MASTER

OAK RIDGE NATIONAL LABORATORY

Operated by

UNION CARBIDE NUCLEAR COMPANY

Division of Union Carbide Corporation

Post Office Box X

Oak Ridge, Tennessee

External Use Authorized

ORNL

CENTRAL FILES NUMBER

59-5-35

DATE: May 11, 1959

SUBJECT: POWER REACTOR FUEL REPROCESSING: MECHANICAL PHASE

TO: W. F. Schaffer, Jr.

FROM: B. B. Klima

COPY NO. 62

ABSTRACT

The major events in the mechanical phase of the Power Reactor fuels reprocessing program during April were:

1. Detailed design of the equipment necessary for the SRE fuel element reprocessing was intensified.
2. Expression on the part of Atomics International that the carrier should be vertically loaded.
3. Cancellation of the surplus shear due to significant progress toward design and procurement of the Production Prototype.

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The schedule (see Table 1) has been expanded considerably to include a further breakdown of the contemplated work. The dates indicated on the schedule have not changed significantly; however, a significant number of new items have been added.

The description of the phases of the work includes a complete description of each item so that references to other documents are unnecessary.

The status of procurement is shown in Table 2. A total of 56 purchase requests have been turned in to the Purchasing Department. A total of \$122,413.06 has been committed by purchase orders and a total of 26 purchase requests have been received for a total value of \$7,496,46.

A summary of the work orders is shown in Table 3. Thirteen design and twelve fabrication and installation work orders are active at this time. Four work orders have been cancelled. The active work orders are for a total of \$319,925 with \$148,576 set aside for Labor. Expenditures on these work orders through the month of March amount to a total of \$102,234.

Based on the cost figures available the average mandays per day of labor expended on the project are shown in Figure 1. Approximately sixteen design personnel and nineteen fabrication and installation craftsmen per day were assigned to this program during the month of March. It is estimated (dotted line) that the effort for the month of April was approximately seventeen designers per day and nineteen craftsmen per day. These figures give an index of the effort expended on this program during the last four months.

Proposed plan and elevation layouts of the equipment in the Segmenting Facility, Building 3048, is shown in Figures 2 and 3. These layouts show both the equipment for decladding and shearing in place. Present philosophy is that only the equipment necessary for the decladding will be installed first. This will include the saw, traversing table, mechanical decladding equipment, auxiliary decladder, slug washer, canner, NaK disposal equipment, scrap disposal containers and many miscellaneous special tools. After all of the SRE fuel elements have been processed, present plans are that most of this special equipment will be decontaminated and removed to make way for the production prototype shear and other equipment needed for the oxide type fuel element reprocessing.

INTRODUCTION

Surveys have been made of the design, fabrication, and installation work requirements for the Mechanical Phase of the Power Reactor Fuel Reprocessing Program.* This report is a complete review of the mechanical phase including the accomplishments during the month of April and gives the status of the various portions of the program at the end of April.

STATUS AND DESCRIPTION

Dejacketing Equipment

Fuel elements of the SRE and PRDC type consist of a stainless steel tubing jacket NaK bonded to uranium or uranium alloy fuel pins. Although these fuels could be sheared and leached, they appear to lend themselves well to dejacketing techniques. The equipment is designed or is in the process of design to remove the inert ~~ends and hardware~~, ~~expel the fuel pins from the~~ stainless cladding, clean the fuel free of the bonding and can the fuel in aluminum containers for chemical reprocessing. The following equipment is now contemplated:

1. Mechanical Decladding Equipment

The mechanical decladding equipment has been designed to take individual SRE fuel rods, remove the wire using a cutter, remove the end pins by cutting the tubes, push the fuel slugs from the outer shell using either a ram or hydraulic pressure, roll the scrap outer shell into a neat spiral, collect the fuel slugs in a basket and collect the NaK in sumps. Most of these operations are carried out under a mineral oil bath. A large lucite or plexiglas window was designed to be installed in front of the cutter heads and basket so that the removal of the slugs could be observed. However, due to the hazards of spilling oil and NaK in case of a fracture an alternate stainless steel window was designed. Both windows are being fabricated. The mechanical decladding equipment is being fabricated without motors, drives and electrical controls. These have been purchased and will be installed at ORNL prior to installation in Building 4505. The equipment is being fabricated at Southern Machine Company, Chattanooga, Tennessee.

*B. B. Klima, ORNL CF-59-1-19, "Power Reactor Fuels Reprocessing: Mechanical Phase" January 7, 1959; ORNL CF-59-1-151, "Power Reactor Fuels Reprocessing: Mechanical Phase," January 30, 1959; ORNL CF-59-1-151 Supplement 1, February 27, 1959; ORNL CF-59-1-151 Supplement 2, March 31, 1959.

Kerosene was originally considered to be the blanket liquid; however, it was found that NaK sank in mineral oil and that it had been successfully used with NaK and had a much higher flash point and consequently, less of a fire hazard. Test quantities have been purchased. Two fifty-gallon lots of mineral oil are on hand for test purposes: Esso Standard Oil Company, 0.878 specific gravity at 22°C, flash point (open cup) 440°F; and No. 6 White Mineral Oil (Mineral Oil Refining Company), specific gravity 0.832 at 60°F, flash point (open cup) 313°F. An additional source for Mineral Oil Refining Company of a new product, No. 5 White Mineral Oil, was found to have a specific gravity of 0.821 at 60°F and a flash point (open cup) of 315°F.

This equipment will be installed in Building 4505 and tested. After testing it will be installed in the segmenting facility (Bldg. 3048).

Drawings: E-33511-15, 33517, 35228-30; D-33496, 33507-10, 33516, 33518-24, 35000, 35225-27, 35231-42, 35248-49.

1a. Basket Draining Station

After the SRE slugs are pushed out of the element into the basket and before they can be loaded into the washing device basket the excess oil and NaK must be drained off of them. A basket draining station is being designed to fit on the side of the decladder. It will provide a place where the baskets may be drained, permitting the excess mineral oil and NaK to drain back into the bath. Also provided is a storage place for the washing basket so a transfer can also be made from one basket to the other at this point. Design is proceeding on this draining station.

1b. Drain Valve Operators

The valves on the bottom of the mechanical decladding equipment sumps must be remotely operated. Design for these valve operators is proceeding.

1c. Perforated Baskets

The basket originally designed to catch the slugs was solid and it was planned to keep the slugs under a blanket of kerosene at all times. After mineral oil was adopted as the bath liquid since it was much more viscous it was found that the slugs could be drained and the residual NaK would still be coated with an organic film so that it would not be oxidized. A perforated basket was designed and the drawings are being checked and issued.

Drawing: D-35010.

ld. Tools - Coil Unloader

A hexagonal tool must be provided to operate the coil unloader after the scrap tubing has been coiled. Design of this tool is proceeding.

le. Coil Winder

The scrap tubing shell of the SRE fuel element after it has been emptied is to be flattened on the end, inserted in a winder and then wound up in a coil similar to the way a tooth paste tube is flattened and rolled. At one time it was believed that one of the electrical impact wrenches could be used for this purpose. Present philosophy is that they operate too fast to be used in this service; therefore an investigation is being made to find the proper tool. A geared down impact wrench will probably be suitable.

lf. Fire Cover

After the mechanical decladding equipment has been received and modified and added too, a cover will be designed and built which can be used to cover the pan to smother a mineral oil fire if one should develop. This is a last-ditch type fire protection since there will be CO₂ protection in the cell and relatively high flash point mineral oil is being used.

lg. Auxiliary Decladder

When the SRE fuel elements are irradiated the fuel pins tend to grow both in diameter and length and some of the pins take on, in this process, a distinct camber (bow). It is contemplated that if this should happen in the extreme case that the fuel pin would stick in the cladding and the mechanical decladding device would become inoperative. If this happens it is contemplated that the cutting rolls on the mechanical decladding equipment could be used to cut off the offending pin complete with cladding and then process it in another piece of equipment the "Auxiliary Decladder".

The individual pin and its clad would be transferred to this "Auxiliary Decladder" where a hydraulic device would force it through a four element cutting die which would cut and peel the clad back; thereby releasing the pin for recovery. The die for use in this machine has been designed and is being fabricated for test before final design of the overall package unit which is presently visualized as being approximately the size of a portable sewing machine.

Drawings: D-35002-03.

lh. Lifting Hook - Single

The single SRE fuel pin is quite flexible and it must be picked up from the traverse table and put into the mechanical decladding equipment bath. A lifting hook has been designed which can pick the element up at two points and insure that it will not kink or break while being transported.

li. Lifting Hook - Element

The seven tube SRE fuel element is flexible and might break or kink if improperly handled. A lifting hook is being designed to transport and handle the fuel element assembly.

lj. Installation and Operational Procedure

A procedure is being written to cover the installation of the mechanical decladding equipment in Building 4505 and the segmenting cell. Included in the procedure will be the details of the operational procedure to be followed.

Both these procedures are necessary to avoid confusion, damage to the equipment and possible excess time of installation (reinstallation in Bldg. 3048) and to avoid breakdowns due to lack of operating technique and know-how.

lk. SRE Process Analysis

A detailed analysis of the steps necessary in the processing of the SRE fuel elements to cover the complete operation from the receipt of the loaded fuel element container to the loading of the canned slugs into the dissolver in Building 3019. This analysis is necessary to minimize the possibility of overlooking a detail in handling technique and finding no tools or equipment available for processing and a subsequent delay in the project.

ll. Windows

At one time it was considered to be necessary to have windows in the side of the oil bath to see the NaK level. Since then an adequate NaK decomposing facility (see item 3) has been designed and the serious consequences of dumping the oil bath (approximately 15 gallons of mineral oil) in case of a break in the window have made it seem to be inadvisable. Design will be held in abeyance until after test of the equipment proves the windows to be required or unnecessary.

lm. NaK Troughs

The NaK draining from the tube might not run into the sump and instead hold up on one of the flat bottoms of the bath. Therefore, troughs will be designed and installed if required to direct the NaK into the sumps.

2. SRE Slug Washing Device

The SRE fuel slug taken from the mechanical decladding equipment is coated with mineral oil and NaK. The purpose of the slug washing device is to wash these uranium rods free of oil and NaK using live steam. The slugs fit upright into a special basket which revolves in an atmosphere swept with jetted steam. This piece of equipment is being fabricated at Brinkman Tool and Die Inc., Dayton, Ohio and it will be tested in Building 4505 as soon as received.

Drawings: E-36375; D-36376-81.

2a. Condenser

The steam from the SRE fuel slug washing device will need to be condensed and therefore a condenser will be necessary; However, there seems to be no quick and easy way to size it. Therefore, after it is set up in Building 4505 for test, the quantity of steam required will be determined as well as the degree of fouling of the condensing surfaces by the mineral oil. After this is determined, a condenser will be designed and installed.

2b. Filter

The condensed steam and mineral oil will probably contain very fine particles of uranium and possibly other radioactive particles washed from the fuel slugs. Installation of a filter in the line before the water and oil is let go down the hot drain would seem to be desirable at this time. Design has not started.

2c. Removable Screen

It is possible that due to the action of the steam jets that large flakes may break off of the fuel slugs during washing operations in the fuel slug washing device. If these broke off, they would foul the passage to the condenser and would also be hard to recover. A removable screen will be designed and installed to permit easy recovery of these flakes.

3. NaK - Oil System

Each SRE fuel rod contains six cubic inches of NaK. The safety and fire personnel require removal of all NaK each day. Original plans called for carriers to remove the NaK and the oil. Investigation at Atomics International indicated that there was a distinct possibility that the NaK might contain flecks or pieces of uranium from the fuel slugs.

A system has been laid out whereby the NaK and a little oil will be caught in a blowcase below the sump. This NaK and oil will be transferred to a reactor, using helium pressure, where it will be reacted with steam. The reactor will be purged with nitrogen so that the hydrogen-nitrogen mixture will be below the flammable mixture level when it enters the air in the cell. The gases and the excess steam pass through a condenser and the excess steam is condensed to form an aqueous layer to dissolve the NaOH and KOH formed by the decomposition. After a complete reaction the aqueous caustic and oil will be drained into a filter. The liquid in the filter will be forced through the filter using gas pressure. The filter will retain all the uranium and any other solids. The liquid will be caught in a separatory funnel and the water drained off to the hot drain and the oil to a disposable container. At the conclusion of an SRE run all of the oil could be processed in this equipment.

This system will be designed, fabricated and tested in Building 4505 and then modified and installed in the segmenting facility.

3a. Oil Supply

An oil supply consisting of a container and a pipe through the shield wall and over to the mechanical decladding equipment (item 1) and the auxiliary decladder (item 1g) will be required in the segmenting facility. Design has not started.

3b. Oil Disposal

A disposable, or possibly a reusable, container in which mineral oil processed could be transported to the burning ground must be designed, fabricated and tested.

3c. NaK Reactor

The NaK reactor is a vessel in which the six cubic inches of NaK and some mineral oil is decomposed using live steam. The hydrogen formed is diluted using nitrogen so that the concentration is below the flammable concentration before it is released to and mixed with the air in the cell. The NaK reactor has a condenser to condense the excess steam from the effluent gases so as to provide water to dissolve the NaOH and KOH formed.

Design of the reactor has been started.

3d. Filter

A stainless steel porous filter will be provided to remove particles of uranium from the aqueous caustic solution and the mineral oil. It will be a simple pressure filter which will be designed to be easily replacable.

Design of the filter has been started.

3e. Oil-Water Separator

A glass separatory funnel has been suggested for use as the oil-water separator. Design of the equipment has started.

3f. NaK Disposal

An alternate devise for possible use is a shielded disposal system for the NaK. This will be used in case of failure of the other system. Design has not started on this alternate piece of equipment.

4. Instruments - H₂ Detector

Since Hydrogen will be generated in the NaK-oil disposal system, the SRE slug washing device, and possibly inadvertently in the cell due to moisture in the air, spills, etc., a hydrogen detector will be included in the cell. The same detector or possible a second one might also be used to determine when all of the NaK has been decomposed in the NaK Reactor.

Design of the system has not started at this time.

5. Utility Scrap Disposal

A small utility scrap disposal basket is considered to be necessary for the cell. This basket would be small enough to be set on the traverse table and in other handy locations so that when a bolt is extracted or washer removed it can be dropped

into it rather than taken across the cell to the large scrap disposal containers. This utility disposal basket can be handled easily by the manipulators and emptied frequently into the larger scrap container.

Design has not started.

6. Element Disassembly Tools

Analysis of the SRE fuel element handling and disassembly techniques has not been completed; however, three tools are indicated at this time. As additional tools are required this item will be expanded.

6a. Sling

A sling will be required to steady the removal of the SRE fuel element from the carrier to the unloading trough.

Design has not started.

6b. Unloading Trough

An unloading trough capable of being adjusted both horizontally and vertically will probably be required to allow the SRE fuel elements to be pulled from all carrier positions.

Design has not started.

6c. Hold Downs

A hold down will probably be required on the traversing table to hold the fuel element to permit it to be worked on by the tools to remove the bolts, and end pieces.

Design has not been started.

7. Recanning

The cleaned SRE fuel slugs will be dissolved in the pilot plant. The slugs will probably need to be stored for a short period of time. Therefore, to avoid the spread of contamination and to ease handling it was decided to store the clean slugs in aluminium cans. The cans will each hold twelve slugs 3/4 in. in diameter and 6 in. long. Six test cans were fabricated by George D. Ellis and Sons, Philadelphia. These were found to be unsatisfactory in that the closure was not adequate and it was felt after test that the bottom chime should be eliminated and the cans be spun. These cans are approximately 3 1/4 in. o.d. and will weigh over 20 pounds when loaded with slugs. A second test batch will be ready for test early in May. Pending a successful test the cans and a canner will be purchased. The design for remotising of the canner can then proceed and will include mechanization of two levers on the canning machine.

Drawings: D-35244; C-35245-47.

7a. Can Storage Crate

A special crate for use in transfer of fuel slug loaded cans from Cell A to Cell B and for use in storage is needed. It

is contemplated that this might be a heavy wire or metal plate basket similar to the cartons Coca Cola and glass milk bottles are transported in. It would have one central lift point and would handle six or eight cans per load. Design has not started at this time.

7b. Can grips - GM

Special grips will probably be desirable for the GM manipulator to permit them to be used on these approximately 3 1/4-in. OD cans. Design work has not started.

7c. Can Grips - No. 8

Special grips will probably be desirable for the No. 8 manipulators to permit them to be used with the cans. Design work has not started.

8. Fuel Can Handling

The canned SRE fuel slugs stored in the storage cell must be transported to Building 3019 and dissolved in the dissolver there. A table will be provided in the northeast corner of the storage cell to hold the can storage crate (item 7a) and permit transfer to the carrier. A hole will have to be drilled through the front face of the storage cell to allow access to the carrier.

Overall design of the equipment and flow sheet for the transfer is essentially complete at this time.

8a. Can Grips - Lee

Special grips will need to be provided for the Lee manipulator in the storage cell. Three grips will probably be required: one to use the wrist motion close to the manipulator or on the table, second and third to be used without benefit of wrist motion at floor level to grab a can resting on its side and on its end. These grips will probably be useful for other purposes in the storage cell.

Design of the hand is awaiting receipt of information from Mr. Lee Miller.

8b. Table

A portable stainless steel table in the northeast corner of the cell is necessary to provide a resting place for the can storage crate (see item 7a) so that the Lee manipulator can remove a loaded can from the crate to the carrier loading device (see item 8e).

Design on the table has not started.

8c. Loading Trough

A trough attached to the inside of the storage cell wall below the opening to support the carrier loading device will be required.

Design has not started on this item.

8d. Special Plug

A stepped hole will be required through the east face of the storage cell. A special plug to fit this hole will be required. Design of this plug has not started.

8e. Carrier

An existing carrier can probably be used to carry the canned slugs to Building 3019 and used to unload the cans at the dissolver. A special carrier loading device will probably need to be designed and fabricated which will permit the cans to be retrieved from inside the cell into the carrier a distance of approximately six feet. The existing carrier which is planned to be used is the "50-in. carrier" as described in Drawing D-13003. It is 7 in. in diameter and 50 in. long inside. It is shielded with 9 in. of lead and is of stainless steel construction. It weights approximately 15,000 pounds.

8f. Carrier Dolly

A dolly for maneuvering the carrier (item 8e) at the segmenting facility will be required.

Design has not been started.

8g. Chute Modification

The external end of the 5-in. discharge chute at the dissolver (Building 3019) probably will need to be modified to adapt for the carrier.

Design has not been started.

Shearing Equipment

Fuel Elements of the Yankee, OMRE, Commonwealth Edison, PWR and Rural Co-op types consist essentially of bundles of clad fuel elements. These bundles are generally held together by welding or brazing, using spacing plates, ferrules, or straps. The individual fuel elements are uranium oxide or mixed uranium-thorium oxide pins encased in stainless steel or zircalloy tubing. One of the approaches for recovery of the uranium from these fuels is to chop the elements into short lengths (~1 inch) and then dissolve the pin and leave the clad material as scrap. Several approaches are being followed in the shearing and dissolution problems. The shears are predicated on the basis of shearing the entire fuel bundle. The task of separating the bundles into separate elements or slabs of elements has also been investigated (see item 100).

10. Manco Shears 4 1/2 in.

The 4 1/2 in. Manco shear has been installed on the third floor of Building 4505. New blades have been fabricated for this shear.

Drawing: D-34787, 34794, 34807, 35474-75; C-34786.

10a. Cover

A cover is being designed to totally enclose the Manco Shear so that uranium may be cut under conditions as closely

approximating those expected at the segmenting facility as possible.

The cover design ends in a slide valve which must have an adaptation for a can (see item 10c).

10b. Feeder

A fuel element feeder for the Manco Shear is being designed to be used in conjunction with the cover (item 10a).

Drawing: C-34784.

10c. Can Adaptation

An adaptation between the can (item 10d) and the cover (item 10a) must be designed. This adaptation should provide a dust and contamination free joint easily and remotely removable and replacable.

10d. Can

It is presently conjectured that the chopped fuel elements will be processed from the shear to the dissolver using an aluminum or iron can. The type closure or can has not been firmed up at this time.

11. Oil Gear Unit

The oil gear unit was modified to permit manual remote control of the speed of the manco shear blade. The modification and installation is completed.

Drawing: D-35474-75.

12. Holding and Clamping Devices

Holding and clamping devices for the Manco Shear have been designed and are being fabricated. These will be used on porcelain pins type fuel elements and as an interim measure until the cover and feed can be designed and fabricated. (items 10a and 10b).

Drawings: D-35367-69.

14. Material Transfer Continuous 4505

A continuous transfer mechanism must be designed to permit the chopped fuel element pieces to be fed to the continuous dissolver being installed in Cell 4A (see item 40 and 41). This system will probably consist of a hopper, feeder, and rotory seal for the acid fumes. Design has started on this mechanism.

15. Manco Shear 1 1/2 in.

The 1 1/2-in. Manco Shear has been installed in the third floor test area of Building 4505. It is currently being used to chop uranium fuels pending preparation of the 4 1/2-in. Manco Shear for this service.

16. Buffalo Plane Shear

A new hole was put in both blades for the Buffalo Plane Shear. After reinstallation of the blade it was necessary to remove the shear and place it in storage so that the test area could be expanded.

18. Surplus Press

A surplus Navy press (200-ton HPM press) was found which would be suitable for our use. An application for transfer of the press to ORNL was made; however, rapid developments in the procurement of the production prototype shear (see item 23) indicated that it would be unwise to get the surplus press. The application for transfer was therefore cancelled.

19. Shear Blade Die Set

A shear blade die set was designed primarily for use with the surplus press. The die sets have been completely designed and are partially fabricated when the surplus shear was cancelled. The fabrication of these die sets will be completed since they can be used on the vendors test presses (see item 23) and a 150-ton press in the ORNL shops. The shear blade die set consists of two punch assemblies and two die assemblies with eight blade shapes.

Drawings: D-35947-49, 36325-34.

21. Explosive Shear

A suggestion for a shearing device using an explosive charge as a driving force was made and investigated. The idea is being held in abeyance pending test work on Production Prototype shear (item 23). This type equipment would be especially valuable if extremely high speed blades were found to be necessary.

23. Production Prototype Shear

Bids have been sent out and contracts awarded to Birdsboro Steel Foundry and Machine Company, Birdsboro, Pennsylvania and Clearing - Division of U. S. Industries, Inc., Chicago, Illinois to design and test shear blades. The Birdsboro Steel Foundry and Machine Company is proceeding along the line of shearing the bundle as delivered with ferrules uncrushed. Clearing on the other hand is proceeding along the line of shearing a compressed bundle or a bundle from which the ferrules have been removed. After test of the blades a contract will be awarded to design the production prototype shear. It is currently being conjectured that the prototype shear would be a horizontal shear.

27. Enclosure (Jericho) 4505

The fire-proof enclosure on the third floor of Building 4505 which is used as the test area has been enlarged.

Drawing: D-34791-93.

28. Top Cell 4A

The steel plate top for Cell 4A, Building 4505, has been installed. As the installation of equipment in Cell 4A proceeds it is entirely probable that more holes will be required in the cell top.

Drawing: D-34796.

31. Shear - Dissolver

A concept of a combination or closely coupled shear and dissolver seems to be highly desirable. Design will start on a unit as soon as the criteria can be determined and settled.

39. Batch Dissolver 4505

The batch dissolver will be installed in Cell 4A, Building 4505. All of the auxiliary equipment, caustic scrubber, entrainment separator and condenser, has been designed, fabricated and installed. The batch dissolver has been designed and is currently being fabricated.

Drawings: D-25169-70, 34795, 34798-99; E-33760-61.

39a. Batch Dissolver 3048

A preliminary layout and flow sheet had been made for installation of the batch dissolver installed in Cell 4A, Building 4505, in Cell B of the Segmenting facility. However, it is now contemplated that the batch dissolver installed in the segmenting facility would be based on an entirely different concept. The present concept is to have an integrated shear and dissolver or at least have a batch dissolver which will not be opened at any time to the cell atmosphere. A rocking or tilting dissolver has been suggested, however, several preliminary concepts are being analyzed. Any installation of a dissolver in the segmenting facility must be unitized for expeditious removal when required.

Drawing: D-31647.

39b. Material Transfer Cell A-B

Design of a transfer mechanism for chopped fuel elements from the shear in Cell A to the dissolver in Cell B cannot be satisfactorily started until after test work has been accomplished at Building 4505 (see item 10). It is also dependent on fixing the dissolver configuration.

39c. Transfer Basket

A transfer basket or can probably will be required and designed to remove chopped fuel elements from the shear to the dissolver without spread of contamination in the cells. Design of the transfer basket will be held up pending a decision on the dissolver configuration.

40. Spiral Vibratory Continuous Dissolver

An adaptation of a spiral vibratory conveyor to serve as a continuous dissolver has been designed, fabricated and installed. This dissolver will operate by having acid flowing down the spiral and countercurrent to it the chopped UO_2 loaded fuel element pieces (approximately one inch long) will rise up the spiral to be discharged as clean empty shells for discard.

Drawings: E-34788; D-34789-90, 34798-99.

40a. Instrumentation

The instrumentation for the spiral vibratory continuous dissolver has been designed and as soon as it becomes available it will be installed.

41. Horizontal Drum Continuous Dissolver Model 1

A horizontal drum continuous dissolver is presently being designed. It contains several unique features. A plexiglas unit for developmental study has been built. It was necessary in order that the holes in the flights might be set since once it is fabricated and welded it would be nearly impossible to change. The title horizontal drum is a misnomer since it will probably be set at a fifteen degree angle with the horizontal.

41a. Drive

A drive for the horizontal drum continuous dissolver incorporates two motions. A slow but steady turn of the spiral in one direction and a slish-slosh (reciprocating) movement to continually mix the chopped elements and the acid. The drive has not been designed at this time.

41b. Feeder

A continuous feeder for this dissolver must be designed.

42. Horizontal Drum Continuous Dissolver Model 2

An adaptation of the AMF design of the continuous dissolver has been made. The design is essentially complete. The dissolver will not be fabricated at this time pending test data on Model No. 1 (see item 41).

43. Rotating Slab Continuous Dissolver

The design of the rotating slab continuous dissolver has

been stopped pending test data from the Horizontal drum continuous dissolver Model 1 (see item 41).

Drawing: E-35476.

47. Fuel Element Data Sheet

Data on the eight fuel elements actively being considered in the PRFR - mechanical phase was scattered. A drawing has been issued on which are listed all of the pertinent data known about these elements. It is being brought up to date as rapidly as the information becomes available.

Drawing: D-33754.

48. Prototype Fuels Mark I Modification 1

The fuel elements used in this program have many different configurations and assembly techniques. In order that shearing, sawing, and other separation devices may be developed a prototype fuel element was designed which had the salient features of the elements. This model of the Mark I prototype will be primarily used for development of a shear and has ferrules, end plates, end caps and end cap pins. It is a 6 x 6 element having 1/2-in. OD tubes and 3/8-in. ferrules with an overall length of six feet. The ferrules are arranged in banks and the ferrules and tubes are joined using "Microbrazed 50". The tubes are loaded with porcelain pins. Fifty of these are being fabricated by Continental Technical Services, Dayton at Ferrotherm Company in Cleveland.

Drawing: D-30869.

48a. Modification 2

This prototype fuel element model is identical with Mod. 1 except that the fuel elements will be fabricated empty by Continental Technical Services, Dayton and after receipt at ORNL they will be filled with Uranium oxide. These elements, after loading, will be used in testing the shear and the sheared pieces filled with UO_2 will be used to test the batch and continuous dissolvers. Twenty-five of these elements will be fabricated.

Drawing: D-30869.

48b. Modification 3

This model of the Mark I prototype will be used primarily for development of a shear and is without end caps and end cap pins. It is a 6 x 6 element having 1/2-in. OD tubes and 3/8-in. ferrules with an overall length of six feet. It has an end plate on each end and the ferrules instead of being in banks are staggered. The ferrules and tubes are joined using "Microbrazed 50". The tubes are loaded with porcelain pins. Twenty-five of these elements are being made by Continental Technical Services, Dayton at Ferrotherm in Cleveland.

Drawing: D-33752.

48c. Modification 4

A simplified version of the prototype fuel element has been designed. This element has no end plates and it has staggered ferrules. These were intended for use in shear test work, however no element will be fabricated from these drawings at this time.

Drawing: D-33757.

48d. Modification 5

A simplified prototype fuel element has been designed without end plates and with banked ferrules. These were intended for use in shear test work, however no elements will be fabricated from these drawings at this time.

Drawing: D-33758.

48e. Modification 6

A revision of the Mark I, Mod. 1, prototype fuel element was designed for use in saw test work. These elements are identical to Model 1 except that a steel pin and a steel spring has been substituted for a porcelain pin at each end of each tube. Six of these prototype fuel elements will be fabricated for use in saw test work.

Drawing: D-33759.

49. Prototype Fuels Mark II

A prototype of the SRE fuel element has been designed. It is identical to the SRE fuel element except that steel slugs are used to fill the elements instead of uranium rods. Eight of these prototype fuel elements will be fabricated without a NaK filling and twelve additional will be fabricated complete with the NaK.

These prototypes will be used to test the mechanical de-cladding equipment (see item 1). The individual slugs for the elements will be given a camber to simulate radiation damage.

A special flange for the welding box had to be fabricated to permit welding of the elements.

Drawing: D-33753.

50. Prototype Fuels Mark III

A design for a prototype of the Consolidated Edison Fuel Element for use in Sulfex studies has been completed. These elements have 36 tubes each 24 in. long and 5/16-in. OD ferrules. The elements are banded and welded using "Nicrobraz 50". Thirty-six of these prototypes are being fabricated by Davidson Chemical Company, Erwin, Tennessee.

Drawing: D-33755.

53. Special Fuel Element

One prototype fuel element with Zircalloy 2 tubes and filled with UO_2 was fabricated. Five additional special fuel elements are being fabricated at Y-12. These are essentially Mark I, Model 1, elements modified slightly.

Drawing: D-30869, 34777

Models

Models of the various fuel elements for instructional and conference use are desirable. These will be fabricated as soon as firm data is available on each fuel element.

57. Fuel Element Models Consolidated Edison

A model of the Consolidated Edison fuel element will be fabricated after receipt of special tubing now on order. It will have a full-sized cross section but will be shortened.

57a. Nuclear Ship Savannah

A full-sized model of the Nuclear Ship Savannah fuel element has been fabricated.

57b. Commonwealth Edison

A model of the Commonwealth Edison fuel element has been fabricated. It has a full-sized cross section and is half length.

Segmenting Facility

A Segmenting Facility is being built in Building 3048. This facility was designed on a limited budget for use with the Slurry Loop In-Pile (SLIP) experiment. In order for this facility to be fully usable for the power reactor fuels reprocessing work, several minor changes are necessary. These include addition of fire extinguishment facilities to the cell, installation of dust collection equipment in the cell, additional clamps and holding devices for the saw tables and a medium capacity manipulator.

61. Segmenting Facility

The contractor is almost finished with the current modifications to the segmenting facility. The cells have not been painted on the inside.

62. General Mills Manipulator

The General Mills manipulator is ready to be installed in Cell A except that the track for it must be lowered approximately one inch.

63. Model 8 Manipulators

A special boot for the No. 8 master slave manipulators has been designed and after test, if successful, it will be adapted to all of the ten manipulators installed in this facility.

64. Lee Manipulator - Cell A

An installation for the Lee Manipulator in Cell A will be designed. It is felt that the manipulator might best be used in Cell A until required in the storage cell. The mounting in Cell A would probably be from the rear wall of the cell.

66. Lee Manipulator - Storage Cell

A mounting of the Lee Manipulator on the bridge crane in the storage cell has been designed. The electrical details of this redesign are the only items not quite complete. The manipulator mounting will be hinged to permit withdrawal of the manipulator over the back wall of the cell.

67. Storage Cell - Bridge Crane

The storage cell bridge crane will be modified to install a electric clutch to permit the crane to be pulled back over the wall in case of failure of the crane locomotion devices. In addition, an electrical box presently mounted on the crane will be moved back behind the rear wall of the cell. Dual crane control stations are also to be provided.

68. Periscope - Storage Cell

Adaptation of one of the periscopes in Building 3048 for use in the storage cell is being designed. A periscope is necessary to see the crane hook in the deep well of the tunnel and to see to change the air filters and to pick up a dropped can close to the window.

69. Zinc Bromide - Windows

The zinc Bromide for the windows has been received and will be installed as late as possible.

70. Tunnel Transfer Cart

Material and equipment may be transferred from Cell A to the storage cell using the Tunnel Transfer Cart. This tunnel also has access to the working area through a hatch so that material or scrap may be removed from the system directly into carriers by this procedure. The cart has been fabricated and awaits installation. The open area of the cart is a rectangle

32-in. x 32 1/4-in. The clearance between the cart table and the roof of the tunnel is 37 1/2 in.

Drawings: E-31286, 31290; D-31287-88, 31291-92.

71. Bridge Crane - Cell A

The bridge crane in Cell A is ready for installation.

72. Bridge Cranes Cell B

The two bridge cranes for Cells B1 and B2 are ready for installation.

73. Traverse Table

A traverse table is provided in the cell to permit movement of and position fuel elements under the saw and as a working area for disassembly operations. The traverse table is 11 ft. 6 in. long by 3 ft. wide and it can be traversed over a distance of 22 ft. 5 in.

The table is being fabricated at this time.

Drawings: E-26590, 29495-97; D-26591, 29086, 29498.

74. Dolly Slip Carrier

The special dolly on which the SLIP carrier is rolled up to the cell face has been fabricated and installed. It has sidewise adjustment but lacks vertical adjustment. Test of the carrier indicated that the track installation was not correct. The track will be correctly installed. Further investigation at that time of the dolly will probably indicate a minor re-design and modification to be required.

Drawings: D-31294-96.

75. Scrap Containers

Scrap containers designed for another project were fabricated for use with this project. They are covered steel containers 27 3/4 in. inside diameter and 19 3/4 in. inside height. Twelve containers are being built at Paducah.

Drawing: D-31299.

76. Scrap Carrier

A scrap carrier for the scrap container (item 75) is being fabricated at Paducah. It will be filled with lead at ORNL.

Drawings: D-31419-23.

77. Carrier Cell "B"

The carrier designed for Cell "B" for use on

another project is being fabricated at Paducah for use on this project.

Drawings: D-32164-67.

78. Fuel Element Carriers

The Atomics International personnel would prefer that the fuel element carrier can be loaded vertically. This will require further revision of the SLIP carrier. Design work on the modification to the carrier to include a new end section and a liner to make the shielding uniform and to provide a fixed boral shield is proceeding. The carrier as presently designed could accommodate up to twelve clusters. Design work on the vertical loading has not started.

Drawings: E-25172-74, 29889; D-29890-97.

79. Lifting Tongs and Tools

A portable band saw has been purchased and modified to permit easier blade changing.

Impact wrenchs and nut setters have been purchased and equipped with holders for easier manipulation.

A pneumatically operated vise has been fabricated for use in the dismantling operations.

Tongs have been fabricated and will probably be found useful in the dismantling operation. They will pick up a rod 9 3/4-in. diameter. Another air operated tong is a modified General Mills manipulator hand assembly.

Drawings: D-31411-18, 35352-54, 35357-58, 35363.

80. Tray and Support

An adjustable set of supports and a tray to clamp on the traversing table were fabricated. These were designed for use with the SLIP experiment. Their utility with the fuel elements is not determined at this time so that no decision has been made as to whether they will be installed and used.

Drawings: E-31407; D-31408-10.

81. Charging Door Closure

The charging door closure was modified to move the door so as to avoid interferences with equipment installations which were found to exist. It has been designed and will be installed in the near future.

Drawings: E-33040; D-31277, 31280, 33041-44.

82. Alignment Gauge

An alignment gauge has been designed and is being fabricated which will permit easy and precise alignment of the loaded SLIP carrier in front of the loading station of the segmenting facility.

Drawing: D-32168.

83. Stainless Steel Roof Liner

A stainless steel roof liner was designed; however, the decision was made to paint the cell roof instead.

Drawings: D-28434-38, 35317-18.

84. Dust Collection System

Dust and metal particles will be generated in the segmenting facility by the saws and shears. A internal dust collection system in the cell to reduce the airborne contamination will be designed. This system will probably consist of a cyclone, a fan, and necessary duct work.

84a. Cyclone

The design of the cyclone has not started at this time.

84b. Fan

The design of the fan has not started at this time.

85. Fire Extinguishment System

A carbon dioxide fire extinguishment system is contemplated to extinguish oil fires in Cell A. The primary source for oil fires would be the mineral oil bath for the mechanical decladding equipment and its auxiliary decladder. The system will discharge an initial concentration of CO₂ and then this concentration will be maintained for the next thirty minutes by subsequent periodic discharges. Specifications for the system have been written and the major components will be purchased. A damper will probably need to be installed in the ventilation system for Cell A.

85a. Cylinder Storage

A storage area will need to be designed for the CO₂ system cylinders.

86. Maintenance Cubicle

A maintenance cubicle will be designed which will be located on top of the segmenting facility Cells A and B. This cubicle will be a controlled air location where a man in an air suit can enter and work on decontaminated equipment to do maintenance work.

87. Opening Cell A - B

When the cell was lined with stainless steel, an opening in the concrete between Cell A and B was dry stacked with concrete blocks in preparation for the day when an additional opening would be required. The location of the shear in Cell A

and the dissolver in Cell B makes this opening very desirable. Design for the opening is complete and work of installation will proceed as soon as manpower is available.

Drawings: D-28434-35, 35317.

88. Cell Door Gasket

An inflatable gasket for the main cell charging door in Cell A is being designed to insure an air-tight seal at this point.

89. Auxiliary Viewing Cell A

Many varied and diversified operations will be necessary to process a fuel element through the various stages of the recovery cycle. Most of the pieces of equipment are going to be large; for instance, a multi-purpose saw, traverse table, shears with their feeders and collection devices. All of these pieces of equipment will need to be in the cell at one time and consequently, it will be impossible to observe all sides of all of the pieces of equipment. Therefore a closed circuit television camera will be installed in Cell A to permit viewing from any angle and to permit close-ups of vital areas. It will also be very valuable for disassembly of elements, trouble-shooting and maintenance.

The TV camera will be equipped with pan and tilt, and in addition, the camera will be encased and the case will be gas purged to avoid contamination of the camera. The pan and tilt will be bagged in plastic. Two plug-ins for the camera will be installed in Cell A to permit the camera to be used in each end of the cell without an excess of cable. A single monitor will be purchased.

89a. Storage Cell

The TV camera can be used to advantage in the storage cell. For this purpose a plug-in station will be provided in that cell.

89b. Camera Storage Cask

A shielded storage cask will be provided to permit the camera to remain in the cell during periods of idleness so that during these periods the lenses will not brown.

Design work has not started.

90a. Dissolver Solution Sampler 4505

The vibrating continuous dissolver and the batch dissolver are both to be installed in Cell 4A. A sampler will be installed for these dissolvers similar to the one which is to be installed for the dissolver in Cell B of Building 3048 except it will be without shielding. Design of this dissolver has started.

90b. Dissolver Soltuion Sampler 3048

A sampler will be installed for the dissolver in Cell B. It will be quite similar to samplers now in use in Building 3019 except that advantage will be taken of the experience gained with that installation.

Design has started for this sampler.

91. Lighting Plug Storage Cell

The lighting plugs currently installed in the storage cell interfere with the bridge crane and the Lee manipulator. The lighting plug is being redesigned to remove this interference.

92. Utilities 3048

Air, water, steam, helium, and nitrogen will be required in Cell A alone. In addition, utilities will have to be provided for the storage cell and Cells B1 and B2. The services required for each piece of equipment will vary. Quick type disconnects capable of being operated remotely by the manipulators will need to be provided for each of these services.

93. Electrical 3048

Electricity will need to be required for almost every piece of equipment in the segmenting facility. Quick disconnects (probably AN plugs) capable of being remotely operated by the manipulators will need to be provided for each electrical service required.

94. Abrasive Wheel Saw - 4505

Two abrasive wheel saws were purchased by ORNL from Ty-Sa-Man as part of another program. One of these saws has been set up on the third floor of Building 4505 for use in the test program.

Drawing: D-33244.

94a. Cut-off Saw Longitudinal Cut 4505

Separation of fuel element bundles by longitudinally cutting the ferrules and/or plates seems to be very desirable. An apparatus whereby this can be accomplished using the prototype fuels has been designed and will be fabricated and tested on the Ty-Sa-Man saw installed on the third floor of Building 4505.

Drawings: D-34810-21.

94b. Clamping Devices

A simple set of clamping vises have been installed for use when making transverse cuts, however, it is felt that additional devices should be designed which would more closely

simulate devices which will be used in the Segmenting Facility. These devices, when designed, will serve as pilot installations.

Drawing: D-34780.

94c. Particle Collection Device

A particle collection device has been designed for use while making transverse cuts of simulated fuel elements. This device is being modified at this time.

Drawing: D-34779.

95. Multi-Purpose Wheel Saw 3048

A multi-purpose wheel saw is being purchased for use in the segmenting facility. This saw will be capable of using Abrasive, saw tooth, friction and diamond cutting wheels. This type saw was deemed to be desirable because of the difficulty experienced when sawing mixed stainless steel tubes and porcelain pins using an abrasive wheel.

This saw will be purchased from Ty-Sa-Man under Specification PRFR - 2 (E and M Div. Spec. No. 213).

Drawings: E-26590; D-26591, 33048.

95a. Longitudinal Cut

A device will be needed to permit longitudinal cutting the fuel elements. Design work will not be started until after test of the unit in Building 4505 (see item 94a). Design work will probably be complicated by the fact that this unit will be designed to cut several different fuel elements and not just prototype fuel elements.

95b. Clamping Devices

A device will be needed to clamp fuel elements for transverse cutting of end pieces and removal of scrap. Design will not be started until after test of the unit in Building 4505 (see item 94b). Design work will be complicated by the fact that this unit will be designed to cut several different fuel elements and not just the prototype fuel element.

95c. Particle Collection Device

A device will be needed to collect the particles during transverse cutting operations. Design will not be started until after test of the unit in Building 4505 (see item 94c). Design work will probably be complicated by the fact that this unit will be designed to cut several different fuel elements and not just prototype fuel elements.

96. Band Saw Study

A multi-purpose wheel saw is currently being specified for use in the segmenting facility. A study is to be made of the applicability and pertinacity of substituting a band saw for these uses. This study is being pursued to make sure a valuable cell tool is not being overlooked.

97. Underwater Fuel Element Disassembly Equipment

An adaptation of the impact wedge (item 100d) for underwater use to separate fuel element bundles is being investigated. If reasonable, a unit will be designed, fabricated and tested.

100. Fuel Element Separation Devices

While shearing of the entire fuel element must still be demonstrated, no one seems to doubt the ability to design or purchase a shear which will satisfactorily cut a single layer of fuel element tubes or individual fuel element tubes. From an economics viewpoint it appears to be much more favorable to shear entire fuel bundles, however, a token effort was made to develop a procedure for handling and tools to separate a fuel element into both individual tubes and single layers of tubes. A satisfactory series of tools were made and demonstrated and a flow sheet developed. A report on this phase of the program is being written which will wind it up unless an individual tool should be needed later in the program.

100a. Ferrule Splitters

A special demonstration die and attendant test fuel cluster of twelve 1/2 in. OD tubes was fabricated. This die was designed to cut the ferrules between each fuel rod and peel it back out of the way. Successful operation would have yielded each rod as an individual tube. The ferrule splitter did not operate successfully.

Drawing: D-35365.

100b. Slabbing Knife

A special demonstration knife and attendant fuel cluster of 13 x 6 - 0.3125 in. OD simulated tubes was designed. In addition, a test rig was fabricated. The knife was designed to cut the ferrules in a plane forming slabs of fuel rods.

This knife did not operate successfully.

Drawings: D-34782-83.

100c. Nicrobrazed Destruction

The "Nicrobrazed 50" used to hold together the ferrules and tubes has special characteristics of brittleness and solubility which might possibly be used as a means of separation of the tubes.

Special acid combinations to attack preferentially the Nicrobrazed were tried, and this mode of attack was abandoned.

Pushing or pressing the element to split off tubes generally gave up agglomerates of tubes, and this mode of attack was abandoned.

Drawing: C-34781.

100d. Impact Wedge

A wedge was designed for use in an arbor press to force two layers of tubes apart by breaking the Nicrobraz 50 attachment between ferrule and tube. This approach was very successful; and while a few individual rods were formed, the results largely came out as layers of tubes.

Based on this success, a hand tool was designed using an air chipping hammer. This was equally successful.

Drawings: C-34778-81; D-34775-76.

100e. Ferrule Stripper

An attachment for the air hammer to strip the ferrules from individual rods was found to be unsatisfactory. Additional models using a different rotating wedging-prying motion were successful and have been applied to two different tube diameters.

Drawings: D-34822, 34824.

103. Dissolved Fuel - Containers and Carriers

The hot uranium and uranium-thorium liquids produced in the dissolvers in the segmenting facilities will need to be transported to Building 3019 for recovery of the valuable constituents. Special carriers and containers would have to be designed for these solutions which would be critically safe. If the liquid transfer line (item 103a) appears to be excessively costly, these carriers and containers for these solutions will be designed.

103a. Dissolved Fuel - Transfer

An off gas duct is to be installed which will originate near Building 3019 and will pass near to Building 3048. A cost estimate is being made of the cost of installing two small lines in that duct to run between those two buildings. If this appears to be cheaper, the hot uranium and uranium-thorium liquids can be transported in that manner. Design work will depend on the outcome of the estimate.

104. Materials Handling Study - Conceptual

A conceptual study of the material handling problems associated with the oxide type fuel elements from their introduction into the cell through their solution in a dissolver to the disposal of the scrap materials. The first plans to be studied will be concerned with the problems associated with shearing techniques in order to determine the optimum system and optimum techniques to assist in design of the shear. The first approaches will compare the techniques of dry shearing, underwater or wet shearing, and shearing under a water spray.

104a. Dry Shearing

104b. Wet Shearing

104c. Spray Shearing

106. Layout Segmenting Facility 3048 - SRE

A layout of the segmenting facility will be made of the equipment required to process the SRE fuel elements.

107. Layout Segmenting Facility 3048 - Shearing

A layout of the segmenting facility will be made of the equipment required to process the oxide type fuel element using shearing techniques.

Drawing: E-33751; D-33750.

108. Layout Test Area 4505

A layout of the Building 4505 test area will be made of the equipment required to process the SRE fuel elements. It will be as close to the layout in the Segmenting facility as practical.

B. B. Klima
Process Design Section
Chemical Technology Division

BBK:jh

TABLE 1 - PRFR Mechanical Phase - Schedule

Notes: 1. Brackets indicate the period of time at which a phase of the work is to be completed.
2. Asterisks indicate phase has been completed.

ITEM NO.	ITEM	January			February			March			April			May			June			July			August			September			Engineer Assigned	REMARKS	Chem. Tech. Contact
1	Mechanical Decladding Equipment 4505											Fabricate						Test									R. J. Emmert		G. A. West		
	3048																		Install			Cold Test					R. J. Emmert		G. A. West		
1a	Basket draining station											Design		Fabricate													R. J. Emmert		G. A. West		
1b	Drain Valve Operators											Design		Install													R. J. Emmert A. W. Alexander		G. A. West		
1c	Perforated Baskets											Fabricate															R. J. Emmert		G. A. West		
1d	Tools-coil Unloader											Fabricate															R. J. Emmert		G. A. West		
1e	Coil Winder												Design		Fabricate													R. J. Emmert		G. A. West	
1f	Fire Cover												Design		Fabricate													R. J. Emmert		G. A. West	
1g	Auxiliary Decladder												Design		Fabricate													R. J. Emmert		G. A. West	
1h	Lifting Hook-single											Design		Fabricate														R. J. Emmert		G. A. West	
1i	Lifting Device - Element												Design					Fabricate										R. J. Emmert		G. A. West	
1j	Installation and Operational Procedure											Analysis		Draft														R. J. Emmert		G. A. West	
1k	SRE Process Analysis												Draft															R. M. Hill		G. A. West	
1l	Windows												Held in abeyance																G. A. West		
1m	NaK Troughs												Design		Fabricate			Install										R. J. Emmert		G. A. West	
2	SRE Sludge Washing Device 4505												Procure					Test										G. E. Pierce		G. A. West	
	3048																		Install			Cold Test						G. E. Pierce		G. A. West	
2a	Condenser												Design		Install													E. L. Hutto		G. A. West	
2b	Filter												Design		Fabricate													E. L. Hutto		G. A. West	
2c	Removable Screen												Design		Fabricate													E. L. Hutto		G. A. West	
3	NaK-Oil System 4505																Install		Test									A. W. Alexander		G. A. West	
	3048																		Install			Cold Test						A. F. Zulliger		G. A. West	
3a	Oil Supply 3048																Design		Install									W. R. Sanford		G. A. West	
3b	Oil Disposal												Design		Fabricate													A. W. Alexander		G. A. West	
3c	NaK Reactor													Fabricate			Design		Install									A. W. Alexander		G. A. West	

TABLE 1 - PRFR Mechanical Phase - Schedule (continued)

ITEM NO.	ITEM	January			February			March			April			May			June			July			August			September			Engineer Assigned	REMARKS	Chem. Tech. Contact
3d	Filter														Fabricate Design		Install										A. W. Alexander		G. A. West		
3e	Oil-Water Separator														Design		Install										A. W. Alexander		G. A. West		
3f	NaK Disposal																Design					Fabricate					A. W. Alexander		G. A. West		
4	Instruments - H ₂ Detector														Design		Install										T. M. Gayle		W. F. Schaffer		
5	Utility Scrap Disposal 3048																Design					Fabricate					R. J. Emmert		G. K. Ellis		
6	Element Disassembly Tools																Design					Fabricate					R. J. Emmert		G. K. Ellis		
6a	Sling																Design					Fabricate					R. J. Emmert		G. K. Ellis		
6b	Unloading Trough																Design					Fabricate					R. J. Emmert		G. K. Ellis		
6c	Hold Downs																Design					Fabricate					R. J. Emmert		G. K. Ellis		
7	Recapping														Test		Procure		Design		Fabricate		Install				R. J. Emmert		G. A. West		
7a	Can Storage Crate																Design					Purchase					E. L. Hutto		B. B. Klima		
7b	Can Grips - G.M.																Design					Fabricate					E. L. Hutto		G. A. West		
7c	Can Grips - #8																	Design				Fabricate					E. L. Hutto		G. A. West		
8	Fuel Can Handling 3048																	Design									E. L. Hutto		W. F. Schaffer		
8a	Can Grips - Lee																	Design				Fabricate					E. L. Hutto		W. F. Schaffer		
8b	Table																Design					Fabricate		Install			E. L. Hutto		W. F. Schaffer		
8c	Loading Trough																Design					Fabricate		Install			E. L. Hutto		W. F. Schaffer		
8d	Special Plug																Design					Fabricate		Install			H. M. Glen E. L. Hutto		W. F. Schaffer		
8e	Carrier																Design						Modify				E. L. Hutto		W. F. Schaffer		
8f	Carrier Dolly																Design					Fabricate					E. L. Hutto		W. F. Schaffer		
8g	Chute Modification 3019																					Design		Modify			E. L. Hutto		W. F. Schaffer		
9																															
10	Manco Shears 4 1/2" - 4505																										--		G. K. Ellis		
10a	Cover														Design		Fabricate			Install							R. C. Kinser		G. K. Ellis		
10b	Feeder														Design		Fabricate			Install							R. C. Kinser		G. K. Ellis		

TABLE 1 - PRFR - Mechanical Phase - Schedule (continued)

ITEM NO.	ITEM	January			February			March			April			May			June			July			August			September			Engineer Assigned	REMARKS	Chem. Tech. Contact
10c	Can Adaptation													Design			Fabricate			Install							M. I. Lundin		G. K. Ellis		
10d	Can													Design			Fabricate										M. I. Lundin		G. K. Ellis		
11	Oil Gear Unit									*Install																	-		G. K. Ellis		
12	Holding and Clamping Devices									*Design		Fabricate		Install													G. E. Pierce		G. K. Ellis		
13																															
14	Material Transfer Continuous	4505												Design			Fabricate			Install							R. C. Kinser		G. K. Ellis		
15	Manco Shears 1 1/2"									*Install																	-		G. K. Ellis		
16	Buffalo Plane Shear									*Install				*Remove													-		G. K. Ellis		
17																															
18	Surplus Press												cancelled														-		-		
19	Shear Blade Die Set									*Design				Fabricate			Install										G. E. Pierce		G. K. Ellis		
20																															
21	Explosive Shear									*Study																	-		W. F. Schaffer		
22																															
23	Production Prototype Shear																Development					Design					M. I. Lundin		C. D. Watson W. F. Schaffer		
24																															
25																															
26																															
27	Enclosure (Jericho) 4505											*Install															-		G. K. Ellis		
28	Top Cell 4A									*Install																	-		G. K. Ellis		
29																															
30																															
31	Shear - Dissolver																			Design				Fabricate			L. N. Howell		G. K. Ellis		
32																															
33																															

TABLE 1 - PRFR - Mechanical Phase - Schedule (continued)

ITEM NO.	ITEM	January			February			March			April			May			June			July			August			September			Engineer Assigned	REMARKS	Chem. Tech. Contact
48e	Prototype Fuels Mk I Modification 6							Design]								Fabricate]											-		W. F. Schaffer		
49	Prototype Fuels Mk II											Fabricate]															G. E. Pierce		G. A. West		
50	Prototype Fuels Mk III															Fabricate]											-		W. F. Schaffer		
51																															
52																															
53	Special Fuel Elements															Fabricate]											G. E. Pierce		G. K. Ellis		
54																															
55																															
56																															
57	Fuel Element Models - Con. Ed.															Fabricate]											G. E. Pierce		G. K. Ellis		
57a	-Nuc. Ship Sav.							*Fabricate]																			-		G. K. Ellis		
57b	-Com. Ed.							*Fabricate]																			-		G. K. Ellis		
58																															
59																															
60																															
61	Segmenting Facility 3048															Modification]											W. T. Flukinger		W. F. Schaffer		
62	General Mills Manipulators																										G. E. Pierce		W. F. Schaffer		
63	Model 8 Manipulators															Test]											W. T. Flukinger C. H. Odom		W. F. Schaffer		
64	Lee Manipulator - Cell A																										T. L. Trent		W. F. Schaffer		
65																															
66	Lee Manipulator - Storage Cell																										E. L. Hutto		W. F. Schaffer		
67	Storage Cell - Bridge Crane																										A. F. Zulliger		W. F. Schaffer		
68	Periscope - Storage Cell																										E. L. Hutto		W. F. Schaffer		
69	Zinc Bromide - Windows																										W. T. Flukinger		W. F. Schaffer		
70	Tunnel Transfer Cart																										W. T. Flukinger		W. F. Schaffer		

TABLE 1 - PRFR - Mechanical Phase - Schedule (continued)

TABLE 1 - PRFR - Mechanical Phase - Schedule (continued)																															
ITEM NO.	ITEM	January			February			March			April			May			June			July			August			September			Engineer Assigned	REMARKS	Chem. Tech. Contact
71	Bridge Crane Cell A																Install										W. T. Flukinger		W. F. Schaffer		
72	Bridge Cranes Cell B																Install										W. T. Flukinger		W. F. Schaffer		
73	Traverse Table									*Design						Fabricate	Install										W. T. Flukinger		W. F. Schaffer		
74	Dolly Slip Carrier									*Install																	-		W. F. Schaffer		
75	Scrap Containers															Fabricate											W. T. Flukinger		W. F. Schaffer		
76	Scrap Carrier																Fabricate										W. T. Flukinger		W. F. Schaffer		
77	Carrier Cell "B"																Fabricate										W. T. Flukinger		W. F. Schaffer		
78	Fuel Element Carriers															Design				Fabricate							R. L. Bragg		W. F. Schaffer		
79	Lifting Tongs and Tools									*Fabricate																	-		W. F. Schaffer		
80	Tray and Supports									*Fabricate																	-		W. F. Schaffer		
81	Charging Door Closure									*Design							Fabricate		Install								W. T. Flukinger		W. F. Schaffer		
82	Alignment Gauge												Fabricate														W. T. Flukinger		W. F. Schaffer		
83	Stainless Steel Roof Liner												cancelled														-		-		
84	Dust Collection System																	Specification							Install		W. R. Sanford		W. F. Schaffer		
84a	Cyclone																		Specification						Install		W. R. Sanford		W. F. Schaffer		
84b	Fan																		Specification						Install		W. R. Sanford		W. F. Schaffer		
85	Fire Extinguishment System															Design			Install								W. R. Sanford		W. F. Schaffer		
85a	Cylinder Storage															Design			Install								W. R. Sanford		W. F. Schaffer		
86	Maintenance Cubicle																		Design						Install		H. M. Glen		W. F. Schaffer		
87	Opening Cell A-B									*Design									Install								W. T. Flukinger		W. F. Schaffer		
88	Cell Door Gasket												Design					Install									R. L. Bragg		W. F. Schaffer		
89	Auxiliary Viewing Cell A																		Design						Install		T. L. Trent		W. F. Schaffer		
89a	Storage Cell																		Design						Install		T. L. Trent		W. F. Schaffer		
89b	Camera Storage Cask																		Design						Install		T. L. Trent		W. F. Schaffer		
90a	Dissolver Solution Sampler 4505																	Design			Fabricate			Install		C. H. Odom		G. K. Ellis			

TABLE 1 - PRFR Mechanical Phase - Schedule (continued)

ITEM NO.	ITEM	January			February			March			April			May			June			July			August			September			Engineer Assigned	REMARKS	Chem. Tech. Contact
90b	Dissolver Solution Sampler 3048																								Design	C. H. Odom		W. F. Schaffer			
91	Lighting Plug Storage Cell										Design						Fabricate									E. L. Hutto		W. F. Schaffer			
92	Utilities 3048																						Design			W. R. Sanford		W. F. Schaffer			
93	Electrical 3048																						Design			C. D. Stout		W. F. Schaffer			
94	Abrasive Wheel Saw 4505																									-		G. K. Ellis			
94a	Longitudinal Cut											*Design					Install									A. B. Fuller		G. A. West			
94b	Clamping Devices																						Design		Fabricate	D. C. Watkin		G. A. West			
94c	Particle Collection Device											*Design					Install									A. B. Fuller		G. A. West			
95	Multipurpose Wheel Saw 3048																Purchase							Install		A. F. Zulliger		W. F. Schaffer			
95a	Longitudinal Cut																						Design			Fabricate	A. F. Zulliger		W. F. Schaffer		
95b	Clamping Devices																						Design			Fabricate	D. C. Watkin		W. F. Schaffer		
95c	Particle Collection Device																						Design			Fabricate	A. B. Fuller		W. F. Schaffer		
96	Band Saw Study																										L. N. Howell		W. F. Schaffer		
97	Underwater Fuel Element Disassembly Equipment																						Design			Fabricate	L. N. Howell		C. D. Watson		
98																															
99																															
100	Fuel Element Separation Device											*Concept					Report										L. N. Howell		G. K. Ellis		
100a	Ferrule Splitters											*Test															-		G. K. Ellis		
100b	Slabbing Knife												*Test														-		G. K. Ellis		
100c	Microbraze Destruction												*Test														-		G. K. Ellis		
100d	Impact Wedge																										-		G. K. Ellis		
100e	Ferrule Stripper												*Test														-		G. K. Ellis		
101																															
102																															
103	Dissolved Fuel-Containers & Carriers																									Design	J. C. Suddath		W. F. Schaffer		

PROCUREMENT SUMMARY

Table 2 - PRFR - Mechanical Phase

ITEM NO.	ITEM	WORK ORDER	PURCHASE REQUEST	PURCHASE REQUISITION	PURCHASE ORDER	PROMISED DELIVERY	COST	RECEIVED	REMARKS
1	Mechanical Decladding Equipment	A-70132-11	11/18/58	D-161062 11/20/58	93X16370 12/24/58	4/30/59	\$ 9,861.50		Southern Machine Co., Chattanooga, Tenn.
2	Prototype Fuel Elements Mark I, Mod. 1, 50 ea.	A-70132-42	12/23/58	D-161064 12/23/58	93X16396 2/4/59	6/20/59	24,293.00		Dayton, Ohio Continental Technical Service, Inc.
3	Prototype Fuel Elements Mark I, Mod. 2, 25 ea.	A-70132-42	12/23/58	D-161064 12/23/58	93X16396 2/4/59	6/20/59	10,900.00		Continental Technical Service, Inc. Dayton, Ohio
4	Prototype Fuel Elements, Mark I, Mod. 3, 25 ea.	A-70132-42	1/7/59	D-161066 1/7/59	93X16396 2/4/59	6/20/59	13,300.00		Continental Technical Service, Inc. Dayton, Ohio
5	Manco Shear Blade for Manco MC125DA	A-70132-41	12/23/58	D-78293 12/26/58	41X37063 12/29/58	1/28/59	1,075.00	2/2/59	Manco Manufacturing Co., Bradley, Ill.
6	Fuel Element Power Shear Testing	A-70132-43	12/30/58	D-161065 12/30/58	93X44534 3/18/59	6/30/59	10,283.00		Clearing, Div. of U.S. Ind., Inc. Chicago 30, Ill.
7u	Fuel Element Power Shear - Testing	A-70132-43	12/30/58	D-161065 12/30/58	93X44533 3/18/59	6/30/59	11,000.00		Birdsboro Steel Foundry and Machine Co. Birdsboro, Pennsylvania
8	Organic Blanket Liquids for Test	A-70132-41	1/16/59	D-161068 1/19/59	OR59-1283 2/20/59	3/1/59	7.15	4/6/59	Union Carbide Chem. Co. New York, New York
9	Porcelain Rod 0.40 in. o.d. x 6" (8000)	A-70132-11	1/19/59	D-78337 1/20/59	54X41902 1/22/59	1/30/59	240.00	2/27/59	Clowes Ceramic Corp., Chattanooga, Tenn.
10	Seamless Stainless Tubing, 304, 0.227" x 0.197"	A-70132-42	1/21/59	D-161075 1/22/59	70X42333 1/29/59	1/30/59	95.52	2/27/59	J. Bishop and Co. Platinum Works Malvern, Pennsylvania
11	Filter Discs Poroloy	A-70132-41	1/27/59	D-161077 1/28/59	26X39578 2/2/59	2/2/59	368.10	2/9/59	Bendix Filter Div. Madison Hghts, Michigan
12	Aluminum Cans and Canner	A-70132-41	1/28/59	D-161079 1/28/59	93X44541 4/2/59	3/13/59	965.00		George D. Ellis and Sons, Inc. Philadelphia, Pennsylvania
13	Prototype Fuel Elements Mk III, 36 ea.	A-70132-42	1/28/59	D-161030 1/29/59	93X44540 4/1/59	6/20/59	15,776.00		Davidson Chem. Division Erwin, Tennessee
14	Medium Capacity Rectilinear Manipulator	A-92456-05	1/28/59	D-161081 1/29/59	22X46724 3/3/59	6/20/59	8,250.00		Lee Associates, Inc., Boise, Idaho
15	Dissolver Installation, Heat Exchr-Stainless Steel	A-70132-41	2/2/59	D-161034 2/2/59	94X39093 2/6/59	2/24/59	1,352.00	3/2/59	Manning & Lewis Engineering Co. Newark 4, New Jersey
16	S and t Butylbenzene	A-70132-41	2/5/59	D-161088 2/5/59	14X43136 2/11/59	3/4/59	105.00	2/17/59	Phillips Petroleum Co. New York 5, New York
17	Vibratory Cont. Diss. - Port Hole Seals	A-70132-41	2/5/59	D-161089 2/5/59	55X45450 2/24/59	3/6/59	22.32	3/17/59	Halogen Insulator and Seal Corp. Franklin Park, Ill.

PROCUREMENT SUMMARY

Table 2 - PRFR - Mechanical Phase (continued)

ITEM NO.	ITEM	WORK ORDER	PURCHASE REQUEST	PURCHASE REQUISITION	PURCHASE ORDER	PROMISED DELIVERY	COST	RECEIVED	REMARKS
18	Vibratory Cont. Dissolver - Windows	A-70132-41	2/5/59	D-161090 2/5/59	21X46234 2/27/59	3/6/59	\$ 43.20	3/6/59	Cincinnati Gasket Packing & Mfg., Inc. Cincinnati, Ohio
19	Vibratory Cont. Dissolver - Diaphragm	A-70132-41	2/6/59	D-161091 2/9/59	96X47223 3/10/59	3/6/59	222.80	3/13/59	American Durafilm Co. Newton Lower Falls, Mass.
20	Vibratory Cont. Dissolver - Diaphragm Clamp	A-70132-41	2/6/59	D-161092 2/9/59	94X44722 2/20/59	3/6/59	32.10	3/2/59	Breeze Corporation, Inc. Union, N. J.
21	Oil Gear Pump - Engineer Advisor	A-70132-41	2/11/59	D-161093 2/11/59	76X42531 2/12/59	2/12/59	198.95	2/13/59	Oilgear Co., Milwaukee, Wis.
22	Oil Gear Pump - Modification, Parts	A-70132-41	2/12/59	D-161097 2/13/59	45X43536 2/12/59	2/18/59	1,029.00	2/17/59	Oilgear Co., Milwaukee, Wis.
23	Dissolver Installation - Eco Pumps	A-70132-41	2/12/59	D-161098 2/13/59	45X43565 2/20/59	3/4/59	852.00	3/3/59	James E. Watson and Co. Marietta, Ga.
24	Prototype Fuel Elements - 3/16"-304SS Tubing	A-70132-17	2/12/59	A-13675 2/12/59	70X42396 2/12/59	2/13/59	77.52	2/6/59	Industrial Piping Supply Co. Knoxville, Tennessee
25	HPM 200 Ton Press	A-70132-41	2/17/59	D-161101 2/18/59		3/18/59			
26	Jericho - Asbestos Safety Curtain	A-70132-14	2/17/59	D-161103 2/18/59	28X47823 3/18/59	3/6/59	117.66	3/25/59	Johns Manville Sales Corp. Atlanta, Georgia
27	Vibratory Cont. Dissolver - Hydraulic Control	A-70132-26	2/18/59	D-161107 2/19/59	71X41687 2/25/59	3/2/59	141.45	3/2/59	Sperry Products, Inc. Danbury, Conn.
28	Dissolver Hydraulic Gauge Hi Pressure	33705-21	2/23/59	D-161110 2/24/59	58X45646 2/25/59	3/2/59	37.44	2/26/59	Tennessee Belting & Supply, Inc. Knoxville, Tenn.
29	Shear Die Set	A-70132-28	3/5/59	D-161114 3/6/59	23X47767 3/17/59	4/6/59	1,153.35	4/3/59	Lempco Industrial, Inc. Bedford, Ohio
30	SRE Decladding. Mineral Oil Sp. Gr. 0.877	A-70132-41	3/5/59	D-161115 3/6/59	33X48373 3/26/59	4/30/59	57.15	3/31/59	Esso Standard Oil Co. Knoxville, Tenn.
31	SRE Decladding. Mineral Oil Sp. Gr. 0.832	A-70132-41	3/5/59	D-161116 3/6/59	33X48348 3/18/59	4/30/59	26.20	4/2/59	Mineral Oil Refining Co. Dickinson, Texas
32	Mech. Decl. Eq. - Plugging Switch, Starters, Etc.	A-70132-41	3/9/59	D-161121 3/10/59	53X48469 3/20/59	4/27/59	337.81		Allen Bradley Co., Knoxville, Tenn. Partial Shipment 4/1/59, 4/13/59
33	Mech. Decl. Eq. - Transformer	A-70132-41	3/10/59	D-161122 3/11/59	53X48454 3/19/59	4/20/59	16.68	3/24/59	Dongan Electric Mfg. Co. Detroit, Mich.
34	Mech. Decl. Eq. - Junction Box	A-70132-41	3/10/59	D-161123 3/11/59	74X49411 3/17/59	4/20/59	52.47	4/7/59	Stokes Electric Co. Knoxville, Tenn.

PROCUREMENT SUMMARY

Table 2 - PRFR - Mechanical Phase (continued)

[illegible]

TABLE 3 - WORK ORDER STATUS
ACCOUNT 3370-21

Work Order Number	Description	Cost Estimate		Expenditures as of 4/1/59	
		Total	Labor	Total	Labor
A 01202-11	Liquid transfer line cost estimate	\$ 755	\$ 600	\$ -	\$ -
A 70132-11	Equipment for decladding SRE fuel elements, fabri- cation and installation	18,500	10,000	8,485	3,965
A 70132-12	Cancelled	-	-	10,261	6,146
A 70132-13	Cancelled	-	-	117	67
A 70132-14	Experimental facility Bldg. 4505 (Jericho) fabrication, alterations, installation, testing	15,000	7,100	11,824	5,074
A 70132-15	Models of prototype fuels	3,375	1,875	3,554	2,013
A 70132-16 (closed)	Install stainless steel floor in Cell 4A, Bldg. 4505	1,725	500	2,663	732
A 70132-17	Test assemblies, Cook's Shop	18,020	6,800	5,690	2,836
A 70132-18	Experimental facilities Bldg. 4505 (Jericho), design	10,920	6,600	4,323	2,618
A 70132-19	Special cell equipment and prototype equipment layout for Segmenting Cell, Bldg. 3048, design	20,920	12,600	10,272	6,225
A 70132-20 (changed to A 92408-05)	Carriers, design	8,390	6,600	2,490	1,509
A 70132-21	Continuous dissolver, design	15,080	9,080	7,538	4,503
A 70132-22	Fuel element separation device, design	5,100	3,000	1,047	632

TABLE 3 - WORK ORDER STATUS (CONTINUED)

ACCOUNT 3370-21

Work Order Number	Description	Cost Estimate		Expenditures as of 4/1/59	
		Total	Labor	Total	Labor
A 70132-23	Shearing device and auxiliaries, design	\$ 8,240	\$ 4,950	2,518	1,526
A 70132-25	Batch dissolver, fabrication and installation	12,000	5,450	852	158
A 70132-26	Continuous dissolver, fabrication and installation	25,754	11,065	13,211	5,225
A 70132-27 (Closed 4/6/59)	Fuel separation devices, fabrication and installation	-	-	55	0
A 70132-28	Shearing devices and auxiliaries, modification and installation	14,600	7,000	7,638	4,244
A 70132-29	Saws, modification and installation	3,000	1,600	0	0
A 70132-30	Saws, design	7,470	4,480	4,160	2,521
A 70132-31	Mechanical decladding equipment and auxiliaries, design	15,590	9,380	5,092	3,089
A 70132-32	Dissolver Instrumentation, Design	2,935	1,600	0	0
A 70132-33	Dissolver Instrumentation, Procurement and Installation	13,270	2,000	0	0
A 92408-02	Carriers, fabrication and/or alterations	40,000	12,100	444	112
A 92456-04	Segmenting Facility Design	14,536	11,536	-	-
A 92456-05	Segmenting Facility- Purchase and installation	35,000	8,000	-	-
A 92832-01	Remote Viewing - Engr. Design	770	600	-	-

TABLE 3 - WORK ORDER STATUS (CONTINUED)

ACCOUNT 3370-21

Work Order Number	Description	Cost Estimate		Expenditures as of 4/1/59	
		Total	Labor	Total	Labor
A 92832-02	Remote Viewing - Instr. Design	\$ 1,330	\$1,000	-	-
A 92832-03	Remote Viewing - Procure- ment and installation	7,645	3,000	-	-
		\$ 319,925	\$148,576	\$102,234	\$ 53,195

UNCLASSIFIED

FIG. 1 - INDEX OF EFFORT EXPENDED - AVERAGE MANDAYS LABOR PER DAY

FIG. 2
Proposed Installation in Segmenting Facility—Bldg. 3048
Plan View—Cell "A" (Dismantling and Shearing)

FIG.3
Proposed Installation in Segmenting Facility – Bldg. 3048
Front Elevation – Cell "A" (Dismantling and Shearing)

DISTRIBUTION

1-2.	W. F. Schaffer, Jr.	26-27.	M. I. Lundin
3.	T. A. Arehart	28.	G. Morris
4.	G. B. Berry	29.	E. W. Parrish
5.	R. E. Blanco	30.	G. E. Pierce
6.	J. C. Bresee	31.	F. Ring
7.	B. F. Bottenfield	32.	W. R. Sanford
8.	K. B. Brown	33.	G. W. Sell
9.	F. R. Bruce	34.	J. C. Suddath
10.	G. A. Cristy	35.	J. A. Swartout
11.	F. L. Culler	36.	E. H. Taylor
12.	H. G. Duggan	37.	H. A. Todd
13.	W. K. Eister	38.	T. L. Trent
14.	G. K. Ellis	39.	W. E. Unger
15.	D. E. Ferguson	40.	C. D. Watson
16.	W. T. Flukinger	41.	G. A. West
17.	O. Freeland	42.	C. E. Winters
18.	C. A. Fritts	43.	F. W. Wuest
19.	R. M. Fuller	44.	A. F. Zulliger
20.	W. R. Gall	45-46.	B. B. Klima
21.	H. E. Goeller	47.	ORNL-RC
22.	L. N. Howell	48.	M. J. Skinner
23.	K. E. Jamison	49-58.	Laboratory Records
24.	J. C. Lauderdale	59-60.	Central Research Library
25.	R. B. Lindauer	61.	Document Reference Section
		62-76.	TISE-AEC
		77.	A. T. Gresky