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THORIUM-URANIUM-233 OXIDE (KILOROD) FACILITY — ROD FABRICATION PROCESS AND EQUIPMENT

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OAK RIDGE NATIONAL LABORATORY
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UNION CARBIDE CORPORATION
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J. D. Sease, A. L. Lotts, and F. C. Davis[1]

ABSTRACT

A fabrication facility with related process equipment has been constructed to fabricate fuel rods containing U^{233} and thorium oxide by the bulk oxide-vibratory compaction route and is now in operation at the Oak Ridge National Laboratory. While the initial motivation for the facility was to fabricate U^{233}-bearing 1/2-in.-diam × 46-in.-long Zircaloy-2 clad fuel rods for criticality experiments at the Brookhaven National Laboratory, sufficient flexibility has been incorporated into the facility to accommodate a variety of development work on a pilot-plant scale. The facility consists of a number of permanent alpha-tight cubicles which are shielded with 4 1/4-in. steel. The fabrication process is carried out remotely in these cubicles with the exception of several gloved-hand operations which occur where the dexterity required for manipulation exceeds that of the remote castle-type tongs. The fabrication equipment that has been installed in the facility performs the operations associated with oxide powder comminution and classification, vibratory compaction of oxide in fuel tubes, tube closure, fuel rod decontamination, and fuel rod inspection. Both the facility and the process equipment are described in detail, and detailed assembly drawings of the process equipment are included.

INTRODUCTION

The potential of the Th-U^{233} fuel cycle for achieving low nuclear fuel cost exists because of the excellent nuclear characteristics of U^{233} which has a higher eta value in the thermal and epithermal energy regions than either U^{235} or Pu^{239}. Obviously, the U^{233} formed in the cycle must be returned to the reactor to capitalize on this potential. Unfortunately, associated with the U^{233} are significant levels of U^{232}, the decay products of which emit penetrating radiation, thus making the

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[1]Plant and Equipment Division.

consideration of shielding and fast processing time mandatory in thorium fuel cycle technology.[2] The development of techniques for reprocessing and fabricating fuels containing thorium and U^{233} is, therefore, an important step toward fulfilling the economic potential of the system. The demonstration of technical feasibility and the establishment of economics for both reprocessing and refabrication are unquestionably essential for accurate determination of the worth of the thorium fuel cycle to nuclear power systems.

As a first step toward developing economical processes and systems for remote refabrication of Th-U^{233}-bearing fuels, a facility (known as the Kilorod Facility) has been constructed and is now in operation at ORNL. In this lightly shielded facility, space is provided to accomplish all the phases of fabrication of radioactive material by the vibratory compaction route.

The facility and its equipment were specifically designed for making fuel rods that are to be used in zero-power criticality experiments at Brookhaven National Laboratory (BNL). These rods are scheduled to be made at a production rate of approximately 10 to 15 rods per day. Other fabrication tasks not accommodated by the BNL fuel fabrication equipment can be accomplished by substituting process equipment in the permanent cubicles.

The processing of the fuel in the Kilorod Facility encompasses two distinct phases – bulk oxide preparation by the sol-gel process[3] and fuel rod fabrication. This report is concerned with the equipment and facilities for the rod fabrication operations which include those steps from the conitioning of the oxide for loading into fuel tubes through inspection of the completed fuel rods. A discussion of the development of the equipment and process up to the commencement of operation with U^{233} is presented. Detailed assembly drawings and purchase specifications of the process equipment are included in the appendices. Also included in the appendices is a complete list of the engineering drawings for the entire facility.

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[2]E. D. Arnold, "Radiation Hazards of Recycled U^{233}-Thorium Fuels," pp 253–84 in Proceedings of the Thorium Fuel Cycle Symposium, Gatlinburg, Tennessee, December 5–7, 1962, TID-7650, Book 1 (1963).

[3]D. E. Ferguson et al., Preparation and Fabrication of ThO_2 Fuels, ORNL-3225 (June 1962).

FUEL ROD DESIGN

The configuration of the reference fuel rod to be fabricated in the facility for the BNL critical experiments is shown in Fig. 1. The BNL experiments require 900 of these rods and 200 rods identical in design except that they are 18 in. in length instead of 46 1/16 in. The detailed design of these two rods may be reviewed in Appendix A.

The nominal compaction density was not specified by BNL but will be determined from the average density of the fuel rods fabricated. It was specified that the rods will have a fuel density of ±2% of this determined average density, and the density within a fuel rod will be to ±2% of the average for that fuel rod. Based on experience with depleted $(U,Th)O_2$ in the "cold" operation of the facility, an average density of 90% of theoretical is expected.

The cone-shaped Zircaloy-2 bottom fitting which will be used to direct the rod in the critical lattice at BNL is welded onto the tube in a tungsten-inert gas-welding operation which is done outside the facility. The annular groove in the bottom plug is used as a handling aid during fabrication. In the facility, the top plug, ceramic spacer, and spring are inserted into the fuel tube after compaction as a unit. The ceramic spacer and spring are used in the void area at the top of the fuel rod to prevent redistribution of the fuel during handling. The Zircaloy-2 top-end plug, joined onto the fuel tube by a fusion edge weld in the facility, is threaded to accommodate the stainless steel hanger fixture. This hanger fitting will be used to facilitate handling of the fuel rod in the critical lattice. The hardware procurement for these rods is described in another document.[4]

ROD FABRICATION PROCESS

The procedures employed to fabricate the BNL fuel rods include: (1) sizing the bulk UO_2-ThO_2 into an optimum particle-size distribution

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[4]S. A. Rabin, Procurement and Evaluation of Hardware for the Brookhaven National Laboratory Fuel Rods, ORNL-TM-739 (in press).

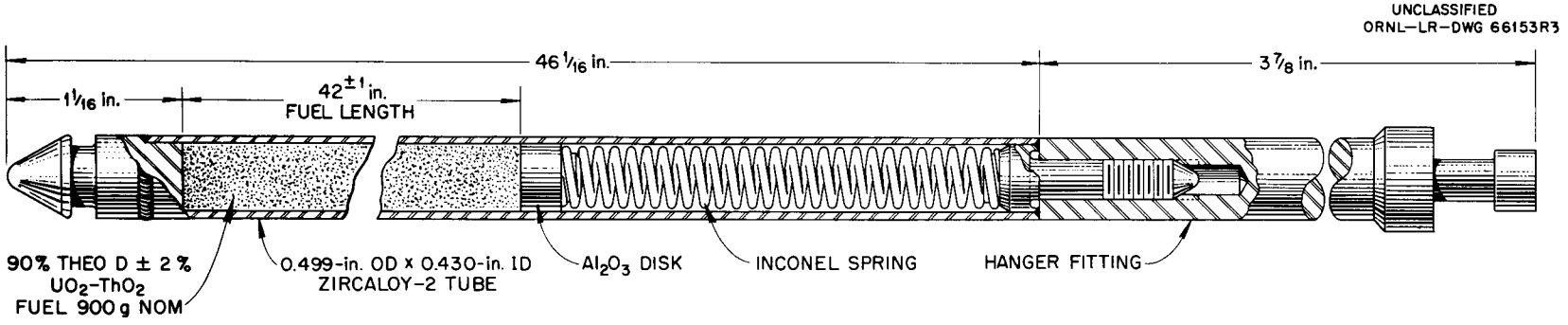

Fig. 1. Design Features of the BNL Fuel Rod.

for vibratory compaction, (2) vibratory compaction, (3) welding of the final end closure, (4) fuel rod decontamination, and (5) fuel rod inspection.

The size distribution required to achieve maximum density by vibratory compaction consists of a mixture of either two or three fractions. For design purposes, the reference size distribution consisted of a mixture of three size fractions. As seen in the flow diagram (Fig. 2), these fractions are produced from the as-received calcined oxide by a system of crushing, classifying, and ball milling. Following comminution and classification of the bulk fuel into the two or three working fractions, quantities of each fraction appropriate to one fuel rod loading are apportioned and blended together. The weight of the fuel charge is then checked prior to transfer to the vibratory compaction filling mechanism.

In the vibratory compaction operation, the blended aliquot of fuel is loaded into a fuel tube which contains one end plug and is vibrated to the specified density. This loaded fuel tube is transferred to a welding fixture, the weld area cleaned by wire brushing, and the final end-closure weld made and visually inspected.

At this juncture, the loaded and sealed fuel rod is decontaminated by ultrasonic cleaning in water and smeared to check the level of surface contamination. The integrity of the end-closure weld is evaluated by helium leak checking, and the density of the fuel is determined with a gamma-absorption scanning device. The weight of the completed fuel rod is then checked for determination of the final fuel rod density. Finally, the hanger fitting is attached prior to loading the fuel rod into a shipping cask.

ROD FABRICATION FACILITY

The rod fabrication steps are accomplished in shielded alpha-tight cubicles (Fig. 3) situated on the bottom two floors of a 20-ft-long × 19-ft-wide × 27-ft-high chemical processing cell (cell No. 4, Bldg. 3019) which provides secondary containment of airborne contamination in the event of an accident.

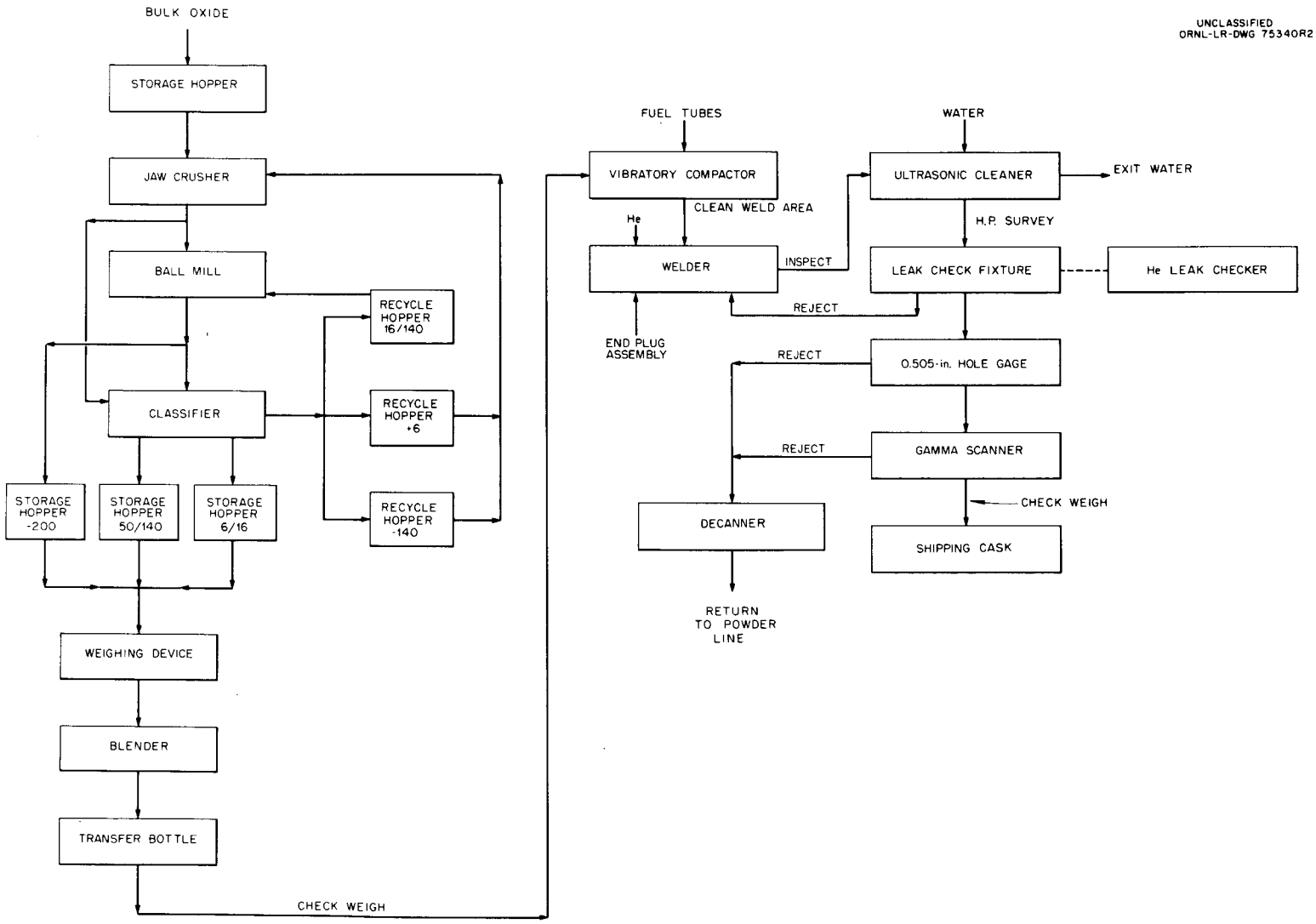

Fig. 2. Rod Fabrication Process Flow Diagram.

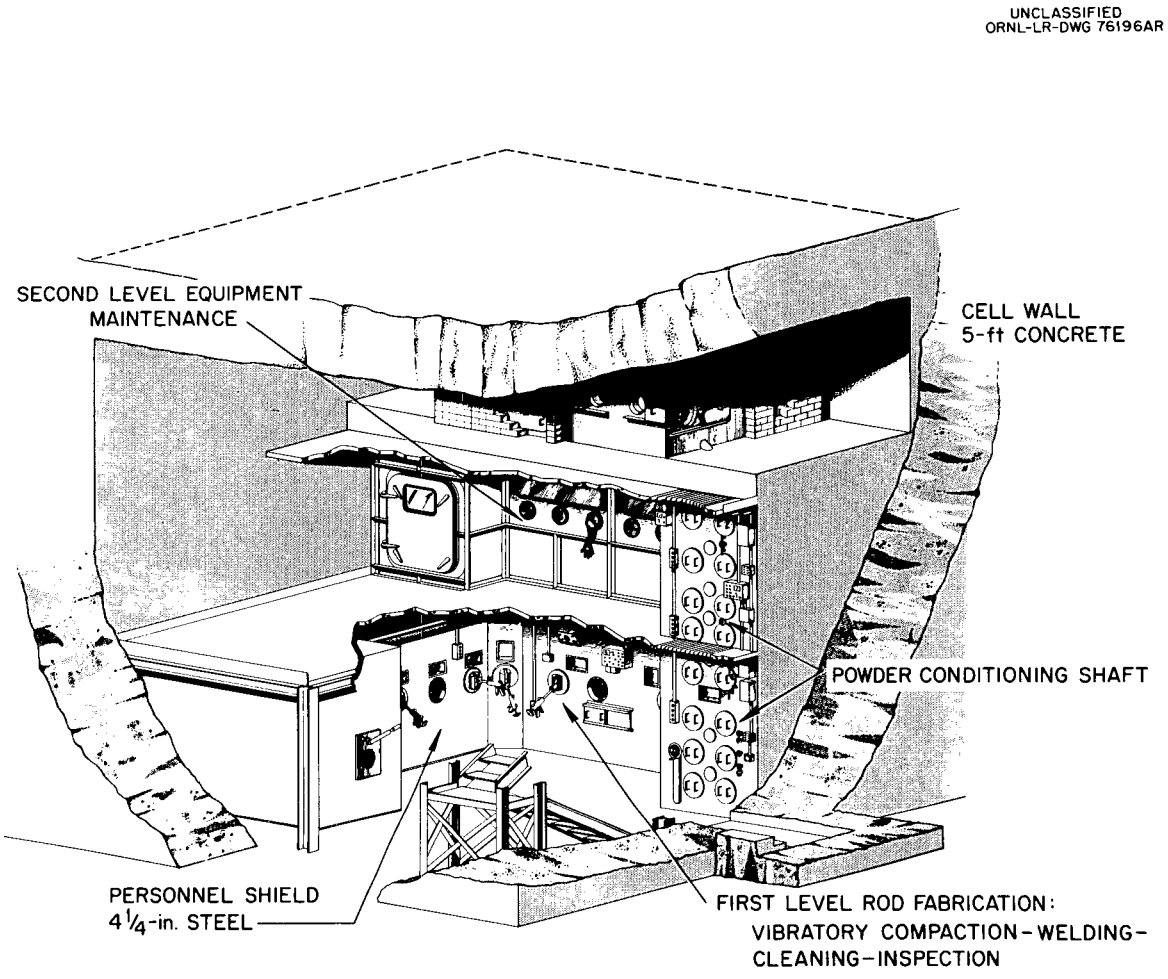

Fig. 3. Overall View of Rod Fabrication Facility.

The fabrication process line was located within a previously used chemical processing cell to utilize existing space. The heavy shielding afforded by the process cell walls has little function in this process. The use of the cell posed a number of problems in design and construction. The limited amount of space available within the cell necessitated the design of cubicles that could be serviced from only the top and one side and also dictated the design of some of the process equipment. The danger of spreading residual contamination retained within the cell wall from previous processes made it necessary to construct the cubicle structure independently of the cell structure.

Cell Layout

The general cell layout may be reviewed in Figs. 4 and 5. Located on one corner of the first level and extending to the top of the second level is the 4- × 7-ft powder-preparation shaft. Directly adjacent to this shaft on the first level are three fabrication cubicles that extend along two walls. The first of these cubicles is used for vibratory compaction and welding, the second for decontamination, and the third for inspection. The cubicles are connected by 1-in.-diam transfer ports. In addition, a 6- × 6-in. port is provided between the vibratory compaction welding cubicle and the decontamination cubicle. A wire screen is located approximately 36 in. from the floor and is used in the cleaning and inspection cubicles to facilitate the recovery of a dropped fuel rod. An unshielded gloved-maintenance area, equipped with a plate glass front and gloves, is located on the second level adjacent to the powder-preparation shaft and directly above the vibratory compaction-welding cubicle and the decontamination cubicle. The maintenance area is equipped with a large bag-out port, an airlock, and a monorail crane which traverses the length of the repair area and the powder-conditioning shaft and is used to lift and convey equipment. A movable worktable and the reject rod decladder are also located in this area. Access to the powder-preparation shaft is through a door in the rear of the shaft which is located on the second floor within the gloved-maintenance area. Access to the fabrication cubicles is through access ports, normally sealed by shield plugs, in the floor of the repair area.

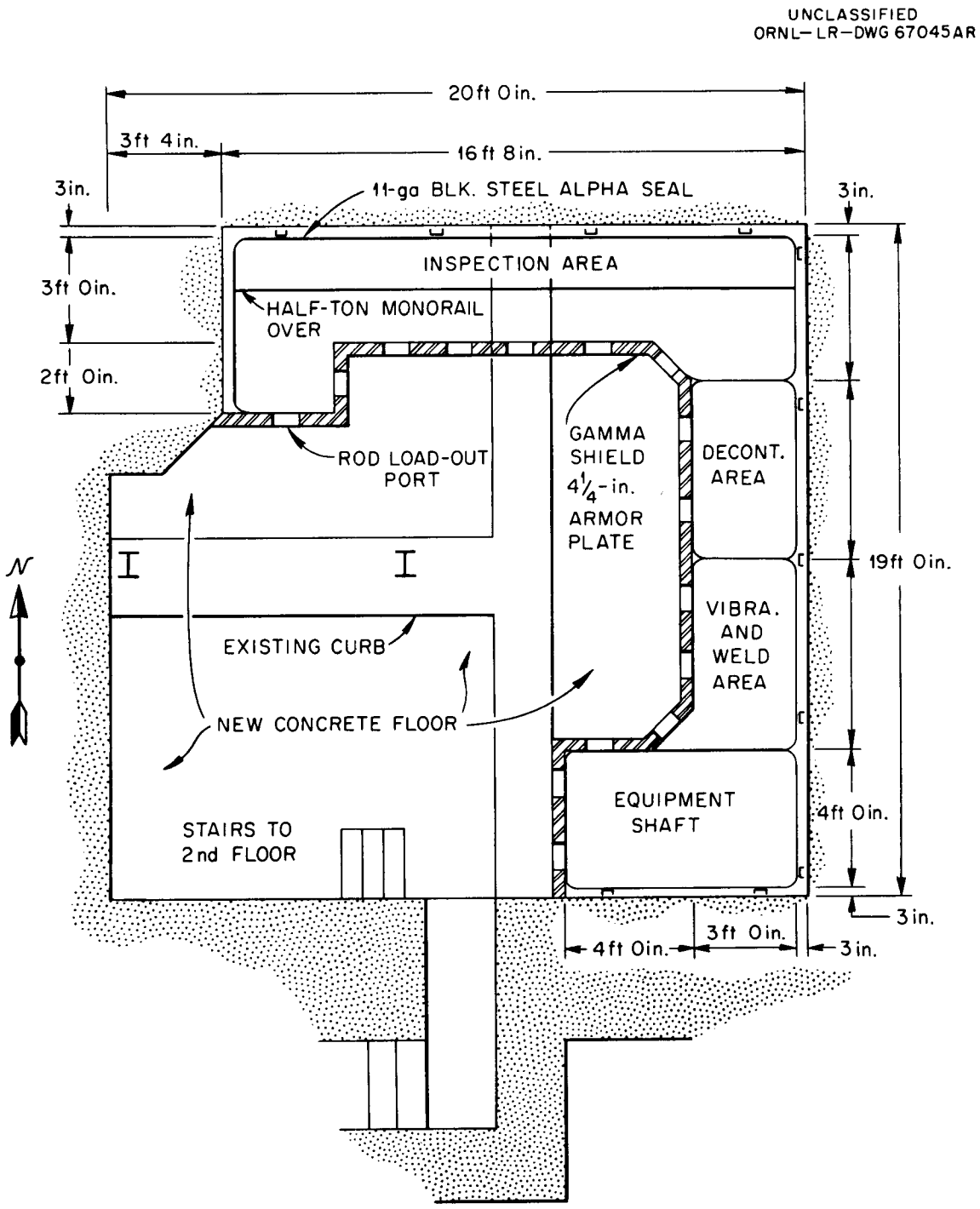

Fig. 4. First Floor Plan — Rod Fabrication Facility.

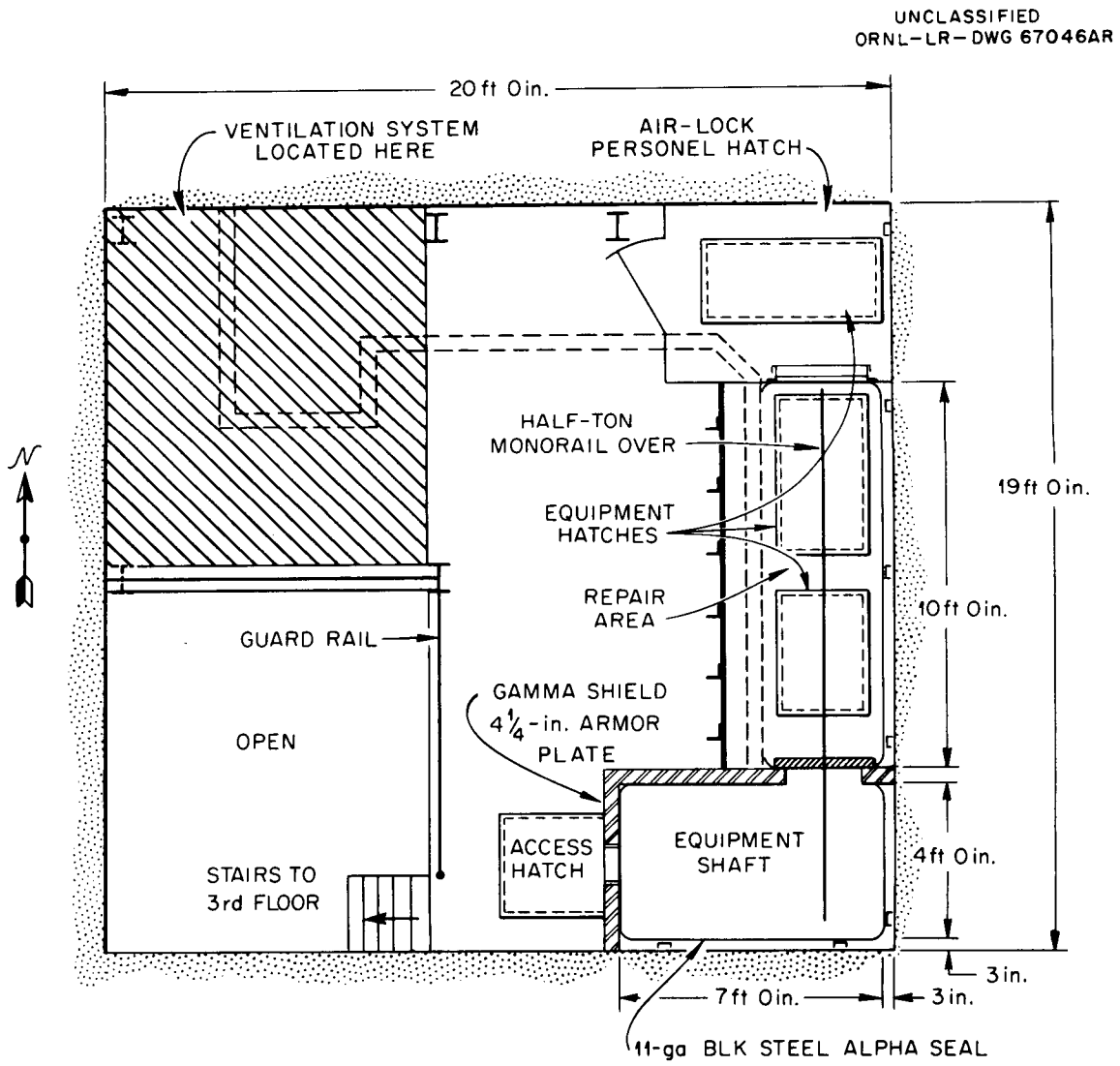

Fig. 5. Second Floor Plan — Rod Fabrication Facility.

Routine entrance and exit of the Kilorod Facility are accomplished through a hatch door and labyrinth located on the first floor. A hatch in the roof of the cell is provided for the entry of the shipping cask or large pieces of equipment. An overhead building crane, located above the cell, is used to transfer the parts through this roof hatch. An emergency personnel hatch is also located on the roof.

Containment

Primary alpha containment for the cubicles is provided by an 11-gage mild steel liner that is painted with an epoxy base (Amercoat No. 74) paint. Gamma shielding is provided by 4 1/4-in. armor plate placed on the top and operating faces of the cubicles. The gamma shielding was designed to allow safe handling of the (Th–3 wt % U^{233})O_2 fuel (the U^{233} contains 40 ppm U^{232}) for a period of 30 days after the purification of the U^{233}. The code used for the shielding calculations may be reviewed in another paper.[5]

A number of difficulties were experienced in using the salvaged surplus armor plate that was employed for the gamma shield. The armor plate had to be surfaced before using because of many irregularities in the surface. The plate was laminated, thus making the burning of holes extremely difficult. After erecting the shield in the cell, it was necessary to place some additional small holes in the armor plate. These holes, less than 1 in. in diameter, were made with some difficulty using standard drilling procedures.

Ventilation

The facility ventilation system (Fig. 6) was designed so that the operating cubicles will be maintained at a pressure below atmospheric through the use of existing ventilation systems in the vicinity of the cell. The cell is maintained at −0.3-in. water gage pressure with respect to ambient, and the cubicles are maintained at −0.3- to −0.35-in.

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[5] E. D. Arnold and B. F. Maskewitz, SDC – A Shielding Design Calculation Code for Fuel Handling Facilities, ORNL-TM-124 (Jan. 1962).

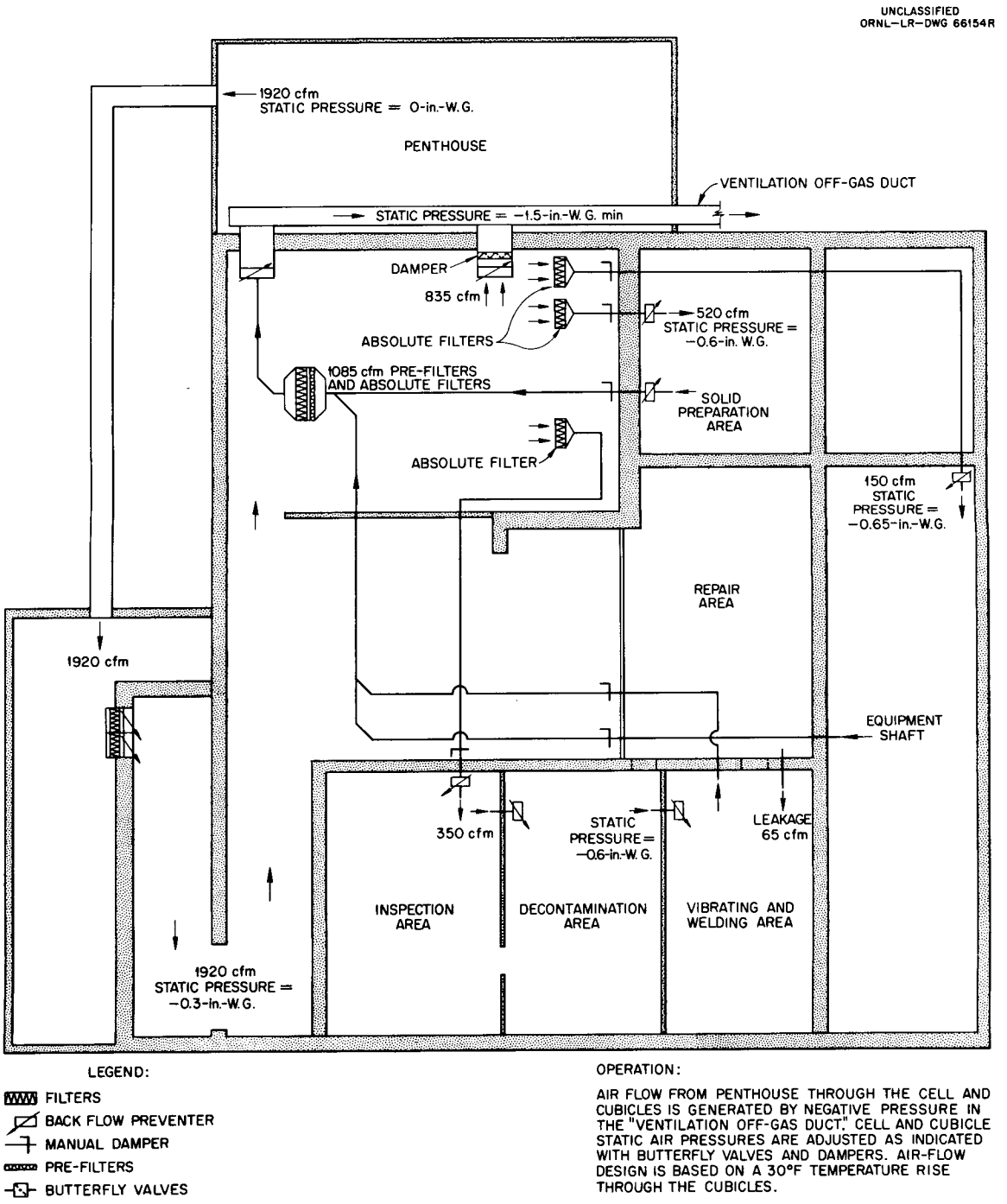

Fig. 6. Cell Ventilation System.

water gage with respect to the cell. All air entering and leaving the cell and cubicles is filtered with high efficiency filters. Cubicle and cell pressures are controlled by manually operated dampers and safeguarded with backflow preventers and differential pressure alarms and indicators. Also, the backflow of air from the cubicles into the cell is filtered through absolute filters. After construction, the exhaust filter housing was modified to include a slide-through filter chamber which enables the changing of one filter by displacing it with its replacement, thus maintaining a filter in the air stream at all times.

Drainage

Drainage is accomplished on the second floor by simple gravity. The first-floor level, below the level of the gravity drain, is drained by means of a steam-jet system. Water lines are available for water trapping the drains to prevent backflow of air from the hot-drain line. In the powder-preparation shaft and welding-vibratory compaction cubicle, where open water in the drains cannot be tolerated, a hand-operated cut-off valve is employed. A disadvantage of the installed steam-jet system is that the piping and steam jets are located within the operating area, thus presenting a severe contamination problem in the event of a rupture of these lines. To improve the originally installed steam-jet system, all screw-type connections were replaced with welded joints in order to reduce the possibility of a leak.

Penetrations

The location of all cell penetrations and detailed assembly drawings of the penetrations may be reviewed in Appendix B.

Glove and Manipulator Ports

A special multipurpose port is employed in the facility that may be fitted with either a glove or a castle-type manipulator, and these units may be interchanged while maintaining an alpha-tight seal. With this port design, the permanent cubicles are given the flexibility of being equipped for different processes that may have different manipulation requirements.

The flexibility of the ports is gained through the use of an adapter ring that can be fitted with either a glove or a manipulator boot. The replacement or the interchanging of a glove or boot is accomplished by displacing the adapter ring by another ring, the replaced unit being pushed completely through the port and into the cubicle. The alpha-sealing ring in the port opening is sufficiently wide to engage the replacement adapter unit before the replaced unit is discharged into the cubicle; thus, an alpha-tight seal is maintained during this replacement operation.

The use of these ports, however, caused some difficulties in installation and operation. The tight tolerances required to effect the alpha seal with the ring made the displacement process extremely difficult, mainly as a result of slight warping of the port insert during installation. This warping of the inserts also made the fitting of the mating parts of the castle joint and the glove-shield plug into the port extremely difficult.

Castle Manipulators

The castle joints and tongs (Fig. 7) are standard Allied Engineering models that were modified to obtain better alpha sealing of the tongs. With the castle manipulator, it is possible to perform only the simplest manipulation as no wrist or elbow action is present. Special rod-handling fingers were developed for the tongs. These fingers, which consist of 1 1/2-in. "V" groove plates and 1 1/2-in. pressure plates, were made by increasing the width of the standard fingers from 1/2 to 1 1/2 in. and by attaching 1/2-in. plates to each side of the manipulator fingers.

Glove Port Shields

Each glove port, when not in use, is fitted with a 4-in.-thick lead plug. This plug has the same contour as the castle joint and fits in the adapter ring in a manner similar to the joint.

Bag-Out Ports

The two permanent bag-out ports, located in the cleaning and the inspection area, are of a right-angle design. The right-angle

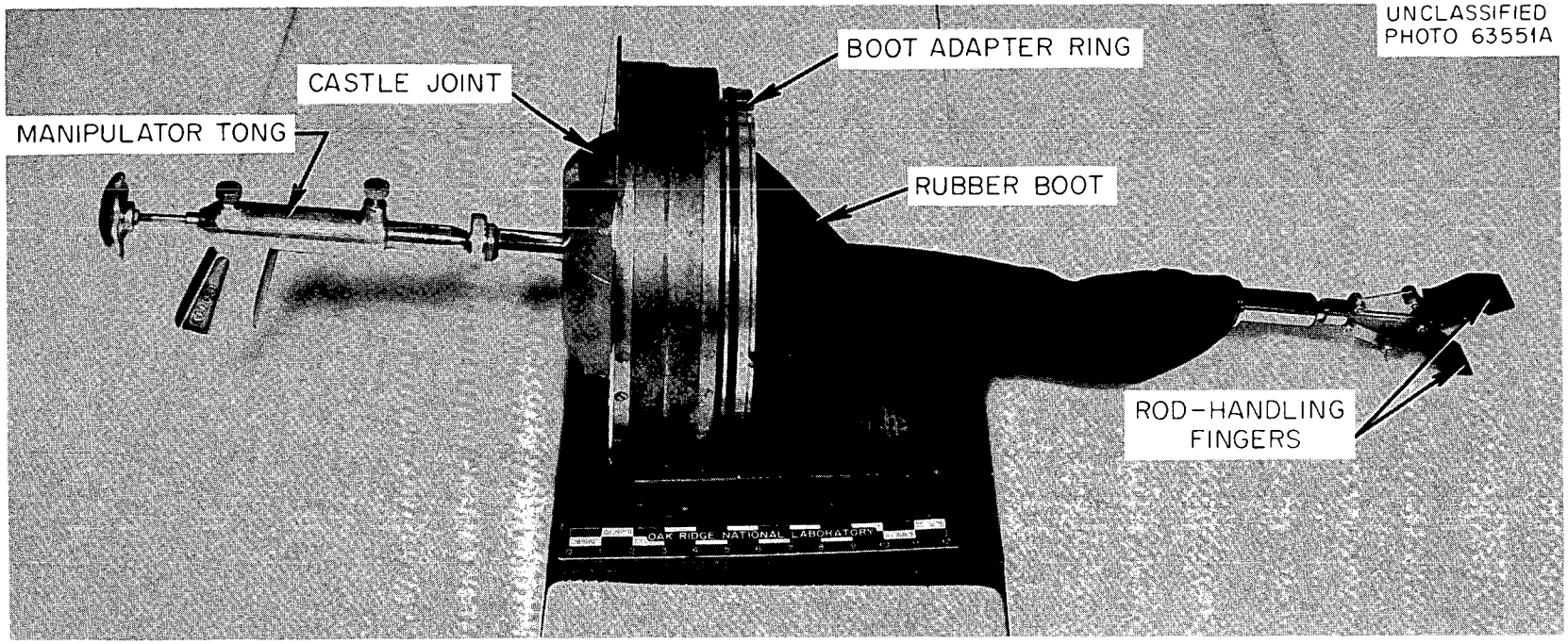

Fig. 7. Castle Manipulator.

configuration of the ports was necessary to lower the exit penetration level below the glove-manipulator port level due to linear space limitations while maintaining the in-cell entry level at a suitable glove-working height. The ports are equipped with a track-mounted gamma shield.

A special bag-out port that can be used in any of the glove-manipulator ports was developed. This port, which uses the principle of the glove-boot adapter ring, is employed mainly on the powder-preparation shaft where no bag-out ports are available.

Valve Connectors

The operation of all the valves in the powder-preparation shaft is performed either with flexible shaft connectors or with shaft universal-joint connectors. The original design called for the exclusive use of the flexible-type connector; however, the large amount of backlash present in the flexible linkage precluded their use in several instances. The universal-joint-type connectors are used on the 2-in. bypass valve, the ball-mill rotation mechanism, and the −16 +50 bypass valve.

Windows

For viewing purposes, the cubicles are fitted with eight 6-in.-diam round and twelve 6- × 12-in. rectangular, 6.2 g/cm^3 density, lead-glass windows that are 4 in. thick.

Electrical

Electrical entries into the cell are made using standard rubber-coated cables through rubber-compression grommets.

PROCESS EQUIPMENT

In the design of the fabrication equipment, standard commercially available units were utilized wherever practicable; however, the majority of the equipment was specifically designed for the process. Where a commercial unit was used, extensive modification of the unit was usually necessary before it could be incorporated into the process scheme.

As would be expected from experimental equipment of this nature, a large number of difficulties were encountered in the as-designed stage.

To evaluate this equipment, it was therefore necessary to test each piece of equipment under simulated conditions before installing it in the facility. After the installation of the equipment in the facility, the process line was again thoroughly evaluated with stand-in oxide before the U^{233}-bearing fuel was introduced.

The following is a discussion of the equipment that is currently being used in the facility. Detailed assembly drawings of the process equipment may be reviewed in Appendix C. Purchase specifications for major components not included in Appendix C may be reviewed in Appendix D.

Powder-Preparation Equipment

The powder-preparation equipment was designed to afford maximum dust confinement and to use gravity for transporting the fuel through pipes from one equipment unit to the next. All the equipment in the powder-preparation shaft (Fig. 8) is remotely controlled either electrically or by flexible shafts. Minor repairs to the equipment are made in place through glove-access ports. To facilitate major repairs, the equipment is mounted on movable racks in the front half of the shaft. The defective piece of equipment can be removed by pushing the equipment rack to the rear and lifting the piece with the hoist and transporting it onto the hoist monorail to the repair area.

The jaw crusher and ball mill are located on the top rack of the shaft. Directly above the jaw crusher is a valve that is used to control the rate of feed to the jaw crusher. The classifier, located directly below the jaw crusher and ball mill, continuously classifies the feed material into dispensing hoppers. The rate of feed to the classifier is controlled either by the feeder valve controlling the feed to the jaw crusher or by a feeder valve controlling the feed rate from the ball mill. Six transparent-glass storage hoppers — three for the working fractions and three for the recycle fractions — are located around the base of the classifier. The three recycle storage hoppers are connected directly to a recycle manifold. The recycle manifold empties into a recycle hopper that conveys material to the jaw crusher or the ball mill for recycling.

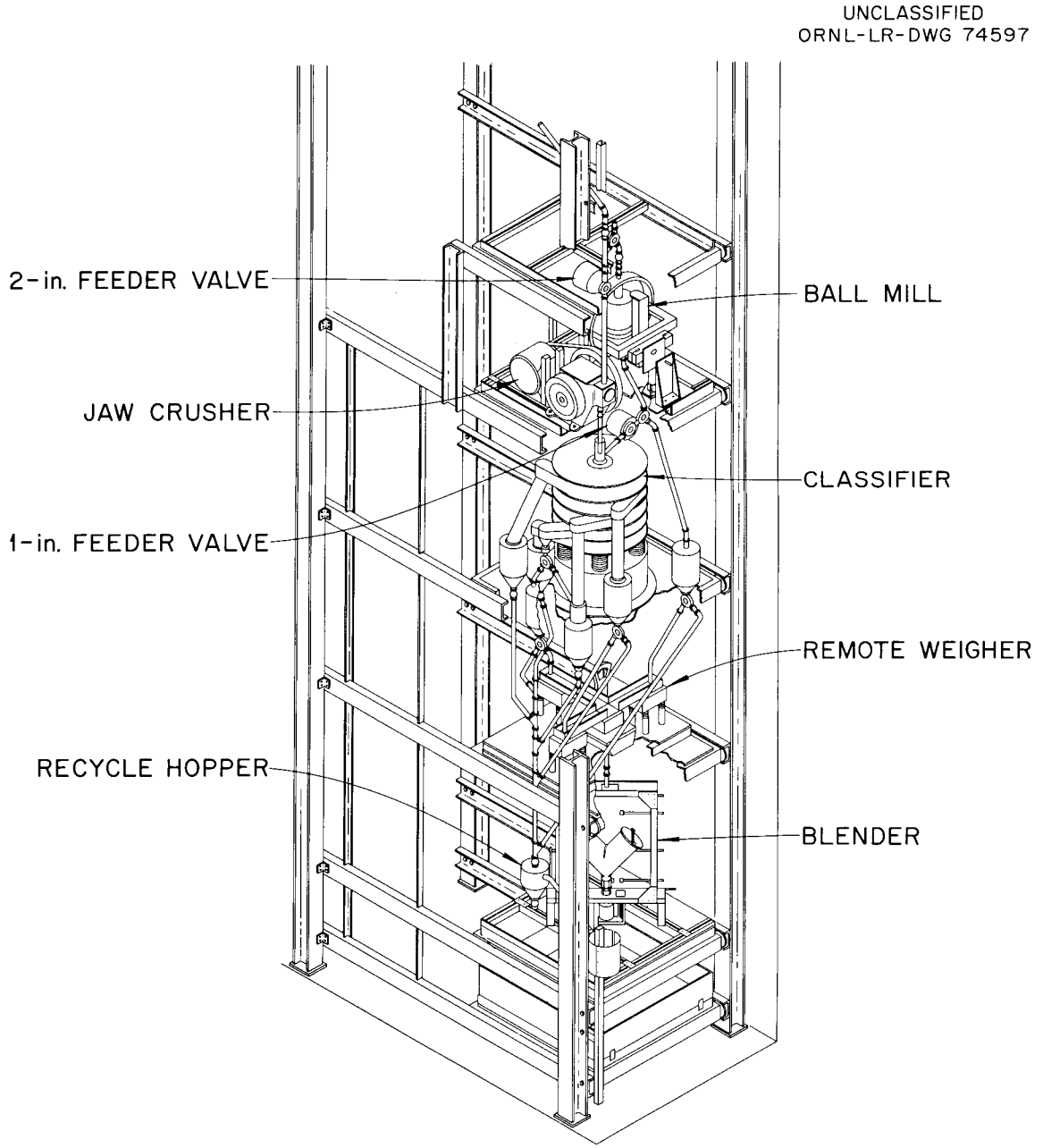

Fig. 8. Overall View, Powder-Preparation Shaft.

Directly below the classifier is a remote weigher where exact quantities of each of the working fractions are obtained. As each fraction is weighed, it is dumped directly into the blender located below the weigher. The blended fuel charge, which is emptied into a bell-valve transfer flask from the blender, is transferred by a manipulator to a top-loading, direct-reading scale located directly behind the blender. After check weighing the fuel charge, the charge is then transferred by two manipulators to the vibratory compaction filling mechanism. A radiation monitoring station is provided in the area of this transfer which allows radiation monitoring of the fuel charge at this juncture. Each major component of the powder-preparation shaft is discussed in the paragraphs that follow.

Jaw Crusher

Sufficient crushing capacity and yields are obtained by employing a standard laboratory-size jaw crusher (Fig. 9). The crusher was modified to allow continuous feeding and discharging and to effect maximum dust confinement.

The major limitations of using a jaw crusher of this nature in a remote facility are (1) the tendency of the crusher to jam under excess feed rates and (2) the difficulty of changing the jaw crusher opening. The jamming tendency can be solved readily by closely controlling the rate of feed to the crusher. Changing of the jaw crushing opening, however, requires disconnections of the powder lines leading to the crushing and the insertion of shim metal behind the stationary jaw.

Ball Mill

A ball mill (Fig. 10) is used for sizing the fine and intermediate fractions for vibratory compaction. As designed, the mill is capable of being filled, ball milling the oxide, and discharging while remaining sealed from the cubicle atmosphere. Because of the small volume of fuel to be processed, a standard 1-gal alumina grinding jar and a single roll mill were incorporated in a device that would allow the grinding jar to be rotated on two separate axes simultaneously. For milling, the grinding jar is charged with approximately 2800 g of 5/8-in.-diam high-alumina porcelain grinding balls.

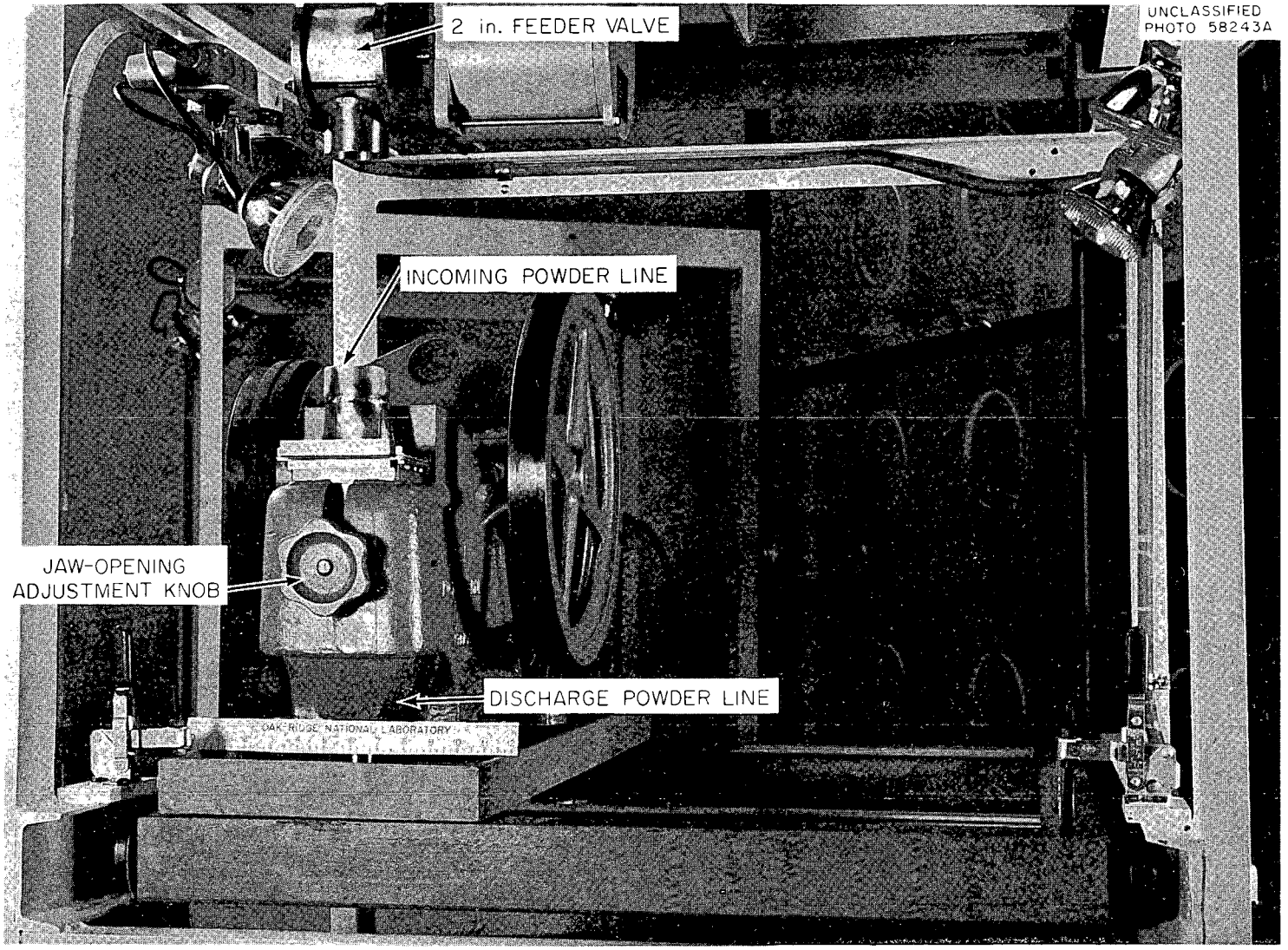

Fig. 9. Jaw Crusher.

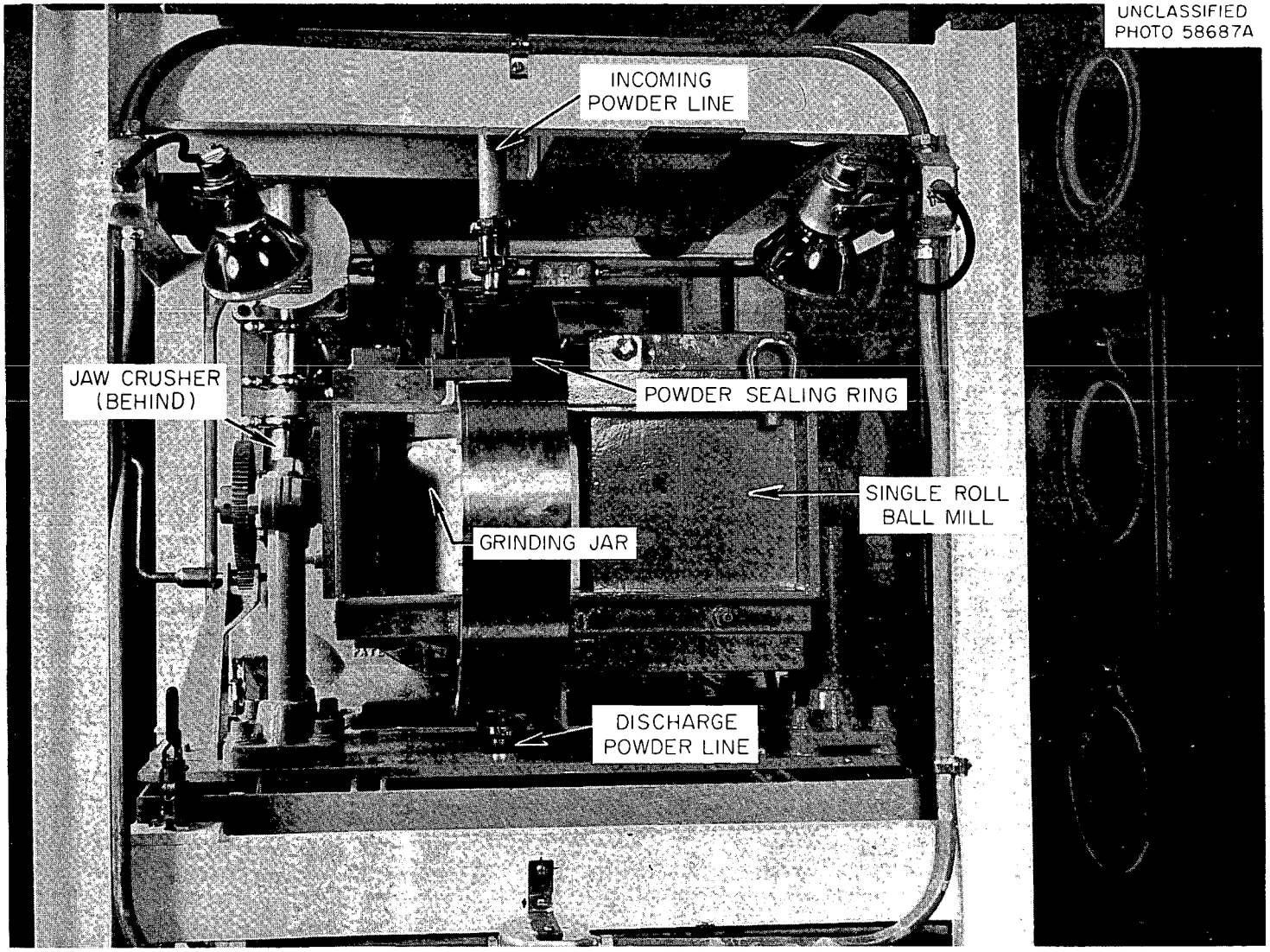

Fig. 10. Ball Mill.

The original ball mill was totally unsatisfactory because of a basic design error that required the alignment of three floating axes of rotation simultaneously. Although the present mill incorporates good design features, there is doubt as to whether a mill of this nature can be made sufficiently reliable. The requirement that the bearings must operate in the very abrasive environment associated with the ball mill is reason for this doubt. A possible answer to the ball-mill problem may be found by using a continuous throughput ball mill. However, commercial units of this type that are available are quite large. Also, for a large production facility where a side-loading batch mill can be employed, the number of problems that are present in this small mill should be greatly decreased.

Classifier

An 18-in., five-deck, vibratory separator is employed for classifying the crushed and ground material into its different size fractions. The classifier (Fig. 11) used in the facility is a commercial unit that was modified to minimize dust and material holdup.

One major limitation of a screen classifier in a remote facility is the tendency of screens to blind. Blinding in the present classifier system is not considered serious since the anticipated process throughput for the Kilorod commitment is only a fraction of the designed throughput of the classifier unit. In a large production facility, screen blinding may present a serious problem. The classifier also presents the largest material holdup problem in powder preparation.

Storage Hoppers

The classified material is discharged into Pyrex glass storage hoppers. The glass storage hopper allows a visual determination of the amount of processed material of each size fraction.

Recycle Hopper

The recycle hopper was designed to lift material for recycling to the jaw crusher and ball mill. The apparatus, which is chain driven by a hand crank outside the cubicle, consists of a hopper that is mounted on a vertical track that runs the height of the cubicle and a cam

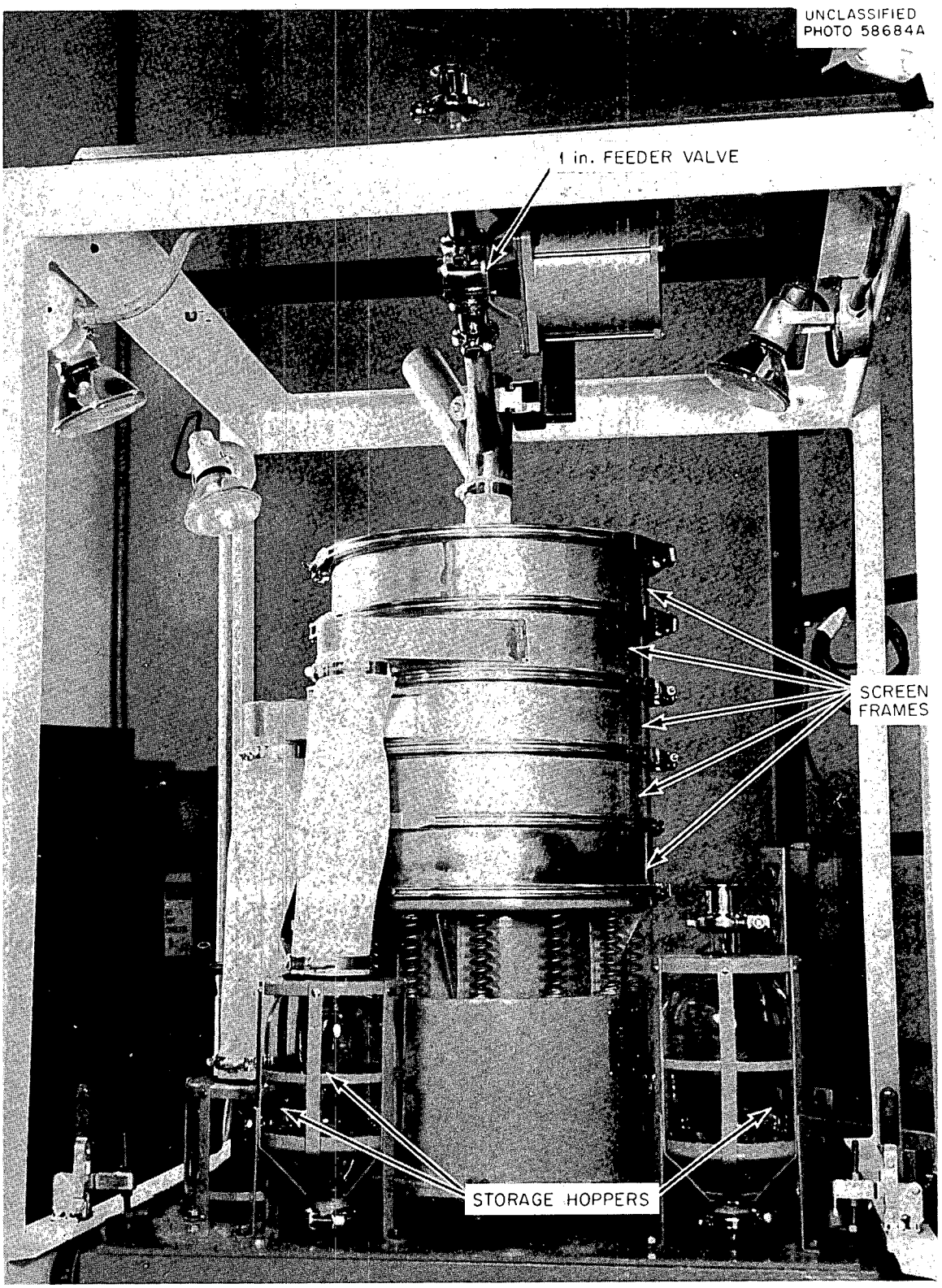

Fig. 11. Classifier.

mechanism for swinging the hopper into and out of position. The main problem with the hopper mechanism was in the initial lineup of the assembly.

Feeder Valves

For controlling the rate of feed to the jaw crusher and/or the classifier, a motor-driven vane-type feeder valve is employed. The rate of feed is controlled by the drive motor which is a stepping-type synchronous motor. The major difficulty in the use of the vane valves was experienced in developing a suitable speed-control circuit for the stepping motors.

Powder Flow-Control Valves

Standard stainless steel ball valves with Teflon packing are employed to control powder flow. The ball valves have worked satisfactorily in the powder lines; however, the force required to operate the valves was much higher than originally anticipated. A great deal of trouble was experienced because of insufficient structural strength of the components of the valve extension handles. A torque of 50 to 100 lb is sometimes required to operate these valves.

Bypass Valve

A special plug-type valve is used to divert powder flow between lines. Using Teflon sealing rings, the valves work easily and have been satisfactory.

Piping

Standard sched-40 stainless steel pipe is used to convey the powder from one unit to the next. Two-inch pipe is used when handling +6 mesh material; 1-in. pipe is used for the other fractions. "Flex-master" couplings were used as pipe connectors to facilitate the maintenance of the equipment. These couplings, however, have proven very difficult to install remotely and also present a small area where material is retained. The amount of fuel retained per joint is small but the total for the entire system is significant.

Line Vibrators

Pulsating magnetic-line vibrators are used to help transport the powder through the lines. In the powder-preparation shaft, eight vibrators are used.

Weigher

The remote weigher (Fig. 12), employing a standard commercial scale, consists of one scale and three individually controlled feeders containing the three size fractions. The weigher uses a one-to-one ratio scale with an "over-under" weight-type indicator, precision feeder cutoff controls, an impact-free dumping mechanism, and an automatic dumping weighing pan. The feeders are electrically linked to weights that correspond to the desired weight of each of the three fractions.

The major limitation of the weigher is associated with the powder-dusting problem. Containing the scale and feeders in a dust-tight enclosure reduces the dust spread; however, this greatly hampers the amount of in-place adjustment and maintenance.

Blender

The blender (Fig. 13) is a 4-qt twin-shell type that employs a cam-actuated seating mechanism for connecting and disconnecting the blender from the powder lines while maintaining a dust-tight seal. After blending, the powder is emptied into a bell valve transfer bottle for transfer to the vibratory compaction apparatus. This machine has presented no difficulties whatsoever.

Direct-Reading Scale

The fuel charge is check weighed on a direct-reading top-loading balance to an accuracy of ±0.1 g.

Reject Rod Decladder

The reject rod decladder (Fig. 14), located in the glove-maintenance area and connected to the powder-preparation area by a pipe, is used to return powder from rejected fuel rods back to the powder-preparation system. The decladder consists of a Plexiglas enclosure in which is located a rod positioner, a tubing cutter, and a funnel for receiving

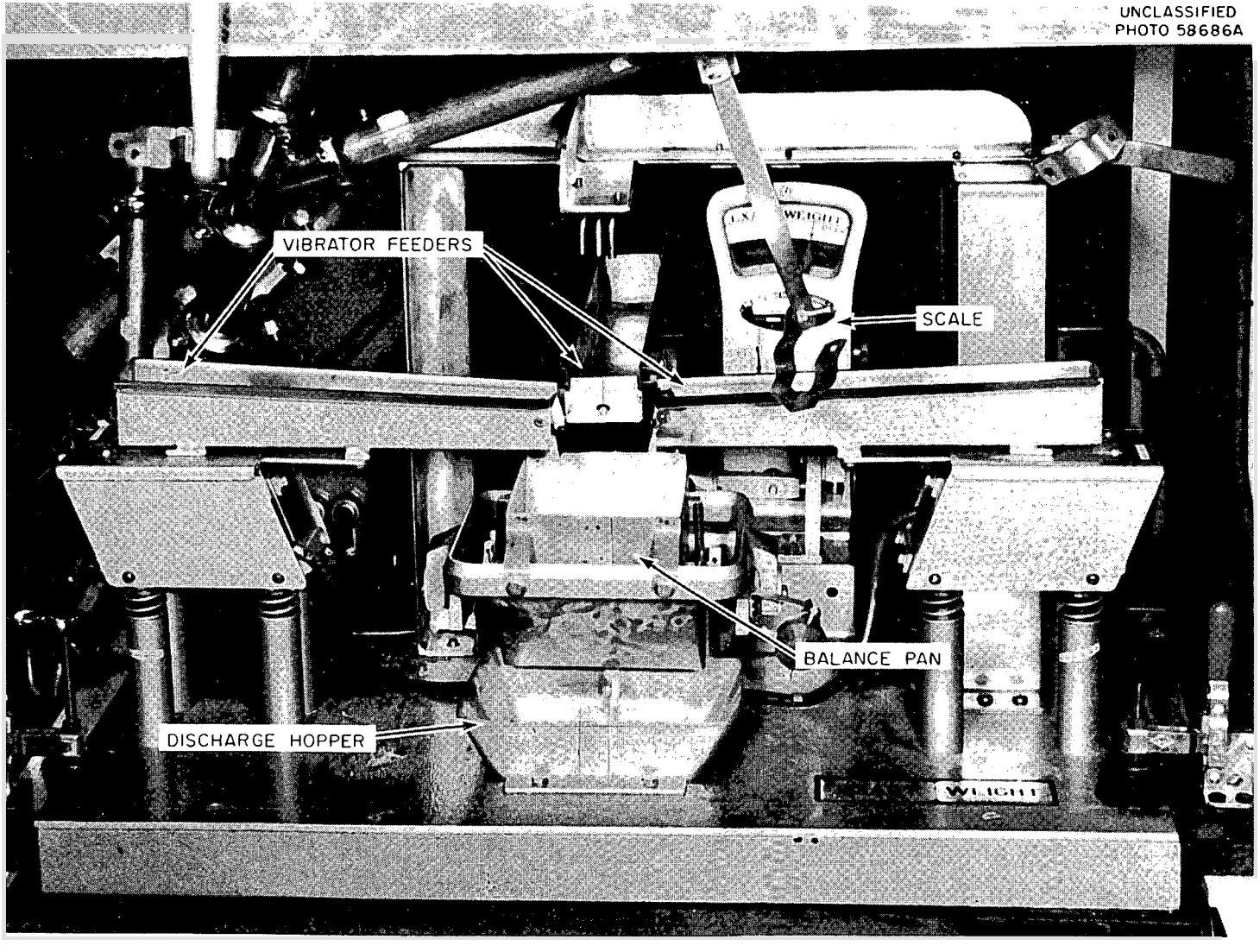

Fig. 12. Remote Weigher.

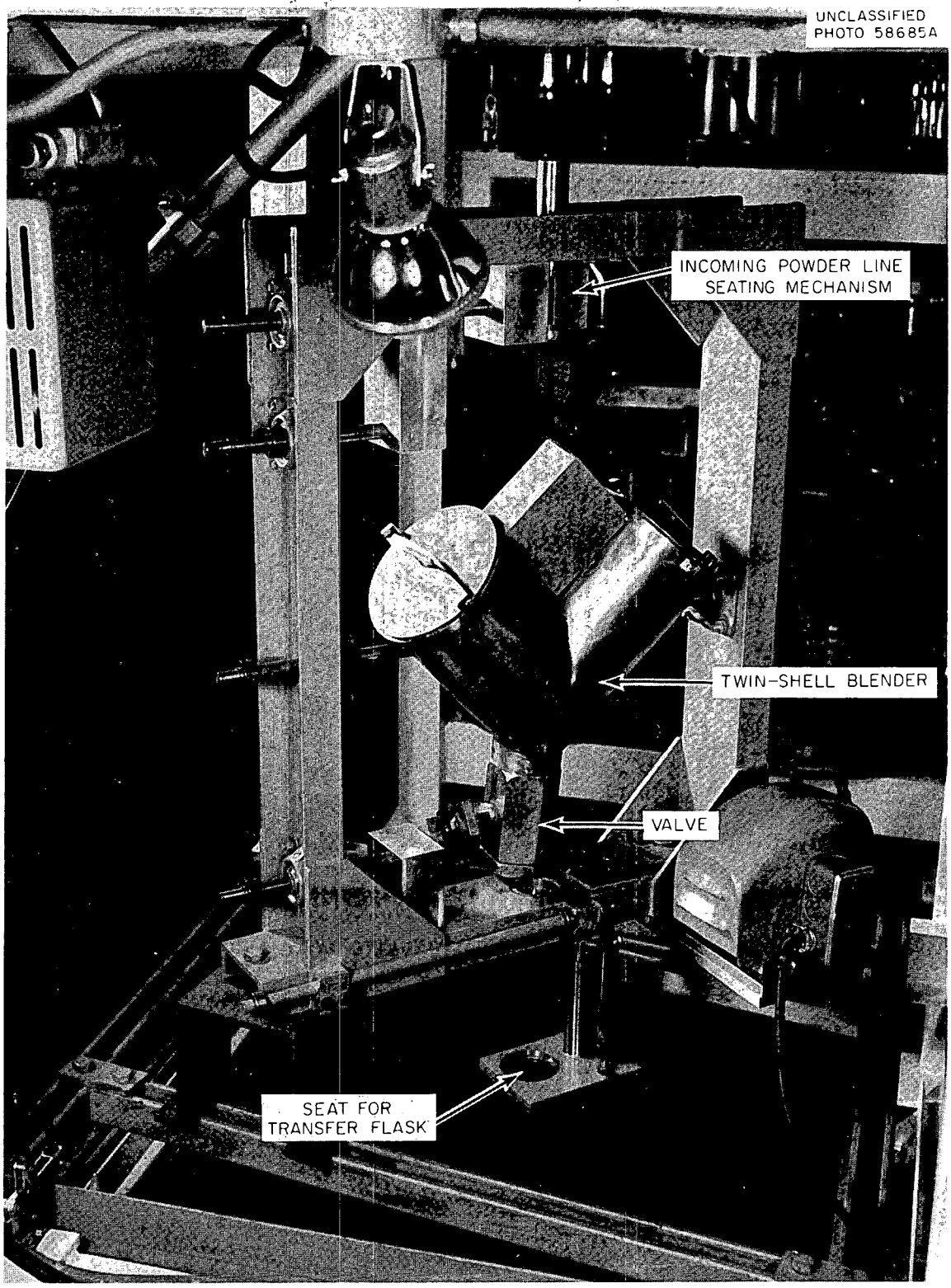

Fig. 13. Blender.

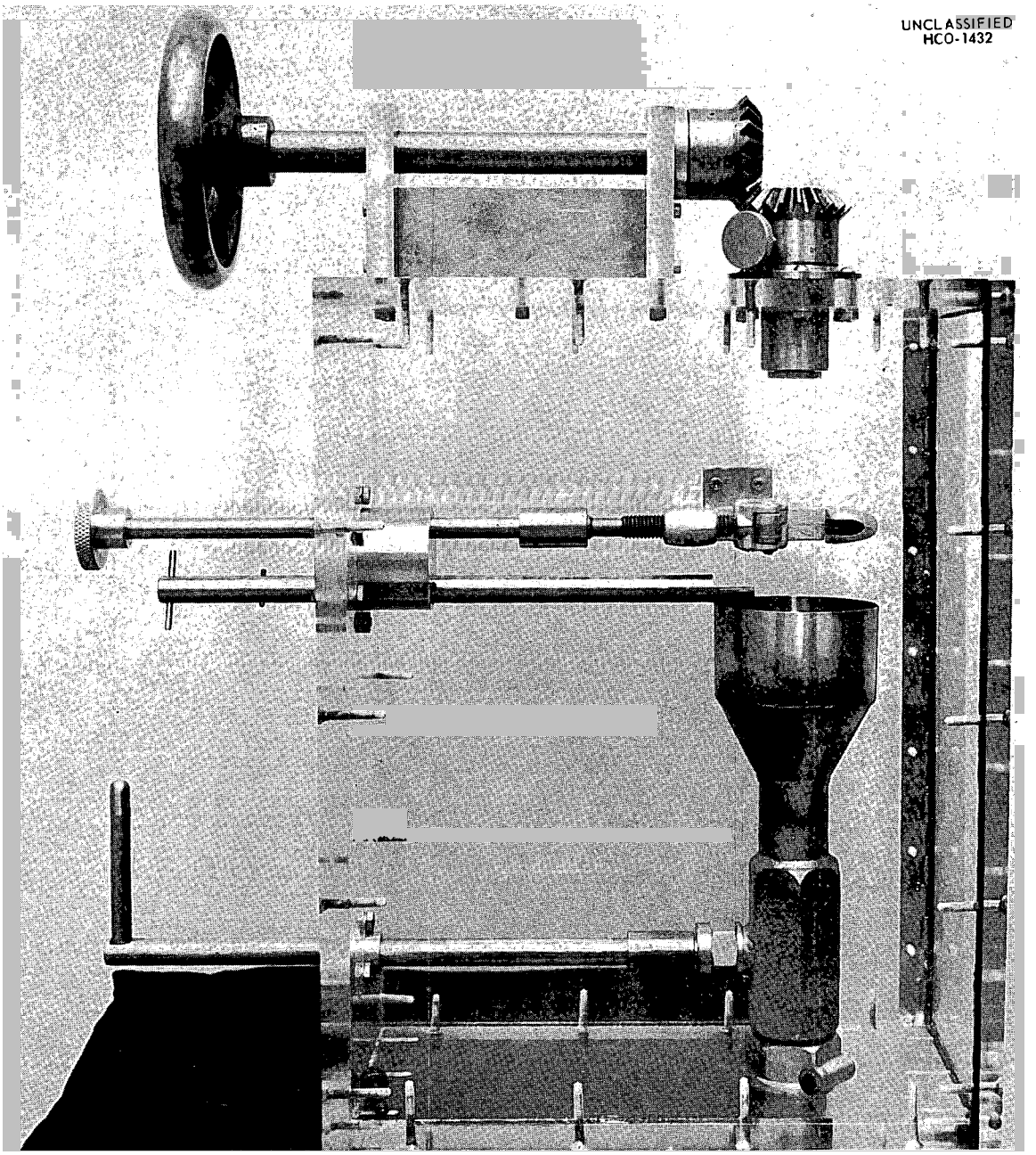

Fig. 14. Reject Rod Decladder.

the fuel. After removing the bottom end plug from the rod, powder is removed by tapping along the length rod with a soft-faced mallet.

Vibratory Compaction Apparatus

The uniformity with which a fuel tube is loaded and the rigidity with which the tube is held during vibration are important considerations in the design of vibratory compaction apparatus. The vibratory compaction equipment (Fig. 15) consists of two main components — the tube-filling assembly and the chuck assembly. The tube-filling assembly is located in the powder-preparation shaft at the upper right corner of the vibratory compaction welder cubicle, but it is separated from it by a nylon iris valve. The fuel tube is inserted through the iris into the filler mechanism.

The tube-filling assembly consists essentially of a hopper into which blended fuel is received and a vibratory feeder which enables close control of the fuel feeding. Also included in this assembly are a funnel for directing the fuel into the tube without spreading dust and a mechanism for applying a static load to the fuel column during vibration. The static load mechanism, which weighs 0.7 kg, consists of a rack gear connected directly to a load and a disengageable pinion gear that enables the lowering of the static load onto the fuel column. The rack gear also serves as a direct means of measuring the height of the fuel column in the tube.

The vibrator-chuck assembly consists of an anvil, to which the chuck is attached and through which the vibrational energy is transmitted, and a "Branford"[6] variable-impact vibrator. The chuck employs cam-actuated sliding-tapered jaws. When the chuck is closed on the fuel rod, the tapered jaws engage the annular groove in the end plug of the rod making a rigid connection. The chuck and anvil are placed inside the cubicle. To allow for convenient servicing, the vibrator is located outside the cubicle and is sealed from the cubicle by a neoprene diaphragm.

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[6]Manufactured by the Branford Company, New Britain, Connecticut.

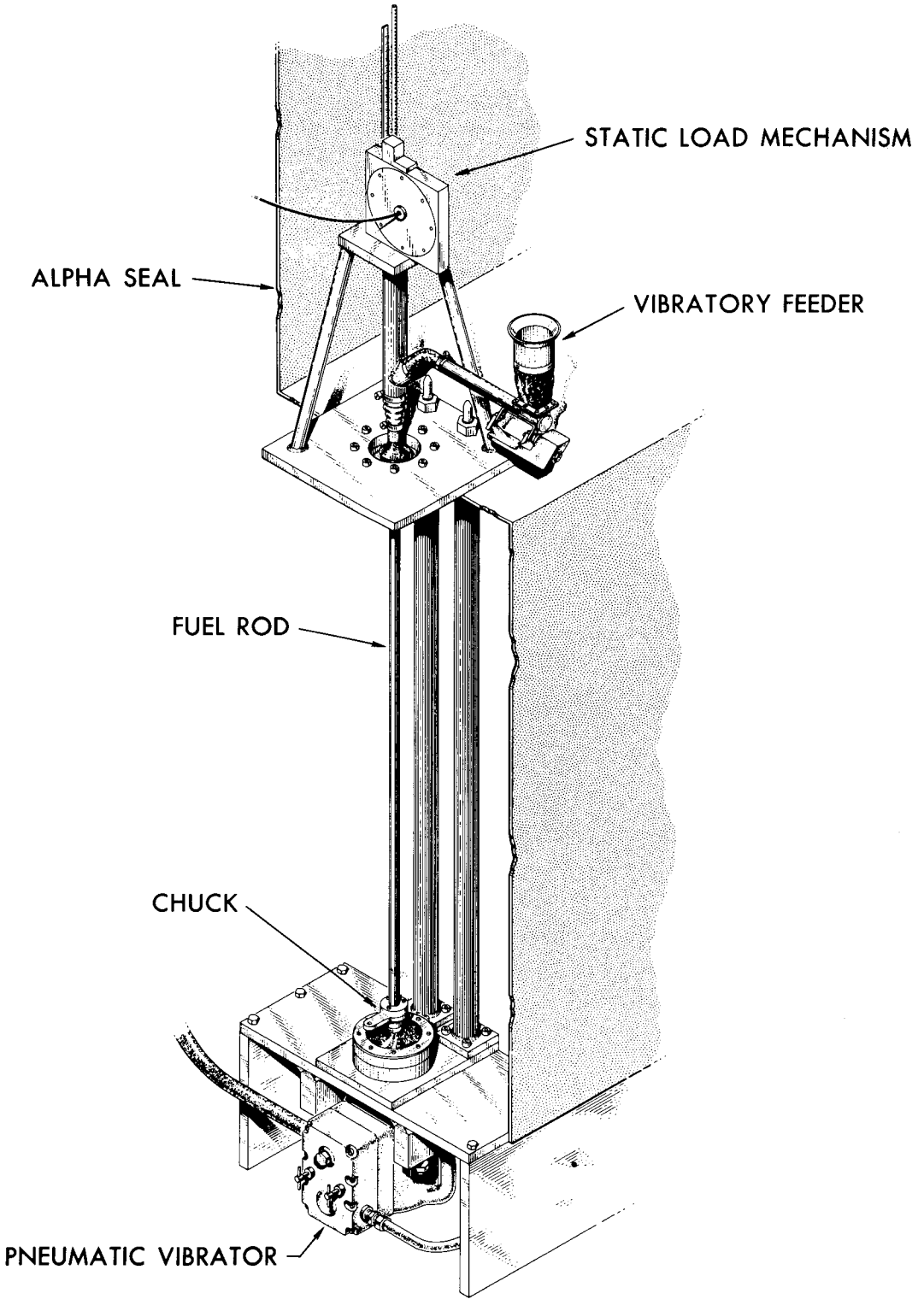


Fig. 15. Vibratory Compaction Equipment.

Fuel Rod Elevator

Empty fuel rods are introduced into the vibratory compaction chamber from the glove-maintenance area by means of an elevator. The elevator, which is actuated in the glove-maintenance area, consists of a hand crank, a rod-holding bob for 10 to 12 rods, a linkage chain, and an elevator shaft.

End-Cap Welding Machine

The vertical end-cap welding machine (Fig. 16) was specifically designed to weld the top end plug onto the fuel rod by a fusion-lip weld. The unit is also equipped with a press for seating the top end plug on the fuel rod immediately after the rod has been evacuated and backfilled with helium. The welding machine is comprised of two main components — an elevating mechanism and the welding chamber.

The elevating mechanism employs a synchronous drive motor and a lead screw arrangement for inserting the fuel rod into the welding chamber. As the elevator seats the rod into the chamber, the elevator contacts a compression grommet which effects a vacuum seal around the rod.

The tungsten-arc torch and the end-plug press are located in the welding chamber. The press uses a lead screw and a synchronous motor-driven arrangement for inserting the end plugs. The torch is positioned by two high-ratio lead-screw motor arrangements. During welding, the rod is rotated at approximately 6 rpm by a constant-speed motor. A lifting mechanism is provided to remove the welding chamber cover in order to change the tungsten welding tip.

Decontamination Equipment

A 1-kw ultrasonic cleaner (Fig. 17) is used to decontaminate the completed fuel rods one at a time. The cleaner is equipped with a cover that embodies a mechanism for holding and rotating the rods during cleaning. The cleaning cycle, which is manually controlled, consists of filling, cleaning, emptying, spray-rinsing, and drying.

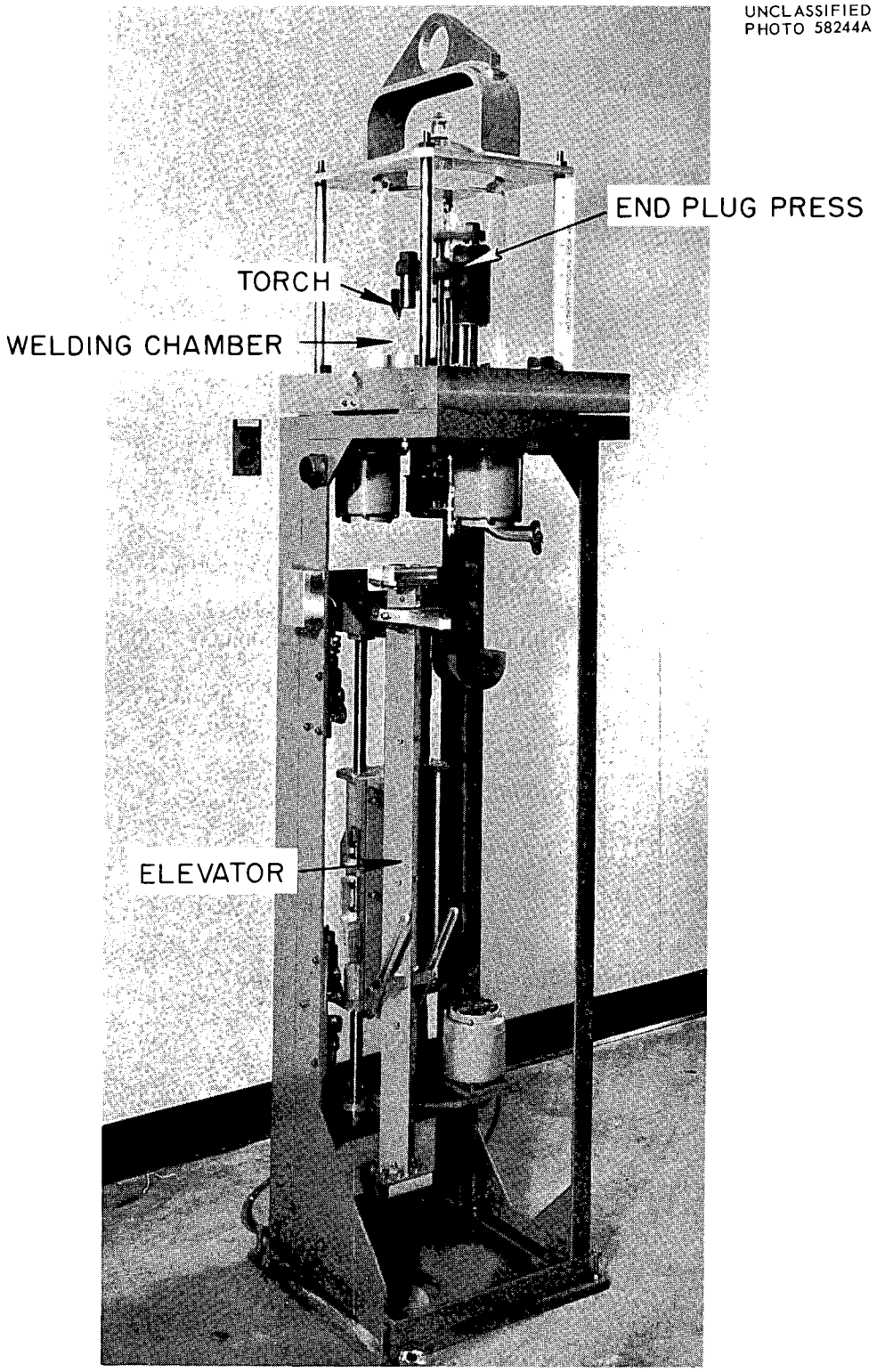


Fig. 16. End-Cap Welding Machine.

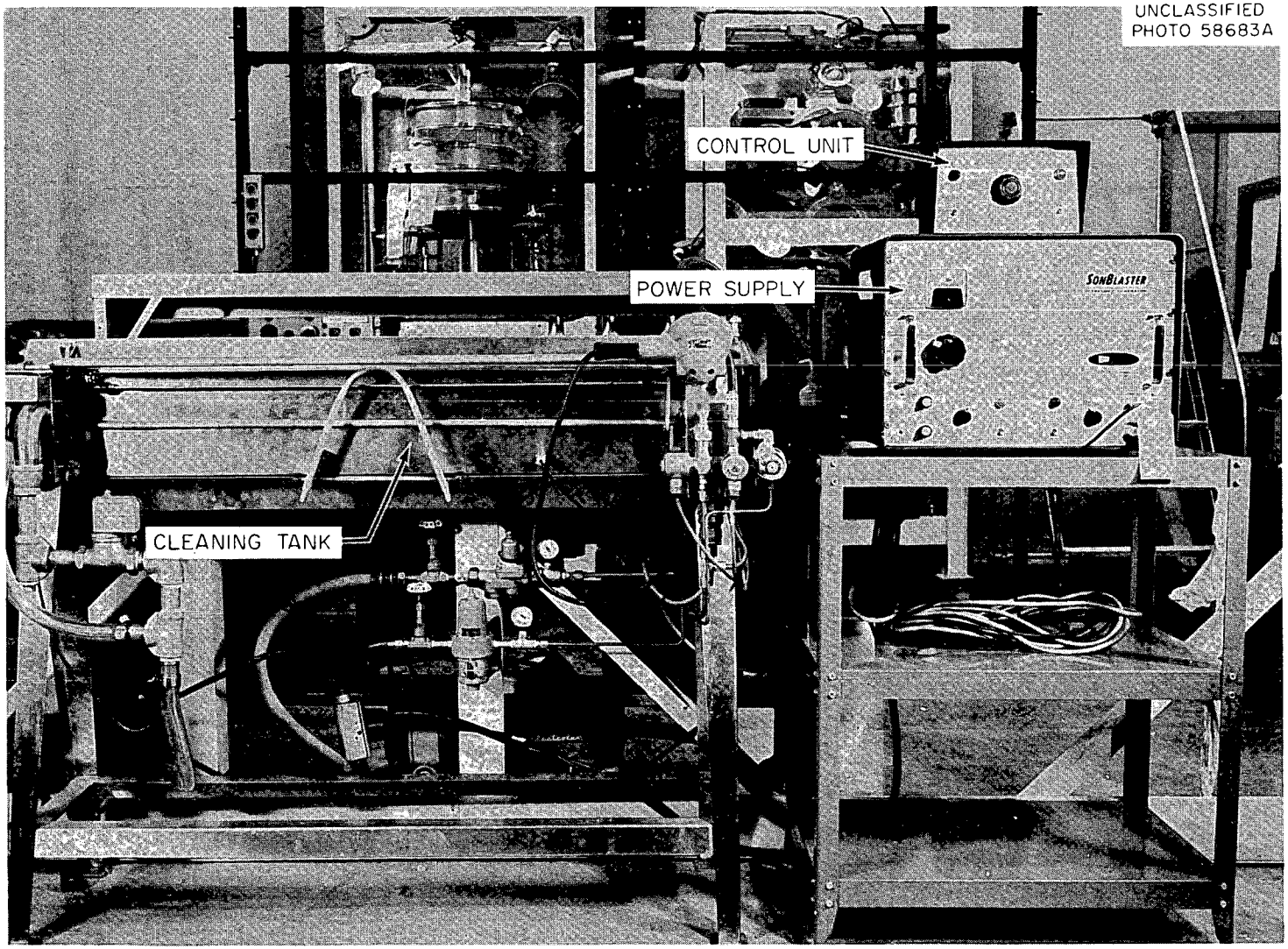


Fig. 17. Ultrasonic Cleaner.

Helium Leak Detection System

The welded and decontaminated rod is checked for leaktightness with a mass-spectrometer helium leak detector having a sensitivity of 1×10^{-10} std cm^3/sec. The system includes a chamber in which the fuel rod is placed, a standard leak, the leak detector, and a roughing vacuum-pump station. Particle filters are used to isolate the vacuum chamber for the rod from the pumping and detection station.

Gamma Scanner

The scanner (Fig. 18) consists of a trolley for passing the fuel rod at a constant speed through a 1/8- × 3/8-in. collimated gamma beam provided by a 1-curie Co^{60} source and a NaI detecting crystal with its related power supply and recording equipment. Variations in the scanning speed from 1 to 10 ipm are obtained through the use of a variable speed drive motor on the trolley. Before scanning each rod, the scanner is calibrated by scanning a standard density rod. The standard rods contain lead-tin alloys which have been calculated and tested to show a density of 88, 89, and 90% of theoretical. Originally, ThO_2-UO_2 pellet rods were to be used for calibration purposes; however, inhomogeneity within pellets in the density range of interest precluded their use.

Shipping Cask

The shipping cask, designed to hold 120 rods, is loaded in the horizontal position in the facility and then discharged vertically at its destination. For loading, the cask is held on a dolly in the horizontal position and secured to the cubicle door with turnbuckles. The lattice structure which is provided in the cask to position the rods is partially inserted into the loading cubicles to facilitate loading by tongs. After loading, the lattice is retracted into the cask, the top secured, and the cask removed by means of an overhead building crane. During production, two casks will be used in a shuttle system.

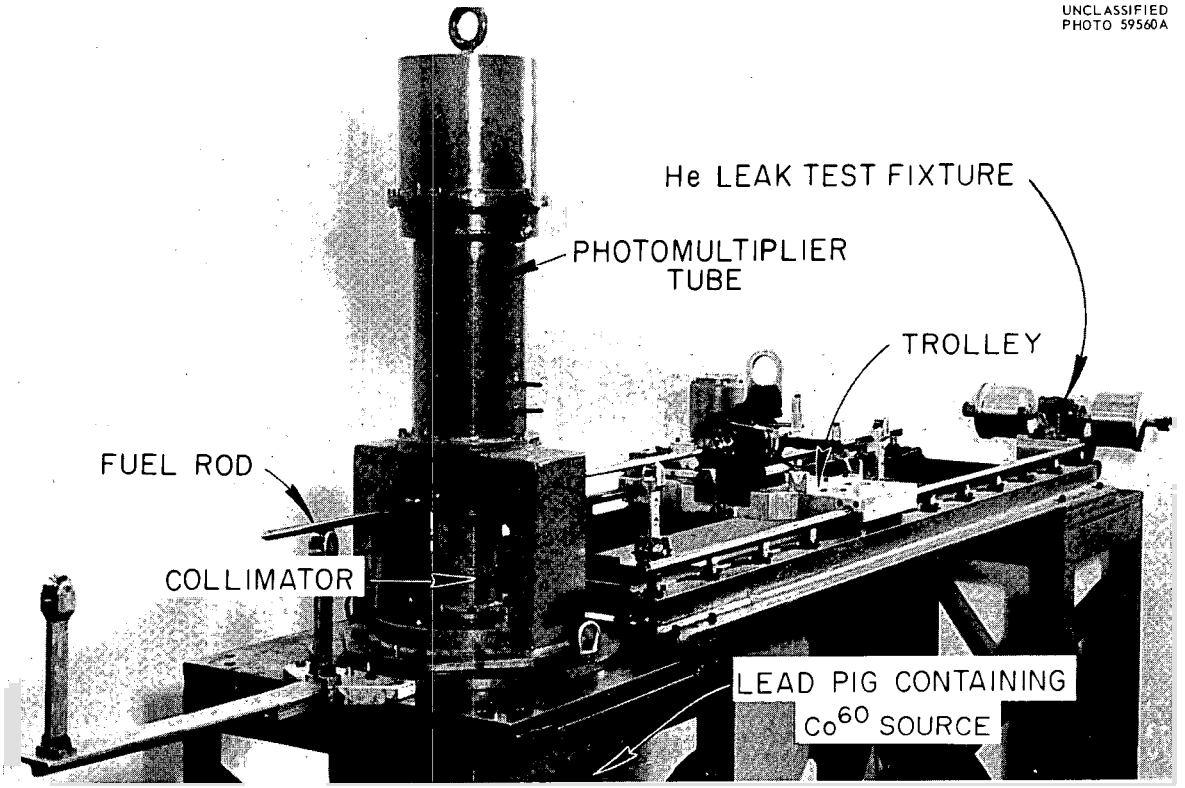


Fig. 18. Gamma Scanner.

CONCEPT OF OPERATION

The facility and process equipment were planned so that the radiation exposure to operating personnel would be held to an absolute minimum. In operations where fuel material is present, the work is viewed through lead glass windows, and all necessary manipulations except where noted are performed with remote controls or with the nonarticulated castle-type manipulators. In most cases, each viewing window in the facility is complemented with two identical glove-manipulator ports. Each specific area of operation is described below.

Powder-Preparation Shaft

Placement and design of the equipment in the powder-preparation shaft were planned for dust confinement, but it was recognized that during operation there would be an accumulation of dust on the outside surfaces of the equipment. The equipment was not designed for maximum dust confinement because of the prohibitive expense. In the equipment shaft, no direct manipulation is required as all operations are performed remotely with either electrical or mechanical linkages. The transfer of the loaded fuel bottle from the blender to the vibrator-feeder assembly is accomplished through the use of three manipulators. Manipulator-to-manipulator transfer is required to accomplish this operation.

Vibratory Compaction

Design of the vibratory compaction and welding cubicle was to confine areas in which fuel is openly handled. The fuel-filling assembly is separated from the main cubicle and is actually in the powder preparation area because of the dusting problem associated with this component. The vibrator is housed in a separately enclosed compartment in the lower right corner of the cubicle to facilitate maintenance and transmits its force through a piston, alpha sealed with a neoprene diaphragm. Access to the vibrator is from the operating area.

One area where handling of the fuel with gloved hands and hand tongs is required is in the vibratory compaction welding cubicle. The operations of removing a rod from the fuel elevator and placing it into the vibratory chuck, unchucking and placing the rod in the welder, removing the rod from the welder, and transferring the rod to the cleaning cubicle require more dexterity than can be accommodated by the castle tong. At no time in the operations are there more than two rods in this cubicle.

Decontamination

The ultrasonic decontamination system will accommodate one fuel rod at a time. Handling of the fuel rod and operation of the unit are done with a manipulator. A glove port is provided in the decontamination cubicle for smearing the fuel rod and transferring smear samples. The decontaminated fuel rod is transferred to the inspection cubicle through a small-diameter pass-through port.

Inspection and Loading

Transfer of the rod to the density checker and density scanning are done remotely. After scanning, the rod is helium leak checked after being placed in the test chamber with a gloved hand and hand tong. The attachment of the hanger fitting requires dexterity beyond the capabilities of the castle manipulator and is done with tongs and a gloved hand. The loading of the fuel rod in the shipping cask is performed with a manipulator.

OPERATING EXPERIENCE

Mockup

The accelerated nature of the program made it impractical to construct an integrated mockup; therefore, each piece of equipment was evaluated independently. In addition, the powder-preparation equipment was partially mocked up. The mockup of the powder-preparation equipment (Fig. 19) was performed in two sections because of the working height limitation of the available laboratory area.

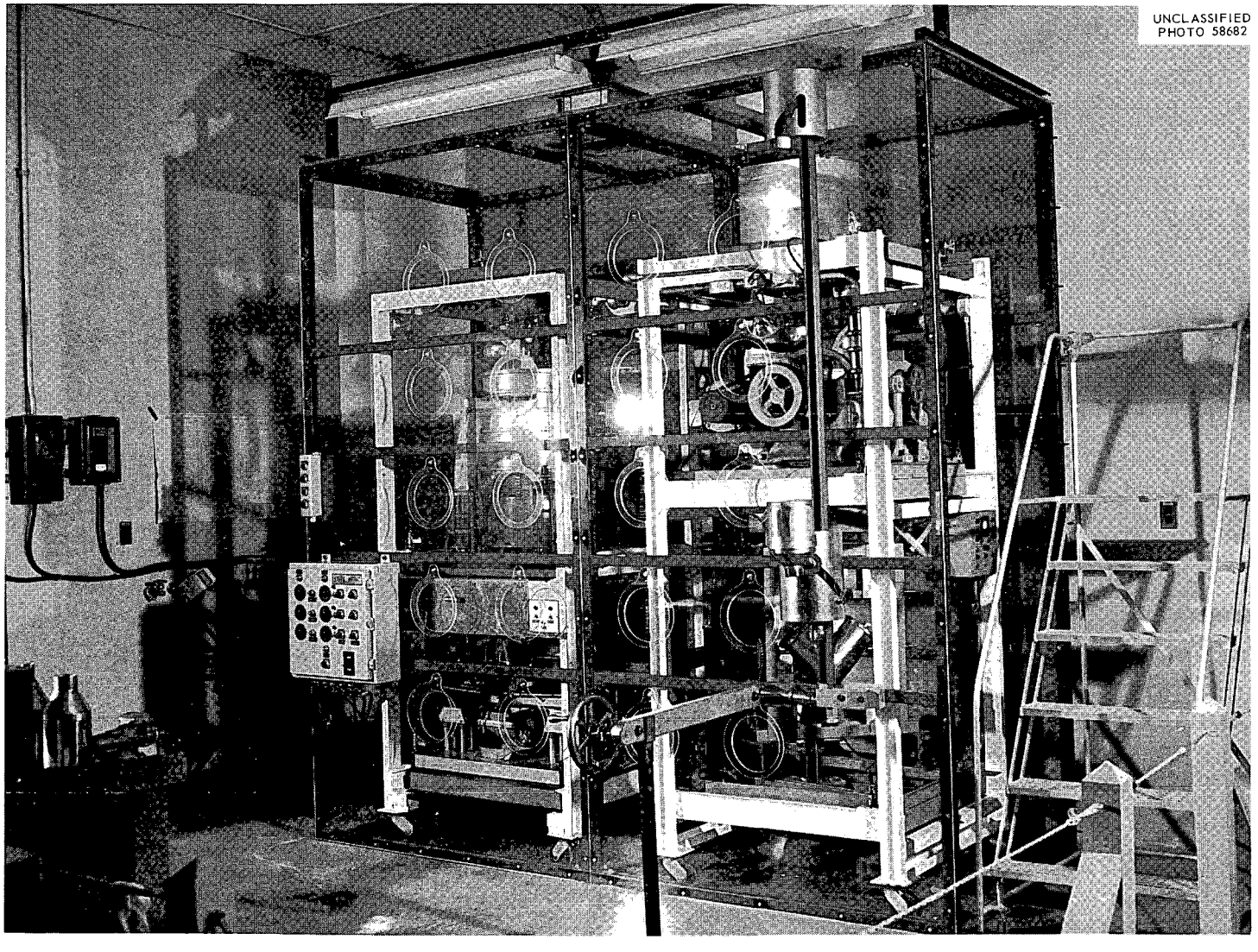


Fig. 19. Building 4508 Mockup of the Powder-Preparation Equipment.

During the mockup period, a large number of assembly and design errors were corrected. In the powder-preparation equipment, the major problem areas were in the jamming of the jaw crusher and in the design of the ball mill. In the vibratory compaction unit, major modifications were made to the fuel-feeding system and the fuel rod-holding chuck. The initial design of the welder had a variable-speed rod-rotating drive motor; however, the high-frequency arc-starting mechanism caused erratic behavior of the synchronous stepping motor; thus, a change to a constant-speed motor was necessitated. No initial difficulties were experienced with the ultrasonic cleaner except for the extremely slow drying cycle. Modifications were made to correct this inadequacy. The major difficulty with the gamma scanner was experienced in the alignment of the gamma-beam collimator. The size of the collimator was changed during this period from a 1/8-in. circular to a 1/8- × 3/8-in. rectangular slot.

Preliminary Check-Out

Cell-containment checks were made before introducing the stand-in $(Th–3$ wt % $U^{238})O_2$ into the system. The containment checks were made with all gloves, bag-out ports, and service entries in the operating condition. After some minor alterations, the air inleakage rate was measured to be 0.004 cell vol/min at 1 in. of water pressure difference. This measured value is well below the maximum recommended value of 0.01 cell vol/min at 2 in. of water pressure.

The noise level associated with the pneumatic vibrator was checked by the ORNL Industrial Hygiene Group. The noise level on the second and third levels was below tolerance while the noise level on the first floor directly in front of the vibrator was slightly above the permissible value (maximum of 90 db compared to permissible level of 86 db). Special ear protectors are provided for the use of the operators in this area. Instrument and functional checks were made on each piece of equipment before operation. These checks corrected a number of alignment and minor operational problems. In this preliminary check-out period, operators were trained in the operation of the equipment.

Operating Experience with Stand-in Oxide

During the initial operation of the fabrication equipment with stand-in oxide (depleted U-Th oxide), it soon became evident that the powder-conditioning equipment was the area of major concern. Despite efforts to contain dust within the system, an unexpectedly large quantity of oxide dust was seen to accumulate on the exterior of the equipment. Obviously, this very abrasive dust can cause excessive wear of bearing and bearing surfaces. The abrasive nature of the powder caused extensive trouble with the ball mill. The requirements of the mill to be rotated about three axes simultaneously required the use of several types of bearings. Extensive modifications were necessary to obtain a suitable working situation. Even after apparently solving the bearing problem, other modifications were necessary because of the wearing of bearing surfaces causing extraneous material to be introduced into the fuel. Before operation, there was concern that the classifier screens might blind during operation; however, during the cold runs there was no evidence of screen blinding. The remainder of the powder-conditioning equipment has performed satisfactorily. The material holdup in the complete system of approximately 2 kg was observed during the cold runs.

During the operation of the vibrator system, several modifications were necessary. The need to observe the feeding of the fuel into the rod required the elimination of the dust boot over the end of the feeder trough. Although the elimination of the boot increased the dusting, it was felt that adequate feeder control could not be obtained without observing the feeding. The chuck for holding the rod was changed to utilize a slightly modified Swagelok tube coupling. This coupling uses a standard 1/2-in. pipe to 1/2-in. tube male connector with specially machined split ferrule. The original chuck was replaced because of the expense and difficulty of replacing it in the event of a failure. During the cold operations, failure of the Swagelok chuck was usually observed after 10 to 12 rods; therefore, it is planned to change the Swagelok tube coupling after the compaction of six rods. Also, a number of failures in the other components of the vibrator-chuck assembly are anticipated because of the extremely high levels of acceleration associated with the

"Branford" vibrator (reportedly as high as 20,000 to 100,000 times the acceleration due to gravity). Along with daily maintenance checks on all fasteners on the unit, spare components to the entire vibratory compaction assembly are considered absolutely essential.

In operating the vibrator, it was found that the freedom of the anvil, to which the rod to be filled is attached and upon which the pneumatic hammer impinges, is a very important factor. The anvil must be allowed to move a finite distance (in the order of 1/16 in.) to obtain the desired compaction. If the anvil is not allowed to reciprocate, a reduction in compacted density of from 8 to 10% is observed. Some difficulties were experienced with the "Branford" vibrator due to component failures within the vibrator unit.

After demonstrating the ability of the powder-preparation equipment to produce powders of three size fractions for loading into the fuel tubes, it was decided to modify the system to produce powders of a binary-size distribution. The decision to operate the system with two size fractions was based on two factors: (1) the binary system is equal to the ternary in compaction density that is attainable and (2) the binary is much easier to operate, especially with a remote system. During the cold runs, the binary size distribution was optimized and now consists of a charge of 55% of a classified −6 +16 mesh fraction and 45% of an unclassified ball-mill fraction. The ball-mill fraction which is produced by controlling the charging rate of the mill and the amount of milling time has the following approximate composition:

−16 +50, 40%	−50 +140, 21%
−140 +200, 7%	−200 +325, 16%
−325, 16%	

With this distribution, 20 cold samples were compacted that had an average bulk density of 90% of theoretical with a deviation from rod-to-rod of less than 1%. The density profile measured with the gamma scanner within these rods was well within the specified ±2% with the majority showing a deviation of less than 1 1/2%. The results were most gratifying as results of this nature had not been predicted from laboratory experience.

CONCLUSIONS

Through the design, construction, and operation of the Kilorod Facility and its fabrication equipment, the practicability and economics of refabrication of $Th(U^{233})O_2$-bearing fuel are being assessed.

Although the fabrication process used in the facility probably represents the simplest remote fabrication route that can possibly be used in the fabrication of such fuels, it nevertheless poses problems of significant proportion, particularly with the equipment. It is our judgment that the problems encountered in design, construction, and simulated operation have been satisfactorily solved. The equipment has now undergone extensive tests under simulated conditions using depleted uranium; however, the applicability of the process and equipment cannot be evaluated fully until the completion of the initial runs with U^{233}. It is certain that improvements in fuel cycle technology and a better understanding of the fuel cycle economics will result from the operation of the facility.

ACKNOWLEDGMENTS

The concerted efforts of many people were involved in the execution of the large project that has been described in this document. The authors would like to acknowledge: D. A. Douglas, W. C. Thurber, D. E. Ferguson, J. C. Bresee, and R. B. Brooksbank for their part in supervision and direction of the Kilorod Program; J. T. Lamartine (now with Westinghouse Astronuclear Corporation, Pittsburgh, Pennsylvania) for the early technical direction; J. E. Van Cleve for invaluable assistance in the installation and cold operation of the process equipment; W. A. Pate and members of his group for the excellent design assistance; G. E. Pierce for engineering assistance; C. M. Smith, Jr., M. E. Woodward, and R. J. Shannon for their assistance in installation and operation of the equipment; W. S. Ernst for laboratory support involving all facets of vibratory compaction; J. W. Tackett for assistance in welding; and B. E. Foster and B. C. Duggins for assistance in density scanning.

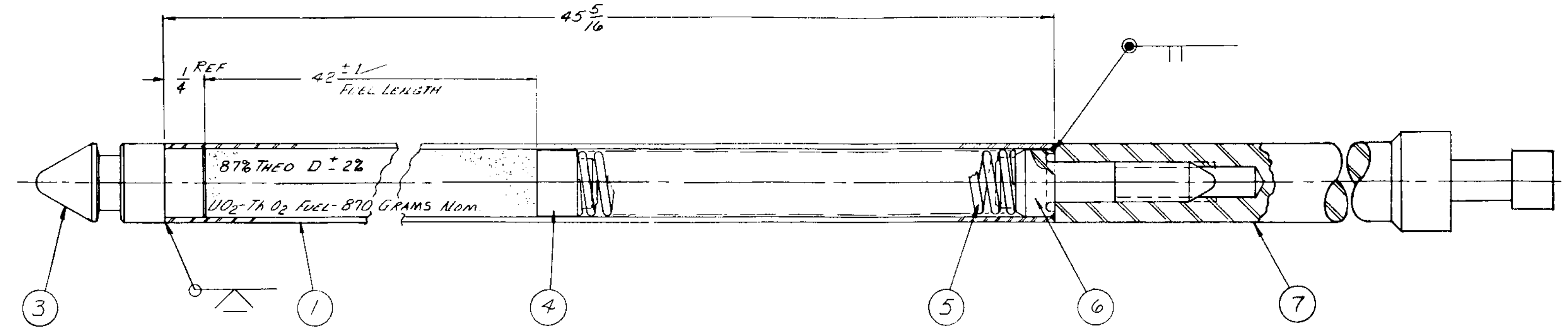
APPENDIX A

Fuel Rod Assemblies

1. 47 1/8-in. Fuel Rod – D-51175

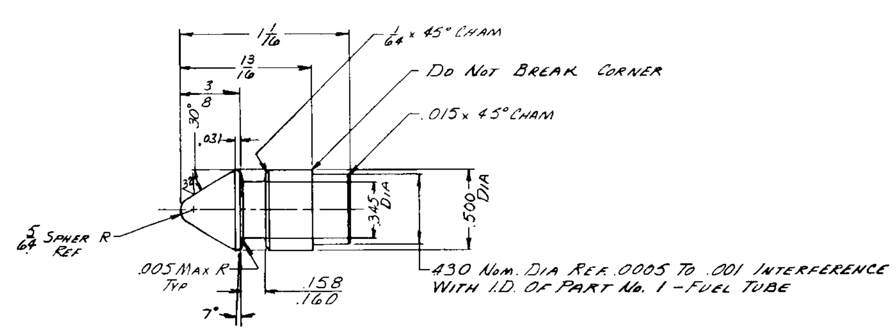
2. 19-in. Fuel Rod – D-54899

PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
1	Stock	1	Fuel tube .499 ±.002 OD x .430 ±.0015 ID x 45 5/16 lg	Zircaloy 2
3	This Dwg	1	Cone	Zircaloy 2
4	This Dwg	1	Disk	Alum-Oxide
5	This Dwg	1	Spring	Inconel-X
6	This Dwg.	1	Top Plug	Zircaloy 2
7	This Dwg.	1	Hanger Fitting	Sst 304

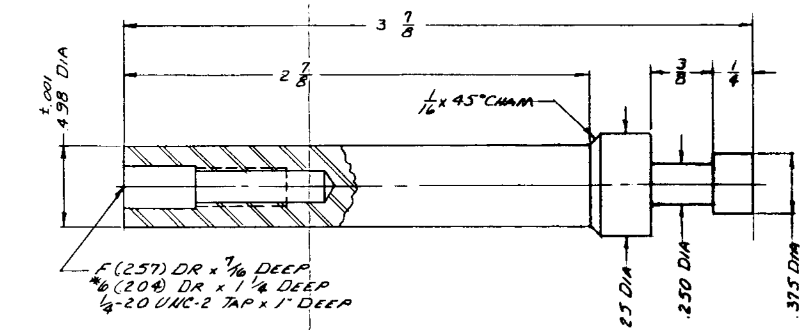


Welding Notes:

1. Weld in accordance with AWS welding symbols.
2. Welding process is to be inert-gas shielded-arc non-consumable electrode (Heliarc).
3. Weld penetration shall be 0.035" Min with complete fusion, free from slag inclusions, tungsten pickup, voids, cracks, pinholes, undercutting, excessive oxidation, or roll over.
4. Weld shall be visually inspected during and after welding. Any visible defects or excessive oxidation shall be cause for rejection.
5. Each weld shall be tested with a sensitive helium leak detector calibrated to a standard leak rate of 7×10^{-9} cc-sec. Any indicated leakage greater than the standard leak rate shall be cause for rejection.
6. Dye penetrant 1st end closure weld (Part #1 to Part #3) in accordance with MET-NDT-4.



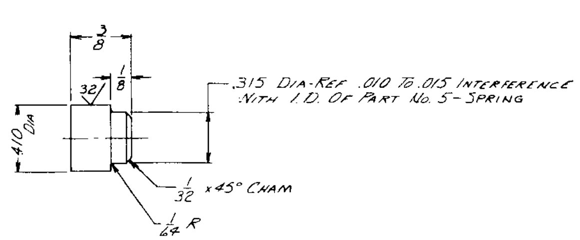
(3) CONE
MATL - ZIRCALOY-2
REQD - ONE



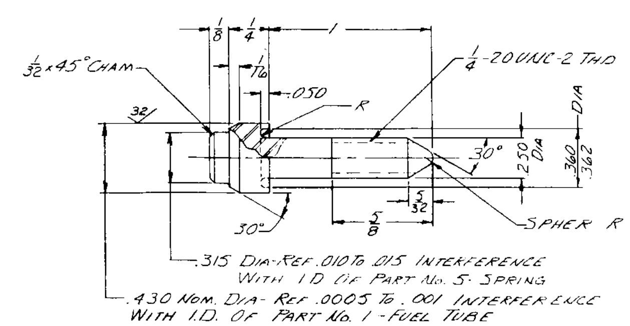
(7) HANGER FITTING
MATL - SST 304
NO. REQD - ONE

(5) SPRING
MATL - INCONEL X SPRING TEMPER
REQD - ONE
OUTSIDE DIA - 3/8 (.380)
INSIDE DIA NOM. - .298
FREE LENGTH - 4"
WIRE SIZE - W & M 19GA (.041)
ACTIVE COILS - 16
TOTAL COILS - 18

ENDS CLOSED AND GROUND SQUARE



(4) DISK
MATL - ALUMINUM OXIDE
REQD - ONE



(6) TOP PLUG
MATL - ZIRCALOY-2
REQD - ONE

LTR	REVISIONS	DATE	APPD	APPD
B	(4) WAS 45 1/2 (3) PT 3 REDESIGNED	8-17-62		
B	(3) PART No. 3 - CONE REVISED	8-17-62		
B	(2) PART No. 2 BOTTOM PLUG REMOVED	8-17-62		
A	SPRING WAS 4 1/4 LG, 23 ACTIVE COILS & 25 TOTAL COILS	4-26-62		

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
R.C. GIBSON	11-15-61	J. Kaserman	11-30-61		
DESIGNED	DATE	SUBMITTED	DATE	APPROVED	DATE
		Pate	1-18-62	H. Duggan	1-18-62

GENERAL SPECIFICATIONS:
1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:
1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed 63.

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ± 1/64
DECIMALS: ± .005
ANGLES: ± 0°-30'
SCALE: 2" = 1"

REFERENCE DRAWINGS	DWG. NO.
THORIUM U233 FUEL ROD FACILITY	BLDG. NO. 3019

47 1/8" FUEL ROD
ASSEMBLY & DETAILS

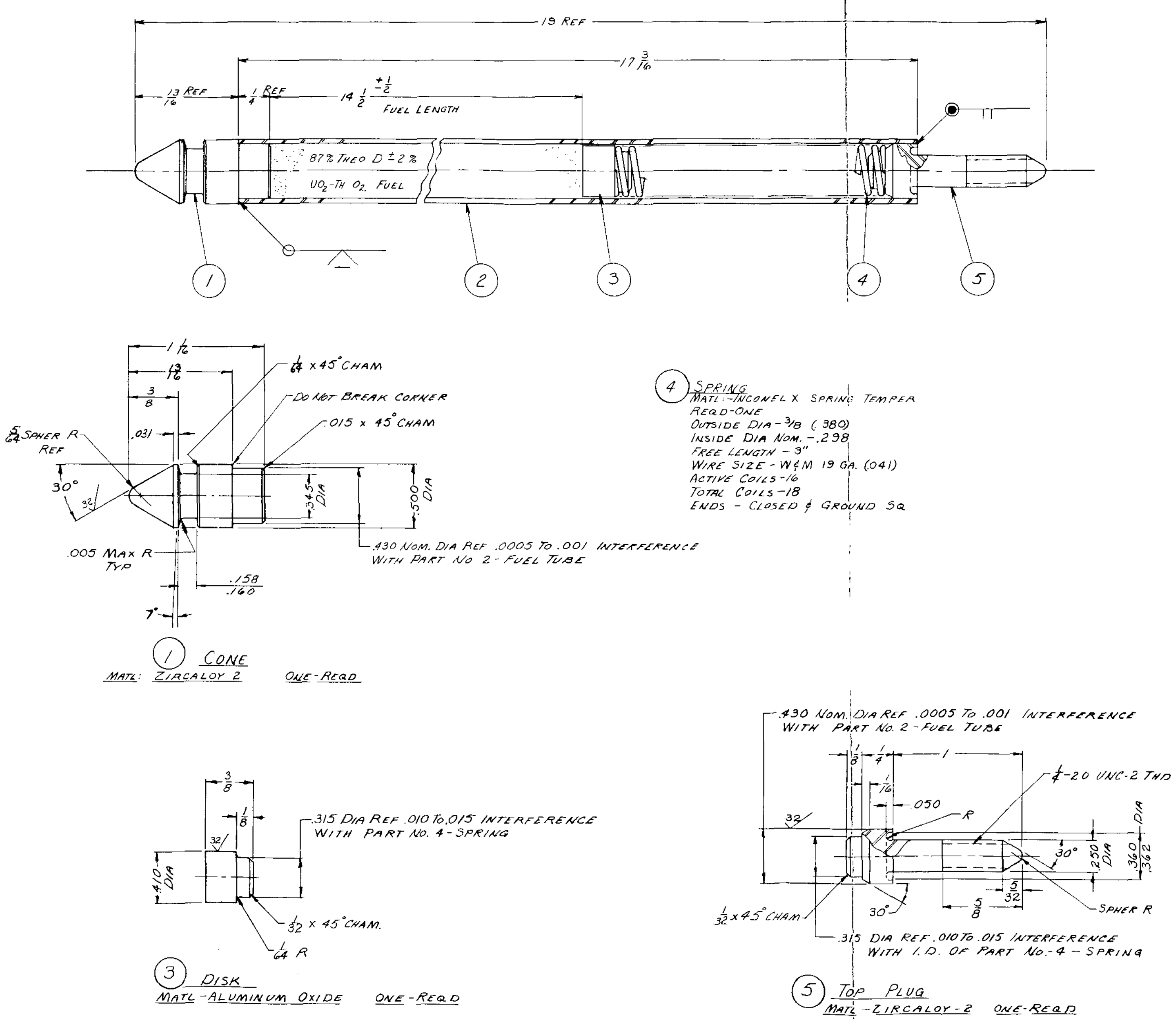
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED / ACCEPTED / APPROVED
D-51175 REV B

APPROVED FOR CONSTRUCTION

PARTS LIST

PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
1	This Dwg.	1	Cone	Zircaloy-2
2	Stock	1	Fuel Tube, .499 ± .002 O.D. x .430 ± .0015 I.D. x 17-3/16 lg.	Zircaloy-2
3	This Dwg.	1	Disk	Alum-Oxide
4	This Dwg.	1	Spring	Inconel-X
5	This Dwg.	1	Top Plug	Zircaloy-2



Welding Notes:

1. Weld in accordance with AWS welding symbols.
2. Welding process is to be inert-gas shielded-arc non-consumable electrode (heliarc).
3. Weld penetration shall be 0.035" min. with complete fusion, free from slag inclusions, tungsten pickup, voids, cracks, pinholes, undercutting, excessive oxidation, or roll-over.
4. Weld shall be visually inspected during and after welding. Any visible defects or excessive oxidation shall be cause for rejection.
5. Each weld shall be tested with a sensitive helium leak detector calibrated to a standard leak rate of 7×10^{-9} CC - sec. Any indicated leakage greater than standard leak rate shall be cause for rejection.
6. Dye penetrant 1st end closure weld (Part #1 to Part #2) in accordance with MET-NDT-4.

LTR	REVISIONS	DATE	APPD	APPD

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
B.G. Gibson	8-16-62	Davis	8-22-62		
DESIGNED	**DATE**	**SUBMITTED**	**DATE**	**APPROVED**	**DATE**
		Pate	8-22-62	H. Duggan	8-23-62

GENERAL SPECIFICATIONS:
1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:
1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed 63√.

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ± 1/64
DECIMALS: ± .005
ANGLES: ± 0°-30'
SCALE: 2" = 1"

REFERENCE DRAWINGS	DWG. NO.

THORIUM U^{233} FULL ROD FACILITY BLDG. NO. 3019

19" FUEL ROD
ASSEMBLY & DETAILS

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED K. E. Jamison — ACCEPTED J. D. [illegible] 5/26 — APPROVED [illegible]

G. E. Pierce

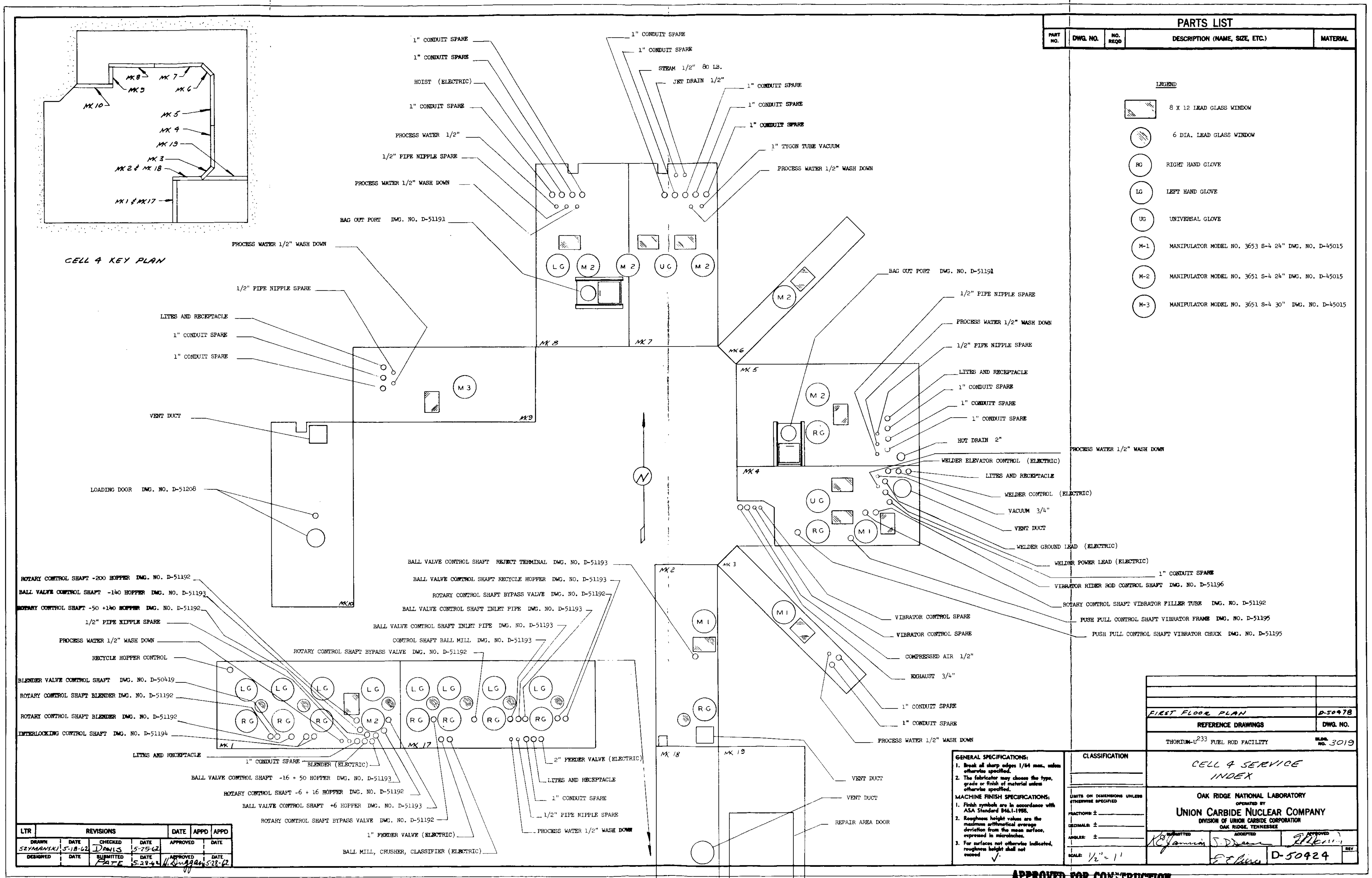
D-54899 REV

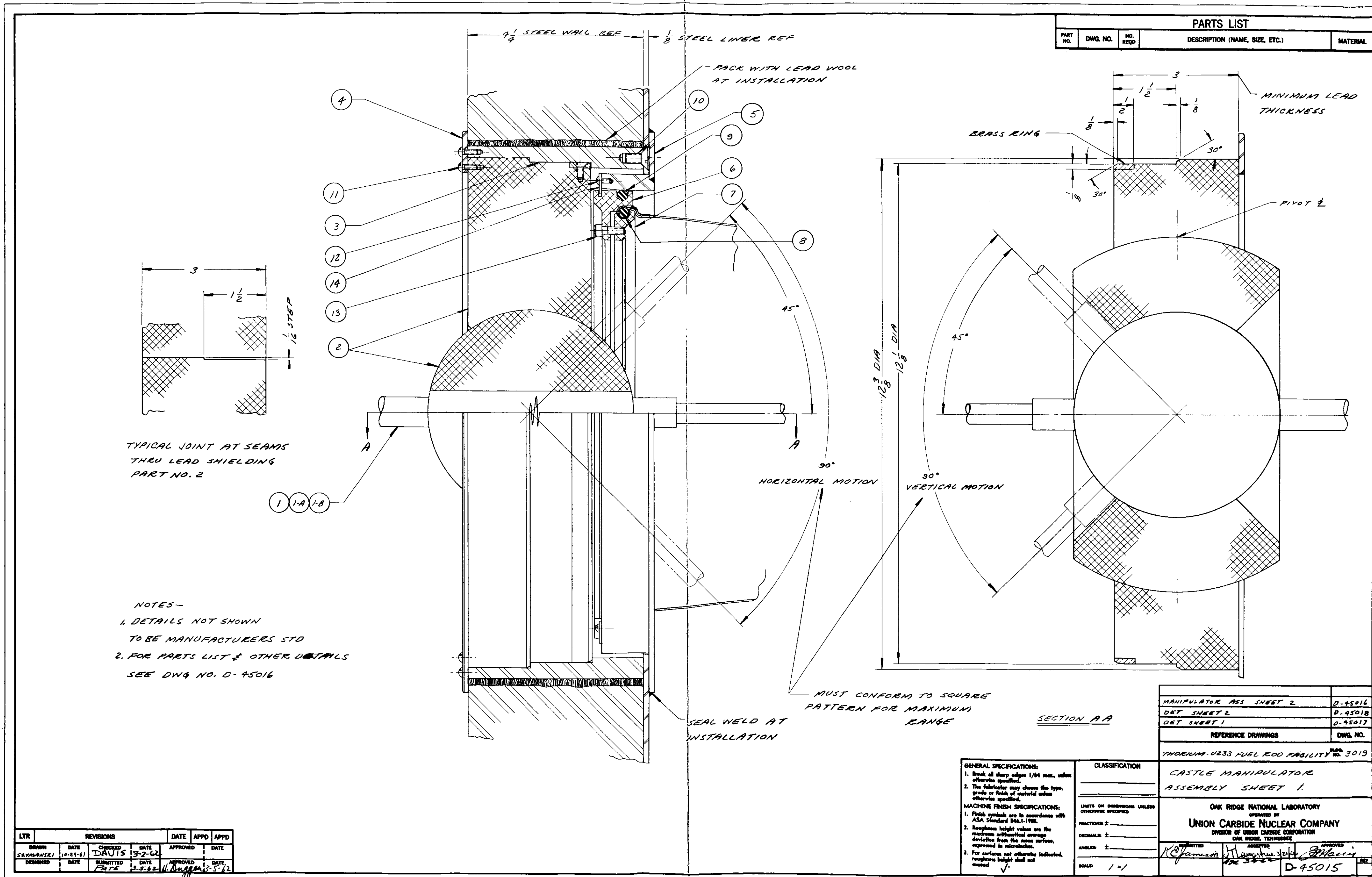
APPROVED FOR CONSTRUCTION

APPENDIX B

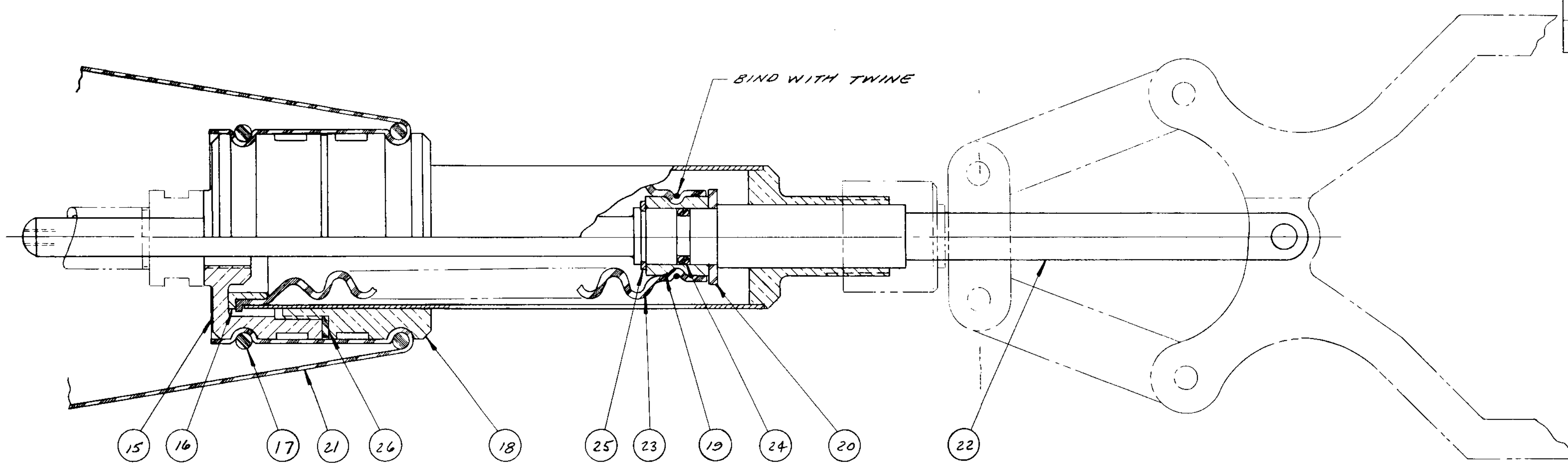
Penetrations

1. Cell 4 Service Index – D-50424
2. Castle Manipulator Assembly Sheet 1 – D-45015
3. Castle Manipulator Assembly Sheet 2 – D-45016
4. Lead Plug for Glove Ports – D-45021
5. Bag-Out Port Adapter – D-56683
6. Bag-Out Port (Off-set) – D-51191
7. Rotary Control Shaft Assemblies – D-51192
8. Ball Valve Control Shaft Assemblies – D-51193


PARTS LIST
PART NO. | DWG. NO. | NO. REQD | DESCRIPTION (NAME, SIZE, ETC.) | MATERIAL
LEGEND
8 X 12 LEAD GLASS WINDOW
6 DIA. LEAD GLASS WINDOW
RIGHT HAND GLOVE
LEFT HAND GLOVE
UNIVERSAL GLOVE
MANIPULATOR MODEL NO. 3653 S-4 24" DWG. NO. D-45015
MANIPULATOR MODEL NO. 3651 S-4 24" DWG. NO. D-45015
MANIPULATOR MODEL NO. 3651 S-4 30" DWG. NO. D-45015
CELL 4 KEY PLAN
MK 1 & MK 17
MK 2 & MK 18
MK 3
MK 4
MK 5
MK 6
MK 7
MK 8
MK 9
MK 10
MK 19
1" CONDUIT SPARE
HOIST (ELECTRIC)
PROCESS WATER 1/2"
1/2" PIPE NIPPLE SPARE
PROCESS WATER 1/2" WASH DOWN
BAG OUT PORT DWG. NO. D-51191
STEAM 1/2" 80 LB.
JET DRAIN 1/2"
1" TYGON TUBE VACUUM
LITES AND RECEPTACLE
VENT DUCT
LOADING DOOR DWG. NO. D-51208
HOT DRAIN 2"
WELDER ELEVATOR CONTROL (ELECTRIC)
WELDER CONTROL (ELECTRIC)
VACUUM 3/4"
WELDER GROUND LEAD (ELECTRIC)
WELDER POWER LEAD (ELECTRIC)
VIBRATOR RIDER ROD CONTROL SHAFT DWG. NO. D-51196
ROTARY CONTROL SHAFT VIBRATOR FILLER TUBE DWG. NO. D-51192
PUSH PULL CONTROL SHAFT VIBRATOR FRAME DWG. NO. D-51195
PUSH PULL CONTROL SHAFT VIBRATOR CHUCK DWG. NO. D-51195
VIBRATOR CONTROL SPARE
COMPRESSED AIR 1/2"
EXHAUST 3/4"
REPAIR AREA DOOR
BALL VALVE CONTROL SHAFT REJECT TERMINAL DWG. NO. D-51193
BALL VALVE CONTROL SHAFT RECYCLE HOPPER DWG. NO. D-51193
ROTARY CONTROL SHAFT BYPASS VALVE DWG. NO. D-51192
BALL VALVE CONTROL SHAFT INLET PIPE DWG. NO. D-51193
CONTROL SHAFT BALL MILL DWG. NO. D-51193
ROTARY CONTROL SHAFT BYPASS VALVE DWG. NO. D-51192
ROTARY CONTROL SHAFT -200 HOPPER DWG. NO. D-51192
BALL VALVE CONTROL SHAFT -140 HOPPER DWG. NO. D-51193
ROTARY CONTROL SHAFT -50 +140 HOPPER DWG. NO. D-51192
RECYCLE HOPPER CONTROL
BLENDER VALVE CONTROL SHAFT DWG. NO. D-50419
ROTARY CONTROL SHAFT BLENDER DWG. NO. D-51192
INTERLOCKING CONTROL SHAFT DWG. NO. D-51194
BLENDER (ELECTRIC)
BALL VALVE CONTROL SHAFT -16 + 50 HOPPER DWG. NO. D-51193
ROTARY CONTROL SHAFT -6 + 16 HOPPER DWG. NO. D-51192
BALL VALVE CONTROL SHAFT +6 HOPPER DWG. NO. D-51193
ROTARY CONTROL SHAFT BYPASS VALVE DWG. NO. D-51192
1" FEEDER VALVE (ELECTRIC)
BALL MILL, CRUSHER, CLASSIFIER (ELECTRIC)
2" FEEDER VALVE (ELECTRIC)
LTR | REVISIONS | DATE | APPD | APPD
DRAWN SZYMANSKI 5-18-62 | CHECKED DAVIS 5-25-62
DESIGNED | SUBMITTED PATE 5-28-62 | APPROVED H. Duggan 5-28-62
FIRST FLOOR PLAN D-50478
REFERENCE DRAWINGS | DWG. NO.
THORIUM-U233 FUEL ROD FACILITY | BLDG. NO. 3019
GENERAL SPECIFICATIONS:
1. Break all sharp edges 1/64 max. unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.
MACHINE FINISH SPECIFICATIONS:
1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed
CLASSIFICATION
LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS ±
DECIMALS ±
ANGLES ±
SCALE: 1/2" = 1'
CELL 4 SERVICE INDEX
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE
SUBMITTED | ACCEPTED | APPROVED
D-50424
APPROVED FOR CONSTRUCTION



APPROVED FOR CONSTRUCTION



PARTS LIST

PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
1[1]	Stock	1	Manipulator tong	
1-A[1]	Stock	1	Manipulator tong	
1-B[1]	Stock	1	Manipulator tong	
2	Stock	1	Castle joint (CYLINDER-DISC TYPE)	
3	D-45017	1	Mounting ring	Stl
4	D-45017	1	Retaining ring	Stl
5	D-45017	1	Sealing ring	Stl
6	D-45018	1	Adapter ring	Alum.
7	D-45018	1	Inner adapter ring	Alum.
8	Stock	1	"O" ring AN-6227-75 9 1/2 x 10 x 1/4	Neoprene
9	Stock	1	"O" ring AN-6227-76 10 x 10 1/2 x 1/4	Neoprene
10	Stock	6	Flat head mach screw, 1/4-20NC x 1/2	Stl
11	Stock	12	Round head screw No. 5-40NC x 3/8	Stl
12	Stock	8	Round head screw No. 5-40NC x 1/4	Stl
13	Stock	4	Soc head cap screw No. 10-24NC x 1/2	Stl
14	D-45018	8	Clip	Stl
15	D-45019	1	Nut	Brass
16	D-45019	1	Band	Brass
17	Stock	2	"O" ring, AN-6227-23 1 1/4 x 1 1/2 x 1/8	Neoprene
18	D-45019	1	Housing	Brass
19	D-45019	1	Ring	Brass
20	Stock	1	Washer, .500 ID x 3/4 OD x .062	STL
21	D-45020	1	Boot	Neoprene
22	D-45019	1	Shaft	SST
23	D-45019	1	Boot	Neoprene
24	Stock	1	"O" ring, AN-6227-6 5/16 x 7/16 x 1/16	Neoprene
25	Stock	1	Retaining ring, Truarc No. 5100-43	Stl
26	Stock	1	Gasket, 1 5/8 OD x 1 1/4 ID x 1/16 thick	Neoprene
27[2]	D-45020	1	BOOT	NEOPRENE

Remarks:

1. Part No. 1 - Model 3653S-4 L = 24"
   Part No. 1-A - Model 3651S-4 L = 24"
   Part No. 1-B - Model 3651S-4 L = 30"
   Modified tips to be on all models.
   Allied Engineering and Production Corp., 2421 Blanding Ave., Alameda, Calif.
2. PART NO. 27 TO BE USED WITH PART NO. 1-B ONLY

REFERENCE DRAWINGS	DWG. NO.
MANIPULATOR ASSY SHEET 1	D-45015
DET SHEET 4	D-45020
DET SHEET 3	D-45019

THORIUM-U233 FUEL ROD FACILITY BLDG. NO. 3019

CASTLE MANIPULATOR ASSEMBLY SHEET 2

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED · ACCEPTED · APPROVED

D-45016 REV

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE: 2 = 1

GENERAL SPECIFICATIONS:

1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

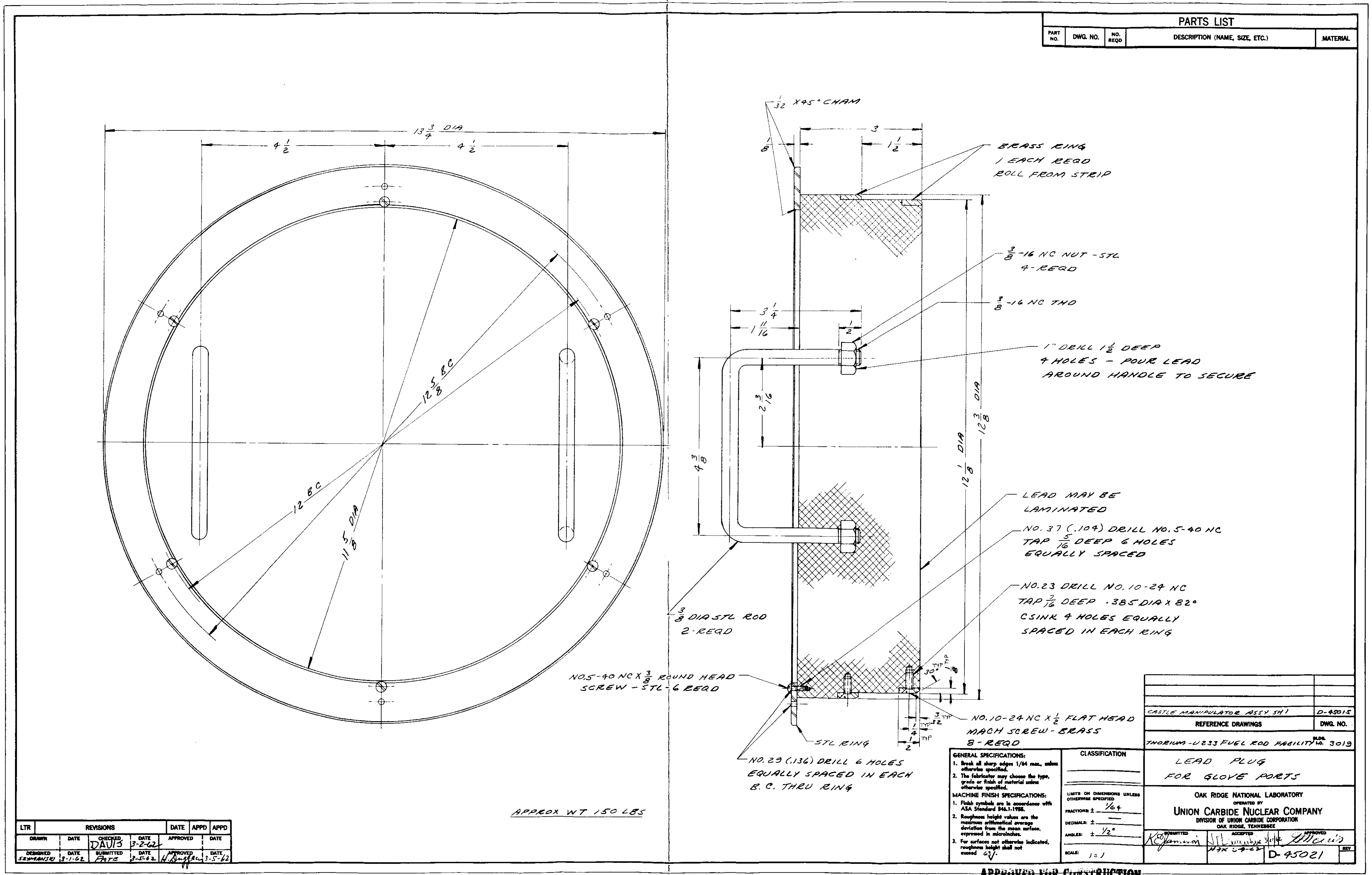
MACHINE FINISH SPECIFICATIONS:

1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed √.

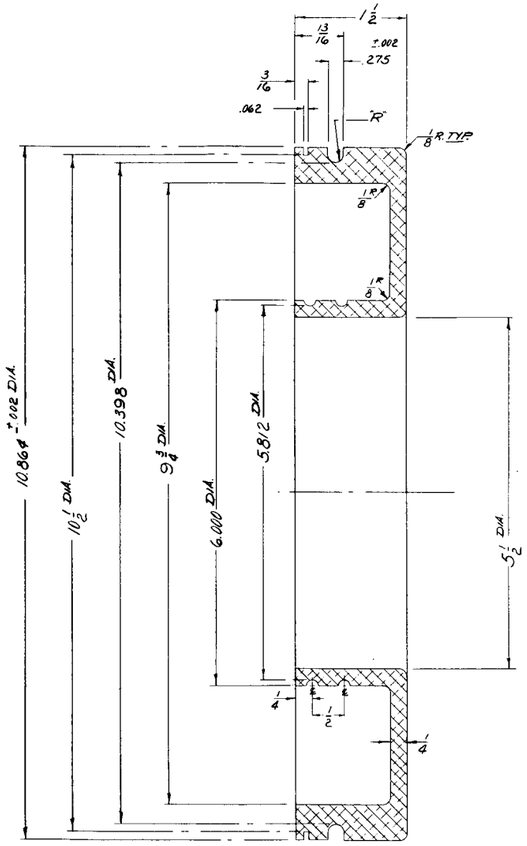
LTR	REVISIONS	DATE	APPD	APPD

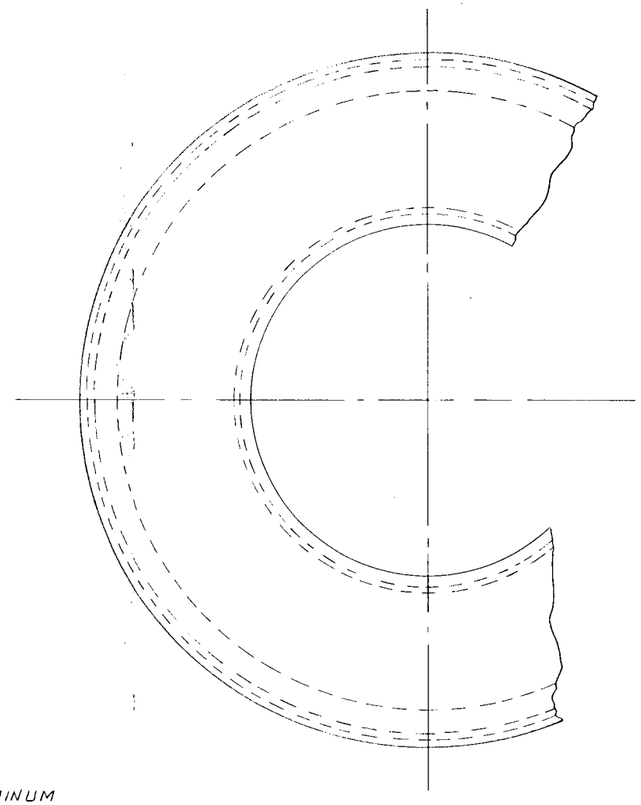
DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
SZYMANSKI	2-20-62	DAVIS	3-2-62		
DESIGNED	DATE	SUBMITTED	DATE	APPROVED	DATE
		PATE	3-5-62		3-5-62

APPROVED FOR CONSTRUCTION


PARTS LIST
PART NO.
DWG. NO.
NO. REQD
DESCRIPTION (NAME, SIZE, ETC.)
MATERIAL
1/32 X45° CHAM
BRASS RING
1 EACH REQD
ROLL FROM STRIP
3/8-16 NC NUT - STL
4-REQD
3/8-16 NC THD
1" DRILL 1 1/2 DEEP
4 HOLES - POUR LEAD
AROUND HANDLE TO SECURE
LEAD MAY BE
LAMINATED
NO. 37 (.104) DRILL NO. 5-40 NC
TAP 5/16 DEEP 6 HOLES
EQUALLY SPACED
NO.23 DRILL NO. 10-24 NC
TAP 7/16 DEEP .385 DIA X 82°
CSINK 4 HOLES EQUALLY
SPACED IN EACH RING
3/8 DIA STL ROD
2-REQD
NO.5-40 NC X 3/8 ROUND HEAD
SCREW - STL - 6 REQD
NO. 10-24 NC X 1/2 FLAT HEAD
MACH SCREW - BRASS
8-REQD
STL RING
NO. 29 (.136) DRILL 6 HOLES
EQUALLY SPACED IN EACH
B. C. THRU RING
13 3/4 DIA
12 5/8 BC
12 BC
11 5/8 DIA
12 1/8 DIA
12 3/8 DIA
APPROX WT 150 LBS
CASTLE MANIPULATOR ASSY SH1 D-45015
REFERENCE DRAWINGS
DWG. NO.
THORIUM-U233 FUEL ROD FACILITY BLDG. NO. 3019
GENERAL SPECIFICATIONS:
1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.
MACHINE FINISH SPECIFICATIONS:
1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed 63.
CLASSIFICATION
LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ± 1/64
DECIMALS: ±
ANGLES: ± 1/2°
SCALE: 1=1
LEAD PLUG
FOR GLOVE PORTS
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE
SUBMITTED
ACCEPTED
APPROVED
D-45021
REV
LTR
REVISIONS
DATE
APPD
DRAWN
CHECKED DAVIS 3-2-62
DESIGNED SEWARSKI 3-1-62
SUBMITTED
APPROVED 3-5-62
APPROVED FOR CONSTRUCTION

PARTS LIST				
PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL





MAT'L : ALUMINUM

LTR	REVISIONS				DATE	APPD	APPD
DRAWN E.J. JURAS	DATE 6-9-65	SUBMITTED PATE	DATE		APPROVED		DATE
DESIGNED	DATE	APPROVED	DATE		APPROVED		DATE
CHECKED DAYS	DATE 6-10-65	APPROVED	DATE		APPROVED		DATE

CASTLE MANIPULATOR ASS'Y	D-45015
REFERENCE DRAWINGS	DWG. NO.
THORIUM U-233 FUEL ROD FACILITY	BLDG. NO. 3019
BAG OUT PORT ADAPTOR	

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ± 1/64
DECIMALS: ± .005
ANGLES: ± 1/2°
SCALE: 1" : 1"

GENERAL SPECIFICATIONS
Unless Otherwise Specified:
1. Break all sharp edges 1/64 max.
2. Type, grade, or finish of material may be chosen by fabricator.
3. Roughness height of machined surfaces shall not exceed √.
(Finish symbols and height values are in accordance with ASA B46.1-1955.)

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED	ACCEPTED	APPROVED
W. A. PAIE		

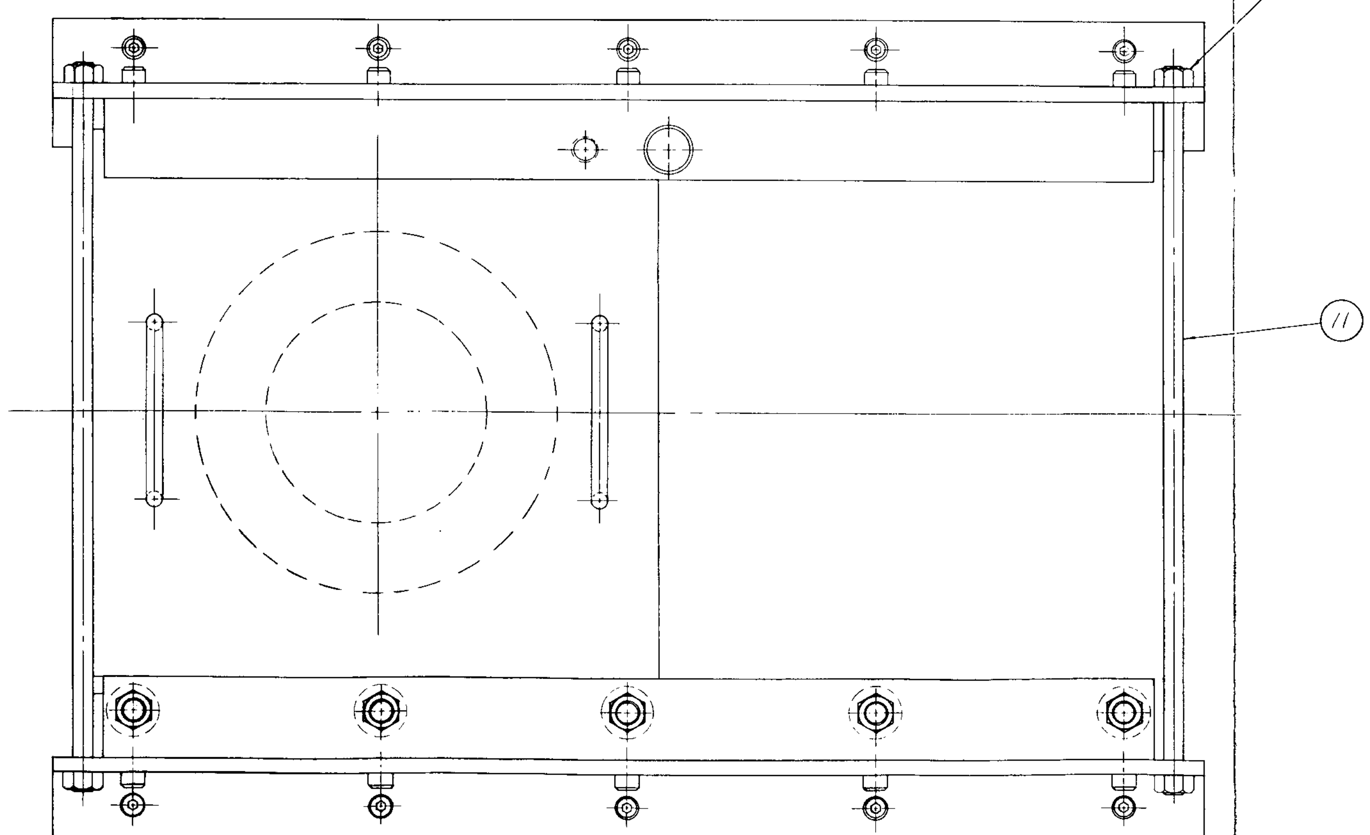
D-56683 REV

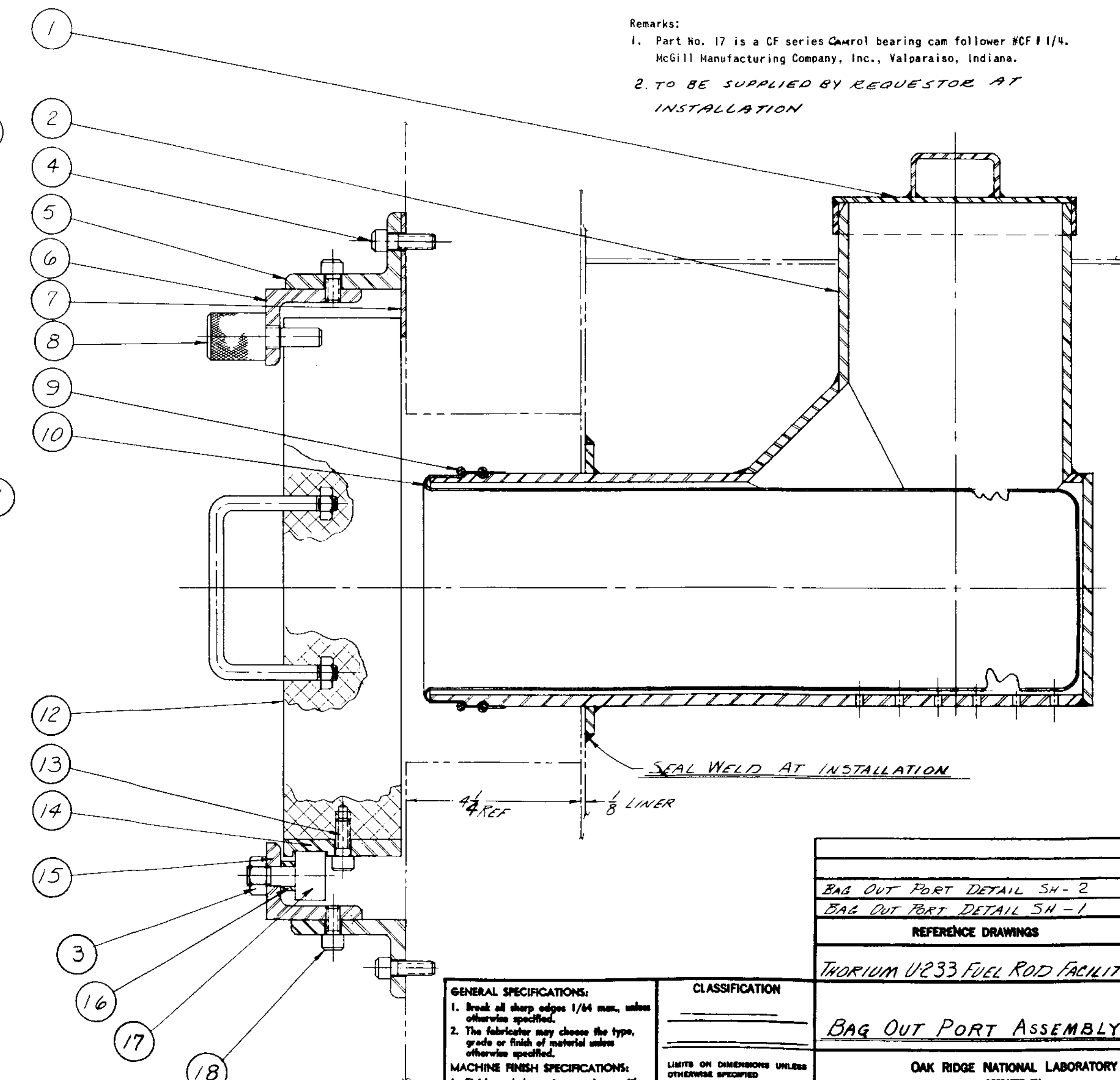
PARTS LIST

PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
1	D-51197	1	Cover	Stl
2	D-51197	1	Bag Out Port	Stl
3	Stock	9	Hex nut, 1/2-20NF-2	Stl
4	Stock	10	Soc hd cap screw, 3/8-16NC-2 x 1 1/4 lg.	Stl
5	D-51198	2	Bracket	Stl
6	D-51198	1	Retainer	Stl
7	D-51198	1	Plate	Stl
8	D-51197	1	Pin	Stl
9	Stock	2	"O" ring #AN6230-34	Neoprene
10 2	Stock	1	6" dia. x .005 thk polyethylene tubing	
11	D-51198	2	Column	Stl
12	D-51198	1	Door	Lead & Stl
13	Stock	4	Soc hd cap screw, 3/8-16NC-2 x 1" lg.	Stl
14	D-51197	1	Door guide	Stl
15	D-51197	1	Cam support	Stl
16	Stock	5	Spacer, 5/8 OD x 17/32 ID x 1/2 lg.	Stl
17 1	Stock	5	Cam follower	
18	Stock	10	Soc hd cap screw, 3/8-16NC-2 x 3/4 lg.	Stl

Remarks:

1. Part No. 17 is a CF series Camrol bearing cam follower #CF 1 1/4. McGill Manufacturing Company, Inc., Valparaiso, Indiana.
2. TO BE SUPPLIED BY REQUESTOR AT INSTALLATION





BAG OUT PORT DETAIL SH - 2	D-51198
BAG OUT PORT DETAIL SH - 1	D-51197
REFERENCE DRAWINGS	DWG. NO.

THORIUM U233 FUEL ROD FACILITY BLDG. NO. 3019

GENERAL SPECIFICATIONS:
1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:
1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed √.

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE: 1/2 : 1

BAG OUT PORT ASSEMBLY

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED: K E Jamison | ACCEPTED: [signature] H7K 3-14-62 | APPROVED: [signature]

D-51191

LTR	REVISIONS	DATE	APPD	APPD

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
B.G. GIBSON	3-5-62	DAVIS			
DESIGNED	DATE	SUBMITTED	DATE	APPROVED	DATE
		PATE	3-14-62	[signature]	3-14-62

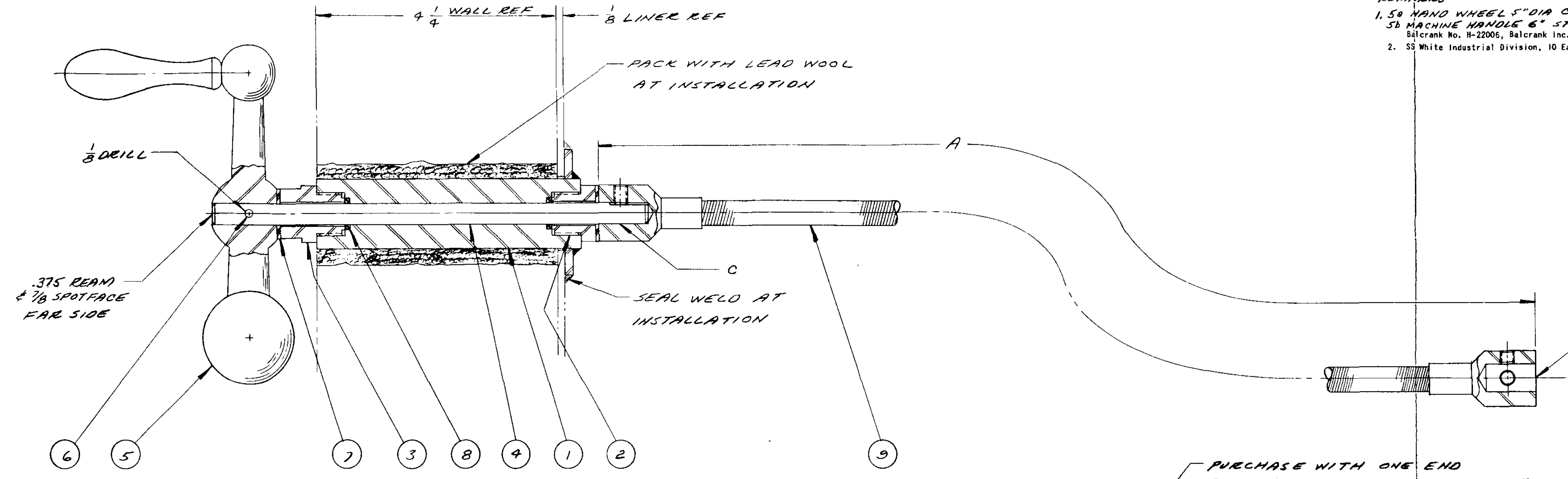
APPROVED FOR CONSTRUCTION

PARTS LIST

PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
1	D-51199	1	Housing	Stl
2	D-51199	1	Bushing	Stl
3	D-51199	1	Bushing	Stl
4	D-51199	1	Rod	Stl
5_1	Stock	1	SEE REMARKS	
6	Stock	1	Rollpin 1/8 dia. x 1 1/4	Stl
7	Stock	2	Washer 13/32 ID x 7/8 OD x 1/16	Teflon
8	Stock	2	O-ring, AN-6227-8 3/8 x 9/16 x 3/32	Neoprene
9_2	Stock	1	Flexible shaft RS-431 x long	

REMARKS

1. 5a HAND WHEEL 5" DIA CI BALCRANK NO. H-29469 A
   5b MACHINE HANDLE 6" STL
   Balcrank No. H-22006, Balcrank Inc., Cincinnati 9, Ohio.
2. SS White Industrial Division, 10 East 40th St., New York 16, N. Y.



PURCHASE WITH ONE END FITTING LOOSE FOR ADJUSTMENT AT INSTALLATION

NO. SHAFTS REQD	EQUIPMENT USED ON	EQUIPMENT DWG NO.	ITEM NO.	SERIES	A	ID B	ID C	USED WITH PART NO.
1	VIBRATOR FILLER TUBE	D-51180	9	RS 25	27"	5/16	3/8	5b
1	BLENDER	D-51275	9	RS 43-1	18"	1/2	3/8	5a
2	BY-PASS VALVE	D-50421	9	RS 43-1	34"	1/2	3/8	5a
1	BY-PASS VALVE	D-50421	9	RS 43-1	22"	1/2	3/8	5a
1	-6+16 HOPPER	D-51211	9	RS 43-1	40"	1/2	3/8	5a
1	-50+140 HOPPER	D-51211	9	RS 43-1	22"	1/2	3/8	5a
1	-200 HOPPER	D-51211	9	RS 43-1	22"	1/2	3/8	5a

REFERENCE DRAWINGS	DWG. NO.
CONTROL SHAFT DETAILS	D-51199

THORIUM-U233 FUEL ROD FACILITY BLDG. NO. 3019

ROTARY CONTROL SHAFT ASSEMBLY

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED — ACCEPTED — APPROVED

D-51192 REV

GENERAL SPECIFICATIONS:
1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:
1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed √.

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE: 1 = 1

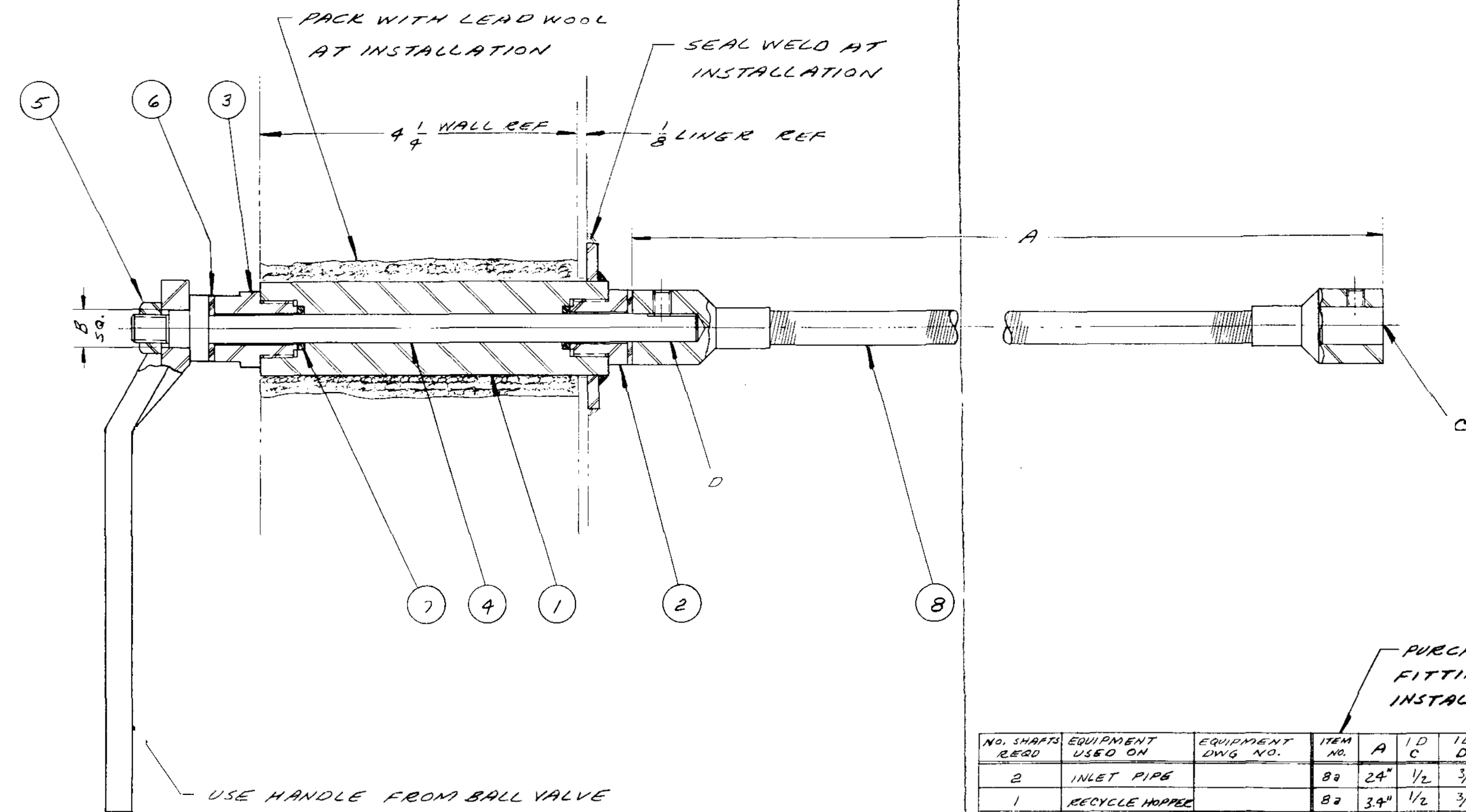
LTR	REVISIONS	DATE	APPD	APPD

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
SZYMANSKI	1-7-62	DAVIS	3-29-62		
DESIGNED	**DATE**	**SUBMITTED**	**DATE**	**APPROVED**	**DATE**
SZYMANSKI	1-7-62	PATE	3-30-62		3-30-62

PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
1	D-50371	1	Housing	Stl
2	D-50371	1	Bushing	Stl
3	D-50371	1	Bushing	Stl
4	D-50371	1	Rod	Stl
5	Stock	1	Hex nut 3/8-16NC	Stl
6	Stock	2	Washer 13/32 ID x 7/8 OD x 1/16	Teflon
7	Stock	2	O-ring, AN-6227-8 3/8 x 9/16 x 3/32	Neoprene
8	Stock	1	Flexible COUPLING	

Remarks:

1. PART 8a FLEXIBLE SHAFT SERIES RS-43-X A LONG
SS WHITE INDUSTRIAL DIVISION
10 EAST 40TH ST NEW YORK NY
PART 8b FLEXIBLE COUPLING BOSTON GEAR
CAT NO. FCR 12 3/8 DIA HOLE



PURCHASE WITH ONE END FITTING LOOSE FOR ADJUSTMENT AT INSTALLATION

NO. SHAFTS REQD	EQUIPMENT USED ON	EQUIPMENT DWG NO.	ITEM NO.	A	ID C	ID D	ITEM 4 B
2	INLET PIPE		8a	24"	1/2	3/8	5/8
1	RECYCLE HOPPER		8a	3.4"	1/2	3/8	1/2
1	BALL MILL	D-51215	8a	24"	1/2	3/8	1/2
1	-140 HOPPER	D-51211	8a	54"	1/2	3/8	1/2
1	-16 +50 HOPPER	D-51211	8a	22"	1/2	3/8	1/2
1	+6 HOPPER	D-51211	8a	54"	1/2	3/8	1/2
1	REJECT TERMINAL		8b		—	—	—

REFERENCE DRAWINGS	DWG. NO.
CONTROL SHAFT DETAILS	D-50371

THORIUM-U233 FUEL ROD FACILITY BLDG. NO. 3019

BALL VALVE CONTROL SHAFT ASSEMBLY

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED [illegible] ACCEPTED [illegible] APPROVED [illegible] [illegible]

D-51193 REV

GENERAL SPECIFICATIONS:

1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:

1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed √.

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ± —
DECIMALS: ± —
ANGLES: ± —
SCALE: 1 = 1

TR	REVISIONS	DATE	APPD	APPD

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
ZYMANSKI	1-14-62	DAVIS	3-29-62		
DESIGNED	DATE	SUBMITTED	DATE	APPROVED	DATE
ZYMANSKI	1-15-62	PATE	3-30-62	N. Duggan	3-30-62

APPENDIX C

Equipment

Powder Preparation

1. Installation Drawing – D-53483
2. Jaw Crusher Assembly – D-51212
3. Ball Mill Assembly – D-51215
4. Ball Mill Assembly, Modifications – D-56699
5. Classifier Assembly – D-53500
6. Blender Assembly – D-51225
7. 2-in. Feeder Valve Assembly – D-51221
8. 1-in. Feeder Valve Assembly – D-51200
9. Feed Valve Motor Control Circuit – D-54471
10. Bypass Valve Assembly – D-50421
11. 2-in. Bypass Valve Assembly – D-56677
12. Recycle Hopper Assembly – D-46558

Vibratory Compactor

1. Vibrator Main Assembly – D-51189
2. Vibrator Chuck Subassembly – D-51176
3. Vibrator Chuck Modifications – D-54270
4. Vibrator Filler Tube Subassembly – D-51180
5. Vibrator Filler Tube Modifications – D-56684

6. Fuel Tube Elevator Assembly – D-45022

End-Cap Welder

1. Remote Welder Main Assembly – D-52450

2. Remote Welder Subassembly A – E-52451

3. Remote Welder Subassembly B – E-52452

Density Checker

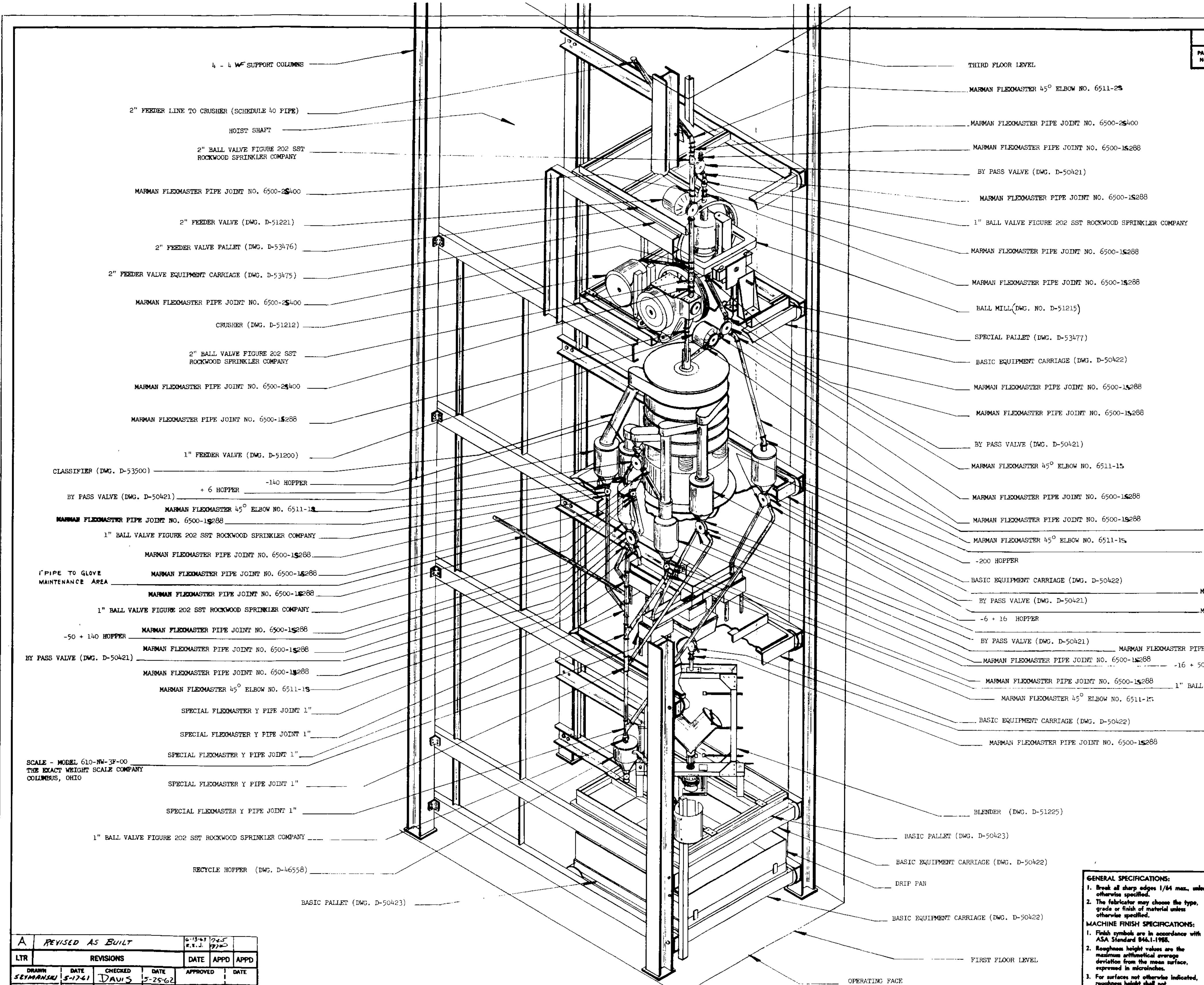
1. Density Checker Main Assembly – E-54877

2. Density Checker Subassembly A – E-54878

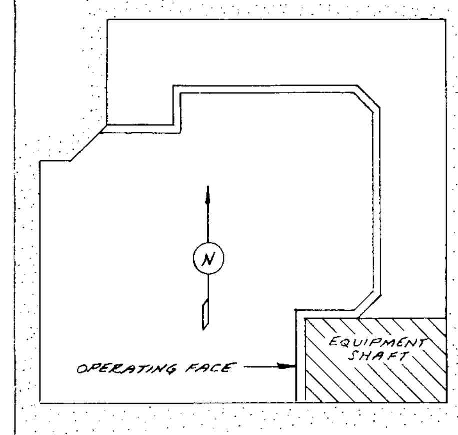
3. Density Checker Subassembly B – D-54879

4. Density Checker Subassembly C – D-54880

5. Density Checker Electrical Layout – Q-2535-12



PARTS LIST				
PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL



CELL 4 KEY PLAN

REFERENCE DRAWINGS	DWG. NO.
FIRST FLOOR PLAN	D-50478

THORIUM-U^{233} FUEL ROD FACILITY — BLDG. NO. 3019

GENERAL SPECIFICATIONS:
1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:
1. Finish symbols are in accordance with ASA Standard B46.1-1962.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed √

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE: 1" = 1'

EQUIPMENT SHAFT CELL 4
INSTALLATION DRAWING

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED / ACCEPTED / APPROVED (signatures)

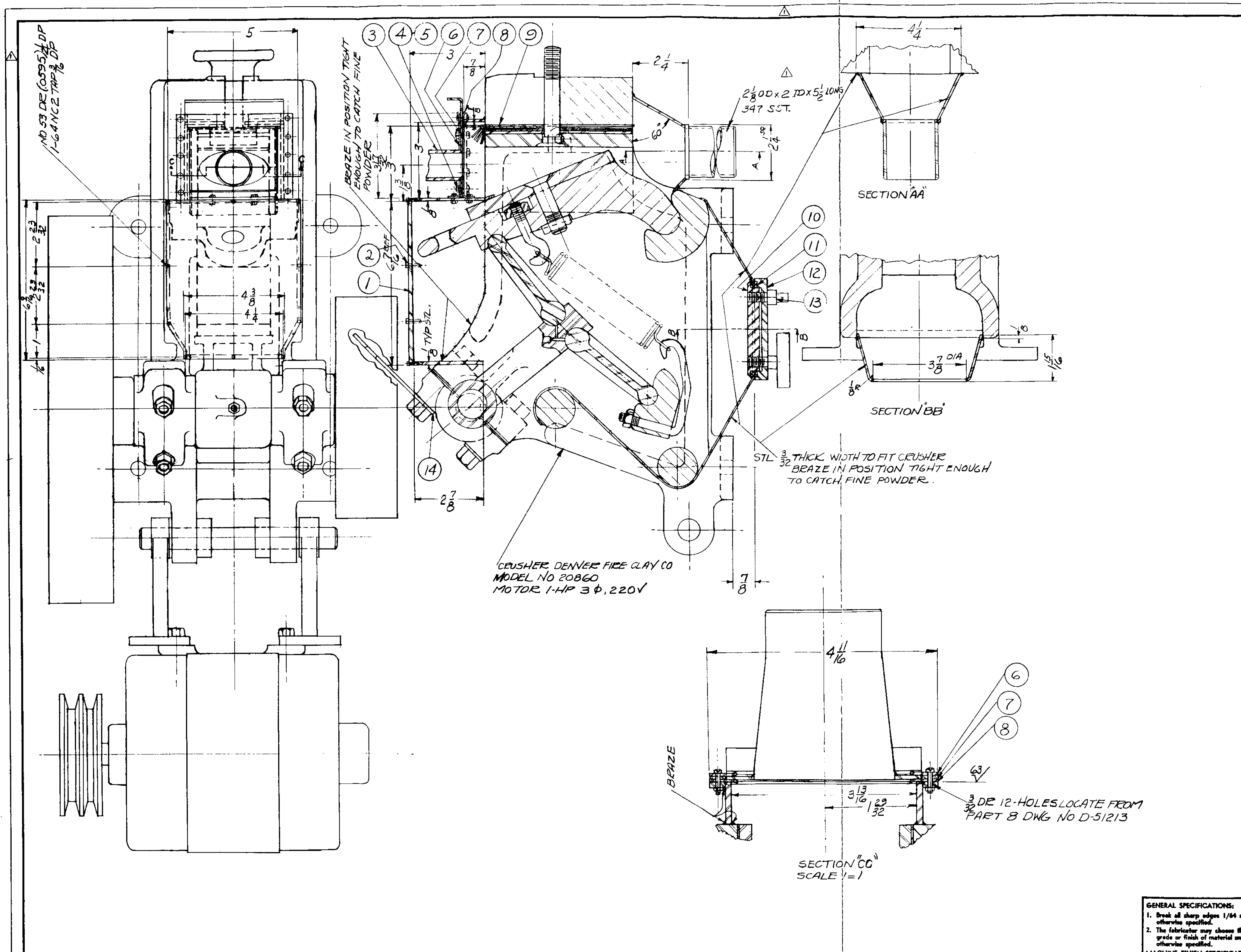
D-53483 REV A

LTR	REVISIONS	DATE	APPD	APPD
A	REVISED AS BUILT	6-15-63		

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
SZYMANSKI	5-17-61	DAVIS	5-25-62		

DESIGNED	DATE	SUBMITTED	DATE	APPROVED	DATE
		PATE	5-28-62	H. Duggan	5-28-62

APPROVED FOR CONSTRUCTION



PARTS LIST				
PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
1	D-51213	1	Lid	Stl
2	Stock	10	Round hd mach screw, 1-64 x 1/4	Stl
3	D-51213	1	Slide top	SST
4	Stock	12	Hex hd machine screw, 5-40 x 1/2	Stl
5	Stock	12	Hex nut 5-40	Stl
6	D-51213	1	Top guide	SST
7	D-51213	2	Spacer	SST
8	D-51213	1	Bottom guide	SST
9	D-51214	1	Back spacer	STL
10	D-51214	1	Guide seal	6061-T6 Al
11	D-51214	1	Seal	Rubber
12	D-51214	1	Seal base	6061-T6 Al
13	D-51213	3	Special hex hd mach screw 1/4-20 x 3/4	Stl
14	D-51214	1	Crane bracket	Stl

LTR	REVISIONS	DATE	APPD	APPD
A	⚠ 2" ID WAS 1 1/16 - PARTS 6 TO 9 CHANGED TO SST.	5-13-63 RE.J	7-23	

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
AMTripp	1-19-62	DAVIS	2-12-62		
DESIGNED	**DATE**	**SUBMITTED**	**DATE**	**APPROVED**	**DATE**
		PATE	2-12-62	[signature]	2-16-62

GENERAL SPECIFICATIONS:

1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:

1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed √.

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ± 1/64
DECIMALS: ± .005
ANGLES: ± 0°-30'
SCALE: 1/2 = 1

REFERENCE DRAWINGS	DWG. NO.
CRUSHER DETAIL SHEET-1-	D-51213
" " " -2-	D-51214

THORIUM U-233 FUEL ROD FACILITY — BLDG. NO. 3019

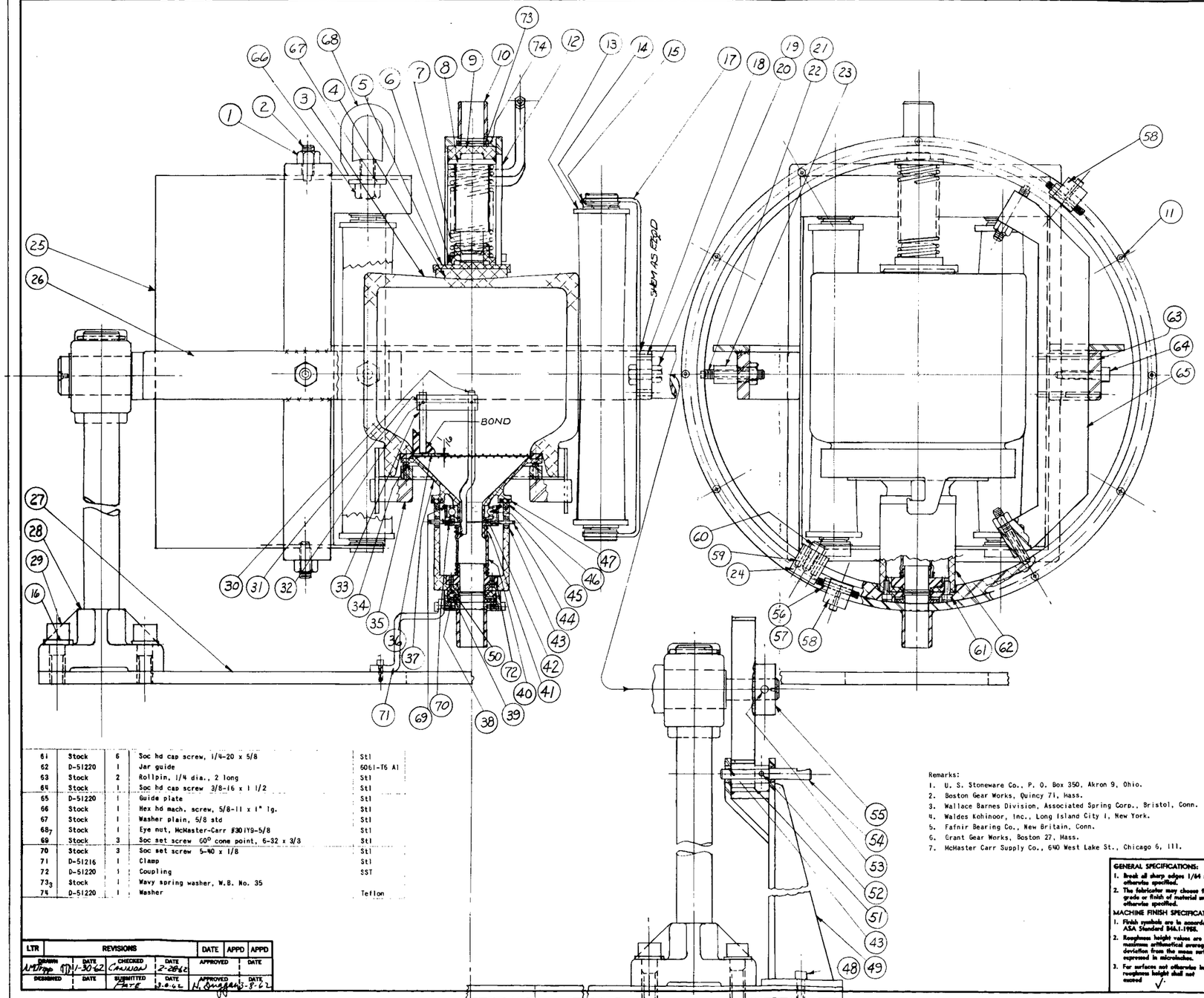
CRUSHER ASSEMBLY

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED [signature] — ACCEPTED 3/7/62 [signature] — APPROVED [signature]

D-51212 — REV A

APPROVED FOR CONSTRUCTION



PARTS LIST

PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
1	Stock	4	Hex nut, 1/2-13	Stl
2	Stock	4	Soc set screw, 1/2-13 x 1 1/2 full dog	Stl
3	Stock	1	High alumina mill jar, size no. 1 (Fig. 773 U. S. Stoneware Co. Bul. JM-290)	
4	D-51216	1	Bumper	Neoprene
5	D-51216	1	Check bearing	Teflon
6	D-51216	1	Spring bearing	Teflon
7	D-51216	1	Spring	Music Wire
8	D-51216	1	Spring guide	6061-T6 Al
9	D-51216	1	Valve disc	6061-T6 Al
10	D-51217	1	Valve ring	Stl
11	Stock	18	Soc hd cap screw, #10-24 x 1/2" lg.	Stl
12	D-51217	1	Retaining washer	Stl
13_1	Stock	1	Idler roll, Dwg. No. PB-1754-D Pt. No. (07502) U. S. Stoneware Company	
14	Stock	2	Flat washer 9/16 std.	Stl
15_1	Stock	2	Ball bearing No. 487016V) Pt. No. 06506	
16	Stock	8	Lockwasher for 5/8 screw	Stl
17	D-51217	1	Roller spring, Stk No.04-836-1660 Strip Stl Oil Hdn	
18	Stock	2	Roll pin, 1/4 dia. x 5/8	Stl
19	Stock	2	Hex nut 3/8-16	Stl
20	Stock	2	Hex hd mach screw, 3/8-16 x 1	Stl
21	Stock	3	Soc set screw, full dog point 3/8-16 x 2 1/2	Stl
22	Stock	3	Lock nut 3/8-16	Stl
23	D-51217	1	Guide bushing	Stl
24	D-51217	1	Stop	Stl
25_1	D-51218	1	Unitized jar mill, U. S. Stoneware Fig. No. 753RM, Serial No. CV62106	
26	D-51218	1	Frame	Stl
27	D-51219	1	Base	Stl
28_2	Stock	2	Adjustable shaft supports Boston Gear No. BHA9 1 5/8 hole	
29	Stock	8	Soc hd cap screw, 5/8-11 x 1 1/2	Stl
30	D-51218	1	Bearing housing and rod	SST
31	D-51219	1	Guide block	SST
32	Stock	2	Roll pin, 1/16 dia. x 1/2	SST
33	D-51219	1	Guide rod	SST
34	Stock	4	Soc set screw, 1/4-20 x 3/4	Stl
35	D-51219	1	Holding ring	Stl
36	D-51219	1	Paddle	Neoprene
37	D-51219	1	Cone	347 SST
38	D-51220	1	Seal	Teflon
39_3	Stock	1	Wavy spring washer, Wallace Barnes No. 40 (1.543 OD, 1.201 I.D., .017 thick, .105 free height, .052 deflected ht., 19-23# load)	
40	D-51220	1	Rubber or neoprene tubing	
41_7	Stock	2	Hose clamp, McMaster Carr #5414K-100	Stl
42_4	Stock	1	Retaining ring, Truarc No. 5100-131	Stl
43_2	Stock	5	Bushing, B.G. #868-3, 1/2 OD x 3/8 ID x 3/8 lg.	
44	D-51220	3	Guide screw	Drill Rod
45_5	Stock	1	Bearing, Torque tube type, Fafnir B5#2DD	Stl
46	D-51220	1	Thrust bearing	Teflon
47	D-51220	1	Thrust washer	Teflon
48	Stock	2	Socket hd cap screw 3/8-16 x 3/4	Stl
49	D-51220	1	Frame	Stl
50	Stock	2	Fl hd machine screw, #10-24 x 1/2 lg.	Stl
51_6	Stock	1	Spur gear, Grant No. 2212 1.000 P.D., 3/8 dia. hole, 3/4 face, 12 pitch, 12 teeth	
52	Stock	1	1/8 roll pin x 3/4 lg.	Stl
53	Stock	1	1/4 roll pin x 1 7/8 lg.	Stl
54	D-51220	1	Shaft	Drill Rod
55	Stock	1	Spur gear, Grant No. 2244, 6.00 P.D., 12 pitch, 12 teeth, 3/4 face	
56	Stock	2	Locknut, hex, 1/4-20	Stl
57	Stock	2	Soc set screw 1/4-20 x 2	Stl
58	D-51217	2	Adjustable stop	Stl
59	Stock	4	Roll pin, 1/4 dia. x 3/4	Stl
60	Stock	2	Soc hd cap screw 3/8-16 x 3/4	Stl
61	Stock	6	Soc hd cap screw, 1/4-20 x 5/8	Stl
62	D-51220	1	Jar guide	6061-T6 Al
63	Stock	2	Rollpin, 1/4 dia., 2 long	Stl
64	Stock	1	Soc hd cap screw 3/8-16 x 1 1/2	Stl
65	D-51220	1	Guide plate	Stl
66	Stock	1	Hex hd mach. screw, 5/8-11 x 1" lg.	Stl
67	Stock	1	Washer plain, 5/8 std	Stl
68_7	Stock	1	Eye nut, McMaster-Carr #3019-5/8	Stl
69	Stock	3	Soc set screw 60° cone point, 6-32 x 3/8	Stl
70	Stock	3	Soc set screw 5-40 x 1/8	Stl
71	D-51216	1	Clamp	Stl
72	D-51220	1	Coupling	SST
73_3	Stock	1	Wavy spring washer, W.B. No. 35	
74	D-51220	1	Washer	Teflon

Remarks:
1. U. S. Stoneware Co., P. O. Box 350, Akron 9, Ohio.
2. Boston Gear Works, Quincy 71, Mass.
3. Wallace Barnes Division, Associated Spring Corp., Bristol, Conn.
4. Waldes Kohinoor, Inc., Long Island City 1, New York.
5. Fafnir Bearing Co., New Britain, Conn.
6. Grant Gear Works, Boston 27, Mass.
7. McMaster Carr Supply Co., 640 West Lake St., Chicago 6, Ill.

LTR	REVISIONS	DATE	APPD	APPD
DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
DESIGNED	DATE	SUBMITTED	DATE	APPROVED	DATE

GENERAL SPECIFICATIONS:
1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:
1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed √.

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE: 1/2 = 1

REFERENCE DRAWINGS	DWG. NO.
BALL MILL DETAIL SHEET-5-	D-51220
BALL MILL DETAIL SHEET-1-	D-51216
" " " -2-	D-51217
" " " -3-	D-51218
" " " -4-	D-51219

THORIUM U-233 FUEL RODS FACILITY — SLAVE NO. 3019

BALL MILL ASSEMBLY

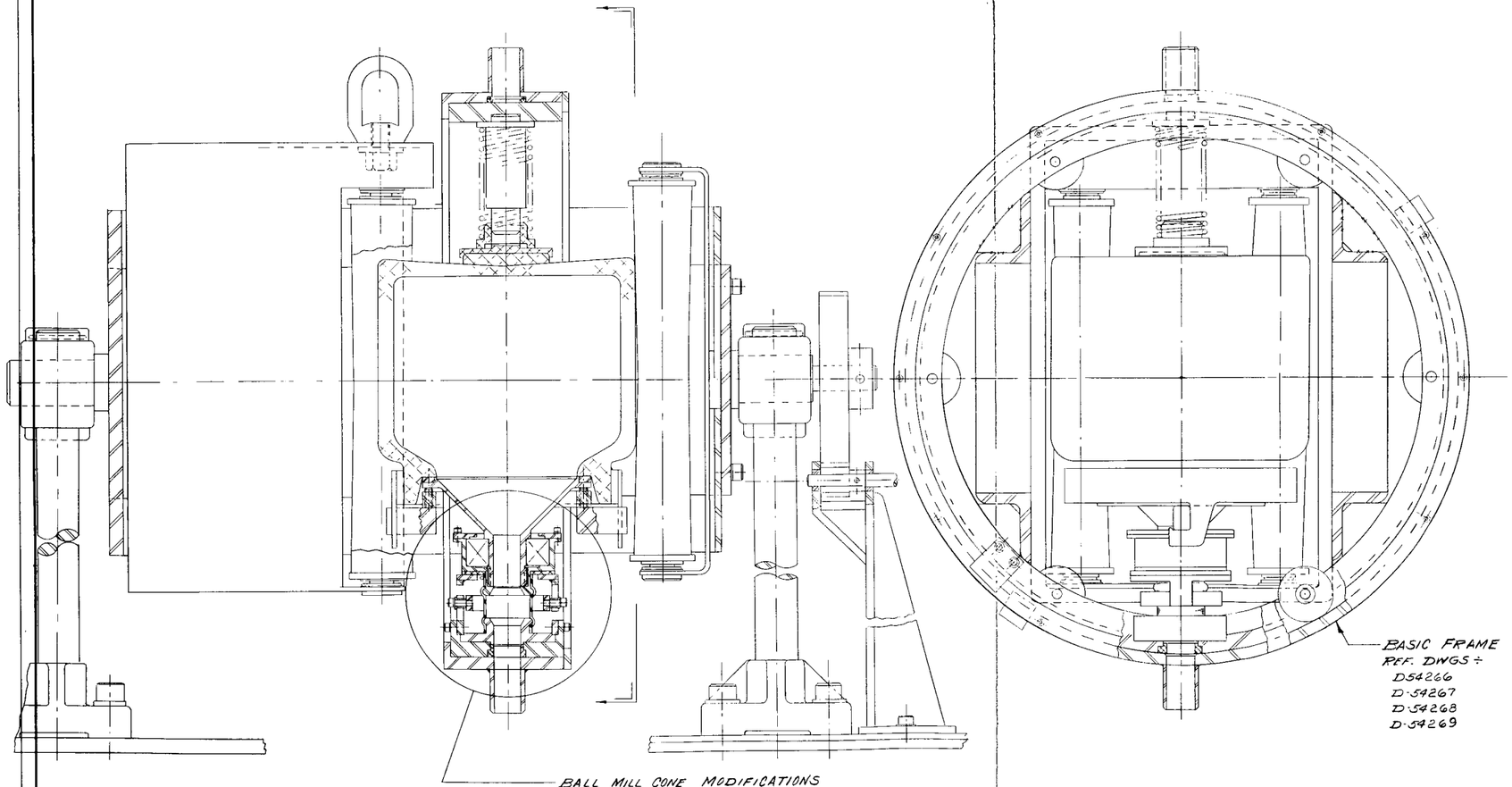
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED — ACCEPTED — APPROVED

D-51215 — REV

APPROVED FOR CONSTRUCTION

PARTS LIST				
PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL



BALL MILL CONE MODIFICATIONS
REF. DWGS ÷
D56693
D56694
D56695

BASIC FRAME STRUCTURE
REF. DWGS ÷
D54266
D-54267
D-54268
D-54269

NOTE:
THIS DRAWING FOR CLARIFICATION OF -
DWG. # D51215

AS BUILT

LTR	REVISIONS				DATE	APPD	APPD
DRAWN M.E. JURKO	DATE 7-18-63	SUBMITTED Pate	DATE 7-25-63		APPROVED		DATE
DESIGNED	DATE	APPROVED	DATE		APPROVED		DATE
CHECKED Davis	DATE 9-22-63	APPROVED	DATE		APPROVED		DATE

BALL MILL CONE MODIF. DETAIL SHT #2	D-56695
BALL MILL CONE MODIF. DETAIL SHT #1	D-56694
BALL MILL CONE MODIFICATIONS	D56693
BALL MILL MODIF. DETAIL SHT # 3	D-54269
BALL MILL MODIF. DETAIL SHT #2	D-54268
BALL MILL MODIF. DETAIL SHT. #1	D-54267
BALL MILL MODIFICATIONS	D-54266
BALL MILL ASS'Y	D51215
REFERENCE DRAWINGS	DWG. NO.

THORIUM U-233 FUEL ROD FACILITY — BLDG. NO. 3019

BALL MILL ASSEMBLY MODIFICATIONS

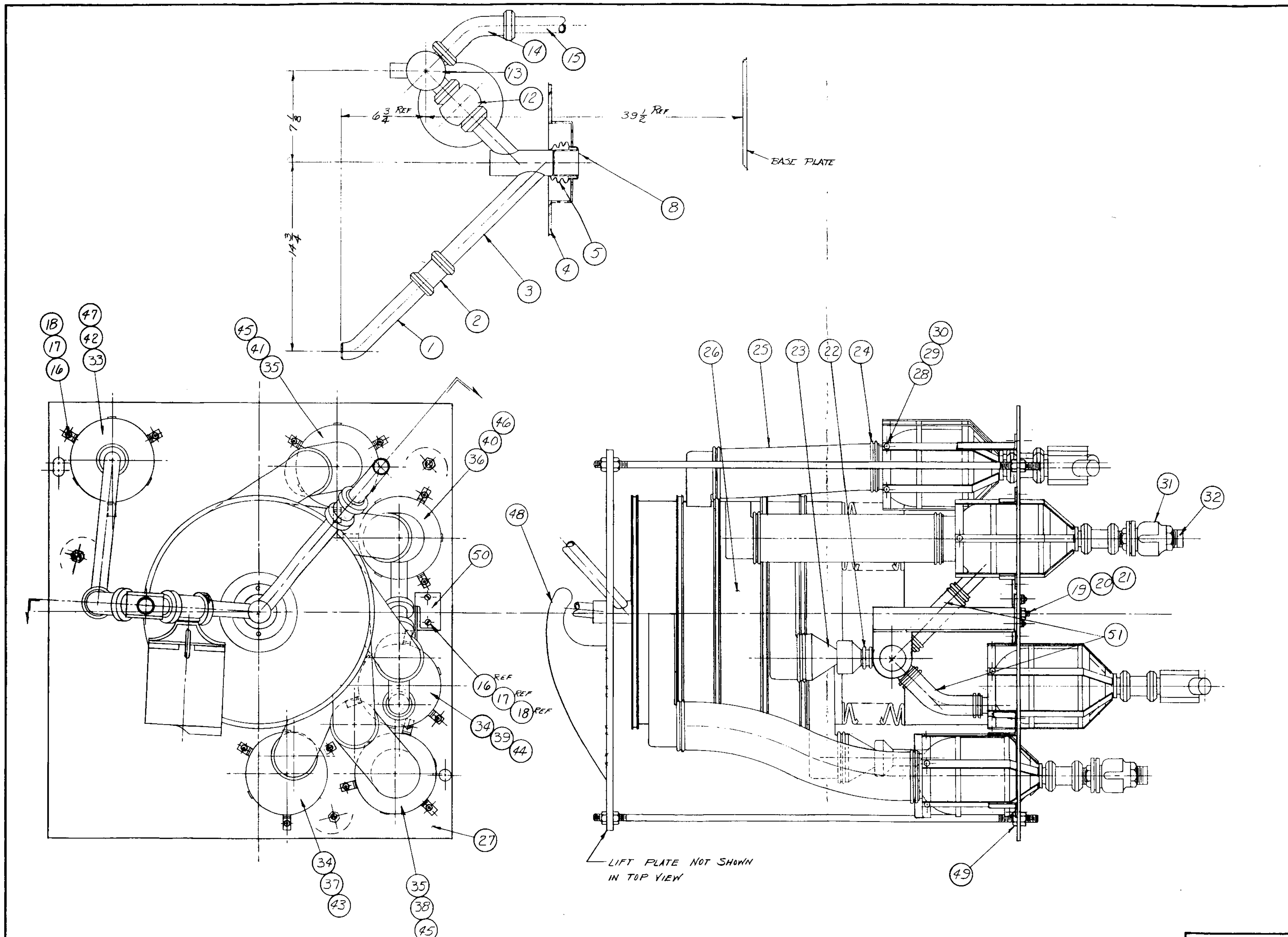
LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE: 1/2 = 1

GENERAL SPECIFICATIONS
Unless Otherwise Specified:
1. Break all sharp edges 1/64 max.
2. Type, grade, or finish of material may be chosen by fabricator.
3. Roughness height of machined surfaces shall not exceed √.
(Finish symbols and height values are in accordance with ASA B46.1-1955.)

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED	ACCEPTED	APPROVED
W A Pate		

D-56699 REV



PARTS LIST				
PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
1	D-53501	1	Pipe	SST
2_1	Stock	2	1" Standard flexmaster pipe joint No. 6500-1S288	SST
3	D-53501	1	Manifold	SST
4	D-53501	1	Separator top	SST
5	STOCK	1	BELLOWS	NEOPRENE
~~6~~	~~D-53501~~	~~1~~	~~Washer~~	~~SST~~
~~7~~	~~Stock~~	~~4~~	~~Soc hd cap screw #6-32NC-2 x 1/2 lg.~~	~~SST~~
8_2	D-53501	1	Diaphragm	
~~9~~	~~Stock~~	~~4~~	~~Hex hd screw #6-32NC-2 x 3/4 lg.~~	~~SST~~
~~10~~	~~Stock~~	~~4~~	~~Lockwasher for #6 screw~~	~~SST~~
~~11~~	~~Stock~~	~~4~~	~~Hex nut #6-32NC-2~~	~~SST~~
12	D-51200	1	1" Feeder valve assembly	
13	D-50421	5	1" bypass valve assembly	
14_1	Stock	1	1" 45° elbow, Flexmaster #6511-1S	SST
15	Stock	as reqd	1" Sch 40 pipe	SST
16	Stock	20	Flat hd screw, 5/16-18NC-2 x 1" lg.	SST
17	Stock	20	Lockwasher for 5/16 screw	SST
18	Stock	20	Hex nut, 5/16-18NC-2	SST
19	Stock	4	Hex hd screw, 3/8-16NC-2 x 1 1/4	SST
20	Stock	4	Lockwasher for 3/8 screw	SST
21	Stock	4	Hex nut, 3/8-16NC-2	SST
22_3	Stock	6	Double band hose clamp, McMaster Carr #150	Stl
23	D-53503	2	Boot	Neoprene
24_3	Stock	8	Double band hose clamp, McMaster Carr #400	Stl
25	Stock	as reqd	Hose, 3 1/2 ID x 1/16 wall	Neoprene
26_4	Stock	1	Separator (on hand)	
27	D-53503	1	Plate	Stl
28	Stock	36	Hex hd screw #10-32NC-2 x 1/2 lg.	SST
29	Stock	36	Lockwasher for #10 screw	SST
30	Stock	36	Hex nut #10-32NC-2	SST
31_5	Stock	3	Valve, ball, 1" IPS	SST
32	D-53502	6	Nipple	SST
33	D-53502	1	Hopper	Pyrex
34	D-53502	2	Hopper	Pyrex
35	D-53502	2	Hopper	Pyrex
36	D-53502	1	Hopper	Pyrex
37	D-53504	1	Hopper frame (1" STD FLEXMASTER PIPE JOINT #6500-1S288)	Stl
38	D-53504	1	Hopper frame " " "	Stl
39	D-53504	1	Hopper frame " " "	Stl
40	D-53504	1	Hopper frame " " "	Stl
41	D-53504	1	Hopper frame " " "	Stl
42	D-53504	1	Hopper frame " " "	Stl
43	D-53504	1	Cover	Stl
44	D-53504	1	Cover	Stl
45	D-53504	2	Cover	Stl
46	D-53504	1	Cover	Stl
47	D-53504	1	Cover	Stl
48	D-53505	1	Lifting bail (McMaster Carr #35Z65)	Stl
49	Stock	6	Hex Nut 1/2-13NC-2	Stl
50	D-53505	1	MOUNTING BRACKET	STL
51	STOCK	AS REQD	HOSE 1¼ O.D. x 1/16 WALL	NEOPRENE

Remarks:

1. Parts No. 2 and 14 are obtained from Aeroquip Corp., Marman Div., Los Angeles, Calif.
2. Part No. 8 is a class 4, cylinder bore 2.50, H - 200, Bellofram Rolling Diaphragm, Bellofram Corp., Burlington, Mass.
3. Part No. 22 and 24 are obtained from McMaster Carr Supply Co., Chicago, Ill.
4. Part No. 26 is a Sweco vibro-energy separator, four deck with five 3" spacing frames. Southwestern Engineering Co., 4800 Santa Fe Ave., Los Angeles 58, California.
5. Part No. 31 is a figure 202 1" ball valve obtained from Rockwood Sprinkler Co., 38 Harlow St., Worcester 5, Mass.

REFERENCE DRAWINGS	DWG. NO.
DETAIL SHEET No. 5	D-53505
DETAIL SHEET No. 4	D-53504
DETAIL SHEET No. 3	D-53503
DETAIL SHEET No. 2	D-53502
DETAIL SHEET No. 1	D-53501

THORIUM U^{233} FUEL ROD FACILITY BLDG. NO. 3019

CLASSIFIER ASSEMBLY

GENERAL SPECIFICATIONS:

1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:

1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed √

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE: 1/4 = 1

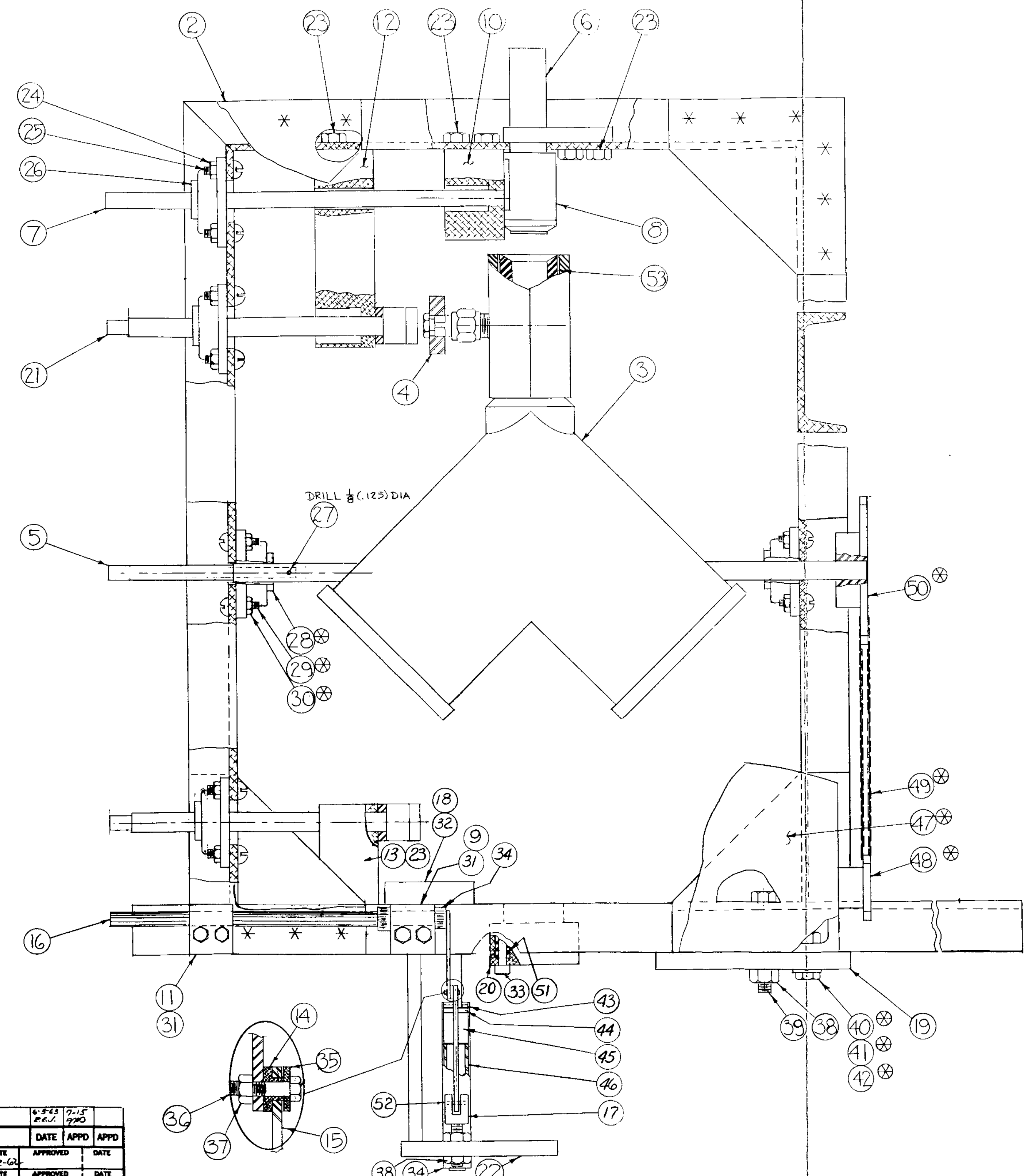
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED	ACCEPTED	APPROVED
G.A. Cristy	J. D. [illegible]	[illegible]
	E. E. [illegible]	D-53500 REV A

LTR	REVISIONS	DATE	APPD	APPD
A	REVISED AS BUILT	6-14-63 W.E.J.	7-23 [illegible]	

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
DAVIS	5-25-62	DAVIS	6-5-62		
DESIGNED	DATE	SUBMITTED	DATE	APPROVED	DATE
		FATE	6-6-62	H. Duggan	6-8-62

APPROVED FOR CONSTRUCTION



PARTS LIST

PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
1_1	D-51225	1	Blender	
2	D-51226	1	Frame	Al
3	D-51227	1	Shell	
4	D-51227	1	Valve handle	Steel
5	D-51227	1	Extension	Steel
6	D-51228	1	Inlet	SST
7	D-51228	1	Cam	Stl
8	D-51228	1	Sleeve	6061-T6 Al
9	D-51228	1	Bracket	6061-T6 Al
10	D-51228	1	Bearing	6061-T6 Al
11	D-51228	1	Bracket	6061-T6 Al
12	D-51228	1	Support	6061-T6 Al
13	D-51228	1	Bearing	6061-T6 Al
14	D-51228	1	Pivot	6061-T6 Al
15	D-51229	1	Link	Steel
16	D-51229	1	Crank	Steel
17	D-51229	1	Anchor	Steel
18	D-51229	1	Elevator Guide	SST
19	D-51229	1	Plate	6061-T6 Al
20	D-51229	1	Dump connector	SST
21	D-51230	2	Valve shaft	Steel
22	D-51230	1	Elevator	Steel
23	Stock	16	Hex hd cap screw, 3/8-16 x 3/4	Steel
24	Stock	12	Hex nut, 5/16 x 18	Steel
25	Stock	12	Rd hd cap screw, 5/16 x 18 x 1 1/4	Steel
26_2	Stock	3	Bearing	Steel
27	Stock	1	Roll pin, 1/8 dia. x 5/8	Steel
*28	Stock	2	Bearing	
*29	Stock	8	Bolt	
*30	Stock	8	Nut	
31	Stock	4	Hex hd cap screw 1/4-20 x 1 1/4	Steel
32	Stock	4	Hex hd cap screw 1/4-20 x 3/4	Steel
33	Stock	4	Socket hd shld screw, 1/4 dia. x 2 shld lg. x 10-24	Steel
34_3	Stock	3	Set screw collar	Steel
35	Stock	1	Washer, 1/4 ID x 3/4 OD x 1/8	Oilite
36	Stock	1	Hex hd bolt, 1/4-20 x 1	Steel
37	Stock	1	Hex nut, 1/4-20	Steel
38	Stock	4	Hex nut, 3/8-16	Steel
39	Stock	2	Hex hd bolt, 3/8-16 x 3	Steel
*40	Stock	2	Nut	Steel
*41	Stock	2	Bolt	Steel
*42	Stock	2	Washer	Steel
43_4	Stock	2	Retaining ring	Steel
44_5	Stock	2	Seal	
45_6	Stock	2	Ball bushing	Steel
46	Stock	1	Spacer, 55/64 OD x 3/4 ID x 2.240	Steel
*47	Stock	1	Motor	
*48	Stock	1	Sprocket	
*49	Stock	1	Chain	
*50	Stock	1	Sprocket	
51	D-51229	4	Compression springs	Music Wire
52	Stock	1	Roll pin, 1/4 dia. x ¾ LG.	Steel
53	D-51229	1	Insert	NOTED
54	STOCK	20	LOCK WASHER ¼	Steel
55	STOCK	24	LOCK WASHER 5/16	Steel
56	STOCK	4	LOCK WASHER 3/8	Steel

Remarks:

1. Twin Shell Lab Blender, 4 qt std. model, The Patterson Kelley Co., East Stroudsburg, Pennsylvania.
2. Ball bearing flanged block for 5/8 dia. shaft, open end, Part No. F-210, Link Belt Co.
3. Set screw collar, 1/2 ID x 1" OD x 7/16, part SC50. Boston Gear Works
4. Retaining ring, Truarc 5000-87, ORNL Part 07-087-0140.
5. Seal for nominal 1/2" shaft, Part S-500, Thompson Industries, Inc.
6. Precision series A ball bushing for 1/2 shaft, Part A-81420, Thompson Industries, Inc.

Notes:

1. Parts marked thus (*) are from blender part 1 and used without modification.
2. Order of Assembly. Assemble dump connector, adjust shell to engage connector, align inlet connection to shell. Install control shafts.
3. LOCK WASHERS TO BE USED UNDER ALL BOLT HEADS AND NUTS

REFERENCE DRAWINGS		DWG. NO.
BLENDER	DETAIL SHEET 5	D-51230
BLENDER	DETAIL SHEET 4	D-51229
BLENDER	DETAIL SHEET 3	D-51228
BLENDER	DETAIL SHEET 2	D-51227
BLENDER	DETAIL SHEET 1	D-51226

THORIUM-U233 FUEL ROD FACILITY BLDG. NO. 3019

BLENDER ASSEMBLY

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED [illegible] ACCEPTED [illegible] APPROVED [illegible]

D-51225 REV

GENERAL SPECIFICATIONS:

1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:

1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed √.

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ± —
DECIMALS: ± —
ANGLES: ± —
SCALE: ½" = 1

LTR	REVISIONS	DATE	APPD	APPD
A	REVISED AS BUILT	6-5-63	7-15	

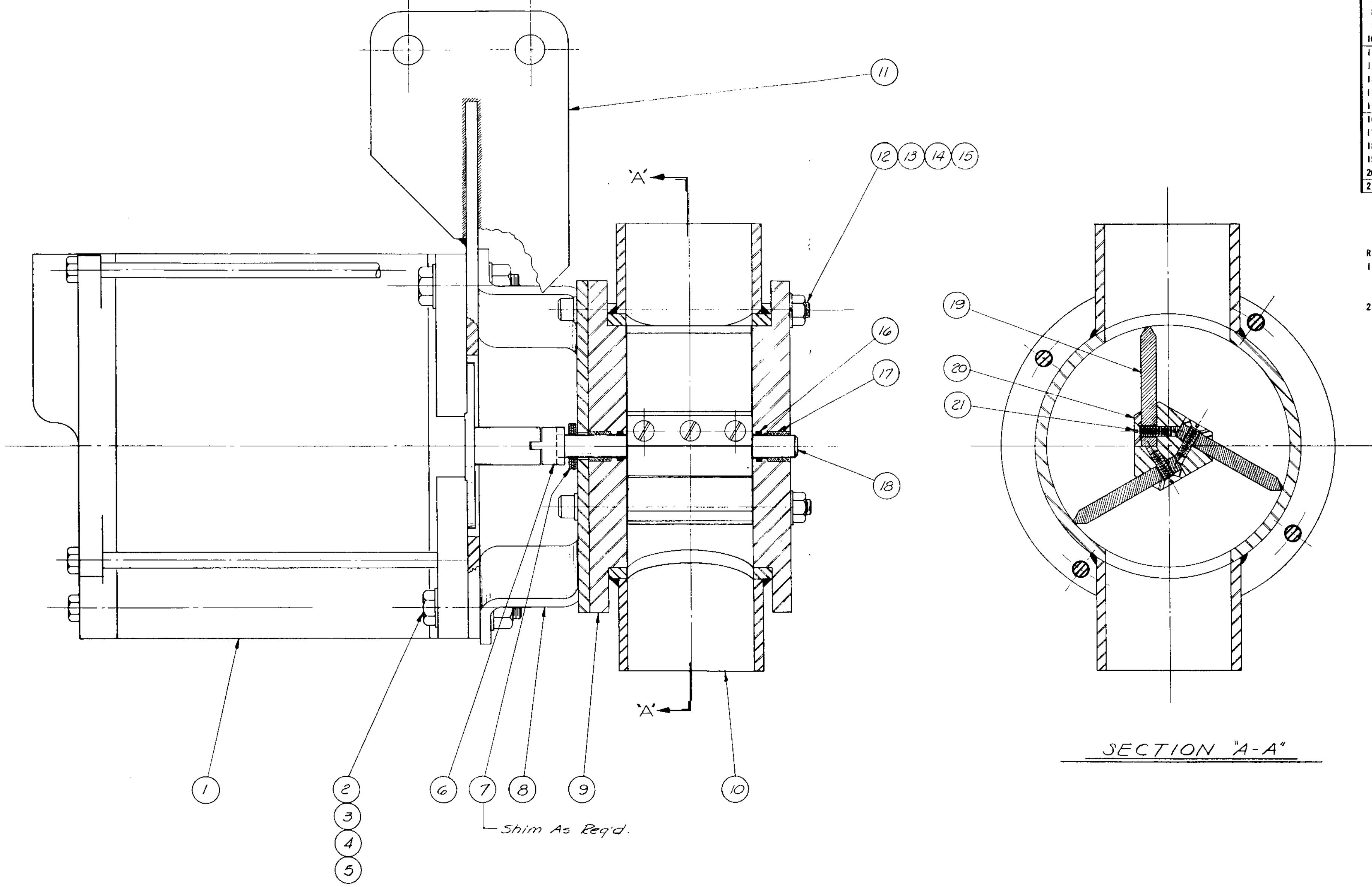
DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
[illegible]	2-2-62	DAVIS	3-2-62		
DESIGNED	DATE	SUBMITTED	DATE	APPROVED	DATE
		Pate	3-5-62	H. Duggan	3-5-62

APPROVED FOR CONSTRUCTION

PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
1	D-51223	1	Motor	Steel
2	Stock	4	Screw, hex hd mach - 3/8-16NC-2 x 1 3/8 lg.	Steel
3	Stock	4	Washer, flat - 3/8 nom. (med.)	Steel
4	Stock	4	Lockwasher - 3/8 nom. (med.)	Steel
5	Stock	4	Nut, hex - 3/8-16NC-2	Steel
6	D-51223	1	Oldham coupling	Drill Rod
7	Stock	5	Thrust bearing - Boston Gear TB-612	Bronze
8	D-51223	1	Motor support bracket	Steel
9	D-51222	2	Flange	316 SST
10	D-51222	1	Body	316 SST
11	D-51223	1	Hanger	Steel
12	Stock	4	Screw, soc hd cap, 1/4-20NC-2 x 4" lg.	Steel
13	Stock	4	Washer, flat - 1/4 nom. (med.)	Steel
14	Stock	4	Lockwasher - 1/4 nom. (med.)	Steel
15	Stock	4	Nut, hex - 1/4-20NC-2	Steel
16	Stock	2	O-ring, 3/8 ID x 1/2 OD x 1/16 W. AN-6227-7	Neoprene
17	Stock	2	Bearing, Boston Gear B-68-3	Bronze
18	D-51222	1	Shaft	See Detail
19	D-51222	3	Blade	Rubber
20	D-51222	3	Retainer	316 SST
21	Stock	9	Screw, F.H. mach - #8-32NC-2 x 5/8 lg.	SST

Remarks:

1. Slo-Syn Bifilar Motor, Type X-1000-1002, The Superior Electric Co., Bristol, Conn.
2. Bearings, oil impregnated bronze, Boston Gear Works, Quincy 71, Mass.



ASSEMBLY

SECTION "A-A"

A	Motor, Pt 1, from Type X-1000	5-8-62			
LTR	REVISIONS	DATE	APPD	APPD	
DRAWN McIntosh	DATE 3-6-62	CHECKED DAVIS	DATE 3-7-62	APPROVED	DATE
DESIGNED	DATE	SUBMITTED Pate	DATE 3-7-62	APPROVED	DATE 3-8-62

A-93809-10 D

GENERAL SPECIFICATIONS:
1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:
1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed √.

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE: 1" = 1"

REFERENCE DRAWINGS	DWG. NO.
2" Feeder Valve - Det. Sh. # 2	D-51223
2" Feeder Valve - Det. Sh. # 1	D-51222

THORIUM U^{235} FUEL ROD FACILITY — BLDG. NO. 3019

2" FEEDER VALVE
— ASSEMBLY —

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED — ACCEPTED 3/29/62 — APPROVED

D-51221 — REV A

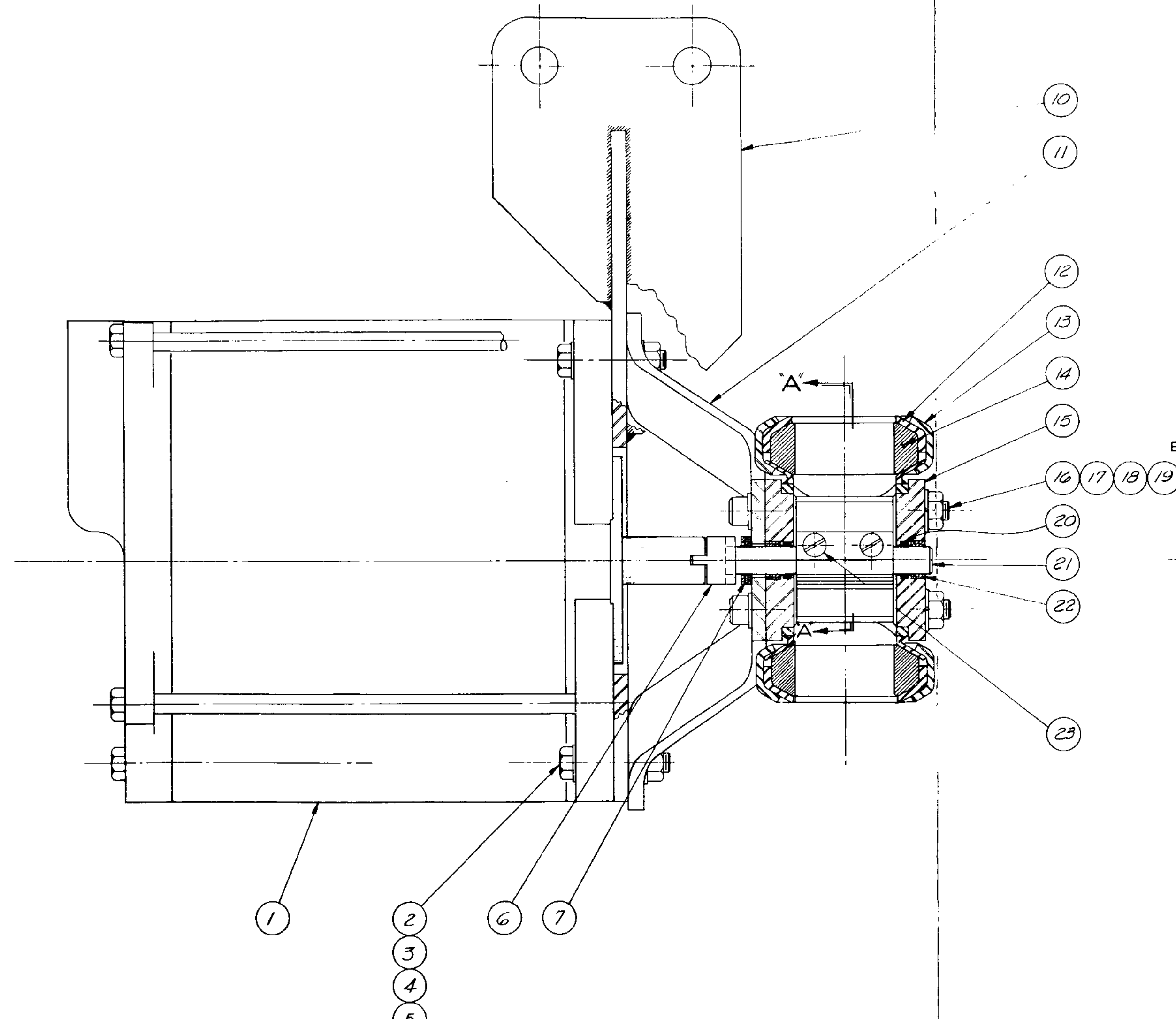
APPROVED FOR CONSTRUCTION

PARTS LIST

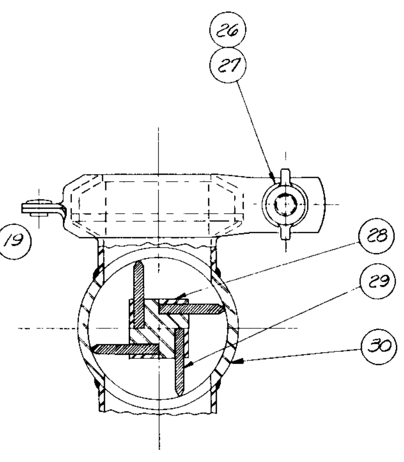
PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
1_1	D-51202	1	Motor	Steel
2	Stock	4	Screw, hex hd. mach. 3/8-16NC-2 x 1 1/4 lg.	Steel
3	Stock	4	Washer, flat, 3/8 nom. (med.)	Steel
4	Stock	4	Nut, hex, 3/8-16NC-2	Steel
5	Stock	4	Lock washer - 3/8 nom. (med.)	Steel
6	D-51201	1	Oldham coupling	Drill Rod
7_2	Stock	5	Thrust bearing, 3/4 OD x .390 ID x 1/32 thk	Bronze
10	D-51202	1	Hanger	Steel
11	D-51202	1	Motor support bracket	Steel
12_4	Stock	2	Gasket retainer - #301883-1S	SST
13_4	Stock	2	Coupling - #55381-1S	SST
14_4	Stock	2	Gasket - #301885-1	Rubber
15	D-51201	2	Flange	316 SST
16	Stock	4	Screw, soc hd cap, 1/4-20NC-2 x 2 3/4 lg.	Steel
17	Stock	4	Washer, flat - 1/4 nom. (med.)	Steel
18	Stock	4	Lockwasher - 1/4 nom. (med.)	Steel
19	Stock	4	Nut, hex, 1/4-20NC-2	Steel
20	Stock	2	O-ring, 3/8 ID x 1/2 OD x 1/16 W. AN-6227-7	Neoprene
21	D-51201	1	Shaft	316 SST
22	D-51201	2	Bearing	Bronze
23	Stock	8	Screw, F.H. mach - #8-32NC-2 x 5/16 lg.	SST
26_4	Stock	2	Bolt, carriage - 5/16-18NC-2 x 1 1/2 lg.	Steel
27	Stock	2	Nut, wing - 5/16-18NC-2	Steel
28	D-51201	4	Retainer	316 SST
29	D-51201	4	Blade	Rubber
30	D-51201	1	Body	316 SST

Remarks:

1. Slo-Syn BIFILAR MOTOR, TYPE X-1040-100Z, THE SUPERIOR ELECTRIC CO, BRISTOL, CONN.
2. Thrust bearing, oil impregnated bronze, #TB-612, Boston Gear Works, Quincy 71, Mass.
4. Parts 12, 13, 14, and 26 are obtained from Flexmaster pipe joint #6500-1-[illegible], Industrial Catalog No. 803, Aeroquip Marman Division, Los Angeles, Calif.



ASSEMBLY
Scale: 1" = 1"



SECTION "A-A"
Scale: 1" = 1"

REFERENCE DRAWINGS	DWG. NO.
1" Feeder Valve - Detail Sh. #2	D-51202
1" Feeder Valve - Detail Sh. #1	D-51201

THORIUM U^{233} FUEL ROD FACILITY — 3019

1" FEEDER VALVE — ASSEMBLY —

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

GENERAL SPECIFICATIONS:
1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:
1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed √

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE: As Noted

SUBMITTED: K. E. [illegible] — ACCEPTED: J. T. [illegible] — APPROVED: [illegible]

D-51200 — REV. A

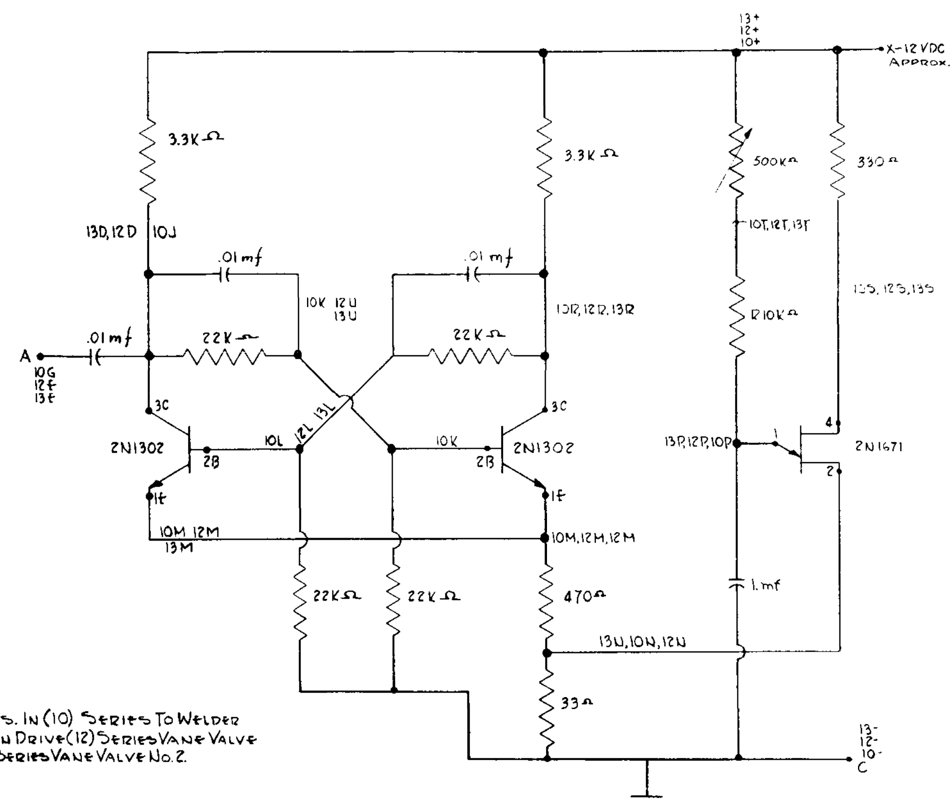
LTR	REVISIONS	DATE	APPD	APPD
A	△ MOTOR Pt. 1 FROM TYPE X-1000	5-8-62	[illegible]	[illegible]

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
McIntosh	3-1-62	DAVIS	3-7-62		

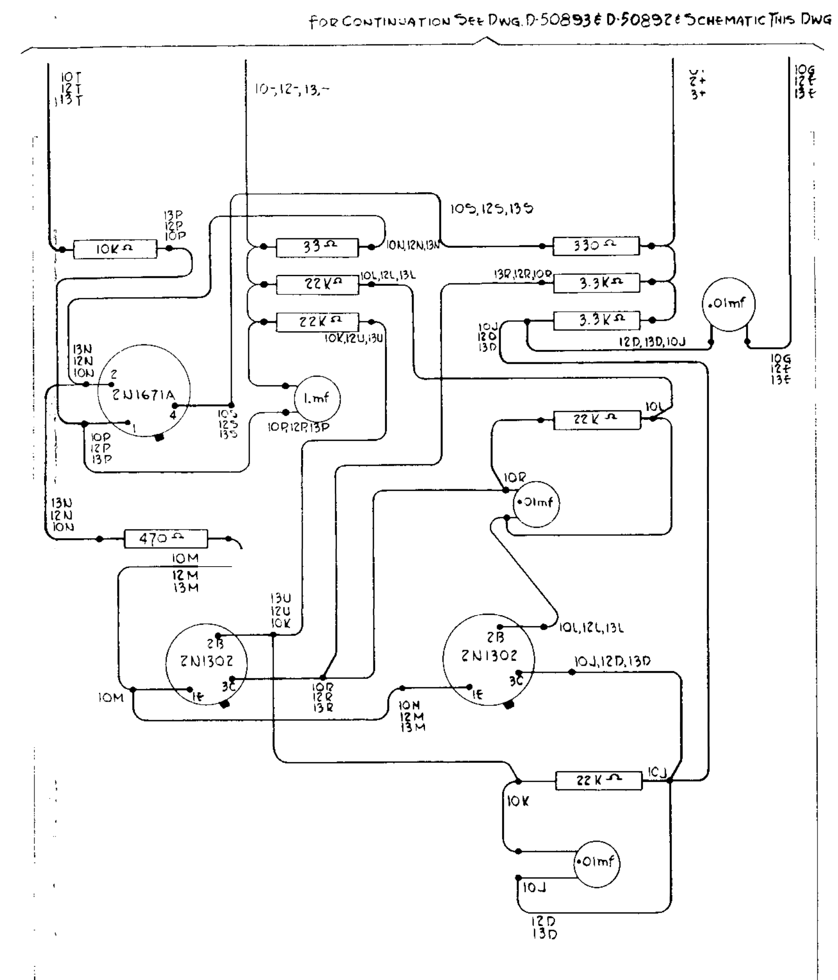
DESIGNED	DATE	SUBMITTED	DATE	APPROVED	DATE
		Pate	3-7-62	[illegible]	3-8-62

A-93809-10 D

APPROVED FOR CONSTRUCTION



NOTE:
1- WIRE NOS. IN (10) SERIES TO WELDER ROTATION DRIVE (12) SERIES VANE VALVE No. 1, (13) SERIES VANE VALVE No. 2.



NOTE:
1- RESISTORS TO BE 2 WATT TYPE

OSCILLATOR CIRCUIT SCHEMATIC

(3-REQUIRED)

1 EA. FOR: WELDER ROTATION DRIVE SEE DWG. D-50894
VANE VALVE #1 & VANE VALVE #2 SEE DWG. D-50892

OSCILLATOR CIRCUIT WIRING DIAGRAM

(3-REQUIRED)

VANE VALVE #1, #2, & WELDER ROTATION DRIVE

REFERENCE DRAWINGS	DWG. NO.
REMOTE WELDER CONNECTION DIAGRAM	D-50893
REMOTE WELDER CONTROL SCHEMATIC	D-50894
CONNECTION DIAGRAM & PANEL DETAILS (SHEET #1)	D-50892

THORIUM-U233 FUEL ROD FACILITY — BLDG. NO. 3019

OSCILLATOR CONTROL CIRCUIT
VANE VALVE #1, #2, & WELDER ROTATION DRIVE

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE:

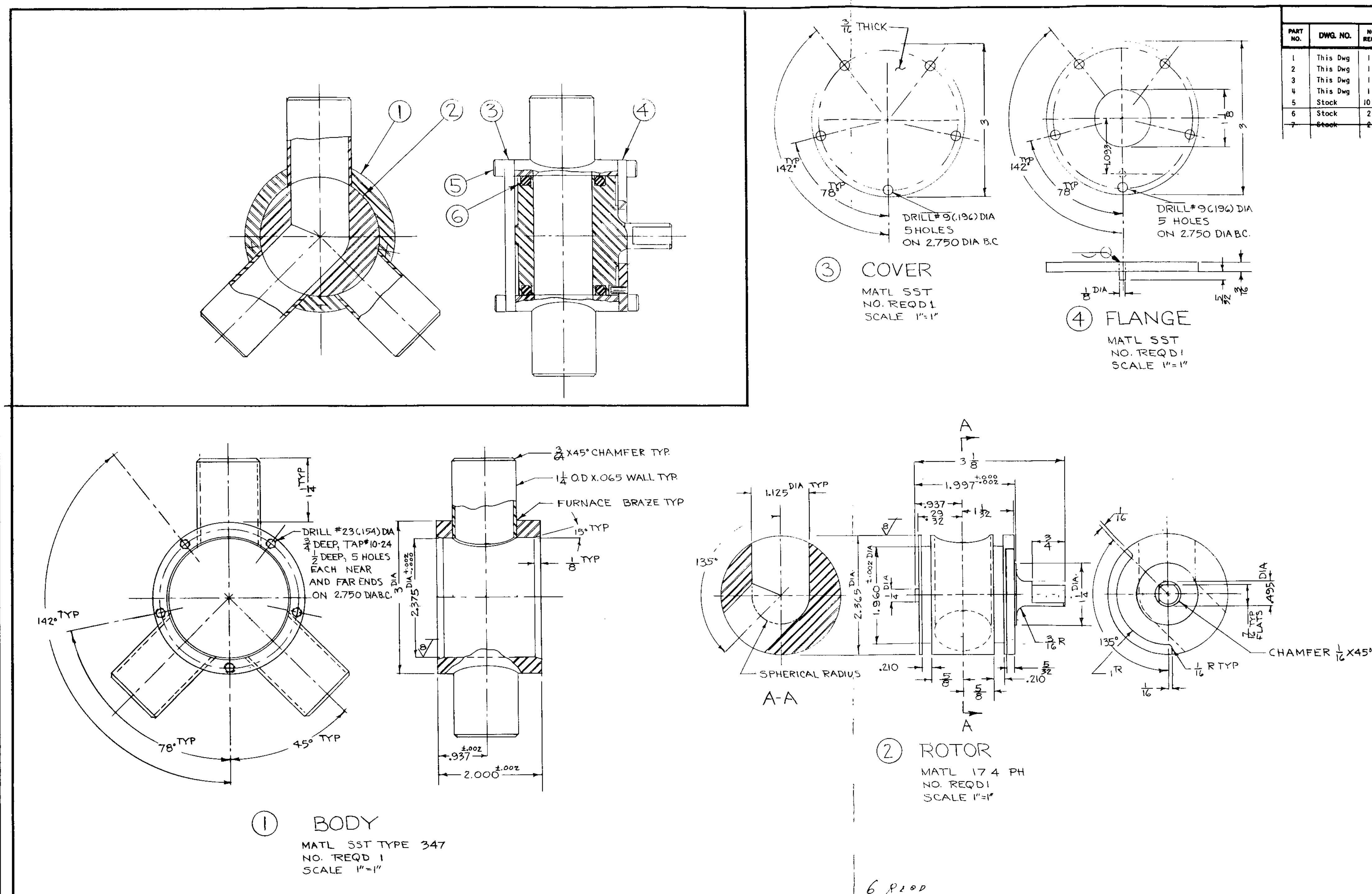
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED / ACCEPTED / APPROVED

D-54471

APPROVED FOR CONSTRUCTION

NO.	REVISIONS	DATE	APPD	APPD
DRAWN	9-11-62	SUBMITTED	9-10-62	APPROVED
DESIGNED		APPROVED	9-11-62	APPROVED
CHECKED	9-11-62	APPROVED	9-11-62	APPROVED 9-13-62



6 R.P.D

PARTS LIST

PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
1	This Dwg	1	Body	SST
2	This Dwg	1	Rotor	17-4 PH
3	This Dwg	1	Cover	SST
4	This Dwg	1	Flange	SST
5	Stock	10	Soc hd cap screw #10-24 x 5/8	SST
6	Stock	2	"O" ring - 1 7/8 x 2 1/4 x 3/16	Neoprene
~~7~~	~~Stock~~	~~2~~	~~Cup point set screw #6-32 x 1/4~~	~~Stl~~

REFERENCE DRAWINGS	DWG. NO.
THORIUM-U233 FUEL ROD FACILITY	BLDG. NO. 3019

GENERAL SPECIFICATIONS:
1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:
1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed 32√.

CLASSIFICATION ✓

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ± 1/64
DECIMALS: ± .005
ANGLES: ± 0°-10'
SCALE: 1"=1"

BYPASS VALVE DETAIL & ASSEMBLY

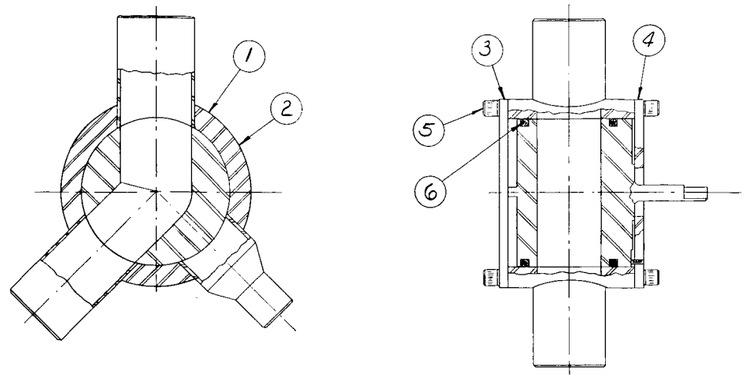
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED | ACCEPTED | APPROVED

D-50421

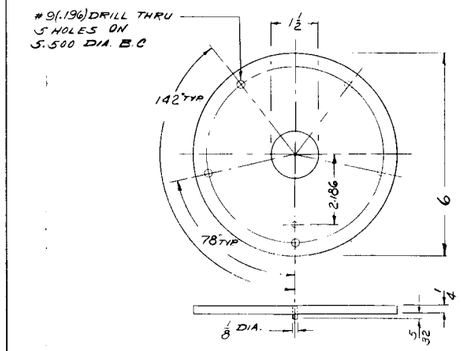
LTR	REVISIONS	DATE	APPD	APPD

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
McWilly	3-21-62	DAVIS	3-29-62		
DESIGNED	DATE	SUBMITTED	DATE	APPROVED	DATE
			3-30-62		3-30-62

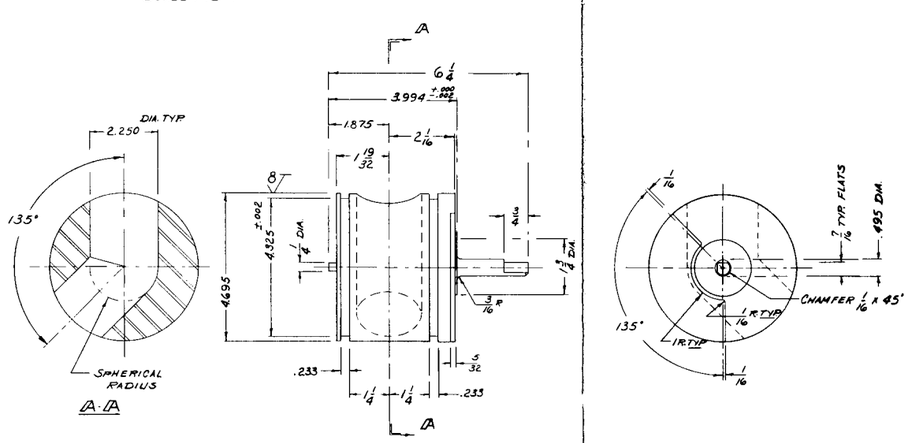


SCALE: 1/2 = 1

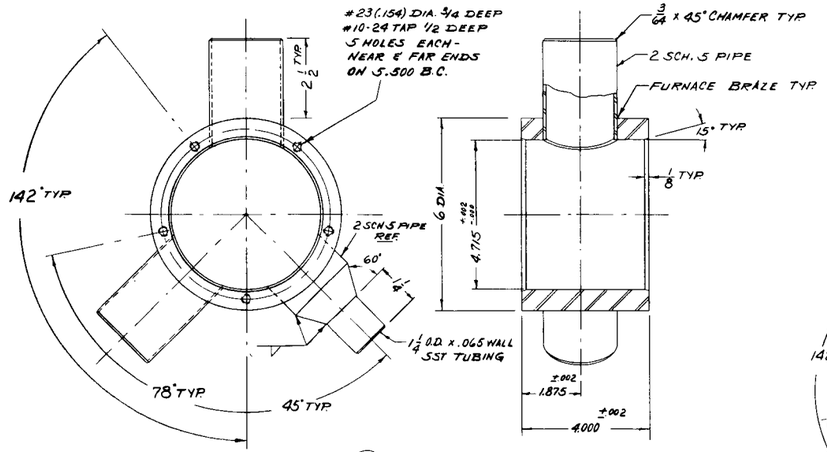
PARTS LIST				
PART NO.	DWG. NO.	NO. REQD.	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
1	THIS DWG.	1	BODY	SST
2	THIS DWG	1	ROTOR	17-4 PH
3	THIS DWG	1	COVER	SST
4	THIS DWG	1	FLANGE	SST
5	STOCK	10	SOC HD CAP SCREW #10-24 X 5/8	SST
6	STOCK	2	"O" RING - 1 7/8 x 2 1/4 x 3/16	TEFLON



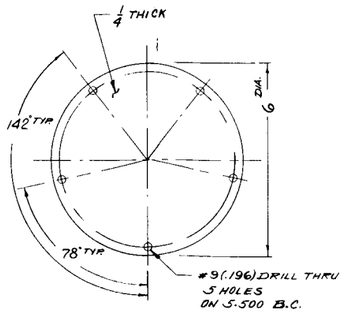
(4) FLANGE
MAT'L: SST
REQ'D: 1
SCALE: 1/2 = 1



(2) ROTOR
MAT'L: 17-4 PH SST
REQ'D: 1
SCALE: 1/2 = 1



(1) BODY
MAT'L: SST TYPE 347
REQ'D: 1
SCALE: 1/2 = 1



(3) COVER
MAT'L: SST
REQ'D: 1
SCALE: 1/2 = 1

NO.	REVISIONS			DATE	APPD	APPD
DRAWN R.E. LUKER	DATE 5-17-63	SUBMITTED DATE	DATE 7-25-68	APPROVED		DATE
DESIGNED	DATE	APPROVED	DATE	APPROVED		DATE
CHECKED Davis	DATE 6-20-69	APPROVED	DATE	APPROVED		DATE

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED:	
FRACTIONS ±	1/64
DECIMALS ±	.005
ANGLES ±	0°-10'
SCALE:	1/2 = 1"

GENERAL SPECIFICATIONS

UNLESS OTHERWISE SPECIFIED:
1. BREAK ALL SHARP EDGES 1/64 MAX.
2. TYPE, GRADE, OR FINISH OF MATERIAL MAY BE CHOSEN BY FABRICATOR.
3. ROUGHNESS HEIGHT OF MACHINED SURFACES SHALL NOT EXCEED ✓ (FINISH SYMBOLS AND HEIGHT VALUES ARE IN ACCORDANCE WITH ASA B46.1-1955.)

REFERENCE DRAWINGS | NO.

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
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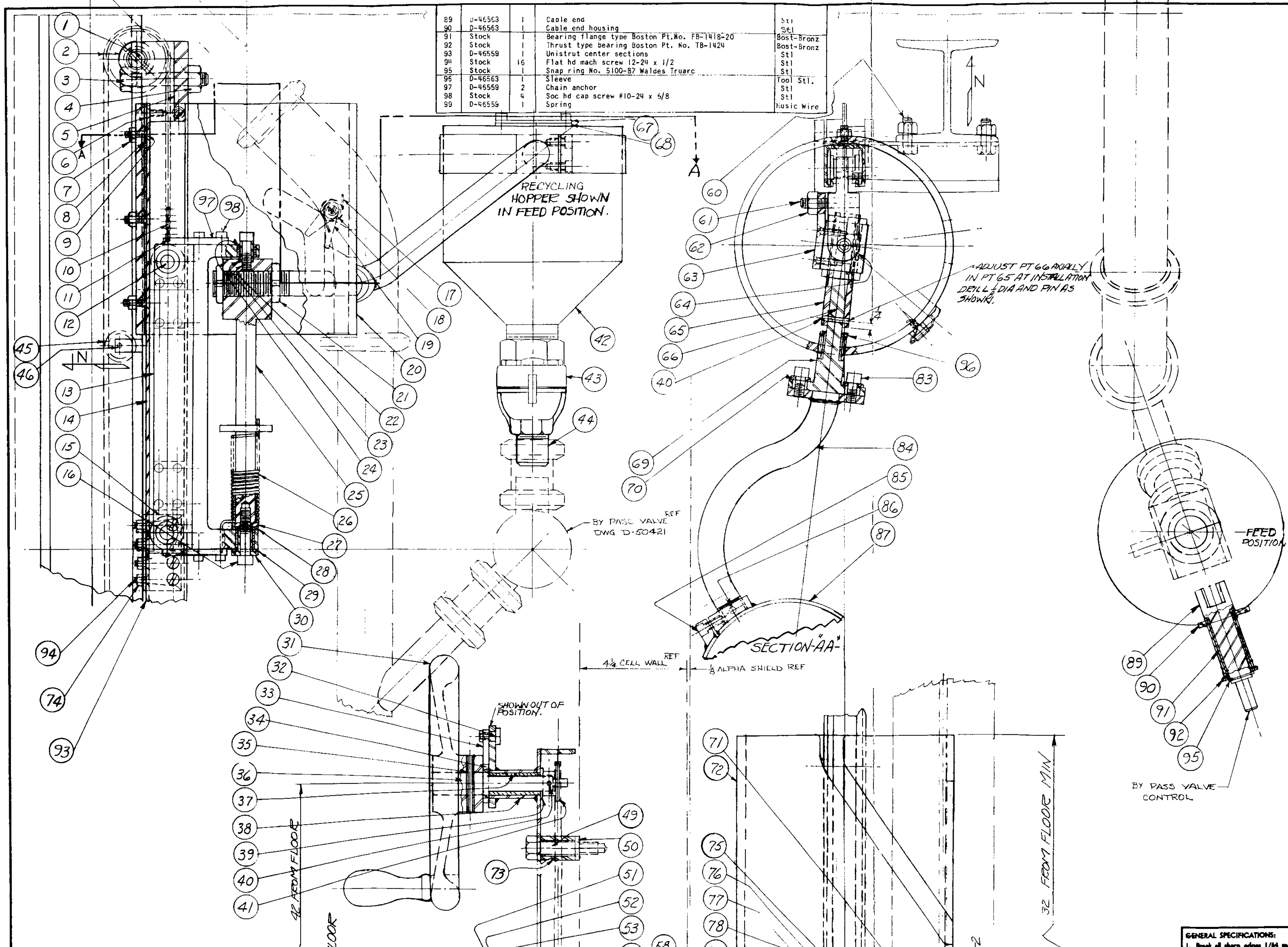
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

THORIUM-U233 FUEL ROD FACILITY BLDG. NO. 3019

2" BY PASS VALVE
DETAILS & ASSEMBLY

SUBMITTED	APPROVED	APPROVED
W.A. PATE APPROVED	56677	D REV.



89	D-46563	1	Cable end	Stl
90	D-46563	1	Cable end housing	Stl
91	Stock	1	Bearing flange type Boston Pt.No. FB-1418-20	Bost-Bronz
92	Stock	1	Thrust type bearing Boston Pt. No. TB-1424	Bost-Bronz
93	D-46559	1	Unistrut center sections	Stl
94	Stock	16	Flat hd mach screw 12-24 x 1/2	Stl
95	Stock	1	Snap ring No. 5100-87 Waldes Truarc	Stl
96	D-46563	1	Sleeve	Tool Stl.
97	D-46559	2	Chain anchor	Stl
98	Stock	4	Soc hd cap screw #10-24 x 5/8	Stl
99	D-46559	1	Spring	Music Wire

PARTS LIST

PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
1	D-46559	1	Top shaft	Drill Rod
2	Stock	1	Sprocket, Boston Cat. No. K2530, page 158	Stl
3	Stock	4	Hex hd mach screw, 1/2-13 x 3	Stl
4	Stock	4	Hex nut, 1/2-13	Stl
5	D-46559	1	Sprocket support	Stl
6	Stock	26	Flat hd mach screw, 1/4-20 x 5/8	Stl
7	Stock	28	Hex nut, 1/4-20	Stl
8	Stock	7	Washer, 1/4	Stl
9	Stock	11	Flat hd mach screw, 1/4-20 x 1	Stl
10	Stock	1	Chain, Boston 1/4 pitch Chain No. 25 43 ft.	Stl
11	Stock	2	3/32 rollpin, 1/2 long	Stl
12	D-46559	2	Trolley Assy	
13	D-46559	1	Carriage	Stl
14	D-46559	2	Unistrut top and bottom	Stl
15	D-46559	2	Unistrut support	Stl
16	Stock	1	Socket hd cap screw 3/8-16 x 1 3/4	Stl
17	D-46559	1	Spring	Music Wire
18	D-46560	2	Shoulder screw	Stl
19	D-46560	2	Spring dog	Stl
20	D-46560	1	Cam, 8" Sch 40 pipe	Stl
21	D-46560	2	Nut special	Stl
22	Stock	1	Soc hd mach screw 5/16-18 x 1	Stl
23	Stock	1	Soft stl bushing 5/16 ID x 1/2 OD x 3/4 Boston Cat. Page 628	
24	Stock	1	Plain cylindrical type .502 ID .753 OD x 1/2 (B812-4) Boston	Bronze
25	D-46560	1	Shaft	Stl
26	D-46560	1	Spring	Music Wire
27	Stock	1	Hardened stl thrust washer 5/8 ID x 1 1/4 OD x 3/16 Boston page 629	
28	Stock	1	Washer thrust type .628 ID 1" OD x 1/8 Boston page 582 Cat. No. TB1019	
29	Stock	1	Bushing flange type, Boston Cat. No. FB-1012-8 cut to 7/8 LG.	
30	D-46563	1	Soft stl bushing	Stl
31	Stock	1	Counter balanced wheel, Cat. No. WRS10, Reid Tool Sup. Co.	
32	D-46561	1	Pin	Stl
33	D-46563	1	Pawl 1/4 thick, Grant Gear Works Boston 27	brass
34	D-46560	1	Ratchet, Part No. 693, Grant Gear Works, Boston 27, Mass.	Brass
35	Stock	1	Rollpin, 3/16 dia x 2	Stl
36	D-46560	1	Shaft	Stl
37	Stock	1	Plain cyl type bearing, Cat. No. B1014-16 Boston	Bost Bronze
38	D-46561	1	Safety shield	Stl
39	Stock	2	Washer thrust type Pt. No. TB-1019 Boston	Bronze
40	Stock	2	Rollpin, 1/8 dia x 1	Stl
41	D-46561	1	Sprocket Cat. No. K2515 Boston	Stl
42	D-46561	1	Hopper	347 SST
43	Stock	1	Valve 2" Rockwood Figure [redacted] Teflon Seals	316 SST
44	D-46561	1	Nipple special	316 SST
45		2	IDLER SPROCKET BOSTON GEAR	STL
46		2	BRACKET (CHANNEL AS REQ'D)	STL
49	Stock	2	Hex hd mach screw 1/2-13 x 2 1/4	Stl
50	Stock	2	Washer, 1/2 Std. extra heavy, .162 thick	Stl
51	D-46561	1	Shaft	Stl
52	Stock	1	Snap ring No. 5100-62 Waldes Truarc	Stl
53	Stock	1	Thrust washer 5/8 ID x 1 OD x 3/16	Stl
54	Stock	1	Bearing flange type Cat. No. FB-1012-4 Boston	Bost-Bronz
55	Stock	1	Sprocket Boston Cat. No. K2530 bore 5/8 hole	Stl
56	Stock	3	Rollpin 3/16 dia x 1 3/8	Stl
57	Stock	2	"O" ring 5/8 ID x 13/16 OD x 3/32 AN-6227-12	Neoprene
58	D-46562	1	Housing	Stl
59	D-46562	2	Bushing	Stl
60	Stock	6	Hex hd mach screw 3/8-16 x 1	Stl
61	Stock	1	Soc set screw 3/8-16 x 1	Stl
62	Stock	7	Hex nut 3/8-16	Stl
63	D-46562	1	Stop strap	Stl
64	Stock	3	Key, 1/8 x 1/8 x 1 Keystock	Stl
65	D-46562	1	Adjustable guide	Stl
66	D-46562	1	Bearing shaft	1045 Stl
67	D-46561	1	Gasket retainer	Stl
68	Stock	1	Gasket, 3" OD x 1" ID x 1/16 thick	Neoprene
69	Stock	1	Type DC needle bearing No. B-1212 Torrington, South Bend 21, Ind.	
70	Stock	2	Thrust washer Boston 3/8 ID, 5/8 OD x 1/8	Hardened stl
71	Stock	1	Flange type bushing Boston Cat. No. FB-1012-4	Bost-Bronz
72	D-46562	1	Bottom cam 8" Sch 40 pipe	Stl
73	Stock	2	Spacers 1/2 Sch 40pipe x 1 5/16 lg.	Stl
74	Stock	16	Hex nut 12-24	Stl
75	D-46559	1	Bottom sprocket support	Stl
76	Stock	3	Flange type bushing Boston Cat. No. FB-68-4	Bost-Bronz
77	Stock	2	Spacer bushing Boston 3/4 OD 5/8 ID x 1/2	Stl
78	D-46562	1	Sprocket, Boston Cat. No. K2530 page 158	Altered Stl
79	D-46563	1	Shaft	Stl
80	D-46563	2	Oldham coupling ends	Stl
81	Stock	2	Soc set screw 3/8-16 x 1 1/2	Stl
82	D-46563	1	Oldham coupling center	OILITE
83	Stock	2	Soc hd cap screw 3/8-16 x 7/8	Stl
84	D-46563	1	Guide arm	Stl
85	Stock	6	Soc hd cap screw 1/4-20 x 5/8	Stl
86	Stock	1	Rollpin, 3/16 dia x 1 1/2	Stl
87	D-46563	1	Strap	Stl

REFERENCE DRAWINGS	DWG. NO.
RECYCLING HOPPER DETS SHEET 1	D-46559
" " " " 2	D-46560
" " " " 3	D-46561
" " " " 4	D-46562
" " " " 5	D-46563

Remarks:
1. Rockwood Sprinkler Co., 38 Harlow St., Worcester 5, Mass.

LTR	REVISIONS	DATE	APPD	APPD
A	REVISED PER AS BUILT	6-5-63 REJ.	7-15 TMD	

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
AMTRIPP	4-12-62	DAVIS	5-16-62		
DESIGNED	DATE	SUBMITTED	DATE	APPROVED	DATE
		Pate	5-17-62	H. Duggan	5-18-62

GENERAL SPECIFICATIONS:
1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:
1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed √

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE: 1/2 = 1

THORIUM-U233 FUEL ROD FACILITY BLDG. NO. 3019

RECYCLING HOPPER ASSEMBLY

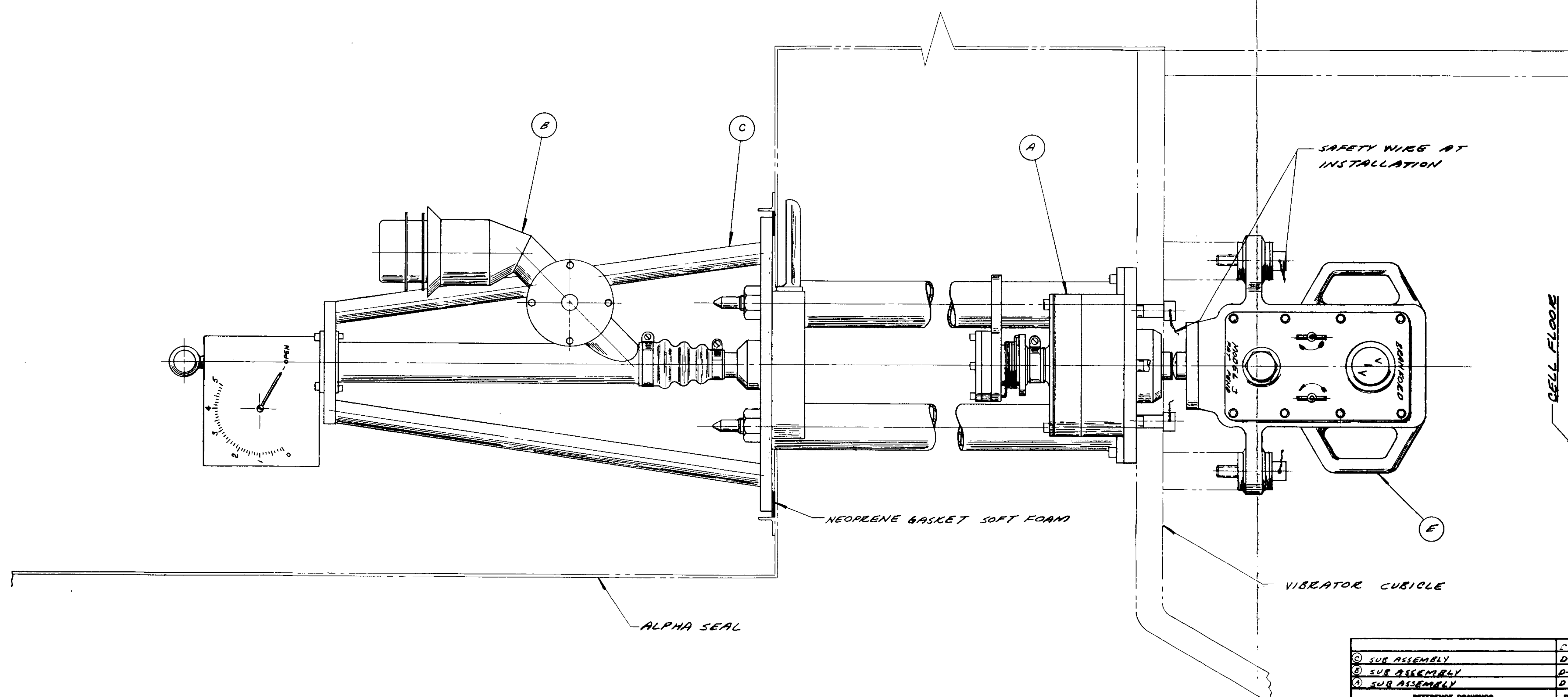
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED: K.E. Jamison | ACCEPTED: J.D. Dean, E.E. Pierce | APPROVED: [signature]

D-46558 REV. A

APPROVED FOR CONSTRUCTION

PARTS LIST				
PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
A	D-51176	1	CHUCK SUB ASSEMBLY	
B	D-51180	1	FILLER TUBE SUB ASSEMBLY	
C	D-51186	1	FRAME SUB ASSEMBLY	
E	STOCK	1	BRANFORD VIBRATOR MOD 3	



Ⓒ SUB ASSEMBLY	D-51186
Ⓑ SUB ASSEMBLY	D-51180
Ⓐ SUB ASSEMBLY	D-51176
REFERENCE DRAWINGS	DWG. NO.

THORIUM-U233 FUEL ROD FACILITY BLDG. NO. 3019

GENERAL SPECIFICATIONS:
1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:
1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed √

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE: 1/2 - 1

VIBRATOR ASSEMBLY

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED K.C. Jamison | ACCEPTED JTL 1-30-62 | APPROVED

D-51189

LTR	REVISIONS	DATE	APPD	APPD

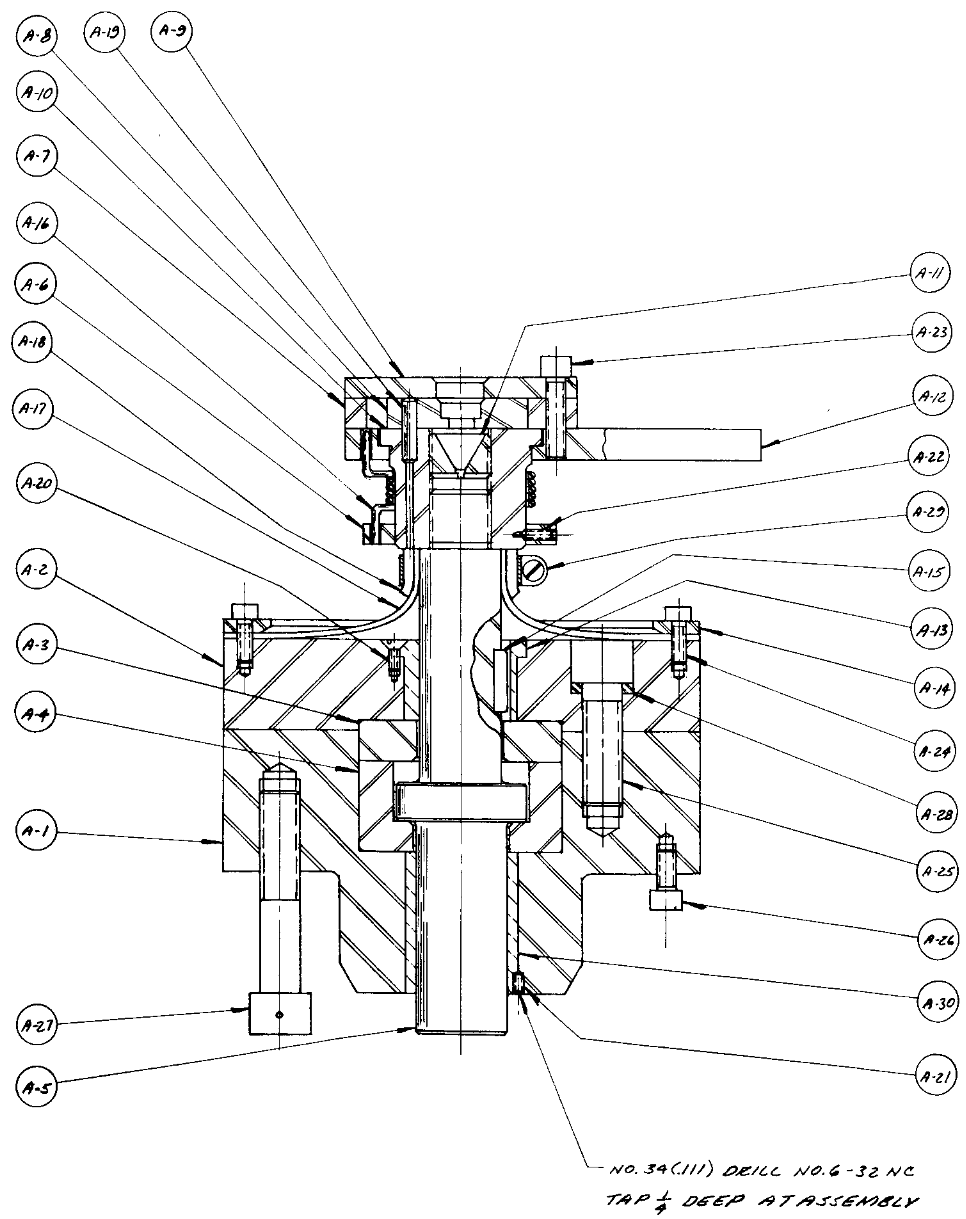
DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
[illegible]	1-11-62	Davis	1-15-62		
DESIGNED	DATE	SUBMITTED	DATE	APPROVED	DATE
Kaiserman	12-6-61	Pate	1-15-62	H. Duggan	1-16-62

A-23809-10

APPROVED FOR CONSTRUCTION

PARTS LIST

PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
A-1	D-51177	1	Housing	Stl
A-2	D-51177	1	Cover	Stl
A-3	D-51177	1	Striker plate	RDS Tool Stl.
A-4	D-51177	1	Retainer bushing	RDS Tool Stl.
A-5	D-51178	1	Anvil	RDS Tool Stl.
A-6	D-51178	1	Tension ring	Stl
A-7	D-51179	1	Cam	OH Tool Stl.
A-8	D-51179	1	Chuck jaws (set of 3)	OH Tool Stl.
A-9	D-51179	1	Retainer plate	OH Tool Stl.
A-10	D-51179	1	Bushing	RDS Tool Stl.
A-11	D-51179	1	Bushing	RDS Tool Stl.
A-12	D-51179	1	Chuck lever	OH Tool Stl.
A-13	D-51178	1	Bushing Boston gear No. FB-1622-8	Bronze
A-14	D-51178	1	Retaining ring	Stl
A-15	D-51178	1	Key	Stl
A-16	D-51178	1	Torsion spring	SST Spring Wire
A-17	Stock	1	Diaphragm 1/4 ID x 5 7/8 OD x 1/16	Neoprene
A-18	Stock	1	Tubing 1 1/8 ID x 1 3/8 OD x 1/2	Tygon
A-19	Stock	3	Dowel 3/16 dia. x 3/4	Stl
A-20	Stock	2	Flat head machine screw No. 6-32NC x 3/8	Stl
A-21	Stock	1	Soc set screw No. 6-32NC x 1/4	Stl
A-22	Stock	3	Soc set screw cone point No. 8-36NF x 3/8	Stl
A-23	Stock	3	Soc head cap screw 1/4-28NF x 1	Stl
A-24	Stock	12	Soc head cap screw No. 10-32NF x 1/2	Stl
A-25	Stock	6	Soc head cap screw 1/2-20NF x 1 1/2	Stl
A-26	Stock	6	Soc head cap screw 1/4-20NF x 1/2	Stl
A-27	Stock	6	Soc head cap screw cross drilled 1/2-13NC x 2 1/2	Stl
A-28	Stock	6	Lockwasher for soc. head cap screw 1/2 dia. screw	Stl
A-29	Stock	1	Pipe clamp 1 1/4 to 1 1/2 dia. Cat. No. 0.S-25-SS American Industrial and Scientific Company	SST
A-30	Stock	1	Bushing, Boston Gear Co. No. 8-1822-14	Bronze



⚠ NOTE: SEE DWG-D54270 FOR MODIFICATIONS

A	⚠ NOTE ADDED	5-14-63 RE.JUDD	SCLS 9190	
LTR	REVISIONS	DATE	APPD	APPD

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
SZYMANSKI	12-1-61	DAVIS	1-15-62		
DESIGNED	DATE	SUBMITTED	DATE	APPROVED	DATE
		PATE	1-15-62	W. Duggan	1-16-62

REFERENCE DRAWINGS	DWG. NO.
DETAIL SHEET 3	D-51179
DETAIL SHEET 2	D-51178
DETAIL SHEET 1	D-51177
MAIN ASSEMBLY	D-51189

THORIUM-U233 FUEL ROD FACILITY. BLDG. NO. 3019

GENERAL SPECIFICATIONS:
1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:
1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed √

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE: 1 = 1

VIBRATOR - CHUCK
(A) SUB-ASSEMBLY

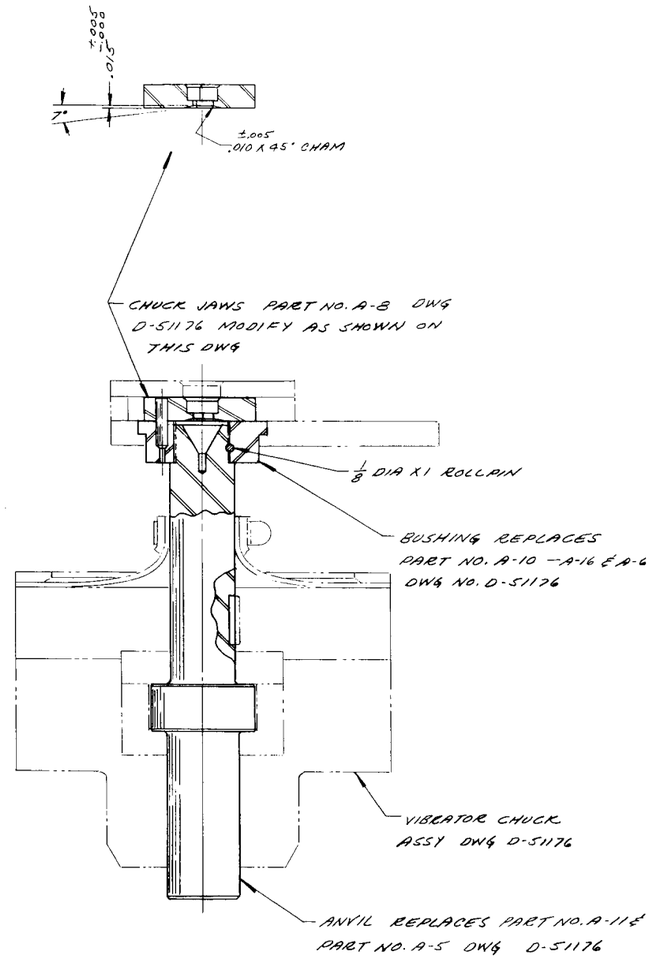
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

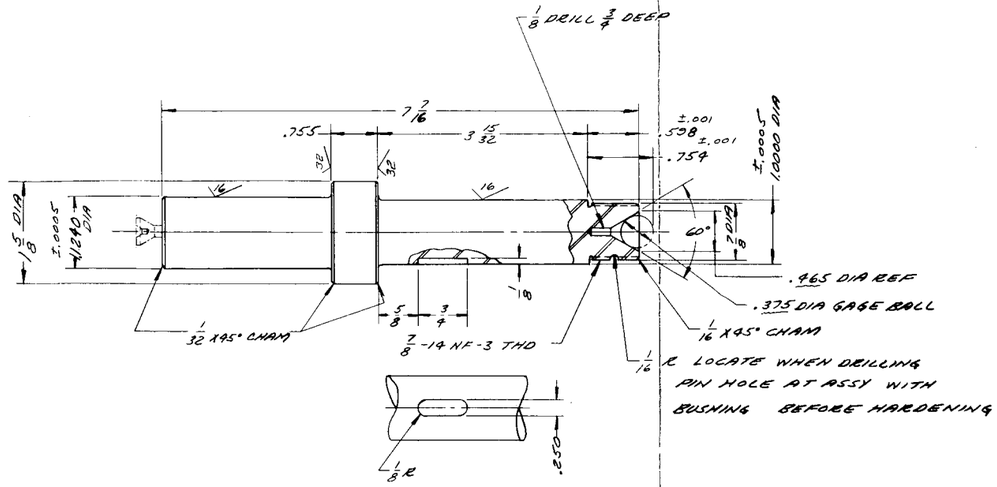
SUBMITTED K. E. Jamison | ACCEPTED | APPROVED

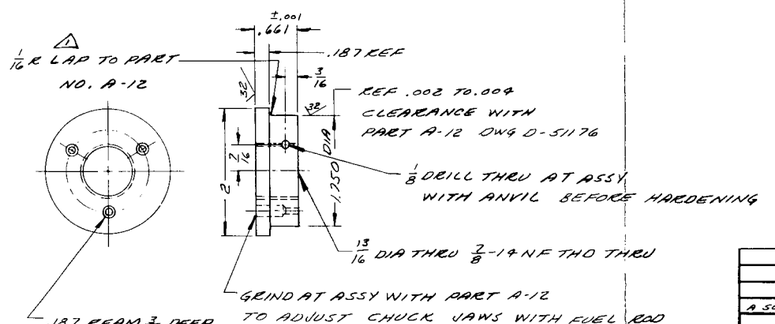
D-51176 A

APPROVED FOR CONSTRUCTION

PARTS LIST				
PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL







LTR	REVISIONS	DATE	APPD	APPD
A	1/16 R ADDED	10-23-62	THD	

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
SEXMANER	8-27-62	DAVIS	8-27-62		
DESIGNED	DATE	SUBMITTED	DATE	APPROVED	DATE
		DATE	8-27-62		

GENERAL SPECIFICATIONS:
1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:
1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed 63.

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS ± 1/32
DECIMALS ± AS NOTED
ANGLES ± ½°
SCALE: 1 = 1

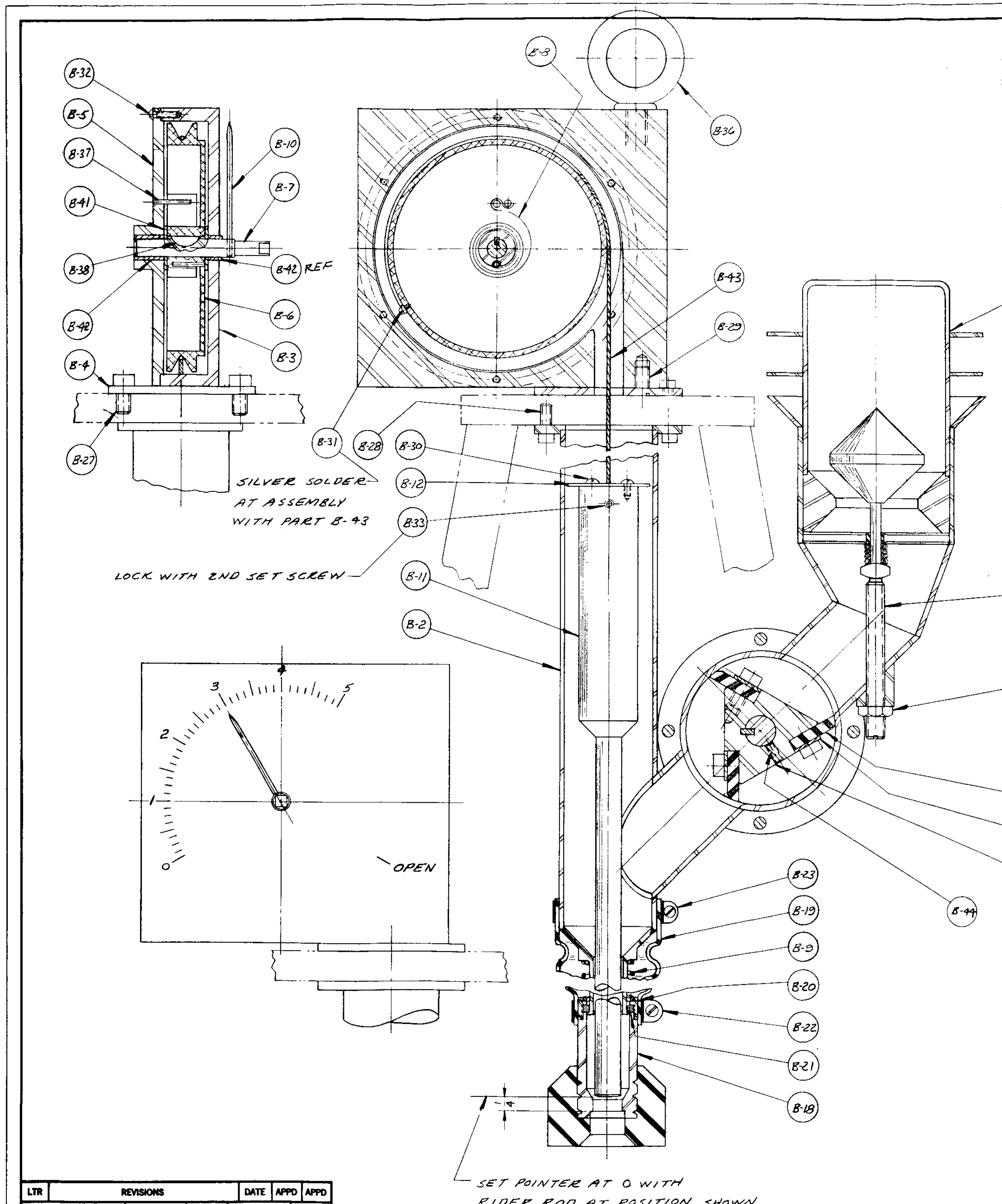
A SUB ASSEMBLY — D-51176
REFERENCE DRAWINGS — DWG. NO.
THORIUM - U 233 FUEL ROD FACILITY — BLDG. NO. 3019

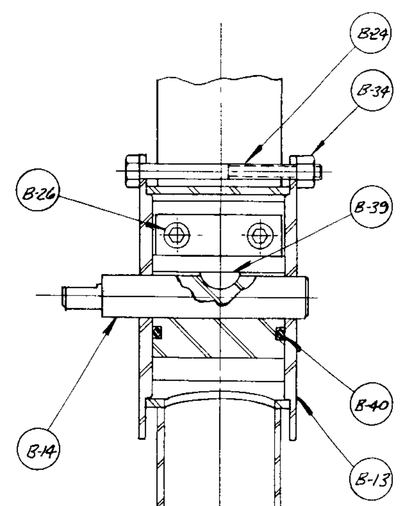
VIBRATOR - CHUCK MODIFICATIONS

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED	ACCEPTED	APPROVED	DWG. NO.	REV.
K.E. Harrison	J.D. Bacon	G. Harris	D-59270	A
	E.E. Lewis			

APPROVED FOR CONSTRUCTION





LTR	REVISIONS	DATE	APPD	APPD

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
Szymanski	1-4-62	Davis	1-15-62		
DESIGNED	DATE	SUBMITTED	DATE	APPROVED	DATE
		Pate	1-15-62	H. Duggan	1-16-62

PARTS LIST

PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
B-1	D-51185	1	Fuel transfer bottle	As noted
B-2	D-51181	1	Filler tube	SST
B-3	D-51182	1	Reel housing	Stl
B-4	D-51182	1	Flange	Stl
B-5	D-51182	1	Cover	Stl
B-6	D-51183	1	Reel	Aluminum
B-7	D-51183	1	Shaft	Stl
B-8	D-51183	1	Torsion spring	Spring Stl
B-9	D-51183	1	Compression spring	Spring Wire
B-10	D-51183	1	Pointer	Drill Rod
B-11	D-51183	1	Rider rod	Vega Tool Stl
B-12	D-51183	1	Guide washer	Stl
B-13	D-51184	2	End plate	SST
B-14	D-51184	1	Shaft	Tool Stl
B-15	D-51184	1	Rotor	SST
B-16	D-51184	3	Retaining plate	SST
B-17	D-51184	3	Paddle	Bumper Rubber
B-18	D-51184	1	Collet	As noted
B-19	D-51184	1	Boot	Neoprene
B-20	D-51184	1	Bushing	Stl
B-21	D-51184	1	O-ring	Teflon
B-22	Stock	1	Pipe clamp Cat. No. 0.S-20-SS	SST
B-23	Stock	1	Pipe clamp Cat. No. 0.S-25-SS	SST
B-24	Stock	4	Hex head cap screw No. 10-24NC x 2 1/4	SST
B-25	Stock	1	Dog point set screw 5/16-18NC x 2 3/4	SST
B-26	Stock	6	Soc head cap screw No. 10-24NC x 1/2	SST
B-27	Stock	4	Soc head cap screw 1/4-20NC x 1/2	SST
B-28	Stock	4	Soc head cap screw No. 10-24NC x 1/2	SST
B-29	Stock	4	Flat head mach screw 1/4-20NC x 1/2	SST
B-30	Stock	2	Round head screw No. 4-40NC x 3/16	SST
B-31	Stock	1	Round head screw No. 3-48NC x 3/16	SST
B-32	Stock	6	Round head screw No. 4-40NC x 3/8	SST
B-33	Stock	2	Soc set screw No. 4-40NC x 1/4	SST
B-34	Stock	4	Hex nut No. 10-24NC	SST
B-35	Stock	1	Hex nut 5/16-18NC	SST
B-36	Stock	1	Eye bolt 3/8-16NC shank 1 1/4 dia. eye	Stl
B-37	Stock	3	Rollpin 3/32 dia. x 5/8	Stl
B-38	Stock	1	Woodruff key No. 204	Stl
B-39	Stock	1	Woodruff key No. 304	Stl
B-40	Stock	2	O-ring AN6227-16 13/16 x 1 1/16 x 1/8	Neoprene
B-41	Stock	2	Thrust bearing Boston Gear No. TB-512	Bronze
B-42	Stock	1	Bearing Boston Gear No. M57-8	Bronze
B-43	Stock	1	Wire rope 1/16 dia. x 15 1/8	SST
B-44	STOCK	1	SOC SET SCREW NO. 10-24 NC-2 X 3/8	SST

Remarks:

1. May be purchased from American Industrial and Scientific Company, 11638 V. Pico Blvd., Los Angeles 54, California.
2. Cut off and face ends to make a 1/2 and 1/4 inch long bushing.

Redrawn - See D-56684 For As Built Dwg. No Details On New Component Parts 6-11-63 RG

REFERENCE DRAWINGS	DWG. NO.
DETAIL SH 5	D-51185
DETAIL SH 4	D-51184
DETAIL SH 3	D-51183
DETAIL SH 2	D-51182
DETAIL SH 1	D-51181
MAIN ASSEMBLY	D-51189

THORIUM-U233 FUEL ROD FACILITY BLDG. NO. 3019

GENERAL SPECIFICATIONS:
1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:
1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed √.

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE: 1 = 1

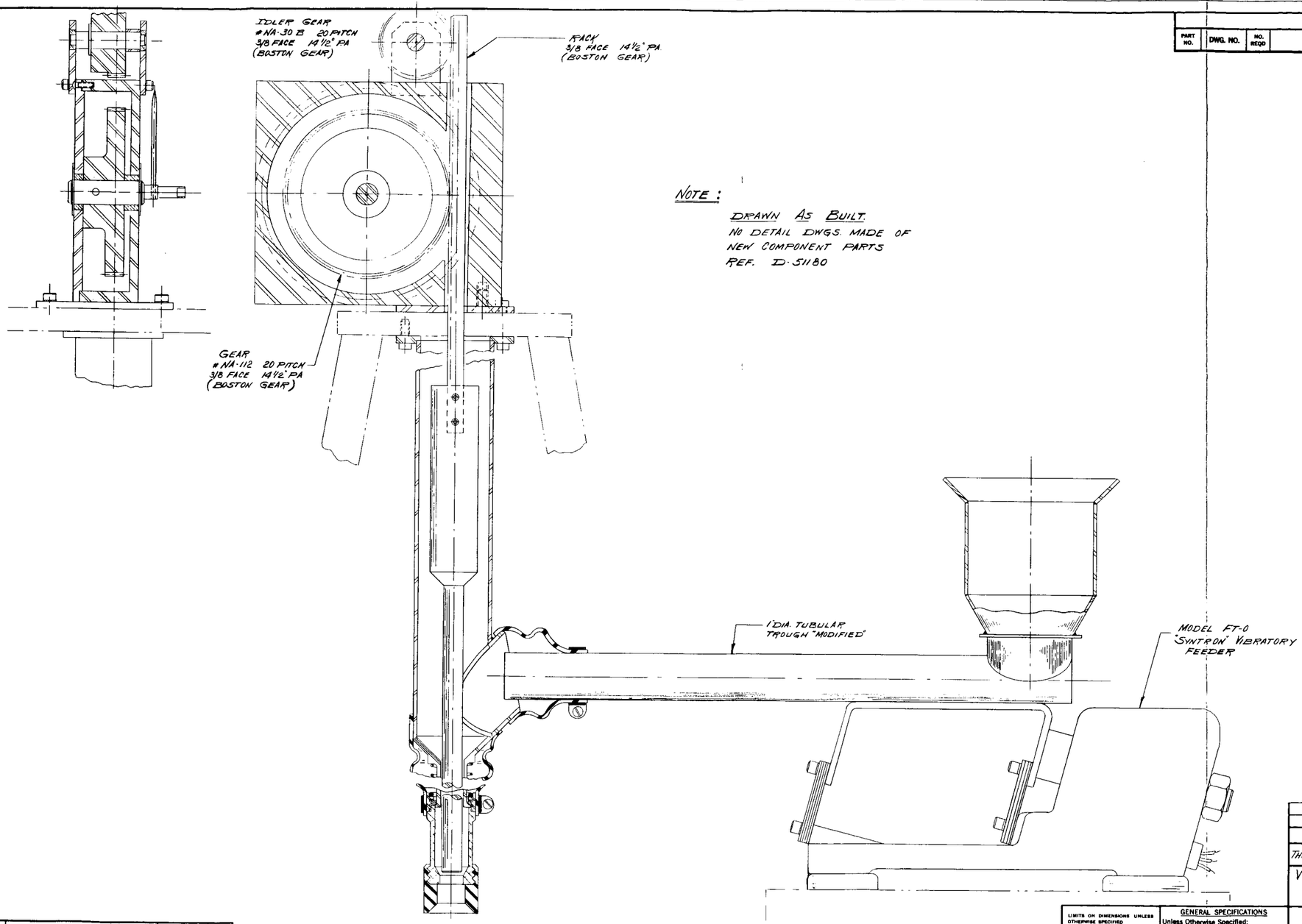
VIBRATOR - FILLER TUBE
(B) SUB ASSEMBLY

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED K.E. Jamison | ACCEPTED | APPROVED | REV

D-51180

APPROVED FOR CONSTRUCTION



NOTE :

DRAWN AS BUILT.
NO DETAIL DWGS. MADE OF
NEW COMPONENT PARTS
REF. D-51180

PARTS LIST				
PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL

LTR	REVISIONS			DATE	APPD	APPD
DRAWN R.E. JARRED	DATE 6-11-63	SUBMITTED [illegible]	DATE 7-3-63	APPROVED		DATE
DESIGNED	DATE	APPROVED	DATE	APPROVED		DATE
CHECKED DAVIS	DATE 6-20-63	APPROVED	DATE	APPROVED		DATE

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE: 1=1

GENERAL SPECIFICATIONS
Unless Otherwise Specified:
1. Break all sharp edges 1/64 max.
2. Type, grade, or finish of material may be chosen by fabricator.
3. Roughness height of machined surfaces shall not exceed √.
(Finish symbols and height values are in accordance with ASA B46.1-1955.)

REFERENCE DRAWINGS — DWG. NO.

THORIUM-U233 FUEL ROD FACILITY — BLDG. NO. 3019

VIBRATOR - FILLER TUBE
SUB ASSEMBLY

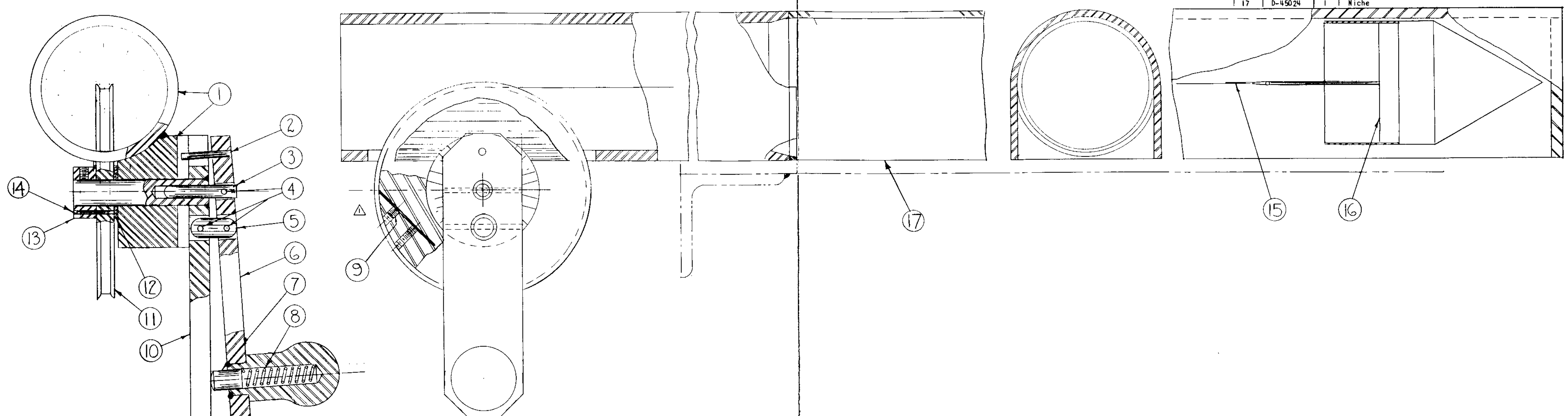
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED	ACCEPTED	APPROVED
N. A. TATE		

D-56684 REV

PARTS LIST

PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
1	D-45023	1	Tube	Steel
2	Stock	1	Rollpin 5/32 dia. x 1	Steel
3	D-45023	1	Guide	Steel
4	Stock	3	Rollpin 3/32 dia x 1	Steel
5	D-45023	1	Link	Steel
6	D-45023	1	Crank	Steel
7	D-45023	1	Plunger	Steel
8	D-45023	1	Spring	Music Wire
9	Stock	2	Soc hd cup point set screw #6-32 x 1/4	Steel
10	D-45023	1	Drum shaft	Steel
11	D-45024	1	Drum	Steel
12	Stock	1	Washer, 17/32 ID x 1" OD x 1/16	Oilite
13	D-45024	1	Shaft collar	Steel
14	Stock	1	Rollpin, 1/16 dia. x 3/4	Steel
15	Stock	1	Tape 3/16 wide x .005 x 15 feet	SST
16	D-45024	1	Bob	Steel
17	D-45024	1	Niche	Steel



LTR	REVISIONS	DATE	APPD	APPD
A	⚠ SLOT CHANGED TO 45°	5-13-65 RE JUDD	7-22 JWD	

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
McWilley	3-8-62	DAVIS	3-15-62		
DESIGNED	**DATE**	**SUBMITTED**	**DATE**	**APPROVED**	**DATE**
		Pate	3-16-62	H. Duggan	3-16-62

GENERAL SPECIFICATIONS:

1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:

1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed √.

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED

FRACTIONS: ±

DECIMALS: ±

ANGLES: ±

SCALE: 1" = 1"

REFERENCE DRAWINGS	DWG. NO.
DETAILS SHEET 1	D-45023
DETAILS SHEET 2	D-45024

THORIUM-U233 FUEL ROD FACILITY BLDG. NO. 3019

ELEVATOR ASSEMBLY

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

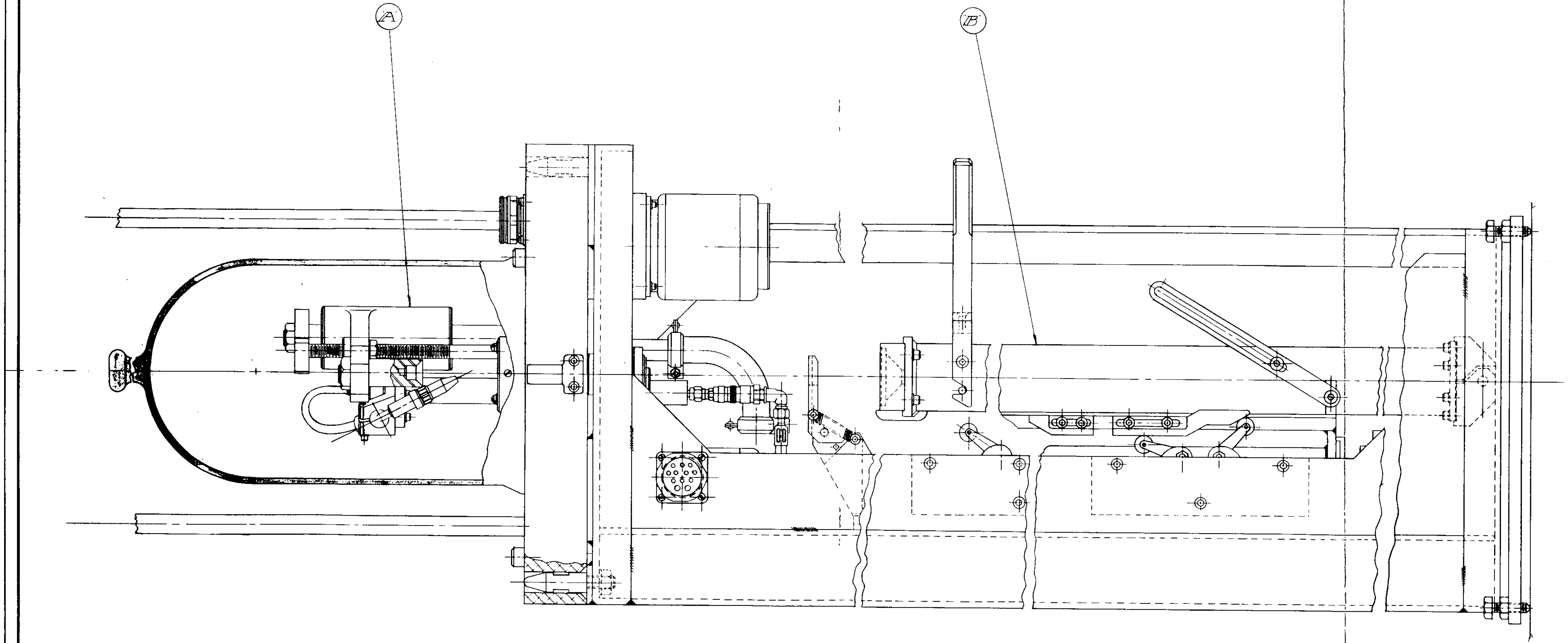
SUBMITTED: K. E. Jamison — ACCEPTED: J. T. Lawrence 3/29/62 — APPROVED: [signature]

D-45022 REV A

APPROVED FOR CONSTRUCTION

PARTS LIST

PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
"A"	E-52451	1	REMOTE WELDER SUB-ASS'Y "A"	
"B"	E-52452	1	REMOTE WELDER SUB-ASS'Y "B"	



A	REVISED AS BUILT	6-12-63 R.E.J	7-25
LTR	REVISIONS	DATE	APPD	APPD

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
B.B. Gibson	2-26-62	CANNON	3-8-62		
DESIGNED	**DATE**	**SUBMITTED**	**DATE**	**APPROVED**	**DATE**
		Pate	3-13-62	H. Duggan	3-14-62

GENERAL SPECIFICATIONS:

1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:

1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed √

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED

FRACTIONS: ±

DECIMALS: ±

ANGLES: ±

SCALE: 1/2 = 1

REFERENCE DRAWINGS	DWG. NO.
SUB-ASS'Y "B"	E-52452
SUB-ASS'Y "A"	E-52451

THORIUM-U233 FUEL ROD FACILITY BLDG. NO. 3019

REMOTE WELDER

MAIN ASSEMBLY

OAK RIDGE NATIONAL LABORATORY

OPERATED BY

UNION CARBIDE NUCLEAR COMPANY

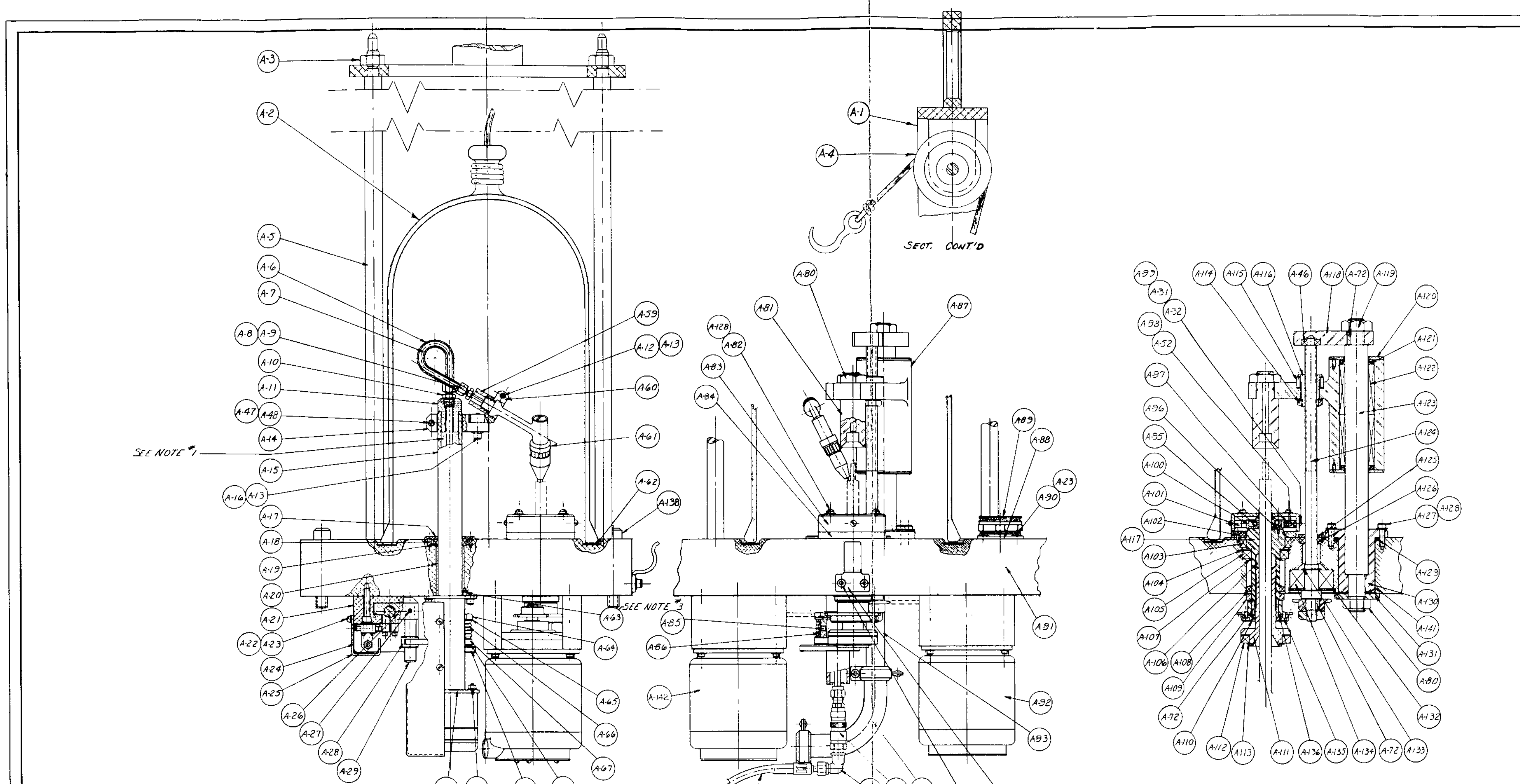
DIVISION OF UNION CARBIDE CORPORATION

OAK RIDGE, TENNESSEE

SUBMITTED: K.E. Jamison ACCEPTED: J.T. Lawrence 3-16-62 APPROVED: G. Davis

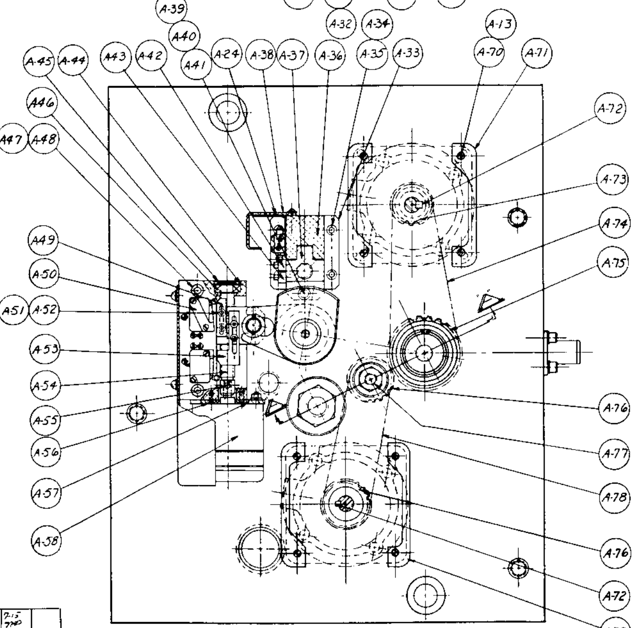
D-52450 REV. A

APPROVED FOR CONSTRUCTION



FRONT VIEW

SECTION A-A



BOTTOM VIEW

PARTS LIST

PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
A-1	D-52464	1	Bell jar clamp	6061-T6 Al
A-2[1]	Stock	1	Bell jar	Glass
A-3	Stock	4	Nut, hex, 1/2-13NC-2	SST
A-4	Stock	1	3" PULLEY WITH HOOK & ROPE	SST
A-5	D-52464	4	Tie rod	SST
A-6	Stock	as reqd	Tubing, 3/8 OD x 1/4 ID x 1/16 wall	Tygon
A-7	Stock	as reqd	Tubing, 3/16 OD x .030 wall	Copper
A-8[2]	Stock	1	Nut, Imperial brass #61-F for 3/16 tube	Brass
A-9[2]	Stock	1	Sleeve, imperial brass #60-F for 3/16 tube	Brass
A-10	D-52456	1	Connector	
A-11[3]	D-52456	1	Cap	Phenolic
A-12	Stock	1	Soc hd cap screw, #10-24NC-2 x 1" lg.	Stl
A-13	Stock	11	Shakeproof lockwasher for #10 screw	Stl
A-14	D-52456	1	Clamp block	6061-T6 Al
A-15	D-52456	1	Column	SST
A-16	Stock	2	Soc hd cap screw #10-24NC-2 x 3/4 lg.	SST
A-17	D-52461	1	Cover	6061-T6 Al
A-18	Stock	14	F.H. mach screw #6-32NC-2 x 3/8 lg.	SST
A-19	Stock	1	Victoprene oil seal, type K4 #66245	
A-20	Stock	1	Bost-Bronz bearing, #B1620-18	
A-21	D-52454	1	Horizontal guide	2024-T4 Al
A-22	Stock	4	Rd hd mach screw #6-32NC-2 x 1/4 lg.	Stl
A-23	Stock	8	Lockwasher for #6 screw	Stl
A-24	Stock	as reqd	Fish paper	
A-25	D-52459	1	Horizontal motor cover	1100-H14 Al
A-26	D-52454	1	Nut	Al-Bronze
A-27	Stock	1	Roll pin, 3/32 dia. x 1 1/4 lg.	Stl
A-28	D-52455	1	Bushing	Nylon
A-29	D-52455	1	Pin	SST
A-30	D-52457	1	Motor mount	6061-T6 Al
A-31	Stock	6	Nut, hex, #8-32NC-2	Stl
A-32	Stock	6	Shakeproof lockwasher for #8 screw	Stl
A-33	D-52457	1	Guide mount	6061-T6 Al
A-34	Stock	6	Soc hd cap screw #10-24NC-2 x 1/2 lg.	Stl
A-35	Stock	6	Lockwasher for #10 screw	Stl
A-36	D-52457	1	Vertical guide	2024-T4 Al
A-37	D-52458	1	Nut	Al-Bronze
A-38	D-52459	1	Vertical motor cover	1100-H14 Al
A-39	D-52458	2	Pad	Nylon
A-40	Stock	1	Soc set screw - flat pt #10-32NF-2 x 1/2 lg.	Stl
A-41	Stock	1	Regular hex jam nut #10-32NF-2	Stl
A-42	D-52458	1	Cam	6061-T6 Al
A-43	D-52458	1	Cam	6061-T6 Al
A-44[4]	Stock	2	Retaining ring, Waldes Truarc #5008-87	Stl
A-45[4]	Stock	2	Retaining ring, Waldes Truarc #5100-37	Stl
A-46[5]	Stock	3	Bearing, Fafnir #KP6A	
A-47	Stock	3	Soc hd cap screw, 1/4-20NC-2 x 1 1/4 lg.	Stl
A-48	Stock	3	Lock washer for 1/4 screw	Stl
A-49	D-52454	1	Cam	6061-T6 Al
A-50[6]	Stock	4	Micro switch	
A-51	Stock	8	Soc hd cap screw, #5-40NC-2 x 5/8 lg.	Stl
A-52	Stock	12	Shakeproof lockwasher for #5 screw	Stl
A-53	D-52454	1	Cam	6061-T6 Al
A-54	D-52455	2	Screw	17-4 PH SST
A-55	Stock	2	Soc set screw - cup pt. #6-32NC-2 x 1/8 lg.	Stl
A-56	Stock	12	F.H. mach screw #8-32NC-2 x 3/8 lg.	Stl
A-57	D-52454	1	Motor mount	6061-T6 Al
A-58[7]	Stock	2	Bodine motor, Cat. #BB192E-900H	
A-59	D-52453	1	Torch handle	
A-60	D-52458	1	Torch holder	6061-T6 Al
A-61[8]	Stock	1	Torch	
A-62	Stock	1	Gasket, 9 3/4 OD x 8 1/8 ID x 1/16 thk	Neoprene
A-63	Stock	1	Soc set screw, cup pt. #6-3"NC-2 x 1/4 lg.	Stl
A-64	D-52455	1	Nut	SST
A-65	D-52455	1	Washer	Stl
A-66	D-52455	1	Clutch spring	SST
A-67	D-52455	1	Fork	SST
A-68[9]	Stock	1	Washer, 1 17/32 ID x 2" OD x 1/16 thk	Phenolic
A-69	D-52456	1	Hub	6061-T6 Al
A-70	Stock	8	Soc hd cap screw #10-24NC-2 x 3" lg.	Stl
A-71	D-52464	2	Motor base	6061-T6 Al
A-72	Stock	5	1/8 sq. key x 7/16 lg.	Stl
A-73[10]	Stock	1	Sprocket, Diamond #25B16 1/2 bore-kwy	Stl
A-74[11]	Stock	1	1/4 pitch #25 rollerless chain	
A-75[10]	D-52462	1	Sprocket - Diamond #25330 Do not sub.	Stl
A-76[10]	Stock	2	Sprocket, Diamond #25B18 1/2 bore-kwy	Stl
A-77	Stock	1	Nut, hex 7/16-20NF-2	Stl
A-78[12]	Stock	1	1/4 pitch #25 rollerless chain	
A-79	D-52464	2	Motor base	6061-T6 Al
A-80	Stock	2	Nut, hex, 3/4-16NF-2	Stl
A-81	D-52460	1	Press head	17-4PH SST
A-82	Stock	4	Fil hd mach screw 1/4-20NC-2 x 1 1/8 lg.	Silver Pl Brass
A-83	D-52465	1	Brush holder	6061-T6 Al
A-84	D-52461	1	Cover	6061-T6 Al
A-85	Stock	2	Soc set screw - dog pt #10-24NC-2 x 1/4 lg.	Stl
A-86	D-52456	1	Spring seat	Brass
A-87	D-52460	1	Housing	Stl
A-88[13]	Stock	1	Amphenol box receptacle #MS3102A-28-11P	
A-89[14]	Stock	1	Wiggins quick connect adapter #QDR-28	
A-90	Stock	4	Fil hd mach screw #6-32NC-2 x 3/8 lg.	Stl
A-91	D-52463	1	Mounting plate	6061-T6 Al
A-92[15]	Stock	1	Slo-Syn motor, type SS250-P1	
A-93	Stock	1	1/2 IPS Sched 40 pipe, 4" lg. (thd one end)	SST
A-94	D-52459	1	Cable hook	1100 H-14 Al
A-95	D-52465	1	Garter spring	SST

A-96	Stock	3	Fil. hd mach screw #5-40NC-2 x 3/8 lg.	Stl
A-97[16]	D-52465	2	Brush	Silver
A-98	Stock	4	Rd hd mach screw, #5-40NC-2 x 3/16 lg.	Silver Pl Brass
A-99	Stock	2	Rd hd mach screw, #8-32NC-2 x 1/4 lg.	Silver Pl Brass
A-100	D-52465	1	Slip ring	Hard Copper
A-101	D-52465	2	Brush spring	Silver Pl Ph Brz.
A-102	Stock	6	F.H. mach. screw #6-32NC-2 x 1/2 lg.	SST
A-103	Stock	1	Victoprene oil seal, type K4 #63310	
A-104[4]	Stock	1	Retaining ring, Waldes Truarc #5000206	Stl
A-105[5]	Stock	1	Bearing, Fafnir #KP21B	
A-106	D-52462	1	Packing	Neoprene
A-107[4]	Stock	2	Retaining ring, Waldes Truarc #5100-131	Stl
A-108[5]	Stock	1	Bearing, Fafnir #B542DD	
A-109	D-52465	1	Spacer ring	SST
A-110	D-52462	1	Split flange	SST
A-111	D-52462	1	Bushing	SST
A-112[5]	Stock	1	Bearing, Fafnir #KP23B	
A-113[4]	Stock	1	Retaining ring, Waldes Truarc #5100-143	Stl
A-114	D-52460	1	Nut	Al-Bronze
A-115	Stock	2	Dowel pin, 1/8 dia. x 1/2 lg.	Stl
A-116	D-52460	1	Press nut	Al-Bronze
A-117	D-52462	1	Bushing	17-4PH SST
A-118	D-52460	1	Bearing plate	SST
A-119	Stock	1	Nut, hex, 5/8-18NF-2 thd	Stl
A-120	D-52460	2	Cover	6061-T6 Al
A-121[17]	Stock	2	Ball bushing seal, Thomson #S-1000	
A-122[17]	Stock	2	Ball bushing, Thomson #A-162536	
A-123[17]	D-52453	1	Shaft	SST
A-124	D-52461	1	Shaft	17-4 PH SST
A-125	D-52461	1	Cover	6061-T6 Al
A-126	Stock	1	Victoprene oil seal, Type K4 #66051	
A-127	Stock	6	Soc hd cap screw 1/4-20NC-2 x 1" lg.	SST
A-128	Stock	10	Shakeproof lockwasher for 1/4 screw	Stl
A-129	Stock	1	O-ring, 1 7/8 OD x 1 5/8 ID x 1/8 dia.	Neoprene
A-130	D-52460	1	Bushing	SST
A-131	D-52461	1	Washer	SST
A-132[4]	Stock	1	Retaining ring, Waldes Truarc #5000-193	Stl
A-133[4]	Stock	1	Retaining ring, Waldes Truarc #5100-62	Stl
A-134[5]	Stock	1	Bearing, Fafnir #DP10	
A-135	Stock	6	Soc hd cap screw #6-32NC-2 x 1/4 lg.	Stl
A-136	D-52459	1	Ring	Music Wire
A-137[18]	Stock	1	Flexmaster pipe joint 90° elbow	
A-138	D-52464	3	Captive screw, soc. hd cap screw, 1/2-13NC-2 x 3" lg.	SST
A-139	Stock	1	Quick connect, Swagelok # 400-QC-1-2-DESO	Brass
A-140	Stock	1	Fitting, Imperial # 70-F elbow 3/16 tube to 1/8 pipe	Brass
A-141	Stock	1	O-ring, 1 OD x 3/4 ID x 1/8 dia	Neoprene
A-142[15]	Stock	1	SS-250 BIFLAR SLO SYN MOTOR	

Remarks:

1. Part No. A-2 is a standard bell jar, 15" high, 8 3/4" OD, 3 gal capacity. Cenco No. 14302-C or Fisher No. 2-626.
2. Imperial Brass Mfg. Co., Chicago, Ill.
3. Part No. A-11 to be laminated phenolic, fine weave fabic base, ORNL Stores No. 07-445-2330.
4. Waldes Kohinoor Inc., Long Island City 1, New York.
5. The Fafnir Bearing Co., New Britain, Connecticut.
6. Part No. A-50 is Microswitch Cat. No. V3-1 switch with JV-5 auxiliary actuator. Microswitch Division of Minneapolis-Honeywell Regulator Co., Freeport, Ill.
7. The Bodine Electric Co., 2254 West Ohio Street, Chicago, Ill.
8. Part No. A-61 is a Heliarc HW-9 (Series 2) - Hand Welding Torch - on hand. Additional parts reqd at installation, 1 tungsten electrode, 1 electrode collet, 1 ceramic cup.
9. Part No. A-68 to be laminated phenolic, fine weave fabric base, ORNL Stores No. 07-450-3910.
10. Diamond Chain Co., Inc., Indianapolis 7, Indiana.
11. Part No. A-74 is a 1/4 pitch, #25 rollerless chain, 64 pitches including connecting link.
12. Part No. A-78 is a 1/4 pitch, #25 rollerless chain, 52 pitches including connecting link.
13. Amphenol Electronics Corp., Chicago 50, Illinois.
14. E. B. Wiggins Oil Tool Co., Inc., 3424 E. Olympic Blvd., Los Angeles 23, Calif.
15. The Superior Electric Co., Bristol, Connecticut.
16. Part No. A-97 brush, 2 reqd, make from silver bar, ORNL Stores No. 50-902-0600 (one stock bar makes 2 brushes).
17. Thomson Industries, Inc., Manhasset, New York.
18. Part No. A-137 is a Flexmaster pipe joint, 90° elbow, Part No. 6512-1/2. Aeroquip Corp. Harman Division, 11214 Exposition Blvd., Los Angeles 64, Calif.

Notes:

1. Thoroughly clean, degrease and assemble parts A-10, A-11, and A-15 as shown with the copper tube centered in the SST pipe. Completely fill the space between tube and pipe with a mixture (composed by weight) of the following: 50% aluminum oxide (Alcoa No. T-61) 45% epoxy resin (Shell Chemical Epon 828) 5% hardener (diethylaminopropylamine). Cure approx. 24 hours at room temperature.
2. All silver plating to be .001 min. thickness unless otherwise specified.
3. Assemble parts A-20 and A-93, #34 (.111) drill 3/8 deep - #6-32NC-2 tap 1/4 deep as shown. Lock assembly with Part A-63 and check for clearance with part A-15 - ream if necessary to prevent binding.

REFERENCE DRAWINGS	DWG. NO.
SUB-ASS'Y "A" DETAIL SHEET #13	D-52465
SUB-ASS'Y "A" DETAIL SHEET #12	D-52464
SUB-ASS'Y "A" DETAIL SHEET #11	D-52463
SUB-ASS'Y "A" DETAIL SHEET #10	D-52462
SUB-ASS'Y "A" DETAIL SHEET #9	D-52461
SUB-ASS'Y "A" DETAIL SHEET #8	D-52460
SUB-ASS'Y "A" DETAIL SHEET #7	D-52459
SUB-ASS'Y "A" DETAIL SHEET #6	D-52458
SUB-ASS'Y "A" DETAIL SHEET #5	D-52457
SUB-ASS'Y "A" DETAIL SHEET #4	D-52456
SUB-ASS'Y "A" DETAIL SHEET #3	D-52455
SUB-ASS'Y "A" DETAIL SHEET #2	D-52454
SUB-ASS'Y "A" & "B" DETAIL SHEET #1	D-52453
REMOTE WELDER MAIN ASS'Y	D-52450

LTR	REVISIONS	DATE	APPD	APPD
B	REVISED PER AS BUILT	6-12-63	7-15	
A	△1 PT 92 QUAN FROM 2 TO 1 △2 ADDED PT 142	5-8-62		

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
B.G.GIBSON	2-20-62	KASERMAN	2-21-62		
DESIGNED	DATE	SUBMITTED	DATE	APPROVED	DATE
		PATE	3-12-62		3-14-62

GENERAL SPECIFICATIONS:

1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:

1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed —√

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE: 1/2 = 1

THORIUM U-233 FUEL ROD FACILITY — BLDG. NO. 3019

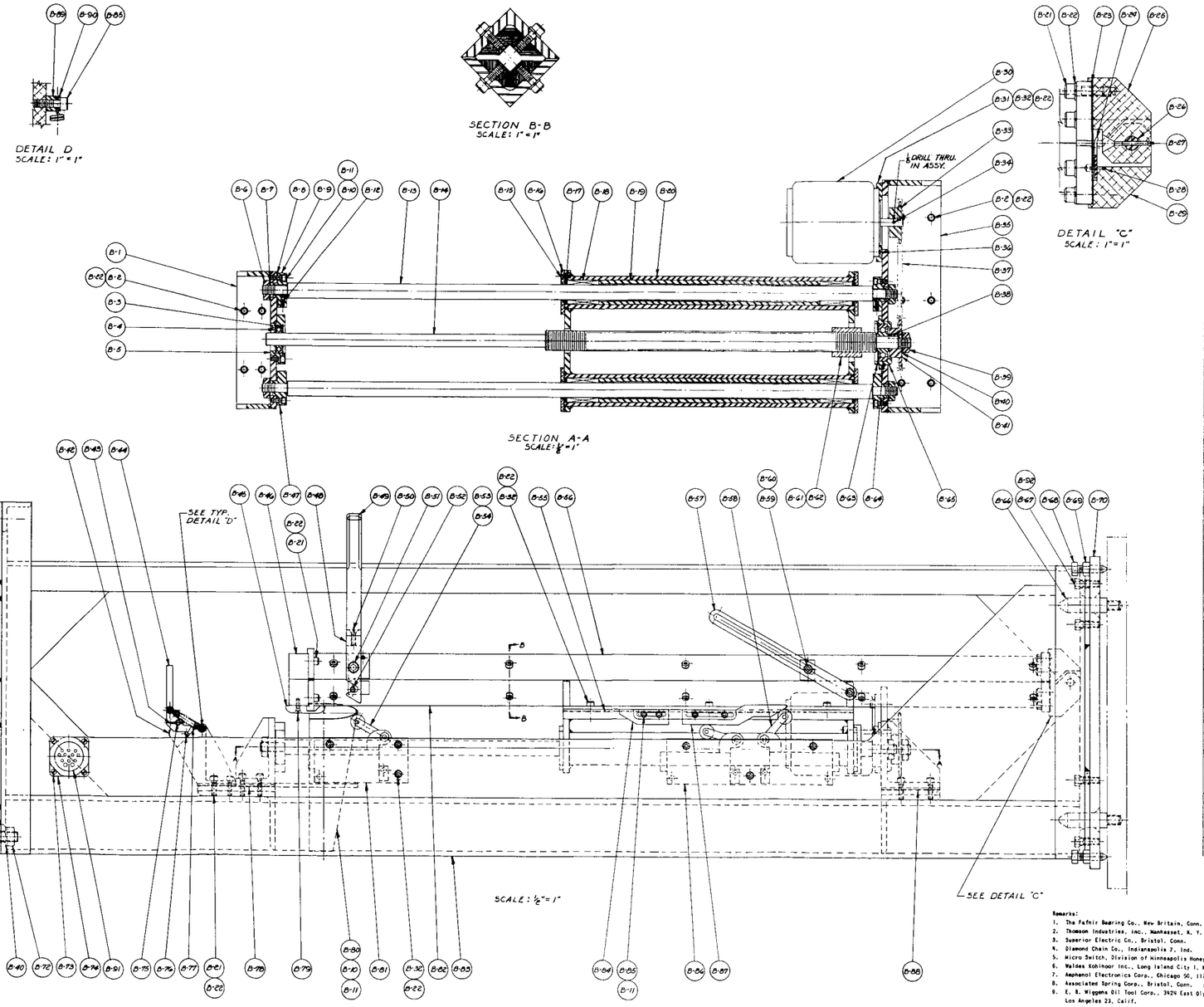
REMOTE WELDER
SUB-ASSEMBLY "A"

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
A DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED | ACCEPTED | APPROVED

E-52451 REV B

APPROVED FOR CONSTRUCTION



PARTS LIST

PART NO.	DWG. NO.	REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
B-1	D-52467	1	Upper bracket	Steel
B-2	Stock	10	Soc hd cap screw 1/4-20NC-2 x 1 lg.	Steel
B-3$_5$	Stock	1	Retaining ring - Truarc #5000-137	Steel
B-4$_1$	Stock	1	Bearing - Fafnir - #EP10A	
B-5	D-52467	1	Bearing housing	Steel
B-6	Stock	4	Hex jam nut 7/16-20NF-2	SST
B-7	Stock	4	Lock washer - 7/16 std	SST
B-8	Stock	2	Shim, (3/4 OD x 25/32 ID x thickness as reqd	Steel
B-9	D-52466	2	Adjustable bushing	Steel
B-10	Stock	21	Soc hd cap screw, #10-24NC-2 x 1/2 lg.	Steel
B-11	Stock	24	Lock washer - #10 std.	Steel
B-12	Stock	6	Soc set screw (cone point) #10-32NF-2 x 1/2 lg.	Steel
B-13$_2$	D-52453	2	Shaft	440C SST
B-14	D-52467	1	Screw	17-7PH SST
B-15	Stock	16	Flat hd mach screw #8-32NC-2 x 1/2 lg.	Steel
B-16	D-52468	4	Retainer	6061-T6 Al
B-17$_2$	Stock	4	Ball bushing seal - Thomson #3-750	
B-18$_2$	Stock	4	Ball bushing - Thomson #A-122026	
B-19	D-52472	2	Spacer	6061-T6 Al
B-20	D-52468	1	Ball bushing housing	Steel
B-21	Stock	14	Soc hd cap screw - 1/4-20NC-2 x 3/4 lg.	Steel
B-22	Stock	46	Lock washer - 1/4 std	Steel
B-23	Stock	1	Shim - 1/32 thick size as reqd.	Steel
B-24	D-52469	1	Clip	Steel
B-25	D-52469	1	Hinge	6061-T6 Al
B-26	D-52469	1	Pin	SST
B-27	Stock	1	Rollpin 3/32 dia. x 5/8 lg.	Steel
B-28	Stock	2	Rollpin 1/16 dia. x 3/8 lg.	Steel
B-29	D-52459	1	Hinge support	6061-T6 Al
B-30$_3$	Stock	1	Synchronous motor - Superior Type SS250	
B-31	D-52466	1	Motor plate	Steel
B-32	Stock	16	Soc hd cap screw 1/4-20NC-2 x 5/8 lg.	Steel
B-33$_4$	Stock	1	Sprocket - Diamond #25B25	Steel
B-34	Stock	1	Rollpin - 1/8 dia. x 1 1/2 lg.	Steel
B-35	D-52466	1	Lower bracket	Steel
B-36	Stock	3	Flat hd mach screw #10-32NF-2 x 3/8 lg.	Steel
B-37$_4$	Stock	1	Sprocket chain, Diamond #25 x 78 pitches lg. (includes one conn. link)	Steel
B-38	Stock	1	Key, 3/16 square x 1/2 lg.	Steel
B-39	Stock	1	Hex jam nut, 1/2-20NF-2	SST
B-40	Stock	3	Lock washer - 1/2 std	SST
B-41$_4$	D-52467	1	Sprocket - Diamond #25B32 (modified)	Steel
B-42	D-52467	1	Fork support	6061-T6 Al
B-43	Stock	1	Rollpin - 1/16 dia. x 5/8 lg.	Steel
B-44	D-52467	1	Fork	6061-T6 Al
B-45	D-52471	1	Cam	Teflon
B-46	D-52470	1	Bearing guide	6061-T6 Al
B-47	D-52466	2	Bushing	Steel
B-48	D-52471	1	Yoke	6061-T6 Al
B-49	D-52471	1	Handle	6061-T6 Al
B-50	Stock	3	Flat hd mach screw - 1/4-20NC-2 x 3/4 lg.	Steel
B-51	Stock	2	Soc hd shoulder screw - 3/8 dia x 3/8 lg shld., 5/16-18UNC-3A thd	Steel
B-52	Stock	2	Dowel, 1/4 dia. x 1" lg.	Steel
B-53$_5$	Stock	2	Micro switch #BZLN2-LH	
B-54	Stock	6	Soc hd cap screw, 1/4-20NC-2 x 1/2 lg.	Steel
B-55	Stock	1	Shim, (4 7/8 x 3 1/4 x 1/32 thick	Steel
B-56	D-52471	1	Movable clamp	As noted
B-57	D-52470	2	Support	6061-T6 Al
B-58$_5$	Stock	1	Micro switch - #BZLN2-RH	
B-59	Stock	4	Soc hd shld.screw 5/16 dia x 3/8 lg shld, 1/4-20UNC-3A thd	Steel
B-60	Stock	4	Washer - 1/2 OD x .328 ID x .046 thick	Steel
B-61	D-52468	1	Nut	Al Bronze
B-62	Stock	2	Soc hd shld screw 1/4 dia x 3/8 lg shld #10-24UNC-3A thd	Steel
B-63$_5$	Stock	1	Retaining ring - Truarc #5000-193	Steel
B-64$_1$	Stock	1	Bearing - Fafnir #EP10	
B-65	D-52466	1	Bearing housing	Steel
B-66	D-52471	2	Dowel	Steel
B-67	Stock	8	Hex hd mach screw - 5/16-18NC-2 x 1" lg.	Steel
B-68	D-52469	4	Hex hd mach screw 3/8-16NC-2 x 2 lg.	Steel
B-69	Stock	4	Hex nut - 3/8-16NC-2	Steel
B-70	D-52472	1	Base plate	Steel
B-71	D-52470	2	Dowel	Steel
B-72	Stock	2	Hex nut - 1/2-13NC-2	Steel
B-73	Stock	6	Rd hd mach screw #6-32NC-2 x 5/16 lg.	Steel
B-74$_7$	Stock	1	Box receptacle - Amphenol AN3102A-28-8P	
B-75	D-52467	1	Pin	SST
B-76	Stock	1	Dowel - 3/16 dia. x 7/8 lg.	Steel
B-77$_8$	Stock	1	Spring - Associated #E32G-041-150	SST
B-78	Stock	1	Shim - 7 x 2 x thickness as reqd	Steel
B-79	Stock	2	Flat hd mach screw - #10-24NC-2 x 5/8 lg.	Steel
B-80	D-52468	1	Funnel	SST
B-81	D-52469	1	Switch plate	6061-T6 Al
B-82	D-52470	1	Clamp	As noted
B-83	D-52472	1	Frame	Steel
B-84	D-52468	1	Upper cam	6061-T6 Al
B-85	Stock	6	Soc hd cap screw #10-24NC-2 x 5/8 lg.	Steel
B-86	D-52469	1	Switch plate	6061-T6 Al
B-87	D-52468	1	Lower cam	6061-T6 Al
B-88	Stock	1	Sh'm - thickness and size as reqd	Steel
B-89	D-52467	2	Spacer	SST
B-90	Stock	2	Washer - 3/8 OD x .203 ID x 1/16 thick	SST
B-91$_9$	Stock	1	Wiggen quick connect nipple #QCR-28	
B-92	Stock	8	Lockwasher 5/16 std	Stl

Remarks:
1. The Fafnir Bearing Co., New Britain, Conn.
2. Thomson Industries, Inc., Manhasset, N. Y.
3. Superior Electric Co., Bristol, Conn.
4. Diamond Chain Co., Indianapolis 7, Ind.
5. Micro Switch, Division of Minneapolis Honeywell, Freeport, Ill.
6. Wallas Kohinoor Inc., Long Island City 1, N. Y.
7. Amphenol Electronics Corp., Chicago 50, Illinois
8. Associated Spring Corp., Bristol, Conn.
9. E. B. Wiggens Oil Tool Corp., 3824 East Olympic Blvd., Los Angeles 23, Calif.

NOTES:
1. - PAINT ALL NON-WORKING STEEL SURFACES WITH ONE COAT OF PRIMER ACCORDING TO MANUFACTURER'S INSTRUCTIONS.

SUB-ASSY. B DETAIL SH. # 8	D-52470
SUB-ASSY. B DETAIL SH. # 7	D-52471
SUB-ASSY. B DETAIL SH. # 6	D-52470
SUB-ASSY. B DETAIL SH. # 5	D-52469
SUB-ASSY. B DETAIL SH. # 4	D-52468
SUB-ASSY. B DETAIL SH. # 3	D-52467
SUB-ASSY. B DETAIL SH. # 2	D-52466
SUB-ASSY. A & B DETAIL SH. # 1	D-52453
SUB-ASSEMBLY "A"	E-52451
REMOTE WELDER-MAIN ASSY.	D-52450
REFERENCE DRAWINGS	DWG. NO.

LTR	REVISIONS	DATE	APPD	APPD
DRAWN R. Franke DATE 3-1-62	SUBMITTED DATE Pate 3-13-62	APPROVED		DATE
DRAWN CANJOA DATE 2-1-62	APPROVED DATE	APPROVED	DATE	DATE
DRAWN CANJOA DATE 3-8-62	APPROVED DATE	APPROVED H. Swagler	DATE 3-14-62	DATE

A-93809-10D

THORIUM-U233 FUEL ROD FACILITY PCRA no. 3019

REMOTE WELDER
SUB-ASSEMBLY "B"

UNLESS OTHERWISE SPECIFIED: FRACTIONS ±; DECIMALS ±; ANGLES ±; SCALE: AS NOTED

GENERAL SPECIFICATIONS
Unless Otherwise Specified
1. Break all sharp edges 1/64 max.
2. Type, grade, or finish of material may be chosen by fabricator.
3. Roughness height of machined surfaces shall not exceed ▽ (Finish symbols and height values are in accordance with ASA B46.1-1955.)

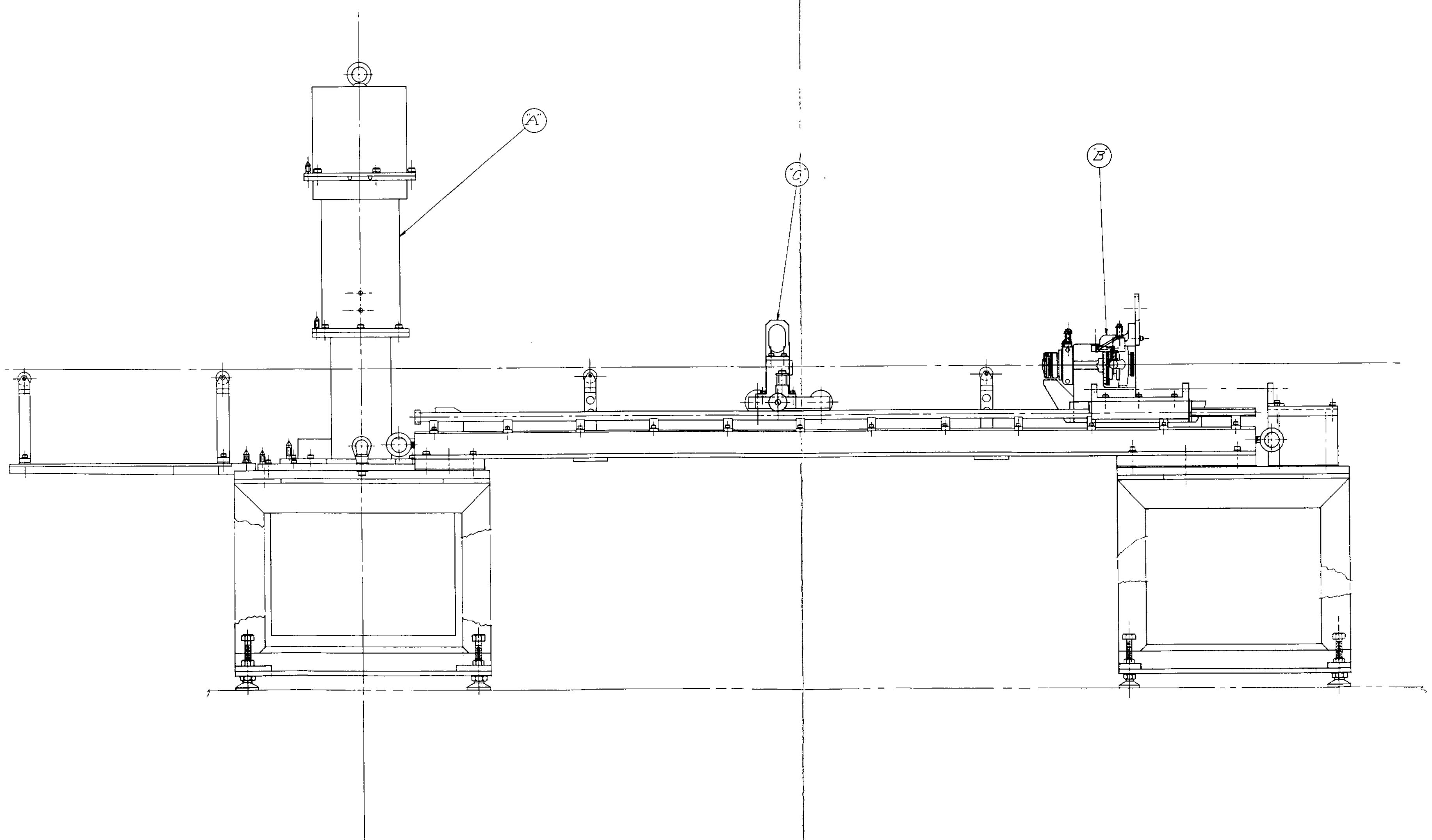
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED [signature] ACCEPTED [signature] APPROVED [signature]

E-52452 REV

APPROVED FOR CONSTRUCTION

PARTS LIST				
PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
A	E-54878	1	SUB-ASS'Y "A" – FRAME	
B	D-54879	1	SUB-ASS'Y "B" – CARRIAGE	
C	D-54880	1	SUB-ASS'Y "C" – TROLLEY	



LTR	REVISIONS	DATE	APPD	APPD

DRAWN	DATE	SUBMITTED	DATE	APPROVED	DATE
B.G. GIBSON	8-7-62	PATE	8-16-62		
DESIGNED	DATE	APPROVED	DATE	APPROVED	DATE
CANNON	6-5-62				
CHECKED	DATE	APPROVED	DATE	APPROVED	DATE
CANNON	8-14-62				8-16-62

REFERENCE DRAWINGS	DWG. NO.
SUB-ASS'Y "C"	D-54880
SUB-ASS'Y "B"	D-54879
SUB-ASS'Y "A"	E-54878

THORIUM U^{233} FUEL ROD FACILITY — BLDG. NO. 3019

DENSITY CHECKER
MAIN ASSEMBLY

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE: $\frac{1}{4} = 1$

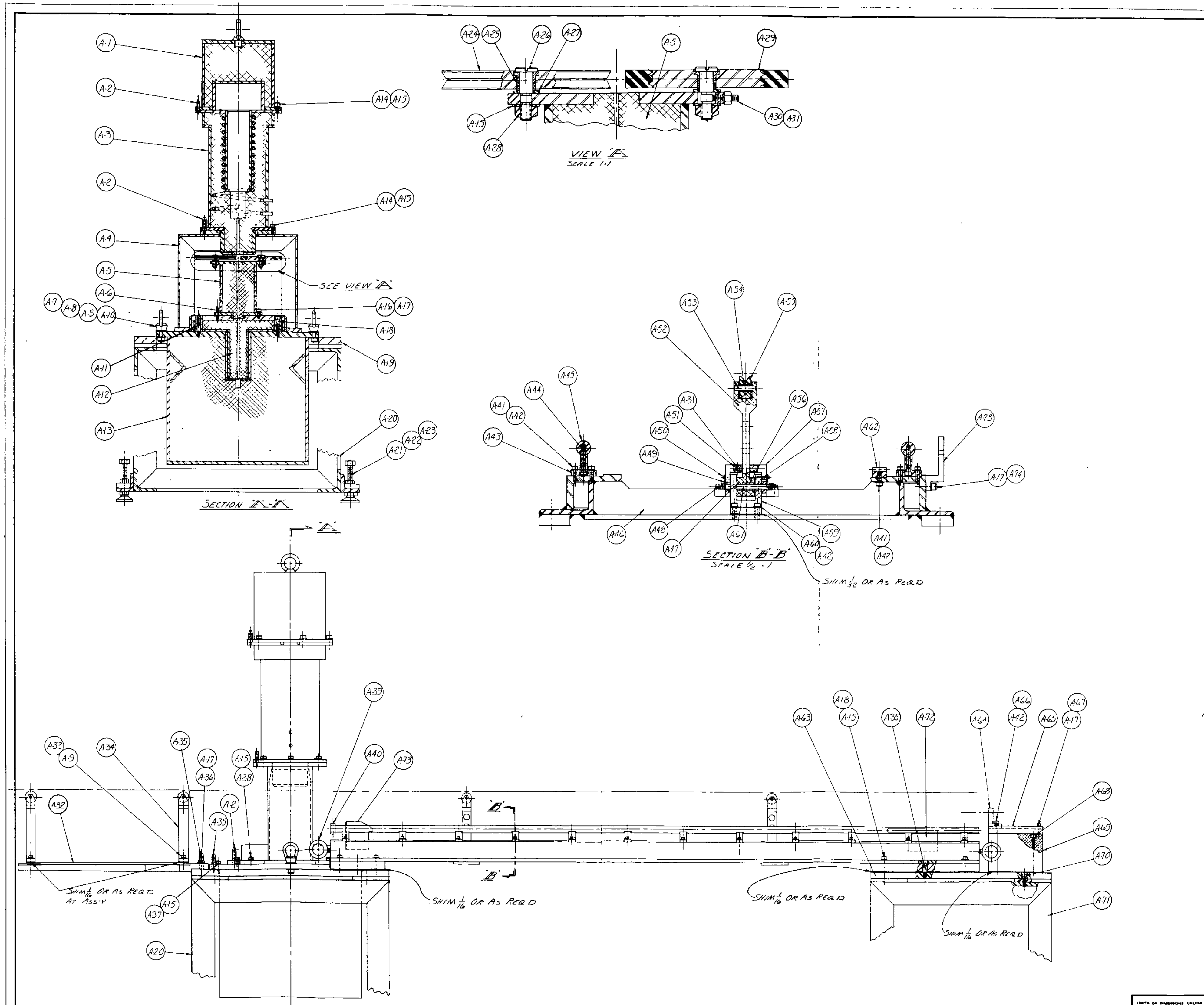
GENERAL SPECIFICATIONS
Unless Otherwise Specified:
1. Break all sharp edges 1/64 max.
2. Type, grade, or finish of material may be chosen by fabricator.
3. Roughness height of machined surfaces shall not exceed ✓
(Finish symbols and height values are in accordance with ASA B46.1-1955.)

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED G. A. Crosby | ACCEPTED J. D. [illegible] | APPROVED

E-54877

APPROVED FOR CONSTRUCTION



PARTS LIST

PART NO.	DWG. NO.	NO. REQ'D	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
A-1	D-54881	1	Cover	Stl & Lead
A-2	D-54885	6	Dowel	SST
A-3	D-54884	1	Detector tube shield	Stl & Lead
A-4	D-54881	1	Support	Stl
A-5	D-54887	1	Upper collimator	Stl & Lead
A-6	D-54885	2	Dowel	SST
A-7[1]	Stock	2	Eye nut 3/8 McMaster Carr #301Y8	Stl
A-8	Stock	2	Flat washer for 3/8 screw	Stl
A-9	Stock	6	Lock washer for 3/8 screw	Stl
A-10	Stock	2	Soc hd cap screw 3/8-16NC-2 x 1 1/4 lg.	Stl
A-11	D-54885	2	Dowel	SST
A-12	D-54885	1	Lower collimator	Stl & Lead
A-13	D-54883	1	Cask	Stl & Lead
A-14	Stock	10	Soc hd cap screw 5/16-18NC-2 x 5/8 lg.	Stl
A-15	Stock	36	Lockwasher for 5/16 screw	Stl
A-16	Stock	4	Soc hd cap screw 1/4-20NC-2 x 3/4 lg.	Stl
A-17	Stock	16	Lockwasher for 1/4 screw	Stl
A-18	Stock	13	Soc hd cap screw 5/16-18NC-2 x 1 3/4 lg.	Stl
A-19	D-54891	1	Mounting plate	Stl
A-20	D-54891	1	Support table	Stl
A-21	Stock	8	Hex hd screw 1/2-13NC-2 x 4" lg.	Stl
A-22	Stock	8	Hex nut 1/2-13NC-2	Stl
A-23[2]	Stock	8	Leveling pad Reid Cat. No. L-1	Stl
A-24	D-54887	1	Roller	SST
A-25[3]	Stock	2	Bearing, Boston Gear #FB68-4	
A-26	D-54887	2	Screw	SST
A-27	Stock	2	Spacer, 25/64 ID x 3/4 OD x .094 thk	SST
A-28	Stock	2	Hex nut 5/16-18NC-2	Stl
A-29	D-54887	1	Roller	Stl & Neop.
A-30	Stock	1	Soc set screw #10-24NC-2 x 3/4 lg.	Stl
A-31	Stock	5	Hex nut #10-24NC-2	Stl
A-32	D-54881	1	Bracket	6061-T6 Al
A-33	Stock	4	Soc hd cap screw 3/8-16NC-2 x 3/4 lg.	Stl
A-34	D-54890	2	Shaft support	6061-T6 Al
A-35	D-54889	7	Dowel	SST
A-36	Stock	4	Hex hd screw 1/4-20NC-2 x 1 1/4 lg.	Stl
A-37	Stock	8	Soc hd cap screw 5/16-18NC-2 x 1 1/4 lg.	Stl
A-38	Stock	8	Soc hd cap screw 5/16-18NC-2 x 3/4 lg.	Stl
A-39[2]	Stock	4	Eye bolt, 3/8-16NC-2 Reid #PE-3	Stl
A-40[4]	Stock	2	Collar, Jergens Cat. No. SHC-750	Stl
A-41	Stock	60	Soc hd cap screw #10-24NC-2 x 1/2 lg.	Stl
A-42	Stock	70	Lockwasher for #10 screw	Stl
A-43	D-54889	24	Shaft support	SST
A-44	Stock	24	Soc hd cap screw #10-24NC-2 x 1 3/8 lg.	Stl
A-45[5]	D-54888	2	Shaft	SST
A-46	D-54888	1	Main Frame	Stl
A-47	Stock	4	Soc set screw #8-32NC-2 x 1/2 lg.	Stl
A-48	Stock	4	Rollpin, 3/32 dia x 1/2 lg.	Stl
A-49	D-54884	4	Spring	Music Wire
A-50	Stock	4	Rd hd screw #5-40NC-2 x 1/4 lg.	Stl
A-51	Stock	4	Soc set screw #10-24NC-2 x 1 3/8 lg.	Stl
A-52	D-54889	2	Rocker arm	6061-T6 Al
A-53	D-54890	4	Roller shaft	SST
A-54[3]	Stock	4	Bearing, Boston Gear #B-46-6	
A-55	D-54889	4	Roller	SST
A-56[3]	Stock	2	Bearing, Boston Gear #B-46-8	
A-57	D-54889	4	Retainer arm	SST
A-58	Stock	4	Roll pin, 1/8 dia x 1/2 lg.	Stl
A-59	D-54889	2	Base	SST
A-60	Stock	8	Soc hd cap screw #10-24NC-2 x 5/8 lg.	Stl
A-61	D-54890	2	Rocker arm Shaft	SST
*A-62[3]	D-54887	1	Rack, Boston Gear #L514	Stl
A-63	D-54882	1	Plate	Stl
A-64	D-54882	1	Tube guide	6061-T6 Al
A-65	D-54882	1	Guide	6061-T6 Al
A-66	Stock	2	Soc hd cap screw #10-24NC-2 x 1" lg.	Stl
A-67	Stock	4	Soc hd cap screw 1/4-20NC-2 x 1 1/2 lg.	Stl
A-68	Stock	2	Soc hd cap screw 1/4-20NC-2 x 4 3/4 lg.	Stl
A-69	D-54882	1	Block	6061-T6 Al
A-70	Stock	16	Soc hd cap screw, 3/8-16NC-2 x 1" lg.	Stl
A-71	D-54891	1	Support table	Stl
A-72	D-54890	1	Rear cam	6061-T6 Al
A-73	D-54890	1	Front cam	6061-T6 Al
A-74	Stock	4	Soc hd cap screw 1/4-20NC-2 x 1/2 lg.	Stl

*See Note 1

Remarks:

1. McMaster Carr Supply Co., 640 West Lake Street, Chicago 6, Illinois.
2. Reid Tool Supply Co., 302 West Delano Ave., Muskegon Heights, Michigan
3. Boston Gear Works, Quincy 71, Mass.
4. Jergens Tool Specialty Co., 712 E. 163rd St., Cleveland 10, Ohio.
5. THOMSON INDUSTRIES, INC. MANHASSET, NEW YORK

NOTES:

1. PART A-62 FURNISHED BY ORNL
2. PAINT ALL UNFINISHED STEEL SURFACES WITH ONE COAT OF A RUST PREVENTIVE PRIMER

REFERENCE DRAWINGS	DWG. NO.
DETAIL SH. #11	D-54891
DETAIL SH. #10	D-54890
DETAIL SH. #9	D-54889
DETAIL SH. #8	D-54888
DETAIL SH. #7	D-54887
DETAIL SH. #6	D-54886
DETAIL SH. #5	D-54885
DETAIL SH. #4	D-54884
DETAIL SH. #3	D-54883
DETAIL SH. #2	D-54882
DETAIL SH. #1	D-54881
MAIN ASS'Y	E-54877

THORIUM U233 FUEL ROD FACILITY BLDG. NO. 3019

DENSITY CHECKER
SUB-ASSEMBLY "A" FRAME

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED: G. A. Cristy | ACCEPTED | APPROVED

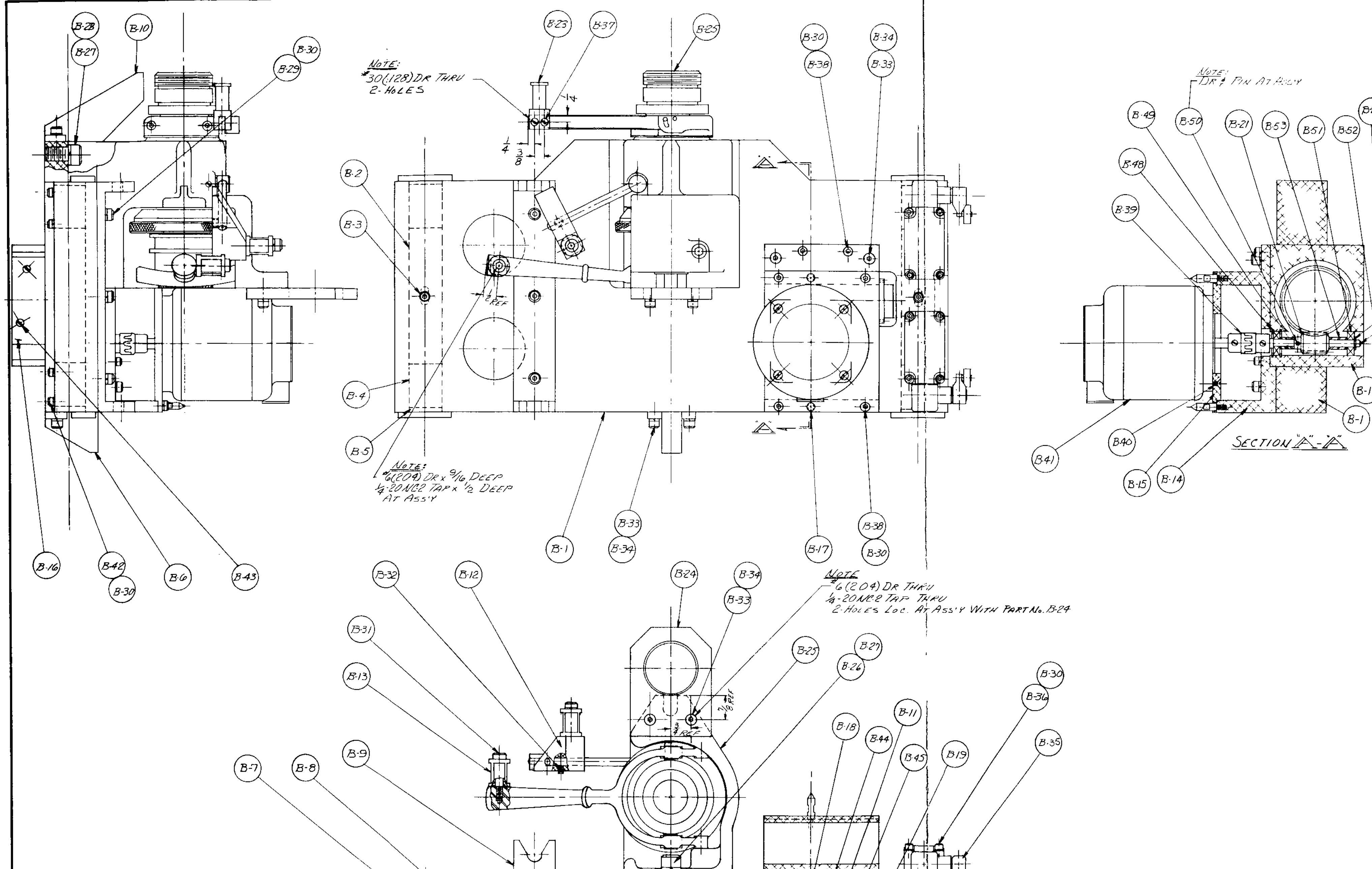
E-54878

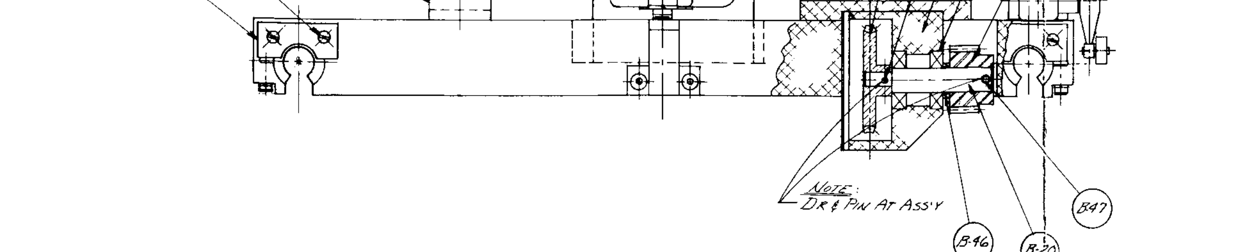
LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE: 1/4 : 1 EXCEPT AS NOTED

GENERAL SPECIFICATIONS
Unless Otherwise Specified:
1. Break all sharp edges 1/64 max.
2. Type, grade, or finish of material may be chosen by fabricator.
3. Roughness height of machined surfaces shall not exceed √
(Finish symbols and height values are in accordance with ASA B46.1-1955.)

LTR	REVISIONS	DATE	APP'D	APP'D
R.G. Gibson 8-1-62	PATE 8-4-62			
CANNON				
CANNON 8-18-62		8-6-62		

APPROVED FOR CONSTRUCTION





PARTS LIST

PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
B-1	D-54892	1	Carriage	6061-T6 Al
B-2	D-54892	2	Spacer	Stl
B-3	Stock	2	Soc set screw (dog point) 1/4-20NC-2 x 1/2 lg.	Stl
*B-4[1]	Stock	4	Ball bushing	
*B-5[2]	Stock	4	Ball bushing seal	
B-6	D-54892	1	Cam	6061-T6 Al
B-7	D-54892	4	Retainer	6061-T6 Al
B-8	Stock	8	Flat hd screw, #10-24NC-2 x 1/2 lg.	Stl
B-9	D-54892	1	Guide	6061-T6 Al
B-10	D-54892	1	Cam	6061-T6 Al
B-11	D-54893	1	Gear box	6061-T6 Al
B-12	D-54893	1	Cam	6061-T6 Al
B-13	D-54893	2	Handle	6061-T6 Al
B-14	D-54893	1	Bracket	6061-T6 Al
B-15	D-54894	1	Motor mount	6061-T6 Al
B-16	D-54894	1	Cover	6061-T6 Al
B-17	D-54894	2	Dowel	SST
*B-18[3]	D-54894	1	Worm gear, Boston Gear #D1144	Bronze
*B-19[3]	D-54894	1	Spur gear, Boston Gear #VD188	Stl
B-20	D-54894	1	Shaft	Stl
*B-21[3]	D-54894	1	Worm, Boston Gear #GDVH	Stl
B-22	D-54894	1	Shaft	Stl
B-23	D-54894	1	Handle	6061-T6 Al
B-24	D-54894	1	Pickup bail	STL
*B-25[4]	Stock	1	Hardinge collet index fixture	
B-26	Stock	1	Soc hd cap screw 1/2-13NC-2 x 2" lg.	Stl
B-27	Stock	2	Lockwasher for 1/2" screw	Stl
B-28	Stock	1	Soc hd cap screw 1/2-13NC-2 x 1 1/4" lg.	Stl
B-29	Stock	3	Soc hd cap screw #10-24NC-2 x 5/8 lg.	Stl
B-30	Stock	27	Lockwasher for #10 screw	Stl
B-31	Stock	2	5/16 soc hd shoulder screw x 1" lg.	Stl
B-32	Stock	1	Soc set screw #10-24NC-2 x 1/4" lg.	Stl
B-33	Stock	10	Soc hd cap screw 1/4-20NC-2 x 3/4" lg.	Stl
B-34	Stock	10	Lockwasher for 1/4 screw	Stl
*B-35[5]	Stock	2	Limit switch	
B-36	Stock	8	Soc hd cap screw, #10-24NC-2 x 1 3/4 lg.	Stl
B-37	Stock	2	Flat Hd screw, #5-40NC-2 x 5/8 lg.	Stl
B-38	Stock	8	Soc hd cap screw, #10-24NC-2 x 3/4 lg.	Stl
*B-39[3]	Stock	1	Multi-jaw coupling, Boston Gear #FA75	Stl
B-40	Stock	3	Flat hd screw #10-32NF-2 x 5/8 lg.	Stl
*B-41[6]	Stock	1	Slo-Syn synchronous motor	
B-42	Stock	8	Soc hd cap screw #10-24NC-2 x 1" lg.	Stl
B-43	Stock	4	Flat hd screw, #5-40NC-2 x 3/8 lg.	Stl
B-44	Stock	1	1/8 dia rollpin x 3/4" lg.	Stl
B-45[7]	Stock	2	Bearing, N.D. #77R-10x1C	
B-46	Stock	1	Spacer, 11/16 ID x 13/16 OD x .125 thk	Stl
B-47	Stock	1	3/16 dia rollpin x 1 1/4" lg.	Stl
B-48[8]	Stock	2	Retaining ring, Truarc #N5000-86	Stl
B-49	Stock	1	Spacer, 21/64 ID x 1/2 OD x .500 lg.	Stl
B-50	Stock	1	1/8 dia rollpin x 7/16" lg.	Stl
B-51[9]	Stock	2	Bearing, N.D. #77038x1C	
B-52[10]	Stock	1	Retaining ring, Truarc #5100-31	Stl
B-53	Stock	1	Spacer, 21/64 ID x 1/2 OD x .688 lg.	Stl

NOTE: *These parts furnished by ORNL.

Remarks:

1. Part No. B-4, ball bushing (open type series) Thomson #OPN-122026. Thomson Industries, Inc., Manhasset, New York.
2. Part No. B-5, ball bushing seal, Thomson #OPN-S-750, Thomson Industries, Inc., Manhasset, New York.
3. Boston Gear Works, Quincy 71, Mass.
4. Part No. B-25, horizontal-vertical collet index fixture (right hand mounting) Hardinge #HV-4N with 24-hole plate , Hardinge Brothers, Inc., Elmira, N. Y.
5. Part No. B-35, limit switch, Micro-switch #1LS1. Micro-Switch Division of Minneapolis Honeywell Regulator Co., Freeport, Illinois.
6. Part No. B-41, Slo-Syn synchronous motor, Bifilar Type #SS250-1002. Superior Electric Co. Bristol, Conn.
7. Part No. B-45, bearing inch series - Type R New Departure #77-R-10x1C, New Departure Division, General Motor Corp., Bristol, Conn.
8. Part No. B-48, retaining ring, Truarc #N-5000-86, Truarc Retaining Rings Division, Waldes Kohinoor, Inc., 47-16 Austel Place, Long Island City 1, N. Y.
9. Part No. B-51 bearing - extra small radial - Type 30, New Departure #77038x1C New Departure Division, General Motor Corp., Bristol, Conn.
10. Part No. B-52, retaining ring, Truarc #5100-31. Truarc Retaining Rings Division, Waldes Kohinoor Inc., 47-16 Austel Place, Long Island City 1, N. Y.

REFERENCE DRAWINGS	DWG. NO.
MAIN ASS'Y	E-54877
SUB-ASS'Y "B" DETAIL SH #3	D-54894
SUB-ASS'Y "B" DETAIL SH. #2	D-54893
SUB-ASS'Y "B" DETAIL SH. #1	D-54892

THORIUM U^{233} FUEL ROD FACILITY BLDG. NO. 3019

GENERAL SPECIFICATIONS:

1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:

1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed √.

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±
SCALE: 1/2 = 1

DENSITY CHECKER
SUB – ASSEMBLY "B"-CARRIAGE-

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED G.G. Cristy ACCEPTED J. D. [illegible] APPROVED [signature] [signature]

D-54879

LTR	REVISIONS			DATE	APPD	APPD
DRAWN	DATE	CHECKED	DATE	APPROVED		DATE
B.G.GIBSON	8-14-62	CANNON	8-15-62			
DESIGNED	DATE	SUBMITTED	DATE	APPROVED		DATE
		PATE	8-15-62	[signature]		8-16-62

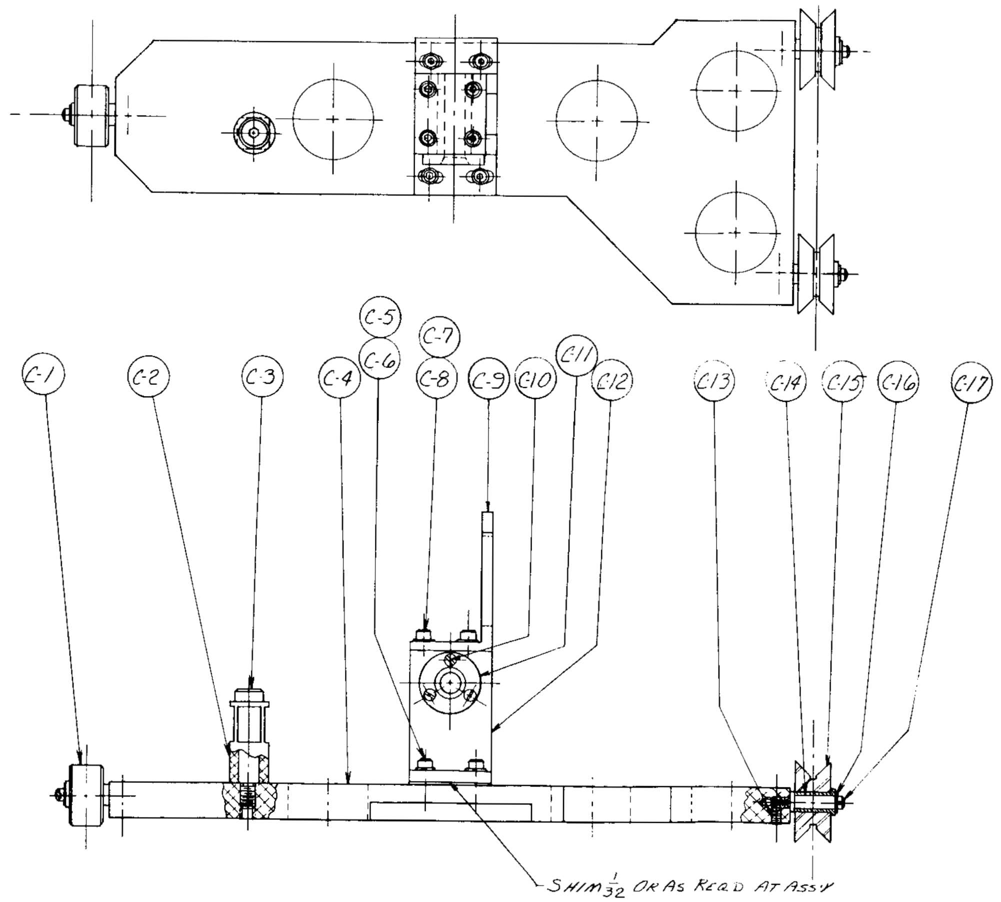
APPROVED FOR CONSTRUCTION

PARTS LIST

PART NO.	DWG. NO.	NO. REQD	DESCRIPTION (NAME, SIZE, ETC.)	MATERIAL
C-1	D-54895	1	Wheel	SST
C-2	D-54895	1	Handle	6061-T6 Al
C-3	Stock	1	1/2 dia soc hd shoulder screw x 2" lg.	Stl
C-4	D-54895	1	Trolley	6061-T6 Al
C-5	Stock	4	Soc hd cap screw 1/4-20NC-2 x 1 1/4 lg.	Stl
C-6	Stock	4	Lockwasher for 1/4 screw	Stl
C-7	Stock	4	Soc hd cap screw #10-24NC-2 x 5/8 lg.	Stl
C-8	Stock	4	Lockwasher for #10 screw	Stl
C-9	D-54895	1	Eye	6061-T6 Al
C-10	Stock	3	Flat hd screw #5-40NC-2 x 1/2 lg.	Stl
C-11	D-54895	1	Gage	Vega Tool Stl
C-12	D-54895	1	Gage block	6061-T6 Al
C-13	Stock	3	Soc set screw #10-24NC-2 x 1/2 lg.	Stl
C-14 [1]	Stock	3	Bearing, Boston Gear #FB-68-8	
C-15	D-54895	2	Wheel	SST
C-16 [2]	Stock	3	Retaining ring, Truarc #5100-37	
C-17	D-54895	3	Screw	SST

Remarks:

1. Boston Gear Works, Quincy 71, Mass.
2. Truarc Retaining Rings Div., Waldes Kohinoor, Inc., 47-16 Austel Place, Long Island City 1, New York.



REFERENCE DRAWINGS	DWG. NO.
SUB-ASS'Y "C" DETAILS	D-54895
MAIN ASS'Y	E-54877

THORIUM U 233 FUEL ROD FACILITY — BLDG. NO. 3019

DENSITY CHECKER
SUB-ASSEMBLY "C" TROLLEY

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

SUBMITTED: G. C. Cristy — ACCEPTED: J. D. Lease — APPROVED: [signature]

[signature] — D-54880 — REV

GENERAL SPECIFICATIONS:

1. Break all sharp edges 1/64 max., unless otherwise specified.
2. The fabricator may choose the type, grade or finish of material unless otherwise specified.

MACHINE FINISH SPECIFICATIONS:

1. Finish symbols are in accordance with ASA Standard B46.1-1955.
2. Roughness height values are the maximum arithmetical average deviation from the mean surface, expressed in microinches.
3. For surfaces not otherwise indicated, roughness height shall not exceed —√.

CLASSIFICATION

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED

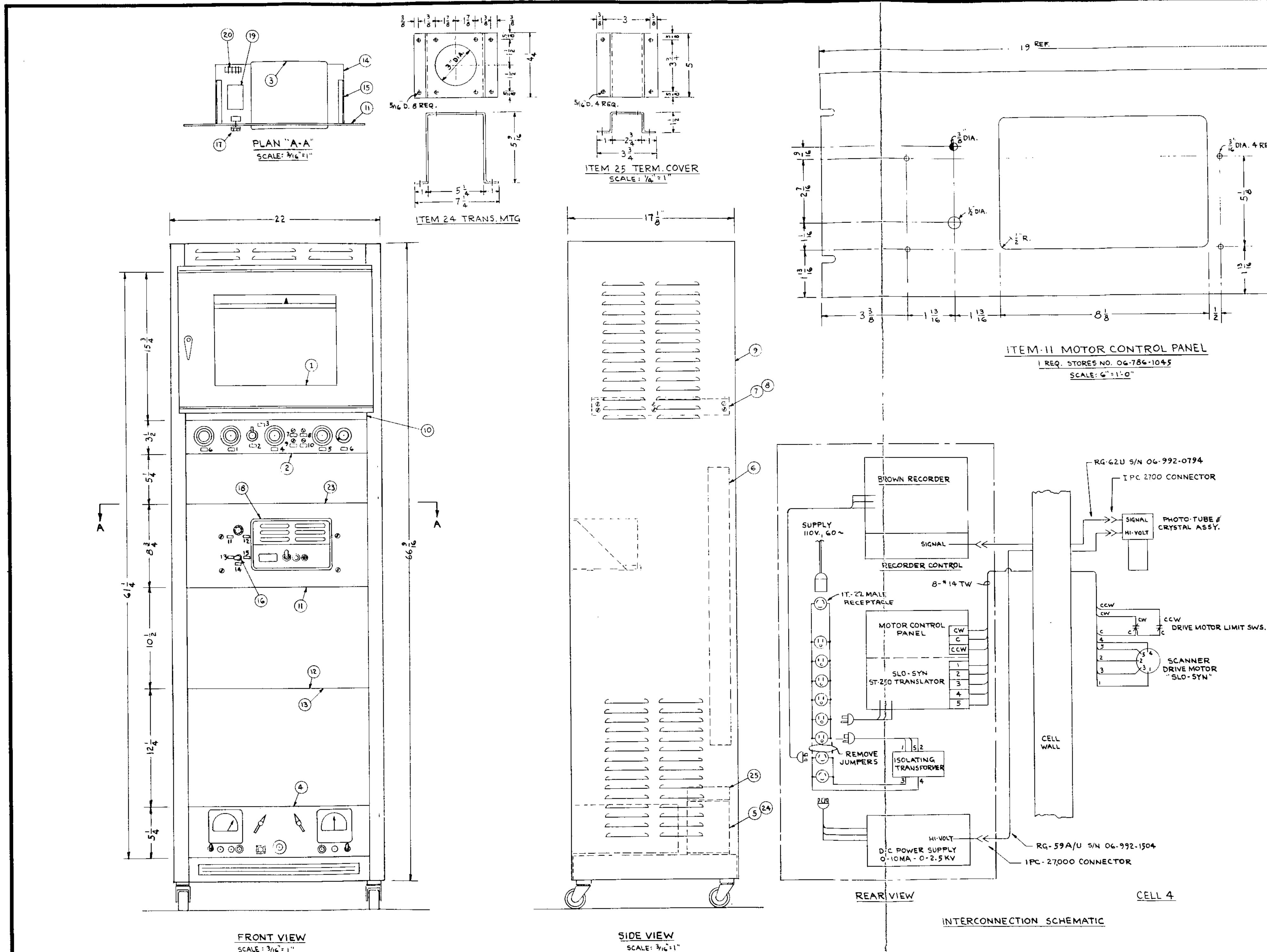
FRACTIONS: ±
DECIMALS: ±
ANGLES: ±

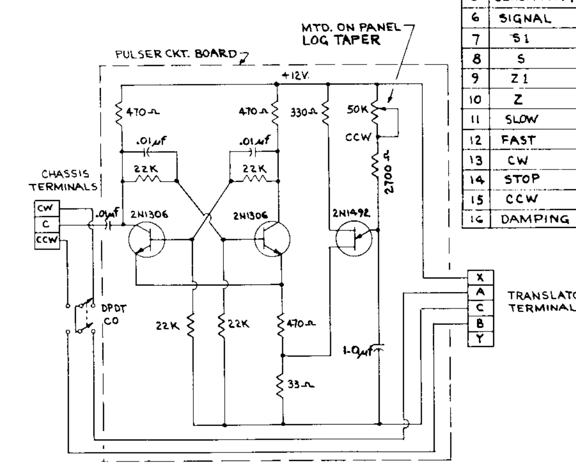
SCALE: 1/2 : 1

LTR	REVISIONS	DATE	APPD	APPD

DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
B.G. GIBSON	8-6-62	CANNON	8-14-62		
DESIGNED	**DATE**	**SUBMITTED**	**DATE**	**APPROVED**	**DATE**
		PATE	8-15-62	H. Duggan	8-16-62

APPROVED FOR CONSTRUCTION





PULSER CIRCUIT

NOTE: MODIFY "X" TERMINAL AT TRANSLATOR BY MOVING INTERNAL CONNECTION TO JUNCTION OF R64 & R65. SEE DWG. Q-2536-2

IT.	REQ.	DESCRIPTION	STORES NO.
1	1	BROWN RECORDER (ADJ. SPAN & ZERO)	
2	1	RECORDER CONTROL PANEL	
3	1	SLO-SYN" ST-250 TRANSLATOR	
4	1	NJE D-C POWER SUPPLY	
5	1	ISOLATING TRANSFORMER	06-982-3560
6	1	RECEPTACLE STRIP (MODIFIED)	06-896-1979
7	2	ANGLE BRACKET - FOR RECORDER	06-772-0612
8	2	MOUNTING BOLT - " "	06-388-0780
9	1	BUD CABINET	06-788-0800
10	1	FILLER STRIP 1 1/4" x 19 (SPECIAL) CUT TO FIT	
11	1	PANEL 8 3/4 x 19 (WITH CUTOUT)	06-786-1045
12	1	PANEL 10 1/2 x 19 (BLANK)	06-786-1055
13	1	PANEL 12 1/4 x 19 (BLANK)	06-786-1065
14	1	CHASSIS	06-774-0713
15	2	BRACE	06-774-0523
16	1	TOGGLE SWITCH DPDT-CENTER "OFF"	06-974-1726
17	1	POT. 50K, 1W (1-TURN)	06-928-2001
18	30"	PLASTIC EDGING 1/4 x 1/4 x 1/16	
19	1	TERMINAL STRIP	06-880-3263
20	1	TERMINAL BLOCK (CURTIS 3 POINT	
21	15	NAME TAGS - "DYMO" EMBOSSED	TABLE BELOW
22	1	HUBBELL # 7327-3W. POL. MALE RECEP.	05-072-3724
23	1	PANEL 5 1/4 x 19 (BLANK)	06-786-1025
24	1	TRANS. MTG. # 11 GA. CRS	
25	1	TERM. COVER # 11 GA. CRS	

IT. 21

N.TAG STAMPING	
NO.	MARKING
1	SPAN
2	FINE
3	ZERO
4	COARSE
5	SENSITIVITY
6	SIGNAL
7	S1
8	S
9	Z1
10	Z
11	SLOW
12	FAST
13	CW
14	STOP
15	CCW
16	DAMPING

NO.	REVISIONS	DATE	APPD	APPD
DRAWN W.F.G.	DATE 10-16-62	SUBMITTED	DATE	APPROVED / DATE
DESIGNED	DATE 10-62	APPROVED BL	DATE 10-19-62	APPROVED / DATE
CHECKED ACB	DATE 10-62	APPROVED	DATE	APPROVED / DATE

REFERENCE DRAWINGS | DWG. NO.

DESIGN RESPONSIBILITY W. J. GRETER

KILOROD CELL 4 — BLDG. 3019

DENSITY CHECKER
INSTRUMENT CABINET

LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED
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INSTRUMENTATION AND CONTROLS DIVISION
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY

SUBMITTED 10-19-62 | ACCEPTED DATE | APPROVED DATE

Q-2535-12 RO

APPENDIX D

Equipment Purchase Specifications

Technical Specifications for Remote Weigher

Remotely Operated Ultrasonic Cleaner

TECHNICAL SPECIFICATIONS FOR REMOTE WEIGHER

I. SCOPE

This specification covers the design, fabrication, and testing of a remotely controlled automatic weighing machine.

II. REFERENCES

None.

III. REQUIREMENTS

A. General Description

1. The machine will be a part of a remotely controlled processing line. It will be used to weigh and batch three different quantities of three different powders preparatory to blending.
2. The machine shall include:
   a. Three electrically or mechanically controlled feed mechanisms.
   b. A single scale assembly capable of weighing, in sequence, three predetermined quantities within ±1% accuracy. Changeover may be either automatic or accomplished manually with the aid of manipulators.
   c. A dump system. Fill and dump controls shall permit fully automatic operation, nonautomatic operation, or any combination of automatic and nonautomatic fill and dump.
   d. A visual indicator which shall be legible at a distance of 10 ft. Readout may be either at the machine itself or on a remote indicator. The scale of the indicator shall be calibrated in grams and half grams.
3. Supply and discharge hoppers will be supplied by the Company.
4. The materials to be weighed and batched are:
   a. Powder No. 1 — 522 g of −6 +16 mesh powder.
   b. Powder No. 2 — 130.5 g of −50 +140 mesh powder.
   c. Powder No. 3 — 217.5 g of −200 mesh powder.

   Powders Nos. 1 and 2 are very dry and abrasive and flow like dry sand. Powder No. 3 flows like dry talc. Sample powders cannot be supplied by the Company.

B. Materials and Equipment

1. All operations shall be electrically or mechanically controlled. Hydraulic or pneumatic operators or controls shall not be used for any part of the system.
2. The maximum permissible voltage at any control or instrument with which the operator comes in contact shall be 110 v ac.
3. The maximum size of the machine, not including hoppers furnished by the Company, shall be 3 ft by 3 ft by 3 ft.
4. The machine shall be fitted with a lifting eye located approximately over the center of gravity to permit handling with a 1/2-ton crane. The machine shall hang reasonably level from the crane hook.
5. Materials: All parts which will come in contact with the powders being weighed shall be made from any 300 series stainless steel. Flat surfaces shall have a 2B sheet finish or equivalent. Welds, if required, shall be ground smooth.
6. All other materials, insofar as practicable, shall be any 300 series stainless steel.

C. Manufacturer's Data

1. The Seller shall furnish the following information with the bids:
   a. Sketch or photographs of the proposed equipment showing principal dimensions and accessory components.
   b. Complete description and sequence of operations.
   c. Complete description of proposed remote controls and operators.
2. The Seller shall furnish the following information with the equipment on delivery:
   a. Three copies of complete operation and servicing instructions.

D. Acceptance and Tests

1. The Seller shall demonstrate the ability of the equipment to be furnished to meet the requirements of this specification prior to shipment. Tests shall be performed at the Seller's site and shall be at the Seller's expense.

2. The Seller shall notify the Company at least 10 days in advance of such tests.
3. Acceptance shall be at the Seller's site upon satisfactory completion of the tests specified above.

E. Packaging and Shipping

1. The equipment shall be securely crated and/or skidded to prevent damage or contamination of the working surfaces during handling and shipping.
2. The Seller shall include a complete set of installation, operating, and service instructions with the equipment upon shipment.

TECHNICAL SPECIFICATIONS FOR ULTRASONIC CLEANER

I. SCOPE

This specification covers the design, fabrication, and test of a remotely operated ultrasonic cleaning system.

II. REFERENCES

None.

III. REQUIREMENTS

A. General Description

The system will be part of a processing line and will be used for cleaning zirconium rods 1/2-in.-diam by 48 in. long. The cleaning medium will be water. The system shall include:

1. A carriage to support and rotate the rod during the following operations. The carriage shall be capable of being raised above the level of the tank to permit the rod to be placed and removed by a remotely operated manipulator.
2. A complete ultrasonic cleaning system, including provisions for remotely controlled filling and draining of the tank. The tank shall drain completely.
3. A water spray system to rinse the rod after the cleaning operation and to thoroughly wash down the interior of the tank after each cleaning operation.
4. A warm air drying system to dry the rod after final rinse.
5. The tank and attached components shall have a lifting eye or lug, located approximately over the center of gravity, for handling with a crane.

B. Equipment

The tank shall be made from any 300 series stainless steel and shall be all welded construction. The interior surfaces shall have a 2B sheet finish or equivalent. All welds shall be ground smooth.

The maximum tank width and length shall be 15 in. and 60 in., respectively. The height of the rod in loading position (carriage raised) shall be 40 in. from the floor.

The carriage assembly shall be made of any 300 series stainless steel. It shall be equipped with powered rollers or other device to rotate the work piece during the cleaning, rinsing, and drying operations. The mechanism for raising and lowering the carriage shall be operated either electrically or mechanically. Hydraulic or pneumatic systems shall not be used. The work piece shall be held in a horizontal position at all times.

The tank shall be fitted with a splash-tight cover to seal the tank during cleaning and rinsing operations. The tank cover may be opened and closed in conjunction with the carriage raising mechanism.

The spray rinse assembly shall spray water in a manner that the work piece, the carriage, and the interior of the tank are thoroughly rinsed.

The warm air dryer shall be capable of thoroughly drying the work piece in less than 5 min.

Controls and operators shall be either electrical or mechanical. No hydraulic or pneumatic controls or operators shall be used. All operations shall be remotely controlled from a console located at least 30 ft from the processing line. Mechanical controls shall be operable by means of nonarticulated manipulators (supplied by the Company). The maximum permissible voltage on any control or instrument at the console shall be 110 v ac.

The power supply and ultrasonic generator shall be located at least 30 ft from the processing line. The ultrasonic generator shall have an output of approximately 500 w at 25 kc.

The transducers shall be lead zirconate.

This equipment shall comply with applicable requirements of the Federal Communications Commission.

C. Operations Sequence

1. Raise carriage, place rod on carriage (by manipulators).

2. Lower carriage into cleaning water (tank may be filled either before or after raising the carriage to receive rod).
3. Cleansing cycle.
4. Drain.
5. Rinse and drain.
6. Dry (5 min maximum).
7. Raise carriage, remove rod.

D. Manufacturer's Data

1. The Seller shall furnish the following information with the bid:
   a. Sketch or sketches of the proposed equipment showing principal dimensions and accessory components.
   b. Complete description and sequence of operation.
   c. Complete description of proposed remote controls and operators.
2. The Seller shall furnish the following information for approval prior to the start of fabrication:
   a. Assembly drawings.
   b. Mill test reports or certifications for all materials to be in contact with work piece or ultrasonic cleaning medium.
3. The Seller shall furnish the following information with the equipment on delivery:
   a. Three copies of complete operation and servicing instructions.

E. Tests and Acceptance

1. The Seller shall demonstrate the ability of the equipment to meet the requirements of this specification by means of operating tests to be performed at the Seller's site and at the Seller's expense.
2. The Seller shall notify the Company at least 10 days in advance of such tests.
3. The Seller shall furnish a certified report of such tests.

4. Acceptance shall be at the Seller's site upon satisfactory demonstration that the equipment furnished meets the requirements of this specification.

F. Packaging and Shipping

1. The equipment shall be securely crated and/or skidded to prevent damage or contamination of the working surfaces during handling and shipping.
2. The Seller shall include a complete set of installation, operating, and service instructions with the equipment during shipment.

APPENDIX E

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