ANL-5704

ARGONAUT

Argonne's Nuclear Assembly for University Training

ENGINEERING CONSTRUCTION AND COSTS

By R. H. Armstrong, W. L. Kolb and D. H. Lennox
Reactor Engineering Division

ARGONNE NATIONAL LABORATORY

OPERATED BY THE UNIVERSITY OF CHICAGO
For the Atomic Energy Commission

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ARGONNE NATIONAL LABORATORY
P. O. Box 299
Lemont, Illinois

ENGINEERING, CONSTRUCTION AND COST OF THE ARGONAUT REACTOR

by

R. H. Armstrong, W. L. Kolb and D. H. Lennox

Including work done by: C. N. Kelber, Andrew Selep and B. I. Spinrad

Reactor Engineering Division

March 1957

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ACKNOWLEDGEMENTS

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:

Reactor Engineering Division

F. W. Bewersdorf	J. N. Young
A. F. Engfer	D. F. Uecker
E. F. Groh	R. H. Jahnke
C. A. Pesce	

Reactor Engineering Division Drafting Group

P. J. Basnar	G. C. Drapalik
P. V. Dauzvardis	R. B. Walters
J. R. Korn	T. W. Lohrentz

Electronics Division	Metallurgy Division
W. K. Brookshier	D. E. Walker
D. C. Thompson	R. A. Nolan
W. W. Managan	

Harry Bryant will supervise the Argonaut training program for students of the International School of Nuclear Science and Engineering.

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.

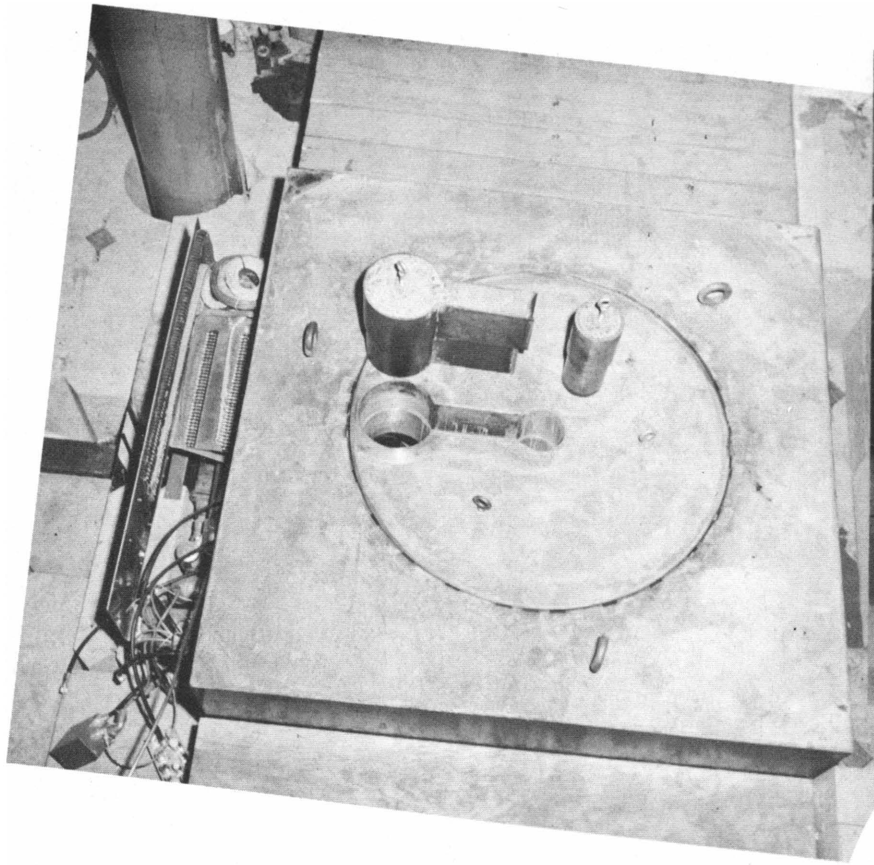
3. Cadmium plates riveted to a clock spring. This is operated from a drum mechanism similar to a window shade.

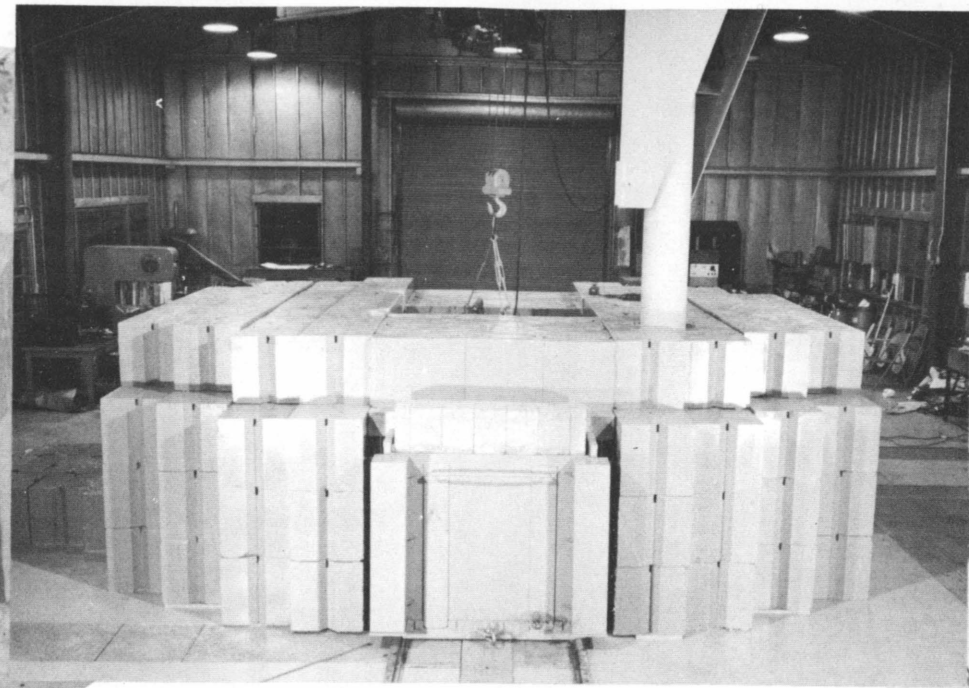
4. Void control, using a vacuum pump to move D_2O into the control zone.

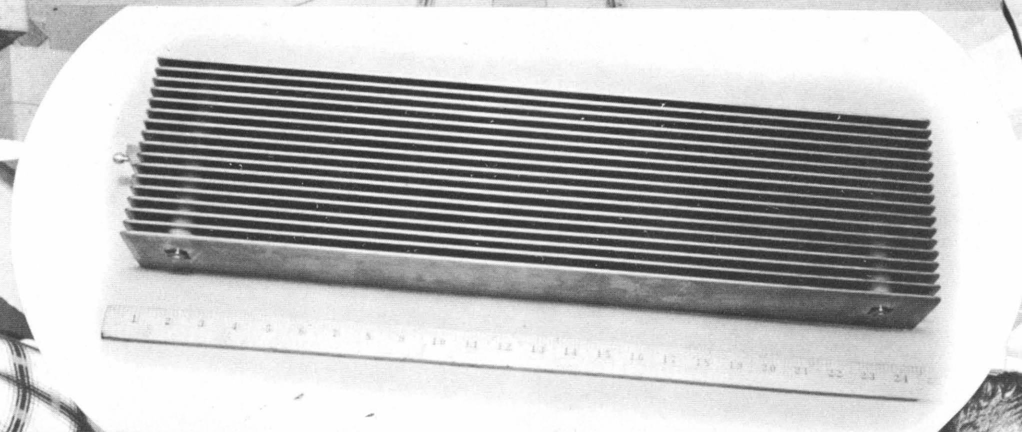
A supplementary safety system is provided by effecting a rapid decrease in moderator bulk density by introducing bubbles. This is done by injecting nitrogen gas through a quick-opening valve simultaneously with the operation of the 6-in. dump system. This gas line is made to fail safe by using the nitrogen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

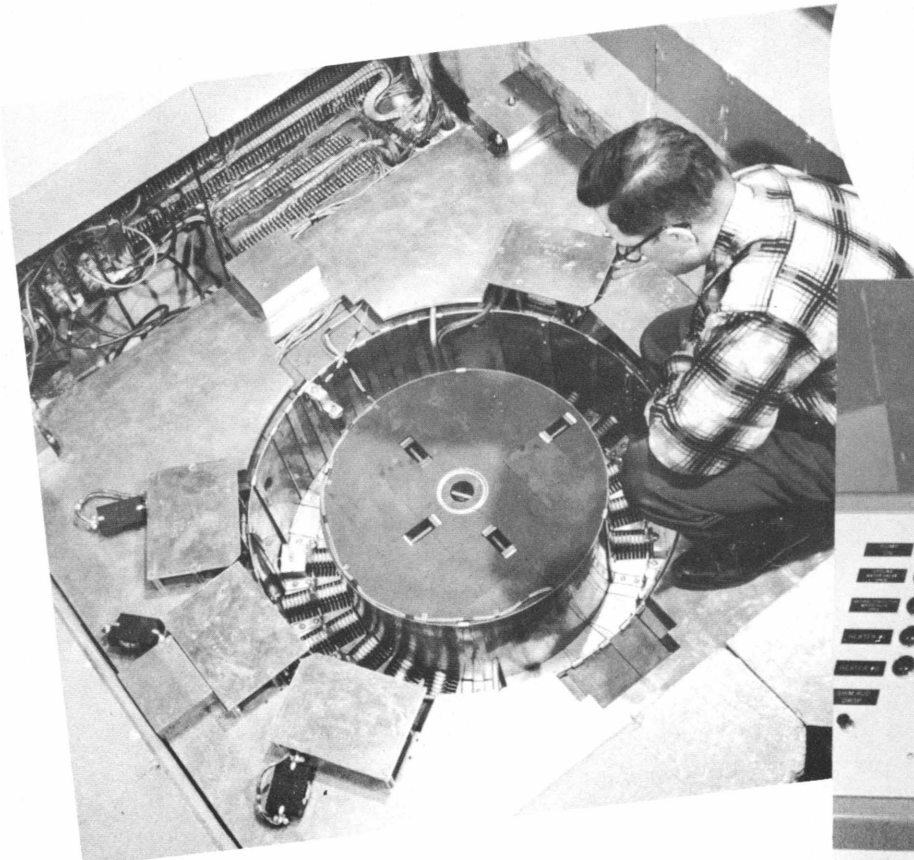
The reactor is contained in a prefabricated metal building 40 ft by 60 ft with 21 ft head room from the floor to inside the ridge. The utility requirements are water at 2 gpm at a temperature of 75°F., and 40 kw of 110-v. A.C. single phase electricity.

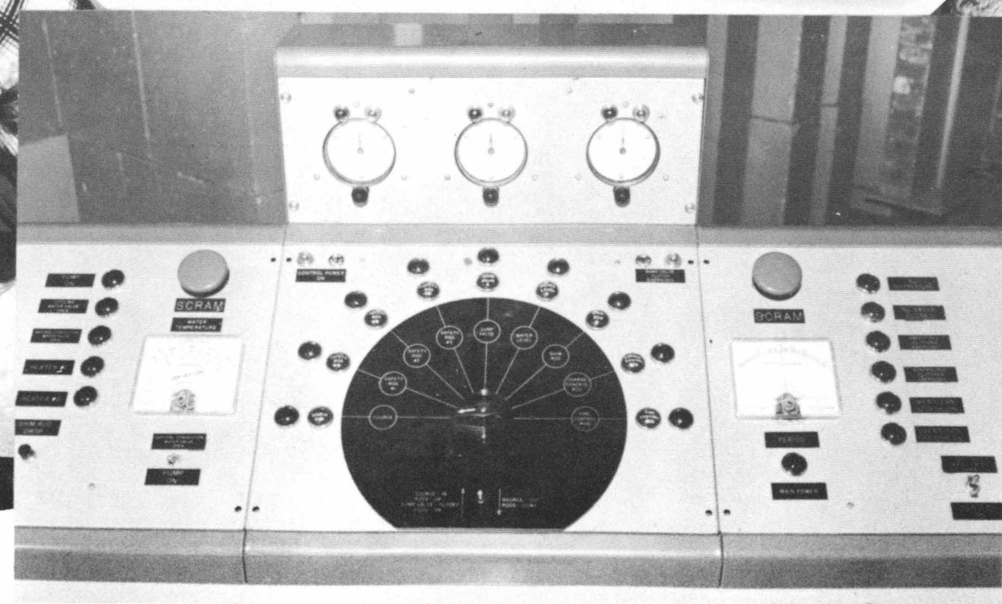
The design as described has been developed on the "do-it-yourself" philosophy, using a minimum of skilled help for the erection and tryout. Exclusive of fuel charges and erection cost, this reactor may be built for $100,000.

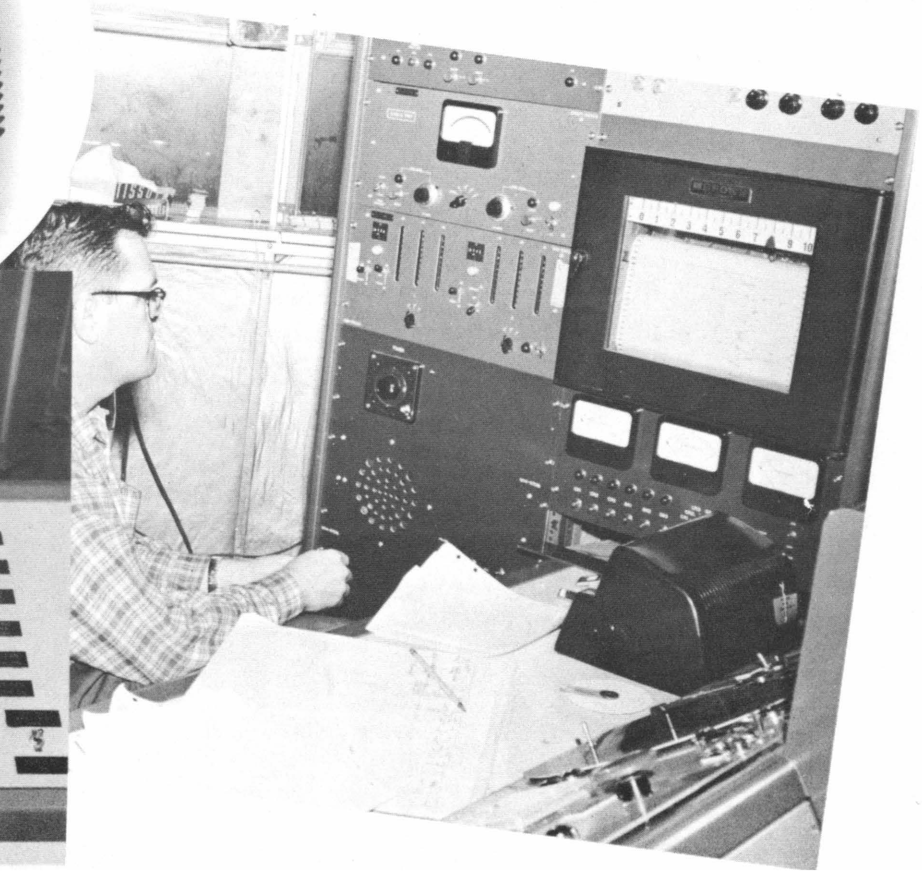









SCRAM
SCRAM



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.

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

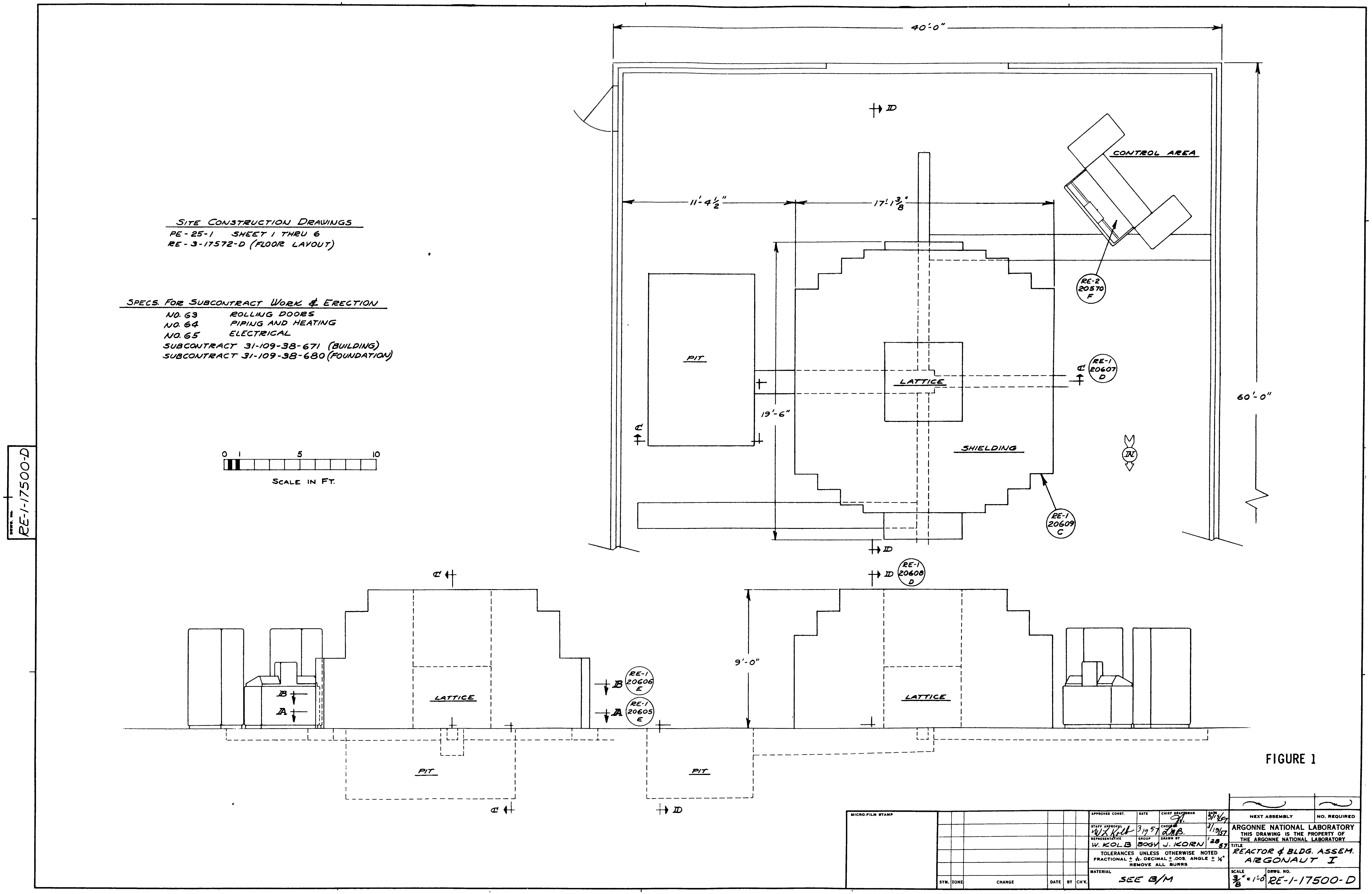
MISCELLANEOUS

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

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

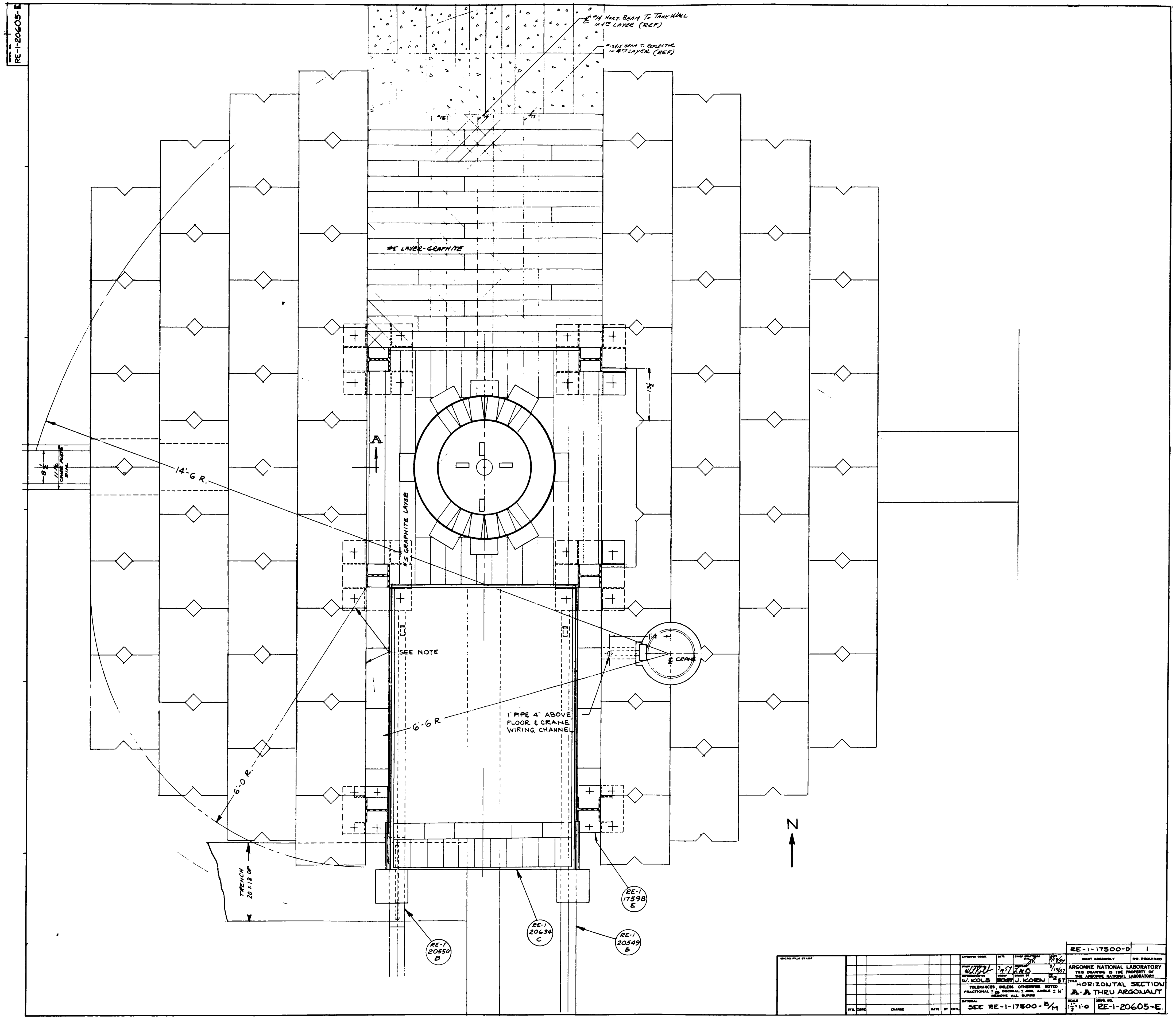
FIGURE 33 (RE-6-20640) ALTERNATE SHIELDING ARRANGEMENT NO. 2 This method uses standard solid concrete building blocks.

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



40'-0"
60'-0"
11'-4 1/2"
17'-1 3/8"
19'-6"
9'-0"
CONTROL AREA
PIT
LATTICE
SHIELDING
RE-2 20570 F
RE-1 20607 D
RE-1 20609 C
RE-1 20608 D
RE-1 20606 E
RE-1 20605 E
SITE CONSTRUCTION DRAWINGS
PE-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.
RE-1-17500-D
MICRO-FILM STAMP
SYM. ZONE CHANGE DATE BY CH'K.
APPROVED CONST.
STAFF APPROVAL
W. KOLB
BOGY
J. KORN
TOLERANCES UNLESS OTHERWISE NOTED
FRACTIONAL ± 1/64, DECIMAL ±.005, ANGLE ± 1/2°
REMOVE ALL BURRS
MATERIAL
SEE B/M
NEXT ASSEMBLY
NO. REQUIRED
ARGONNE NATIONAL LABORATORY
THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY
REACTOR & BLDG. ASSEM.
ARGONAUT I
3/8" = 1'-0"
RE-1-17500-D

FIGURE 1



RE-1-20605-E
#5 LAYER-GRAPHITE
#5 GRAPHITE LAYER
14'-6 R.
6'-6 R
6'-0 R.
SEE NOTE
1" PIPE 4" ABOVE
FLOOR & CRANE
WIRING CHANNEL
TRENCH
N
A
RE-1 20550 B
RE-1 20634 C
RE-1 20549 B
RE-1 17598 E
RE-1-17500-D
1
NEXT ASSEMBLY
NO. REQUIRED
W. KOLB
J. KORN
TOLERANCES UNLESS OTHERWISE NOTED
REMOVE ALL BURRS
SEE RE-1-17500-B/M
ARGONNE NATIONAL LABORATORY
THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY
HORIZONTAL SECTION A-A THRU ARGONAUT
RE-1-20605-E.

FIGURE 2

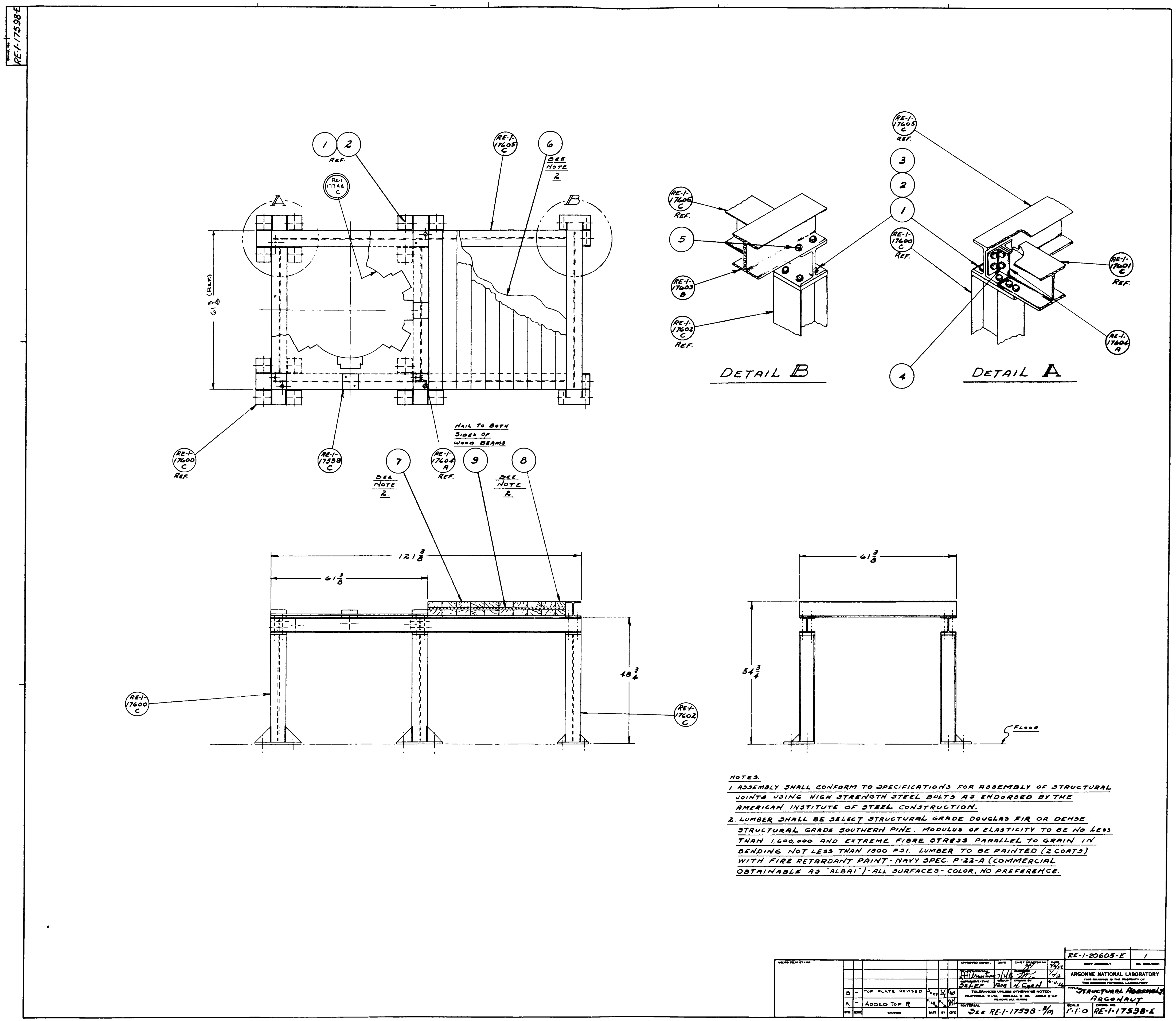

RE-1-17598-E
DETAIL B
DETAIL A
A
B
REF.
SEE NOTE 2
NAIL TO BOTH SIDES OF WOOD BEAMS
121 3/8
61 3/8
48 3/4
54 3/4
FLOOR
NOTES.
1 ASSEMBLY SHALL CONFORM TO SPECIFICATIONS FOR ASSEMBLY OF STRUCTURAL JOINTS USING HIGH STRENGTH STEEL BOLTS AS ENDORSED BY THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION.
2. LUMBER SHALL BE SELECT STRUCTURAL GRADE DOUGLAS FIR OR DENSE STRUCTURAL GRADE SOUTHERN PINE. MODULUS OF ELASTICITY TO BE NO LESS THAN 1,600,000 AND EXTREME FIBRE STRESS PARALLEL TO GRAIN IN BENDING NOT LESS THAN 1800 PSI. LUMBER TO BE PAINTED (2 COATS) WITH FIRE RETARDANT PAINT - NAVY SPEC. P-22-A (COMMERCIAL OBTAINABLE AS 'ALBAI') - ALL SURFACES - COLOR, NO PREFERENCE.
RE-1-20605-E
1
ARGONNE NATIONAL LABORATORY
B - TOP PLATE REVISED
A - ADDED TOP R
TOLERANCES UNLESS OTHERWISE NOTED:
SEE RE-1-17598-B/M
STRUCTURAL ASSEMBLY ARGONAUT
1'-1'-0
RE-1-17598-E

FIGURE 3

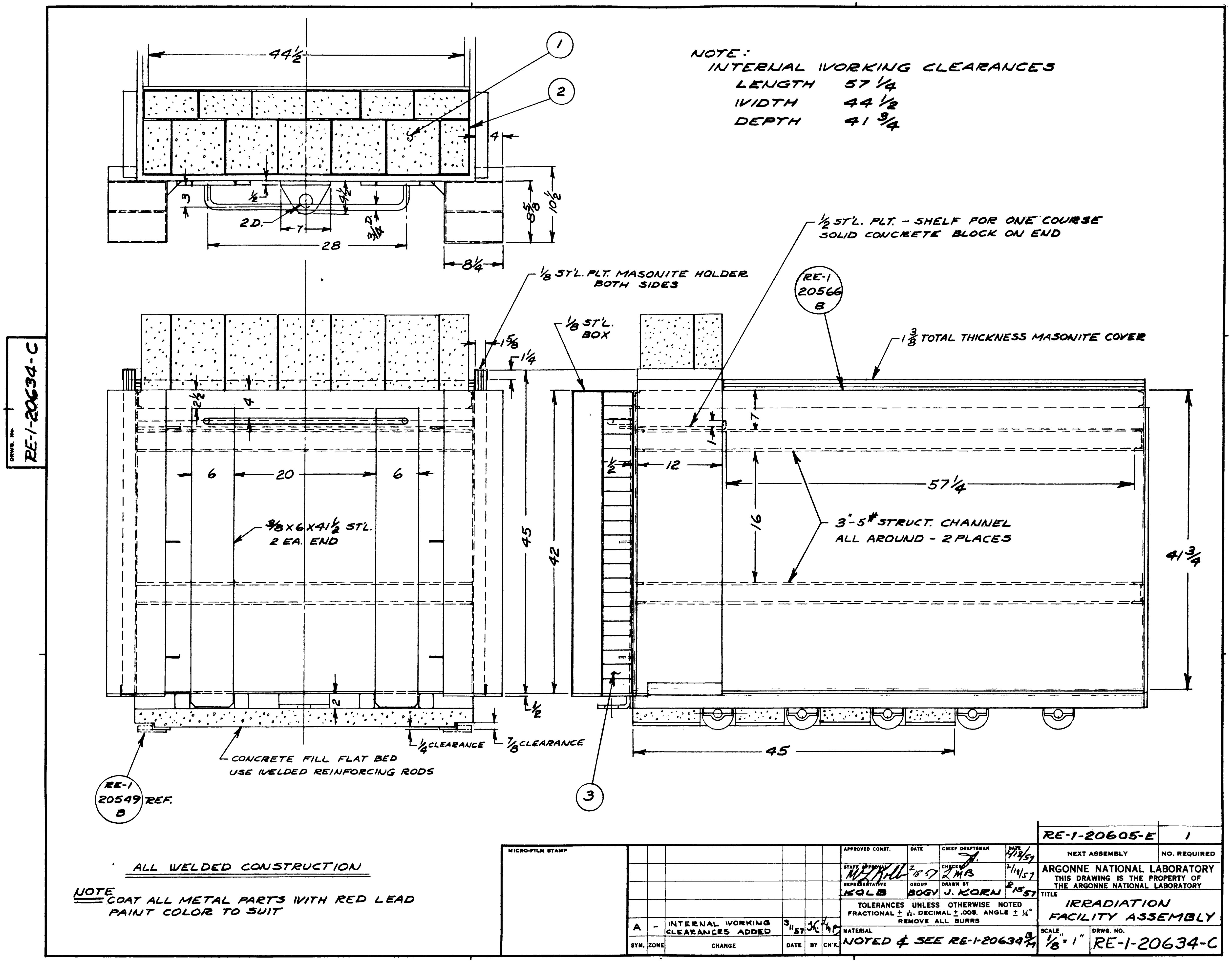

NOTE:
INTERNAL WORKING CLEARANCES
LENGTH 57 1/4
WIDTH 44 1/2
DEPTH 41 3/4
1/2 ST'L. PLT. - SHELF FOR ONE COURSE SOLID CONCRETE BLOCK ON END
1/8 ST'L. PLT. MASONITE HOLDER BOTH SIDES
1/8 ST'L. BOX
RE-1 20566 B
1 3/8 TOTAL THICKNESS MASONITE COVER
3/8 X 6 X 41 1/2 ST'L. 2 EA. END
3"-5# STRUCT. CHANNEL ALL AROUND - 2 PLACES
1/4 CLEARANCE
7/8 CLEARANCE
CONCRETE FILL FLAT BED USE WELDED REINFORCING RODS
RE-1 20549 B REF.
ALL WELDED CONSTRUCTION
NOTE COAT ALL METAL PARTS WITH RED LEAD PAINT COLOR TO SUIT
MICRO-FILM STAMP
A - INTERNAL WORKING CLEARANCES ADDED 3/11/57
SYM. ZONE CHANGE DATE BY CH'K.
APPROVED CONST. DATE CHIEF DRAFTSMAN DATE 2/18/57
STAFF APPROVAL 2/18/57 CHECKED LMB 2/18/57
REPRESENTATIVE KQLB GROUP BOGV DRAWN BY J. KORN 2/15/57
TOLERANCES UNLESS OTHERWISE NOTED FRACTIONAL ± 1/64, DECIMAL ± .005, ANGLE ± 1/2°
REMOVE ALL BURRS
MATERIAL NOTED & SEE RE-1-20634 B/M
RE-1-20605-E 1
NEXT ASSEMBLY NO. REQUIRED
ARGONNE NATIONAL LABORATORY
THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY
TITLE IRRADIATION FACILITY ASSEMBLY
SCALE 1/8" = 1"
DRWG. NO. RE-1-20634-C
DRWG. NO. RE-1-20634-C

FIGURE 4

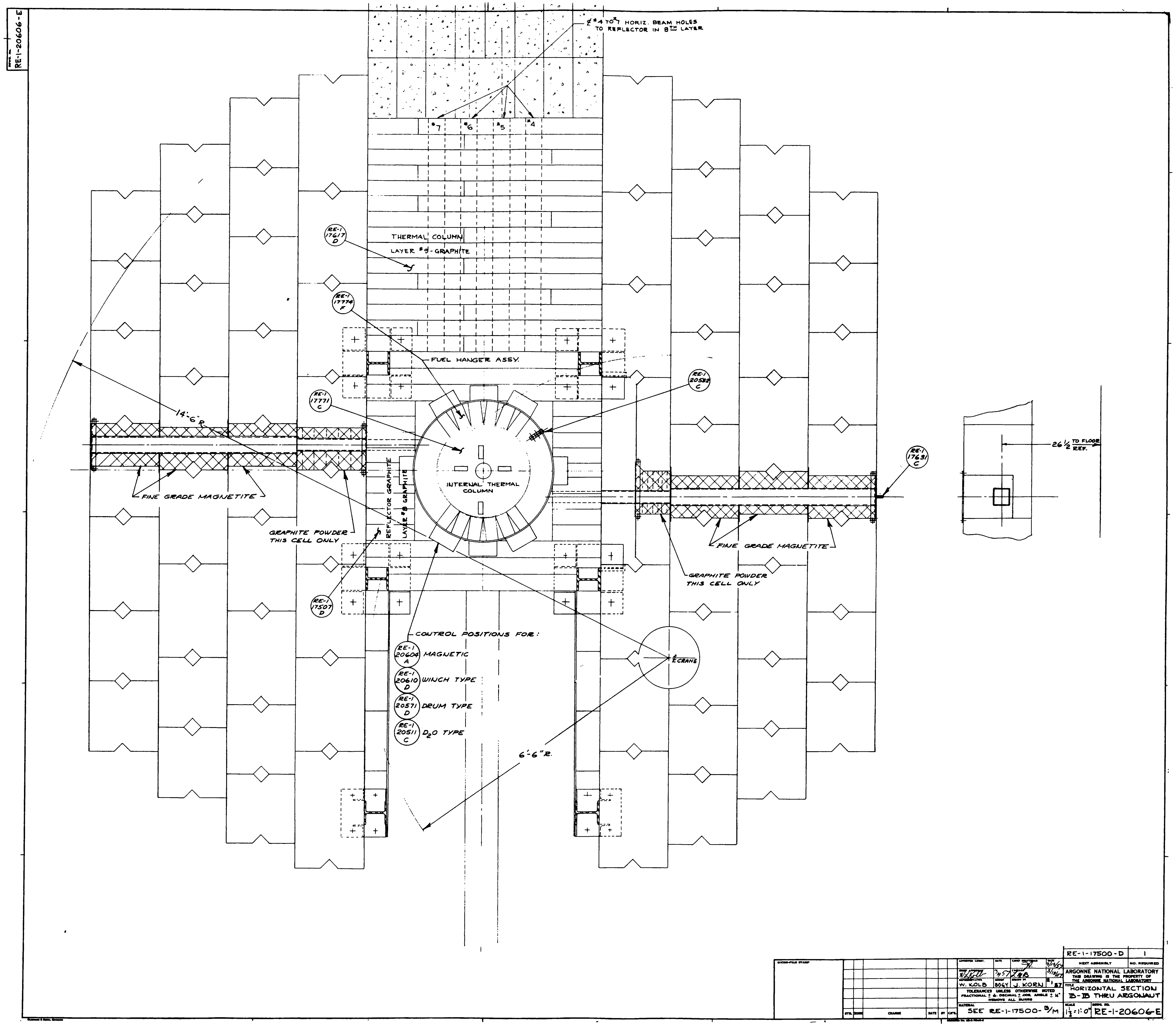

RE-1-20606-E
℄ #4 TO #7 HORIZ. BEAM HOLES TO REFLECTOR IN 8TH LAYER
#7 #6 #5 #4
THERMAL COLUMN
LAYER #9 - GRAPHITE
FUEL HANGER ASSY.
INTERNAL THERMAL COLUMN
REFLECTOR GRAPHITE
LAYER #8 GRAPHITE
14'-6" R.
FINE GRADE MAGNETITE
GRAPHITE POWDER THIS CELL ONLY
CONTROL POSITIONS FOR:
MAGNETIC
WINCH TYPE
DRUM TYPE
D2O TYPE
℄ CRANE
6'-6" R.
26 1/2 TO FLOOR REF.
RE-1 17617 D
RE-1 17774 F
RE-1 17771 C
RE-1 20538 C
RE-1 17691 C
RE-1 17507 D
RE-1 20604 A
RE-1 20610 D
RE-1 20571 D
RE-1 20511 C
RE-1-17500-D
1
NEXT ASSEMBLY
NO. REQUIRED
ARGONNE NATIONAL LABORATORY
THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY
TITLE HORIZONTAL SECTION B-B THRU ARGONAUT
W. KOLB
BOGY
J. KORN
TOLERANCES UNLESS OTHERWISE NOTED
REMOVE ALL BURRS
MATERIAL
SEE RE-1-17500-B/M
SCALE
1 1/2 : 1'-0"
RE-1-20606-E

FIGURE 5

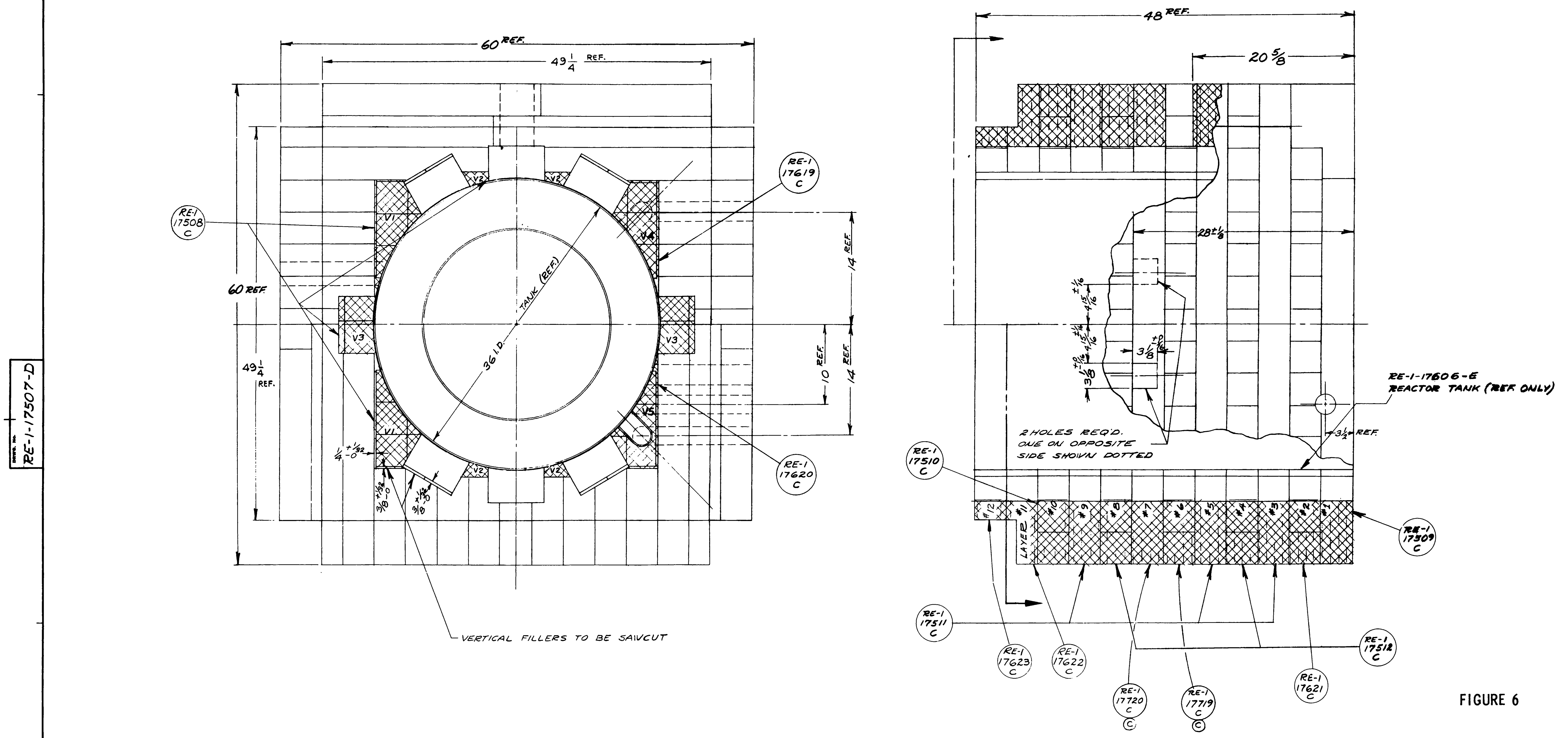


FIGURE 6

MICRO-FILM STAMP	SYM.	ZONE	CHANGE	DATE	BY	CH'K.
	D		TITLE WAS GRAPHITE ASSEMBLY ARGONAUT	3/11/57		
	C		RE-1-17719 & 720 ADDED			
	C		SECTIONING CHGD			
	B		GEN. REVISIONS	10/10/56	JK	
	A		GEN. REVISIONS	6/27/56	TW	JK

APPROVED CONST.	DATE	CHIEF DRAFTSMAN	DATE 2/15/56
STAFF APPROVAL W. Kolb	2/15/56	CHECKED	2/15/56
REPRESENTATIVE W. KOLB	GROUP BOGY	DRAWN BY J. KORN	2/4/56

TOLERANCES UNLESS OTHERWISE NOTED FRACTIONAL ± 1/64, DECIMAL ±.005, ANGLE ± 1/2°
REMOVE ALL BURRS

MATERIAL: SEE RE-1-17507 B/M

NEXT ASSEMBLY	NO. REQUIRED
RE-1-20606-E	1

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TITLE: REFLECTOR GRAPHITE ASSEM.-ARGONAUT

SCALE: 2" = 1'0"
DRWG. NO. RE-1-17507-D

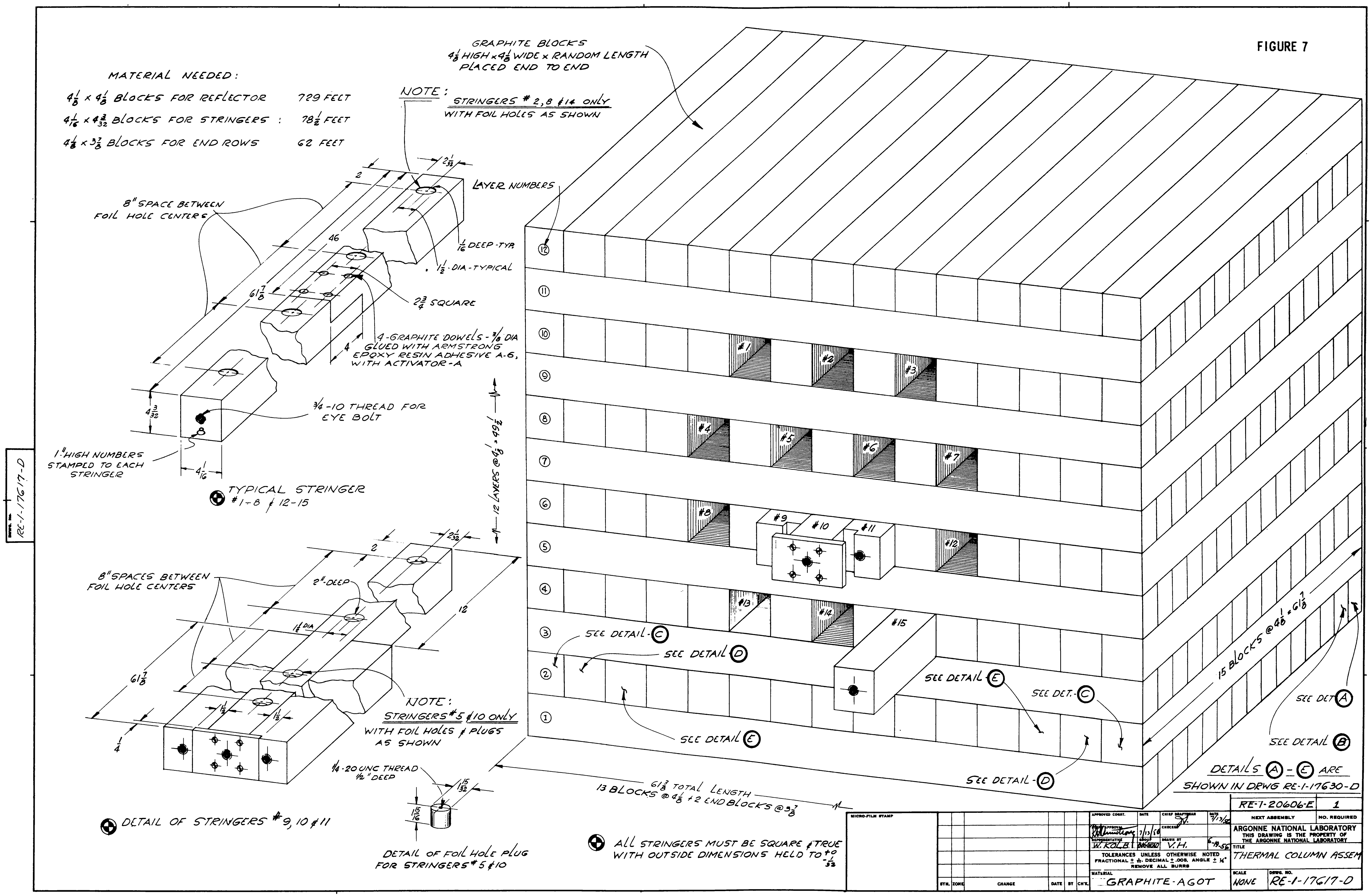
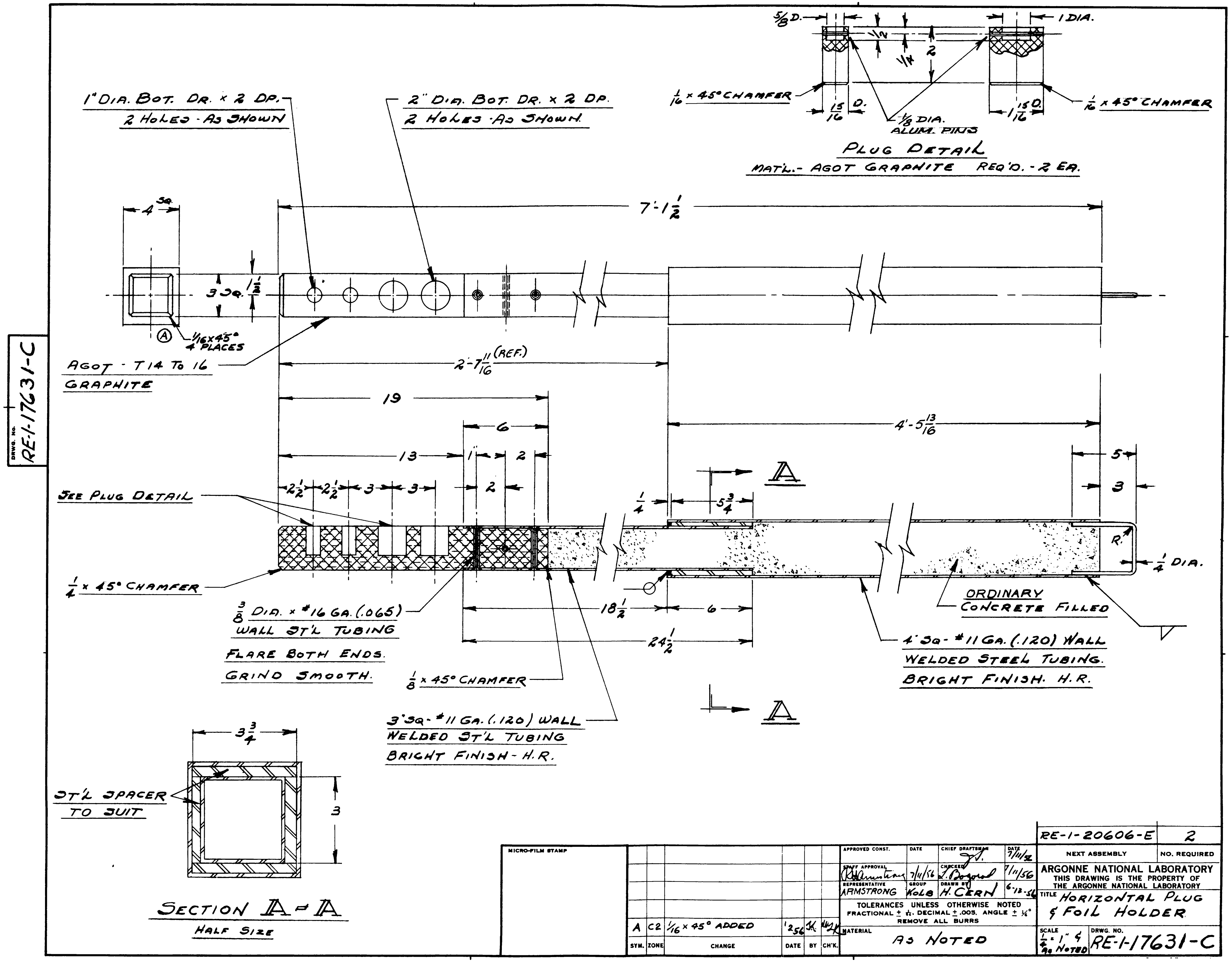
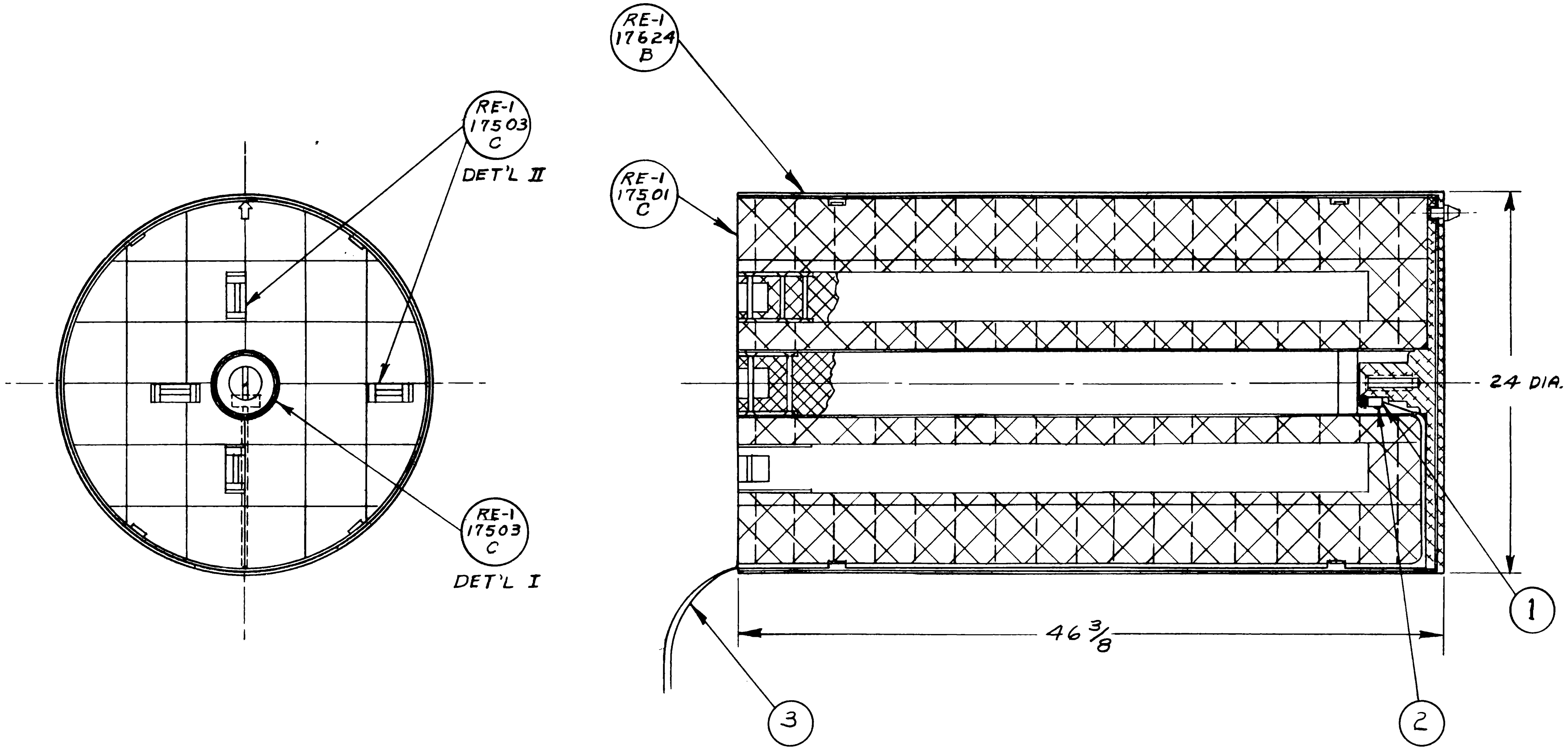

MATERIAL NEEDED:
4 1/8 x 4 1/8 BLOCKS FOR REFLECTOR 729 FEET
4 1/16 x 4 3/32 BLOCKS FOR STRINGERS : 78 1/2 FEET
4 1/8 x 3 7/8 BLOCKS FOR END ROWS 62 FEET
GRAPHITE BLOCKS
4 1/8 HIGH x 4 1/8 WIDE x RANDOM LENGTH
PLACED END TO END
NOTE: STRINGERS # 2, 8 & 14 ONLY
WITH FOIL HOLES AS SHOWN
LAYER NUMBERS
8" SPACE BETWEEN FOIL HOLE CENTERS
1/16 DEEP-TYP.
1 1/2 - DIA - TYPICAL
2 3/4 SQUARE
4-GRAPHITE DOWELS - 3/8 DIA
GLUED WITH ARMSTRONG
EPOXY RESIN ADHESIVE A-6,
WITH ACTIVATOR-A
3/4-10 THREAD FOR
EYE BOLT
1" HIGH NUMBERS
STAMPED TO EACH
STRINGER
TYPICAL STRINGER
1-8 & 12-15
12 LAYERS @ 4 1/8 = 49 1/2
8" SPACES BETWEEN
FOIL HOLE CENTERS
2"-DEEP
1 1/2 DIA
NOTE:
STRINGERS # 5 & 10 ONLY
WITH FOIL HOLES & PLUGS
AS SHOWN
1/4-20 UNC THREAD
1/2" DEEP
DETAIL OF STRINGERS # 9, 10 & 11
DETAIL OF FOIL HOLE PLUG
FOR STRINGERS # 5 & 10
ALL STRINGERS MUST BE SQUARE & TRUE
WITH OUTSIDE DIMENSIONS HELD TO +0 -1/32
61 7/8 TOTAL LENGTH
13 BLOCKS @ 4 1/8 + 2 END BLOCKS @ 3 7/8
15 BLOCKS @ 4 1/8 = 61 7/8
SEE DETAIL - C
SEE DETAIL - D
SEE DETAIL - E
SEE DET. - C
SEE DET. A
SEE DETAIL B
SEE DETAIL E
SEE DETAIL - D
DETAILS A - E ARE
SHOWN IN DRWG RE-1-17630-D
RE-1-20606-E 1
NEXT ASSEMBLY NO. REQUIRED
ARGONNE NATIONAL LABORATORY
THIS DRAWING IS THE PROPERTY OF
THE ARGONNE NATIONAL LABORATORY
TITLE THERMAL COLUMN ASSEM
W. KOLB V.H.
TOLERANCES UNLESS OTHERWISE NOTED
FRACTIONAL ± 1/64, DECIMAL ± .005, ANGLE ± 1/2°
REMOVE ALL BURRS
MATERIAL GRAPHITE-AGOT
SCALE NONE
DRWG. NO. RE-1-17617-D
MICRO-FILM STAMP
SYM. ZONE CHANGE DATE BY CH'K.
RE-1-17617-D

FIGURE 7



1" DIA. BOT. DR. × 2 DP.-
2 HOLES - AS SHOWN
2" DIA. BOT. DR. × 2 DP.
2 HOLES - AS SHOWN
PLUG DETAIL
MAT'L.- AGOT GRAPHITE REQ'D. - 2 EA.
1/16 × 45° CHAMFER
1/8 DIA. ALUM. PINS
1 DIA.
AGOT - T14 TO 16 GRAPHITE
1/16 × 45° 4 PLACES
7'-1 1/2
2'-7 11/16 (REF.)
4'-5 13/16
SEE PLUG DETAIL
1/4 × 45° CHAMFER
3/8 DIA. × #16 GA. (.065) WALL ST'L TUBING
FLARE BOTH ENDS.
GRIND SMOOTH.
1/8 × 45° CHAMFER
3" SQ - #11 GA. (.120) WALL
WELDED ST'L TUBING
BRIGHT FINISH - H.R.
ORDINARY CONCRETE FILLED
4" SQ - #11 GA. (.120) WALL
WELDED STEEL TUBING.
BRIGHT FINISH. H.R.
1/4 DIA.
ST'L SPACER TO SUIT
SECTION A-A
HALF SIZE
RE-1-20606-E 2
NEXT ASSEMBLY NO. REQUIRED
ARGONNE NATIONAL LABORATORY
THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY
TITLE HORIZONTAL PLUG & FOIL HOLDER
TOLERANCES UNLESS OTHERWISE NOTED
FRACTIONAL ± 1/64. DECIMAL ± .005. ANGLE ± 1/2°
REMOVE ALL BURRS
MATERIAL AS NOTED
ARMSTRONG KOLB H. CERN
A C2 1/16 × 45° ADDED
DRWG. NO. RE-1-17631-C

FIGURE 8



DRWG. NO. RE-1-17771-C

MICRO-FILM STAMP

SYM.	ZONE	CHANGE	DATE	BY	CH'K.
A	–	OVERALL DIM'S ADDED	3/11/57	K	JMB

APPROVED CONST. | DATE | CHIEF DRAFTSMAN | DATE 3/12/57
STAFF APPROVAL 3/12/57 | CHECKED Lenzen 12 3 56
REPRESENTATIVE ARMSTRONG | GROUP BOGY | DRAWN BY J KORN 11/28/56

TOLERANCES UNLESS OTHERWISE NOTED
FRACTIONAL ± 1/64, DECIMAL ± .005, ANGLE ± 1/2°
REMOVE ALL BURRS

MATERIAL: SEE RE-1 17771- B/M

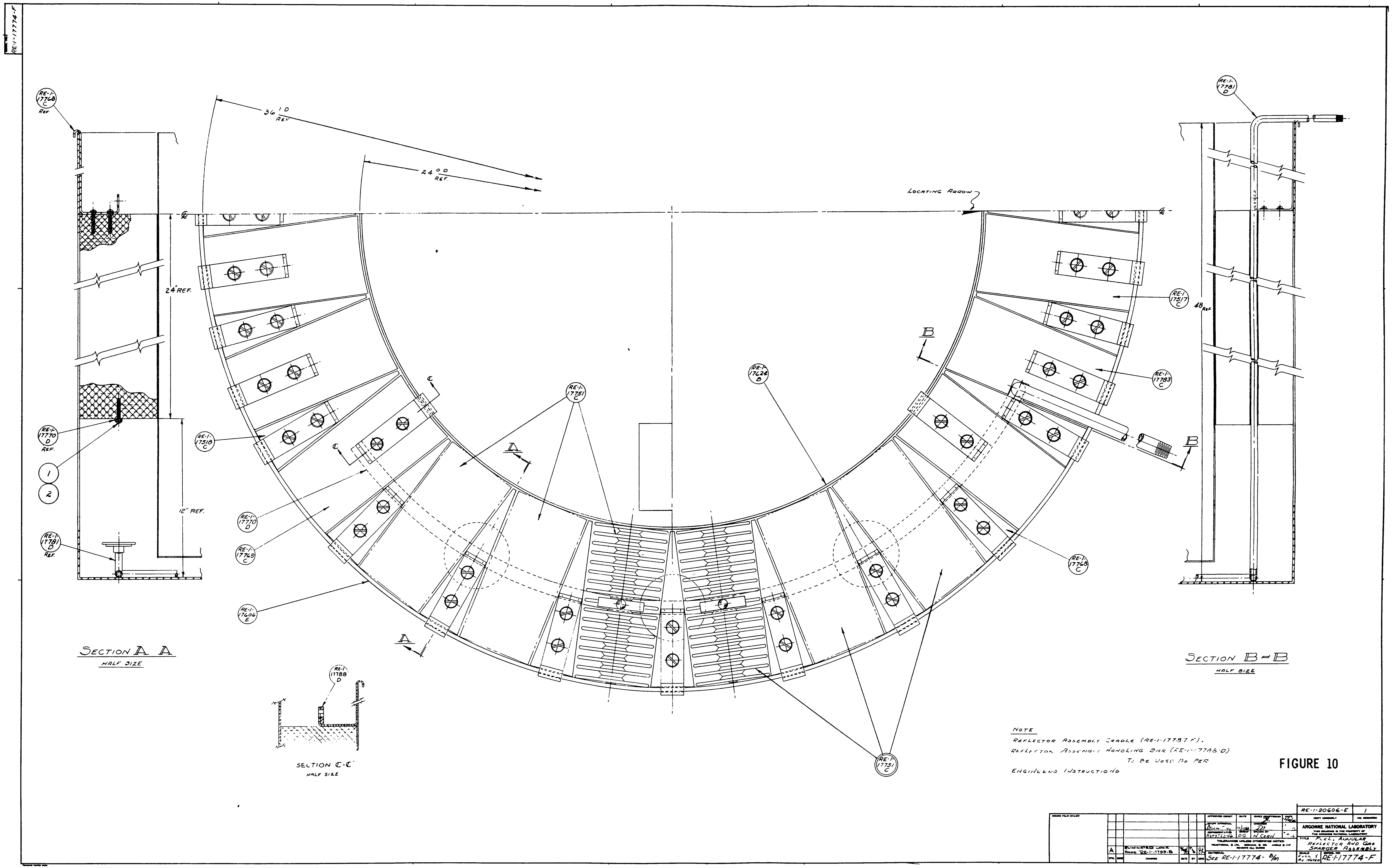
NEXT ASSEMBLY	NO. REQUIRED
RE-1-20606-E	1

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

TITLE: INTERNAL THERMAL COLUMN ASSEM.

SCALE: 2"=1' | DRWG. NO. RE-1-17771-C

FIGURE 9



RE-1-17774-F
SECTION A-A
HALF SIZE
SECTION B-B
HALF SIZE
SECTION C-C
HALF SIZE
LOCATING ARROW
24" REF.
12" REF.
48 REF.
36° 10' REF.
24° 00' REF.
RE-1-17768 C REF.
RE-1-17770 D REF.
RE-1-17781 D REF.
RE-1-17518 C
RE-1-17770 D
RE-1-17769 C
RE-1-17606 E
RE-1-17751 C
RE-1-17624 B
RE-1-17517 C
RE-1-17783 C
RE-1-17768 C
RE-1-17781 D
RE-1-17788 D
NOTE
REFLECTOR ASSEMBLY CRADLE (RE-1-17787 F),
REFLECTOR ASSEMBLY HANDLING BAR (RE-1-17785-D)
TO BE USED AS PER
ENGINEERS INSTRUCTIONS
RE-1-20606-E
1
ARGONNE NATIONAL LABORATORY
TITLE FUEL, ANNULAR REFLECTOR AND GAS SPARGER ASSEMBLY
A ELIMINATED LOCK HOOK RE-1-17799-B
H CERN
DG
MATERIAL SEE RE-1-17774- B/M
SCALE FULL & AS NOTED
DWG. NO RE-1-17774-F

FIGURE 10

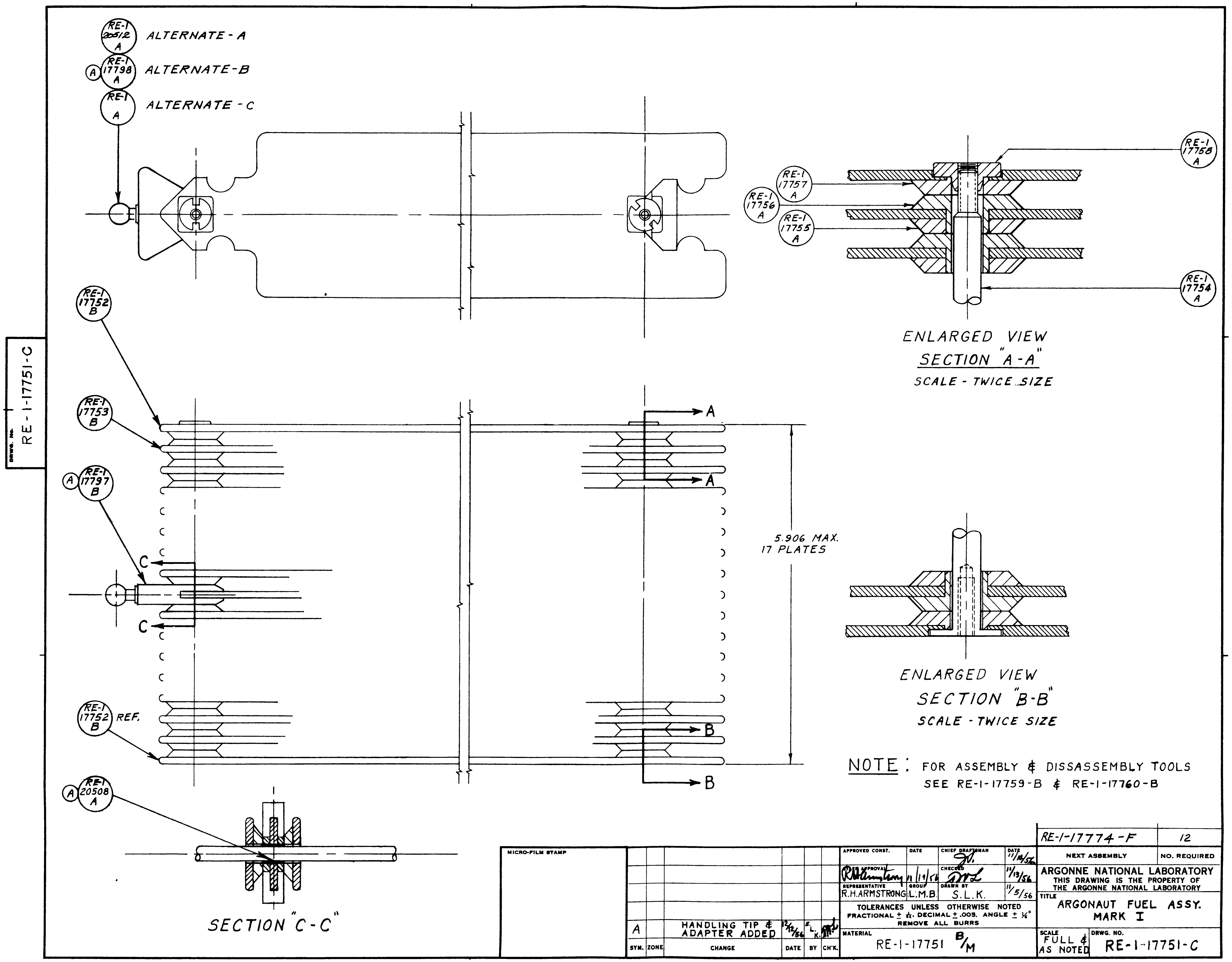

RE-1 20512 A ALTERNATE - A
(A) RE-1 17798 A ALTERNATE - B
RE-1 A ALTERNATE - C
RE-1 17752 B
RE-1 17753 B
(A) RE-1 17797 B
RE-1 17752 B REF.
(A) RE-1 20508 A
RE-1 17757 A
RE-1 17756 A
RE-1 17755 A
RE-1 17758 A
RE-1 17754 A
ENLARGED VIEW
SECTION "A-A"
SCALE - TWICE SIZE
5.906 MAX.
17 PLATES
ENLARGED VIEW
SECTION "B-B"
SCALE - TWICE SIZE
NOTE: FOR ASSEMBLY & DISSASSEMBLY TOOLS
SEE RE-1-17759-B & RE-1-17760-B
SECTION "C-C"
A
B
C
MICRO-FILM STAMP
A HANDLING TIP & ADAPTER ADDED
SYM. ZONE CHANGE DATE BY CH'K.
APPROVED CONST. DATE CHIEF DRAFTSMAN DATE
APPROVAL CHECKED
REPRESENTATIVE GROUP DRAWN BY
R.H.ARMSTRONG L.M.B S.L.K. 11/5/56
TOLERANCES UNLESS OTHERWISE NOTED
FRACTIONAL ± 1/64, DECIMAL ± .005, ANGLE ± 1/2°
REMOVE ALL BURRS
MATERIAL
RE-1-17751 B/M
RE-1-17774-F 12
NEXT ASSEMBLY NO. REQUIRED
ARGONNE NATIONAL LABORATORY
THIS DRAWING IS THE PROPERTY OF
THE ARGONNE NATIONAL LABORATORY
TITLE
ARGONAUT FUEL ASSY.
MARK I
SCALE
FULL & AS NOTED
DRWG. NO.
RE-1-17751-C
DRWG. No. RE-1-17751-C

FIGURE 11

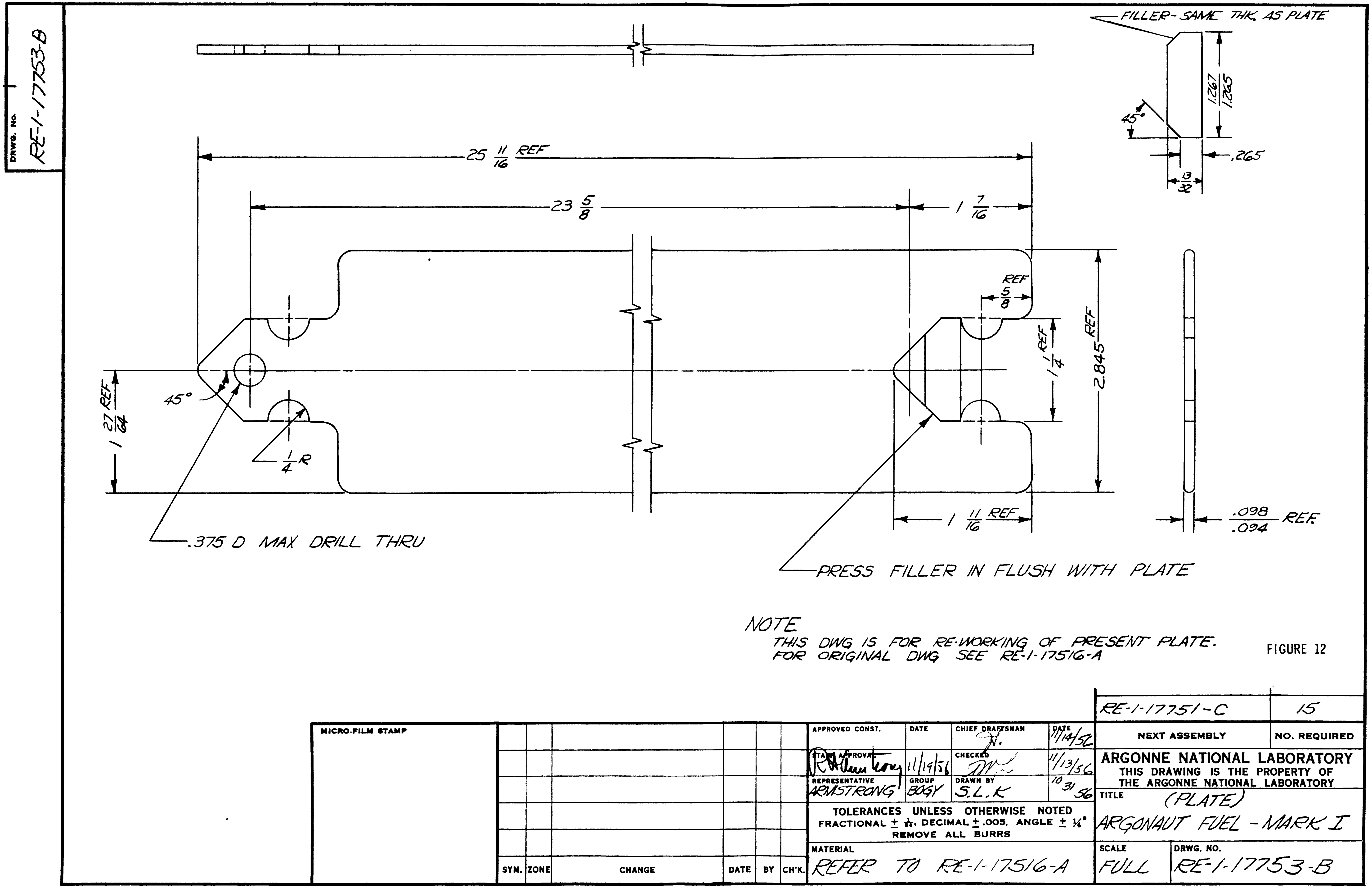

DRWG. No. RE-1-17753-B
FILLER-SAME THK. AS PLATE
1.267
1.265
45°
.265
13/32
25 11/16 REF
23 5/8
1 7/16
REF 5/8
1 1/4 REF
2.845 REF
1 27/64 REF
45°
1/4 R
.375 D MAX DRILL THRU
1 11/16 REF
.098
.094 REF.
PRESS FILLER IN FLUSH WITH PLATE
NOTE
THIS DWG IS FOR RE-WORKING OF PRESENT PLATE.
FOR ORIGINAL DWG SEE RE-1-17516-A
RE-1-17751-C
15
NEXT ASSEMBLY
NO. REQUIRED
MICRO-FILM STAMP
APPROVED CONST.
DATE
CHIEF DRAFTSMAN
DATE 11/14/56
STAFF APPROVAL
11/19/56
CHECKED
11/13/56
REPRESENTATIVE
ARMSTRONG
GROUP
BOGY
DRAWN BY
S.L.K
10/31/56
ARGONNE NATIONAL LABORATORY
THIS DRAWING IS THE PROPERTY OF
THE ARGONNE NATIONAL LABORATORY
TITLE
(PLATE)
ARGONAUT FUEL - MARK I
TOLERANCES UNLESS OTHERWISE NOTED
FRACTIONAL ± 1/64, DECIMAL ± .005, ANGLE ± 1/4°
REMOVE ALL BURRS
MATERIAL
REFER TO RE-1-17516-A
SCALE
FULL
DRWG. NO.
RE-1-17753-B
SYM.
ZONE
CHANGE
DATE
BY
CH'K.

FIGURE 12

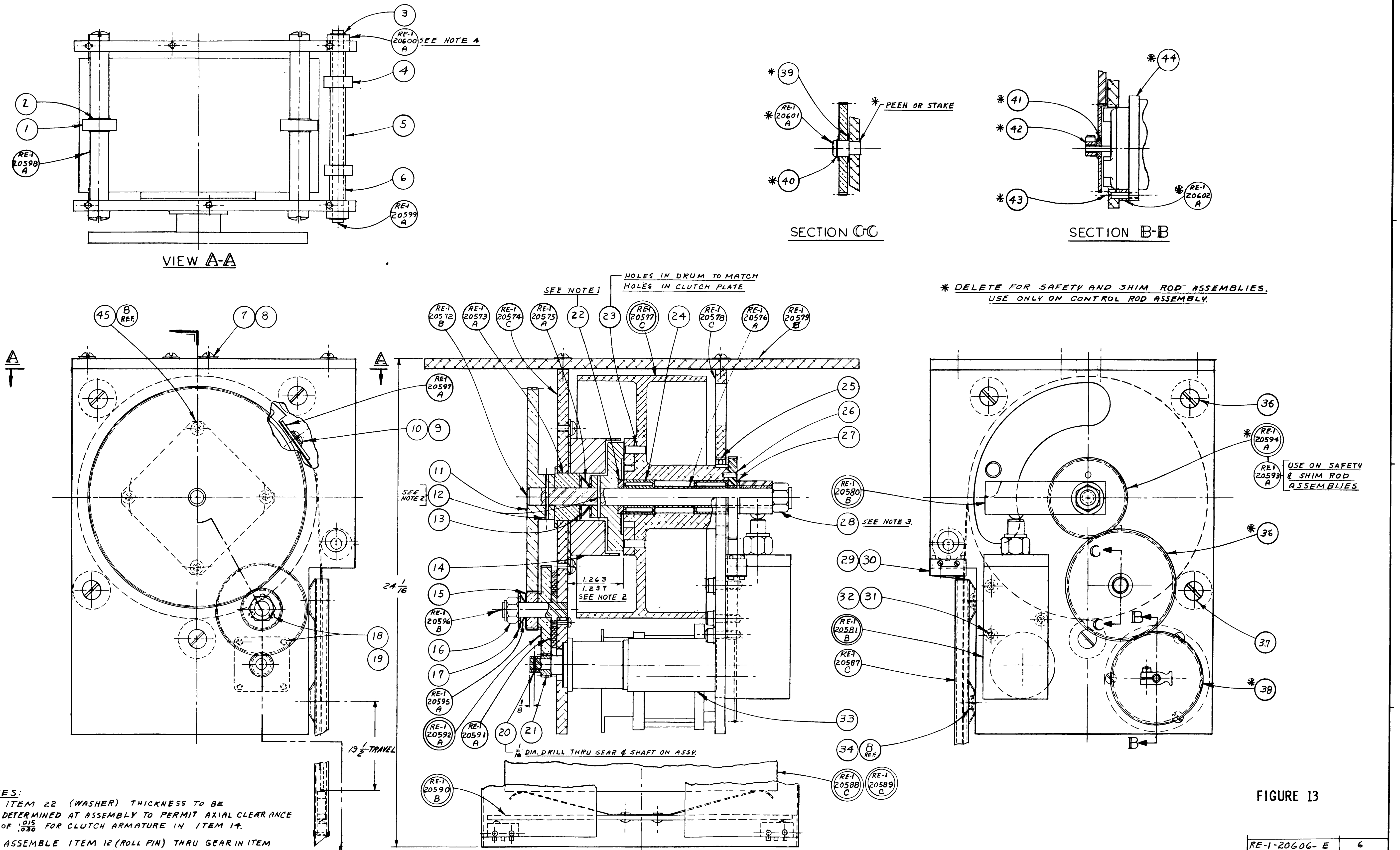


FIGURE 13

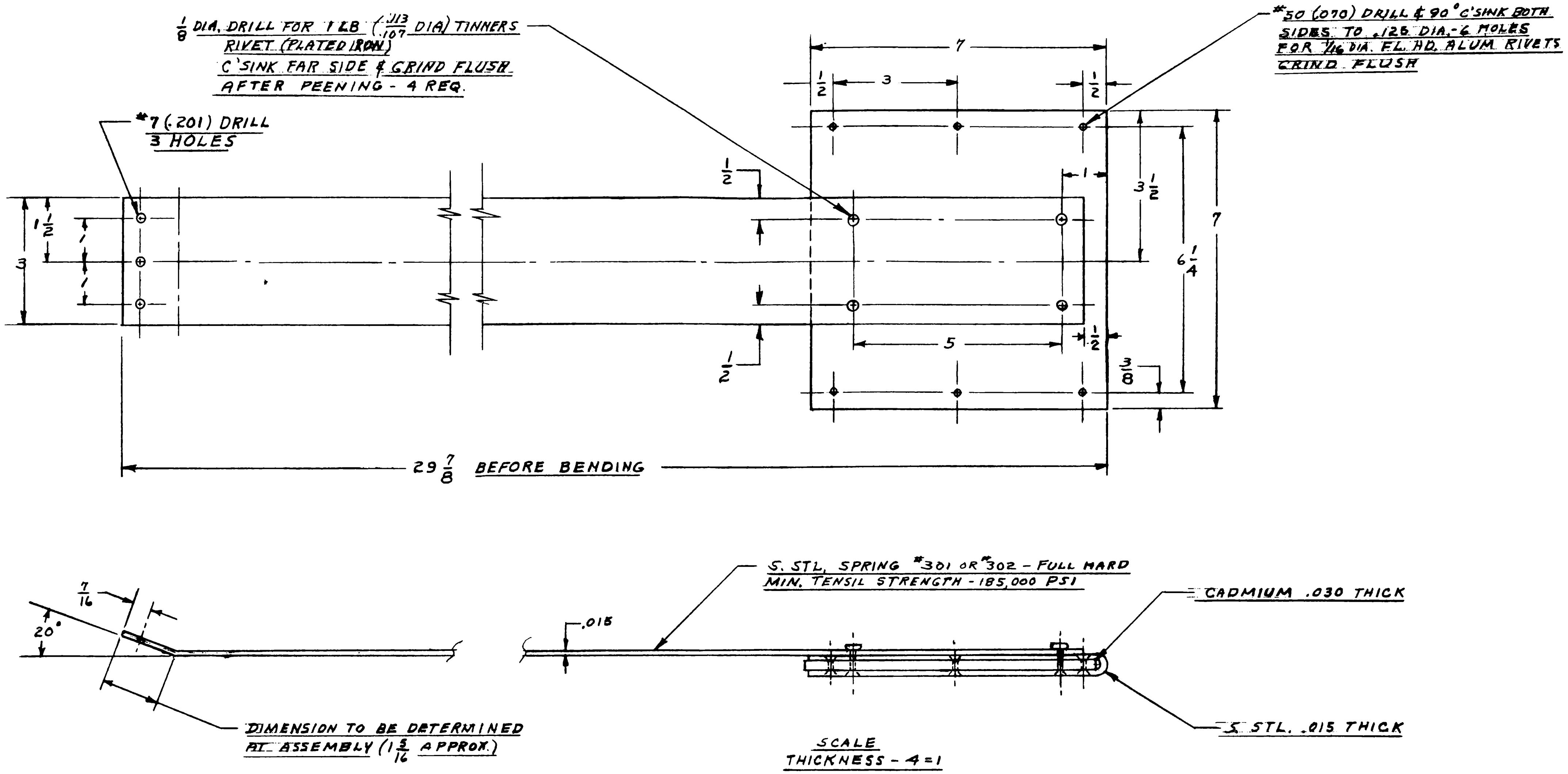
NOTES:

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 28, IN ASSEMBLY FOR .030 ± .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

NEXT ASSEMBLY	RE-1-20606-E
NO. REQUIRED	6
APPROVED CONST. / CHIEF DRAFTSMAN / CHECKED	3/18/57
STAFF APPROVAL	JAHNKE
GROUP	REACTOR
DRAWN BY	F TURNER 1-30-57
TOLERANCES UNLESS OTHERWISE NOTED	FRACTIONAL ± 1/64, DECIMAL ± .005, ANGLE ± 1/2°. REMOVE ALL BURRS
MATERIAL	SEE RE-1-20571-D B/M
	ARGONNE NATIONAL LABORATORY. THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY
TITLE	ARGONAUT DRUM TYPE MECHANISM & CONTROL ROD ASSEMBLY
SCALE	FULL
DRWG. NO.	RE-1-20571-D

MICRO-FILM STAMP

SYM.	ZONE	CHANGE	DATE	BY	CH'K.



DRWG. NO. RE-1-20588-C

RE-1-20571-D — NEXT ASSEMBLY — NO. REQUIRED

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

TITLE: CONTROL ROD

SCALE: 1=2 & NOTED — DRWG. NO. RE-1-20588-C

MATERIAL: NOTED

TOLERANCES UNLESS OTHERWISE NOTED FRACTIONAL ± 1/64, DECIMAL ± .005, ANGLE ± 1/4° REMOVE ALL BURRS

STAFF APPROVAL: R. Jahnke 3/18/57 — REPRESENTATIVE: JAHNKE — GROUP: [illegible] — DRAWN BY: F TURNER 1-18-57 — CHECKED 3/18/57 — CHIEF DRAFTSMAN 3/18/57

MICRO-FILM STAMP

SYM. | ZONE | CHANGE | DATE | BY | CH'K.

FIGURE 14

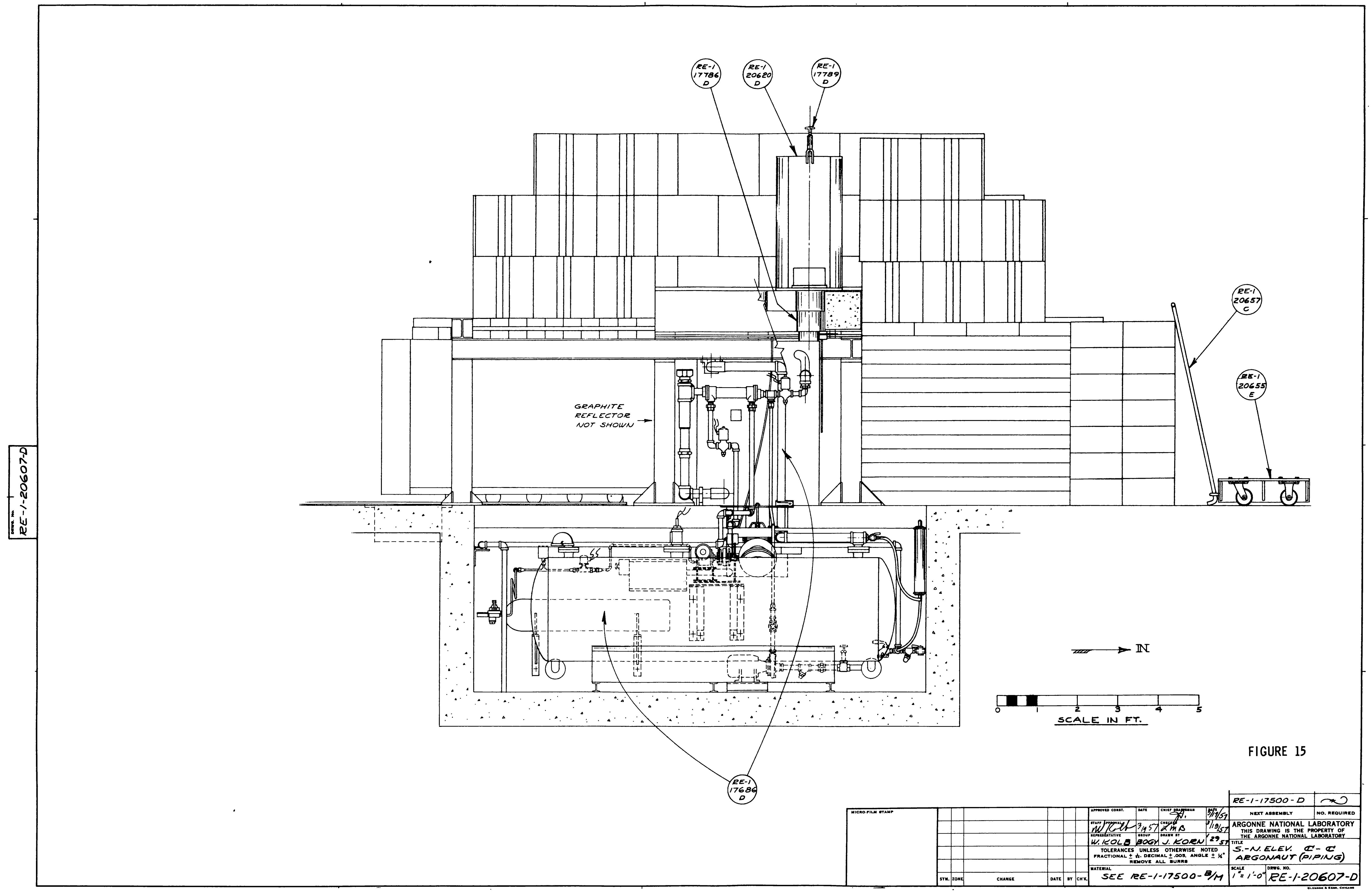

RE-1 17786 D
RE-1 20620 D
RE-1 17789 D
RE-1 20657 C
RE-1 20655 E
RE-1 17686 D
GRAPHITE REFLECTOR NOT SHOWN
N
SCALE IN FT.
0 1 2 3 4 5
RE-1-20607-D
RE-1-17500-D
NEXT ASSEMBLY
NO. REQUIRED
ARGONNE NATIONAL LABORATORY
THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY
S.-N. ELEV. C-C
ARGONAUT (PIPING)
W. KOLB
BOGY
J. KORN
ZMB
TOLERANCES UNLESS OTHERWISE NOTED
REMOVE ALL BURRS
MATERIAL
SEE RE-1-17500-B/M
SCALE 1"=1'-0"
DRWG. NO. RE-1-20607-D
MICRO-FILM STAMP
SYM. ZONE CHANGE DATE BY CH'K.

FIGURE 15

ITEM	DRIVG. 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 ST'L. BRACKET (FIELD FAB.) 1" PIPE CLAMP	3
5		1/2" ST'L. PLT. BRACKET FOR NITROGEN TANK (FIELD FAB.)	2
6		3/16X1" ST'L. 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"X2 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 ST'L BRACKET (FIELD FAB.) 2" PIPE CLAMP	1
14		3/8"X2 ST'L. BRACKET (FIELD FAB.) (1 EA. SIDE OF FLANGE)	2
15		1/2" ST'L. PLT. SHELF FOR DUMP VALVE	1
16		3/4-10 UNC X 4 LG. HEX. HD. CAP SCR.	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

DRWG. NO. RE-1-17686-D

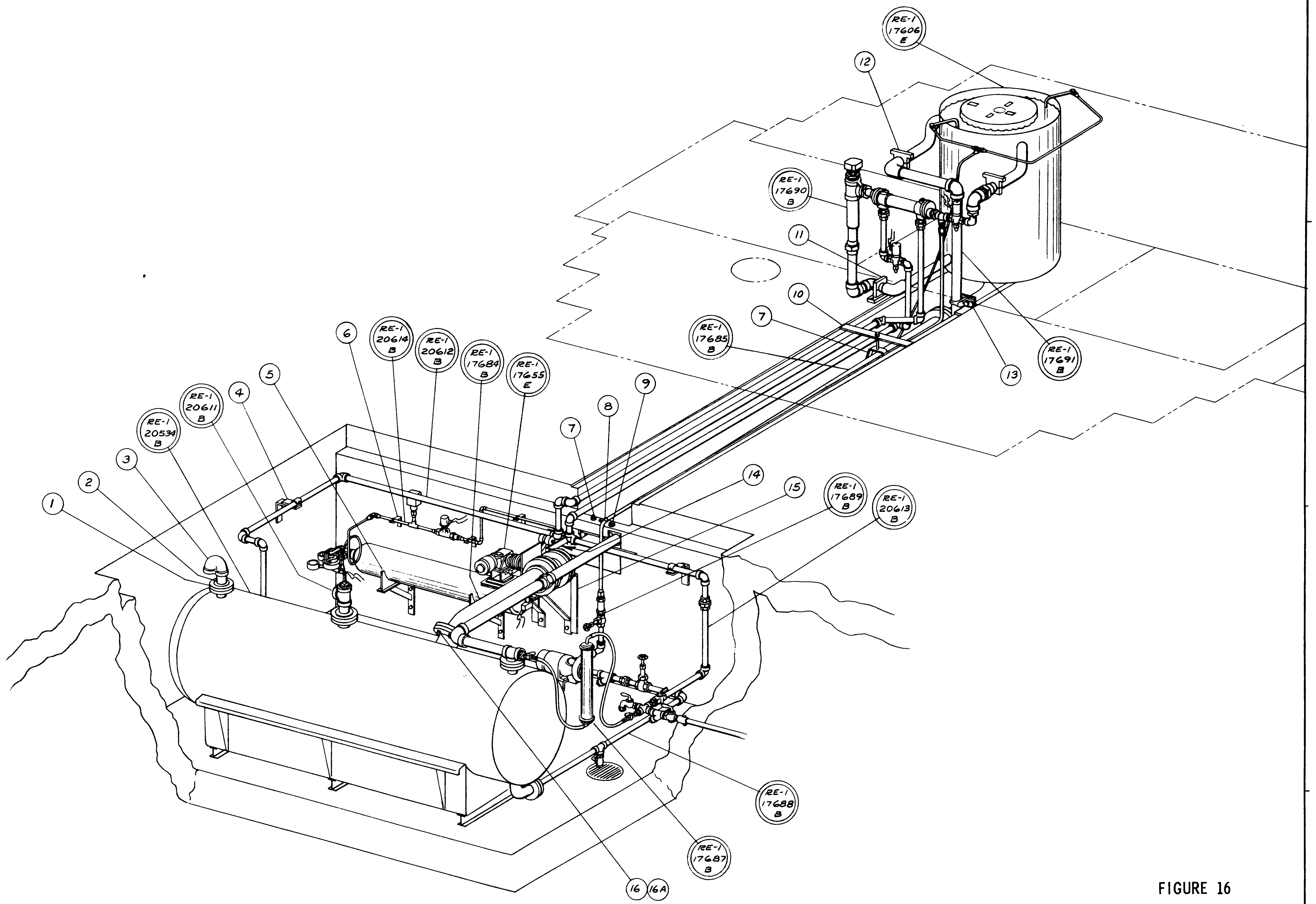


FIGURE 16

RE-1-20607-D	1
NEXT ASSEMBLY	NO. REQUIRED

MICRO-FILM STAMP

SYM.	ZONE	CHANGE	DATE	BY	CH'K.

APPROVED CONST. / DATE / CHIEF DRAFTSMAN / DATE 3/14/57

STAFF APPROVAL / CHECKED Lenzen 3/11/57

REPRESENTATIVE ARMSTRONG / GROUP BOGY / DRAWN BY J. KORN 2/12/57

TOLERANCES UNLESS OTHERWISE NOTED FRACTIONAL ± 1/64. DECIMAL ± .005. ANGLE ± 1/2° REMOVE ALL BURRS

MATERIAL NO SEPARATE B/M ALL PART INDICATED ON DRWGS.

ARGONNE NATIONAL LABORATORY

THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY

TITLE ARGONAUT PIPING ASSEMBLY

SCALE —

DRWG. NO. RE-1-17686-D

REORDER NO. RE-8-11944-D

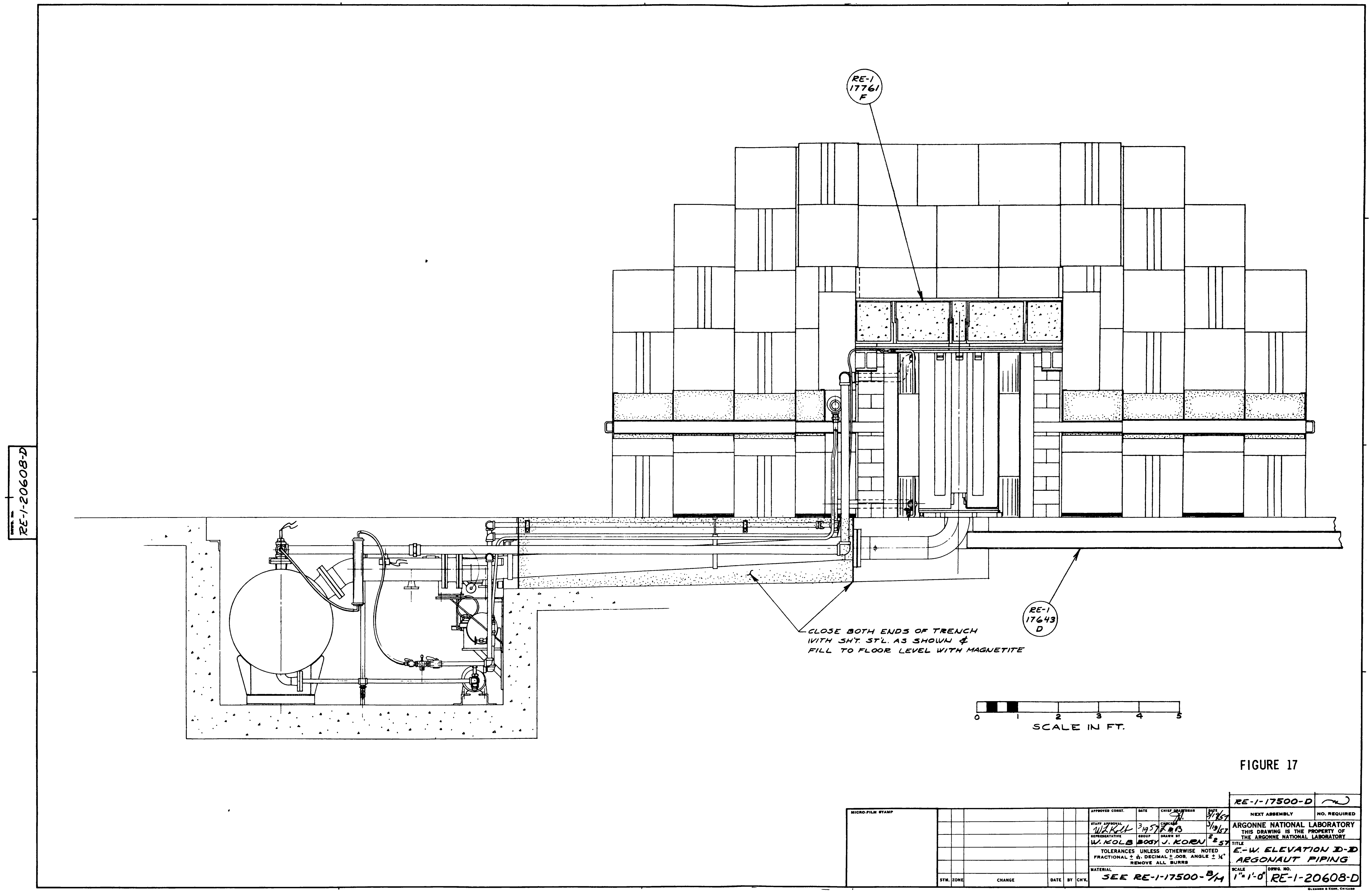

RE-1-20608-D
RE-1
17761
F
RE-1
17643
D
CLOSE BOTH ENDS OF TRENCH
WITH SH'T. ST'L. AS SHOWN &
FILL TO FLOOR LEVEL WITH MAGNETITE
0 1 2 3 4 5
SCALE IN FT.
MICRO-FILM STAMP
STM. ZONE CHANGE DATE BY CH'K.
APPROVED CONST. DATE CHIEF DRAFTSMAN DATE
STAFF APPROVAL
REPRESENTATIVE W. KOLB GROUP BOSY DRAWN BY J. KORN
TOLERANCES UNLESS OTHERWISE NOTED
FRACTIONAL ± 1/64, DECIMAL ±.005, ANGLE ± 1/2°
REMOVE ALL BURRS
MATERIAL
SEE RE-1-17500-B/M
RE-1-17500-D
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

FIGURE 17

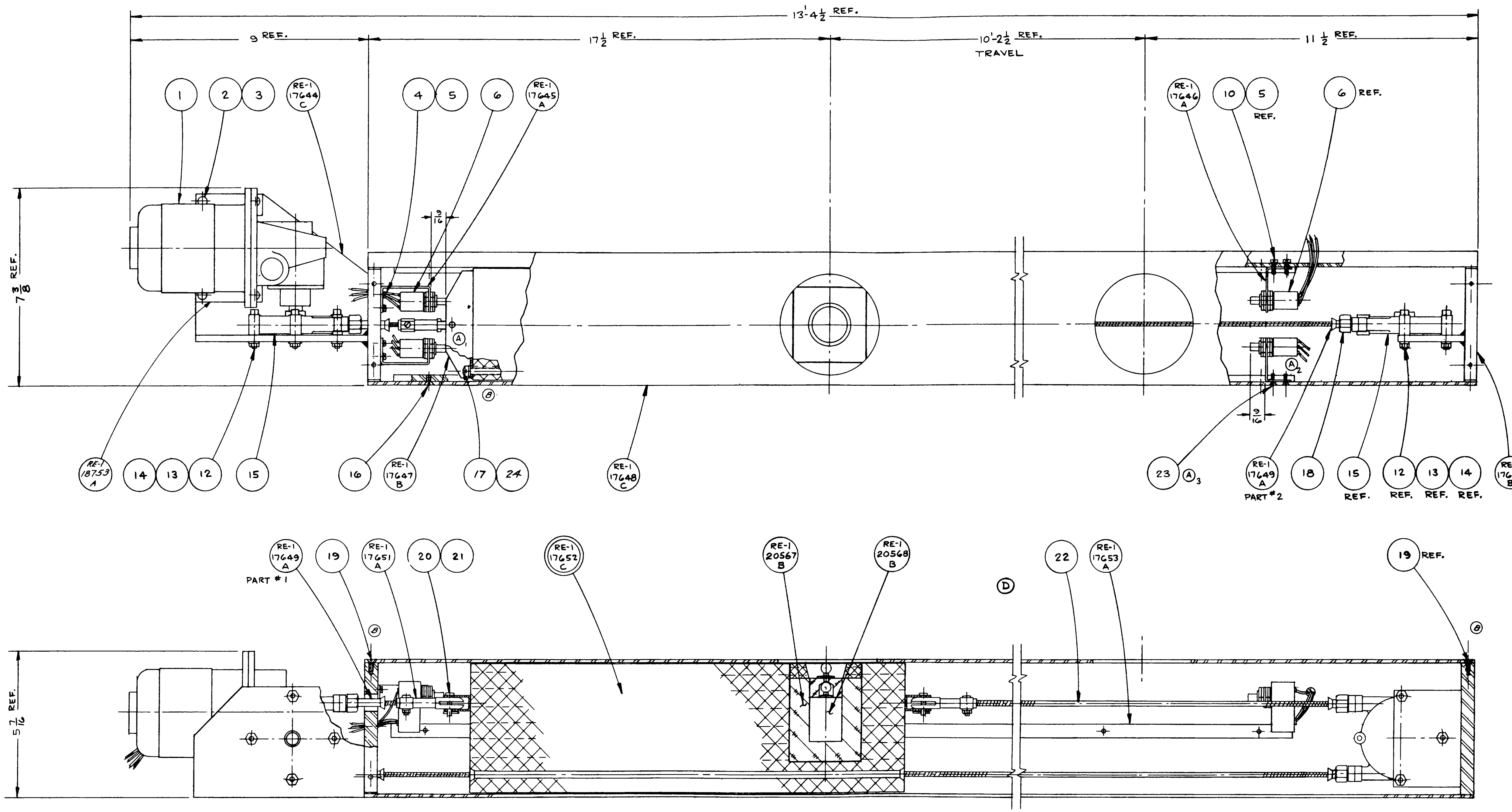


FIGURE 18

SYM.	ZONE	CHANGE	DATE	BY	CH'K.
D	2C	RE-1-20567-B & RE-1-20568-B ADDED	1-25-57		
C	4b	Removed Item 11 And Changed Dw'g. To Agree	12-6-56	C.C.	
B		DWG. CHANGED TO AGREE WITH DETAILS	8-30-56	G.D.	
A	3d 3b	1 & 2 - ADDED SW. & BRKT. 3 - ADDED ITEM 23	7-31-56	G.G.	

APPROVED CONST.	DATE	CHIEF DRAFTSMAN	DATE
STAFF APPROVAL	7-30-56	CHECKED	7/25/56
REPRESENTATIVE SELEP	GROUP LMB	DRAWN BY GIORGIS	7-11-56

TOLERANCES UNLESS OTHERWISE NOTED FRACTIONAL ± 1/64, DECIMAL ± .005, ANGLE ± 1/4°
REMOVE ALL BURRS

MATERIAL: SEE RE-1-17643-BM

NEXT ASSEMBLY	NO. REQUIRED
RE-1-20608-D	1

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

TITLE: SOURCE DRIVE MECHANISM

SCALE: HALF
DRWG. NO. RE-1-17643-D

DRWG. NO. RE-1-17643-D

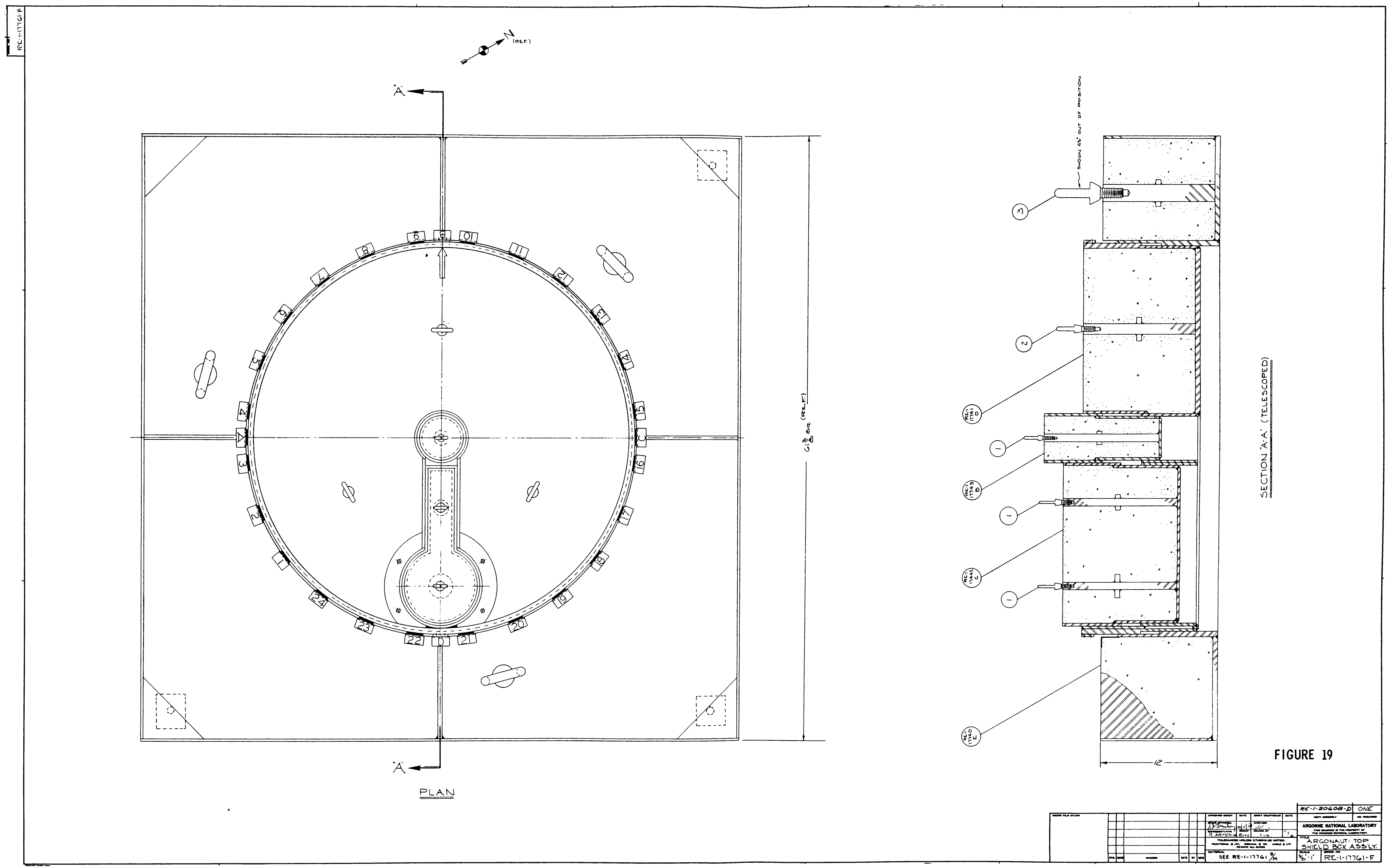

N (REF)
"A"
PLAN
SECTION "A-A" (TELESCOPED)
12
ARGONNE NATIONAL LABORATORY
ARGONAUT- TOP SHIELD BOX ASS'LY.
RE-1-20608-D
ONE
SEE RE-1-17761 B/M
RE-1-17761-F
R ARMSTRONG

FIGURE 19

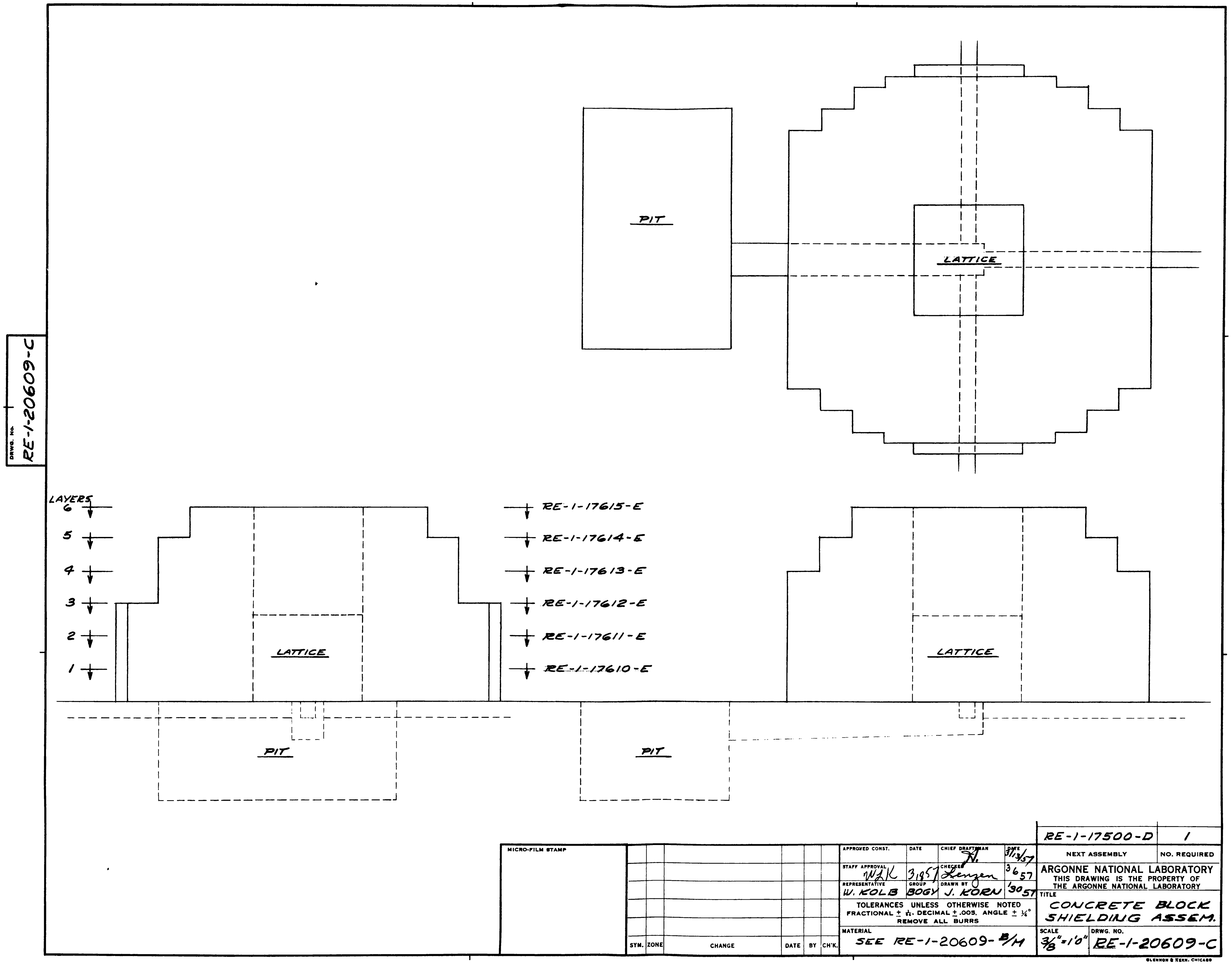

DRWG. No. RE-1-20609-C
PIT
LATTICE
LAYERS
6
5
4
3
2
1
RE-1-17615-E
RE-1-17614-E
RE-1-17613-E
RE-1-17612-E
RE-1-17611-E
RE-1-17610-E
LATTICE
LATTICE
PIT
PIT
MICRO-FILM STAMP
SYM. ZONE CHANGE DATE BY CH'K.
APPROVED CONST. DATE CHIEF DRAFTSMAN DATE 3/13/57
STAFF APPROVAL W.K 3,1957 CHECKED Lenzen 3 6 57
REPRESENTATIVE W. KOLB GROUP BOGY DRAWN BY J. KORN 1 30 57
TOLERANCES UNLESS OTHERWISE NOTED
FRACTIONAL ± 1/64, DECIMAL ± .005, ANGLE ± 1/4°
REMOVE ALL BURRS
MATERIAL SEE RE-1-20609-B/M
RE-1-17500-D 1
NEXT ASSEMBLY NO. REQUIRED
ARGONNE NATIONAL LABORATORY
THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY
TITLE CONCRETE BLOCK SHIELDING ASSEM.
SCALE 3/8"=1'0"
DRWG. NO. RE-1-20609-C
GLENNON & KERN, CHICAGO

FIGURE 20

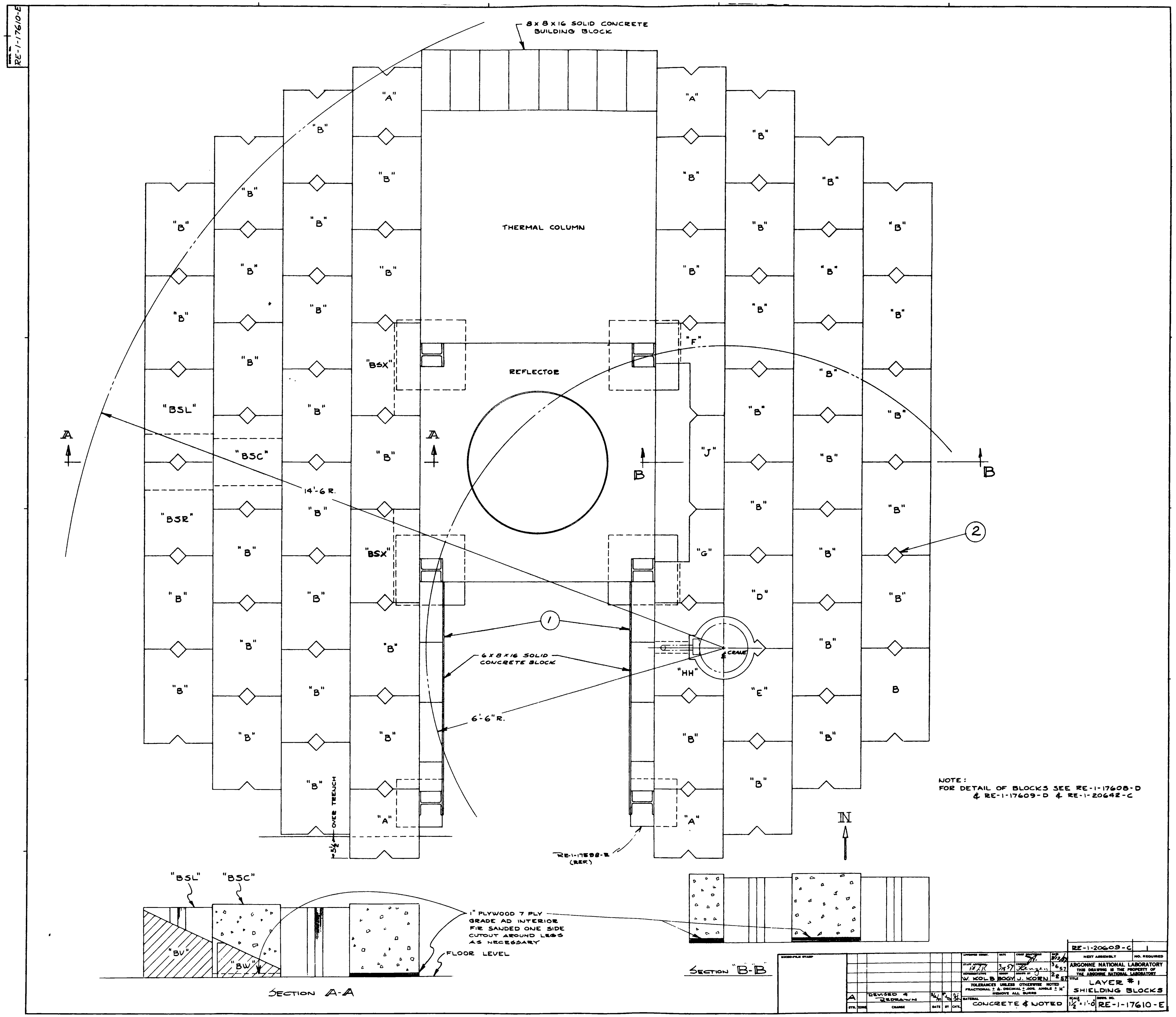

RE-1-17610-E
8 x 8 x 16 SOLID CONCRETE BUILDING BLOCK
THERMAL COLUMN
REFLECTOR
"A"
"B"
"BSX"
"BSL"
"BSC"
"BSR"
"F"
"J"
"G"
"D"
"E"
"HH"
CRANE
14'-6 R.
6'-6" R.
6 x 8 x 16 SOLID CONCRETE BLOCK
OVER TRENCH
RE-1-17598-E (REF)
NOTE: FOR DETAIL OF BLOCKS SEE RE-1-17608-D & RE-1-17609-D & RE-1-20642-C
1" PLYWOOD 7 PLY GRADE AD INTERIOR FIR SANDED ONE SIDE CUTOUT AROUND LEGS AS NECESSARY
FLOOR LEVEL
"BV"
"BW"
SECTION A-A
SECTION "B-B"
RE-1-20609-C
NEXT ASSEMBLY
NO. REQUIRED
ARGONNE NATIONAL LABORATORY
THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY
W. KOLB
BOGY
J. KORN
TOLERANCES UNLESS OTHERWISE NOTED
REMOVE ALL BURRS
LAYER #1
SHIELDING BLOCKS
REVISED & REDRAWN
CONCRETE & NOTED
1/2" = 1'-0
RE-1-17610-E

FIGURE 21

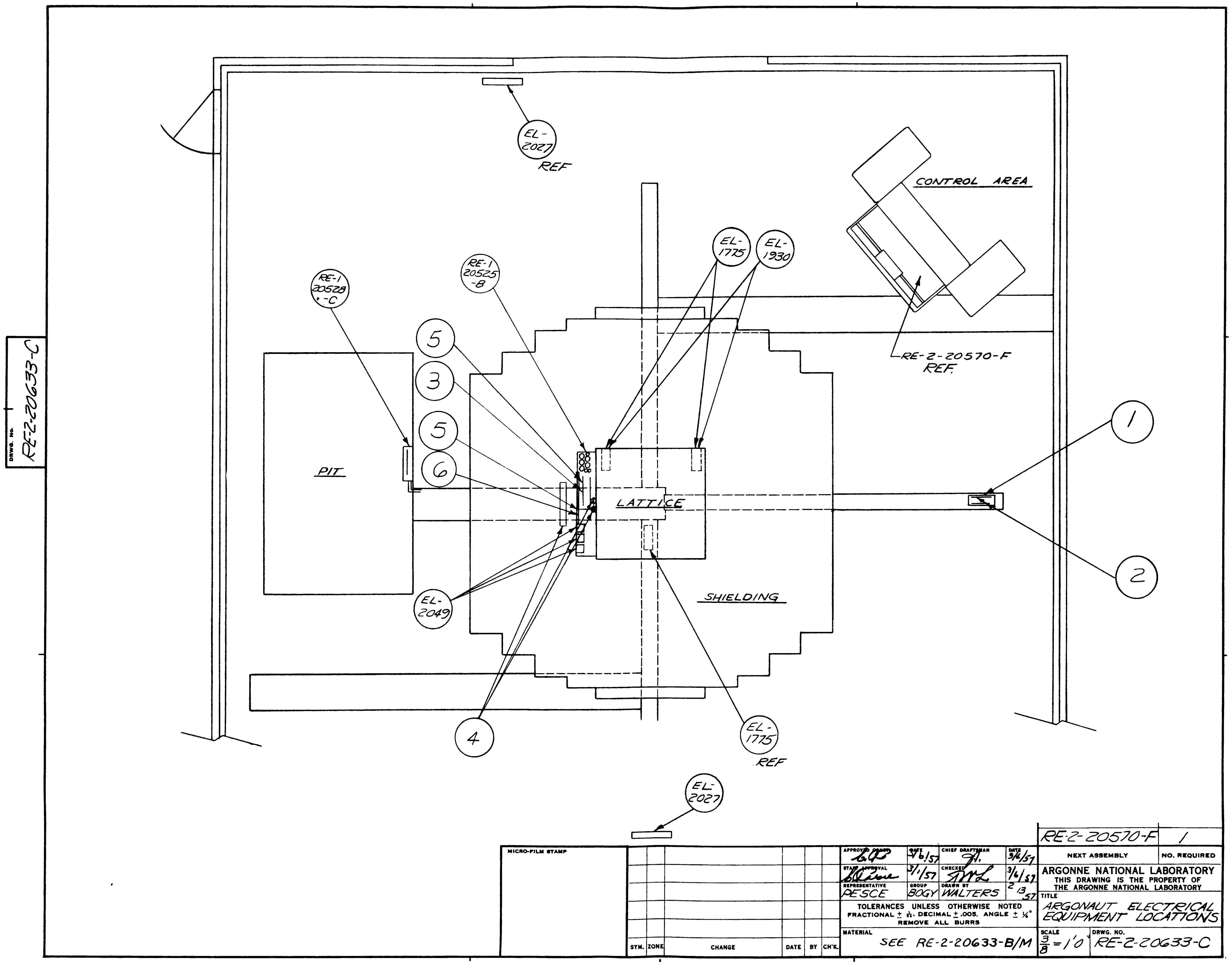

DRWG. No. RE-2-20633-C
EL-2027 REF
CONTROL AREA
EL-1775
EL-1930
RE-1 20525 -B
RE-1 20528 -C
RE-2-20570-F REF.
5
3
5
6
1
2
PIT
LATTICE
SHIELDING
EL-2049
4
EL-1775 REF
EL-2027
RE-2-20570-F
1
NEXT ASSEMBLY
NO. REQUIRED
ARGONNE NATIONAL LABORATORY
THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY
TITLE ARGONAUT ELECTRICAL EQUIPMENT LOCATIONS
MICRO-FILM STAMP
SYM.
ZONE
CHANGE
DATE
BY
CH'K.
APPROVED
DATE 3/6/57
CHIEF DRAFTSMAN
DATE 3/6/57
3/1/57
CHECKED
3/6/57
REPRESENTATIVE PESCE
GROUP BOGY
DRAWN BY WALTERS
2/13/57
TOLERANCES UNLESS OTHERWISE NOTED
FRACTIONAL ± 1/64, DECIMAL ± .005, ANGLE ± 1/4°
REMOVE ALL BURRS
MATERIAL SEE RE-2-20633-B/M
SCALE 3/8 = 1'0"
DRWG. NO. RE-2-20633-C

FIGURE 22

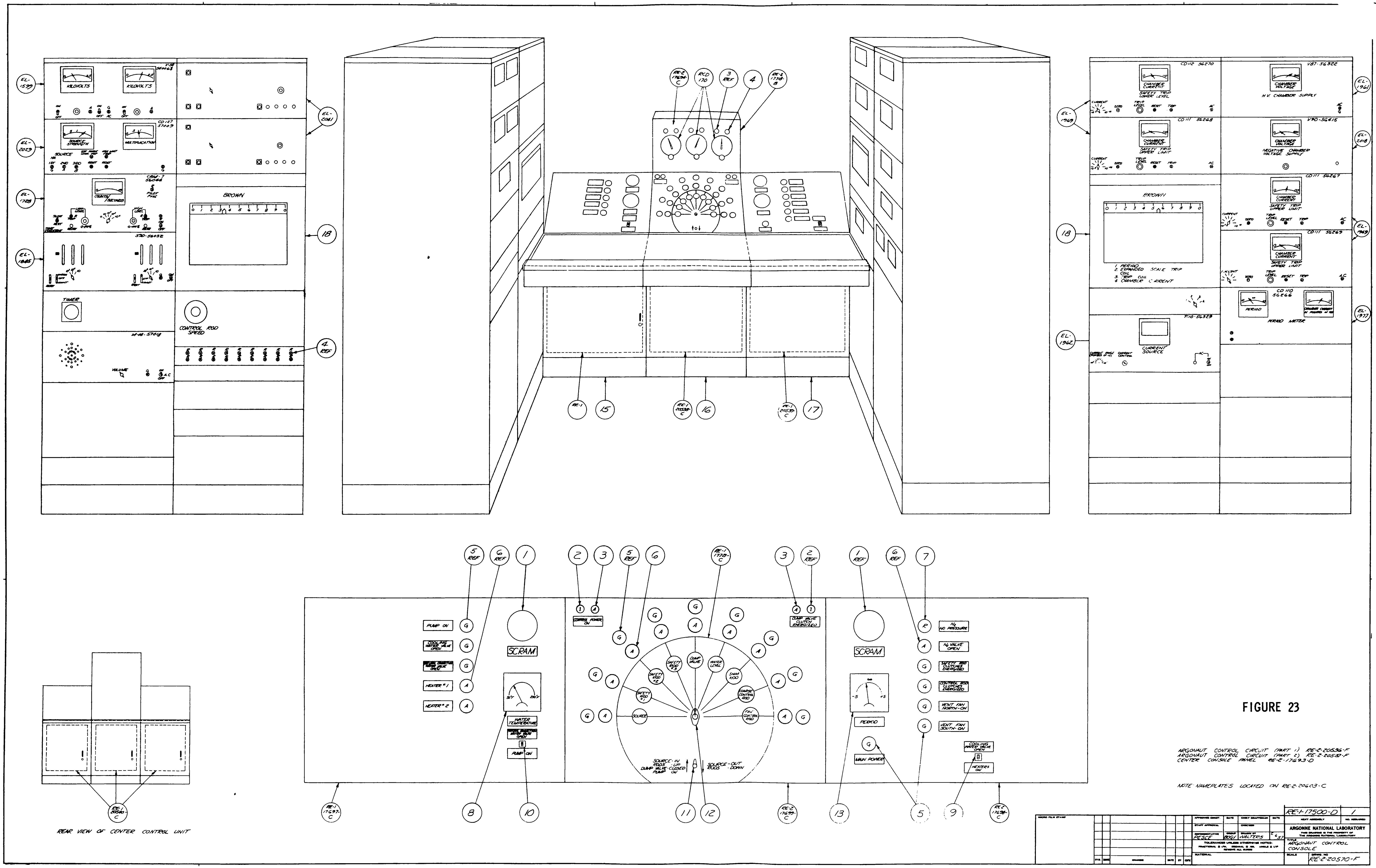

KILOVOLTS
KILOVOLTS
SOURCE STRENGTH
MULTIPLICATION
SOURCE
COUNTS/SECONDS
TIMER
VOLUME
BROWN
CONTROL ROD SPEED
CHAMBER CURRENT
SAFETY TRIP LOWER LEVEL
CHAMBER VOLTAGE
H.V. CHAMBER SUPPLY
SAFETY TRIP UPPER UNIT
NEGATIVE CHAMBER VOLTAGE SUPPLY
1. PERIOD
2. EXPANDED SCALE TRIP COIL
3. TRIP COIL
4. CHAMBER CURRENT
PERIOD
PERIOD METER
CURRENT SOURCE
PUMP ON
HEATER #1
HEATER #2
SCRAM
WATER TEMPERATURE
PUMP ON
CONTROL POWER ON
DUMP VALVE CLUTCH ENERGIZED
SAFETY ROD #1
SAFETY ROD #2
SAFETY ROD #3
DUMP VALVE
WATER LEVEL
SHIM ROD
COARSE CONTROL ROD
FINE CONTROL ROD
SOURCE
SOURCE - IN RODS - UP DUMP VALVE - CLOSED PUMP ON
SOURCE - OUT RODS - DOWN
SCRAM
PERIOD
MAIN POWER
N2 NO PRESSURE
N2 VALVE OPEN
SAFETY ROD CLUTCHES ENERGIZED
CONTROL ROD CLUTCHES ENERGIZED
VENT FAN NORTH - ON
VENT FAN SOUTH - ON
COOLING WATER VALVE OPEN
HEATERS ON
REAR VIEW OF CENTER CONTROL UNIT
ARGONAUT CONTROL CIRCUIT (PART 1) RE-2-20536-F
ARGONAUT CONTROL CIRCUIT (PART 2) RE-2-20510-F
CENTER CONSOLE PANEL RE-2-17693-D
NOTE: NAMEPLATES LOCATED ON RE-2-20603-C
RE-1-17500-D
ARGONNE NATIONAL LABORATORY
ARGONAUT CONTROL CONSOLE
RE-2-20570-F

FIGURE 23

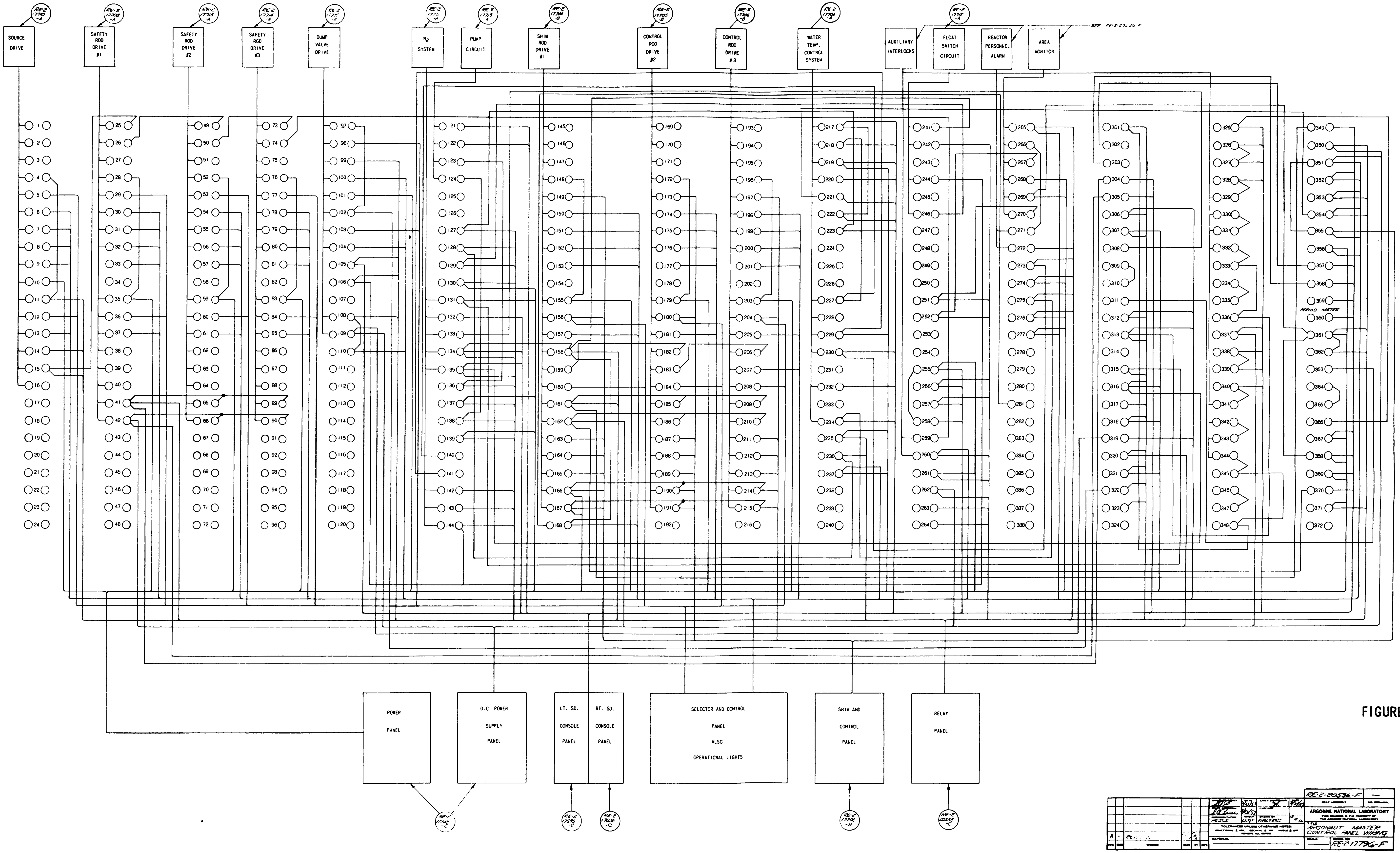

SOURCE DRIVE
SAFETY ROD DRIVE #1
SAFETY ROD DRIVE #2
SAFETY ROD DRIVE #3
DUMP VALVE DRIVE
N2 SYSTEM
PUMP CIRCUIT
SHIM ROD DRIVE #1
CONTROL ROD DRIVE #2
CONTROL ROD DRIVE #3
WATER TEMP. CONTROL SYSTEM
AUXILIARY INTERLOCKS
FLOAT SWITCH CIRCUIT
REACTOR PERSONNEL ALARM
AREA MONITOR
POWER PANEL
D.C. POWER SUPPLY PANEL
LT. SD. CONSOLE PANEL
RT. SD. CONSOLE PANEL
SELECTOR AND CONTROL PANEL ALSO OPERATIONAL LIGHTS
SHIM AND CONTROL PANEL
RELAY PANEL
RE-2-20536-F
ARGONNE NATIONAL LABORATORY
ARGONAUT MASTER CONTROL PANEL WIRING
RE-2-17796-F

FIGURE 24

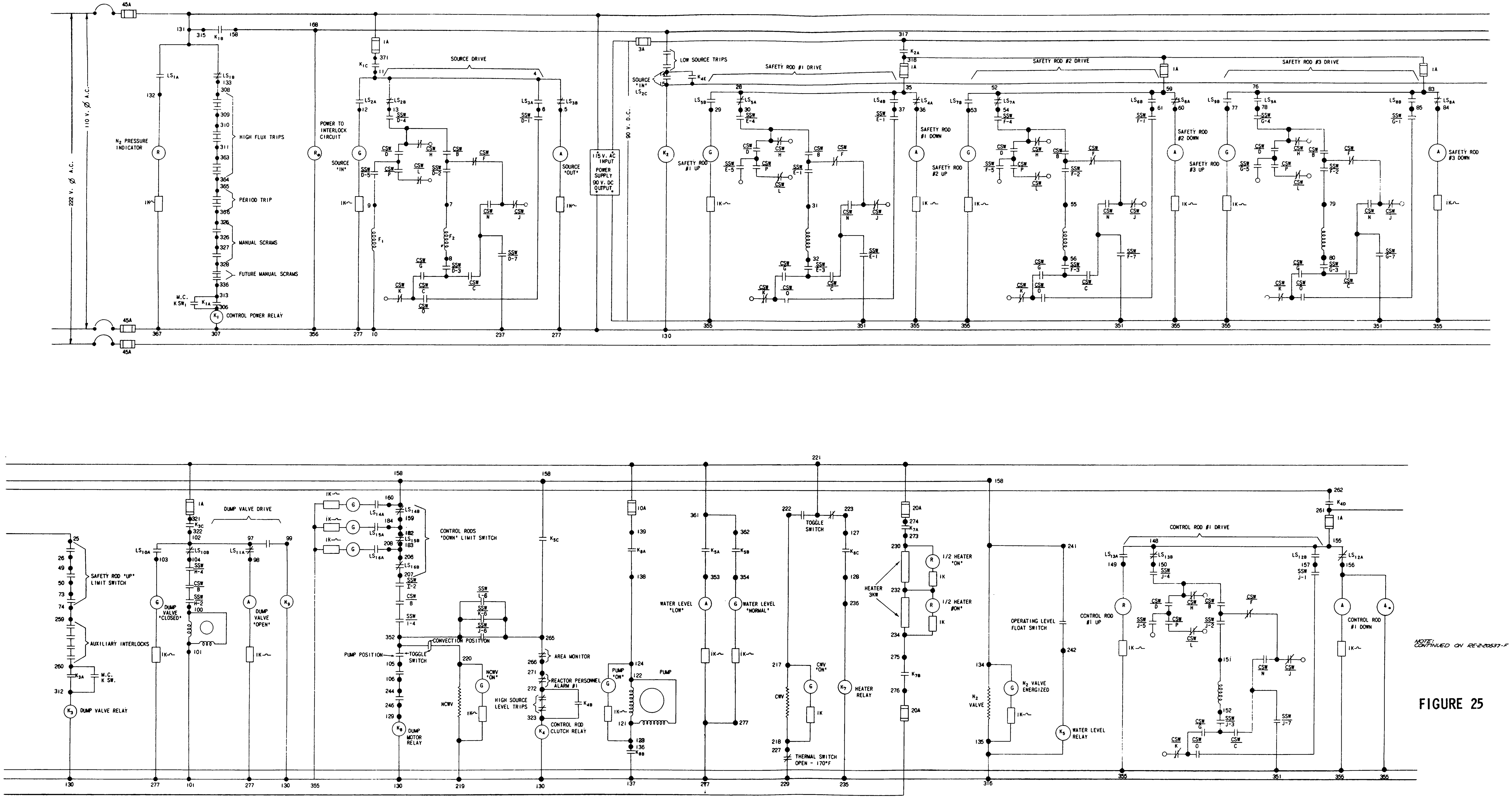
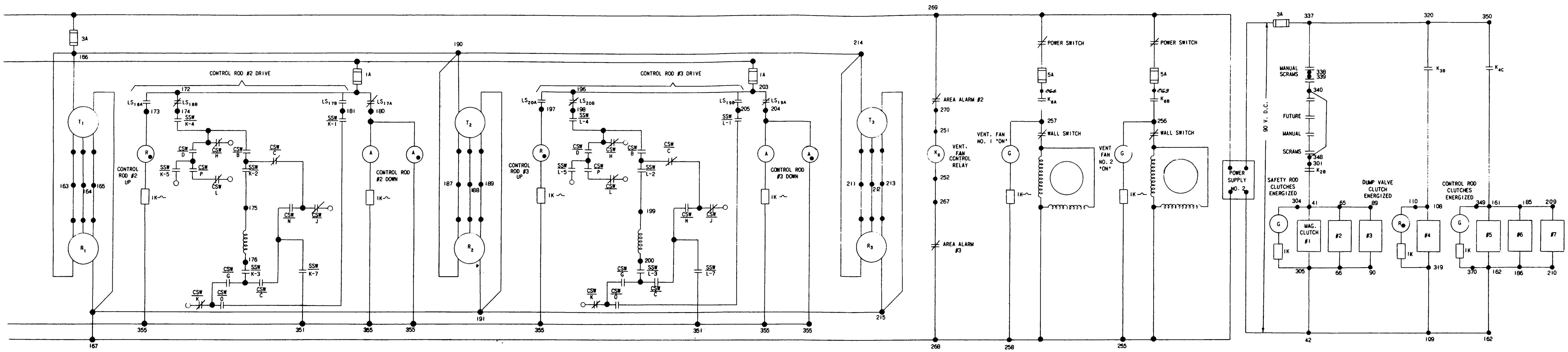


FIGURE 25

ARGONNE NATIONAL LABORATORY

ARGONAUT CONTROL CIRCUIT (PART 1)

RE-2-20536-F



NOTE: ABOVE IS A CONTINUATION OF RE-2-20536-F

A	AMBER INDICATOR
CSW	CONTROL SWITCH
CWV	CONVECTION WATER VALVE
F_1 & F_2	MOTOR FIELDS
G	GREEN INDICATOR
K's	RELAY AND CONTACTS
LS_1	N_1 PRESSURE SYSTEM LIMIT SWITCH
LS_2	SOURCE 'IN' LIMIT SWITCH
LS_3	SOURCE 'OUT' LIMIT SWITCH
LS_4	SAFETY ROD #1 'DOWN' LIMIT SWITCH
LS_5	SAFETY ROD #1 'UP' LIMIT SWITCH
LS_6	SAFETY ROD #2 'DOWN' LIMIT SWITCH
LS_7	SAFETY ROD #2 'UP' LIMIT SWITCH
LS_8	SAFETY ROD #3 'DOWN' LIMIT SWITCH
LS_9	SAFETY ROD #3 'UP' LIMIT SWITCH
LS_{10}	DUMP VALVE 'CLOSED' LIMIT SWITCH
LS_{11}	DUMP VALVE 'OPEN' LIMIT SWITCH
LS_{12}	CONTROL ROD #1 'DOWN' LIMIT SWITCH
LS_{13}	CONTROL ROD #1 'UP' LIMIT SWITCH
LS_{14}	CONTROL RODS 'DOWN' LIMIT SWITCH
LS_{15}	CONTROL ROD 'DOWN' LIMIT SWITCH
LS_{16}	CONTROL ROD 'DOWN' LIMIT SWITCH
LS_{17}	CONTROL ROD #2 'DOWN' LIMIT SWITCH
LS_{18}	CONTROL ROD #2 'UP' LIMIT SWITCH
LS_{19}	CONTROL ROD #3 'DOWN' LIMIT SWITCH
LS_{20}	CONTROL ROD #3 'UP' LIMIT SWITCH
MAG.	MAGNETIC CLUTCH
NCWV	NATURAL COOLING WATER VALVE
R	RED INDICATOR
R_1, R_2 & R_3	RECEIVER SYNCHRO
SSW	SELECTOR SWITCH
T	TRANSMITTER SYNCHRO
IK	1000 OHMS (RESISTANCE)

SSW
D-1
POSITION SECTION

CSW - CONTROL SWITCH

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

SSW - SELECTOR SWITCH

POSITION	D SOURCE DRIVE	E SAFETY ROD DRIVE #1	F SAFETY ROD DRIVE #2	G SAFETY ROD DRIVE #3	H DUMP VALVE	I PUMP	J CONTROL ROD	K CONTROL ROD	L CONTROL ROD
SECTION	1	X	X	X			X	X	X
	2	X	X	X	X	X	X	X	X
	3	X	X	X			X	X	X
	4	X	X	X	X	X	X	X	X
	5	X	X	X			X	X	X
	6	X	X	X			X	X	X
	7	X	X	X			X	X	X

FIGURE 26

APPROVED CONST.	DATE	CHIEF DRAFTSMAN	DATE	NEXT ASSEMBLY RE-2-20570-F	NO. REQUIRED 1
STAFF APPROVAL		CHECKED		ARGONNE NATIONAL LABORATORY THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY	
REPRESENTATIVE PESCE	GROUP BOGY	DRAWN BY WALTERS	7-4-57		
TOLERANCES UNLESS OTHERWISE NOTED: FRACTIONAL ± 1/64 DECIMAL ± .005 ANGLE ± 1/2° REMOVE ALL BURRS				TITLE ARGONAUT CONTROL CIRCUIT (PART 2)	
MATERIAL				SCALE	DWG. NO. RE-2-20537-F

CHANGE	DATE	BY	CH'K

ARGONNE NATIONAL LABORATORY — BILL OF MATERIAL — NO. RE-1-17500 - SUPPLEMENT — COST DATA

CLASS: MANUFACTURED M; PURCHASED SPECIAL SPEC. P; PURCHASED COMM. RAW R; PURCHASED ARGONNE FINISH A

PREPARED BY R.H. ARMSTRONG — APPROVED BY — SHEET 1 OF 3 — PROJECT ENGINEER LENNOX — PROJECT NAME ARGONAUT REACTOR COST SUMMATION — THIS B/M SUPPLEMENTS GENERAL REACTOR B/M RE-1-17500 — PREPARED BY — APPROVED BY

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		S.O.	4113			1	158		528	869	1397	
4	RE-1-17744-C	STRUCTURAL TOP PLATE ASSY.	1	" " RE-1-17744		S.O.	5028-5397				78		126	430	556	
5												STRUCTURE SUB-TOTAL	654	1299	1953	1953
6																
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			S.O.	4534			2	103		255	567	822	
10	RE-1-17685-B	DUMP LINE (TANK TO VALVE)	1			S.O.	4705				21½		107	118	225	
11	RE-1-17655-E	DUMP VALVE ASSY.	1	SEE B/M RE-1-17655		S.O.	4623			3	104	VALVE P.O. 193857 - $167.00	380	572	952	
12	RE-1-17684-B	DUMP LINE (VALVE TO DUMP TANK)	1			S.O.	4705				21½		81	118	199	
13	RE-1-20534-B	DUMP TANK ASSY.	1	ALUMINUM		P.O.	210743			4			300		300	
14												DUMP SYSTEM SUB-TOTAL	1123	1375	2498	
15		~WATER CIRCUIT-COOLANT LINE TUBE SIDE~	1 x													
16	RE-1-17688-B	PUMP INLET PIPING-LESS PUMP	1									FIELD CUT & ASSEMBLE	108		108	
17		PUMP	1	CENTRIFUGAL ¼ HP		P.O.	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 HEAT EXCH.	1									" " " "	229		229	
20		HEAT EXCHANGER	1	34000 BTU - S.S.		P.O.	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 SIDE	1 x													
24	RE-1-20613-B	COOLING WATER PIPING-INLET	1									VALVE P.O. 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		S.O.	5206				12	SPARGER P.O. 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		S.O. 2858 S.O. 4151		MULTIPLICATION EXP. ARGONAUT REWORK			185 HRS. = 206 HRS. =	1017.50 + 7.60 MATERIAL = 1025.10 1133.00	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		S.O.	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			S.O.	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.	1	SEE B/M RE-1-17774-F		S.O.	3099, 5131, 3419, 5213				123	METAL PARTS MAT. & LABOR - 30 HRS.	12	165	177	
53		LESS GAS SYSTEM, FUEL, OUTER & INNER TANKS				BLANK GRAPHITE 476 LBS. AT $0.50 PER LB. = 238.00							238	507	745	
54													250	672	922	
55																
56																

Revision margin: DATE / CHANGE / SYM — 3-15-57 — REVISED — 1

RE-19 (11-52)

FIGURE 27

ARGONNE NATIONAL LABORATORY — BILL OF MATERIAL — NO. RE-1-17500 - SUPPLEMENT — COST DATA

CLASS: MANUFACTURED M; PURCHASED SPECIAL SPEC. P; PURCHASED COMM. RAW R; PURCHASED ARGONNE FINISH A

PREPARED BY R.H. ARMSTRONG — APPROVED BY — SHEET 2 OF 3 — PROJECT ENGINEER LENNOX — PROJECT NAME ARGONAUT REACTOR COST SUMMATION — COST DATA: PREPARED BY — APPROVED BY

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
57	RE-1-17575-A	CONTROL ROD FILLER BLOCKS	8								86.4	BLANK GRAPHITE 797LBS AT. 0.50LB	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. 0.50 LB.	16	19	35	
60																
61	RE-1-17652-C	SOURCE CARRIER GRAPHITE	1	SEE LINE FOR BALANCE OF COST		S.O.	4292				2.2	BLANK GRAPHITE 20 LB. AT 0.50 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			P.O.	210179			5	60	410.00 PURCHASE COST + 330.00 REWORK	410	330	740	
72		TUNNEL LINING	AS REQ.	MASONITE		P.O.	213874						182		182	
73		LEAD BRICKS	42	2x4x8 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			P.O.	216260						9		9	
76		CONCRETE SHIELD & PAINT	1			OPER	#LWD808				37		20	205	225	
77		EYE BOLTS	4				STOCK					.68 EACH.	3		3	
78		CAR MOVER	1			P.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. 11.20 LAB. 121.88 = 133.08	262	2965	3227	
83																
84	RE-1-17610-15 E	CONCRETE SHIELDING BLOCKS	AS REQ.	SEE B/M RE-1-17610-15		LWD657	OPER. #1476·9133			7	459	LAYERS 1 TO 6	115	2525	2640	
85		PLYWOOD SPACER	5	1"x48"x96" 7 PLY FIR		P.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	SEE P.O.			P.O.	216112						157		157	
89		STOCK CONCRETE BLOCKS	220				STOCK					$10.50 EACH.	2310		2310	
90												GENERAL SHIELDING SUB-TOTAL	2684	2841	5525	
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			P.O.	219414						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	8250	16500	16500

DATE / CHANGE / SYM — 3-15-57 — REVISED — 1

RE-19 (11-52)

FIGURE 28

ARGONNE NATIONAL LABORATORY — **BILL OF MATERIAL** — NO. RE-1-17500 - SUPPLEMENT

CLASS: MANUFACTURED M · PURCHASED SPECIAL SPEC. P · PURCHASED COMM. RAW R · PURCHASED ARGONNE FINISH A

PREPARED BY R.H. ARMSTRONG · APPROVED BY · SHEET 3 OF 3 · PROJECT ENGINEER LENNOX · PROJECT NAME ARGONAUT REACTOR COST SUMMATION

COST DATA — PREPARED BY · APPROVED BY

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
113		~ CONTROL ROD MECHANISMS & ASSOCIATE PARTS ~ (ADD DESIRED COMBINATIONS TO TOTAL 6 CONTROL UNITS)														
114																
115	RE·1·20610·D	WINCH TYPE CONTROL ASSY.	1	SEE B/M RE·1·20610		S.O.	5178-5421-5389			6	65	UNIT COST	244	358	602	
116												TOTAL COST OF 6 UNITS	1464	2148	3612	3612
117																
118	RE·1·20604·A	MAGNETIC CONTROL ASSY.	1	SEE B/M RE·1·20604		S.O.	5254-5421-5389				31	UNIT COST	75	171	246	
119	RE·1	CONTROL BOX ASSY.	1								36	1 BOX SERVES 6 MECHANISMS	200	200	400	
120												TOTAL COST OF 6 UNITS	650	1226	1876	1876
121											86.2					
122	RE·1·20571·D	DRUM TYPE CONTROL ASSY.	1	SEE B/M RE·1·20571		S.O.	5227	CONTROL ROD COST SHOWN-				-SAFTEY ROD COST· M.197-L. 474	280	474	754	
123							4 SAFETY RODS + 2 CONTROL—					TOTAL COST OF 6 UNITS	1348	2844	4192	4192 •
124																
125	RE·1·20511·C	D_2O CONTROL ASSY.	1	SEE B/M RE·1·20511		S.O.	5228				71	ADD $24.00 FOR EACH ADDITIONAL ROD. COST BASED ON ALL RODS	209	391	600	
126		(ROD USED AS SAFETY ROD										USING 1 VACUUM PUMP & DEHYDRATOR COSTING 76.00				
127		ONLY. THEREFORE 4 RODS										TOTAL COST OF 4 UNITS	608	1564	2172	2172
128		PER REACTOR CAN BE USED)														
129																
130	RE·1	CARDIOID CAM CONTROL ROD	1	SEE B/M RE·1		S.O.	5656									
131																
132																
133																
134		~ MISC. ITEMS ~														
135		SLING CHAIN 14000 LB. CAP.	1			P.O.	214224						95		95	
136		" " 850 " "	1				"						39		39	
137		UTILITY HAND CART	1			P.O.	216040						261		261	
138																
139																
140													395		395	395 •
141																
142											5968	TOTAL REACTOR COST	29431	32831	62431	62431 x
143																
144																
145		~ BUILDING BREAKDOWN-DRAWINGS ~										~ BUILDING BREAKDOWN - COSTS ~				
146	PE·25·1 SHT. 1	PLOT & ACCESS PLAN			A							BUILDING	12294			
147	" " 2	FLOOR PLAN & ELEVATION			B							FLOOR & FOUNDATION	8376			
148	" " 3	SLAB & FOOTING DETAILS			C							JIB CRANE & HOIST	1543			
149	" " 4	" " "			D							" " " " INSTALL.	225			
150	" " 5	STEAM & CONDENSATE PIPING & HEATING			E							DOORS-OVER HEAD TYPE	1666			
151	" " 6	POWER & LIGHTING			F							ELECTRICAL SERVICES	2831			
152	" -2 " 1	EXHAUST FANS			G							PLUMBING & HEATING SERVICE	2776			
153	RE·3·17572·D	REACTOR ENGINEERING FLOOR LAYOUT			H							FLOOR PITS FOR FUEL STORAGE	1444			
154	SPEC. NO. 63	INSTALLATION OF 2 STEEL ROLLING DOORS														
155	" " 64	STEAM & CONDENSATE PIPING & HEATING										TOTAL BUILDING COST	31155			31155 x
156	" " 65	ELECTRICAL POWER & LIGHTING														
157	SUB·CONTRACT 31109·38-680	INSTALLATION OF														
158		EQUIPMENT FOUNDATION														
159	SUB·CONTRACT 31-109-38-671	CONSTRUCTION OF														
160		ARGONAUT REACTOR BUILDING														
161																
162																
163																
164																
165												TOTAL REACTOR COST				62431
166												TOTAL BUILDING COST				31155
167												GRAND TOTAL				93586
168				ASSEMBLY & ERECTION CA 7 1/2 MAN MONTHS OR 1300 HRS.												

Revision block: DATE · CHANGE · SYM — 3-15-57 · REVISED · 1

RE-19 (11-52)

FIGURE 29

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/ft^3 Density - Actual Size 7-5/8 x 7-5/8 x 15-5/8". $ 0.35 ea.

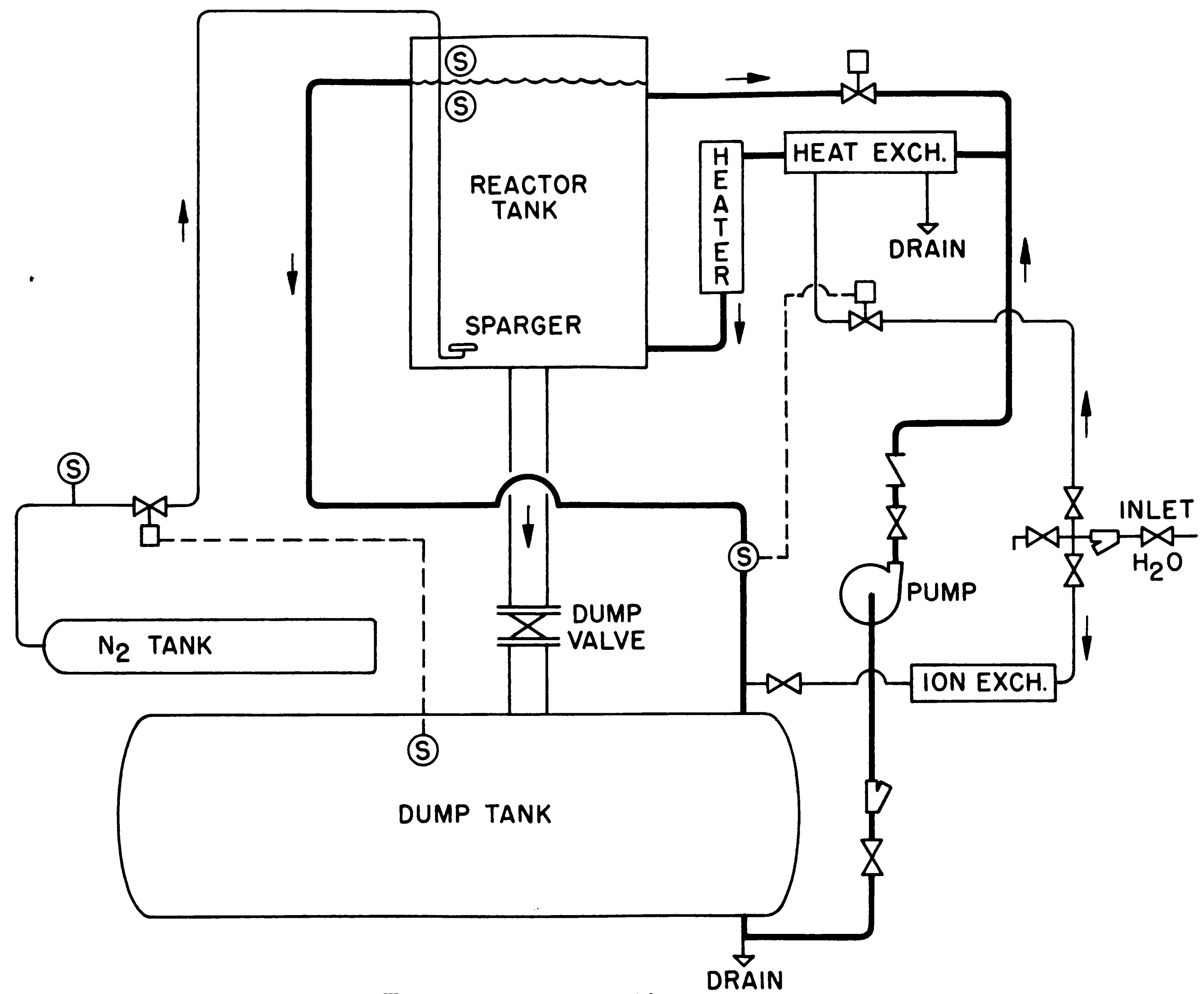
BIDDERS

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)

FIGURE 30



ARGONAUT FLOW DIAGRAM

DRWG. No. RE-8-20646-C

MICRO-FILM STAMP	
SYM. / ZONE / CHANGE / DATE / BY / CH'K.	
APPROVED CONST. / DATE / CHIEF DRAFTSMAN / DATE	
STAFF APPROVAL / CHECKED	
REPRESENTATIVE: W. KOLB / GROUP: BOGY / DRAWN BY: J. KORN / 2 25 57	
TOLERANCES UNLESS OTHERWISE NOTED FRACTIONAL ± 1/64, DECIMAL ± .005, ANGLE ± 1/4° REMOVE ALL BURRS	
MATERIAL: —	
NEXT ASSEMBLY: —	NO. REQUIRED: —
ARGONNE NATIONAL LABORATORY THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY	
TITLE: FLOW DIAGRAM ARGONAUT	
SCALE: —	DRWG. NO. RE-8-20646-C

FIGURE 31

RE-2-2065 I-C
W. KOLB:F.T., 3-1-57

PICTORIAL DIAGRAM OF ARGONAUT INSTRUMENTATION

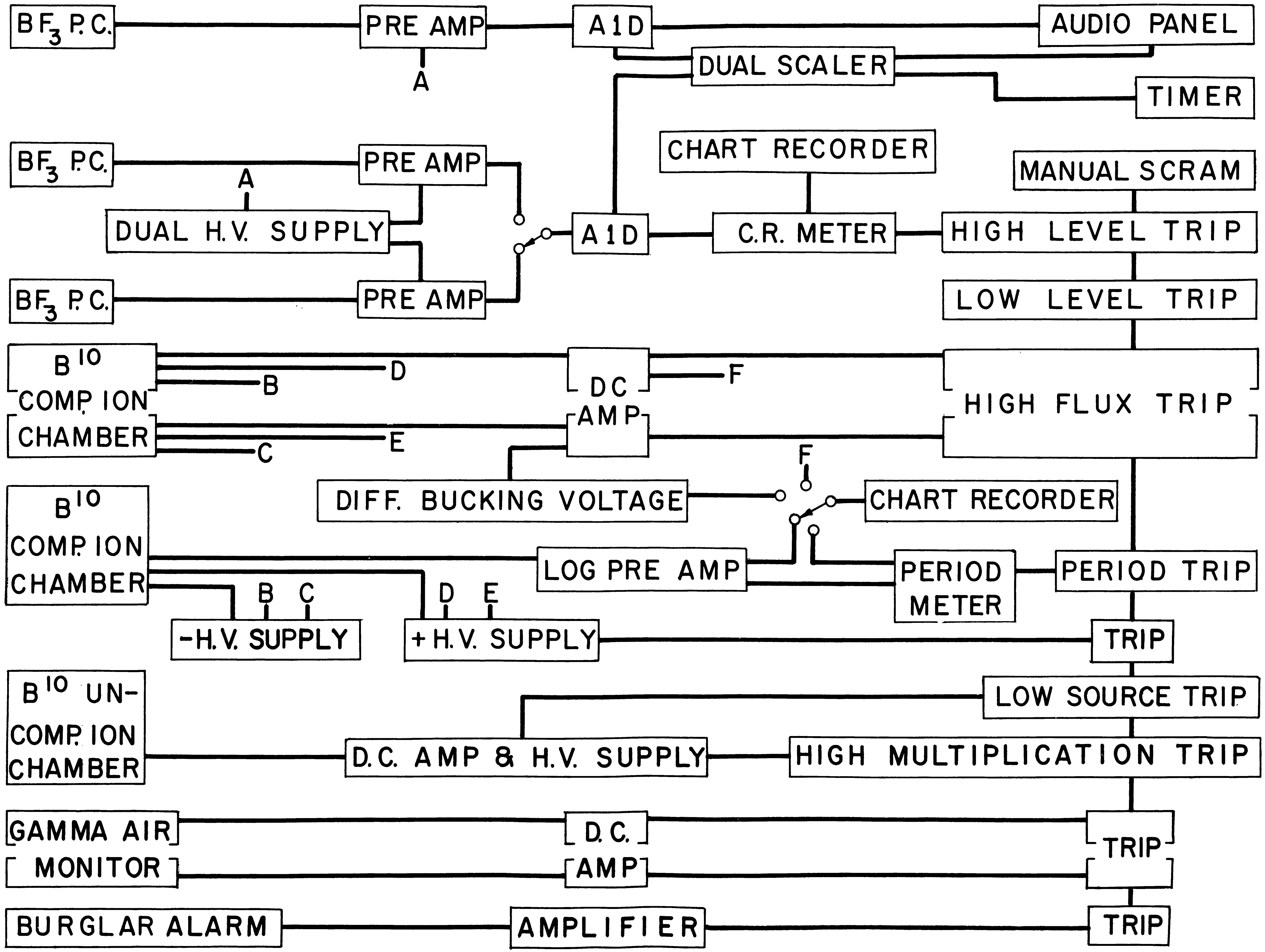
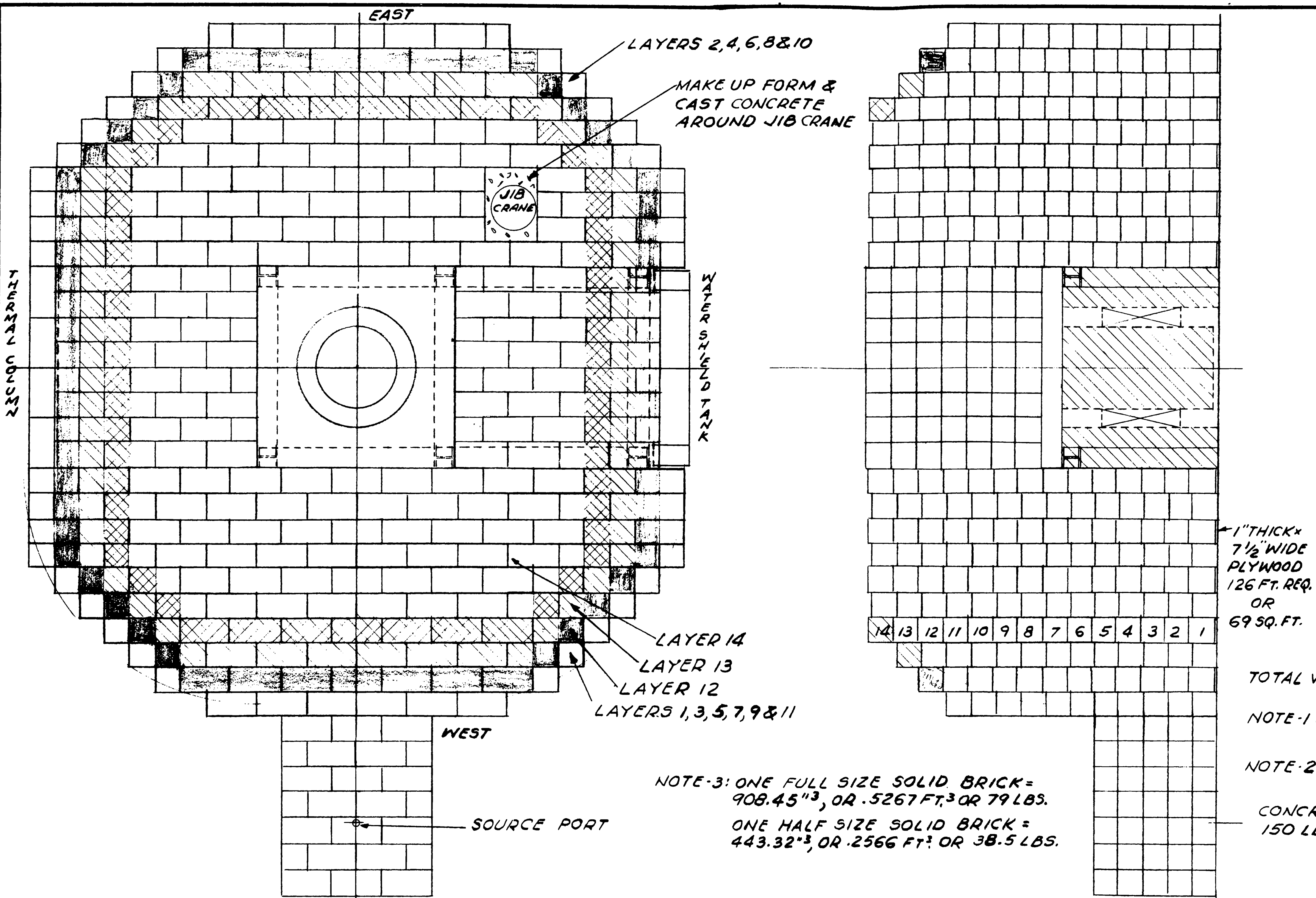


FIGURE 32

DRWG. No. RE-6-20640-B



LAYER	EAST SIDE FULL SIZE[1]	EAST SIDE HALF SIZE[2]	WEST SIDE FULL SIZE	WEST SIDE HALF SIZE
1	96	18	101	14
2	101	8	105	6
3	96	18	101	14
4	101	8	105	6
5	96	18	101	14
6	101	8	105	6
7	96	18	101	14
8	101	8	105	6
9	96	18	101	14
10	101	8	105	6
11	96	18	101	14
12	82	16	86	14
13	67	16	72	12
14	55	10	59	8
SIDE SHIELD TOTALS	1285	190	1348	148

	FULL SIZE[1]	HALF SIZE[2]
SIDES	2633	338
OVER WATER SHIELD TANK	196	56
OVER THERMAL COLUMN	252	64
OVER SOURCE PORT	90	30
OVER CENTER PLUG	192	0
SPARES	127	132
TOTALS	3490	620

TOTAL VOLUME = 1892 FT.³ OR 2838 LBS.

NOTE-1: NOMINAL SIZE 8"×8"×16"
ACTUAL 7⅝"×7⅝"×15⅝"

NOTE-2: NOMINAL SIZE 8"×8"×8"
ACTUAL 7⅝"×7⅝"×7⅝"

CONCRETE DENSITY TO BE 150 LBS PER FT.³

NOTE-3: ONE FULL SIZE SOLID BRICK = 908.45"³, OR .5267 FT.³ OR 79 LBS.
ONE HALF SIZE SOLID BRICK = 443.32"³, OR .2566 FT.³ OR 38.5 LBS.

FIGURE 33

MICRO-FILM STAMP	SYM	ZONE	CHANGE	DATE	BY	CH'K.

APPROVED CONST.	DATE	CHIEF DRAFTSMAN	DATE
STAFF APPROVAL R.H. Armstrong	3-15-57	CHECKED	
REPRESENTATIVE	GROUP	DRAWN BY RHA	2-13-57

TOLERANCES UNLESS OTHERWISE NOTED
FRACTIONAL ± 1/64, DECIMAL ± .005, ANGLE ± ½°
REMOVE ALL BURRS

MATERIAL: REFER ABOVE

NEXT ASSEMBLY	NO. REQUIRED

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

TITLE: ALTERNATE SHIELDING ARRANGEMENT NO. 2

SCALE: 3/8" = 1 FT.

DRWG. NO. RE-6-20640-B

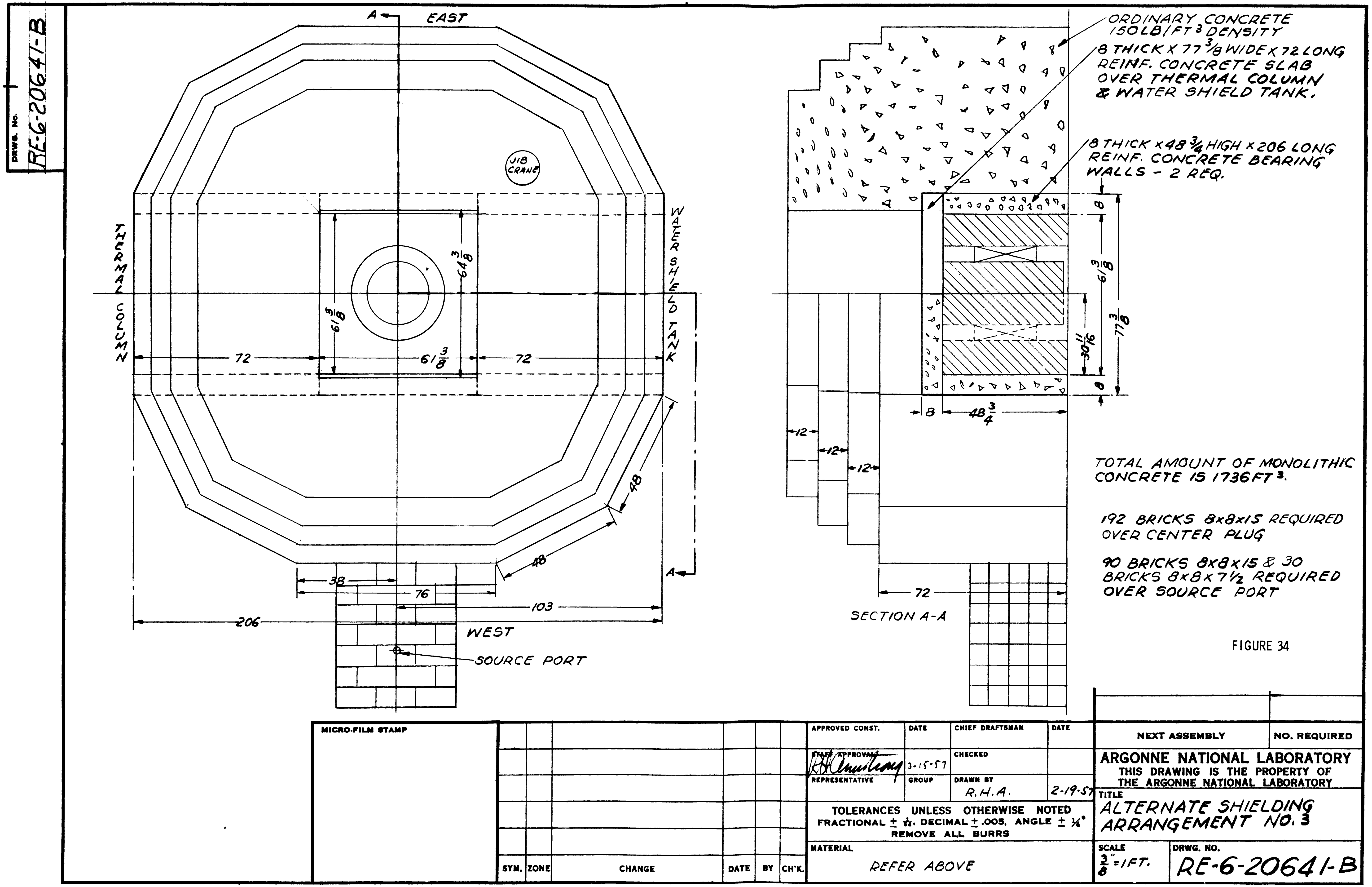
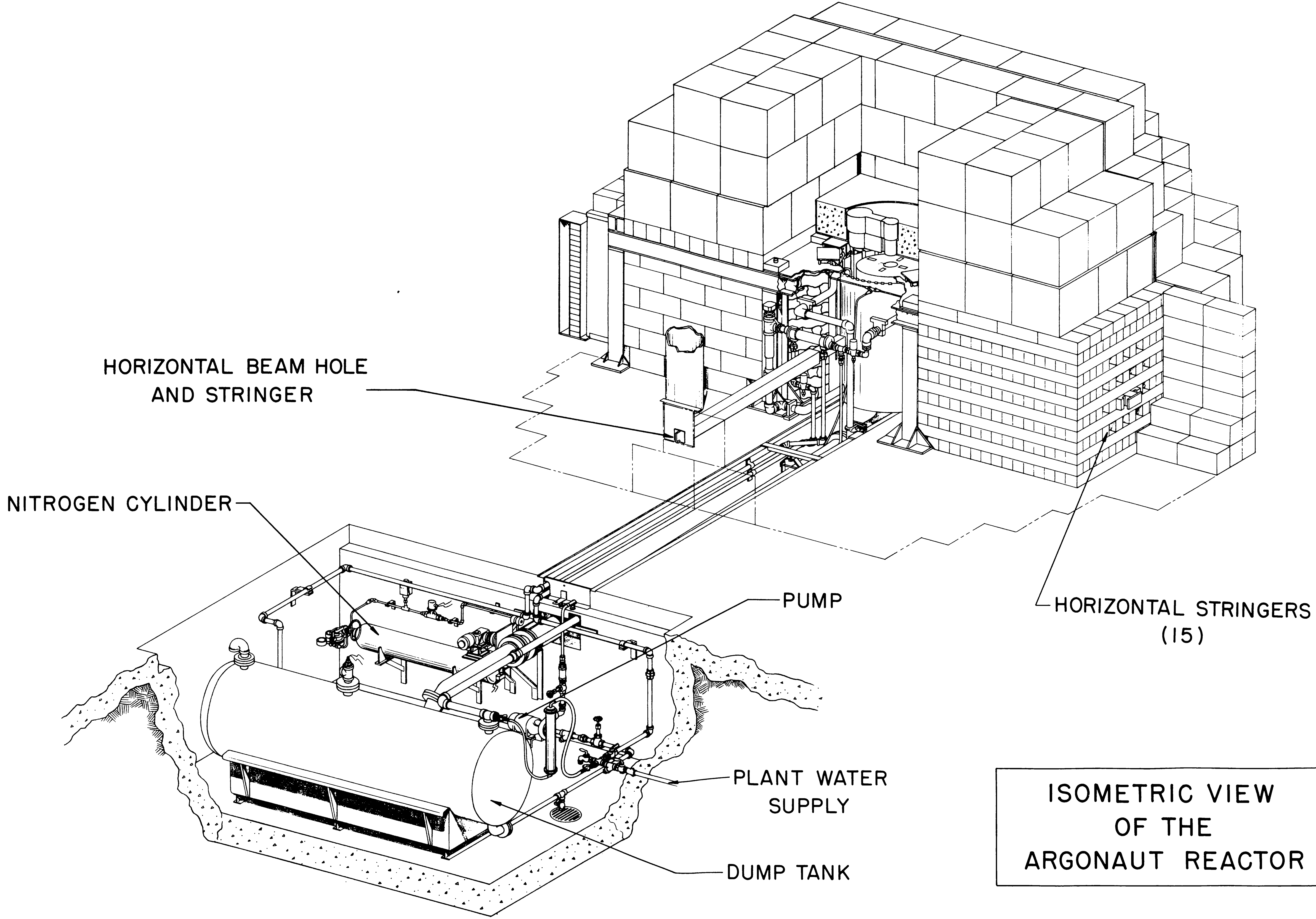

DRWG. No. RE-6-20641-B
A
EAST
JIB CRANE
THERMAL COLUMN
WATER SHIELD TANK
64 3/8
61 3/8
61 3/8
72
72
48
48
38
76
103
206
WEST
SOURCE PORT
A
ORDINARY CONCRETE 150 LB/FT³ DENSITY
8 THICK X 77 3/8 WIDE X 72 LONG REINF. CONCRETE SLAB OVER THERMAL COLUMN & WATER SHIELD TANK.
8 THICK X 48 3/4 HIGH X 206 LONG REINF. CONCRETE BEARING WALLS - 2 REQ.
8
61 3/8
30 11/16
77 3/8
8
8
48 3/4
12
12
12
72
SECTION A-A
TOTAL AMOUNT OF MONOLITHIC CONCRETE IS 1736 FT³.
192 BRICKS 8x8x15 REQUIRED OVER CENTER PLUG
90 BRICKS 8x8x15 & 30 BRICKS 8x8x7½ REQUIRED OVER SOURCE PORT
MICRO-FILM STAMP
SYM. ZONE CHANGE DATE BY CH'K.
APPROVED CONST. DATE CHIEF DRAFTSMAN DATE
STAFF APPROVAL 3-15-57 CHECKED
REPRESENTATIVE GROUP DRAWN BY R.H.A. 2-19-57
TOLERANCES UNLESS OTHERWISE NOTED
FRACTIONAL ± 1/64, DECIMAL ± .005, ANGLE ± ¼°
REMOVE ALL BURRS
MATERIAL REFER ABOVE
NEXT ASSEMBLY NO. REQUIRED
ARGONNE NATIONAL LABORATORY
THIS DRAWING IS THE PROPERTY OF THE ARGONNE NATIONAL LABORATORY
TITLE ALTERNATE SHIELDING ARRANGEMENT NO. 3
SCALE 3/8" = 1 FT.
DRWG. NO. RE-6-20641-B

FIGURE 34



ISOMETRIC VIEW
OF THE
ARGONAUT REACTOR