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AEC RESEARCH AND DEVELOPMENT REPORT

ORNL 995, Series A
Progress Report

7RB 5/8/51

53a

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

MARCH, 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

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ORNL 995
This document consists of 26 pages. Copy 53 of 54, Series A.

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OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

MARCH, 1951

W. E. Thompson

Date Issued: APR 9 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

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OAK RIDGE NATIONAL LABORATORY

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Oak Ridge National Laborator[illegible]

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PROGRAM 1000 - RESEARCH FACILITIES

Research Laboratory Building #4500

Work on this building is approximately 15% complete. Concrete foundation work is approximately 95% complete. Structural steel erection is approximately 80% complete. Concrete floor slabs for second floor have been partly poured on Wings #3 and #4. Compacted stone fill is being placed in all four wings of building for concrete floor slabs on grade.

Isotope Research and Semi-Works Building #4501

This building is approximately 17% complete. Structural steel erection is approximately 65% complete. Concrete is being placed for cell blocks in Isotope Research Area and Semi-Works Area. Falsework forms for Elev. 802 are being placed and steel is being fireproofed.

High Voltage Laboratory Building #4503

V. L. Nicholson Company, Knoxville, Tennessee, has been ordered to proceed with this project. Contractor is clearing site and fabricating construction buildings. Excavator is changing course of creek south of this project.

Health Physics Waste Research Building #3504

Excavation has been completed. Concrete foundation walls and concrete platforms have been installed. Compacted stone fill has been placed for concrete floor slab. Plumbers and electricians are installing underground services. Estimated completion - 15%.

Chemical Isolation Laboratory Building #23

Phase I drawings and specifications have been approved, and the Architect-Engineer has been authorized to proceed with Phase II engineering.

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PROGRAM 2000 - SOURCE AND FISSIONABLE MATERIAL

TBP Process for Waste Metal Recovery (AEC Activity 2802-2)

Minor revisions to the ORNL metal recovery equipment are being made to provide facilities for processing Chalk River irradiated metal. A storage canal for the handling of Chalk River material will be the major addition to the system. The design of these alterations has been completed.

The transfer of metal waste sludge from storage tank W-7 to W-10 is now in progress. This sludge is apparently easy to slurry and indicates that little difficulty will be experienced in transferring sludge to the Metal Recovery Plant.

Purex Process (AEC Activity 2802-3)

The pilot plant demonstration of the Purex Process with inactive feed in both packed and pulse type solvent extractors was completed. During these runs, the uranium losses were less than 0.1% for each solvent extraction cycle. Further tests of the pulse column system with irradiated feed are now planned. The first runs will be made at 10% ORNL slug dissolving activity, and by June 1 the Purex Process will have been demonstrated at 30% Hanford level in the pulse columns. Preliminary tests of the pilot plant acid recovery evaporator gave satisfactory results and this study is to be continued to determine optimum operating conditions.

The Laboratory study of nitric acid recovery and fume evolution from metal dissolving was continued. A study of the isolation of plutonium from the Purex product was initiated. The application of the plutonium peroxide precipitation procedure to the Purex product will be studied, and an alternate procedure involving ion exchange for plutonium purification will also be considered to eliminate the necessity for recycling the isolation waste back into the main line process.

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PROGRAM 3000 - WEAPONS

RaLa Development (AEC Activity 3670)

The installation of the ion exchange equipment in the modified ORNL RaLa Plant is nearing completion and initial tests of this equipment with active solutions are now in progress.

The design group for the MTR RaLa Pilot Plant has initiated work on the equipment design.

Special Separations (AEC Activity 3670)

The initial run of the second stage separation of U 236 from irradiated U 235 has yielded 330 mg of uranium assaying 96.65% U 236, 3.09% U 235, 0.21% U 238, and 0.05% U 234.

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PROGRAM 4000 - REACTOR DEVELOPMENT

MATERIALS TESTING REACTOR

Mockup Conversion (AEC Activity 9543)

Although a test run was carried out during which the reactor was operated continuously for three days, insufficient manpower is available to allow long-term continuous operation at this time. It is anticipated that two-shift operation will be started early in April with the possibility that uninterrupted operation may be attained by the end of the month.

Thirty-nine Phillips Petroleum employees arrived at the end of the month to start their training program. Classwork will be started on April 4.

Pre-Installation Assembly of MTR Components (AEC Activity 9543)

The pre-installation assembly of the reactor tank and its components is about 65% complete. It is expected that the assembly will be completed in April and that the reactor will be shipped to Arco in the latter part of May.

Materials Testing Reactor - 25 Process Design (AEC Activity 9541)

Design of the Chemical Process Plant for the Idaho Reactor Test Station is now 35% complete with the ORNL phase of this program approximately 70% complete. To accelerate the program of construction design, five ORNL personnel and eighteen of the Foster Wheeler personnel who participated in the ORNL phase of the design program are scheduled to be transferred to the New York Office during the coming months.

HOMOGENEOUS REACTOR PROJECT

The Homogeneous Reactor Project was established in March, with J. A. Swartout as Project Director, C. E. Winters as HRE Project Engineer and C. H. Secoy as Project Chemist. The Project will have three major phases:

1) development of the UO_2SO_4-stainless steel system for the HRE.

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2) development of alternate HRE systems.

3) development of a full scale homogeneous reactor.

Currently, development of the UO_2SO_4-stainless steel system for the HRE is the main line of attack.

Radiation Stability of Fuel Media (AEC Activity 4263)

The protective film deposited on stainless steel by pretreatment with chromic or nitric acid seems to give satisfactory protection in stagnant systems but is currently somewhat less trustworthy in circulating systems. However, it is believed that the difference may be due to the fact that in stagnant bombs, fresh, aerated UO_2SO_4 solution is put in the bomb once a week, replacing the old solution, whereas in the circulating system the original solution is maintained at an elevated temperature under pressure until failure occurs. Since it is well known that films of this type are generally quite sensitive to oxygen, it is suspected that the circulating loops may be failing because the oxygen in the system is used up. This hypothesis is supported by the fact that bombs have been run with fresh solution each week for essentially indefinite periods while every loop to date has failed after periods ranging from a few to several hundred hours operation.

A series of experiments to determine the effects of oxygen is being undertaken. The possibility that maintaining a partial pressure of oxygen in the system may eliminate the need for pretreatment will be investigated.

HRE Fuel and Blanket Studies (AEC Activity 4263)

Solutions containing 40 grams of uranium per liter have been prepared with dilute phosphoric acid and heated to 250°C with no apparent bad effects. It is doubtful that much higher concentrations can be reached unless concentrated phosphoric acid is used, because of the low solubility of uranyl phosphate.

Recombination of Hydrogen and Oxygen (AEC Activity 4263)

The emphasis this month has been on the development of a method for effecting catalytic recombination of undiluted hydrogen and oxygen.

The principal difficulty is that of removing the heat from the reaction zone to prevent auto-ignition of the gas. The various techniques being tested are: dilution of the catalyst with inert material, lowering of the activity by sintering or poisoning, efficient cooling of the catalyst, and massive catalysts such as platinum, silver, copper, and nickel tubing. Sintered platinum on alumina catalysts and platinum tubing show promise of being successful.

There have been indications that a trap containing stainless steel would remove iodine from a hydrogen-oxygen stream and could be used ahead of the catalyst to eliminate poisoning. Such a trap has been used ahead of a platinum on charcoal catalyst for almost a month with no indication of poisoning of the catalyst. (There has been approximately 50 mg per day of iodine put into the system.)

Slurry Fuel Media Study (AEC Activity 4263)

Radiation stability studies of both uranium oxide and thorium oxide slurries stabilized with Bentonite have been initiated. Studies were also initiated on slurries containing higher concentrations of uranium which would be useful in a plutonium producing type reactor.

Experimental and Design Engineering for the HRE (AEC Activity 4264)

The 100-gpm Westinghouse pump has been modified in an effort to reduce the number of metals which come in contact with the fuel solution. The tantalum labyrinth has been replaced with stainless steel; the graphite bearings have been replaced with stellite and the inconel sleeve is to be replaced with stainless steel.

Building 7500 - HRE (AEC Activity 4261)

The underground piping and conduit for the reactor have been installed and the foundation is well up. Installation of the D_2O system will be started in April.

AIRCRAFT NUCLEAR PROPULSION PROJECT

ANP Central Design (AEC Activity 4271)

The detailed design of the ARE reactor has been sufficiently well established to permit the placement of orders for the pressure shell, fuel tubes, coolant tubes, and moderator. Inconel is specified as the

construction material for this mono-metallic reactor as its compatibility with the coolant-sodium- and the liquid fuel - NaF · BeF_2 · UF_4 - appears the most favorable. The latest calculations of critical mass indicate that either 21.5 lbs. or 26 lbs. (+ 15% - 30%) of uranium will be required, depending upon the fuel tube (.200 in i.d. or .150 in i.d., respectively) that is used. The alternative fuel tube sizes were specified to permit realization of a critical fuel volume while using a fuel restricted in uranium concentration.

The Nuclear Development Associates, Inc., are analyzing the super-critical water reactor. Thus far, they have considered heat transfer and fluid flow characteristics, reactivity, and the properties of materials which comprise the system. For each of these considerations the super-critical water reactor was found to be satisfactory. Furthermore, it appears that the requisite amounts of heat can be handled with less iron surface (than indicated in the original proposal - Wash-24) and that the size of the reactor can be appreciably reduced.

ANP Experimental Engineering (AEC Activity 4271)

After about 300 hours operation with sodium at 1500°F, the "figure 8" loop failed at the exit of the heater section, causing the worst fire which has been experienced to date in the liquid metals program. A complicating factor was that the system would not drain after the leak was detected.

One power panel for the continuous automatic operation of two convection loops has been constructed and is now ready for use.

All lithium harps tried to date have failed in less than 34 hours. The harps have been constructed of iron and V-36 cobalt alloy. All lead harps have plugged with the crystalline material composed of iron, chromium, nickel and lead, as described in earlier reports.

Three stress-rupture test rigs have been completed and are ready for use. A program of testing mixed fluoride salts inside a simulated fuel tube immersed in liquid metals is being started.

Radiation Damage (AEC Activity 4274)

Hot NaK, to be used for controlling the temperature of targets in the cyclotron, would damage the cyclotron dees if the target should develop a leak. A test using about 2.5 lbs. of NaK at 1500° indicates that a 1/4" carbon sheath should be sufficient protection for the copper surfaces.

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Heat Transfer and Liquid Metals (AEC Activity 4275)

A liquid metals pump having no bearings has been developed and is being tested on water, pumping 15 gpm at a 12 psi head. The rotor of the pump serves as a plain journal bearing with the can around it being the other bearing surface. The high periforal speed of liquid flowing around the rotor supports it in the middle of the can. It is expected that this pump will be operated with liquid metals about the first of May.

The measurement of heat capacities of liquid metals and salts is now being performed on a routine basis. The apparatus for measuring thermal conductivity of liquids has been given a test run and is now dismantled for minor modifications. The apparatus for measuring thermal conductivity in solids is also being modified to enable temperatures above 600°C to be reached.

Recent work has established that in a small tube with internal heating, such as a fuel tube, natural convection occurs and contributes greatly to carrying off the heat. A minimum value for the effective conductivity due to natural convection has been established.

A report on the theoretical investigation of thermal entrance effects in conduits is being issued as ORNL-913.

New Bulk Shielding Facility (AEC Activity 4277)

The first measurements on the shielding reactor have been made in the water shield. These agree very well with predictions based on lid tank data and constitute the first independent check of them.

Liquid Fuel System for High Temperature Reactor (AEC Activity 4275)

Low Melting Fluoride Systems. Preliminary experiments have shown that UF_4 can be reduced to UF_3 by metallic U in liquid NaF-UF_4 mixtures at temperatures above 1000°C. Analysis of the mixtures for UF_4, UF_3, U and UO_2 is not yet complete. The cooling curve for the mixture was substantially changed by this reaction.

The phase diagram for PbF_2-UF_4 system is reasonably well established and considerable information on low melting mixtures in the ternary NaF-PbF_2-UF_4 system has been obtained. Some reduction of PbF_2 by the graphite has been observed.

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Suspensions of Uranium Compounds in Alkali Hydroxides. Sodium monouranate has been prepared by heating stoichiometric proportions of sodium nitrate and UO_3 to about 1200°C.

Suspensions of uranium compounds in NaOH-KOH mixtures (melting point 180°C) have been shown to be relatively stable at temperatures below 350°C. At elevated temperatures, however, the suspensions are somewhat less stable than those in NaOH alone.

It has been established that, in spite of the insolubility of uranium compounds in NaOH, UO_3 is soluble to the extent of 0.5% by weight in LiOH and to about 0.2% in KOH.

ANP Liquid Fuels Corrosion (AEC Activity 4275)

Work has progressed to the point at which it appears that inconel and/or 347 stainless steel will be satisfactory for use with either $NaF-BeF_2-UF_4$ or $NaF-KF-UF_4$ liquid mixtures. These materials should last for sufficient time to enable tests of reasonable duration to be run on the ARE. A full report is at present being written detailing results leading to these decisions.

Liquid Metals Research (AEC Activity 4275)

During the month of March the following static corrosion tests were made at 1000°C:

in sodium:	types 310, 347, 410 stainless steel, Hastelloy B, Hastelloy C, tantalum, molybdenum, columbium, and special MIT alloys.
in lithium:	types 310, 410 stainless steel, molybdenum, tantalum, columbium, zirconium, and special MIT alloys.
in lead:	types 310, 316, 430 stainless steel, tantalum, molybdenum, and columbium.

A special thermal gradient test was made using a columbium tube containing molten lead; the hot end was held at approximately 1000°C and the cold end was below 500°C. Results of this test are not yet available.

Fifteen new stainless steel thermal convection loops have been constructed for testing and are being set up for operation. Alloy test specimens are

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now being prepared for insertion into the hot and cold zones of the loop to permit more accurate determination of corrosive effects.

Seven lead-containing loops which had plugged during operation were radiographed and cut up for examination. It is hoped that the material causing the obstruction can be identified and the mechanism for transfer be better understood so that corrective steps can be taken. A few addition agents are being studied in an effort to develop an inhibitor.

In other research directed toward developing solid fuel elements for the ANP reactor the following activities have been carried out:

1. Loose powder sintering and solid phase bonding tests.

2. Additional compatability tests.

3. Examination of previously rolled MTR type fuel element samples.

4. Decarburization of inconel with wet hydrogen.

5. Mechanical perforation of metal plates.

6. Preliminary operation of the molybdenum furnace, a gas purification train and a high frequency UO_2 sintering furnace.

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PROGRAM 5000 - PHYSICAL RESEARCH

PRODUCTION OF RADIOISOTOPES

Radioisotope Production, Development and Operations (AEC Activity 5111)

The total accumulated KWH for pile operation during March was 2,551,449 averaging 3860 KW per operating hour. Pile down time was 11.2% as compared with 9.2% during February. Five ruptured slugs were located and discharged without difficulty. In only one previous month have more ruptured slugs been found; during July 1949 there were six.

The total number of radioisotope shipments during February was 793.

Calutron Operation and Process Development (AEC Activity 5121)

During March, 1951, primary attention was given to development of a Beta type filament changer, the electrodeposition of lithium, evaluation of ruthenium and selenium charge materials, collections of calcium, samarium, and selenium isotopes, and to the construction of a prototype hydraulic system for studying the criticality of turbulent systems.

Two Beta type filament changers were constructed and tested under operating conditions. Initial operations were satisfactory, however electrical insulation failures developed. These failures were due primarily to high sparking. Tests of better insulations and methods for by-passing the high frequency currents are incomplete.

Lithium metal was deposited on a highly polished stainless steel disc by electrolysis of lithium iodide dissolved in pyridine. The solution in the cathode chamber was continually agitated to reduce polarization concentration at this electrode. Methods of preserving the lithium deposit in metallic form were studied.

Ruthenium trichloride ($RuCl_3$) and selenium tetrachloride ($SeCl_4$) were tested in the charge evaluation laboratory as possible charge materials to be used in the calutron. Both charges operated smoothly with stable arcs and acceptable outputs. Preparations were made to test some carbonyl compounds.

Refrigerated liners were used during the latter part of the selenium collection series. Estimated total collections of selenium in water-cooled

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liners was 6.2 grams and in refrigerated liners 3.6 grams. Estimated total calcium collections was 88.2 grams. By the end of the month an estimated 10.1 grams of samarium was collected.

Preliminary work was begun on a clear plastic hydraulic system and plans were made to study the flow and turbulence of solutions in this system as a preliminary to the investigation of criticality in turbulent systems.

Isotope Chemistry (AEC Activity 5121)

Sample Summary

Chemical Refinement Completed	12
Isotope Samples in Process, March 30	5
Samples in Backlog March 30	26
Mass Assay Samples submitted	18
Mass Assays reported	9
Mass Assay Sample Backlog	60
Isotope Shipments made	72

Chemical services and charge materials were supplied for calutron operations with selenium, calcium, samarium, lithium, and nickel. Chemical refinement was done on potassium, carbon, iron, selenium, calcium, and rubidium. Materials were prepared for mass analysis of isotopes of hafnium, potassium, chromium, indium, and titanium. Difficulties in weight ratio method for determination of zirconium and hafnium in mixtures were overcome and successful analyses were made. Quantities of rare earths were fractionated by means of double nitrate crystallization and precipitation of mandelates.

PHYSICS

Scintillation Spectrometry and Instrument Development (AEC Activity 5211)

It has been found that the resolution of the sodium iodide scintillation spectrometer depends sharply upon the surface condition of the crystal as well as the ultraviolet transmission of the lucite light piper. The crystals should be polished without the aid of propyl alcohol and the ultraviolet transmission of lucite has to be checked from batch to batch.

Neutron Diffraction (AEC Activity 5211)

Two samples from Los Alamos were examined by neutron diffraction techniques: one a uranium-beryllium alloy and the other a sample of cerium hydride. Structure analysis for the U-Be alloy is continuing at Los Alamos while the cerium hydride analysis here suggests it to be isomorphous to CaF_2. The determination of the antiferromagnetic structures existing at very low temperatures in MnF_2, CoF_2, and FeF_2 is continuing.

High Voltage Program (AEC Activity 5211)

The 5 MV Van de Graaff generator has been installed and the wiring of the machine is being completed. It is expected that first operation will be tried early in April.

The 86" Cyclotron (AEC Activity 5261)

The cyclotron has been closed down to permit modifications such as installation of the machined magnetic shims, a vacuum lock at the top for the ion source, and a lock at the bottom for the target. Insulation of the dees for dc bias purposes will eliminate the tank grids. These new features are now being tested.

The 63" Cyclotron (AEC Activity 5261)

The magnetic shims have been installed and field plotting is under way. Designs have been completed for source and probe vacuum locks and for the reaction chamber. Tests of the rf system are being made on the recently completed electrical mock-up.

The 22" Test Cyclotron (AEC Activity 5261)

It has been found that more stable operation is obtained when the dees are negatively biased at 300 to 500 volts. This makes it possible to maintain higher dee potentials without breakdown.

Isotope Analysis Methods Laboratory (AEC Activity 5261)

Microwave Spectroscopy. The rotational spectrum of vinyl iodide (C_2H_3I) has been observed at 25,000 mc and at 31,000 mc for the J = 3 to 4 and the J = 4 to 5 transitions (Δ K=0), respectively. Preliminary frequency values have been determined and theoretical considerations indicate that the molecular electric dipole moment may

be smaller than has been previously reported.

X-Ray Spectroscopy. An investigation into the precision of the uranium L III absorption method at various uranium concentration levels gave the following data. Thirty individual measurements were made on each sample which contained $UO_2(NO_3)_2$ in water.

Uranium Concentration	L. E. ($\bar{X}$,.05) for One Determination
7372 ppm	86 ppm
3686	114
294	63
147	27

Atomic Spectroscopy. Assay for isotopes of lithium by optical spectroscopy utilizing the lithium isotope shifts in the resonance line at 6707A has been improved. Data on the Li-7 content of four samples which have been assayed are compared with mass spectrometer data:

Optical	Spectrometer
96.0 %	96.0 %
94.2	93.6
94.2	94.0
92.2	92.0

Spectrographic Analysis. A total of 206 samples were analyzed spectrographically for 2034 element determinations. Investigation of AgCl and $SrCl_2$ as carriers for analysis of ZrO_2 showed no appreciable difference except for Al for which $SrCl_2$ appears the better carrier.

Nuclear Resonance. Preliminary investigations of enhanced Se_2O_3 for the $_{34}Se^{77}$ resonance assuming approximate unit magnetic moment and various spins show no resonances as yet for spins of 1/2 or 3/2. A new head unit is being made to permit investigation of the gyromagnetic ratio for an assumed spin of 9/2 (nuclei containing 41, 47, and 49 neutrons have spins of 9/2).

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Mass Spectrometer and Vacuum Laboratories (AEC Activity 5261)

Mass Spectrometer. Molybdenum pentachloride has been found to be superior to the trioxide for isotopic studies of molybdenum. The base pressure of the instrument has been lowered. Secondary electron difficulties in the receiver have been overcome and the electrometer instability has been improved. The charge evaluation laboratory has confirmed the prediction that iron carbonyl is a suitable charge material.

Two papers were prepared for presentation to the Southeastern Section of the American Physical Society meeting in Chattanooga.

Vacuum Laboratory. Data has been obtained on gasket materials and preliminary work has been done on testing vapor pressures of diffusion pump oils. Additional data was also obtained on a magnetic flux meter.

Two papers were prepared for presentation to the Southeastern Section of the American Physical Society in Chattanooga.

CHEMISTRY

Chemistry of the Heavy Elements (AEC Activity 5310)

Uranyl fluoride solutions varying from 0.1 M to saturated have been studied with the ultracentrifuge in an attempt to elucidate the reasons for the extremely low activity coefficients previously observed in UO_2F_2 solutions. Interest in this problem was stimulated by the fact that UO_2F_2 has been proposed as a possible homogeneous reactor fuel. By combining the centrifuge data with previous data on freezing point lowering, conductivity, acidity, and estimates of the stability constants of the fluoride complexes, it has been possible to show that the solution primarily contains undissociated UO_2F_2 in equilibrium with varying amounts of the dimer, depending upon the concentration. The dimerization reaction may be endothermic, in which case at higher temperatures polymerization reactions will become more important.

Chemical Physics - Neutron Diffraction (AEC Activity 5311)

The crystal structure of deutero-ammonium bromide has been determined at 80° K and at 300° K from neutron diffraction data, employing neutrons of wavelength 1.15 A monochromatized by reflection from the (111) plane of

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a single crystal of copper. At the lower temperature, the deuterium atoms occupy the 4-fold positions of the cubic space-group T_d' - P 43m, and the sturcture is closely similar to that recently determined for the low temperature phase of ammonium chloride . At room temperature, on the contrary, the four deuterium atoms are spacially distributed about the 8-fold positions of space-group O_h' - Pm3m, the distributions, due to temperature motion, being more extensive perpendicular to than along the N-D link. The room temperature phase thus shows orientational disorder of the ammonium ions, in contrast to the structure reported for the chloride. The N-D distance is 0.995 ± 0.015 A.

Chemistry of Uranium Raw Materials (AEC Activity 5361)

Three samples of Marysvale ore from different locations have been received and will be used in further testing of the process developed for these ores. A report describing this process (which includes leaching with sulfuric acid and precipitation of the uranium as uranous phosphate) is being prepared. Preliminary data have also demonstrated the possibility of a uranyl phosphate precipitation method.

A report on the spectrophotometer study of uranyl fluoride solutions is being issued. A report on similar studies of sodium carbonate solutions of uranium is being prepared.

Contrary to experience with several other types of Western ores, it has been found that the vanadium in high lime ores may be dissolved fairly easily by direct treatment with hot acid solutions. This treatment is being compared on an economic basis with other methods for extracting the uranium and vanadium from these ores.

Lithium Isotope Separation (AEC Activity 5361)

Seven runs were made in a countercurrent apparatus which consisted of alternate compartments of violent agitation and unagitated electrolysing compartments. The best results from these runs gave an enrichment of Li^6 from 7.1% to 8.5%. Also, this apparatus gave the best (or shortest) single stage processing time of any apparatus tested thus far. The value of the single stage processing time achieved was 2.4 minutes.

During the month of March the stairstep electro-exchanger has been put into operation and six mechanically successful runs have been made.

Smooth operation was characteristic of all these runs. No assay results have been received from samples taken.

Chemical Separation of Isotopes (AEC Activity 5361)

The equipment for the preparation of nitrogen isotope samples has been completed. Trial samples have been prepared.

Samples of molybdenum hexafluoride suitable for isotopic assay have been prepared. Assay precision appears to be adequate to detect changes in the system under study.

METALLURGY

Materials Laboratory Research (AEC Activity 5461)

Preliminary work on stabilization of stainless steel with hafnium has indicated that the process is feasible. Since there are only two commercial methods of stabilization - columbium and titanium - both of which involve materials under strict allocation, it may be possible to utilize the extraction procedures developed at Y-12 to provide a large enough supply of hafnium to ease the critical shortage of stabilized stainless steel.

Thorium Research (AEC Activity 5410)

Extrusion of thorium into rods and tubing has been performed successfully. The extrusion variables which have been investigated include the following:

1. temperature range of 700°C to 950°C.
2. reduction ratios from 2.5/1.0 to 36/1.0.
3. extrusion rates from 4 ft/min to $\sim$ 500 ft/min.

The extrusion rate and reduction ratio appear to have little effect upon the quality of the extruded piece. The optimum extrusion temperature appears to be about 800°C.

Further welding tests on thorium have been performed and tensile test specimens have been made.

Metallographic examinations of the welds have shown no porosity. Hardness surveys of the welds indicate a somewhat greater hardness in the weld zone. Hardness tests on specimens annealed subsequent to welding are in progress to show if the increased hardness is a result of impurity pickup or an effect of heat treatment.

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

March, 1951

PROGRAM 6000 - BIOLOGY AND MEDICINE

BIOLOGY

Cytogenetics (AEC Activity 6400)

Last month's report brought out the finding that two new groups of compounds will protect bacteria significantly against X-ray damage. An extension of this work has shown that these chemicals protect not only against killing effect but also against mutation production in bacteria.

It has been brought out by other investigators that there are a number of compounds which produce mutations in living cells. The nitrogen mustards are typical of these mutagenic compounds. The compounds discussed here can be called "antimutagens" since they protect against the mutagenic effect of X-rays.

A group cooperating on Operation Greenhouse has taken a large number of tradescantia plants to Eniwetok for the tests.

Mammalian Genetics and Development (AEC Activity 6400)

In an effort to show that reduction of oxygen tension will reduce the radiation damage produced by X-rays in mice, a few preliminary experiments were carried out. It was found possible to keep mice for 15 to 20 minutes in an atmosphere containing only 5% oxygen if the other 95% were helium in place of CO_2 or nitrogen. It was also found that the mice could be kept in as low a concentration of oxygen as 2% in helium for a very limited time.

[redacted]

[redacted]

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

March, 1951

PERSONNEL SUMMARY

	Number of Employees March 31, 1951	New Hires March	Terminations March
Administration	84	2	0
Operations*	116	3	1
Engineering, Shops, and Mechanical	923	0	14
Laboratory and Research	1165	8	8
Protection	172	0	4
Service	344	2	11
TOTAL:	2804	15	38

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

RADIOISOTOPE SALES

Sales	January, 1951	February, 1951
Transfer within AEC	850.00	0
Cash Sales	40,780.38	32,801.64
Foreign	1,138.80	1,096.10
Cancer Program (Free)	37,264.90	30,948.96
Technical Cooperation Plan	-0-	-0-
Total Sales and Transfers to Date	1,413,071.91	1,530,901.68
Total Cancer Program (Free) to Date	720,890.35	751,839.31
Technical Cooperation Plan (Shipments to date)	6,993.04	6,993.04

[redacted]

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OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

March, 1951

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

(a)	Actual Cost for February, 1951	2,260,178	
	Construction - Program "H"	116,202	
	Total Operating & Const. Cost		2,376,380
(b)	Estimated Operating Costs for March, 1951		2,400,000
(c)	Actual Accumulative FY 1951 Operating Cost through Feb., 1951	15,220,446	
	Actual Accumulative FY 1951 Const. Cost through Feb., 1951	523,623	
	Total Accumulative FY 1951 Operating and Const. Cost through Feb., 1951		15,744,069
(d)	Estimated Operating Cost FY 1951 through March, 1951		18,144,069

[redacted]