ORNL 1104
Progress Report

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August 1951

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
CARBIDE AND CARBON CHEMICALS COMPANY
A DIVISION OF UNION CARBIDE AND CARBON CORPORATION
UCC
POST OFFICE BOX P
OAK RIDGE, TENNESSEE

[redacted]

ORNL 1104
This document consists of 26 pages. Copy 55 of 55. Series A.

Contract No. W-7405, eng 26

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August, 1951

W. E. Thompson

Date Issued: SEP 10 1951

OAK RIDGE NATIONAL LABORATORY
Operated By
CARBIDE AND CARBON CHEMICALS COMPANY
A Division of Union Carbide and Carbon Corporation
Post Office Box P
Oak Ridge, Tennessee

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August, 1951

Distribution

Offices of Directed Operations

1-4.	N. H. Woodruff	Oak Ridge, Tennessee
5.	Technical Information Div.	Oak Ridge, Tennessee
6.	C. A. Nelson	Wilmington, Delaware

AEC Installations

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

Oak Ridge National Laboratory

21.	E. P. Blizard	
22.	G. E. Boyd	
23.	R. C. Briant	
24.	G. H. Clewett	
25.	W. K. Eister	
26.	C. B. Ellis	
27.	J. H. Frye, Jr.	
28.	A. Hollaender	
29.	J. T. Howe	
30.	C. P. Keim	
31.	J. A. Lane	
32.	C. E. Larson	
33.	W. D. Lavers	
34.	R. S. Livingston	
35.	H. N. Lyon	
36.	K. M. Mann	
37.	H. F. McAlduff	
38.	J. A. McNally	
39.	K. Z. Morgan	
40.	M. E. Ramsey	
41.	E. D. Shipley	
42.	A. H. Snell	
43.	F. L. Steahly	
44.	Hezz Stringfield	
45.	J. A. Swartout	
46.	E. H. Taylor	
47.	W. E. Thompson	
48.	A. M. Weinberg	
49.	C. E. Winters	
50.	F. C. VonderLage	
51-55.	Central Files	

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August, 1951

TABLE OF CONTENTS

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August, 1951

TABLE OF CONTENTS

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August, 1951

TABLE OF CONTENTS

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August, 1951

PROGRAM 1000 - RESEARCH FACILITIES

Research Laboratory Building #4500

Work on this building is approximately 60% complete. All concrete foundations, floor slabs, stairs and platforms are 100% complete. All exterior masonry walls are 99% complete. Built-up roofing has been completed on Wings 1, 2, 3 and 4. Plumbing, heating and service piping is 50% complete. Air conditioning, ventilating, and duct work is 60% complete. Electrical services for light and power are 40% complete.

Isotope Research and Semi-Works Building #4501

Exterior masonry walls of Semi-Works section are 100% complete. Exterior masonry walls of Isotope Research section are 90% complete. Interior masonry walls of Semi-Works section are 95% complete. Interior masonry walls of Isotope Research section are 10% complete. Air conditioning, ventilating, and duct work in Semi-Works section are 70% complete, and 25% complete in Isotope Research section. Plumbing, service piping and electrical work are 70% complete in Semi-Works section, and 40% complete in the Isotope Research section.

High Voltage Laboratory Building #4503

Foundation walls to first floor level are 80% complete. Interior concrete walls around target rooms are complete to second floor level. Structural steel has been delivered to job site. Grading around exterior walls is 50% complete. Total completion - 18%.

Health Physics Waste Research Building #3504

This building is approximately 95% complete. Items of work remaining to be done are: Install monorail, hang and apply hardware on exterior doors, finish installing metal partitions, finish installing metal ceilings, install plumbing and electrical fixtures, complete painting, connect potable water, process water and process drains, finish exterior grading.

Chemical Isolation and Purification Laboratory Building #3508

This building is approximately 8% complete. Pouring concrete footings, pedestals and grade beam walls.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August, 1951

The ARE Building #7503

Excavation for pier footings complete. Excavation for foundation walls complete. Concrete foundation walls complete. Plumbers running soil lines. Total completion - 10%.

ORSORT Laboratory Building #3017 (Maxon Construction Company)

Excavation complete. Concrete foundation walls complete. Concrete walls of counter rooms complete. Concrete floor slab complete. Exterior concrete block walls 60% complete. Connections made to water and sewer lines. Underground soil and water lines installed. Total completion - 25%.

[redacted]

PROGRAM 2000 - SOURCE AND FISSIONABLE MATERIALS

Purex Process (AEC Activity 2802-3)

Chemical studies on the ion exchange procedure for plutonium isolation have been successful in increasing the process operability and the concentration of the product stream. A study on the recovery of plutonium from metallurgical wastes has indicated revisions in the present Los Alamos procedure which should increase the plutonium recovery. A preliminary flowsheet for this procedure will be prepared during the next month.

The Pilot Plant has now been shut down to modify the equipment. The equipment modifications are for (1) the dissolver off-gas decontamination system, (2) continuous solvent recovery, (3) continuous evaporation of the uranium product, (4) modification of the waste evaporator, and (5) recycle of evaporator condensates to the process to reduce the volume of water and acid discharged from the process.

SCRUP Separation (AEC Activity 2344)

The equipment test program was continued during this month and the second shipment of Chalk River material was received. Cold process test runs are scheduled to be started in September.

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August, 1951

PROGRAM 3000 - WEAPONS

RaLa Production (AEC Activity 3982)

Run number 45 was completed with the shipment of more than the minimum requirement of Ba^{140} to Los Alamos on August 17, 1951. Difficulty was experienced in the resin column operation as a result of the fact that the pH of the versene feed solution kept increasing, possibly as a result of radiation decomposition. Also it was noted that with 13,000 curies adsorbed on the resin column, a 20% loss in capacity due to resin breakdown was experienced.

After completion of the run, one of the plastic valves in the newly rebuilt final purification cell broke again. As a result of this and the processing difficulties encountered, the final purification cell is to be rebuilt with extensive modifications and the processing method is to be altered somewhat.

MTR-RaLa Development (AEC Activity 3982)

The development program for the MTR-RaLa process was reviewed to determine the economy possible by carrying out the pilot plant study at Idaho. The data developed indicated that the location had little effect on the overall development cost. The design of the Pilot Plant was sufficiently advanced that purchasing of critical materials will be started during the next month.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August, 1951

PROGRAM 4000 - REACTOR DEVELOPMENT

MATERIALS TESTING REACTOR

LITR Operation (AEC Activity 9543)

Final instrument testing and minor maintenance has been completed and continuous operation at a power level of about 750 KW is scheduled to start early in September.

At 750 KW the neutron flux in the fuel elements is about 1×10^{13} and in the beam holes about 1.5×10^{13}, and it is planned to take advantage of these fluxes for experimental uses.

MTR Project Engineering (AEC Activity 4221)

The MTR control instruments constructed at ORNL were shipped to Arco on August 31, 1951. The only remaining components to be shipped from ORNL are the aluminum gasket rings for the tank sections and the logarithmic potentiometer for the control system. These are scheduled for shipment in September.

Idaho Chemical Plant Design (AEC Activity 9541)

The construction of the Idaho Chemical Plant and its associated facilities is now about 35% complete. The laboratory facilities will be completed about December, 1951. The first draft of the SF accountability manual is complete and the operation manual is under way. Only one ORNL man is left with Foster Wheeler in New York and five are now in Idaho.

HOMOGENEOUS REACTOR PROJECT

Experimental and Design Engineering (AEC Activity 4264)

Successful operation of the gas let-down system has been demonstrated sufficiently to permit construction and installation of the HRE fuel system to procede. Major engineering effort is now being devoted to setting up the HRE mockup to operate with a normal uranium fuel solution and to final checking out of minor design features.

Except for minor revisions, the design of the HRE is now complete. Completion of all construction designs is expected by the end of September.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August, 1951

HRE Reactor Chemistry (AEC Activity 4263)

A production procedure for chemically pure uranyl sulfate has been developed on the basis of experience to date. Chemical studies are being extended to cover alternate fuels and container materials, although effort on the UO_2SO_4-347 stainless steel system is not being reduced. During August a long term circulating loop test was started with UO_2SO_4 (30 g U/l) at 150°C to determine the effect of operating at lower temperature.

Radiation Stability of Fuel Media (AEC Activity 4263)

Analytical results on the UO_2SO_4 contained in five 347 stainless steel bombs which were irradiated in the ORNL graphite-uranium reactor for 2000 hours indicate good solution stability but high corrosion -- probably as a result of pretreatment by obsolete procedures. Five additional bombs pretreated by improved methods were placed in the pile for long term irradiation.

HR Fuel and Blanket Studies (AEC Activity 4263)

The laboratory studies of uranium slurries for circulating and boiling type reactors were continued. Equipment is now being set up to evaluate these slurries under boiling conditions.

HR Fuel Reprocessing Studies (AEC Activity 4263)

The chemical evaluation of processing a uranyl sulfate solution after pile irradiation has indicated that an ion exchange procedure is not as attractive as solvent extraction. This is primarily due to plutonium precipitation. Therefore, the work on an ion exchange process for a homogeneous plutonium producing reactor has been terminated pending further incentive for this work.

Homogeneous Reactor Chemistry (AEC Activity 4263)

Present plans for recombining the hydrogen and oxygen produced in the HRE core call for the gas to be burned in a flame recombiner which has been tested and is being fabricated. An alternate recombiner using a platinum-on-alumina catalyst packed in a tube-and-shell heat exchanger is now being tested. The size of this experimental unit is 1/30th of full scale, equivalent to a reactor power level of 33 KW.

[redacted]

Slurry Pumping Studies (AEC Activity 4264)

A centrifugal pumping system of 347 stainless steel has been operated for ten days at temperatures from 110 to 150°C with a 100 g U/l slurry of UO_3. No abrasion was observed and analysis of the slurry after the test showed no increase in iron, chromium or nickel content, indicating that there was no appreciable corrosion.

Building 7500 - HRE (AEC Activity 4261)

The D_2O reflector system is essentially complete and has been pressure tested to 1500 psi. About 85% of the components of the fuel system have been fabricated and are now being installed with the attendant piping. The overall reactor facility is now about 70% complete.

AIRCRAFT NUCLEAR PROPULSION PROJECT

ANP Central Design (AEC Activity 4271)

A preliminary design has been completed of an aircraft reactor employing a fluid hydroxide as the combination coolant-moderator. In this reactor design the fuel temperature gradients are minimized by the use of annular fuel elements in which the fuel annulus is approximately .012" thick. The annular fuel elements are cooled internally and externally by the circulating moderator-coolant. The multipass design permits routing the coolant first through that portion of the reactor with the highest specific power, and subsequently through portions of lower specific power, thus minimizing peak temperatures. The cross-sectional areas of the flow passes are adjusted to provide highest velocities, and therefore, highest heat transfer coefficients at the coolant discharge.

The H. K. Ferguson Company has almost completed its design study on an NaOH moderated and cooled reactor suitable for driving a B-36 or B-52. They show the NaOH in about 30,000 coolant tubes passing through a spherical pot of liquid fluoride fuel. Automatic control is to be accomplished by thermal expansion of this fuel body. A report will be presented in the near future.

The ARE engineering modifications of BeO moderator blocks, clearance, etc., as well as new evaluations of physical constants have been followed by detailed physics calculations. The estimated enriched uranium investment of the ARE design of August 1, 1951, is 25 pounds for the hot, depleted poisoned reactor with control rod thimbles. The kinetic behavior of the

ARE following various accidental changes in multiplication constant and in input coolant temperature has been calculated numerically using IBM equipment, and in all cases has resulted in a well-damped, safely-tolerated transient.

Calculations on proposals employing a hydroxide moderator coolant are in process of development. A numerical solution of the multigroup age equations in cylindrical coordinates--with varying uranium loading--has been devised and is nearly ready for trial. Investigation into the difference equations used in IBM procedure has revealed improvements which can be made.

Induced Activity in ANP Pile Coolant (AEC Activity 4272)

The in-pile lithium circulating loop was inserted in the pile for one week at 1000°F. The 316 stainless steel showed no detectable corrosion (by measuring induced activities of stainless steel as impurities in the lithium). The Bremsstrahlung from lithium 8 were measured and found to be 2×10^9 Mev per cc per second where the in-pile flux was about 1.5×10^{11}. The average energy of the Bremsstrahlung was found to be 0.06 Mev.

It is now planned to test an in-pile loop with sodium circulating in inconel at 1500°F. A second sodium loop for exposure in the LITR is being designed primarily for stress-corrosion and creep of inconel. Preliminary design for an in-pile experiment for the MTR has been started.

Heat Transfer and Liquid Metals Research (AEC Activity 4275)

The canned rotor liquid metal pump has been operated with NaK for 90 hours at temperatures up to 400°F with no appreciable signs of wear. After inspection, the pump is being reassembled for operation at higher temperatures.

Preliminary tests on the thermal conductivity of fluoride salt fuel mixtures have been carried out and indicate that the thermal conductivity is about 0.54 $Btu/(hr)(ft^2)(^oF)/ft$.

Heat capacities have been measured for sapphire, stainless steel, molybdenum, lithium, and zirconium. The value obtained for lithium checks earlier values which indicate that the heat capacity is close to 1.

Preliminary data obtained from the lithium heat transfer studies indicate that the heat transfer rates are about those expected from theory, although detailed analysis of the data is not complete.

Radiation Damage (AEC Activity 4274)

Preliminary experiments at 820°C on inconel being irradiated in the ORNL graphite-uranium reactor show a decrease by a factor of two in the thermal conductivity over a period of about a week after which there is no further decrease. More refined experiments are now under way and conclusive proof of the decrease in thermal conductivity of inconel under irradiation must await completion of these experiments. Similar experiments with 310 stainless steel are being started. Plans are also being made for an experiment to measure the change in thermal conductivity of fluoride salt fuel in an inconel fuel tube. This experiment will be set up in such a way as to measure the change in thermal conductivity of both the fuel and the inconel tube.

A series of three fairly reproducible cantilever creep tests conducted in the ORNL graphite reactor exhibited increased total creep strain in 347 stainless steel, compared to bench tests, after approximately one hundred hours of operation. Up to 100 hours there appears to be slightly less creep under irradiation than on the bench. The in-pile specimens show about 10% greater creep strain after 200 hours and nearly 20% more strain than the corresponding bench test after about 250 hours. Type 347 stainless steel was the metal tested, the maximum fiber stress was 1500 psi, and the temperature was 1500°F.

ANP Reactor Chemistry (AEC Activity 4275)

Phase Studies. The ternary systems, RbF, LiF, and UF_4, KF, LiF, and UF_4, NaF, LiF, and UF_4 were studied during the month. The last named system is the best studied to date with regard to flexibility of uranium concentration in the temperature range of interest.

Work was started on various systems of hydroxides, hydroxides and fluorides, and hydroxides and tetraborate.

ANP Critical Experiments (AEC Activity 4272)

A mockup of the proposed air-water cycle reactor for aircraft was investigated as a joint GE-ORNL endeavor and the critical mass dimensions, thermal neutron distribution and fuel self-shielding factor were determined. The homogeneous uranium-silicon carbide which has been projected for this reactor was mocked-up with pieces of metallic uranium spaced among blocks of graphite and the water was simulated by plexiglass.

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August, 1951

A uranium-graphite critical assembly has been set up for the purpose of comparison of experiment and theory. The dimensions have been measured; power and neutron flux measurements are in progress.

ANP Experimental Engineering (AEC Activity 4271)

Thermal convection loop operations and fluoride fuel capsule tests were continued throughout the month although emphasis on thermal convection loop operation with liquid metals is decreasing. Five loops were operating at the beginning of the period, but five startups and six terminations left four operating at the end of the month. During the month, four inconel and one each of types 310 and 316 stainless steels completed 1000-hour tests with sodium at 1500°F. One inconel loop terminated for apparent plugging. Four inconel and one 316 stainless steel loops were put into operation. Static tests of fluoride fuel capsules immersed in sodium at 1500°F were continued and during the month tests on the 200- and 400-hour capsules were completed. The total operating time accumulated on corrosion testing operations was 3860 hours.

Design and preliminary experimental work on liquid fuel system mockup #3 was continued. The molten fuel viewing tank for visually observing fuel transfer, through an air cooled observation window, has been assembled and instrumentation provided. Experimental work has demonstrated the necessity for using thermal insulation on the system as well as the advisability of using calrod heaters in preference to wrap-around heaters. One actual transfer of non-enriched fluoride fuel mixture was made from one fuel tank to another to determine the efficiency of filtration through a stainless steel filter. Considerable insoluble material was left behind and very little hold-up, if any, occurred on the discharge side of the filter in the 3/16" O.D. transfer line.

A frozen sodium seal has operated for approximately 700 hours in a test apparatus. This seal is effected by freezing sodium in the annular space between a rotating shaft and a sleeve. For 300 hours of this time, the sodium temperature inside the test apparatus was 1500°F and the pressure differential across the seal 26 psig. As a practical application of the seal, a conventional centrifugal pump was modified to incorporate it; this pump was in operation with sodium at 650°F, delivering ~15 gpm at 2000 rpm at the end of the month. In other test equipment, a graphitar ring gas seal operating against Ketos tool steel rings had sealed against 10 psig differential gas pressure for 400 hours; 50 hours of this time was in the presence of vapor coming from a NaK bath at 500°F.

[redacted]

The gas purification equipment has been put into operation to reduce oxide contamination of liquid metals from impure blanketing gas. The equipment has demonstrated that oxygen content of gases can be kept below 15 ppm. Aging sodium at 250° for 24 hours or longer, then filtering twice through five micron filters reduces the oxide content to about 200 ppm. Also, modifications to sampling techniques to assure more representative analytical samples are being made. Analytical results received on a series of sodium samples taken during test equipment cleaning operations using 800°F sodium again indicate the inadequacy of present methods for detecting oxygen in sodium.

Self-welding tests in sodium at 1500°F showed that finely ground surfaces of inconel welded together while no welding was evident between similar surfaces of zirconium and inconel. A thin-walled tube of inconel in sodium at 1500°F has continued under test for approximately 700 hours without failure when hoop-stressed to approximately 1500 psi. Stainless steels are also under investigation. A stress-rupture apparatus for testing sheet metal in a liquid at elevated temperatures has been designed and fabricated. Initial tests are under way.

GENERAL REACTOR DEVELOPMENT

Waste Treatment (AEC Activity 4582)

A Cottrell electrostatic precipitator has been demonstrated to be effective for the removal of radioactive particulates from radiochemical process off-gas systems. As a result of this study an effective procedure for evaluating radioactive contamination in air has been developed.

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August, 1951

PROGRAM 5000 - PHYSICAL RESEARCH

PRODUCTION OF RADIOISOTOPES

Radioisotope Production, Development and Operations (AEC Activity 5111)

The total accumulated KWH for pile operation during August was 2,628,061, averaging 3784.5 per operating hour. Pile down time was 6.7% as compared with 10.3% during July. There was one ruptured slug (the first since April) which was located and discharged without difficulty. The total number of radioisotope shipments was 759.

PRODUCTION OF STABLE ISOTOPES

Calutron Operation and Process Development (AEC Activity 5121)

Experimental runs for electrodepositing lithium metal were made using acetone as a solvent for lithium bromide. These runs were not successful because of the water that was present. Anhydrous characteristics of materials are more important than was at first concluded. A pre-electrolysis cell has been fabricated to aid in removing water and associated products. Better lithium production is expected. Many samples of lithium have been deposited; however, preserving this material has presented probably an even greater problem than that of depositing. Copper plating has been considered as a method of protecting the collected sample. A standardized titration technique is being investigated as a quick method of determining the amount of deposited lithium.

A grid slit system was tested in the Charge Evaluation Laboratory to determine operating characteristics as compared with the standard straight slits using lithium bromide as the charge material. Further tests will be made, substituting lithium metal for the bromide.

Better retention has been noted with the use of the new type receiver pockets in iron and lithium collections. A carbon pocket was inserted into the Fe-56 copper shell to withstand the erosion of the strong Fe-56 beam. These pockets have cooling passages as an integral part of the design.

Iron collections that were started in July in the Beta channels were continued throughout this month. These runs have yielded an estimated 298.1 grams of separated isotopes. Lithium operations were in progress this month in the Alpha channels. This collection was started in March and an estimated total of 718.8 grams of lithium isotopes have been collected thus far.

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August, 1951

There were 35 stable isotope shipments during August.

PHYSICS

High Voltage Laboratory (AEC Activity 5211)

The 2 MV Van de Graaff accelerator has been used to give a 60-microampere proton beam at 600 Kev and has reached 2.7 Mev without a beam. A complete calibration curve accurate to about 10 KV has been obtained for the 6 MV Van de Graaff. This accelerator has been used to discover 15 new resonances in the fluorine P-γ reaction between 2 and 5.2 Mev.

Scintillation Spectrometry (AEC Activity 5211)

The spectrum of inner Bremsstrahlung accompanying K capture in Fe^{55} has been measured with the scintillation spectrometer. The results lend themselves to the construction of a Kurie plot which is straight and has an end point which agrees well with the value which would be predicted from the threshold of the Mn^{55} p-n reaction. It appears that this is a suitable new technique for measuring the disintegration energy of K capturing nuclides.

Isotope Analysis Methods Laboratory (AEC Activity 5261)

Nuclear Resonance. Calculations have been made on maximum anticipated signal strength of several nuclei. A H_2Se solution under 10 atmospheres pressure was investigated unsuccessfully for the Se-77 resonance. Assay studies have been initiated on D_2O enriched samples. The sensitivity of balance conditions on the signal amplitude and phase is being thoroughly investigated.

Microwave Spectroscopy. Frequence measurements on the spectrum of vinyl iodide have been completed. Interpretation of the data is in progress and predictions of missing absorption lines are being accumulated for later experimental study.

Infra-Red Spectroscopy. The Perkin-Elmer 12B spectrometer has been reassembled and is ready for use in support of ANP Chemistry research activities.

High Resolution Spectroscopy. A Zeeman echellogram of uranium was obtained at a magnetic field strength of 25,000 gauss. Both π and σ components were obtained unseparated using only a 5 mg sample of uranium deposited on copper. Resolution is only about 0.3 g units because of high intensity background on these exposures.

Spectro-Isotopic Analysis. Isotope shifts in the Li-6/Li-7 spectra have been studied as a function of sample life, pressure, and sample size. The line intensity ratio, I_6/I_7 of several 400 microgram lithium samples, shows a two per cent reduction after a ten-hour burning period. Life tests indicate sampling consumption per exposure corresponds to approximately 0.1 microgram of lithium in agreement with earlier observations on a 10 microgram sample. A phototube mount has been constructed and electronic comparison amplifier circuits are being rebuilt for photoelectric monitoring of the lithium.

Fluoro-Photometric Studies. Fluorometric analysis methods for uranium in various liquid coolants (Na, NaK, NaF-BeF-KF) are being investigated as a possible "leak detector" on ANP reactor test assemblies. Results on NaK have been not too successful to date.

Spectrochemical Development and Analysis. Development of analytical methods is being pursued on the following materials: (1) stainless steel quantitatives for Mo, Cb, Ta, Ti, Si; (2) low concentration zirconium in HRE solution samples; (3) NaF-KF-UF_4 eutectic for Fe, Cr, Ni, Mo; and (4) BeO moderator material for B, Co, Fe, Ag, Zn. Analysis results reported out during this month include a total of 125 samples for 2518 impurity determinations.

X-Ray Spectroscopy. Pulse energy studies with the Tektronik oscilloscope indicate that a set of low energy pulses were being counted with the 17 KV X-Rays under study for homochromatic absorption at the uranium L III edge. The higher energy pulses from second order diffractions are readily eliminated by reduction of tube voltage.

Studies on grain size and crystal effects have been initiated on canned ORNL uranium slugs for comparison with Hanford slugs.

Mass Spectrometer Laboratory

Further investigations have been made of the dissociation properties of the proposed aircraft reactor fuel. Evidence now indicates that the SiF_4 found in the mass spectrometer was produced by the attack of fluorine on the silicon constituent of the stainless steel charge bottle. The sublimation properties of UF_5 at 500°C and in vacuum have been investigated. An analysis of the dissociation of UF_3 at 800°C in vacuum indicates that little if any dissociation takes place. A satisfactory procedure has been worked out for removing the UF_4 impurity from UF_3.

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August, 1951

The 86-Inch Cyclotron (AEC Activity 5261)

The cyclotron can now be operated over long periods of time with very few unscheduled interruptions. In an isotope production run innage was 97% for a 60-hour period with a beam current of 400 μa at 22 Mev. In tests with special targets the beam current has reached 1500 μa at 22 Mev; a beam power of 33 KW was verified calorimetrically.

The 63-Inch Cyclotron (AEC Activity 5261)

Testing on the electrical model of the 63-inch cyclotron is complete. The circuit constants for the oscillator and coupling circuits have been determined. Fabrication of cyclotron components continues. The power supply for the oscillator is 60% complete. Vacuum manifold and liner have been delivered and vacuum tested.

Special Separations (AEC Activity 5261)

The fifth separation in the second stage of the U 236 program yielded 260 mg of U_3O_8 concentrated to 95.5% U 236. This corresponds to a U 236 process efficiency of 5.4% and a 236:235 enhancement of 48. A sixth and last separation run has been completed but assay data are not yet available. This second stage is expected to yield a total of 1.8 grams of top product U 236.

CHEMISTRY

Thorex Process Development (AEC Activity 5361)

The Thorex Process development program was initiated during the past month. The objective of this program is to develop an integrated process for the separation of uranium 233, protactinium 233, thorium and fission products from neutron irradiated thorium. The production plant for this proposed process is tentatively scheduled to start up in 1954.

Electrochemical Studies (AEC Activity 5311)

Electrostripping for the decontamination of metallic equipment has been demonstrated to be a very effective procedure. Equipment varying from laboratory beakers and valves to 200 gallon capacity tanks have been decontaminated from greater than 1 roentgen/hour to radiation tolerance levels. The application of this procedure to installed process equipment has been

[redacted]

studied. In this case, the decontamination of pipe lines has not been satisfactorily demonstrated.

Chemistry of Uranium Raw Materials (AEC Activity 5361)

A program has been initiated for study of the complex uranium ions in phosphate solutions, using solubility and spectrophotometric measurements.

In the investigations of organic complexing agents which are capable of affecting the precipitation of uranium and/or its extraction into organic solvents, it has been found that dibutyl and dihexyl-phosphinic acids are equal in extracting power to dibutyl phosphate as well as being more stable toward hydrolytic conditions.

Further studies in the carbonate-uranium systen have shown that appreciable solubilities of uranium can be achieved at high temperatures with high (600 psi) CO_2 pressures.

Uranium recovery studies on Bartow Clay have shown that somewhat selective extractions of uranium can be obtained at certain acidities.

Chemical Separation of Isotopes (AEC Activity 5361)

The system LiSCN-tributyl phosphate-water has been completed. Ten passes were made in which one-half of the lithium present in the TBP was extracted in the aqueous phase each time. Complete isotopic analyses are not yet available, but results from the first eight passes indicate a lack of isotopic fractionation under the conditions studied.

A preliminary run was made with the 10-foot, one-inch column in which the system HCl (gas) -Cl^- is being studied. It was found desirable to change the design of the feed arrangement and to lengthen the column. This has been done. Exchange studies of the system have been made, using Cl^{36} as a tracer. It was found that complete isotopic exchange occurs in one minute or less. A method of preparing $KCl^{36}O_3$ from KCl^{36} has been developed.

Lithium Isotope Separation (AEC Activity 5361)

The highest enrichment to date was achieved in the 48-foot by one-inch stirred trough. Without baffles this apparatus gave an enrichment from 7.2% Li^6 to 13.2% Li^6 at flows of 100 cc/min.

Further work on rate of reaction of Li (amalgam) with water shows that reaction rate varies as the square root of the amalgam concentration.

Operation of the pilot plant will begin the first week in September.

METALLURGY

Preferred Orientation in Uranium (AEC Activity 5410)

It had been shown earlier that the type of preferred orientation developed in some high-α-extruded uranium rod in the as-extruded condition varied with extrusion ratio and from front to back end of a given extruded length. The texture was predominantly a duplex $[0\bar{1}0]$ - $[\bar{4}10]$ fiber texture with minor components $[0\bar{3}1]$, $[\bar{3}21]$, $[00\bar{1}]$, and $[\bar{1}00]$, but the intensity of the $[\bar{4}10]$ relative to that of the $[0\bar{1}0]$ component increased with increase in extrusion ratio and decreased from front to back end of the extruded length. Since the degree of recrystallization correspondingly changed with these variables, it was suggested that the texture depended upon the degree of recrystallization in that the intensity of the $[\bar{4}10]$ relative to that of the $[0\bar{1}0]$ component increased with increase in degree of recrystallization.

To check this hypothesis, a new set of preferred orientation experiments was carried out, using unrecrystallized and recrystallized samples. Analysis of the data revealed the unrecrystallized sample to have a duplex $[0\bar{1}0]$ - $[\bar{4}10]$ fiber texture with minor $[0\bar{3}1]$, $[00\bar{1}]$, and $[\bar{4}31]$ components, but the recrystallized sample (U9-26) to have essentially a pure $[\bar{4}31]$ fiber texture.

These results show very definitely that uranium rod upon recrystallization does not always retain the texture developed upon deformation. Not only is the texture produced by deliberate recrystallization different from that of the structure from which it recrystallized but also is considerably different from that in uranium rod which had been extruded under higher extrusion ratio and thus were recrystallized in the as-extruded condition.

The situation may be similar to that observed for some other metals, in that rod in which the deformation texture is very well developed tends to retain that texture upon recrystallization, whereas rod in which the deformation texture is not so well developed tends to assume a different texture upon recrystallization.

To check this point, rods extruded at higher extrusion ratios will be examined in the as-extruded and in the annealed conditions.

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August, 1951

PROGRAM 6000 - BIOLOGY AND MEDICINE

BIOPHYSICS

Experimental Radiation Measurements (AEC Activity 6541)

During the past six months the solenoidal beta ray spectrometer has been improved until satisfactory operation is now routine. Results now being obtained with this instrument indicate that its resolving power is 1/2%, a factor of six better than the ordinary magnetic lens spectrometer. Using monoenergetic betas from Cs^{137}, beta straggling curves are being measured in foils of different thicknesses and atomic numbers. Calculations are being carried on concurrently in an effort to compare the data with energy loss theories and with range measurements. It is hoped that this data will enable an improvement in the dosage calculations for beta particles.

Waste Disposal Research (AEC Activity 6532)

An ecological survey is being made in the White Oak Lake system which carries the overflow from the ORNL settling basin of the waste disposal system. This drainage system is useful for biological studies since the lake has a normal population of fish and other aquatic life and contains several hundred curies of mixed fission products. One purpose of this study is to determine whether this level of contamination over a period of about seven years has brought about any detectable change in plant and animal life. So far, no deleterious effects of radiation exposure upon the flora and fauna have been observed. It is of interest, however, that deformed specimens of Juncus effusus (chain rush) have been found along the shores of the lake. The deformed specimens have nearly flat and twisted stems as compared with normal round and straight leaves. Both normal and deformed specimens are now being grown under controlled conditions to determine whether the abnormality is radiation induced and whether it is hereditary.

Other variants including cattails with varicolored leaves have been observed and these are to be studied further.

A downstream river bottom reconnaissance survey has been undertaken to determine the locality, distribution and movement of deposits containing higher than background radioactivity. This survey was made feasible by the development of a sensitive bottom-scanning instrument.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August, 1951

Instrument Development (AEC Activity 6542)

A fast neutron dosimeter has been developed as a means of determining neutron dosage separately from the gamma background. The counter utilizes the Bragg-Gray relationship for dosage measurements, but uses a proportional counter instead of an ionization chamber. This enables one to use an electronic device to cut out all the pulses due to gamma rays. Since the height of the pulse in a proportional counter is proportional to the number of ion pairs causing the pulse, the dose due to fast neutrons may be obtained by integration of the pulse heights.

The instrument consists of a series of discriminators which sort the pulses into various height groups. These in turn are fed into various stages of a binary scaler which automatically weighs the pulses according to height.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August, 1951

PERSONNEL SUMMARY

	Number of Employees August 31, 1951	New Hires August	Terminations August
Administration	96	4	2
Operations*	118	1	2
Engineering, Shops and Mechanical	903	2	15
Laboratory and Research	1334	24	49
Protection	170	2	2
Service	371	8	3
TOTAL:	2992	41	73

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

RADIOISOTOPE SALES

Sales	June	July
Transfer within AEC	19,728.60	6,439.55
Cash Sales	9,170.00	22,272.47
Foreign	599.00	1,038.90
Cancer Program (Free)	37,331.05	41,272.53
Technical Cooperation Plan	4,020.00	460.00
Total Sales and Transfers to Date	1,768,927.87	1,808,386.49
Total Cancer Program (Free) to Date	897,408.78	938,681.31
Technical Cooperation Plan (Shipments to Date)	11,613.04	12,073.04

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

August, 1951

GROSS OPERATING COSTS
(Including X-10 & Y-12)

(a)	Actual Cost for July 1951	2,359,201	
	Construction - Program "H"	22,113	
	Total Operating & Constr. Cost		2,381,314
(b)	Estimated Operating Cost for August 1951		2,400,000
(c)	Actual Accumulative FY 1952 Operating Cost through July 1951	2,359,201	
	Actual Accumulative FY 1952 Construction Costs through July 1951	22,113	
	Total Actual Accumulative FY 1952 Operating & Construction Costs through July 1951		2,381,314
(d)	Estimated Operating Cost FY 1952 through August 1951.		4,781,314

[redacted]