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ENGINEERING, CONSTRUCTION AND COST OF THE ARGONAUT REACTOR

by

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Reactor Engineering Division

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This report is a compilation of information derived through the process of engineering, construction and costs of designing and building the Argonaut Reactor. The following personnel contributed at various times to this project:

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At this time we would like to express our many thanks to the various service groups of the Laboratory for their excellent support in this project. Special credit is mentioned for the work performed by the Central Shops and Purchasing Department personnel whose participation accelerated the completion and operation of the Argonaut Reactor.

The Argonaut Reactor

The expansion of the nuclear field at Argonne National Laboratory has clearly indicated our need for a low level supplementary reactor facility. In designing a reactor to fill these requirements, we considered the probability that such a reactor might also be of interest to universities engaged in a program in the nuclear sciences. Recognizing the importance of the cost aspects of such a program, we have designed to a cost goal which we feel is compatible with safety and flexibility of use. This reactor is hereinafter referred to as the Argonaut, and is now in the test stage.

The reactor is a thermal heterogeneous type, with an annular core, with internal and external reflectors, and with water moderation. The maximum flux is about 5×10^{11} neutrons per cm per sec at a power level of 10 kw. The critical loading is about 4 kg of U^{235} .

The Argonaut lattice is basically a cube of graphite 5 ft by 5 ft by 4 ft high, containing a centrally located water annulus 2 ft I.D. by 3 ft O.D. by 4 ft high formed by two concentric aluminum tanks. A 2 ft diameter internal graphite reflector is thus formed and contains a center hole plus four additional holes around the periphery. These ports may be used as a locus for Pile Oscillator Measurements and Danger Coefficient Experiments. This internal reflector plug is removable and may be replaced by a portion of a lattice assembly for internal exponential experiments. The top of the reactor must be accessible for loading of fuel assemblies, for insertion of experiments in the center reflector, and for the possible placement of an external exponential assembly. Therefore, this area is kept free of control mechanisms. Against one face of the graphite lattice is a graphite thermal column 5 ft wide by 5 ft long by 4 ft high, containing 15 horizontal experimental ports. Opposite to this face on the other side of the lattice is a mobile flat bed truck to which is assembled a demountable water tank 4 ft wide by 6 ft long by 3-1/2 ft high.

This tank may be used for shielding studies using aqueous media, or, by removing this tank, solid materials may be stacked on the bed of the truck for testing. Concrete blocks are stacked against the remaining two lattice faces, each of which contains an additional experimental port. The Argonaut reactor, therefore, contains a total of 22 experimental ports, five of which are vertical and 17 of which are horizontal.

The area directly over the lattice is shielded by a 5 ft square by 1 ft high steel box containing a removable plug located directly over the internal graphite reflector. Adjacent to this plug are additional removable plugs which provide apertures for the insertion of fuel assemblies. This entire steel box, including the plugs, is filled with heavy concrete. For experiments at higher power, additional ordinary concrete bricks will be used to supplement the heavy concrete shield. A jib crane of 3-ton capacity with a boom arc of 15 ft is provided for the removal of these shielding components.

The upper shielding over the lattice and shield test facility is supported by a structural assembly formed by bolting together 6-in. wide flange aluminum beams. In addition, a five foot square by 1/2 in. thick aluminum plate is bolted over the lattice, and 6 in. by 6 in. wooden beams are mounted over the water shielding test tank. This forms an adequate structure which may be assembled with the simplest of tools, yet one which may be dismantled with ease if, at some later date, it is necessary to move the reactor. The column loading at the four inside columns is 10,000 pounds per column, and at the two outer columns is 4700 pounds per column. The maximum bending stress on the horizontal beams is 7000 psi. The floor loading aside from the column loads is 1500 psf.

The moderating water is contained in an annulus. There are approximately 190 fuel plates arranged in 12 clusters which are separated by graphite segments. This graphite is waterproofed by spraying with Krylon Aluminum Paint. The fuel plates are 2-27/32 in. wide by 24 in. long by 0.096 in. thick, and are made of 40 weight %, U_3O_8 (20% enriched) in an aluminum matrix. The source is an antimony plug inserted in a beryllium cube, and is moved into the fuel zone by an electric drive. The source is capable of 10^8 neutrons per second.

At an allowable short term power level of 10 kw, the heat generation is about 50 watts or 170 BTU per hour per plate. Heat removal is accomplished by circulating water between the fuel plates. At the maximum power level the circulation rate is about 6.5 gpm. The water system contains a 1/4-H.P., stainless steel centrifugal pump (capable of 20 gpm against a 14-ft head), a 34,000-BTU single-pass shell and tube stainless steel heat exchanger (containing 4.3 square feet of surface), a 3-kw heater for moderator temperature control, suitable solenoid valves, strainers, check valves, 1-in. aluminum line piping, and finally a 275-gallon dump and make-up water tank. A 5-gph laboratory ion exchanger is supplied to provide water of adequate purity. A utility trench located under the reactor tank contains the dump line, cooling water line, gas line and electric lines. This trench terminates in a 7 ft wide x 11 ft long x 4 ft deep covered utility pit. Thus, all the above elements are easily accessible for servicing. The pit cover may be locked to prevent access to this area by unauthorized persons.

The dump line is a 6-in. aluminum pipe located directly under the main reactor tank and terminates in the utility pit. The terminal end of the dump line is connected to a 6-in. rubber-lined, electrically operated, butterfly valve which is held closed by a magnetic clutch. A weighted lever arm opens the valve when the clutch is de-energized, emptying the water into the dump tank. Loss of moderator effects positive shutdown.

Control is obtained by conventional absorbing materials located next to the core in the outer reflector. There are now four types of control devices under test. They are:

1. Gravity-actuated rods replacing the graphite reflector with a cadmium-plastic absorber. This is operated by a winch type of mechanism.
2. Same rod as No. 1, except the actuator is a magnetic jack.
3. Cadmium plates riveted to a clock spring. This is operated from a drum mechanism similar to a window shade.
4. Void control, using a vacuum pump to move D_2O into the control zone.

A supplementary safety system is provided by effecting a rapid decrease in moderator bulk density by introducing bubbles. This is done by injecting nitrogen gas through a quick-opening valve simultaneously with the operation of the 6-in. dump system. This gas line is made to fail safe by using the nitrogen pressure to close a normally open mercoid switch in the interlock system. Thus, two completely independent systems effect the shutdown.

The reactor is contained in a prefabricated metal building 40 ft by 60 ft with 21 ft head room from the floor to inside the ridge. The utility requirements are water at 2 gpm at a temperature of 75°F., and 40 kw of 110-v. A.C. single phase electricity.

The design as described has been developed on the "do-it-yourself" philosophy, using a minimum of skilled help for the erection and tryout. Exclusive of fuel charges and erection cost, this reactor may be built for \$100,000.

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The figures in this book are intended to supplement the general description of Argonaut given in ANL-5647, ANL-5552 and in Nucleonics 15 (3), 62 (1957). A complete description is in preparation as ANL-5705. This material is published now for the information of those who may have an interest in constructing Argonaut reactors, or supplying components for them.

Descriptive Drawings

FIGURE 1 (RE-1-17500-D) ARGONAUT REACTOR AND BUILDING This key drawing shows the locations of the reactor, work area, pit, trenches, and control console area in the building. The positions of the lattice and shielding are indicated for clarity.

FIGURE 2 (RE-1-20605) HORIZONTAL SECTION A-A This figure is taken through the reactor at the top of the first level of shielding blocks, locating shielding, graphite reflector and thermal columns, structural assembly and the irradiation facility.

FIGURE 3 (RE-1-17598-E) STRUCTURAL ASSEMBLY This shows the supporting beams, cover plate and shielding over the irradiation facility; methods of construction and materials are indicated.

FIGURE 4 (RE-1-20634-C) IRRADIATION FACILITY ASSEMBLY This figure indicates components and working clearances within the assembly for conducting experiments.

FIGURE 5 (RE-1-20606-E) HORIZONTAL SECTION B-B This figure is taken through the reactor at the top of the second level of shielding blocks. This section locates the liners for the horizontal beam holes and can serve as a general plan of the reactor core and reflectors.

FIGURE 6 (RE-1-17507-D) REFLECTOR GRAPHITE ASSEMBLY This drawing indicates the configuration of the 4 in. square graphite that was used to construct the Argonaut reflector. It should be noted on this and the following drawing that larger sizes of graphite block are under consideration as being preferable.

FIGURE 7 (RE-1-17617-D) THERMAL COLUMN ASSEMBLY This assembly shows the location and construction of the fifteen (15) stringers and the thermal column assembly. It should be noted on this drawing that larger sizes of graphite block are under consideration as being preferable.

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FIGURE 8 (RE-1-17631-C) HORIZONTAL PLUG AND FOIL HOLDER This figure indicates plugs for beam holes extending to the reactor tank.

FIGURE 9 (RE-1-17771-C) INTERNAL THERMAL COLUMN This drawing indicates central thimble with interlock and the four (4) rectangular stringers. See description of Figure 6 concerning graphite module.

FIGURE 10 (RE-1-17774-F) FUEL, ANNULAR REFLECTOR AND GAS SPARGER ASSEMBLY This drawing indicates the fuel and graphite arrangement in the annulus. The gas sparger heads and piping for the spargers are shown.

FIGURE 11 (RE-1-17751-C) FUEL ASSEMBLY This is the Mark I Fuel Assembly now in use. This and the following figure are subject to revision according to the method of handling adopted.

FIGURE 12 (RE-1-17753-B) ARGONAUT FUEL PLATE - MARK I This figure shows plate as reworked for the Mark I assembly.

FIGURE 13 (RE-1-20571-D) DRUM TYPE CONTROL ROD MECHANISM The drawing shows the major components of the control mechanism.

FIGURE 14 (RE-1-20588-C) CONTROL ROD The actual size of cadmium and method of attachment for the drum control rod is shown on the drawing.

FIGURE 15 (RE-1-20607-D) NORTH-SOUTH ELEVATION "C-C" This figure is an elevation taken through the pit, trench, and reactor, showing the piping and the fuel transfer tools in place on the top Shield Box Assembly.

FIGURE 16 (RE-1-17686-D) ARGONAUT PIPING ASSEMBLY This is an isometric drawing of the piping and its location in the reactor. A description of the various units is included.

FIGURE 17 (RE-1-20608-D) EAST-WEST ELEVATION "D-D" This figure through the vertical centerline of the reactor locates the top shield box assembly (RE-1-17761-F) and source drive unit (RE-1-17643-D).

FIGURE 18 (RE-1-17643-D) SOURCE DRIVE This shows the major components and the space requirements of the source assembly.

FIGURE 19 (RE-1-17761-F) TOP SHIELD BOX ASSEMBLY This drawing indicates the removable center plug section which can be positioned as required for fuel removal.

FIGURE 20 (RE-1-20609-C) CONCRETE BLOCK SHIELDING ASSEMBLY This figure is a key for the detailed shielding drawings.

FIGURE 21 (RE-1-17610-E) LAYER #1 SHIELDING BLOCKS This drawing shows the configuration of shielding in relation to the major reactor components which is carried out through the other layers.

FIGURE 22 (RE-2-20633-C) ARGONAUT ELECTRICAL EQUIPMENT LOCATIONS This drawing is a master key to all the electrical units that are used in the reactor operation and control.

FIGURE 23 (RE-2-20570-F) ARGONAUT CONTROL CONSOLE ASSEMBLY This figure represents the control console desk, sequence panel and instrumentation rack cabinets. The operation and control of reactor is conducted from this area.

FIGURE 24 (RE-2-17796-F) ARGONAUT MASTER CONTROL PANEL WIRING This figure indicates the wiring from the control console to the various units within the reactor and pit.

FIGURE 25 (RE-2-20536-F) ARGONAUT CONTROL CIRCUIT - PART I Schematic drawings showing complete electrical operations of the reactor.

FIGURE 26 (RE-2-20537-F) ARGONAUT CONTROL CIRCUIT - PART II Schematic drawings showing complete electrical operations of the reactor.

COST INFORMATION

FIGURE 27 (RE-1-17500-Supplement, Sheet 1) ARGONAUT REACTOR COST SUMMATION

FIGURE 28 (RE-1-17500-Supplement, Sheet 2) ARGONAUT REACTOR COST SUMMATION

FIGURE 29 (RE-1-17500-Supplement, Sheet 3) ARGONAUT REACTOR COST SUMMATION

These Figures 27, 28 and 29 show all the units required for construction and a break down on their cost. Labor and material are shown in separate columns when the unit was fabricated in ANL Central Shops, and is indicated by the prefix S. O. xxxx. Purchased parts are noted in the P. O. column.

FIGURE 30 FOOTNOTES OF THE ARGONAUT REACTOR COST SUMMATION

MISCELLANEOUS

FIGURE 31 (RE-8-20646-C) FLOW DIAGRAM

FIGURE 32 (RE-2-20651-C) PICTORIAL DIAGRAM OF ARGONAUT INSTRUMENTATION

FIGURE 33 (RE-6-20640) ALTERNATE SHIELDING ARRANGEMENT NO. 2 This method uses standard solid concrete building blocks.

FIGURE 34 (RE-6-20641) ALTERNATE SHIELDING ARRANGEMENT NO. 3 This is a monolithic concrete construction.

SITE CONSTRUCTION DRAWINGS
 RE-25-1 SHEET 1 THRU 6
 RE-3-17572-D (FLOOR LAYOUT)

SPECS FOR SUBCONTRACT WORK & ERECTION
 NO. 63 ROLLING DOORS
 NO. 64 PIPING AND HEATING
 NO. 65 ELECTRICAL
 SUBCONTRACT 31-109-38-671 (BUILDING)
 SUBCONTRACT 31-109-38-680 (FOUNDATION)

0 1 5 10
 SCALE IN FT.

FIGURE 1

MICRO FILM STAMP		APPROVED COPY	DATE	CHIEF DRAFTER	DATE	NEXT ASSEMBLY	NO REQUIRED
		STATE APPROVAL	3/19/57	W. K. BOG	3/19/57	ARGONNE NATIONAL LABORATORY	
		DESIGNED BY		GROUP		THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY	
		W. K. BOG		J. KORN	28	TITLES	
		TOLERANCES UNLESS OTHERWISE NOTED				REACTOR & BLDG. ASSEM.	
		FRACTIONAL ± 1/16, DECIMAL ± .005, ANGLE ± 1/4°				ARGONAUT I	
		REMOVE ALL BURRS				SCALE 3/8" = 1'-0"	
		MATERIAL SEE B/M				DRWG NO. RE-1-17500-D	
SYM	ZONE	CHANGE	DATE	BY	CHK

FIGURE 3

FIGURE 5

REV. NO.
 RE-1-17631-C

FIGURE 8

DRWG NO.
RE-1-17771-C

MICRO-FILM STAMP		APPROVED CONST		DATE	CHIEF DRAFTSMAN	DATE	RE-1-20606-E	1
		STAFF APPROVAL		3/12/57	CHECKED	3/12/57	NEXT ASSEMBLY	NO. REQUIRED
		REPRESENTATIVE		ARMSTRONG BOGY	DRAWN BY	J KORN	ARGONNE NATIONAL LABORATORY THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY	
		TOLERANCES UNLESS OTHERWISE NOTED		FRACTIONAL $\pm .005$, DECIMAL $\pm .005$, ANGLE $\pm 1/2^\circ$		TITLE INTERNAL THERMAL COLUMN ASSEM.		
		MATERIAL		SEE RE-1 17771-B/M		SCALE 2"=1'		
A - OVERALL DIM'S ADDED		3/14/57		K M P		DRWG NO. RE-1-17771-C		
SYM.	ZONE	CHANGE	DATE	BY	CH'K.			

FIGURE 9

RE-1-17751-C

MICRO-FILM STAMP								APPROVED CONST		DATE		CHIEF DRAFTSMAN		DATE		NEXT ASSEMBLY		NO. REQUIRE			
								DESIGN APPROVAL		11/14/56		CHECKED		11/14/56		ARGONNE NATIONAL LABORATORY					
								REPRESENTATIVE		GROUP		DRAWN BY		11/5/56		THIS DRAWING IS THE PROPERTY OF					
								R.H. ARMSTRONG		L.M.B.		S.L.K.				THE ARGONNE NATIONAL LABORATORY					
								TOLERANCES UNLESS OTHERWISE NOTED										TITLE			
								FRACTIONAL $\pm$.001, DECIMAL $\pm$.003, ANGLE $\pm$ 1/4°										ARGONAUT FUEL ASSY.			
								REMOVE ALL BURRS										MARK I			
								MATERIAL										SCALE		DRWG NO.	
A				HANDLING TIP & ADAPTER ADDED				RE-1-17751										FULL & AS NOTED		RE-1-17751-C	
SYM. ZONE				CHANGE				DATE				BY		CH'K.							

FIGURE 11

DRWG. NO.

RE-1-17753-B

NOTE

THIS DWG IS FOR RE-WORKING OF PRESENT PLATE.
FOR ORIGINAL DWG SEE RE-1-17516-A

FIGURE 12

MICRO-FILM STAMP

SYM. ZONE

CHANGE

DATE

BY

CH'K.

APPROVED CONST.

DATE

CHIEF DRAFTSMAN

DATE

STAMP APPROVAL

CHECKED

GROUP

DRAWN BY

DATE

REPRESENTATIVE

GROUP

DRAWN BY

DATE

TOLERANCES UNLESS OTHERWISE NOTED
FRACTIONAL $\pm \frac{1}{16}$, DECIMAL $\pm .005$, ANGLE $\pm \frac{1}{4}^\circ$
REMOVE ALL BURRS

MATERIAL

REFER TO RE-1-17516-A

RE-1-17751-C

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NEXT ASSEMBLY

NO. REQUIRED

ARGONNE NATIONAL LABORATORY
THIS DRAWING IS THE PROPERTY OF
THE ARGONNE NATIONAL LABORATORY

TITLE (PLATE)

ARGONAUT FUEL - MARK I

SCALE

FULL

DRWG. NO.

RE-1-17753-B

NOTES:

- NOTES:
1. ITEM 22 (WASHER) THICKNESS TO BE DETERMINED AT ASSEMBLY TO PERMIT AXIAL CLEARANCE OF $\frac{.015}{.030}$ FOR CLUTCH ARMATURE IN ITEM 14.
 2. ASSEMBLE ITEM 12 (ROLL PIN) THRU GEAR IN ITEM 14 & SHAFT, DWG #RE-1-20572-B, TO PRODUCE DIMENSION SHOWN WITH GEAR HUB SNUG AGAINST BUSHING.
 3. ADJUST NUT, ITEM 20, IN ASSEMBLY FOR .030 $\pm$.010 END PLAY BETWEEN NUT & CLUTCH PLATE IN ITEM 14.
 4. ADJUST ECCENTRICITY RE-1-20600-A & RE-1-20599-A IN ASSEMBLY TO CENTER SPRING IN SHEATH, RE-1-20587-C AT ENTRANCE

MICRO FILM STAMP				APPROVED CORSET		DATE	CHECK DRAWING	DATE	NEXT ASSEMBLY	NO. REQUIRED
				STAFF APPROVAL	7/18/57	CHECKED	7/18/57	ARGONNE NATIONAL LABORATORY THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY TITLE DRUM TYPE MECHANISM & CONTROL ROD ASSEMBLY		
				REPRESENTATIVE	JOHN JANKE	CHIEF	F. TURNER	1-30-57	SCALE FULL DRG NO. RE-1-20571-D	
				TOLERANCES UNLESS OTHERWISE NOTED FRACTIONAL $\pm \frac{1}{16}$, DECIMAL $\pm .005$, ANGLE $\pm \frac{1}{4}^\circ$ REMOVE ALL BURRS						
				MATERIAL						
				SEE RE-1-20571-D B/M						
SYM.	ZONE	CHANGE	DATE	BY	CHK.					

DRWG. NO.
RE-1-20588-C

MICRO-FILM STAMP		APPROVED CONST		DATE	CHIEF DRAFTER	DATE	RE-1-20571-D	—
		STAFF APPROVAL		3/18/57	CHECKED	7/18/57	NEXT ASSEMBLY	NO. REQUIRED
		REPRESENTATIVE		JAHNKE	GROUP	BOGORAD	ARGONNE NATIONAL LABORATORY	
		DRAWN BY		F TURNER	1-18-57		THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY	
		TOLERANCES UNLESS OTHERWISE NOTED						TITLE
		FRACTIONAL $\pm$ $\frac{1}{16}$, DECIMAL $\pm$.005, ANGLE $\pm$ $\frac{1}{2}$ °						CONTROL ROD
		REMOVE ALL BURRS						SCALE
		MATERIAL						1-2 & RE-1-20588-C
		NOTED						NOTED
SYN.	ZONE	CHANGE	DATE	BY	CHK.			

FIGURE 14

FIGURE 15

RE-1-20607-D

MICRO FILM STAMP		APPROVED CORST		DATE	CHEF ENGINEER	DATE	RE-1-17500-D	NO REQUIRED
		STATE		11/1/57	W. KOLB	11/1/57	ARGONNE NATIONAL LABORATORY	THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY.
		REPRESENTATIVE		GROUP	W. KOLB	GROUP	ARGONNAUT (PIPING)	
		TOLERANCES UNLESS OTHERWISE NOTED						
		FRACTIONAL ± DECIMAL ± .005 ANGLE ± 1/2°						
		REMOVE ALL BURRS						
		MATERIAL						
		SEE RE-1-17500-B/M						
		SCALE						
		1" = 1'-0"						
		DRAWG NO						
		RE-1-20607-D						

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ITEM	DRWG NO	DESCRIPTION	QUAN
1		2"-150# SCREWED FLANGE IRON	1
2		2" SCHED 40 CLOSE NIPPLE IRON	1
3		2"-150# 180° RETURN IRON	1
4		1/4"x2 STL BRACKET (FIELD FAB) 1" PIPE CLAMP	3
5		1/2 STL PLT BRACKET FOR NITROGEN TANK (FIELD FAB)	2
6		3/16"x1" STL BRACKET (FIELD FAB) 1/2" TUBE CLAMP	3
7		6 PIPE HANGER	2
8		3/4" TUBE CLAMP	1
9		2" PIPE CLAMP HANGER	1
10		1/2 X 2 HANGER BAR (FIELD FAB)	1
11		2 PIPE CLAMP DEVICE (FIELD FAB) (FASTEN TO FLOOR)	1
12		2' PIPE CLAMP DEVICE (FIELD FAB) (FASTEN TO STRUCTURAL ASSY)	2
13		1/4"x2 STL BRACKET (FIELD FAB) 2' PIPE CLAMP	1
14		3/8"x2 STL BRACKET (FIELD FAB) (1 EA SIDE OF FLANGE)	2
15		1/2" STL PLT SHELF FOR DUMP VALVE	1
16		3/4-10 UNC X 4 LG HEX HD CAPSCR	32
16A		3/4-10 UNC NUT X LOCKWASHER	32
RE-1-17606-E		REACTOR VESSEL ARGONAUT	1
RE-1-17655-E		ARGONAUT DUMP VALVE II	1
RE-1-17684-B		ARGONAUT DUMP LINE (VALVE TO DUMP TANK)	1
RE-1-17685-B		ARGONAUT DUMP LINE (REACTOR TO VALVE)	1
RE-1-17687-B		FEED WATER PIPING	1
RE-1-17688-B		PUMP INLET PIPING	1
RE-1-17689-B		PUMP DISCHARGE PIPING	1
RE-1-17690-B		HEAT EXCHANGE PIPING	1
RE-1-17691-B		RETURN PIPING	1
RE-1-20534-B		ARGONAUT DUMP TANK	1
RE-1-20611-B		FLOAT SWITCH PIPING (GAS SHUT-OFF)	1
RE-1-20612-B		COOLING WATER PIPING (DRAIN)	1
RE-1-20613-B		COOLING WATER PIPING (INLET)	1
RE-1-20614-B		GAS LINE PIPING	1

RE-1-17686-D

FIGURE 16

MICRO FILM STAMP		APPROVED CONST		DATE	CD OF DRAFTSMAN	SYN	ZONE	CHANGE	DATE	BY	CHK	RECORD NO	RE-1-17686-D
STAFF APPROVAL		CHUCK		3/11/57	3/11/57	ARMSTRONG		BOG		J KORN		RE-1-17686-D	
REPRESENTATIVE		ARMSTRONG		BOG		J KORN		RE-1-17686-D		RE-1-17686-D		RE-1-17686-D	
TOLERANCES UNLESS OTHERWISE NOTED		FRACTIONAL ± 1/16 DECIMAL ± .005 ANGLE ± 1/2°		REMOVE ALL BURRS		MATERIAL NO SEPARATE BY ALL		PART INDICATED ON DRWS		SCALE		DRWG NO	
NEXT ASSEMBLY		NO REQUIRED		ARGONNE NATIONAL LABORATORY		THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY		TITLE		ARGONAUT PIPING ASSEMBLY		RE-1-17686-D	

RE-1-20608-D

FIGURE 17

RE-1-17500-D		NO REQUIRED	
NEXT ASSEMBLY		NO REQUIRED	
ARGONNE NATIONAL LABORATORY THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY			
TITLE E-W ELEVATION D-D ARGONAUT PIPING			
SCALE 1"=1'-0"		DRWG NO RE-1-20608-D	
MATERIAL SEE RE-1-17500-B/M			
TOLERANCES UNLESS OTHERWISE NOTED FRACTIONAL ± 1/16" DECIMAL ± .005 ANGLE ± 1/2° REMOVE ALL BURRS			
APPROVED CONST DATE 3/19/67 CH OF DESIGNER W KOLB GROUP BOGAL DRAWN BY J KORN 2/57			
STAFF APPROVAL 3/19/67 REPRESENTATIVE W KOLB			
MICRO FILM STAMP			
SYN	ZONE	CHANGE	DATE BY CH K

RE-1-20608-D	1
--------------	---

MICRO FILM STRAP				APPROVED COMET		DATE	CREEC CRAFTSMAN	DATE	NEXT ASSEMBLY	NO. REQUIRE
D	2C	RE-1-20567-B & RE-1-20568-B ADDED	25/5	5/2	STATE APPROVAL	7-30-54	CHECKED	7/26/54	ARGONNE NATIONAL LABORATORY THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY	
C	4b	Removed Item 11 and changed D to A type	5/2	5/2	REPRESENTATIVE	SELECTED	GEORGI	7-11-54	TITLE	
B		ONE CHANGED TO 10 DEGREE WITH DETAILS	5/2	5/2	TOLERANCES UNLESS OTHERWISE NOTED FRACTIONAL ± 1/16 DECIMAL ± .005 ANGLE ± 1/2°					
A	2d	1-2 ADDED SW. & BRKT.	7/31	5/2	SOURCE DRIVE MECHANISM					
	3b	3-ADDED ITEM 23	5/2	5/2	REMOVE ALL BURRS					
SYM. ZONE				CHANGE	DATE	BY	CHK	MATERIAL		
					SEP	RE-1-17643	-BM	SCALE		
								HALF		
								DRWG. NO.		
								RE-1-17643-D		

DRWG NO.
RE-1-20609-C

MICRO FILM STAMP		APPROVED CONST		DATE	CHIEF DRAFTSMAN	DATE	RE-1-17500-D	1
		STAFF APPROVAL		3/19/57	CHIEF DRAFTSMAN	3/19/57	NEXT ASSEMBLY	
		REPRESENTATIVE		W. KOLB	GROUP	BOGIV	NO. REQUIRED	
		TOLERANCES UNLESS OTHERWISE NOTED		FRACTIONAL $\pm$ 1/16, DECIMAL $\pm$.005, ANGLE $\pm$ 1/4°		ARGONNE NATIONAL LABORATORY		
		REMOVE ALL BURRS		SEE RE-1-20609-B/M		THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY		
		MATERIAL		3/8" - 10"		TITLE		
		SYN. ZONE		CHANGE		SCALE		DRWG NO.
		DATE		BY		3/8" - 10"		RE-1-20609-C
		CH'K.				GLENNON & KERN, CHICAGO		

FIGURE 20

DRWG. NO.
RE-2-20633-C

MICRO-FILM STAMP		APPROVED <i>603</i>		DATE <i>3/6/57</i>	CHIEF DRAFTSMAN <i>SM</i>	DATE <i>3/6/57</i>	RE-2-20570-F		1
		STAMP APPROVAL <i>RESC</i>		DATE <i>3/1/57</i>	CHECKED <i>SM</i>	DATE <i>3/6/57</i>	NEXT ASSEMBLY		NO. REQUIRED
		REPRESENTATIVE <i>RESC</i>		GROUP <i>BOGY</i>	DRAWN BY <i>WALTERS</i>	DATE <i>2/13/57</i>	ARGONNE NATIONAL LABORATORY		
		TOLERANCES UNLESS OTHERWISE NOTED FRACTIONAL $\pm$ 1/16, DECIMAL $\pm$.005, ANGLE $\pm$ 1/4° REMOVE ALL BURRS					THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY		
		MATERIAL					TITLE		
		SEE RE-2-20633-B/M					ARGONAUT ELECTRICAL EQUIPMENT LOCATIONS		
		SCALE $\frac{3}{8} = 1'0$					DRWG. NO.		
							RE-2-20633-C		
SYM.	ZONE	CHANGE	DATE	BY	CHK.				

FIGURE 22

FIGURE 24

RE 2 20596 F		REV. 1	
ARGONNE NATIONAL LABORATORY		ARGONNE NATIONAL LABORATORY	
THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY		THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY	
TOLERANCES UNLESS OTHERWISE NOTED		TOLERANCES UNLESS OTHERWISE NOTED	
PREF. DIM. IS IN. DECIMALS TO TWO PLACES		PREF. DIM. IS IN. DECIMALS TO TWO PLACES	
REMOVE ALL DIMENSIONS		REMOVE ALL DIMENSIONS	
DATE: 11/1/54		DATE: 11/1/54	
BY: [Signature]		BY: [Signature]	
CHECKED: [Signature]		CHECKED: [Signature]	
APPROVED: [Signature]		APPROVED: [Signature]	
SCALE: 1/8" = 1"		SCALE: 1/8" = 1"	
RE 2 17796-F		RE 2 17796-F

NOTE:
CONTINUED ON RE-220537-F

[illegible]

NOTE
THIS IS A CONTINUATION
OF FIGURE 25

A AMBER INDICATOR
CSW CONTROL SWITCH
CWV CONVECTION WATER VALVE
F₁ & F₂ MOTOR FUSE
G GREEN INDICATOR
K & RELAY AND CONTACTS
LS₁ PRESSURE SYSTEM LIMIT SWITCH
LS₂ SOURCE "IN" LIMIT SWITCH
LS₃ SOURCE "OUT" LIMIT SWITCH
LS₄ SAFETY ROD #1 "DOWN" LIMIT SWITCH
LS₅ SAFETY ROD #1 "UP" LIMIT SWITCH
LS₆ SAFETY ROD #2 "DOWN" LIMIT SWITCH
LS₇ SAFETY ROD #2 "UP" LIMIT SWITCH
LS₈ SAFETY ROD #3 "DOWN" LIMIT SWITCH
LS₉ SAFETY ROD #3 "UP" LIMIT SWITCH
LS₁₀ DUMP VALVE "CLOSED" LIMIT SWITCH
LS₁₁ DUMP VALVE "OPEN" LIMIT SWITCH
LS₁₂ CONTROL ROD #1 "DOWN" LIMIT SWITCH
LS₁₃ CONTROL ROD #1 "UP" LIMIT SWITCH
LS₁₄ CONTROL ROD #2 "DOWN" LIMIT SWITCH
LS₁₅ CONTROL ROD #2 "UP" LIMIT SWITCH
LS₁₆ CONTROL ROD #3 "DOWN" LIMIT SWITCH
LS₁₇ CONTROL ROD #3 "UP" LIMIT SWITCH
LS₁₈ CONTROL ROD #3 "UP" LIMIT SWITCH
MAG MAGNETIC CLUTCH
NCWV NATURAL CONVECTION WATER VALVE
R RED INDICATOR
R₁ & R₂ RECEIVER SWITCH
SSW SELECTOR SWITCH
T TRANSMITTER SWITCH
K 1000 OHMS (RESISTANCE)

CSW
D
POSITION SECTION

CSW CONTROL SWITCH

CONTACT (MADE)	SOURCE "IN" RODS "UP" DUMP VALVE CLOSED DUMP "ON"	CFF	SOURCE "OUT" RODS "DOWN"
A			
B			
C			
D			
E			
F			
G			
H			
I			
J			
K			
L			
M			
N			
O			

CSW SELECTOR SWITCH

POSITION	UP/DRIVE	SAFETY ROD DRIVE #1	SAFETY ROD DRIVE #2	SAFETY ROD DRIVE #3	DUMP VALVE	DUMP	CONTROL ROD	CONTROL ROD	CONTROL ROD
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

FIGURE 26

APPROVED COPY	DATE	CHIEF ENGINEER	DATE
REVIEW COPY	DATE	CHIEF ENGINEER	DATE
ARIZONA NATIONAL LABORATORY THIS DRAWING IS THE PROPERTY OF THE ARIZONA NATIONAL LABORATORY IT IS TO BE KEPT IN THE LABORATORY AND NOT TO BE LOANED OR REPRODUCED WITHOUT THE WRITTEN PERMISSION OF THE CHIEF ENGINEER			
TITLE: CONTROL CIRCUIT (PART 2) SCALE: FE 2-20537 F			

CLASS		ARGONNE NATIONAL LABORATORY		BILL OF MATERIAL		NO. RE-1-17500 - SUPPLEMENT										COST DATA			
MANUFACTURED		PREPARED BY		APPROVED BY		SHEET		PROJECT ENGINEER		PROJECT NAME		THIS B/M SUPPLEMENTS GENERAL REACTOR B/M RE-1-17500		PREPARED BY		APPROVED BY			
PURCHASED SPECIAL SPEC.		BY				1 OF 3		LENNOX		ARGONAUT REACTOR COST SUMMATION									
PURCHASED COMM. RAW		R																	
PURCHASED ARGONNE FINISH		A																	
DATE	CHANGE	SYM	DATE	CHANGE	SYM	DATE	CHANGE	SYM	DATE	CHANGE	SYM	DATE	CHANGE	SYM	DATE	CHANGE	SYM		
ITEM	PART NUMBER	PART NAME	REQ. PER UNIT	MATERIAL DESCRIPTION	CLASS	PUR. REQ. ISSUED	P.O. OR W.O. NUMBER	DATE ISSUED	DELIVERY PROMISE	SEE FOOT NOTE NO.	LABOR HOURS	REMARKS	MAT.	LABOR	UNIT TOTAL	SUB-TOTAL			
1	RE-1-17500	REACTOR ASSEMBLY	1 X																
2																			
3	RE-1-17598-E	STRUCTURE ASSY.	1	SEE B/M RE-1-17598		3.0	4113			1	158		528	869	1397				
4	RE-1-17744-C	STRUCTURAL TOP PLATE ASSY.	1	" " RE-1-17744		3.0	5028-5397				78		126	430	556				
5																			
6												STRUCTURE SUB-TOTAL	654	1299	1953	1953			
7	RE-1-17686-D	PIPING ASSEMBLY	1 X																
8		~ WATER CIRCUIT- DUMP SYSTEM ~	1 X																
9	RE-1-17606-E	REACTOR TANK ASSY. (OUTER)	1			5.0	4534			2	103		255	567	822				
10	RE-1-17685-B	DUMP LINE (TANK TO VALVE)	1			5.0	4705				21 1/2		107	118	225				
11	RE-1-17655-E	DUMP VALVE ASSY.	1	SEE B/M RE-1-17655		5.0	4623			3	104	VALVE RO. 193857 - \$167.00	380	572	952				
12	RE-1-17684-B	DUMP LINE (VALVE TO DUMP TANK)	1			3.0	4705				21 1/2		81	118	199				
13	RE-1-20534-B	DUMP TANK ASSY.	1	ALUMINUM		RO.	210743			4			300		300				
14												DUMP SYSTEM SUB-TOTAL	1123	1975	2498				
15		~ WATER CIRCUIT-COOLANT LINE TUBE ~	1 X																
16	RE-1-17688-B	PUMP INLET PIPING-LESS PUMP	1									FIELD CUT & ASSEMBLE	108		108				
17		PUMP	1	CENTRIFUGAL - 1/4 HP		RO.	196728						135		135				
18	RE-1-17689-B	PUMP DISCHARGE PIPING	1									FIELD CUT & ASSEMBLE	78		78				
19	RE-1-17690-B	HEAT EXCHANGER PIPING LESS EXCH.	1									" " " "	229		229				
20		HEAT EXCHANGER	1	34000 BTU. - S.S.		RO.	200739					1 PASS 34000 BTU	175		175				
21	RE-1-17691-B	RETURN PIPING	1									FIELD CUT & ASSEMBLE	242		242				
22												SUB-TOTAL	967		967				
23		~ WATER CIRCUIT-COOLANT LINE SHELL ~	1 X																
24	RE-1-20613-B	COOLING WATER PIPING-INLET	1									VALVE RO. 206298 - \$37.00 FIELD CUT & ASSEMBLE	48		48				
25	RE-1-20612-B	COOLING WATER PIPING-OUTLET	1									" " " "	8		8				
26												SUB TOTAL	56		56				
27	RE-1-17687-B	FEED WATER PIPING	1									FIELD CUT & ASSEMBLE	103		103				
28																			
29		~ GAS LINE PIPING ~	1 X																
30	RE-1-20614-B	GAS LINE PIPING LESS SPARGER SECTION	1									FIELD CUT & ASSEMBLE	84		84				
31	RE-1-17781-D	SPARGER ASSEMBLY	2	SEE B/M RE-1-17771		5.0	5206			12		SPARGER RO. 213241 - \$72.00	83	66	149				
32	RE-1-20611-B	FLOAT SWITCH ASSY. GAS SHUT OFF	1								2		20	11	31				
33												SUB TOTAL	187	77	264				
34		MISC. HARDWARE	1	SEE DWG. RE-1-17686-D									100		100				
35												PIPING SUB-TOTAL	2536	1452	3988	3988			
36																			
37		~ GRAPHITE & ASSOCIATE PARTS ~																	
38	RE-1-17507-D	REFLECTOR ASSY.	1	SEE B/M RE-1-17507-D		5.0	2858	MULTIPLICATION EXR. ARGONAUT REWORK		185	183.1	1817.50 + 7.50 MATERIAL = 1025.10	8	2151	2159				
39												BLANK GRAPHITE 7896 LBS. AT \$0.50 PER LB. =	3948		3948				
40												REFLECTOR SUB-TOTAL	3956	2151	6107				
41	RE-1-17771-C	INTERNAL THERMAL COLUMN	1 X	SEE B/M RE-1-17771-C															
42	RE-1-17624-B	INTERNAL VESSEL	1	ALUMINUM		5.0	2767			2	70		55	385	440				
43	RE-1-17501-C	GRAPHITE	1								135	1238 LBS. AT \$0.50 PER LB.	619	742	1361				
44		GRAPHITE METAL BASE & HOOK	1	ALUM. - STEEL							10		44	55	99				
45	RE-1-17503-C	STRINGERS PLUS WIRING	1								9	68 LBS. GRAPHITE AT \$0.50 LB. 34.00	47	50	97				
46												INTERNAL T.C. SUB-TOTAL	765	1232	1997				
47																			
48	RE-1-17617-D	THERMAL COLUMN	1			5.0	4205				214	METAL PARTS MATERIAL	2	1177	1179				
49												BLANK GRAPHITE 11336 LBS AT \$0.50 PER LB. = 5668.00	5668		5668				
50												THERMAL COLUMN SUB-TOTAL	5670	1177	6847				
51																			
52	RE-1-17774-F	ANNULAR REFLECTOR ASSY. LESS GAS SYSTEM, FUEL, OUTER & INNER TANKS	1	SEE B/M RE-1-17774-F		5.0	3099, 5131, 3419, 5213				123	METAL PARTS MAT. & LABOR - 30 HRS.	12	165	177				
53												BLANK GRAPHITE 476 LBS. AT \$0.50 PER LB. = 238.00	238	507	745				
54													250	672	922				
55																			
56																			

FIGURE 27

CLASS		ARGONNE NATIONAL LABORATORY										BILL OF MATERIAL										NO. RE-1-17500 - SUPPLEMENT										COST DATA			
MANUFACTURED		PURCHASED SPECIAL SPEC.		PURCHASED COMM. RAW		PURCHASED ARGONNE FINISH		PREPARED BY R.N. ARMSTRONG		APPROVED BY		SHEET 2 OF 3		PROJECT ENGINEER LENNOX		PROJECT NAME ARGONAUT REACTOR COST SUMMATION						PREPARED BY		APPROVED BY											
DATE	CHANGE	SYM	DATE	CHANGE	SYM	DATE	CHANGE	SYM	DATE	CHANGE	SYM	DATE	CHANGE	SYM	DATE	CHANGE	SYM	DATE	CHANGE	SYM	DATE	CHANGE	SYM	DATE	CHANGE	SYM									
ITEM	PART NUMBER	PART NAME				REQ. PER UNIT		MATERIAL DESCRIPTION				CLAS	PUR. REQ. ISSUED	P.O. OR W.O. NUMBER	DATE ISSUED	DELIVERY PROMISE	SEE FOOT NOTE NO.	LABOR HOURS	REMARKS				MAT.	LABOR	UNIT TOTAL	SUB-TOTAL									
57	RE-1-17575-A	CONTROL ROD FILLER BLOCKS				8													86.4	BLANK GRAPHITE 797 LBS AT .050 LB				398	478	876									
58																																			
59	RE-1-17631-C	SHIELD STRINGER GRAPHITE				2		SEE LINE 1 FOR BALANCE OF COST					S.O.	4152					3.5	BLANK GRAPHITE 32 LBS. AT .050 LB.				16	19	35									
60																																			
61	RE-1-17652-C	SOURCE CARRIER GRAPHITE				1		SEE LINE 1 FOR BALANCE OF COST					S.O.	4292					2.2	BLANK GRAPHITE 20 LB. AT .050 LB.				10	12	22									
62																			1044	GRAPHITE PARTS SUB-TOTAL				11065	5741	16806	16806								
63																																			
64	RE-1-17751-C	FUEL ASSEMBLY MARK 1				12		SEE B/M RE-1-17751					S.O.	5057 & 5208					473	INCLUDING FUEL PLATE REWORK				228	2602	2830	2830								
65																																			
66	RE-1-17643-D	SOURCE DRIVE ASSY.				1		SEE B/M RE-1-17643					S.O.	4292					116.8	LESS SOURCE, BE BLOCK & GRAPHITE GRAPHITE COSTS SHOWN ON LINE 61				166	643	809									
67	RE-1-20568-B	ANTIMONY SOURCE				1							S.O.						28					220	154	374									
68	RE-1-20567-B	BE BLOCK				1																													
69																				SOURCE PARTS SUB-TOTAL				386	797	1183	1183								
70																																			
71	RE-1-20634-C	WATER SHIELD TANK ASSY.				1 X							R.O.	210179					5	60	410 ²⁰ PURCHASE COST + 330 ²⁰ REWORK				410	330	740								
72		TUNNEL LINING				25		MASONITE					R.O.	213874											182		182								
73		LEAD BRICKS				42		2 X 4 X 8 LEAD						STOCK							26.27 LBS. EA. AT .20 PER LB = 5.25 EACH				221		221								
74		TRACK & STOP				1							S.O.	5185					15					45	83	128									
75		FLOOR LOCK				1							R.O.	216260											9		9								
76		CONCRETE SHIELD & PAINT				1							O.P.E.R.	#140808					37					20	205	225									
77		EYE BOLTS				4								STOCK							.68 EACH.				3		3								
78		CAR MOVER				1							R.O.	209412											13		13								
79																					WATER SHIELD TANK SUB-TOTAL				903	618	1521	1521							
80																																			
81	~ SHIELDING - GENERAL (SEE ALTERNATE ARRANGEMENTS PER RE-6-20640-B & RE-6-20641-B)																																		
82	RE-1-17761-F	TOP SHIELD BOX ASSY.				1		SEE B/M RE-1-17761					S.O.	5046					539	CONCRETE MAT. 11.80 LAB. 121.00 = 133.08				262	2965	3227									
83																																			
84	RE-1-17610-15-E	CONCRETE SHIELDING BLOCKS				25		SEE B/M RE-1-17610-15					LWD657 O.P.E.R. #1476	9133				7	459	LAYERS 1706				115	2525	2640									
85		PLYWOOD SPACER				5		1" X 48" X 96" 7 PLY FIR					R.O.	213786						FIELD CUT				60		60									
86	RE-1-17607-C	LINER HORIZONTAL PLUG				2		SEE LINE 59 FOR BALANCE OF COST					S.O.	4152					57.5					42	316	358									
87	RE-1-17631-C	HORIZONTAL FOIL & PLUG HOLDER				2																													
88		SPECIAL CONCRETE BLOCKS				25							R.O.	216112											157		157								
89		STOCK CONCRETE BLOCKS				220								STOCK							# 10.50 EACH.				2310		2310								
90																					GENERAL SHIELDING SUB-TOTAL				2884	2841	5925								
91																					TOTAL SHIELDING				2946	5806	8752	8752							
92																																			
93	~ INTERLOCKS ETC.																																		
94	RE-1-17766-C	INTERLOCK SPACER ASSY.				1		SEE B/M RE-1-17766					S.O.	5186					30					46	165	211									
95	RE-1-20532-C	FLOAT SWITCH ASSY.				1		SEE B/M RE-1-20532					S.O.	5286					6					53	33	86									
96	RE-1-	PIT TERMINAL BOARD				1							S.O.	5225					15					8	83	91									
97		DETECTO RAY PHOTO SYSTEM				2							R.O.	219412											59		59								
98																																			
99																					SUB-TOTAL				166	281	447	447							
100																																			
101	~ FUEL HANDLING ETC. ~																																		
102	RE-1-20620-D	TRANSFER COFFIN ASSY.				1		SEE B/M RE-1-20620					S.O.	5758					420					450	2310	2760									
103	RE-1-17789-D	FUEL GRABBER ASSY.				1		SEE B/M RE-1-17789					S.O.	5210					87					43	479	522									
104	RE-1-17786-D	FUEL HANDLING GUIDE				1							S.O.	5698					64					230	352	582									
105																					FUEL HANDLING SUB-TOTAL				723	3141	3864	3864							
106																																			
107	~ ELECTRONICS ~																																		
108	RE-2-17796-F	MASTER CONTROL PANEL WIRING				1		SEE B/M RE-2-17796																											
109																																			
110																																			
111																																			
112																			1500	ELECTRONIC TOTAL				8250	8850	16500	16500								

FIGURE 28

[illegible]

FIGURE 29

2

FOOT NOTES
(OUTSIDE QUOTATIONS)

1. Structure Assy. RE-1-17598-E, Req. #360136. \$855.61

BIDDERS

Schelm Brothers
Chicago Boiler Company
Sherman Reynolds Company
Oakley Company
Chicago Metal Manufacturing Company
Allis Chalmers Company

2. Reactor Tanks Outer and Inner RE-1-17606-E &
RE-1-17624-B, Req. 359047. \$832.54

BIDDERS

Cherry Burrell Company
S. Blickman, Incorporated
Schelm Brothers
Process Equipment Company
Aluminum Company of America (NO BID)
Stacy Manufacturing Company (NO BID)

3. 6" Dump Valve (Less Operator) RE-1-17655 -
P. O. 193857 - Price \$167.00.

6" Dump Valve Assy. RE-1-17655, Req. 360062. \$606.00

BIDDERS

Boyar Schultz Company (less valve)
Laystrom Mfg. Company (less valve)
General Mills Company (time and material only)

NO BIDS OR BIDS OFFERING SUBSTITUTES ON DUMP VALVE
FROM FOLLOWING:

American Bosch, Arma Division
Kempsmith Machine Company
Northwestern Tool & Eng. Company
Acme Industrial Company
Cook Electric Company
Merz Machine & Tool Works
Johnson Corporation
R. G. Lawrence Company
Associated Valve & Eng. Company
S. Morgan Smith Company
Everlasting Valve Company
W. P. Nevins Company
Allis Chalmers Company
Ruggles Lingeman Mfg. Company
Davis Regulator Company
McRae Corporation
Meters & Controls
Akomatic Valve Company
Hammel-Dahl Valve Company
Automatic Switch Company

4. Dump Tank Assy. RE-1-20534-B, Req. #354195. \$299.43

BIDDERS ON ALUMINUM TANK

Schelm Brothers
Chicago Boiler Company
Aluminum Company

BIDDERS ON STEEL TANK

Bennett Industries, Inc.
Tanks, Incorporated
Chicago Boiler Company
Chicago Steel Tank Company

5. Water Shield Tank RE-1-20634-C (Cart and
Tank Only) Req. #R-354177. \$410.00

BIDDERS

Brett Machine Company
Montgomery Equipment Company
Howe Hand Trucks
Mercury Manufacturing Company
Midwest Handling Company
Materials Trans. Company
Elpar Engineering Company

6. Winch-type Control Mechanism RE-1-20610-D,
Req. #360063. \$572.76 (Six Units Basis)

BIDDERS

General Mills Mech. Division
A.F.C. Tool & Machine Company
American Manufacturing Company
Columbus Tool, Die & Machine Co. (NO BID)
Economy Machine Products (NO BID)
American Machine & Foundry (NO BID)
United Shoe Machinery Company (NO BID)
Ford Instrument Company (NO BID)

7. Solid Shield Blocks, Req. #366702 - 150 lbs/ft³
Density - Actual Size 7-5/8 x 7-5/8 x 15-5/8".
\$ 0.35 ea.

BIDDERS

Werden Buck Company
Joliet Concrete
Products Company
Materials Service Corporation

8. Graphite - BIDDERS \$22,300.00

National Carbon Company
United Carbon Products Company
Great Lakes Carbon Company
Stackpole Carbon Company (NO BID)
International Graphite Company (NO BID)
U. S. Graphite (NO BID)

MICRO-FILM STAMP					APPROVED CONST.	DATE	CHIEF DRAFTSMAN	DATE	<i>K</i>	<i>K</i>
					STAFF APPROVAL		CHECKED		NEXT ASSEMBLY	NO. REQUIRED
					REPRESENTATIVE	GROUP	DRAWN BY		ARGONNE NATIONAL LABORATORY	
					IV. KOLB	BOGY	J. KORN	22537	THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY	
					TOLERANCES UNLESS OTHERWISE NOTED FRACTIONAL $\pm \frac{1}{16}$, DECIMAL $\pm .005$, ANGLE $\pm \frac{1}{2}^\circ$ REMOVE ALL BURRS				TITLE	FLOW DIAGRAM ARGONAUT
					MATERIAL	<i>K</i>			SCALE	DRWG. NO.
	SYM.	ZONE	CHANGE	DATE	BY	CH'K.			<i>K</i>	RE-8-20646-C

FIGURE 31

PICTORIAL DIAGRAM OF ARGONAUT INSTRUMENTATION

FIGURE 32

75

MICRO-FILM STAMP						APPROVED CONST	DATE	CHIEF DRAFTSMAN	DATE	NEXT ASSEMBLY	NO. REQUIRED	
						STAFF APPROVAL	3-15-57	CHECKED		ARGONNE NATIONAL LABORATORY THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY		
						REPRESENTATIVE	GROUP	DRAWN BY	2-13-57			
						TOLERANCES UNLESS OTHERWISE NOTED FRACTIONAL ± 1/16, DECIMAL ± .005, ANGLE ± 1/2° REMOVE ALL BURRS				TITLE ALTERNATE SHIELDING ARRANGEMENT NO. 2		
						MATERIAL REFER ABOVE				SCALE 3" = 1 FT.	DRWG. NO. RE-6-20640-B	
	SYM	ONE	CHANGE	DATE	BY	CHK.						

DRWG. NO.
RE-6-20641-B

FIGURE 34

MICRO-FILM STAMP						APPROVED CONST.	DATE	CHIEF DRAFTSMAN	DATE	NEXT ASSEMBLY	NO. REQUIRED
						STAFF APPROVING <i>R.H. Armstrong</i>	3-15-57	CHECKED		ARGONNE NATIONAL LABORATORY	
						REPRESENTATIVE	GROUP	DRAWN BY <i>R.H.A</i>	2-19-57	THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY	
						TOLERANCES UNLESS OTHERWISE NOTED FRACTIONAL $\pm \frac{1}{16}$, DECIMAL $\pm .005$, ANGLE $\pm \frac{1}{4}^\circ$ REMOVE ALL BURRS				TITLE ALTERNATE SHIELDING ARRANGEMENT NO. 3	
						MATERIAL REFER ABOVE				SCALE $\frac{3}{8} = 1 \text{ FT.}$	DRWG. NO. <i>RE-6-20641-B</i>
SYM.	ZONE	CHANGE			DATE	BY	CH'K.

ISOMETRIC VIEW
OF THE
ARGONAUT REACTOR