[redacted]

MARTIN MARIETTA ENERGY SYSTEMS LIBRARIES
3 4456 0360494 5

ORNL 646
Progress Report

35a

AEC RESEARCH AND DEVELOPMENT REPORT

CLASSIFICATION CHANGED TO
BY AUTHORITY OF
BY:

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

February, 1950

LABORATORY RECORDS 1954

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
POST OFFICE BOX P
OAK RIDGE, TENNESSEE

[redacted]

[redacted]

ORNL 646
This document consists of 20 pages. Copy 35 of 40, Series A.

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

FEBRUARY, 1950

W. E. Thompson

Date Issued MAR 8 1950

OAK RIDGE NATIONAL LABORATORY

Operated by

CARBIDE AND CARBON CHEMICALS DIVISION
Union Carbide and Carbon Corporation
Post Office Box P
Oak Ridge, Tennessee

[redacted]

[redacted]

MARTIN MARIETTA ENERGY SYSTEMS LIBRARIES

3 4456 0360494 5

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

FEBRUARY, 1950

Distribution

Offices of Directed Operations

1-3.	A. H. Holland, Jr.	Oak Ridge, Tennessee
4.	Howard R. Freitag	Hanford Operations Office

AEC Installations

5.	H. A. Blair	University of Rochester
6.	N. E. Bradbury	Los Alamos Scientific Laboratory
7.	C. E. Center	Carbide & Carbon Chemicals Division
8.	G. T. Felbeck	Carbide and Carbon Chemicals Division
9.	A. B. Greninger	Hanford Works
10.	L. J. Haworth	Brookhaven National Laboratory
11.	A. R. Kaufman	M.I.T. Metallurgical Laboratory
12.	K. H. Kingdon	Knolls Atomic Power Laboratory
13.	H. D. Kinsey	Carbide & Carbon Chemicals Corp.
14.	E. O. Lawrence	Univ. of Calif. Radiation Laboratory
15.	F. L. Mohler	National Bureau of Standards
16.	H. W. Russell	Battelle Memorial Institute
17.	F. H. Spedding	Ames Laboratory
18.	W. H. Zinn	Argonne National Laboratory

Oak Ridge National Laboratory

19.	E. P. Blizard	34.	J. A. Swartout
20.	C. B. Ellis	35.	W. E. Thompson
21.	L. B. Emlet	36.	A. M. Weinberg
22.	J. H. Frye, Jr.	37.	C. E. Winters
23.	W. M. Hawkins	38.	F. C. Vondy Lage
24.	A. Hollaender	39-40.	Central Files
25.	J. A. Lane		
26-27.	C. E. Larson		
28.	W. D. Lavers		
29.	M. M. Mann		
30.	K. Z. Morgan		
31.	A. W. Snell		
32.	F. L. Steahly		
33.	Hezz Stringfield		

[redacted]

[redacted]

CONTENTS

Page

PROGRAM 2000 - SOURCE AND FISSIONABLE MATERIALS..... 5
Hanford Metal Recovery..... 5

PROGRAM 3000 - WEAPONS..... 6
RaLa Production..... 6
RaLa Process Improvement..... 6

PROGRAM 4000- REACTOR DEVELOPMENT..... 7
Reactor Projects..... 7
Materials Testing Reactor..... 7
Design of the MTR..... 7
Reactor Controls Development..... 7
Critical Experiments in the Mock-up..... 7
MTR Fuel Assemblies and Shim Rods..... 8
Aircraft Nuclear Propulsion Project..... 8
Radiation Damage..... 8
Shielding..... 8
Liquid Metals Corrosion..... 8
Homogeneous Reactor Project..... 8
Engineering Development..... 8
Radiation Damage..... 9
Design Engineering..... 9
General Reactor Research and Development..... 9
Chemical Technology..... 9
25 Process..... 9
23 Process..... 9
Purex Process..... 10

PROGRAM 5000 - PHYSICAL RESEARCH..... 11
Radioisotope Production and Development..... 11
Radioisotope Production..... 11
Control, Distribution and Accountability..... 11
Pile Operation..... 11
Radioisotope Production Process Development..... 12
Tank Farm and Burial Ground..... 12
Physics..... 12
Neutron Diffraction..... 12
Neutron Decay..... 12
Fundamental Research in Radiation Effects in Solids..... 13
Resonance Absorption and Age in Zr-H_2O Systems..... 13
Chemistry..... 13
Heavy Element and Fission Product Separation Studies..... 13
Chemistry of the Heavy Elements..... 14
Lithium 7 Separation..... 14
Radio-Calorimetry..... 14

[redacted]

[redacted]

CONTENTS (continued)

Page

Metallurgy..... 15
Study of Thorium and its Alloys..... 15
Training and University Cooperation..... 15

PROGRAM 6000 - BIOLOGY AND MEDICINE..... 16
Biological Research..... 16
Pathology..... 16
Cytogenetics..... 16
Mammalian Genetics..... 16
Microbiology..... 16

PROGRAM 1000 - PLANT AND EQUIPMENT..... 17
Research Facilities..... 17

Personnel Summary..... 19

Radioisotope Sales..... 19

Gross Operating Costs..... 20

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

FEBRUARY, 1950

PROGRAM 2000 - SOURCE AND FISSIONABLE MATERIALS

Hanford Metal Recovery

The recent studies of the TBP Process for the recovery of uranium from the Hanford Metal Waste have indicated that significant chemical savings may be realized by reducing the amount of scrub in solvent extraction and by virtue of the fact that the solvent may require very little treatment before re-use.

The chemical laboratory study concerned with the recovery of plutonium from the ORNL metal waste is being continued.

Design was started for the ORNL Metal Recovery Plant which is scheduled for start-up in October, 1950. In addition, evaporation equipment was installed for use in evaluating the evaporation process for solvent extraction raffinate volume reduction.

The Hanford sludge sample required for the final hot pilot plant program was received and this program is scheduled for completion in June, 1950.

[redacted]

[redacted]

STATUS AND PROGRESS REPORT

FEBRUARY, 1950

PROGRAM 3000 - WEAPONS

RaLa Production

Run Number 40, originally scheduled to start March 5, has been postponed until March 12 at the request of Hanford because of a conflect with operational schedules. By the time Run Number 40 is started, the cell ventilation will be tied into the new isotope area 250-foot stack.

RaLa Process Improvement

The chemical development of the RaLa Process was continued to improve the ion exchange purification step, to separate barium sulfate with lead carrier, and to improve the filtration operations. The design group has prepared a change recommendation to be submitted to AEC covering the proposed revision of the present plan.

[redacted]

[redacted]

STATUS AND PROGRESS REPORT

FEBRUARY, 1950

PROGRAM 4000 - REACTOR DEVELOPMENT

The Design Engineering, Experimental Engineering, Project and Reactor Physics Departments of the former Technical Division will comprise a new Division of Reactor Technology.

REACTOR PROJECTS

Materials Testing Reactor

Design of the MTR

Design of the reactor tank and its components is progressing satisfactorily. Transfer of funds from the AEC Idaho Office to cover procurement of the tank and its parts by ORNL has been approved, and purchasing will be started in April. Meanwhile, design of a mock-up to prove the redesigned tank joints is complete and detailing has been started. Tests are planned for the month of May.

Blaw-Knox has started detailed drawings on the reactor structure, based on ORNL drawings and reports. Their construction schedule has been modified to provide the closed and heated reactor building by November 1, 1950 and the biological shield ready for reactor tank installation in the early Spring of 1951.

Reactor Controls Development

A new type of fission chamber for the MTR has been designed and is being constructed. Design of the 3-inch safety chamber has been completed. Some progress is being made on the design of water monitoring instruments.

The instrumentation of the mock-up has proved satisfactory in operation during the critical experiments.

Critical Experiments in the Mock-up

The assembly is now critical; control mechanisms are being tested and the determination of power levels and flux distribution is under way.

[redacted]

[redacted]

STATUS AND PROGRESS REPORT

FEBRUARY, 1950

MTR Fuel Assemblies and Shim Rods

The total number of assemblies made for the critical experiment was 28, including 3 assemblies in control rods and 4 partial assemblies (containing inactive aluminum plates). Of the 28 assemblies, 4 exceeded tolerance in one annulus but not enough to make them unacceptable. There were no rejects.

Aircraft Nuclear Propulsion Project

Radiation Damage

An experiment is being designed for simultaneous radiation damage and heat transfer tests of circulating lithium systems in the ORNL reactor.

Shielding

The formal proposal for the new bulk shield testing facility, a 10-KW water moderated critical assembly, is now awaiting AEC approval.

Lid tank measurements on pure water have been completed; analysis of the lead-water data shows that secondary gammas are observable in lead-water combinations containing as much as 26% lead.

Liquid Metals Corrosion

A number of static corrosion tests have been made in which nickel, zirconium, iron, tungsten, tantalum, molybdenum, and columbium have been exposed to liquid lithium and bismuth for four hours at 1800°F. The next series of tests will be conducted at 1800°F for 40 hours. The first preliminary data from liquid lithium tests indicate best resistance in iron, molybdenum, and zirconium.

Homogeneous Reactor Project

Engineering Development

Motion pictures of the full-scale lucite model of the reactor tank during bubble removal tests indicate that the bubble residence time will certainly be less than one-half second in the reactor.

[redacted]

[redacted]

STATUS AND PROGRESS REPORT

FEBRUARY, 1950

Radiation Damage

During an in-pile experiment in which enriched UO_2SO_4 solution (40 grams U per liter) was kept at 250°C in the pile for one week, the pressure, after apparently leveling off at an early stage, continued to rise for the entire time. It is not known yet whether the continued increase in pressure after an apparent leveling-off means that decomposition-recombination equilibrium was not reached or whether it indicates that some other reaction was taking place. However, because the final pressure was only 1200 psi, it is clear that the elevated temperature is causing appreciable recombination.

Design Engineering

It is expected that a combinbed feasibility and safeguards report can be issued about April 1. The location to be recommended for the homogeneous reactor is south and slightly east of the Laboratory, on the other side of a high ridge.

GENERAL REACTOR RESEARCH AND DEVELOPMENT

Chemical Technology

General

The Chemical Technology Division was established as of February 1, 1950 with Dr. F. L. Steahly, Division Director. There are three sections in the Division, the Chemical Laboratory Section, the Unit Operations Section, and the Pilot Plants Section. This Division was formerly a department in the Technical Division.

25 Process

The final purification of the Uranium 235 resulting from pilot plant operation is essentially complete. The losses were very low and the final product purity was good.

The design program for the MTR chemical plant at Arco has been established and at present calculations are being made to determine such factors as inventory, cooling time, and production of various isotopes.

23 Process

The pilot plant development of the 23 Process was continued and to date over half of the Uranium 233 has been recovered with an isotopic

[redacted]

purity of 98.5 per cent. The total 23 loss has been less than 0.2%; gross decontamination factors are greater than 10^4. The fission product activity associated with the final product is equivalent to the Uranium 233 background.

Purex Process

The Purex Process was demonstrated through the first and second uranium and plutonium cycles in batch countercurrent equipment with very satisfactory results. Other chemical studies are in progress to increase volumetric efficiency, to determine the radiation stability of the system using the Van de Graaff, and to determine HETS data for plutonium.

[redacted]

STATUS AND PROGRESS REPORT

FEBRUARY, 1950

PROGRAM 5000 - PHYSICAL RESEARCH

Radioisotope Production and Development

Radioisotope Production

During February a leak developed in the line through which iodine 131 is transferred from the cell where dissolving and processing takes place to the final purification equipment. The leak, being inside the concrete cell, has caused no contamination or radiation hazards but has necessitated the development of an alternate method of solution transfer to be used until repairs can be made. Production has been continued at the usual rate.

The phosphorus 32 processing equipment, which caused considerable trouble several months ago, is now operating at a high capacity and giving very good yields.

During the month of February 548 radioisotope shipments were made, as compared with 404 in February of 1949.

Control, Distribution and Accountability

At a conference between representatives of the AEC and medical users of cobalt 60, it was reported that specific activities of the order of 10 curies per gram are needed for teletherapy work. The maximum specific activity reasonably attainable, even with Hanford irradiation, is about 3 curies per gram.

The University of Wisconsin registered a complaint about the quality of carbon 14 labeled glycine and alanine distributed by the ORNL. This material was synthesized at the University of California and they are investigating the complaint which concerned the presence of impurities.

Pile Operation

Pile down time for the month of February was 8.3%, as compared with 9.1% for January. The total accumulated KWH was 2,165,931, averaging 3516.03 KW per operating hour. Two ruptured slugs were located by visual scanning and discharged without difficulty. The fans were down four and 14 hours respectively as a result of shorts caused when lightning struck the power supply line.

[redacted]

[redacted]

STATUS AND PROGRESS REPORT

FEBRUARY, 1950

All research facilities on the South experimental levels are back in operation and the final stages of the permanentization program are progressing slowly.

Radioisotope Production Process Development

The procedure for plating an inactive coating on high-level activity cobalt 60 sources has been worked out and is now in routine operation. It has been found that silver plating is more satisfactory than nickel plating.

The plating of 125 mc of high specific activity ruthenium 106 onto a copper spool 1/8 inch diameter by 3/4 inch long has been successfully completed. After a plating of inactive silver was applied over the Ru 106, the source read 6000 R/hr at one inch.

Tank Farm and Burial Ground

An improvement by a factor of about two in the decontamination factor for the waste evaporator has been achieved as a result of better operating techniques.

Three 2300-gallon tanks have been installed in the tank farm with suitable lines to handle storage of the Chalk River material raffinates from the special Redox test runs.

Physics

Neutron Diffraction

A lead crystal monochromator has been installed in place of the old rock salt crystal and the result is an improvement by a factor of three in the diffracted beam intensity.

Neutron Decay

A set of data has been completed which gives evidence of neutron decay sufficiently conclusive to merit a letter to the editor of the Physical Review. Plans are under way to improve the accuracy of the half-life determination. Instrumentation has been improved by the installation of four double, beta proportional counters of improved design.

[redacted]

[redacted]

STATUS AND PROGRESS REPORT

FEBRUARY, 1950

Fundamental Research in Radiation Effects in Solids

Production of radiation damage by high speed electrons, first reported from the West coast and greeted with some skepticism here, has been confirmed by means of the electrons from the 2-Mev Van de Graaff accelerator. A change of several per cent in the electrical resistance of Be-Cu was produced by the electron bombardment.

Resonance Absorption and Age in Zr-H_2O systems

The experimental work has been completed; the results are being written up and will be issued in the report ORNL-641. It is shown that in a Zr-H_2O system containing 20.4% Zr by volume the age is 35 cm^2 (normalized to a value of 30 cm^2 for water).

Chemistry

Heavy Element and Fission Product Separation Studies

From 20 Chalk River fuel rods (600 g/T) which are to be processed in the Redox Pilot Plant to separate plutonium, large amounts of long-lived radioisotopes can be obtained. The Chemistry Division is preparing to isolate about 25 isotopes from the Redox raffinates. The major isotopes to be separated are as follows:

Isotope	Weight (grams)	Activity (curies)
Np^{237}	2	--
Am^{241}	0.2	--
Tc^{99}	19.0	0.14
Ru^{106}-Rh^{106}	0.15	3×10^3
I^{129}	4	4×10^{-4}
Pm^{147}	11.8	6×10^3
Sm^{151}	2.3	11.6
Eu^{155}	0.14	160

The installation of storage tanks with attendant transfer lines for storage of the raffinates is nearing completion; a concrete storage pit in which concentrates will be stored in 5-gallon stainless

[redacted]

[redacted]

steel tanks pending final purification has been completed. It is expected that chemical processing will be started about April 1.

Reasonable amounts of the separated isotopes will be made available for use by other AEC installations.

Chemistry of the Heavy Elements

A modification of Hurley's method for plating aluminum on uranium has been developed by Milton Lietzke and found to give promising results. On a very small scale 7 grams of $AlBr_3$ in 2 grams of fused ethyl pyridinium bromide gave a very adherent, smooth deposit on the uranium cathode. There was no detectable blistering, peeling, or scaling and the aluminum plate was quite hard. At a current density of 0.4 amp/dm^2, the current efficiency was very good.

These results were so encouraging that an attempt to plate zirconium on uranium by a similar method was immediately made. A very good zirconium plate exhibiting the same qualities of the aluminum plate was obtained from $ZrCl_4$ in fused ethyl pyridinium bromide.

It is emphasized that no physical tests have been made on the coatings obtained and that the work is in very early stages; no large-scale plating by this method has been attempted yet.

Lithium 7 Separation

Lithium isotopes have been separated to an appreciable extent by an ion exchange method. Work is being continued in an effort to improve the degree of separation and quantity of product.

Radio-Calorimetry

A liquid nitrogen calorimeter for measuring the power level of the MTR to calibrate ionization chambers has been designed and is being constructed.

[redacted]

[redacted]

STATUS AND PROGRESS REPORT

FEBRUARY, 1950

Metallurgy

Study of Thorium and its Alloys

The mechanical properties, namely, Young's modulus, Poisson's ratio, tensile and yield strengths and ductility have been determined for the most recent Ames thorium.

Training and University Cooperation

The pilot group of students who were chosen from AEC installations, the armed forces and industry will start classes in the Oak Ridge School of Reactor Technology on March 6. This group is distinct from the group which starts training in September in that they were selected primarily because of urgent AEC needs of the moment.

The Reactor Technology laboratory is being equipped; construction of the exponential pile is underway.

[redacted]

[redacted]

STATUS AND PROGRESS REPORT

FEBRUARY, 1950

PROGRAM 6000 - BIOLOGY AND MEDICINE

Biological Research

Pathology

Further background on the effects of slow neutrons on cataract formation has been developed.

Cytogenetics

The work on the effect of oxygen on the sensitivity of living organisms to x-rays has been extended considerably. The rate of mitosis of the grasshopper neuroblast has been found to be easily influenced by the concentration of oxygen. Similar results in regard to the division rate in paramecia have been found.

Mammalian Genetics

The study of the fertility of mice after x-ray irradiation has developed certain interesting results. Acute irradiation of 200 R of female mice during the first five days after copulation significantly decreases the number of living young born. This decrease is the result of at least two mechanisms: (1) Failure of implantation. (2) Death between the time of implantation and day 10.5 of pregnancy. Survivors at day 10.5 are normal and continue thus to term.

Microbiology

It has been found that bacteria which have been irradiated by x-rays survive in higher percentages if they are incubated after irradiation at somewhat higher than normal temperature.

[redacted]

[redacted]

STATUS AND PROGRESS REPORT

FEBRUARY, 1950

PROGRAM 1000 - PLANT AND EQUIPMENT

Research Facilities

Pile Building #105 and Change House Addition

In the Pile Building, wiring for Pile Control and Instrumentation has not been started. The plans have been approved. There remains 5% of the roofing, 5% of interior painting, 20% of duct insulation, and 10% of metal partitions to be completed. In the Change House Addition there remains 10% of insulation on air conditioner, 10% of electrical work, 20% of plumbing, 75% of painting and 25% of doors to be hung, yet to be done.

Separations Building #205

J. A. Jones Construction Company started construction February 13, 1950. Footings poured in north side of building. Excavating for footings on south side of building and for process sewer. Started on new concrete roof for canal entrance. (East End of Bldg.) Rain delayed progress of the work.

Research Laboratory

Plans and specifications will be ready for bids March 6, 1950, and bids are to be opened May 4, 1950.

Physics of Solids Building

Construction is under way and the contractor is proceeding with pouring of foundations and placing of wall forms.

Cafeteria Building

Construction started 11/9/49. Foundations, structural steel, exterior masonry walls, roof structure and roofing, and concrete floor slabs completed. Plumbers, steam fitters, and electricians installing services to fixtures and equipment. Progress slow due to rain. Total completion, 35%.

[redacted]

[redacted]

STATUS AND PROGRESS REPORT

FEBRUARY, 1950

Instrument Laboratory

Construction started January 28, 1950, by H. A. Ivey, Inc. Excavation for footings, piers and grade beams completed. Erecting foundation forms and placing reinforcing steel. Total completion, 2%.

Health Physics Calibration Building #104-A

Construction started January 3, 1950; the foundations have been completed. The laying of soil lines and back filling for floor slab is now under way, after being delayed by rain.

Isotope Research and Semi-Works Building

Phase II design is proceeding satisfactorily and is scheduled for completion April 30th.

[redacted]

[redacted]

STATUS AND PROGRESS REPORT

FEBRUARY, 1950

PERSONNEL SUMMARY

	Number of Employees February 28, 1950	New Hires February	Terminations February
Administration	88	2	1
Operations *	103	0	2
Engineering, Shops, and Mechanical	659	24	0
Laboratory and Research	764	17	3
Protection	170	0	0
Service	301	3	2
Total	2085	46	8

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

RADIOISOTOPE SALES

Sales	December, 1949	January, 1950
Transfers within AEC	$21,700.50	$10,251.45
Off Project	6,672.90	15,572.46
Foreign	1,520.70	1,851.00
Cancer Program (Free)	29,014.35	31,103.80
Technical Cooperation Plan	-0-	-0-

Total Sales and Transfers to Date	$954,792.31
Total Cancer Program (free) to Date	381,315.31
Technical Cooperation Plan	400.00

[redacted]

[redacted]

STATUS AND PROGRESS REPORT

FEBRUARY, 1950

GROSS OPERATING COSTS

(a)	Actual ORNL operating cost for January, 1950	$1,069,008	
	Construction - ORNL portion of Program "H"	54,003	
	Total ORNL operating and Construction costs		$1,123,011
(b)	Estimated ORNL operating cost for Feb. 1950		$1,150,000
(c)	Actual accumulative FY 50 ORNL operating cost through Jan., 1950	$7,209,504	
	Actual accumulative FY 50 ORNL construction costs (Program "H") through Jan., 1950	$ 184,178	
	Total Actual Accumulative FY 50 operating and construction costs through Jan., 1950		$7,393,682
(d)	Estimated ORNL operating cost FY 50 through Feb., 1950		$8,543,682

[redacted]