[redacted]

MARTIN MARIETTA ENERGY SYSTEMS LIBRARIES
3 4456 0360928 1

ORNL-1168
Progress Report
56a

AEC RESEARCH AND DEVELOPMENT REPORT

LABORATORY RECORDS
1954

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

NOVEMBER 1951

DECLASSIFIED
Classification Changed To:
By Authority Of: AEC List 9-24-70
By: E. Goldberg 2-4-71

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 COMPANY
A DIVISION OF UNION CARBIDE AND CARBON CORPORATION
UCC
POST OFFICE BOX P
OAK RIDGE, TENNESSEE

[redacted]

[redacted]

ORNL 1168
This document consists of
25 pages. Copy 56
of 56. Series A.

Contract No. W-7405, Eng. 26

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

J. P. Lane

Date Issued: DEC 10 1951

MARTIN MARIETTA ENERGY SYSTEMS LIBRARIES
3 4456 0360928 1

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]

[redacted]

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

Distribution

Offices of Directed Operations

1-4.	[redacted]H. Woodruff	Oak Ridge [redacted]ennessee
5.	Te[redacted]ical Information Div.	Oak Rid[redacted] Tennessee
6.	C. A[redacted]elson	Wilmin[redacted]n, Delaware

AEC Installati[redacted]

7.	H. A. Blair	U[redacted]ersity of Rochester
8.	N. E. Bradbu[redacted]	[redacted] Alamos Scientific Laboratory
9.	C. E. Center	[redacted]rbide and Carbon Chemicals Company
10.	G. T. Felbeck	Carbide and Carbon Chemicals Company
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 Company
16.	E. O. Lawrence	Univ. of Calif. Radiation Laboratory
17.	F. L. Mohler	National Bureau of Standards
18.	H. W. Russell	Battelle Memorial Institute
19.	F. H. Spedding	Ames Laboratory
20.	W. H. Zinn	Argonne National Laboratory

Oak Ridge National Labora[redacted]y

21.	E. P. Blizard	37[redacted]	R. N. Lyon
22.	G. E. Boyd	38.	[redacted] J. McAlduff
23.	R. C. Briant	39.	[redacted]R. McNally
24.	J. H. Buck	40.	K. [redacted] Morgan
25.	G. H. Clewet[redacted]	41.	M. [redacted]Ramsey
26.	W. K. Eist[redacted]	42.	E. D. [redacted]ipley
27.	C. B. Ell[redacted]	43.	A. H. [redacted]ll
28.	J. H. F[redacted], Jr.	44.	F. L. S[redacted]hly
29.	A. Hol[redacted]nder	45.	Hezz Stri[redacted]ield
30.	J. T. [redacted]we	46.	J. A. Swar[redacted]t
31.	C. [redacted]eim	47.	E. H. Taylor
32.	J. [redacted] Lane	48.	W. E. Thompso[redacted]
33.	J[redacted]. Lane	49.	A. M. Weinberg
34.	[redacted]E. Larson	50.	C. E. Winters
35.	[redacted]. D. Lavers	51.	F. C. VonderLage
36[redacted]	R. S. Livingston	52-56.	Central F[redacted]

[redacted]

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

TABLE OF CONTENTS

	Page
PROGRAM 1000 - RESEARCH FACILITIES	6
Research Laboratory Building #4500	6
Isotope Research & Unit Operations Building #4501	6
High Voltage Laboratory Building #5500	6
West Portal Building #2016	6
East Portal Building #5000	7
Health Physics Waste Research Laboratory Building #3504	7
Test Facilities Building #7503 (ARE)	7
ORSORT Laboratory Building #3017	7
Chemical Isolation & Purification Laboratory Building #3508	7
PROGRAM 2000 - SOURCE AND FISSIONABLE MATERIALS	8
Purex Process	8
SCRUP Separation	8
"23" Processing	8
PROGRAM 3000 - WEAPONS	9
RaLa Production	9
MTR RaLa Development	9
PROGRAM 4000 - REACTOR DEVELOPMENT	10
MATERIALS TESTING REACTOR	10
LITR Operation	10
Fuel Elements, Fuel Media, Producer Element Development	10
HOMOGENEOUS REACTOR PROJECT	10
Experimental and Design Engineering	10
Building 7500 - HRE	10
AIRCRAFT NUCLEAR PROPULSION PROJECT	11
Liquid Metals Research	11
ANP Experimental Engineering	11
Fuel Elements	13
ANP Reactor Chemistry	13
Hydroxide Preparations	13
Phase Studies	13
Corrosion Testing	13
ANP Central Design	13

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

TABLE OF CONTENTS

Page

Shielding Research 15
General Reactor Research - Idaho Chemical Plant Design 15

PROGRAM 5000 - PHYSICAL RESEARCH 16

PRODUCTION OF RADIOISOTOPES 16
Radioisotope Production 16
Stable Isotope Production 16
Radioisotope Research and Development 16

PHYSICS 16
High Voltage Laboratory 16
Neutron Diffraction 16
Low Temperature Work 17
Pile Operations 17
Isotope Analysis Methods Laboratory 17
Nuclear Resonance 17
Mass Spectrometer Laboratory 18
86-Inch Cyclotron 18
Special Separations 19
63-Inch Cyclotron 19

CHEMISTRY 19
Nuclear Chemistry of Fission Products 20
Chemistry of Uranium Raw Materials 20
Thorex Process Chemical Development 20
Chemical Engineering Research Studies 20

METALLURGY 21
Fundamental Radiation and Physical Metallurgy 21

PROGRAM 6000 - BIOLOGY AND MEDICINE 22

BIOLOGY 22
Pathology and Physiology 22

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

TABLE OF CONTENTS

Page

BIOCHEMISTRY..... 22
Radiation Chemistry..... 22

BIOPHYSICS..... 23
Waste Disposal Research..... 23

PERSONNEL SUMMARY..... 24

RADIOISOTOPE SALES..... 24

GROSS OPERATING COSTS..... 25

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

PROGRAM 1000 - RESEARCH FACILITIES

Research Laboratory Building #4500

Acoustical tile and plastered ceilings in Wings #1, #2, #3 and #4 are 98% complete. Metal partitions in Wing #2 are 50% complete. Metal partitions in Wing #3 are 87% complete. Metal partitions in Wing #4 are 98% complete. Masonry partitions of service area are 80% complete. Service and process piping is 75% complete. Electrical services are 80% complete. Substation #20 is 50% complete. Concrete curbing for roads is 50% complete.

Building - 85% complete.

Isotope Research & Unit Operations Building #4501

Unit Operations Section. Metal partitions are 75% complete. Electrical services are 90% complete. Service and process piping is 90% complete. Painting is 80% complete. Acoustical ceilings are 85% complete. Air conditioning is 95% complete. Interior masonry partitions are 100% complete.

Isotope Research Section. Interior masonry partitions are 90% complete. Acoustical ceilings are 50% complete. Painting is 40% complete. Service and process piping is 75% complete. Electrical services are 75% complete. Air conditioning is 75% complete. Concrete curbing for roads is 90% complete.

Building - 88% complete.

High Voltage Laboratory Building #5500

Exterior masonry walls are 40% complete. Structural steel erection is 98% complete. Concrete floor slabs are 40% complete. Service piping is 10% complete. Electrical services are 20% complete.

Building - 36% complete.

West Portal Building #2016

This building has been accepted and is being occupied by ORNL forces. Final completion Form F-3 has not been processed and signed.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

East Portal Building #5000

This building has been completed in accordance with specifications and drawings. Completion Form F-2 has been processed with exceptions. Steam heating and ventilation has been balanced. Electrical power is not yet available for this building.

Health Physics Waste Research Laboratory Building #3504

This building has been completed in accordance with specifications and drawings, with exceptions. Final completion Form F-3 will be processed and signed when operating manuals for equipment have been turned over to ORNL forces. Building is now being occupied by ORNL forces.

Test Facilities Building #7503 (ARE)

This building is approximately 65% complete. All concrete work is complete. Structural steel is complete. Roofing is complete. All masonry partitions have been erected. All underground soil and water lines are complete. Electrical, plumbing and heating service lines are being installed in building.

ORSORT Laboratory Building #3017

Inspection of the work performed by Maxon Construction Company on this building was made on November 30, 1951. The exceptions noted at this inspection will be completed November 30, 1951. ORNL partition in the completion of this building will be started December 3, 1951, and it is estimated that this work will be completed on or before December 15, 1951.

Chemical Isolation & Purification Laboratory Building #3508

This building is approximately 60% complete. All concrete foundation work is complete. Structural steel frame is complete. Gypsum floor slabs have been applied on roof. Concrete floors on first and second floor areas are being installed. All underground service lines have been installed. Metal siding will be delivered during second week in December.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

PROGRAM 2000 - SOURCE AND FISSIONABLE MATERIALS

Purex Process (AEC Activity 2802-3)

The Purex No. 3 Flowsheet has now been established as the basic flowsheet for the final development of the Purex Process. On the basis of this flowsheet, laboratory studies are in progress on the plutonium coupling and isolation step, the final uranium product decontamination, the waste treatment studies, and the recovery of plutonium from metallurgical wastes. Laboratory studies have indicated that silica gel absorption was the most direct and effective method for obtaining the required purification of the uranium product stream. It is planned to install this system in the Pilot Plant for final demonstration. A preliminary waste flowsheet has been prepared that will be used as the basis for future laboratory and pilot plant studies.

The modification of the Pilot Plant is essentially complete and preliminary testing of equipment is now in progress.

SCRUP Separation (AEC Activity 2344)

The modification of the Metal Recovery Plant for the SCRUP process operation was continued. The major job yet to be completed is the installation of the hot samplers and the pulse generators for the solvent extraction column.

"23" Processing (AEC Activity 2XXX)

A firm decision has now been made on the quantity of uranium 233 that will be required and the delivery date for this product. Design work is now in progress to modify the equipment in Building 3503 for this program.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

PROGRAM 3000 - WEAPONS

RaLa Production (AEC Activity 3982)

The rebuilding of the resin column cubicle is essentially completed and dummy runs are being made. The next production run is scheduled for January 6, 1952.

MTR RaLa Development (AEC Activity 3982)

The final Laboratory and Unit Operations studies are now in progress and are scheduled to be completed before January, 1952. The first draft of the final design report has been completed and work has been initiated in the final reports covering the Laboratory and Unit Operations phases.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

PROGRAM 4000 - REACTOR DEVELOPMENT

MATERIALS TESTING REACTOR

LITR Operation (AEC Activity 9543)

The LITR operated at 770 KW per operating hour during November. The scheduled construction of a cooling tower is expected to save 200,000 gallons of water per day under present requirements and 500,000 gallons per day under future requirements.

Fuel Elements, Fuel Media, Producer Element Development (AEC Activity 9543)

A total of twelve kilograms of enriched U^{235} has been processed into standard 14.2% uranium-aluminum formed material, which has been fabricated into standard alclad MTR fuel plates. A total of fifty-five fuel units and eight shim fuel sections have been completed under an accelerated schedule. Initial pile loading for start-up will require twenty-three fuel units and eight shim rods.

Production of aluminum alloy 356 end boxes (adapters) by an outside contractor is presently three months behind schedule and shipment in the immediate future is doubtful. All other accessories such as springs, bevel rings, and snap retainer rings are on hand.

A program is being initiated to develop suitable fabrication methods for cladding thorium for irradiation in the MTR to produce U^{233}.

HOMOGENEOUS REACTOR PROJECT

Experimental and Design Engineering (AEC Activity 4264)

The HRE mock-up has been operating with uranyl sulfate at 250°C and 1000 psi for about one week. No operational difficulty has been encountered and the fuel solution samples appear normal in every respect. Based on the rate of increase of nickel concentration in the fuel solution, the general corrosion rate has increased from 1.5 mils per year to about 3 mils per year during the first week's operation.

Building 7500 - HRE (AEC Activity 4261)

Construction of the fuel, reflector, and control systems has been completed except for minor revisions which are being made. Testing of these systems is now under way. It is expected that critical experiments will be started in December.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

The reactor shield has not been completed because of the need for easy access to the components of the system during the testing period. However, laying of concrete blocks to fill the interior of the shield (except the equipment cells) has been started. The steam system and turbo-generator are essentially complete and will be tested during December.

AIRCRAFT NUCLEAR PROPULSION PROJECT

Liquid Metals Research (AEC Activity 4275)

Creep tests have shown that the heat treatments on Duranickel will increase the creep strength considerably and this increase will still be in effect at 800°C. An apparatus is being set up for the plating of chromium and molybdenum on stainless steels using solutions of chromium and molybdenum carbonyls dissolved in the hydrocarbons.

Thermal gradient standpipe test furnaces and "see-saw" test furnaces in which the corrosion medium is sloshed back and forth from the hot leg to the cold leg have been constructed. These test furnaces will be used to study the mass transfer phenomenon in hydroxides and fluorides. Corrosion experiments are continuing in an effort to find suitable container materials for the hydroxides, fluorides, and various liquid metals. Various additions are being made in the hydroxides in the attempt to find corrosion inhibitors so structural metal like stainless steel and inconel can be used.

A new G.E. d.c. welding generator has been set up for use with the cone arc welding technique. Experiments are now under way to evaluate its operating characteristics and when all this data have been obtained conventional calibration curves will be plotted. These plots will contain the effect of the following variables on the welding conditions: arc voltages, electrode sizes, current settings, open circuit voltage, and type and quantity of inert gas flow.

Experiments are being conducted on brazing alloys for high temperature service. It has been shown that if the entrance dew point of the hydrogen is below -78°F and the flow rate is sufficient to give an exit dew point of -60°F, i.e. excellent brazing can be accomplished and the material will have a good surface appearance, free of surface discoloration.

ANP Experimental Engineering (AEC Activity 4271)

Major emphasis has been placed on fluorides production and the testing of seals, thermal convection loops, valves, pumps, and hoop stressed tubes

[redacted]

in the presence of high temperature and/or corrosive media.

During the month, 260 pounds of eutectic NaF-KF-LiF and 82 pounds of NaF-KF-LiF and UF_4 were produced. Of this amount 250 pounds of eutectic fluorides were supplied to other groups for experimentation. Experience with fluorides production has shown that micrometallic filters of type 316 stainless steel having either 5 or 10 micron porosity operate satisfactorily, and after use may be cleaned successfully with water and nitric acid. Also, the problems of heater life and preheating fluorides transfer lines have been investigated. Direct resistance heating of fluorides transfer lines showed promise, and calrod heater sheath must be carefully controlled to prevent premature burnout. Improved methods for fluorides manufacture, storage and transfer are under design. All fluorides operations and transfers must be effected either in a vacuum or under inert atmospheres since this material is corrosive at elevated temperatures and in the presence of air.

Tests on both frozen fluorides and frozen sodium seals were conducted. The fluorides seal test was conducted with a shaft extending through a finned cooling sleeve into a pot containing NaF-KF-LiF and UF_4 at 1200°F. Gas pressure on the bath, hence across the seal, was 20 psig. This test continued for 19 hours before a leak and a burned out heater caused termination. Postrun inspection revealed slight scoring of the shaft near the bottom end and a layer of magnetic material deposited on both the shaft and sleeve. The pump incorporating the frozen sodium seal had operated for 200 hours by the end of the month with sodium at 1500°F in the loop. Sodium temperature at the pump was 850°F. In other equipment, a vertical shaft centrifugal pump with a gas seal operated with LiF-NaF-KF at 1250°F for 35 hours continuously before a leak in the system caused termination.

A Figure-Eight loop incorporating a NaK-to-NaK heat exchanger had operated continuously for 550 hours as the period ended with an EM pump. Maximum NaK temperature in the system was 1510°F with the pump operating at 950°F and producing 5 gpm.

The limited amount of testing done thus far with fluorides in thermal convection loops indicates that inconel is attacked less severely than is type 316 stainless steel. Failure of 316 stainless steel loops has been for plugs in the cold leg in the majority of cases, but one terminated for a leak in the hot leg. Testing of commercially available bellows sealed valves is under way with both sodium and molten fluorides at 1500°F. Results are inconclusive. Ball check valves with 316 stainless steel bodies, inconel seats, and 1/4" passivated type 440 stainless steel balls

were tested in fluorides at 1400°F for 14 hours during which time 50 cycles were completed. Toward the end of the test a slight tendency to stick was observed, but jarring or sudden reversal of pressure relieved the condition. Postrun inspection revealed that the balls had been slightly attacked by the fluorides.

A 316 stainless steel tube stressed to 2600 psi completed a 1000-hr test in sodium at 1500°F. No intergranular attack and only a minor amount of pitting occurred. An inconel specimen failed after 465 hours under 1250 psi tension in 1500°F sodium. Failure was through an area high in impurity.

Fuel Elements (AEC Activity 4275)

Development work has begun on the methods of production of fuel elements for the G.E. aircraft reactor. Rolling mill techniques are being studied for the fabrication of fuel elements consisting of a powder mix of UO_2 and 309 stainless steel which will be clad with 309 stainless steel.

ANP Reactor Chemistry (AEC Activity 4275)

Hydroxide Preparations. Preparation of sufficient $Ba(OH)_2$ of a purity suitable for testing in the harp systems was completed during the month. Purification of $Sr(OH)_2$ is in progress using the same method.

The purification of KOH by recrystallization from isopropyl alcohol appears to be feasible and is being utilized to prepare material for corrosion testing.

Phase Studies. Work was in progress on systems of fluorides containing 6-8 pounds of uranium per cubic foot. Five such systems have been found which are within the range of useful melting points.

Corrosion Testing. Static corrosion testing indicated that KOH is less corrosive than NaOH. However, neither appear to possess corrosive properties desirable for use in structural materials at 800°C. Viscosity studies indicate that the viscosity of fluoride melts is nearly independent of uranium concentration up to 20 mol percent uranium.

ANP Central Design (AEC Activity 4275)

A circulating-fuel reactor with light-water moderation has been laid out in preliminary form. The fuel flows into the core through inlet headers

and thence into orificed fuel tubes 2 inches in diameter which pass through the moderating region. With a water moderator these fuel tubes are clad on the outside by a thin insulating blanket and are encased in another tube which is in contact with the water. Space is allowed in the compound headers for differential expansion of the hot and cold surfaces. This differential expansion tends to cause a radial movement of the hot tube relative to the cold tube which may be accommodated by the placement of bellows in the cold tubes. The use of bellows is advantageous as they minimize the void volume within the active lattice.

It appears that a BeO moderated circulating-fuel reactor would resemble the water moderated core, with but the elimination of the double wall construction and insulation, and substitution of BeO blocks for water. It would also be desirable with the BeO that it be cooled, and consideration is being given to the use of $NaF-BeF_2$ surrounding the moderator blocks.

A survey of light-water-moderated, circulating-fuel reactor, critical mass values as a function of reactor size and volume-fraction of fuel-coolant has shown the following:

a) The $BeF_2-NaF-UF_4$ fuel-coolant reactor has a minimum total uranium requirement of 60 pounds with 0.70 fuel-coolant volume fraction in a 3 ft. diameter core.

b) The $KF-LiF-NaF-UF_4$ fuel-coolant reactor has a minimum total uranium requirement of 120 pounds with 0.50 fuel-coolant volume fraction in a 3 ft. diameter core.

Both cores have a 6-inch reflector of water and a 15 ft^3 volume of fuel-coolant external to the core. The values quoted are the minimal values on a uranium requirement vs. volume fraction fuel-coolant curve.

The analysis of the supercritical water reactor by NDA is essentially complete and a final report is now being written. This report will complete the NDA studies of the steam cycle for ORNL although NDA will continue this work under AEC contract. The only results not previously mentioned are in the control aspects. The reactor has been shown to be stable for small oscillations, and a startup technique has been devised in which the control mechanism is derived from changes of water density in the reactor.

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

Shielding Research (AEC Activity 4277)

Work is being done to arrive at a simplified theory of ducts--particularly air ducts--through water. Several experiments have been performed at the lid tank and at the thermal column in the graphite pile and it is found that neutron transmissions of the duct consisting of several straight sections with bends between them is given by a picture of free flight down the straight sections with the formation of virtual sources at the corners. An effective Albedo accounts for neutron losses at the corners.

General Reactor Research - Idaho Chemical Plant Design (AEC Activity 9547)

The Idaho Chemical Plant is now scheduled for cold startup about July 15, 1952. Planning for this startup is now in progress. The process piping is being installed and the majority of the instruments have been installed. The furniture is being installed in the laboratories. The concrete work for the Waste Building has been completed and the stack is now up and being lined with stainless steel.

The design of the dissolver off-gas system has been moved from ORNL to New York. At ORNL the EBR slug carrier dissolver chute and dissolver are now being re-designed. The change in design was caused by increasing the size of the EBR slug.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

PROGRAM 5000 - PHYSICAL RESEARCH

PRODUCTION OF RADIOISOTOPES

Radioisotope Production (AEC Activity 5111)

The total accumulated KWH for pile operation during November was 2,607,479, averaging 3937 KW per operating hour. Pile down time was 8.02%, as compared with 10.56% during October.

The total number of radioisotope shipments was 816. One 300-curie cobalt source for ORINS and one 100-curie cobalt source for the University of California were shipped.

Stable Isotope Production (AEC Activity 5121)

There were twenty-nine stable isotope shipments made during November.

Radioisotope Research and Development (AEC Activity 5131)

Development work on the separation of multicurie amounts of fission products from Purex wastes indicates that because of low yields, high effluent volume, and radiation damage to the resin, the ion exchange method of separation is not attractive. Precipitation methods for separating strontium, rare earths, cesium, and ruthenium are now in the chemical laboratory stage prior to being tried on a multicurie level.

PHYSICS

High Voltage Laboratory (AEC Activity 5211)

The total cross-section of iron has been measured with moderate resolution up to neutron energies of 4 Mev. The spectrum is very rich in resonances and undoubtedly many others could be found if there were time to work at high resolution. The work is continuing. The cross-sections for the reaction $He^3(d,p)He^4$ has been measured in the range 200-400 kilovolts and does not agree with what would be expected from a theoretical comparison with the $H^3(d,n)He^4$ reaction.

Neutron Diffraction (AEC Activity 5211)

The examination by neutron diffraction of a series of rare earth compounds has been started in order to determine their nuclear and magnetic scattering properties. Part of this work is being done on calutron-separated stable isotopes.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

Low Temperature Work (AEC Activity 5211)

The magnetic susceptability of hafnium has been observed between 0.22°K and 4.18°K and no evidence of superconductivity has been found, which is contrary to the results of Kürti and Simon who reported a transition at 0.35°K. Two hafnium samples containing about 5% zirconium were used, one prepared by chemical reduction and the other by the growth of the metal on a hot hafnium wire from the iodide vapor. The latter "crystal bar" sample had a volume of 0.87 cc and was pressed in the form of lathe chips with 1.14 cc of chromium-potassium alum. Upon demagnetization of this composite sample to a final field of 0.44 oersted, the T^{Θ} value (reciprocal susceptability) obtained was within .001° of that expected for pure chromium-potassium alum. In all experiments the susceptibility decreased linearly with time as the sample warmed up, showing no abrupt rise as would be expected if a superconducting transition occurred. Typical warm-up times from 0.22°K to 1.1°K were about forty minutes, but in one experiment the sample was maintained below 0.25°K for eighty minutes to allow ample time for thermal equilibrium to occur. A duplicate experiment on zirconium gave a very sharp transition near the expected temperature of 0.70°K. The absence of superconductivity in hafnium is of interest because in the periodic table it is surrounded by superconducting elements. Measurements on hafnium down to 0.05°K are planned.

Pile Operations (AEC Activity 5211)

Development work is continuing for a satisfactory method of fabricating silicon bonded slugs for refueling the X-10 graphite pile such that metal temperatures of 350°C may be experienced without slug ruptures. The alpha canning technique, which will eliminate the tin treatment step, is now being tried. Tin is believed to be a cause of diffusion blisters on the slugs. In place of a bronze bath a salt bath is being used, and instead of a tin dip, water quenching will be utilized. These new slugs should increase the power level of the pile by 30%.

Isotope Analysis Methods Laboratory (AEC Activity 5261)

Nuclear Resonance. Chemical conversion of enriched vanadium, $_{23}V^{50}$, to $VOCl_3$ was accomplished with a yield of 92 per cent. The nuclear resonance of this odd-odd isotope was found in the enhanced material and subsequently in normal material (V 50 = 0.25%). A preliminary nuclear "g" factor is +0.557. In addition, several other frequency ratios, believed to be more accurate than published values, were measured as follows:

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

$V^{50}/Rb^{85} = 1.0326$	$Rb^{85}/D_2 = 0.62898$
$V^{50}/Cl^{35} = 1.0175$	$Cl^{35}/D_2 = 0.63834$
$V^{50}/D_2 = 0.64953$	$Rb^{85}/Cl^{35} = 0.98541$

Mass Spectrometer Laboratory

Mass spectrometer studies of a sample of technetium separated from uranium fission products have been completed. Upper limits for the non-existence of three isotopes have been set relative to Tc 99 as follows: Tc 97, 1/2000; Tc 100, 1/5000 and Tc 101, 1/5000. Observations were made of the large number of ion fragments and the large number of valence states which are peculiar to technetium. These were confirmed by like observations on rhenium which was present as an impurity.

86-Inch Cyclotron (AEC Activity 5261)

Operation of the 86-inch cyclotron has continued at an overall innage of 60% with a total of 244,000 microampere-hours of beam during 57 separate runs. The highest weekly innage to date (80.1%) was attained for the week ending December 2. This included 11 runs for special experiments and isotope production.

By use of radio chemical techniques, the relative yields of Ba^{140}, Ag^{111}, and Mo^{99} from proton produced fission in normal uranium have been investigated. The results indicate that the fission process for this type of fission is considerably different from fission produced by thermal neutrons. The counters were calibrated by performing the identical analysis for thermal neutron fission produced in similar quantities of normal uranium. By use of stacked foil technique, the ratio of Ag^{111} and Mo^{99} yields relative to Ba^{140} was determined as a function of proton bombarding energy, the latter was found from the proton range and the known p,n and p,2n excitation function of Cu^{63}. The relative yield of Mo^{99}, which for thermal neutron fission lies on the low mass peak, is roughly the same as for thermal neutron fission (within a factor of two). The relative yield of Ag^{111}, which for thermal neutron fission lies in the minimum between the two peaks, varies as a function proton energy, and is about 100 to 200 times more in the range from $E_p = 13 - 18$ Mev than the yield in the case of thermal neutron fission.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

Special Separations (AEC Activity 5261)

Determination of the specific activity and fine structure of U^{235} has been hampered by the alpha-active contaminant U^{234}. About 40% of the alpha activity of the purest U^{235} previously available was due to U^{234}. In order to reduce the U^{234} content some enriched U^{235}, already low in U^{234}, has been processed in a calutron designed to separate all uranium isotopes. The 7.5 grams of highly purified U^{235} obtained has an estimated composition as follows:

Isotope	Isotopic Composition Feed	Isotopic Composition U^{235} Product	Relative Alpha-Activity in Product
U^{235}	99.81%	99.994%	97%
U^{236}	0.06%	0.004%	0.1%
U^{238}	0.10%	0.001%	-0-
U^{234}	0.03%	0.001%	3%

63-Inch Cyclotron (AEC Activity 5261)

The vacuum tank has been leak tested to 2×10^{-5} mm Hg; testing is being continued. The transmission line shield, the dee sides, the liner, and liner face plate have been completed. The oscillator has been constructed and control and safety circuits are being installed.

CHEMISTRY

Nuclear Chemistry of Fission Products (AEC Activity 5311)

Magnetic susceptibility studies have been completed on technetium metal, pertechnetate ion, technetium heptoxide, rhenium metal, perrhenate ion, rhenium heptoxide, rhenium trioxide, and complex rhenium $^{+4}$ compounds. Other oxides of technetium and rhenium as well as chlorides will be prepared and their magnetic susceptibilities will be measured in the near future.

The Medical Division of ORINS has been interested in the possible use of gallium^{67} in radiotherapy. Since earlier work on the isotope has not been complete enough to permit calculation of radiation dosages, further study is being made of its decay scheme. Although the work has progressed to the point where radiation dosages can be computed with some assurance, it has not been possible to devise a decay scheme which will include all the observed low intensity gamma transitions.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

Chemistry of Uranium Raw Materials (AEC Activity 5361)

A report describing the development of various processes for handling the high lime carnotite ores has been issued as document Y-826.

Measurements in the Na_2O-UO_3-CO_2-H_2O system at high CO_2 pressures have found to give an insoluble uranium compound tentatively identified as uranous hydroxide. Further studies of this reaction are being made to determine possible application to plant liquors.

Using spectrophotometric data and the method of continuous variations, a complex ion species containing a 1:1 ratio of $PO_4^{\equiv}$ to UO_2^{++} in 1 M $HClO_4$ has been identified.

In investigations of organic agents which are capable of effecting the extraction of uranium into organic solvents, it has been found that di-n-butyl arsonic acid and n-butyl arsonic acid are promising reagents for effecting the extraction of uranium from nitrate solutions.

Optimum conditions for acid extraction of uranium from Barton Clay have been determined. Work is now progressing on methods for recovering uranium (and by-products) from the acid liquors.

Chemistry - Ion Exchange Studies (AEC Activity 5361)

A new scheme has recently been proposed for adapting ion exchange to a semi-continuous process. This equipment has now been set up in the laboratory and preliminary evaluation is in progress.

Thorex Process Chemical Development (AEC Activity 5361)

The laboratory phase of the Thorex Process development is now in progress. The preliminary studies have indicated that a solvent extraction process will be capable of separating the protactinium, uranium 233, thorium, and fission products and the development is proceeding on this basis.

Chemical Engineering Research Studies (AEC Activity 5361)

The pulse type solvent extraction column has been demonstrated to be effective for carrying out uranium extraction from a feed containing 25 percent solids by volume. This study was initiated by the desire of the Feed Materials Production Center to extract the uranium from acidified ore concentrate without prior filtration of the feed. This eliminated the troublesome filtration step in the existing process. The solvent used in this study was tributyl phosphate.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

METALLURGY

Fundamental Radiation and Physical Metallurgy (AEC Activity 5411)

Experiments in the effects of radiation on single copper crystals have been made. Studies of electrical resistance, X-ray diffraction, and plastic properties indicate that the radiation effects introduce imperfections in the crystal which distort the lattice in a manner analgous to that of impurity atoms. The studies made of the effect of irradiation on the elastic limit (critical shear stress) of copper crystals have also been used as a monitor of the relative integrated fast neutron flux (above 5 Kev). Measurements have been made of the relative flux in various locations in the ORNL graphite reactor and the LITR. This method is convenient as the experimental technique is simple and allows comparison of the fast flux facilities of various reactors in an energy range which is difficult to measure by nuclear reactions.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

PROGRAM 6000 - BIOLOGY AND MEDICINE

BIOLOGY

Pathology and Physiology (AEC Activity 6400)

The mice from Operation Greenhouse indicate that the number of cataracts are proportional to neutron intensity; this is in contrast to the leukemias which are now appearing in considerable number and which follow the total amount of ionizing radiation. Pituitary tumors appear in mice which have received considerable amounts of radioactive iodine and are proving to be interesting sources for certain hormones.

BIOCHEMISTRY (AEC Activity 6400)

The isotope effect in the urease-catalyzed hydrolysis of Urea-C^{14} which has been investigated in cooperation with the organic chemistry group gave the expected isotopic effect and failed to verify the reverse effect which has been reported by Meyerson and Daniels.

Radiation Chemistry (AEC Activity 6400)

Studies have been made of the effects of radiation on acetic acid, benzoic acid, propionic acid and buteric acid. Acetic acid has been found to form succinnic acid, glycolic acid, carbon dioxide, and carbon monoxide upon irradiation. Other materials are formed which have not yet been identified. Fused ring hydrocarbons such as phenanthrene and chrysene have been shown to yield acidic products when irradiated in 90% aqueous acetic acid. The isotope effect in the decomposition of formic acid has been studied with carbon 13 and carbon 14 labeled material. The carbon 13 isotope effect has been shown to be approximately half of the effect which has been demonstrated with carbon 14. The effect of temperature has also been demonstrated; in general the lower temperatures favor a larger isotope effect.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

BIOPHYSICS

Waste Disposal Research (AEC Activity 6532)

A review and study has begun for determining the radiation hazards that might occur in the event of a tank failure in the ORNL tank farm where radioactive wastes are stored. This study would contain in its scope the possible effect of contamination to ORNL facilities and the effect of contamination in creeks and rivers downstream from ORNL, plus the long range planning for location of radioactive waste storage tanks at Atomic Energy Installations.

Construction of the new Waste Disposal Research Building has been completed and a major portion of the Health Physics waste disposal research program has moved into this facility. Experiments on radioactive contaminants in civilian and military water supplies are being continued in this new location.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

PERSONNEL SUMMARY

	Number of Employees November, 1951	New Hires November	Terminations November
Administration	104	4	4
Operations*	120	0	0
Engineering, Shops and Mechanical	881	0	4
Laboratory and Research	1371	33	9
Protection	179	5	0
Service	373	7	2
Total:	3028	49	19

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

RADIOISOTOPE SALES

Sales	September	October
Transfers within AEC	$ 613.45	$ 714.85
Cash Sales	18,894.80	18,431.43
Foreign	1,157.00	18,227.30
Cancer Program (Free)	42,598.30	45,776.60
Technical Cooperation Plan	19.69	248.27
Total Sales and Transfers to Date	1,878,124.74	1,944,060.57
Total Cancer Program (Free) to Date	1,015,926.61	1,061,703.21
Technical Cooperation Plan (Shipments to Date)	12,104.73	12,353.00

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

November, 1951

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

(a)	Actual Cost for October 1951	$ 2,065,286.00	
	Construction Program "H"	60,692.00	
	Total Operating and Const. Cost for October 1951		2,125,978.00
(b)	Estimated Operating Cost for November 1951		2,500,000.00
(c)	Actual Accumulative FY 1952 Operating Cost thru October 1951	10,126,623.00	
	Actual Accumulative FY 1952 Construction Cost thru October 1951	178,112.00	
	Total Actual Accumulative FY 1952 Operating and Const. thru October 1951		10,304,735.00
(d)	Estimated Operating Cost FY 1952 thru November 1951		12,892,834.00

[redacted]