted by *R. H. Jechens*

Approved by *C. D. Malone*

Chas. M. Cooper

Authorized by *H. B. Vernon*

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File Serial 38

Problem No. 207-ML-55-2e
(207-ML-59-2e)
Date August 1, 1944
Priority A-2

PROGRAM REVIEW

Title: Design of a Submerged Reactor for Installation in the Metal Storage Canal at Hanford.

Progress and Present Status:

As of August 1 the reactors were being fabricated and the capillary tubing had been received. The Ryerson Shop will assemble the two units as soon as received.

Program for Balance of Authorization:

Provide facilities for handling the reactors at West Stands, so that the Engineering Development Section can carry out sufficient bismuth phosphate cycles to show that reproducible results can be obtained.

We have been requested to have the units at Hanford ready for operation by October 15, and this schedule can be met.

Reports: None

Man-Days Expended 4

Next Review Date October 15, 1944

Group Leader Responsible R.H. Jekens

Section Chief J.B. McGree

Division Director W.B. Greninger

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File Serial 38

Problem No. 207-ML-55-2e

Date November 21, 1944

Priority A-2

FINAL REVIEW

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Title: Design of a Submerged Reactor for Installation in the Metal
Storage Canal at Hanford.

R. L. Sloan Pers

Closing Status: The submerged reactor for carrying out the precipitation steps under gamma radiation in the separation of product from tuballoy and fission products has been designed and constructed. Two units were built and the second unit will be used as a control unit. The units have been tested by the Engineering Development Section and found to give reproducible results in yield and decontamination. The units have been sent to Hanford, attention L. Squires, on October 12, 1944.

Reports: CN-2369

Total Man-Months Expended: 5-1/3

R. H. J. [unclear]
Group Leader

J. O. Maloney
Section Chief

Chas M. Cooper
Division Director

Report received: November 30, 1944

Issued:

DEC 11 1944

The design is LIMITED. Indicated
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PROGRAM AUTHORIZATION

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Title:

Study of Defects in W-Slug Metal.

CS-1465 File Serial 39

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Objective:

To determine the nature, extent, and seriousness of defects in W-slugs and to develop tests for soundness of W-size slugs or rods.

Present Status:

Many W-slugs show considerable porosity. Some slugs show voids ranging from small pores to blow holes 1/8 inches in diameter. Others show seams of non-metallic material. Bulk densities have been found to range from 18.77 to 18.94 grams/cm³.

Proposed Program:

Many W-slugs should be sectioned and examined for soundness. This will show the frequency, nature and magnitude of defects in these slugs. Non-destructive tests for soundness should be developed. Bulk density measurements may serve this purpose. Other tests, such as supersonic transmission may be necessary.

Reason for Proposed Work:

Porosity in W-slugs is undesirable in that it decreases thermal conductivity and mechanical strength and interferes with complete wetting during hot dipping. The origin of the porosity is not definitely known. Visual inspection of the machined slug does not indicate the extent of the porosity.

Remarks:

Review Date April 15, 1944

Man-Months Authorized 2

Estimated Completion Date April 15, '44

Estimated Man-Months to Complete 2

Submitted by Frank J. Frost

Approved by AB Brinkley

Authorized by H. L. Vernon

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 39

Problem No. 155-ML-54-5g

Date April 15, 1944

Priority A-2

PROGRAM AUTHORIZATION (Part II)

Title: Study of Defects in W-Slug Metal

CS-1465 File Serial #39 Part II
Supple. A - This document consists
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Objective: To determine the nature, extent and seriousness of defects in W-slugs
and to develop tests for soundness of W-size slugs or rods.

Progress (Part I) and Present Status:

1. W-Slugs cut from extruded rod contain many concealed defects in the form of holes and seams. These defects do not appear to be serious from the heat flow standpoint but may be serious from the mechanical strength standpoint.
2. Density determinations do not appear to be a satisfactory non-destructive testing method. Measurement of supersonic transmission does appear to be a satisfactory testing method.
3. Swaging of extruded rod does not improve the quality of the rod as regards internal defects and often results in surface damage. Rolling at 600°C produces W-size rod of much higher quality than does extrusion.

Proposed Program:

1. Work on the testing, sectioning and examination of W-slugs cut from metal rods produced by different fabrication methods will be continued to include a greater number of pieces. Particular attention will be paid to rods fabricated by alpha phase rolling.

Reasons for Proposed Work:

1. The development of alpha phase rolling as a fabrication method required that the program on evaluation of metal quality be extended to include this metal.

Next Review Date June 15, 1944
Man-Months Authorized (Part II) 2
Man-Months Used (Part I) 2
Estimated Completion Date June 15, 1944
Estimated Man-Months to Complete 2
Supervisor Responsible Frank Foote

Submitted by: Frank Foote

Approved by: A.B. Sheringer
J. Chipman
Chas. M. Cooper

Authorized by: H.C. Vernon

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File Serial 39

CS-1465
F.S.#39 Sup.B
Problem No. 155-ML-54-5
Date July 1, 1944
Priority A-2

PROGRAM AUTHORIZATION (Part III)

UNCLASSIFIED

Title: Study of Defects in W-Slug Metal

Objective: To determine the nature, extent and seriousness of defects in W-Slugs and to develop tests for soundness of W-Size slugs or rods.

Progress (Parts I and II) and Present Status:

1. W-Slugs cut from gamma extruded rod contain many concealed defects in the form of holes and seams. Cold swaging of gamma extruded rod does not improve the quality of the rod as regards internal defects and often results in surface damage. W-Slugs cut from alpha rolled rods are sound internally but may show surface seams and laps.
2. Internal and visually undetectable defects do not appear to be serious from the heat flow standpoint. Surface defects are serious in that they interfere with complete coverage during hot dipping or plating.
3. Density measurements are not satisfactory as a non-destructive testing procedure. Supersonic transmission tests are satisfactory for the detection of internal defects. The Zyglo method is satisfactory for the detection of surface defects.

Proposed Program:

Specimens of rod, gamma extruded by an improved process have been received. These specimens will be examined for soundness and compared with gamma extruded rods previously examined.

Rods fabricated by alpha rolling will be examined for defects and the results correlated with rolling technique and particularly with roll pass design.

Reasons for Proposed Work:

Recent changes in extrusion technique and in roll pass design requires that the program on evaluation of metal quality be extended to include rods prepared by these procedures.

Next Review Date August 15, 1944
Man-Months Authorized (Part III) 3
Man-Months Used (Parts I and II) 4
Estimated Completion Date August 15, 1944
Estimated Man-Months to Complete 3
Supervision Responsible Frank Foote

Submitted by Frank Foote
Approved by W.B. Hensinger
Chas M Cooper
Authorized by H.B. Vernon 7/3

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Received: July 12, 1944
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File Serial No. 40

University of Chicago
Metallurgical Laboratory
Technical Division

Problem No. 390-ML-55-S

Date 2/29/44

Priority A-1

PROGRAM AUTHORIZATION

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This document consists of
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Title: General Assistance and Design Studies

- Objective:
- (1) To render assistance on engineering problems for which no program authorization is available.
 - (2) To carry out preliminary designs on processes which might have possibilities.

Present Status:

Proposed Program: The program depends upon the amount of assistance required. No more than 1/2 man-month per month will be spent on any one problem without more formal authorization.

Reason for Proposed Work: Such a general account is necessary for any group operating on program authorizations. In many cases it is necessary to do a certain amount of library and preliminary calculations in order to determine if a program is in order.

Review Date 6/1/44
Man-Months Authorized 4
Estimated Completion Date _____
Estimated Man-Months to Complete _____
Supervisor Responsible G. E. Kinn

Submitted by J. O. Maloney
Approved by G. E. Kinn
Chas M Cooper
Authorized by H. B. Thomas Jr

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University of Chicago
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File Serial No. 40

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PROGRAM AUTHORIZATION (PART II)

CS-1465

F.S.#40 Supple. A

Problem No. 390-ML-56-S

Date June 21, 1944

Priority A-1

UNCLASSIFIED

Title: General Assistance and Design Studies

- Objective:
- (1) To render assistance on engineering problems for which no program authorization is available.
 - (2) To carry out preliminary designs on processes which might have possibilities.

Present Status: Work performed under this authorization may be divided into two groups, conducting exploratory calculations and designs on processes believed to have possibilities, and rendering assistance on small jobs for which no program authorization exists or is needed.

Examples of the first group are

1. Preliminary studies of purification of the product by extraction (subsequently F.S.49).
2. Preliminary studies on the long tube cartridge (F.S.48).

Examples of the second group are

1. Development of an improved method of analysis of adsorption data. (Report CN-1672)
2. Survey of the information on the boiling disease.
3. Calculations on the various schemes for the testing of slugs.

Proposed Program: The program is a direct function of the amount of assistance required by the various Sections and Divisions. As in the past no more than 1/2 man-month per month will be spent on any one problem without more formal authorization.

Reason for Proposed Work: Such a general account is necessary for preliminary survey of the heterogeneous problems that come to the Section and for rendering limited assistance to other portions of the Project.

Next Review Date October 1, 1944
Man-Months Authorized (Part II) 6
Man-Months Used (Part I) 6
Estimated Completion Date None
Estimated Man-Months to Complete Indefinite

Submitted by J.O. Maloney

Approved by J.O. Maloney

Chas M Cooper

Supervisor Responsible J.O. Maloney

Authorized by H.B. Vernon

MUC-EWB-217

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 40Problem No. 390-ML-55-S
(390-ML-59-S)Date August 30, 1944Priority A-1

SEP 16 1944

PROGRAM AUTHORIZATION (PART III)

Title: General Assistance and Design Studies

- Objective: (1) To render assistance on engineering problems for which no program authorization is available.
- (2) To carry out preliminary designs on processes which might have possibilities.

Present Status: The time charged against this account has consisted principally in rendering assistance on work for which no program authorization exists or is needed. Considerable ventilation work has been done including the carpenter shop at the Armory, the machine tools in Room 135, Site B, and the laboratory centrifuges handling product. A survey of the problems involved in the storage and disposal of active wastes has been made. Auxiliary equipment for installing a chain drawbench has been secured and the drawbench set up to operate. Calculations on the peroxide concentration of the water film in the pile tube at W have been made.

Proposed Program: The program is a direct function of the amount of assistance required by the various Sections and Divisions. As in the past no more than 1/2 man-month per month will be spent on any one problem without more formal authorization.

Reason for Proposed Work: Such a general account is necessary for preliminary survey of the heterogeneous problems that come to the Section and for rendering limited assistance to other portions of the Project.

Reports: NoneNext Review Date December 1, 1944Man-Months Authorized (Part III) 8Man-Months Used (Parts I and II) 12Estimated Completion Date NoneEstimated Man-Months to Complete IndefiniteGroup Leader Responsible J. O. MaloneyWritten by J. O. MaloneyApproved by J. O. Maloney
(Section Chief Responsible)Authorized by H. C. Vernon

CS-1465 F.S. #40
Supplement B
Part III
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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial No. 41

Problem No. 151 ML 54-2
Date 3/1/44
Priority --

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PROGRAM AUTHORIZATION

CS-1465 File Serial 41
This document consists of 1
page and 0 figures.
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Series A
Issued to: Clinton

Title: Metallurgy of Tuballoy (Foundry).

- Objective:
1. Custom casting - Preparation of metal of special shape or composition;
 2. Scrap recovery, metal purification.

Present Status:

1. Several extrusion billets are cast for Creutz every week, occasional request from Creutz and others for castings of particular size, shape or composition are filled.
2. Considerable scrap metal returned to Site B foundry is contaminated with impurities picked up in extrusion, rolling, coating, etc. Present indications are that this impure metal can be purified to some extent by melting under fluxes with small amounts of lead which is subsequently volatilized by vacuum melting.

Proposed Program:

1. The foundry will continue to fill request for special castings.
2. The foundry will continue work on the melting and purification of scrap metal using different fluxes and volatile metals such as lead, antimony, bismuth, etc.

Reasons for Proposed Work:

1. Special castings are required.
2. To insure full utilization of scrap metal, information obtained may have application in work on product metal.

Remarks:

Review Date May 15, 1944
Man-Months Authorized 5
Estimated Completion Date --
Estimated Man-Months to Complete --

Submitted by Frank Foote
Approved by W. B. Heninger
John Chapman
Authorized by W. B. Heninger 3/4

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~~LIMITED~~

Next Review Date June 15, 1944
Man-Months Authorized (Part II) 11
Man-Months Used (Part I) 9
Estimated Completion Date None
Estimated Man-Months to Complete Con-
tinues indefinitely
Supervisor Responsible F. Foote

Submitted by Frank Foote
Approved by AB Greninger
Chas. H. Cargen
Chapman
Authorized by W. H. Greninger

University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 41

Doc. No. 151 ML-54-1
Date April 1, 1944
Priority ---

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PROGRAM AUTHORIZATION (Part II)

CS-1465 File Serial 41 Part II.
This document consists of 2 pages
of text and 0 pages of figures.
Series A.
Issued to: 27 - Clinton

Title: Metallurgy of Tuballoy (Melting, Casting, Physical Properties)

Objective:

1. Custom Casting - To prepare metals and alloys of special shape or composition.
2. Physical Properties - To measure properties such as hardness, tensile strength and ductility as affected by metal quality, mechanical working and heat treatment.

Progress (Part I) and Present Status:

1. A total of 60 castings weighing a total of 3,670 pounds have been made in the period of January 1, 1944 to March 31, 1944.
2. Work on physical properties have hitherto been carried on as exploratory work. Most of the previous work on physical properties have been done on extruded metal which is of doubtful quality as shown by work under P.A. No. 155-ML-54-5g. The validity of the results previously obtained is questionable because of the uncertain quality of metal used as specimens.
3. Work on scrap recovery and metal purification has been completed.

Proposed Program:

1. The foundry will continue to fill requests for special castings.
2. Hardness and tensile tests will be made on high quality metal fabricated by rolling. The tests will be made on the metal as rolled and after annealing in the alpha range and after quenching and slow cooling from the beta and gamma ranges. The physical properties will be correlated with the prior treatment of the metal and will be compared with those of lower quality metal.

Reasons for Proposed Work:

1. Special castings are required by various project members.
2. Rolled metal appears to be of much higher quality than extruded metal heretofore available. Physical property measurements on this high quality metal should yield values more nearly representative of tuballoy metal and would give a better idea of the behavior and limitations of objects made of tuballoy metal.

Reports on Part I:

1. Custom casting in January, February and March monthly reports.
2. A report on hardness and tensile strength measurements will be issued by April 15, 1944
3. A report on scrap recovery and metal purification will be issued as soon as chemical analyses are completed.

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41

Program Authorization (Part III)

Title: Metallurgy of Tuballoy (Melting, Casting, Physical Properties)

Objective:

1. Custom Casting - To prepare metals and alloys of special shape or composition.
2. Physical Properties - To measure properties such as hardness, tensile strength, and ductility as affected by metal quality, mechanical working, and heat treatment.

Progress (Parts I and II) and Present Status:

1. A total of 111 castings weighing a total of 11,090 pounds have been made under this program. Considerable progress has been made in developing methods for making foundry size tuballoy dioxide crucibles. Tuballoy can be melted in these crucibles without contamination by carbon or by other metals.
2. Alpha rolled tuballoy has a tensile strength of about 100,000 lbs/in² and good ductility as indicated by 19% elongation in 2 in. and 16% reduction in area. The tensile strength decreased slightly and the ductility increased after recrystallization in the Alpha range. The tensile strength decreased, yield strength increased, hardness increased and ductility decreased after quenching from the Beta and Gamma region. A considerable number of additional samples have been heat treated but not yet tested.

Proposed Program:

1. The foundry will continue to fill requests for special castings.
2. The physical properties of heat treated specimens will be determined.

Reasons for Proposed Work:

1. Special castings are required by various project members.
2. Physical property measurements on high quality alpha rolled metal should give a better understanding of the behavior and limitations of objects made of tuballoy metal.

Reports on Parts I and II:

1. Monthly Status reports - January thru June, 1944.

Next Review Date October 1, 1944

Man-Months Authorized (Part III) 11

Man-Months used (Parts I and II) 16

Estimated Completion Date Continuing

Estimated Man-Months to complete 3-4 men full time

Supervisor Responsible Frank Foote

Submitted by Frank Foote
Frank Foote

Approved AB Greening

Chas M Cooper

Authorized by H. L. Vernon

ITUC-FWB-227

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University of Chicago
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Technical Division

File Serial 42

Problem No. 154 ML 54-31

Date March 1, 1944

Priority A-1

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PROGRAM AUTHORIZATION

Title:

Coatings Research
Welding, Arc and Sear

Objective:

To develop and apply methods of welding a can closure

Present Status:

Seam welded closures were used in canning metal for Clinton. By proper cleaning, reasonable perfection of weld is possible. However, the weld is not readily tested for perfection. Moreover, severe pitting corrosion takes place under the fold as ordinarily made. A combination of seam and fusion welds is possible.

Argon welding now used for Clinton Production, but is not yet satisfactory for Hanford. Atomic hydrogen welding not evaluated.

Proposed Program:

Weld large numbers of complete bonded slug assemblies from each canning method developed for H.E.W. and Clinton. Critically test the welds under operating conditions as well as more severe conditions. Evaluate each welding process, and outline an operating procedure.

Reason for Proposed Work:

A good welding method is essential for both Clinton and Hanford.

Remarks:

This authorization replaces and enlarges Problem No. 154 ML 54-31, dated January 17, File Serial #30 which is hereby closed out.

Review Date June 1, 1944

Man-Months Authorized 15

Estimated Completion Date July 1, 1944

Estimated Man-Months to Complete 25

Supervisor Responsible D. Gurinsky

Submitted by John P. Howe

Approved by A. B. Penninger
J. Chipman
W. M. Cooper

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51-20
Problem No. 201 ML 51-20
Date February 15, 1944
Priority A-1

PROGRAM AUTHORIZATION

Title: Dissolving bonded slug jackets.

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Objective: To investigate in the laboratory and evaluate in the semi-works methods of dissolving bonded slug jackets.

Present Status: Current developments indicate the possible use of an aluminum-silicon brazing alloy for bonding aluminum jackets to slugs. Other methods being evaluated are zinc bonding and solder bonding. These new canning procedures may require modifications to be made in the plant method of dissolving slug coats.

Factors involved in the decision regarding the most satisfactory jacketing procedure include (1) ease and completeness of dissolving jacket material and (2) possible interference in the separations process due to carrying of some of the bond materials into the process solution.

Proposed Program: In line with the program of the Chemical Division (201MLC1301), carry out a cooperative laboratory and semi-works investigation of the following:

- (1) Most practical plant method of removing the aluminum jacket and bonding material from "W" slugs.
 - (2) The effect of bonding materials in process solutions on product yield and decontamination efficiency.
 - (3) Check the laboratory results of items (1) and (2) above in semi-works runs using Clinton irradiated slugs having the preferred type of can bonding. The final evaluation will undoubtedly be made in the semi-works at Clinton, but some initial work may be done at Chicago.
- Reason for the Proposed Work: This study is fundamental in helping to evaluate the several slug bonding procedures now under consideration. Further, more, such an investigation must be made before attempting to use bonded slugs in actual plant operations.

Review Date April 1, 1944
Man-Months Authorized 4
Estimated Completion Date June 1, 1944
Estimated Man-Months to Complete 10
Supervisor Responsible C. E. Kircher

Submitted by *E. E. Kircher*
Approved by *Chas. M. Cooper*
H. W. Bell

Authorized by *Samuel K. Ullman*

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seen by: *J. E. Willard*
noted by *T. R. Hoggins*

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 43

Problem No. 201-ML-51-20

Date, May 19, 1944

Priority A1

PROGRAM AUTHORIZATION PART II

Title: Dissolving Bonded Slug Jackets

CS-1465 - F.S.#43 Supple.A
Pt.II This document contains
1 pages. Copy 27 of
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Objective: To investigate in the laboratory and evaluate in the Semi-works a method of dissolving bonded slug jackets followed by a determination of the affect of such dissolving procedure on the bismuth phosphate separation process.

Progress (Part I) and Present Status: Current developments indicate the possible use of aluminum-silicon or zinc for bonding aluminum cans to slugs. Another possibility is the use of solder bonding. The actual plant method of dissolving bonded slug jackets will necessarily depend on the type of bond used.

No practical method has yet been developed which will completely dissolve Al-Si bonds, but methods were developed in the laboratory for removing them, employing various combinations of acid and/or alkali treatments. In all cases an insoluble scale amounting to from 0.1% to 0.2% of the weight of uranium was left as a residue. In laboratory tests performed by the Chemical Division this scale did not seem to interfere with product carrying or decontamination.

On the recommendation of TNX Personnel a Semi-works evaluation of a dissolving procedure for Al-Si bonded slugs, consisting of successive treatments with nitric acid, caustic, and then nitric acid, was undertaken. The affect of bond scale on the chemistry of the process was checked by carrying out an extraction and one decontamination cycle on active solutions containing a maximum amount of such scale. This investigation was carried out in cooperation with the Chemistry Division. (201-MLC-1301) During the month of April 4 Semi-works runs of the type just mentioned as well as 3 control runs were made, and the results were included in the April review report.

The manpower required to carry out the above work exceeded that originally authorized in P.N. 201-ML-51-20 by 16 man-months. This Part II Request is to cover the current overrun and obtain further authorized time to complete the program recommended by TNX and the Chemistry Division.

Proposed Program: Complete the Semi-works evaluation of dissolving procedure for Al-Si bonded slugs and the affect of bond scale on the BiPO₄ separation process using Al-Si bonded slug irradiated in the Clinton pile.

Reason for the Proposed Work: To investigate the possible effects on "W" plant operation, mechanical or chemical, associated with the use of slugs having bonded jackets.

Reports on Part I: CN-1491, CN-1584.

Notebooks: 504-B, LY-20

Next Review Date: 8/1/44

Man-months Authorized (Part II): 26*

Man-months Used (Part I): 20

Estimated Completion Date: 8/1/44

Estimated Man-months to Complete: 10

Supervisor Responsible: A. C. Hyde

*This includes the overrun on Part I of 16 man-months.

Received: May 26, 1944
Issued:

Submitted by: [Signature]

Approved by: C. E. Kitcher

Chas. M. Cooper

Authorized by: [Signature]

JUN 24 1944

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File Serial 43

Problem No. 201-ML-51-20
Date, August 17, 1944

FINAL REVIEW

CS-1465 F. S. #43, Supple. B
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Title: Dissolving Bonded Slug Jackets.

Closing Status: On the basis of semi-works runs and extensive laboratory work, it was determined that the Al-Si bond between the jacket and the "W" slug could best be penetrated by an acid-caustic-acid treatment. A sufficient part of the slug surface was exposed by this treatment to permit complete dissolution of the tuballoy in 60% HNO₃ for subsequent processing by the BiPO₄ process. The resulting insoluble bond residue was found to be soft and did not interfere noticeably, either chemically or mechanically, with the BiPO₄ process. However, it was found that this sludge absorbed approximately 20% of the total gamma activity present in tuballoy HNO₃ solution.

Another process, developed by the Chemistry Division (CN-1584), consisted of processing the slugs in a NaOH solution containing NaNO₃. It was found that a 5M NaOH solution which was 1M in NaNO₃ gave an ammonia to hydrogen ratio by volume of 75 to 1. Indications were that almost all of the ammonia was liberated during the first five minutes of the treatment.

While jacket and bond removal procedures which have been evaluated in the semi-works are believed adequate, the difference in scope between the semi-works and Hanford may be too great to allow direct application of these procedures to Hanford.

Reports: CN-1353, CN-1491, CN-1584, CN-1953. Also notebook No. LY-20.
CN-1751, CN-1787. Subjects covered are given below.

Total Man-months Expended: 22

Group Leader Responsible *A. C. Miller*
Section Chief *A. C. Miller*
Division Director *A. B. Greninger*

CN-1353 Preliminary Investigations
CN-1491 Laboratory Investigations on Slug Sections
CN-1584 Effect of Dissolution Process on BiPO₄ Separation Process
CN-1751 Rate of Gas Evolution During Dissolution of Aluminum
CN-1787 } Off-gas Analyses During Jacket Removal
CN-1953 }

Received: October 25, 1944
Issued: OCT 30 1944

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File Serial 44

Problem No. 251 ML-54-1a
Date March 6, 1944
Priority A-1

PROGRAM AUTHORIZATION

CS-1465 File Serial 44
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Title: Synthetic W metal containing fission elements.

Objective: To prepare metal slugs containing fission elements at or above the Hanford level.

Present Status:

Master alloys of Cb, Zr and Mo have been prepared.

Proposed Program:

Master alloys of Ru, La, Ce, Nd and Y will be prepared. The master alloys will be used to prepare extrusion billets containing the required amounts of fission elements. About 1200 pounds of casting will be required. The billets will be cast and turned over to Clinton for extrusion, machining, and canning.

Reason for Proposed work:

Metal containing the Hanford level of fission products is needed for tests of the solution process at Clinton. (See letter from M. D. Whitaker to John Chipman, dated February 9, 1944.)

Remarks:

Review Date May 1, 1944

Man-Months Authorized 1

Estimated completion Date May 1, 1944

Estimated Man-Months to Complete 1

Supervisor Responsible Frank Foote

Submitted by Frank Froole

Approved by W B Gieninger

Chas. M. Cooke

Authorized by: H. E. ...

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 45

Problem No. 381-ML-54-³8
Date April 1, 1944
Priority See below

PROGRAM AUTHORIZATION

Title: Metallurgy of Tuballoy (Phase Diagrams, Phase Identification and Diffusion)

Objective:

1. To complete the Tuballoy-nickel phase diagram and to devise means of increasing the corrosion resistance of tuballoy slugs by diffusing nickel into the surface. (Priority B-2)
2. To identify the phases present in the bonding layers of jacketed slugs bonded with Al/Si and Zn/Al. (Priority A-1)

Present Status:

1. The high tuballoy nickel-tuballoy alloy system has been studied by thermal analysis methods and by microscopic methods. Considerable X-ray diffraction work has been done on pure tuballoy. Work on corrosion rates of tuballoy alloys under P.A.No. 391-ML-54-4e has shown the low nickel tuballoy-nickel alloys are more resistant to corrosion than is unalloyed tuballoy. Preliminary diffusion experiments have shown that it is possible to increase the nickel content of the surface layers.
2. Microscopic examination of jacketed slugs bonded by the Al/Si and by the Zn/Al process shows a complex series of reaction layers. Little is known concerning the nature or origin of the reaction layers.

Proposed Program:

1. The tuballoy-nickel alloy diagram will be completed. Slugs electroplated with nickel will be heat treated for various times at different temperatures.
2. Slugs bonded by the Al/Si and by the Zn/Al procedure will be examined by microscopic, X-ray and chemical methods after each stage of the procedure and at various depths below the surface and the phases present identified.

Reason for Proposed Work:

1. The tuballoy-nickel phase diagram should be completed as part of our general background of information on tuballoy alloy systems. The diagram is also necessary for an understanding and evaluation of heat treated nickel plated slugs. Corrosion protection by surface alloying with nickel is a possible alternate to present protective coatings.
2. The microscopic interpretation and evaluation of structures occurring in jacketed and bonded slugs is handicapped by lack of knowledge of the character and origin of the structures present.

Remarks:

Review Date June 15, 1944
Man-Months Authorized 15

Estimated Completion Date 6/15/44
Estimated Man-Months to Complete 15

Supervisor Responsible F. Foote

Submitted by Frank Foote
Approved by W.B. Greninger
J. Chipman
Chas. H. Co
ized by H. J. ...

Supplement A
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PROGRAM AUTHORIZATION (PART II)

Title: Metallurgy of Tuballoy (Phase Identification,
Phase Diagrams, Diffusion)

Objective:

1. To identify the phases present in the bonding layers of jacketed slugs bonded with Al/Si. (Priority A-1)
2. To complete the tuballoy-nickel phase diagram and to devise means of increasing the corrosion resistance of tuballoy slugs by diffusing nickel into the surface. (Priority B-2)

Progress (Part I) and Present Status:

1. Microscopic examination of slugs bonded with Al/Si has shown that the reaction layer between tuballoy and Al/Si consists of three layers. The two outer layers are 0.5-1. mils thick, the inner layer is extremely thin. The outer layer has been identified as $TuSi_3$ with some aluminum in solid solution. The middle layer has been tentatively identified as Tu_2Si_3 . The inner layer has not been isolated or identified.
2. In the Tu-Ni alloy system, two compounds Tu_6Ni and $TuNi_2$ have been identified; a third compound is believed to exist in the neighborhood of 50-60 atomic percent nickel. Tu_6Ni decomposes by peritectic reaction at about $785^\circ C$, $TuNi_2$ is stable up to the melting point. An eutectic containing 37 atomic percent nickel melts at about $730^\circ C$. Another eutectic exists at the high nickel end of the system. Nickel plated and diffused slugs are more resistant to hot water corrosion than are unplated slugs. The surfaces of the diffused slugs are rather rough and pitting corrosion occurs at defects in the tuballoy-nickel alloy surface.

Proposed Program:

1. The middle compound layer will be studied further to obtain a more positive identification. Attempts will be made to isolate and identify the inner compound layer.
2. The tuballoy-nickel phase diagram will be completed. Efforts will be made to improve the surface finish of nickel plated and diffused slugs by modification of present plating and diffusing technique.

Reasons for Proposed Work:

1. Further work is necessary to completely identify the phases in the compound layers formed by reaction between tuballoy and Al/Si. The tentative identification of these compounds as tuballoy-silicon rather than tuballoy-aluminum compounds suggests that the nature and thickness of this brittle reaction layer could be modified by controlling the silicon content of the coating alloy.
2. The tuballoy-nickel phase diagram should be completed as part of our general background of information on tuballoy alloys system. The tuballoy-nickel alloys are of particular interest since the addition of nickel to tuballoy markedly increases the corrosion resistance.

Reports on Part I:

Weekly reports of Metallurgy Section
Monthly status reports of Metallurgy Section

Next Review Date October 1, 1944
Man Months Authorized (Part II) 9
Man Months Used (Part I) 32
Estimated Completion Date October 1, 1944
Estimated Man Months to Complete 9
Group Leader Responsible J. R. Clark

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Supplement A
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Written by Frank Foote

Approved by Charles M. Cooper

Authorized by H. J. ...

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Technical Division

File Serial 46

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Problem No. 150 ML-55-5

Date 4/14/44

Priority A-1

CS-1465 File Serial #46

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PROGRAM AUTHORIZATION

Title: Design and Construct Equipment for Large Test Hole, Site W

Objective: To design and construct suitable equipment in which samples, such as aluminum and graphite, may be placed in an NEW pile to determine the effect of neutron bombardment.

Present Status: Equipment for inserting and removing test samples in one of the test holes in the W pile has been designed by the Physics Division of the Laboratory and submitted to the duPont Company for reference. This design has the general approval of the Laboratory Director and is to be constructed and tested at Chicago and shipped to W for use in the pile. An alternative design is currently being prepared by the duPont Company.

Proposed Program: Under the general direction of the Physics Division, it is proposed that the General Engineering Section of the Technical Division will design and assist in the procurement and fabrication of the test apparatus. In conjunction with the Engineering Development Section, auxiliary equipment will be set up and tests made in cooperation with the Physics Division.

Reason for Proposed Work: This work has been requested by the Physics Division and has the general approval of the Laboratory Director.

Remarks: In view of the fact that this equipment must be completed and tested prior to July 15, 1944, it may be necessary to carry out the test work with substitute materials for some of the pieces of the apparatus. The proper materials, however, will be placed on order and the unit, as it goes to W, will be constructed of the materials specified by the Physics Division.

Review Date 6/1/44
Man-Months Authorized 9

Estimated Completion Date 7/15/44
Estimated Man-Months to Complete 9

Supervisor responsible Physics

Division - Frederick Seitz F.S.

Gen. Eng. Sec. - W. O. Christy

Submitted by J. O. Maloney

Approved by G. E. Kish

Authorized by W. O. Christy

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F.S.#46
Supple. A

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File Serial 46

Problem No. 150-ML-55-5
Date 7/15/44
Priority A-1

PROGRAM REVIEW (PART I)

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Title: Design and Construct Equipment for Large Test Hole, Site W

Progress and Present Status: A water-cooled assembly of graphite cylinders to fit into the existing aluminum test thimble in the pile at W is being fabricated at Site B. This assembly provides nine holes and specimen trains for holding test specimens of aluminum and graphite. Completion of this assembly is scheduled for July 26. A coffin for receiving test specimen trains to be withdrawn from the test holes is scheduled for completion September 30.

Program for Balance of Authorization: An alternate type of coffin and extractor tool is being evaluated to simplify the method of withdrawal of test specimens from the test holes and to reduce the weight of the coffin.

Reports: None.

Man-Months Authorized (Part I) 9

Man-Months Expended (Part I) 1

Next Review Date September 30

Supervisor Responsible W. O. Christy

Section Chief J. O. Maloney

MUC-EMB-238

Received: July 27, 1944

Issued: **AUG 9 1944**

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 46

(150-ML-59-5) Old
Problem No. 150-ML-55-5 New
Date September 30, 1944
Priority A-1

PROGRAM REVIEW

Title: Design and Construct Equipment for Large Test Hole, Site W.

Progress and Present Status: A water-cooled assembly of graphite cylinders to fit into the existing aluminum test thimble in the pile at Site W was shipped from Chicago, September 5. This unit will be installed in the second W pile to provide nine holes extending into the pile for holding test specimens of aluminum and graphite. A long box coffin for receiving 4-foot long trains of 12 test specimens each will be ready for shipment to W October 18.

A full-scale wood model of an alternate type small box coffin for handling individual test specimen containers was tested with satisfactory results. However, no further work will be done on this proposal on account of the limited time allowable for fabrication.

Program for Balance of Authorization: The long box coffin will be inspected by a representative of the General Engineering Section before shipment from the fabricator's plant, so that the equipment can be trans-shipped to Site W within the minimum period of time. A final report on this program authorization will be written.

Reports: None.

Man-months Expended 2-1/2

Next Review Date December 31, 1944

Group Leader Responsible W. O. Christy

Section Chief J. D. Maloney

Division Director A. B. Thompson

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CS-1465 F. S. 46
Supplement B
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Issued to: Clinton
B. J. Roan-Ross

Report received: October 16, 1944

Issued:

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University of Chicago
Metallurgical Laboratory
Technical Division

Problem No. 150-ML-55-5
Date November 21, 1944

File Serial 46

FINAL REVIEW

Title: Design and Construct Equipment for Large Test Hole, Site W.

Closing Status:

In the construction of the Hanford piles the principal structural materials are graphite and aluminum. There is evidence that these materials, under the neutron fluxes existing in the piles, might undergo changes which would result in unsatisfactory physical properties. In order to determine these changes occurring in the aluminum and graphite, it was necessary to construct equipment suitable for inserting samples into the active zone of the W pile and removing them for physical tests. It was decided that one such unit would be constructed by the DuPont Co. and one by the Metallurgical Laboratory.

A water-cooled assembly of graphite cylinders to fit into the existing aluminum test thimble in the pile at Site W was shipped from Chicago September 5. This unit was to have been installed in the second W pile to provide 9 holes extending into the pile for holding test specimens. A long box coffin for receiving 4-ft. long trains of 12 test specimens each was shipped to W October 20.

The latest information indicates that the DuPont unit will be installed in the pile instead of the equipment supplied by the Metallurgical Laboratory.

Reports: CE-2371.

~~It is the policy of the University of Chicago to keep the information contained in this report confidential and to prevent its disclosure to unauthorized persons. It is prohibited by law to disclose this information to unauthorized persons.~~

Total Man-Months Expended 3

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R. L. Doan Gen.

Group Leader Responsible W. O. Christy

Section Chief J. O. Maloney

Division Director Chas M Cooper

Report received: November 30, 1944

Issued: DEC 11 1944

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PROGRAM AUTHORIZATION

CS-1465 File Serial 47 This document consists of 1 page and 0 figures. Copy No. 27
of 43 copies. Series A Issued to:

Title: Protection of heavy metal against oxygen pick-up in ordinary atmosphere. *Clinton*

Objective: To find a convenient procedure for coating tuballoy to prevent it picking up oxygen when exposed to ordinary atmospheric conditions indoors and out. Coating must be applied without elaborate mechanical pretreatment or any treatment involving appreciable losses.

Present Status: In general, electroplates may be applied with a minimum of mechanical handling of the metal. Adherent electroplates may be applied to tuballoy following pretreatments which remove less than 0.0005" of metal. With proper care, electroplates may be made impervious. During the course of development work, a variety of specimens have stood around in ordinary laboratory conditions for several months without showing corrosion.

Proposed Program: It is proposed (a) to plate specimens as follows and (b) expose to atmospheric conditions on the roof of Site B in a latched grilled box as well as in the laboratory. Weights will be followed at intervals of 2-3 months. Photographs will serve as part of the records.

<u>Coating</u>	<u>Thickness</u>	<u>Coating</u>	<u>Thickness</u>	<u>Coating</u>	<u>Thickness</u>
Lead	0.001"	(Nickel	0.001"	(Copper	0.001" buff
Lead	0.002"	(Chromium	0.0002"	(Cadmium	0.001"
(Copper	0.005"	Copper	0.001"	(Nickel	0.001"
(Lead	0.001"	Copper	0.002"	(Zinc	0.001"
Zinc	0.001"	(Copper	0.001" buff	(Nickel	0.001"
Zinc	0.002"	(Nickel	0.001" bright	(Cadmium	0.001"
Nickel	0.001"	(Chromium	0.001"	(Brass	0.001"
Nickel	0.002"	(Copper	0.001" buff	(Brass	0.001"
Chromium	0.001"	(Zinc	0.001"	(Nickel	0.001"
Chromium	0.002"			(Copper	0.001"
				(Nickel	0.001"

Apparatus will be set up to determine and test porosity in electroplates considered for the work. A sample of each type of coat will be sent to Dr. C. Smith.

Reason for Proposed Work: The work has been requested by Dr. C. Smith. (CK-1266, p. 5-1/13/44)

Remarks: This work will be directed by Dr. A. G. Gray of the du Pont Company, Electroplating Division. Part of the specimens will be prepared in Chicago and part in Cleveland. All tests will be performed in Chicago. The testing work will extend over a period of a year.

Review Date 6-25-44

Man-Months Authorized 3

Estimated Completion Date (a) 5-1-44 (b) 5-1-45

Estimated Man-Months to Complete 3

Supervisor Responsible A. G. Gray (L. M. Foster)

Submitted by: *John P. Howe*

Approved by: *W. B. Greninger*

J. Chapman

Chas. M. Cooper

Authorized by: *H. C. Johnson*

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 47 Problem No. 154-ML-52-4
Date 11/1/44
Priority C-1

PROGRAM REVIEW

CS-1465 F. S. 47
Supplement A
This document contains
1 pages of text.
Copy 22 of 36 Copies
Series A
Issued to: *Clinton L. R. L. Doan*

Title: Protection of Heavy Metal Against Oxygen Pickup in Ordinary Atmosphere *R. L. Doan Pers.*

Progress and Present Status:

One hundred and eight X size specimens plated with varied thicknesses of lead, copper, zinc, nickel, chromium, cadmium, tin and various combinations of those were placed in atmospheric corrosion test July 1, 1944. The specimens were weighed, photographed and examined before being placed in a specially designed rack located on the roof of Site B.

On October 23, 1944, the specimens were closely examined, weighed, and photographed. All of the six specimens plated with Ni-Cr (0.001" Ni followed by 0.001" Cr) showed considerable corrosion of the pit type. The plates showed cracks and blisters indicating a strained, brittle deposit. Five of the six composite Ni-Cu-Ni plated slugs (0.001" Ni + 0.001" Cu + 0.001" Ni) showed peeling of the plate at the ends in the region of the contact marks. One of the five showed pitting along the side of the slug. One of the six brass plated slugs (0.001" Brass) failed due to pit type of corrosion. No evidence of failure of the remaining specimens was observed. Although the specimens were weighed to the second decimal place with a probable accuracy of $\pm 0.05g$. no measurable change in weight was observed after four months exposure to Chicago atmosphere.

Program for Balance of Authorization:

The specimens will be re-examined and weighed three months hence.

Reports:

None

Man-Months Expended 1/4

Next Review Date 2-1-45

Group Leader Responsible *L. M. Foster*
Section Chief *J. H. Chapin*
Division Director *Chas McCooper*

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Report received: November 30, 1944

Issued: DEC 11 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 48

Problem No. 181 ML-56-6
Date April 19, 1944
Priority B-1

PROGRAM AUTHORIZATION

Title: Neutronic Reactor Loading Cartridge.

CS.1465 File Serial #48
This document consists of 1 page
of text and 0 pages of figures.
Copy 27 of 36 Series A
Issued to: Clinton

Objective: To develop a cartridge, consisting of a simple aluminum shell or jacket containing a multiplicity of metal slugs, and auxiliary apparatus for its proper application to an HEW pile.

Present Status: Sufficient work of exploratory nature has been done to show that a helium "floated" cartridge has definite promise. This work has uncovered many problems which will require solutions but has not revealed, as yet, any insurmountable difficulties.

Proposed Program: To design, fabricate and test a suitable cartridge and auxiliary apparatus for an HEW pile. Major responsibility for the program will be concentrated in the Technical Division with the work going forward cooperatively with the Divisions of General and Nuclear Physics.

Reason for Proposed Work: The present uncertainties surrounding the use of a multiplicity of individually bonded and canned slugs makes it necessary to explore alternate methods of slug protection and pile loading. The cartridge system is attractive because:

1. It avoids the bonding and canning of individual slugs.
2. It reduces the number and vulnerability of the welded sealing points.
3. It provides, through the helium "float", a positive method of detecting "leakers" in the pile.

Remarks: Design activities will be centered in the General Engineering Section while the fabrication and testing work will be carried out by the Development Engineering Section.

Review Date August 1, 1944
Man-Months Authorized 20

Estimated Completion Date Nov. 1, 1944
Estimated Man-Months to Complete 40

Supervisor responsible J. O. Maloney

Submitted by J. O. Maloney

Approved by G. E. Kinn

Chas M Cooper

Authorized by H. G. Vernon 1/29

MUC-IWB #90

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 48

Problem No. 181 ML-59-6
Date August 1, 1944
Priority B-1

PROGRAM AUTHORIZATION (PART II)

Title: Neutronic Reactor Loading Cartridge.

CS-1465 F.S. #48
Supplement A
This document contains
1 page. Part II
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Series A

Issued to: Clinton. (R.L.)

Objective: To develop a cartridge, consisting of a gas tight aluminum shell or jacket containing a multiplicity of metal slugs and dummies, means for detecting leaks in the cartridge, and auxiliary apparatus for its proper application to an HEW pile. Doan - Pera.)

Present Status: Sufficient work of an exploratory nature has been done to show that a helium filled cartridge has definite promise although additional ribs on the jacket or in the pile tube may be necessary. This work has uncovered many problems which will require solutions but has not revealed, as yet, any insurmountable difficulties.

Proposed Program: To design, fabricate and test a suitable cartridge and auxiliary apparatus for an HEW pile. Major responsibility for the program will be concentrated in the Technical Division with the work going forward cooperatively with the Physics Division.

Reason for Proposed Work: The present uncertainties surrounding the use of individually bonded and camed slugs make it necessary to explore alternate methods of slug protection and pile loading. The cartridge system is attractive because:

1. It avoids the bonding and caming of individual slugs.
2. It reduces the number and vulnerability of the welded sealing points.
3. It provides definite possibilities of a self contained, positive method of detecting "leakers" in the pile.

Remarks: Design activities will be centered in the General Engineering Section with assistance on special problems by the Theoretical Physics Section. Fabrication and testing work will be carried out by the Engineering Development Section with assistance on certain problems by the General Physics Section.

Next Review Date October 1
Man-Months Authorized (Part II) 20
Man-Months Used (Part I) 14
Estimated Completion Date November 1
Estimated Man-Months to Complete 50

Written by L.A. Ohlinger
Approved by J.O. Maloney

Group Leader Responsible L.A. Ohlinger

Authorized by H. Vernon 9/6

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Report received: September 7, 1944
Issued:

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 49

UNCLASSIFIED

Problem No. 213 ML-5-7
Date April 25, 1944
Priority A-1

~~LIMITED~~

PROGRAM AUTHORIZATION

CS-1465 File Serial #49

This document consists of 1 pages of text and 0 pages of figures. This is copy 27 of 36. Series A.
Issued to: Clinton

Title: Solvent Extraction Process for Product Purification

Objective: The general objective of this program is to cooperate with the Division of Chemistry, Section C-I, Group 4, in the development of a solvent extraction process for use at Site Y in the final purification of product.

Present Status: The Division of Chemistry has been actively engaged for some time in making a fundamental investigation of the various processes being considered for use in the final purification of product. A comparison of the advantages of these processes reveals that a solvent extraction method is one of the most favorable. Considerable equilibrium distribution data for product and various impurities between aqueous and immiscible solvent phases and other basic information have been obtained. The engineering problems concerned with the construction and operation of a production scale plant have not been studied to any appreciable degree.

Proposed Program: It is proposed that the work of developing a process for final product purification by solvent extraction be carried forward along the following lines:

1. Small laboratory apparatus will be designed and constructed by the General Engineering Section and used by the Chemistry Section C-I to demonstrate as far as possible on this scale the chemical and mechanical feasibility of the process.
2. If the work described above (1) is successful and it is decided to design and construct a full-scale plant, the General Engineering Section will render assistance in this undertaking. Indications are that this plant would be about the size of the present continuous extraction semi-works which is capable of treating approximately 20 gal./day of product solution.
3. The numerous subsidiary studies which are necessary to the successful completion of (2) above will be carried out simultaneously with (1).

Reason for Proposed Work: The General Engineering Section was requested verbally by Mr. E. F. Orlemann, Assistant Chief, Section C-I, Division of Chemistry, to undertake the work described in the present authorization.

Review Date August 1, 1944
Man-Months Authorized 4
Estimated Completion Date 10/1/44
Estimated Man-Months to Complete 6

Supervisor Responsible J. B. Tepe

Submitted by J. O. McLooney

Approved by G. E. Kuhl

Chas M Cooper

Noted by H. J. Secor
T. H. H. H.

Authorized by H. B. Vernon 49

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University of Chicago
Metallurgical Laboratory
Technical Division

Problem No. 213-ML-55-7
Date November 11, 1944
Priority A-1

CS-1465 F. S. 49

Supplement A

This document contains

1 pages of text.

Copy 27 of 36 Copies

Series A Issued To: *Chantow Lal*PROGRAM REVIEWTitle: Solvent Extraction Process for Product Purification

Progress and Present Status: The General Engineering Section cooperated with the Chemistry Division in carrying out an investigation to find a solvent suitable for use in a solvent extraction product purification process at Site Y. Methyl isobutyl ketone (hexone) was selected as the best solvent tested on the basis of its chemical and physical properties and selectivity for product in the presence of the undesirable light element impurities.

Laboratory-scale continuous-batch extraction experiments were carried out which confirmed the conclusion grounded on batch extraction studies that a hexone extraction purification process is feasible.

A full-scale continuous countercurrent extraction system was constructed, but an experimental product purification program using this equipment was not initiated. The solvent extraction column was 1 in. in diameter and 16 ft. tall. The system was constructed entirely of glass. It was planned to duplicate this equipment in quartz or some other suitable material of construction for use at Site Y. The planned work was not carried out because the Metallurgical Laboratory was relieved of responsibility with respect to the purification program.

At present this program is largely inactive. A final report is being written. The 1-in. continuous countercurrent extraction system is being used with excellent results in developing a solvent extraction process for isolating product.

Program for Balance of Authorization: A final report covering the work which was done will be written and issued. The program will be carried out before January 1, 1945.

Reports: CK-2089.

Report received: November 30, 1944

Issued: DEC 11 1944

Man-Months Expended 3Next Review Date January 1, 1945Group Leader Responsible *J.B. Taper*Section Chief *J.O. Maloney*Division Director *Chas M. Cooper*

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File Serial 49

MUC-ENB 340

This document consist of 1 page and 0 figures. No of 10 copies. Series A.
Problem No. 213-ML-55-7
Date December 7, 1944

FINAL REVIEW

Title: Solvent Extraction Process for Product Purification

Closing Status:

No work is being done at Chicago on the development of a process for the final purification of product because the programs on this subject were terminated in July when the purity of product required for reduction to metal was redefined. At that time an extensive program of fundamental laboratory study had been essentially completed and full-scale glass continuous countercurrent extraction equipment had been constructed. This equipment is now being used successfully in the development of a solvent extraction process for isolating product. A final report describing the work done under this authorization is being issued at this time.

Reports:

CK-2089 (Chemistry)
CK-2430 (Final Report - Tech. Div.)

Total Man Months Expended: 3

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Supervisor Responsible B. Tebe

Section Chief J. O. Maloney

Division Director Chas. M. Cooper

Report received: December 29, 1944

Issued: JAN 3 1945

CS - 1465 F. S. #49
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Metallurgical Laboratory
Technical Division

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File Serial 50

Problem No. 215 ML-54-7a

Date April 1, 1944

Priority A-2

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PROGRAM AUTHORIZATION

CS-1465 File Serial 50. This document consists of 1 pages of text and 0 of figures. Series A.

Issued to: 27-Clinton

Title: Bomb Reductions of Uranium and Uranium Alloys.

Objective: To improve and standardize existing methods and extend the work at Chicago from a one gram scale to a ten and one hundred gram scale operation, particularly with a view to obtain high purity.

Present Status: Preliminary runs have been made but no satisfactory technique developed. Other sites have developed these techniques so that the program should be short.

Proposed Program: To adopt the techniques which have been successful at other sites and regularize the most satisfactory procedures, so it can be used as a standard in evaluating crucibles and other starting materials. The relative merits of various reducing agents will be determined. Preparation of alloys by such reductions will also be attempted.

Reason for Proposed Work: This type of work with uranium should be useful to Y for Pu. Uranium is regarded as the best stand-in for plutonium in determining effects of reduction methods upon purity. It is also a necessary laboratory manipulation in connection with other parts of the project.

Remarks: Formerly part of File Serial #36.

Review Date July 1

Man-Months Authorized 9

Estimated Completion Date 9/1/44

Estimated Man-Months to Complete 18

Supervisor Responsible G. Lerge

Submitted by G. Lerge

Approved by AB Heninger

L. Chipman

Chas M. Conner

Authorized by SK Allison

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PROGRAM REVIEW

Title: Bomb Reductions of Uranium and Uranium Alloys

Objective: To improve and standardize existing methods and extend the work at Chicago from a one gram scale to a ten and one-hundred gram scale operation, particularly with a view to obtaining high purity.

Progress (Part I) and Present Status: See MUC-EWB-#103 for previous work. Experimental work by A. E. Martin, W. Chandler and O. Widmoyer.

The work has been confined to 1 g. and 5 g. scale reductions. Many minor changes in technique have been combined to bring small scale bomb reductions under better control. The most important of these are:

(1) Apparatus:

The bombs are located in the induction furnace and insulated in such a way that their temperature is more uniform and therefore subject to closer regulation. These parts are all contained in a quartz tube which can be evacuated or filled with an inert atmosphere. With this arrangement it is possible to use graphite bombs with screw tops. These can be used repeatedly. When these bombs are used with refractory liners the metal produced contains no more carbon than that reduced in steel bombs. A foundry type vibrator improves metal agglomeration.

(2) Selection of Charge and Control of Reduction:

The Ca + I₂ booster has been eliminated as heat can be supplied by the furnace. Materials are chosen so the resultant slag will have a low melting point and allow easy separation of slag and metal. To accomplish this CaCl₂ is added when fluorides are used as a source of uranium, but this is not required with either UCl₄ or UCl₃. The charged bomb is heated slowly so the bomb temperature may be regarded as a close approach to the temperature of the charge. A mechanical vibrator is held on the bench for a few minutes at the end of the reductions. With this procedure well agglomerated buttons are obtained in stationary bomb reductions.

With the above techniques reductions of UF₄, UCl₄ and UCl₃ have been made with the latter regarded as the best all around material. It is not hygroscopic, forms a low melting slag and gives a good yield per unit volume of crucible.

Ba has been used as an alternate for Ca with excellent results, however, it is not as readily handled as it is more difficult to prepare in a finely divided state and it oxidizes more readily in air.

(3) Appraisal of Quality:

For the purposes of this work it was felt that yields alone do not provide an adequate index of merit. Density measurements have been made, but they are subject to many uncertainties and are not being developed further. However, metal-

lographic examination has proven very valuable. Slag inclusions and blow holes can be observed and new phases resulting from contamination are evident. Eutectic structures are frequently observed and have been correlated with the excess of Ca in the charge, but actual phases found may be due to either Be or Ca.

(4) Other Stand-ins:

A broader experience has been obtained by using CeBr_3 and CeCl_3 as sources of metal and quite satisfactory reductions have resulted.

Metallic La and Ce have been produced by distillation of their amalgams.

Proposed Program: Work on this program will be discontinued and a final report will be issued by September 1, 1944.

Reports on Part I: Review for Thomas Meeting - April 17, 1944 (G. Derge)
MUC-JC-#122 - May 15, 1944
MUC-JC-#136 - June 19, 1944

CS-1465 F.S. #50
Supplement A
This document contains
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Man Months Authorized (Part I) 9

Man Months Expended (Part I) 6.4

Submitted by G.D. Derge

Approved by J. Chapman
A.B. H. Smith

Authorized by CUC by 31 1944

Date October 11, 1944

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FINAL REVIEW

SECRET

CS-1465 F. S. #50 Supple. E

This document contains 1 pages.

Copy 27 of 36 Copies.

Series A

Issued to: Chintoy

P. L. Rosen-ber

Title: Bomb Reduction of Uranium and Uranium Alloys

Closing Status: Small scale reductions of uranium halides and rare earth halides were carried out with the view of developing techniques which could later be applied to the reduction of plutonium halides. The project was discontinued before the latter reductions were attempted. A secondary object was to investigate the possibility of producing high purity uranium by bomb reductions.

Successful reductions of UF_4 , UCl_3 , UCl_4 and UCl_5 by Ca, Ba, Sr, Li and Mg and of $CeCl_3$, $CeBr_3$ and $LaBr_3$ by Ca and Ba were accomplished. The temperature of reaction between $CeCl_3$ and Ca was determined as $575^\circ C$.

Comparisons were obtained among the reducing agents, the halides and the crucibles used in the reductions based upon yields of uranium and its purity. Calcium and magnesium were found to be the best all-around reducing agents. UF_4 and UCl_3 were the most satisfactory uranium halides. Uranium produced in MgO crucibles was higher in boron and silicon than metal produced in beryllia crucibles, but on the other hand there was less contamination with Mg from MgO crucibles than with Be from BeO crucibles.

The value of a controlled atmosphere furnace for bomb reductions was established as well as the use of vibration during small scale reductions.

A eutectic structure in uranium samples obtained by reductions of uranium halides in beryllia crucibles was correlated with the beryllium content.

The value of an addition of $CaCl_2$ to the charge in UF_4 reductions to lower the melting point of the slag and thus promote a better separation of slag and metal was demonstrated.

Reports: Previous Problem: Final Review, April 25, 1944 - MUC-ENB-#103
Problem No. 215-ML-54-7 - File Serial 36

Review for Thomas Meeting	- April 17, 1944	(CK-1604)
"	"	- May 15, 1944 (CK-1731)
"	"	- May 15, 1944 (MUC-JC-#122)
"	"	- June 19, 1944 (MUC-JC-#136 - CK-1826)
FINAL REPORT	- October, 1944	CT-2276

Total Man-Months Expended 17

Group Leader Responsible W. D. Sarge

Section Chief Frank F. Frost

Division Director W. D. Sarge

Received: November 7, 1944

Issued:

NOV 10 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial

51

Problem No. 341 ML-54-7e
Date April 1, 1944
Priority A-2

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PROGRAM AUTHORIZATION

Supplement A-CS-1465-File Serial 51
This Document contains 1 Pages of
Text and 0 Pages of Figures.
This is Copy 27 of 40. Series A.
Issued to: *Clinton*

Title: Measurement of Vapor Pressure of Uranium, Plutonium and
Their Compounds.

Objective: See title.

Present Status: An apparatus for the measurement of vapor pressures by the effusion method has been built and approximate values for UO_2 and PuO_2 have been determined. Improved techniques are being developed.

Proposed Program: To improve the operation of the above apparatus so that more precise measurements can be made. This involves better methods of temperature measurement, better vacuum technique and an investigation of crucible materials. Known materials, such as copper, will be measured to demonstrate the reliability of the apparatus and procedure. Work planned in immediate future will be confined to the metals and a re-determination of vapor pressures of their oxides.

Reason for Proposed Work: These metals must frequently be melted and cast in vacuum to avoid oxidation and a knowledge of the vapor pressure would be of value in estimating losses. This is especially true when melting alloys.

The preparation of the pure metals by the hot wire technique requires a knowledge of the vapor pressure. Responsibility for this has been assigned to Chicago.

Remarks: The Chemistry Division has also shown an interest in this problem and a satisfactory cooperative program must be worked out with them. Additional ventilation must be installed before work with Plutonium can be begun.

Formerly part of File Serial #36.

Review Date July 1
Man-Months Authorized 4

Estimated Completion Date 9/1/44
Estimated Man-Months to Complete 7

Supervisor Responsible Gerhard Lerge

Submitted by *KL Lerge*

Approved by *AB Gensinger*

Authorized by *SK Appleson*

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I would like to see this arranged so that when product is studied, the apparatus is moved to a properly ventilated area, rather than have such an area enclosed at B
SKA

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PROGRAM REVIEW

Title: Measurement of Vapor Pressure of Uranium, Plutonium and Their Compounds.

Objective: See title.

Progress (Part I) and Present Status: See MUC-ENB-#103 for previous work. Experimental work by M. Cefola.

The design and operation of the apparatus has been checked by determining the vapor pressure of Cu for which good data are available in the literature.

Modifications were then made for the measurement of uranium and preliminary values have been obtained:

<u>Vapor Pressure</u> <u>(atmospheres)</u>	<u>Temperature</u> <u>°C</u>	<u>Heat of vapor-</u> <u>ization</u>	<u>Crucible</u>
4.35×10^{-8}	1300	64,700 cal.	Ta with Ta orifice
1.45×10^{-7}	1400		" " "
1.26×10^{-7}	1500		BeO with Ta orifice
1.28×10^{-7}	1500		" " "

The optical temperature measurements have been calibrated against the melting point of copper and with a noble metal thermocouple.

The apparatus has been moved to room #300 which is specially equipped for plutonium work. It has been redesigned to provide flushing with purified hydrogen and better cooling of the walls.

Proposed Program: Work on this program will be discontinued and a final report will be issued by September 1, 1944.

Reports on Part I: Review for Thomas Meeting - April 17, 1944 (G. Derge)
MUC-JC-#122 - May 15, 1944

Man Months Authorized (Part I) 4

Man Months Expended (Part I) 5.4

Submitted by G. Derge

Approved by J. Chapman
A. D. Heninger

Authorized by CMC July 31, 1944

CS-1465 F.S. #51
Supplement A
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FINAL REVIEW

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CS-1465 F. S. #51, Supple. B
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Series A
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Title: Measurement of Vapor Pressure of Uranium, Plutonium & Their Compounds

Closing Status: The vapor pressure of uranium has been measured by effusion through an orifice and collimator onto a metal target. The results are not entirely satisfactory because adequate crucibles were not available. Apparently the best values were obtained from Ta crucibles and these are represented by the equation

$$\log P_{\text{mmHg}} = - \frac{12500}{T} + 3.3$$

The molar heat of vaporization calculated from these data is 57,200 calories.

The data obtained from BeO crucibles are much lower and probably represent the pressure of an oxide. They are represented by the equation

$$\log P_{\text{mmHg}} = - \frac{30000}{T} + 12.5$$

which gives a molar heat of vaporization of 142,000 calories.

Further experiments with other refractories are suggested as a means of evaluating these data.

Reports: Previous Problem: Final Review, April 25, 1944 - MUC-EWB-#103
Prob. No. 215-ML-54-7 - File Serial 36

Secret Notebook No. 795, issued to Michael Cefola, pages 72-170
" " " 515-B, issued to J. Chipman for G. Derge,
pages 1, 2, 6, 11, 12, 50, 130, 131, 132, 150
and 159

Thomas Meeting - April 17, 1944 (CK-1604)
" " - May 15, 1944 (CK-1731)
Review for Thomas Meeting - May (MUC-TC-#122)

Program Review, July 1, 1944 - MUC-EWB-#244
Prob. No. 341-ML-54-7E - File Serial 51

FINAL REPORT - October, 1944 CT-2277

Total Man-Months Expended 5

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Group Leader Responsible G. Derge

Section Chief Frank Froot

Division Director W.B. Sherman

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Received: November 7, 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 52

Problem No. 215 ML-54-71

Date April 1, 1944

Priority A-2

PROGRAM AUTHORIZATION

CS-1465 File Serial 52. This document consists of 1 pages of text and 0 pages of figures. Series A. Copy 27 of 36. Issued to: Clinton

Title: Production of Uranium Metal by the Hot Wire Technique.

- Objective:
- (a) To obtain purer uranium metal than has hitherto been available.
 - (b) To evaluate the method as a means of producing 49 of requisite purity.

Present Status: Exploratory experiments by Magel have shown that UI₄ can be decomposed on a thoria coated tungsten filament, but the reaction was not continuous. Prescott and Reynolds, report Chem. S-206, suggested the operation as carried out by Magel. They have continued work on this problem but no further reports are available. An apparatus has been constructed which will allow an extensive study to determine the optimum condition for the process.

Proposed Program: The following variables will be studied:

- (a) Filament materials
- (b) Filament temperature
- (c) Sources of uranium
- (d) Gases, such as hydrogen auxiliary
- (e) Conditions for high recovery of metal
- (f) Purity of product relative to starting material
- (g) Conditions required for continuous operation.

Reason for Proposed Work:

1. It is desirable to obtain uranium of the highest possible purity to determine its properties accurately.
2. This is a promising means of obtaining 49 of the requisite purity and uranium will be used in these experiments as a stand-in.

Remarks: The primary responsibility for the investigation of this method has been assigned to Chicago. This program will require extensive chemical analyses for very small amounts of material in uranium.

Formerly part of File Serial #36.

Review Date July 1, 1944

Man-Months Authorized 9

Estimated Completion Date 10/1

Estimated Man-Months to Complete 21

Supervisor Responsible G. Derge

Submitted by H. D. Magel

Approved by D. B. Greninger

J. Chipman

H. D. Magel

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Authorized by H. D. Magel

* Willard and Derge have conferred about this at my request and allocated the work.

PROGRAM AUTHORIZATION (PART II)

Titles Production of Tuballoy Metal by the Hot Wire Technique

UNCLASSIFIED

Objectives:

1. To produce tuballoy metal of higher purity than has hitherto been available and to study the properties of this high purity metal.

Progress (Part I) and Present Status:

1. Tuballoy metal of high purity has been produced by the hot-wire technique, using thoriated tungsten filaments operating at 1500°C. As much as 4 grams have been produced in a single run. Other methods of production, such as gradient tube furnace and vapor phase reduction with calcium, have been tried but would require further development to increase yield. Very little is known concerning the properties of high purity tuballoy.

Proposed Program:

1. Pure tuballoy will be prepared by the hot wire or gradient tube furnace as required. Further development work to reduce the methods to standard practice will be carried out. The pure metal will be analyzed spectrographically and examined metallographically. The physical properties and corrosion resistance will be measured.

Reason for Proposed Work:

The structure and properties of highly pure tuballoy should be determined in order to establish a base point for the evaluation of commercially pure tuballoy. Minor constituents often have marked effects upon the properties and behavior of metals and these effects should be established for tuballoy. Rapid and fairly accurate analysis for minor impurities would be possible if the relationship between amount and kind of impurity and the number and kind of inclusions could be established. Prior to September 1, 1944, the work on this program was under the supervision of G. Derge. It will be continued as part of the program on the metallurgy of tuballoy under the supervision of D. L. Schwartz.

Reports on Part I

G. Derge - Review for Thomas Meeting - - - - -	April 17, 1944
MUC-JC-122 - - - - -	May 15, 1944
MUC-JC-136 - - - - -	June 19, 1944

A record report on the results of work prior to September 1, 1944 is being prepared by G. Derge.

Next Review Date	November 1, 1944
Man-Months Authorized (Part II)	12
Man-Months Used (Part I)	11
Estimated Completion Date	Continues
Estimated Man-Months to Complete 1-2 Men full time	
Group Leader Responsible	D. L. Schwartz

Written by Frank Forte

Approved by Robert Casper

Authorized by W. E. Vernon

CS-1465 F.S. 52

Supplement A

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Report received: September 29, 1944

Issued: OCT 3 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 52

Problem No. 215-ML-54-1

Date October 11, 1944

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FINAL REVIEW

CS-1465, F. S. #52, Supple. B
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Title: Production of Uranium Metal by the Hot Wire Technique R. F. Doan - Pers.

Closing Status: The hot wire process has been demonstrated to be a workable and effective method for removing metallic impurities from uranium. Some question remains as to whether or not C can be reduced much below that in the crude metal, but it is believed that further control of the sources of this element in the reagents and refractories would be effective. The oxygen content is also subject to further investigation as sufficient analytical information has not been obtained to date. The chemical evidence on purity is substantiated by microscope examination. Uranium prepared by this method is very much purer than that made by other known methods, and it is recommended for use in fundamental research where small amounts of material are adequate.

The standard flow system is valuable in its present form for producing 5 gram batches. Very minor revisions, which should cause no complications in operation, would extend this to batches of several hundred grams. The reactor should be made of clear quartz. For any larger scale operation the further development of the thermal gradient system seems most logical. Present information certainly indicates that a flow system is required.

The experience with uranium as a stand-in indicates that the hot wire process should be regarded as an important method for preparing high purity plutonium.

Reports: Previous Problem: Final Review, April 25, 1944 - MUC-ENB-#103
Problem No. 215-ML-54-7 - File Serial 36

Review for Thomas Meeting	- April 17, 1944	(CK-1604)
"	"	- May 15, 1944 (CK-1731)
"	"	- May 15, 1944 (MUC-JC-#122)
"	"	- June 19, 1944 (MUC-JC-#136 - CK-1826)
FINAL REPORT	- October, 1944	CT-2278

Total Man-Months Expended 16

Group Leader Responsible Ch. Doan

Section Chief Frank H. Root

Division Director Ch. Doan

Received: November 7, 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 53

UNCLASSIFIED

Problem No. 201-ML-51-21
Date, April 21, 1944
Priority A-1

PROGRAM AUTHORIZATION

Title: Salvaging Imperfectly Jacketed "W" Slugs

CS-1465 File Serial #53

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of text and 0 pages of figures.

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Objective: To develop in the laboratory and Semi-works a method for removing defective jackets from "W" slugs so the slugs can be recanned.

Present Status: It is estimated that perhaps 50% of the slugs canned at "W" will have defective jackets. The Technical Division Metallurgy Section has at present about 700 "W" slugs with faulty Al-Si bonded jackets and they accumulate at the rate of about 250 per month. It is evident that a process is urgently required whereby these defective jackets can be removed and the slugs recanned.

Preliminary tests indicate that procedures developed under problem 201-ML-51-20, "Dissolving Bonded Slug Jackets", may be applicable.

Proposed Program: In collaboration with the Metallurgy Section of the Technical Division, carry out the following work:

- (1) Develop a practical procedure for removing defective jackets from slug which will leave the slugs in a condition suitable for recanning.
- (2) Design or adapt equipment for carrying out the above process on slugs which accumulate from canning process development work at Chicago.
- (3) Assist in initiating salvaging operations for canned slugs now being stored at Site "B".

Reason for Proposed Work: A procedure for salvaging slugs with defective jackets is urgently needed to reduce the amount of tuballoy required for current experimental work at Chicago and for plant operations at "W".

Review Date: June 15, 1944

Submitted by:

Man-months Authorized: 13

Estimated Completion Date: August 15, 1944 Approved by:

Estimated Man-months to Complete: 27

Supervisor Responsible: A. C. Hyde

E. E. Kitcher

A. B. Greninger

Charles M. Cooper

Authorized by:

H. E. Vernon

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 53

Problem No. 201-ML-51-21

Date June 15, 1944

Priority A-1

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PROGRAM REVIEW

CS-1465 F.S.# 53 Supple. A

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Issued to: Clinton
R. S. Sloan - Pers.

Title: Salvaging Imperfectly Jacketed "W" Slugs.

Progress and Present Status: A procedure for removing aluminum jackets and bonding material from slugs has been developed and temporary equipment set up at the West Stands to reclaim slugs for the Metallurgy Section. The procedure now being used which consists of treatment with a NaOH - NaNO_3 solution effects a complete removal of the can and bond from zinc bonded slugs with little apparent tuballoy attack. However, the majority of the Al-Si bonded slugs using the same procedure still have visible areas of incomplete bond removal after one treatment, making further processing necessary before the slugs are clean enough for recanning. About 150 slugs have been processed to date.

Program for Balance of Authorization: Variations in the present procedure will be investigated in order to obtain a more complete removal of the Al-Si bond on the initial treatment. Slugs will be processed as they are needed by the Metallurgy Section.

Reports: CN-1787

Man-months Expended: 0.75

Next Review Date: August 15, 1944

Supervisor Responsible: _____

Section Chief: C. E. Kuehner

NUC-EWB-133

Received: July 3, 1944

Issued:

JUL 22 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 53

Problem No. 201-ML-51-21
Date, August 15, 1944
Priority A-1

PROGRAM REVIEW

Title: Salvaging Imperfectly Jacketed "W" Slugs.

Progress and Present Status: A procedure has been developed in the Semi-works for reclaiming imperfectly jacketed Al-Si bonded "W" slugs. The first step in the cleaning cycle consists of a treatment in a boiling 5M NaOH, 1.5M NaNO₃ solution to remove the jackets. The slugs are then washed and placed in boiling 10% HNO₃ containing .05% Hg(NO₃)₂ for approximately one-half hour. To complete one cycle the slugs are removed, wire-brushed under water and inspected for bond removal. Generally, two or three additional cycles are required to remove satisfactorily the Al-Si bonding material from the slugs. Very little pitting or corroding of the metal occurred during the treatment. No tests have been made to indicate definitely that this method will reclaim Al-Si bonded slugs in such form as to be suitable for recanning.

The semi-works equipment for this process consists of four tanks, two fifty-five gallon steel tanks and two forty-five gallon stainless steel tanks, each heated by a steam coil. A stainless steel basket to hold the slugs is moved from tank to tank by means of an overhead hoist. The equipment and procedure is now being used to reclaim imperfectly jacketed slugs which have accumulated at the Armory.

Program for Balance of Authorization: A man of the Inventory Control Group will be trained to use the present equipment and procedure for the routine reclamation of imperfectly jacketed "W" slugs.

Reports: Notebook 747-B

Man-months Expended: 2

Next Review Date: 10/1/44

Group Leader Responsible A. C. Miller

Section Chief A. C. Miller

Division Director A. B. Livingston

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 53

Problem No. 201-ML-51-21
Date, December 4, 1944

FINAL REVIEW

Title: Salvaging Imperfectly Jacketed W Slugs

Closing Status: On the basis of Semi-works tests, a procedure was devised and equipment constructed for the recovery of imperfectly jacketed W slugs. This procedure involves the use of alternate treatments of hot caustic (5M in NaOH and 1.5M in NaNO₃ and at about 90° C) and hot acid (10% HNO₃ containing .05% Hg(NO₃)₂ and at about 90° C). Approximately one thousand imperfectly jacketed W slugs, bonded with various materials, were cleaned in the semi-works and delivered to the Metallurgical Section.

The equipment was set up in the courtyard of the West Stands and consisted of two fifty-five gallon steel drums, one forty-gallon stainless steel drum, stainless steel steam coils, a stainless steel basket, and an overhead hoist.

At the completion of the semi-works study, a man from the Special Materials Section was trained to use the present equipment and procedure for the routine cleaning and reclamation of imperfectly jacketed W slugs, Clinton slugs and scrap metal which had accumulated at the Armory.

Reports: CN-1787, CT-2416, Notebook 747-B.

Total Man-Months Expended - 2.3

Group Leader Responsible C. J. Egan

Section Chief A. C. Miller

Division Director Charles M. Egan

Report received: December 29, 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 54

Problem No. 222 ML-51-23

Date, May 8, 1944

Priority, B-1

27-Clinton

PROGRAM AUTHORIZATION

Title: Saving of Waste Metal from Semi-works
Operations.

UNCLASSIFIED

Objective:

To develop a practical method of saving, for ultimate recovery, the heavy metal now being thrown to waste in solutions from Semi-works operations.

Present Status:

The Semi-works procedure used at present for disposing of waste solutions containing uranium is to add citric acid and hydrogen peroxide to prevent precipitation of uranium on neutralization of free acid with sodium carbonate and dilution with water to reduce the activity to such a low level that the solution can be safely run to the sewer. This procedure, developed by the Chemistry Division, is outlined in MUC-GTS-445.

Proposed Program:

To investigate, in cooperation with the Chemistry Division, methods of concentrating and storing uranium from waste solutions so that the metal can be recovered at some future date.

If a procedure such as indicated above can be developed, proceed with plans for equipment required to carry out the operations.

Reason for Proposed Work:

- (1) To save the 100 - 200 lbs. of uranium now being thrown to waste in Semi-works solutions per month.
- (2) To save the citric acid and hydrogen peroxide now being used in waste disposal, since these chemicals are on the restricted list and are difficult to obtain in the quantities required.

Review Date: June 15, 1944

Man-months Authorized: 2

Estimated Completion Date: July 15, 1944

Estimated Man-months to Complete: 4

Supervisor Responsible: A. C. Hyde

Submitted by A. C. Hyde

Approved by E. E. Kischer

Authorized by James K. Allison

MUC-EWB-104

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Metallurgical Laboratory
Technical Division

File Serial 54

Problem No. 222-ML-51-23

Date, June 15, 1944

Priority B-1

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PROGRAM REVIEW

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Title: Saving of Waste Metal from Semi-works Operations

Progress and Present Status:

A separation of tuballoy from solution by the precipitation of an insoluble compound was found to entail a mechanical separation of the precipitate since all the ordinary precipitates are voluminous and do not readily settle out. On the basis of Semi-works tests the nutsche filter appeared to be the most suitable equipment for this separation both from the point of view of safety and operating cost. Very little decontamination is effected by such precipitation methods.

Significant decontamination (ca. 10^2) was effected on a Semi-works scale by batch extraction of ether-UN solutions using aqueous $\text{Ca}(\text{NO}_3)_2$ to remove the activity but not the heavy metal. Tuballoy losses using this procedure were low for wastes from the continuous ether extraction system. The procedure is not suitable for wastes from BiPO_4 extraction without first removing the sulphate and phosphate ions present. A method of doing this is being developed.

Program for the Balance of Authorization:

All waste metal solutions free from sulphate and phosphate ions will be decontaminated and stored. Efforts will be made to develop a simplified procedure for the recovery of metal from BiPO_4 extraction step wastes.

Reports: CN-1787, CN-1751

Man-months Expended, 0.85

Next Review Date, August 15, 1944

Supervisor Responsible: J. C. Mykle

Section Chief: C. E. Ketcher

NUC-EWB-132

Received: July 3, 1944

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JUL 22 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 54

Problem No. 222-ML-51-23
Date, August 3, 1944
Priority, B-1

PROGRAM AUTHORIZATION (PART II)

Title: Saving of Waste Metal from Semi-works Operations.

Objective: To develop a practical method of saving, for ultimate recovery, the heavy metal being thrown to waste in solutions from semi-works operation.

Progress (Part I) and Present Status: A batch ether extraction method has been developed for concentrating and partially decontaminating waste metal from the continuous ether extraction investigation. The metal in the form of nitrate crystals of low activity is stored in glass bottles behind concrete block shielding. No method of recovering waste metal from the BiPO_4 process has been completely developed on the semi-works scale.

Proposed Program: Two methods of recovering waste metal from the BiPO_4 process are under investigation. The first includes a separation of the metal from the interfering phosphate and sulphate ions by precipitation with NaOH followed by dissolution of the precipitate in nitric acid and decontamination by ether extraction. The second depends on the use of aluminum or ferric nitrate to salt the metal from an aqueous phase into an ether phase, in spite of the phosphate and sulphate ions present. Equipment will be set up for the most economical method of recovering waste metal from the BiPO_4 process, and metal recovery will be made from all semi-works runs.

Reason for Proposed Work: (1) To save 100 - 200 lbs. of tuballoy now being thrown to waste in semi-works solutions per month.
(2) To save the citric acid and hydrogen peroxide now being used in waste disposal, since these chemicals are on the restricted list and are difficult to obtain in the quantities required.

Reports on Part I: CN-1787

Next Review Date - October 15, 1944
Man-months Authorized (Part II) - 5
Man-months Used (Part I) - 2
Estimated Completion Date - 11/1/44
Estimated Man-months to Complete - 5

Group Leader Responsible

Written by

Approved by

(Sec. Chief Responsible)

Authorized by

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Problem No. 222-ML-51-23

Date, November 23, 1944

Priority B-1

University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 54

FINAL REVIEW

Title: Saving of Waste Metal from Semi-works Operations.

Closing Status: A gamma decontamination factor of about 100 was effected on a Semi-works scale by batch extraction of ether-UNH solutions after washing the ether extract with aqueous $\text{Ca}(\text{NO}_3)_2$. The original waste solutions were from the continuous ether system and contained no interfering ions such as phosphate and sulphate which are present in BiPO_4 extraction step wastes. In the laboratory, precipitation of sodium diuranate or uranium peroxide from BiPO_4 extract effluents resulted in little decontamination and failed to give sufficient separation of uranium from the phosphate and sulphate ions. Ether, hexone, diethyl cello-solve and dibutyl carbitol have been investigated as solvents for direct extrac-tion of BiPO_4 extract effluents with aluminum nitrate as the salting-out agent. Of these, dibutyl carbitol was the most satisfactory solvent with respect to stability and limited solubility in water. With dibutyl carbitol as the solvent and aluminum nitrate as the salting-out agent, gamma decontamination factors averaging 5×10^3 with a high uranium recovery, have been obtained in three extraction cycles.

Reports: CN-1751, CN-1787, CN-2162

Notebooks, 693-B, 884-B, 1087-B, 1415-B

Total Man-months Expended - 8.2

Group Leader Responsible

C. J. Egan

Section Chief

R. C. Miller

Division Director

Chas M Cooper

Report received: December 29, 1944

Issued: JAN 3 1945

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27-Clinton

Title: Testing of Internally Heated Bonded Slugs

Objective:

The object is to test jacketed bonded slugs under conditions simulating W pile operations and to evaluate the results as regards bond stability and resistance to corrosion. The testing is divided into two classes.

1. Thermal cycling: To determine the relative endurance of various types of bonds to repeated thermal shock; and to study the propagation of defects developed before and during testing resulting from alternate expansion and contraction.
2. Corrosion testing: To determine the corrosion resistance of the bonding layer of jacketed slugs under conditions simulating pile operation.

Present Status

The actual operation of the equipment for corrosion testing with internally heated slugs will be, as in the past, carried out by the Engineering Development Section under Problem No. 124 ML-51-17, File Serial 14. Work to date on Thermal Cycling has been a part of Coatings Research, F. Testing, File Serial 31, Problem No. 154 ML-54-3j.

Proposed Program

Slugs considered passable by present inspection standards are to be prepared for test by the metallography group. Cycling tests will be done completely by J. H. McMahon of this group; however, for corrosion tests the samples will be submitted to V. Donihee of Engineering Development section who, upon the completion of the tests, will return the samples and operating data to C. Norbert and L. Kelman of metallography group for interpretation of the data.

1. Thermal Cycling: 28 pieces will be prepared. Nine of these are to be drilled for the electrode and thermocouples. Thermocouple holes are for thermal analysis of the test pieces.
2. Corrosion testing: 18 extruded slugs and 21 jacketed slugs will be prepared for testing.

Reason for Proposed Work

These tests are needed to determine if the present methods of protecting slugs against corrosion will be satisfactory under conditions simulating pile operation.

Review Date July 15, 1944

Man-Months Authorized 6

Estimated Completion Date 7-15-44

Estimated Man-Months to Complete 6

Supervisor Responsible D. L. Schwartz

MUC-KWB-108

Submitted by H. L. Schwartz

Approved by A. B. Cheninger

Authorized by H. L. Schwartz

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PROGRAM AUTHORIZATION (Part II)

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Title: Testing of Internally Heated Bonded Slugs

Objective:

The object is to test jacketed bonded slugs under conditions simulating W pile operations and to evaluate the results as regards bond stability and resistance to corrosion. The testing is divided into two classes.

1. Thermal cycling: To determine the relative endurance of various types of bonds to repeated thermal shock; and to study the propagation of defects developed before and during testing resulting from alternate expansion and contraction.
2. Corrosion testing: To determine the corrosion resistance of the bonding layer of jacketed slugs under conditions simulating pile operation.

Present Status:

Corrosion Testing: Results of the work indicate that: (1) Al/Si is superior to Zn/Al (2) Cast Al/Si without a ductile can will flake off rather than swell if the tuballoy corrodes. Specimens have been prepared to collect more data and to substantiate further the facts already collected. Furthermore, specimens have been selected for tests in units heated by high pressure steam as soon as the initial tests to check the equipment are completed.

Thermal Cycling: Testing has just started of four inch slugs since the time was spent re-conditioning and evaluating the equipment. Furthermore the apparatus was altered so that eight inch, as well as four inch, slugs could be cycled.

Proposed Program:

Corrosion Tests: The specimens now in process should be finished. Interpretation of the results of tests run in high pressure steam units is to be made.

Since work has been started on the protection of the tuballoy with only a cast Al/Si coat eliminating the aluminum jacket, corrosion tests will have to be run in order to evaluate their behavior under conditions simulating pile operation.

Thermal Cycling: The twenty eight specimens previously prepared for test have to be finished.

This equipment will be used to evaluate the quality of cast Al/Si coated slugs. It will also be used in conjunction with corrosion tests to determine the effect of the propagation of defects as result of thermal strains decreasing the protection of the slug against corrosion.

Reason for Proposed Work

These tests are needed to determine if the method of protecting the slugs against corrosion will be satisfactory under conditions simulating pile operation. Again, the tests should supply information which will be useful in the development of a method by which satisfactory protection of the slug in the pile can be achieved.

Reports on Part I

MUC-FF-119 Results on First Series of Corrosion Tests on Internally Heated Slugs.

Review Date October 1, 1944

Months Authorized (Part II) 12

Man Months Used (Part I) 6

Estimated Completion Date Indefinite

Estimated Man-Months to Complete

Supervisor Responsible D. L. Schwartz

Submitted by D. L. Schwartz

Approved by J. B. Thoeniger

UNCLASSIFIED

MUC-EWB-219

Received: July 12, 1944 Issued: Aug 9 1944

Authorized by J. B. Thoeniger

PROGRAM REVIEW

CS-1465 F. S. 55
Supplement B
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Title: Testing Internally Heated Slugs

Progress and Present Status:

UNCLASSIFIED

Corrosion Testing: Bonded and jacketed slugs pimple and swell due to accumulation of tuballoy corrosion product under the ductile jacket. A part of corrosion product from certain test specimens has been identified as hydride.

No evidence of corrosion of Al/Si bonding layer or of compound reaction layer has been found except for high tin specimen. A condition leading to corrosion and swelling would exist for all sizes of holes and pores in Al jacket as long as they extend into an unsound Al/Si layer. If good bond at Al//Al/Si interface exists adjacent to a defect in aluminum can, swelling is confined to a small area, thereby causing rupture of the can at 100% power level. The time required to jam slug in annulus was 45 hours after swelling once started. At 50% power level, no swelling after 741 hours was noted.

Zn/Al bonding layer and compound reaction layers are not themselves resistant to corrosion. Zn/Al bonded slugs will swell if a defect in Al jacket extends into or to Zn/Al bonding layer. At 100% power level, time to jam slug in annulus was estimated at 45 hours after swelling once started. At 50% power level, no swelling was noted after 308 hours in test.

Tests on unbonded Al/Si die casts at 100% and 50% power levels have been completed. At 100% level, time to swell and jam annulus was less than nine hours whereas at 50% level jamming occurred in approximately 18 hours.

Operation of leaky unbonded aluminum jacketed slugs at 50% power level is not considered safe, swelling and jamming occurred in 25 hours. At 20% power level, swelling and jamming of annulus developed in 500 hours.

Thermal Cycling: No positive results on the effect of thermal cycling upon bond stability has been obtained. Cycling changes are being evaluated by frost tests and supersonic tests before and after cycling. Terminal report on results of the work is being prepared.

Progress for Balance of Authorization:

Corrosion Testing: Further testing of single-dip and triple-dip Al/Si slugs at 100% power to determine if cracking of Al jacket is characteristic of canning technique employed at Chicago.

Effect of perforated can on swelling and cracking of aluminum jacket.
Completion of test on Al/Si bonded slugs at 50% power level.
Completion of test on Zn/Al bonded slugs at 50% power level.
Further tests on Al/Si die cast slugs.
Testing of corrosion resistant tuballoy alloys such as Tu/Mo, Tu/Cb, etc.
Testing of Al/Si gravity cast slugs.

Thermal Cycling: Finish terminal report.

Group Leader Responsible

D. L. Schwartz
D. L. Schwartz

Reports: MUC-FF-88, 119, 152, 163, 172, 173,
174, 175

Section Chief

Frank Foote
Frank Foote

Man-Months Expended 14.5

Division Director

Charles M. Cooper
C. M. Cooper

Next Review Date January 1st, 1945

Report received: November 30, 1944
Issued:

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Metallurgical Laboratory
Technical Division

Problem No.: 203 ML 51-26
Date: June 14, 1944
Priority: A-1

PROGRAM AUTHORIZATION

CS-1465 F.S.# 56
This document contains 1 pages.

Title: Semi-works Investigation of Methods to Improve Decontamination in the BiPO_4 Process.

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B. L. Doan - Pers.

Objective: To evaluate on a semi-works scale methods of increasing the decontamination per cycle achieved by the BiPO_4 process. The use of scavengers, variations in concentrations of reagents and other modifications will be investigated.

Present Status: The present BiPO_4 process does not appear capable of achieving the 10" decontamination desired in one extraction step and two decontamination cycles at Hanford. Process variations yielding higher decontamination have been investigated in the laboratory by the Chicago Chemistry Division.

Proposed Program: Hanford flow sheet conditions for the BiPO_4 extraction step and two decontamination cycles will be followed using solutions prepared from X metal having a concentration of 40 to 80 micrograms of product per pound and having inactive fission elements added to give expected Hanford Concentrations.

Variations, from the main line procedure, recommended by the Chemistry Division will be introduced and evaluated by comparison with control runs. The work will be done in collaboration with the Chemistry Division, whose authorization for this study is 200 MLC 1311.

Reason for the Proposed Work: Unless greater decontamination can be achieved per BiPO_4 cycle than has been demonstrated in scouting runs using the proposed Hanford procedure, more than two cycles would be required at "W" to obtain the desired decontamination in the canyon. This would necessarily complicate operations, besides resulting in increased product losses. Process variations developed by the Chemistry Division to improve decontamination need to be tested on a semi-works scale in stainless steel equipment.

Remarks:

Submitted by: A. H. ...

Review Date: August 1, 1944

Approved by: T. E. Kincaid

Man-months Authorized: 40

Man-months to complete: 80

Charles McCooper

Estimated Completion Date: October 1, 1944

Noted by G. J. Lee Co

Authorized by:

Noted by TRH/guest

H. B. Vernon Jr

MUC-IWB-131

Received: July 3, 1944

Issued:

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 56

Problem No. 203-ML-51-26
Date August 4, 1944
Priority A-1

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PROGRAM AUTHORIZATION (PART II)

Title: Semi-works Investigation of Methods to Improve Decontamination in the BiPO₄ Process.

Objective: To evaluate on a semi-works scale methods of increasing the decontamination per cycle achieved by the BiPO₄ process. Variations in reagent concentrations and other modifications will be investigated.

Progress (Part I) and Present Status: A base line decontamination of 1.2×10^4 for gamma activity and 4.3×10^4 for beta activity has been established in present semi-works equipment for a BiPO₄ extraction step and two unmodified decontamination cycles in the presence of the expected Hanford concentrations of fission product elements. One centrifuge was used in the extraction step and first cycle and a separate centrifuge in the second cycle. Scouting runs are now being made on the present equipment using the low acidity modification of the BiPO₄ process.

Proposed Program: Three additional centrifuges will be installed and all common piping eliminated. Runs will be made based on the low acidity modifications of the BiPO₄ process, using solutions of X-metal having a concentration of 40 to 80 micrograms of product per pound and having inactive fission elements added to give expected Hanford concentrations. The work will be done in collaboration with the Chemistry division whose authorization for the study is 203-ML-C-1310.

Reason for Proposed Work: Unless a decontamination of 10^5 can be obtained in the BiPO₄ extraction step and two decontamination cycles at Hanford, additional equipment and more complicated operations will be necessary, resulting in loss of time and in increased product losses. The low acidity type run and other process variations being developed by the Chemistry Division need to be tested in semi-works scale equipment.

Reports on Part I: CN-1953

Next Review Date - November 1, 1944
Man-months Authorized (Part II) - 50
Man-months Used (Part I) - 40
Estimated Completion Date - 11/1/44
Estimated Man-months to Complete - 90

Written by B. L. Wendrow
Approved by A. C. Miller
(Section Chief Responsible)
Charles M. Cooper
Authorized by H. J. Brown 9/18

Group Leader Responsible AC Miller

Noted by G. J. Leborg
Noted by T. R. Hognes
Report received: September 23, 1944
Issued: OCT 3 1944

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Problem No. 203-ML-51-26

Date, November 23, 1944

Priority A-1

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University of Chicago
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File Serial 56

FINAL REVIEW

Title: Semi-works Investigation of Methods to Improve Decontamination in the BiPO₄ Process.

Closing Status: Decontamination of 1.2×10^4 for gamma activity and 4.3×10^4 for beta had been established in the semi-works for a BiPO₄ extraction and two unmodified decontamination cycles in the presence of Hanford concentrations of fission product elements. One centrifuge was used in the extraction and first cycle and a separate centrifuge in the second cycle. Scouting runs, based on the low acidity modifications of the BiPO₄ process, were made using the same equipment. Rather low decontamination factors and product yields were obtained, probably due to process irregularities.

New piping, additional tanks and a centrifuge for each step of the BiPO₄ process were installed to eliminate recontamination by reuse of equipment during a run. With the BiPO₄ extraction step equipment, eleven runs were completed in a study of a reprecipitation process to reduce the iron content of the LaF₃ product precipitate at the end of the cross-over. Iron reduction to 0.3% of original Fe content in the first precipitation and to 0.08% in the reprecipitation was obtained with an initial Fe of 0.1M. When the initial Fe was 0.01M, corresponding reductions to 3% and 1.6% were obtained.

Active BiPO₄ runs, based on the Hanford flowsheet without scavengers, are now being processed to test the revised equipment and to establish new base line decontamination factors. This program will be continued under the direction of the Chemistry Division.

Reports: CN-1953, CN-2084, CN-2162, CN-2287, CN-2414

Notebooks: 375-B, 1033-B, 1000-B, 1032-B

Total Man-months Expended - 77

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Group Leader Responsible C. J. EdwardsSection Chief R. C. TillerDivision Director Charles M. Cooke~~SECRET~~

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File Serial

57

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CS-1465 F.S. 57
Problem No. 136 ML 56-8
Date July 5, 1944
Priority B-1

PROGRAM AUTHORIZATION

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B. H. Brown Pers.

Title: Service in Optics to Argonne.

Objective: To provide for service in optical instrument design, and consultation in optical problems to Argonne, and construction of instruments requested.

Present Status: The construction of the P-9 Pile is such that optical instruments are now needed. These are in general of two sorts: (a) periscopes for looking inside the Pile, (b) periscopes for checking the P-9 pipe system for leaks and other possible breakdown. Consultations have been held and designs are being submitted to Mr. Zinn.

Proposed Program: In general, an attempt has been made to use standard type instruments which require no great deviations in design from those made for other sites. Two principal instruments of the periscope type are suggested, both $1\frac{1}{2}$ " in diameter. One is to be inserted vertically into the Pile during shutdown and permit a view of any part of the inside. Another is an instrument sectioned like a borescope for insertion into any one of several holes into the pipe room with provision for variable length. Plans are also being submitted for overall viewers with flat window ends and North American lenses which may be swung over the inner end at will, for viewing larger areas.

Reason for Proposed Work: Request by W. H. Zinn.

Remarks: None.

Review Date October 1, 1944
Man-Months Authorized 2
Estimated Completion Date Oct. 1, 1944
Estimated Man-Months to Complete 2

Submitted by Georges Monte

Approved by Chas. D. Carver

Supervisor Responsible William H. McLeish

Authorized by H. C. Brown 7/2

MUC-EWB-226

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File Serial 57

Problem No. 136-MI-56-8

Date June 1, 1945

Priority B-1

PROGRAM REVIEW

Title: Service in Optics to Argonne.

Progress and Present Status: Since April 1, 1945, a type A-A periscope has been designed and several parts of it have been completed. Preliminary work has been started on an improved stereoscopic optical system for the Argonne cloud chamber.

Program for Balance of Authorization: To complete the projects begun under this authorization as rapidly as possible.

Reports: None.

Man-Months Expended 1/2

Next Review Date _____

Supervisor Responsible

Section Chief

Division Director

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File Serial 57

Problem No. 136-ML-56-8

Date October 1, 1944

Priority B-1

PROGRAM REVIEW

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Title: Service in Optics to Argonne.

Progress and Present Status: Drawings have been made and submitted and comments are awaited.

Program for Balance of Authorization: Until comments are forthcoming and a request for a specific instrument is made, nothing can be done.

Reports: None.

Man-Months Expended 0

Next Review Date Jan. 1, 1944

Group Leader Responsible William P. M. C. Korb
Section Chief George S. Brown
Division Director Chas M. Cooper

Report received: October 16, 1944
Issued:

OCT 20 1944

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File Serial 57

Problem No. 136-ML-56-8
Date January 1, 1945
Priority B-1

PROGRAM REVIEW

Title: Service in Optics to Argonne.

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(R. L. Davenport)

Progress and Present Status: No work has been done ^{on} this program to date.

Program for Balance of Authorization: To continue the objective of this
Authorization as requests for service are received.

Reports: None.

Man-Months Expended 0

Next Review Date April 1, 1945

Group Leader Responsible *William W. Burke*

Section Chief *Robert Mann*

Division Director *Chas M Cooper*

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Technical Division

File Serial 57

Problem No. 136-ML-56-8
Date April 1, 1945
Priority B-1

PROGRAM REVIEW

Title: Service in Optics to Argonne.

Progress and Present Status: No work has been done on this program to date.

Program For Balance of Authorization: To continue the objective of this authorization as requests for service are received.

Reports: None.

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Man-Months Expended 0

Next Review Date June 1, 1945

Group Leader Responsible

Willard W. McBurnett

Section Chief

George S. Monahan

Division Director

J. C. Stearns

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Technical Division

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File Serial 58

Problem No. 211-MI-59-8Date July 31, 1944Priority A-1PROGRAM AUTHORIZATION

Title: Solvent Extraction Processes for Concentration & Isolation of Product.

Objective: To develop the engineering features of a solvent extraction process for the concentration and isolation of product and to demonstrate the feasibility of using this process on the Hanford scale of operation.

Present Status: A wholly satisfactory concentration and isolation step employing chemical precipitation methods has not as yet been completely developed for the Hanford separation process.

Solvent extraction methods have been used successfully for several months by the Chemistry Division for recovering purified product in high yields from solutions containing many types of impurities. It is indicated on the basis of this work that a solvent extraction concentration and isolation process using methyl isobutyl ketone can be developed for full-scale application.

Proposed Program: A program for the development of a solvent extraction concentration and isolation process will be carried out along the following lines:

1. The Chemistry Division will have the principal responsibility for obtaining the fundamental information necessary to the accomplishment of the objective. The General Engineering Section will assist in the planning of the laboratory-scale experimental studies.
2. Intermediate-scale extraction units will be designed, constructed, and operated in order to obtain the performance data needed in designing full-scale equipment.
3. A system capable of processing the Hanford production will be assembled and tested.
4. In the event that experimental work at Clinton is necessary, the General Engineering Section will cooperate in all phases of the work at that site.

Reason for Proposed Work: There is good reason to expect that the proposed investigation will develop a superior method for carrying out concentration and isolation step of the Hanford separation process.

Remarks: This program has been discussed with interested individuals of the Clinton Laboratories and the duPont Company who have expressed approval of the planned investigation.

Review Date November 1, 1944Man-Months Authorized (Part I) 10*Estimated Completion Date January 1, 1944Estimated Man-Months to Complete 16*

Supervisor Responsible

J. B. Stepe

Submitted by

J. O. Maloney

Approved by

Chas. M. Cooper

Noted by

T. R. Hogness

* Technical Division Personnel Only.

Authorized by

H. G. Vernon 8/3/44

University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 58

Problem No. 211-MI-55-8
Date November 3, 1944
Priority A-1

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PROGRAM AUTHORIZATION (PART II)

CS-1465 F. S. 52
Supplement A
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A. T. Brown - Res.

Title: Solvent Extraction Process for Concentration
and Isolation of Product

Objective: To develop the engineering features of a solvent extraction process for the concentration and isolation of product and to demonstrate the feasibility of using this process on the Hanford scale of operation.

Progress (Part I) and Present Status: The experimental work which has been carried out to date includes fundamental laboratory studies by Dawson's and Lawroski's groups, Chemistry Division, and the operation of a continuous countercurrent extraction unit by Lawroski's group. The fundamental work included the determination of the equilibrium distribution of Pu, La, and Zr between methyl isobutyl ketone (hexone) and aqueous salt solutions and a variety of small-scale batch extraction experiments. The continuous countercurrent extraction experiments were made using a column 1 in. in diameter and 16 ft. tall. The column runs were wholly successful, better than 99% yield and purity being obtained in all cases.

At present the major emphasis in this program is on completing the construction of a full-scale continuous countercurrent hexone extraction system. The columns in this system are glass, 3 in. in diameter and between 20 and 30 ft. tall. This equipment has sufficient capacity to isolate product at the Hanford rate of production. Not more than 2 gm. of product will be handled at any one time, however, because of the health hazard involved.

Proposed Program: The future program is the same as that described on the original program authorization except that Part 2 which had to do with the operation of the intermediate-scale continuous extraction unit has been completed.

Reason for Proposed Work: There is good reason to believe that solvent extraction methods will prove highly desirable for use in isolating product and perhaps in carrying out other steps of the separations process.

Reports on Part I: Progress report in preparation.

Next Review Date February 1, 1945
Man-Months Authorized (Part II) 10
Man-Months Used (Part I) 12-1/2
Estimated Completion Date May 1, 1945
Estimated Man-Months to Complete 20

Group Leader Responsible

Written by

Approved by

Authorized by

Report received: November 30, 1944
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Technical Division

File Serial 58

Problem No. 211-ML-55-8
Date December 30, 1944

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FINAL REVIEW

Title: Solvent Extraction Processes for Concentration & Isolation of Product

Closing Status:

The objective of this program was to develop through laboratory, semi-works, and full-scale, a solvent extraction process for concentration and isolation of product at Hanford.

A program of fundamental laboratory investigation was carried out which successfully collected all of the basic information needed in planning experimental work on a larger scale. Extraction studies were then carried out using a continuous countercurrent system several times smaller than full-scale. The results obtained with this equipment were excellent, 99.9% purity of product and 99.7% yield being consistently obtained. Finally a full-scale glass extraction system having columns 3 in. in diameter and over 30 ft. tall was constructed. Only preliminary operating results have been obtained using this equipment. So far, however, the excellent performance of the smaller unit has been duplicated in all respects. No product has as yet been used in the large system.

This program will be carried on by Larowski's group of the Chemistry Division, Section C-I. All files and materials have been turned over to this group. A progress report on all work accomplished to date is being issued at the present time.

Reports: CN-2511

Total Man-Months Expended 22

Group Leader responsible *J. B. Tepe*

Section Chief *J. O. Maloney*

Division Director *Chas. M. Casper*

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 59

Problem No. 154-ML-52-5
Date September 13, 1944
Priority B-1

PROGRAM AUTHORIZATION

Title: Manufacture of Zinc Bonded Assemblies.

Objective: To can a sufficient number of W slugs, using the zinc bonding technique, to permit evaluation of the process at H.E.W.

Present Status: A group has been organized/for carrying out the proposed program at Site B. 1600 W slugs and 2500 cans have been received from H.E.W.

Proposed Program: This proposal embodies the following:

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- (1) Preparation of 1600 complete (welded) zinc bonded assemblies.
- (2) Testing and classification of these assemblies.
- (3) Recovery of Tu from rejected assemblies.
- (4) Repetition of (1), (2) and (3) until as many as possible acceptable assemblies have been made.

Reason for Proposed Work: This work is proposed for the following reasons:

- (1) H.E.W. has requested that 1600 assemblies be prepared using zinc, in order that they may properly evaluate the process, which is probably the best alternative to the present method of production.
- (2) It is desirable to have a complete crew, entirely familiar with the process, which could go into plant production of zinc bonded pieces, should this become necessary.

Review Date November 1st
Man-Months Authorized 16
Estimated Completion Date November 1st
Estimated Man-Months to Complete 16

Written by J H Chapin
Approved by J H Chapin
(Section Chief Responsible)
Chas M Cooper

Group Leader Responsible T. J. Armstrong

Report received: September 20, 1944
Issued: SEP 28 1944
Authorized by H. C. Vernon 7/14

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File Serial
59

Problem No. 154-ML-52-5
Date 11/1/44

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FINAL REVIEW

Title: Manufacture of Zinc Bonded Assemblies

B. J. Sloan - Pers

Closing Status:

1602 Hanford slugs were processed by the Zinc Bonding Group. It was demonstrated that as high as 89% of all slugs processed can be made Class 111 with about 3% Class 211. A maximum rate of 153 per 8 hour shift has been attained on the canning line.

Measurement of k loss by the Physics Division showed that the coating is equivalent to 12-14 mils of zinc on 1.359" diameter slugs. It is feasible to can slugs up to 1.362" diameter on a production basis.

Reports:

Daily Canning Report, CT-2284 and CT- 2471.

Total Man-Months Expended 15.4

Group Leader Responsible T. J. Armitage

Section Chief J. H. Chapin

Division Director W. L. M. Carpenter

Report received: December 29, 1944

Issued: JAN 3 1945

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File Serial 60

University of Chicago
Metallurgical Laboratory
Technical Division

Problem No. 154-ML-52-6
Date September 20, 1944
Priority B-1

PROGRAM AUTHORIZATION

Title: Die Cast Coatings

Objective: To develop and evaluate a suitable die cast coating for tuballoy.

Present Status: W slugs have been coated by die casting at the Garwood plant of Alcoa under a variety of conditions. The product has been partially evaluated at Chicago. Construction of a new die has been initiated at Garwood. Work to September 20 has been carried on under 154-ML-52-1.

Proposed Program: It is proposed that several hundred slugs be jacketed by die casting at Garwood, using a new die embodying the features found desirable during the early experimentation. These pieces would be evaluated at Chicago, using the usual tests.

Reason for Proposed Work:

(1) Insufficient numbers of slugs have been prepared under any given set of conditions to permit proper evaluation of the best product that can be made.

(2) It is believed desirable to have a die, tested by use and in readiness for production of die cast jacketed slugs in quantity, should such production for HEW be required on short notice.

Review Date November 1, 1944
Man-Months Authorized 4
Estimated Completion Date Nov. 1, 1944
Estimated Man-Months to Complete 2

Written by J. H. Chapin
Approved by J. H. Chapin
(Section Chief Responsible)

Group Leader Responsible J. H. Chapin

W. M. Carpenter
A. B. Greninger

Authorized by H. C. Vernon 9/22

Report received: September 25, 1944
Issued: OCT 3 1944

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 60

Problem No. 154-ML-52-6

Date Nov. 1, 1944

Priority B-1

PROGRAM REVIEW

CS-1465 F. S. 60
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Title: Die Cast Coatings

Progress and Present Status:

A new die with about 1 cu.in. metal overflow was constructed at Garwood. 300 unbonded slugs were cast using 360 alloy at high temperatures. Half of the slugs were pre-heated in air to about 200° F. immediately prior to casting. About 8% failures in the autoclave were encountered in this run with no significant difference between the pre-heated and the room temperature slugs.

A number of slugs were pickled in Nitric Acid and dipped in 360 or in Al3 alloy, the excess alloy brushed off and the slug inserted in the die while hot. 360 or Al3 was then cast over to form the jacket. When Al3 was used for the preliminary dip an excellent bond was obtained in all cases. Because of the temperatures involved in this operation and the pressure of the flowing metal during the casting operation, the slugs were upset and/or bowed in nearly every case.

Thoroughly bonded and relatively sound jackets have been obtained. The difficulty involved in the weakness of tuballoy at dipping temperatures must still be overcome before a satisfactory product will have been obtained.

Program for Balance of Authorization:

It is recommended that a further trial be made using lower dipping temperatures and a more highly developed method for removing excess dipping alloy.

Reports:

None

Report received: November 30, 1944

Issued: DEC 11 1944

Man-Months Expended 3.2

Next Review Date 1-1-45

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Group Leader Responsible JH Chapin

Section Chief JH Chapin

Division Director Chas M Cooper

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SECRET

University of Chicago
Metallurgical Laboratory
Optics Section

File Serial 61

Problem No. 136-ML-56-9

Date March 1, 1945

Priority

PROGRAM REVIEW

CS-1465 F. S. #61 Supple B
This document consists
of 1 page of text.
Copy 27 of 36 Copies
Series A.

Issued to:

Clinton Lab
R. L. Doan, pers.

Title: Service in Optics.

Progress and Present Status: The Optics Section is called upon by individuals in other divisions, sections, and groups to assist in the design and construction of optical instruments for Project needs. In furtherance of this program the Optics Section has assisted in the design of a fluorimeter for the Health Group, performed certain services in the design of a periscope for Seaborg's section and has performed numerous other small services of a constructional or design nature.

Program for Balance of Authorization: To continue assistance in accordance with the authorization.

Reports: None.

Man-Months Expended: 1 $\frac{1}{2}$

Next Review Date June 5, 1945

Supervisor Responsible

George S. Doan

Section Chief

George S. Doan

UNCLASSIFIED

University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 61

Problem No. 136-ML-56-9
Date November 28, 1944
Priority - -

UNCLASSIFIED

PROGRAM AUTHORIZATION

CS - 1465 F. S. #61
This document consists
of 1 page of text.
Copy 27 of 36 Copies.
Series A.

Issued to: Clinton
(R. L. Brown - pers.)

Title: Service in Optics.

Objective: To design and supervise construction of optical instruments as requested by other Project groups.

Present Status: The Optics Section is called upon by individuals in other divisions, sections, and groups to assist in the design and construction of optical instruments for Project needs.

Proposed Program: To assist and cooperate with individuals and groups in the Project who have optical problems. It is expected that this authorization will cover only those cases in which the amount of assistance rendered by this section is less than two or three man weeks. For longer programs it is expected that special program authorizations will be written.

Reason for Proposed Work: The reason in each case will be furnished by the group desiring the work to be done.

Review Date March 1, 1945
Man-Months Authorized 3
Estimated Completion Date _____
Estimated Man-Months to Complete _____

Written by

George L. Brown

Approved by

George L. Brown
(Section Chief)

Group Leader Responsible To be assigned.

Authorized by

Chas M. Cooper
J. C. Stearns

Report received: December 29, 1944

Issued: JAN 3 1945

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University of Chicago
Metallurgical Laboratory
Optics Section

File Serial 62

Problem No. 313-ML-56-10

Date April 15, 1945

Priority

PROGRAM REVIEW

Title: Service to Section C-1, Chemistry Division, in Metallic Film Deposition for Alpha Back-Scattering Measurements.

Progress and Present Status: Crystallization of evaporated films has resisted attempts at elimination. A recent investigation of the literature indicates that a change in crystal structure of evaporated films in the region of 10-50 molecular layers thickness is inherent to such films, when deposited on "structureless" polished surfaces. Such a change in crystal structure may account for the highly crystallized form which appears.

This difficulty may be overcome by the method of cementation of a secondary backing to the film and subsequent stripping off of film and secondary backing from the original backing.

Microtoming has been tried and does not work, even on soft metals, such as lead. The resulting surface shows minute scratches and streaks. Electrolytic polishing will not be attempted since a surface polished by this method is uneven or has little ridges. Good lead surfaces have been prepared by hydraulically flowing the lead over the polished face of a stellite mirror; this method may be used for lead.

Program for Balance of Authorization: Further work on the secondary backing technique will continue, as successful results have been obtained with it. As soon as seven satisfactory samples of each of the five metals Al, Ce, In, Se, and Pb are made, the work covered by this authorization will be completed.

Reports: None.

Man-Months Expended: 0.8

Next Review Date: June 25, 1945

CS-1465 F. S. 62

Sup.C

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Series A

Issued: Clinton Lab

R. L. Doan.

Supervisor Responsible Pete R. Girardot

Section Chief Georges Monn

Report received: May 10, 1945

Issued:

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PROGRAM AUTHORIZATION (PART II)

Title: Service to Section C-1, Chemistry Division, in Metallic Film Deposition for Alpha Back-Scattering Measurements.

Objective: To develop and standardize techniques in preparing metallic and other films having characteristics unlike those commonly prepared.

Present Status: Films of the desired thickness have been prepared to date of the following metals: Al, Zn, Ag, In, Sn, Pt, Pb, and Bi. All exhibit crystallized surfaces which are undesirable for the requirements specified. Cooling of the samples to liquid nitrogen temperatures during deposition of the metal films improves surface characteristics, but has not yet been shown to eliminate crystallization completely.

By cementation of a rigid secondary backing medium to the crystallized film, and subsequent stripping off of the film and backing, a satisfactorily surfaced disc can be obtained. About 90% rejection occurs in the process, so far, because of difficulty with unequalized thermal expansion between backing disc and film at low temperatures.

Proposed Program: Two methods under investigation which may produce good results are electrolytic polishing and microtoming, especially for the softer metals. Further work on the secondary backing technique will continue, as successful results have been achieved with it. As soon as seven satisfactory samples of each of the five metals Al, Ce, In, Se, and Bp are made, the work covered by this authorization will be completed.

Reason for Proposed Work: The back-scattering from flat surfaces of pure metals must be studied to determine percentage geometry error in "52% geometry" counters. Evaporated films have been successfully made for use, but are difficult to prepare. Other methods of preparation are under investigation.

Reports: None.

Next Review Date April 15, 1945
Man-Months Authorized (Part II) 10
Man-Months Used (Part I) 5.5
Estimated Completion Date April 30, 1945
Estimated Man-Months to Complete 7
Supervisor Responsible P. R. Girardot

CS-1465 F.S.#62 Supple.B
This document consists
of 1 page of text.
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Series A

ISSUED TO: Clinton Lab.
B. L. Drown, pers.

Submitted by Peter R. Girardot

Approved by George S. Monck

Authorized by J. C. Stearns

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University of Chicago
Metallurgical Laboratory
Technical Division

File Serial 62

Problem No. 313-ML-56-10

Date January 8, 1945

Priority _____

PROGRAM AUTHORIZATION

CS-1465 F.S. #62

Supple A

This document consists of
1 page of text.

Copy 27 of 36 Copies.

Series A. Issued to *Clinton*
(R. L. Dean pers.)

Title: Service to Section C-1, Chemistry Division, in Metallic Film Deposition
for Alpha Scattering.

Objective: To develop and standardize techniques in evaporating metallic and
other films having characteristics unlike those commonly deposited.

Present Status: An investigation was started in December as to the possibility
of depositing thick (i.e. from three to six times as thick as the usually de-
posited coat) films of various metals selected throughout the periodic table,
with rigidly specified characteristics. Difficulty is being encountered in an
undesirable crystallization of the surface, and means of elimination require
further study.

Proposed Program: Development of a technique to deposit thick films with the
wanted characteristics will be carried out to completion. Other investigations
of a like nature will be carried out as required and authorized.

Reasons for Proposed Work: The back-scattering from very flat surfaces of pure
metals must be studied to determine percentage geometry error in "52% geometry"
counters. Evaporation of films promises to give more general satisfaction than
other methods of preparation of surfaces.

Remarks: None.

Reports: None.

Review Date February 15, 1945
Man-Months Authorized 5
Estimated Completion Date: 3/1/45
Estimated Man-Months to Complete 4

Written by *Peter R. Girardot*

Approved by *George H. Moore*

Chas. M. Cooper

Group Leader Responsible P. R. Girardot

Authorized by *J. C. Stearns*

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August 4, 1944

To Recipients of Technical Division Program Authorizations (List A)
Section Chiefs and Group Leaders - Technical Division

From E. W. Brugmann

Please note the following changes in Problem Numbers:

COATINGS SECTION, J. H. Chapin, Section Chief

<u>File Serial No.</u>	<u>Old Number</u>	<u>New Number</u>
9	154 ML 54-3	154 ML 52-1
27	154 ML 54-3d	154 ML 52-2
28	154 ML 54-3e	154 ML 52-3
47	154 ML 54-3M	154 ML 52-4

CORROSION SECTION, E. W. Brugmann, Section Chief

18	124 ML 54-4a	124 ML 53-1
19	124 ML 54-4f	124 ML 53-2
20	124 ML 54-4d	124 ML 53-3
22	391 ML 54-4e	391 ML 53-4

METALLURGY SECTION, Frank Foote, Section Chief

39	155 ML 54-5g	155 ML 54-1
41	151 ML 54-1	151 ML 54-2
45	381 ML 54-6	381 ML 54-3
52	215 ML 54-7f	215 ML 54-4
55	124 ML 54-3N	124 ML 54-5

These changes reflect a change in organization of the Technical Division whereby the old Metallurgy Section, A. B. Greninger, Section Chief, is divided into the three sections noted above. Mr. Greninger becomes Associate Director of this Division.

Work done during the month of July will be reported under the old problem numbers. The new problem numbers will be used to report work done during August, and thereafter. Section Chiefs and Group Leaders are asked to show both the old and the new problem numbers on the next program authorization part or review, as well as the first weekly report on which the new numbers are used.

E. W. Brugmann

UNCLASSIFIED

cc A. B. Greninger, C. M. Cooper

Changes made August 18, 1944
by Helen R. Hoofield for
R. L. Doan

R. L. Dean

~~XXXXXXXXXX~~

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August 5, 1944

TO: Recipients of Tech. Div. Program Authorizations (List A)
Section Chiefs and Group Leaders - Technical Division

FROM: E. W. Brugmann, per C. M. Cooper

Please note the following changes in Problem Numbers:

GENERAL ENGINEERING SECTION, J. O. Maloney, Section Chief

*Changes made August 18, 1944
by Helen R. Hazelwood
for R. L. Dean*

<u>File Serial No.</u>	<u>Old Number</u>	<u>New Number</u>
2	281-ML-59-2b	281-ML-55-2b ✓
33	281-ML-59-2b1	281-ML-55-2b1 ✓
34	285-ML-59-4	285-ML-55-4 ✓
35	226-ML-59-2d	226-ML-55-2d ✓
38	207-ML-59-2e	207-ML-55-2e ✓
40	390-ML-59-S	390-ML-55-S ✓
46	150-ML-59-5	150-ML-55-5 ✓
48	181-ML-59-6	181-ML-55-6 ✓
49	213-ML-59-7	213-ML-55-7 ✓
58	211-ML-59-8	211-ML-55-8

These changes result from renumbering of the General Engineering Section to fit in with the section numbering system resulting from recent changes.

Work done during the month of July will be reported under the old problem numbers. The new problem numbers will be used to report work done during August, and thereafter. Section Chiefs and Group Leaders are asked to show both the old and the new problem numbers on the next program authorization part or review, as well as the first weekly report on which the new numbers are used.

TECHNICAL DIVISION

E. W. Brugmann
E. W. Brugmann, per
Chas. M. Cooper

fw
cc - A. B. Greninger

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