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PROCESS DESIGN SECTION STATUS REPORT FOR JUNE 1962

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 June 1962. The five major projects discussed are Transuranium, Volatility, Power Reactor Fuel Processing, Waste Studies, and Thorium Fuel Cycle Development. 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.

1.0 TRANSURANIUM PROGRAM
(W. E. Unger)

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

A final review of the Title I drawings and report writeups was conducted in Philadelphia, June 11-15, in conjunction with the AEC. The Title I cost estimate is scheduled to be issued July 6 and the completed report on July 15.

Authorization has been given Catalytic as of July 1, to proceed with Title II design in all areas and phases of the project.

1.2 Project Critical Path Schedule (B. N. Robards)

Arrow diagrams of all the phases of ORNL participation in the TRU Facility were completed and transmitted to Catalytic Construction Company where they were combined with the building design and construction diagrams to form the master schedule. This schedule contains approximately 3000 activities, 1700 contributed by Catalytic Construction Company and 1300 by ORNL. The diagrams show the correct sequencing and durations of the activities, but are not in final form since manpower leveling is not complete.

Analysis of the building construction diagram indicates a building completion date of June 15, 1964, for a cost plus fixed fee contract and October 23, 1964 for a lump sum contract. Required delivery dates for the conveyor housing and the bottom, back, and top of the cubicles, all furnished by ORNL and which must be installed during building construction, are August 19, 1963, and October 7, 1963, respectively. Early and late procurement dates for ORNL furnished material used in the fabrication of Catalytic Construction Company designed items, i.e., cell pit liners, Hastelloy C piping, and magnetite concrete, have been determined. As an example, Hastelloy C for the cell pit floor pans must be available for a CPFF contract in mid-December, 1962.

1.3 Special Mechanical Equipment Design (F. L. Hannon)

Intercell Conveyor. Detailed design of the conveyor housing was begun; eight drawings have been completed and are ready for checking. One drawing has been completed to show conveyor components and their installation, and a design has been completed for conveyor dolly removal equipment. Fabrication of the automated port closure has been completed; however, bench testing has been delayed because of the heavy work load in the shop.

Equipment Removal System. The design status of the various sub-assemblies of the transfer case is as follows:

Bottom Assembly	40% Complete
Top Assembly	75% Complete
Door Lift	90% Complete
Top Plate	20% Complete
Hoist	100% Complete (being Checked)

A mockup for testing of a single locking mechanism has been completed. A development program is under way to evaluate materials, finishes, etc. to be used in this device.

Cell Cubicles. Detailed design of the portion of the cell cubicles for which ORNL is responsible is complete; 14 drawings have been completed and transmitted. Two drawings have been completed to transmit criteria to the A-E concerning design information for inclusion in their drawings to accommodate ORNL equipment.

Miscellaneous Equipment. Design of transfer area cubicle mockup components has been completed and is awaiting checking; six drawings were prepared. This equipment will be incorporated in the Y-12 mockup.

1.4 Process Equipment Design (W. D. Burch, O. O. Yarbro)

Two additional engineering flowsheets were drawn up and issued as check prints. A total of four out of the 14 required have now been completed. The detailed design of an equipment rack was completed which incorporated mounting and handling features consistent with the transfer caisson and in-cubicle track arrangement to be used in the TRU Facility. Tests in the mockup will be performed to demonstrate these features.

Detailed estimates of the individual design activities on the critical path schedule arrow diagram showed that a total of 250 drawings requiring approximately 12 man-years of drafting time and 6 man-years of engineering time will be necessary to complete the processing equipment design.

1.5 TRU Concrete Shielding Studies (J. P. Nichols)

Renupak shielding calculations were made to compare Montana Magnetite concrete with possible alternates which were suggested by E & M. For a fission source of 3×10^{12} neutrons/sec located 2 ft from the inside of a 4.5 ft concrete wall the dose rates at the outside surface of walls of Montana Magnetite at 25°C, Montana Magnetite at 100°C, Wyoming Magnetite-Maryland Serpentine at 100°C, and Tennessee Ferrophos-Maryland Serpentine at 100°C were 0.85, 3.1, 5.0, and 0.85 mrem/hr, respectively.

On the basis of these calculations the Wyoming Magnetite-Maryland Serpentine concrete has been ruled unsatisfactory. The Tennessee Ferrophos-Maryland Serpentine concrete appears interesting and will be studied further, especially since it appears that the cost of materials for this concrete may be as low as 85 $/yd as compared to 108 $/yd for Wyoming Magnetite.

1.6 Building 4507 TRU Facility (F. L. Peishel, W. R. Whitson)

The design of Cell 4 equipment and supporting areas is 56% complete. A decision was made to use steam coil heating for the tanks requiring boiling operations and to purchase extended reach manipulators. The specifications for the cell tanks are being written, and these will be sent out with the tanks for bids the first week of July.

K-25 is proceeding with cell design based on the acceptance of an equipment layout by Chemical Technology personnel. The tankage for the makeup area has been reviewed and approved. Designs of the transfer drawer between Cells 3 and 4, the mercury vapor lighting fixture and the cell exhaust filters are in the process of review by Chemical Technology personnel. Some piping and shielding for transfer of solutions from Cell 1 to Cell 4 has been installed. The cell is in the process of having an Amercoat 74 system applied.

2.0 VOLATILITY PROGRAM
(R. P. Milford)

2.1 Program Planning

A meeting was held at AEC headquarters, Germantown, Maryland, on July 9 and 10, 1962, for a discussion of the over-all Volatility program between the various sites engaging in volatility activities and AEC representatives, particularly the Division of Reactor Development. Some impressions gained from attending the meeting are as follows:

(1) The present molten salt volatility program for Cells 1 and 2, Building 3019, will probably proceed as now planned through an equipment decontamination followed by several long-cooled checkout runs, a series of short-cooled zirconium-uranium runs, recovery of the EBR-1 - Core 2 meltdown material, oxide fuel runs, and shutdown for installation of improved molten salt handling equipment in Cell 1.

(2) In all probability no zirconium fluidized bed hot pilot plant equipment will be installed in Building 3019. Argonne National Laboratory personnel do not think it necessary to study either of their fluidized bed processes in a hot pilot plant. Instead, they propose to use a semi-works approach in which individual major items of equipment would be constructed full scale

and tested extensively cold. There were indications that they might request assistance from ORGDP in this effort.

(3) The Chemical Technology Division will probably install an oxidation unit in Cell 3, Building 3019, to study the processing of graphite base power reactor fuels.

(4) Another request was made that the Molten Salt Fluoride Volatility Process be evaluated by means of a full scale plant conceptual design and operating cost study. Reassurance was given that this will be completed during this fiscal year.

(5) The Division of Reactor Development has unallocated money available since the cancellation of the aqueous development work at the ICPP. A decision will be made in the near future as to whether a major portion of this money is made available for the Volatility Program or for some other effort in DRD. Chemical Technology requested additional funds for further corrosion studies at BMI, a greater effort on salt and fluorine recycle in Unit Operations, an extension of the plutonium effort in the laboratory, and more emphasis on the search for suitable salt mixtures for recovering uranium from aluminum and stainless steel base fuels.

(6) An interest was expressed by DRD personnel in an evaluation of the over-all AEC Volatility Program--either by a private engineering firm or by ORGDP personnel.

2.2 Fortran Program for Unfired Pressure Vessel Design (C. E. Prince)

To meet the need for the rapid design and costing of a number of vessels for a conceptual plant study, a Fortran program has been written for the IBM 7090 computer which will make the necessary calculations for the design of an unfired pressure vessel conforming to the 1959 ASME Boiler and Pressure Vessel Code, Section VIII, "Unfired Pressure Vessel." The program will consider both internal and external pressures and besides vessel dimensions will calculate the vessel weight, metal cost, fabrication cost on a weight basis, and sum these for the total vessel cost. It will design the vessels to a specified list of 27 standard outside diameters from 5.563 in. (5 in. Sch 40 pipe) through 84 in. and standard wall thicknesses from 0.125 in. through 1.5 in. The program is designed for use with ASME type dished heads, and thus far does not take into consideration nozzles, openings, or jackets.

Input data includes design capacity, freeboard ratio, straight side-to-outside diameter ratio, modulus of elasticity, maximum allowable tensile stress, design temperature, external and internal design pressures, metal and fabrication costs in dollars per pound, weld efficiency, corrosion allowance, material of construction, vessel identification number, and metal density.

Output data consists of a statement of the controlling pressure (external or internal) for both the shell and head of the vessel, a list of the input data, vessel design dimensions, total metal weight, total metal cost, total fabrication cost, total vessel cost, and several other intermediate calculated values.

This program was designed to apply to the straight line portions of the charts in Appendix V of the ASME Code which include only values of straight side length-to-outside diameter (L/D_o) below the critical length. Straight side length is the length of unsupported shell between heads or between circumferential stiffener rings. The upper limit of L/D_o in most cases is 4.0 and the lower limit is 0.8. The outside diameter to thickness ratio varies from 8. to 672. due to the input data. The program is also limited to that range in which the modulus of elasticity can be considered constant.

At present the program is in the final stages of operational testing.

Future plans are for the inclusion of a routine for jacket design, the inclusion of nozzles and flanges in the vessel weight, and for extension to longer vessels by using one L/D_o ratio for determining vessel shape and another in the external pressure shell thickness calculation which would use L equal to the distance between circumferential stiffener rings.

2.3 Assistance from BMI

The experimental alloys bracketing Alloy 79-4 in composition as previously listed (1) were exposed to HF in a melt supposedly 37.0-50.5-12.5 mole % LiF-NaF-BeF_2 at 650°C as in the previous alloy development experiment.(2) Numerical penetration values are not yet available, but the experiment resulted in very high corrosion as evidenced by penetration of the INOR-8 sparge tube, first in two days, and then in one day after replacing the original tube and resuming the test. In past runs under similar conditions, 93 and at least 100 hr exposure times have been possible.

The most reasonable salt charge analytical results show a composition of 46-30.7-23.3 mole % LiF-NaF-BeF_2 as compared to the 37-50.5-12.5 mole % requested. Two additional independent analytical checks are being made. Unfortunately, melting points of the two compositions are too close to be of any help, but a check of the melting point after addition of a specified amount of NaF to the test vessel would be informative, and this has been suggested to BMI.

The next study planned at BMI will involve cyclic exposure of various nickel-base alloys to O_2 and F_2 at elevated temperatures.

(1) ORNL-TM-287, "PDS Status Report for May 1962," June 29, 1962.
(2) ORNL-TM-257, "PDS Status Report for April 1962," May 31, 1962.

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

3.1 Hydrochlorination Test Equipment (A. M. Rom)

Design and drafting of the equipment for the Halogen Torrefactor Experiment were completed during the month and the drawings were submitted to the shop for fabrication. Materials for the equipment were placed on order as the design proceeded and are either already on hand or expected at an early date.

3.2 Chop and Leach Facility (W. F. Schaffer)

Operation of the cold chop-leach facility with aluminum jacketed-UO_2 simulated fuel elements began during the last week of the month. Certain chemical difficulties were encountered but the complex appeared to operate satisfactorily in all other respects.

3.3 PRDC and CPPD Design Study (W. F. Schaffer)

Removal of CPPD End Hardware. A simulated CPPD end hardware and fuel tube assembly was potted in a plastic compound and solidly clamped in the same fixture used in previous tests, except that the spring loading feature was not employed. The repaired 12 in. slitting saw was used and the cutting was done under mineral oil. The mill was operated under the same conditions as used previously, namely a speed of 15 rpm and feed rate of 3/8 in. per min. The cut was made easily and all pieces were retained by the potting compound. A second cut was made to further check the ability of the plastic to retain the cut pieces; a wafer approximately 3/16-in. thick was produced and remained intact. The method appears to be quite satisfactory and can undoubtably be adapted for remote operation for all fuels of this type. The method has the disadvantage of requiring additional steps in the reprocessing cycle, but appears to offer a reliable means of removing the end hardware without the frequent blade breakage experienced with the high speed abrasive wheels.

4.0 WASTE STUDIES
(J. O. Blomeke)

4.1 Plant Waste Modification (F. N. Browder, F. E. Harrington)

The Title I Engineering for the project phase I, Melton Valley waste systems and the structure for the waste evaporator and storage tanks, was completed. All required drawings and specifications were approved by ORNL and sent to AEC for final approval.

Title I Engineering for phase 2, process systems for waste evaporator and storage tanks, is progressing, but is several weeks behind schedule. The use of external cooling coils originally proposed for the high-level storage tank has met with fabrication and cost difficulties. The Engineering Department is conducting a review of these coils and the study of alternate methods. Final decision is expected to be reached early in July.

4.2 Pot Calcination Hot Cell Facility (B. B. Klima)

Meetings were held during the month to establish the location and tentative schedule for the installation of the Pot Calcination Hot Cell Facility. It was decided to locate the facility in Cell 1, Bldg. 4507, as originally planned.

The additional design work necessary for this installation is to be expedited so that the equipment can be installed initially in the Bldg. 4507 Cell Mockup on the third floor of Bldg. 4505 as soon as possible. Cell 1 should be ready for final installation in November 1962, and the cold testing in the mockup should be completed by that time.

Pilot Pit 2 will be modified to permit adiabatic storage of the calcined pots at that location. This facility should be ready by early 1963. The changes to the pilot pit will entail only modification of the top of the furnace and activation of the furnace and its controls, fitting and drilling of the plugs for the pit, minimal activation of the off-gas system, and an off-gas sampling station.

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

Process Design. A design meeting was held at Hanford with HLO personnel during the period of June 26-28. Subjects discussed included the Hanford Waste Management Program, the Hanford Spray Calciner flowsheet, the design of the Fuels Recycle Pilot Plant which will house the waste calcination processes, the pot calcination process flowsheet and mechanical program and the Chemical Technology pot calcination development program for Fiscal 1963. Results of the meeting pertaining to the pot calcination process and the Chemical Technology program were as follows:

(1) The proposed flowsheet and operating procedure were explained in detail to the Hanford personnel. An agreement was reached on the equipment items except for the fractionator where Hanford suggested the use of a "nitric acid absorber" that would produce 30% HNO_3 instead of the 60% using a reboiler and stripping section. Advantages given for an absorber included economy and lower corrosion rates due to the lower HNO_3 concentrations. ORNL agreed to study this proposal. The secondary off gas system proposed for preventing cell contamination during pot disconnecting was also left open for study since the proposed cells do not have a separate off gas system for this service. Several ways of tying this off-gas system into the process were discussed.

(2) Hanford will take over the development of a welded seal for the pot calciner as a continuation of their welding program for sealing fission product containers. Their proposed weld design is similar to that developed in our mechanical program except that it has a heavier weld section that doesn't permit full penetration. This is done to prevent "blow through" of the arc and does not require as close control of the current during automatic remote welding. We indicated that this design would be satisfactory if the crack below the weld did not accelerate corrosion under permanent pot storage conditions. Corrosion tests will be made to study this problem.

(3) Design and layout of the pot calcination equipment has been started. The engineering flowsheet will be developed jointly during a meeting in August. Hanford will install the process in the larger Fuel Recycle Pilot Plant cell (23 x 25 ft floor) formerly called the "Low Bay Cell." Its floor has been dropped 10 ft to give a total height to the bottom of the crane of about 27 ft. An attempt will be made to specify and purchase as much of the equipment as possible during Fiscal 1963. The building will probably be ready in 1964 which will provide sufficient time to mock up and test the process cold before installation in the hot cells.

(4) Hanford suggested that we test a Deming deep well type jet pump during our pump test program since they have had good success with this type pump on simulated IWW waste. A contact has been made to purchase one of these pumps for testing in our UNOP program.

(5) Information received on Purex IWW indicates that it will contain mercury intermittently and its concentration may be as high as 0.075 M (15 g/liter) which is higher than TBP-25 waste (5 g/liter). Therefore, it will be necessary to develop a calciner off gas system that will effectively handle mercury compounds from both Purex and TBP-25 wastes.

(6) Liaison with Hanford will be maintained through scheduled telephone calls. Check prints of drawings prepared by Hanford will be forwarded as soon as possible for comment by ORNL. Progress on the programs at both sites will be reviewed periodically during visits.

(7) A sampling schedule for the process was requested by Hanford in order to properly position samplers and design equipment for in-cell radiation monitors.

Mechanical Test Program. Two calcination pots and a filling station are under construction by the ORNL shops. The decision was made to do the work here after receipt of bids which gave delivery dates that would have delayed the program significantly. Installation of the furnace dolly control panel and furnace mockup at the Georgia Nuclear Laboratory has been completed. Control of the dolly and the furnace lift mechanism is currently being checked out.

4.4 Hydrofracturing Waste Disposal Experiment (H. O. Weeren)

An estimate was made of the cost of the materials for the cement mix proposed by Westco Research for the hydrofracture experiment. It was found that the fluid loss additive was the single most expensive ingredient; its use increased the cost of the mix by approximately a factor of three. About $17,000 worth of additive would be required for the proposed injection experiment. A search for a less expensive additive is now in process.

An M.I.T. Practice School study of the probable costs of waste disposal by hydrofracture (KT-585) indicates that for the disposal of unconcentrated waste the single greatest cost (by about a factor of five) is the cost of the materials that are injected with the waste. For the injection of waste concentrated by a factor of ten, amortization and labor costs become significant. If fluid loss additives must be used, however, material costs will be the major cost even for disposal of concentrated waste. These figures emphasize the necessity for development of a cheap mix for both concentrated and unconcentrated waste.

4.5 Storage of Calcined Waste in Salt (W. F. Schaffer, H. O. Weeren)

A preliminary cost estimate was prepared for an experiment to investigate the feasibility and safety of storage of calcined radioactive waste containers in salt mines using spent fuel elements to simulate the calcined waste. The demonstration would involve the packaging, handling and transportation of fourteen 30-day cooled ETR elements from National Reactor Test Station, Idaho, to the proposed Lyons, Kansas site or alternate Gnome site near Carlsbad, New Mexico. The packaged fuel elements would be transferred from the shipping cask on the surface through a vertical small bore hole to a subterranean room in the mine where the package would be remotely guided into a shielded loading fixture. Personnel at the mine level would transfer the fuel capsule from the shield into stainless steel lined holes located under the loading fixture. Two elements would be placed in each of seven holes arranged in a circular configuration with one center hole and six outer holes. The shield and loading fixture would be designed to move on a floor mounted bridge system capable of both traverse and lateral motion. The device would be designed so that its components could be lowered by means of the personnel lift and assembly could then be made with hand tools in the mine. The carrier proposed in the estimate would be a modified SRE cask with a new inner magazine and additional lead shielding. Conceptional drawings of the cask, loading fixture and arrangement of the experiment were also prepared.

The cost estimate included purchase of real estate for the surface installation, capital improvements at the mine site, surface installation, mine level preparation, transportation equipment, instruments, safety equipment, carrier and carrier auxiliaries (cooling equipment), shipping costs and operating costs for a two year period. A dummy run with a radioactive source, a concurrent mockup experiment with an electrically heated array in an adjacent mine area, were also included as well as design costs and a contingency of 25%. The two high cost items appear to be the capital improvements at the mine site (approximately 19.5%) and an operating cost of approximately 27% of the entire project. The total cost of the demonstration was estimated to be approximately $805,000. A savings of approximately $150,000 might be made by using the Gnome site since the capital improvements necessary at that site are minimized and other auxiliary equipment may be available for use. The salt structure is poor at the Gnome site and is not considered desirable for permanent storage of waste.

5.0 THORIUM FUEL CYCLE STUDIES
(A. R. Irvine)

5.1 Thorium Fuel Cycle Development Facility Conceptual Design (A. R. Irvine)

Giffels and Rossetti, Inc., have now submitted all drawings and sketches, a conceptual design report, and a cost estimate for approval. Most of the drawings were checked, red-lined, and approved as noted; the remaining items will be reviewed next month.

Material and welding specifications were prepared in cooperation with J. R. McGuffey and W. L. Morgan. These specifications apply to the cell liners, ventilation ducting, and radioactive off-gas and liquid waste lines. In brief, all 304L stainless steel will be bought to standard ASTM specifications with the exception that piping for radioactive off-gas and liquid waste lines will be corrosion tested and that the carbon content for all shapes, (i.e., sheet, plate, and tubing) will be limited to 0.030%. High quality welding to be used for the more critical services will be by the inert gas tungsten arc process and will require dye penetrant inspection of root pass and finished weld plus radiographic inspection. Second quality welding will be used for cell liners and similar materials. This quality welding may be by metal arc, submerged arc, or inert gas tungsten arc. Welders must be qualified to ASME Unfired Pressure Vessel Code including radiographic inspection of first welds. Finished welds will be dye penetrant inspected and soap-bubble leak tested.

Giffels and Rossetti, Inc., made a brief study of an incessant filter pit system. The study indicated that the mechanical operations required for changing filters by this system is quite simple. The criteria originally specified resulted in excessive costs being incurred for shielded mechanical devices and for stainless steel filter frame plates. The design can be revised to minimize the movable shielding and its attendant cost and aluminum can be substituted for stainless steel at a significant savings in both material and labor cost. With these changes, the increased cost for the better contained and more readily renewable system is approximately $30,000.

It was decided that the wall and ceiling liners and associated items in the Mechanical Processing and Contaminated Fabrication Cell should be specified as stainless steel rather than carbon steel in view of the lack of a demonstrated satisfactory method of protecting against atmospheric corrosion in a high radiation level, remotely maintained cell.

Two changes were made to improve materials handling in the facility. A 5-ton auxiliary crane was added to the bridge and a 3-ton elevator added to operate from the first floor level to the third floor.

The facility design was reviewed and approved by the Radiochemical Plants Review Committee.

5.2 Thorium-U^{233} Fuel Rod Facility (B. B. Klima)

Eight additional drawings were signed and released for fabrication during the month of June. The calcining furnace has been received, set up, and the door handling modification essentially completed. The uranium tank was fabricated. The Vanton pump in the system was replaced by a Durimet 20 centrifugal pump after the diaphragm of the Vanton pump failed twice. The vessel off-gas filter was tested and found to have a maximum efficiency at 50 cfm gas flow of 99.96%. The efficiency falls off with increased flow. A report on the filter test will be written in the near future.

Two additional problems have been studied. The first was sampling, and the second was repackaging of U^{233} metal components for dissolution.

6.0 MISCELLANEOUS PROJECTS

6.1 Eurochemic Assistance Program (W. M. Sproule)

No transmittal letters were sent. All Eurochemic-originated documents being held by Laboratory Records were released for distribution. Four previously received Eurochemic-originated documents were reproduced and distributed. E. M. Shank departed for his new assignment at the Eurochemic Company in Mol, Belgium.

6.2 Fuel Shipping Study (L. B. Shappert)

Six cask drop tests were made during the month. Pertinent data on these tests are given in Table 1, below.

Table 1. Summary of Data on Cask Drop Tests #20 thru #25

Drop No.	Cask Weight, tons	Drop Height, ft	Attitude	Special Features of Test
20	6	2	Horizontal	Cask stress coated
21	1-1/2	10	Horizontal	Dropped on 2 trunions
22	1-1/2	5	Horizontal	Dropped onto 6" Piston
23	1-1/2	20	Horizontal	Dropped on 2 trunions
24	6	4	Horizontal	Cask stress coated
25	1-1/2	28	Horizontal	Weld Failure

The stress patterns observed in Drop #20 were quite similar to those observed when a 1-1/2 ton cask was dropped from similar heights.

In tests 21 and 23 in which the casks were dropped on trunions the casks were fabricated with the four trunions penetrating about 1 in. through the outer steel shell into the lead and were fastened by a seal weld to the outer shell. These welds broke on both trunions in Drop #21 and the trunions were pushed approximately 2 in. further into the lead. The lead flowed quite easily and tended to act as a shock absorber. The inner shell was not visually indented by the impacting trunion even though the thickness of the lead shield is about 3-1/2 in. In Drop #23 the trunions were driven in flush with the outer shell but did not penetrate the inner shell stopping about 1 in. from it. The inner shell was slightly dented.

In Drop #22 apparent damage was no greater than found in Drop #18 when the same size cask was dropped 3-1/2 ft onto the 6-in. diameter piston. No penetration was achieved in either case.

In Drop #24 the stress patterns were again similar to the patterns obtained from previous smaller cask drops.

Drop #25 produced a failure in the weld at the point of impact where the outer shell joins the end of the cask. This is the first failure obtained by dropping the cask in a horizontal attitude. A crack was also produced around the lead filling hole which happened to be just above the point of impact. High stress areas have been observed around lead filling holes in stress coated drops even from low drop heights. Care must be taken to make full penetration welds of any plugged holes which penetrate the steel shell of a lead-filled cask.

A study of the effect of shipping different types of fuels on the shipping costs is continuing.

6.3 AHBR Chemical Plant Cost Study (F. E. Harrington, W. G. Stockdale)

The estimate of the capital costs for the two chemical plants required to complete the fuel cycle for the two reactor complexes described in SL 1875, "1000 Mw_e AHBR Thorium Breeder Reactor Plant Cost Evaluation" was completed. The estimated total project costs were $13,920,000 and $15,720,000 for the two plants with 222 and 1065 kg Th per day throughput, respectively.

6.4 Saline Water Studies (F. E. Harrington)

Large Nuclear Reactors. R. P. Hammond of Los Alamos Scientific Laboratory recently suggested that large breeder reactors offered steam for saline water conversion at a small fraction of the cost of fossil fuel. Specifically, Dr. Hammond's studies were based on a fast paste plutonium breeder. I. Spiewak and R. H. Chapman of ORNL, in a preliminary study, have also shown potential for low cost steam from reactors based on scale-up of existing reactor types. These surveys have led to the initiation of a detail study of reactor types suitable for large-scale water desalination. ORNL will investigate the molten salt, pebble bed, and D_2O moderated reactors at 2,500, 25,000, and 100,000 Mw thermal outputs. Dr. Hammond will investigate the fast paste breeder reactor at 25,000 Mw thermal. An effort will be made to encourage Babcock & Wilcox to evaluate their spectral shift reactor. Chemical Technology will provide assistance in these studies by evaluating the fuel cycle costs and later by optimization studies on the water conversion plants to go with the various reactors.

Cost of Pumping Water. An evaluation of the cost of pumping water based on 7.4% amortization and 1¢/kwh operating charges was made to check L. Koenig's data reported in "Disposal of Saline Water Conversion Brines," OSW Report #20 (PB161 394-1958).

The results, compared with Koenig's figures, are as follows:

Flow x 10^6 gpd	Koenig's Study ¢/1000 gal	This Study ¢/1000 gal
0.1	3.2	
0.144		3.9
1.0	1.0	
1.44		0.9
10	0.32	
14.4		0.5
100	0.1	
1000	0.032	

Value of Scale Control. Current practice for scale control involves a combination of addition of H_2SO_4, at a cost of about 2¢/1000 gal of product, for pH (~7.5) control and operational procedures to limit the maximum temperature in distillation and the concentration factor for the feed liquor. To evaluate additional scale control, an increase of 50°F in available ΔT was assumed and the cost of product water calculated for current practices and the increased ΔT. At an energy cost of 30¢/10^6 Btu a saving of ~5¢/1000 gal of product water would result in an existing plant. An additional ~6¢/1000 gal could be obtained by a reoptimization of the distillation plant resulting in more evaporator effects.

6.5 IWW Carrier Fabrication (A. M. Rom)

Fabrication of the IWW Carrier was approximately 85% complete; effort during the past month was concentrated on the stainless steel parts of the carrier. Slag stringers in the stainless steel were encountered during machining of the base flange of the lead collar but the part was accepted after due consideration since it was felt that the presence of slag stringers would not adversely affect the intended use of the part.

Metallic "O" rings A-16, C-15, and C-16 were received, thereby completing delivery on all items requisitioned for the carrier.

7.0 PROJECT ENGINEERING

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

A list of the 43 drawings started during June 1962 is given in Table 2. In addition, 34 drawings started earlier proceeded to the check print stage and 10 to approved status. In addition, 7 older drawings were revised. In June, 8 sketches and 84 illustrations were prepared.

A breakdown of drafting time during June by cost accounts is as follows:

Acct. No.	Man-hours	% of Total	Acct. No.	Man-hours	% of Total
3370-1	22.0	1.0	3290-70	2.0	0.1
3370-20	104.0	4.8	3490-29	66.5	3.1
3370-22	14.0	0.6	4435-72	30.0	1.4
3370-33	97.0	4.5	A70615-61	1.0	-
3370-34	223.5	10.4	A70616-61	73.0	3.4
3370-72	12.0	0.6	A70624-61	4.0	0.2
3370-73	36.0	1.7	A70625-61	105.0	4.9
3370-104	104.0	4.8	A70627-61	4.0	0.2
3370-106	82.0	3.8	A70629-61	98.0	4.5
3370-108	232.0	10.8	A70640-61	96.0	4.5
3370-110	80.0	3.7	A70641-61	48.0	2.2
3370-128	8.0	0.4	A70644-61	23.0	1.0
3370-133	193.0	9.0	A70665-61	10.0	0.5
3370-135	337.0	15.6	A70666-61	44.0	2.0
3370-137	6.0	0.3	Total	2155.0	100.0%

Overtime worked in June was 139 man-hours.

7.2 Engineering Department Assistance

A summary of drawings prepared during June in the Engineering Department is given in Table 3.

7.3 Material Purchase Status

Table 4 gives a listing of all outstanding purchase requisitions (except instruments) as of July 1, 1962.

7.4 Work Order Status

Table 5 presents a listing of all outstanding work orders as of July 1, 1962, for which the Process Design Section is responsible.

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

HEG:nr
Attachments: Tables 2 through 5

Table 2. Summary of Drawings Started in the PDS Drafting Room During June 1962

Job No.	Dwg. No.	Rev.	Title	Date Started
3370-20	D-46101		Chloride Volatility Halogen Torrefactor - Assembly	4/10/62
3370-20	D-46125		Chloride Volatility Halogen Torrefactor - Product Collector	6/8/62
3370-20	D-46126		Chloride Volatility Halogen Torrefactor - Hood Frame & Hoist	6/8/62
3370-20	D-46131		Chloride Volatility Halogen Torrefactor - Layout	6/8/62
3370-20	D-46146		PRFP - Scanning Periscope - Optical System	6/28/62
3370-34	D-46098		Waste Disposal Development - UNOP Pump Loop Piping	6/19/62
3370-34	E-46106		Waste Calcination Pilot Plant Pot Calcination Flowsheet - Darex APPR Waste Batch Operation, 8" Dia Pot	6/6/62
3370-34	D-46114		Waste Disposal Development - Modification to Tank CT-324	6/29/62
3370-108	(TRU)			
A70615-61	D-45834		TRU Development - Cell 4 Special Plugs B & C - Assembly and Details	6/5/62
A70629-61	D-52249		TRU Process Facility - TRU Diaphragm Pump Mounting - Assembly and Details	5/25/62
A70629-61	D-52250		TRU Process Facility - TRU Diaphragm Pump Arrangement	5/25/62
A70640-61	D-46137		TRU Development - Cell Face Mockup Transfer General Agt	6/15/62
A70640-61	D-46138		TRU Development - Cell Face Mockup Transfer Area - Cell Frame Base and Floor Plate	6/18/62
A70640-61	D-46139		TRU Development - Cell Face Mockup Transfer Area - Viewing Window & Manipulator Section, Framing & Sheating Details	6/19/62
A70640-61	D-46140		TRU Development - Cell Face Mockup Transfer Area - Window Detail	6/20/62
A70640-61	D-46141		TRU Development - Cell Face Mockup Transfer Area - Dry Box Section	6/20/62

Table 2, Continued

Job No.	Dwg. No.	Rev.	Title	Date Started
A70640-61	D-46142		TRU Development - Cell Face Mockup Isometric Arrangement	6/11/62
A70640-61	D-46143		TRU Development - Cell Face Mockup Transfer Area Addition	6/25/62
A70641-61	E-52064		TRU Process Facility - Engineering Flowsheet No. 1	6/12/62
A70641-61	E-52065		TRU Process Facility - Engineering Flowsheet No. 2	6/12/62
A70641-61	E-52066		TRU Process Facility - Engineering Flowsheet No. 3	6/12/62
A70643-61	E-52214		TRU Process Facility - Right Side Equip. Rack, Test Struct. Dets.	6/15/62
A70643-61	E-52215		TRU Process Facility - Right Side Equip. - Basic Structure	6/13/62
A70644-61	D-52177		TRU Process Facility - Mtg. Details of Service Disc. on Cub. Roof	5/7/62
A70665-61	C-46132		TRU Process Facility - HFIR Target - Irradiation Prototype - Alternate No. 1	6/6/62
A70665-61	D-46144		TRU Development - MTR Irradiation Holder for TRU HFIR Target Prototype	6/27/62
A70665-61	D-46145		TRU Development - MTR Irradiation Holder for TRU HFIR Target Prototype - Alternate No. 2	6/28/62
3370-133	C-44694		Pu-Al Alloy Fuel Rod Carrier - Relief Valve	6/9/62
3370-133	D-46129		Pu-Al Alloy Fuel Rod Carrier - Assembly - Relief Valve Housing and Mid Section Shield Ring Details	6/21/62
3370-133	D-46133		Pu-Al Alloy Fuel Rod Carrier - Relief Valve Assembly & Dets.	6/1/62
3370-133	C-46147		Pu-Al Alloy Fuel Rod Carrier - Thermocouple Assembly	6/28/62
3370-135	D-46135		ThO_2 Blending & Weighing Facility - ThO_2 Blender Shell	6/14/62
3370-135	D-46136		ThO_2 Blending & Weighing Facility - ThO_2 Blender Assembly	6/18/62
3490-29	D-45982		Radioactive Solids Disposal Demonstration - Concept Surface Charging Arrangement	6/8/62
3490-29	D-45983		Radioactive Solids Disposal Demonstration - SRE Carrier Modification for Demonstration Assembly	6/4/62

Table 2, Continued

Job No.	Dwg. No.	Rev.	Title	Date Started
3490-29	D-45984		Radioactive Solids Disposal Demonstration - SRE Carrier Modification for Demonstration - Carrier Rack Subassembly	6/5/62
3490-29	D-45985		Radioactive Solids Disposal Demonstration - SRE Carrier Modification for Demonstration - Detail Sheet No. 1	6/15/62
3490-29	D-45986		Radioactive Solids Disposal Demonstration - SRE Carrier Modification for Demonstration - Detail Sheet No. 2	6/6/62
3490-29	D-45987		Radioactive Solids Disposal Demonstration - Plot Plan Showing Location of Demonstration Relative to City of Lyons	6/13/62
3490-29	D-45988		Radioactive Solids Disposal Demonstration - Plan of Lyons Mine Showing Ventilation and Surface Railroad	6/12/62
3490-29	D-45989		Radioactive Solids Disposal Demonstration - Schematic Cross Section of Demonstration	6/11/62
3490-29	D-45990		Combustion Volatility Facility Consolidated Service Piping for Cell "A" West Bank	6/18/62
3490-29	D-45991		Combustion Volatility Facility Consolidated Service Piping for Cell "A" West Bank Section	6/22/62
3490-29	D-45992		Combustion Volatility Facility - Plot Plan	6/18/62
3490-29	D-45993		Combustion Volatility Facility - Schematic Gas & Cooling Supply Services	6/28/62

Table 3. Summary of Drawing Progress in Engineering Department for Month of June 1962

Bldg. No.	W. O. No.	Dwg. No.	Rev.	Title	Transmittal Date
3019	A-93809-10	D-50424		Cell #4 Service Index	6/12/62
3019	A-93809-10	D-50885		Electrical Notes & Legends	6/6/62
3019	A-93809-10	D-50886		Power & Lighting Plan, First Floor	6/6/62
3019	A-93809-10	D-50887		Power & Lighting Plan, Second Floor	6/6/62
3019	A-93809-10	D-50888		Electrical Section Details & Panel Schedule	6/6/62
3019	A-93809-10	D-50889		Electrical Elevations & Details	6/6/62
3019	A-93809-10	D-50890		440 Volt Wiring Diagram	6/6/62
3019	A-93809-10	D-50891		Equipment Shaft Connection Diagram	6/6/62
3019	A-93809-10	D-50892		Connection Diagram & Panel Details Sheet #1	6/6/62
3019	A-93809-10	D-50893		Remote Welder Connection Diagram	6/6/62
3019	A-93809-10	D-50894		Remote Welder Control Schematic	6/6/62
3019	A-93809-10	D-50895		Connection Diagram & Panel Details Sheet #2	6/6/62
3019	A-93809-10	D-53483		Equipment Shaft Cell #4 Installation Drawing	6/12/62
3019	A-93809-10	D-53484		Cell #4 Equipment Shaft Frame Structure	6/12/62
3019	A-93809-10	D-53485		Miscellaneous Details	6/14/62
3019	A-93809-10	D-53500		Classifier Assembly	6/14/62
3019	A-93809-10	D-53501		Classifier Detail Sheet No. 1	6/14/62
3019	A-93809-10	D-53502		Classifier Detail Sheet No. 2	6/14/62
3019	A-93809-10	D-53503		Classifier Detail Sheet No. 3	6/14/62
3019	A-93809-10	D-53504		Classifier Detail Sheet No. 4	6/14/62
3019	A-93809-10	D-53505		Classifier Detail Sheet No. 5	6/14/62
3019	A-93809-11	D-46558		Recycling Hopper - Assembly	6/1/62
3019	A-93809-11	D-46559		Recycling Hopper - Detail Sheet No. 1	6/1/62
3019	A-93809-11	D-46560		Recycling Hopper - Detail Sheet No. 2	6/1/62
3019	A-93809-11	D-46561		Recycling Hopper - Detail Sheet No. 3	6/1/62
3019	A-93809-11	D-46562		Recycling Hopper - Detail Sheet No. 4	6/1/62

Table 3, continued

Bldg. No.	W. O. No.	Dwg. No.	Rev.	Title	Transmittal Date
3019	A-93809-11	D-46563		Recycling Hopper - Detail Sheet No. 5	6/1/62
3019	A-93809-11	D-51224		Glove Port Detail Sheet No. 1	6/1/62
3019	A-93809-11	D-52966	1	Batch Evaporator Details	6/1/62
3019	A-93809-11	D-52967	1	Compressed Gas Cylinder Station	6/21/62
3019	A-93809-11	D-53479		Repair Area Carriage Assembly and Details	6/1/62
3019	A-93809-11	D-53480		Repair Area Door Assembly and Details	6/1/62
3019	A-93809-11	D-53481		Vibrator Control Brackets Sheet No. 1	6/1/62
3019	A-93809-11	D-53482		Vibrator Control Brackets Sheet No. 2	6/1/62
3019	A-93809-11	D-53835		Drawing Index	6/1/62
3019	A-93809-11	D-54256		Left Hand Glove Port & Right Hand Glove Port Assy.	6/1/62
3019	A-93809-11	D-54257		Glove Port & Shielding Glove Port Assembly	6/1/62
3019	A-93809-11	D-54259		Service Panel Installation Details	6/1/62
3019	A-93809-11	D-54260		Glove Port Detail Sheet No. 2	6/1/62
3019	A-93809-11	D-54261		Glove Port Detail Sheet No. 3	6/1/62
3019	A-93809-11	D-54263		Blend Tank Details	6/1/62
3019	A-93809-11	D-54264		Blend Tank Table Installation	6/1/62
4505	A-93174-03	D-37222		Traveling Knife Model III	6/7/62
4505	A-70579-17	D-51061		NaK Reactor Assembly & Details	6/20/62
4505	A-70579-17	D-51062		NaK Reactor Details	6/20/62
4507	A-70611-11	D-45810	2	MS-442-16 Stage Miser Settler - Assembly	6/5/62
4507	A-70611-11	D-45811	2	MS-443-8 Stage Mixer Settler - Assembly	6/5/62
4507	A-70611-11	D-45814	2	Mixer Settler Detail Sheet No. 3	6/5/62
4507	A-70611-11	D-45817	2	Mixer Settler Detail Sheet No. 6	6/5/62
4507	A-70611-11	D-45819	0	Mixer Settler Impellers, Subassembly	6/5/62

Table 3, continued

Bldg. No.	W. O. No.	Dwg. No.	Rev.		Transmittal Date
7920	A-70442-11	D-43972		Transfer Area Carrier - Charging Concept	6/25/62
7920	A-70442-11	D-43973		Transfer Area Cubicle - AE Portion	6/25/62
7920	A-70442-11	D-53981		Cell Cubicle #1 Floor Pan - Assembly & Details	6/27/62
7920	A-70442-11	D-53982		Cell Cubicle #1 Floor Pan - Detail Sheet #1	6/27/62
7920	A-70442-11	D-53983		Cell Cubicle #2 Floor Pan - Assembly & Details	6/27/62
7920	A-70442-11	D-53984		Cell Cubicle #2 Floor Pan - Detail Sheet #2	6/27/62
7920	A-70442-11	D-53991		Cell Cubicle 8 & 9 - Bagout Station Subassy A	6/28/62
7920	A-70442-11	D-53992		Cell Cubicle 8 & 9 - Bagout Station Det. Sh. 1	6/28/62
7920	A-70442-11	D-53993		Cell Cubicle 8 & 9 - Bagout Station Det. Sh. 2	6/28/62
7920	A-70442-11	D-53994		Cell Cubicle 8 & 9 - Bagout Station Det. Sh. 3	6/28/62
7920	A-70442-11	D-53997		Cell Cubicle 1,2, & 3 - Roof - Assy. & Details	6/25/62
7920	A-70442-11	D-53998		Cell Cubicle Typical Roof Details	6/25/62
7920	A-70442-11	D-53999		Cell Cubicle 4,5,6,7 - Assembly & Details	6/25/62
7920	A-70442-11	D-54000		Cell Cubicle 8 & 9 Roof - Assembly & Details	6/25/62

Table 4. Purchase Requisition Status, June 1, 1962

Job No.	Purchase Req. No.	Date Issued	Description
Miscellaneous			
-59	D-0014	3/29/61	U jet and explosive valve tests
-30	D-0116	3/12/62	Six 316 SS O-ring gaskets
-135	D-0121	3/27/62	30,000 Pyrex raschig rings
700	D-0128	4/30/62	Hastelloy-C seamless tubing
700	D-0129	4/30/62	Hastelloy-C plate and bar
700	D-0130	4/30/62	Taper tube expander
-133	D-0139*	6/5/62	Spring for relief valve
-28	D-0141*	6/13/62	6 Zytel male connectors
-20	D-0142	6/19/62	1 safety head assembly
-28	D-0143	6/20/62	24 pc AGR graphite
-30	D-0144	6/22/62	Instrument paint
-73	D-0145*	6/26/62	Photoreduce drawings
-108	D-0146	6/26/62	600 perforated tantalum discs
Waste Calcination			
605	G-1003	6/7/61	Lockheed subcontract
PRFP - Mechanical			
511	D-6270	3/9/62	Fabricate shear valve
Volatility			
404	D-7019	6/29/61	INOR-8 pipe and tubing
404	D-7022	12/20/61	HyMu 80 plate
TRU - Solvent Extraction Facility			
702	G-7508	2/15/62	Two Lapp Microflo Pulsafeeders
702	G-7510	2/16/62	One diaphragm pump
702	G-7521	4/6/62	Homalite plate for MS
702	G-7529	5/17/62	
702	G-7530	5/23/62	80 Bronze gate valves
702	G-7531	5/23/62	16 Brass ball check valves
702	G-7532	5/23/62	11 SS ball valves
702	G-7533	5/28/62	Six pieces Homalite plate
702	G-7534	5/31/62	Fabricate 500 disconnect plate

Table 4, Continued

Job No.	Purchase Requisition	Date Issued	Description
108	G-7535*	6/4/62	Teflon seats for Hills McCanna valve
108	G-7536	6/12/62	45 Graphite rods
108	G-7537	6/13/62	2 Electronic tuners
108	G-7538	6/15/62	1/2 HP vacuum pump
108	G-7539	6/18/62	3 pc Homalite plate
108	G-7540	6/18/62	Amercoat #74
108	G-7541	6/18/62	25 Mixer Settler Impellers
108	G-7542*	6/19/62	20 ml/min Microflo pump
108	G-7543	6/25/62	4 toggle clamps
108	G-7544	6/26/62	12 - 135 cfm Absolute filters
108	G-7545	6/26/62	12 - 135 cfm prefilters
108	G-7546	6/28/62	20 pc Pyroceram
BNL-Kilorod Program			
-135	G-7714	4/30/62	Personnel plastic suit
-135	G-7716	6/1/62	Wire tying tool
-135	G-7717	6/5/62	4 Furnace terminal straps
-135	G-7718	6/12/62	6 Alumina crucibles
-135	G-7719	6/14/62	20 gpm SS centrifugal pump

*Issued and completed in June, 1962.

Table 5. Work Order Status July 1, 1962

Number	Job Order Number	Charge Number	Engr.	Date Issued	Cost Estimate	Description
3508	A-06412-11		EJF	6/ /62		Preliminary Design of Alpha Lab. Addition to 3508
IWW Carrier						
-30	A-93789-30	3902-40-3370-0030	AMR	2/15/62	15,400	Fabricate IWW Carrier
Fuel Shipping Study						
-113	A-01570-11	3370-53-0113	LBS	9/20/61	12,000	Assistance by B.L. Greenstreet (Y-12) on Cask Drop Tests
-113	A-01603-11	3370-54-0113	LBS	1/12/62	15,000	Design and Install Cask Drop Pad and Perform Drop Tests
-113	A-20688-11	3370XX-113	LBS	5/18/62	15,000	Instr. for Cask Drop Tests
BNL-Kilorod Program						
-135	A-01597-11	3370-53-0135	BBK	12/21/61	1,300	Build Mockup Cell
-135	A-01634-11	3370-53-0135	BBK	4/5/62	1,200	Fabricate Experimental Th-U Blending Tank
PuAl Carrier						
-139	A-01661-11	3370XX-139	ARI	6/29/62	2,100	Revise PuAl Fuel Cask
Power Reactor Fuel Processing						
500	A-94019-30	3902-40-3370-0020	FEH	3/7/62	5,000	Build Transfer Carrier for HRLAF
500	A-20706-11	3370-XX-0020	AMR	6/22/62	7,300	Instrumentation for Halogen Tarrefactor
Waste Program						
603	A-93534-10	3900-40-3632	FEH			Design of Waste Tank and Evaporator
605	A-01636-11	3370-54-0034	JMH	4/17/62	12,000	Fabricate Two Calcination Pots
605	A-01638-11	3370-54-0034	JMH	4/24/62	4,500	Fabricate Filling Station Parts
605	A-01645-11	3370-XX-34	JMH	6/23/62	18,000	Fabricate Filling Station and Alternate
605	A-70604-11	3370-53-0030	HOW	7/26/61	19,300	Fabricate and Install Pot Calcination Hot Cell Unit
605	A-70604-12	3370-53-0030	JOB	8/28/61	1,980	Fabricate Densimeter and Controlled Rate Steam Jet
Transuranium Facility						
-108	A-43042-11	3370-53-0108	BFB	2/13/62	10,000	TRU Facility Design Support and Review by E & M
-108	A-43042-12	3370-53-0108	BFB	2/13/62	5,000	TRU Facility Design Support and Review by I & C
-108	A-70611-11	3370-53-0108	FLP	1/8/62		Design of Two Mixer-Settlers
-108	A-70611-12	3370-53-0108	FLP	1/24/62	3,000	Design Drive for TRU Mixer-Settlers, 4507
-108	A-70611-20	3370-54-0108	FLP	3/16/62	4,250	Fabricate Mixer-Settler
-108	A-70615-11	3370-53-0108	FLP	2/2/62	2,500	Design Filters for Cell 4, 4507
-108	A-70615-12	3370-53-0108	FLP	3/12/62	1,120	Design Transfer Port, Cells 3 to 4, Bldg. 4507
-108	A-70615-13	3370-53-0108	FLP	3/27/62	700	Fabricate 30 Seals for 2-1/2 in. Pipe Sleeves
-108	A-70615-14	3370-54-0108	FLP	4/19/62	1,650	Design Replaceable Manipulator Boot
-108	A-70615-15	3370-XX-0108	FLP	6/11/62	600	Fabricate Sleeve Inserts, Cell 4, 4507
-108	A-70615-16	3370-XX-0108	FLP	6/20/62	1,300	Fabricate Two Filter Housings for Cell 4, 4507
-108	A-70617-11	3370-53-0108	FLP	2/3/62	280	Design Service Piping Extensions
-108	A-70617-12	3370-53-0108	FLP	2/3/62	1,850	Design Makeup Area Equipment
-108	A-70617-13	3370-53-0108	FLP	2/3/62	1,120	Design Solution Addition Glove Box
-108	A-70617-14	3370-53-0108	FLP	2/3/62	560	Design Pipe Sleeve Inserts
-108	A-70617-15	3370-53-0108	FLP	2/3/62	1,400	Design Service Piping, Makeup Area
-108	A-70617-16	3370-XX-0108	FLP	6/20/62	3,910	Fabricate Tanks & Equipment for 4507 Facility
-108	A-70617-17	3370-XX-0108	FLP	6/27/62	9,000	Fabricate and Install Makeup Equip. for Cell 4, 4507
-108	A-70617-21	3370-53-0108	FLP	3/16/62	4,010	Fabricate 500 Lead Bricks
-108	A-70617-22	3370-53-0108	FLP	4/9/62	7,500	Modifications to Cell 4, Bldg. 4507

Table 5, Continued

Number	Job Order Number	Charge Number	Engr.	Date Issued	Cost Estimate	Description
-108	A-70617-23	3370-53-0108	FLP	4/9/62	600	Fabricate Two Disconnect Clamps
-108	A-70617-24	3370-XX-0108	FLP	5/2/62	1,100	Fabricate Hastelloy Pipe
-108	A-70617-25	3370-XX-0108	FLP	4/27/62	3,700	Install Shielding Support in Cell 4
-108	A-70617-26	3370-XX-0108	FLP	5/2/62	4,200	Install Piping for T-416 and T-417
-108	A-70618-11	3370-53-0108	FLP	1/24/62	14,000	Design Equipment Removal Cubicle, 4507
-108	A-70619-11	3370-53-0108	FLP	1/24/62	9,680	Design Sample Removal Cubicle
-108	A-70620-11	3370-53-0108	FLP	2/3/62	2,240	Design In-Cell Service Piping
-108	A-70620-12	3370-53-0108	FLP	2/3/62	560	Design Electrical Sleeve Inserts
-108	A-70620-13	3370-XX-0108	FLP	6/27/62		Fabricate and Install Service Piping for Cell 4, 4507
-108	A-70621-11	3370-53-0108	FLP	2/8/62	840	Design Carrier for Sample Cubicle
-108	A-70622-11	3370-53-0108	FLP	2/3/62	1,680	Design Electrical Equipment for TRU Solvent Extraction Facility
-108	A-70623-11	3370-54-0108	FLP	1/16/62	5,344	TRU Instrumentation Design, Solvent Extraction Facility, 4507
-108	A-70623-12	3370-53-0108	FLP	1/16/62	9,403	Procure Instruments for TRU Solvent Extraction Facility
-108	A-70623-13	3370-53-0108	FLP	2/21/62	5,347	Fabricate and Install Instruments for TRU Salvent Extraction Facility
-108	A-70625-11	3370-53-0108	WDB	4/12/62	11,800	Fabricate Experimental Pulse Column Set
-108	A-70625-12	3370-XX-0108	WDB	4/23/62	500	Fabricate Test Parts for Mixer-Settler
-108	A-70627-12	3370-53-0108	EJB	4/3/62	180	Fabricate Parts for TRU Disconnects
-108	A-70627-14	3370-53-0108	WDB	4/9/62	150	Roll Tantalum and Hastelloy-C Tubing
-108	A-70633-11	3370-XX-0108	WDB	5/4/62	14,000	Pre Title II Design Studies for TRU Chem. Proc. Instr. (Replaces A-70442-12)
-108	A-70660-11	3370-53-0108	FLP	4/16/62	2,600	Fabricate One 16-Stage Mixer-Settler
-108	A-70666-11	3370-XX-0108	BFB	5/2/62	10,000	Assignment of F. L. Hannon to TRU Mech. Design Status
-108	A-70666-12	3370-XX-0108	BFB	5/2/62	1,500	Fabricate Model of TRU Cells
-108	A-70666-13	3370-XX-0108	BFB	6/7/62	10,000	Preliminary Design and Specs for Intercell Conveyor, 7920
-108	A-70666-14	3370-XX-0108	BFB	6/7/62	7,500	Preliminary Design of Cell Cubicle, 7920
-108	A-70666-15	3370-XX-0108	BFB	6/7/62	7,800	Preliminary Design of Transfer System Components, 7920
-108	A-70666-16	3370-XX-0108	BFB	6/7/62	2,400	Preliminary Design of Transfer Area, Cubicle Area, Charging Components, 7920
-108	A-70666-17	3370-XX-0108	BFB	6/7/62	2,400	Preliminary Design for MS Manipulator Booting Assemblies
-108	A-70667-11	3370-XX-0108	FLH	5/16/62	34,000	Design Equipment Transfer System
-108	A-70668-11	3370-XX-0108	FLH	5/16/62	4,400	Design Cell Cubicle Components
-108	A-70669-11	3370-XX-0108	FLH	5/16/62	8,500	Design Transfer Area Cubicle Carrier Parts
-108	A-70670-11	3370-XX-0108	FLH	5/16/62	3,400	Design Manipulator Booting Assemblies
-108	A-70671-11	3592-	WEU	5/3/62	30,000	Assignment of B. N. Rabards to TRU Critical Path Scheduling

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