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RHTG # 44,832

BOX # 7568

TOP SECRET DOCUMENT NUMBER XIII-809-1A

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REPOSITORY Oakridge Operations Records Holding Task Group

COLLECTION Class. Doc. 1944-94 Vault

BOX No. RHTG # 266, Bldg. 2714-H

FOLDER RHTG Doc. # 44,832

Consolidated: December 13, 1954

Approved By: [signature]

New Document No. XIII-809-1A

DECLASSIFICATION AUTHORIZED

MALCOLM THEIBEN, ANALYSAS

Name (ADC) - Organization

9-14-94

Date

DECLASSIFICATION RECOMMENDED

ROY ANDERSON, ANALYSAS

Name (ADC) - Organization

9-14-94

Date

RESTRICTED DATA

This document contains restricted data as defined in the Atomic Energy Act of 1954. Its transmittal or disclosure [illegible]

[redacted]

1.

1113303

[redacted]

Edgar J. Murphy

MONTHLY REPORT ON OPERATIONS OF THE CLINTON LABORATORIES FOR THE MONTH OF MAY 1944

1 June 1944.

This document consists of 4 pages and _____ figures.
No. 3 of 3 copies, Series A

I. PRODUCTION

Item	During Month	To Date
Tons of Slugs received	22.16	182.08
Tons of Slugs placed in Production Pile	19.96	106.44
Tons of Slugs removed from Production Pile	19.77	68.40
Units of Product Concentrated	12.70	50.737
Units of Product actually shipped	12.70	50.737
Units of Product scheduled for shipment		80.600*
Anticipated shipments next month	16.0	

* Revised schedule submitted by A. H. C., 22 May 1944.

II. COSTS

Estimated operating cost for current month:	$ 700,000.00
Estimated operating cost to date:	$5,700,000.00
Estimated total operating costs from beginning of Contract to 6/30/44:	$4,400,000.00*
Estimated total operating costs from beginning of Contract to 6/30/45:	$15,500,000.00

* This figure based on cost to date and estimated cost for June.

III. PERSONNEL

Total number of Clinton Laboratories employees:	**1,470**
Number of duPont Trainees at Clinton Laboratories:	88

CLASSIFICATION CANCELLED OR CHANGED TO ...
BY AUTHORITY OF ...
DATE JAN 22 1975

[redacted]

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IV. NARRATIVE REPORT

The greatest energy output by the pile for any one month occurred during May. Even though the pile was shutdown for a period of about seven days, the total amounted to 778,000 KWH, thus exceeding the previous maximum developed during April by 95,000 KWH. The total accumulated energy to date is 3,490,000 KWH.

During the afore-mentioned shutdown, alterations in pile structure were undertaken and completed in accordance with the plans of the comprehensive program for increasing the power output of the pile. Chief among these was the installation of the air-block beam for preventing the useless flow of cooling air over the top of the graphite, - a factor of major importance when the two new 50,000 cfm fans are put in operation. The effectiveness of the installed air-block, however, became immediately evident when, upon start-up, the pressure drop across the pile increased about 20%. The resulting improvement produced in power generated is reflected in the monthly total.

The cooling capacity required to achieve the energy output contemplated in the extensive program for increasing the power is to be provided by two fans capable of circulating jointly 100,000 cfm of air through metal-bearing channels of the pile. Because of the inability of the fabricator to procure SKF bearings on time, the delivery of these fans to the Clinton Laboratories is several days behind schedule. If present delivery schedules are met, the installation of both fans will be completed about 1 July. Upon completion of the installation, the general program for increasing the power output will have been completed in all its essential features and the pile will then be capable of operating at the maximum capacity under summer weather conditions. It is estimated that the power output under these conditions should materially increase the current operating level.

One of the most essential factors which determines the maximum operating level is the efficiency of the cooling system in removing the heat generated as a result of the nuclear reactions. The present method of cooling depends upon the circulation of filtered air through the channels containing metal. It has been suggested that the efficiency of cooling may be greatly improved by the introduction of water in the form of sprays into the air stream before it enters the pile. Estimates, based on information obtained from related experiments, indicate that a gain of about 50% in power production may be expected, provided the water changes from the liquid to the vapor state while passing through the pile. In order to determine the merits of this method and to obtain data of engineering value, a Problem Assignment has been written covering the experimental work required.

The work of expanding the facilities in Building 205 is proceeding according to schedule. It appears at this time that the new cells will be ready for actual plant operation on or about 1 July. The additional cells will make it possible to test the W modified bismuth phosphate method of product separation. The results of these runs will be of great importance to the operations at W.

Since the start-up of operations on 20 December, 1943, one hundred and twenty-two "Runs" were processed in Building 205, amounting to about forty tons of metal. During the month of May, twenty-three (23) one-third ton "Runs" of "hot" metal were completely processed compared with thirty-one (31) for April. This decrease is only apparent and does not mean that the processing was greatly reduced, since seven or eight "Runs" are consolidated to form a batch before the final stages of separation are completed. Four such batches were completed during the month of April, whereas only three were completely processed during the month of May. The next batch, consisting of eight "Runs", will be completed and ready for delivery to the chemists for final isolation within the first few days in June.

Much effort is being expended by Clinton Laboratories to acquire information of particular interest to W in regard to decontamination - a phase in product separation of major importance to the success of the Project. In this connection, test runs were made in the cross-over cycle of the product separation process in Building 206 by adding a lanthanum fluoride by-product precipitation step, a procedure which is not followed under normal X conditions of operation. As a result of these tests, the decontamination was increased by a factor of about ten.

It has been found that the clothing of personnel handling radioactive material becomes highly contaminated. For this reason, the persons working with the active metal are required to wear protective clothing. A laundry has been constructed and is now operating, the function of which is to study methods for removing the contamination from the clothing. Results available at this time indicate that the major part of the active material can be successfully removed from the garments. Experimental data obtained thus far shows that the greater the degree of contamination, the greater the percentage of radioactive material is removed by washing. This program is of much interest to the health division and is receiving a great deal of consideration.

Requests have been received for the preparation of several special highly radioactive sources for shipment to another location on the Project. This Office has taken the necessary steps to procure the required vehicles and equipment for effecting shipment. Four enlisted men from the Special Engineer Detachment, who will accompany the convoy, have been assigned to this Office and have been given a rather intensive course in health hazards and safety measures. The schedule calls for several sources having an activity of approximately 1 curie and several larger sources having an activity of approximately 100 curies.

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The chemists who have been assigned to the task of preparing these special sources have succeeded, with a great deal of difficulty, in preparing the first radioactive lanthanum source for shipment. It is believed that the experience acquired in the preparation of this source will enable them to prepare the sources for future shipments more nearly on schedule and with fewer interruptions. The first source was delivered to the U. S. Engineer Office 31 May and plans are completed for effecting shipment 1 June. The Engineering Development Section has completed calculations and design of a container for the shipment of the 100 curie sources. Construction of this container will be started within the next few days. Every effort is being made to prepare these sources in accordance with instructions and to complete shipment to the final destination, giving due consideration to all health hazards and security measures

In addition to the above-mentioned special sources, a request has been submitted for the preparation and shipment of specially prepared sources of T-237. These sources are to be shipped to Berkeley, California, at intervals of about two weeks for an indefinite period. The material in question is formed as a by-product in normal pile operation and possesses certain features which are particularly advantageous in performing certain experiments which require tracer material. The first source will be ready for shipment during the first week in June.

The quantity of acceptable canned slugs delivered to Clinton Laboratories by the fabricator took a sharp drop in the earlier part of May. Although the cause was not immediately evident, it was suspected, however, that the quality of the argon gas used was another factor which should have been taken into consideration. Subsequent experiments proved this to be correct, and, when the proper quality of argon gas was used, the production rate approached the scheduled number of 1,000 slugs per day. It is believed that this will be maintained and even surpassed in June.

The grand total of Research and Development Problems, covered in the Problem Assignment Manual, completed to date, numbers fifty-two (52). Of this total, eleven (11) were considered as finished during the month of May.

Highly favorable reports concerning the quality of work done by the enlisted men of the Special Engineer Detachment continue to be received from supervisors and others familiar with the tasks performed. The contingent assigned to duty at Clinton Laboratories numbers sixty-five (65) men, and this group has contributed materially towards relieving the shortage of technical personnel.

Copies #1 and #2 - District Engineer, Manh. Dist. 5 June 1944. Courier - Major Edgar J. Murphy.

Copy #3 - File Copy, U. S. Engineer Office, Clinton Laboratories. 5 June 1944.

1113307

U-5-XVIII

~~TOP SECRET~~
By Authority of the District Engineer
Per [redacted]

1 July 1944.

MONTHLY REPORT ON OPERATIONS
OF THE CLINTON LABORATORIES
FOR THE MONTH OF JUNE 1944

This document consists of 5
pages and ——— figures.
No. 3 of 3 copies, Series A.

1. PRODUCTION

Item	During Month	To Date
Tons of Slugs Received	26.76	208.79
Tons of Slugs Placed in Production Pile	4.26	110.70
Tons of Slugs Removed from Production Pile	2.13	70.53
Units of Product Concentrated	15.375	46.112
Units of Product Actually Shipped	9.385 *	40.122
Units of Product Scheduled for shipment	16.000	46.600
Anticipated shipments next month:	14.000	

* 5.06 units were delivered to the U. S. Engineer Office on 30 June 1944, the shipment of which was not effected until 1 July 1944. Therefore, the shipments are not as far behind schedule as the figures above would imply.

II. COSTS

Estimated operating cost for current month:	$ 752,000.00
Estimated operating cost to date:	$ 4,986,000.00 *
Estimated total operating costs from beginning of Contract to 6/30/45:	$15,500,000.00

* This figure includes $521,800.00 covering material furnished by the United States Government up to and including 31 May 1944.

III. PERSONNEL

Total number of Clinton Laboratories employees:	1,513
Number of duPont Trainees at Clinton Laboratories:	58

CLASSIFICATION CANCELLED
OR CHANGED TO [illegible]
BY AUTHORITY OF [illegible]
BY [illegible] DATE JAN 9 1975 [redacted]

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IV. NARRATIVE REPORT

The energy dissipated by the pile during the month of June amounted to 998,100 MWH compared with 541,700 MWH in March. From this comparison a measure of the effectiveness of the improvements made to date in the pile according to the plans of the program for increasing the energy generated can be gaged since it was in March that the work required for the success of the program was started.

Further satisfactory progress was made during the month of June towards attaining the ultimate goal of the aforementioned program, with the following objectives being achieved: (a) the pile now contains 40.5 tons of metal as compared with the original amount of 35.8 tons; (b) the metal-bearing channels are charged with slugs having arc-welded aluminum jackets; (c) the loading pattern contains 44 slugs per channel as compared with 66; and (d) "poisoning" material in the form of specially prepared slugs have been added to the pile. (Poisoning materials, as used here, are those which readily absorb neutrons.) According to theoretical considerations, and to some practical experience, the use and the strategic positioning of such materials can be made to influence the neutron distribution in such a manner as to allow the pile to be operated at a higher energy output. The practical application of this suggestion by adding thirty-four "poisonous" slugs in two of the pile channels, has resulted in a gain of roughly 8% in the pile power develope

On 20 June, the first of the two 50,000 cfm fans was received for use in circulating air through the metal-bearing channels of the pile. The work of installing, aligning and testing the unit was begun immediately, and it appears that the fan will be in actual service on, or about 3 July. If the fabricators promised delivery date of 3 July is met, the second fan should be in operation on or about 15 July, and the two fans in combination will circulate cooling air at the rate of 100,000 cfm or over 6000 pounds per minute. The installation of these fans will complete the major and final phase of the comprehensive program for increasing the power output of the pile.

A plant problem which has occupied the close attention of the Clinton Laboratories is concerned with the disposal of the radioactive chemical wastes resulting from the process of product separation as carried out in Building 205. Apart from the Z-metal waste, which is segregated and stored in gunite tanks of 200,000-gallon capacities, the plant produces about 4000 gallons of chemical wastes per day under normal conditions of operation. The original disposal consisted in discharging the waste into the White Oak Creek Retention Pond after it had been diluted to the extent of making it safe with regard to health hazards; specifically, diluting the 4000 gallons to 750,000. Although it was believed that the disposal problem had been solved satisfactorily, later investigation showed, however, that the nature of the mineral content of the water produced phosphate precipitates which carried down with them much of the radioactive content of the water, depositing and concentrating in the clay bottom of the pond. To remedy this condition

the Clinton Laboratories decided to build a settling basin of 1,600,000 gallon capacity within the Area. By means of this, it is expected to keep the radioactive deposits under control; while the overflow, greatly reduced in chemical waste content, can be permitted to empty in White Oak Creek with safety. The Settling Basin will be ready for plant use on or about 5 July.

During the month of June, thirty-one (31) "Runs" were chemically processed in Building 205, representing over ten (10) tons of "hot" metal. The efficiency of the operations for this set of "Runs" has shown a decided uptrend, the product yield exceeding 90% by a slight margin. Since the start-up of plant operations on 20 December 1943, one hundred fifty-three (153) "Runs" have been processed for a total of fifty (50) tons of "hot" metal, showing an overall product yield of over 80%.

The final testing of chemical equipment installed in the two new cells of Building 205 was completed by the end of the month; and, by means of the additional cell facilities, the Clinton Laboratories will be in a position to acquire information of value to W by following the W flowsheet of product separation from "hot" metal. The actual plant use of the newly outfitted cells is scheduled to begin on 1 July.

Since the beginning of plant operations, the isolation of the product compound has been a specific task of the Chemistry Research Division. On or about 15 July, however, the responsibility will be transferred to Plant Operations, and the equipment and personnel will be housed in Building 204. Although the procedure developed in the laboratory has proven highly efficient for X levels of product concentration, there is much evidence to indicate that the method will require considerable revision before it can be applied successfully to W levels and W conditions of operation. The main object of the newly organized group is to develop procedures and techniques capable of coping adequately with process requirements of product isolation under W conditions. In this respect, the experience and cooperation of the Chemistry Research Division will be utilized to its fullest extent. A further object, no less important, is the training of personnel to apply successfully the procedures and techniques as developed.

In the earliest stages of the Project, technical calculations and preliminary experiments indicated that a pile consisting of ordinary water and metal would not be chain reacting. Although the results available at that time appeared to be negative, it was felt that they were not conclusive. At the completion of the Snell Experiment, several weeks ago, it appeared that it was an opportune time for obtaining further experimental data on such a water-metal pile, in view of the fact that, with a relatively

small amount of additional equipment and effort, such a pile could be readily constructed and tested in the position formerly used for the Snell Experiment apparatus. The preliminary results available at the end of June indicated that the production factor of the water-metal pile was very close to unity. In order for such a pile to be used for practical purposes, it must necessarily have a reproduction factor greater than unity by 2 to 3%. Experimental studies are now underway which should give some definite and conclusive information on this question within the next few weeks.

During the past month, shipment of two radioactive sources were made to Site Y: one consisting of approximately 1 curie source of radio-lanthanum and the other of about 0.8 curie of radio-tantalum. Plans are now well underway for the preparation and delivery of the 100 curie source of radio-lanthanum. The shipping container has been designed and fabricated. The engineering section, which was charged with the design and installation of the equipment required for the preparation of the large source, has completed its task and test runs are now being performed. It is anticipated that the first large source will be ready for shipment the latter part of July.

The procurement of X-metal for use here at Clinton Laboratories is progressing according to schedule. Revere Copper & Brass Co. has completed the extrusion of all metal covered by Clinton Laboratories' purchase order, which called for the extrusion of about 158 tons. Of this amount of material, 140.7 tons of rods were realized, yielding a percentage recovery of 89.3%.

The machining of slugs at Baker Bros. has now progressed to the stage where it is no longer necessary to operate three 8-hour shifts, seven days a week, but instead, they are now operating two 10-hour shifts, 5-1/2 days a week. This will enable them to use only the more experienced machinists and thereby obtain a greater percentage of perfectly machined pieces. It appears at this time that Baker Bros. will complete their program during the first week of August.

The argon arc-welding of cans at the Aluminum Cooking Utensil Co. has shown gradual improvement and during the last two weeks the highest production rate thus far was attained. The duPont Company is now using the facilities for the canning of slugs for Site W. It is anticipated that they will make use of these facilities until about 1 August, at which time the Aluminum Company will continue with the Clinton Laboratories' order. It would appear now that the canning rate of from 1200 to 1500 per day can be attained. There remain approximately 35,000 more slugs to be canned. Assuming no unforseen difficulties they should complete the job by 1 September 1944.

During the power shutdown 18 June 1944, the air conditioning unit serving the animal farm was shut off. When the current came on, the

unit did not start up. This being an exceptionally hot day, the temperature in the rooms where the animals are kept became excessively high. This resulted in the loss of a large number of the animals which were being used in making certain biological studies. Definite steps are being taken to eliminate the possibility of such an accident occuring in the future.

The Clinton Laboratories will submit on or about 1 July, an appropriation request for a project to build an annex to the Health Building 719. The purpose of this annex is to provide sufficient animal housing and additional laboratory facilities required in the study of the biological effects of chronic doses of radiation on healthy tissue. In the study of chronic effects, the animals are subjected to measured amounts of radiation, repeated over a protracted period of time, such as, six months, for example. This means that each animal under observation must be provided with living space for a long time, whereas, in the recent studies of the effect of acute doses, the animal was kept only for a short time since it was sacrificed usually after a single radiation exposure. The need for the study of biological effects of chronic doses results from the fact that insufficient information is available as to the effect of repeated exposures on the human beings.

Much consideration has been given to the matter of health hazards involved in the occasional spilling of the product compound and of radioactive materials as handled by the chemists in the course of experiments, preparations and isolations. The present flooring is concrete, which gradually becomes powdered under constant use, producing atmospheric dust which carries with it some of the spilled substances. Judging from some experimental data obtained on animals, the product compound is particularly dangerous since it is cumulative, - being excreted with extreme difficulty by animal bodies, and, in this respect, is much worse than radium. Recent studies further indicate that a very small quantity of product is sufficient for a lethal dose. These hazards, however, can be reduced considerably by the use of linoleum floor covering since linoleum is far less friable than concrete; and a waxed and varnished linoleum surface is much more durable and resistant to wear than a surface of painted concrete.

Seven (7) Problem Assignments, as covered in the Problem Assignment manual, were completed during the past month. To date, a grand total of fifty-nine (59) are considered as completed studies.

There are sixty-nine (69) enlisted men of the Special Engineer Detachment assigned for duty with Clinton Laboratories, showing an increase of nine (9) over the previous month. Supervisory comments, which have been received by this Office, indicate that the quality of the work has been highly satisfactory; and, in the cases of several individuals, the work has been termed as excellent.

Copies #1 and #2 - District Engineer, Manh. Dist. 4 July 1944. Courier - Capt. F. A. Valente.

Copy #3 - File Copy, U. S. Engr. Office Clinton Laboratories. 4 July 1944.

~~TOP SECRET~~

1113312

[redacted] Edgar F. Magoffin

1 July 1944.

U-6-XVII

PRODUCTION AND SHIPMENT OF PRODUCT X-49

SUMMARY REPORT FOR JUNE 1944

This [illegible] 2 pages and ——— figures.
No. 2 of 3 copies, Series A

Date Delivered to U. S. Engineers	Batch No.	Number of Units	SHIPMENTS MADE			For Use Under Supveriision of
			To	Date	Units	
6/ 1/44	16 Lot 16A	0.970	Site Y	6/ 1/44	0.970 *	Oppenheimer
-----	17 Lot 17A	0.930	-----	-----	0.930 **	Oppenheimer
6/16/44	19	4.075	Clinton L.	6/16/44 6/16/44	3.200 0.885	Whitaker Oppenheimer
6/16/44	20	4.330	Site Y	6/16/44	4.330	Oppenheimer
6/30/44	21	5.060	Site Y	-------***	5.060	Oppenheimer

TOTAL FOR MONTH: 15.575

NOTES:

* The final isolation of this Lot was carried out by the chemists at the Metallurgical Laboratory. The purified Product was transferred from Chicago to Site Y through the respective Area Engineers in the usual manner.

** This shipment is part of Batch 17 which was sent to the Metallurgical Laboratory for final isolation. The process has been completed, however, the transfer from Chicago to Site Y has not been made, but will be effected during the first part of July.

*** Plans have been completed for shipment to location as indicated above 1 July 1944.

[redacted] CLASSIFICATION CANCELLED
OR CHANGED TO
BY AUTHORITY OF
BY [redacted] DATE JAN 22 1948

[redacted]

SUMMARY OF SHIPMENTS TO DATE

Los Alamos	Chicago	Clinton Lab	Berkeley	Ames	Total
25.728	5.005	9.296	0.081	0.015	40.122

Copy #1 - Maj. Gen. L. R. Groves

Kept meeting

Copy #2 - District Engineer, Manhattan District. 5 July 1944. Courier - Capt. F. A. Valente.

Copy #3 - Maj. Edgar J. Murphy, date 5 July 1944 (file copy).

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J-7-XVIII

1 August 1944.

MONTHLY REPORT ON OPERATIONS
OF THE CLINTON LABORATORIES
FOR THE MONTH OF JULY 1944

This document consists of 5 pages and [redacted] figures.
No. 3 of 3 copies, Series A

1. PRODUCTION

Item	During Month	To Date
Tons of Slugs Received:	0.40	209.15
Tons of Slugs Placed in Production Pile:	7.30	118.00
Tons of Slugs Removed from Production Pile:	7.18	77.71
Units of Product Concentrated:	28.330	74.442
Units of Product Actually Shipped:	34.320	74.442
Units of Product Scheduled for Shipment:	14.000 *	60.600
Anticipated Shipments Next month:	15.000	

Note:

* This figure is not as far out of line as it would appear when compared with the figures "Units of Product Actually Shipped" and "Units of Product Concentrated". The number of units of Product concentrated was greater than had been previously estimated for the following reasons:

(a) A Batch containing 4.630 units was completed the first of the month, therefore reported as production for the month of July.

(b) The separation process following the Hanford Flow Sheet required less time per run than had been estimated.

(c) The efficiency of separation was much higher than had been expected.

The units of Product actually shipped are greater than the number concentrated during the month of July since one Batch was completed the latter part of June and was not shipped until 1 July.

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II. COSTS

Estimated Operating Cost for Current Month:	$ 789,000.00	
Estimated Operating Cost To Date:	$ 5,253,000.00	*
Estimated Total Operating Costs from Beginning of Contract to 12/31/44:	$ 9,253,000.00	**
Estimated Total Operating Costs from Beginning of Contract to 6/30/45:	$15,500,000.00	
Estimated Total Operating Costs from Beginning of Contract to 12/31/45:	$20,300,000.00	**

Notes:

* This figure does not include the cost of materials and services furnished by the United States Government through June 1[illegible], amounting to [illegible],659.00

** **These figures are based on the assumption that operations will continue at approximately the present rate. The latest information available concerning the general policy indicates that after 1 January 1[illegible] more emphasis will be placed upon research work and none on production. It is reasonable to believe at this time that the operating cost will not vary very much from the present rate as the emphasis is shifted from production to research. It is impossible to give more accurate figures on the operating cost until a more definite research program is adopted.**

III. PERSONNEL

Total Number of Clinton Laboratories employees:	1,491
Number of duPont Trainees at Clinton Laboratories:	31

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IV. NARRATIVE REPORT

Comparison of July kilowatt-hour total output to that of Marc index month during which a program for boosting power output start gives 1,485,015 against 541,700 KWH. This represents a 174% incre a relative measure of the improvements. To show the rise more cle a summary of the average daily power for operating time per month start-up is given:

November	448 KW	February	834 KW	May	1461 KW
December	648 KW	March	831 KW	June	1704 KW
January	861 KW	April	1034 KW	June	2637 KW.

The drop in KW from January to February and March was caused by in temperature rise. August should show a higher average power consu than July since the level of only the last few days of July was ab 3000 KW.

The last major item in this program was the installation of t large fans, which, when connected in parallel, provides approximat 120,000 cfm of cooling air through the pile. The operation of the completed 4 July, showed an 11.2% increase in the average power and 34.6% increase in the rate of circulating air, while addition of t second, completed 22 July, shows from preliminary data, 67% and 17C increases respectively. There is little else believed possible to a major boost in power output. Slight increases may occur by pile ing-material shift, operat[illegible] temperature rise, and inlet-air te decrease.

The 1,600,000 gallon settling basin was completed and started [illegible] plant waste from the underground storage tanks on 1 July. Unde conditions the 205 Building discharges about 5,000 gallons of che to these underground tanks per day. At present, almost 10,000 gall being discharged from them to the settling basin in order to empty the tanks in time to receive X-metal waste in September. The overf White Oak Creek retention pond is not as low in activity as was ant but when the overflow is decreased to an equilibrium based upon Bui 205 discharge, the estimated activity will be less than one curie pe

The recently formed product isolation group under the Plant Ope Division has moved into their newly equipped laboratory in Building Their equipment is devised for flow of product separation phases und series of inclosed hoods eliminating the hazardous personal contact. niques are to be studied and procedure developed for isolation with

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of product concentration. Nine of the present personnel of this group are trainees for Hanford with an expected eight additional to arrive

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During June and July experiments were undertaken using the "W" water tube -- a tube patterned after those to be used for pile cooling at Hanford site. Water was allowed to flow through the tube with conditions adjusted to simulate as closely as possible those at W, and the activity was measured by suitable counters. With the standard aluminum jacketed slugs, the well-known activity from the isotope N^{16}, produced from neutron capture of O^{16}, and the activity from the isotope Al^{28} showed up. For the maximum rate of flow 1200 cc/sec, the exit water had a gamma ray intensity of approximately 1/4 millicuries per liter. Under the estimated "W" conditions this would give a calculated intensity around 8 millicuries per liter.

In view of the method of pile cooling planned for the Hanford site a much more thorough slug pre-testing than applied at Site X must be done to assure little or no slug jacket failure. Recent data obtained here under the Engineering Development Section indicates that flaws in the aluminum jackets will show up in a very short time if the slugs are subjected to higher pressure steam. The Chicago group suggests the exposure of the slugs to steam at 100 to 150 lbs. per sq. inch for two weeks. Failures were produced here under these conditions within twenty-two hours. It is not planned to replace the dry heating method now is use at Site X by the steam pressure method, since the method presently in use here appears to be quite satisfactory.

During the month sixteen (16) Research and Development Problems from the Problem Assignment Manual were completed, making seventy-three (73) as the total studies finished to date.

The annex to the animal farm building was started 22 July and is scheduled for completion 1 September.

Three additional enlisted men of the Special Engineer Detachment were assigned for duty with Clinton Laboratories, bringing the total to seventy-two (72). The excellent work being done by this group continues to bear highly favorable comment.

Copies #1 and #2 - District Engineer, Manhattan District. 4 August 1944.
Courier - Major Edgar J. Murphy

Copy #3 - File Copy, U. S. Engineer Office, Clinton Laboratories, 4 August 1944.

1113319

[redacted]

1 August 194[illegible]

2-8-XVIII

PRODUCTION AND SHIPMENT OF PRODUCT X-19

SUMMARY REPORT FOR JULY 194[illegible]

EJM/ me

This document consists of 1 pages and [illegible] figures.
No. 3 of 3 copies, Series A

Date Delivered to U. S. Engineers	Batch No.	Number of Units	SHIPMENTS MADE			For Use Under Supervision of
			To	Date	Units	
7/ 1/44	22	4.630	Site Y Met. Lab	7/ 1/44 7/ 1/44	3.630 1.000	Oppenheimer Allison
7/15/44	23	5.180	Clinton L	7/15/44	5.180	Whitaker
7/15/44	24	6.050	Site Y	7/15/44	6.050	Oppenheimer
7/25/44	25	7.820	Clinton L	7/25/44	7.820	Whitaker
7/25/44	26	4.350 *	Site Y Calif.	7/25/44 7/25/44	4.250 0.100	Oppenheimer Latimer

TOTAL FOR MONTH: 28.330

NOTE:

* - A slurry solution from Room D containing about 2 units from Batch #26 was sent to the Metallurgical Laboratory where the chemists will complete the final stages of isolation. The quantity indicated by the final assay will be shown on the Report for August 194[illegible].

[redacted]
CLASSIFICATION CANCELLED
BY AUTHORITY OF [illegible]
BY [illegible] DATE JAN 22 1975

[redacted]

18

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[redacted]

SUMMARY OF SHIPMENTS TO DATE

Los Alamos	Chicago	Clinton Lab	Berkeley	Ames	Total
45.682 *	6.003	22.560	0.181	0.015	74.442

NOTE:

* - This figure includes a shipment of 0.950 units from Batch #17 which was shown on the report for June as being produced during that month. The shipment was effected 15 July 1944.

Copies #1 and #2 - District Engineer, Manhattan District, 4 August 1944.

Courier - Major Edgar J. Murphy.

Copy #3 - Major Edgar J. Murphy, 2 August 1944. (File Copy)

[redacted]

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[redacted]

2-9-XVIII-

1 September 194..

MONTHLY REPORT ON OPERATIONS
OF THE CLINTON LABORATORIES
FOR THE MONTH OF AUGUST 1944.

This document consists of 6 pages and ——— figures.
No. 3 of 3 copies, Series A.

I. PRODUCTION

Item	During Month	To Date
Tons of Slugs Received	8.55	217.70
Tons of Slugs Placed in Production Pile	9.57	127.57
Tons of Slugs Removed from Production Pile	9.59	87.30
Units of Product Concentrated	10.894 •	85.336
Units of Product Actually Shipped	10.894 •	85.336
Units of Product Scheduled for Shipment	13.000	75.600
Anticipated Shipments Next month	22.000	

Note:

• Approximately 2 units of Product in slurry solutions were sent to the Metallurgical Laboratory for isolation. The final assay values have not been determined as of this date, and, therefore are not included in these figures. A lot consisting of 2.010 units will be ready for shipment shortly after the first of September.

[redacted]

[redacted]

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II. COSTS

Estimated Operating Cost for Current Month:	$ 632,000.00
Estimated Operating Cost to Date:	$ 5,890,000.00
Estimated Total Operating Costs from Beginning of Contract to 12/31/44:	$ 8,600,000.00
Estimated Total Operating Costs from Beginning of Contract to 6/30/45:	$12,800,000.00 *
Estimated Total Operating Costs from Beginning of Contract to 12/31/45:	$17,000,000.00 *

Note:

* Estimates are based on the assumption that operations will continue at about the present rate. The scope and extent of the work to be included in the 1945 program are very indefinite at this time.

III. PERSONNEL

Total Number of Clinton Laboratories Employees:	1443
Number of duPont Trainees at Clinton Laboratories:	29

IV. NARRATIVE REPORT

The power output for the X-10 pile during the month of August shows a 120,000 MWH increase over that of the previous month even though there was a serious accident to one of the fans used in the pile cooling system. Daily average power developed for the first ten days of the month was above 3000 Kw, at which time the breakdown occurred causing the operation to continue at approximately 2000 Kw until one of the old fans was installed and put into operation on 26 August. During the last five days of the month, the 3000 Kw level was maintained by boosting maximum operating temperatures from 200° C to 250° C making the total monthly power output 1,604,600 KWH.

One of the large 50,000 cfm fans, located in Building 115 and used for pulling air through the pile, failed about 11:15 PM 8 August 1944. It is believed that the accident occurred as a result of a bearing failure. Damage was done to the fan and motor to the extent that repair work at this location was impossible. It was necessary to return them to the factories for the required repairs. The fan was returned to the manufacturer, Buffalo Forge Co., at Buffalo, N. Y. According to present information, the new fan assembly will be ready for shipment to Clinton Laboratories on or about 15 September 1944. The motor was sent to Allis Chalmers at Milwaukee, Wisconsin for overhauling and checking. The promised shipping date for the repaired motor is 11 September 1944.

Immediate steps were taken to install the larger of the two old fans which were removed when the two large fans were installed. The installation of the old fan was completed 25 August and was placed in operation in parallel with the large No. 3 fan, after a 24-hour test run.

The fans are now operating in parallel and are exhausting approximately 5200 lbs. of air per minute, compared with 4200 lbs. by the No. 3 fan alone and 7200 lbs. by the two large fans before the accident occurred. The operating level under the present conditions is from 2800 to 3000 Kw, depending on outside temperatures, compared with 2100 for the No. 3 fan alone and 3100 Kw with the two large fans operating in parallel before the accident. It is estimated that, with the two fans in operation, an operating power level of approximately 2900 Kw will be possible if the maximum allowable metal temperature can be maintained at 250° C.

In spite of the fan accident which will cause some interruption in the rate of production it appears at this time that the production schedule as of 31 December 1944 will be realized. During the month of September some of the Product which was used in connection with special test runs for the Hanford process will be recovered and made available for shipment.

[redacted]

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The waste supernatant solutions from the various batches which have accumulated during the past several months have been satisfactorily processed by the chemists and resulted in yielding about two units of Product.

During the month of August two relatively small sources of Ba-La - 105 and 90 mc - were prepared in the "Hot Laboratory" (Building 706 C) and shipped to Site Y for preliminary runs preparatory to the handling of the first 100 curie source.

After a great many construction difficulties, trial runs have been started, and it is estimated that the first 100 curie source will be ready for shipment during the second week of September. Plans have been made for shipping this source to Site Y by means of a truck convoy under armed guards.

A 1,500-gallon catch tank has been installed outside Building 706 C to receive the metal waste solution which will later be processed for the recovery of the Product contained in the metal and also the metal itself.

A project was started during the month of August to provide a storage place behind Building 706 C for "hot" processed slugs and other "hot" sources. The plans called for this project to be completed at an earlier date but maintenance demands on the other more important jobs have caused the completion date to be extended.

In August sixteen "runs" were chemically processed in Building 205, representing about five tons of metal. Since start-up there have been two hundred and one "runs" amounting to approximately sixty-seven tons of X-metal.

Under the original plan of producing a small amount of Product, Site X-10 was provided with two gunite tanks capable of storing approximately 70 tons of waste metal in solution. Since the production plans have been changed considerably, greater facility for the waste metal storage is required. In order to obtain this space necessary by the middle of September, a program of emptying two of the four gunite tanks used for the chemical wastes was started in July and finished this month. These two 175,000 gallon tanks will hold an additional 70 tons of waste metal. The activity of the overflow from the new 1,600,000 gallon settling pond has been materially decreased with the resumption of normal discharge conditions. In order to clear the two tanks mentioned above, it was necessary to increase the rate of discharge to the pond from 5,000 gallons per day to around 10,000 gallons per day. Now that the flow rate has been reduced, the activity of the discharge water to White Oak Creek

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has dropped from 1½ curies per day to a value of less than 1 curie per day. This is well below tolerance and under normal operation will not provide a major problem in the near future.

The change in type of experiments by the biologists from acute exposures to chronic exposures has brought about a necessity for the enlargement of available storage space for the animals. This change in experiments means an increase in the number of animals and also an increase in the life of the animals as fewer will be sacrificed under the chronic exposure program. Since the present storage space is already overcrowded, an addition to the animal farm is being constructed to alleviate the situation. Present plans call for storage space for 6,000 to 10,000 mice and several hundred rabbits which are to be subjected to short exposures of fast and slow neutrons and gamma rays. Construction was started on the extension during August and it is expected to be ready for use about 15 September and physically completed by 1 October.

An air conditioned room was installed on the south balcony of the pile building in connection with the experimentation on test specimens by the biological division. Since the normal temperatures at this location of the building averaged about 150° F, it was necessary to control the temperature to about 75° F. A cubicle approximately 16' x 10' x 11' was constructed of Celotex and Masonite and provided with an air conditioning unit. This change has been of considerable importance to the program of studying the effects of chronic exposure of animals to neutrons.

After a great deal of experimentation and a number of failures, a confirmation of the existence of Tritium (H^3) produced from the neutron capture by Lithium has been obtained. A Lithium Fluoride sample was irradiated in the pile and the gases formed were driven off and collected by heating the sample in a reduced pressure system. A Tritium line was obtained on the spectrographic plate confirming the existance of H^3 in the sample.

Present plans call for the production of 3 cc of Tritium for another location, and it is hoped that this request can be fulfilled in the near future. It is also desired to obtain certain physical properties of Tritium such as capture cross section, half-life, and nuclear spin.

Further studies on the problem of decontamination of clothing worn by workers in the various laboratories have produced data important in developing a method of laundrying. About 70% of the activity is removed in the first cycle detergent wash. Further activity removal of about 20 to 25% is rendered by a three percent acetic acid treatment giving approximately 90 to 95% total decontamination. The remaining activity from successive contaminations has been noticed to accumulate regardless of regular washes. The best results have been obtained by separating the clothes into groups with similar activity levels. When

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the residual activity exceeds tolerance and cannot be removed by special handling, the garments are destroyed.

During the month eight Research and Development Problems from the Problem Assignment Manual were completed, making 81 as the total studies to date.

Eleven additional enlisted men from the Special Engineer Detachment were assigned for duty with Clinton Laboratories, bringing the total to 83. Plans are being made for transferring 10 enlisted men from this group to Y-12 during the early part of September.

Copies #1 and #2 - District Engineer, Manhattan District, 9/ 5/44.
Courier - Major Edgar J. Murphy.

Copy #3 - Major Edgar J. Murphy, 9/ 4/44. (File Copy)

[redacted]

U-19-XVIII-

1 September 1944.

PRODUCTION AND SHIPMENT OF PRODUCT X-19

SUMMARY REPORT FOR AUGUST 1944.

This document consists of 2 pages and ____ figures
No. 3 of 3 copies, Series A

Date Delivered to U. S. Engineers	Batch No.	Number of Units	SHIPMENTS MADE			For Use Under Supervision of
			To	Date	Units	
8/ 3/44	27	4.810	Site Y	8/ 5/44	4.810	Oppenheimer
8/19/44	28 *	2.050	Site Y	8/20/44	2.050	Oppenheimer
8/28/44	29	4.034	Site Y	8/29/44	4.034	Oppenheimer

TOTAL FOR MONTH: 10.894

NOTE:

* - A slurry solution from this Batch, containing approximately 2 grams of Product X-19, was sent to the Metallurgical Laboratory for final isolation by the chemists at that location. The Product, when isolated, will be shipped to Site Y. The results of the final assay will be shown on the Report for September 1944.

[redacted]

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Production and Shipment of Product X-19 (cont'd)

SUMMARY OF SHIPMENTS TO DATE

Site Y	Chicago	Clinton Lab	Berkeley	Ames
56.577	6.003	22.560	0.181	0.015

Note:

Part of the material allocated to the Clinton Laboratories f
in connection with development of the Hanford Process will b
covered and sent to Site Y during September.

Copies #1 and #2 - District Engineer, Manhattan District, 5 August 194

Courier Major Edgar J. Murphy.

Copy #3- Major Edgar J. Murphy, 4 August 1944. (File Copy)

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[redacted]

1 October 1944

MONTHLY REPORT OF OPERATIONS
OF THE CLINTON LABORATORIES
FOR THE MONTH OF SEPTEMBER 1944

5

1. PRODUCTION

3 3 A

Item	During Month	To Date
Tons of Slugs Received	20.19	237.89
Tons of Slugs Placed in Production File	7.62	135.19
Tons of Slugs Removed from Production File	7.62	94.92
Units of Product Concentrated	[redacted]	99.804
Units of Product Actually Shipped	[redacted] *	99.804
Units of Product Scheduled for Shipment	22.00	97.600
Anticipated Shipments Next Month	40.00	

NOTE:

* This figure appears to be low when compared with the estimated production of 22 units. However, the quantity actually isolated is in line with expectations when the following facts are taken into consideration. Approximately 2 units of partially extracted material were sent to Chicago for final isolation by the chemists at that location. Also, solutions containing about 5.8 units of Product were diverted from the usual isolation procedure for the purpose of performing certain experiments in connection with the Hanford Separation and Isolation Procedure. The final isolation of this material will be completed and made available for shipment during October.

This figure does not include 5.6 units which were recovered from material that had been in experimental use in connection with the development of the Separations Process at Clinton Laboratories.

CLASSIFICATION CANCELLED
OR CHANGED TO [redacted]
BY AUTHORITY OF [redacted]
BY [redacted]
DATE JAN 22 1975

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II. COSTS

Estimated Operating Cost for Current Month	$ 515,000.00
Estimated Operating Cost to Date	$ 6,405,000.00
Estimated Total Operating Costs from Beginning of Contract to 12/31/44:	$ 8,600,000.00 *
Estimated Total Operating Costs from Beginning of Contract to 6/30/45:	$12,800,000.00 *
Estimated Total Operating Costs from Beginning of Contract to 12/31/45:	$17,000,000.00 *

NOTE:

* In arriving at the above estimates it is assumed that the extent of activity will continue at approximately the present rate.

III. PERSONNEL

Total Number of Clinton Laboratories Employees:	1328
Number of duPont Trainees at Clinton Laboratories:	8

[redacted]

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The energy output for the X-10 pile during the month of September was 1,863,600 MWH showing an increase over the past month by 160,000 MWH. Operation was maintained for the first half of the month at an average power level of 3100 KW and after the accessory #2 exhaust fan was shut down for dismantling, the average level dropped to 2900 KW. This over-all boost in total energy derives from continuous operation on a higher temperature level along with a slight affect produced by lower inlet-air temperature.

The 900 h.p. motor and the large #2 fan which were shipped to the factories have been repaired and returned to the plant site. The old fan which was put into operation during the interim has been removed and concrete foundations poured for the installation of the large fan. According to schedule, the installation of the repaired equipment will be completed and ready for a test run on 3 October. If the test run proves satisfactory, the No. 2 Fan will be placed in operation in parallel with the other one on 4 October. Assuming that operations will continue with a maximum slug temperature of 250°C an operating level of about 4000 KW should be maintained with the two large fans in parallel.

The first of the series of proposed large shipments of the Lanthanum isotope of mass 140 was dispatched to Site Y, 18 September. It was prepared by separating its parent, the Barium 140, from 214 irradiated uranium slugs. An unexpected problem in making the assay of the specific activity was encountered. After making the necessary dilutions by factors of 10^8, the analyses were quite erratic. However, after slight changes in procedure, the Barium activity was ascertained to be of the order of 230 curies. The final assay made by the chemists at Site Y indicated a value of around 300 curies of Lanthanum activity. The material was shipped in a 3000-pound lead shield inclosed in a wooden box and mounted on a 1-½ ton truck. The convoy, consisting of two trucks (one used for sleeping purposes) and one escort car made the trip in approximately 52 hours. It was necessary to deliver the material in the shortest possible time since its characteristics are such that the activity continues to increase until 5.5 days after the time of preparation. The remarkably short time required for the delivery was considered to be quite satisfactory. According to future requirements, it will be necessary to prepare and deliver a source of similar strength every three weeks for a period of four months. According to present plans, the next source is scheduled to leave Site X on or about 16 October.

During the last week of the month very high radiation readings were discovered as the Operations Group performed a routine inspection of the 50,000 cfm fan. It was first believed that the cause of the high readings was a break in one of the thorium carbonate slugs located on the outer periphery of the present pile loading: however, a survey of the two channels failed to reveal the cause of the trouble and a "scanning" of the pile proper was begun to find

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the broken slug. After ten hours of "scanning" using a device to measure the activity in the air flow from each channel, the ruptured slug was located and the metal from the channel was discharged into the canal. The situation was immediately relieved and operation returned to normal. This is the first time a slug with a ruptured jacket has been detected in the pile, however, on one other occasion a slug in the canal was found with a broken jacket believed to have occurred during irradiation.

Concrete bricks prepared with the same specifications as those used in the preparation of the X-10 pile concrete (Hanford-Barytes mixture) were obtained for the evaluation of the shielding qualities when dry. The bricks were cured for seven days and charged into a test oven for a seven-day subjection to high temperature. They were then placed in a six-foot cube formation in front of the core hole of the pile where they will receive maximum neutron and gamma irradiation. By the use of metal foils placed at intervals throughout the experimental shield, the stopping power of the dry concrete will be obtained which will give a relative indication of the value of the X-10 shield after the natural drying occurs.

One shipment consisting of ninety-six irradiated slugs was sent by guarded truck to Site W. Included with this shipment were four solutions taken from different process intervals. These materials are to be used in their convey for testing the equipment prior to actual startup.

During the month one Research and Development Problem from the Problem Assignment Manual was completed, making eighty-two completed studies to date.

An apparatus is now being constructed for an experiment on continuous production of Tritium (H^3). It consists of concentric aluminum tubes with Lithium Fluoride placed in the annular space. The entire unit is to be placed within the pile and the gases formed will be collected outside the pile. At present, small samples of Lithium Fluoride are being irradiated and minute amounts of H^3 collected in order to provide sufficient data for calculation of the approximate yield obtained. Some experimentation is also being done using Lithium-lead alloys for the production of Tritium. Although no confirmative results have been obtained as yet, early indications show promise for this method.

The major part of the work in connection with the development of a Separations Process for use at Hanford has been completed in the semi-works. The main steps in the bismuth phosphate process are considered to be in a satisfactory state of development and insofar as can be determined at this time there should be no major difficulties in putting this procedure in operation at Hanford. All phases of the proposed Hanford process have been demon-

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strated in the Clinton Plant at Clinton Product and Clinton active fission levels. Demonstration runs at Hanford Product concentrations have been successfully carried out and laboratory runs at Hanford activity levels have shown no process problems resulting from higher activity. Besides this, alternative procedures have been developed at several steps in the process as added safeguards. These include several different procedures employing various scavengers, a combination of scavengers, and an alternative metathesis procedure to allow removal of iron.

Sixteen runs were chemically processed in the 200 Area representing about six tons of metal. This brings the total since startup to 217 runs or about 72 tons.

The Biological Section of the Research Division has installed in one of the banks of cells in the "hot laboratory" equipment for separation of tracer solutions from irradiated slugs. The separation phase utilizes the method of selective absorption by IR-I resin columns. The results of several runs are very encouraging and indicate strongly the possibility of separation of many of the major fission products in relative large amounts, with high purity in respect to chemical and radio-chemical contamination, and without the aid of carriers or of conventional chemistry.

The construction of the addition to the animal farm is proceeding according to schedule. It is approximately 90% complete at this time. It is estimated that the entire addition will be completed and ready for occupancy during the early part of October.

A project was submitted during the month covering an addition to the present Physics Building (706 B). The object of this extension is to accomodate the group of physicists who are transferring to Clinton Laboratories from the Metallurgical Laboratory. The construction work is well under way, being approximately 30% complete at the close of the month. It is estimated that it will be completed and available for use during the latter part of October.

A transfer of ten enlisted men from the Analytical Section of this Site to Site Y-12 and the assignment to duty of seven additional men of the Special Engineer Detachment brings the total to 79 working with Clinton Laboratories. As the duPont men transfer from here more responsibility is placed upon the enlisted men. Continual favorable comments are received concerning the good conduct and excellent work of this group.

Copies #1 and #2 - District Engineer, Manhattan District, 4 October 1944.
Courier - Edgar J. Murphy, Major, C. E.
Copy #3 - Edgar J. Murphy, Major, C. E. 4 October 1944. (File Copy)

[redacted]

1113334

[redacted] Edgar F. Murphy

1 October 1944

2-12-XVIII-

PRODUCTION [redacted] PRODUCT I-49

SUMMARY REPORT FOR SEPTEMBER 1944

A

Date Delivered to U.S. Engineers	Batch No.	Number of Units	SHIPMENTS MADE			For Use Under Supervision of
			To	Date	Units	
9/ 4/44 *	29-B	2.040	Site Y	9/ 9/44	2.040	For Oppenheimer
9/ 7/44 **	8-6	3.620	Site Y	9/ 9/44	3.620	For Oppenheimer
9/13/44 **	8-7	1.298	Site Y	9/30/44	1.298	For Oppenheimer
9/28/44 **	8-8	0.698	Site Y	9/30/44	0.698	For Oppenheimer
9/30/44	31	4.860	Site Y	9/30/44	4.860	For Oppenheimer
9/30/44 ***	32	6.760	Site Y	9/30/44	3.460	For Oppenheimer
			Site W	9/30/44	3.300	For Simon
9/30/44	33	0.808	Site Y	9/30/44	0.808	For Oppenheimer

TOTAL FOR MONTH:

New Production:	14.468
Recovered Material:	5.616
	20.084

NOTE:

* This Lot was isolated from miscellaneous by-product precipitates and supernatant solutions accumulated during the past few months from [redacted] regular isolation processes.

** These Lots were recovered from material which had been in experimental use in connection with the development of the Separation Processes at Clinton Laboratories.

*** A slurry solution from this Batch, containing approximately 0.8 units of Product, was sent to the Metallurgical Laboratory for final isolation by the chemists at that location. All of Batch 30, in the form of a 50-gallon solution, was also sent to Chicago for final isolation. The results of the final assays will be shown on a later report.

CLASSIFICATION CANCELLED
CHANGED TO
BY AUTHORITY OF [redacted]
BY [redacted] DATE JAN 22 1975

1113335

[redacted]

Production and Shipment of Product X-49 - (cont'd)

SUMMARY OF SHIPMENTS TO DATE

Site Y	Chicago	Clinton Lab	Berkeley	Ames	Site W	Total
73.341	6.003	16.944 *	0.181	0.015	3.320	99.804

NOTE:

* It will be noted that the total quantity charged to Clinton Laboratories has been reduced by the amount of recovered material which was made available for shipment to Y during the month of September.

Copies #1 and #2 - District Engineer, Manhattan District, 4 October 1944.

Courier - Edgar J. Murphy, Major, G.S.

Copy #3 - Edgar J. Murphy, 4 October 1944. (File Copy)

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U-13-XVIII

11/1/44

MONTHLY REPORT OF OPERATIONS
OF THE CLINTON LABORATORIES
FOR THE MONTH OF OCTOBER, 1944.

7

3 3 ... Series A

1. PRODUCTION

Item	During Month	To Date
Tons of Slugs Received	10.85	248.74
Tons of Slugs Placed in Production Pile	13.28	148.47
Tons of Slugs Removed from Production Pile	13.28	108.20
Units of Product Concentrated	37.426	137.230
Units of Product Actually Shipped	37.426	137.230
Units of Product Scheduled for Shipment	40.00	142.6
Anticipated Shipments Next Month	45.00	

NOTE:

This figure would indicate that the anticipated production schedule was not met. However, the production is on schedule taking into consideration the following facts:

a. A Slurry Solution containing approximately 2.5 units of Product were sent to the Metallurgical Laboratory for final isolation. The results of the final assay will be included with future production figures.

b. The isolation procedures presently in use require a saturated recycling solution. In order to maintain this condition, it is necessary to hold approximately 5 units of Product in solution.

CLASSIFICATION CANCELLED
BY AUTHORITY OF
BY ... DATE JAN 22 1975

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1113337

II. COSTS

Estimated Operating Cost for Current Month	$ 576,729.00
Estimated Operating Cost to Date	6,892,000.00
Estimated Total Operating Costs from Beginning of Contract to 12/31/44:	8,600,000.00 •
Estimated Total Operating Costs from Beginning of Contract to 6/30/45:	12,800,000.00 •
Estimated Total Operating Costs from Beginning of Contract to 12/31/45:	17,000,000.00 •

NOTE:

• These figures are based upon the assumption that operations will remain approximately at same level.

III. PERSONNEL

Total Number of Clinton Laboratories Employees:	1267
Number of du Pont Trainees at Clinton Laboratories:	5

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During October the X-10 Pile operated at an average power level of 3727 kilowatts per operating hour. Although shutdown time was greater than the normal 10%, reaching about 25%, and special problems necessitated low generation, there was an energy output of 235,984 KWH greater than for any previous month, making the value for October 2,099,584 KWH and a grand total since startup of 11,583,535 KWH. One factor contributing greatly to the increased power level was the continued use of the full cooling capacity offered by joint operation of the two 50,000 cfm fans.

During the past month, production was interrupted on two occasions on account of bearing failures in the large fans which exhaust the air from the pile. The first of these occurred on the 18th of October, at which time, an examination of the bearings showed that bearing No. 5 on Fan No. 3 was damaged to the extent that it had to be replaced. At this time, it was observed that the temperature of the bearings on No. 2 Fan fluctuated erratically for a few hours. A careful examination indicated that the bearing assembly No. 3 and No. 4 were damaged sufficiently to warrant replacement. The damaged bearings on both fans were replaced with spares which were on the Plant Site. The repairs to No. 2 Fan were completed and a test run made 21 October. The No. 3 Fan was tested and put into operation on 23 October. The effect on production was not as great as would be expected judging from the time the fans were not in operation. The physicists took advantage of this shutdown to perform several experiments which had been planned for the following week, and in this way they were able to complete certain measurements and thus avoid having to shut down the pile for this purpose at some later time.

On October 31st another bearing failure occurred on No. 2 Fan. No. 3 Fan was also inspected at this time; there being no noticeable damage to the bearings, it was immediately put back into operation. No. 2 Fan was decontaminated and removed from the housing; an inspection revealed that the No. 3 bearing was badly damaged and had to be replaced.

The cause of the bearing failures is not known at this time. During the shutdown, due to the failure which occurred on 18 October, a representative from SKF came to the Plant Site and inspected the damaged parts. He recommended the use of higher viscosity oil in the belief that the oil which had been used (also recommended by SKF) did not have a sufficiently high viscosity. His recommendations were carried out.

In order to make a complete study of the design and installation of the present equipment, the necessary steps have been taken to obtain a fan expert from the Buffalo Forge Company, and a ball bearing expert from

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the SKF Company, to visit the plant site while the No. 2 Fan is disassembled, for the purpose of performing a complete inspection. Arrangements have also been made to have an engineer, who has knowledge of similar installations, from the du Pont Company to visit the Plant Site and make a study of the design and installation of the equipment now in use.

There have been a total of three slug failures in the pile since startup; two of which occurred during the month of October. These slug failures are quite bothersome in view of the fact that the fans and all their component parts become highly contaminated due to the depositing of the radioactive fission products which are released from the slug when the aluminum can bursts. At the time of the first slug failure during this month, the radiation level on the fan housing was found to be about 1200 mr/hr. The contamination in the fans during the second burst was not so serious, the radiation level being a maximum of about 100 mr/hr. Consideration is now being given to the advisability of operating the pile at a lower maximum slug temperature.

About 25 tons of X-metal rods were rolled at the Joslyn Manufacturing Company and shipped to the Plant Site, during the past month. These rods are to be used in connection with water pile studies. According to present plans, investigations along this line are to be started during the coming month.

In order that the requirements at Site Y for extremely large sources (over 300 curies) of radioactive fission products are fulfilled, it will be necessary to add an extension to the present 706 C Building. Present facilities are inadequate for the preparation of such large sources. Not only is the equipment inadequate, but the shielding is not sufficient to give the necessary protection since it was designed for shielding against a maximum of 10 curie sources. It has been found that an extremely high radiation intensity has a pronounced effect on glass ware and causes it to become very brittle and easily broken. A great deal of trouble was encountered during the preparation of the large sources that have been prepared and shipped. Plans are now being drawn up for the construction of a suitable cell containing plant size equipment, made mostly of stainless steel. This is highly desirable in that it will make it possible to have the sources prepared at regular scheduled time. This/extremely important in that the delivery of the sources has to be coordinated with the arrangements at Site Y.

Since the part being played by tracer materials is becoming more important, an increased demand for the radioactive isotopes is apparent. In fulfilling these requests during the past several months, fission products and other radioactive isotopes, produced by neutron irradiation, have been isolated. For example the preparation and shipment of Zirconium, Columbium, and Lanthanum to Site W in lots of 40 millicuries each were

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made. A request has been received for a similar shipment on about December 1st. Besides the large 300 curie source of Lanthanum, there was also a 10 millicurie source of Zirconium-Columbium mixture to Site Y and a shipment of 5 mc Columbium tracer to the Metallurgical Laboratory.

A series of low generation runs were used at the beginning of the month to obtain data relevant to the problem of pile poisoning at Hanford. After four days of study of the growth and decay of pile reactivity, it was determined that there is a definite short period poisoning effect caused by some fission product. Results indicated that the 9.4 hour Xenon 135 is the responsible isotope and that the contribution of longer period poisoning is small in comparison. The failure to observe the poison build-up in the Clinton Pile, until a specific research was made, results from the importance placed upon the effect of temperature coefficient and distribution upon the reactivity, along with the relatively small effect of the poisoning at low operating power levels. Further work on the problem has been undertaken by the Chemistry Division. By use of a radiochemical small method, the capture cross-section for pile neutrons of the fission product Xenon 135, has been tentatively determined to be between 2 and 3 megabarns. This value, compared to 20 Kilobarns, the next highest known capture cross-section, that of Gadolinium, is unusually high and could easily account for the drop in reactivity encountered as the growth of the isotope developed.

The second large source of Radiolanthanum was sent to Site Y, 15 October. The parent Barium for this material was separated from 150 Clinton slugs of the 40-day irradiation variety. Continued difficulty arises in the radioassaying of material of such magnitude. The control analyses and assays made by the standard radiochemical method set the value between 100 and 300 curies while the radiophysical method using a Lauritson electroscope indicated the activity to be about 220. The final value obtained by Chemists at Site Y was about 300 curies of Lanthanum activity. To prevent the container corrosion noticed in the previous shipment, a special Tantalum lined stainless steel cone was furnished. The delivery of this source, together with two other "Hot" sources was accomplished in 48 hours by truck convoy.

During the month nine Research and Development Problems from the Problem Assignment Manual have been completed, making ninety-one completed studies to date.

Twenty-nine runs, eleven of which were 1/2 ton and eighteen were the usual 1/3 ton dissolvings, were chemically processed in the 200 Area, representing about 11 1/2 tons of metal. This brings the total to date as 246 runs or about 83 1/2 tons of X-metal.

1113341

The addition to the Physics Building has been completed according to schedule and is ready for occupancy. The enlargement, necessitated by expansion of the Physics Sections, is for the accommodation of a group transferring from the Metallurgical Laboratory.

The Biological Section of the Research Division has extended its series of exposures of mice to slow neutrons. The groups of mice are exposed to graded doses which have been measured in an arbitrary fashion by a boron sheathed radiation meter attached to the top of the animal carriage. Evaluation of the arbitrary unit has not been completed. It has been found that the slow neutron exposures also include a significant fast neutron component which will have to be allowed for. The dosage, in single exposures, ranged from 134 to 520 arbitrary units, and the percentage of survival over a three-week period was noted. Indications are that the 50% lethal dose lies between 350 and 400 arbitrary units, and that the completely lethal dose is between 500 and 600 units. However, survival percentages of mice exposed to 434 and 500 arbitrary units, 27% and 12% respectively may be lower since in neither case has the three-week waiting period elapsed. The effect of dividing the dose is illustrated by the comparative survival following 434 units in a single exposure and 417 units given in two doses spaced a day apart. In the first case, survival was reduced to 27% and possibly lower; in the second, only to 58%. At both 134 and 193 arbitrary units 100% survival was noted.

The Biological Section is also determining the effects of small periodic doses of fast neutrons on mice. Three series of groups were exposed. The first series received 1.15 units of neutrons per day and showed a slight retardation in growth after about 50 days. There was a marked mortality of from 40% to 58% in the second series receiving 4.3 units of neutrons per day, after a total dosage of about 270 units had been reached. Two groups in the third series died off completely after receiving an accumulated exposure of about 300 units at the rate of 13 per day.

Further work by this group is the experiment to determine the biological effects of external beta rays on rabbits. Approximately 40 sq cm on the back of the animals were exposed to doses ranging from 5,000 to 20,000 roentgens. Some difficulty was experienced in determining early, or mild stages, of skin damage due to the variation in skin texture and color. Unmistakable effects were observed on the eighteenth day following irradiation. At this time four animals receiving 30,000 roentgens showed slight scaling, dry skin and a pronounced tendency for the superficial layer of the skin to become separated from underlying tissue. These effects became quite severe by the 21st day. The same symptoms appeared in some of the rabbits receiving 10,000 and 15,000 roentgens, 21 to 25 days after irradiation.

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One of the acknowledged dangers present in certain areas of the project is the inhalation of large quantities of radioactive iodine. Upon absorption into the body most of the iodine is carried to the thyroid gland in a relatively short time. In addition to its beta emission, the iodine gives off a gamma of 0.4 - 0.8 mev, the presence of which makes possible the detection of the radioactive iodine through the skin. The first group to be tested were members of the Health-Physics Section whose work subjected them to various degrees of exposure. A gamma counter was used to determine the amount of radiation emanating from the thyroid gland by placing the sensitive region of the counter as close as possible to the thyroid. Counts were also taken at the chest to provide a check on clothing contamination, since this condition would affect the reading at the gland. All results proved to be negative. No person in this group was found to have absorbed any significant amount of radioactive iodine. A similar series of counts were taken on men working in the "Hot Laboratory", where a substantial amount of radioactive iodine is present, with the same results as above.

Two enlisted men from Clinton Laboratories and one from this Office were transferred to Officers' Candidate School. Three new men were assigned here for duty with Clinton Laboratories, bringing the total to 80 working at the laboratory.

Copies 1 and 2 - District Engineer, Manhattan District, 4 November 1944

- Courier - J. J. Cunningham.

Copy #3 - Edgar J. Murphy, Major, C. E. 4 November 1944. (File Copy).

1113343

Edgar J. Murphy

U-14-XVIII-

PRODUCTION AND SHIPMENT OF PRODUCT X-49

SUMMARY REPORT FOR OCTOBER 1944

This document consists of 2 pages and ____ figures
No. 3 of 3 copies, Series A

Date Delivered to U. S. Engineers	Batch No.	Number of Units	SHIPMENTS MADE To	Date	Units	For Use Under Supervision of
10/ 9/44	34	5.158	Site Y	10/11/44	1.306 3.852	For Oppenheimer
10/23/44	35	10.211	Site Y	10/23/44	7.250 2.961	For Oppenheimer
10/24/44	36	8.404	Site Y	10/25/44	8.404	For Oppenheimer
10/31/44	38 *	2.356	Site W	10/31/44	2.356	For Simon
10/31/44	39	3.807	Site Y	10/31/44	3.807	For Oppenheimer
10/31/44	40	5.975	Site Y	10/31/44	5.975	For Oppenheimer
9/25/44	26-A **	1.515	Site Y	10/18/44	1.515	For Oppenheimer
				TOTAL:	37.426	(Accuracy ± 3%)

NOTE:

* All of Batch 37, in the form of a slurry solution, containing approximately 2.5 units of Product X-49, was sent to the Metallurgical Laboratory for final isolation by the chemists at that location. The results of the final assay will be shown on a future report.

** This Lot was shipped to the Metallurgical Laboratory 9/25/44 in the form of a slurry solution for isolation of the final Product.

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[redacted]

Production & Shipment of Product X-49 - Summary Report for October 1944.

SUMMARY OF SHIPMENTS TO DATE

Site Y	Chicago	Clinton	Site W	Berkeley	Ames	TOTAL
108.411	6.003	16.944 4.478 * 12.466	5.676	0.181	0.015	137.250

NOTE:

* This amount has been consumed in experimental work at Clinton Laboratories in connection with the development of the Hanford Extraction Process.

Copies #1 and #2 - District Engineer, Manhattan District, 4 November 1944.

Courier - J. J. Cunningham

Copy #3 - Edgar J. Murphy, Major, C. E. 3 November 1944 (File Copy)

[redacted]

1113345

FOR SECRET
By Authority of the District Engineer
Per Edgar J. Murphy

2-15-XVIII

EIDMX-1

MONTHLY REPORT OF OPERATIONS
OF THE CLINTON LABORATORIES
FOR THE MONTH OF NOVEMBER 1944

12/ 1/44

This document consists of 7 pages and ____ figures.
No. 3 of 3 copies, Series A

I. PRODUCTION

Item	During Month	To Date
Tons of Slugs Received	23.69	272.43
Tons of Slugs Placed in Production Pile	9.42	157.89
Tons of Slugs Removed from Production Pile	9.41	117.61
Units of Product Concentrated	41.287	178.517
Units of Product Actually Shipped	41.287	178.517
Units of Product Scheduled for Shipment	45.000 *	181.600 **
Anticipated Shipments Next Month	85.000	

NOTE:

* The isolation process which is now used makes it necessary to maintain a staurated re-cycling solution. There are at present approximately 11 units of Product in solution which are necessary to maintain a saturated condition.

** Approximately six units of Product have been sent to the Metallurgical Laboratory for final isolation and purification. This Product is still being used for experimental work and so far no final assay values have been made available. Therefore, the quantity thus involved is not included in the total production figures to date.

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II. COSTS

Estimated Operating Cost for Current Month:	$ 531,000.00
Estimated Operating Cost to Date:	$7,512,000.00
Estimated Total Operating Costs from Beginning of Contract to 12/31/44:	$8,080,000.00 *
Estimated Total Operating Costs from Beginning of Contract to 6/30/45:	$11,386,000.00 *
Estimated Total Operating Costs from Beginning of Contract to 12/31/45:	$14,152,000.00 *

NOTE:

* It will be noted that these figures have been revised downward. These new estimates are based on the following assumptions:

(a) The Separations Building (205) will close down 1 January 1945.

(b) There will be some reduction in personnel upon the completion of certain phases of work in the future.

(c) The necessity for additional projects will decrease as the research and development work become more stabilized.

(d) No major additional assignments will be undertaken which call for the expenditure of relatively large sums of money.

III. PERSONNEL

Total Number of Clinton Laboratories Employees: 1273

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IV. NARRATIVE REPORT

The energy output for the X-10 pile for November was slightly less than the previous month, but greater than any other month during the past year of operations. A review of the energy output achieved per month for the past year of operation is given to show the over-all progress:

November 1943:	125,600 KWH	June 1944:	1,040,900 KWH
December 1943:	325,000 KWH	July 1944:	1,485,000 KWH
January 1944:	520,000 KWH	August 1944:	1,604,600 KWH
February 1944:	517,000 KWH	September 1944:	1,863,600 KWH
March 1944:	541,700 KWH	October 1944:	2,099,600 KWH
April 1944:	682,900 KWH	November 1944:	2,040,400 KWH
May 1944:	778,000 KWH		

Total energy accumulation since start-up is 13,624,000 KWH.

Following the failure of the No. 3 bearing on the No. 2 fan 31 October 1944, arrangements were made to have Mr. William Staniar of the du Pont Company, Mr. N. R. Heath and Mr. Madisem of the Buffalo Forge Co., and Mr. J. L. Bruses of the SKF Co. visit the plant site and inspect the fan installations. During the inspection and the conferences which followed, several recommendations were made which have been put into effect. Mr. Madison spent several days here with a portable field testing set making tests to determine the dynamic stability of the fans. Only slight deviations from perfectly stabilized conditions were found to exist. These, however, were corrected. The fans are now operating quite satisfactorily with constant, and quite safe, temperatures on all bearings.

Mr. Staniar submitted a report on the results of his calculations having to do with the critical torsional vibrations. His calculations on the No. 2 fan indicated that the normal operating speed was not in a critical range and therefore, it was not subject to torsional vibrations. However, on the No. 3 fan, the one which has the jack-shaft coupling, a critical torsional

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vibration exists in the neighborhood of 1760 RPM. This would indicate the possibility of a second order critical of 3520 RPM. In view of this condition, Mr. Staniar has recommended that the No. 3 fan be close-coupled, the same as the No. 2 fan, in order to eliminate the possibility of this critical condition. Plans are now under way to bring about this change within the near future. An effort will be made to schedule the work so as not to interfere with the other urgent jobs. (A copy of Mr. Staniar's report, containing more detailed information, together with one compiled by Clinton Laboratories, is being forwarded to the District Engineer's Office.)

Experiments involving the spraying of a small jet of water into a metal-bearing channel of the pile has been continued. It has been determined that a rate of flow of water below 50 cubic centimeters per minute produces no measurable poisoning effect, and that if this amount were introduced into all channels, a 1500 KW power increase could be expected. Greater flow rates cause the pile reactivity to decrease slowly.

Preparation of the third large batch of radioactive Barium was started 15 November by dissolving 180 hot slugs which had been irradiated for this purpose. The inadequacy of the present facilities for processing of such large radioactive sources was demonstrated once more by the failure of glassware, the clogging of transfer lines, and the resulting over-exposure of 17 men. After nine days of continuous processing, the chemists finally succeeded in preparing a source which assayed approximately 300 curies of radioactive Ba-La. Just prior to the final preparation for shipment of this source, several important measurements were made which will have some bearing on the final use of the material. The main purpose of the measurements was to obtain more accurate values of the gamma ray energies which are emitted by the radio-lanthanum. The chemists were successful in obtaining a very good lead absorption curve. The material was transferred to Site Y by truck convoy in about 55 hours from the time it left Site X.

The "Hot Laboratory" extension, designed for conditions particular to these large source Ba-La productions, was started 15 November. During the 15 days of the month, the excavation was 90% completed and the foundation wall form work approximately 70%. The actual pouring of the concrete will be started 1 December 1944. The foundation reinforcement steel is all in place ready for the pouring of the concrete for Cells 1 and 2. Material deliveries are progressing satisfactorily.

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The problem of tritium production developed to the point where the operators are highly optimistic of the results. From the equipment for continuous operation, installed on one of the experimental levels of the pile with a twelve-foot tube and heater arrangement extending into the pile, amounts of gas containing about 0.1 cc of tritium have been collected per day. Protium contamination in the first few samples was very high, but a definite decrease was noted as collection continued. Further accomplishments were hampered by an electrical failure in the heating coil with a mechanical leak developing soon thereafter in the aluminum portion of the vacuum system, necessitating removal and installation of a modified system. Operation of the reconstructed apparatus is to start soon after the first of the month. Simultaneously a batch process is underway by another group. By subjecting an irradiated Lithium-lead alloy in a steel shell to high temperatures and low vacuum, tritium with protium is evolved. Collection of gas from individual slugs has yielded 0.5 cc measured under standard conditions.

During November nineteen "Runs" were chemically processed in the 205 Building. These include 10 half-ton and 9 third-ton runs, representing eight tons of metal dissolved. Since start-up there have been a total of two hundred sixty "Runs" completed involving approximately ninety-one tons of metal.

The fabrication of all X-metal slugs for Site X was completed during the month of November. The work at all locations in connection with this program has been closed out and all scrap metal returned to the Madison Square Area. All of the finished pieces have been shipped to this location for the final testing.

During the month fifteen Research and Development Problems from the Problem Assignment Manual were completed, making a total of one hundred six studies closed out to date. There are presently approximately eighty-nine problems under active investigation.

Experimentation with instruments to give a more accurate and direct indication of pile operating power level is being continued. There are now three thermopiles, or so-called Neutron Thermometers, located at various places within the pile. Previous instrument readings have varied according to control rod positions, however, this latest method has shown

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agreement between the three different locations within 1% regardless of the control rod positions. The object is to obtain a direct reading of the power for any given period by connecting one or more thermopiles to a MH integrating recorder.

The work on exponential piles, made of water and heavy metal lattices, during the month has included continuation of the study on co-axial gap types using stripped X-metal slugs, and the preparation for the construction of a new lattice with the recently received X-metal rods. Measurements on a co-axial gap type lattice with the water to metal volume ratio equal to 1.92 indicate the reactivity to be around 0.985. Allowances for the large amount of aluminum used, and for the fact that the optimum water to metal volume ratio is probably 1.6, will raise the reactivity close to, or over 1. The self-poisoning effect recently discovered at Site W, however, indicates the necessity for more excess reactivity than is believed obtainable in piles of this type, so the possibility of the production of a water-metal power producing structure appears to be less promising.

During the past several months, samples of air have been taken from locations within a mile of the plant during the dissolving of "hot" metal. Attempts were made to obtain three samples near points of maximum active gas concentration, the locations of which were determined by the odor of nitrogen oxide. The radio-xenon collected was in most cases near 10^{-12} curies per cubic foot of air, while no radio-iodine could be detected. The preliminary results of this experiment indicate that there are no particularly hazardous conditions created by the stack gases from the Separations Plant.

Preliminary work on the recovery of the waste metal in the storage tank was started during the month. The studies so far indicate that an organic solvent extraction is the preferable method of decontamination. Further chemical research is underway to determine partition coefficients for fission products and uranium between the acidified waste and the organic solvents, and the stability of the solvents in the presence of excess acids and radiations. Some effort is also being made to investigate the possibility of removing the undesirable phosphates from the solution by a precipitation method. Ten foot columns have been erected in the Semi-Works for preliminary small-scale operation with added fission products as tracers.

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The problem of preparation and study of C^{14} specifically for the determination of the neutron absorption cross section of the isotope was undertaken in two phases. The first, or batch method, was set up to examine several organic and inorganic nitrogen-containing compounds as to their temperature and radiation stability, and to determine the extraction efficiency of C^{14}. So far no organic nitrogen compound has been found sufficiently stable under normal pile operating conditions to give a good yield. For the second phase, equipment has been designed, and is now under construction, for the circulation of concentrated ammonium nitrate through a piping system within the pile. The isotope formed by the irradiation will be removed periodically, or continuously, by the extraction stage of the equipment located outside the pile shield.

Fourteen additional enlisted men of the Special Engineer Detachment were assigned to Clinton Laboratories bringing the total to ninety-nine.

Copies #1 and #2 - District Engineer, Manhattan District, 5 December 1944. Courier - J. J. Cunningham.

Copy #3 - Edgar J. Murphy, Major, G. S. 4 December 1944. (File Copy)

1113352

By Authority of the Executive Engineer
For Edgar J. Murphy

BIDMX-1

12/ 1/44.

PRODUCTION AND SHIPMENT OF PRODUCT X-49.

U-10-XVIII-

SUMMARY REPORT FOR NOVEMBER 1944.

This document consists of 2 pages and [illegible] figures.
No. 3 of 3 copies, Series A

Date Delivered to U. S. Engineers	Batch No.	Number of Units	SHIPMENTS MADE			For Use Under Supervision of
			To	Date	Units	
11/ 8/44	40-B	5.929	Site Y	11/ 8/44	5.929	Oppenheimer
11/11/44	41	11.887	Site Y	11/11/44	11.887	Oppenheimer
11/17/44	42	6.708	Site Y	11/17/44	6.708	Oppenheimer
11/29/44	43	16.763	Site Y	11/29/44	16.763	Oppenheimer

TOTAL: 41.287 (Accuracy ± 3%)

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Production & Shipment of Product X-49 (cont'd)

SUMMARY OF SHIPMENTS TO DATE

Site Y	Chicago	Clinton	Site W	Berkeley	Ames	TOTAL
149.698	6.004	16.944 4.855 12.089 *	5.676	0.181	0.015	178.517 178.517

NOTE:

* The amount of 4.855 units has been consumed in experimental work at Clinton Laboratories in connection with the development of the Hanford Extraction Process.

Copies #1 and #2 - District Engineer, Manhattan District, 5 December 1944.

Courier - J. J. Cunningham.

Copy #3 - Edgar J. Murphy, Major, C. E. 3 December 1944 (File copy)

1113354

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By Authority of the District Engineer
Edgar J. Murphy

CL-17-XVIII
BIDEX-1

MONTHLY REPORT OF OPERATIONS
FOR THE CLINTON LABORATORIES
MONTH OF DECEMBER 1944

1/ 1/45

This document consists of 8 pages and ____ figures.
No. 3 of 3 copies, Series A

1. PRODUCTION

Item	During Month	To Date
Tons of Slugs Received	None	272.43
Tons of Slugs placed in Production Pile	0.21	158.10
Tons of Slugs Removed from Production Pile	0.23	118.84
Units of Product Concentrated	92.897	271.396
Units of Product Actually Shipped	92.897	271.396
Units of Product Scheduled for Shipment	85.000	266.61
Anticipated Shipments Next Month	25.000	

NOTE: The six units of Product in the form of slurry solutions, mentioned in last month's report, which were sent to the Metallurgical Laboratory for final isolation, are still being used for experimental work and, so far, no final assay values have been made available. Therefore, the figures presented above do not include this material.

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II. COSTS

Estimated Operating Cost for Current Month:	$ 724,000
Estimated Operating Cost to Date:	$ 8,236,000
Estimated Total Operating Costs from Beginning of Contract to 6/30/45:	$11,326,000
Estimated Total Operating Costs from Beginning of Contract to 12/31/45:	$15,416,000 •
Estimated Total Operating Costs from Beginning of Contract to 6/30/46:	$19,116,000

• This estimate is somewhat higher than that submitted in the last report. Since that report was compiled, more information concerning the general trend of the future program is available. For your information, the following explanation of the increase in estimate is submitted:

a. The previous estimates were based upon the assumption that the Separations Building (205) would be closed during the coming year. However, it is more apparent at this time, in the light of recent experimental results, that this building will very likely be used in connection with the recovery of waste metal. This will require rather extensive alterations to the equipment and a relatively large operating staff.

b. When the previously submitted estimates were made, it was assumed that there would be some reduction in personnel upon completion of certain phases of the work. However, it would appear at this time that plans are crystallizing to transfer to Clinton Laboratories some of the personnel presently engaged at the Metallurgical Laboratory.

c. Serious consideration is now being given to the advisability of including in the future program studies having to do with the design and development of new types of piles during the coming year. There is a possibility that this particular phase of the work may become quite extensive and require a relatively large amount of research, engineering development and construction work.

d. The demand for special radioactive tracer sources seems to be increasing. In order to supply these, it will very likely call for an increase in personnel and facilities directly concerned with these preparations.

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e. More emphasis is being placed on research work having to do with health hazards and a possible means of coping with them. Expansions in this phase of the program will require more special instruments, supplies and alterations to present facilities.

III. PERSONNEL

Total Number of Clinton Laboratories Employees: 1291

1113357

IV NARRATIVE REPORT

The additional energy developed in the X-10 pile during the month of December amounted to 2,852,500 MWH. Since the last metal for processing was pushed from the pile during the latter part of November the operating power level was adjusted to conform with the physical research program requirements during the month rather than for maximum production.

During the past month, twenty-six "Runs" were chemically processed in the 205 Building. These included 14 half-ton runs and 12 two-third ton runs, representing approximately 15 tons of metal. Since start-up, there have been a total of 291 "Runs" completed, involving about 106 tons of X-metal. There remain an estimated eight "Runs" to process in order to complete the operations in this building. After these are completed the equipment will be cleaned and made ready for any future use which may develop. It is anticipated that part of this equipment will be used in connection with the recovery of the waste metal.

Four Research and Development Problems from the Problem Assignment Manual were completed during the period covered by this report, making a total of 110 assignments completed to date. There are now 99 under active investigation.

Decontamination of the equipment and cells, which were used for preparing the last large Ba-La source in 706-C, was carried on. Repairs to the existing equipment have been made as rapidly as possible under the circumstances. It was necessary to proceed cautiously in order to prevent over-exposure of the personnel involved. It is anticipated that the actual preparation of the next large source will begin about the middle of January.

An apparatus of interest to Hanford has been set up to study the activity in gases which occur in water discharged from an experimental "W" tube in the pile. After the water has passed through the pile the gases dissolved in it are removed. Thus far a radioactive isotope of oxygen has been found and there are indications that other isotopes are also present, although positive identification as yet has not been made. Plans for continuation of this work envisage passing gases such as hydrogen, nitrogen, and oxygen through the tube in order to see whether or not any of the unidentified activities arise from them.

A better method for preparing Ba^{140} was investigated by the Technical Division during this period. The development group has made preliminary demonstrations of the feasibility of transferring liquids by large remote-controlled pipettes. A sampling procedure has also been developed, the

principle of which utilises capillary attraction in a tube touching the surface of the liquid to be sampled. Batch type centrifuges of capacities up to about 350 ml have been tested and seem to perform satisfactorily. Tests have also been made on sample types of optical instruments to determine whether they are suitable for viewing cell operations and if they will provide sufficient protection to the operating personnel. As a result, two types of instruments have been selected: one for over-all viewing of the cell, and the other for close observation of special operations. Investigations are almost complete on the final evaporation steps, the object of which is to reduce the barium containing solution to a small volume. Evaporation of all the volatile mixture has been found possible, and is regarded as an improvement over the dropping technique previously thought necessary.

Early difficulties caused by the swelling of slugs encountered in operating experimental water tubes, of the type used at Site W, made it necessary to have some means of detecting the swelling before it became serious enough to prevent the slug from being removed from the tube. The work on this problem was performed using an electrical method of detection based on the supposition that in a system where the slugs were insulated from the tube the swelling might be detected before, or shortly after contact with the tube by changes in current, potential difference, or electrical resistance. When the growth of blisters on the slugs were augmented sufficiently so that contact was made with the tube wall, the recording instruments showed values of zero or some reading near zero. The work on this problem was of a preliminary nature to determine the feasibility of the method for detection. Results of the tests indicate that under proper conditions, potential and current readings probably could be used to detect the slug swelling. Resistance measurements would be of little value in actual operation since the resistance of the circuit would be too low for high sensitivity.

To understand thoroughly, and correct for the problems of radio-colloidality, a study is being made to determine the occurrence, nature, and extent of colloid formation in separations plant solutions. So far the elements Cb, Zr, Ba, La, and Pu (IV) were observed in the laboratory to exist in colloidal state under conditions where insoluble salts or hydrolysis products might be expected. However, with solutions of X-10 concentration using the Hanford process, only Cb persisted as a colloid. Besides this, Zr showed definite colloidality in analogous solutions of two different phases in the separations procedure. As a result of this research, the existence of the problem seems fairly well established, and further work directed toward removal of radio-colloids must follow.

The factory for production of C^{14} was installed in one of the experimental holes of the pile and preliminary tests were made by filling it with water. The circulating and safety systems worked well with the exception

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that complete emptying of the container did not occur. The neutron absorption due to the water was more than had been expected so it was necessary to redesign the apparatus. With 1/3 of the volume, the drop in pile reactivity was 54 inhours compared to 100 inhours for the previous size. The present loading of the pile does not produce enough excess reactivity to carry the load estimated for this factory and it is anticipated that at least two more tons of metal will be necessary.

In the search for the isotope U^{236}, ordinary uranium was irradiated in the X-10 pile and concentrated by a Sailard-Chalmers process. The large amount of ordinary uranium in the final sample interfered with the examination for the determination of the ranges of the alpha particles but a comparison of the alpha ray curve with that from an unirradiated sample revealed a small percentage of the rays with a different range. Continuation of the characterization of the isotope is important in that it may constitute a more efficient utilization of materials enriched for use at Site Y.

Twice during the month measurements were made to determine temperature coefficient of the Clinton pile. These were performed at power levels less than one KW. The first was made after the pile had been thermally isolated for 20 hours and the value of 1.5 inhours per degree Centigrade was obtained. In the second determination the reactivity change was measured by two methods, by change in critical position, and by change in the pile period using the same rod positions. The most reliable value obtained by these methods was 1.1 inhours/degree C. This redetermination was considered in order since recent measurements indicated the coefficient was different than that reported at the time the pile was first started.

Work on the recovery of waste metal has been concentrated during the month on two alternative processes for preparation of the waste for the solvent extraction step. One process was originally regarded with little favor because the precipitate which formed did not settle readily and seemed to be rather viscous. The study on this process is being continued however, in lieu of the formerly stressed method in which three precipitations were required. Since the Technical Division has been working on the methods applicable to Clinton Laboratory metal recovery, and is now in a position to start on a semi-works scale, the section from the Chemistry Division, which also has been assigned to the problem, will confine its investigation to recovery from Hanford wastes.

The demands of special radioactive tracer sources have become of such importance that a special section has been organized and charged with the responsibility for preparing these sources. During the past month, approximately 20 such sources were prepared for shipment to other locations on the project. In addition to these, a large number were prepared for use here at Clinton Laboratories.

Often the most fundamental evaluation required concerning samples irradiated in the Clinton pile is the number of neutrons responsible for changes which occur. To determine this accurately a service has been established to supply calibrated neutron detectors of a standard size silver wire for exposure along with the samples. After the irradiation is completed the monitors are returned to the Physics Section where the calculation of the neutron flux is made. Four trials have been made with results only slightly lower than that determined by other means.

A charge of Hanford production slugs was exposed to simulated "W" conditions in the Clinton pile for about 100 days to determine the extent of corrosion caused by radiation. At the end of this test all the slugs were in good condition. Weight losses corresponding to a corrosion rate of about 0.3 mil per month were measured on a number of slugs.

The experimental work of determining the effect of pile radiation, of the intensity available at Clinton, on film formation in water tubes has been concluded. Artificially produced film has been observed to give considerable pressure drop and heat transfer interference. Therefore, it was necessary to know how the rate of formation of this film would be affected by radiation, since an appreciable increase might seriously impede Hanford operation. Laboratory studies were carried out to ascertain what chemical properties the water must have in order to cause the film to develop. After this was determined, water containing just barely enough of these impurities was passed through a "W" tube in the pile and the effect on the rate of formation was noted. Following this, water containing not quite enough to cause film formation was passed through the pile and the same observations were repeated. Results indicated that radiation has no very important effect on film formation at "X" power levels.

Construction work on the new building designed for the preparation of Ba^{140} is proceeding in accordance with the original schedule. Process design is proceeding as rapidly as the Project Engineer's Office is able to accept and develop new information. The Project Group in turn is keeping ahead of construction in supplying new drawings to the field. The Chemistry Division is carrying out new process research and has made several important revisions and simplifications in the original flow sheet submitted. The building itself is about 20% complete, with over 50% of the concrete poured. The heavy rains have interfered with the preparation and pouring of the concrete to some extent, however, this did not delay the over-all completion appreciably as this time was spent constructing new forms, and fabricating the building trusses. The equipment for this project is arriving on the plant site in accordance with schedule.

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Health considerations make it desirable that a reasonably accurate, and continuous record be obtained of the amount of radioactive gases discharged into the atmosphere from the 200 Area stack. These active materials are radioactive iodine and xenon liberated during the metal dissolving operation. Monitoring equipment was installed through which flowed a continuous sample from the stack. Individual ionization currents for the iodine and xenon are continually measured and recorded after separation occurs. Data which have been taken indicate that all of the xenon and 5-10% of the iodine present in the metal at the time of the dissolving are vented to the stack along with oxides of nitrogen, nitric acid vapor, and air from the 200 Area ventilating system, resulting in a many-fold dilution. Concurrent analyses of xenon taken from the atmosphere at various points on the plant site indicate that the activity was well below tolerance.

One additional enlisted man from the Special Engineer Detachment was assigned for duty with Clinton Laboratories during the month.

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5 January 1945.
Courier - James F. Grafton, Captain, C. E.

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TOP SECRET
By Authority of the District Engineer
Per Edgar F. Hufton

4-18-XVIII-

This document consists of 2 pages and ... figures. No. 3 of 3 copies, Series A

PRODUCTION AND SHIPMENT OF PRODUCT X-10
SUMMARY REPORT FOR DECEMBER 1944

EIDMX-1

1/ 1/45

Date Delivered to U. S. Engineers	Batch No.	Number of Units	SHIPMENTS MADE			For Use Under Supervision of
			To	Date	Units	
12/ 9/44	44	22.235	Site Y	12/ 9/44	22.235	Oppenheimer
12/18/44	45	33.554	Site Y	12/19/44	33.554	Oppenheimer
12/23/44	46	19.250	Site Y	12/27/44	19.250	Oppenheimer
12/27/44	47	17.840	Site Y	12/27/44	17.840	Oppenheimer

TOTAL FOR MONTH: 92.879 (Accuracy ± 3%)

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17.0

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1113363

Production and Shipment of Product X-10 (cont'd)

SUMMARY OF SHIPMENTS TO DATE

Site Y	Chicago	Clinton	Site W	Berkeley	Ames	TOTAL
242.577	6.003	16.914 * 4.955	5.676	0.181	0.015	871.396

NOTE - * - Total consumed to date in experimental work at the Clinton Laboratories.

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1113364

[redacted] Engineer.
Per Edward Murphy

4-19-xVIII-
EID/X-1

MONTHLY REPORT OF OPERATIONS FOR THE CLINTON LABORATORIES MONTH OF JANUARY 1945

2/ 1/45

6 pages and [illegible] figures
No. 3 of 3 copies, series A

1. PRODUCTION

Item	During Month	To Date
Tons of Slugs Received	0	272.43
Tons of Slugs Placed in Production Pile	1.73	159.83
Tons of Slugs Removed from Production Pile	0.60	119.44
Units of Product Concentrated	54.994 *	386.398
Units of Product Actually Shipped	18.032 **	269.438
Units of Product Scheduled for Shipment	25.000	291.610

NOTE:

* Final assay values have been obtained for the several slurry solutions which were shipped to the Metallurgical Laboratory for final isolation. The results of the assays are included in this figure.

** Shipment of Batches 49 and 50 was not made during the past month, pending the preparation for shipment of Batches 51 and 52. A final shipment will be made to Site Y of all four Batches on or about 7 February 1945. The postponement of shipment has the approval of Messrs. Oppenheimer and Compton.

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BY AUTHORITY OF [redacted]
BY [redacted] DATE JAN 22 1975

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II. COSTS

Estimated Operating Cost for Current Month:	$ 781,000
Estimated Operating Cost to Date:	$ 9,017,000
Estimated Total Operating Costs from Beginning of Contract to 6/30/45:	$11,326,000

III. PERSONNEL

Total Number of Clinton Laboratories Employees:	1317

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IV. NARRATIVE REPORT

The last batch of metal was dissolved on 2 January and the final cleanup work in the 200 Area started immediately. The first phases of the cleanup work were well under way by the end of the month. This consisted of making a series of chemical washes of all the equipment in the cells. The chemical washes were carried out with nitric acid solutions containing ammonium fluosilicate, followed by sodium carbonate and caustic solutions. It required a total of about twenty successive washes to clean the equipment and reduce the contamination below tolerance level. Sufficient product was picked up in making the first few washes to justify processing. The final isolation of this will be completed during the first week in February at which time the final shipment of product will be made.

The decontamination of cells and equipment has been quite successful. Only in a few places is the radiation level now above tolerance, most of which are around the cell drainages. The motors and centrifuges will be removed from the cells and thoroughly cleaned and oiled. They will then be stored in the 205 Building and held for use either here or at Hanford. Hanford has requested that all equipment in the 205 Building be held for replacement, if necessary, at their location.

It is of interest to know how well the process equipment has withstood the unusual conditions to which it has been subjected during the past year. There was some question as to whether motors and other pieces of equipment, particularly those having some form of insulation, might not be effected by high radiation levels applied continuously over a long period of time. This information is of particular interest to Hanford. The examinations made so far do not reveal any more wear and deterioration than would be expected under normal conditions.

During the past month the technique of drying the product in its final form has been greatly improved with the result that the time required for drying an ordinary batch, consisting of about 10 grams, has been reduced from approximately 72 hours to about 24 hours.

The operating force in the 200 area has been reduced and additional personnel will be released as soon as the work is completed. Some will be transferred to Site "", others will be recalled by the Du Pont Company, and some will be assigned to other duties at Clinton Laboratories.

An inventory of the excess process materials was prepared and a copy forwarded to the Area Engineer at Hanford who has requested that all these materials be ear-marked for shipment to his area. Part of them have already been shipped and the remainder will be transferred as soon as shipping instructions are received. Many critical items, such as meters, valves,

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and special equipment are being removed from Building 205 and installed in 706-C extension. This procedure will make it possible to start operations in this building sooner than would have been possible otherwise, since this type of equipment is extremely difficult to procure.

During January the X-10 pile was operated at an average power level of 1585 kilowatts per operating hour. An 80 inhour increase in pile reactivity was produced this month by charging an additional 1.1 tons of metal, and discharging the poisoning materials, specifically six cans of thorium carbonate and three "W" tubes of water, upon completion of studies under investigation. The increase in reactivity was necessary to accomodate the equipment required for the production of C^{14}.

At the close of the month there were eighteen bismuth bricks in the pile containing approximately 190 curies of polonium. This is well above the minimum amount (120 curies) which Clinton Laboratories has been directed to maintain. Two shipments were made during the month of January in accordance with instructions from Mr. Lum.

During the first week in January a detailed inspection of the bearings on the two large fans was made, the results of which indicated that the ball bearings in the inboard and outboard units of both fans showed a slight amount of wear and some pitting. Rather than run the risk of a complete failure, resulting in excessive damage, all bearings which showed an indication of wear were replaced. The appearance of these balls indicated that they had not been subjected to excessive temperatures. Therefore, it was decided to have them thoroughly tested for hardness. Representative balls, some showing wear and others showing no wear, were sent over to the Y-12 Area and subjected to the Rockwell Hardness Test. The results of the test indicated that the balls met the required specifications, that is, yielding values between 63 and 64 on the C scale (this corresponds to a strength of 459,000 pounds/sq. in.). The same balls were then subjected to gamma ray photography to determine if the excessive wear was due to a fold in the metal formed as a result of ineffective burnishing. The results of this test did not indicate any defects. Even though the wearing was not sufficient to cause a failure, it does show that the problem of keeping these fans in operation is far from being completely solved. According to representatives from the manufacturer of the fans and also the SKF Company, bearings of this type are capable of carrying a load many times greater than that to which they are subjected. So far, no complete and satisfactory explanation for this excessive wear has been offered. At the request of Mr. J. L. Bruska of the SKF Company, the damaged bearings were returned to him for a thorough laboratory test. The results of the test are not available at this time. The design engineers of Buffalo Forge and the SKF Company are giving consideration to the advisability of recommending the use of the deep-groove type of bearing instead of the self aligning type presently in use.

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The construction work on the 700 C extension building has progressed very nicely during the past ten days. The recent favorable weather has made it possible to complete the major part of the concrete placing. The framing of the building is now well underway, being approximately 25 percent complete. The procurement of operating equipment for this building is progressing according to schedule and it appears at this time that, if all delivery dates are met, there will be no undue hold-up. The over-all construction was about 45 percent complete at the close of the month.

The progress on tritium production looks favorable. The factory which was installed during previous months has been adjusted for satisfactory operation and has undergone considerable outgassing. An accumulation from five days irradiation of the lithium fluoride was pumped off, yielding about four cc of gas. This sample estimated roughly by spectrographic analysis contains about 15 percent tritium. Previous samples of gas drawn successively have shown an increasing ratio of tritium to protium indicating that the outgassing of the system is becoming more complete. Since this continuous extraction process appears to have pronounced superiority over the batch methods, work upon the latter has been dropped. This material is of particular interest to Site Y.

The magnetic lens spectrograph has been modified to make coincidence studies of beta and gamma radiations. It should now be possible to determine disintegration schemes of unstable nuclei as well as the energy of the radiation. At present the arrangement will allow gamma-focused electron coincidence measurements to be taken, with which a more definite assignment of cascade gammas can be made. In the case of complex beta decays it should be possible to associate the various gamma rays with the corresponding beta component. Interpretation of the studies on the beta spectra of several isotopes correspond to results made by other investigators while with Ta^{182} besides the gamma energies previously reported, the presence of another gamma has been indicated.

Preparation of radioactive tracers for the various laboratories within the project is rapidly becoming an important item. Twenty-two samples of isotopes totalling 1200 millicuries of activity were separated, sixteen of which containing about 1000 mc were transferred to other locations.

In view of the problem of decontamination which is common to nearly all phses of this project and is particularly important in the operations carried out at Site W, considerable work has been carried on developing a water soluble coating for application to cell walls and equipment pieces. Within a relative humidity range from zero to 70 percent, which can be expected in the cells at Hanford, the coating containing glycerine shows good film adhesion and cohesion. Since the material is easily removed by water washings and therefore gives high decontamination, it has been recommended for use in the Hanford cells.

1113369

After considerable work replacing the disintegrated glass storage bottles with stainless steel tanks in the dissolver-equipment for radio-barium production, the fourth large run in the hot laboratory was started. Since the glass-equipped cell for separation had been used for the three preceding preparations and had successively received greater damage, further reliability could not be considered, and the stand-by cell was put into use. Regardless of this move, a failure occurred in one portion after it had been subjected to the intense radiation, and the final quantity of product-barium was lower than that expected. Before further equipment disintegration could occur, the fifth preparation was started. Since the requests call for a minimum of 100 curies, the 170-curies batch produced in the fourth separation was dispatched and delivered after a 60-hour trip to Site Y. The fifth and largest source prepared so far is expected to be completed and shipped during the early part of February.

The chemistry and engineering development work having to do with the waste uranium recovery was continued along the same general lines as reported last month. The process to be used has been reduced to a choice between three somewhat similar methods, two of which involve a solvent-extraction step using dibutal carbitol as the solvent. Work was started on the development of equipment in preparation for semi-works studies.

The Clinton Laboratories laundry continues to perform an important service in connection with the decontamination of clothing and other protective items. It is proposed to extend this service to include the contaminated clothing from the Metallurgical Laboratory. The work which is being done at present includes decontaminating and washing outer garments and laboratory coats at the average rate of 240 per day, decontaminating miscellaneous items such as gloves, sandals and caps at the rate of 215 per day, and repairing worn or torn garments at about 85 per day. During January a total of 14,600 pounds of clothing were sent through the decontaminating process. It is estimated that the laundry is now handling about 50 % of its capacity with the expectation that the increase due to proposed operations in 706 C extension and from the Metallurgical Laboratory will raise this to nearly full.

There were 26 Problem Assignments completed this month making 136 as the total closed out to date. No new assignments were added: the total number under active investigation is 73.

Five additional Special Engineer Detachment men were assigned to Clinton Laboratories during January.

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1113370

[redacted] Per Edgar J. Murphy

U-20-X/111-

EID X-1

PRODUCTION AND SHIPMENT REPORT OF PRODUCT X-49

2/ 1/45

SUMMARY REPORT FOR JANUARY 1945.

This document consists of 2 pages and ____ figures.
No. 3 of 3 copies, Series A

Date Delivered to U. S. Engineers	Batch No.	Number of Units	SHIPMENTS To	Date	Units	For Use Under Supervision of
1/11/45	48	10.927	Site Y Calif	1/12/45 1/12/45	10.454 0.473	Oppenheimer Latimer
	*	2.800	Site Y	1/20/45	2.800	Oppenheimer
	49	7.708	Site Y	**	7.708	Oppenheimer
	50	10.019	Site Y	**	10.019	Oppenheimer
	51	2.500	Site Y	**	2.500	Oppenheimer
	52	16.725	Site Y Clinton	**	11.420 5.305	Oppenheimer Whitaker
		4.315	Chicago	***	4.315	Stearns

TOTAL: 54.994 (Accuracy ±3%)

NOTE:

* This is part of the material sent to Chicago in the form of slurry solutions for final isolation. It was transferred to Site Y through the Chicago Area Engineer.

** Batches 49 and 50 were not shipped during the month of January, pending the completion of Batches 51 and 52. The isolation of this material will be completed within a few days and a final shipment made to Site Y on or about 7 February. This arrangement meets with the approval of Messrs. Compton and Oppenheimer.

*** This is the final assay value obtained by the chemists at the Metallurgical Laboratory for the material which was forwarded to them in the form of slurry solutions, as mentioned in previous reports.

CLASSIFICATION CANCELLED
BY AUTHORITY OF [redacted]
BY [redacted] DATE JAN 28 1948

1113371

SUMMARY OF SHIPMENTS TO DATE

Site Y	Chicago	Clinton	Site W	Berkeley	Ames	TOTAL
287.478	10.318	22.249 5.049 * 17.200	5.676	0.654	0.015	326.390

Note:

* Total consumed to date in experimental work at the Clinton Laboratories.

FINAL REPORT

Copies #1 and #2 - District Engineer, Manhattan District, Oak Ridge, Tenn. 5 February 1945. Courier - Edgar J. Murphy, Major, C. E.

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[redacted]

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