

~~SECRET~~

MARTIN MARIETTA ENERGY SYSTEMS LIBRARIES



3 4456 0360798 8

ORNL 773
Progress
372

INV 65

CLASSIFICATION CHANGED TO:
 BY AUTHORITY OF: *82720*
 BY: *C. G. G. 12-28-70*

AEC RESEARCH AND DEVELOPMENT REPORT

LABORATORY RECORDS
1954

OAK RIDGE NATIONAL LABORATORY
STATUS AND PROGRESS REPORT

JUNE, 1950

OAK RIDGE NATIONAL LABORATORY
CENTRAL RESEARCH LIBRARY
CIRCULATION SECTION
4500N ROOM 175
LIBRARY LOAN COPY
DO NOT TRANSFER TO ANOTHER PERSON
If you wish someone else to see this report, send in name with report and the library will arrange a loan.

UCN-7969 (3 9-77)



OAK RIDGE NATIONAL LABORATORY
OPERATED BY
CARBIDE AND CARBON CHEMICALS DIVISION
UNION CARBIDE AND CARBON CORPORATION

UCC
POST OFFICE BOX P
OAK RIDGE, TENNESSEE

CLASSIFICATION CANCELLED
Dwight Hamm ORNL CO 12/4/09

ADD Signature
Single review of CCRP-declassified document was authorized by DOE Office of Declassification memo of August 22, 1984.

~~SECRET~~

INV 70

INV 69

INV 68

INV 64

INV 63

INV 60

ORNL 773
Progress

This document consists of
21 pages.
Copy 37 of 42. Series A.

Contract No. W-7405, eng 26

OAK RIDGE NATIONAL LABORATORY
STATUS AND PROGRESS REPORT

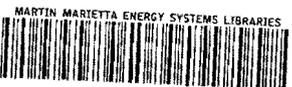
June, 1950

W. E. Thompson

Date Issued: JUL 10 1950

OAK RIDGE NATIONAL LABORATORY
operated by
CARBIDE AND CARBON CHEMICALS DIVISION
Union Carbide and Carbon Corporation
Post Office Box P
Oak Ridge, Tennessee

RE
This
defin



3 4456 0360798 8

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

JUNE, 1950

Distribution

Offices of Directed Operations

- 1-3. A. H. Holland, Jr.
- 4. Howard R. Freitag

Oak Ridge, Tennessee
Hanford Operations Office

leave off

AEC Installations

- 5. H. A. Blair
- 6. N. E. Bradbury
- 7. C. E. Center
- 8. G. T. Felbeck
- 9. A. B. Greninger
- 10. L. J. Haworth
- 11. A. R. Kaufman
- 12. K. H. Kingdon
- 13. H. D. Kinsey
- 14. E. O. Lawrence
- 15. F. L. Mohler
- 16. H. W. Russell
- 17. F. H. Spedding
- 18. W. H. Zinn

University of Rochester
 Los Alamos Scientific Laboratory
 Carbide and Carbon Chemicals Div.
 Carbide and Carbon Chemicals Div.
 Hanford Works
 Brookhaven National Laboratory
 M.I.T. Metallurgical Laboratory
 Knolls Atomic Power Laboratory
 Carbide and Carbon Chemicals Div.
 Univ. of Calif. Radiation Laboratory
 National Bureau of Standards
 Battelle Memorial Institute
 Ames Laboratory
 Argonne National Laboratory

Oak Ridge National Laboratory

- 19. E. P. Blizard
- 20. W. K. Eister
- 21. C. B. Elliott
- 22. L. B. Emery
- 23. J. H. Egan, Jr.
- 24. W. M. Hawkins
- 25. A. H. Haender
- 26. J. Lane
- 27-28. C. Larson
- 29. D. Lavers
- 30. M. Mann
- 31. K. Z. Morgan
- 32. E. D. Shipley
- 33. A. H. Snell
- 34. F. L. Steahly

- 35. Hezz Stringfield
- 36. J. A. Swartout
- 37. W. E. Thompson
- 38. A. M. Weinberg
- 39. E. E. Winters
- 40. F. C. VonderLage
- 41-42. Central Files

H. S. Mc Alduff

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

JUNE, 1950

TABLE OF CONTENTS

	<u>Page</u>
PROGRAM 2000 - SOURCE AND FISSIONABLE MATERIALS.....	6
TBP Process for Waste Metal Recovery.....	6
PROGRAM 3000 - WEAPONS.....	7
Chalk River Separations.....	7
RaLa Development.....	7
RaLa Production.....	7
PROGRAM 4000 - REACTOR DEVELOPMENT.....	8
MATERIALS TESTING REACTOR.....	8
DESIGN AND EVALUATION.....	8
MTR Project Engineering.....	8
MTR Analysis and Engineering Design.....	8
REACTOR PHYSICS AND CRITICAL ASSEMBLY WORK.....	9
MTR Critical Experiments.....	9
FUEL ELEMENTS.....	9
Complete Fuel Assembly for Chalk River Reactor	9
Irradiation.....	9
MODERATOR, STRUCTURAL MATERIALS AND REFLECTOR.....	9
MTR Test and Development other than Critical	9
Experiments.....	9
Beryllium Production.....	9
CHEMICAL PROCESSING.....	9
25 Process Design.....	9
AIRCRAFT NUCLEAR PROPULSION PROJECT.....	10
DESIGN AND EVALUATION.....	10
ANP Central Design Group.....	10
MECHANICAL DESIGN AND EXPERIMENTAL ENGINEERING	
FOR ANP CRITICAL EXPERIMENTS.....	10

	<u>Page</u>
SHIELD DEVELOPMENT.....	10
CHEMICAL PROCESSING.....	10
COOLING, HEAT TRANSFER AND POWER GENERATION.....	11
Liquid Metals Research.....	11
HOMOGENEOUS REACTOR EXPERIMENT PROJECT.....	11
EXPERIMENTAL ENGINEERING.....	11
Experimental and Design Engineering for Homogeneous Reactor.....	11
FUEL ELEMENTS.....	11
Phase Relationships of Fuel Media.....	11
Radiation Stability of Fuel Media.....	11
Slurry Fuel Media for Homogeneous Reactor.....	12
GENERAL REACTOR DEVELOPMENT.....	12
CHEMICAL PROCESSING.....	12
23 Process.....	12
PROGRAM 5000 - PHYSICAL RESEARCH.....	13
PRODUCTION OF RADIOISOTOPES.....	13
Radioisotope Production, Development and Operation.....	13
PHYSICS.....	13
Neutron Diffraction.....	13
Short Period Activities.....	14
Instrument Development.....	14
Cross Section Studies.....	14
High Voltage Program.....	14
Scintillation Spectrometry.....	14
CHEMISTRY.....	14
Fundamental Chemistry of the Heavy Elements.....	14
Noble Gas Separations.....	15
Calorimetric Measurements.....	15
Determination of Crystal Structure by Neutron Diffraction.....	15
Purex Process.....	15
Hot Laboratory Research - Recovery of By-Products from CR Processing.....	15
METALLURGY.....	16
Tensile Properties of Pure Metals.....	16
Target Development Program.....	16

PROGRAM 6000 - BIOLOGY AND MEDICINE.....17

 BIOLOGY.....17

 Pathological Effects of Radiation.....17

 Genetic Effects of Radiation on Mice..... 17

 Plant Physiology.....17

 Biochemistry.....17

PROGRAM 1000 - PLANT AND EQUIPMENT.....18

PERSONNEL SUMMARY.....^A.....20

RADIOISOTOPE SALES.....20

GROSS OPERATING COSTS.....21

[REDACTED]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

JUNE, 1950

PROGRAM 2000 - SOURCE AND FISSIONABLE MATERIALS

TBP Process for Waste Metal Recovery

The laboratory and hot pilot plant investigations directly applicable to the Hanford waste metal recovery are essentially complete with the exception of a unit operations study of the process waste evaporation.

The design of the ORNL Metal Recovery Plant was continued. The AEC has requested that design of the building and services be completed before obtaining a construction contractor. This will make possible a lump sum contract.

[REDACTED]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

JUNE, 1950

PROGRAM 3000 - WEAPONS

Chalk River Separations

Processing of the Chalk River irradiated metal and the special, Hanford irradiated metal was completed. Equipment has been installed in the Isolation Laboratory for the final concentration and purification of the plutonium product.

RaLa Development

Construction was started on the RaLa Plant modifications and the new equipment is being tested before installation.

The chemical development of the RaLa Process continued toward elimination of the metathesis step from the present process and to determine a procedure for barium separation from spent MTR fuel units.

RaLa Production

Run No. 42 was completed on June 16 without operational difficulty. Following completion of the run, the cells were decontaminated to allow construction of facilities for the improved RaLa Process.

[REDACTED]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

JUNE, 1950

PROGRAM 4000 - REACTOR DEVELOPMENT

MATERIALS TESTING REACTOR

Design and Evaluation

MTR Project Engineering

Procurement of parts to be supplied by ORNL is continuing as permitted by completion of engineering details. A new and more realistic schedule is now in effect, calling for completion of the reactor "check out" on March 15, 1951. Delivery commitments from various vendors appear more optimistic than originally predicted and, consequently, the March 15 completion date has been established with a reasonable degree of certainty.

Drawings are arriving from Blaw-Knox in increasing numbers for checking and approval by ORNL. A concerted effort is being made to complete the reactor tank engineering in order to relieve personnel for assignment to the checking of Blaw-Knox drawings.

MTR Analysis and Engineering Design

Mock-up data have been used to determine more accurately the shielding requirements of the top and bottom plugs, resulting in simplification of the design. Experiments are under way to establish valves for the heat generation in the concrete, since calculations indicate that it may not be negligible.

Details of the beryllium reflector have been completed. Prints are being sent to Y-12 to await arrival of individual beryllium castings from Brush Beryllium Corporation for final machining. The bottom plug design has been completed and prints are being forwarded to the Y-12 shops where the plug is to be fabricated. Design of the reactor tank is now complete and prints are being furnished the vendor for review. Completion of these items will allow work to proceed on the monitor tubes, vertical hydraulics, special handling tools, and other small parts. Meanwhile, as reactor tank assignments are completed, personnel are being shifted to assume the steadily increasing load of Blaw-Knox structure drawings submitted for ORNL approval.

[REDACTED]

STATUS AND PROGRESS REPORT

JUNE, 1950

Reactor Physics and Critical Assembly Work

MTR Critical Experiments

The temperature coefficient has been checked and found to agree with previously reported values. Recalibration of the regulating rod has been completed. Further gamma and neutron flux measurements are being taken.

Fuel Elements

Complete Fuel Assembly for Chalk River Reactor Irradiation

The fuel assemblies and testing apparatus have been shipped to Chalk River for installation in the reactor about July 1. The exposure is scheduled to last for six months.

Moderator, Structural Materials and Reflector

MTR Test and Development other than Critical Experiments

Testing of the reactor tank flanged joints has been delayed by the procurement of the various parts. It now appears that tests will be started early in September. The testing program is scheduled for completion in time to start fabrication of the reactor tank October 1. This will allow tank delivery by early January for fitting of the reflector in Y-12 as originally planned.

Beryllium Production

Rough machined shapes of beryllium for the reflector are being received from Brush Beryllium Corporation for final machining at Y-12.

Chemical Processing

25 Process Design

Foster-Wheeler has been selected as the architect-engineer for the Arco 25 Process Plant. Facilities were obtained at Oak Ridge National Laboratory for their engineers to work with the engineers of the Chemical Technology Division. The chemical flowsheets for the processing of spent fuel from the Materials Testing Reactor, the Enriched Breeder Reactor and the NP program were completed along with preliminary equipment flowsheets and the building layout.

[REDACTED]

STATUS AND PROGRESS REPORT

JUNE, 1950

AIRCRAFT NUCLEAR PROPULSION PROJECT

Design and Evaluation

ANP Central Design Group

A preliminary reactor design for the Aircraft Reactor Experiment is being established to serve as the basis for discussion and development of a suitable ARE design. A "Preliminary Feasibility Report for the Aircraft Reactor Experiment," (Report Number Y-F5-15) has been distributed to stimulate suggestions, criticism, and comment leading to design improvements. It is emphasized that the current design is by no means final; it is meant to serve as a starting point in the development program.

Mechanical Design and Experimental Engineering for ANP Critical Experiments

It is expected that the critical experiment building will be completed by the end of July and that critical experiments can be started in November. Current planning is to place major emphasis of the first experiments on the testing of various ARE designs.

Shield Development

The fast neutron spectrometer was tested with a uranium fission spectrum and considerable difficulty was experienced with both gamma and neutron backgrounds. Changing the counter gas from argon to propane has considerably alleviated this situation and it is expected that this instrument will be useful in the near future.

The 1/3 lead, 2/3 water (by volume) shield mock-up has been tested and preliminary analysis indicates that this experiment confirms the other lead-water measurements.

Chemical Processing

A program has been activated in the Chemical Technology Division to consider the chemical processing of the spent fuel. The present program will be limited to following the development of the fuel units and considerations of the applicability of the chemical processes now available.

██████████

STATUS AND PROGRESS REPORT

JUNE, 1950

Cooling, Heat Transfer and Power Generation

Liquid Metals Research

A rather large number of static corrosion sorting tests on a wide variety of materials in lithium, bismuth and lead as well as some materials in lead-uranium alloy and bismuth-uranium alloy have been completed. Similar tests are under way with sodium and sodium hydroxide. Fabrication of a number of thermal convection loops for dynamic corrosion testing in liquid metals is nearing completion. They should be in operation in July to determine the effects of thermal coefficients of solubility on transfer of material within a system. Positive circulation flow-corrosion test loops are being constructed and will be placed in operation on the coolant which is eventually selected for the ARE.

HOMOGENEOUS REACTOR EXPERIMENT

Experimental Engineering

Experimental and Design Engineering for Homogeneous Reactor

The Homogeneous Reactor Experiment feasibility and safety reports, ORNL-730 and 731, have been issued. On June 29 the Reactor Safeguards Committee met with representatives of ORNL to consider the homogeneous reactor; results of this meeting will be reported by the Committee. A letter requesting authorization to start construction of facilities for the Homogeneous Reactor Experiment has been submitted to the AEC.

Fuel Elements

Phase Relationships of Fuel Media

Studies of the phase relationships of the UO_2F_2 -water system indicate that at all concentrations up to about 65% UO_2F_2 by weight the solution is stable and homogeneous up to about 313°C. In the temperature range of 150 - 250°C it is possible to reach concentrations of about 80% UO_2F_2 before phase separation takes place.

Radiation Stability of Fuel Media

In one in pile experiment in which a 300 psi oxygen pressure was maintained over the UO_2SO_4 solution in the bomb, it was noted that there was no increase in total pressure at 260°C during the first four days in the pile. After four days, a gradual increase in pressure was noted for the next

████████████████████
SECRET

STATUS AND PROGRESS REPORT

JUNE, 1950

three days; however, after pile shutdown and thermal cooling, only 300 psi pressure remained.

Slurry Fuel Media for Homogeneous Reactor

Chemical stability studies are in progress to evaluate uranium oxide and uranyl phosphate slurries for use in a homogeneous type nuclear reactor. The results to date are encouraging.

GENERAL REACTOR DEVELOPMENT

Chemical Processing

23 Process

The isolation processing of the uranium 233 product resulting from the 23 Process pilot plant program is essentially complete.

[REDACTED]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

JUNE, 1950

PROGRAM 5000 - PHYSICAL RESEARCH

PRODUCTION OF RADIOISOTOPES

Radioisotope Production, Development and Operation

The total accumulated KWH for pile operation during June was 2,042,032, averaging 3225 KW per operating hour. Pile down time was 12.1%, as compared with 11.2% during June. There were no ruptured slugs during the month. Because of a shorted coil in the number 3 exhaust fan motor the pile was forced to operate at half power for about 24 hours while repairs were being made.

A total of 721 radioisotope shipments was made during the month of June.

The large orders of strontium 90 reported last month have been filled from a 25-curie batch produced in June. A reserve supply of strontium 90 is being kept on hand in anticipation of future orders. A special order of 20 curies of cesium 137 has been partially filled with the shipment of 10 curies sealed in a small platinum capsule. The equipment for producing cesium 137 was designed, constructed and put into successful operation in the two-month period since May 1.

PHYSICS

Neutron Diffraction

Neutron diffraction studies of iron-chromium alloy have shown that chromium scatters with positive phase and a cross section of 1.7 barns. An examination of uranium dicarbide by neutron diffraction has determined the positions of the carbon atoms in the body-centered tetragonal unit cell. Previous X-ray data obtained elsewhere had been unable to yield this information.

Short Period Activities

The fast pneumatic tube has been equipped with a krypton-filled proportional counter for the study of X radiations emitted from rapidly decaying radioactive sources. Characteristic X rays have been observed from



STATUS AND PROGRESS REPORT

JUNE, 1950

make a homogeneous liquid, suitable for a circulating fuel in an aircraft reactor.

Noble Gas Separations

The chromatographic separation of noble gases by means of helium elution from a charcoal adsorption column has been applied to the separation of xenon and radon. It now appears feasible to decontaminate xenon from radon by a factor of 10^6 with relatively simple equipment. Laboratory tests indicate that one liter of xenon separated from the atmosphere, normally giving about 1,000,000 counts per minute because of radon contamination, can be decontaminated to a background of a few counts per minute of radon.

Calorimetric Measurements

The calorimetric measurement of heat generation in a small section of graphite placed in the ORNL pile has been used as a means of calibrating an ion chamber of the type used in determining heat generation in the graphite of the MTR mock-up. The calibration measurements have been completed and the CO_2 -filled ion chamber has been found to give results in close agreement with those obtained calorimetrically.

Determination of Crystal Structure by Neutron Diffraction

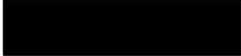
The neutron spectrometer is now in operation on the south experimental level of the ORNL reactor and a program of study of the crystal structure of hydrogen-containing compounds has been undertaken.

Purex Process

The chemical development of the Purex Process was continued and AEC has approved the cost of the equipment alterations that will be required for the pilot plant demonstration. The first solvent extraction cycle was tested in columns this month and effort was increased to establish a satisfactory second plutonium cycle.

Hot Laboratory Research -- Recovery of By-Products from CR Processing

The equipment for use in the recovery of fission products from the Chalk River metal processing wastes has been completed and tested. Tracer runs are now under way and full-scale processing will be started during July.



STATUS AND PROGRESS REPORT

JUNE, 1950

METALLURGY

Tensile Properties of Pure Metals

Progress is being made in testing the working hypothesis of stress-strain-time functions of metals. Copper at room temperature has been tested in tension and in creep. The data are being evaluated mathematically and by diagrams. No conflict with the hypothesis has so far appeared. The general expressions obtained are quite complicated for use in numerical computations; however, it is believed that simplified functions which apply well over limited areas can be developed. A preliminary report on the experimental work is now being written.

Target Development Program

Preliminary work indicates two very promising methods of fabrication of target materials: one is a roll-cladding technique similar in all respects to that used in industry to produce stainless-clad carbon steel; the other involves a low-temperature liquid bonding process using silver plated uranium and mercury or tin as the bonding agent.

[REDACTED]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

JUNE, 1950

PROGRAM 6000 - BIOLOGY AND MEDICINE

BIOLOGY

Pathological Effects of Radiation

Cataract formation has been observed in mice as a result of either slow neutrons or X rays at roentgen values as low as 50. The cataracts appear earlier in the neutron irradiated mice.

Genetic Effects of Radiation on Mice

Pregnant mice, irradiated with X-ray dosages as low as 25 r have shown important changes in the skeleton structure of the embryo. This r value is not unusual for fluoroscopic observations in pregnant women.

Plant Physiology

In connection with studies of the effects of X rays on mutation production in peanuts carried out in cooperation with North Carolina State College, early results indicate highly significant implications of this experiment. Further work on the physiological aspects of this problem is being conducted at ORNL.

Biochemistry

A new method of great simplicity has been developed to follow the electrophoretic pattern of proteins adsorbed on filter paper. This new method opens a new possibility for the study of the effect of radiation on proteins.

[REDACTED]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

JUNE, 1950

PROGRAM 1000 - PLANT AND EQUIPMENT

File Building #105 and Change House Addition

Work on Pile Control and Instrumentation continues and is estimated to be about 75% completed. Delivery on a panel board and special wire has made it necessary to re-schedule completion of this part of the work to September 1, 1950. Installation of new Pile Air Intake Filters and Filter House started on June 26 and is progressing satisfactorily. Correction of the deficiency in air conditioning on the third South platform and other minor corrections to the refrigeration equipment are being made.

Research Laboratory

Notice to proceed was received by the contractor on May 24 with 540 calendar days allowed for completion. If no extensions are granted, completion is scheduled for November 20, 1951. Plans for finishing the second floor extensions ready for occupancy have been completed by The Austin Company and issued to the contractor for cost estimate. A revision of the location of the Bethel Valley Road, parking lot and East Portal Building is being made to provide for future plant expansion. The contractor is now engaged in excavation and site preparation work and the laying of underground drains. Progress photographs are being made at weekly or bi-weekly intervals as indicated by the work activity.

Physics of Solids Building

Structural steel framing, roughing in of underground plumbing and hot drains and concrete floor slab at 840 Elevation are all completed. Masonry work has been started at the lower level. Pouring of floor at the upper level is progressing. Some form work for cells Nos. 1, 2 and 3 is in place but is awaiting inserts. The building is roughly estimated to be 55% completed with final completion date remaining at October 30, 1950.

Isotope Research and Semi-Works Building

No acceptable bid was received on June 15 and the job is being readvertised. Bids will again be received on July 19, 1950.

[REDACTED]

STATUS AND PROGRESS REPORT

JUNE, 1950

Fan House, Building #115

This building is now completely enclosed and construction forces are rehangng electrical and service lines and removing the old wood structure on the north side of the building. The shipping date for the two B. F. Sturtevant Compressors (Fans) has now been advanced from June 26 to August 21, 1950; however, completion date remains as October 31, 1950.

Separations Building #205

Concrete block exterior walls - 92% complete. Steel window sash - 90% complete. Pent House steel roof deck - 100% complete. Process drains - 25% complete. Service piping - 25% complete. Total job approximately 62% completed. Scheduled completion date is September 30, 1950.

Cafeteria Building

This building was released by J. A. Jones Company to ORNL on June 10, 1950. The building was opened for service June 12, 1950. Completion Form 4-A was processed by J. A. Jones Company June 23, 1950. Formal transfer of ORNL owned equipment and furniture was made for property accountability. Completion date re-scheduled for June 18, 1950.

Instrument Laboratory

Exterior brick masonry walls are completed and cast stone coping is being set. Application of built-up roofing over metal decking is being completed. Masons are erecting interior tile partitions. The concrete floor slab is completed. Total completion, 50%; scheduled completion date, November 1, 1950.

[REDACTED]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

JUNE, 1950

PERSONNEL SUMMARY

	<u>Number of Employees</u> June 30, 1950	<u>New Hires</u> June	<u>Terminations</u> June
Administration	91	1	2
Operations*	104	2	0
Engineering, Shops and Mechanical	789	28	0
Laboratory & Research	872	66	0
Protection	168	0	0
Service	<u>316</u>	<u>7</u>	<u>0</u>
TOTAL	<u>2340</u>	<u>104</u>	<u>2</u>

*Includes Electrical Distribution and Steam Plant as well as the Operations Division.

RADIOISOTOPE SALES

<u>Sales</u>	<u>April, 1950</u>	<u>May, 1950</u>
Transfers within AEC	\$ 9,981.64	\$15,470.95
Off Project	17,270.28	20,099.15
Foreign	838.60	1,668.00
Cancer Program (Free)	28,032.62	26,802.47
Technical Cooperation Plan	-0-	76.40
Total Sales and Transfers to Date		\$1,083,426.15
Total Cancer Program (Free) to Date		\$486,588.05
Technical Cooperation Plan		\$2,919.30

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

JUNE, 1950

GROSS OPERATING COSTS

(a)	Actual cost for May, 1950	\$1,444,519	
	Construction - Program "H"	<u>\$33,547</u>	
	Total Operating & Construction Costs		\$1,478,066
(b)	Estimated operating costs for June, 1950		\$1,569,000
(c)	Actual accumulative FY 50 operating cost through May, 1950	\$12,177,349	
	Actual accumulative FY 50 construction cost through May, 1950	<u>\$368,127</u>	
	Total accumulative FY 50 construction and operating cost through May, 1950		\$12,545,476
(d)	Estimated operating cost FY 50 through June, 1950		\$14,114,476