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AEC RESEARCH AND DEVELOPMENT REPORT

OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

OCTOBER, 1951

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OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

October, 1951

W. E. Thompson

Date Issued: NOV 7 1951

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PROGRAM 1000 - RESEARCH FACILITIES

Research Laboratory Building #4500

Work on this building is approximately 75% complete. All exterior walls and roofs are completed. Glazing exterior windows are complete. All concrete foundations, steps and platforms are complete. Metal lathing and plastering is 60% complete. Acoustical tile ceilings are 50% complete. Metal partitions are 25% complete. Metal ductwork and insulation is 75% complete. Electrical plumbing and heating services are 80% complete. Cooling tower is 100% complete. East parking area is 35% complete. Underground steam line to High Voltage Laboratory Building #5500 is 95% complete. Outside electrical power service is approximately 80% complete.

Isotope Research and Unit Operations Building #4501

This building is approximately 80% complete.

Isotope Research Section: Interior masonry and glazed tile partitions are 75% complete. Suspended ceilings are 25% complete. Roof of concrete cell block is poured. Plumbing, heating and service piping are 75% complete. Electrical services are 75% complete. Air conditioning, ventilation ductwork and insulation are 75% complete. Painting is 20% complete.

Unit Operations Section: Masonry and glazed tile partitions are 95% complete. Suspended ceilings and acoustical tile ceilings are 25% complete. Metal partitions are 10% complete. Plumbing, heating and process service piping are 80% complete. Air conditioning, ventilating ductwork and insulation are 75% complete. Painting is 60% complete.

General: Brick masonry walls of passageway to Building #4500 is 75% complete. Finish grading west of building is 50% complete.

West Portal Building #2016

This building has been completed in accordance with specifications and drawings. Completion Form F-3 has been processed and signed, and building has been turned over to ORNL forces for occupancy.

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East Portal Building #5000

This building is approximately 92% complete. Work items remaining to be finished are: finish erecting metal partitions and counters; finish installing asphalt tile flooring; finish hanging doors and applying hardware; finish installing electrical and plumbing fixtures; complete painting and cleaning; finish grading and seeding.

High Voltage Laboratory Building #5500

Structural steel erection and riveting is 80% complete. Decking for first floor slab and reinforcing is 80% complete. Exterior masonry walls have been started. Process drain lines are being installed. Building - 28% complete.

Health Physics Waste Research Building #3504

This building has been completed in accordance with specifications and drawings. Completion Form F-3 is being processed for acceptance signatures.

Test Facilities Building #7503 (ARE)

This building is approximately 35% complete. All concrete foundations have been erected. First floor concrete floor slab has been erected. Structural steel has been erected and is being aligned and bolted. Plumbers installing underground services. Six-inch water line from Building #7500 to this building is approximately 95% complete.

ORSORT Laboratory Building #3017

This building is approximately 90% complete. The scheduled occupancy date of this building is January 1, 1952. As of this date progress is on schedule.

Chemical Isolation & Purification Laboratory Building #3508

This building is approximately 30% complete. All concrete foundation work has been completed. Structural steel has been erected and is being riveted and bolted. Compacted stone fill under concrete ground floor slab is being placed and compacted.

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PROGRAM 2000 - SOURCE AND FISSIONABLE MATERIALS

Purex Process (AEC Activity 2802-3)

During the past month, the modification of the pilot plant equipment was in progress. These modifications include the installation of a continuous solvent treatment operation installation of a dissolver off-gas decontamination system, alterations of piping to allow the recycle of acid and water in the process, and the installation of a continuous evaporator for the first cycle uranium stream. The Savannah River prototype evaporator was operated at rates up to 4000 lbs/hr. The decontamination factor was found to vary from 10^7 at 2000 lbs/hr. to 10^4 at 4000 lbs/hr.

Laboratory studies were in progress on the second uranium cycle, plutonium recovery from metallurgical waste and general waste processing studies.

SCRUP Separations (AEC Activity 2344)

The process equipment testing program was continued during this month, and the installation of second cycle plutonium equipment was started. The operation of the metal dissolver is now being tested.

23 Processing (AEC Activity 2XXX)

The laboratory study is now in progress to determine the feasibility of using a tributyl phosphate solvent instead of methyl isobutyl ketone. The use of the tributyl phosphate is desirable in that the processing time should be significantly decreased. Work was also initiated to modify the existing equipment for this job.

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PROGRAM 3000 - WEAPONS

RaLa Production (AEC Activity 3982)

The resin column cubicle has been completed and is now being tested. Remodeling of the second cubicle will not be started until tests show the newly completed cubicle to be satisfactory.

MTR-RaLa Development (AEC Activity 3982)

The design program for the MTR-RaLa has now been terminated and the final report is nearing completion. Work is continuing on the laboratory and unit operations studies and this should be completed by the end of the next month, after which, the final reports on these phases of the program will be written.

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PROGRAM 4000 - REACTOR DEVELOPMENT

MATERIALS TESTING REACTOR

Idaho Chemical Plant Design (AEC Activity 9547)

The chemical process building is now enclosed, process piping is in progress, and the laboratories are being equipped. Engineering design in progress at ORNL includes the isotope sampler, the product handling equipment, sample carriers, and the dissolver off-gas decontamination system. The EBR dissolvers are being re-evaluated because of a change in the fuel elements. The operating manuals are now in rough draft, and work is continuing on the criticality manual and the accountability manual. The waste processing manual has been started.

There are now fifteen ORNL engineers assigned at Idaho.

HOMOGENEOUS REACTOR PROJECT

Experimental and Design Engineering (AEC Activity 4264)

Adaptation of the full-scale mockup of the HRE to operation with normal uranyl sulfate is now essentially complete. It is expected that the mockup will be used as a corrosion loop with uranyl sulfate at 250°C and 1000 psi, starting early in November.

Equipment is now being set up for hydrodynamic studies of an 8-foot sphere with very high flow rates. Pumping capacity (seven pumps) is sufficient to provide flows of nearly 50,000 gallons per minute.

Radiation Stability of Fuel Media (AEC Activity 4263)

It has been demonstrated that the copper ion is effective as a catalyst for the recombination of hydrogen and oxygen in uranyl sulfate solutions at elevated temperatures and pressures. At constant temperature, the rate of recombination is a linear function of copper concentration. At constant copper concentrations the rate of recombination is a function of temperature. Under the operating conditions of the HRE, it is expected that about 1500 parts per million of copper will recombine all the hydrogen and oxygen rapidly enough to prevent the formation of bubbles.

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Building 7500 - HRE (AEC Activity 4261)

Construction of the HRE is expected to be completed during November. Testing will be started as soon afterward as possible. It is now planned to test the system with unenriched uranyl sulfate under operating conditions for some time before starting critical experiments.

HR Fuel Reprocessing Studies (AEC Activity 4263)

It has been previously reported that PuO_2 precipitates from the uranyl sulfate proposed for use in a homogeneous reactor. The recovery of this plutonium by filtration and subsequent dissolution is being studied. It was found that PuO_2 can be dissolved in dilute nitric acid at room temperature by the addition of silver peroxide. Work is also in progress to determine the rate of dehydration of uranyl sulfate. The dehydration of uranyl sulfate is desirable to prevent the light water dilution of heavy water when preparing feed.

ANP Experimental Engineering (AEC Activity 4271)

Thermal convection loop operations conducted in collaboration with the Metallurgy Division were continued throughout the month. Four loops were operated during the month. One inconel loop with (LiNaK)F was operated 96 hours at 1500°F. Two nickel loops, one with KOH and the other with LiOH were operated at 1400°F for 55 hours and 319 hours, respectively. Each of these loop experiments terminated when plugging occurred. The inconel loop with (LiNaK)F was still in operation at 1500°F after 120 hours.

A frozen sodium shaft seal test operated successfully for 1200 hours against sodium at 1500°F and a differential pressure of up to 150 psi. Slight sodium leakage occurred at pressures above 150 psi. A centrifugal pump using a frozen sodium shaft seal was operated 350 hours pumping sodium at the rate of 40 gallons per minute before the experiment was terminated when a silver soldered joint leaked at 1100°F. Equipment has been designed and is being fabricated to test the feasibility of a frozen fluorides seal. A pump using a Teflon packed gas seal pumped (LiNaK)F eutectic at 1025°F for three hours. Excessive gas leakage through the seal was experienced.

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The unit for melting and purifying fluoride salts has been completed and three melts, each of the eutectic mixture of LiF, NaF, and KF, have been produced, totaling approximately 140 pounds. During operation, it was found that there was an appreciable amount of water in the anhydrous salts as purchased and that the mixture attacked the cylinder walls at high temperatures removing slight amounts of Fe, Cr, Ni, and Mo. The Fe, Cr, and Ni were removed from the eutectic mixture by filtration through a sintered stainless steel filter, but the Mo analysis remained unchanged.

A Figure-Eight heat exchanger endurance test had been in operation 100 hours by the end of the month using NaK-to-NaK at 1200°F input and 11 gpm flow. Δ T was 200°F. No increase in pressure drop or change in heat performance has been noted.

Previous low stress values for inconel in a tube burst test have been shown to be caused by faulty tubing; however, a new tube has been under a stress of 1200 psi for 500 hours. A 316 stainless steel tube has been under a stress of 2600 psi for 700 hours. Both tests were still in operation as the month ended.

Evidence of dendritic crystals of nickel found in the uranium fluoride taken from the molten fuel transfer experiment indicated mass transfer. Mass transfer phenomena with fused fluorides is to be investigated more thoroughly in convection loop operations.

An instrument committee has been informed to correlate all work on instruments and controls. Sufficient equipment has been procured to set up a temporary instrument laboratory.

Liquid Metals Research (AEC Activity 4275)

A brazing alloy consisting of 60% palladium and 40% nickel has been used in making joints of the tube-to-header type for corrosion testing, tensile test and metallographic examination. A tensile test showed the strength of joints prepared with this alloy to be approximately 90,000 psi. Additional work is planned to evaluate the high temperature properties of this alloy, since it seems to have excellent brazing properties. A series of alloys of palladium-nickel with varying amounts will be prepared in order to lower the melting point and possibly improve the other properties of the alloy.

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Laminated fuel tubes produced by the modified MTR fuel element-fabrication technique and by the rubber-static pressing technique were drawn at Superior Tube Company. The tubes were reduced from a 3/4-inch outside diameter, 0.045-inch wall to a 1/8-inch O.D., 0.015-inch wall. This first attempt to draw laminated tubes has shown that if a proper drawing sequence is followed, fuel tubes can be made from the fuel plate laminates. Metallographic examination of these tubes is under way so the distribution of the uranium oxide in the core can be determined.

One hundred hour thermal gradient standpipe tests show that KOH under a hydrogen atmosphere will not attack inconel at 1000°F and will cause only a 4-mil attack on inconel at 1300°F. Nickel thermal convection loops operating at 1400°F with KOH-NaOH-LiOH show stoppage of natural convection flow due to mass transfer at 51, 54 and 317 hours, respectively.

ANP Radiation Damage (AEC Activity 4275)

Radiation damage experiments in which purified KOH in 316 stainless steel was irradiated in the LITR at 430°C showed a slight increase in pressure during the irradiation. It is suspected that this pressure may have been due to decomposition of a small amount of water present in the KOH.

Studies of a sodium-potassium-enriched uranium fluoride salt mixture irradiated in an inconel capsule at a flux of 1.6×10^{13} neutrons/cm^2/sec in the LITR at 740°C has showed no large pressure rise during irradiation to date. The test is not yet complete.

A series of irradiations at 1.04×10^{12} neutrons/cm^2/sec has been conducted on this same salt mixture in inconel capsules in the ORNL graphite-uranium reactor at 800°C. These are now being tested for fuel decomposition and corrosion.

Equipment for long-term static tests of fuel decomposition and corrosion is now being bench tested prior to its installation in a horizontal hole in the LITR.

Radiation Damage (AEC Activity 4275)

Eleven inconel tubes containing UF_4-NaF-KF eutectic have been irradiated in the 86-inch cyclotron with 20 Mev protons. Chemical analysis of the

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eutectic gave no indication of decomposition. Metallographic tests of the inconel showed very slight intergranular penetration. Alumel-chromel thermocouples used for determining the temperature of the tubes during irradiation are necessarily mounted in strong magnetic and rf fields. Calibration of these thermocouples at the melting points of lead, aluminum, and silver (at 325°C, 655°C, and 957°C, respectively) indicates that they are accurate to within 5%.

ANP Reactor Chemistry (AEC Activity 4275)

Hydroxide Purification. Four pounds of purified $Ba(OH)_2$ have been produced. Several batches of LiOH have been dehydrated, and purifications of NaOH and KOH by alcoholates and by carbonate precipitation have been continued. An effort to adapt polarographic techniques to fused hydroxides has been initiated.

Phase Equilibrium Studies. A program for a more detailed study of the mechanism and effect of pretreatment of the fuels has been initiated. Phase diagrams pertaining to dilute fuels suitable for circulation are under examination along with low melting coolants containing alkali hydroxides and fluorides. Preliminary vapor pressure measurements on the $NaF-KF-UF_4$ eutectic fuel give values close to the literature values for NaF.

Moderator Studies. Phthalocyanine compounds have shown promise as useful solid moderators from the standpoint of thermal and radiation stability. Their moderating properties are probably comparable to those of NaOH.

Corrosion Studies. Some effects of added metals serving as "oxygen-getters" or as sacrificial anodes have been investigated in connection with corrosion due to hydroxides. Greatly reduced corrosion rates were obtained, but the amounts of metal used were too large to give results of practical interest. Without special treatment inconel resisted corrosion at 500° to 600°C for 100 hours in KOH. At higher temperatures the corrosion increased in an approximately logarithmic manner. Surprisingly large solubilities of metals in fused hydroxides were obtained by a method which did not preclude the possibility that oxides rather than metals were responsible for the high values. The most recent rough viscosity measurements on the fluoride coolant eutectic gave values of from 2.2 to 2.6 centipoises at 800°C.

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Shielding Research (AEC Activity 4277)

The Bulk Shielding Reactor has been used as a neutron source in preliminary measurements of n-p cross sections in O^{16} and O^{17}. The product nucleii N^{16} and N^{17} give a 6 Mev gamma ray and a fast neutron respectively. The radiations are both of considerable importance in reactor designs in which water is circulated from regions of high neutron flux into occupied areas.

By careful measurement of the heat dissipation in the reactor and of the thermal flux in the reactor, a new value has been obtained for the heat per fission of U^{235}. The results of these measurements will be reported separately.

The reactor has also been used for lead shadow shield measurements in water. Subsequent to this sodium was activated in the reactor and similar shadow shielding measurements were reported using the sodium source.

Preliminary measurements have been made using a double crystal scintillation spectrometer of the spectrum of gammas from the operating reactor. The primary component appears to be the aluminum capture gamma rays.

The reactor is being reloaded in a different shape preparatory to full scale tests in an aircraft divided shield mockup.

The Lid Tank has completed a preliminary investigation of air ducts for the direct cycle aircraft reactor. Ducts have been developed and tested which are adequate both from shielding and gas transfer consideration, although an optimum has surely not been reached. In connection with this program a simple theory has been devised to explain all the data taken thus far. On the basis of this theory new and better ducts will be designed, built and tested.

Measurements have been completed in the Lid Tank to determine an effective shielding cross section for beryllium. This work will be extended to include a full mockup of the primary shield for the submarine intermediate reactor. Prior to the foregoing the Lid Tank was used to measure unit shields with increased boron concentration in the water. The position of the lead slabs was also changed by the standard optimization procedure, resulting in a decrease in total shield weight of about 5%.

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ANP Central Design (AEC Activity 4271)

A committee has been designated to explore the aircraft reactor systems based upon some form of a circulating-fuel reactor employing fused fluorides as the working fluid. It is the specific objective of the committee to determine by the end of two months of intensive design and study, a particular circulating-fuel reactor capable of the propulsion of a supersonic aircraft of military value. One of the first decisions to be made on the reactor design is between the use of a solid or liquid moderator. The experimental reactor to be constructed here at ORNL will be a prototype of the aircraft reactor recommended by this committee.

Two circulating fuel reactor core designs incorporating water moderation have been laid out in preliminary form. The design of heat exchangers, pumps, radiators, and shields for this reactor system are being analyzed for the aircraft reactor. At the same time, it is apparent that over 90% of the equipment now on order for the 'first' ARE will be amenable to a circulating-fuel ARE.

The projected circulating-fuel, BeO-moderated reactor has a uranium inventory of 90 pounds (for a 20-ft^3 heat exchanger volume) for a moderator volume fraction of 0.55. Design factors for this epi-thermal reactor (55% thermal fissions) include a core radius of two feet, a BeO reflector of six inches, 0.015 volume fraction of inconel, and a fuel-coolant volume fraction of 0.405. The assumed fuel-coolant material is $NaF-UF_4$.

Comparison of critical experiment results with bare reactor calculations have shown consistency within $\pm$ 1 % for both water moderated bare or reflected reactors and carbon moderated bare reactors. The multigroup bare reactor calculations have been wired upon IBM machines so that 10 calculations per hour of non-hydrogenous and 10 calculations per two hours of hydrogenous calculations can be completed. Thus complete reactivity maps can be obtained in a relatively short time.

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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 October was 2,556,832, averaging 3842 KW per operating hour. Pile down time was 10.56%, as compared with 9.0% during September. There was one ruptured slug which was located and discharged without difficulty.

The total number of radioisotope shipments was 832.

PRODUCTION OF STABLE ISOTOPES

Calutron Operation and Process Development (AEC Activity 5121)

There were twenty stable isotope shipments during the month of October.

PHYSICS

High Voltage Laboratory (AEC Activity 5211)

A survey of the gamma ray yield from the $F^{19}(p,\alpha)O^{16}$ reaction has been completed, using the 5-MV Van de Graaff accelerator. The gamma rays emitted by the product nucleus O^{16} have been studied with high resolution through the hitherto unexplored voltage range 2.5 - 5.5 Mev with the result that 17 new resonances have been discovered.

A program of total cross section measurement with the 5-MV Van de Graaff has gotten underway with the measurement of known resonances in F^{19}. This element was chosen for initial studies because it has been investigated by this group before and, on the basis of their familiarity with it, can be used in improving experimental techniques.

Scintillation Spectrometry (AEC Activity 5211)

In further experiments to determine whether the blue glow observed in the LITR is due solely to Cerenkov radiation or to a combination of Cerenkov radiation and ionization (fluorescence), a search has been made for visible light produced in water by 16 Mev protons. No pulses were observed with a photomultiplier tube in contact with the water.

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Further, the possibility of visible light resulting from impurities in the water in the reactor has been investigated by observing the effect of 3 Mev betas from 1-year Ru^{106} upon double-distilled water, demineralized water (used in the LITR), tap water, and sea water. In all cases the amount of light produced was the same, indicating that fluorescence plays no part in the blue glow observed in the LITR.

The 86-Inch Cyclotron (AEC Activity 5261)

The cyclotron has been operated steadily without major changes. For October the overall innage was 66% and the output totalled 252,000 microampere-hours of proton beam. The machine is used for radiation damage and basic physics two days per week, the rest of the time being used for isotope production.

Nuclear Reactions (AEC Activity 5261)

Novel types of nuclear reactions such as (p,2p), (p,t), (p,He_3), and (p,γ) have been observed when targets such as Be, Mg, Fe, Cr, Cu, and Cb were exposed to the proton beam in the 86-inch cyclotron. Equipment is being prepared for determining the excitation functions of these reactions and for finding the angular distribution of products. A technique for determining the angular distributions by activity measurements has been developed.

The 63-Inch Cyclotron (AEC Activity 5261)

The vacuum tank, manifold, diffusion pumps, and necessary connections have been installed and the system is ready for vacuum testing. The power supplies for the oscillator are ready and their controls are installed in the console. The necessary electrical conduits have been laid and the circuits which are to couple the rf from the oscillator to the cyclotron have also been completed. The cooling water supply has also been completed. Work is continuing on the construction of the oscillator.

Ion Injector for Cyclotron (AEC Activity 5261)

In a test model designed for the investigation of methods of ion injection, the use of a dc potential for accelerating ions from an ion source into a cyclotron has given, in initial tests, results which indicate better focus, greater stability, and increased percentage of H^+ output.

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Isotope Analysis Methods Laboratory (AEC Activity 5261)

Nuclear Resonance. Tests on the limiting sensitivity of the nuclear induction equipment using the O^{17} signal in natural distilled water (0.04% O^{17}) gave a signal to noise ratio of 2 to 1 at 7 megacycles. The odd-odd isotope $_{23}V^{50}$ is now under study using $VOCl_3$. The Mayer model suggests $f_{7/2}$ nucleons for both odd particles, thus indicating a maximum spin value of 7 for $_{23}V^{50}$.

Optical Spectroscopy. A preliminary report on spectro-isotopic assay of lithium by photography has been completed. Emphasis is now directed toward a photoelectric direct-reader. Early results give a reproducibility on Li-6/Li-7 photocurrents of about ±1.5 per cent.

Mass Spectrometer Laboratory (AEC Activity 5261)

A sample of technetium separated from uranium fission products has been analyzed in the mass spectrometer for the purpose of establishing as accurately as possible the non-existence of isotopes other than mass 99. The sample of fission technetium used was technetium oxide produced by the decomposing of ammonium pertechnetate. In addition to the expected peak at mass 99 there were also large ion currents originating from TcO_4, TcO_3, TcO_2, and TcO. It was determined that if any other isotopes of technetium existed in the sample they were present to less than 1 part in 1500 of the mass 99.

CHEMISTRY

Nuclear Chemistry of Fission Products (AEC Activity 5311)

To date 17 grams of technetium have been separated and purified from fission product wastes. Of this amount one gram has been repurified and reduced to technetium metal. The metal samples are being used in measuring magnetic susceptibility of the oxides and chlorides of Tc, determining thermodynamic properties, investigating nuclear characteristics and establishing physical properties such as melting point, boiling point and electrical conductivity.

Mass spectrographic analyses of the purified Tc samples show 100% Tc^{99} and no detectable Tc^{100}, indicating that the neutron absorption cross section of Tc^{99} is probably very small. This is to be checked by a pile oscillator measurement of σ_a for Tc^{99}.

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It is estimated that Chalk River irradiated uranium scheduled for delivery to ORNL contains 150-200 grams of technetium. A new chemical procedure which is specific for removing Tc from even fairly highly acidic metal wastes is expected to allow very nearly complete recovery of Tc with a minimum of chemical processing. The procedure consists of adding tetraphenyl arsonium chloride to complex the Tc and then extracting the complex with chloroform. The procedure is so specific that decontamination factors of 10^6 are obtained in the first extraction.

Chemistry of Uranium Raw Materials (AEC Activity 5361)

A report on the studies made to date with ion exchange resins has been issued as document Y-816.

In investigations of organic agents which are capable of effecting the extraction of uranium into organic solvents, it has been found that guanidine stearate, phenyl biguanide, and dodecyl phosphonic acid are promising reagents for effecting the extraction of uranium from nitrate solutions. It has also been shown that mono octyl phosphate is better than dibutyl phosphate as an extractant of uranium from phosphate solutions.

Further measurements in the Na_2O-UO_3-CO_2-H_2O system has confirmed the very appreciable solubility of uranium at high temperature and pressures.

METALLURGY

Thorium Research (AEC Activity 5410)

A method for cladding thorium with zirconium has been developed. A good metallurgical bond between thorium and zirconium is obtained by rolling at elevated temperatures. In order to roll at these temperatures it is necessary to protect the zirconium from the atmosphere and this cannot be done satisfactorily by canning in steel because a liquid phase forms at these temperatures between zirconium and steel, making it impossible to roll. This has been overcome by inserting tantalum between the zirconium and steel; and rolling this material at elevated temperatures gives a good metallurgical bond between thorium and zirconium. However, a metallurgical bond is also formed between the zirconium and tantalum, making it impossible to remove the outer two layers after rolling.

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To obtain zirconium-clad thorium pieces in which there is a good metallurgical bond between the thorium and zirconium, it is now believed that a satisfactory procedure will be to hot roll the thorium and zirconium encased in layers of ceramic, tantalum and steel, in that order. The ceramic should prevent bonding of zirconium with tantalum and enable the outer casing to be removed after rolling, leaving the zirconium-clad thorium piece, although this process remains to be demonstrated.

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PROGRAM 6000 - BIOLOGY AND MEDICINE

BIOLOGY

Pathology and Physiology (AEC Activity 6400)

Studies of the mice from Operation Greenhouse are starting to give interesting results in regard to radiation damage produced by atomic explosions.

The final report on the use of *Tradescantia* in biological monitoring of radiation from atomic explosions (Operations Greenhouse) has been submitted.

Cytogenetics (AEC Activity 6400)

It has been found that the previously reported effect of oxygen in breaking chromosomes results from the same mechanism by which X rays cause chromosome breaks.

It now appears that the oxygen produces radicals of the same type, or a similar type, as those produced by X rays and that these radicals are responsible for chromosome breakage.

This hypothesis requires experimental proof.

Radiation Protection (AEC Activity 6400)

It has been found that mechalyl bromide is a good protector against X-ray damage in mice. This finding opens up the whole range of choline compounds for radiation protection studies.

The use of temperature control for bringing about recovery after exposure to X rays continues to give interesting results. It suggests the possibility of treatment after exposure to aid in recovery from X-ray damage.

BIOPHYSICS

Permissible Internal Dosage - Radioisotopes (AEC Activity 6520)

The maximum permissible amounts of radioisotopes in the human body, in

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air and in water have now been established for 71 radioisotopes. These values are being submitted for publication in a handbook to be prepared by the National Radiation Protection Committee, sponsored by the U.S. Bureau of Standards.

The values established are those which are considered sage for continuous exposure for 10^4 days without causing detectable damage as a result of the exposure.

Special Problems (AEC Activity 6520)

A technique for surveying by air large ground areas for uranium deposits has been developed. From a height of 250 to 500 feet and at a speed of about 150 miles per hour, it is possible to establish radiation contour lines which have been shown to agree quite well with ground radiation surveys and with known geological data.

Using this technique, promising areas for further investigation by ground surveys have been located. In all cases, known uranium bearing formations which have been mined were detected readily and accurately.

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PERSONNEL SUMMARY

	Number of Employees October, 1951	New Hires October	Terminations October
Administration	96	3	3
Operations*	119	1	1
Engineering, Shops and Mechanical	883	9	4
Laboratory and Research	1370	36	13
Protection	176	5	0
Service	376	5	5
Total:	3020	59	26

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

RADIOISOTOPE SALES

Sales	August	September
Transfers within AEC	$ 3,322.75	$ 613.45
Cash Sales	27,097.20	18,894.80
Foreign	397.50	1,157.00
Cancer Program (Free)	34,647.00	42,598.30
Technical Cooperation Plan	12.00	19.69
Total Sales and Transfers to Date	1,846,047.09	1,878,124.74
Total Cancer Program (Free) to Date	973,328.31	1,015,926.61
Technical Cooperation Plan (Shipments to Date)	12,085.04	12,104.73

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

(a)	Actual Cost for September 1951	$ 2,449,698.00	
	Construction Program "H"	$ 37,392.00	
	Total Operating and Const. Cost for September 1951		$ 2,487,090.00
(b)	Estimated Operating Cost for October 1951		$ 2,500,000.00
(c)	Actual Accumulative FY 1952 Operating Cost thru Spetember 1951	$ 7,589,464.00	
	Actual Accumulative FY 1952 Construction Cost thru September 1951	$ 90,458.00	
	Total Actual Accumulative FY 1952 Const. and Operating Cost thru September 1951		$ 7,679,922.00
(d)	Estimated Operating Cost FY 1952 thru October 1951		$ 10,392,834.00

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