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OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

MAY 1952

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OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

May, 1952

J. P. Lane

Date Issued: JUN 9 1952

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STATUS AND PROGRESS REPORT

May, 1952

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OAK RIDGE NATIONAL LABORATORY

STATUS AND PROGRESS REPORT

May, 1952

PROGRAM 2000 - SOURCE AND FISSIONABLE MATERIALS

Purex Process (AEC Activity 2803.2)

Laboratory scale experiments indicated that boiling of the second cycle uranium feed with sodium nitrite to remove ruthenium and the treating of the product with silica gel to remove zirconium and niobium considerably improves the purity of the uranium. The plutonium coupling by ion exchange methods has been successfully demonstrated. Prototype Savannah River ion exchange columns six inches in diameter have been evaluated.

SCRUP Separation (AEC Activity 2344)

Preliminary research runs on Chalk River metal are in progress. Each batch has a distinct irradiation history, and the plutonium from each batch is being isolated for study. The fission products will be processed for Sr^{90} separation.

[redacted]

PROGRAM 4000 - REACTOR DEVELOPMENT

MATERIALS TESTING REACTOR

LITR Operations

The LITR operated at 1326 KW per operating hour during May. Down time was 16.6% as compared with 11.2% in April. In two tests the water level was lowered in the reactor; the maximum fuel element temperature caused from fission product radiations was 254°C. In another test the water in the fuel elements was allowed to boil after the water circulating pumps were shut off. The results of this test indicate that the MTR type reactor would eject the coolant-moderator from the fuel assemblies and shut itself down before an uncontrollable operating condition could arise.

HOMOGENEOUS REACTOR PROJECT

Homogeneous Reactor Experiment (AEC Activity 4261)

During May the homogeneous reactor was started 15 times and operated for a total of 180 hours at a power level of approximately 10 milliwatts. For this period the operating pressure was 100 psi and the temperature 30 to 100°C. The high pressure portion of the fuel circulating system was isolated from the low pressure system at all times.

The fuel concentration for criticality at 30°C was 25.0 grams of U^{235} per kilogram of water; since April 15 additions of fuel in 20 to 50 gram increments have been made at 2 to 3-day intervals until the concentration is now 27.5 grams U^{235}/l. At each new fuel concentration data were taken on several of the following reactor characteristics:

Temperature coefficient	4.1×10^{-4} $K_{eff}/°C$ at 30°C to 5.4×10^{-4} at 100°C
Shim and control rod calibration	0.52% K_{eff} (shim & safety rods) 0.33%-(control rod)
Value of reflector at various levels	~6.5% K_{eff}
Effect of circulating pump	~0.2% K_{eff}
Pressure coefficient	1.65×10^{-6} K_{eff}/psi

Experiments were discontinued on May 23 for one week to allow completion of the shield structure and minor equipment revisions before beginning the high temperature, high pressure portion of the experimental program.

Homogeneous Reactor Slurry Studies (AEC Activity 4264)

Calculations showed that individual uranium oxide particles in an operating reactor would be expected to attain a temperature only about 10°C above that of their environment.

A slurry was boiled for 41 hours at 250°C in a 347 stainless steel container without evidence of corrosion or caking.

Slurry Pumping Studies (AEC Activity 4264)

A standard 100-gpm pump loop of 347 stainless steel has been completed and is now being checked out prior to use in slurry pumping studies. A supply of purified UO_3 has been prepared in the form of hexagonal, rod shaped crystals for use in the tests, which will be conducted at 250°C.

Boiling Reactor Studies (AEC Activity 4264)

A rough draft of the feasibility report on a small scale outdoor boiling reactor experiment has been completed and is now being reviewed. The experiments proposed for this facility have been clearly outlined and the first draft of an overall boiling reactor research and development program for ORNL is being reviewed. The proposed program is designed to obtain the necessary information for evaluating boiling reactors in comparison with other types of reactors.

Dynamic Corrosion Studies (AEC Activity 4264)

A 100 gpm circulating loop of 347 stainless steel was operated for 120 hours with uranyl sulfate solution in which UO_3 has been dissolved to raise the pH to 2.9 (at room temperature). The total uranium concentration was 300 g U/l and the uranium to sulfate ratio was 1:19. The corrosion rates observed at 250°C were essentially the same as those usually experienced with stoichiometric solutions of UO_2SO_4 at the same concentration.

A 347 stainless steel loop containing 100 g U/l uranyl sulfate has been operated at 100°C for 580 hours with a general corrosion rate less than one mil per year. At 300 g U/l and 100°C the general corrosion rate was also less than one mil per year at the end of 600 hours. A 250°C loop containing 5 g U/l uranyl sulfate showed a general corrosion rate of less than one mil per year after 800 hours.

ISHR Predesign (AEC Activity 4342)

Two ISHR equipment layouts are now in progress, each involving a maximum liquid flow of 10,000 gpm. The first shows two cells, each containing a 5,000 gpm pump, heat exchanger and gas separator. The layouts are being

studied to determine which scheme better satisfies the requirements of the reactor upon basis of cost, holdup of fluid, reliability of operation, and equipment development considerations. Piping stress calculations are being made on both systems at present.

A reactor vessel design has been prepared. The vessel is to consist of an inner liner of stainless steel 3/4 inch thick and 6 feet in diameter, two concentric shells of steel each one inch thick as thermal shielding, and an outer pressure vessel 2 1/2 inch thick. The concentric shells are separated by 3/4 inch of water. This design permits the pressure vessel and thermal shield to be made of carbon steel and cooled with ordinary water. Titanium lining may be put in the vessel with little or no change in design.

Calculations are being made to show the performance of the reactor at temperatures from 100 to 250°C, and with U concentrations from 1 to 500 gm/l with corresponding critical enrichments between 93.5 and 1.5% U^{235}. These calculations will show whether the reactor meets the requirements of a prototype for a plutonium production machine and a power producer in the range of temperatures and uranium concentrations of interest in aqueous homogeneous reactors.

AIRCRAFT NUCLEAR PROPULSION PROJECT

ANP General Design (AEC Activity 4271)

The design of small circulating fluoride fuel reactors both with and without moderator in the active lattice has been considered. Critical masses for reactors having no moderator in the core but including a 12 inch BeO reflector have been estimated. The U^{235} investment in a 16 inch diameter core was 23 pounds and in a 32 inch core was 40 pounds.

Aircraft Reactor Experiment (AEC Activity 4271)

The assembly drawings of the core and core heat shield have been completed. The fluid circuit drawings are still in process but will be finished as soon as available drafting man-hours permit. The instrumentation layout has received a major effort and the panel layout of the control room instrumentation is 75% complete. The core support structure and the primary tanks have been 75% completed by the Y-12 shops. The safety rod actuator details were released to the shops for fabrication. The secondary fill and dump tanks have been received from the supplier. The control rods actuator mechanism is expected from the contractor in about ninety days.

ANP Experimental Engineering (AEC Activity 4271)

In two Inconel thermal connection loops (Na-K-Zr-U)Fx has been circulated at 1500°F for 500 hours. The corrosion in the hot sections appears to be

the same type as that caused by (Na-K-Li-U)Fx, although not quite as severe. A thin non-metallic deposit was found in the cooler portion of the loops. A considerable amount of sublimed ZrF_4 was found on the top surface of the expansion pot.

An Inconel stress-to-rupture specimen stressed at 6,000 psi in (Na-K-Li-U)Fx at 1500°F failed after 133 hours. An Inconel tube-burst specimen stressed at 2900 psi in (Na-K-Li-U)Fx at 1500°F failed after 80 hours. Both failures agree with previous results.

Increased emphasis will be placed on developing completely reliable valves that are to be operated in fluoride systems at 1500°F.

ANP Metallurgy (AEC Activity 4275)

A program of evaluating high-temperature brazing alloys is underway. The alloys are first screened for their suitability by conducting "flowability" tests. Alloys showing good flowability characteristics are tested for corrosion resistance and load carrying abilities when placed in a brazed joint. The alloy, 60% Pd-40% Ni, has shown good flowability and corrosion resistance, so its strength characteristics were determined. Joints were tested at room temperatures and at 1500°F. These were compared with the strength of the plain base material, 316 stainless steel, that had been placed through the same temperature cycle as the brazing cycle. The joint efficiency was calculated by comparing the strength of the specimen having the braze with the strength of the 316 stainless steel specimen. The joint efficiency at room temperature was found to be 92%, and at 1500°F was 87%.

The hole formations that fluoride corrosion cause in Inconel has been attributed to the diffusion of chromium into the fluoride. This corrosion has been arrested by the addition of chromium, magnesium, calcium, and sodium to the fluoride mixture. This same type of hole formation has been produced in Inconel and in the alloy 80% Ni-20% Cr when the chromium loss occurs by oxidation at high temperatures and volatilizing the chromium out of the metal by a high-temperature vacuum treatment.

Tests to determine the effect of residual stresses, induced by cold rolling, upon the corrosion resistance of Inconel in NaOH at 816°C have been completed, and the results indicate that such stresses have a deleterious effect. The tests are being extended to other metals and corrosive media.

ANP Radiation Damage (AEC Activity 4275)

An apparatus for irradiating prospective aircraft reactor fuels in the MTR has been fabricated and tested. It will dissipate by air cooling 3000 watts per cc of fuel during static radiation damage tests.

Metallographic analysis of fuel pins containing (Na-K-U)Fx which were irradiated with protons in the 86-inch cyclotron has been completed. Corrosion of the Inconel is evident in the one pin receiving the highest irradiation--425 watts/cc for six hours. The corrosion was limited to the irradiated region.

ANP Reactor Chemistry (AEC Activity 4275)

Cooling curves were run on quarternary mixtures of ZrF_4, NaF, KF, and UF_4 containing 4 mol percent UF_4 with varying proportions of NaF, KF, and ZrF_4. The lowest melting point found at this uranium concentration was about 500°C. Ternary mixtures of ZrF_4, NaF, and UF_4 gave melting points slightly higher than 500°C.

The vapor pressure of the quarternary system NaF, KF, ZrF_4, and 2% UF_4 was determined up to a temperature of 970°C. New apparatus for viscosity determinations is being fabricated.

ANP Corrosion (AEC Activity 4275)

Most of the chromium removed from the structural metals of thermal connection loops appear as K_2NaCrF_6. It has been found that corrosion increases proportionately to the amount of sulfur present in the fuel mixture.

Physical Properties and Heat Transfer Research (AEC Activity 4275)

The heat capacity of the several fluoride mixtures and hydroxides examined are well represented by the equation $C_p \cdot \frac{M}{n} = 9.4$ where M is the average molecular weight and n is the average number of ions. The thermal conductivity of (Na-K-Li)Fx (11.5-42.0-46.5 mol %) is 2.6 Btu per (hr.ft. °F) for $500°C < t < 700°C$, which in conjunction with its high heat capacity, indicates that this fluoride mixture has the properties of a good coolant.

The density (γ in g/cc) of several fluoride mixtures is as follows:

(Na-K-Zr-U)Fx (5.0-51.0-42.0-2.0 mol %); $\gamma = 3.78 - 1.09 \times 10^{-3} t$; $430°C < t < 600°C$

(Na-K-Zr-U)Fx (4.8-50.1-41.3-3.8 mol %); $\gamma = 4.27 - 1.62 \times 10^{-3} t$; $750°C < t < 900°C$

(Na-K-Zr-U)Fx (34.7-17.4-44.4-3.5 mol %); $\gamma = 3.72 - 0.82 \times 10^{-3} t$; $580°C < t < 900°C$

General heat-transfer studies are being conducted on (a) the application of circulating-fuel heat transfer analyses to a circulating fuel-circulating moderator system and (b) heat-momentum transfer analysis of thermal convection loops.

Reactor Physics (AEC Activity 4277)

The somewhat idealized kinetic equation of the circulating-fuel reactor was run off on the Differential Analyzer of the University of Pennsylvania. In some cases the damping due to the fuel circulation is so strong that a periodic motion rather than any oscillation occurs. Apart from this work, it has now been rigorously demonstrated for the somewhat idealized case that there are no anti-damped power oscillations and that no undamped oscillations can persist except those which have a period equal to the fuel transit time through the reactor or equal to a submultiple thereof. The implication is that in a reactor in which the transit time varies from fuel element to fuel element, there would always be a damping introduced due to the fuel circulation. This damping tends to counteract any anti-damping effects otherwise present in the reactor.

GENERAL REACTOR RESEARCH

Idaho Chemical Plant (AEC Activity 10547)

The Analytical Laboratory and the Chemical Processing Buildings have been completed. The Laboratory is partially in operation. The chemical and water testing and the calibration of equipment in the Process Building is complete and cold uranium runs should start in July. The Waste Processing Building is 85% complete; testing and calibration of equipment should start in the next few weeks.

General Reactor Radiation Damage (AEC Activity 4540)

ORNL is assisting Air Force personnel in determining the effects of radiation on operating electronic equipment similar to that which is installed in aircraft. At present the equipment is being tested in the Bulk Shield Testing Facility.

Cladding of Thorium (AEC Activity 4540)

An improved method of cladding thorium with zirconium has been developed. An eutectic of 22% zirconium - 78% thorium as a "bond-aid" is placed between the base thorium plate and the zirconium cladding. After it is brazed in vacuum with the eutectic, the five ply "sandwich" can be rolled to specifications.

PROGRAM 5000 - PHYSICAL RESEARCH

PRODUCTION OF ISOTOPES

Radioisotope Production (AEC Activity 5111)

The total accumulated KWH for pile operations during May were 2,474,896, averaging 3761 KW per operating hour. Pile down time was 11.6% as compared with 14.9% in April.

There were 869 radioisotope shipments during May.

Stable Isotope Production (AEC Activity 5121)

The calutron tank time was devoted to the collection of boron and barium isotopes. Overall innage for the four calutrons was 1054 hours with an integrated output of 16,545 milliampere hours for the Beta channels and 9,473 milliampere hours for the two Alpha channels. Outage time was 30.8% as compared with 46.6% during April.

Chemical processing refinement was conducted on isotopes of calcium, cerium, and tin. Chemical services were supplied to the calutrons for the separation of isotopes of boron and barium.

Ion deceleration experiments were continued during the month. Evaluations of accelerating electrode systems were made.

There were 22 stable isotope shipments during May.

PHYSICS

Neutron Diffraction (AEC Activity 5211)

Neutron diffraction patterns were studied for superconducting elements such as vanadium, lead, and niobium at liquid helium temperatures. No anomalous intensity effects were found in the nuclear reflections and there was no evidence for the appearance of any new electronic scattering effects either coherent or incoherent.

Scintillation Spectrometry and Instrument Development (AEC Activity 5211)

The investigation of the spectrum of gamma rays degraded in thick shields is continuing. The absolute efficiency of NaI crystals is being determined by measuring the diffusion and absorption of monoenergetic gamma rays in thick crystals.

High Voltage Program (AEC Activity 5211)

The fission cross section of U^{234} has been determined over the energy range of 700 Kev to 4 Mev. The total cross section of N^{14} has been measured from 1.5 to 4 Mev neutron energy. An attempt has been made to observe proton groups in the energy spectra of protons from the reactions $He^3 + H^3 \longrightarrow He^5 + p$ and $He^3 + He^3 \longrightarrow Li^5 + p$. In both reactions the ground state transitions were observed, but the lower energy groups, if present, were obscured by the competing three body break-up.

The 2 Mv Van de Graaff is being dismantled prior to its installation in the High Voltage Laboratory Building.

The 86-Inch Cyclotron (AEC Activity 5261)

The highest proton beam current and incident target power to date have been attained for the 86-inch cyclotron. With the cyclotron operating steadily at 0.5 ma and at 22.5 Mev the beam was increased progressively until the metered beam current approached 2 ma. At each level the power dissipated in a 10" by 6" aluminum target was measured calorimetrically. The maximum beam power measured by this method was over 41 KW, corresponding to an average beam current of 1.85 ma, and the power input to the oscillator was 330 KW.

Two targets containing 220 and 340 mc of Ga^{67} were prepared for ORINS.

Electronuclear Machines (AEC Activity 5261)

The various components of the 63-inch cyclotron are now performing satisfactorily. With 65 Kv dee-to-dee, a magnetically sensitive beam probe current of 100 μa was observed at a radius of six inches. At 21 inches radius gamma radiation eight times background was noted. Beam probe currents of the order of 10 μa have been recorded at a radius of 23 inches.

With a newly designed accelerating electrode mounted on the dee adjacent to the ion source, a 3.0 ma beam current at $\sim$1.5 Mev has been obtained at the maximum radius of the 22-inch cyclotron; the dee-to-dee potential was 24 Kv.

Isotope Analysis Methods Laboratory (AEC Activity 5261)

The nuclear resonance of Se^{77} has been observed at fair strength in H_2Se. Attempts have been made to detect nuclear resonance fine structure due to interaction of the nuclear quadrupole moment with strong internal electric fields available in polar molecules "frozen" in the direction of the magnetic field.

CHEMISTRY

Thorex (AEC Activity 5361)

An improved process employing an acid feed and an acid deficient scrub was studied. This process yielded good recovery of U^{233} and good decontamination from protactinium and fission products. Use of 4% oxalic acid was found to be very effective for protactinium elution from the silica gel bed. Development of an alternate recovery scheme, employing 41% TBP for extraction of protactinium from the first column waste, was initiated.

23 Processing (AEC Activity 5361)

The first batch of U^{233} was separated and precipitated as UO_4. It is planned to use this material in criticality experiments at ORNL. Another batch will be processed before November 1, 1952.

Volatility Studies (AEC Activity 5361)

Distillation experiments show that neptunium, tellurium, and iodine fluorides can be easily removed from uranium hexafluoride and that molybdenum will be the limiting activity for reactor media processed after short cooling periods.

Hot Laboratory Research (AEC Activity 5361)

Specimens of the synthetic elements technetium and promethium are being prepared for display at the Academy of Arts and Science in Boston. An experiment is being initiated to measure the scattering cross section of Xe^{135}; a 1000 to 2000 curie sample of xenon will be used.

Chemistry of Uranium Raw Materials (AEC Activity 5361)

Additional samples of Florida Leached Zone material have been obtained from the U. S. Geological Survey and from TVA, giving improved representation of the variation to be expected throughout the beds. A fair correlation has been found between the calcium content and the fraction of the contained uranium which is readily leached by dilute acid.

Multistage extraction of Leached Zone nitric acid leach liquor (70 ppm U) with di-2-ethylhexylphosphinic acid in petroleum ether has concentrated more than 3 g uranium per liter of the organic phase. Single stage extractions of the acidified unfiltered ore pulp have given encouraging results.

In cascade experiments involving extraction of uranium from Colorado process liquors (2-3 g uranium per liter) with di-2-ethylhexylphosphinic acid, subsequent stripping of the organic phase with aqueous HF has yielded solutions containing 23 g uranium per liter. Continued use of the phosphinic acid for five cycles shows no loss in extraction efficiency.

Chemical Engineering Research (AEC Activity 5361)

An experimental continuous dissolver column has been operated satisfactorily. This equipment, consisting of a 2-inch by 4-foot glass cylinder, has been used to prepare dibasic aluminum nitrate scrub and thorium feed, both of which might be incorporated into the Thorex process. Also it has been used to dissolve the U-Al alloys similar to those processed at the Idaho Chemical Plant. The scrub solution is prepared by dissolving aluminum metal in nitric acid within the apparatus; the chemical costs of the Thorex scrub solution may be considerably reduced by this method of preparation.

METALLURGY

Physical Metallurgy of Reactor Materials (AEC Activity 5411)

A comparative study of the mechanical properties of virgin and remelted Ames thorium is underway. The remelted thorium has greater strength, but is less ductile than the virgin metal; otherwise the mechanical properties are similar. The presence of impurities such as beryllium, carbon, and nitrogen in the remelted thorium appear to account for the slight difference.

The impact strength of thorium after special treatments was determined. Extruded metal was the strongest; metal which had been extruded, cold rolled, and annealed had less strength; and cold rolled metal had the least strength.

Fundamental Radiation Damage (AEC Activity 5411)

A cryostat has been installed in the X-10 Graphite Reactor for low temperature studies. One of the first problems to be undertaken with this apparatus will be the investigation of the "annealing out" of radiation damage at room temperature.

Creep Laboratory (AEC Activity 5411)

A study of the longitudinal creep behavior of the following are in progress:

(a) Alpha rolled uranium at 500°C in vacuum.

(b) Thorium at 300°C in vacuum between the critical stress values of 16,000 to 19,000 psi.

(c) Thorium and uranium in various atmospheres such as hydrogen, argon, and nitrogen.

As information becomes available, tables of creep rates of uranium and thorium will be issued for use in reactor engineering.

TRAINING

Research Participation (AEC Activity 5620)

There will be 50 research participants at ORNL this summer in conjunction with the Physical Research Program.

PROGRAM 6000 - BIOLOGY AND MEDICINE

BIOLOGY

Cytogenetics (AEC Activity 6400)

A new analysis of the mutation rate induced by X-rays in *Drosophila* was made in an effort to secure more reliable data for comparison with mutation rates in mice. The new data verify the previous results that X-rays caused a more increased mutation rate in mice than in *Drosophila*. The effect of oxygen on chromosome breaks in *Tradescantia* was found to increase with the temperature and length of exposure to the oxygen.

Pathology and Physiology (AEC Activity 6400)

It has been found possible to transmit pituitary tumors caused by radioiodine to normal untreated mice. Data from the continuing leukemia studies indicate that even transient, cortisone-induced thymic atrophy results in a significant and marked reduction in incidence of leukemia.

Radiation Effects (AEC Activity 6400)

A comparative study of X, gamma and beta rays on *Tradescantia* pollen grains shows consistently that X-rays are twice as effective as either gamma rays from Co^{60} or beta rays from P^{32} in producing aberrations in *Tradescantia* pollen tube chromosomes.

TRAINING

Research Participation (AEC Activity 6720)

There will be 16 research participants at ORNL this summer in conjunction with the Biology and Medicine Program.

PROGRAM 9000 - RESEARCH FACILITIES

Research Laboratory Building #4500

The contractor is 99% complete. During this past month Wings #3 and #4 have been checked, accepted, and turned over to ORNL. A contract to install the laboratory hoods has been let to the John F. Humphrey Company. A punch list of incomplete items of construction has been made on the first and second floors of the administrative area and these items are now 99% completed. A punch list of incomplete items of construction is being made on Wing #2. The road from the Bethel Valley Road through the East Portal has been black topped, also roads on the east, south, and north sides of the building have been black topped. J. A. Johnson Company's estimate of final completion of this building is June 15, 1952.

Isotope Research and Unit Operations Building #4501

ORNL forces are installing equipment. This work will probably continue for several months with the outfitting of the hot cells being the last work completed.

Conversion of Jones Construction Camp (Central Shops Building #7012)

Stripping of top soil at building site has been completed and excavating for footings has started.

Gas Decontamination Facilities for Buildings #4500 and #4501

The total job is approximately 23% complete. The portion of this job which is under contract to Kaminer-Helgarsen, Inc. is approximately 47% complete.

High Voltage Laboratory Building #5500

All phases of construction work in this building are 97% complete. The 20-ton crane in the work area and the service elevator have been installed and tested as to loads, travel, etc., and have been accepted. A punch list of incomplete items of construction is being made and work is progressing on this phase. Top soiling and seeding is complete on the exterior building site. The Contractor's estimate of the final completion is June 6, 1952.

Test Facilities Building #7503

The building is ready for final inspection and should be turned over by the contractor to ORNL by June 6, 1952.

Chemical Isolation and Purification Laboratory #3508

With the exception of minor items whose delivery has been delayed, ORNL forces have completed their installations in this building.

Stripping and Alterations of Building #9204-1 (for HRP)

The building of steel grate floors is continuing in the east track area. The installation of equipment in the chemical laboratory is continuing.

RADIOISOTOPE SALES

Sales	March	April
Transfers within AEC	$ 846.25	$ 298.00
Cash Sales	18,096.15	13,960.30
Foreign	1,258.40	948.15
Cancer Program (Free)	46,950.55	49,723.20
Technical Cooperation Plan	53.61	-0-
Total Sales and Transfers to Date	2,227,345.41	2,334,214.06
Total Cancer Program (Free) to Date	1,288,807.38	1,338,530.58
Technical Cooperation Plan (Shipments to Date)	14,517.55	14,517.55

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

(a)	Actual Cost for April 1952	2,523,501.00	
	Actual Plant and Equipment Cost	537,429.00	
	Construction Program "H"	38,348.00	
	Total Operating and Construction Cost for April 1952		3,099,278.00
(b)	Estimated Operating Cost for May 1952		3,000,000.00
(c)	Actual Accumulative FY 1952 Operating Cost through April 1952	23,321,359.00	
	Actual Accumulative FY 1952 Plant and Equipment Cost through April 1952	3,640,435.00	
	Actual Accumulative FY 1952 Construction Program "H" Cost through April 1952	414,853.00	
	Total Accumulative FY 1952 Operating, Construction, and Plant and Equipment Cost through April 1952		27,376,647.00
(d)	Estimated Operating Cost FY 1952 through May 1952		30,376,647.00

PERSONNEL SUMMARY

	Number of Employees May, 1952	New Hires May	Terminations May
Administration	80		1
Operations*	121		3
Engineering, Shops and Mechanical	897	10	11
Laboratory and Research	1471	21	8
Protection	179	1	1
Service	391	2	4
Total	3139	34	28

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