OAK RIDGE NATIONAL LABORATORY

operated by

UNION CARBIDE CORPORATION

for the

U.S. ATOMIC ENERGY COMMISSION

ORNL-TM-47

COPY NO. - 64

DATE - October 30, 1961

PROCESS DESIGN SECTION STATUS REPORT FOR SEPTEMBER 1961

By

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ABSTRACT

This report summarizes the accomplishments of the Process Design Section of the Chemical Technology Division during the month of September 1961. The four major projects discussed are Transuranium, Volatility, Power Reactor Fuel Processing, and Waste Studies. A number of smaller programs are reviewed under the section on Miscellaneous Projects, and Project Engineering accomplishments and status are reviewed in the last section.

NOTICE

1.0 TRANSURANIUM PROGRAM
(W. E. Unger)

1.1 Transuranium Facility, Bldg. 7920 (B. F. Bottenfield, G. B. Berry, E. J. Breeding)

The permissible cost of the TrU facility in Melton Valley was arbitrarily reduced from the $14,000,000, which was estimated by AEC-ORO and ORNL as the amount necessary to provide the facility which was required for the expanded processing requirement, to $8,000,000. A rough cost estimate was made which indicated that a facility based roughly on the Title I design parameters of April 1961 could be built and furnished for this amount of money provided some $650,000 worth of developmental equipment, which will be fabricated and tested from operating funds, may be installed in the facility at no cost to the capital project other than cost of installation. The following major criteria reductions were required to reduce the cost:

Reduction in Shielding. The capture cross section for Cf^{253}, which had previously been assumed to be 120 barns maximum, is now thought to be of the order of 6 barns. The reduced value was obtained from data from sites which are currently studying the matter. In addition, the design basis for the shielding was modified by using a 200 mg source of Cf^{252} instead of the 1 g used in the $14,000,000 estimate. The result of these assumptions was to reduce the bulk shielding requirement from 72 in. of magnetite concrete to 54 in. on the front and end faces of the cell bank and from 66 in. to 48 in. on the rear face and roof of the bank. The curtain walls between cells were also reduced from 36 in. to 24 in. of magnetite concrete. Smaller reductions were also made in the off-gas and cell ventilation filter pits.

Reduction in Cell Bank Size. The number of cells was reduced from 12 to 9, reverting to the previous Title I processing scope, i.e., a facility to fabricate and reprocess targets for the HFIR and to separate groups of isotopes above Cf.

Such special problems as fabrication of a Cf target for HFIR irradiation and separation and purification of einsteinium and fermium will be performed, if at all, only as side line programs and as permitted by the HFIR processing schedule.

Building Size Reduction. Three full-size laboratories and the mockup area for final testing of equipment units prior to installation in the cell bank were deleted from the building. Other supporting facilities such as storage areas, office areas, operating area, limited access area, counting room, and equipment rooms were reduced in size. In some cases the functions normally performed in these areas will have to be done elsewhere. In others, reductions came about as a result of the reductions in processing scope and shielding requirements.

Equipment. Many equipment items were deleted from the facility, some of which will have to be furnished after one or two years of operation. Other deletions will throw additional loads on existing ORNL facilities and equipment. Finally, some deletions serve to limit the functions of the facility.

Some of the equipment items which were eliminated are: the 50-ton crane for handling heavy equipment at the building loading dock (the facility will depend on mobile heavy equipment from Bethel Valley); the radiolytic off-gas collection and treatment system (the lower spontaneous fission neutron activity level does not produce fission gases in excess of that which can be safely discharged through the HFIR stack); the rare earth fission product storage vessel and transfer carrier; and product solution carriers for shipments of transplutonium elements to other sites.

Revised criteria are being prepared for the Architect-Engineer in order that he may prepare another conceptual design-cost estimate to determine whether or not the job has been properly scoped to fit an $8,000,000 budget. Discussions will take place with the Architect-Engineer on October 5-6.

1.2 Mechanical Equipment Design (F. L. Hannon)

Intercell Conveyor. Fabrication of the chain length simulator is completed. It has now been installed on the mockup conveyor for testing.

Fabrication of the following items is in progress:

1. Automated port closure to make the opening of the canister to the cubicle a "push-button" operation rather than a manipulator operation.

2. Canister removal fixture to lift the canister from the dolly into the transfer cubicle for maintenance or replacement.

3. Drive clutch adaptors to change the conveyor drive clutch from a mechanical device to an electro-mechanical arrangement.

The following criteria drawings for the Architect-Engineer have been completed:

1. Conveyor maintenance area and drive shielding concept No. 2.

2. Intercell conveyor cell bank penetrations - concept.

3. Intercell conveyor installation and support in transfer area - concept No. 2.

Miscellaneous design modifications are in progress on the dolly and conveyor control system.

Equipment Removal System. Conceptual design of the equipment transfer station and associated components has been completed. Detailed design of the door assembly and bottom section of the transfer case has been completed and is ready for transmittal for fabrication.

Cell Cubicle Design. Conceptual drawings of cubicle details and installation and support design have been brought up to date. A criteria sketch of the intercell pass-through has been completed for use by the Architect-Engineer. Detailed design of the equipment transfer hatch has been completed and is ready for transmittal for fabrication. A concept has been completed for the equipment rack tracks to be located on the cubicle floor pan.

1.3 Transuranium Flowsheet Studies (J. E. Bigelow)

Aluminum Dissolution. Measurements were made of the heat transfer from dissolving aluminum. Heat transfer coefficients for a vertical rod varied from about 500 to 1300 Btu/hr-ft^2-°F, depending on dissolving rate. Calculated coefficients were on the order of 50 for natural convection and 500 for forced convection using a draft tube. Evidently the strong evolution of hydrogen from the aluminum surface creates as good circulation of the bulk liquid as a draft tube could. A further improvement in heat transfer results from the scouring action of the hydrogen bubbles as they agitate the stagnant surface film. Actual heat transfer coefficients may be less than the over-all numbers reported here, since some of the heat is evolved directly in the liquid phase and does not have to be transferred across the aluminum-acid interface.

Solvent Extraction. The second cycle of solvent extraction in the flowsheet for processing HFIR target rods involves extraction from hydrochloric acid into a diethyl-benzene solution of 2-ethyl-hexyl phenyl phosphoric acid (2 EH[ØP] A). This material has the typical chelating effect on the actinide chlorides. The extraction varies as the third power of the 2 EH(ØP)A concentration and inversely as the third power of the acid concentration. Since the materials being extracted are present only on a microscopic scale, the distribution coefficients should remain constant throughout the contactor.

For the simple case of constant distribution coefficients, it is possible to write explicit equations for the concentration of all components in the extract and raffinate. If two sets of compositions are specified (as in designing for a given separation), the number of stages can be computed by an iterative procedure and then the concentrations of all other components computed.

Since a large number of calculations would be required to optimize the design of the solvent extraction system, and to study the effects of imprecision in flow and composition control, a program was written in Algol for the ORACLE to perform these calculations. Two test runs of this program checked hand calculations within slide-rule precision.

1.4 Shielding and Safety Studies (J. P. Nichols)

A Cf^{253} capture cross section of 3 barns, the most probable cross section for the HFIR irradiation, was established this month as the design criterion for Transuranium shielding and radiation calculations. This cross section will allow the use of a 4.5-ft magnetite concrete cell wall. The dose rate at the outside surface of the cell wall will be 0.8 and 2.5 mrem/hr for a source composed of a fifth cycle rod and an irradiated, 1-gram Cf traget, respectively, located 2 ft from the inside face of the shield. The dose rates for the maximum probable Cf^{253} cross section will be a factor of 3 higher than these values.

A 4.5-ft-thick cell window has been designed, based on LTSF data, that will be approximately equivalent in shielding effectiveness for TrU radiation sources to the 4.5-ft magnetite shield. The window consists of appropriate laminations of three 1-in.-thick glass cover plates, an 8-in. piece of 3.3 glass, two 6-in. pieces of 6.2 glass, and 31 in. of oil. A full depth mockup of this window will be tested in the LTSF in October.

Two new neutron shielding codes, being developed by the Neutron Physics Division and NDA, are currently being applied to TrU shielding problems. These codes offer promise of extremely accurate prediction of neutron dose rates, even though nonhydrogeneous shields; they should be much more reliable than the previously used multigroup reactor codes. Niobe, based on numerical integration of the Boltzman equation, can handle, in one dimension, a multi-laminated shield with five elemental components per lamination; it is currently being used to evaluate the neutron shielding properties of the 54-in. TrU window and of the 48-in. nonhydrogeneous 4507 cell window. Renupak, a moments method code, is applicable for one dimension calculations in a homogeneous medium; it is currently being used to evaluate the effect of reduced water content in the TrU magnetite concrete cell wall.

1.5 Transuranium Studies in Bldg. 4507 (F. L. Peishel)

Cells 3 and 4 in Bldg. 4507 will be equipped with dissolution and solvent extraction equipment, plus all the necessary supporting items required for these operations, to check the proposed chemical flowsheets for the Transuranium Processing Facility at higher radiation levels than is allowable in laboratory hoods or glove boxes. Equipment used in these cells will be designed with the primary purpose of checking the TrU Facility chemistry by July 1963. This date has been designated to confirm design of TrU Facility processing equipment. If special items of equipment intended for the TrU Facility are adaptable and will not delay the installation of the units in Bldg. 4507, these will be used.

Preliminary design criteria explaining the proposed methods of accomplishing the above program were prepared and will be published early in October.

2.0 VOLATILITY PROGRAM
(R. P. Milford)

2.1 General

Considerable effort this period was devoted to the preparation of a section for the December 1961 issue of Nuclear Safety on "Radioactive Fluids Leak Detection" and to assistance in the completion of the Electrochemical Society paper on VPP corrosion experience.

2.2 Volatility Economic Studies

In response to our letter of June 7, 1961, R. P. Fasulo, Pittsburgh Naval Reactor Operations Office, furnished four full-scale drawings of the S5W Cores 2 and 3 clusters. He also confirmed the correctness of the information submitted on Form 434 dated August 13, 1958, on S5W-2 cores. His confidential letter of September 7, 1961, also presented additional information on pre-processing handling of S5W cores.

2.3 Assistance from BMI and Metallurgy Division

Letter reports on the corrosion of HyMu 80[1] and L-nickel[2] were received from BMI during September. Information contained therein was summarized on a preliminary basis in last month's report.

While at ORNL for the Chemical Technology Division Annual Information Meeting, Paul Miller presented preliminary weight loss information on HyMu 80 under hydrofluorination conditions. This information is summarized in Table 1. Metallographic examination revealed a maximum intergranular penetration of 1.5 mils on specimens 30-13 and 30-11. This corresponds to a penetration rate of about 6 mils/month of HF exposure.

Since HyMu 80 contains no chromium, it is expected to be subject to oxidation in air in the 500-700°C temperature range. Consequently, BMI is checking HyMu 80 for oxidation by heating bare, aluminum-coated and chromium-treated specimens in air at 700°C. Results of the test at 187 hr are shown in the table on page 8.

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[1] F. W. Fink, P. D. Miller, and C. F. Stephan, "Corrosion Investigation of HyMu 80 Under Fluorination Conditions" (Sept. 1, 1961).

[2] F. W. Fink et al, "Corrosion Investigation of L-nickel Under Fluorination Conditions" (Sept. 15, 1961).

Table 1. Corrosion of HyMu 80 by Weight Loss During Hydrofluorination (Run HF-30)

Conditions:

Salt - 37.5-37.5-25 mole % NaF-LiF-ZrF_4 (nominal)
34.0-40.4-25.6 mole % (by analysis)

Temperature - 650°C

Run Time - 200 hr

Zircaloy-2 Consumption - 1372 g

Specification Number	Specification Description	Exposure Location	Corrosion Rate, mils/mo (weight change basis)
30-1	HyMu 80 - HT	Vapor - TCM	0.5
30-2	HyMu 80 - HT	Vapor - TCS	0.1
30-5	HyMu 80 - as received	Vapor - TCM	0.5
30-7	HyMu 80 - weld - HT	Vapor - TCM	gain
30-8	HyMu 80 - weld - HT	Vapor - TCS	0.3
30-20	INOR-8	Vapor - TCS	0.1
30-3	HyMu 80 - HT	Liquid - TCM	gain (crystals)*
30-4	HyMu 80 - HR	Liquid - TCS	gain (crystals)*
30-6	HyMu 80 - as received	Liquid - TCM	gain (crystals)*
30-9	HyMu 80 - weld - HT	Liquid - TCM	0.6
30-10	HyMu 80 - weld - HT	Liquid - TCS	gain (crystals)*
30-19	INOR-8	Liquid - TCS	gain (crystals)*
30-11	HyMu 80 - HT	Interface - TCM	0.1
30-12	HyMu 80 - HT	Interface - TCS	0.1
30-13	HyMu 80 - as received	Interface - TCM	0.2
30-14	HyMu 80 - as received	Interface - TCS	0.3
30-15	HyMu 80 - weld - HT	Interface - TCM	0.1
30-16	HyMu 80 - weld - HT	Interface - TCS	0.1
30-21	INOR-8	Interface - TCM	0.2
30-22	INOR-8	Interface - TCS	0.3
	Long pieces suspended from head in vapor		
30-17	HyMu 80 - HT	Vapor	0.1
30-18	HyMu 80 - as received	Vapor	0.1

Abbreviations:
HT - Heat treated (probably H_2 anneal at 2050°F)
TCM - Movable specimen holder (constand interface level)
TCS - Stationary specimen holder (moving interface level)

* Crystals were predominantly zirconium.

Specimen Description	Weight Gain, g
Bare HyMu 80	0.008
Aluminum-coated HyMu 80	0.020
Chromallized HyMu 80	0.000

Specimen size - 2.5 x 0.5 x 0.1 in.
(Approximate weight, 20 g)

These results indicate that oxidation of the exterior of a vessel fabricated from HyMu 80 should be controllable by commercially available chromium treatment.

The next run scheduled at BMI is a check of HyMu 80 and INOR-8 in 37.0-50.5-12.5 mole % $LiF-NaF-BeF_2$ at 650°C while dissolving Zircaloy-2 with HF. The filled test pot is expected to leave Y-12 about October 17.

Memo and Report Status. A paper entitled "Corrosion Associated with the Oak Ridge National Laboratory Fused Salt Fluoride Volatility Process" (ORNL-CF-61-4-59) by A. P. Litman and R. P. Milford was presented by Litman at the Detroit Meeting of the Electrochemical Society on October 2, 1961.

An ORNL-TM memo, "Corrosion of the Volatility Pilot Plant Mark I INOR-8 Hydrofluorinator and Mark III L-nickel Fluorinator After Fourteen Dissolution Runs," by A. P. Litman, is in process of being approved by Metallurgy Division supervisory personnel.

3.0 POWER REACTOR FUEL PROCESSING
(E. L. Nicholson)

3.1 Darex Process Design Studies (E. L. Nicholson)

Pilot-planting of the Darex process under the ORNL-ICPP cooperative program has been authorized by the AEC. Design studies were begun to optimize the flowsheet.

The use of NO_2 gas for low-temperature stripping of chloride from Darex dissolver product solutions was investigated to see if this chloride removal method was really attractive from the cost and operability standpoints. It was found that batch NO_2 stripping of chloride did not seem attractive when compared to the reference batch Darex flowsheets using 60% or 90% nitric acid because this NO_2 flowsheet generates large amounts of off-gas scrubber waste. However, a flowsheet for continuous Darex dissolution and NO_2 stripping of chloride was prepared that looked quite attractive. The equipment requirements were about the same as for the original continuous Darex flowsheet which used nitric acid vapor stripping of chloride.

Recovery of all chlorine compounds and "recoverable" nitrogen oxides in the off-gas appeared possible, thereby eliminating a substantial off-gas scrubber waste which has never really been seriously considered in previous Darex flowsheets. Hopefully, the rapid plugging of the continuous chloride stripper tower by silica in the nitric acid vapor stripping flowsheet could be circumvented by the lower temperature NO_2 stripping which would be less likely to hydrolize the silicon in the stripper tower feed solutions. A substantial amount of development work, dealing principally with countercurrent NO_2 gas stripping of chloride and off-gas scrubbing is required to get a firm flowsheet. The results of the study are summarized in ORNL CF-61-9-33, "Low Temperature Chloride Stripping Darex Flowsheets ('Poor Man's Darex')."

3.2 Survey of Processes for Graphite Fuels (E. L. Nicholson)

A survey was started on the development work that had been done for processing graphite fuels. The recovery methods receiving the most chemical development study have been grind-leach, chemical disintegration (either with 90% HNO_3 or halogens) and leaching, and combustion with ash leaching. Preliminary observations are as follows:

1. Grind-leach processing gives a very considerable grinding problem in reducing the bulk graphite to the very small particles required to ensure high U and U-Th recovery with some fuels. The leaching will certainly result in the production of some organic compounds in the acidic leach liquor which may be hazardous in a subsequent evaporation step. Filtration and solids handling and the radioactivity associated with graphite residue present considerable problems. Leaching, unless done with extremely corrosive reagents, probably will not recover fuel which has diffused into refractory coatings. An extremely fine grind (< 200 mesh) is required to ensure breakage of pyrolytic carbon or Al_2O_3-coated fuel particles which are inert to leaching reagents.

2. Chemical disintegration should be limited to the 90% nitric acid approach, since the halogen (Br, I, Cl, etc.) disintegration presents severe corrosion problems. The 90% nitric acid disintegration method has all the adverse problems of the grind-leach method except that the fine grinding is not required. Use of 90% HNO_3 will not break up pyrolytic carbon or Al_2O_3-coated fuel particles. In general, it gives as good or better recovery than grind-leach using ordinary concentrated nitric acid. Unfueled graphite is not very readily disintegrated.

3. Combustion presents problems of burner control, burnout, dusting (not as bad as grind-leach), and explosion prevention. It is applicable to all fuel types except that Al_2O_3-coated particles would still require a grinding operation. However, only a small ash residue would require grinding. Refractory, uranium-containing coatings will not be burned but will be concentrated in

the ash; thus, special leaching reagents can be used more easily than when the bulk graphite is present as in methods 1 and 2 above. Solids handling after burning is a minor problem. The CO_2 from combustion can be easily cleaned and then discharged to the atmosphere, thereby eliminating a substantial solid or liquid radioactive waste storage problem. Metallic fission product volatilization in the CO_2 gas occurs only with ruthenium in the high temperature zone. Virtually qualitative plating out of the Ru occurs on the equipment walls in a zone between the combustion chamber and the ~100°C gas exit. The ash residue in the combustion chamber is not likely to result in organic compounds in the leach liquor.

A preliminary recommendation is to develop the combustion technique, concentrating on the unit operations aspects. The combustion system might have a rough crusher feeding a low gas velocity shallow slab burner bed. The off-gas treatment system might have a recirculating water quench tower to cool off gases and remove entrained oxides and volatilized ruthenium; a gas dehumidifier to remove excess water in the gas and particulates; followed by a heater, absolute filtration, and disposal to atmosphere. Ash would be sluiced to a dissolution vessel where suitable reagents could be used for dissolution of oxides and/or refractory compounds. Roll crushing of the ash is indicated if Al_2O_3-coated fuel particles were present.

3.3 Pu-Al Processing Facility, Bldg. 4507 (E. J. Frederick)

Installation of process equipment was completed and the process turned over to the operating group. This completes the Process Design Section commitment toward the Pu-Al program.

3.4 Mechanical Processing of Fuels (W. F. Schaffer, Jr.)

Decladding of SRE Core 1 Fuel. Processing of the final shipment of SRE Core 1 fuel was completed during the month. According to the information received from Atomics International, this shipment was to contain, in addition to three complete fuel assemblies, three incomplete elements consisting of six full-length rods each and one cut rod from which one or two slugs had been removed for examination. The partial assemblies actually received differed radically from the reported shipment; the first contained only two complete rods and three cut rods, the second contained nine complete rods, and the third contained one element with end hardware but with fuel rods with badly damaged and broken jackets.

Processing proceeded smoothly until the start of processing of the last and damaged element. Prior to the last element, fuel was processed at an average rate of 6.61 kg U/hr, the maximum rate was 9.2 kg U/hr, and the minimum rate was 3.47 kg U/hr.

The remainder of the month was marred by a seige of difficulties beginning with a minor NaK explosion and oil fire involving the NaK disposal system on October 20. This incident has been reported in memos by C. D. Watson, dated October 2, 1961, and G. A. West, dated October 11, 1961.

The final assembly processed appeared to be one which had been removed from the region of the reactor in which the fuel had suffered severe damage during the SRE power excursion of July 13, 1959. The element was broken in several places, the jackets were bent and cracked, and several slugs were missing. The condition of this assembly prevented use of standard dejacketing techniques. The rods were cut or broken into slug-length sections and dejacketed by means of the auxiliary dejacketer until wear of the die components led to the loss of a key part of both dies onto the floor of the cell. Repair of the dies was not performed, because of lack of priority in the shops to machine the new pieces. Approximately 30 slugs were manually dejacketed with manipulators using a hammer and specially ground chisel.

In the course of processing the last element, a batch of ten slugs, eight with jackets and two without, was placed in the steam cleaner for temporary storage at the end of a shift and the cover was closed for security. The slugs remained in the cleaner for a period of approximately 64 hr over a weekend. Upon examination on the next shift, it was noted that the slugs had been converted to oxide and had disintegrated as a result of a small steam leak which produced a warm humid atmosphere in the cleaner tank. The slugs had swollen and had burst the steel jackets and even deformed the cleaning basket which was fabricated from 3/16-in. stainless steel rod. A large portion of the sludge dropped into the 1-1/2-in. discharge line, blocking the line and preventing flushing of the system to the filter. Permission was obtained to bury the material remaining in the basket. The basket was sealed in a metal can and placed in a second container for disposal. The remaining sludge was finally dissolved, using a decontaminating mixture of acetic acid, hydrogen peroxide, and ammonium oxalate. The presence of a copper cooling coil in the condenser prevented the use of nitric acid. Unfortunately, when the sludge broke loose, some of it overflowed the filter and contaminated the floor of the cell, which undoubtedly will increase the length of time required for cell decontamination.

In the final phases of processing, one of the motors in the General Mills manipulator also burned out; the motor was replaced remotely and the manipulator placed back in operation.

In the course of normal operation of the hydraulic saw to remove the end hardware from the last element, the hydraulic system developed a severe hammer on startup and shutdown sufficient to cause a general leakage on all unwelded pipe joints and a large leak in one of the swivel joints on a line in the cell. The cause of this difficulty has not yet been solved; E & M has been requested to make a complete investigation.

After removal of any NaK still remaining in the dejacketing trough and dump tank, using a flushing and siphoning operation with Bayol-D oil, cell decontamination will begin, followed by equipment removal and final cell decontamination.

Shipment of SRE Fuel to Savannah River for Processing. A prototype SRE fuel canister was fabricated based on sketches prepared by engineering. The canister was designed to seal without welding or brazing or the use of plastic seals. The seal is made by the tapered edge of a circular metal plate which is forced into a mating surface on the top of the cylindrical container by the action of a screwed cover. No leakage was detected with 30 psig air applied to the inside of the canister. Final drawings have been completed, and a requisition has been placed for the procurement of 65 canisters.

A rough cost estimate indicates that a new carrier, designed specifically for handling the fuel canisters, will result in less over-all cost than the modification of an existing 50-in. carrier previously planned for the shipments. Preliminary drawings have been prepared, and criticality approval for the shipment of nine cans of fuel per carrier (three canisters each containing ~29.6 kg U) has been obtained. The use of the new carrier will reduce the number of shipments by one-third and will simplify the handling operations in the storage cell. Final design of the carrier has been started.

Chop and Leach Program. Minor modifications to the shear are being made to improve gaging and feeding of the fuel bundle. Shearing of fuel bundles down to a length of approximately 1-1/2 in. appears to be quite feasible and has been demonstrated.

The control circuit for the shear-conveyor-leacher complex has been discussed, and a plan for design phasing and testing of the system has been made. The design will be divided into three phases leading toward remote-automatic or manual operation of the system as follows:

Phase 1. Basic control circuit for the operation of the leacher and conveyor. This design was completed September 22, 1961.

Phase 2. Addition of the shear controls to the leacher and conveyor control panel and the addition of a remote control panel.

Phase 3. Addition of pilot lights to the control panel which indicate fuel position in the conveyor and addition of indicating and recording systems necessary for complete automation of the system.

A work order has been issued for the conceptual design of an instrumented monitor circuit to determine fuel positions in the conveyor feeder system as a check on the electrical-mechanical system now under design.

The conveyor has been delivered and is now ready for cell installation. The leacher is disassembled and will be operated during the next month without the exterior shell to study the action of sheared porcelain-filled prototype fuel in respect to the backmixing and fines problems.

4.0 WASTE STUDIES
(J. O. Blomeke)

4.1 High-level Waste Evaporator and Storage Facility (F. E. Harrington, F. N. Browder)

Management approved the preliminary proposal (Project 62-5, Subprogram 9400) for this facility and the Melton Valley Waste Collection and Transfer System the last week of the month. The proposal was then sent to AEC-ORO for their approval.

4.2 Low-level Waste Ion Exchange Pilot Plant (W. R. Whitson)

The installation of the Low-level Waste Ion Exchange Pilot Plant in Bldg. 2528 was completed. The feed pump has been installed in the basement of the Lime-Soda Treatment Plant, Bldg. 3518, and the 2-in., Schedule 80, PVC underground feed line between Bldgs. 3518 and 2528 has been pressure-tested for leaks with water at 85 psi.

Cold testing of the process equipment at flowsheet conditions was begun using process tap water as feed for the plant. Mechanically, the equipment has performed very well for periods of 130 and 44 hr of continuous operation, except for failure of the plastic tubing in the finger-type sludge draw-off pump.

A good compact sludge cake was obtained using the Eimco-Burwell plate and frame pressure filter. However, because of the containment problem involved in using the pressure type filter, a self-contained rotary drum, vacuum-type filter was salvaged from the burial ground, decontaminated, and put in operable condition. Testing of this vacuum filter will begin as soon as sufficient data on the pressure type filter have been obtained by the Pilot Plant operating personnel. Use of the vacuum filter will eliminate the need of the troublesome sludge draw-off pump because the liquid level in the clarifier provides sufficient head to permit flow of the sludge to the filter drum.

The flow-diverting baffle in the inlet nozzle of the clarifier was replaced with a cone. The cone will offer two distinct advantages over the baffle: (1) it will reduce the time required to establish a satisfactory sludge blanket and (2) it will reduce the volume of sludge needed in the clarifier by a factor of three or more. Tests are now being conducted to determine the feasibility of using a cone instead of a baffle in the clarifier.

The vessel off-gas system was tested; the blower pulls a vacuum of 5 in. of water on the acid storage tanks. Painting of the equipment and of the operating area and office was started and is 60% complete.

4.3 Pot Calcination Hot Cell Facility (H. O. Weeren)

Preliminary designs have been completed for all of the vessels that are to be used in the small-scale pot calciner experiment to be located in Cell 1 of Bldg. 4507, and work on the layout of this equipment has been started. Existing equipment in Cell 1 limits the space available to an area approximately 30 in. wide running the depth of the cell. The necessity of having some equipment located so that it is accessible to the manipulators and the need for locating the calciner pot immediately below the hole in the roof are further limitations.

The flowsheet for the experiment has been modified to permit studies of ruthenium volatility during evaporation. This will be done by periodically replacing the calciner pot with a pot of slightly different design that can be sampled and emptied. A semi-continuous evaporation of waste solution can then be carried out in the pot; analysis of feed, condensate, and bottoms will show the degree of ruthenium volatility.

4.4 Pot Calcination Pilot Plant (J. M. Holmes, E. J. Frederick)

The TBP-25 flowsheets for the ORNL-ICPP waste calcination pilot plant are about 60% complete. Tentative operating conditions reported last month have been changed to the following:

TBP-25 feed: from ICPP Tank WM-182.
Pot size: 12 in. dia x 6 ft active length.
Volume of feed/pot: 286 gal.
Volume of cake: 33.5 gal.
Maximum stripping water/feed ratio: 4.0 lb H_2O/lb feed.
Total feed time: 35.2 hr.
Total time for calcination: 47 hr.
Evaporator df for entrained solids: 10^5.
Evaporator df for ruthenium: 1000.
Fractionator df for overhead condensate: 10^3.
Organic content of feed to calciner: $<0.1\%$.
Activity in condensate from fractionator: gross gamma ~546 d/min/ml
gross beta ~1321 d/min/ml

A meeting was held at ORNL with ICPP personnel on September 30, 1961, to discuss the proposed waste calcination pilot plant. Agreement was reached upon the following items:

1. The gas holder and gas recycle blower proposed in the original process flowsheet (ORNL CF-60-12-121) will not be installed in the initial pilot plant. The production of a minimum volume of noncondensable off-gas remains a basic objective of the plant, but no attempt will be made to recycle this gas back through the scrubber for additional removal of absorbable oxides

of nitrogen. Present plans call for metering and analyzing of off-gas and then venting it to the plant vessel off-gas system. Design of the scrubber column will proceed, and its installation will be considered when equipment fabrication is started. This scrubber will probably be required to remove the excess nitric oxide generated during the addition of phosphite to the process or the purging of the evaporator with nitric oxide gas to minimize ruthenium volatility. The nitric oxide would be converted to nitrogen dioxide by oxygen addition before absorption in the gas scrubber.

2. Fillet welding of the calcination pot seals will be considered in the mechanical program. The North American Aviation facility at McGregor, Texas, will be visited to inspect their equipment for sealing carbon steel rocket fuel containers.

3. ORNL will investigate the effect of organic addition to the pot calcination feed streams. Organics to be studied will include TBP, DBP, and MBP. ICPP will sample their waste tanks and analyze for organics.

4. Pot sizes to be tested in the ICPP pilot plant will be 6-, 8-, and 12-in. diameters with an active length of 6 ft. The furnace will be designed to process all of these pot sizes.

5. Representatives of ORNL and ICPP will visit Brookhaven National Laboratory during October to inspect the rotary ball calciner. A review of the problems to be considered when the rotary calciner is installed will be made with BNL personnel. Present plans call for leaving space in the pilot plant for subsequent installation of this equipment.

6. ORNL will study various types of pumps, a steam jet, and a gravity feed system for feeding the waste solutions to the pot calciner. ICPP will provide for pumping, jetting, and gravity feeding in their pilot plant. Several different types of pumps, including a canned rotor type and a submerged type pump, will be tested at ORNL by the Unit Operations Section.

The design of mechanical equipment for demonstration of the pot calciner positioning, connecting, and sealing procedures is about 60% complete. The equipment is sized for either the Lockheed Nuclear Products Company cells at Dawsonville, Georgia, or for the ICPP Hot Pilot Plant Cell 2. A contract has been signed with Lockheed and the work will start about October 11, 1961. The initial portion of the work will be concerned with welding tests to develop an adequate welded seal for filled pots. Bid invitations for equipment construction will be issued during October 1961, and construction should start during November 1961.

5.0 MISCELLANEOUS PROJECTS

5.1 Containment Program

Building 4507 Containment, (A. M. Rom). Further caulking of the penthouse and the correction of a faulty adjustment in the ventilation stack shutoff damper enabled the penthouse pressure to be reduced from an initial -0.06 in. H_2O to -0.3 in. H_2O in 4 seconds. This far exceeds the Radiation Safety and Control Manual requirement of pulldown to -0.3 in. H_2O in 20 seconds. The penthouse inleakage rate at -0.3 in. H_2O exceeded the manual requirement of 6×10^{-3} volumes per minute by an order of magnitude due to the fact that the structural components were of standard design which does not guarantee the degree of tightness required by the Laboratory's containment standards. However, the penthouse is believed to be acceptable from a containment viewpoint because of the capability of rapid drawdown. These same observations and comments apply to the other portion of the building. The leak-tightness of Cells 1 and 2 met specifications; Cell 3 is in process of being sealed. Radiation instruments in the building are all installed and operating except for one monitron in the makeup area. The process water monitron in the 4505 cold pipe tunnel is also installed and operating. This essentially completes the 4507 containment alterations. Any minor jobs which remain will be taken care of before October 31, at which date the 4507 containment job directive will be closed out.

Building 3508 Containment (B. F. Bottenfield). The design of the containment revisions to Bldg. 3508 is about 90% complete. Air handling drawings will be ready for review by October 5 and the electrical drawings are due soon thereafter. A final cost estimate is also being prepared by the Engineering and Mechanical Division.

Cell Ventilation Filters for Bldgs. 4501, 4505, and 4507 (W. G. Stockdale). Installation of instruments on the filter house for subject filters was 75% complete at the end of September. The project should be complete and turned over to the Operations Division for operation by October 15.

Cell Ventilation Filters for Analytical Cells, Bldg. 3019 (W. G. Stockdale). This project was 98% complete at the end of September and the filters are now in operation. The principal remaining work to be done is the access road paving. The exhaust fan apparently is neither delivering the required suction nor air flow. This is being checked prior to acceptance by the Laboratory from the contractor.

Sample Gallery Ventilation, Bldg. 3019 (W. G. Stockdale). The specifications for this system have been completed by the Engineering Department. They have not yet been delivered to Chemical Technology for review.

5.2 Thorium Fuel Cycle Development Facility (A. R. Irvine). Consideration is being given to expanding the scope and purpose of the proposed facility to include means for chemical processing of nominal amounts of U^{233}-Th fuels in addition to refabrication of the decontaminated fertile and fissile matter into fuel assemblies. The expanded scope would permit study of the thorium fuel cycle as an entity rather than in parts. Included in the items under consideration are low decontamination processes, short-cooled processing, and the more conventional solvent extraction processes.

In order to meet the demands of an expanded scope, the criteria previously established must be entirely reworked. The major problem lies in setting objectives that can be attained within the framework of reasonable financial support. The cooling period, assembly size, and diversity of processes to be accommodated all work together to increase facility cost. In order to obtain the maximum flexibility, it will likely be necessary to employ less conservative design criteria than previously specified for the fabrication facility.

5.3 BNL Kilorod Program (A. R. Irvine, B. B. Klima, E. M. Shank)

The AEC has requested the Laboratory to proceed with research and installation work necessary to fabricate 100 rods (0.5-in.-dia by 42-in. filled length) containing thoria with 3% U^{233}. Additional funding in the amount of $390,000 for construction of facilities was provided. Completion of construction is scheduled for June 1, 1962. It is anticipated that design will be completed by January 15, 1962, leaving the remaining time for procurement and installation. The major hazard in this schedule is the possibility that the gel preparation and firing procedure may not develop as favorably as it now appears, in which case a considerable revision in concept could occur at a late date. Plans are currently being laid on the basis of favorable, but limited, information from the research groups which indicate a good probability for being able to prepare sol in Bldg. 4501 at least days in advance of the need. Uranium would be added to the sol in Bldg. 3019 as uranyl nitrate. It also appears that only one relatively small furnace will be required for calcining the oxide, provided that the "plunge" from a 500°C temperature to a temperature of 1150°C is not necessary and that bed depth can be as great as 3 in. in the firing tray.

5.4 Pa-U Program (B. B. Klima)

Installation of the containment box in Cell 3 of Bldg. 4507 and of a 2-in.-thick lead-shielded twin glove box and two unshielded glove boxes in Laboratory 1, Bldg. 3508, is nearing completion. Design of the installation is estimated to be 100% complete at this time; however, a few additional as-built drawings will be necessary to detail equipment which was fabricated or assembled without drawings. Other drawings will need to be modified to reflect changes necessary in the development and testing period. Fabrication is estimated to be 93% complete and installation is estimated to be 87% complete. Most of the remaining work is for the twin shielded glove box.

5.5 Eurochemic Assistance Program (E. M. Shank)

One specifically-prepared document containing ICPP-originated information was sent to Eurochemic via DIA. One letter requesting information was received from R. J. Sloat. One Eurochemic-originated document was reproduced but not distributed. "The Eurochemic Assistance Program: Progress Report for July 1960 Through June 1961" was issued.

5.6 Fuel Shipping Study (L. B. Shappert)

A rig was designed to test the accelerometers, which have been purchased for the cask drop tests, under laboratory conditions. The rig consists of a 4-in. steel dowel about 4 in. long and cut in half. One-half is bolted to a 58-in. rigid moment arm. The accelerometers may be fastened to the flat surface of the dowel, which can be dropped so as to strike a solid surface consistently in the same manner, with the same force when released from the same height.

A new drop pad is presently being designed which should be capable of resisting the fall of the 6-ton casks when dropped from a height of 20 ft without fracturing the concrete. The first series of cask drops will be made after the casks have been covered with a Stress-Kote material. This material is presently on order.

5.7 CANE Project (J. W. Landry)

Fabrication of the CANE sequenced sampler, including the vessels, valving apparatus, and instrumentation for timing and recording, was completed in September. The vessels and valving apparatus consist of:

1. Seven stainless steel vessels of 1-cu-ft capacity each.
2. Eight normally-open explosive-operated pinchcocks developed for the CANE problem by Pitman-Dunn Laboratory group of Frankford Arsenal.
3. Five normally-closed and one normally-open explosive-operated valves supplied by Conax Corporation of Buffalo.
4. Associated electrical gear, orifices, gauges, and piping connections.
5. Support frame.

The instrumentation consists of:

1. A timer to control the valving of sample material into the vessels in a pre-arranged time sequence.
2. Eight pressure transducers with amplifier channels.
3. A "Visicorder" recorder to record the arrival (pressure) histories of the samples in the vessels.
4. A 2-kw power generator.
5. Associated cables.

Because of uncertainties in estimates of shock and motion effects at the location of the sampling vessels, it was necessary to modify the equipment in order to locate the instrumentation 3000 ft away. Additional cable for this was ordered. It will be entrenched to control damage by rodents. The CANE sequenced sampler experiment is part of the Lawrence Radiation Laboratory prompt sampling experiment of Project Gnome.

5.8 AHBR Chemical Plant Cost Estimate (F. E. Harrington)

The study of the two conceptual chemical plants to close the cycle for the two reactor complexes discussed in SL-1875 is about 30% complete.

All criteria for the study have been established in two meetings with W. L. Carter, L. G. Alexander, and W. G. Stockdale. These are:

1. 10-days cooling for blanket material.

2. 90-days cooling for core material.

3. One cycle of Thorex solvent extraction.

4. 200 days for Pa to "23" decay after initial "23" separation.

5. Remote maintenance of process equipment.

6. Location on-site, adjacent to reactors.

Three letters were issued to W. L. Carter by F. E. Harrington as follows:

1. August 31, "1000 Mw_e AHBR Chemical Plant (sulfate content in chemical plant)."

2. September 13, "1000 Mw_e AHBR Chemical Plant Shielding."

3. September 18, "1000 Mw_e AHBR Reprocessing Flowsheets."

The last of these letters contained drawings D-45769, D-45770, and D-45771 presenting simplified block diagrams for most of the major equipment required in the processing canyon.

A list of all process equipment is 50% complete.

5.9 Assistance to Chemical Development (A. M. Rom)

Bldg. 4507 Optics. Check prints were completed and submitted to the shop to permit fabrication to proceed in view of the limited time available for fabrication. As-built drawings will be made of the completed equipment at a later date.

Purex IWW Carrier. Construction drawings are approximately 90% complete.

Gas-solid Reactions. Preliminary design studies were continued.

6.0 PROJECT ENGINEERING

6.1 Process Design Section Drafting Room Status (J. H. Manney)

A list of the 39 drawings started during September 1961 is given in Table 2. In addition, 26 drawings started earlier proceeded to the check print stage and 23 to approved status. In September 19 sketches and 63 illustrations were prepared.

A breakdown of drafting time during September by cost account is as follows:

Account Number	Manhours	% of Total
3370-1	14	0.8
3370-8	1	0
3370-20	112	6.6
3370-22	218	12.8
3370-24	8	0.5
3370-30	20	1.2
3370-33	95	5.6
3370-34	37	2.2
3370-56	12	0.7
3370-57	24	1.4
3370-72	16	0.9
3370-73	116	6.8
3370-108	657	38.6
3370-123	181	10.6
3370-133	40	2.4
3290	116	6.8
3632	15	0.9
4420-42	20	1.2
Total	1702 hr	100.0%

There were 22 hours of overtime worked in September 1961.

6.2 Engineering and Instrument Department Assistance

A summary of drawings prepared during September in the Engineering and Instrument Departments is given in Table 3.

6.3 Material Purchase Status

Table 4 gives a listing of all outstanding purchase requisitions (except instruments) as of October 1, 1961.

6.4 Work Order Status

Table 5 presents a listing of all outstanding work orders as of October 1, 1961, for which the Process Design Section is responsible.

H. E. Goeller, Chief
Process Design Section
Chemical Technology Division

HEG:mep

Table 2. Summary of Drawings Started in the PDS Drafting Room During September 1961

Job No.	Drawing No.	Rev.	Title	Date Started
103	C-34097	1	Redistribution Plate Location and Insertion Tool	9/7/61
504	D-34467	3	Pu-Al Alloy Fuel Rod Carrier Interim and Bottom Section, Details	9/1/61
	D-34468	3	Pu-Al Alloy Fuel Rod Carrier Interim and Bottom Section, Assembly	9/1/61
	D-45762		IWW Carrier, Assembly	8/23/61
	D-45763		IWW Carrier, Subassembly and Details of Tank	9/15/61
	D-45766		IWW Carrier, Subassembly and Details of Bottom Section	8/26/61
505	D-45774		Optical System, Cell 2 Inner Sleeve	8/29/61
701	E-34239		TrU Lab., TrU Process Flowsheet Cell 4	9/7/61
	E-34248		TrU Lab., Typical Tank Pit Layout, Plan	9/18/61
	D-45780		TrU-CP, Single or Gang Disconnect Assembly and Details	9/19/61
	D-45781		TrU-CP, Single Gang Disconnect Casting Details	9/7/61
	E-45801		TrU Development Americium-241 Target	9/27/61
702	E-45662	2	Pa-U Program, Dissolver Assembly Equipment Rack A	9/25/61
	C-45663	3	Pa-U Program, Dissolver	9/15/61
	D-45668	2	Pa-U Program, Cell 3 Interim Closure Details, Sheet 1	9/27/61
	D-45676	1	Pa-U Program, Cell 3 Interim Closure Details, Sheet 5	9/28/61
	D-45679	1	Pa-U Program, Cell 3 Electrical Installation	8/28/61
	D-45681	2	Pa-U Program, Cole Connector Assembly and Details	8/28/61
	E-45689	2	Pa-U Program, Processing Box Back Elevation	9/27/61
	E-45693	2	Pa-U Program, Equipment Rack B	9/26/61
	D-45700	1	Pa-U Program, Cell 3 Piping Flowsheet	9/13/61
	D-45701		Pa-U Program, Cell 3 Service Piping Operating Area	9/6/61
	D-45704	1	Pa-U Program, Main and Auxiliary Panelboards	9/1/61
	D-45705		Pa-U Program, Panelboard Wiring Diagram	9/1/61

(Continued)

Table 2, Continued

Job No.	Drawing No.	Rev.	Title	Date Started
702, continued	D-45706	1	Pa-U Program, Electrical Schematic	8/28/61
	E-45711		Pa-U Program, Service Piping Electrical and Instrumentation Addition 2-in. Tandem Cave Sheet 1	8/18/61
	E-45712		Pa-U Program, Service Piping Electrical and Instrumentation Addition 2-in. Tandem Cave Sheet 2	8/18/61
	D-45714		Pa-U Program, Bldg. 4507 Cell 3 Flowsheet	9/8/61
	D-45715		Pa-U Program, Panelboard Wiring Diagram	9/1/61
	D-45716		Pa-U Program, Microbellows Pump Flow Gage	9/5/61
	D-45717		Pa-U Program, Insulator Plate	9/12/61
-20	C-45772		Mark III ORNL PRFP Fuel Rod Holder	9/8/61
	C-45782		PRFP UC Capsules Series A	9/20/61
-30	D-45768		Calciner Pot	8/30/61
	D-45773		Pot Calciner Experiment Flowsheet	9/11/61
	D-45775		Condenser	9/12/61
	D-45776		Feed Tank	9/13/61
	D-45777		Condensate Catch Tank	9/14/61
	D-45778		Transfer Tank	9/18/61
	D-45779		Seal Pot	9/20/61
	C-45783		Scrub Liquor Catch Tank	9/21/61
	C-45784		Scrubber	9/21/61
-34	D-45788		Waste Calciner PP ICPP Continuous Pot Calcination TBP-25 Waste	9/29/61
-56	D-34536	1	Lab 259-D Exhaust System	9/14/61
-57	D-45758		Belgium Model Mixer-settler Mark IV, Assembly	8/28/61
	D-45759		Belgium Model Mixer-settler Mark IV, Detail Sheet 1	8/23/61

(Continued)

Table 2, Continued

Job No.	Drawing No.	Rev.	Title	Date Started
-57,	D-45760		Belgium Model Mixer-settler Mark IV, Detail Sheet 2	8/23/61
continued	D-45761		Belgium Model Mixer-settler Mark IV, Detail Sheet 3	8/23/61
-133	D-45785		Cradle for Pu-Al Alloy Shipping Cask	9/22/61
4435-72	E-45769		Section I, 1000 Mw_e AHBR Feed Preparation Section	9/8/61
	D-45770		Section II, 1000 Mw_e AHBR Solvent Extraction Section	9/8/61
	D-45771		Section III, 1000 Mw_e AHBR Reactor Feeds	9/11/61

Table 3. Summary of Drawing Progress in Engineering and Instrument Departments for Month of September 1961

Job No.	Job Order Number	Drawing Number	Rev.	Title	Transmittal Date
3026	A-70579-13	D-42960		SRE Canned Fuel Slug Canister	9/25/61
2528	A-70455-12	Q-2233-2	1	Instrument Panelboard (Back) Electric and Pneumatic	9/22/61
		Q-2233-4	2	Instrument Panelboard Wiring Schematic	9/22/61
		Q-2233-5	1	Electrical Equipment Layout	9/22/61
		Q-2233-11	0	Radiation Equipment Location and Details	9/11/61
		Q-2233-12	0	Bldg. 2528 and 4507 Alarm Tie-in	9/11/61
4505	A-93174-11D	D-45597	0	Wiring Diagram for Conveyor and Leacher	9/28/61
		D-45595	0	Electrical Leacher and Conveyor Control Diagram	9/28/61

Table 4. Purchase Requisition Status October 1, 1961

Job No.	Purchase Req. No.	Date Issued	Description
Miscellaneous			
-59	D-0014	3/29/61	U Jet tests and explosive valve tests
4507	D-0043	5/26/61	Periscope alterations
-59	D-0062	8/1/61	12 Hose clamps
4507	D-0068	8/15/61	One telescope and camera
-59	D-0069	8/16/61	Field costs, Gnome test
-59	D-0072	8/29/61	One Conax valve assembly
-20	D-0073	9/1/61	Fabricate 2 Pyroceram vessels
-133	D-0074*	9/6/61	50 ft Teflon tape
-113	D-0075	9/18/61	Rent on Visicorder
-113	D-0076	9/15/61	20 Rolls chart paper
-20	D-0077	9/20/61	Tube furnace
-108	D-0078	9/22/61	Cyrogenics disconnect for testing
-80	D-0079	9/26/61	Copper gasket
Transuranium - 4507			
700	D-0303	12/28/60	Bids request, fabrication of TrU carrier
700	D-0328	3/24/61	Two manipulator boots for alpha box
702	G-9701	6/29/61	30 Air-operated polythene valves
-123	G-9715	7/21/61	One 1/6 hp gear motor
-123	G-9717	7/21/61	One 2-ton lift table
-123	G-9725	8/3/61	150 SS Swagelok fittings
702	G-9729	8/7/61	Teflon air-operated valve
-123	G-9733	8/9/61	Neoprene gaskets
-123	G-9743*	9/1/61	Two peristaltic pumps
-123	G-9744*	9/1/61	Two d-c motors and controllers
-123	G-9745*	9/1/61	8 Swagelok shut-off fittings
-123	G-9746*	9/1/61	Two gang covers
-123	G-9747*	9/12/61	6 Swagelok connectors
-123	G-9748	9/13/61	Electric switches
-123	G-9749*	9/15/61	Five 220 v, 10 amp relays
-123	G-9750*	9/21/61	Six clamps
-123	G-9751*	9/22/61	One sprocket
-123	G-9752	9/26/61	24 Ball-bearing casters
Waste - Calcination Pilot Plant			
605	G-1002	4/27/61	One centrifugal pump for ANN
605	G-1003	6/7/61	Lockheed subcontract

(Continued)

Table 4, Continued

Job No.	Purchase Req. No.	Date Issued	Description
Waste - Ion Exchange Pilot Plant			
604	F-2013	9/14/61	Sand and gravel for Permutit filter
604	F-2014	9/15/61	Parts for Lapp pump conversion
Power Reactor Fuel Processing - Mechanical			
510	D-6247	5/26/61	Twelve 18-in.-dia cutoff wheels
504	D-6262	8/7/61	Stainless steel tubing
510	D-6265	9/26/61	65 Canisters
Power Reactor Fuel Processing - Chemical			
503	D-6414	3/21/61	Glove boxes and auxiliaries
Transuranium - 3508			
702	D-6621	9/15/61	11 Hardened steel shafts
Volatility			
404	D-7019	6/29/61	INOR-8 pipe and tubing
404	D-7020	6/26/61	INOR-8 sheet and plate

* Issued and completed in September 1961.

Table 5. Work Order Status October 1, 1961

Job Number	Job Order Number	Charge Number	Engr.	Date Issued	Cost Estimate	Description	% Complete
3019	A-01546-11	337053-125	WGS	7/24/61		Ventilation System for Sample Gallery	20
3019C	A-93249-01	329090	WGS	6/29/60	9,100	Hot Analytical Cell and Hood Vent Filters, Titles I, II, and III	99
3019C	A-93249-02	329090	WGS	6/29/60	2,600	Hot Analytical Cell and Hood Vent Filters, ORNL Participation	99
3019C	A-93249-03	329090	WGS	6/29/60	1,500	Hot Analytical Cell and Hood Vent Filters, I & C Division Participation	99
3019C	A-93249-04	329090	WGS	6/29/60	82,600	Hot Analytical Cell and Hood Vent Filters, Lump-sum Contract, Hixon Construction Co.	99
3505	A-70570-11	337053-132	HBG	7/26/61	15,000	Loading of SRP Carriers	5
3505	A-70570-12	337065-132	FEH	8/4/61	1,500	Install Jet and Line from 3505 Canal to W-5	0
4507C	A-01362-11	337053-20	AMR	6/15/60	10,115	Temporary Containment Changes for Cell 2	100
4507	A-01559-11	337053-133	AMR	8/31/61	1,900	Final Adjustments for 4507 Containment	25
4507C	A-93114-02	337090-01	AMR	7/29/60	11,300	4507 Containment Changes, ORNL Participation	95
4507C	A-93114-03	337090-01	AMR	7/29/60	106,000	4507 Containment Changes, CPFF Contract	90
4507C	A-93114-04	337090-01	AMR	7/29/60	21,000	4507 Containment Changes, Detection Instruments	65
4507C	A-93114-05	337090-01	AMR	7/29/60	5,000	4507 Containment Changes, Title II Engineering	100
General Division Programs							
-1	A-01549-11	337053-1	WGS	8/4/61		Design and Estimate for Off-gas Filter Portable Shield	20
-1	A-41624-41 & -61	337053-01	PLR	7/16/59	10,000	General Equipment Repair and Storage for Re-use	100
CANE Project							
-59	A-01545-11	337053-59	JWL	7/24/61	7,318	Fabricate Gnome Sampler Vessels	65
-59	A-20475-11	337053-59	JWL	3/16/61	6,508	Fabricate Instrumentation for Gnome Sequenced Sampler	100
-59	A-20484-11	337053-59	JWL	4/14/61	5,000	Design and Fabricate Transistorized Timer	100
Fuel Shipping Study							
-113	A-01499-11	337053-113	LBS	5/5/61	15,000	Fabricate Three Carrier Models for Drop Test	90
-113	A-01570-11	3370XX-113	LBS	9/20/61	5,000	Assistance by B. L. Greenstreet (Y-12) on Cask Drop Tests	0
Pa-U Program							
-123	A-01553-11*	337053-123	BBK	8/17/61	150	Amercoat Interior of Cell 3, Bldg. 4507 (cancelled)	0
-123	A-70499-11*	337053-123	BBK	5/26/61	18,900	Fabrication and Installation of Pa Process Equipment, 4507 Mockup	100
-123	A-70499-12	337053-123	BBK	5/26/61	10,800	Fabricate Carrier for Pa	65
-123	A-70499-13	337053-123	BFB-FLH	5/31/61	1,900	Alpha Seal Adapt. for Castle Manipulator	100
-123	A-93483-01	337092-123	BBK	5/29/61	34,900	Install Shielded Glove Box and Equipment, Lab 1, Bldg. 3508	50
-123	A-93687-01	337092-123	BBK	7/21/61	6,875	Convert Model 8 Manipulators in 4507 Mockup for Heavy-duty Service	0
Homogeneous Reactor Program							
304	A-20345-11	337053-109	BFB	5/18/60	3,707	Instruments for Spectrophotometric Fuel Analysis Loop	100
Volatility Program							
404	A-01533-11	337053-73	RPM	6/28/61		Assistance to BMI on VPP Corrosion Tests	10
Power Reactor Fuel Processing							
500	A-20428-11	337053-22	ARI	11/30/60	580	Instrumentation for Experimental Flowmeter Test	0
503	A-70447-11	337053-133	ELN	1/16/61	50,000	Modification of Immi Equipment for Pu-Al Processing	100
503	A-93553-01	337092-133	ELN	3/7/61	3,350	Fabricate Accessories for Pu-Al Carrier	80
506	A-01528-11	337053-132	WRWh	6/27/61	1,765	Install Glove Box Sampling Station, 3019	30
506	A-93636-01	337092-132	WRWh	5/19/61	4,730	Install and Pipe U-233 Storage Tank	100
506	A-93636-03	337092-132	WRWh	7/10/61	2,850	Install 6-in. Lead Shield Around U-233 Storage Tank	20

(Continued)

Table 5, Continued

Job Number	Job Order Number	Charge Number	Engr.	Date Issued	Cost Estimate	Description	% Complete
Power Reactor Fuel Processing, continued							
510	A-01418-11	337053-106	WFS	9/2/60	14,113	Final Design Items, Segmenting Facility	95
510	A-01525-11	337054-106	WFS	6/12/61	6,850	Maintenance on SRE Equipment	100
511	A-01448-11	337053-106	WFS	12/14/60	18,234	Fabrication of Inclined Conveyor	100
511	A-01491-11	337053-107	WFS	4/19/61	12,000	Design of 250-ton Shear Auxiliary Equipment	75
511	A-20556-11	337053-107	WFS	9/22/61	1,000	Preliminary Study of Leacher Position Indicator	0
511	A-93174-01	337092-106	WFS		171,600	Procure 250-ton Shear from Birdsboro Corporation	100
511	A-93174-02,3,4,5	337093-106	WFS	6/2/60	3,360	Design Auxiliaries for 250-ton Shear	25
Waste Program							
603	A-93534-10	363290-00	FEH			Design of Waste Tank and Evaporator	100
604	A-01524-11	337053-34	JOB	5/3/61	3,000	Install PVC Line from 3518 to 2328	35
604	A-70455-11	337053-34	JOB	3/2/61	30,000	Fabricate and Install Equipment for Ion Exchange Pilot Plant	75
604	A-70455-12	337053-34	JOB	2/28/61	10,000	Procure and Install Instruments for Ion Exchange Pilot Plant	100
604	A-70455-13	337053-34	JOB	3/30/61	2,000	Decontamination of Used Equipment for Ion Exchange Pilot Plant	40
605	A-01484-11	337053-34	JOB	3/27/61	15,000	Design Pot Seals for Calciner Pilot Plant	60
605	A-01547-11	337053-30	HOW	7/26/61	19,300	Fabricate and Install Pot Calcination Hot Cell Unit	0
605	A-01558-11	337053-33	JOB	8/28/61	1,980	Fabricate Densimeter and Controlled Rate Steam Jet	25
Transuranium Facility							
7511	A-01550-11	337053-108	WDB	8/8/61	2,000	Design Revision of TrU Concepts	15
7511	A-70489-61	337053-108	WEU	4/25/61		Architect-Engineer Design Assistance, TrU Mechanical Equipment	0
7511	A-70397-14	337053-28	BFB	12/12/60	24,500	Fabricate and Install Mockup of Intercell Conveyor	100
702	A-01480-11*	337053-108	BBK	3/21/61	2,150	Piping and Electrical Design Revisions to Transuranium Alpha Box Cell 3, 4507	100
702	A-70397-13	337053-28	BBK	7/15/60	4,950	Design and Install Instruments for Transuranium Cell 3 Glove Box	100
702	A-70397-15	337053-28	BBK	3/22/61	12,000	Install Alpha Box and Equipment in Cell 3, 4507	75
702	A-70397-16	337053-28	BBK	5/26/61	18,900	Modify Cell 4, Bldg. 4507, and Install TrU SOX	0
702	A-70397-17	337053-28	BBK	5/26/61	28,100	Fabricate and Install TrU SOX Equipment, 4507 Mockup	0
702	A-70397-18*	337053-28	BBK	5/26/61	5,400	Instrumentation Design and Installation, TrU SOX, 4507 Mockup	0
702	A-70442-13*	3370XX-108	BBK	6/28/61	7,740	Design Changes on TrU Transfer Box, 4507	0
702	A-70442-14*	3370XX-108	BBK	7/21/61	5,500	Provide New O-Ring Seals on TrU Transfer Box	0
702	A-70442-16	3370XX-108	BFB	8/21/61	25,000	Fabricate Mockup of TrU Carrier and Alpha Container	0

C - Work Orders concerned with containment.

* - Request for close-out submitted.