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ABWR—PL-2 DESIGN REPORT

October 15, 1960

Nuclear Division
Combustion Engineering, Inc.
Windsor, Connecticut

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REACTOR TECHNOLOGY

ABWR
PL-2 DESIGN REPORT

October 15, 1960

Contract Number AT(10-1)-967
U.S. Atomic Energy Commission
and
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U.S. Army Engineer Research and
Development Laboratories

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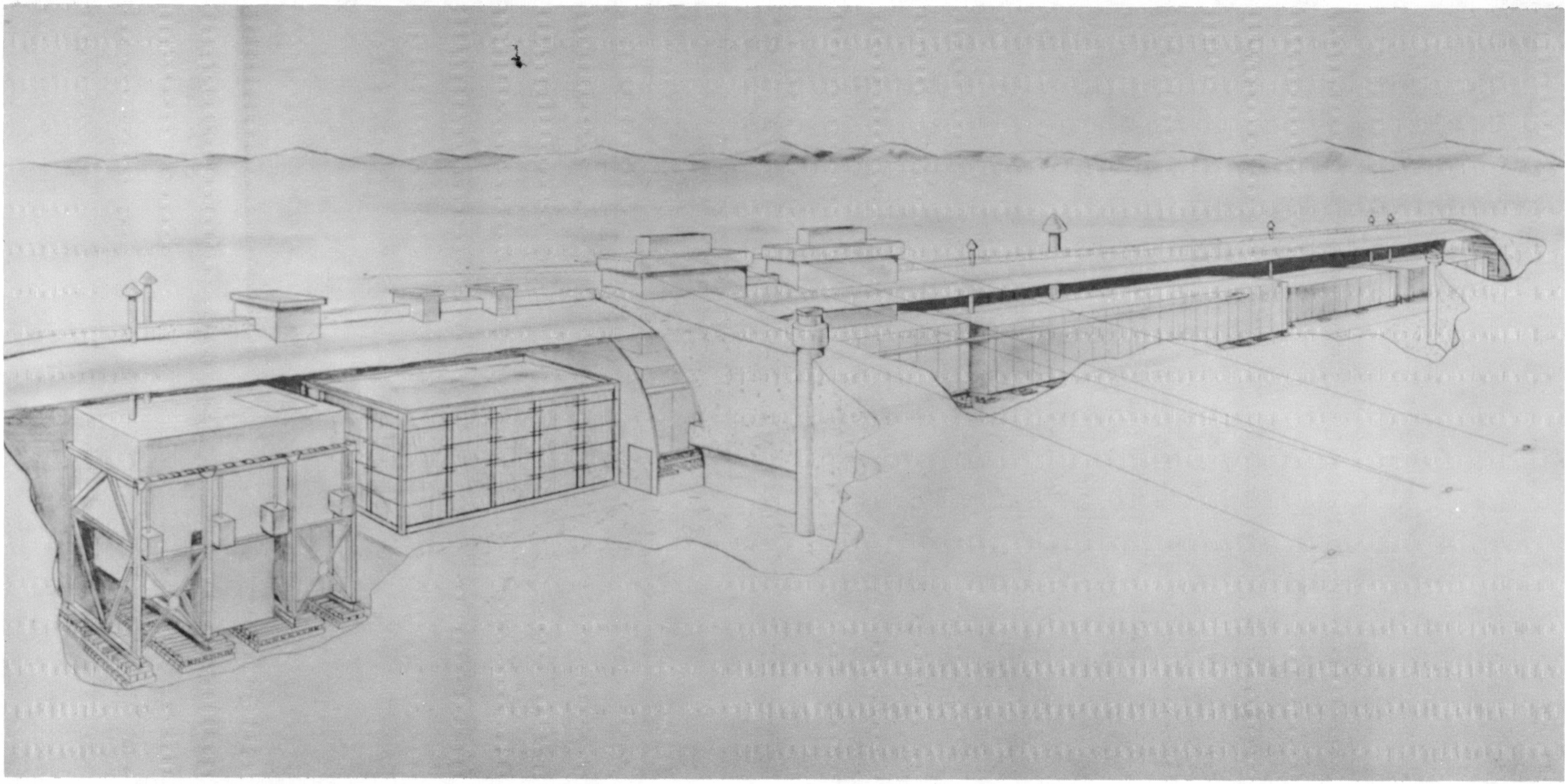

PL-2 SNOW TUNNEL

PREFACE

ABWR - PL-2 DESIGN REPORT

This report is presented in partial fulfillment of the requirements of ERDL Contract DA-44-192-ENG-11 and USAEC Contract AT(10-1)-967.

A separate report covers the PL-1 design.

This report satisfies the quarterly progress report requirements for PL-1 and PL-2 plant design work for the period ending September 30, 1960. At present time a SL-1 Core II is under construction. This is a replacement core for SL-1 (ALPR) and will be identical to a PL-2 core; a PL condenser is under test at the SL-1 facility; final construction plans for PL components and modules which are not site sensitive will be completed in March 1961.

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ILLUSTRATIONS (Cont'd)

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I. SUMMARY

PL-2 is a natural circulation, boiling water reactor plant designed to deliver 1000 KW of net electrical power and 1,365,000 BTU/Hr. of net thermal power for space heating. The plant is similar in design to the SL-1 (ALPR) which has been operating at NRTS as a power demonstration plant, test and training facility since late 1958.

Modular construction is employed to minimize field erection. All modules can be transported by C130A aircraft and are suitable for all types of surface transport.

In this report the installation of PL-2 in a snow tunnel is developed. PL-2 is, however, suitable for installation on permafrost and conventional underburdens. The plant will deliver design output for elevations up to 10,000 feet and for ambient temperatures up to 60°F. The PL-2 plant does not require a source of cooling water to reject cycle heat and is suitable for installation at arid sites.

The reactor is conservatively designed and relies on proven techniques for the fabrication of cores for power reactors. The first production core is now being fabricated and will be installed in the SL-1 in the summer of 1961. The core has a design life of three full power years.

The PL-2 plant is designed for continuity of power operation. Installed spares are provided wherever practical and automatic transfer to standby equipment is provided where immediate transfer is mandatory for continuous operation. All equipment required for power generation is accessible for maintenance during power operation with the exception of the control rod drives. The leveling jacks in the reactor complex are not operated when the reactor is critical.

Steam is generated in the reactor at 600 psig and discharged through a 4" steam main to a geared turbine generator set rated at 1250 KW gross electrical power. The turbine exhausts to two air-cooled condensers, which are designed to condense at 15" Hg absolute and subcool to 100°F when the ambient temperature is 60°F. The first production unit of this type is now installed at SL-1, Figures 79, 80 and 81. Proof tests were initiated in October 1960 and will be completed by March, 1961. The condenser is mounted in an enclosure and control of inlet air temperature is accomplished by recirculation of hot exhaust air.

The condensers drain to a common hotwell where one of two installed condensate pumps discharge to the auxiliary cooling water supply header which distributes water to the various auxiliary heat-exchangers. The auxiliary heat exchangers discharge through a common header to the reserve feed tank. A three-way valve in this discharge header recirculates condensate to the subcooling section of the main condenser during low load operation to maintain adequate cooling water flow. One of two installed feed pumps supplies water to the reactor through the feed regulating valve which is controlled by reactor water level.

A bypass purification system continuously maintains reactor water chemistry. Reactor water is cooled, demineralized and then pumped back to the reactor through the feed line by one of two canned rotor pumps.

Plant drain water is processed by an evaporator and demineralizer so that drains may be returned to the plant or meet the discharge activity concentration without dilution.

All instrumentation and rod drive power is supplied from a 3 section DC bus. The first section supplies nuclear instrumentation power; the second section, rod drive power, process instrumentation, radiation monitoring and communications; the third section supplies the circuit breaker tripping power. Each section is isolated by a blocking rectifier. One of two rectifier regulators provides DC power. In the event of interruption of AC power the batteries take up the load.

A 200 KW auxiliary diesel is provided for plant startup and shutdown.

II PL-2 PLANT DATA

A. Reactor:

Thermal Power	8.0 MW
Core Lifetime, full power years	3
Maximum Burnup, MWd/metric ton of U	33,000
Average Burnup, MWd/metric ton of U	7,650
Steam Production	24,724 lbs/hr
Operating Pressure	600 psig
Operating Temperature	$489^{o}F$
Feedwater Enthalpy	134.0 Btu/lb.

B. Electrical:

Net Output	1000 KW
Voltage	2400/4160
Frequency	60 cycles
Phase	3
Power Factor	0.8
Standby Power (diesel-generator)	200 KW

C. Environmental:

Ambient Temperature	60 to $-125^{o}F$
Wind Velocity (Sustained)	125 Knots
Altitude	0-10,000 ft

D. PL-2 Core Numerical Data:

1. Fuel Element:

Fuel Composition	UO_2
Fuel Loading, Metric Tons U	1.145
Fuel Enrichment	4.5%
UO_2 Pellet Diameter	0.420 inches
UO_2 Pellet Density	10.30 gm/cm
Clad Material	AISI 348 SS, 0.05 w/o Co.
Clad Thickness	0.020 inches
Fuel Tube Inner Diameter	0.428 inches
Number of Fuel Tubes Per Assembly	60
Number of Poison Rods Per Sub-assembly	2
Number of Fuel Elements In Core	1440
Number of Poison Rods in Core	48

2. Core Geometry:

Equivalent Core Diameter	35.5 inches
Active Core Length	38.3 inches
Number of Assemblies	24
Fuel Assembly Width	5.592 inches (square)
Fuel Assembly Length	46.3 inches
Tube Spacing (pitch)	0.732 inches
Riser Height	3 feet

3. Control:

Number of Rods	9
Rod Type	Cruciform
Overall Length	58-5/8 inches
Overall Span	11.44 inches
Overall Thickness	0.250 inches
Length of Travel	39.0 inches
Control Material	Ag-In-Cd
Clad Material	AISI 348 SS, 0.05 w/o Co
Length of Active Section	39-3/4 inches
Span of Active Section	10.578 inches
Thickness of Active Section	0.135 inches

4. Thermal and Hydraulic:

Average Power Density, KW/liter of Active Core	13.3
Average Power Density, KW/liter of Coolant in Active Core	26.6
Heat Transfer Area	564 ft^2
Average Heat Flux	48,400 Btu/hr-ft^2
Maximum Heat Flux	279,000 Btu/hr-ft^2
Burnout Heat Flux (Conservative estimate)	1,000,000 Btu/hr-ft^2

E. Main Steam System:

Total Steam Flow	24,724 lb/hr
Steam Pressure	600 psig
Steam Temperature	489°F
Turbine-Generator Steam Flow	24,211 lbs/hr
TG Steam Inlet Pressure	590 psig
TG Steam Exhaust Pressure	15" Hg. Abs.
TG Extraction Steam Flow	1895 lbs/hr
Space Heat Exchanger Steam Flow	1895 lbs/hr
Space Heat Exchanger Steam Pressure	25 psig
Heat Transferred	1.715 x 10^6 Btu/hr
Air Ejector Steam Flow	314 lbs/hr
Air Ejector Steam Pressure	150 psig

Service Water System Evaporator Steam Flow	149 lbs/hr
Service Water System Evaporator Steam Pressure	150 psig
Turbine Seal Steam Flow	100 lbs/hr
Turbine Seal Steam Pressure	2-3 psig

F. Condensate System:

Air Cooled Condenser & Subcooler	
Steam Flow	22,410 lbs/hr
Steam Pressure	15" Hg.Abs.
Steam Temperature, In	179° F
Condensate Temperature, Out	100° F
Condensate Recirculated	8,756 lbs/hr
Condensate Recirculation Temperature	150°F
Air Flow (Two Units)	2.95×10^5 cfm @ 60°F & 6000 ft.
Air Temperature, In	60°F
Heat Transferred (Two Units)	21.41×10^6 Btu/hr
Number of Fans (Two Units)	8
H. P. per Fan	20
Fan Head	1.77" H_2O @ STP
Precooler & After Condenser	
Motive Steam Flow	314 lbs/hr
Motive Steam Pressure	150 psig
To Precooler	
Steam	100.2 lbs/hr
Air	70 lbs/hr
Temperature	185° F
From Precooler	
Steam	6.4 lbs/hr
Air	70 lbs/hr
Condensate	93.8 lbs/hr
Temperature	120°F
To After Condenser	
Steam	414.3 lbs/hr
Air	90 lbs/hr
Decomposition Gases	3.2 lbs/hr
Temperature	208°F

From After Condenser	
Condensate	396.2 lbs/hr
Temperature	170°F
Vent	
Steam	18.1 lbs/hr
Air	90 lbs/hr
Decomposition Gases	3.2 lbs/hr
Temperature	140°F
Coolant	
Flow Rate	10,000 lbs/hr
Temperature, In	100°F
Temperature, Out	152°F
Heat Transferred	516,340 Btu/hr
Hotwell	
Condensate Flow	31,052 lbs/hr
Makeup Water Flow	18 lbs/hr
Makeup Water Temperature	40°F
Condensate Pumps	
Capacity	60 GPM
Suction Pressure	-8.3 psig
Discharge Pressure	40 psig
Total Head	48.3 psig
Condensate Temperature	100°F
Motor Horsepower	5

G. <u>Feedwater System:</u>

Reserve Feed Tank	
Condensate Flow	22,314 lbs/hr
Condensate Temperature, In	150°F
Condensate Temperature, Out	153°F
Feedwater Recirculation Flow	2500 lbs/hr
Feedwater Recirculation Temperature	153°F
Low Pressure Drains Flow	2660 lbs/hr
Low Pressure Drains Temperature	179°F
Feedwater Pumps	
Capacity	54 GPM
Suction Pressure	0 psig
Discharge Pressure	700 psig
Feedwater Temperature	153°F
Motor Horsepower	60

H. Purification System:

First Stage Heat Exchanger

Purification Flow	2476 lbs/hr
Temperature, In	489°F
Temperature, Out	331°F
Coolant Flow	2476 lbs/hr
Coolant Temperature, In	120°F
Coolant Temperature, Out	291°F
Heat Transferred	427,880 Btu/hr

Second Stage Heat Exchanger

Purification Flow	2476 lbs/hr
Temperature, In	331°F
Temperature, Out	120°F
Coolant Flow	6575 lbs/hr
Coolant Temperature, In	100°F
Coolant Temperature, Out	181°F
Heat Transferred	529,740 Btu/hr

Demineralizer

Purification Flow	2476 lbs/hr
Water Temperature	120°F
Resin Capacity	2.8 ft^3

Purification Pumps

Type	Canned rotor
Capacity, Normal Flow	5 GPM
Suction Pressure	590 psig
Discharge Pressure	645 psig
Water Temperature	120°F
Motor Horesepower	1.5

Eductor

Motive Water	7.2 GPM
Lift Water	5 GPM
Total Operating Head	67 psig
Motive Water Temperature	120°F
Lift Water Temperature	170°F
Total Discharge Head	15 psig
NPSH	13.7 ft.

I. Shield Cooling System:

Shield Cooler

Coolant Flow	3155 lbs/hr
Coolant Temperature, In	100°F
Coolant Temperature, Out	141°F
Heat Transferred	127,800 Btu/hr

J. Raw Water Purification System:

Makeup Water Storage	50 gals.
Makeup Water Pump	
Capacity	5 GPM
Suction Pressure	atms.
Discharge Pressure	34.0 psig
Motor Horsepower	0.50
Raw Water Demineralizer	
Flow Rate	5 GPM
Water Temperature	40 - 70°F
Resin Capacity	3.0 ft.^{3}

K. Lube Oil Cooling System:

L. O. System Intercooler	
Fluid Flow	6010 lbs/hr
Fluid Temperature, In	140°F
Fluid Temperature, Out	115°F
Coolant Flow	5860 lbs/hr
Coolant Temperature, In	100°F
Coolant Temperature, Out	126°F
Heat Transferred	150,000 Btu/hr
L. O. Cooler	
Lube Oil Flow	13,910 lbs/hr
L. O. Temperature, In	157°F
L. O. Temperature, Out	130°F
Coolant Flow	6010 lbs/hr
Coolant Temperature, In	115°F
Coolant Temperature, Out	140°F
Heat Transferred	150,000 Btu/hr
Lube Oil Coolant Pump	
Capacity	12.5 GPM
Head	25 psig
Fluid Temperature	115° F
Motor Horsepower	0.50

L. HP Drain System:

Capacity	2094 lbs/hr

M. Low Pressure Drain System:

LP Drain Pump	
Capacity	20 GPM
Suction Pressure	-6.8 psig

LP Drain Pump (Continued)

Discharge Pressure	10.5 psig
Total Head	17.3 psig
Drain Temperature	179°F
Motor Horsepower	0.5

N. Plant Heating System:

Operating

Air Flow to Plant	1600 cfm
Ambient Temperature	0°F (tunnel)
Room Temperature	60° F
Heat Transferred	1.715×10^6 Btu/hr
Space Heating Supplied	1.365×10^6 Btu/hr
Plant Heating Supplied	0.350×10^6 Btu/hr

Shutdown

Air Flow to Plant	3260 cfm
Ambient Temperature	0°F (tunnel)
Room Temperature	60°F
Heat Transferred	1.913×10^6 Btu/hr
Space Heating Supplied	1.365×10^6 Btu/hr
Plant Heating Supplied	0.548×10^6 Btu/hr

Space Heat Exchanger

Steam Flow	1895 lbs/hr
Steam Temperature, In	294°F
Condensate Flow, Out	1895 lbs/hr
Condensate Temperature, Out	250°F
Vent Flow	Negligible
Coolant Water Flow	56,825 lbs/hr
Coolant Temperature, In	190°F
Coolant Temperature, Out	220°F
Heat Transferred	1.715×10^6 Btu/hr

Plant Heating Pump

Capacity	35 GPM
Suction Pressure	0 psig
Discharge Pressure	15 psig
Fluid Temperature	190°F
Motor Horsepower	0.75

O. Service Water System:

Spent Fuel Tank Cooler

Spent Fuel Tank Cooler Flow	3670 lbs/hr
Temperature, In	160°F
Temperature, Out	119°F
Coolant Flow	3489 lbs/hr
Coolant Temperature, In	100°F
Coolant Temperature, Out	143°F
Heat Transferred	150,000 Btu/hr

Demineralizer	
Flow	3670 lbs/hr
Water Temperature	120°F
Resin Capacity	2.8 ft^3
Evaporator	
Capacity	200 GPD
Overhead Purity	Not more than 1×10^{-8} uc/cc
Bottom Solids Concentration	Not less than 50% solids by weight
Overhead Condensate Temperature to Storage	120°F
Drain Tank Pump	
Type	Sump
Capacity	7.5 GPM
Suction Pressure	Atm
Discharge Pressure	29.4 psig
Fluid Temperature	40 - 120°F
Motor Horsepower	0.5
Spent Fuel Tank Pump	
Type	Sump
Capacity	7.5 GPM
Suction Pressure	Atm
Discharge Pressure	29.4 psig
Fluid Temperature	40 - 120°F
Motor Horsepower	0.5
Waste Tank Pump	
Type	Sump
Capacity	2 GPM
Suction Pressure	Atm
Discharge Pressure	14.2 psig
Fluid Temperature	40 - 120°F
Motor Horsepower	0.5
Disposal Tank Pump	
Type	Centrifugal
Capacity	10 GPM
Suction Pressure	Atm
Discharge Pressure	21.6 psig
Fluid Temperature	40 - 120°F
Motor Horsepower	0.5

P. Shipping (Snow Tunnel)

Foundation, Structural and Enclosures	236 tons
Airlift Loads (C 130A)	16
Plant Components	242 tons
Airlift Loads (C130A)	18
Primary System	3 loads
Secondary System	7 loads
Interconnects plus Off skid	8 loads

III. PLANT DESCRIPTION

A. ARRANGEMENTS

1. Snow Tunnel Design and Construction

The general arrangement, Figure 1. of the PL-2 reactor plant for an inland Antarctic site, utilizes a large snow tunnel with all the buildings and facilities arranged in a straight line within the tunnel. Many problems of construction and operation encountered at surface installations where severe climatic conditions exist are thereby eliminated.

Construction of the plant will be greatly facilitated by ramping the tunnel at both ends. This will allow construction of the plant to proceed simultaneously in the Reactor and Power Plant areas and reduce total construction time. Two mechanized snow plows, such as the Peter Snow Miller will be required because of the two levels of tunnel depth. For the portion of tunnel at the Reactor Complex some additional equipment will be required to remove the snow excavated at the lower depths.

The tunnel will be roofed with corrugated metal arches, seated on a snow ledge approximately ten feet below the ground surface. The floor will extend to a depth of twenty-four feet in the tunnel section housing all buildings except the Reactor Complex. The tunnel section for the Reactor Complex will be excavated to approximately forty-one feet below the surface. Snow will be back-filled over the arches to a depth of approximately three feet by the snow plows to obtain an insulating blanket.

A decrease in tunnel height, as a function of time, due to the differential settlement rates of the tunnel floor and the roof arch, is anticipated. The depth of tunnel has been established to allow for an initial clearance of two feet six inch minimum between the top of the buildings and the roof arch. Experience at Camp Century will be evaluated to determine what allowance for settling of the tunnel arch is required.

The tunnel is sealed for weather tightness at the base of the ramp with a timber bulkhead. Large steel roll-up doors in the bulkhead will provide for the entry of vehicles.

Penetrations of the corrugated metal roof arch will be limited to the intake and exhaust ducts of the air cooled steam condensers, the hatch openings above the snow shield, the ventilation ducts for the buildings, and the various exhaust stacks from machinery.

Emergency escape hatches are provided at locations shown in Figure (1). The hatches will be offset from the main tunnel and consist of either vertical ladder shafts or spiral stairwells projecting several feet above the snow surface and connected at the base to the main tunnel by means of small access tunnels.

A thirty foot tunnel width provides five feet minimum clearance between the building wall and the tunnel wall. The snow floor of this space will be covered over with two inch planking and utilized as a walkway. Tunnel lighting for the walkways will consist of fixtures mounted on the exterior walls of the buildings.

All steam, water, drainage and steam condensate piping carried within the tunnel will be insulated and electrically traced. Piping within buildings will be insulated only.

A biological shield is provided between the Reactor Complex and the remainder of the plant by means of a fifty foot section of snow shielding within the tunnel. There is no direct line of sight between the Reactor and the portion of the tunnel housing stations for the operating personnel. The snow shield comprises backfilled snow compacted to a minimum density of .50 grams per cubic centimeter and contained within a timber retaining bin held together with steel tension rods. Two hatches are provided in the metal arch roof directly above to allow the snow to be blown into the bin from the surface by the Peter Plow.

The snow shield is flanked on two sides with small accessways, connecting the two tunnel sections, for personnel, piping and utilities.

Separate buildings for Condensers. Power Plant Equipment, Personnel and Service are provided in that order, starting from the snow shield.

These buildings will be carried on a structural steel floor framing system supported on heavy timber cribbing foundations. The steel was sized to provide a relatively rigid support level for jacking. All building and equipment loads, except the turbine generator, will be mounted on separate cribbing foundations, independent of the building. Foundations for the Reactor Complex structure consist of heavy timber forming raft type foundations resting on the tunnel floor.

Maximum snow bearing pressures do not exceed 1000 pounds per square foot on any foundation. The foundation timber has been designed and proportioned to obtain, within practical limits, equal snow bearing pressures under all foundations during operation.

Operating weights of various plant equipment and the resulting bearing pressures beneath their foundation are as follows:

Purification skid	40,000 lbs.	625 psf
Feed & Condensate skid	50,000 lbs.	655 psf
Turbine Generator skid	40,000 lbs.	660 psf
Electrical skid	30,000 lbs.	625 psf
Auxiliary Boiler	11,000 lbs.	635 psf
Diesel Generator	6,500 lbs.	630 psf
Condenser skid	30,000 lbs.	680 psf
Reactor	200,000 lbs.	635 to 650 psf
Spent Fuel Tank	165,000 lbs.	
Drain Tank	48,000 lbs.	

Differential settlement can be expected between foundations but the anticipated amount has been greatly minimized by the following features:

(1) Foundations are symmetrical.

(2) Comparatively equal bearing pressures are obtained under operating loads.

(3) Maximum bearing pressures do not exceed the weight of the excavated snow.

(4) A relatively rigid steel floor framing system under the building tends to equalize loadings to the foundations.

However, differential settlement is possible. Control will be obtained with a central manometer system installed at various critical locations and a simple maintenance procedure can be established for jacking and leveling using the steel floor framing and low height ball bearing journal jacks, in all buildings except the Reactor Complex structure.

The Reactor Complex structure contains eight jack screws located at the operating level, of approximately 60 and 130 ton capacity, for leveling the upper portion of the steel structure. Sensitive adjustments of vertical height in the steel structure are possible with the motor operated jacks and reduction gears. Corrections of height as small as .1 inch per minute can be obtained with this mechanism.

Piping runs will be designed to provide flexibility far in excess of that necessary to allow for the maximum anticipated differential settlement between piping support points.

2. Enclosures

The PL-2 plant may be housed in any enclosure with adequate width, height, and length. The T-5 building has been used in developing these plans.

The panels will be fabricated to provide for pipe penetrations between buildings.

The steel structure for the Reactor Complex will be enclosed with the same T-5 type of panels except for the main columns.

3. Machinery Arrangement

The PL-2 machinery arrangement incorporates factory assembled modules. These modules permit great latitude in adjusting the overall machinery arrangement to specific site requirements without changing the basic machinery modules. The arrangement selected for the snow tunnel minimizes tunnel construction work, and maintains adequate room for maintenance and operation. The arrangement permits routine operation by one man. Startup will require two men.

The Reactor Complex, Figures 2, 3, 4, 5 and 6 contains the reactor vessel and shield tank, the spent fuel tank, the waste tank, and the plant drain tank. A 15 ton overhead crane is provided to remove the pressure vessel head, transfer fuel elements from the reactor vessel head, transfer fuel elements from the reactor vessel to the spent fuel tank and to load the spent fuel shipping cask. The entire reactor complex is supported at eight jacking points. The lifting mechanism is designed so as to allow the upper complex structure to move up 6 feet. The jacks are supported on eight stationary columns which distribute the load to the reactor complex foundation, Figure 3. Pipe ways and wire ways are run under removable sections of the floor plates to the complex wall so that the operating floor is clear for refueling and maintenance operations. The control rod drive trains are protected by a raised section of floor grating. The grating is removable in sections for access to the mechanisms which are in a well ventilated space and will not be subject to excessive temperatures.

The condensers are housed in a separate building which is modified to accept the intake and exhaust ducts, Figure 1. The floor of the condenser building is 2 feet above the power plant building floor to facilitate draining.

The power plant building houses, in order, the purification module, the feed and condensate module, the turbine generator module and the electrical module. The arrangement provides for a continuous operating aisle 5 feet wide on one side of the building. On the other side are the pipe and wire ways for interconnecting piping. All equipment is accessible for operation and pull space is provided so that maintenance on any one component will not require disassembly of operable equipment. All pipe connections are anchored at the skids and connected with a flexible pipe configuration to the interconnecting piping. This flexible configuration is designed to facilitate field interconnection and will not require extremely precise skid location in order to make up the flanged connections.

The Service building has two compartments and houses a small maintenance shop and equipment for emergency power. The shop contains a lathe, grinder, work bench, welding machine, pipe threader and parts bin. The power equipment consists of a diesel generator, fuel tank and auxiliary boiler. For boiler maintenance, work space is provided by opening the door connecting to the shop, and pulling the tubes into the shop area.

The Personnel building contains office space, toilet, laboratory, decontamination shower, washer, and lockers. The layout allows entry from the operating area directly into the lab and decontamination area without passage through the office space.

4. Shipping

The PL-2 plant shown in Figure (1) can be shipped by 3 aircraft in a total of 34 loads, transporting a total of 478 tons within a 22 day period.

The shipping arrangements are prepared within the limitations of the PL-2 Guidelines, Appendix A, and the C130A aircraft load-space limits of 30,000 pounds within an envelope not to exceed 30 feet in length, 8'8" in width and 8'6" in height.

All principal components are skid mounted, and with the exception of foundation timber and structural steel, all components (including skids) are seal-crated in 3/8" plywood with hoisting, buttressing and tiedown provisions adequate for both aircraft and surface transportation.

a. Plant Equipment

Schedule (A) presents the shipping arrangement for the nuclear plant machinery and furnishings. Exclusive of spare parts and special tools, the plant comprises 242 tons, air transportable in 18 loads. The items tabulated are noted on the Figure indicated in the "figure" column.

It should be noted that 8 fuel assemblies and 3 control rod blades are shipped in each of the 3 spent fuel cask shipping assemblies, Figure 21.

Schedule A is generally applicable and will not change significantly for other installations which have similar requirements for refuelling and waste disposal. Where spent fuel may be abandoned or accommodated by mobile equipment, a reduction in shipping of two to three loads may be anticipated.

It should be noted that this shipping list includes everything required to complete the erection, startup and operation of the plant. The equipment required for the generation of power including provisions for storing spent fuel is:

	C130A Loads
Primary Loop	
Reactor	1
Spent Fuel & Drain Tanks	1
Shield Tank	1
Total	3
Secondary Loop	
2 Condensers	4
Purification and Waste Disposal	1
Feed and Condensate	1
Turbine Generator	1
Electrical and Control	1
Total	8

Interconnecting plumbing and wiring and items such as the spent fuel shipping casks, auxiliary diesel and shutdown boiler account for the remaining 7 packages. The loads for the two condensers include the combined inlet and exhaust stacks required to penetrate the tunnel arch.

SCHEDULE A

SHIPPING ARRANGEMENT FOR NUCLEAR PLANT MACHINERY AND FURNISHINGS

Load	Box	Contents	Wt (lbs)	Size (ft)	Figure
1	1	Feed and Condensate Skid	29,874	30x8.5x8	29
2	2	Purification Skid	29,836	14x7x8	27
	21b	5 CIC-UIC Ion Chambers	132	1.5x1x1	37
			29,968		
3	6f	Wiring, Outlets, Lighting Fixtures	733	4x4x6	31
	15b	Transfer Cask Mechanism	82	1x1x1	22
	3	Turbine Generator Skid	29,262	17x7x6	39
			30,077		
4	4	Electrical Skid	29,730	26x8.5x8.5	30
	6i	Bench	257	7x2x2	31
			29,987		
5	7	React. Vessel, Hd.&Hd. Shielding	29,280	20x6x8	7
	19b1	Cont. Rod Mechanism Actuator	732	5x1x1	11
			30,012		
6	5a	Condenser Skid	23,758	25x8x8	38
	13f	Crane Assy Provisions	558	6x4x3	3/4
	19b2	Cont. Rod Mechanism Actuator	732	5x1x1	11
	19c1	Cont. Rod Drive Package	213	2x1.5x1.5	4
			25,261		
7	5b	Condenser Skid	23,758	25x8x3	38
	6g	Heating, Piping, Radiator, Controls	1.112	8x3x3	31
	6l	Fire Protection Equip. and Control	913	4x4x8	31
	6k	Toilet, Sink, Lavatory, Plumbing	1.035	5x4x3	31
			26,818		
8	8	Core	2,006	7x4x4	15
	12	Waste Tank	1,892	8x4x2	2/3/4
	16d	Switch Gear, Welder, Grinder, Tools	1,764	4x4x3	1
	5c	(2) Sets Dampers and Supports	15,900	25x8x8	38
	26	Source	471	4x1x1	15
			22,033		
9	9a	Spent Fuel Shipping Assy	29,305	10x5x7	21**
	13d	Crane Drive Unit	697	6x3.5x3	3/4/5
			30,002		

** Includes 8 Fuel Assemblies and 3 Control Rods

SCHEDULE A (Cont'd)

Load	Box	Contents	Wt (lbs)	Size (ft)	Figure
10	9b	Spent Fuel Shipping Assy	29,305	10x5x7	21**
	16h	Lathe	619	6x4x2	
			29,924		
11	9c	Spent Fuel Shipping Assy	29,305	10x5x7	21**
	19b3	Cont. Rod Mechanism Actuator	732	5x1x1	11
			30,037		
12	10	Shield Tank Assy	29,978	21x8.5x8.5	18
13	11	Spent Fuel, Plant Drain Tanks Shipp.	29,512	27x8.5x8.5	19
	19d	Cont. Rod Drive Connectors	503	6x2x2	3
			30,015		
14	15a	Transfer Cask Assy	11,874	6x3x3	22
	16b	Auxiliary Boiler	8,000	10x8.5x5	
	6j	Shower, Plumbing, Stool	648	3x3x8	31
	6k	Washer, Dryer	688	4x4x4	31
	6b	(4) File Cabinets	559	8x3x6	31
	6c	(6) Personnel Lockers	830	6x6x7	31
			22,599		
15	5d1	Cond. Stack Girders, Beams Brackets	4,442	13x4.5x1.5	25
	13a	(2) Crane Trusses	1,825	21x2x3	3/4
	13b	(2) Crane Rail Beams	3,625	21x2x3	3/4
	14f	Ratiometer Jack	1,808	14x1x1	3
	14g	Ratiometer Jack	1,808	14x1x1	3
	14h	Ratiometer Jack	1,808	14x1x1	3
	15c	Transfer Cask Ext. Racks (3)	272	7x1x1	22
	18	Refueling Plate Assy	6,519	5.5x5.5x1	23
	24	Off Skid Heating Provisions	593	6x2x2	59
	20	Instrument Well Shipping Pack	6,697	17x4x3.5	35
			28,397		
16	5d2	Cond. Stack Panels	3,442	13x7x6	25
	5d3	Cond. Stack Panels	3,442	13x7x6	25
	13c	(2) Crane End Beams	1,252	12x2x2	3/4
	14a	Ratiometer Jack	1,858	14x1x1	3
	14b	Ratiometer Jack	1,858	14x1x1	3
	14c	Ratiometer Jack	1,858	14x1x1	3
	14d	Ratiometer Jack	1,858	14x1x1	3
	14e	Ratiometer Jack	1,808	14x1x1	3
	19b4	Cont. Rod Mechanism Actuator	732	5x1x1	11
	19b5	Cont. Rod Mechanism Actuator	732	5x1x1	11

** Includes 8 Fuel Assemblies and 3 Control Rods

SCHEDULE A (Cont'd)

Load	Box	Contents	Wt (lbs)	Size (ft)	Figure
16 (cont'd)					
	19b6	Cont. Rod Mechanism Actuator	732	5x1x1	11
	19b7	Cont. Rod Mechanism Actuator	732	5x1x1	11
	19b8	Cont. Rod Mechanism Actuator	732	5x1x1	11
	19b9	Cont. Rod Mechanism Actuator	732	5x1x1	11
			21,968		
17	5d4	Cond. Stack Panels	3,442	13x7x6	25
	5d5	Cond. Stack Cowling, Covers, Deck	2,218	14x7x6	25
	6n	(2) Desks, (2) Chairs	1,074	9x6x3	31
	6a	Radiation Counter	673	2x2x6	31
	6d	Contaminated Clothes Bin, Waste Box	431	4x2x4	31
	6m	Table	589	7x3x2	31
	13e	Crane Trolley, Motor, Reducer	1,843	8x7x2.5	3/4
			10,270		
18	6e	(4) Internal Partitions	1,969	12x3x4	31
	16a	Auxiliary Diesel Generator	7,445	9.5x3.5x6.5	
	16c	Fuel Tank Pipe Thread. Drill Press	1,138	6x4x4	
	16e	Wiring Lights, Bins	1,012	6x6x3	
	16f	Bench Boiler Piping	1,237	6x6x3	
	16g	Heating and Fire System	1,898	12x4x4	
	16i	Internal Partitions	1,723	11x4x2	
	17	Spent Fuel Storage Rack	1,763	4x4x2.5	33
	19c2	Cont. Rod Drive Package	213	2x1.5x1.5	4
	19c3	Cont. Rod Drive Package	213	2x1.5x1.5	4
	19c4	Cont. Rod Drive Package	213	2x1.5x1.5	4
	19c5	Cont. Rod Drive Package	213	2x1.5x1.5	4
	19c6	Cont. Rod Drive Package	213	2x1.5x1.5	4
	19c7	Cont. Rod Drive Package	213	2x1.5x1.5	4
	19c8	Cont. Rod Drive Package	213	2x1.5x1.5	4
	19c9	Cont. Rod Drive Package	213	2x1.5x1.5	4
	19e	Cont. Rod Extension Shafts	208	6x1x1	11
	21a	(2) BF_3 Instruments	286	4x1x1	36
	22	Portable Radiation Monitoring	755	4x3x3	69
	23	Fixed Radiation Monitoring	555	4x3x3	69
	25a	Feed Pump Motor	1,206	4x4x4	29
	25b	Feed Pump Motor	1,206	4x4x4	29
			24,105		

b. Foundations and Enclosures - (Snow Tunnel Installation)

Foundation timber, structural steel and building panels for the entire plant weigh a total of 236 tons and will require a total of sixteen plane loads. The timber and steel can be bundled into packages convenient for handling and shipping. The T-5 building panels are stacked flat on a wooden skid, encased in plywood sheathing and wrapped in heavy Manila paper. The crates are fastened to the skid with metal straps. The weight per crate varies from 2800 to 3300 pounds and can be easily handled with a fork lift truck. The sizes of crates vary in length from 9 to 16 feet, in width from 2'-6" to 4'-6" and in height from 4'-0" to 5'-0". There will be a maximum of 50 crates for building panels. The delivery of material to the site will be arranged so that timber and floor steel are followed by building panels and equipment, according to the erection requirements.

The following schedule (B) presents the shipping arrangement for foundation timber, structural steel and enclosures. Schedule B is applicable to a snow tunnel installation. Significant reductions can be expected for surface installations.

SCHEDULE B

SHIPPING ARRANGEMENT FOR FOUNDATION TIMBER, STRUCTURAL STEEL (including Reactor Complex) AND ENCLOSURES

Load No.	No.	Item	Wt.
1.	2 -	16 x 3 x 5 Crates	6600.#
	2 -	13 x 3-6 x 5 Crates	6600.
	15 -	12 x 12 - 26 ft.	16500.
			29700.#
		Steel	180
			29880.#
2.	2 -	16 x 3 x 5 Crates	6600.
	1 -	13 x 3-6 x 5 Crates	3300.
	1 -	11 x 4-6 x 5 Crates	3200.
	8 -	12 x 12-24 Ft.	8000.
	1 -	12 x 12-26 Ft.	1100.
	7 -	18 WF50 20 Ft.	7000.
			29200.#
		Steel	565
			29765.#
3.	2 -	16 x 3 x 5 Crates	6600.
	2 -	13 x 3-6 x 5 Crates	5400.
	15 -	12 x 12 - 3 Ft.	1880.
	8 -	18 WF 50 20 Ft.	8000.
	26 -	6 x 12 - 13 Ft.	7150.
			29030.#
		Steel	910
			29940#
4.	2 -	16 x 3 x 5 Crates	6600.
	1 -	11 x 4-6 x 5 Crates	3200.
	26 -	6 x 12 - 11'-0	5650

SCHEDULE B (Cont.)

Load No.	No.	Item	Wt. (lbs.)
4.	8 -	18 WF 50 - 16 Ft.	6400.
	13 -	16 WF 40 - 12 Ft.	6240.
	15 -	12 x 12 3 Ft.	1880.
			29970.
5.	4 -	11 x 4-6 x 5 Crates	12800.
	13 -	12 x 12 5'6" Crates	3000.
	7 -	18 WF 50 20 Ft.	7000.
	4 -	8 WF17 16 Ft.	1090.
	13 -	16 WF 40 10 Ft.	5200.
	1 -	10 WF 25 15 Ft.	375.
			29465.
		Steel	515.
			29950.
6.	2 -	11 x 4-6 x 5 Crates	6400.
	3 -	9 x 4-6 x 5 Crates	3460.
	4 -	16 x 16 10 Ft.	3000.
	8 -	12 U 20.7 12 Ft.	2000.
	12 -	8 U 11.5 12 Ft.	1660.
		Timber	8000.
			29520.
7.	2 -	9 x 5 x 5 Crates	6250.
	2 -	11 x 4 x 5 Crates	5860.
	46 -	8 WF17 89 Ft.	6260.
	15 -	12 x 12-3-0 Ft.	1880.
	15 -	12 x 12-3-0 Ft.	1880.
		Timber	7140.
			29270.
8.	1 -	9 x 5 x 5 Crates	3125.
	4 -	11 x 4 x 5 Crates	11720.
	3 -	8 WF17 12 Ft.	615.
		Timber	7280.
		Timber	7350.
			30090.
9.	2 -	11 x 4 x 5 Crates	5860.
	1 -	11 x 2-6 x 5 Crates	1900.
	1 -	9-6 x 3-6 x 5 Crates	1900.
		Timber	16800.
		Steel	3525.
			29985.

SCHEDULE B (Cont.)

Load No.	No.	Item	Wt. (lbs.)
10.	1 -	12 x 4 x 4 Crates	3500.
		Timber	3360.
		Timber	18000.
		Steel	2900.
		Timber	2200.
			29960.
11.		Timber	19195.
		Reactor Steel	10800.
			29995.
12.		Flooring	5000.
		Reactor Steel	15000.
	3 -	Crates	10000.
			30000.
13.		Reactor Steel	20000.
	3 -	Crates	10000.
			30000.
14.		Reactor Steel	15770.
	3 -	Crates	10000.
		Flooring	4000.
			29770.
15.		Reactor Steel	20000.
	3 -	Crates	10000.
			30000.
16.		Checker Plate	2310.
		Grating	2655.
		Flooring	3000.
		Snow Shield	20000.
			27965.

5. Erection and Assembly Schedule - Snow Tunnel Installation

a. Procedure

The Construction Procedure in the Reactor area is based on having access from a ramp adjacent to the Reactor and the availability of equipment for lifting a maximum of 20 tons.

The sequence of construction will proceed as follows:

(1) Construct foundation cribbing on column lines 4 and 3, Figure 5.

(2) Erect temporary timber support for Spent Fuel Tank and place four 10 ton hydraulic jacks in position.

(3) Install Spent Fuel Tank in temporary position on jacks.

(4) Erect steel columns at column line intersections 4x, 4y, 3x, and 3y, Figure 5.

(5) Erect steel framing and bracing of lower steel structure between columns 4x, 4y, 3x and 3y, Figure 5.

(6) Install jacking devices near column line 4 and attach 21 WF 73 at bottom of jacks.

(7) Construct foundation cribbing on column line 2 and repeat step 2 for supporting Shield Tank and Reactor between column line 2 and 3, Figure 5.

(8) Install Shield Tank in temporary position on jacks.

(9) Install Reactor in Shield Tank.

(10) Jack Shield Tank and Reactor so that support brackets are higher than the final position.

(11) Erect steel columns and framing of lower steel structure between column lines 2 and 3.

(12) Install jacking devices near column lines 2 and 3 and attach 30 WF 108 and 27 WF 94 at bottom of jacks.

(13) Construct foundation cribbing on column line 1, Figure 5.

(14) Erect temporary timber support for Drain Tank and place four 5 ton hydraulic jacks in position.

(15) Install Drain Tank in temporary position on jacks.

(16) Erect columns at column line 1 and complete lower steel structure framing and bracing.

(17) Install last two jacking devices and attach 16 WF 58 at bottom.

(18) Lower Reactor and Shield Tank to proper final position, erect supporting level of steel and fasten to Shield Tank.

(19) Remove temporary hydraulic jacks and supporting timber under Shield Tank to transfer loading to structure.

(20) Jack Spent Fuel Tank into proper final position, erect supporting level of steel and fasten to Tank.

(21) Jack Drain Tank into proper final position, erect supporting level of steel and fasten to Tank.

(22) Remove temporary hydraulic jacks and supporting timber under Spent Fuel Tank and Drain Tank, to transfer loading to structure.

(23) Erect upper steel structure above elevation 84' - 0".

(24) Install 15 ton crane.

(25) Install Waste Tank beside Spent Fuel Tank.

(26) Proceed with housing enclosure of entire complex.

(27) Install electrical power and lighting.

(28) Level equipment and upper steel structure to proper elevation by means of eight jacking devices.

(29) Install piping and insulation.

(30) Install exhaust stacks and ventilation system.

b. Sequence

The sequence of construction procedure in the machinery area is based on having a power winch in the tunnel capable of pulling equipment into position.

(1) Construct foundation cribbing for Condenser and Power Plant buildings to same elevation. Top two layers of cribbing under condenser building will not be erected at this time. Place temporary timber for jacking purpose under condenser building.

(2) Erect steel floor framing.

(3) Erect floor panels.

(4) Place 2 x 12 flooring in Power Plant building floor.

(5) Mark location of equipment on floors of both Condenser and Power Plant buildings.

(6) Construct temporary timber bridge between Power Plant and Condenser buildings to span opening between.

(7) Install condensers by rolling on pipe rollers across Power Plant building, over bridge and onto Condenser building floor. Louver assembly will be mounted on condensers before installation.

(8) Jack Condenser building to final elevation and insert top two layers of cribbing on foundations.

(9) Erect walls and rafters of Condenser building.

(10) Remove temporary timber and jacks from beneath condenser building.

(11) Erect structural steel supports for stacks in Condenser building.

(12) Dismantle timber bridge between buildings.

(13) Install equipment in Power Plant building in this order - 1. Purification skid 2. Feed and Condensate skid 3. Turbine Generator 4. Electrical skid.

(14) Erect walls, rafters and roof of Power Plant building and roof of Condenser building.

(15) Construct foundations for Personnel and Service buildings.

(16) Level all equipment skids.

(17) Install pipe supports in buildings.

(18) Erect condenser stacks in condenser building and exhaust stacks in power plant building.

(19) Install electrical power and lighting Condenser and Power Plant buildings.

(20) Install piping and insulation Condenser and Power Plant buildings.

(21) Erect steel floor framing for Personnel and Service buildings.

(22) Install heating & ventilation system in Power Plant and Condenser buildings.

(23) Install stairs at all buildings.

(24) Erect floor panels in Personnel and Service building.

(25) Construct timber for Snow Shield.

(26) Erect walls, rafters and roof Personnel building.

(27) Install plumbing, toilet fixtures, etc. in Personnel building.

(28) Place 2 x 12 flooring in Service building.

(29) Install Diesel Generator and Auxiliary Boiler in Service building.

(30) Install piping in Service building.

(31) Install piping in tunnel.

(32) Erect walls, interior and exterior, rafters and roof of Service building.

(33) Install electrical power and lighting in Personnel and Service buildings.

(34) Install shop equipment and lab.

(35) Install Heating and Ventilation system in Personnel and Service buildings.

(36) Install Fire Protection system all buildings.

(37) Check levels of all equipment and buildings.

(38) Backfill Snow Shield.

(39) Painting all areas.

(40) Install Office furniture and equipment.

(41) Testing.

c. Schedule

The Erection Schedule, Schedule C, is based on the following work being completed and work proceeding in the Reactor and Machinery areas simultaneously:

(1) Tunnel excavation, roofing and bulkheading.

(2) Penetrations in metal roof arch reinforced with structural steel members and protected with temporary coverings.

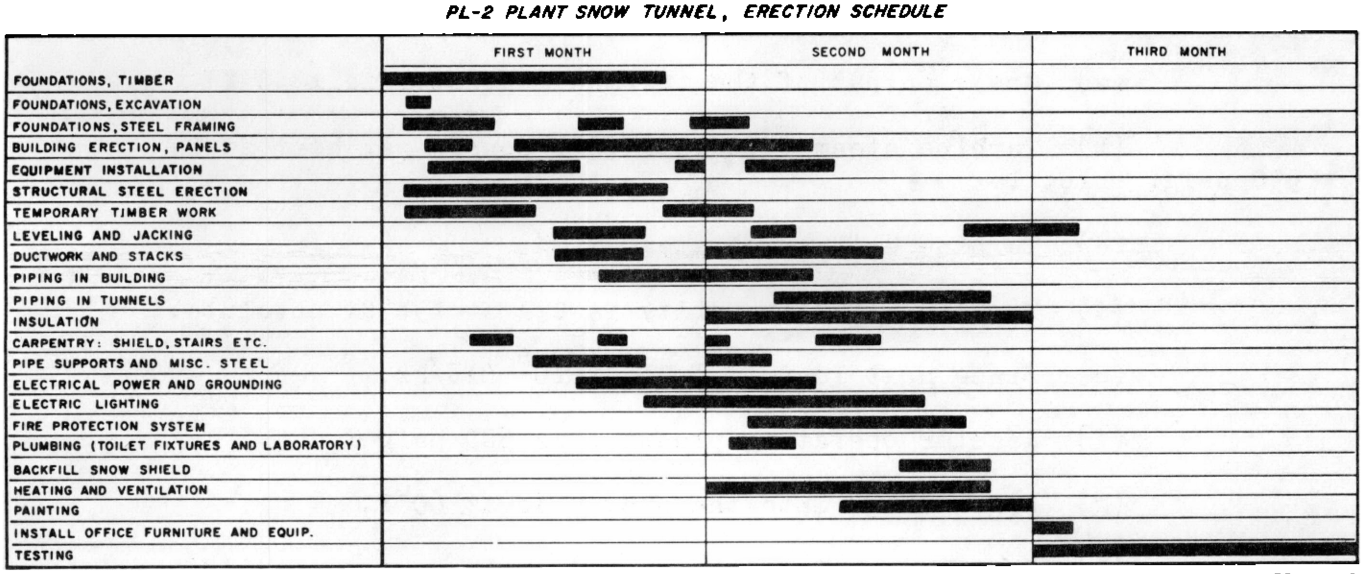
(3) Emergency escape hatches and connecting accessways.

(4) Tunnel lighting.

(5) Survey work for location of foundations.

(6) All material and equipment delivered at site.

PL-2 PLANT SNOW TUNNEL, ERECTION SCHEDULE



SCHEDULE C

B. MECHANICAL SYSTEMS

1. Plant Heat Balance

The heat balance, Figure 41, for the PL-2 plant indicates that 8.0 MW, thermal, of reactor power will produce a gross electrical output of 1235 KW plus a gross heating load of 502 KW. The net electrical power is 1000 KW at a power factor of not less than .8, while 235 KW is required for the plant load. The net heating load is 400 KW with the remaining heating load providing space heat for the plant. The turbine engine efficiency is 64.7%.

Steam flow from the reactor is 24,724 pounds per hour of which 24,211 goes to the turbine, 463 pounds per hour goes to the reducing station, and 50 pounds per hour is assumed to be condensed due to piping losses and is drained to the low pressure drain tank. Space heat is obtained from turbine extraction steam of 1895 pounds per hour at 93% quality.

The air cooled condenser load is 19.332×10^6 BTU/hr. The load on the subcooler is 2.076×10^6 BTU/hr. The total flow through the subcooler is 31,051.9 pounds per hour of which 8,756 pounds per hour is continually by-passed to provide the required capacity for auxiliary cooling.

For this heat balance the following assumptions were made:

(a) Gross output of the turbine generator is 1235 KW.

(b) Turbine steam rate is 24,211 pounds per hour at 590 psig, throttle.

(c) Turbine extraction steam 7.8%.

(d) Turbine exhaust quality is 87% at 15" Hg absolute.

(e) Space heat load is 1.715×10^6 BTU/hr.

(f) Reactor operating pressure is 600 psig.

(g) Air leakage into the system is at 60°F.

(h) Heat losses from the liquid system are neglected.

(i) Heat losses from the steam system are represented by steam condensation of 50 lbs/hr.

(j) Friction heating in the pumps and pump work is neglected.

2. System Descriptions

a. Process Systems

1) Main and Auxiliary Steam System

The Main and Auxiliary Steam System, Figure 42, distributes steam generated in the reactor vessel to the following equipment and systems:

Turbine
Turbine gland seal system
Steam reducing station
Service water system
Air ejectors
Space heat exchangers
Air cooled condenser

Main steam flow passes through a motor-operated stop valve, main steam valve, combination trip and hand operated throttle valve and governor valves into the turbine. Exhaust steam from the turbine is distributed to two air cooled condenser units. The remotely operated stop valve along with the stop valve in the feedwater line back to the reactor are located within the reactor complex. Their purpose is to isolate the reactor from the plant under various emergency conditions. The main steam valve is located just inside the power plant building and is furnished with a small by-pass for system warm up.

The trip throttle is normally held open by oil pressure from the turbine lube oil system, and will trip shut on low oil pressure or turbine overspeed. When the throttle valve is closed as a result of a trubine trip, it is necessary to manually reset by turning the handwheel to the closed position. The governor valves which are controlled by the hydraulically operated governing system, automatically regulate steam flow to the first stage nozzles of the turbine.

The turbine is a multi-valve, multi-stage geared unit rated at 1,250 KW. A single point of extraction is provided where 7.8% of steam turbine flow is taken at 50 psig for the space heat exchanger.

A motor operated by-pass valve is furnished at the turbine. It will operate as a back-up for the reactor rod control system. Normally, the by-pass will be closed. In the event that maintenance is required on a rod control system, the by-pass may be opened, exhausting steam directly into the main condenser. The by-pass valve will control steam pressure by maintaining constant reactor steam flow.

A reducing station is provided which takes 600 psig steam from the main steam line, at a point between the flow nozzle and the turbine isolation valve, and reduces the pressure to 150 psig. The 150 psig steam is then distributed between the space heat exchanger, air ejector motive steam, and the service water system. Under normal operating conditions the space heat exchanger receives its steam supply from the turbine generator extraction stage. However, the controls are so arranged that during low load turbine operation, when the extraction steam will not be sufficient for space heat requirements, steam is drawn from the reducing station to provide additional capacity. Space heat can be supplied from the reducing station in the event the turbine is shut down for any reason provided the reactor can be operated.

Service steam for the turbine gland seal system is taken from the main steam line upstream of the main steam strainer. The gland seal system is included as part of the turbine generator skid. The system includes a gland seal regulator and a gland seal back pressure regulating valve. The two valves maintain steam pressure in the gland seal system between 2 and 3 psig. When system pressure falls below 2 psig, the gland seal regulator opens allowing the pressure to rise. When the system pressure is above 3 psig, the back pressure regulating valve will vent steam to main condenser.

Two steam relief valves are connected to the main steam line between the reactor and the motor operated stop valve. They provide over-pressure protection for the reactor, and discharge directly to the atmosphere through the reactor - complex exhaust stack. Steam piping downstream of the main steam reducing station is also protected by a relief valve. This valve discharges to atmosphere through the power plant exhuast stack. Condensate from both the reactor complex stack and power plant stack is drained through steam traps to the waste tank in the service water system.

2) Condensate System

The Condensate System, Figure 44, condenses exhaust steam, provides cooling water for the auxiliary heat exchangers throughout the plant, and supplies the condensate to the feedwater system. Specifically, the condensate system performs the following functions:

(a) Condenses exhaust steam from the turbine and flash steam vented from the low pressure tank and return the condensate to the reserve feed tank.

(b) Maintains a partial vacuum at the turbine exhaust.

(c) Sub-cools the condensate sufficiently to permit using it for auiliary cooling.

(d) Supplies condensate to the auxiliary heat exchangers throughout the plant for use as a coolant.

(e) Condenses the gland exhaust and seal leak-off vapors and returns the condensate to the low pressure drain system.

The condensate system contains two air cooled finned-tube condensers, a hotwell tank, two condensate pumps, two condenser air ejector sets, two gland exhaust air ejector sets, an after condenser to condense the exhaust from the condenser and gland exhaust air ejectors, and a precooler to condense the gland exhaust and seal leak-off vapors.

Steam exhausted from the turbine and flash steam vented from the low pressure drain tank enters the tube side of the two condensers where it is condensed and the condensate sub-cooled by air forced over the outside of the condenser tubes by eight propeller type fans, four per condenser. The sub-cooled condensate drains by gravity and is collected in a separate hotwell tank located on the feed and condensate skid. A control valve in the condensate drain line from each condenser automatically maintains a preset level of condensate in the sub-cooling portion of the condenser.

One of the two condensate pumps, taking suction from the hotwell, delivers condensate through a discharge header to a heat exchanger supply header. Loss of discharge pressure will automatically transfer service to the standby pump. The heat exchanger supply header distributes condensate for use as a coolant to the following heat exchangers:

(a) After condenser and precooler which are connected in series.

(b) Shield water coolers.

(c) L. O. Intercooler.

(d) 2nd stage regenerative heat exchanger.

(e) Spent fuel tank cooler.

(f) Evaporator condenser.

(g) Shield tank coolers.

Condensate from the heat exchangers is delivered to the reserve feed tank through a return header. A three-way valve in the line to the reserve feed tank automatically maintains a constant level in the reserve feed tank by by-passing part or all of the condensate back to the sub-cooling portion of the condenser.

Makeup water can be added to the hotwell manually by a vacuum drag connection from the makeup feed tank or a connection from the makeup pump discharge header.

One of the two sets of condenser air ejectors is normally operating to remove air and other non-condensible gases from the tube side of the two air cooled condensers and thus helps to maintain the design condensing pressure, 15 inches Hg absolute at full power. The other air ejector is manually started if the operating ejector fails.

One of the two sets of gland exhaust air ejectors is normally operating to remove air and other non-condensible gases from the shell side of the precooler and thus help to maintain the design vacuum of 3 inches Hg. The other air ejector is manually started if the operating unit fails.

The two air-cooled condensers are connected in parallel and are located in a single T-5 building. The condensers are designed to condense the turbine exhaust steam and maintain the design pressure of 15 inches Hg absolute in the turbine exhaust line at full power when the ambient air is 60°F. The condensers are also designed to sub-cool the condensate from 180°F to 100°F. The two condensers have a total thermal capacity of 21.4×10^6 BTU/hr.

Cooling air is supplied to each condenser by four 20 horsepower propeller type fans mounted under the condensing and sub-cooling surfaces. The fans take suction from inside the building and discharge through the condenser tube bank, a control plenum, and a 5 feet by 15 feet exhaust stack to ambient above grade. Intake air is supplied to the condenser building through a duct which completely encloses the exhaust stack on all four sides and serves to insulate the snow tunnel roof from the hot, exhaust air. The intake air is directed through vertical, fixed storm louvers open on all four sides of the stack. A sheet metal shield protects these louvers from direct blowing snow. Manually operated single bladed dampers are provided in the intake duct outlets on either side of the condenser inside the T-5 building. A flexible connection is provided between the control plenum and the stack to isolate the stack from any vibration generated by the condenser. Provision is made for the addition of 3 feet extensions in the air intake and exhaust stacks above grade to compensate for snow accumulation.

Freezing in the condenser is prevented by recirculation of part of the hot exhaust air to temper cold intake air and maintain safe inlet air temperature to the fans. This is accomplished by the control plenum located on top of each condenser. The plenum contains two automatically controlled sets of dampers, exhaust and bypass, which control the proportion of recirculated air to maintain a constant inlet air temperature to the fans. The condensers drain completely on shut down and space heat is recorded in the condenser buildings to provide protection against freeze up.

Figure 38 shows the arrangement of a single condenser for application in a snow tunnel. Figure 25 shows details of the intake and exhaust stack.

3) Feedwater System

The Feedwater System, Figure 46, delivers feedwater to the reactor. The feedwater system also performs the following secondary functions:

(a) Supplies sealing water to the control rod drive seals.

(b) Collects the plant steam drains and returns them to the reactor.

(c) Returns the purified water from the purification system to the reactor.

The feedwater system contains a reserve feed tank, two feed pumps, and a control rod drive seal water filter.

Condensate from the condensate system and steam drains from the low pressure drain system are delivered to the reserve feed tank. The water level in the reserve feed tank is maintained constant by the condensate control valve in the condensate system. An overflow connection to the hotwell is provided to prevent loss of the condensate from the system if the condensate control valve fails. The reserve feed tank provides a positive suction head to the feed pumps and approximately a ten minute reserve feedwater supply in the event of a condensate system failure. The reserve feed tank is vented to the after condenser to prevent escape of vapors to the plant spaces.

One of the two feed pumps is operated to transfer feedwater from the reserve feed tank through a discharge header to the reactor and the control rod drive seals. An automatic feedwater control valve controls the feedwater supply to the reactor to maintain a constant water level in the reactor. A connection ahead of the feedwater control valve provides seal water to the control rod drive seals. A replaceable cartridge type filter protects the control rod drive seals from damage due to foreign materials.

An orifice meter is provided downstream of the feedwater control valve to indicate the feedwater flow rate to the reactor. The purification system discharges into the feedwater line downstream of the orifice meter. A check valve is provided in the feedwater line ahead of the purification system connection to prevent backup of the purification flow into the feedwater system. A fine screen strainer is located in the feedwater line after the purification system connection to protect the reactor from any foreign material which might be carried by the feedwater or the purification water. A motor operated stop-check valve is provided near the reactor to prevent any reverse flow from the reactor and permit remote isolation of the reactor from the control console.

A by-pass line, with an orifice, is provided from the feed pump discharge to the reserve feed tank to protect the feed pumps from overheating during operation at or near shutoff conditions. Loss of discharge pressure will automatically transfer service to the standby pump.

4) Coolant Purification System

The Coolant Purification System, Figure 48, removes soluble and insoluble impurities from the reactor coolant by continuously passing a portion of the coolant through a demineralizer column. The soluble materials are removed by ion exchange and the insoluble materials are removed by the filtering action of the resin bed.

A purification flow of 5 gpm (at 120°F) flows from the reactor to a holdup section (enlarged section of pipe) where the fluid is held up to allow N^{16} radioactivity to decay. The flow is then cooled to 120°F by the 1st and 2nd stage heat exchangers. Passing through the demineralizer, the purified water is pumped by the coolant purification pump into the reactor feedwater line upstream of the feedwater strainer. This strainer provides secondary protection against demineralizer resin entering the reactor vessel. Primary protection is provided by filters integral to the demineralizer. Before the fluid is returned to the feedwater line, it passes through the 1st stage heat exchanger and acts as a cooling medium for the purification flow coming from the reactor. Sub-cooled steam condensate is used as a cooling medium in the 2nd stage heat exchanger.

Sampling taps are located upstream and downstream of the demineralizer to allow coolant samples to be taken for analysis purposes. A resistance thermometer is located in the inlet line to the demineralizer and provides alarm and control functions to protect the demineralizer resin from high coolant temperature. Should the coolant temperature rise above 140°F, a signal from the resistance thermometer will de-energize the coolant purification pump, thus stopping flow to the demineralizer. A thermocouple is also installed in the inlet line to the demineralizer to provide temperature indication at the plant control panel. The pressure switch located downstream of the purification pumps will transfer service to the standby pump on low pump discharge pressure. A flow measuring orifice is located in the purification return line to the reactor to provide indication of the purification flow rate.

The Coolant Purification System is utilized to cool down the plant after a reactor shutdown and also to remove decay heat from the reactor. An eductor is used to pull water from the reactor during a shutdown when sufficient head is not available to make water flow to the purification system. Eductor motive water is provided by recirculating a portion of the purification pump discharge through the eductor.

A packaged demineralizer, Figure 28, is employed to remove soluble and insoluble materials from the reactor water. The unit is a completely shielded shipping package designed to permit shipment of a spent unit without exceeding ICC shipping regulations. The demineralizer is located on the purification skid in the machinery building and is fitted with unions for connection to the piping system. Replacement of the demineralizer can be accomplished without interrupting power operation.

5) High Pressure Drain System

The High Pressure Drain System, Figure 52, operates to continuously drain any condensation from the main and auxiliary steam lines, the space heat exchanger, and relief valve discharge lines (except main steam relief valve discharge lines). The main and auxiliary steam lines drain through impulse steam traps having integral strainers to a common return header. Stop-check valves are provided in the discharge line from each trap to prevent reverse flow. The return header is drained to the low pressure drain tank through a float trap. The casing of the float trap is vented to the reserve feed tank. Isolation and by-pass valves are provided for each trap to permit maintenance and repair of the traps without interrupting plant operation.

6) Low Pressure Drain System

The Low Pressure Drain System, Figure 53, operates to:

(a) Collect the seal leak-off from the control rod drive seals and reactor vessel head seal, and the gland exhaust from the turbine shaft seals, drain the condensate to the low pressure drain tank, and vent the vapors and non-condensible gases to the precooler in the condensate system.

(b) Collect the condensate from the high pressure drain system, the turbine casing drains, and the after condenser and precooler.

(c) Return the collected drains to the reserve feed tank for re-use as feedwater.

The leak-off connections from the control rod drive seals and the reactor vessel head seal and the gland seal exhaust connections from the turbine high and low pressure shaft seals join to a common return header. This header is drained to the low pressure drain tank through a float trap and vented to the precooler. The precooler condenses any vapors and is maintained at 3 inch Hg vacuum by the gland exhaust jet.

Condensate from the shell side of the after condenser and precooler, drains to the low pressure drain tank through a duplex drainer. The turbine steam chest and exhaust casing is drained to the low pressure drain tank through a common header. An impulse trap is provided in the steam chest drain line and a stop-check valve is provided in the line from the exhaust casing to prevent reverse flow.

The condensate is collected in the low pressure drain tank. The low pressure drain tank is maintained at turbine exhaust pressure, 15 inches Hg absolute, by a vent to the turbine exhaust line which allows vapors and non-condensible gases to pass to the main condensers. Condensate is transferred from the low pressure drain tank to the reserve feed tank by one of two low pressure drain pumps. The pump is operated by a level signal from the low pressure drain tank water level. If the operating pump fails to start on the high level signal, a high level alarm will be sounded at the control console and the operator will manually transfer service to the standby pump. A stop-check valve in the discharge line from each low pressure drain pump prevents reverse flow through the standby pump.

7) Lube Oil Service System

The Lube Oil Service System, Figure 55, consists of the following major components:

(a) Lube oil sump.

(b) Lube oil strainer.

(c) Main lube oil pump.

(d) Standby lube oil pump.

(e) Duplex lube oil cooler (one standby).

(f) Lube oil purifier.

(g) Two lube oil coolant pumps (one standby).

(h) Lube oil intercooler.

(i) Coolant surge tank.

All of the above items except the lube oil intercooler and the coolant surge tank are located on the turbine generator skid. The lube oil intercooler is carried on the feed and condensate skid. The coolant surge tank is a two feet long six inch schedule 40 pipe.

The main lube oil pump is driven from the main gear and takes oil from the lube oil sump located in the turbine generator skid base, pumps it through the lube oil strainer, through one side of the duplex cooler, and to the turbine generator bearings and reducing gears. A portion of the lube oil is taken just after the strainer and is sent to the turbine generator governor. Oil to the duplex coolers is controlled by a manual duplex 3-way valve. An intermediate cooling system is provided which minimizes the possibility of oil from the lube oil system mixing directly with primary water. The intermediate cooling system includes the intercooler, surge tank and coolant pumps. The coolant pump circulates water to the lube oil coolers, where it picks up heat from the oil, then to the intercooler where the heat is given up to the condensate system. The surge tank allows for the necessary expansion volume in this system.

A turbine lube oil purifier, complete with corrosion resistant bowl, integrally mounted inlet and discharge pumps is provided. Both the centrifuge and the pumps are driven by a single splash proof motor. The purifier and the lube oil sump are furnished with immersion heaters.

b. Utility Systems

1) Raw Water Purification System

The Raw Water Purification System, Figure 50, changes base water to reactor grade quality by use of an ion exchange demineralizer. The system is operated intermittently, dependent on makeup water requirement.

Raw Water(5 gpm) from the base water main passes through a mixed resin bed demineralizer. Soluble ionic impurities such as Ca^{++}, Mg^{++}, CO_3^{--}, Cl^- are removed by ion exchange with a hydrogen-hydroxyl form resin. Insoluble non-ionic impurities are removed by the filtering action of the resin bed. Since the resin will not remove dissolved non-ionic impurities such as chlorine gas, the raw water is tapped off the base water main upstream of the chlorinator. The demineralizer is sized to contain three cubic feet of resin. It is a cartridge type unit, that is, the resin is contained in a cartridge which can be inserted into the demineralizer by removal of its head. Since it is not intended to regenerate the resin on site, the cartridge type unit eliminates regeneration facilities which would require acid and caustic handling and storage. The demineralized water then flows to a storage tank. Water from the storage tank can be pumped to the following plant locations:

(a) Main condenser hotwell.

(b) Spent fuel pit.

(c) Shield water tank.

Provision is also made so that makeup water from the storage tank can be vacuum dragged to the main condenser hotwell during plant operation.

A conductivity cell is located in the demineralizer effluent line. The cell will initiate an alarm signal at the plant control panel when the conductivity of the water rises to 1.7 μmhos. The cell also gives an indication of conductivity level at the plant control panel. A conductivity level of 2 μmhos is an indication that the resin is expended. Another conductivity cell is located downstream of the storage tank to determine the quality of the water leaving the tank. If the water stored in the tank does not meet required quality it can be recirculated through the demineralizer through a recirculation line, which runs from the pump discharge to the demineralizer inlet line. The recirculation will improve the water quality and insure that the water supplied to the system meets specifications of:

pH	$6\frac{1}{2}$ - $7\frac{1}{2}$
Conductivity	2 μmhos, max.

Provision is made to reuse water previously rejected from the plant. Processed water of reactor grade quality from the Service Water System is pumped, as required, to the makeup tank.

The makeup pump is utilized to provide a head for cooldown flow to the Coolant Purification System during a reactor shutdown operation. When cooling the reactor below 201°F, prior to putting the Coolant Purification System eductor into service, the makeup pump runs at shutoff head to provide the required head. A recirculation line around the pump is provided to prevent damage to the pump when it is operating at shutoff head. The pump discharge is connected to the feedwater line during this operation.

2) Service Water System

The Service Water System, Figure 57, collects all plant radioactive water and processes this water so that (1) it meets maximum permissible activity limits for disposal, (2) it meets reactor grade specification for reuse in the plant. A spent fuel tank is also included in the system to store spent fuel elements.

Waste Tank

The waste tank located in the reactor complex collects all plant contaminated wastes and radioactive drains. The following locations discharge to the waste tank:

(a) All power plant building skid drains.

(b) Radioactive laboratory drain.

(c) Radioactive shower drain.

(d) Reactor complex exhaust stack drain.

(e) Contaminated laundry waste.

(f) Decontamination fluid.

(g) Relief valve drain.

(h) Shield water tank.

The tank capacity is 64 cubic feet and is sized to contain the total wash and rinse volumes from a decontamination operation. Water from this tank will be processed in a 200 gallon per day evaporator.

Evaporator

A 200 gallon per day evaporator which processes radioactive water from the waste tank is located on the purification skid in the power plant building. The overhead condensate will gravity drain to the disposal tank also located on the purification skid. The evaporator will concentrate the feed to about a 50-50% water-solid mixture. It is estimated the evaporator can operate for one year or more before it is required to dump the bottoms product. The bottoms product will be packaged for shipment to a disposal area.

The following is a tabulation of normal liquid makeup and activity concentrations from the evaporator.

	Gal/wk	μc/cc
Evaporator Overhead	427.7	1×10^{-8}
Evaporator Bottoms	1.3	4.57×10^{-1} (activity level at end of one year)

The evaporator heating medium is 150 pounds steam from the Main Steam System. The steam condensate will drain to the High Pressure Drain System.

Disposal Tank

The disposal tank which primarily stores evaporator overhead acts as a holdup reservoir prior to disposing of this water. If it is desired to dispose of the water to the base sewer, samples can be taken to insure the water meets permissible radioactivity dumping limits. If for any reason the water doesnot meet the permissible limits, it can be pumped back to the waste tank for another pass through the evaporator. If it is desired to utilize disposal tank water for reactor plant makeup, the water is pumped to the drain tank to await further processing through the spent fuel tank demineralizer. This processing will insure water of reactor grade quality. A disposal tank recirculation line is provided to insure that a representative sample is taken during a sampling operation. The disposal tank is located on the purification skid and has a capacity of 35 cubic feet.

The following table is an estimate of plant waste water volumes, and plant makeup water requirements.

TABLE I

	Gal/day	Gal/week
Laboratory drains (from sampling) and laboratory equipment cleaning	10	70
Plant Leakage	5	35
Radioactive laundry wastes		324
Gross Plant Waste Water		429
Plant makeup water requirements		
Water loss through plant air ejectors	58	
Sampling and leakage losses	10	
Radiolysis of reactor water	5	
	73	511
Makeup water requirements from Raw Water Purification System		82

Drain Tank

The drain tank located in the reactor complex is provided to store the total amount of operational reactor plant water. Water from the reactor plant will be stored in this tank if it becomes necessary to pump out the plant during a plant maintenance period. Reactor plant water can be pumped to the tank either from the Coolant Purification System or Condensate System.

During operation of the plant, plant makeup water from the disposal tank will be stored in the drain tank prior to circulation through the spent fuel tank demineralizer. Circulation of this water through the demineralizer will insure water of reactor grade quality for re-use in the plant. Water from this tank can also be pumped back to the disposal tank. The drain tank has a capacity of 467 cubic feet.

Spent Fuel System Demineralizer

The spent fuel system demineralizer is utilized to purify water from the spent fuel tank. A cooler located upstream of the demineralizer cools the cirulating water to 120°F to insure the demineralizer resin does not suffer thermal damage. Water can also be circulated through the cooler to take excess heat away from the water due to heat generation from spent fuel elements. During this operation the demineralizer is by-passed.

Reactor plant makeup water requirements can partially be satisfied by re-using evaporator overhead condensate. Disposal tank water is thus pumped to the drain tank for eventual reuse. When makeup water is required, the drain tank water is circulated through the spent fuel system demineralizer to insure water of reactor grade quality.

pH	6.5 - 7.5
Conductivity	2 μmhos, max.

Reactor grade water is then pumped to the makeup water storage tank on the feed and condensate skid. Sample taps are provided upstream and downstream of the demineralizer for water analyses purposes. The demineralizer is of the packaged type, and is identical to that used in the Coolant Purification System. It is also located on the purification skid.

Spent Fuel Tank

The spent fuel tank is a large open top tank in the reactor complex utilized to store spent fuel elementsunder water.

3) Plant Heating and Ventilating System

The plant heating system, Figure 59, is operated to supply the thermal equivalent of 400 KW net for site heating and to provide sufficient additional heat to maintain the machinery and associated spaces at 60°F. The system consists of a unit heater in the boiler room and the machine shop; wall fin convectors in the reactor complex, condenser, power plant and personnel buildings and piping connections to supply site heating. A steam to water heat exchanger (space heat exchanger) is connected in parallel with an oil fired hot water heater (shutdown boiler) and two hot water circulating pumps and surge tank are provided.

The shutdown boiler and the space heat exchanger are connected to common inlet and outlet headers such that either unit can supply the plant heating load and the 400 KW (t) net site heat load. The space heat exchanger is used during normal operation and the shutdown boiler is operated whenever reactor steam is not available. Water at 190°F is supplied to the inlet header and either heat exchanger by the circulating pumps. The water is heated to 220°F and distributed via the outlet header to the plant heaters and to the site heating system. Equipment necessary for site distribution is not included in this system. Water from the plant heaters and site heating system is returned to the pump suction where a surge tank provides storage and surge capacity.

Hot water from the heat exchanger outlet header to the plant heating system passes through a three-way tempering valve which senses the outside ambient temperature and mixes cold water from the plant heating pump discharge with the hot water to vary the supply water temperature to the heating system. The heating system consists of two parallel loops, one loop supplies the condenser and reactor complex and the other loop supplies the power plant, personnel and service building. An orifice connects the supply and return legs of each loop and insures a minimum flow of approximately 1 gpm through each loop to prevent freezing.

The reactor complex, condenser building, and power plant building are heated by two parallel wall fin convectors mounted along each side wall of the building. Common supply and return headers connect the convectors to the supply and return legs of the heating loop. A thermostatically controlled valve installed in the return header and operated by a self-contained temperature pilot regulates the flow through the wall fin convectors to maintain 60°F in the building. Normal ventilation of each building is provided by manually operated wall louvers and an insulated gravity exhaust stack which discharges through the roof of the building. A manually controlled exhaust fan in the exhaust stack of the reactor complex and the power plant building permits forced purging of these buildings, if required.

During normal plant operation, the condenser building is heated by recirculated air from the condenser exhaust stack. During shutdown conditions, natural circulation through the condenser and ducts will provide adequate ventilation.

The service building is heated by two unit heaters, one in the boiler room and the other in the machine shop, which recirculates air within the space. Ventilation is provided by manually operated wall louvers and an insulated gravity exhaust stack to the ambient above grade. Temperature in the building is controlled by a thermostat in each space which starts and stops its respective heater fan.

Spring loaded dampers with fusible links are provided in each exhaust stack to provide automatic closure in the event of fire.

4) Fire Protection System

The fire protection system consists of two major parts, the fire extinguishing system and the detection and alarm system.

The fire extinguishing system is made up of a separate fixed total-flooding carbon dioxide system for each building, backed up by portable hand extinguishers. The fixed flooding systems are designed for manual operation from the plant control station and from a local station immediately outside each building. Automatic devices are provided to shut ventilation openings and stop any fans in the event of a fire.

The detection and alarm system performs two principle functions:

(a) Warns the plant operator of an excessive temperature condition in any building.

(b) Sounds an audible alarm in the affected space to warn personnel to leave when the fixed flooding system is actuated.

Temperature detectors will be located throughout each building in the vicinity of major fire hazards. Two alarm points are provided at each detection station, one at $85^{o}F$ and the second at $130^{o}F$. The normal procedure is to send an investigation team to the scene at the lower alarm point to determine if fire or a malfunction of the heating system is the cause and take remedial action as necessary. This early warning will normally permit extinguishing the fire with portable hand extinguishers while it is small and before it does extensive damage. At the higher alarm point the automatic closure devices operate and, if an investigating team is not at the scene, the operator should immediately actuate the fixed flooding system. When an investigating team is at the scene, actuation of the fixed flooding system should normally be left to their discretion.

When the fixed flooding system is actuated, an audible alarm will warn personnel to evacuate the space and will delay release of the gas a pre-set time interval to permit evacuation. Carbon dioxide is a smothering agent and therefore dangerous to personnel. Care must be exercised after release of the gas to use proper protection, such as oxygen or fresh air breathing apparatus, for personnel entering the space. After the fire is extinguished, the space will be thoroughly purged to remove the carbon dioxide gas.

Suitable provisions to permit testing of the fire protection system without release of the carbon dioxide gas are built into the system.

3. Shielding

a. Operating

The functions of the PL-2 reactor shielding may be divided into two categories: One, its function during periods of reactor operation and two, its function during periods of reactor shutdown. Because the reactor complex (Figure 3) is located in a snow tunnel, the shielding must not only take biological effects into account but also the heat generation in the tunnel walls and floor. When the reactor is operating, therefore, the shielding must:

1) Limit the exposure of plant personnel to a dose rate not exceeding 100 mr per work week of 84 hours during normal plant operation.

2) Limit the heat generation in the snow to a value consistent with foundation requirements.

It is not anticipated that access to the reactor complex will be permitted during reactor operation.

Attenuation of the reactor core gammas and escape neutrons is accomplished along the core mid-plane by the following materials, in sequence from the core surface:

(a)	Reactor coolant, water,	8.3 inches
(b)	Pressure vessel wall, steel,	1.3 inches
(c)	Thermal insulation,	2.5 inches
(d)	Support, steel,	.125 inches
(e)	Space,	1.5 inches
(f)	Inner shield tank wall, steel,	.25 inches
(g)	Lead,	3.5 inches
(h)	Shield water,	15.5 inches
(i)	Outer shield tank wall, steel,	.3 inches

The shield tank is surrounded by insulated panels about 3.5 inches thick. A space of about two feet exists between the tank and panels. These panels serve to minimize thermal radiation from the reactor complex to the surrounding snow in the tunnel and reduce the heating requirements of the reactor complex.

Interposed between the shield assembly, Figure 18, and the power plant buildings is the spent fuel tank containing water, eight feet front to back, and about fifty feet of snow. In addition, the tunnel floor is offset about seventeen feet below the access tunnel floor. Computation of the dose rate at the plant buildings, using only the effect of the fifty feet of snow, gives a level of less than 1 mr/hr during full power reactor operation. Table II below gives anticipated dose rates at selected locations in the reactor complex. These are the total of neutron and gamma contributions from an 8 MW(th) reactor core and include absorption gammas, i.e., gammas emitted when a thermal neutron is absorbed in a material.

TABLE II

DOSE RATES IN REACTOR COMPLEX, OPERATING

Location		Dose Rate	Notes
Lead Shield:	outside surface	2.5×10^5 R/hr	
Shield Tank:	outside surface	6.8×10^4 R/hr	
Spent Fuel Tank:	outside surface	250 mr/hr	opposite core, 24 hrs. after insertion of spent fuel
Operating Floor:		2.9×10^3 R/hr	directly over core

b. Shutdown

The reactor shielding must allow access to the reactor floor for refueling and maintenance after the reactor is shutdown. Refueling is done after the reactor has been cooled down and the system depressurized. Water level in the reactor vessel is raised during this process to a point below the vessel flange. The fuel is transferred (by means of a shielded transfer cask) from the core structure to the storage section in the spent fuel tank. Here the activity of the fuel elements is allowed to decay to a level facilitating shipment in shielded containers to a reprocessing plant. The transfer cask is designed to give a dose rate of 50 mr/hr during fuel transfer from the pressure vessel to the spent fuel tank.

Spent fuel in the spent fuel tank is covered by about twelve and a half feet of water which is recirculated to remove the heat generated by the spent fuel. When this heat generation has decreased to a level allowing shipment, the spent fuel shipping cask can be lowered alongside the storage section and the fuel transferred to it.

Table III lists the expected dose rates at the mentioned locations after shutdown:

TABLE III

DOSE RATES AFTER SHUTDOWN (MR/HR)

Location	.5h	4h	12h	24h	Notes
Operating Floor: Above Core	1	1	1	1	
Water Surface	74	43	29	26	Inside pressure vessel
Refueling Station	-	-	-	-	Alongside transfer cask
Operating Floor: Above Tank	1	1	1	7*	*With spent fuel in storage

c. Foundation Heating, Reactor Complex

When the reactor is in operation, a continuous stream of neutrons and gamma photons leaves the core. The gammas are attenuated or debilitated in energy as the gamma stream passes through the structural materials and shielding. Energy absorbed appears as heat and affects a temperature rise in the material. The attenuated gammas finally reach the snow and become absorbed. Neutrons leaving the core are predominantly fast neutrons. In passing through the materials surrounding the core, these neutrons are gradually thermalized and absorbed. The absorption of thermal neutrons is accompanied by the release of gamma photons which are in turn gradually absorbed as they proceed through the structural materials. Thus there is a shower of released gammas that joins the core gammas and neutrons and helps generate heat when absorbed in the snow.

A computer study has been made to determine the effects of heat generation in the snow surrounding the reactor structure. Figure 73 depicts the model used in the study. A section was taken across the tunnel. With the core centerline as the axis, a cylindrical geometry was assumed. Heat transfer was taken as zero across the centerline and across the snow at a height of 9 feet above the tunnel floor. Heat sinks were assumed at 49 feet below the tunnel floor and 52 feet from the tunnel wall. These distances were selected on the assumption that they would not vary greatly with time. The tunnel wall and floor were maintained at a constant temperature. A sink temperature of $-30^{\circ}F$ was selected as representative of the temperatures found in the snow at the plant site.

The snow volume under consideration was divided into two major sections: A heat-generating section and a simple conducting section. In turn, the heat-generating section was subdivided into 18 regions, each with its own rate of heat generation. Other assumptions made were:

(1) Snow density is constant at 0.5 g/cc.

(2) Snow conductivity is constant at .4116 BTU/hr-ft^2-F/ft.

(3) Heat generation is constant in each of 18 regions.

(4) Heat generation varies with radial as well as axial regions.

(5) Heat sinks are not affected by heat flow.

(6) Snow is the only material of foundation.

(7) Induced activity in the snow is negligible.

As a comparison, two tunnel temperatures were selected: $0^{\circ}F$ and $-15^{\circ}F$. Figure 74 shows the resulting isotherms when the temperature is $0^{\circ}F$. A "hot spot" appears about two feet below the floor but the rise is only three degrees above the tunnel temperature. When $-15^{\circ}F$ is assumed in the tunnel, the spot is at a depth of three feet and at five degrees above the base temperature. Figures 76 and 77 are the result of assuming that the heat generation has been increased by a factor of two and four respectively. As expected, the maximum temperature increases and the isotherm tends to appear at a greater depth. The value of the maximum temperature, however, is not a linear function of heat generation. At a tunnel temperature of $0^{\circ}F$, the maximum temperature follows the approximation:

$$T = T_o(Q/Q_o)^n$$

where T = max. T, deg. F

T_o = max. T, with Q_o, deg. F

Q_o = reference heat generation, BTU/hr-ft^3

Q = heat generation, BTU/hr-ft^3

$n = 1.65 \pm .15$

The effect of using an added heat sink to control temperature rise can be seen in Figure 78 where an additional 0°F sink was established two feet below the tunnel floor. Its effect was to lower the maximum temperature by a factor of 0.65 but it drove the "hot spot" to a greater depth. To circumvent this, it is suggested that any heat sink be used at a depth greater than that at which the original maximum temperature is expected to appear. This would not only depress the temperature rise but also limit its movement.

In comparing Figures 77 and 78, it should be noted that the addition of another heat sink as shown has a limited influence upon the surrounding snow structure. The change is a shift of a few inches in the isotherms below five degrees when the tunnel is at 0°F. Most of the variation in isotherms above 5 degrees occurs within a few feet of the heat sink.

The boundary value temperatures selected for the study are conservative for Byrd Station. The resulting maximum temperatures at the indicated "hot spots" are far below the range of temperatures that can be considered to affect the stability of the snow surfaces.

C. ELECTRICAL SYSTEMS

1. Electrical Power Load Analysis, Figure 61

An analysis of plant electrical loads under various operating conditions was made to size the components in the power system.

The analysis, Figure 61, shows that the total 480 volt load at design full power is 218 KW or 240 Kva. This represents a conservative load for the 300 Kva plant load center.

During startup conditions, the sum of the loads is shown to be 122.5 KW. The shutdown power required is 91 KW. On this basis, the auxiliary AC power source to supply startup and shutdown power must be rated in excess of 125 KW. The maximum power transient during startup conditions occurs when the feed pump is started. Using reduced voltage, autotransformer (65% taps) starters for the feed pumps, the starting Kva of these motors is 145. An 1800 rpm generator with a fast response exciter requires a rating of 170%, of applied starting Kva to keep the minimum terminal voltage above 85% during the transient* A 200 KW diesel generator unit is used for the auxiliary supply.

The analysis shows that the highest load on the DC bus occurs during shutdown conditions with a peak of 3860 watts. To supply this demand 5 KW converters are used.

2. Main Electrical System, Figure 63

a. Main Generator

1) Description

The gross electrical power is generated by a synchronous generator of the open dripproof, horizontal, separately excited revolving field type. The principal generator characteristics are: speed-1200 rpm, capacity-1250 KW continuous, 3 phase, 4160/2400 volt, 60 cycle, insulation-Class B. Generator equipment includes: a direct connected exciter, amortisseur windings in each field pole, six thermocouples embedded in the stator with leads brought out to a terminal board, a ventilating fan bolted to the rotor shaft, and an end shield bearing.

The turbine prime mover, the reduction gear and the generator are mounted on a common skid base which, with a protective enclosure for the equipment, is suitable for shipment on an operational base.

2) Auxiliary Equipment

Control and protective equipment for the main generator is housed in equipment cabinets on the electrical skid. Generator protection is provided for overcurrent, undervoltage, and directional differential current conditions. When the trip points in any of these areas are exceeded, a lockout relay is actuated. This, in turn, trips a power circuit breaker, 4.16Kv, 1200 ampere, metal-clad type, in the generator output line and a field breaker in the generator field circuit.

Current and potential transformers in the high voltage feeder lines provide signals of voltage, current, frequency and power which are indicated on the front of the control cabinets and on the secondary control board at the console. A synchroscope is provided to enable the turbine-generator to be

* At an estimated constant current initial load of 20 KW

synchronized with an outside power source or with the plant diesel generator.

3) Maintenance

The power circuit breakers are roll out components to facilitate access for inspection and servicing. Cabinet access from both front and rear makes the other components available for service in addition to providing a compact arrangement.

b. High Voltage and Distribution

1) Description

The gross generator output is fed from the generator output breaker, ME-CB-02, to two utilization points. The first is the plant load center, ME-T-01, which is located on the electrical skid adjacent to the generator control cabinets. The generator output is also fed to the station load through a power circuit breaker, ME-CB-03, (oilless metal-clad type) which is located on the electrical skid.

2) Ratings

The generator and station load breakers are 4.16 KV class with an interrupting rating of 75 MVA. Stored energy operating mechanisms provide rapid (5 to 8 cycles) closure and trip which prolongs breaker life and reduces maintenance. The available energy is sufficient to close the contacts under full short circuit conditions.

c. Plant Load Center

1) Description

The load center is a coordinated equipment arrangement for stepping down from the generation voltage of 4160 Y/2400 to the plant supply voltage of 480 Y/277 and for protecting and switching the low voltage power distribution circuit. The assembly is enclosed in a freestanding, three section, metal cabinet. The first section contains a fused, air-interrupter switch for disconnecting the center from the primary and for protecting the transformer. The center section contains a three-phase, 4160 to 480 Y/277 volt, open dry-type transformer. The low voltage section contains a low voltage power circuit breaker for protecting the plant distribution bus. A parallel breaker (not shown) is provided as backup to increase system reliability.

2) Ratings

The incoming line section fused switch is rated at 4160V and an interrupting capacity of 60,000 amperes (asymetrical) RMS. The 4160: 480 Y/277 volt transformer has a rated capacity of 300 KVA. The secondary breaker is rated at 600 volts, 600 amperes continuous, and 60,000 amperes (asymetrical) RMS interrupting.

3) Maintenance

Access to the interrupter switch cabinet is from the side of the skid. The access door is key interlocked with the secondary breaker for safety to personnel and protection to service continuity. The air-break type switch has an air insulating medium which does not leak or require maintenance and has contacts readily available for inspection and testing.

The transformer taps and connections are available through a panel in the front of the transformer cabinet. Periodic cleaning of the coils and core structure is required. The silicone insulation minimizes drying times required before reenergizing after a shutdown period.

The secondary breakers are dead-front switch board mounted in the low voltage cabinet and are accessible from the side of the skid.

3. Auxiliary and Emergency Electrical System, Figure 64

a. Diesel-Generator

An auxiliary source of AC power is required in the plant for several operating conditions. Because the plant is an isolated, self-powered unit, an alternate source of power is necessary during plant startup, plant shutdown or emergency outages. To fulfill these requirements a diesel powered generator is provided.

1) Description

The generator is a horizontal, open-drip-proof assembly utilizing a fabricated steel housing and a single ball bearing. A plate type coupling at the front of the generator attaches the generator motor to the engine flywheel. The excitor is top mounted and belt driven. The magnetic amplifier type voltage regulator is located in a housing on top of the generator.

The engine is a 4-cycle diesel unit with the following characteristics:

cylinders - 6
rpm - 1800
fuel oil type - #2, gear type transfer pump
governor - flyball type, right side, engine mounted
starting - electric
standard accessories which includes:

aftercooler
air cleaner, dry type
full flow filters, fuel and lube oil
flexible fuel lines
gauges: fuel pressure, oil pressure, water temperature lifting eyes
lube oil cooler, water cooled
pumps: fuel transfer, packet water, lube oil
service meter
mounting brackets
thermostats and housing
turbo charger

2) Rating

Generator capacity is 200 KW continuous. The voltage regulator will maintain a steady state voltage within ± 3 1/2% of rated voltage. Minimum generator voltage during the maximum starting transient is 85% of rated load voltage.

3) Auxiliary Equipment

Accessories provided with the generator include:

Amortisseur windings in the field pole faces.

A wall mounted control panel which house a voltmeter, an ammeter with selector switch and a circuit breaker.

An automatic transfer - starting unit to start the diesel upon failure of the turbine generator supply and transfer the electrical load to the diesel generator.

The following equipment is supplied with the diesel unit:

overhead silencer

radiator and shaft mounted fan

4) Operation

The diesel generator is located in the service building and is connected to the 480 volt plant power distribution but through the automatic starting-transfer unit.

During plant startup, the diesel unit supplies power to the plant loads, pumps, lighting, etc. As the turbine generator is started, the load is transferred to it and the diesel unit is stopped. In the event of failure of main electrical power, the diesel unit is automatically started and transferred to the line within, for normal operation, 10 seconds. The utility loads and emergency power loads are picked up immediately and the desired pumps may be started manually.

b. Emergency System

An emergency electrical supply is provided for the plant to provide electrical power for critical equipment in the event of an interruption of power from other sources.

1) Description

The emergency bus is a DC bus which is fed from two sources. During normal plant operation with AC power supplied to the low voltage distribution bus, a pair of AC to DC converters supply 78 volts, to the DC bus. Three load sections are fed from this bus, each section being isolated from the bus by a power rectifier. A bank of storage batteries is connected to each section and floated on the line when DC power is supplied from the converters. The batteries continue to supply current to the loads, during AC power interruptions, for a period of 5 hours.

Battery Section A supplies the nuclear instrumentation with +25 volts and - 25 volts, Section B supplies the control rod drive system, the process instrumentation and the communications and alarm system with +65 volts, and Section C supplies the power circuit breaker trip circuits with +64 volts DC. Series regulators in each section supply circuit keep the output voltage to the load within 0.75% of the preset value for input voltage variations along the battery discharge curve.

The power supplied to the control rod drives from Section B is 208 Y/120 volt, 3 Ø 60 cps. Dual inverters are used to supply this output from the convertor or battery input.

2) Ratings

(a) Converter

input voltage	480 volt, three phase
capacity	5KW
output	78 VDC adjustable from 65 to 85 volts

(b) Rectifier

type	silicon, power
current	100 amps rating
inverse voltage	300 volt

(c) Batteries

type	nickel-cadmium
no. cells per section	59
capacity (section)	60 ampere hour

(d) Inverters

input voltage	78 to 65 VDC
output voltage	208 Y/120 volt
phases	3
frequency	60 cps
capacity	3 Kw
type	static

3) Reliability

Operation of the instrumentation, communications and switch gear trips from the DC bus affords a high degree of reliability since the equipment can be powered directly by the primary DC source, i.e. the batteries. The dual, static converters, which supply DC during normal plant operation, provide a reliable source and require little maintenance.

4. Plant Motor Supply

From the plant load center, power is fed, Figure 66, to plant loads through a plug-in bus which is carried into all plant areas. At skid and/or equipment locations, feeders, connected to the bus through plug-in breakers, conduct the power to the motor locations. The number, application and location of the plant motors is summarized as follows:

Location	Application	No. Installed	Hp
Service building	oil pump	1	3/4
	blower	1	3
Condenser building	condenser fan	8	20
	louver	4	3/4
	valve	2	1/3
Turbine gen. skid	standby lube-oil	1	7-1/2
	lube oil cooling pump	2	1/2
	lube oil purifier	1	1/2
Feed & Condensate skid	feed pump	2	60
	cond. pump	2	5
	plant heating pump	2	3/4
	low press. drain pump	2	1/2
	make up pump valve	1	1/2
Purification skid	purification pump	2	1-1/2
	disposal tank pump	2	1/2
Reactor complex	waste tank pump	2	1/2
	spent fuel tank pump	2	1/2
	drain tank pump	2	1/2

The motors are supplied through combination starters with circuit breakers and overload relays. In accordance with JIC standards, size 1 starters are used on all motors through 7 1/2 horsepower. The starters for the 20 horsepower motors are NEMA size 2, full voltage and the 60 horsepower motor starters are NEMA size 4, reduced voltage, auto transformer type. Local starting stations are provided for all motors at convenient locations on the skids or in the various areas. In selected cases, a secondary or remote station is provided at the plant control console for starting the motors.

In critical applications, two motors are provided (one operating and one standby) to insure a higher degree of service continuity. To further this arrangement, dual feeders are run to these skids or areas and each feeder supplies one motor of the pair used for a particular application.

5. Plant Utility System, Figure 65

a. Plant Lighting

Area lighting for the various buildings is supplied to I.E.S. recommended lighting levels by fluorescent units suspended from the ceilings. The supply voltage to these lights is 277 volts, 60 cps, single phase. Power is taken from the 480 volt plant distribution bus to lighting distribution boxes mounted on the building walls. The numbering of individual light circuits (line to neutral) is balanced on the three phase supply to reduce the unbalance currents that may exist in the bus.

The light units are 4 light, cold cathode type. Use of the cold cathode units reduces the possibility of bulb breakage and reduces the bulb replacement requirement since the manufacturers guaranteed lifetime is 25,000 hours (2.85 years continuous) at rated operating conditions.

Emergency lighting is provided by a series of battery powered lights located at strategic points in the buildings or areas. The units are each capable of illuminating 10,000 square feet at maximum brightness for a period of four hours. During normal plant operation, the emergency light batteries are trickle charged from the convenience outlet supply. Upon an AC power interruption, the lights come on automatically and remain on until AC power is resumed or until rated life is exceeded.

b. Plant Convenience Power

Convenience outlets are provided along the walls in each building for hand tools, test equipment or other apparatus requiring 115 volt, 60 cps. power. These outlets are supplied from the 480 volt plant distribution bus through plug-in breakers, feeder lines, 480 - 208 Y/120 volt transformers and junction boxes. The junction boxes divide the single phase loads among the 3 phase inputs and provide a protective breaker in each circuit.

6. Nuclear Instrumentation System

The nuclear instrumentation, Figure 67, includes seven channels of neutron flux monitoring equipment, scram logic apparatus and a means of self-checking. The detectors are located in instrument wells, Figures 36 and 37, which are installed in the reactor complex. The readout, scram logic and test equipment is located in a cabinet in the plant control console.

a. Source Channels

Flux detection in the source range is done with two sensitive BF_3 chambers located 180° apart around the reactor and 90° to the startup source. The outputs from these detectors in separate, identical channels are converted to log count rate signals and reactor period signals. Local meters on the instrument drawer face provide a continuous indication of the count rate and the period signals from either channel. Signals for the count rate and period from either channel may be selected for presentation on the face of the control console.

b. Intermediate Range

Flux detection in the intermediate range is accomplished by two compensated ion chambers spaced 180° apart. Ranges for the CIC's overlap the source and the power detector ranges by a minimum of two decades. Signals from these detectors, in separate identical channels, are converted to log N and period signals. Local meters on the instrument drawer face provide continuous indications of the selected log and period signals. Signals for the count rate and the period may also be selected, by a switch, for presentation on the face of the control console.

In addition, the signals from the detectors are amplified and presented in linear form to the flux level meter on the face of the plant control console. A selector switch selects the desired decade to be monitored.

c. Power Range

Three uncompensated ion chambers are used in the power range to monitor flux. These chambers are installed with a 90° spacing. Each of these channels detects and indicates linearly the power of the reactor from .0015% to 150%. Local indication of the selected power signal appears on a meter on the instrument drawer face. The selector switch on the console panel face may select the linear signal for presentation on the power indicator on the console.

d. Scram Logic

Period signals in the source and intermediate ranges are auctioneered and fed to the scram logic. Signals which indicate a period shorter than 15 seconds will initiate an alarm and those shorter than 10 seconds will initiate a reactor scram. In the power range, the power signals are used in coincidence so that an alarm occurs if one signal exceeds 135% power and a reactor scram is initiated if a coincidence of two out of three high power signals occurs. A scram is initiated by interrupting the clutch holding power supplied to the control rod drive mechanisms.

e. Self-Checking

To insure that the equipment is in operating condition, a self-checking feature is provided to continuously scan the channel components with test signals and, if a faulty component is found, indicate the location of the component.

f. Mechanical Assembly

The components for each range are located in a single drawer. The drawer chasses are mounted on roller bearing slides and are secured to mounting angles of the cabinet on the front panel. Quick lock detents are provided on the slides for easy removal of the drawer assemblies.

g. Maintenance

The pull out drawers provide easy access to the operating components. Plug-in components reduce the time required to change components if faults are indicated by the self-checking system. Circuit connections between drawers are made through AN connectors.

7. Process Instrumentation Systems

Monitoring instruments for process parameters have been installed to provide the plant operator with information on plant process conditions. The equipment was selected and applied to provide this information with a high degree of reliability and a minimum of different types of equipment. Wherever possible, identical components are used in the different systems to provide interchangeability and to reduce the spare parts stock.

All process instrumentation, with the exception of temperature alarms, is supplied directly from the DC emergency supply to insure continuity of service under all plant conditions. This also increases system reliability by elimination of the converters required to supply DC power. All pressure and differential pressure transmitters are zero-displacement, force-balance type and in most cases do not require seal pots. DC signals are used for transmission to reduce the problems of electrical pick-up and frequency variations in the supply circuit. Wherever the measurement is critical or access to the sensor is limited, dual channels or separate channels for indication and alarm are provided to increase system reliability.

a. Main Steam System, Figure 43

Reactor water level is detected by two displacement float assemblies which supply signals to identical channels of alarm units, indicators, controllers, and to a common recorder. Either channel, as selected by the operator, may be used to regulate the feedwater flow valve and control reactor water level. The other parameters monitored are:

		indication		function		
		local*	remote**	control	alarm[□]	scram
temperature,	main steam		x			
	main steam vent discharge				H	
	aux. steam discharge		x		H	
	turbine exh. discharge		x		H	
	turbine exhaust	x				
pressure,	main steam	x	x			H,L
	reactor steam		x	x	H,L	
	auxiliary steam	x				
	T. G. steam	x	x			
	space heat exchanger	x				
	T. G. gland seal	x				
	T. G. gland exhaust	x				
	T. G. exhaust	x	x		H	
flow,	main steam		x			

In a similar fashion, the instruments in the other systems are as follows:

b. Condensate System, Figure 45

	indication		function		
Application	local	remote	control	alarm	scram
temperature					
condenser air inlet		x	x	L	
condensate pump discharge	x	x			
after condenser vent	x	x		H	
shield tank temperature		x		H	
shield tank cooler outlet		x			
cond. to RFT	x	x			

* local refers to an area near the sensor

** remote indicators are located in the plant control console

□ H - high level alarm

L - low level alarm

ATA - indicator pump automatic transfer

	indication		function		
Application	local	remote	control	alarm	scram
evaporator condenser outlet	x				
after condenser water out	x				
L.O. intercooler outlet	x				
2nd stage heat exch. outlet	x				
cond. from SFT cooler	x				
liquid level					
condenser subcoolers			x	H,L	
hotwell	x	x		H,L	
flow					
condensate pump discharge	x	x			
pressure					
hotwell	x	x			
cond. pump seal water	x				
cond. pump discharge	x	x	x	ATA	
precooler shell	x				
after condenser shell	x				

c. Feedwater System, Figure 47

	indication		function		
Application	local	remote	control	alarm	scram
temperature, feedwater	x	x			
liquid level, RFT	x		x	H,L	
flow, feedwater	x	x			
pressure, feed pump discharge	x	x		ATA	
CRD seal water	x	x		L	

d. Coolant Purification, Figure 49

	indication		function		
Application	local	remote	control	alarm	scram
temperature, reactor water		x			
purif. loop		x	x	H	
pressure, purif. pump discharge	x			ATA	
flow, purification loop		x			

e. Raw Water Purification, Figure 51

	indication		function		
Application	local	remote	control	alarm	scram
conductivity, demineralizer outlet		x		H	
makeup feed		x		H	
liquid level, makeup tank	x	x		H,L	
pressure, makeup pump discharge	x				

f. Low Pressure Drain, Figure 54

Application	local	indication remote	control	function alarm	scram
temperature					
control rod drive seal water		x		H	
reactor vessel head seal water		x		H	
liquid level, L.P. drain tank	x	x	x	H	
pressure, L.P. drain pump disch.	x				

g. Lube Oil Service, Figure 56

Application	local	indication remote	control	function alarm	scram
temperature, lube oil	x				
T.G. bearings oil	x			H	
L.O. cooler outlet	x				
L.O. system cooler outlet	x				
pressure, L.O. cooling pump discharge	x			L	
L.O. pump discharge	x				
L.O. strainer differential	x				
T. G. bearing oil	x				

h. Service Water, Figure 58

Application	local	indication remote	control	function alarm	scram
temperature, spent fuel tank		x		H	
SFT cooler outlet		x		H	
drain tank		x			
waste tank		x			
evap. condenser coolant		x			
evaporator		x			
disposal tank	x				
pressure, SFT pump discharge	x	x			
drain tank pump discharge	x	x			
waste tank pump discharge	x	x			
disposal tank pump discharge	x				
liquid level, spent fuel tank	x	x		H,L	
drain tank	x	x		H,L	
disposal tank	x			H,L	
waste tank	x			H,L	
conductivity, demin. outlet		x		H	

i. Plant Heating, Figure 60

Application	indication local	indication remote	function control	function alarm	scram
temperature, shutdown boiler outlet	x		x		
pressure, plant heating pump	x		x	L	
shutdown boiler shell	x				
fuel oil pump discharge	x				

8. Radiation Monitoring Systems, Figures 69 & 70

a. Gaseous Effluent Monitor

Radioactive effluent gases are vented from the process loop through the aftercondenser vent line. A Tracerlab in-line gas monitoring system, Figure 69, consisting of a gas chamber with detector housing and shielding, a ratemeter and power supply with alarm unit, two flow meters, and dual filters is provided to detect and indicate the level of activity being released to the atmosphere. Measurement of the activity covers 5 decades from 10 cpm to 10^6 cpm. The alarm point is adjustable within the measurement range. The filters are absolute type filter which retain particles larger than .3 microns in diameter. These filters are installed in parallel upstream of the radioactive detection apparatus to prevent the release of particulate matter. Parallel installation permits one to be removed while the other is operating.

b. Area Monitoring

The radioactivities at various locations, Figure 70, in the plant are monitored by a Victoreen area monitoring units which provide indication of the activity levels at the control console and an alarm if the activity exceeds a preset level. The Beta-gamma detectors supply indicating station which cover a range of three decades. The alarm point may be set at any point within the indicating range.

The sensing units in hermetically sealed assemblies are mounted at their respective positions. The indicating stations are located on the right wing of the plant control console.

Power for the area monitoring channels is obtained from the DC emergency power supply for reliability and continuity of service.

c. Air Particulate Monitoring

To monitor the plant area for airborne, radioactive, particulate matter, a mobile monitoring system is supplied. The assembly includes a filter assembly with shielding, a pumping and flow control system, a β-γ detector with ratemeter, recorder and alarm system. The unit monitors activity over a 3 decade (logarithmic) range as it is deposited on the filter paper. Adjustable filter paper advance speeds and adjustable pumping rates provide a wide range of operating conditions.

The alarm is adjustable and has two levels. The first is an alert indicated by an amber light and a 10 sec. audible alarm; the second a continuous alarm with a red light.

All units are mounted on a mobile cart. Power is obtained from a convenience outlet in the area where the monitor is located.

9. Plant Control Systems

The center for plant control is the plant control console, Figure 40.

a. Reactor Control

The reactor control equipment is placed directly in front of the operator as he sits facing the console. On the control board, the control rod drive actuators occupy a central position. The pistol grip switch at right center moves the manually controlled rods in or out; the switch at left center moves those rods which can be manually or automatically controlled. The rods to be moved are selected by the oval handled switches adjacent to the drive switches. Reactor parameters of flux, linear and logarithmic, water level, and period are indicated on the vertical panel above the control board. Selector switches adjacent to the meter permit each channel to be monitored.

Control rod positions are indicated by meters located above the reactor vessel display.

Automatic control of the reactor is accomplished by movement of the control rods in response to a pressure deviation signal from the P-Po measuring circuit. A motor controlled bypass valve around the turbine (to the condenser), provides a back-up plant control and enables the operator to accomodate large, programmed changes in power with a minimum of reactor adjustment. A pistol grip switch (not shown) located to the right of the manual rod control switch, is provided for operation of this valve from the console.

b. Process Control

The values of important process parameters are indicated on the control panel. The indicators are arranged in a graphic display for quick familiarity with the process.

Continuous control is provided for reactor steam pressure, reactor water level and condenser inlet air temperature. All controllers have provisions for an indication of the set point, an indication of controlled variable position and manual operation.

c. Secondary Electrical Control

A secondary control station for the generators control equipment is located on the panel face of the left wing of the console. Switches in the mimic bus arrangement provide for operation of the power breakers. Meters provide indication of power parameters in the various systems.

Below the switchgear panel is a motor control board. Duplicate starting stations at this point permit critical process motors to be started or stopped.

d. Plant Communications

The plant communications system consists of 1) an amplifier-master station at the console with remote-slave speakers distributed through the plant areas and living quarters and 2) a number of telephone stations. The telephone stations are capable of paging all speakers through the master station. A sound power phone circuit connects the control center to all plant machinery spaces.

Alarms are provided to transmit evacuation or fire alarms through the amplifier system regardless of cut off relay or volume control position.

e. Auxiliary Systems

A power totalizing system is provided on the right hand panel to provide a record of instantaneous plant power and integrated plant power.

An independent temperature monitoring system is provided for snow tunnel and other critical temperatures. The selector switch and readout meter are located on the right hand panel.

IV. REACTOR DESIGN

A. Summary of Design and Performance Characteristics

The PL-2 reactor is a natural circulation boiling water type with a power output of 8.0 Mw (t). It is designed to produce 24,724 lb/hr of dry steam at 600 psig. The reactor core is capable of producing a total energy output of 24 MW (t)-years over a lifetime of three full-power years.

The core for the PL-2 reactor is similar in design to the SL-1 Core II which is now being built. Core II will be installed in the SL-1 plant by midsummer of 1961. Operation of Core II should also verify the capability of this type of reactor for reaching the long life times which are needed for economical operation of remotely located plants.

In the PL-2 plant this type of core will operate at a pressure of 600 psig instead of the 400 psig to which the SL-1 plant is limited. The higher pressure operation in the PL-2 plant should enhance the behavior of the core.

Significant design characteristics and operating data of the PL-2 reactor are presented in Table IV.

B. Reactor Core

1. Nuclear and Thermal Behavior

a. Nuclear Characteristics

To meet present guidelines (Appendix A) the PL-2 plant requires a reactor that can operate at 8.0 megawatts (th) for a full power lifetime of three years. In addition the control rods must be capable of shutting down the reactor at 68° F with any rod stuck in its operating position, at 180° F with any rod fully withdrawn and at 39° F with all rods fully inserted. The 4.5 w/o U^{235} enrichment for PL-2 was based on the shutdown requirements. With this enrichment the core has the maximum reactivity which will still permit shutdown. Estimates of the eigenvalues for PL-2 at beginning of life are shown in Table V. These values are based on SL-1 Core II 400 psig data; detailed analysis of PL-2 at 600 psig must be done in the future.

TABLE IV

PL-2 REACTOR DATA

A. GENERAL

Power, MW	8.0
Core Lifetime, full power years (design value)	3
Maximum Burnup, MWd/metric ton of U (design value)	33,000
Average Burnup, MWd/metric ton of U	7,650
Steam Production, lb/hr	24,724
Operating Pressure, psig	600
Operating Temperature, ^{o}F	489
Feedwater Enthalpy, BTU/lb	134
Fuel Composition	UO_2
Fuel Enrichment, %	4.5
Fuel Loading Metric tons U	1.145

B. CORE

1. Geometry

Equivalent Core Diameter, Inches	35.46
Active Core Length, Inches	38.3
Number of Assemblies	24
Fuel Assembly Width, Inches (square)	5.592
Fuel Assembly Length, Inches	46.3
Element Spacing (Pitch), Inches	.732
Riser Height, Feet	3

2. Fuel Element

UO_2 Pellet Diameter, Inches	.420
UO_2 Pellet Density, gm/cm^3	10.30
Clad Material	AISI 348 SS .05 w/o Co
Clad Thickness, Inches	.020
Fuel Tube Inner Diameter, Inches	.428
Number of Fuel Elements Per Assembly	60
Number of Poison Rods Per Assembly	2
Number of Fuel Elements in Core	1440
Number of Poison Rods in Core	48
Burnable Poison, gm B^{10}	16.6

TABLE IV (Cont'd)

3. Control Rod

Number of Rods	9
Rod Type	Cruciform
Over-all Length, Inches	58 5/8
Over-all Span, Inches	11.44
Over-all Thickness, Inches	.25
Length of Travel, Inches	39.0
Absorber Material	Ag-In-Cd
Clad Material	AISI 348 SS .05 w/o Co
Length of Active Section, Inches	39 3/4
Span of Active Section, Inches	10.578
Thickness of Active Section, Inches	0.135

4. Thermal and Hydraulic Characteristics

Average Power Density, KW/liter of Active Core	13.3
Average Power Density, KW/liter of Coolant	26.6
Heat Transfer Area, ft^2	564
Average Heat Flux, BTU/hr-ft^2	48,400
Maximum Heat Flux, BTU/hr-ft^2	279,000
Burnout Heat Flux, BTU/hr-ft^2	1,000,000
Average Exit Quality, w/o Vapor	0.91
Average Boiling Length, Inches	32.97
Maximum Meat Temperature, °F (at 140%)	4930
Allowable Meat Temperature, °F	5000
Average Void Fraction, %	14.18
Downcomer Velocity, ft/sec	2.0
Stability Margin	2.6
Exit Void Fraction, Hot Assembly, %	25.21
Average Steam Release Rate, lb/hr-ft^2	1800

5. Nuclear Characteristics

Core Reactivity, Beginning of Core Life	k_{eff}
Cold, all rods out	1.141
Hot, zero power, all rods out	1.117
Hot, equilibrium Xe, full power, all rods out	1.081
68°F, center rod out	.9998

Power Peaking	
Gross Axial Factor, (beginning of life)	2.7
Radial x Local Factor, (beginning of life)	1.85
Over-all Peaking Factor, (beginning of life)	5.0
Over-all Burnup Peak, (lifetime average)	3.7
Integrated Fuel Element Factor, (lifetime average)	1.85

C. REACTOR VESSEL AND HEAD

Pressure Vessel and Head Over-all Height, Inches	225
Pressure Vessel Height Over Flange, Inches	181 5/16
Pressure Vessel O.D., Inches	54 5/8
Pressure Vessel I.D., Inches	52
Vessel Wall Thickness Excluding Cladding, Inches	1 1/8
Clad Thickness, Inches	3/16
Bolt Circle Diameter, Inches	62
Flexitallic Type Closure Seal, Mean Diameter, Inches	54 1/2
Head Type	2:1 Semi Elliptical, Integrally Reinforced
Head Thickness Excluding Cladding, Inches	2
Clad Thickness, Inches	3/16
Closure Studs (52)	1 1/2 - NC-8 with 1.250" Diameter Shank
Vessel Penetrations	
Feedwater Inlet Nozzle	2" Sch 80
Steam Outlet Nozzle	4" Sch 160
Purification Flow Nozzle	1 1/2" Sch 80
Head Penetrations	
Control Rod Extension Housings (9)	3" Sch 80
Level Control Nozzles (2)	4" Sch 80

D. STEAM DRYER

Type	Static, multiple screen
Position	Internal, attached to head
Height, Inches	15
Thickness Parallel to Flow, Inches	5 1/4
Number of Segments	6
Maximum Outlet Moisture, w/o	.10

E. CONTROL ROD DRIVE MECHANISM

Type	Electro Mechanical, Rack and Pinion
Stroke, Inches	39
Scram Actuator	Gravity
Speed, Normal, Inches/Minute	3
Speed, Scram	Initial 4.5 Inches in 0.3 sec.
Load Capacity, lbs.	Withdrawal - 225 Insertion - 450
Position Indication	Synchro - Pair with Digital Readout
Position Indication Accuracy, Inches	± 0.10

TABLE V

BEGINNING OF LIFE EIGENVALUES FOR

PL-2 AS EXTRAPOLATED FROM SL-1 CORE II

Condition	K_{eff}
Cold (68°F) Center Rod Out	.9998
Cold, All Rods Out	1.141
Hot, Zero Power	1.117
Hot Operating	1.081

The cold stuck rod eigenvalue appears to be marginal, but it is felt that the number is somewhat conservative. Further calculations will be needed to ascertain this conservatism.

The hot operating reactivity was calculated using a core average void fraction of 15%. This was based on thermal calculations using the beginning of life axial power distribution which is shown in Figure 72. There is considerable uncertainty in both the eigenvalue and the power distribution since iteration between the power and vapor distributions must still be carried out. The analysis of the lifetime behavior of the core at 600 psig remains to be done so that, at present, the ability of the core to meet the three year design lifetime has not been verified.

As shown in Figure 72, the axial power peaking factor at beginning of life with no xenon is 2.70. The combined radial and local factor with a uniform vapor distribution is 2.00. In general this factor is reduced by about 8% when the actual radial vapor distribution is taken into account resulting in a radial factor of 1.85. The overall peaking factor at beginning of life is therefore 5.0, with an uncertainty of ± 15%.

b. Thermal and Hydraulic Criteria

The thermal characteristics of PL-2 were selected to produce the required output of 8 thermal megawatts within the framework established by physical limitations of core materials. These limitations may be summarized as follows:

(1) The maximum local fuel burnup shall not exceed 33,000 Mwd/metric ton of U.

(2) The maximum fuel temperature shall not exceed 5,000° F at 140% of full power.

(3) The hottest fuel assembly shall be hydraulically stable up to 140% of full power.

(4) The internal pressure in the hottest fuel element shall not exceed 1000 psi at end of life.

(5) There shall be no steam entrainment in the downcomer. To prevent entrainment, the coolant velocity in the downcomer region is limited to a maximum of 2 feet per second.

(6) The moisture carryover in the steam shall not exceed 0.1% by weight.

(7) The maximum steady state heat flux must be less than 333,000 BTU/hr-ft^2 to provide a burnout ratio of 3 based on a burnout heat flux of 1,000,000 BTU/hr-ft^2.

In order to accomodate transients, the overpower scram is set at 135% of full power. Since the instrument error is ± 5%, the reactor could reach 140% of 8 Mw (t) before scramming. The core was therefore designed to operate safely for short periods of time at 140% of full power. It is for this reason that the fuel temperature and stability are determined at 140% of full power.

The downcomer velocity is limited to prevent steam entrainment. Steam in the downcomer decreases the density of the fluid, thus reducing the driving head. The reduced driving head increases the void fraction in the core, thus adversely affecting hydraulic stability and reducing core reactivity life. Experience has shown that if downcomer liquid velocity is below 2 feet per second, entrainment is negligible.

The reactor is assumed to be stable if the rate of change of inlet velocity to the hottest fuel assembly with respect to power level is positive. This is a conversative assumption since there are stable boiling water reactors which operate at power levels where this rate of change is negative and there are no boiling water reactors which are unstable where the rate of change is positive.

Moisture carryover is prevented by gravity fallout of water droplets in the steam dome and by a screen type steam dryer. The vessel height available for gravity fallout is limited by reactor space and weight considerations. For this reason, and because of the limited experimental and theoretical data available on gravity fallout, a screen dryer has been incorporated in the design. Maximum steam velocity through the dryer is limited to 6 feet per second and the moisture at the inlet must not exceed 10%.

c. Flow and Temperature Data

The centerline temperature in the fuel pellet is the saturation temperature of the water at maximum pressure, augmented by the temperature drop through the boiling film, tube wall, gas gap, and fuel. The temperature drop through the boiling film was calculated using the Jens and Lottes boiling film drop correlation. The other temperature drops were calculated by the standard heat conduction equations. The maximum temperature in the fuel is 4930° F which is within the limit. This is based on the following assumptions:

(1) The saturation temperature is 499° F, corresponding to a maximum reactor pressure of 660 psig.

(2) The thermal conductivity of UO_2 is 1.0 BTU/hr-ft-$^{\circ}$ F.

(3) The smallest pellet (0.4195 inch diameter) and the largest tube (0.4285 inch ID) are at the hottest spot in the core.

(4) Five percent of the gaseous fission products generated in the fuel have escaped into the gas gap.

(5) The total power peak is 5.75. This consists of a calculated peak of 5.00 plus 15% uncertainty in the nuclear calculations.

(6) The maximum instantaneous power is 1.4 times the steady state power of 8.0 Mw (t).

The best estimate of the burnup peak is 4.0 which yields a maximum burnup in the core of 30,800 MWD/Tonne. This burnup is slightly below the limit of 33,000 MWD/Tonne.

The fuel element internal pressure was calculated to be 940 psi. This calculation is based on the assumption that the largest pellet is in the smallest tube. The fission product gas release rate was assumed to be 30%. This is an extremely conservative estimate of the release rate and is assumed in the pressure calculation in order to eliminate any possibility of fuel element rupture due to internal pressure. In the pellet temperature calculation a release rate of 5% was assumed. This assumption is based on the fact that 5% is the maximum release rate observed for stoichiometric UO_2. This is a sufficiently conservative estimate for the temperature calculation, which is very conservative in other respects.

The maximum steady state heat flux was calculated to be 279,000 BTU/hr-ft^2 which is well below the allowable limit of 333,000 BTU/hr-ft^2.

Hydraulic calculations for the core were done by means of STREAC, and IBM-704 Code. The input to STREAC is the power level, pressure, steam rate, and pertinent core geometry such as core length, flow area, and hydraulic diameter. The code balances pressure losses due to friction, expansion and contraction against the pressure gain due to density differences between core and downcomer fluid. STREAC then determines the core flow rate, void fraction, void profiles, and flow rates for each typical fuel assembly.

The inlet velocity to the hottest fuel assembly does not peak until the reactor power level reaches 2.6 times the design power. Thus the reactor meets the hydraulic stability requirements.

Table VI is a summary of the core hydraulic characteristics. The subassembly numbering system used in the table is shown in Figure 71. The exit void fraction from the hottest assembly is 25.2% which is well below the maximum exit void fraction of 54.6% calculated for EBWR. This is a further indication that the PL-2 core is hydraulically stable.

TABLE VI

PL-2 HYDRAULIC CHARACTERISTICS

	Subassembly				Average Core
Parameter	1	2	3	4	
Radial Peaking Factor	1.471	1.176	0.856	0.660	1.000
Inlet Velocity	4.54	4.27	3.86	3.47	3.99
Boiling Length, in.	33.95	33.39	32.34	31.46	32.97
Exit Quality, %	1.35	1.08	0.79	0.62	0.91
Exit Void Fraction, %	25.21	22.03	18.16	15.41	19.83
Avg. Void Fraction, %	18.78	16.14	12.86	10.57	14.18

The downcomer velocity is 2.0 ft/second. Since steam entrainment in the downcomer does not become a problem until velocities somewhat greater than 2 feet per second are reached, there should be solid water in the downcomer.

d. Hydraulic Experiments

To determine the validity of the analytical model assumed in the hydraulic design, a half-scale air-water model of the reactor has been built and tested. This model has shown that steam entrainment at atmospheric pressure and 70° F will occur with downcomer velocities as low as .4 ft/second. The amount of entrainment decreases very sharply with increasing temperature. It appears that there will be no appreciable entrainment in the PL-1 and PL-2. However, the effect of pressure on entrainment has not been determined as yet.

For conservatism the PL-2 design is based on a total loss coefficient which is higher than the theoretical prediction. This loss coefficient is based on extrapolation from the air-water model, which indicates that the region between the top of the core and the steam-water interface is extremely turbulent.

Further tests are required to determine the following:

(1) The differences, if any, between air-in-water and steam-in-water.

(2) The effect of introducing vapor at the bottom of the core rather than along the length of the core.

(3) The effect of cold water quenching on steam entrainment.

(4) The variation of entrainment with pressure.

(5) Slip ratio in two phase flow around tubular elements.

2. Fuel Assembly Design

Each of the 24 PL- fuel assemblies is composed of 60 fuel elements, 2 poison rods, two end plates, ferrule type lattice spacers and fixtures for lifting and guiding the assembly. The fuel assembly is approximately square in cross section and is graphically represented in Figure 13. Typical fuel element and poison rod assemblies are shown in Figure 10.

The fuel element consists of a column of uranium dioxide fuel pellets hermetically sealed in a helium atmosphere, in a tube with two welded-on end caps. The fuel pellets are .420 inches in diameter and .776 inches in length. The fuel tubes are low cobalt type 348 stainless steel with an internal diameter of .428 inch, a wall thickness of .020 inch and a length of 39.3 inches. An initial cold clearance of .006 inch on the diameter and 1.00 inches on the length has been established in order to minimize the hot gap size and yet prevent an interference fit between hottest pellets and the cladding. This clearance space also serves to contain the fission gas products released from the fuel over lifetime.

The two burnable poison rods are provided for power peak suppression and reactivity shaping. Each rod consists of a borated stainless steel material encased in a stainless steel tube similar to the fuel element tubes.

A group of 60 fuel elements and 2 poison rods are held in position by two end plates. The fuel elements are pin connected at each end. The poison rods are suspended from two opposite corners of the top plate by hanger bolts, and are pin connected at the lower end. Additional lateral support of the assembly is gained through the use of two sets of intermediate ferrule spacers. The sets of ferrules are arranged in parallel planes equidistant from each other and the end plates. Integral with the top plate is a lifting fixture. Two installation guides are attached under the bottom plate to provide additional lead-in during core assembly. The lifting fixture and installation guides are welded in place after the fuel elements and ferrules are brazed in one operation into an assembly. All twenty-four assemblies are identical for uniform fabrication procedures and ease of handling.

3. Control Rod Blade

The PL-2 reactor will have nine control rods of the basic design illustrated in Figure 12. This design fulfills the following control rod requirements:

(1) Adequate corrosion resistance.

(2) Adequate physics worth.

(3) Metallurgical stability under irradiation.

(4) Adequate mechanical strength and ductility.

(5) Use of readily available materials.

The neutron absorbing material used is an alloy consisting of 80% silver, 15% indium and 5% cadmium. A thin nickel plate assures that the material will not be subject to corrosion, even under the worst possible operating conditions. Because of the low creep strength of this material, a welded sheath of type 348 stainless steel is required to provide sufficient mechanical strength and structural rigidity. This sheath is composed of a "picture frame" type structure to which are welded four pre-formed right angle sections. The structure is given increased rigidity by joining the sheath sections together through the active filler plates.

The threaded male connector at the top of the control rod provides a simple means of remotely engaging and disengaging the control rod drive mechanism extension shaft. The cruciform configuration of this connector is required to provide adequate clearance for fuel assembly removal or insertion. The thread fit makes the joint sufficiently flexible to compensate for small misalignments between the core and the closure head.

During manufacturing, the blade will be held within a fixed envelope over its full length. This envelope is such that binding of the blade during operation, because of possible misalignments in the core, is impossible. Small guide pads at the bottom of the blade allow the use of wide channels in the stanchions while maintaining the required clearance between the control rod and adjacent fuel tubes.

4. Core Structure

The core structure (Figure 9) in the PL-2 reactor was designed to meet the following requirements:

(1) The fuel assemblies must be securely supported and accurately located.

(2) Accurately located and aligned channels must be provided for the control rod blades.

(3) The downcomer region must be physically separated from the steam riser region.

(4) A source must be positioned at the core mid-plate.

Figures 15, 16 and 17 show a half-scale model of the core structure.

The major structural member is the cast stainless steel lower grid.

Supported by four gusset plates protruding from the wall of the pressure vessel, this lower grid is able to rigidly support the full weight of the fuel and remaining core structure. Location of the 24 fuel assemblies is provided by the vertical stanchions fastened to the lower grid. The upper grid is a welded structure which rests on, and is pinned into, each of the vertical stanchions. In this manner, the upper grid accurately locates the upper ends of the stanchions, and stiffens the core structure by providing lateral support for the stanchions.

In order to separate the fuel from the downcomer, a lower core shroud is provided. This shroud consists of stainless steel sheet sections welded to the outer stanchions. Separation of the steam riser region from the downcomer region is accomplished by the upper core shroud. This shroud, formed from stainless steel plate stiffened by flanges, bolts to the upper grid. The feedwater spray ring is supported by this shroud.

A source pipe extends down from the upper grid, to which it is fastened, into the downcomer region. This pipe positions the source at the core midplane. Due to its position in the downcomer, the source will be provided with ample cooling.

Each fuel assembly, supported from its top plate which rests on the top of two stanchions, is laterally positioned at the top by the upper grid and at the bottom by the stanchions. The nine control rods move vertically in guide channels formed by the upper grid and slots in the stanchions.

Positioning of the core structure in the pressure vessel is accomplished by means of two alignment pins in the lower grid which fit into holes in two of the gusset plates supporting the structure. Two holddown bolts securely fasten the grid to the remaining two gusset plates.

In order to avoid excessive thermal stresses in the pressure vessel walls due to gamma heating, a thermal shield is positioned in the pressure vessel at the core elevation. This thermal shield is a 3/4 inch thick stainless steel cylinder supported and located by the same gusset plates that support the core.

5. Neutron Source Design

An antimony-beryllium photoneutron source of approximately 1.6×10^7 neutron/second output is provided for use during reactor start-up operations. The antimony-beryllium type of source has been selected in preference to other suitable source types because the antimony-beryllium uniquely combines a relatively long half-life (60 days) with low cost and high yield. This source is especially suitable for reactor applications, since it can be designed as a semi-permanent part of the reactor, being constantly reactivated by the neutron flux in the reactor.

The preliminary design consists of a natural antimony cylinder 1/2 inch in diameter and 6 1/2 inches long surrounded by a hollow cylinder of beryllium with an outside diameter of 1 1/2 inches. These two components are then encapsulated in a stainless steel container. The source capsule will be designed to fit in a support structure attached to the reactor core upper grid. In this position the source would be close to the core and would be located such that the nuclear instruments essentially read core reactivity.

Since the source decays out-of-pile, the strength of a new source will have a contingency factor to compensate for possible delays in reactor start-up. The contingency factor will be adjustment in source output which will allow a maximum delay period of 6 months.

6. Core Servicing

a. New Core Shipping

1) Fuel Elements

The fuel element complement will be shipped to the site in the spent fuel shipping casks. Figure 20 shows the cask and Figure 21 shows the cask prepared for shipment.

2) Control Rods

The control rod blade assemblies will be shipped to the site in the spent fuel shipping casks with the fuel assemblies. This compact arrangement permits a cask, three blade assemblies, and eight fuel assemblies to be shipped as a single package.

3) Source

The source will be transported in its own individual lead pig. Pool facilities at the site will be used to transfer the source from its shipping container to the transfer cask.

b. Refueling Procedure

1) Transfer Cask

The transfer cask, Figure 22, is used to individually transfer a control rod, a fuel assembly, and the source. To remove a spent fuel assembly or control rod, the transfer cask is positioned over the appropriate hole in the refueling plate assembly. The particular hole is determined by the component to be removed. Locating the cask centrally over the plate opening automatically positions it for a direct vertical lift. The lift is accomplished by a rack and pinion mechanism attached to the top of the cask. One end of the rack extends out the top of the cask and the opposite end, to which a screw type gripper is permanently attached, is within the cask. The rack is made in sections so that overhead clearance is not critical. The entire lifting mechanism can be rotated in either direction to enable the gripper to engage or disengage an object, and to permit full use of 360° alignment.

A typical transfer procedure is as follows:

(a) Flood the vessel.

(b) Remove the vessel head.

(c) Install alignment ring and refueling plate.

(d) Position transfer cask on refueling plate.

(e) Lower gripper and engage fuel element (or control rod).

(f) Retract element into cask.

(g) Move cask to spent fuel pit.

(h) Submerge cask, lower fuel into pit, and disengage element.

(i) Retract gripper and remove cask.

(j) Using manual tools, insert element in spent fuel storage container.

(k) Repeat items (d) through (j) for removal of each assembly.

The spent fuel storage container (Figure 3) is approximately 14 feet below the surface of the water in the spent fuel pit. It is a rack type container providing storage for 24 spent fuel elements and 9 control rods, and is designed to be subcritical at 4°C, fully loaded, with no specific loading sequence required.

Following item (k) above, new assemblies are inserted into the reactor through the refueling plate openings, one at a time, using manual tools. The transfer cask is used for replacement of irradiated assemblies. The refueling plate and ring are removed, the head replaced, water level corrected, and preparations for startup are carried out.

2) Refueling Plate Assembly

The refueling plate assembly, Figure 23, serves as a transfer cask support and positioner, and as a shield when removing irradiated components.

An alignment ring fits on the core barrel flange, using bullet nose pins in the flange guide holes for positioning.

Its purpose is to protect the barrel flange surface. The support plate rests on the alignment ring and can be positioned on or at 90° intervals from the core centerline. The overhead crane is used to rotate the plate, which is held in position by an index pin and matched holes in the alignment ring.

The plugs in the plate are removable and also can be indexed at 90° intervals. The plate-hole index combination permits all fuel assemblies, and all control rod blade assemblies except the central assembly, to be accessible through a hole in the refueling plate. Further, the centerlines of these components and the centerlines of the respective holes above them coincide, and, therefore, a transfer cask centered over a particular refueling plate opening is also centered over a particular component in the reactor. To remove the center blade assembly, manual tools transfer it to an adjacent blade location so that it is in position for a vertical lift. The control rod is then removed as described in paragraph 1 above.

3) Shipping Cask

The spent fuel shipping cask, Figure 20, will be used to ship eight fuel assemblies and three control rod blade assemblies. The loading operation is completed underwater in the spent fuel well using hand tools to transfer components from the storage container to the shipping cask. The cask cover is bolted in place, the sealed container is removed from the spent fuel well, and is prepared for shipment as shown in Figure 21. The site complement consists of three fuel shipping casks to handle a full core loading of twenty-four fuel elements and nine control rod blade assemblies.

C. Control Rod Drive Mechanism Design

1. Description

The control rod drive mechanism is an electro-mechanical device which utilizes a rack and pinion combination to achieve controlled linear motion of a control rod in response to operating signals from the reactor control system. The design is basically a modification of the existing SL-1 drive mechanism. The modification was undertaken to produce a simpler and more reliable mechanism by incorporating those design features of the SL-1 mechanisms that have proven successful and modifying the design features that have been problem areas.

Through use of gearing combinations, the mechanism is capable of being driven at fixed speeds in the range from 1 to 7 inches per minute. The mechanism will satisfy the scram requirement of dropping the rod through its first 4.5 inches of travel in 0.3 seconds from any position of withdrawal.

A position indication system is furnished which provides positive indication of the rod position within ± 0.100 inches throughout the full range of rod travel.

2. Actuator Design

The design of the mechanism actuator is shown in Figure 11. Each control rod in the reactor is mechanically coupled to a drive mechanism by means of a tubular extension shaft. The upper end of this extension shaft is connected to the hollow rack shaft by means of a connector bolt which passes through the rack shaft and screws into the end of the extension shaft. Relative rotation of the extension shaft and rack shaft is prevented by a spline. The rack and extension shafts pass through a stellite bushing at the lower end of the housing extension sleeve. This bushing serves the dual purpose of controlling the lateral position of the shafts, and the rate of flow of cooling water through the mechanism. The housing extension sleeves are seated in the control rod drive nozzles on the vessel closure head.

The pinion housing, which contains the pinion, back-up roller, and associated shafting and bearings, is bolted to the control rod drive nozzle. The rack passes up into this housing and is held in engagement with the pinion by the back-up roller. A circular shoulder at the top of the rack shaft, in combination with the removable hard stop, provides positive stoppage of the control rod at the end of the scram. Ball bearings on the pinion shaft accurately locate the pinion and allow rotation with a minimum of the friction.

The seal assembly is connected to the pinion housing by a bolted flange. The seal shaft is connected to the pinion shaft by means of a tongue and groove arrangement which prevents the introduction of any loads into the seal assembly. The seal is a floating ring, controlled leakage type, thus allowing a direct mechanical drive into the mechanism. Cool, purified reactor feedwater is introduced into the seal housing inboard of the seal. Approximately 10% of this flow leaks through the seal and is then collected and returned to the feedwater system at 10 psia. The remainder of the feedwater flows through the actuator into the reactor to provide cooling and lubrication of the actuator components.

An upper housing, which is bolted to the flange at the top of the pinion housing, completes the actuator assembly.

3. Drive Package Design

The design of the mechanism drive package is essentially the same as that of the present SL-1 drive unit. The drive package is designed to be mounted outside the reactor shielding as shown in Figure 2. This method of mounting in a region of low ambient temperature and radiation level allows the use of conventional components and facilitates maintenance. Each actuator is connected to its drive package by a shaft which passes through the shielding. Flexible couplings at each end of the shaft compensate for possible actuator-drive package misalignment. The drive package consists of a drive motor, clutch assembly, and position indication equipment.

The drive motor is a commercial, three-phase motor with integral reduction gearing. An integral friction type brake is incorporated in the motor to prevent coasting and consequent over-travel of the rods in operation. The motor is coupled to the clutch assembly by a quick change gear set. A shear pin is incorporated to limit the torque that the motor can transmit to the remainder of the system. It also prevents possible motor failure due to stalling which might result if the limit switch failed to de-energize the motor when the rods were driven to full insertion.

The clutch assembly consists of a magnetic clutch paralled with a cam type over-running clutch, the latter operating in the "rod-in" direction only. During normal operation, the magnetic clutch is energized to allow the motor to drive the control rod or to hold it in a fixed position. During scram, the clutch is de-energized, so that the control rod can drop into the core. As long as the control rod drops at a higher than normal operating speed, the over-running clutch rotates freely. If the rod should stop for any reason, the over-running clutch allows the motor to drive the rod into full insertion. Because of the high torque capacity of the over-running clutch, the drive package can exert a drive-in torque equal to 3 times the normal running torque.

The position indication system used with this mechanism consists of a high accuracy synchro-pair and associated readout equipment. The synchro-transmitter is mounted on the drive package. To prevent any ambiguity of the position indication signal, the synchro rotation is held to less than one revolution for full rod travel. A rotary cam type limit switch is used to provide "rod-in" and "rod-out" signals and to de-energize the drive motor at either limit of rod travel.

D. Reactor Vessel Assembly

1. General Description

The reactor vessel assembly, as pictured in Figure 8, consists of a cylindrical vessel, a welded ellipsoidal lower head, and an ellipsoidal flanged closure head.

An integral steam dryer is mounted in the closure head cavity. A shield can is mounted on the closure to hold a mixture of radiation shielding and thermal insulation. Four pads are located in the bottom head of the vessel to provide the main core support.

Three penetrations are provided in the pressure vessel for a feedwater inlet, a steam outlet, and a purification outlet line. The closure head is provided with 9 control rod mechanism nozzles and 2 water level control nozzles.

Both vessel and head are designed in accordance with the ASME Unfired Pressure Vessel Code, Section VIII, 1959 edition, and with the nuclear addenda as published in "Mechanical Engineering", July, 1959. Design pressure and temperature for items governed by the Code are 720 psig and 600° F, respectively.

The specific design of the vessel and head have been calculated using SA212B carbon steel clad with AISI 304L stainless. However, effort is being expended on the uses of other suitable materials such as stainless steel and inconel. The general configuration of the vessel and its installation are not affected by changes in vessel materials.

2. Vessel and Head Design

a. Reactor Pressure Vessel

The vessel is a simple cylinder, 52 inches inside diameter, fabricated of SA212B boiler plate, 1 1/8 inches thick. It is clad with 3/16 inches AISI 304L stainless steel for corrosion resistance. The bottom head is a 2:1 ellipse welded to the cylinder at the tangent point of the head. The bottom head is also 1 1/8 inches thick, clad with 3/16 inches of stainless cladding.

The flange of the pressure vessel is a weld-neck flange forging of SA-105 Gr II low alloy steel. The flange has tapped holes for fifty-two 1 1/2 inch diameter 8 threads per inch, studs and a double groove for placement of a stainless steel, spiral-wound, asbestos filled inner gasket, and a soft metallic outer gasket. Between the gasket grooves, a leak-off drain is provided to collect any possible seepage of reactor coolant.

Three penetrations are provided in the side wall of the vessel. These are:

(1) Carbon steel (SA-212B) main steam outlet nozzle with a stainless steel (AISI 304) transition piece and bolting flange for field connection to the main steam piping. The nozzle is designed to connect to 4 inch schedule 80 stainless steel pipe.

(2) Stainless steel (AISI 304) feedwater nozzle. This nozzle is of the double wall type. A long nozzle is welded directly to the vessel wall, and the continuous feed pipe is welded inside the nozzle. This design prevents thermal shock of the vessel wall. The feedwater nozzle is designed to accomodate a 2 inch schedule 80 stainless steel feedwater pipe.

(3) Stainless steel (AISI 304) purification nozzle. This pipe serves as a line through which a portion of reactor coolant is circulated through the purification system continuously to remove radioactive contaminents from the main plant system. A 1 1/2 inch schedule 80 stainless pipe is welded by transition metal directly into the vessel wall.

All piping penetrations meet the ASME Code requirement of full reinforcement for primary vessel penetrations.

Four stainless steel (AISI 304) core support pads are mounted in the bottom head of the vessel for the purpose of supporting and aligning the core and for supporting the thermal shield.

b. Vessel Head

The closure head assembly (Figure 14) utilizes a standard semi-ellipsoidal head fabricated from SA-212B boiler plate and clad on the inner surface with AISI 304L stainless steel. The head flange is a SA-105 Gr II forged bolting flange clad with 304L stainless steel. Head thickness is 2 inches throughout except for the bolting flange which has a varying contour. All clad surfaces have a minimum 3/16 inches of stainless steel except the sealing surface of the head flange which has a minimum 1/2 inch of cladding.

Head penetrations consist of 11 welded nozzles as follows:

Nine, 3 inch (Nominal) Control Rod Drive Nozzles

Two, 4 inch (Nominal) Level Control Nozzles

The center control rod drive nozzle flange is 8 inches higher than the others to meet control rod drive mechanism installation requirements.

All nozzles terminate with bolted flanges at the upper end. Sealing is obtained by spiral-wound stainless steel, asbestos-filled gaskets. All nozzle flanges are standard, AISI 304 stainless steel 600 lb. welding neck flanges.

Three lifting lugs, made from structural "TEE" beams, are welded to the head 120° F apart. Each lug has been designed to sustain the total closure head assembly weight under a 5 "G" shock loading.

A cylindrical shielding container is formed by welding 3 curved plates circumferentially to the outside diameter of the ellipsoidal head, and longitudinally to the lifting lug flanges. The cylinder thus formed is approximately 56 3/8 inches ID by 26 inches long. A flat, perforated circular plate bolted to the upper end covers the cylindrical container, allowing the nozzle flanges to protrude through the perforations.

3. Integral Steam Dryer Design

The steam dryer shown in the closure head assembly drawing Figure 14, is installed inside the closure head dome. The dryer is fabricated entirely of type 304 stainless steel materials. Steam drying takes place as the steam flows radially inward through an annular arrangement of 6 dryer cartridges. A baffle directs the steam from the center region to a steam outlet adapter which delivers it to the pressure vessel main steam outlet.

Each dryer cartridge consists of eleven alternate layers of flat and corrugated wire screen contained in a 4 sided frame. The inner and outer screens are flat, 2 1/2 mesh, 0.135 inch diameter wire. The sandwiched screening is 6 mesh, 0.047 inch diameter wire.

The cartridges are welded into the dryer support structure which in turn is bolted to a ring on the concave portion of the head. The dryer support structure contains a top plate and a bottom plate, both conically sloped to provide for water drainage. The top and bottom plates are connected by eight 3 1/4 inch OD tubes. These tubes provide passage through the structure for the control rod extension shafts.

Passage for water level control equipment is provided by holes cut through the structure in line with the corresponding head penetration. To provide passage through the entire length of the structure, screen area is removed and replaced by baffle plates which are welded to the top and bottom plates.

4. Arrangement of Vessel Internals

In addition to the 4 core support pads previously described, the vessel contains the main steam transfer duct, the vertical leg of the feedwater pipe, and the feedwater ring.

The steam transfer duct is flanged at its lower end for bolting to a boss on the inside wall of the pressure vessel. At its upper end is a spring loaded flange which mates with a flange in the steam dryer support structure when the head is in place. The transfer duct is the carrier for dry steam away from the dryer and out of the vessel into the main system piping.

The feed piping, after penetrating the vessel wall is bent at a 90° angle to form a free standing pipe which is connected to the feedwater ring. The feedwater ring rests on brackets which are welded to the upper shroud of the core support structure. Since the ring is not rigidly attached to the brackets, differential thermal expansions can be tolerated.

APPENDIX A

PL-2 GUIDELINES (REV 1 of June 1, 1960)

I. General Requirements and Objectives

Essentially, the PL-2 shall be a factory pre-packaged modular nuclear power plant to provide heat and electricity. The plant shall be:

a. Factory assembled into air-transportable packages suitable for rapid on-site installation and interconnection, and suitable for expeditious relocations to alternate operating sites at minimum installed and capital costs.

b. Designed such that all components and accessories shall be located in an easily accessible position for operation and maintenance. Each component shall be accessible without the movement of any other component, where practicable. Maintenance and adjustments shall be made readily utilizing conventional, general-purpose tools normally associated with items of this nautre, and with minimum drainage requirements. Plant maintenance requirements shall be held to a minimum. Predictable maintenance shall be accomplished with a minimum number of operating and maintenance personnel.

c. Designed to insure adequate safety to personnel and equipment.

d. Designed in accord with the National Bureau of Standards health and safety regulations and requirements.

II. Power Plant Requirements

The PL-2 nuclear power plant shall be designed, fabricated and erected to meet the following requirements:

1. The plant shall produce and deliver a minimum of 800 KWe (net electrical power) and 1,300,000 BTU/HR suitable for central heating at the designated site.

2. The plant shall be safe to operate and service.

3. The plant shall be designed for factory assembly into packages which will facilitate transportation, erection and interconnection at minimum installed costs.

4. The plant shall be capable of satisfactory operation as an independent power source and satisfactory operation in parallel with electrical and heating facilities at the operating site. No distribution equipment shall be provided to tie in with electrical and heating facilities at the operating site.

5. The plant shall operate at design output with cycle heat (all cooling requirements) being rejected to the atmosphere under the following three (3) conditions:

a. Temperature........................$60^oF + 70^oF$
Altitude...........................Sea Level
Wind...............................0 mph
Humidity...........................0%
Precipitation......................0 in.
Sunlight...........................Full

b. Temperature........................*
Altitude...........................*
Wind...............................0 mph
Humidity...........................0%
Precipitation......................0 in.
Sunlight...........................Full
*Station A

c. Temperature........................**
Altitude...........................**
Wind...............................0 mph
Humidity...........................0%
Precipitation......................0 in.
Sunlight...........................Full
**Station B

6. The generator(s) output voltage characteristics shall be 2400/4160 volts, 3 phase, 60 cycle and 4 wire. The generator(s) shall permit external connection to delta or grounded wye.

7. The heat source for power production shall be a nuclear reactor designed to operate the plant for a minimum of one year or integral years thereafter at 100% rated capacity. The plant shall be capable of startup within 24 hours after plant shutdown from extended power operation.

8. The overall plant shall be capable of continuous operation for the maximum period of time; i.e., total downtime per year shall be minimized and not exceed three (3) weeks. The specified three (3) weeks downtime per year shall include annual maintenance and complete core replacement within four (4) days from shutdown to "on-the-line" operation at rated output.

9. Major plant components, including reactor vessel and heat but excluding core components, shall be designed for a useful life of 20 years under conditions of normal use and maintenance.

10. Each factory-assembled package or module shall be designed and fabricated with a rigid base to facilitate shipment, erection, and relocation.

11. The physical layout of the plant and the equipment arrangement within each package shall facilitate plant operation and maintenance.

12. The plant shall be contained in the fewest practicable number of packages suitable for air transport by C-130A type aircraft over a range of 1000 miles under standard operating loads. Each package, complete with all shipping appurtenances, shall conform to the cargo requirements of this aircraft.

13. The packages with all shipping appurtenances shall also be designed, so far as practicable, for transport by rail, ship, and military ground transport vehicles; such as a trailer, flatbed, 40 feet long.

14. The design of the plant shall be such that field erection to a fully operating condition at a remote site is practicable in the minimum period of time, not to exceed three (3) months. Installed facilities (foundations, off-site utilities, vapor container, if required, etc.) shall be erected during the plant erection period indicated above.

15. The heat source shall be a heterogeneous boiling light water cooled and moderated reactor using enriched uranium.

16. The reactor shall have inherent safety characteristics under all conditions of startup and power operation; i.e., negative temperature and void coefficients, etc.

17. The reactor shall have the minimum number of control rods consistent with the core design. The rods shall be capable of shutting down and holding down the reactor at any time of core life at any temperature from operating to ambient if all rods are operative. If any one rod becomes immovable in its normal operating position, the remaining rods shall be capable of shutting down and holding down the reactor at any time of life at any temperature from operating to ambient air temperature (70°F). Further, if any one rod becomes immovable in its full out position, the remaining rods shall be capable of shutting down and hold down the reactor at any time of life at any temperature from operating to 180°F.

18. The plant shall incorporate the following:

a. System design to provide steam of such quality that negligible moisture carryover into the turbine inlet shall occur during any plant transinet or during steady state operations.

b. Proper safeguards to protect all equipment and components of the plant.

c. Minimum requirements for make up water.

19. An emergency batter chargeable by the turbine-generator as well as by the diesel backup generator(s) shall be provided to supply power to operate essential lighting, instrumentation, recorders, valves, and other vital equipment for a period of time adequate for plant safety following loss of station electrical power.

20. The design shall provide auxiliary power to allow plant start-up from the cold shutdown conditions.

21. The plant controls and console arrangement shall conform to meet the following requirements:

a. Operable by one (1) man during normal operation.

b. Minimum operator fatigue.

c. Instrumentation and control sufficient for manual control of the integrated plant and conspicuously displayed.

d. Malfunctions and abnormal conditions which could have a serious effect on plant operation shall be indicated both visible and audibly at the control panel. "Test", "Reset", and "Acknowledge" controls for the annunciator shall be located on the control console.

22. Instrumentation and control systems shall be as simple as possible consistent with reliability and accuracy. Semi-conductors, magnetic amplifiers, and other high reliability components shall preferably be used wherever possible. Relays and vacuum tubes shall be avoided where possible in favor of more reliable components such as those mentioned above.

23. (Deleted)

24. Neutron flux instrumentation must record flux and indicate reactor period from source level upward to 1.5 maximum design flux. Positive overlap of at least one decade must be provided between channels for flux measurement.

25. The contractor shall make recommendations on the following aspects of fuel handling and storage:

a. Storage of replacement core prior to utilization.

b. Spent fuel storage facility.

c. Practicable method of removing spent fuel from the core and placing them in storage facility.

d. Practicable method of removing spent fuel from storage facility, placing it in a shippingcontainer and removing it for shipment during reactor operation.

e. Spent fuel element transfer cask which shall permit air-transport of the maximum number of spent fuel elements from the plant site to a reprocessing plant.

26. Shielding shall be such that operating crews working an 84 hour week under routine conditions shall not receive radiation exposures greater than the maximum permissible limits (Ref. NBS Handbook 69 dated June 5, 1959).

27. Fixed radiation monitoring equipment shall be provided in pertinent areas of the plant. Immediate indication of a radiation level above normal and its locations shall be made in the control area. An automatic, fail safe, battery-operated evacuation warning system shall be provided.

28. Adequate health physics facilities shall be provided to include monitoring equipment, special clothing, etc. Also, the plant shall include provisions for facilitating decontamination of personnel, equipment and areas subject to radioactive spills or leaks.

29. The plant shall include provisions for monitoring and safe controlled disposal of radioactive solid, liquid and gaseous wastes. Provisions shall be included for draining and storing all primary coolant and additional storage as may be necessary for other radioactive wastes.

30. The plant equipment where applicable shall be equipped with the necessary drains, vents, hand or man holes, etc., to facilitate inspection, maintenance and decontamination.

31. All piping and electrical connections between packages shall be designed for quick connection and disconnection, insofar as practicable.

32. Heating facilities shall be provided to prevent freezing of process fluids and to permit useful occupancy of the plant by personnel during plant shutdowns.

33. A recommended method for relocating the plant after extended power operation shall be submitted by the contractor for review by the AEC.

34. The design shall be accomplished to meet the following enviornmental conditions and climatic forces.

Wind Load........................125 knots
Temperature Range................-125°F to 70°F
Snow Load........................40 lbs/ft²
Ice Thnickness...................2 inches
Drift............................Height of structure

35. Means shall be provided to inject a chemical poison into the reactor without power, in sufficient quantity to maintain the core subcritical at cold conditions with inoperative rods.

III. Power Plant Objectives

1. The turbine-generator electrical specifications shall be:

Capacity:	Turbine-generator capability shall be sufficient to insure at least 800 KW(e) net power.
Voltage:	2400/4160 volts
Phase and Freq:	3 phase, 60 cycle
Connection:	External, to permit delta or 4 wire wye
Power Factor:	0.8
Steady State Voltage:	Plus or minus .5%
Steady State Freq:	Plus or minus .25%
Transient Voltage:	Maximum variation not to exceed ± 2% in the range between 10% and 120% of rated station load when subjected to an instantaneous station load change of 30% at 0.8 power factor.
Transient Freq:	Maximum variation not to exceed ± 2% in the range between 10% and 120% of rated station load when subjected to an instantaneous station load change of 30% at 0.8 power factor.
Recovery Time from Transient to Steady State Conditions:	Voltage 1.5 seconds Frequency 5 seconds

Parallel Operations:	Capable of paralleling
Deviation Factor: (line to line volt)	From no load to balanced full load 5%
RMS value of all harmonics:	5% (at full rated load)
RMS value of any one harmonic:	2% (at full rated load)
Plant Factor:	0.7
Overload:	200 KW at .8 P.F. continuously

2. (Deleted)

3. Control systems shall be designed such that any single error by an operator does not result in physical damage of consequence to the overall plant.

4. The contractor shall consider the consequence of a fission product release (viz: ruptured fuel element) on the safe operation and maintenance of the overall plant.

5. The plant shall be capable of startup with a maximum of two(2) men.

6. (Deleted)

7. Field strength welds shall not be permitted at the erection site.

8. The reactor shall be capable of producing 50% power with the most valuable rod immovable in the fully inserted position.

APPENDIX B

WEIGHT REPORT

Breakdown of the "per box" weight estimates sued to arrive at the "per load" totals for each of the eighteen C130A loads summarized in section III.A.4.a, is as follows:

Box 1	Load 1	Wt. (lbs.)
Feed and Condensate Skid (Figure 29)		
Skid and Support Members		
12 WF 27, 66 ft.		1,582
10 WF 21, 44 ft.		924
10 U 20, 74 ft.		1,480
8 WF 17, 19 ft.		323
8 U 19, 32 ft.		608
8 I 19, 6 ft.		114
7 U 10, 2 ft.		20
4x4 I 13, 6 ft.		78
4" Pipe 15, 40 ft.		600
3 I 8, 8 ft.		64
2 L 4, 150 ft.		600
1/4" BP, 24 sq. ft.		290
1/4" BP, Lo-Pressure Drain Tank Saddle		102
1/4" BP, After-Condenser Saddle		40
1/4" BP, Pre-Cooler Saddle		40
1/4" BP, Hot-Well Saddle		132
1/8" Weld Rod, 2000 ft.		25
Misc. Gussets, Clips, Angles, Fasteners, Shims		200
Total Skid and Support		7,222
Components and Piping		
Feed Pump, 2 req'd @ 3000 ea.(pump motors on Load 18)		6,000
Reserve Feed Tank		1,000
Hotwell		800
Condensate Pump, 2 req'd @ 250 ea.		500
Plant Heating Pump, 2 req'd @ 140 ea.		280
Makeup Pump		70
Lo-Pressure Drain Pump, 2 req'd @ 110 ea.		220
Makeup Tank		250
Lo-Pressure Drain Tank		600
Raw Water Demineralizer		750
Lube-Oil Intercooler		806
Space Heat Exchanger		807
After Condenser		1,010
Pre-Cooler		1,220
Condensate Control		500
Feed Water Control Valve		500
Duplex Drain Controller and Trap		125

Box 1 - Load 1 (Cont'd)

	Wt. (lbs.)
Components and Piping (Cont'd)	
Steam Traps, 3 req'd @ 42 ea.	126
1/2" Valves (average), 35 req'd @ 23 ea.	805
2" Valves (average), 35 req'd @ 56 ea.	1,960
1/2" Piping (average) 200 ft. @ .851 lbs/ft.	170
2" Piping (average) 200 ft. @ 3.653 lbs/ft.	731
Total Components and Piping	19,230
Electrical	
Feed Pumps Motor Starter Center	800
Starter Boxes, 5 req'd @ 21 ea.	105
Push Button Boxes, 9 req'd @ 5 ea.	45
Electrical Disconnects, 10 req'd @ 2 ea.	20
4x4 Wireway, 40 ft. @ 3.5 lbs/ft.	140
6x6 Wireway, 40 ft. @ 5.5 lbs/ft.	220
Wiring	300
Total Electrical	1,630
Pack and Ship	1,732
Total Feed and Condensate Skid	29,814
Total Box 1	29,814
Total Load 1	29,814

Box 2 Load 2

Purification Skid (Figure 27)

Skid and Support Members	
12 WF 27, 28 ft.	756
8 WF 24, 62 ft.	1,488
4 U 7.2, 1.5 ft.	11
Clips, 4 req'd @ 3 ea.	12
4 I 13, 7 ft.	100
Purification Saddles, 2 req'd @ 30 ft.	60
4 U 5.4, 4 ft.	22
2 L 4.6, 6 ft.	28
Disposal Tank Cradle, 2 req'd @ 110 ft.	220
Miscellaneous Bolting, Gussets, Angles, Fasteners, Shims	75
Welds	50
Total Skid and Support Members	2,822
Components and Piping	
Evaporator	1,162
Demineralizer, 2 req'd @ 7800 ea.	15,600
First Stage Heat Exchanger	150
Second Stage Heat Exchanger	300

Box 2 - Load 2	Wt. (lbs.)
Components and Piping (Cont'd)	
Spent Fuel Pit Cooler	490
Purification Pumps, 2 req'd @ 200 ea.	400
Poison Cylinder	800
Disposal Tank	572
Disposal Pump, 2 req'd @ 150 ea.	300
Shielding 76 ft.^{2} @ 41 ft.	3,120
1-1/2" Piping, 76 ft. @ 2.7 ea.	205
1" Piping, 147 ft. @ 1.7 ea.	250
1/2" Piping, 220 ft. @ .85 ea.	187
1/2" 150 Lb. Valves, 25 req'd @ 6 ea.	150
1" 150 Lb. Valves, 12 req'd @ 14 ea.	168
1-1/2" 150 Lb. Valves, 2 req'd @ 27 ea.	54
1/2" 600 Lb. Valves, 13 req'd @ 18 ea.	234
1" 600 Lb. Valves, 10 req'd @ 42 ea.	420
1-1/2" 600 Lb. Valves, 7 req'd @ 80 ea.	560
Flanges (approximate)	100
Total Components and Piping	25,222
Electrical	165
Pack and Ship	1,626
Total Box 2	29,835
Box 21b	
CIC Ionization Chamber, 2 req'd @ 20 ea.	40
UIC Ionization Chamber, 3 req'd @ 10 ea.	30
Pack and Ship	62
Total Box 21b	132
Total Load 2	29,967

Box 6f — Load 3

Personnel Bldg. Equipment (Figure 31)	
Wiring Including Outlets	250
Lighting Fixtures	150
Pack and Ship	333
Total Box 6f	733

Box 15b - Load 3	Wt. (lbs.)
Transfer Cask Mechanism (Figure 22)	45
Pack and Ship	37
Total Box 15b	82
Box 3	
Turbine Generator Skid (Figure 39)	
Turbine	4,200
Generator	14,000
Reduction Gear	3,800
Base Plate and Plumbing	3,000
Lube - Oil Coolers	1,600
Auxiliary Lube - Oil Pump	200
Lube - Oil Filter	80
Lube - Oil Purifier	550
Coolant Circulation Pumps	150
Pack and Ship	1,682
Total Box 3	29,262
Total Load 3	30,077

Load 4

Box 4	
Electrical Skid (Figure 30)	
10 WF 33 - 53 ft.	1,749
8 WF 31 - 28 ft.	868
8 WF 17 - 71 ft.	1,207
6 U 8.2 - 28 ft.	230
Misc. Brackets, Shims, Gussets, Chips	250
Weld	72
Wireways	190
Wiring and Installation	769
Total Base Structurals and Wiring	5,335
Control Console	4,787
Batteries	982
Metalclad Switchgear - Aux. Cabinet	1,721
Metalclad Switchgear, Station Feeder Cabinet	2,013
Metalclad Switchgear Generator & Instr. & Control Cabinet	4,886

Box 4 - Load 4	Wt. (Lbs.)
Electric Skid (Figure 30) - (Cont'd)	
Power Center, Distribution Center, Transformer Section and High Voltage Inlet	5,512
Grounding Reactor	1,628
Total Components	21,529
Pack and Ship	2,894
Total Box 4	29,758
Total Load 4	29,758

Load 5

Box 7	
Reactor Vessel, Head and Head Shielding (Figure 27)	27,100
Pack and Ship	2,180
Total Box 7	29,280
Box 19b1	
Control Rod Mechanism Actuator (Figure 11)	650
Pack and Ship	82
Total Box 19b1	732
Total Load 5	30,012

Load 6

Box 5a	
Condenser Skid (Figure 38) (Actual)	22,000
Pack and Ship	1,758
Total Box 5a	23,758

Box 13f - Load 6	Wt. (Lbs.)
Crane Assy Provisions (Figure 4)	448
Pack and Ship	90
Total Box 13f	538
Box 19b2	
Control Rod Mechanism Actuator (Figure 11)	650
Pack and Ship	82
Total Box 19b2	732
Box 19c1	
Control Rod Drive Package (Figure 2)	150
Pack and Ship	63
Total Box 19c1	213
Total Load 6	25,241
Box 5b	

Load 7

Box 5b	
Condenser Skid (Figure 38) (Actual)	22,000
Pack and Ship	1,758
Total Box 5b	23,758
Box 6g	
Personnel Bldg. (Figure 31)	
Heating Radiations Piping and Controls	850
Pack and Ship	262
Total Box 6g	1,112
Box 61	
Personnel Bldg. (Figure 31)	
Fire Protection System and Tanks	600
Pack and Ship	313
Total Box 61	913

Box 6h - Load 7	Wt. (Lbs.)
Personnel Bldg. (Figure 31)	
Water Closet Including Plumbing	425
Lavatory Including Plumbing	200
Sink Including Plumbing	200
Pack and Ship	210
Total Box 6h	1,035
Total Load 7	26,818

Load 8

Box 8	
Core (Figure 8)	1,750
Pack and Ship	256
Total Box 8	2,006
Box 12	
Waste Tank (Figure 3)	1,500
Pack and Ship	392
Total Box 12	1,892
Box 16d	
Service Bldg.	
Switch Gear	300
Welder	500
Hand Tools	650
Grinder	150
Pack and Ship	164
Total Box 16d	1,764
Box 5c	
Condenser Dampers and Supports (2 sets) (Figure 38)	
Actual	12,240
Pack and Ship	3,660
Total Box 5c	15,900

Box 26 - Load 8	Wt. (Lbs.)
Source, Contained (Figure 15)	385
Pack and Ship	86
Total Box 26	471
Total Load 8	22,033

Load 9

Box 9a	
Spent Fuel Shipping Assy (Fig. 21) Includes 8 Assys & 3 Rods	28,250
Pack and Ship	1,055
Total Box 9a	29,305

Box 13d	
Crane Bridge Drive Unit Including Motor & Reducer (Figure 4)	500
Pack and Ship	197
Total Box 13d	697
Total Load 9	30,002

Load 10

Box 9b	
Spent Fuel Shipping Assy (Fig. 21) Includes 8 Assys & 3 Rods	28,250
Pack and Ship	1,055
Total Box 9b	29,305

Box 16h	
Service Bldg. Lathe	400
Pack and Ship	219
Total Box 9b	619
Total Load 10	29,924

Box 9c	Load 11	Wt. (Lbs.)
Spent Fuel Shipping Assy (Fig. 21) Includes 8 Assys & 3 Rods		28,250
Pack and Ship		1,055
Total Box 9c		29,305
Box 19b3		
Control Rod Mechanism Actuator (Figure 11)		650
Pack and Ship		82
Total Box 19b3		732
Total Load 11		30,037
	Load 12	
Box 10		
Shield Tank Assembly (Figure 18)		27,954
Pack and Ship		2,024
Total Box 10		29,978
Total Load 12		29,978
	Load 13	
Box 11		
Spent Fuel and Plant Drain Tanks Shipping Assy (Figure 19)		26,550
Pack and Ship		2,963
Total Box 11		29,513
Box 19d		
Control Rod Drive Connectors (Figure 8)		360
Pack and Ship		143
Total Box 19d		503
Total Load 13		30,016

Box 15a	Load 14	Wt. (Lbs.)
Transfer Cask Assembly (Figure 22)		11,499
Pack and Ship		375
Total Box 15a		11,874
Box 16b		
Service Bldg. Auxiliary Boiler		7,535
Pack and Ship		465
Total Box 16f		8,000
Box 6j		
Personnel Bldg. (Figure 31)		
Shower, Stall and Plumbing		350
Stool		35
Pack and Ship		263
Total Box 6j		648
Box 6k		
Personnel Bldg. (Figure 31)		
Washer and Dryer		400
Pack and Ship		288
Total Box 6k		688
Box 6b		
Personnel Bldg. (Figure 31)		
(4) File Cabinets		240
Pack and Ship		319
Total Box 6b		559
Box 6c		
Personnel Bldg. (Figure 31)		
(6) Personnel Lockers		360
Pack and Ship		470
Total Box 6c		830
Total Load 14		22,599

Box 5d1	Load 15	Wt. (Lbs.)
Condenser Stack Structure (Figure 25)		
Columns, Girders, Beams, Brackets		4,052
Pack and Ship		390
Total Box 5d1		4,442
Box 13a		
Cranes Trusses, 2 req'd @ 700 ea. (Figure 4)		1,400
Pack and Ship		425
Total Box 13a		1,825
Box 13b		
Crane Rail Beams, 2 req'd @ 1600 ea. (Fig. 4)		3,200
Pack and Ship		425
Total Box 13b		3,625
Box 14f		
Ratiometer Jack (Figure 3)		1,712
Pack and Ship		96
Total Box 14f		1,808
Box 14g		
Ratiometer Jack (Figure 3)		1,712
Pack and Ship		96
Total Box 14g		1,808
Box 14h		
Ratiometer Jack (Figure 3)		1,712
Pack and Ship		96
Total Box 14h		1,808
Box 15c		
Transfer Cask Extension Racks, 3 req'd @ 40 ea. (Figure 22)		120
Pack and Ship		152
Total Box 15c		272

Box 18 - Load 15	Wt. (Lbs.)
Refueling Plate Assembly (Figure 23)	6,100
Pack and Ship	419
Total Box 18	6,519
Box 24	
Off-Skid Heating Provisions (Figure 59)	450
Pack and Ship	143
Total Box 24	593
Box 20	
Instrument Well Shipping Pack Skid (Figure 35)	
Skid Steel	646
Skid Lumber	1,775
BF_3 Wells, 2 req'd @ 558 ea.	1,116
3 UIC Wells @ 544 ea.	1,635
2 CIC Wells @ 545 ea.	1,090
Pack and Ship	435
Total Box 20	6,697
Total Load 15	29,397

Load 16

Box 5d2	
Condenser Stack Panels (Figure 25)	2,700
Pack and Ship	742
Total Box 5d2	3,442
Box 5d3	
Condenser Stack Panels (Figure 25)	2,700
Pack and Ship	742
Total Box 5d3	3,442
Box 13c	
Crane End Beams, 2 req'd @ 500 ea. (Figure 4)	1,000
Pack and Ship	252
Total Box 13c	1,252

APPENDIX B (Cont'd)

	Wt. (Lbs.)
Box 14a - Load 16	
Ratiometer Jack (Figure 3)	1,746
Pack and Ship	112
Total Box 13a	1,858
Box 14b	
Ratiometer Jack (Figure 3)	1,746
Pack and Ship	112
Total Box 14b	1,858
Box 14c	
Ratiometer Jack (Figure 3)	1,746
Pack and Ship	112
Total Box 14c	1,858
Box 14d	
Ratiometer Jack (Figure 3)	1,746
Pack and Ship	112
Total Box 14d	1,858
Box 14e	
Ratiometer Jack (Figure 3)	1,712
Pack and Ship	96
Total Box 14e	1,808
Box 19b4	
Control Rod Mechanism Actuator (Figure 11)	650
Pack and Ship	82
Total Box 19b4	732
Box 19b5	
Control Rod Mechanism Actuator (Figure 11)	650
Pack and Ship	82
Total Box 19b5	732

Box 19b6 - Load 16	Wt. (Lbs.)
Control Rod Mechanism Actuator (Figure 11)	650
Pack and Ship	82
Total Box 19b6	732
Box 19b7	
Control Rod Mechanism Actuator (Figure 11)	650
Pack and Ship	82
Total Box 19b7	732
Box 19b8	
Control Rod Mechanism Actuator (Figure 11)	650
Pack and Ship	82
Total Box 19b8	732
Box 19b9	
Control Rod Mechanism Actuator (Figure 11)	650
Pack and Ship	82
Total Box 19b9	732
Total Load 16	21,768

Load 17

Box 5dr	
Condenser Stack Panels (Figure 25)	2,700
Pack and Ship	742
Total Box 5d4	3,442
Box 5d5	
Condenser Stack Cowling, Covers, Desk (Figure 25)	1,490
Pack and Ship	728
Total Box 5d5	2,218

Box 6n - Load 17	Wt. (Lbs.)
Personnel Bldg. (Figure 31)	
(2) Desks @ 300 ea.	600
(2) Chairs @ 30 ea.	60
Pack and Ship	414
Total Box 6n	1,074
Box 6a	
Personnel Bldg. (Figure 31)	
Radiation Counter	500
Pack and Ship	173
Total Box 6a	673
Box 6d	
Personnel Bldg. (Figure 31)	
Contaminated Clothes Bin	75
Waste Box	200
Pack and Ship	156
Total Box 6d	431
Box 6m	
Personnel Bldg. (Figure 31)	
Table	400
Pack and Ship	189
Total Box 6m	589
Box 13e	
Crane Trolley Including Motor and Reducer for Drive Plus Hoist and Hoist Motor (Figure 3 and 4)	1,500
Pack and Ship	343
Total Box 13e	1,843
Total Load 17	10,270

Box 6e	Load 18	Wt. (Lbs.)
Personnel Bldg. (Figure 31)		
400 ft.^{2} Internal Partitions @ 4 ea.		1,600
Pack and Ship		369
Total Box 6e		1,969
Box 16a		
Service Building		
Auxiliary Diesel Generator (Skid Mounted)		6,985
Pack and Ship		460
Total Box 16a		7,445
Box 16c		
Service Building		
Fuel Tank		400
Pipe Threader		200
Drill Press		300
Pack and Ship		238
Total Box 16c		1,138
Box 16e		
Service Building		
Wiring		250
Lights		150
Parts Bins		350
Pack and Ship		262
Total Box 16e		1,012
Box 16f		
Service Building		
Work Bench		175
Boiler Piping		800
Pack and Ship		262
Total Box 16f		1,237
Box 16g		
Service Building		
Heating and Fire Protection Including Plumbing		1,450
Pack and Ship		448
Total Box 16g		1,898

Box 16i - Load 18 (Cont'd)	Wt. (Lbs.)
Service Bldg. Internal Partitions	1,400
Pack and Ship	323
Total Box 16i	1,723
Box 17	
Spent Fuel Storage Rack (Figure 33)	1,474
Pack and Ship	289
Total Box 17	1,763
Box 19c2	
Control Rod Drive Package (Figure 2)	150
Pack and Ship	63
Total Box 19c2	213
Box 19c3	
Control Rod Drive Package (Figure 2)	150
Pack and Ship	63
Total Box 19c3	213
Box 19c4	
Control Rod Drive Package (Figure 2)	150
Pack and Ship	63
Total Box 19c4	213
Box 19c5	
Control Rod Drive Package (Figure 2)	150
Pack and Ship	63
Total Box 19c5	213
Box 19c6	
Control Rod Drive Package (Figure 2)	150
Pack and Ship	63
Total Box 19c6	213

Box 19c7 - Load 18 (Cont'd)	Wt. (Lbs.)
Control Rod Drive Package (Figure 2)	150
Pack and Ship	63
Total Box 19c7	213
Box 19c8	
Control Rod Drive Package (Figure 2)	150
Pack and Ship	63
Total Box 19c8	213
Box 19c9	
Control Rod Drive Package (Figure 2)	150
Pack and Ship	63
Total Box 19c9	213
Box 19e	
Control Extension Shafts, 9 req'd (Figure 11)	117
Pack and Ship	91
Total Box 19e	208
Box 21a	
BF_3 Instruments, 2 req'd @ 100 ea. (Figure 36)	200
Pack and Ship	86
Total Box 21a	286
Box 22	
Portable Radiation Monitoring (Figure 69)	550
Pack and Ship	205
Total Box 22	755
Box 23	
Fixed Radiation Monitoring	350
Pack and Ship	205
Total Box 23	555

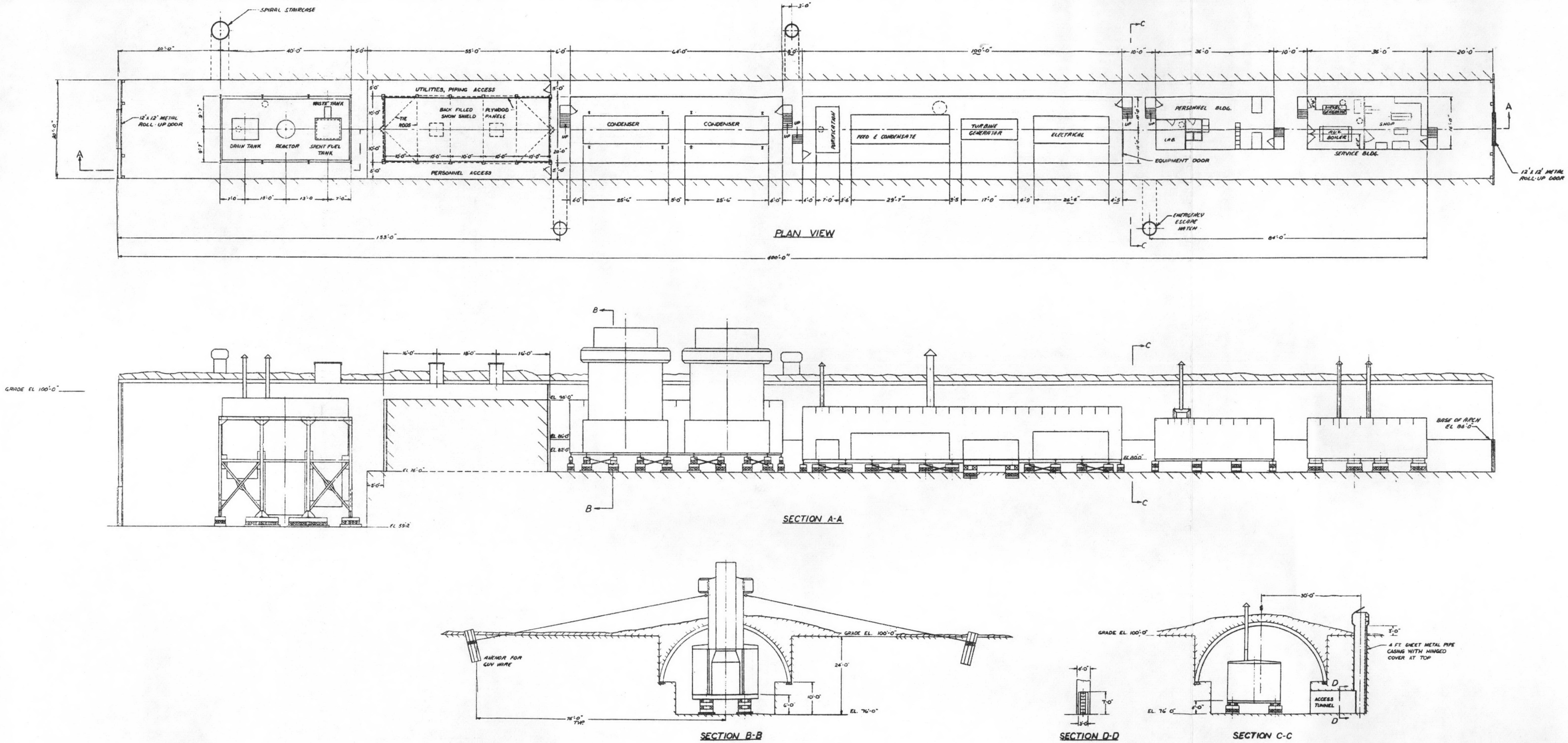
APPENDIX B (Cont'd)

Box 25a - Load 18 (Cont'd)	Wt. (Lbs.)
Feed Pump Motor (Figure 29)	1,000
Pack and Ship	206
Total Box 25a	1,206
Box 25b	
Feed Pump Motor (Figure 29)	1,000
Pack and Ship	206
Total Box 25b	1,206
Total Load 18	24,105

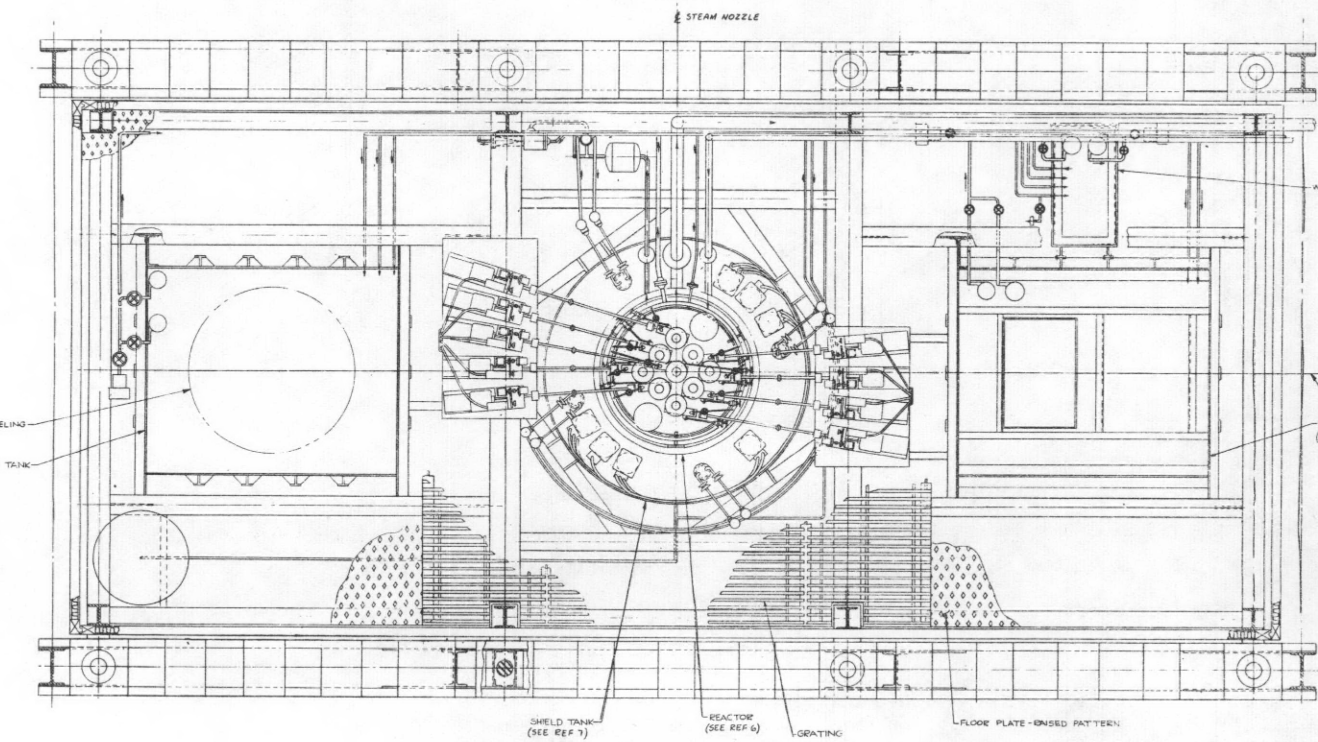
APPENDIX C

1/4 SCALE MOCKUP

The 1/4 scale mockup has been used to develop the arrangement plans shown in this report. Maximum pull space and operational access have been provided on the mockup. Since the last report the T-5 building shells have been completed, and the stationary structure of the reactor complex completed. Final machinery arrangements and interconnecting piping are being incorporated. Figures 82, 83, 84, 85, 86, 87, and 88 are photographs of the mockup as of October 31, 1960.



GENERAL ARRANGEMENT
Fig. 1

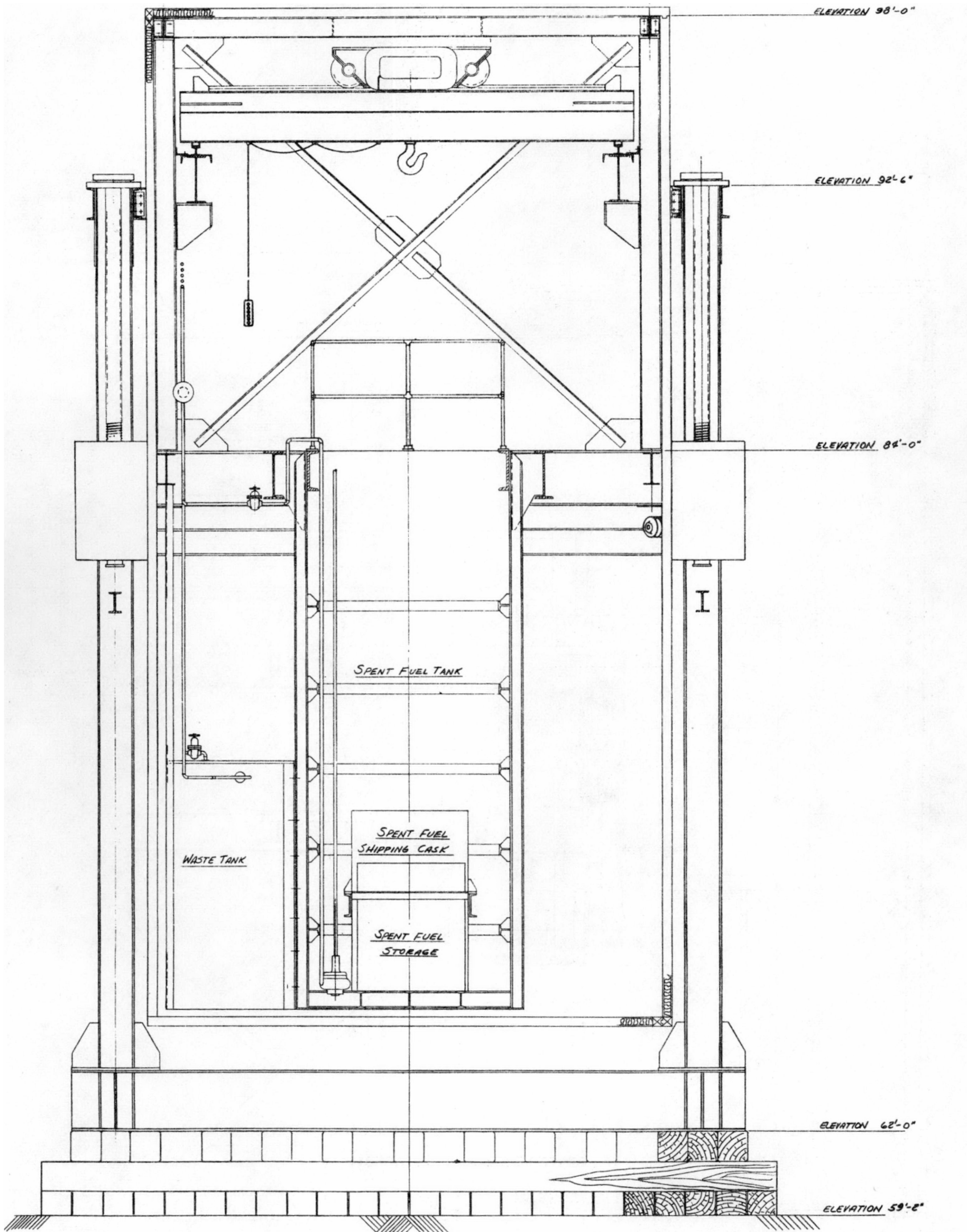


REF NO	DRAWING NO	PROJECT NO	TITLE
7	PL2E2356	2301-05	SHIELD TANK ASSEMBLY
6	PL2J2220		REACTOR ELEVATION
5	PL2E2268	2301-06-02	SPENT FUEL TANK
4	PL2E2269	2301-06-03	PLANT DRAIN TANK
3	PL2E2346	2301-03	REACTOR COMPLEX STRUCT STL
2	PL2E2336 SH3	2301-01-03	REACTOR COMPLEX (SECTION)
1	PL2E2336 SH2	2301-01-02	REACTOR COMPLEX (ELEVATION)

REFERENCE DRAWINGS

REACTOR COMPLEX-PLAN

Fig. 2

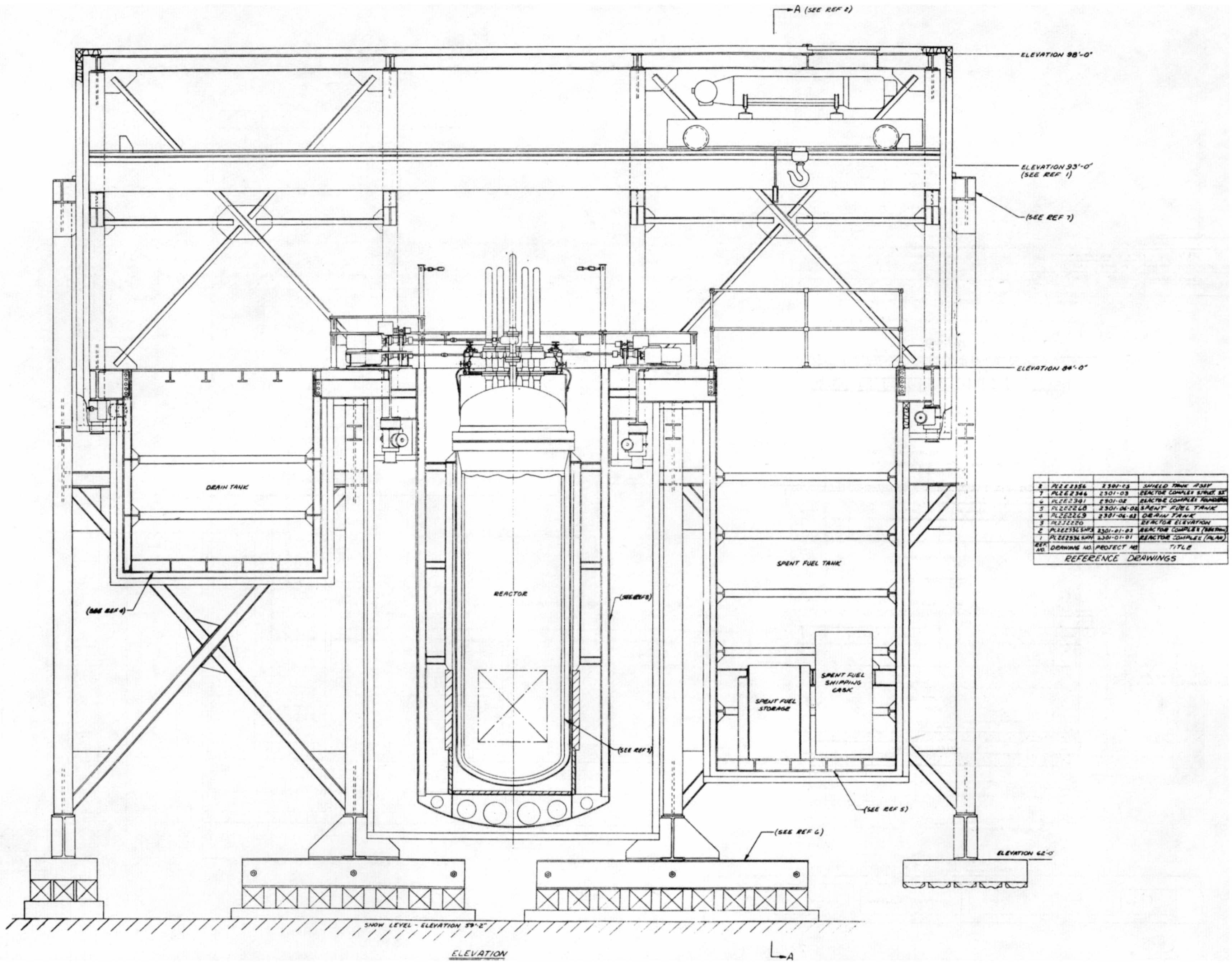


REF Nº	DWG Nº	PROJECT Nº	TITLE
6	PLZE 2277	2301-07-04	SPENT FUEL SHIPPING CASK
5	PLZE 2268	2301-06-02	SPENT FUEL TANK
4	PLZE 2341	2301-02	REACTOR COMPLEX (FOUNDATIONS)
3	PLZE 2346	2301-03	REACTOR COMPLEX (STRUCTURAL STL)
2	PLZE 2336-SHT 2	2301-01-02	REACTOR COMPLEX (ELEVATION)
1	PLZE 2336-SHT. 1.	2301-01-01	REACTOR COMPLEX (PLAN)

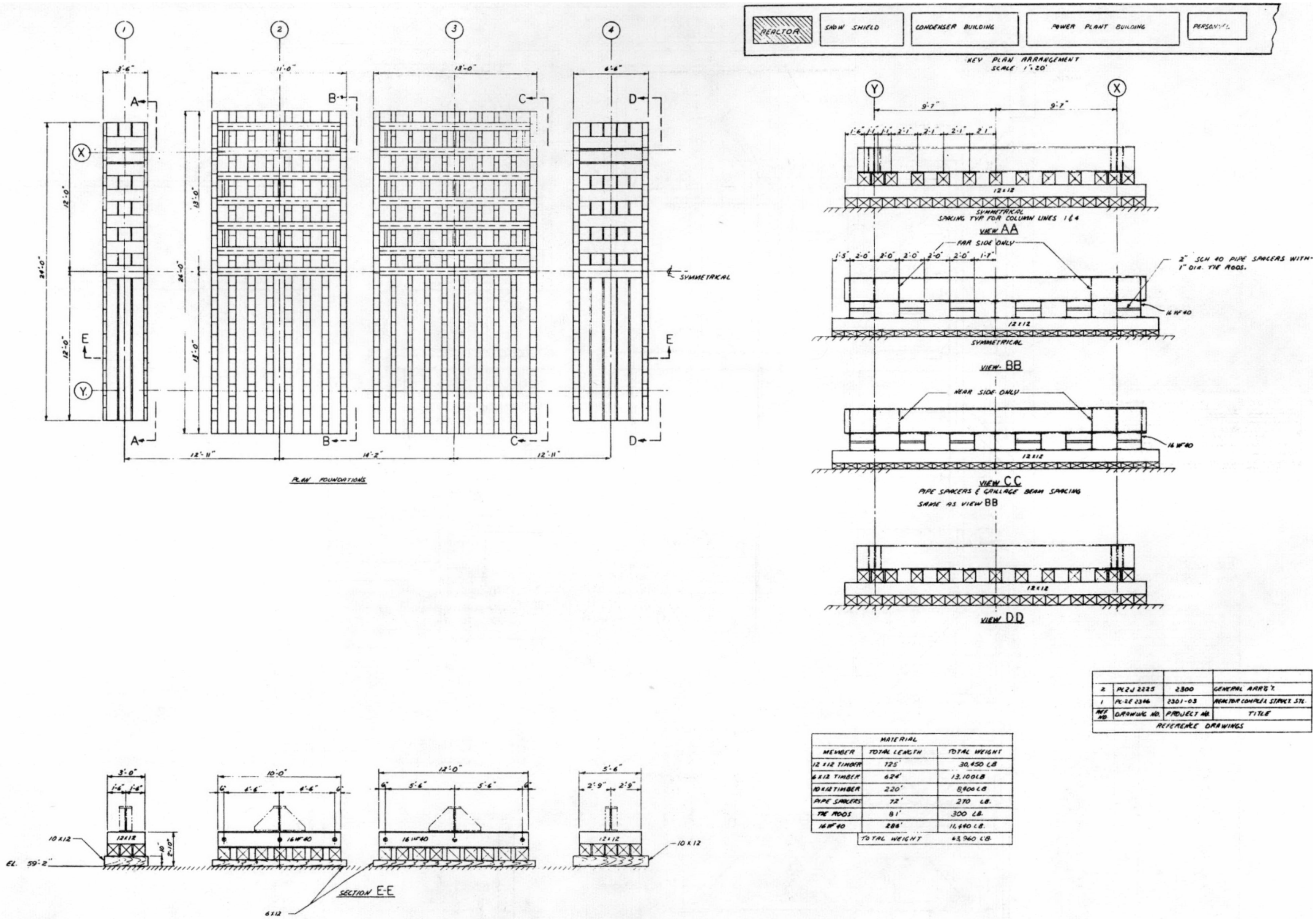
REFERENCE DRAWINGS

SECTION A-A

REACTOR COMPLEX—SECTION
Fig. 3



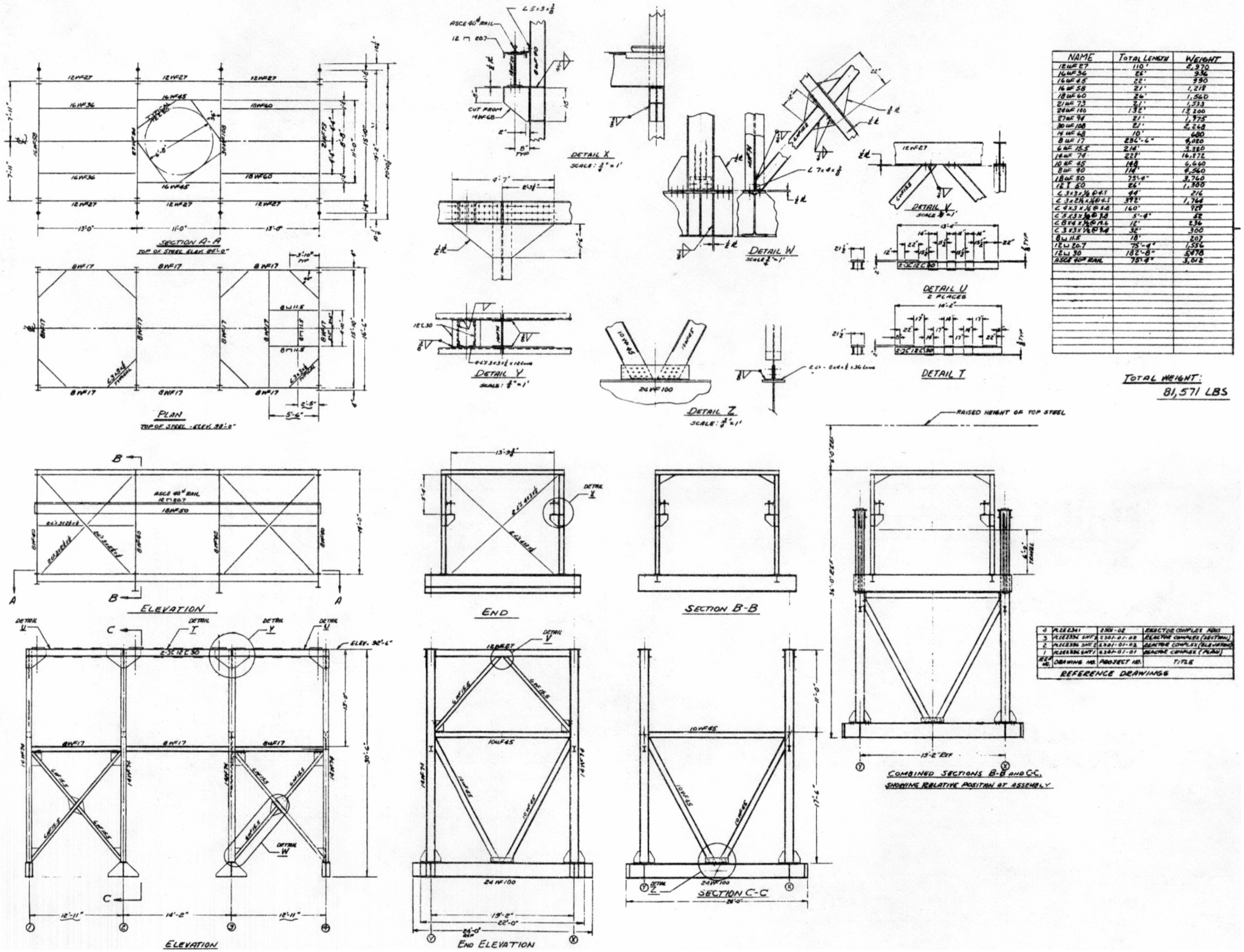
REACTOR COMPLEX — ELEVATION
Fig. 4



MATERIAL		
MEMBER	TOTAL LENGTH	TOTAL WEIGHT
12 x 12 TIMBER	725'	30,450 LB
6 x 12 TIMBER	624'	13,100 LB
10 x 12 TIMBER	220'	8,400 LB
PIPE SPACERS	72'	270 LB.
TIE RODS	81'	300 LB.
16 WF 40	286'	11,440 LB.
	TOTAL WEIGHT	63,960 LB.

2	PL2J 2225	2300	GENERAL ARR'G'T.
1	PL-2E 2346	2301-03	REACTOR COMPLEX STRUCT. STL.
REF NO.	DRAWING NO.	PROJECT NO.	TITLE
REFERENCE DRAWINGS			

REACTOR COMPLEX-FOUNDATIONS
Fig. 5

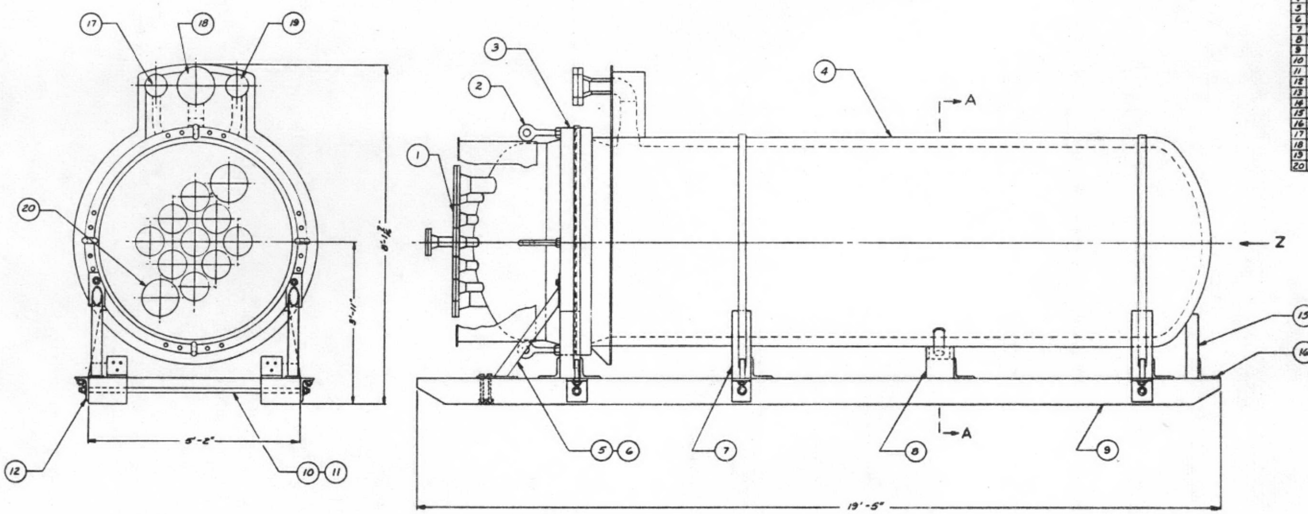


NAME	TOTAL LENGTH	WEIGHT
12 WF 27	110'	2,970
16 WF 36	26'	936
16 WF 45	22'	990
16 WF 58	21'	1,218
18 WF 60	26'	1,560
21 WF 73	21'	1,533
24 WF 100	132'	13,200
27 WF 94	21'	1,975
30 WF 108	21'	2,268
14 WF 68	10'	680
8 WF 17	236'-6"	4,020
6 WF 15.5	214'	3,320
14 WF 74	228'	16,872
10 WF 45	148	6,660
8 WF 40	114'	4,560
18 WF 50	75'-4"	3,760
12 I 50	26'	1,300
L 3x3x1/4 @ 4.9	44'	216
L 3x2½x¼ @ 4.5	392'	1,764
L 4x3x1/4 @ 5.8	160'	928
L 5x3x1/4 @ 7.8	5'-4"	42
L 8x4x1/2 @ 19.6	12'	236
L 3x3x1/2 @ 9.4	32'	300
8 ⊔ 11.5	18'	207
12 ⊔ 20.7	75'-4"	1,556
12 ⊔ 30	182'-8"	5,478
ASCE 40# RAIL	75'-4"	3,012

TOTAL WEIGHT: 81,571 LBS

REACTOR COMPLEX-STRUCTURAL STEEL

Fig. 6

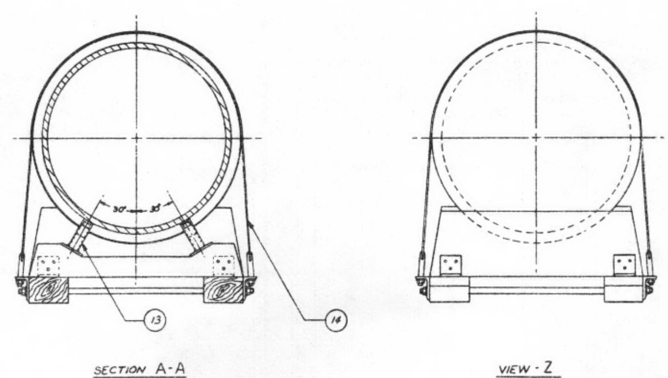


ITEM NO.	PIECE NUMBER	NAME	NO. REQ.	MATERIAL	REMARKS
1		BLIND FLANGE	9		8¼" DIA × 1¼ THICK
2		LIFTING EYES	4		1½" DIA × 12" LONG
3		PRESSURE VESSEL AND HEAD	1		SEE REF 1
4		INSULATION CASING	1		
5		BRACE	2		3" PIPE × 32" LONG
6		HEX. HEAD BOLT AND NUT	50		¾-10UNC-2 × 7" LONG
7		SUPPORT BEAM	3		6" × 30" × 62" LONG
8		VESSEL SUPPORT BEAM	1		8" × 10" × 62" LONG
9		SKID	2		8" × 12" × 19'-6" LONG
10		TIE BAR	3		1½" DIA × 68" LONG
11		HEX. NUT SEMI-FINISHED	12		1½"-6UNC-2
12		ANCHOR ANGLE	6		∠4" × 7" × 6" LONG
13		VESSEL SUPPORT FEET	2		5" PIPE × 8" (SPECIAL)
14		TIE STRAP WITH 1½ DIA STUDS	3		½" × 2" × 15" LONG
15		END SUPPORT BEAM	1		4" × 18" × 62" LONG
16		ANGLE BRACE	12		∠6" × 6" × 6" LONG
17		BLIND FLANGE	1		6⅞" DIA × 1⅛" THICK
18		BLIND FLANGE	1		10¾" DIA × 1¾ THICK
19		BLIND FLANGE	1		7½" DIA × 1⅛" THICK
20		BLIND FLANGE	2		10¾ DIA × 1¼ THICK

BILL OF MATERIALS
QUANTITIES ARE FOR UNITS

REF NO.	DRAWING NO.	PROJECT NO.	TITLE
1	M2J2220		REACTOR ELEVATION

REFERENCE DRAWINGS



SECTION A-A

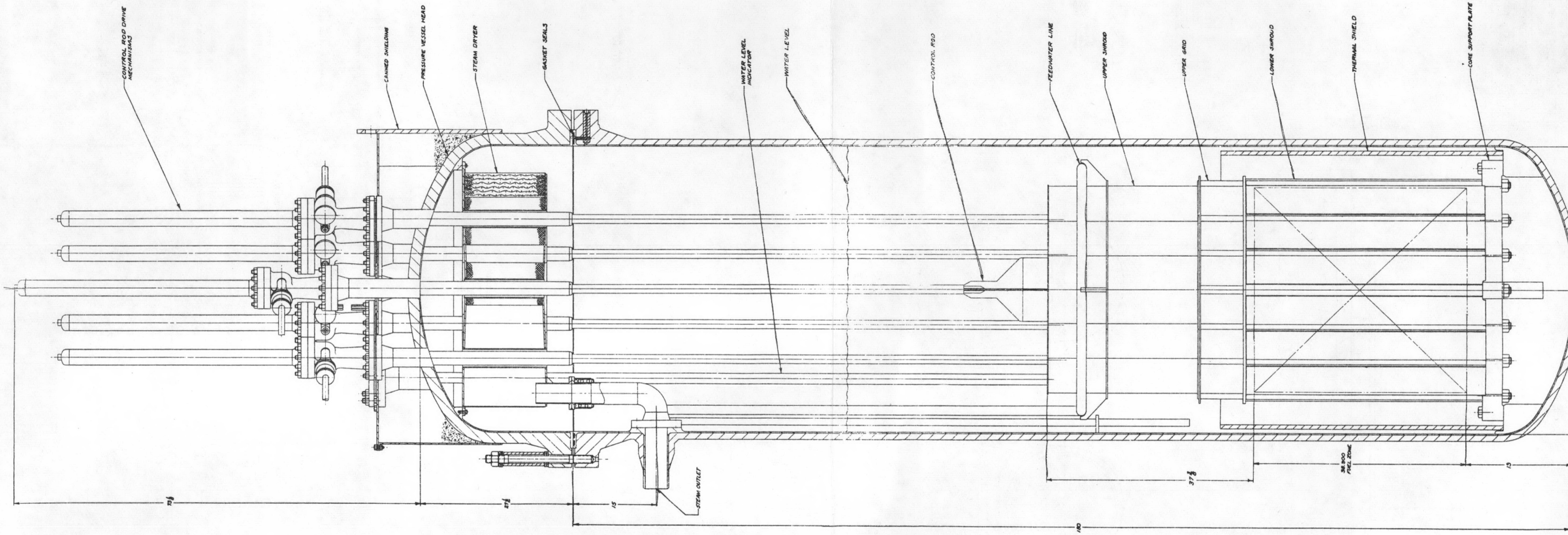
VIEW - Z

WEIGHTS:

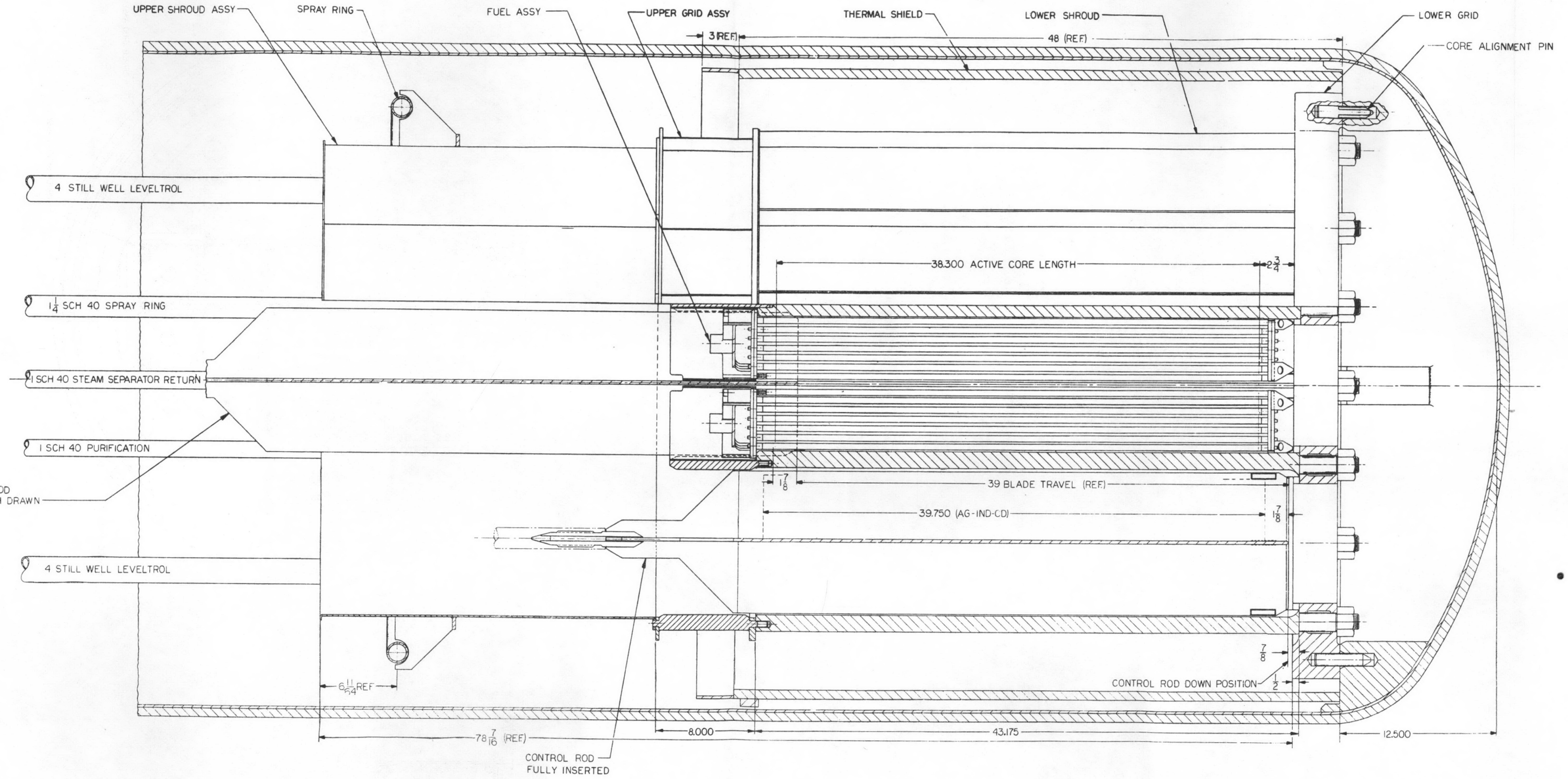
PRESSURE VESSEL AND HEAD	19,500 LBS
CASING AND INSULATION	3,000 LBS
SHIPPING SKID	2,500 LBS
TOTAL	25,000 LBS

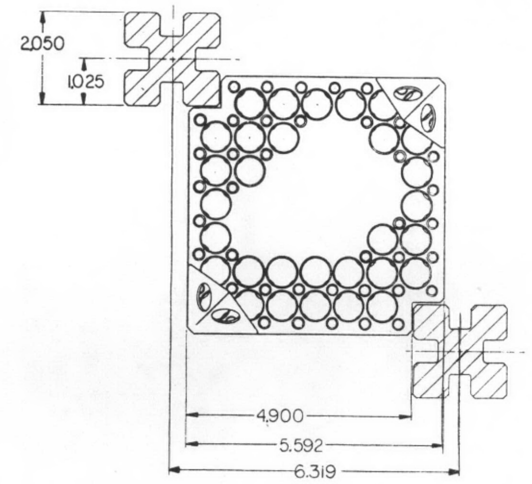
REACTOR VESSEL AND HEAD SHIPPING PACK

Fig. 7



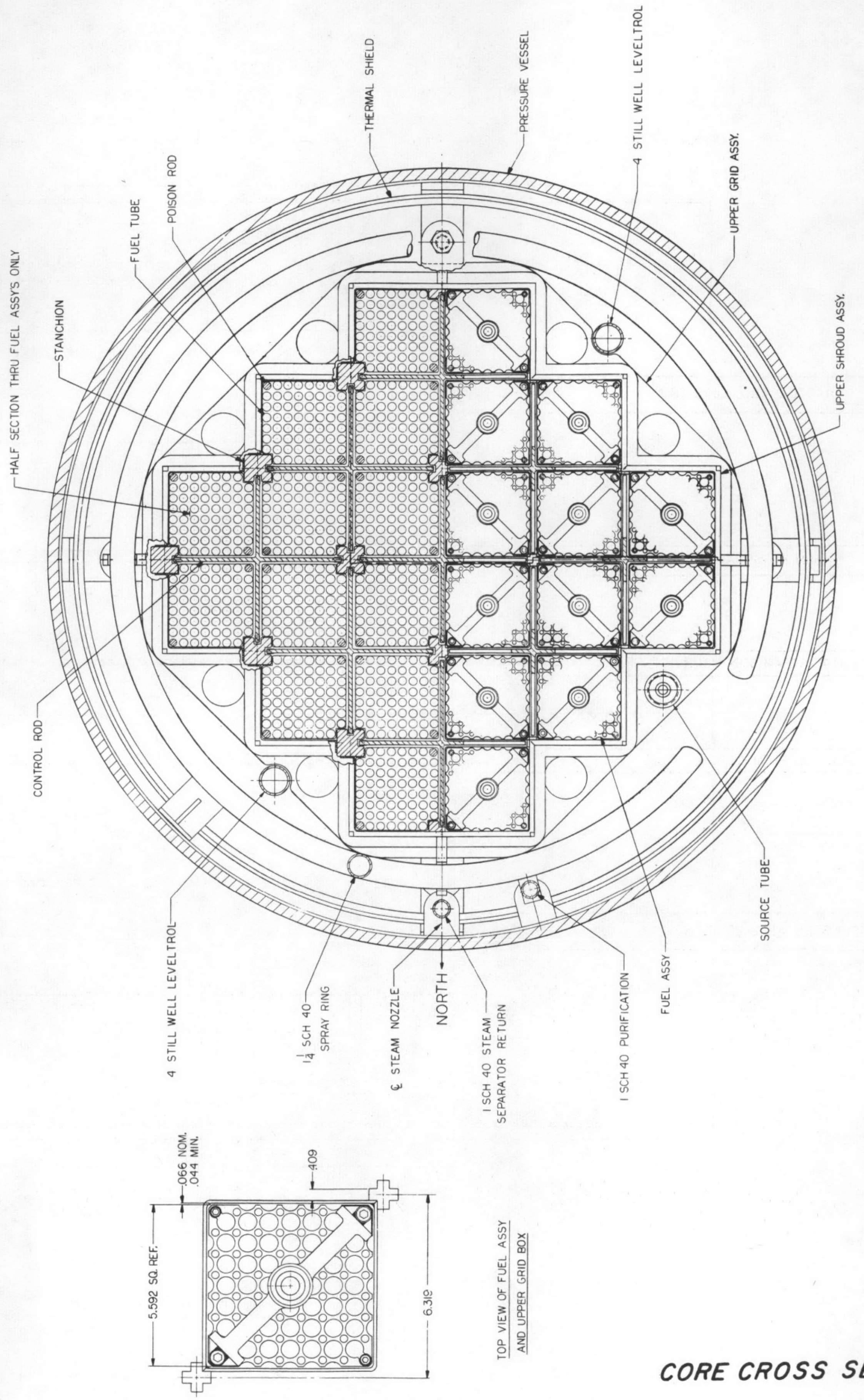
REACTOR ELEVATION
Fig. 8



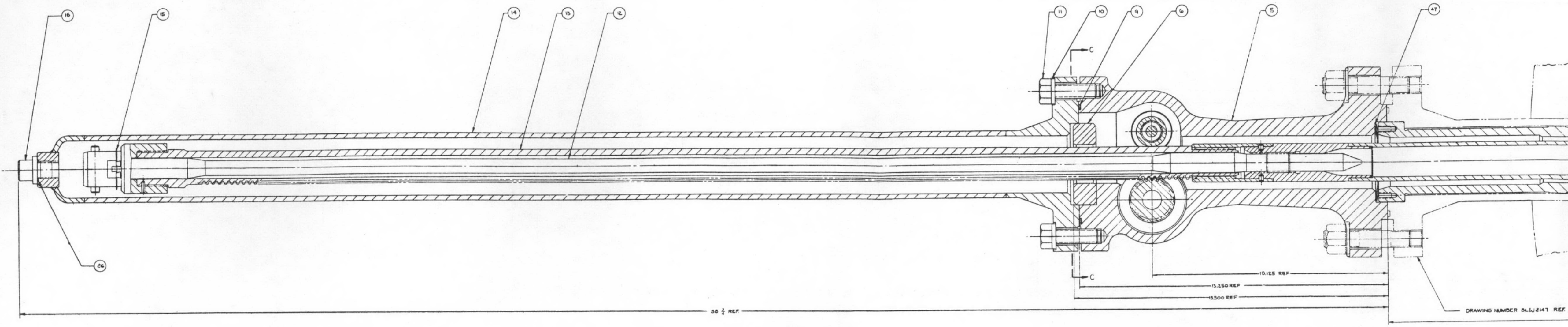


SECTIONAL VIEW OF BOTTOM FUEL ASSY AND STANCHIONS

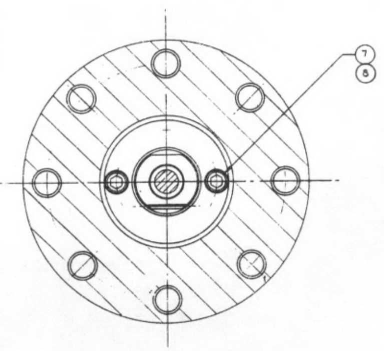
CORE ELEVATION
Fig. 9



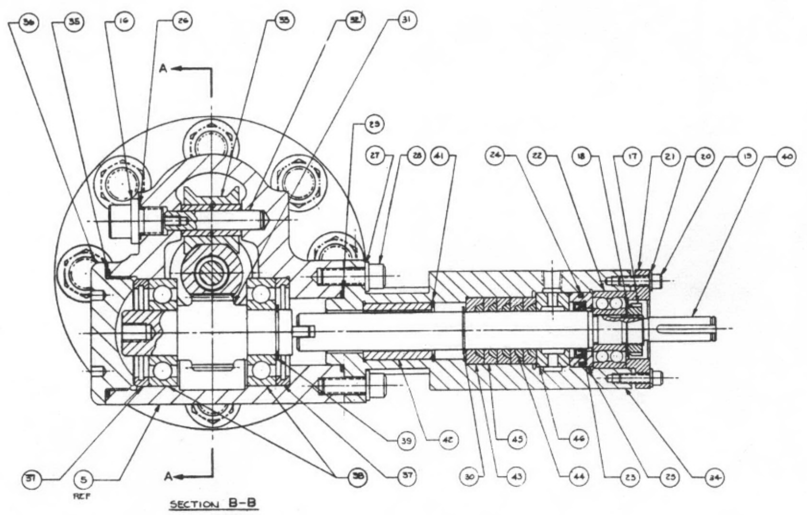
CORE CROSS SECTION
Fig. 10



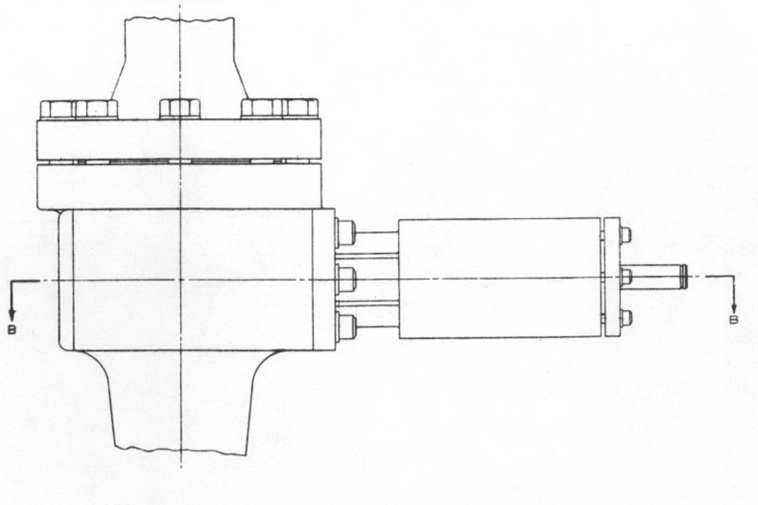
SECTION A-A



SECTION C-C



SECTION B-B



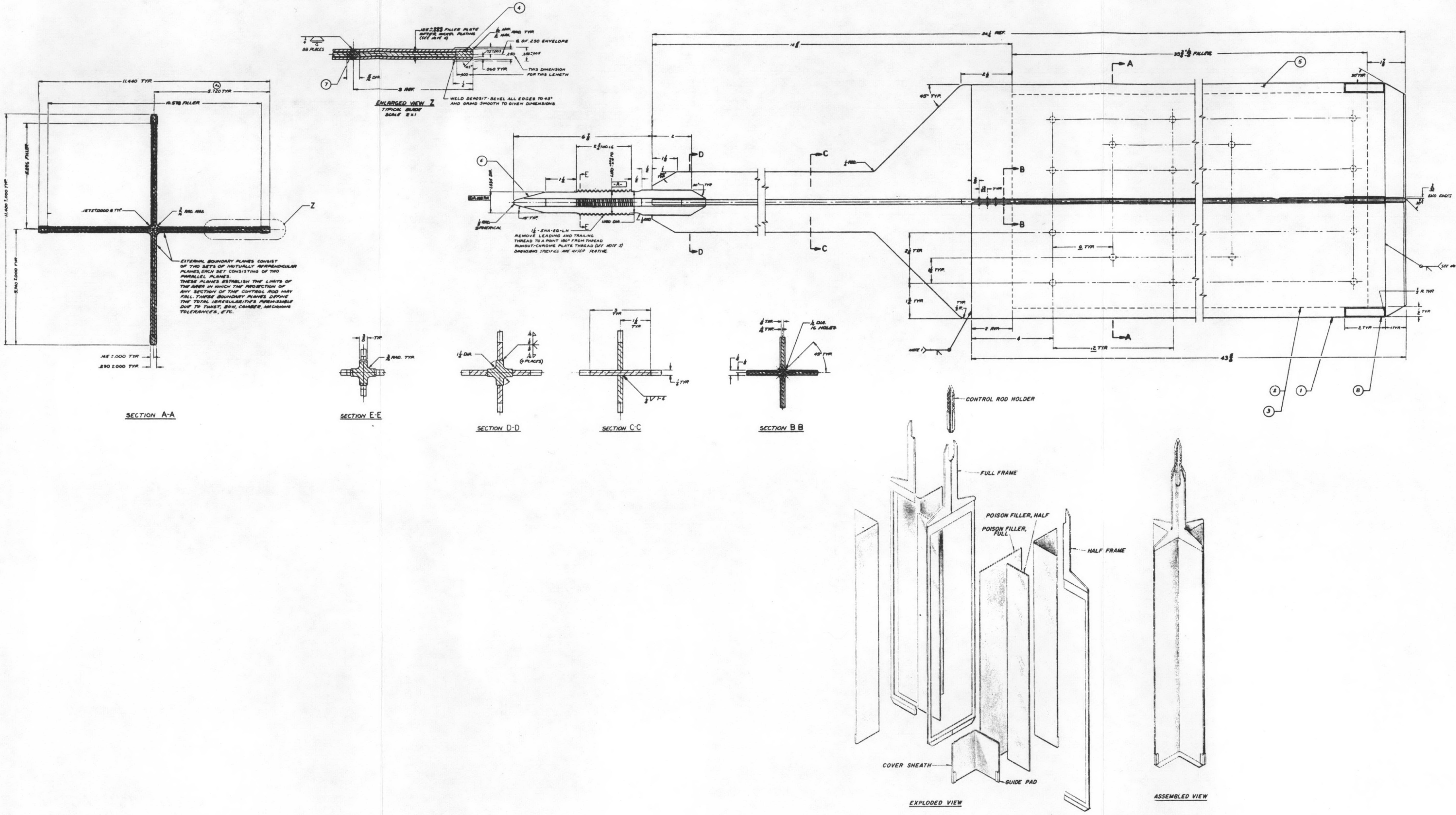
BILL OF MATERIALS
QUANTITIES ARE FOR 1 UNITS

ITEM NO.	PIECE NUMBER	NAME	NO. REQ.	MATERIAL	REMARKS
	5LIJ2193	CONTROL ROD MECHANISM ACTUATOR ASSEMBLY	1		
1	5LID2474	EXTENSION SHAFT ASSEMBLY	1		
2	[illegible]	RETAINING RING	1	AISI TYPE 420	[illegible]
3	5LIB2994	BUSHING, SLEEVE, NOZZLE	1	STELLITE NO. 6	
4	5LID2473	SLEEVE, NOZZLE	1	AISI TYPE 304 SST	
5	5LIJ2194	HOUSING, PINION	1	ASME SA-351 GR CF8	
6	5LIB2995	HARD STOP		AISI TYPE 347 SST	
7	[illegible]	CAP SCREW HEX SOCKET HEAD	2	[illegible]	[illegible] -16 UNC-3A
8	[illegible]	SPRING LOCK WASHER (MEDIUM)	2	AISI TYPE 302 SST	[illegible] NOM. DIA
9	CNDB2968-02	GASKET, SPIRAL WOUND	1	[illegible]	[illegible]
10	[illegible]	SPRING LOCK WASHER (MEDIUM)	8	AISI TYPE 302 SST	[illegible] NOM. DIA
11	[illegible]	BOLT - REGULAR HEXAGON	8	AISI TYPE 304 SST	[illegible] -11 UNC-2A
12	5LIC2739	BOLT ASSEMBLY, CONNECTOR	1		
13	5LID2470	RACK ASSEMBLY	1		
14	5LID2484	HOUSING ASSEMBLY UPPER	1		
15	5LIB2996	WASHER, KEY, BOLT, CONNECTOR	1	AISI TYPE 304 SST	
16	5LIB2969	PLUG, SEAL	2	AISI TYPE 347 SST	1/2 -10 UNC-3A
17	5LIB2992	LOCKNUT, BEARING	1	[illegible]	
18	5LIB2993	WASHER KEY, BEARING	1	AISI TYPE 304 SST	
19	[illegible]	CAP SCREW HEX SOCKET HEAD	6	[illegible]	1/4 -20 UNC-3A
20	[illegible]	SPRING LOCK WASHER (MEDIUM)	6	AISI TYPE 302 SST	1/4 NOM DIA
21	5LIC2734	RETAINER, BEARING	1	AISI TYPE 304 SST	
22	5LIB2991	BEARING, BALL, ANNULAR, DOUBLE	1	[illegible]	[illegible]
23	5LIB2990	SEAL, SIRVENE	1		[illegible]
24	CNDB3014-02	O-RING GASKET (STATIC USE)	1	SILICONE RUBBER	
25	5LIB2999	RETAINER, SEAL, SIRVENE	1	AISI TYPE 347 SST	
26	CNDB2961-02	O-RING, METALLIC, SELF-ENERGIZING	2	AISI TYPE 321 SST	[illegible]
27	[illegible]	SPRING LOCK WASHER (MEDIUM)	6	AISI TYPE 302 SST	[illegible] NOM DIA
28	[illegible]	CAP SCREW HEXAGON SOCKET HEAD	6	[illegible]	[illegible] -14 UNC-3A
29	CNDB2961-03	O-RING, METALLIC, SELF-ENERGIZING	1	AISI TYPE 321 SST	[illegible]
30	CNDB3013-01	RETAINING RING	1	AISI TYPE 420 SST	[illegible]
31	5LID2472	PINION, RACK	1	ARMCO 17-4PH SST	
32	5LIB2980	SHAFT, ROLLER, RACK	1	ARMCO 17-4PH SST	
33	5LIC2729	ROLLER ASSEMBLY, RACK	1		
34	5LID2516	HOUSING, SEAL, WATER	1	AISI TYPE 304 SST	
35	CNDB2961-01	O-RING, METALLIC, SELF-ENERGIZING	1	AISI TYPE 321 SST	[illegible]
36	5LIC2732	CAP, HOUSING, PINION	1	AISI TYPE 347 SST	
37	5LIB2983	SPACER, BEARING	2	AISI TYPE 304 SST	
38	5LIB2984	BEARING, BALL, ANNULAR, SINGLE	2	AISI TYPE 440-C SST	[illegible]
39	CNDB3013-02	RETAINING RING	1	AISI TYPE 420 SST	[illegible]
40	5LID2418	SHAFT, SEAL	1	ARMCO 17-4PH SST	
41	[illegible]	RETAINING RING	1	AISI TYPE 420 SST	[illegible]
42	5LIB2985	BUSHING, SHAFT, SEAL	1	STELLITE NO. 6	
43	5LIB2986	DIAPHRAGM, LOWER, SEAL	1	STELLITE NO. 6	
44	5LIB2987	FLOATING RING, SEAL	5	STELLITE NO. 3	
45	5LIB2988	DIAPHRAGM, SEAL	4	STELLITE NO. 6	
46	5LIB2989	LANTERN RING, SEAL	1	STELLITE NO. 6	
47	5LIB3041	WASHER, WAVE	1	INCONEL	

1 CLEAN BEFORE ASSEMBLY BY DEGREASING WITH ACETONE, RINSING WITH WATER AND DRYING WITH LINT FREE CLOTH WITH THE FOLLOWING EXCEPTIONS: ITEM NUMBERS 9, 10, 11, 13, 20, 22, 23, 24, 26, 27, 28, 29 AND 35.

MECHANISM ACTUATOR
Fig. 11

BILL OF MATERIALS QUANTITIES ARE FOR 1 UNIT					
ITEM NO.	PART NUMBER	NAME	NO. REQ.	MATERIAL	REMARKS
	SLI J2179	CONTROL ROD BLADE ASSEMBLY	1		
1		COVER SHEATH	4	AISI TYPE 348 SST	
2		POISON FILLER - FULL	1	80% [illegible] Ag, 15%	% In 5% Cd (SEE NOTE 4)
3		POISON FILLER - HALF	2	80% % Ag, 15%	
4		HALF FRAME	2	AISI TYPE 348 SST	
5		FULL FRAME	1	AISI TYPE 348 SST	
6		CONTROL ROD HOLDER	1	AISI TYPE 348 SST	
7		PLUG	44	AISI TYPE 348 SST	
8		GUIDE PAD	8	[illegible]	WELD DEPOSIT



6. CLEAN BY DEGREASING WITH ACETONE, RINSING WITH WATER AND DRYING WITH LINT FREE CLOTH, CLEANING SOLUTIONS CONTAINING GREATER THAN 25 PPM OF CHLORIDES ARE PROHIBITED DURING ALL PHASES OF MANUFACTURING.

5. CHROME PLATE .0002 TO .0006 THICK IN ACCORDANCE WITH ASTM SPEC. B 177-55. ABRASIVE CLEANING (PARA 3-4) & POST PLATING TREATMENT (PARA 7) ARE REQUIRED

4. NICKEL PLATE .0003 TO .0007 PER SPECIFICATION 3SIP-6-30

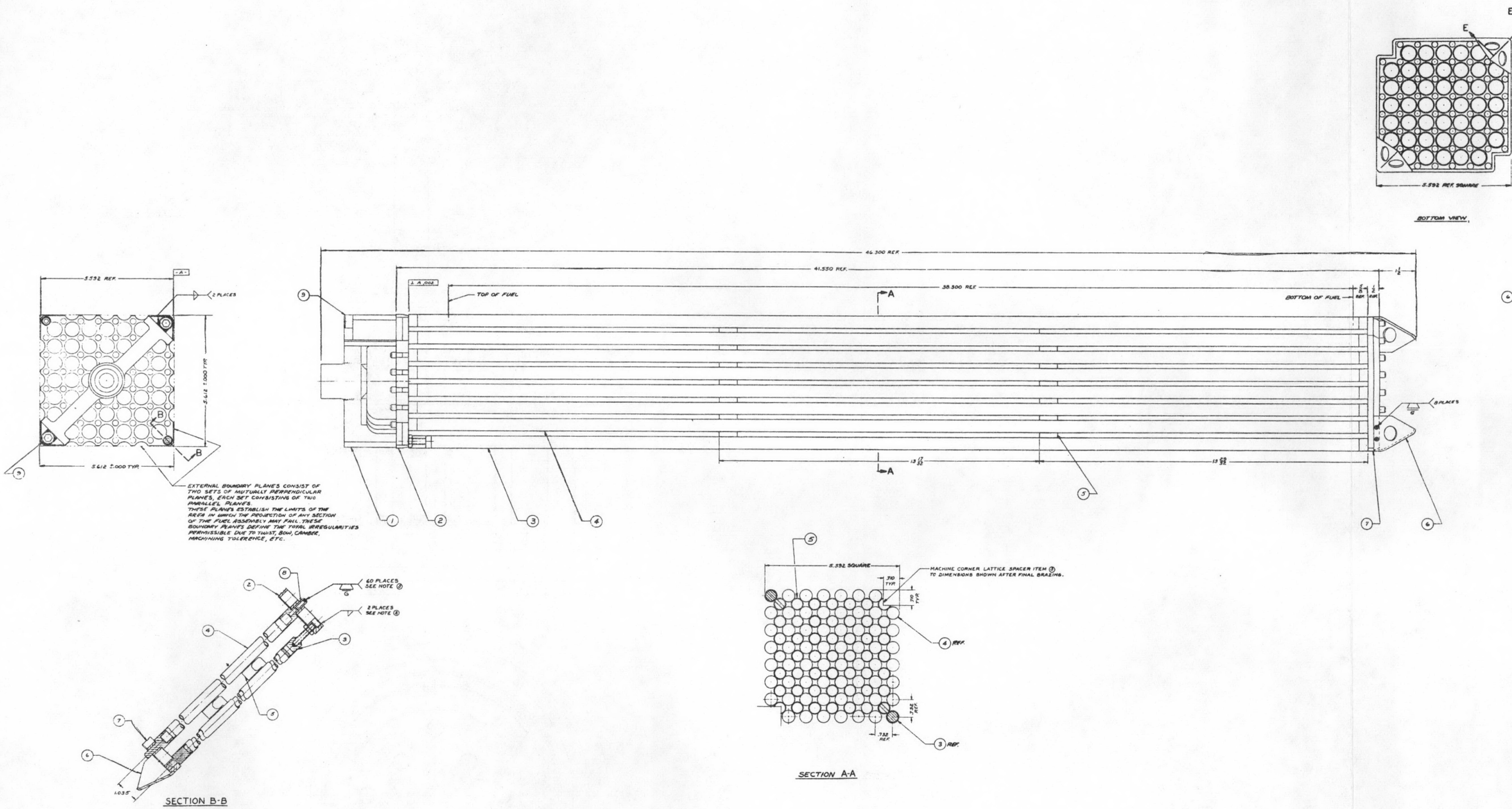
3. OVERALL ENVELOPE OF FINISHED CONTROL ROD TO FALL WITHIN THEORETICAL ENVELOPE FOR FULL LENGTH.

~~2. [illegible]~~

1. COVER SHEATH (ITEM-1) TO BE JOINED TO HALF FRAME (ITEM-4) AND FULL FRAME (ITEM-5) WITH A CONTINUOUS PENETRATION WELD OF 1/16 MIN DEPTH.

BLADE
Fig. 12

BILL OF MATERIALS QUANTITIES ARE FOR 1 UNIT					
Item No.	PIECE NUMBER	NAME	No. Req'd	MATERIAL	REMARKS
	SL1J2183	FUEL ASSEMBLY			
1	SL1C2717	LIFTING FIXTURE	1		[illegible]
2	SL1D2456	PLATE, SUPPORT, TOP	1	AISI TYPE 347 SST	[illegible]
3	SL1C2459	POISON ROD ASSY.	2		[illegible]
4	SL1D2438	FUEL ELEMENT ASSY., STANDARD	60		[illegible]
5	SL1B2965	SPACER, LATTICE	98	AISI TYPE 348 SST	[illegible]
6	SL1C2761	GUIDE, FUEL	2	AISI TYPE 304 SST	[illegible]
7	SL1D2456	PLATE, SUPPORT, BOTTOM	1	AISI TYPE 347 SST	[illegible]
8	SL1J2183-01	PLUG	60	AISI TYPE 347 SST [illegible]	.3252 ±.0001 DIA. x 1/2 LONG
9	[illegible]	SOCKET HEAD CAP SCREW	2	AISI TYPE 316 SST	3/8-16 UNC-2A x 2 1/2 LONG



8. CLEAN FINAL ASSEMBLY BY DEGREASING WITH WARM DETERGENT SOLUTION, RINSING WITH DISTILLED WATER AND DRYING WITH LINT FREE CLOTH. CLEANING SOLUTIONS CONTAINING GREATER THAN 25 PPM OF CHLORIDES ARE PROHIBITED DURING ALL PHASES OF MANUFACTURING.

7. FINAL INSPECTION
THE FINISHED FUEL ASSEMBLY WILL BE PLACED IN AN EVACUATED CHAMBER AND SNIFF TESTED FOR HELIUM LEAKAGE. NO LEAKAGE SHOULD BE NOTED WITH AN INSTRUMENT CAPABLE OF MEASURING A LEAKAGE RATE OF 10-8 CC/SEC.

6. INSPECTION FOLLOWING SEAL WELDING:
THE SEAL WELDS WILL BE LIQUID PENETRANT CHECKED OVER THE EXPOSED AREA OF THE FUEL ELEMENT ITEM (4) FOR CRACKS, SEAMS, CREVICES, PITS AND OTHER SURFACE FLAWS.

5. FOLLOWING BRAZING THE FUEL ELEMENTS WILL BE EVACUATED THRU THE VENT HOLES AND FILLED WITH HELIUM. THIS WILL BE REPEATED UNTIL THE GAS INSIDE THE FUEL ELEMENTS IS 95% PURE HELIUM AT ATMOSPHERIC PRESSURE. PLUGS ITEM (8) WILL THAN BE PRESS INTO THE VENT HOLES AND THE ENDS SEAL WELED AND GROUND SMOOTH.

4. INSPECTION REQUIREMENTS:
(a) THE OUTER TWO ROWS OF ITEM (5) ARE TO BE BRAZED TO EACH ADJACENT FUEL ELEMENT FOR THE FULL LENGTH OF THE SPACER. THIS IS TO BE CHECKED BY VISUAL INSPECTION FOR FILLETS.
(b) EACH REMAINING SPACER IS TO BE BRAZED TO AT LEAST THREE OF THE FOUR ADJACENT FUEL ELEMENTS FOR FULL LENGTH OF THE SPACER.
(c) THE BRAZE ALLOY FOR THE JOINT JOINING ITEM (4) TO ITEMS (2) AND (7) WILL BE APPLIED TO THE INNER FACE OF THE SUPPORT PLATES. A BRAZED JOINT WILL BE ACCEPTABLE ONLY IF ALLOY IS OBSERVED AT THE OUTER FACE AFTER BRAZING. PLATE BRAZE SHALL BE CONSIDERED ACCEPTABLE IF BRAZE HAS BEEN MADE TO ALL THE OUTER ROWS OF FUEL ELEMENTS AND AT LEAST 75% OF THE REMAININGS ONES.

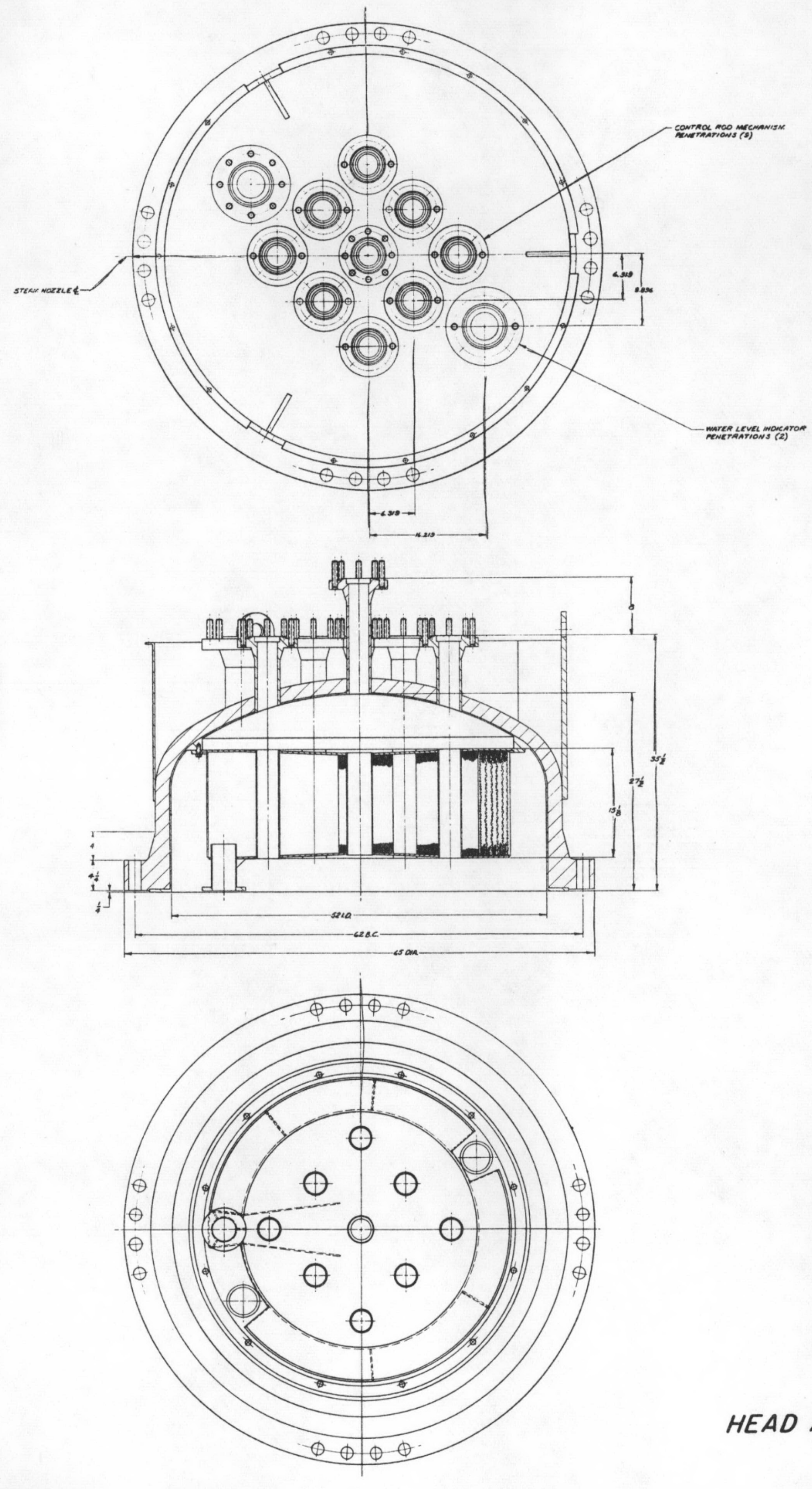
3. ITEM NOS. (2), (4), (5) AND (7) TO BE ASSEMBLED AND BONDED, FORMING ONE INTEGRAL UNIT IN ACCORDANCE WITH BRAZE PROCEDURE.

2. BORON ROD ASSEMBLY ITEM NO. (3) TO BE REMOVEABLE AT INITIAL ASSEMBLY AND TO BE WELDED IN PLACE TO ITEM NO. (2) AFTER COLD CRITICALITY TEST.

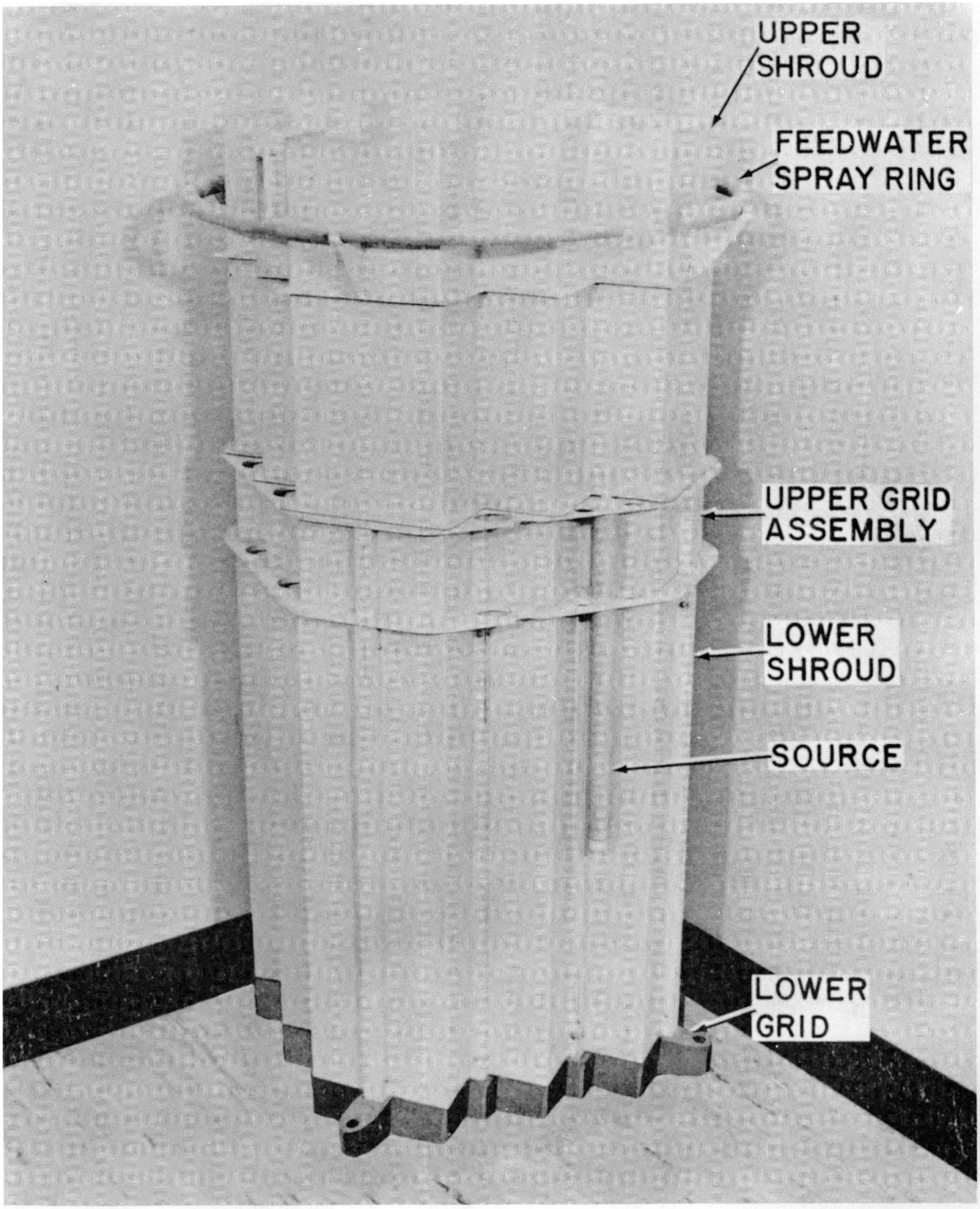
1. BEFORE BRAZING INSURE THAT EACH FUEL ELEMENT IS ORIENTED SUCH THAT THE VENT HOLE IS AT THE TOP.

SL1J2183 A

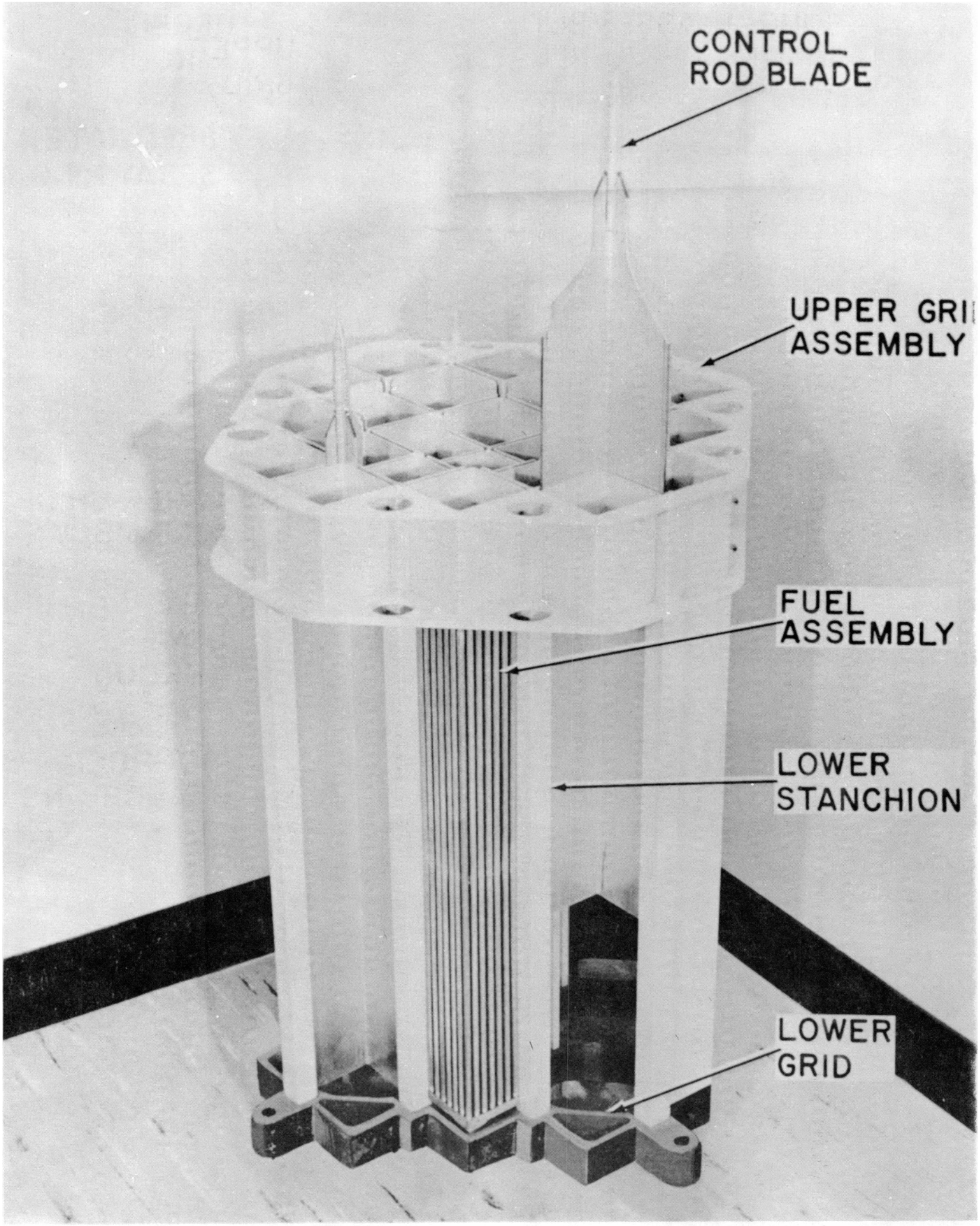
FUEL ASSEMBLY
Fig. 13



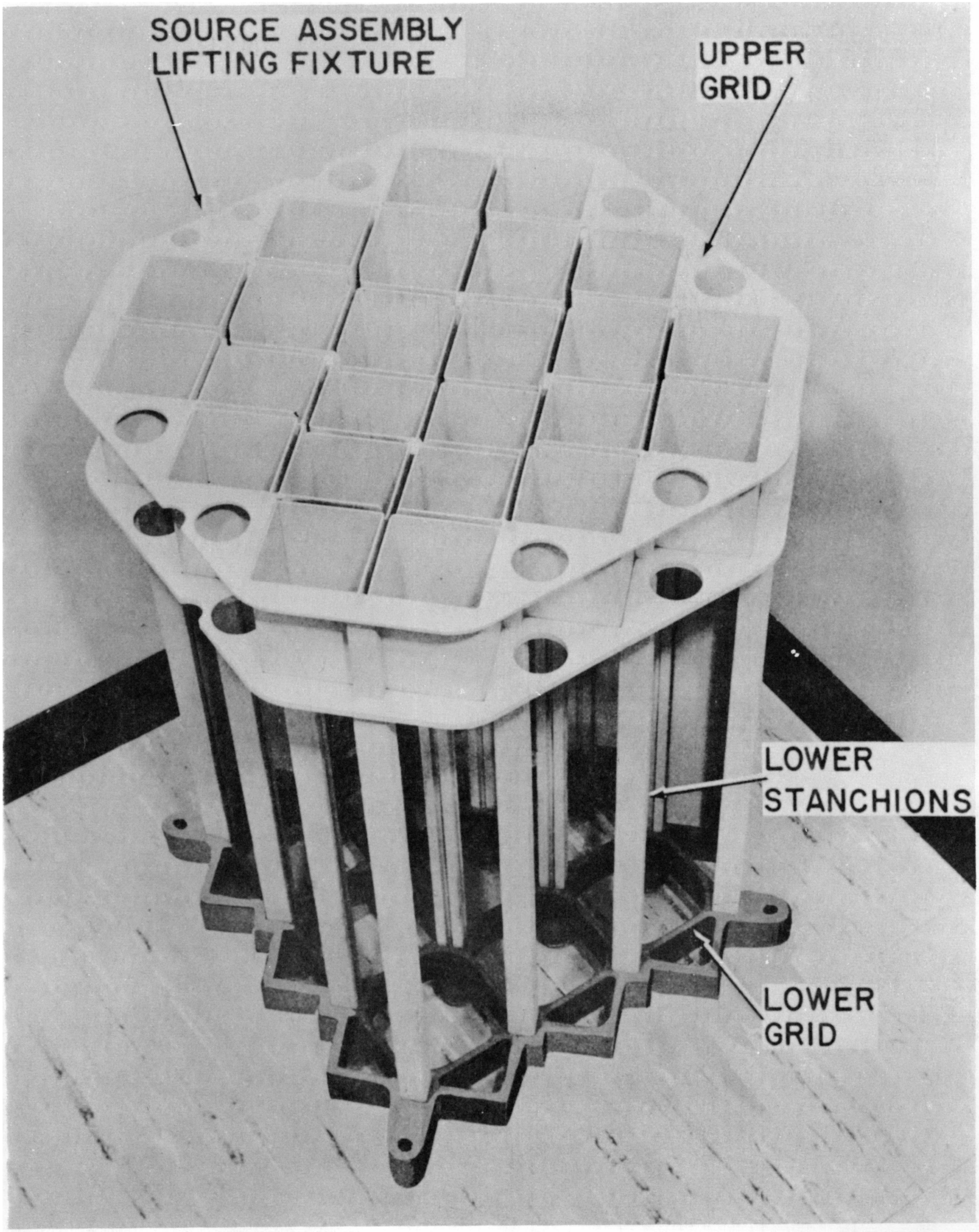
HEAD ASSEMBLY
Fig. 14



HALF SCALE CORE STRUCTURE MOCKUP
Fig. 15



HALF SCALE CORE STRUCTURE MOCKU
Fig.

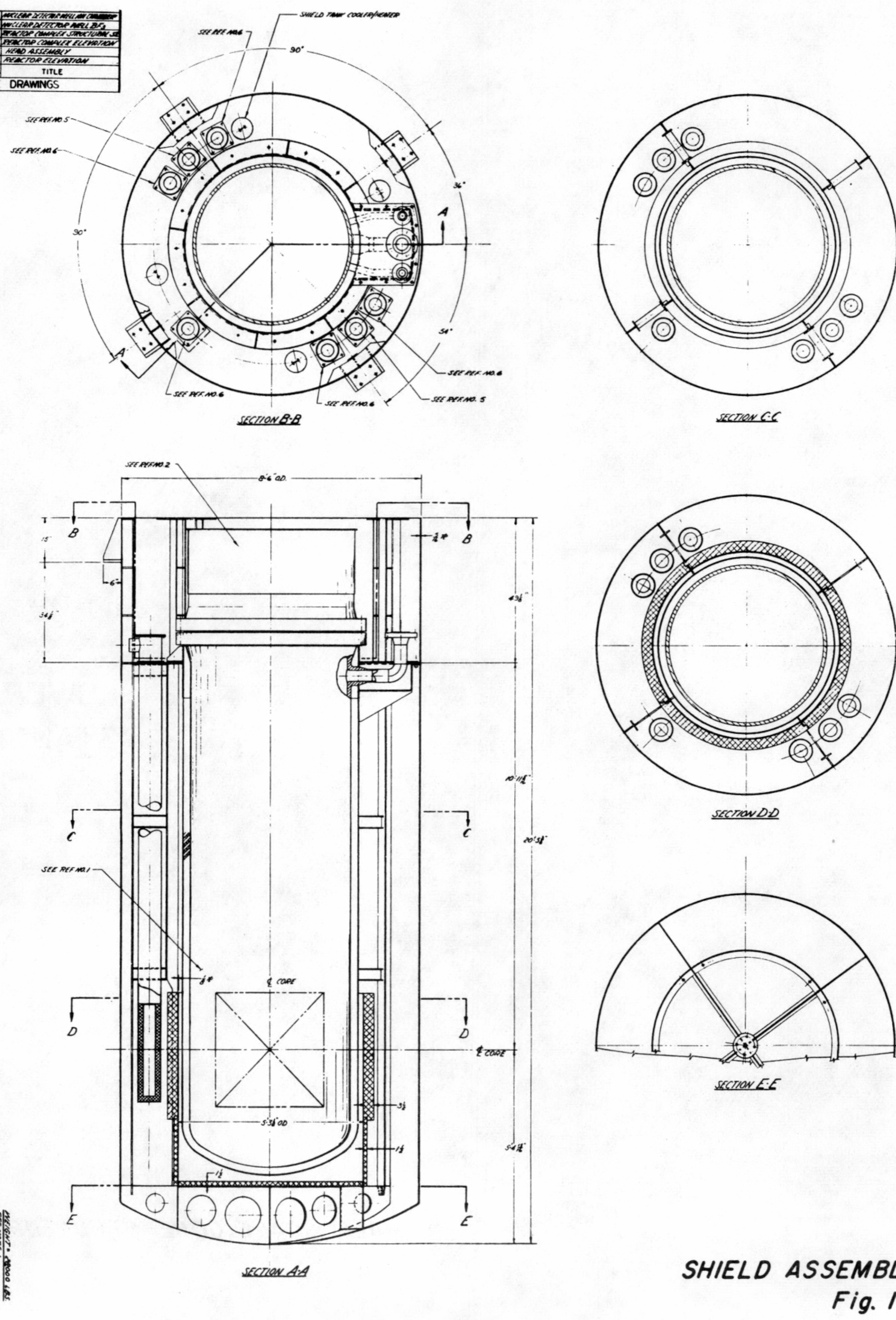


HALF SCALE CORE STRUCTURE MOCKUP
Fig. 17

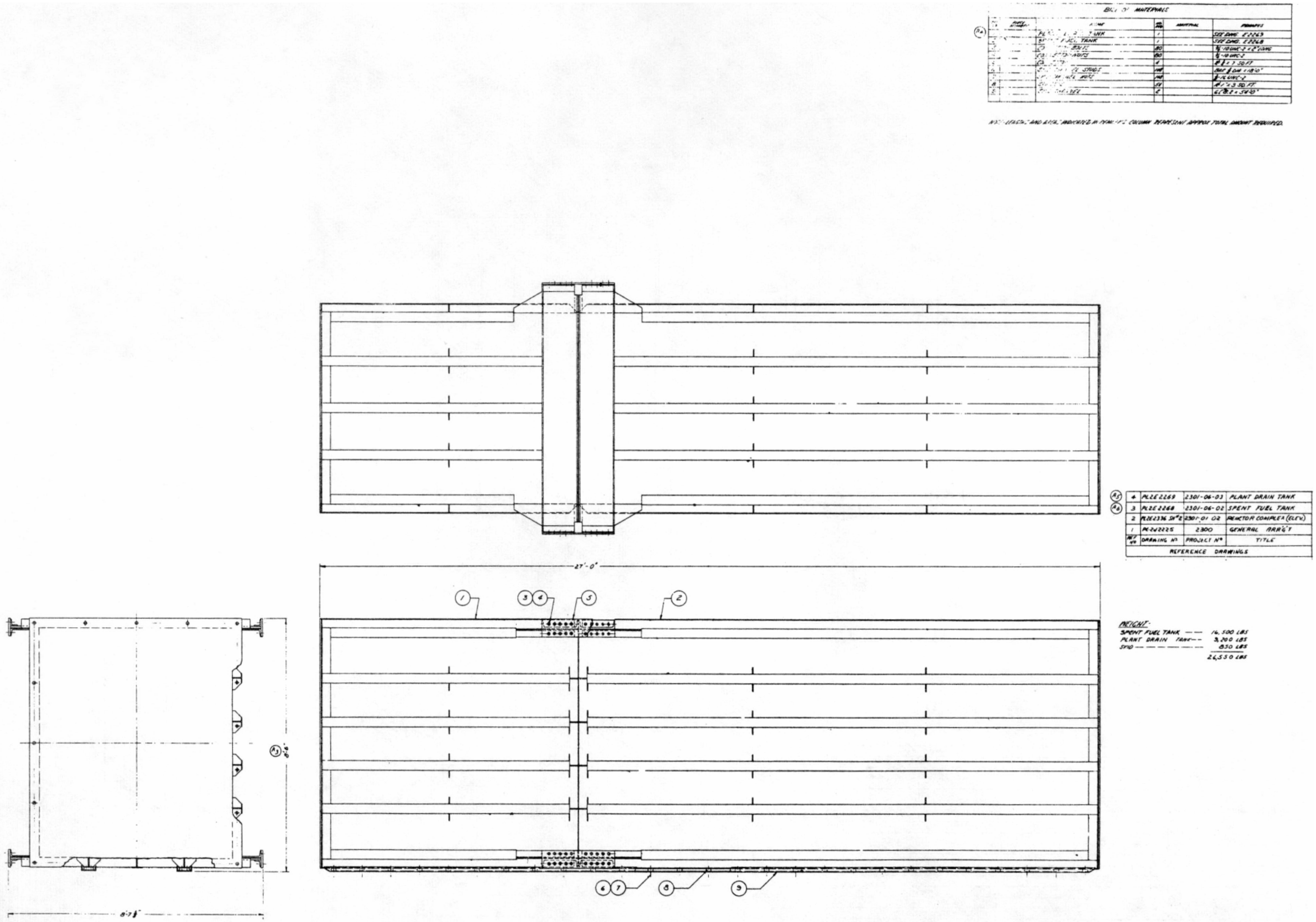
1- REACTOR VESSEL, REACTOR HEAD, NUCLEAR DETECTOR WELLS AND SHIELD TANK HEATER-COOLERS ARE SHOWN FOR LOCATION REF. ONLY. WEIGHT INDICATED REFERS TO SHIELD ASSY. ONLY.

REF NO	DRAWING NO.	PROJECT NO.	TITLE
6	PL2J 2151	2301-05-02	NUCLEAR DETECTOR WELL ION CHAMBER
5	PL2J2150	2301-05-01	NUCLEAR DETECTOR WELL BF_3
4	PL2E 2246	2300-03	REACTOR COMPLEX STRUCTURAL SE
3	PL2E2536 SHT2	2300-01-02	REACTOR COMPLEX ELEVATION
2	PL2J 2221		HEAD ASSEMBLY
1	PL2J2220		REACTOR ELEVATION

REFERENCE DRAWINGS

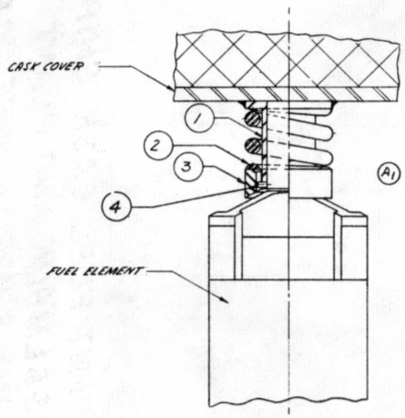


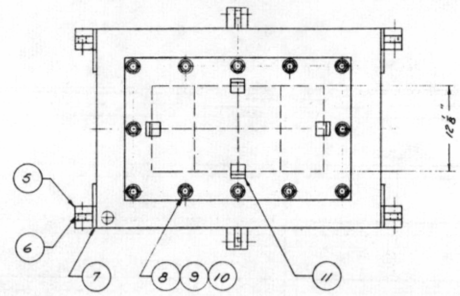
SHIELD ASSEMBLY
Fig. 18



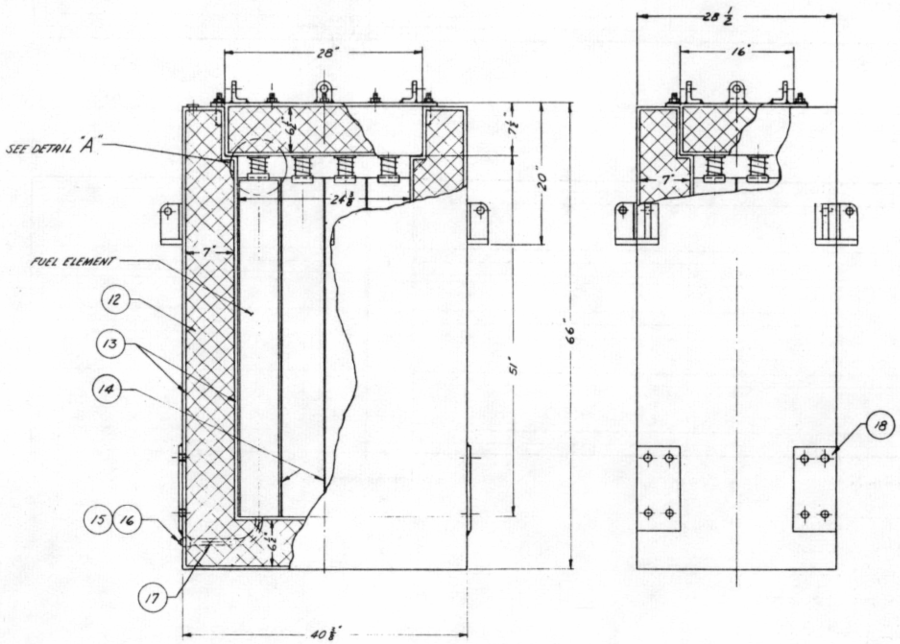
SPENT FUEL TANK AND PLANT DRAIN TANK SHIPPING ASSEMBLY

Fig. 19





ITEM Nº	PIECE Nº	NAME	Nº REQ	MATERIAL	REMARKS
1		SPRING GUIDE	8		BAR, 3" DIA x 3½" LONG
2		SPRING	8		3" OD x 2½ LONG, ½ DIA ROD
3		SPRING FOLLOWER	8		BAR, 3" DIA x 1½" LONG
4		RETAINING PIN	24		ROD, ⅜ DIA x ¾" LONG
5		SUPPORT	6		PL ½ x 3 x 3
6		LIFTING LUG	6		PL ½ x 2½ x 5½
7		BACK PLATE	6		PL ½ x 3 x 5½
8		WASHER	12		PL ¼ x 3" DIA.
9		NUT	12		¾"-10 UNC-2
10		STUD	12		¾"-10 UNC-2, 4½" LONG, THD 2"
11		COVER LIFTING LUG	4		PL ½" x 3 x 5" LONG
12		LEAD	—		21,300 LBS
13		SKIN	1		¼" PL x 145 SQ FT
14		SEPARATORS	4		⅛ PL x 24 SQ FT
15		PLUG	1		1" STD
16		COUPLING	1		1" STD
17		PIPE	1		1" SCH 40 x 18" LONG
18		TIE DOWN PADS	4		PL ½ x 6" x 12"



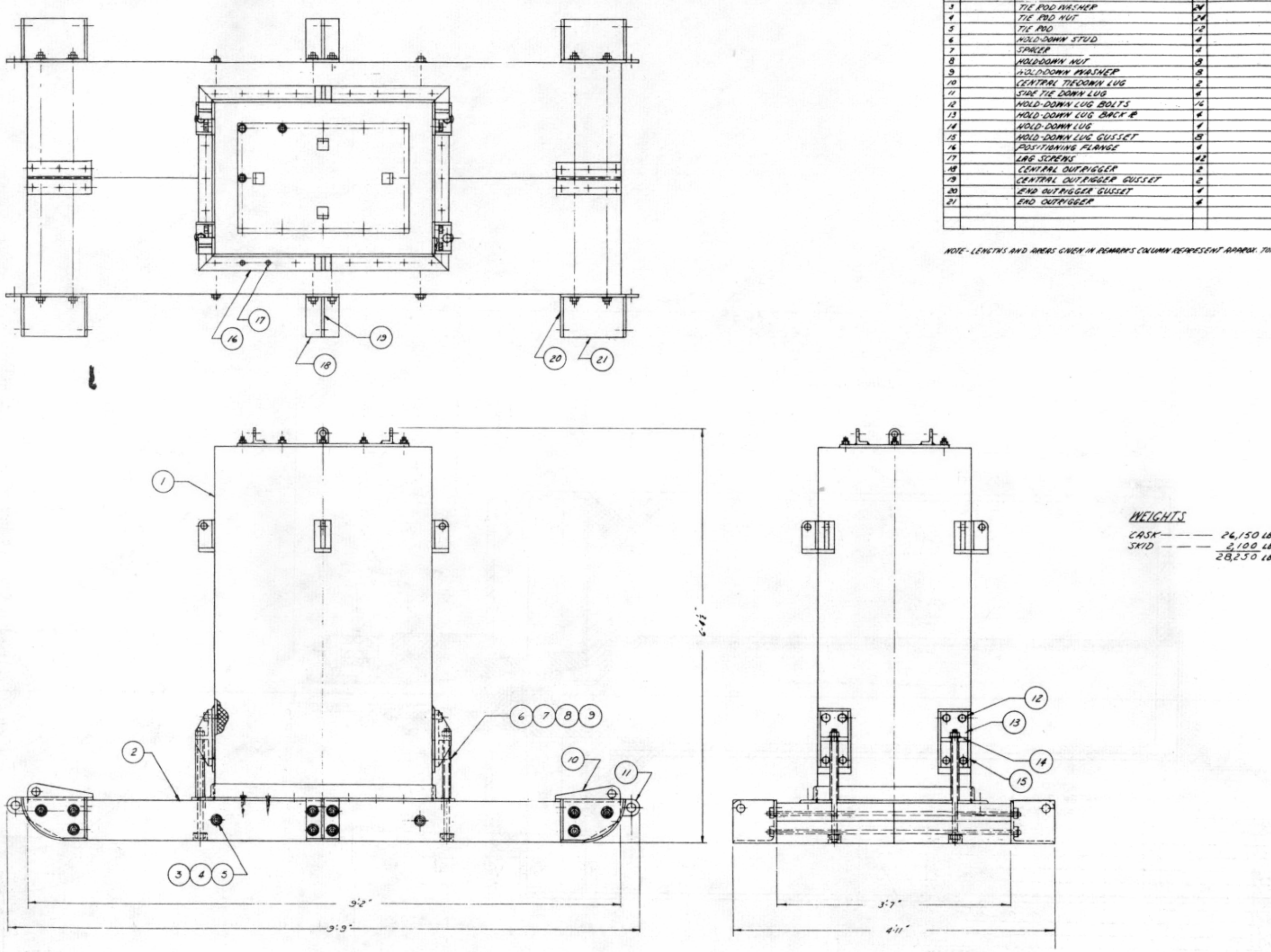
WEIGHTS

CASK	24,600 LBS.
FUEL ELEMENTS (8)	1,200 LBS
WATER	350 LBS
	26,150 LBS

SPENT FUEL SHIPPING CASK
Fig. 20

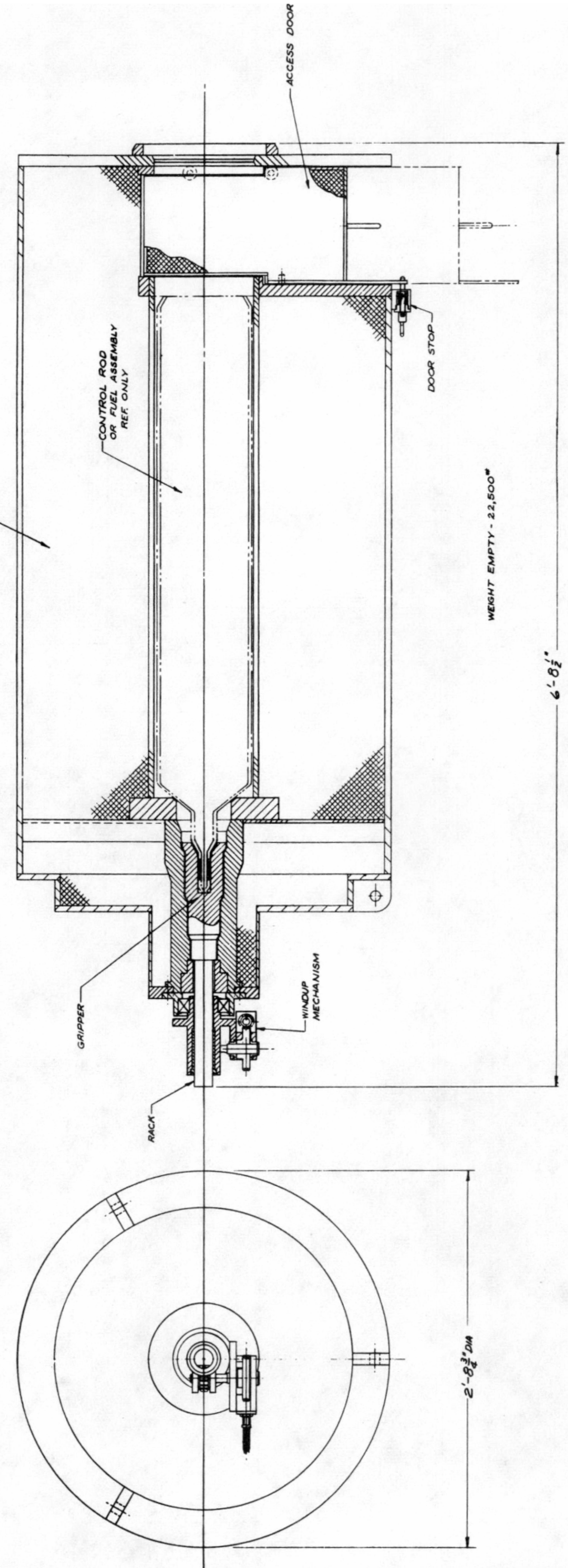
BILL OF MATERIALS					
ITEM NO.	PIECE NUMBER	NAME	NO. REQ.	MATERIAL	REMARKS
1		SPENT FUEL CASK	1		SEE DWG D-2407
2		SKID TIMBER	1		8"x22"x 18'4"
3		TIE ROD WASHER	24		3/4" DIA AMER. STD.
4		TIE ROD NUT	24		3/4-10UNC-2
5		TIE ROD	12		BAR, 3/4 DIA x 48'-0"
6		HOLD-DOWN STUD	4		BAR 1 1/4 DIA. x 7'-0"
7		SPACER	4		PIPE 1 1/4 DIA SCH40 x 4'-0"
8		HOLDDOWN NUT	8		1 1/4-7UNC-2
9		HOLDDOWN WASHER	8		1 1/4 DIA AMER. STD.
10		CENTRAL TIEDOWN LUG	2		PL 1/2" x 2.5 SQ FT
11		SIDE TIE DOWN LUG	4		PL 1/2" x .5 SQ FT
12		HOLD-DOWN LUG BOLTS	16		1"-8UNC-2 x 2" LONG
13		HOLD-DOWN LUG BACK PL	4		PL 1/2 x 2 SQ FT
14		HOLD-DOWN LUG	4		PL 1/2 x .5 SQ FT
15		HOLD-DOWN LUG GUSSET	8		PL 1/2 x 2 SQ FT
16		POSITIONING FLANGE	4		L 3x3 x 1/2 x 14'
17		LAG SCREWS	42		1/2 DIA x 4" LONG
18		CENTRAL OUTRIGGER	2		L 8x8 x 1/2" x 1'-8"
19		CENTRAL OUTRIGGER GUSSET	2		PL 1/2" x 2 SQ FT
20		END OUTRIGGER GUSSET	4		PL 1/2 x 4 SQ FT
21		END OUTRIGGER	4		L 8x8 x 5'-6" LONG

NOTE - LENGTHS AND AREAS GIVEN IN REMARKS COLUMN REPRESENT APPROX. TOTAL AMOUNTS REQUIRED



SPENT FUEL CASK SHIPPING ASSEMBLY

Fig. 21

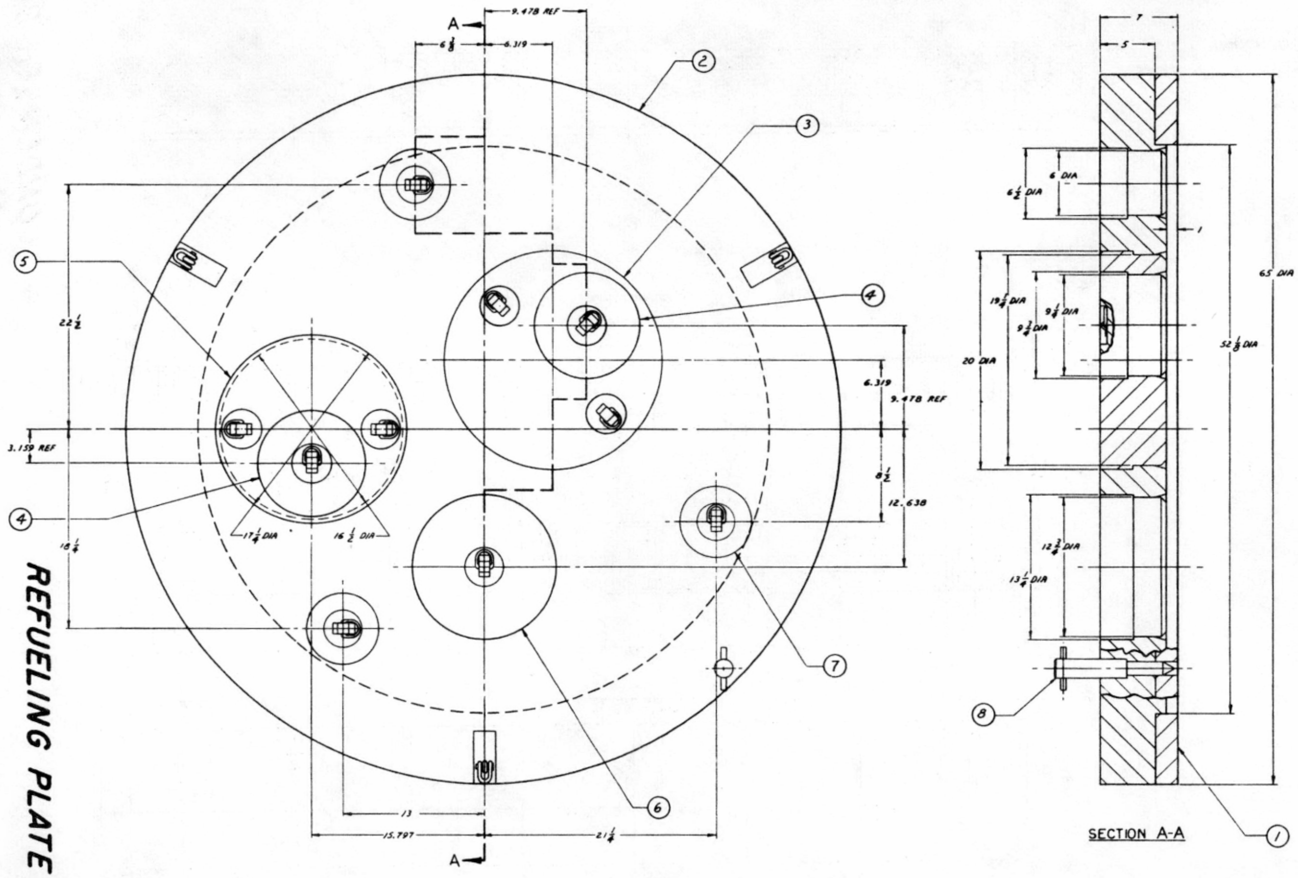


TRANSFER CASK ASSEMBLY
Fig. 22

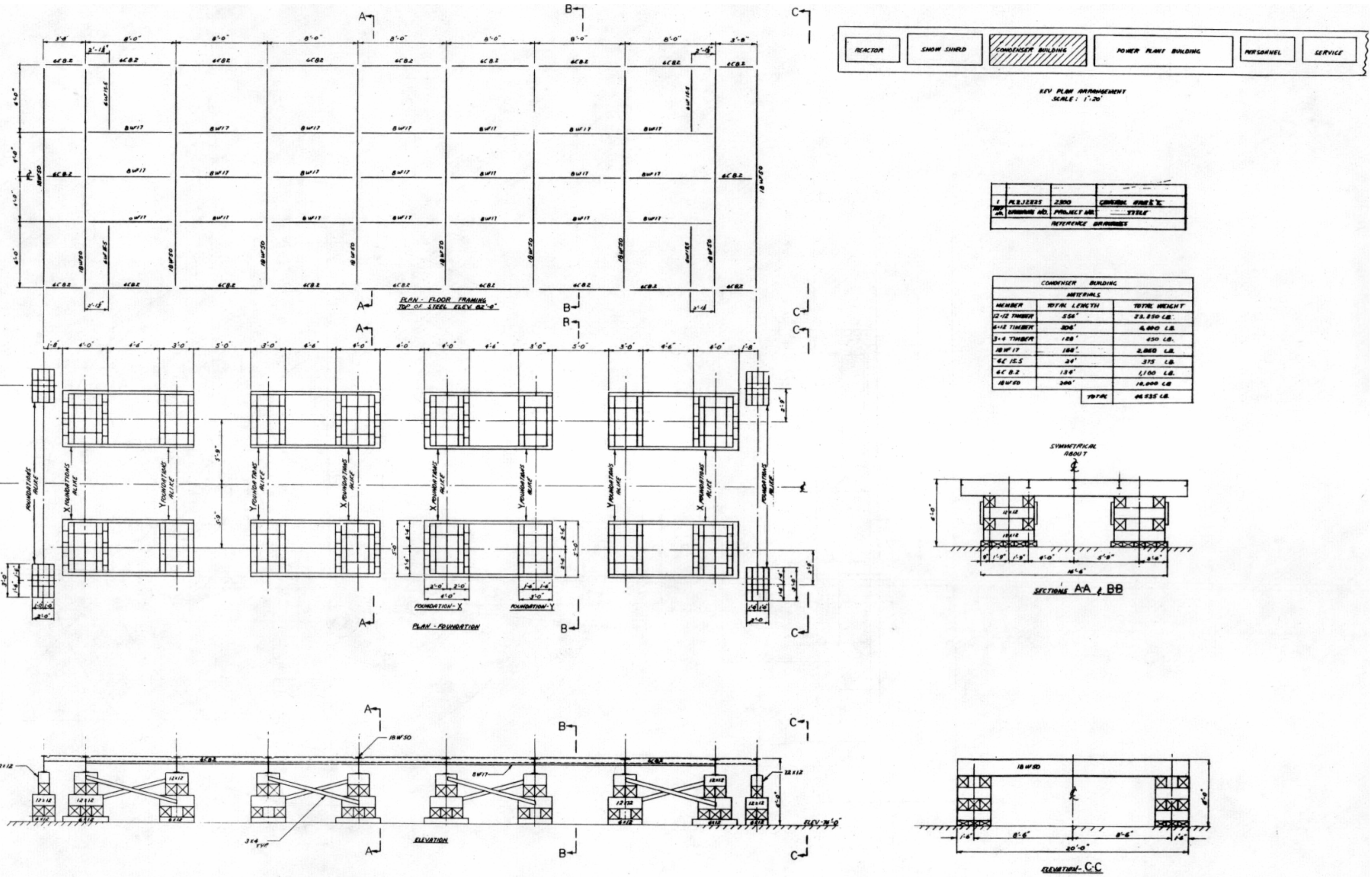
BILL OF MATERIALS
QUANTITIES ARE FOR UNITS

ITEM NO.	PIECE NUMBER	NAME	NO. REQ'D	MATERIAL	REMARKS
1		ALIGNMENT RING	1	304 SST	
2		SUPPORT PLATE	1	304 SST	
3		QUADRANT ACCESS PLUG	1	304 SST	
4		FUEL ACCESS PLUG	2	304 SST	
5		PERIPHERAL ACCESS PLUG	1	304 SST	
6		CONTROL ROD ACCESS PLUG	1	304 SST	
7		TOOL ACCESS PLUG	3	304 SST	
8		INDEXING PIN	1	304 SST	

ESTIMATED WEIGHT: 6100#



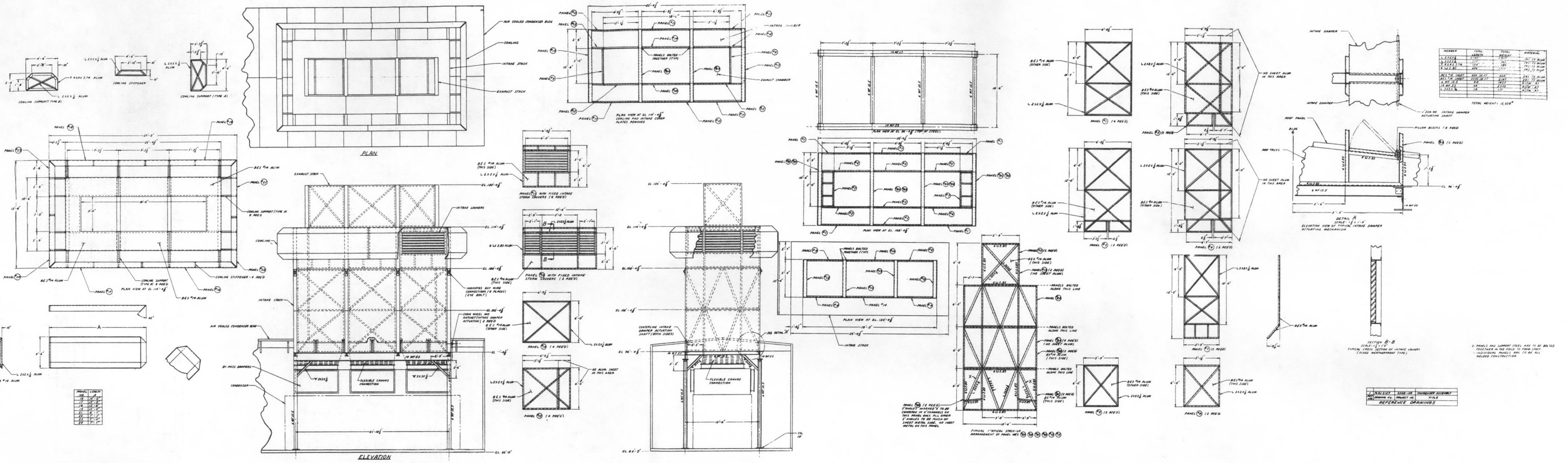
REFUELING PLATE ASSEMBLY
Fig. 23



CONDENSER BUILDING		
MATERIALS		
MEMBER	TOTAL LENGTH	TOTAL WEIGHT
12x12 TIMBER	556'	23,250 LB.
4x12 TIMBER	304'	6,000 LB.
3x4 TIMBER	128'	450 LB.
18WF17	168'	2,060 LB.
6[15.5	24'	375 LB.
6[8.2	134'	1,100 LB.
18WF50	200'	10,000 LB.
	TOTAL	44,535 LB.

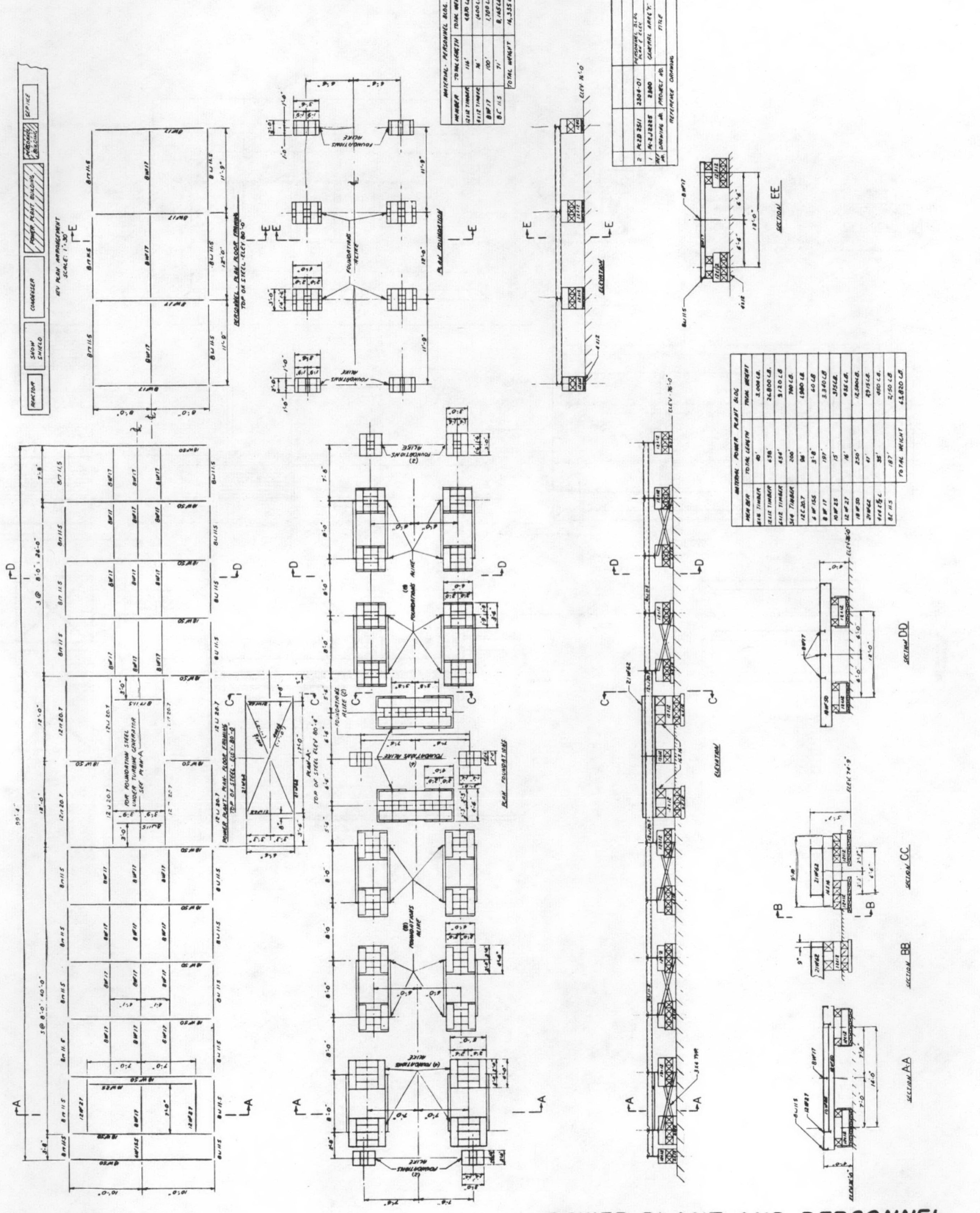
CONDENSER BUILDING FOUNDATION

Fig. 24



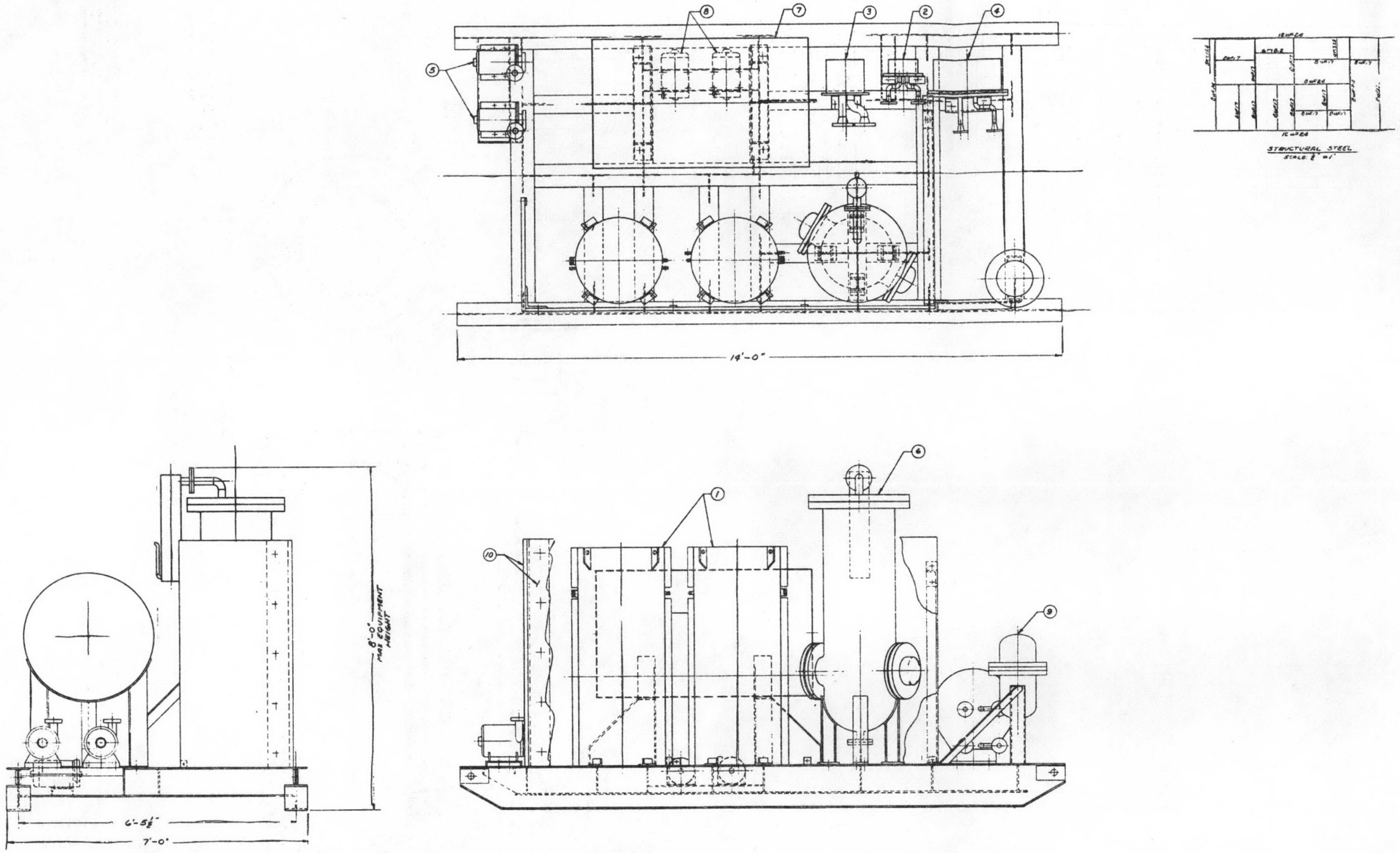
CONDENSER EXHAUST AND INLET STACK ASSEMBLY

Fig. 25



POWER PLANT AND PERSONNEL BUILDING FOUNDATION

Fig. 26



COMPONENTS LIST				
ITEM NO.	NAME	NO. REQ'D	WEIGHT	REMARKS
1	DEMINERALIZER	2	15,600	
2	1st STAGE HEAT EXCHANGER	1	150	
3	2nd STAGE HEAT EXCHANGER	1	300	
4	SPENT FUEL PIT COOLER	1	500	
5	PURIFICATION PUMPS	2	400	
6	EVAPORATOR	1	1,200	
7	DISPOSAL TANK	1	650	
8	DISPOSAL TANK PUMPS	2	300	
9	POISON CYLINDER	1	800	
10	SHIELDING		3,120	
	PIPING, VALVES, FITTINGS AND CONTROLS		2,350	
	SKID BASE AND STRUCTURALS		2,600	
	TOTAL		28,120	

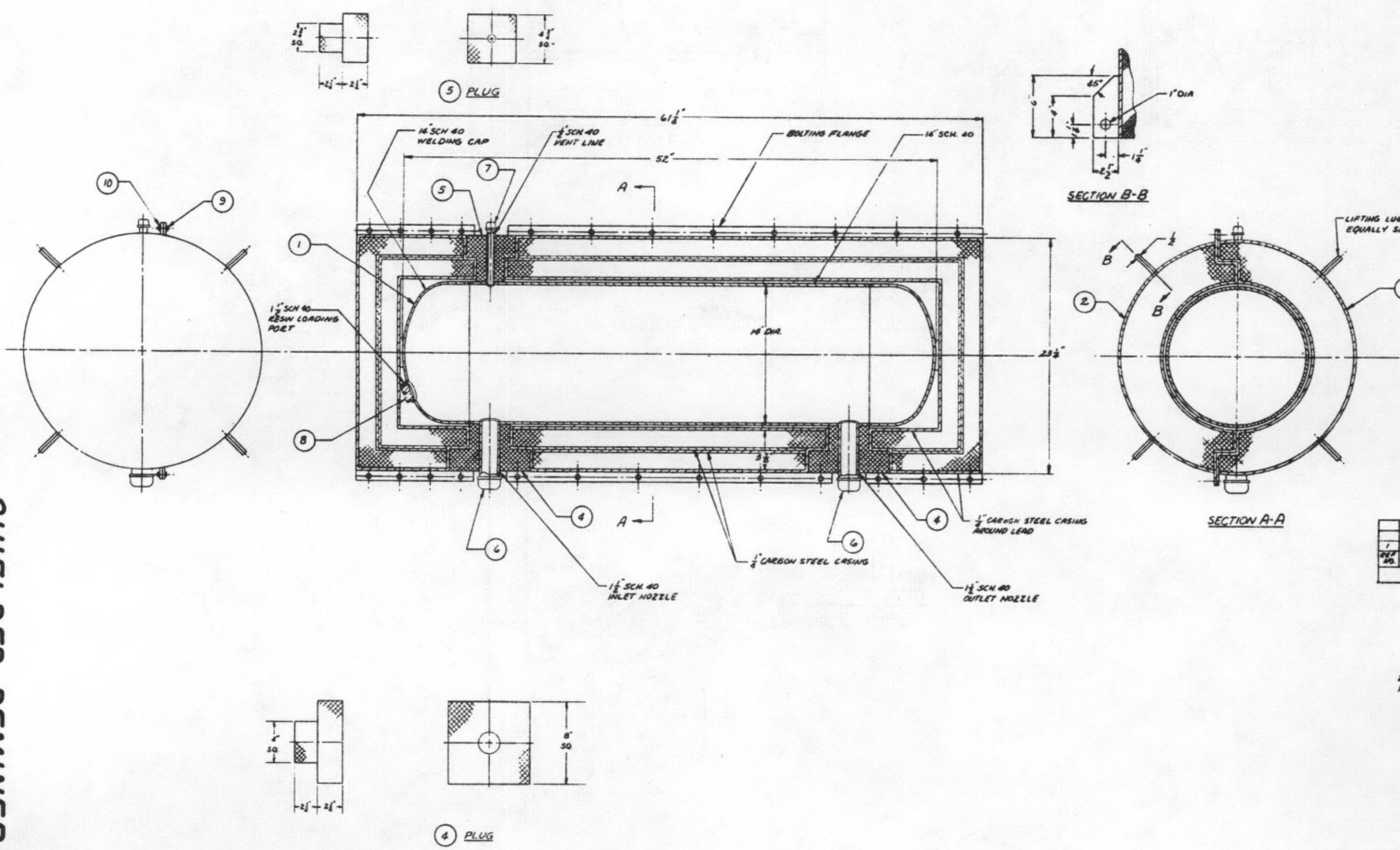
REF NO.	DWG NO.	PROJECT NO.	TITLE
1	PCE-12886	2300	GENERAL ARRANGEMENT (SHOW TUNNEL)

REFERENCE DRAWINGS

PURIFICATION SKID MACHINERY ARRANGEMENT

Fig. 27

BILL OF MATERIALS QUANTITIES ARE FOR UNITS					
ITEM NO.	PIECE NUMBER	NAME	NO. REQ.	MATERIAL	REMARKS
1		DEMINERALIZER TANK	1	304 SST.	
2		LEAD CASING ASSEMBLY	1		
3		LEAD CASING ASSEMBLY	1		
4		PLUG	2	LEAD	SEE NOTE 2
5		PLUG	1	LEAD	SEE NOTE 2
6		CAP	2	304 SST.	1½ NPT
7		CAP	1	304 SST.	½ NPT
8		PLUG	1	304 SST.	1½ NPT
9		BOLT	25	CARBON STEEL	½-13UNC-2A x 1¼ LONG
10		NUT	25	CARBON STEEL	½-13UNC-2B

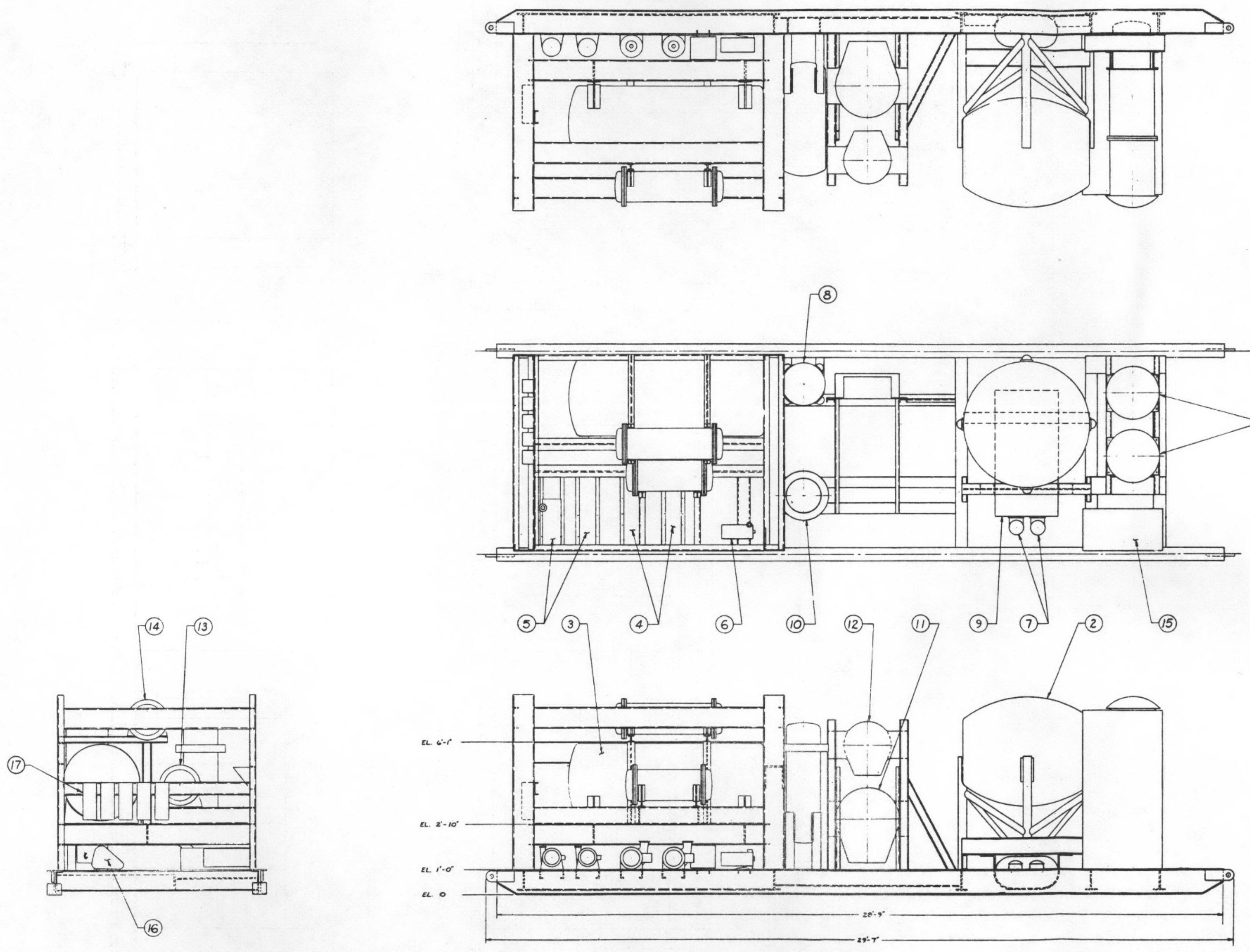


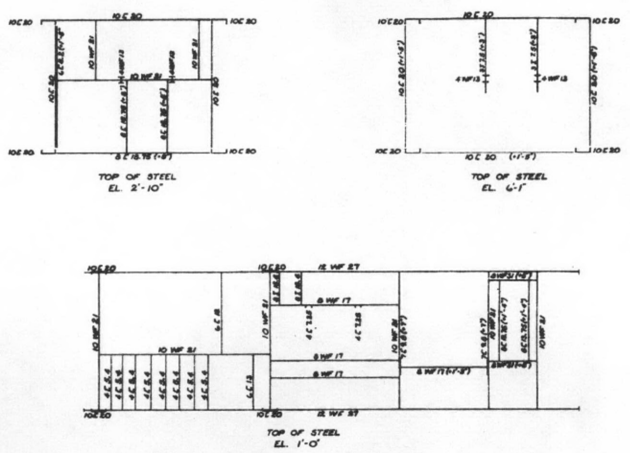
1	PL2J2226	2303-04-02	PURIFICATION SKID
REF NO.	DRAWING NO.	PROJECT NO.	TITLE
REFERENCE DRAWINGS			

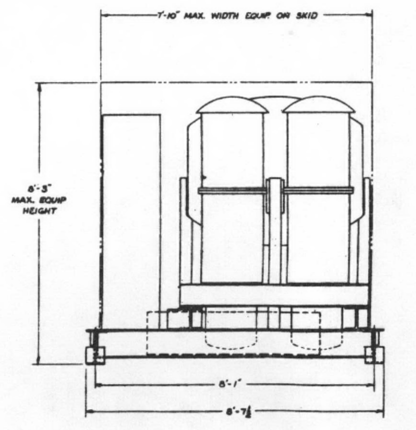
2. ALL LEAD PLUG HOLES MUST BE MOLDED TO MATCH PIPE OL
1. ALL MALE PIPE THREADS AND RESIN PORT PLUG THREADS TO BE CHROME PLATED .0002 TO .0006 THICK IN ACCORDANCE WITH ASTM SPEC. B177-55. ABRASIVE CLEANING (PARA 3-6) AND POST PLATING TREATMENT (PARA 7-6) ARE REQUIRED.

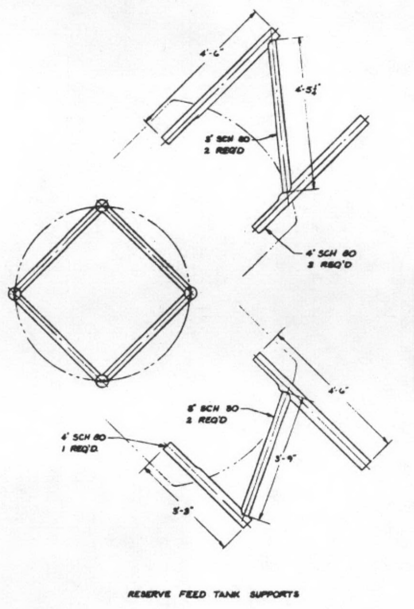
SHIELDED DEMINERALIZER ASSEMBLY

Fig. 28









COMPONENTS LIST

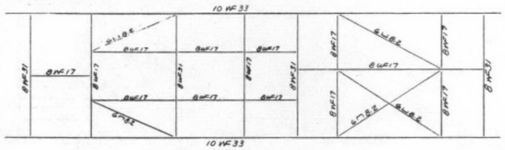
ITEM NO.	NAME	NO REQ'D	WEIGHT	REMARKS
1	FEED PUMP	2	8000	
2	RESERVE FEED TANK	1	1000	
3	HOTWELL	1	800	
4	CONDENSATE PUMP	2	500	
5	PLANT HEATING PUMP	2	280	
6	MAKE UP FEED PUMP	1	70	
7	LOW PRESSURE DRAIN PUMP	2	220	
8	MAKE UP FEED TANK	1	250	
9	LOW PRESSURE DRAIN TANK	1	600	
10	RAW WATER DEMINERALIZER	1	750	
11	LUBE OIL INTERCOOLER	1	866	
12	SPACE HEAT EXCHANGER	1	807	
13	AFTER CONDENSER	1	1010	
14	PRECOOLER	1	1220	
15	FEED PUMPS STARTER	1	800	
16	DUPLEX DRAIN CONTROLLER	1	125	
17	STARTERS	5	115	
	VALVES, PIPE LINES, SUPPORTS & TRAPS (ESTIMATED)		4226	
	TOTAL EQUIPMENT WEIGHT		17298	
	MISC. ELECTRICAL, WIRING & INSTALLATION		725	
	STRUCTURAL STEEL IN SKID		7162	
	TOTAL FOR EQUIPMENT AND FOUNDATION		29526	

REFERENCE DRAWINGS

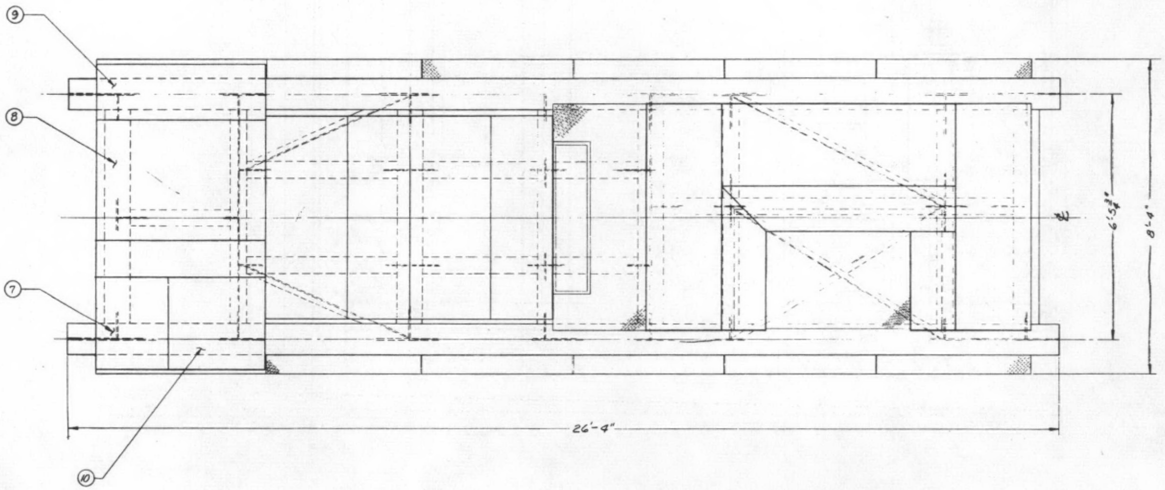
REF. NO.	DRAWING NO.	PROJECT NO.	TITLE
1	PL2J2225	2300	GENERAL ARRANGEMENT

FEED AND CONDENSATE SKID MACHINERY ARRANGEMENT

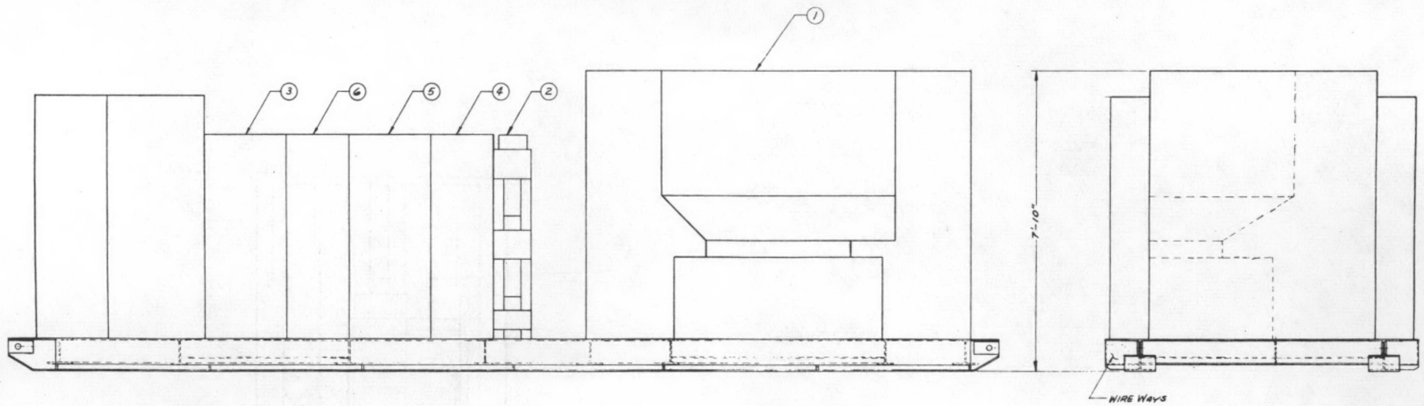
Fig. 29



COMPONENTS LIST			
ITEM №	NAME	WEIGHT	REMARKS
1	PLANT CONTROL CONSOLE	4,787	
2	BATTERIES	982	
3	METAL CLAD SWITCHGEAR, AUXILIARY CABINET	1,721	
4	METAL CLAD SWITCHGEAR, STATION FEEDER CAB	2,013	
5	METAL CLAD SWITCHGEAR INSTRUMENT AND CONTROL CAB	4,886	
6	METAL CLAD SWITCHGEAR GENERATOR CABINET		
7	POWER CENTER DISTRIBUTION CENTER	5,512	
8	POWER CENTER TRANSFORMER SECTION		
9	POWER CENTER HIGH VOLTAGE INLET		
10	GROUNDING REACTOR	1,628	
	SKID BASE AND STRUCTURALS	5,335	
	TOTAL WEIGHT	26,864	

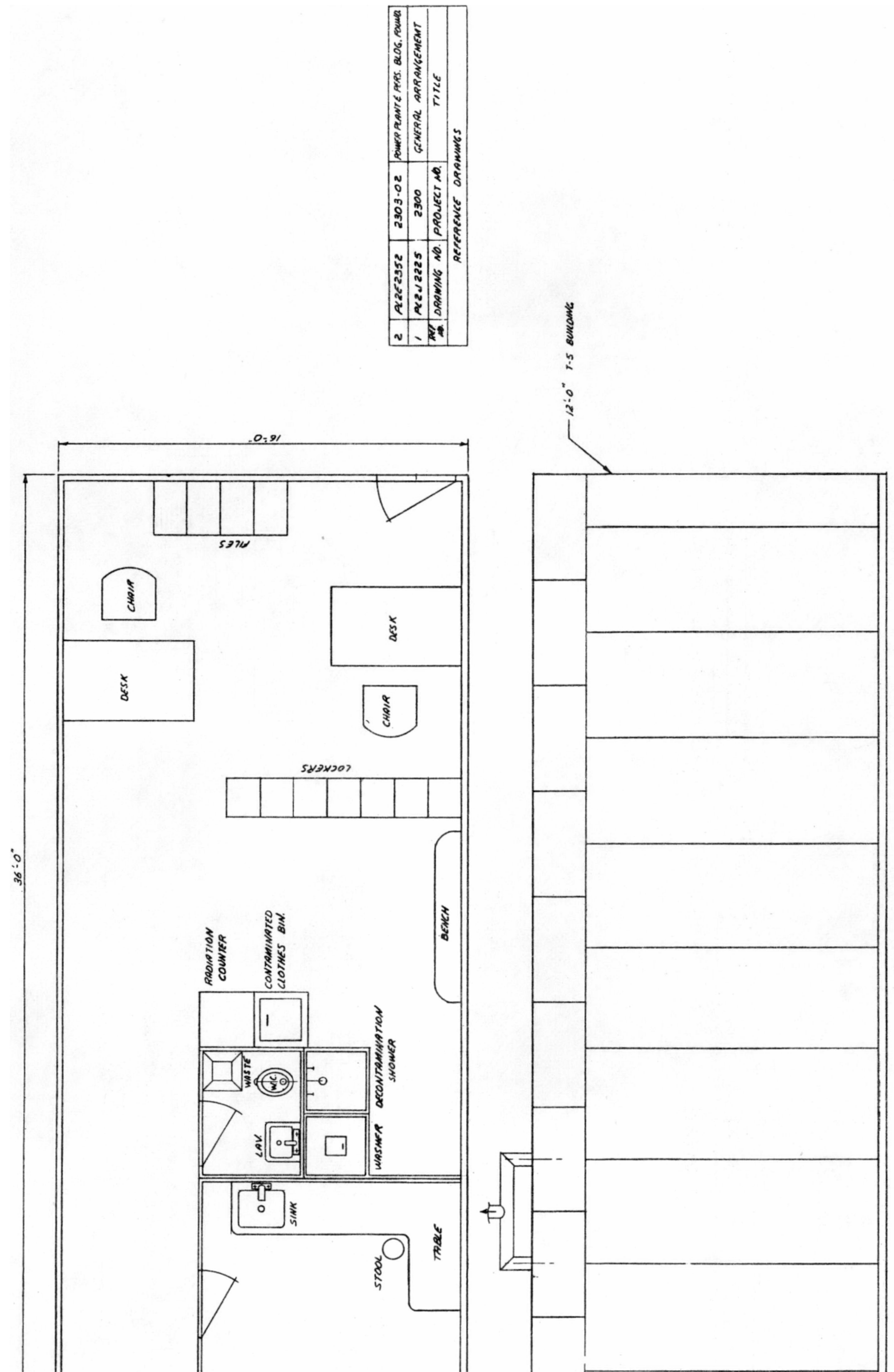


2	PL2J2231	2303-08-04	PLANT CONTROL CONSOLE
1	PL2J2226	2300	GENERAL ARRANGEMENT (SNOW TUNNEL)
REF №	DWG №	PROJECT №	TITLE
REFERENCE DRAWINGS			



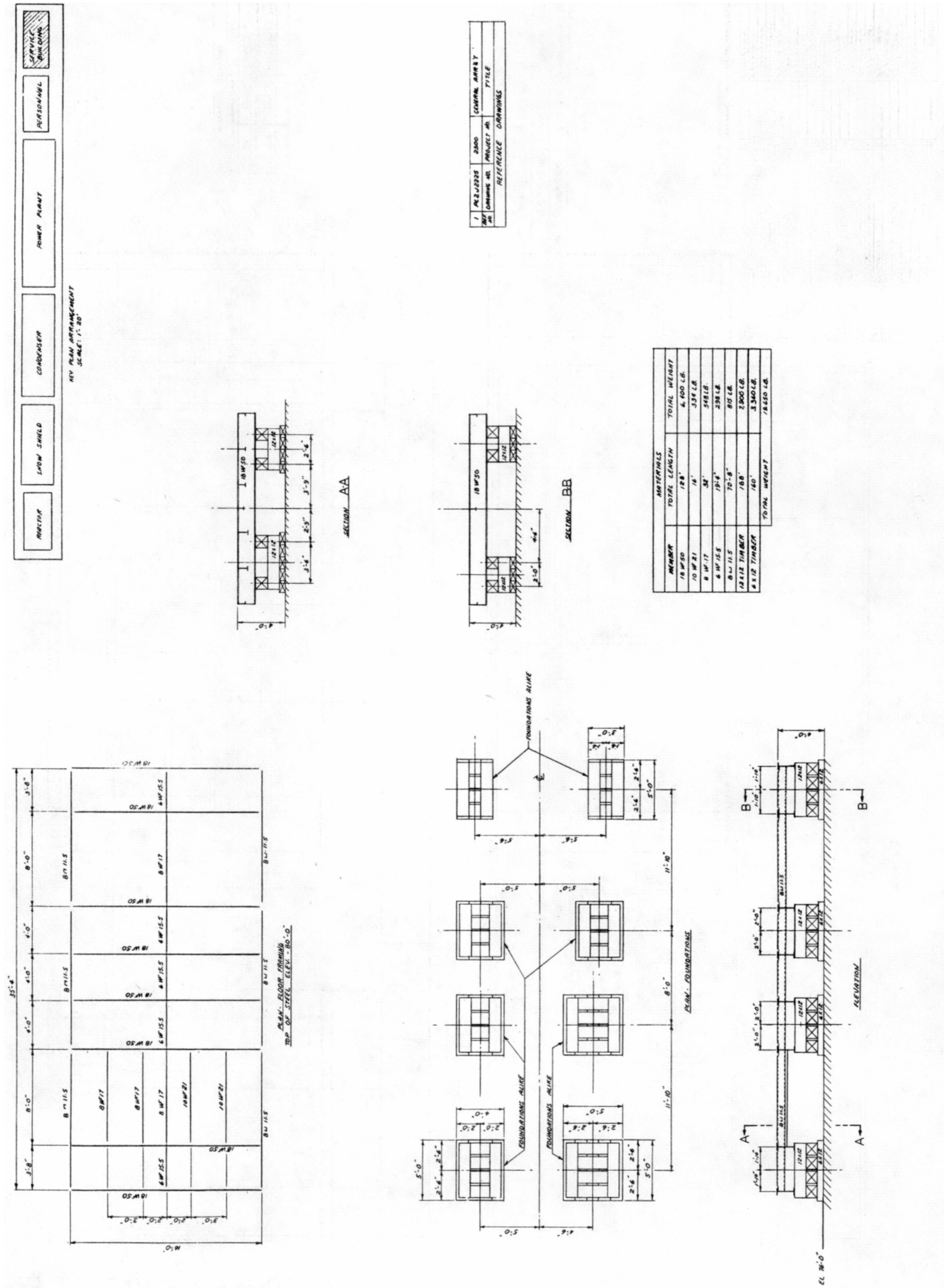
ELECTRICAL SKID MACHINERY ARRANGEMENT

Fig. 30



PERSONNEL BUILDING PLAN AND ELEVATION

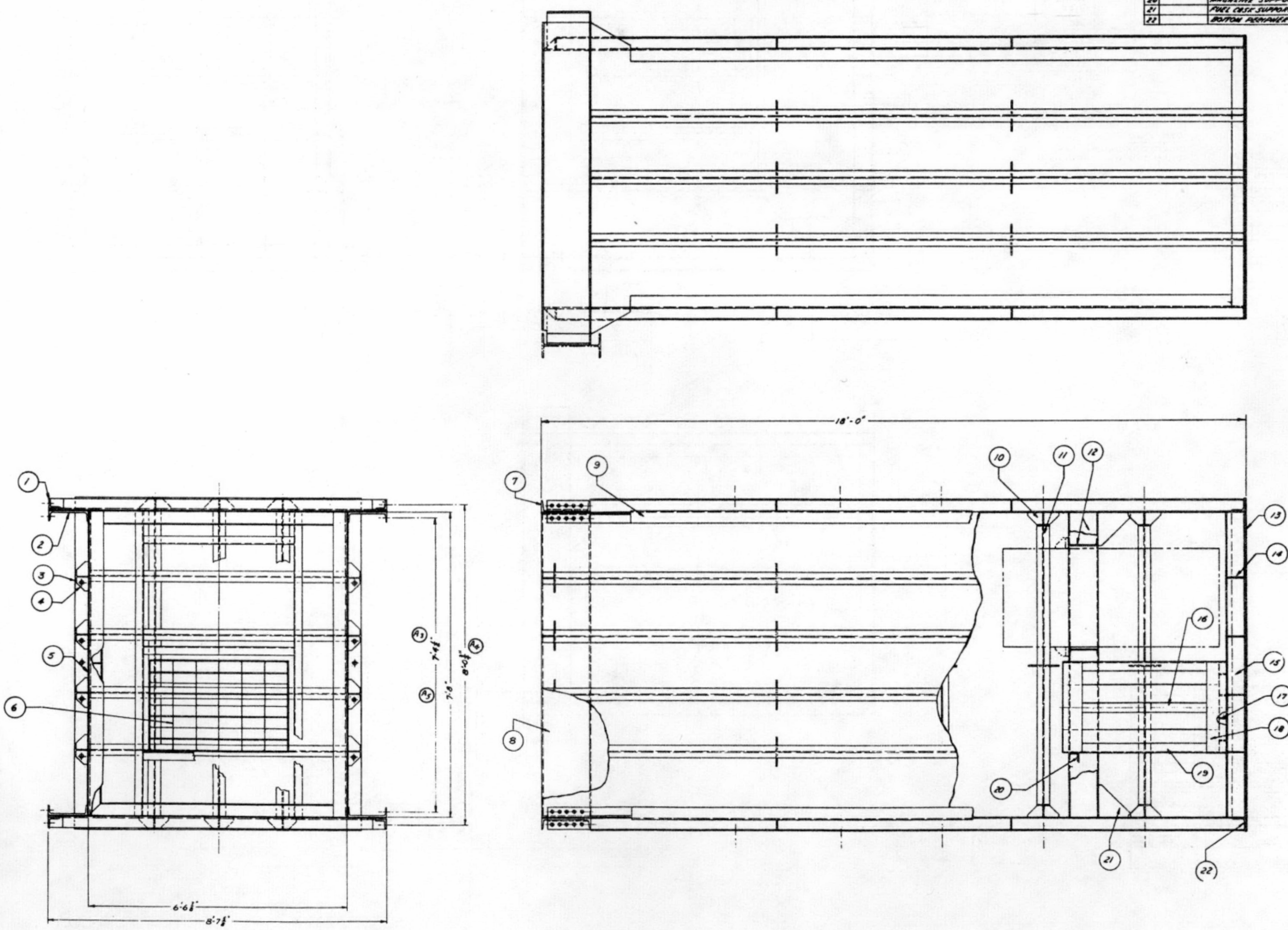
Fig. 31



SERVICE BUILDING FOUNDATION
Fig. 32

BILL OF MATERIALS					
ITEM NO.	PART NUMBER	NAME	QTY. REQ'D	MATERIAL	REMARKS
1		HANGER ANGLE	4		L 3×3×3/8×5'-0"
2		HANGER CHANNEL	4		12 [30×9'-0"
3		VERTICAL STIFFENER	14		ST4B 6.5×250'-0"
4		VERTICAL STIFFENER GUSSET	34		R 3/8×10 SQ.FT.
5		SIDE SKIN	4		R 3/8×530 SQ.FT.
6		SEPARATORS	6		R 3/8×145 SQ.FT.
7		HORIZONTAL SUPPORT CHANNEL	2		15 [50×18'-0"
8		INTERIOR SUPPORT CHANNEL	2		15 [50×16'-0"
9		CORNER POST	4		L 4×4×3/8×65'-0"
10		HORIZONTAL STIFFENER GUSSET	20		R 3/8×6 SQ.FT.
11		HORIZONTAL STIFFENER	20		ST4B 6.5×8'-0"
12		FUEL CASK SUPPORT CHANNEL	4		9 [13.4×24'-0"
13		BOTTOM SKIN	1		R 3/8×133 SQ.FT.
14		BOTTOM STRINGERS	4		ST6B 8.25×26'-0"
15		BOTTOM BEAMS	3		6 I 17.25×24'-8"
16		MAGAZINE CONNECTING PLATE	4		R 3/8×3 SQ.FT.
17		ELEMENT SUPPORTS	4		BAR 3/8×2×14'-0"
18		MAGAZINE SKIRT	1		R 3/8×12 SQ.FT.
19		MAGAZINE CORNER POST	4		L 3×3×3/8×18'-0"
20		MAGAZINE SUPPORT	1		L×3×3×3/8×4'-0"
21		FUEL CASK SUPPORT CHANNEL GUSSET	4		R 3/8×4 SQ.FT.
22		BOTTOM PERIPHERY ANGLE	4		L 4×4×3/8×36'-0"

NOTE - LENGTHS AND AREAS GIVEN REMARKS COLUMN REPRESENT APPROX. TOTAL AMOUNT REQUIRED



REF. Nº	DRAWING Nº	PROJECT Nº	TITLE
4			
3	PL2 J 2189	2110	SERVICE WATER SYS.
2	PL2 E 2336 SH #2	2301-01-02	REACTOR COMPLEX (ELEV)
1	PL2 J 2225	2300	GENERAL ARR'G'T

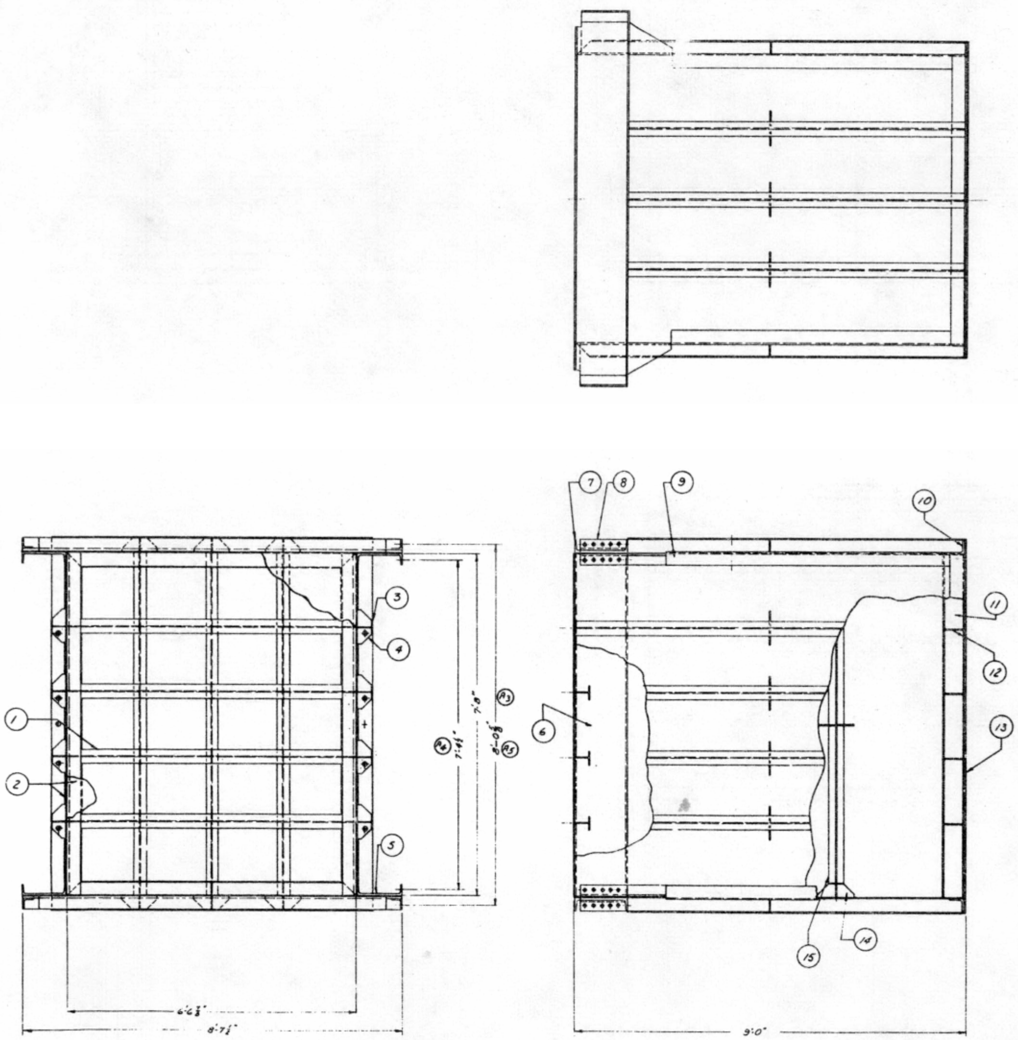
REFERENCE DRAWINGS

WEIGHTS -

TANK (934 CU.FT.) 16,500 LBS
WATER (926 CU.FT.) 57,800 LBS
CASK — — — 24,600 LBS
FUEL ELEMENTS — 3,600 LBS
102,500 LBS

SPENT FUEL TANK ASSEMBLY

Fig. 33



ITEM No	PIECE NUMBER	NAME	NO. REQ'D	MATERIAL	REMARKS
1		COVER PLATE SUPPORT	4		ST4B6.5 × 28'-0"
2		SIDE AND TOP SKIN	—		PL 1/4 × 318 SQ.FT
3		VERTICAL STIFFENER	14		ST4B6.5 × 125'-0"
4		VERTICAL STIFFENER GUSSET	14		PL 1/4 × 4 SQ.FT.
5		HANGER CHANNEL	4		12 [30.0 × 9'-0"
6		INTERIOR SUPPORT CHANNEL	2		15 [50.0 × 16'-0"
7		HORIZONTAL SUPPORT CHANNEL	2		15 [50.0 × 18'-0"
8		HANGER ANGLE	4		L 3×3×1/2 × 5'-0"
9		CORNER POST	4		L 4×4×1/2 × 33'-0"
10		BOTTOM PERIPHERY ANGLE	4		L 4×4×1/2 × 30'-0"
11		BOTTOM BEAM	3		6I 17.25 × 24'-0"
12		BOTTOM STRINGER	4		ST6B8.25 × 26'-0"
13		BOTTOM PLATE	1		PL 1/2 × 53 SQ.FT
14		HORIZONTAL STIFFENER GUSSET	16		PL 1/4 × 3 SQ.FT.
15		HORIZONTAL STIFFENER	8		ST4B6.25 × 58'-0"

BILL OF MATERIALS

NOTE - LENGTHS & AREAS GIVEN IN REMARKS COLUMN REPRESENT APPROX. TOTAL AMOUNT REQUIRED

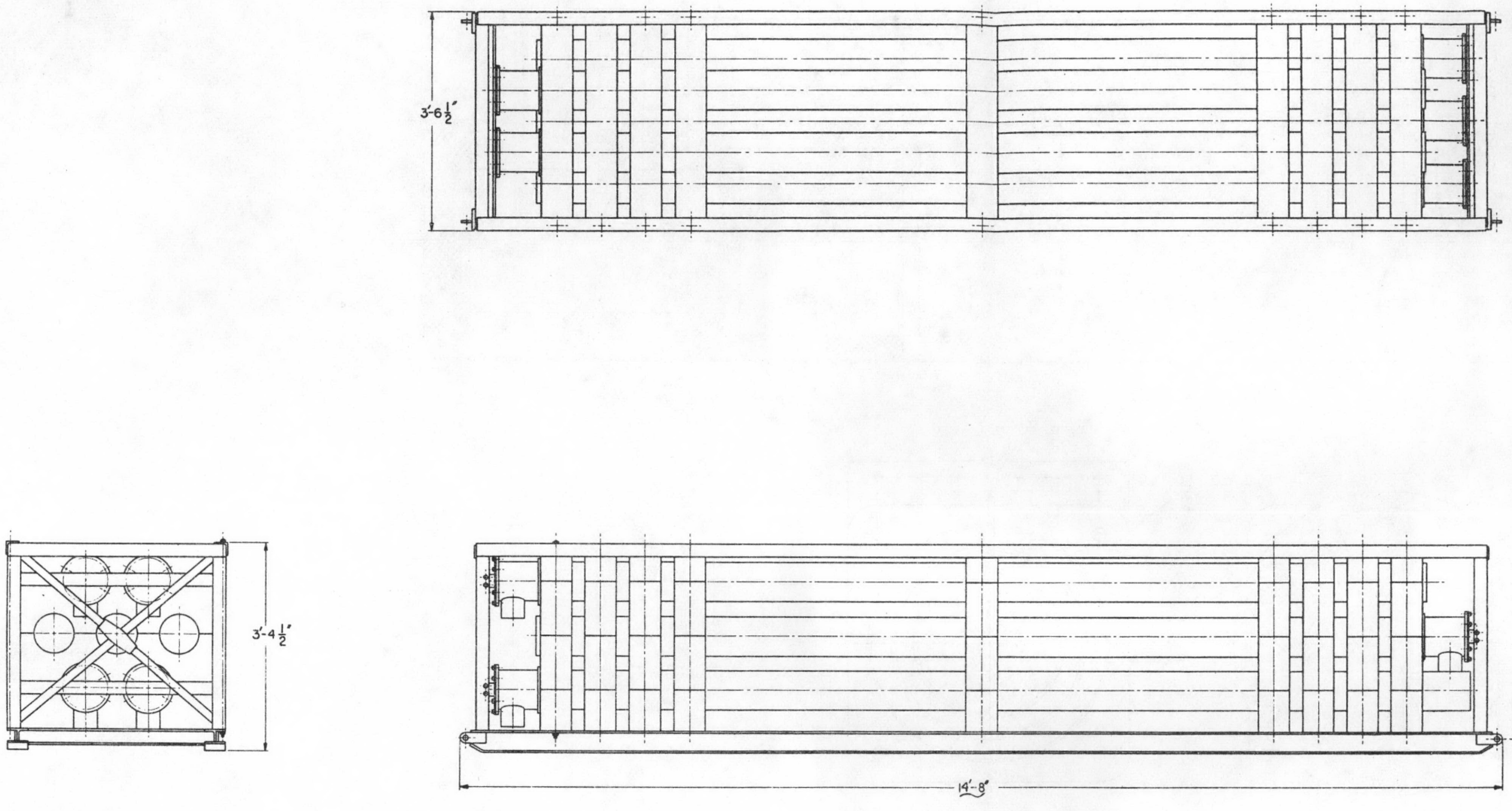
WEIGHTS

PLANT DRAIN TANK - 9,200 LBS
WATER (467 CU FT) - 29,150 LBS
38,350 LBS

REF. No	DRAWING No	PROJECT No	TITLE
5			
4			
3	PL2E2336 SH#2	2301-01-02	REACTOR COMPLEX (ELEV)
2	PL2J 2225	2300	GENERAL ARR'G'T
1	PL2J 2189	2110	SERVICE WATER SYS.

REFERENCE DRAWINGS

PLANT DRAIN TANK ASSEMBLY
Fig. 34



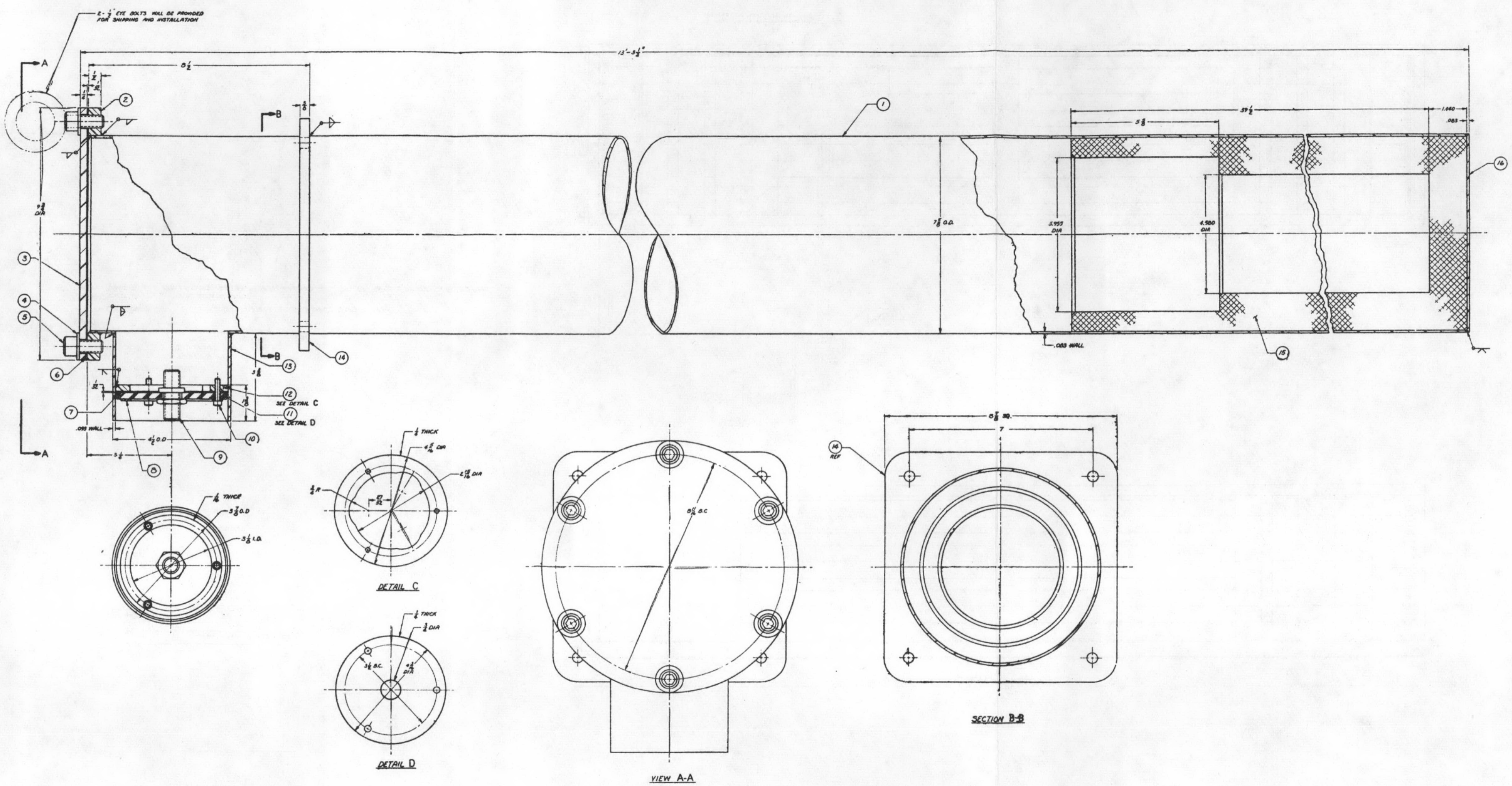
NUCLEAR DETECTOR WELL, ION CHAMBER-UNCOMPENSATED 3 @ 545 = 1635
-COMPENSATED 2 @ 545 = 1090
NUCLEAR DETECTOR WELL, BF_3 2 @ 560 = 1120
3,845

SKID - STEEL 695
- LUMBER 1775
- CRATING 435
TOTAL WEIGHT 6,700

REF NO.	DRAWING Nº	PROJECT NO.	TITLE
2	PLZJ2151	2301-05-01	NUC. DETECTOR WELL BF_3
1	PLZJ2150	2301-05-02	NUC. DET. WELL ION CHAMBER
REFERENCE DRAWINGS			

SHIPPING ARRANGEMENT FOR INSTRUMENT WELLS

Fig. 35

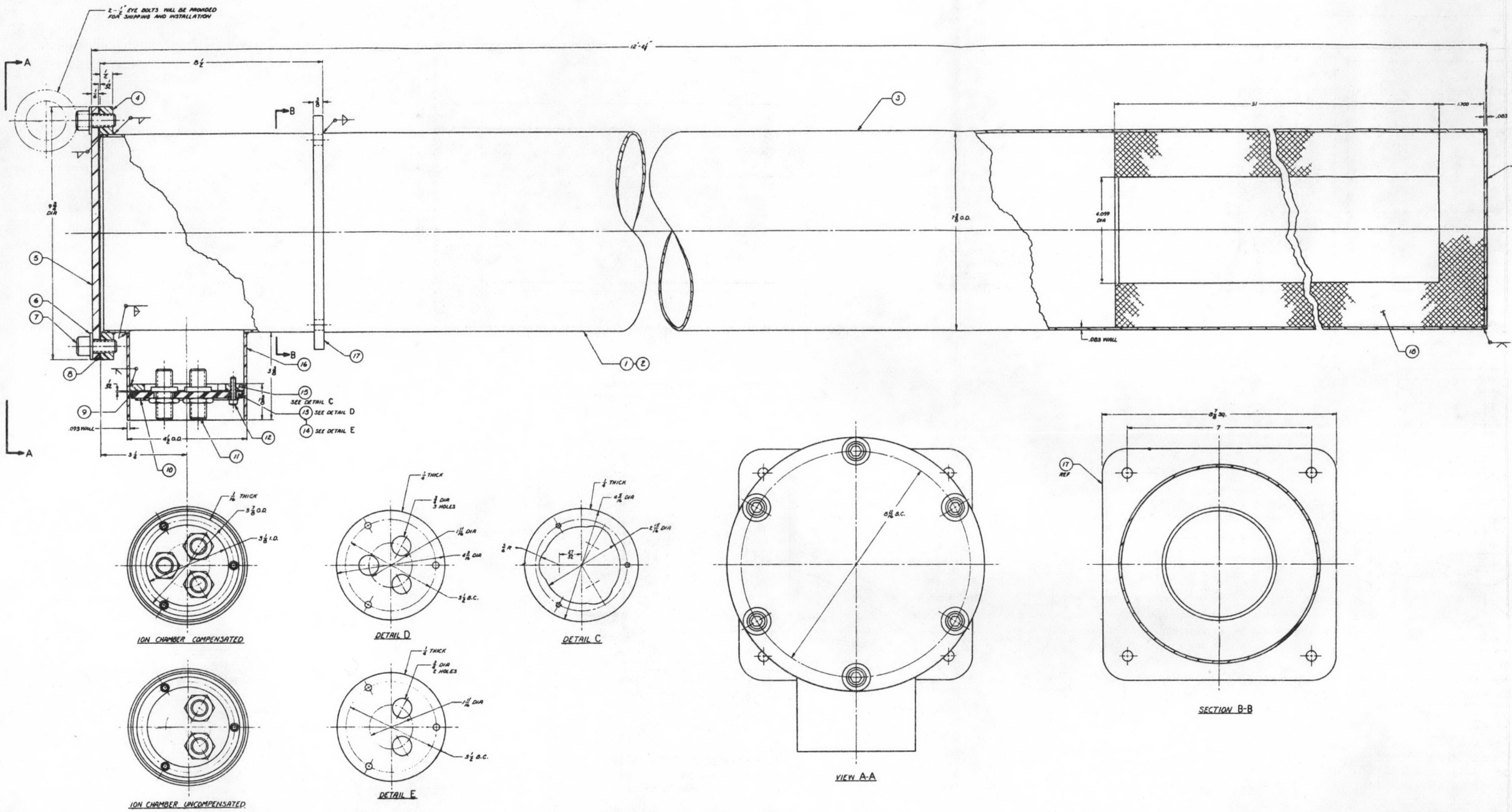


BILL OF MATERIALS QUANTITIES ARE FOR UNITS					
ITEM NO.	PART NUMBER	NAME	NO. REQ.	MATERIAL	REMARKS
1		INSTRUMENT WELL	1	AISI TYPE 304 SST	
2		INSTRUMENT WELL COVER FLANGE	1	AISI TYPE 304 SST	
3		INSTRUMENT WELL COVER	1	AISI TYPE 304 SST	
4		INSTRUMENT WELL COVER BOLT WASHER	6	AISI TYPE 304 SST	STD [illegible]
5		INSTRUMENT WELL COVER BOLT	6	AISI TYPE 316 SST	[illegible]
6		INSTRUMENT WELL COVER GASKET	1	NEOPRENE	
7		INST. CONN. MOUNTING PLATE GASKET	1	NEOPRENE	
8		INST. CONN. MOUNTING PLATE RETAINER	1	AISI TYPE 304 SST	
9		INSTRUMENT CONNECTOR	1		[illegible]
10		INST. CONN. MOUNTING PLATE SCREW	3	AISI TYPE 316 SST	[illegible]
11		INST. CONN. MOUNTING PLATE	1		
12		INST. CONN. MOUNTING PLATE SUPPORT	1	AISI TYPE 304 SST	
13		INSTRUMENT CONNECTOR HOUSING	1	AISI TYPE 304 SST	
14		INSTRUMENT WELL SUPPORT FLANGE	1	AISI TYPE 304 SST	
15		INSTRUMENT WELL SHIELDING	1	LEAD	
16		INST. WELL [illegible] PLATE	1	AISI TYPE 304 SST	

REF. NO.	DRAWING Nº	PROJECT Nº	TITLE
2.	P-2J2125	2202	NUC. INST. BLOCK DIAG.
1.	P-2E2356	2301-05	SHIELD ASSY
REFERENCE DRAWINGS.			

NUCLEAR DETECTOR WELL, BF_3

Fig. 36



BILL OF MATERIALS
QUANTITIES ARE FOR UNITS

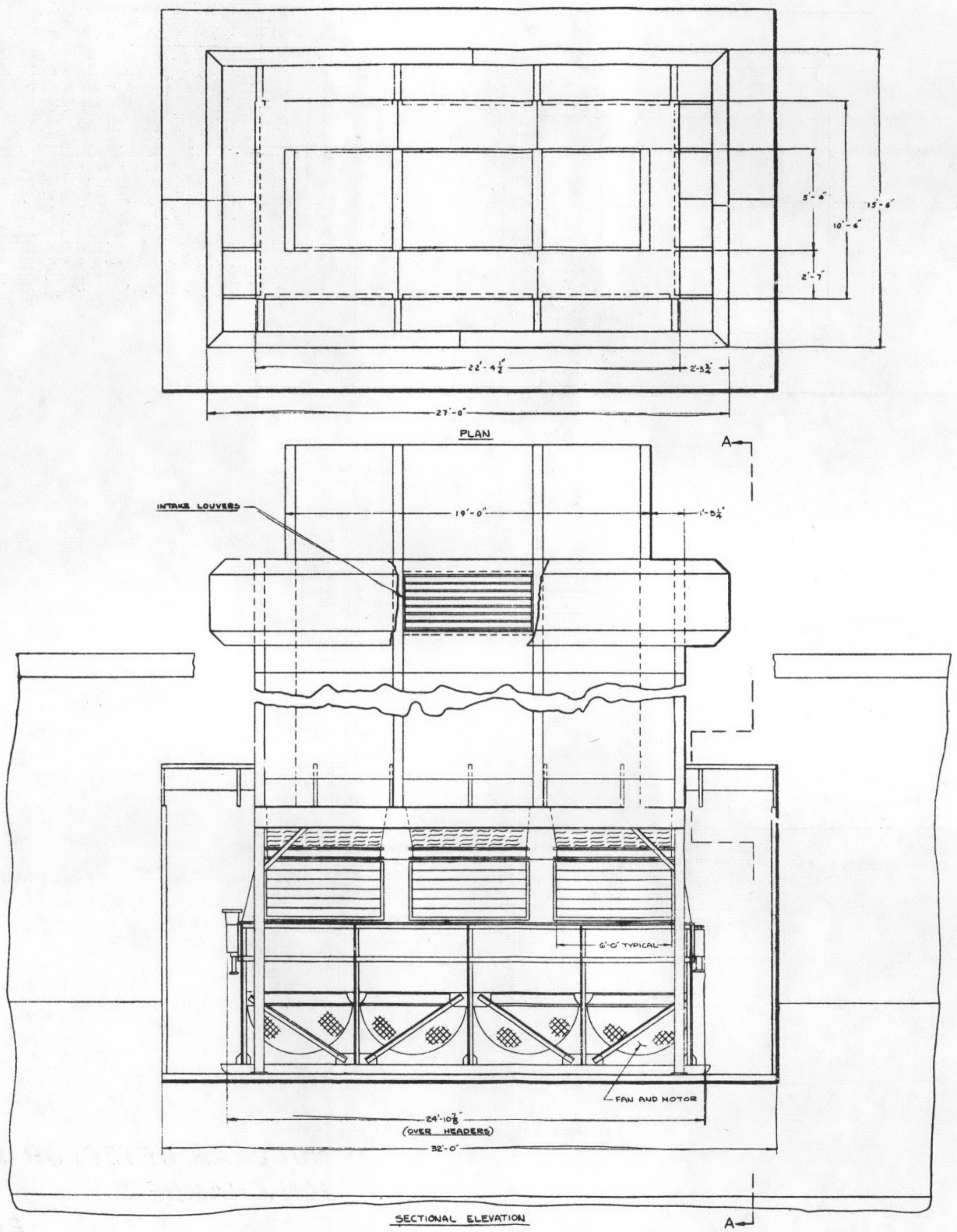
ITEM NO.	PIECE NUMBER	NAME	NO. REQ.	MATERIAL	REMARKS
1		NUCLEAR INST. WELL - ION CHAMBER COMPENSATED			
3		INSTRUMENT WELL	1	AISI TYPE 304 SST	
4		INSTRUMENT WELL COVER FLANGE	1	AISI TYPE 304 SST	
5		INSTRUMENT WELL COVER	1	AISI TYPE 304 SST	
6		INSTRUMENT WELL COVER BOLT WASHER	6	AISI TYPE 304 SST	STD. ½
7		INSTRUMENT WELL COVER BOLT	6	AISI TYPE 316 SST	½-13UNC-2A × 1¼ LG [illegible] CAP SCREW
8		INSTRUMENT WELL COVER GASKET	1	NEOPRENE	
9		INST. CONN. MOUNTING PLATE GASKET	1	NEOPRENE	
10		INST. CONN. MOUNTING PLATE RETAINER	1	AISI TYPE 304 SST	
11		INSTRUMENT CONNECTOR	3		[illegible]
12		INSTRUMENT CONN. MOUNTING PLATE SCREW	3	AISI TYPE 316 SST	10-24UNC-2A × [illegible] LG [illegible] CAP SCREW
13		INSTRUMENT CONN. MOUNTING PLATE	1		
15		INST. CONN. MOUNTING PLATE SUPPORT	1	AISI TYPE 304 SST	
16		INSTRUMENT CONNECTOR HOUSING	1	AISI TYPE 304 SST	
17		INSTRUMENT WELL SUPPORT FLANGE	1	AISI TYPE 304 SST	
18		INSTRUMENT WELL SHIELDING	1	LEAD	
19		INST. WELL BOTTOM PLATE	1	AISI TYPE 304 SST	
2		NUCLEAR INST. WELL - ION CHAMBER UNCOMPENSATED			
3		INSTRUMENT WELL	1	AISI TYPE 304 SST	
4		INST. WELL COVER FLANGE	1	AISI TYPE 304 SST	
5		INST. WELL COVER	1	AISI TYPE 304 SST	
6		INST. WELL COVER BOLT WASHER	6	AISI TYPE 304 SST	STD ½
7		INST. WELL COVER BOLT	6	AISI TYPE 316 SST	½-13UNC-2A × 1¼ LG [illegible] CAP SCREW
8		INST. WELL COVER GASKET	1	NEOPRENE	
9		INST. CONN. MOUNTING PLATE GASKET	1	NEOPRENE	
10		INST. CONN. MOUNTING PLATE RETAINER	1	AISI TYPE 304 SST	
11		INSTRUMENT CONNECTOR	2		[illegible]
12		INST. CONN. MOUNTING PLATE SCREW	3	AISI TYPE 316 SST	10-24UNC-2A × [illegible] LG [illegible] CAP SCREW
14		INST. CONN. MOUNTING PLATE	1		
15		INST. CONN. MOUNTING PLATE SUPPORT	1	AISI TYPE 304 SST	
16		INSTRUMENT CONNECTOR HOUSING	1	AISI TYPE 304 SST	
17		INSTRUMENT WELL SUPPORT FLANGE	1	AISI TYPE 304 SST	
18		INSTRUMENT WELL SHIELDING	1	LEAD	
19		INST. WELL BOTTOM PLATE	1	AISI TYPE 304 SST	

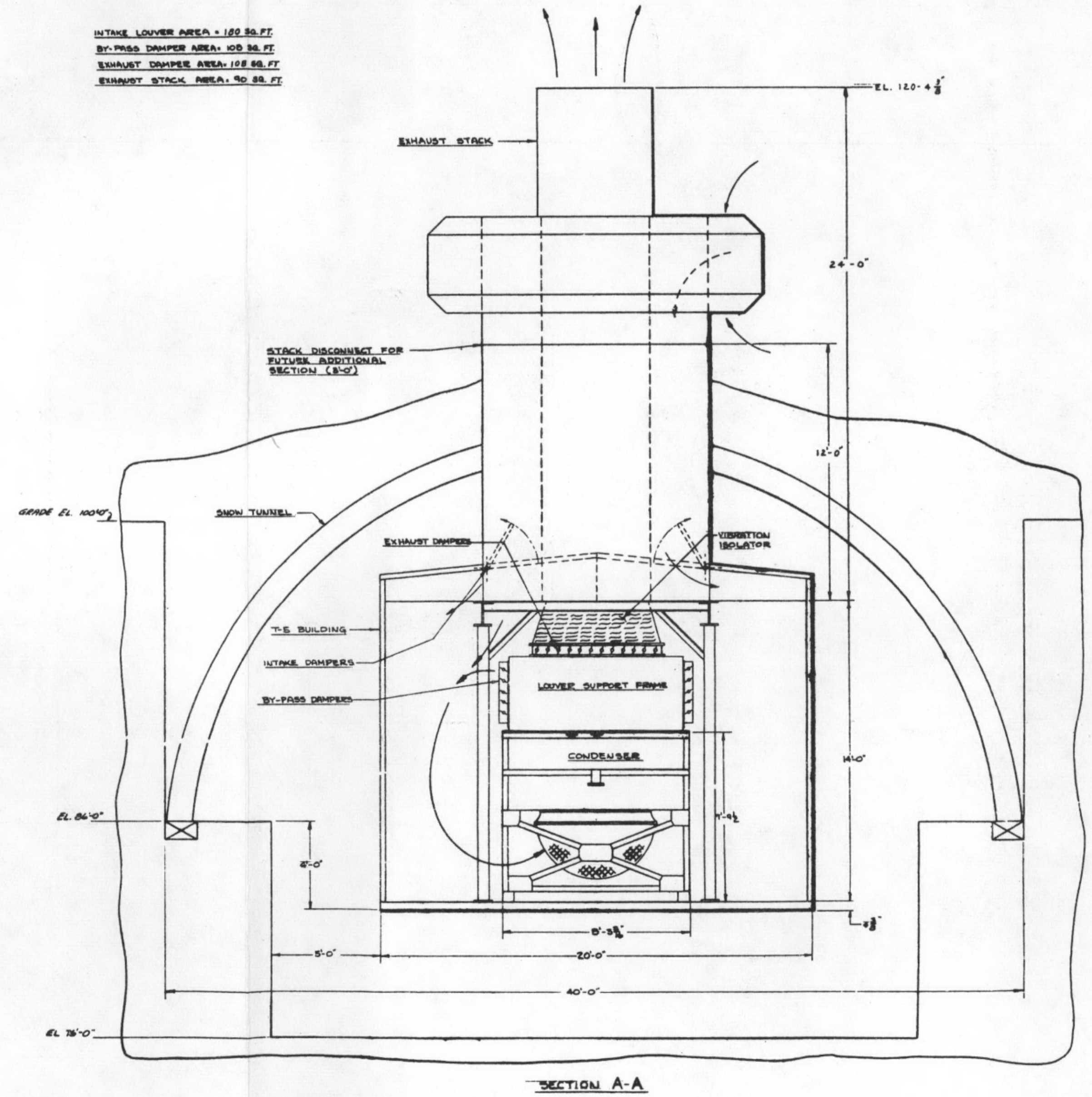
REF. No.	DRAWING No.	PROJECT No.	TITLE
2.	PL2J2125	2202	NUC. INST BLOCK DIAG
1	PL 2E 2356	2301-05	SHIELD ASSY

REFERENCE DRAWINGS

NUCLEAR DETECTOR WELL, ION CHAMBER

Fig. 37

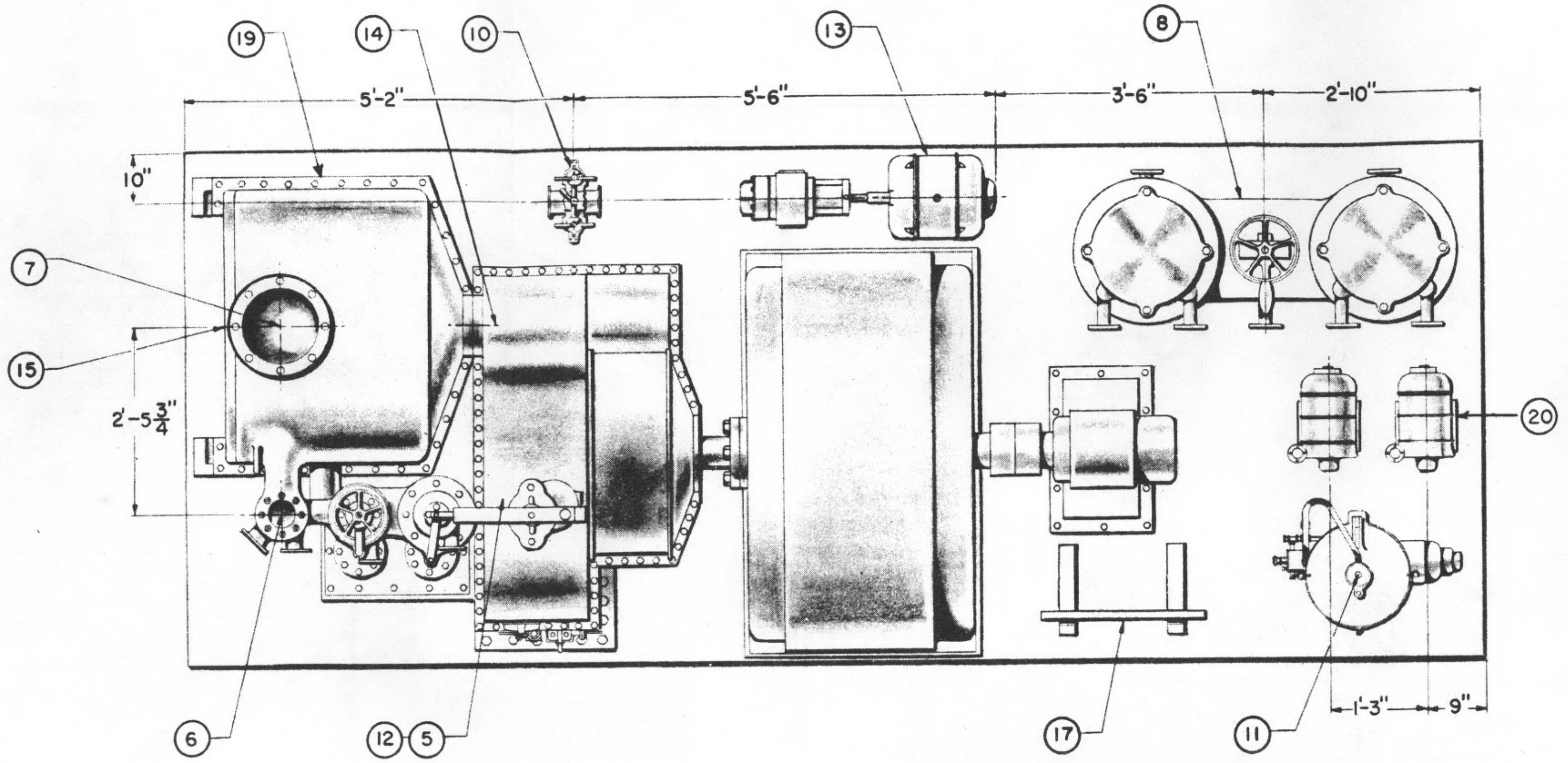




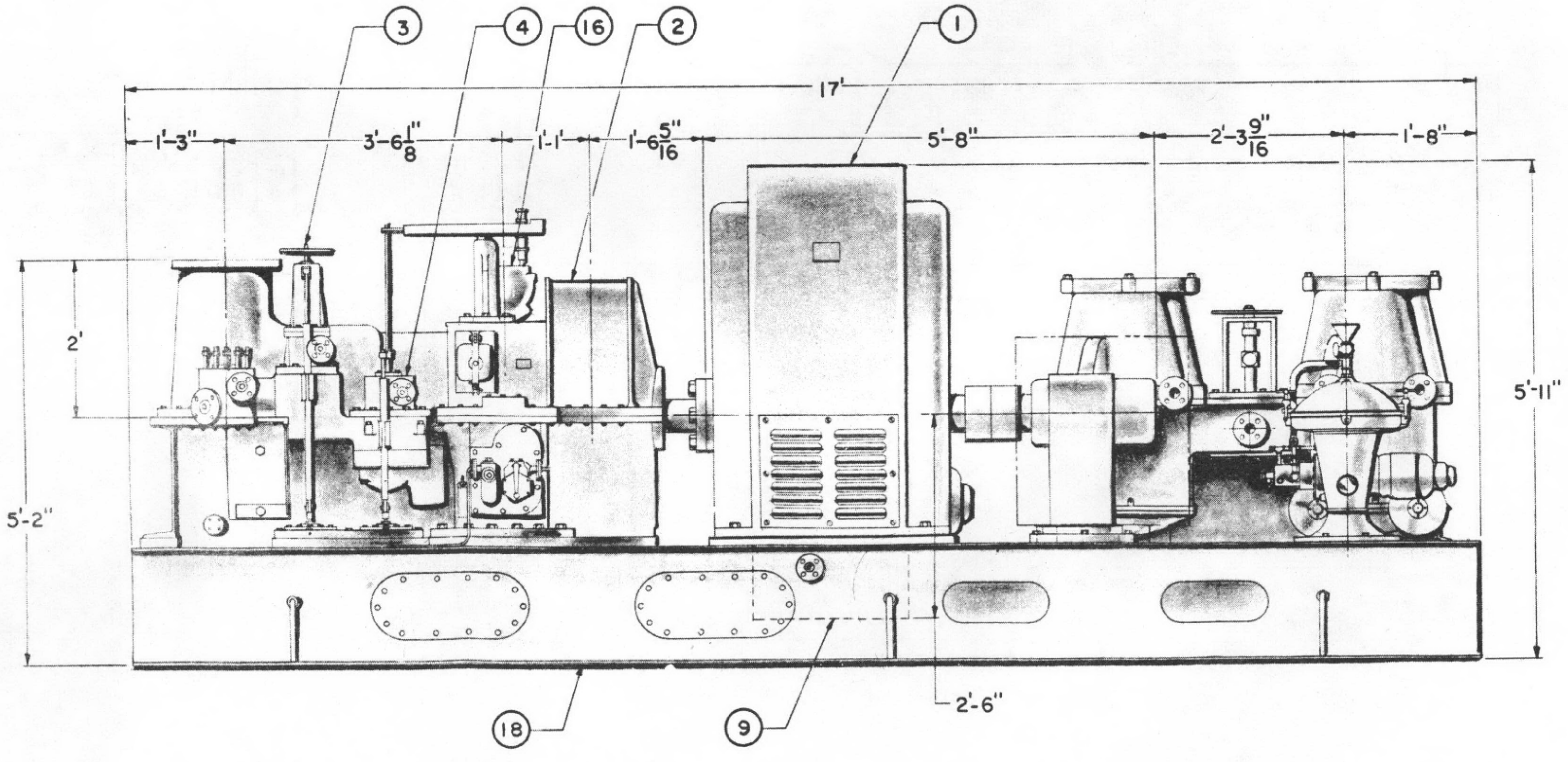
REF. NO.	DRAWING NO.	PROJECT NO.	TITLE
2	PL2J2222	2302-02	CONDENSER BLDG FOUNDATION
1	PL2J2218	2302-04-03	CONDENSER STACK ASSY

REFERENCE DRAWINGS

CONDENSER ASSEMBLY
Fig. 38



ITEM NO.	DESCRIPTION	WEIGHT
1	SYNCHRONOUS GENERATOR	14,000 LBS
2	REDUCTION GEAR	3,800 LBS
3	TURBINE THROTTLE VALVE	
4	GOVERNING MECHANISM	
5	GOVERNOR MOTOR	
6	STEAM INLET	
7	EXHAUST	
8	OIL COOLER	1,600 LBS
9	OIL RESERVOIR	
10	OIL STRAINER	80 LBS
11	OIL PURIFIER	550 LBS
12	MAIN OIL PUMP	
13	AUX. LUBE OIL PUMP	200 LBS
14	STEAM END BEARING	
15	EXHAUST END BEARING	
16	SYNCHRONIZER MOTOR	
17	GAUGE BOARD	
18	BASE PLATE	3,000 LBS
19	TURBINE	4,200 LBS
20	COOLANT CIRC. PUMPS	150 LBS
	TOTAL APPROX. WEIGHT	27,580 LBS



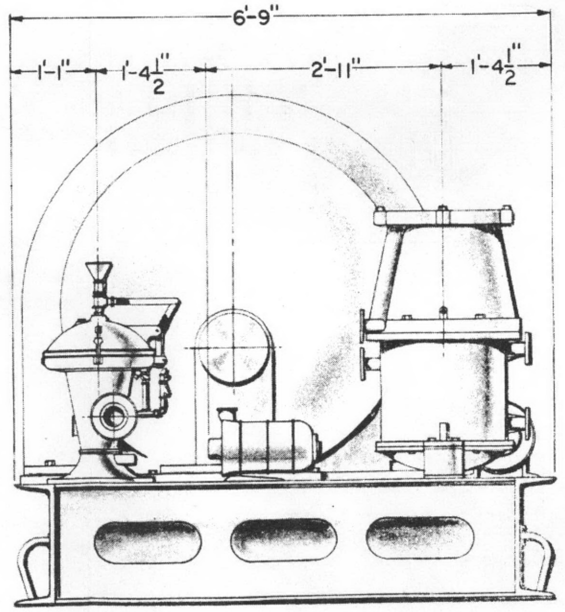


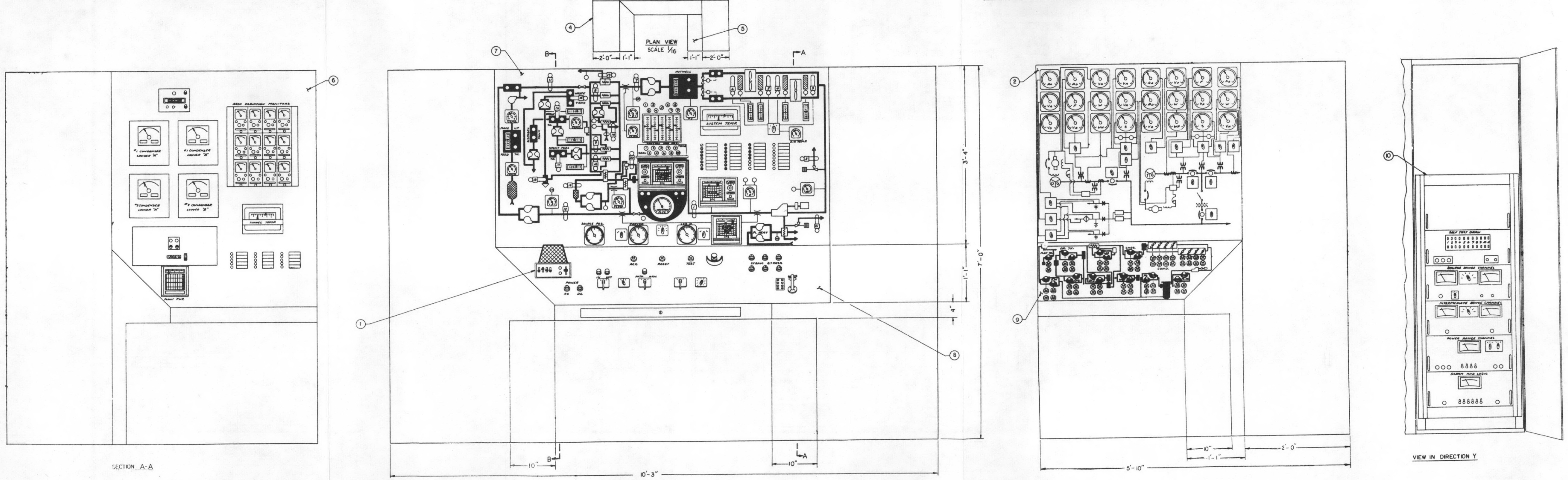
Fig. 39 TURBINE GENERATOR SKID MACHINERY ARRANGEMENT

PANEL IDENTIFICATION LIST

ITEM	DESCRIPTION	REF NO. DRAWING	REF NO. PROJECT
1	INTERCOM		
2	SECONDARY ELECTRICAL CONTROL PANEL		
3	ROD CONTROL EQUIPMENT		
4	RECTIFIERS AND REGULATORS		
5	WRITING DESK		
6	RADIATION MONITOR, AREA TEMP., LOUVER CONTROL, POWER TOTALIZER		
7	PROCESS INSTRUMENTATION PANEL		
8	REACTOR CONTROL PANEL		
9	PLANT MOTOR CONTROL PANEL		
10	NUCLEAR INSTRUMENT EQUIPMENT		

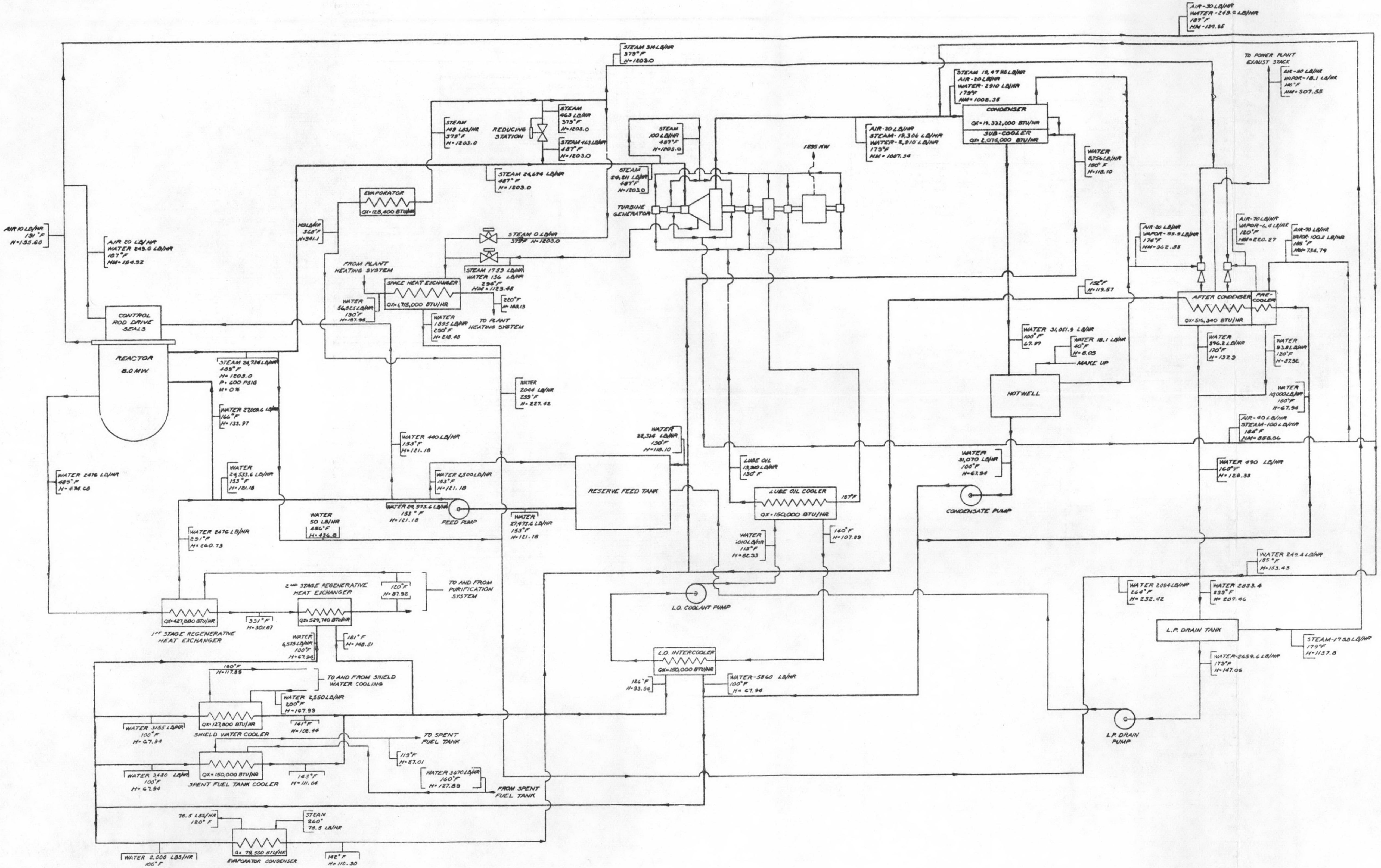
REF. NO.	DRAWING NO.	PROJECT NO.	TITLE
1	AEJ 2230	1303-08-03	ELEC. SKID MACH. ARR.

REFERENCE DRAWINGS



PLANT CONTROL CONSOLE ASSEMBLY

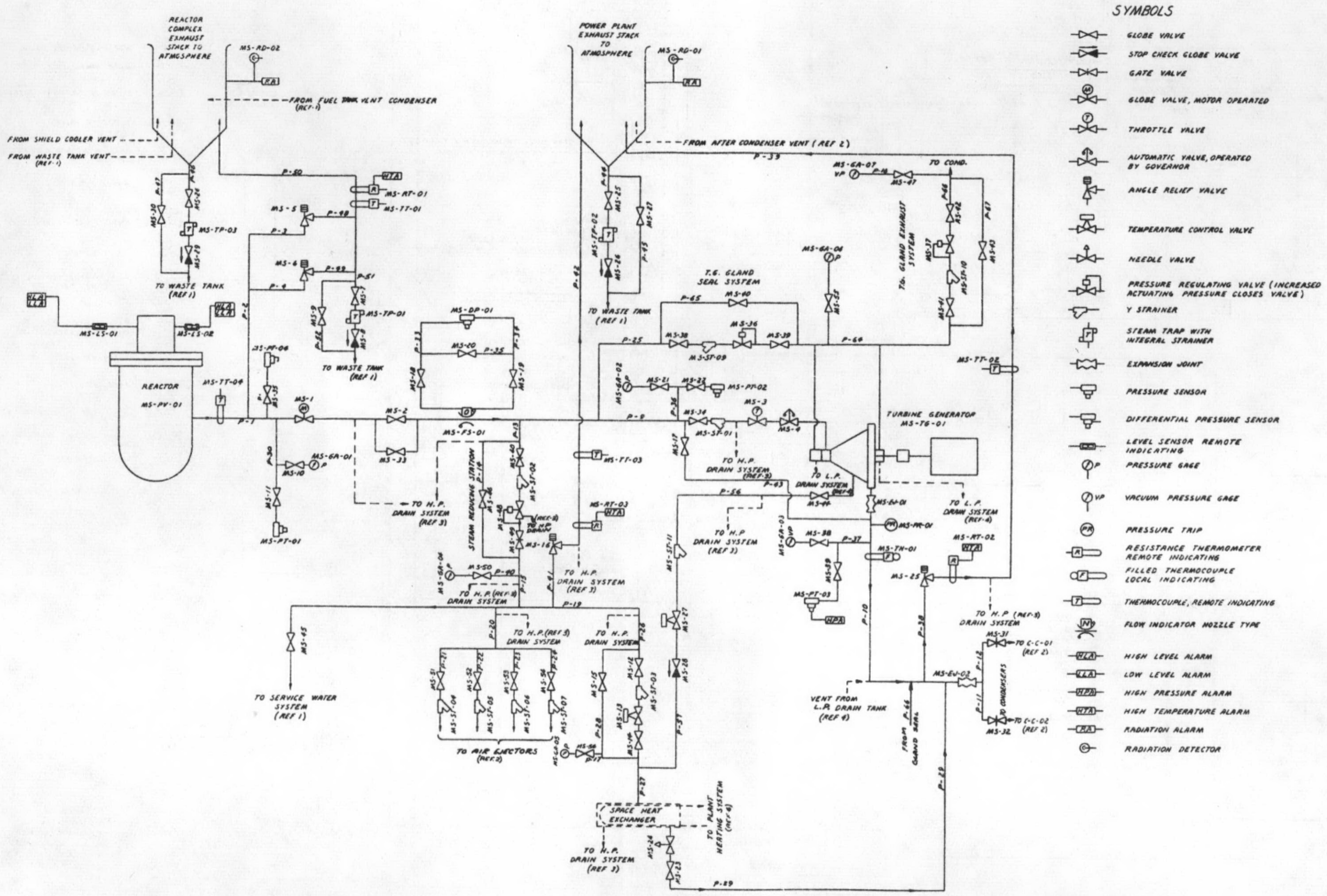
Fig. 40



NOTE: TEMPERATURES HAVE BEEN ROUNDED OFF TO THE NEAREST WHOLE DEGREE.

REACTOR THERMAL POWER	6.0 MW
GROSS ELECTRICAL OUTPUT	1235 KW
NET ELECTRICAL OUTPUT	1000 KW
GROSS SPACE HEAT OUTPUT	1.715×10^{6} BTU/HR
TURBINE STEAM RATE	18.61 LB/KW HR
GENERATOR EFFICIENCY	93.6 %
GEAR EFFICIENCY	98 %
TURBINE ENGINE EFFICIENCY	69.7 %
CONDENSER PRESSURE	15" Hg ABS
CONDENSER AIR FLOW	1.08×10^{6} LB/HR
CONDENSER INLET AIR TEMPERATURE	60°F
REACTOR PRESSURE	600 PSIG

HEAT BALANCE DIAGRAM
Fig. 41



SPECIAL VALVE AND FITTING LIST

VALVE NO.	COMPONENT NO.	SERVICE	NOM. SIZE	TYPE	END CONN.	ACTUATING MEDIUM	FAIL POSITION	MATERIAL	EQUIP. SPEC. NO.	REMARKS
MS-1		MAIN STEAM STOP	4"	GLOBE	FLANGED	MOTOR CONT.	AS IS	SST	PL-2101-00-5	
MS-3		TURBINE THROTTLE	–	GLOBE	FLANGED		CLOSED	SST	PL-2101-00-3	INCL. WITH T.G.
MS-4		TURBINE GOVERNOR	–	GLOBE		OIL HYD.			PL-2101-00-3	INCL. WITH T.G.
MS-25		TURB. EXH. PRESS. RELIEF	8x10		FLANGED	PROCESS ST.		SST	PL-2100-55	SET POINT-15 PSIG
MS-5		MAIN STEAM PRESS. RELIEF	2x3		FLANGED	PROCESS ST.		SST	PL-2100-55	SET POINT-660 PSIG
MS-6		MAIN STEAM PRESS. RELIEF	2x3		FLANGED	PROCESS ST.		SST	PL-2100-55	SET POINT-700 PSIG
MS-48		ST. REDUCING VALVE	2"	GLOBE	FLANGED	PROCESS ST.	CLOSED	SST	PL-2101-00-6	600 PSIG/150 PSIG
MS-16		AUX. STEAM PRESS. RELIEF	1 1/2x2 1/2		FLANGED	PROCESS ST.		SST	PL-2100-0055	SET POINT-125 PSIG
MS-13		TEMPERATURE CONTROL	1 1/2	GLOBE	FLANGED	ELECT. HYD.	CLOSED	SST	PL-2101-00-1	
	MS-TP-01	MAIN ST. RELIEF VALVE DRAIN TRAP	1"	–	FLANGED	FLOAT		SST	PL-2100-005T	
	MS-TP-02	POWERPLANT EXHAUST STACK DRAIN TRAP	1"	–	FLANGED	FLOAT		SST	PL-2100-005T	
	MS-TP-03	REAC. COMPLEX EXH. STACK DRAIN TRAP	1"	–	FLANGED	FLOAT		SST	PL-2100-005T	
	MS-ST-01	STEAM TO T.G.	–	–	FLANGED	–		SST	PL-2101-00-3	INCL. WITH T.G.
	MS-ST-02	ST. TO RED. VALVE	1"	–	B.W.	–		SST	PL-2100-00-58	
	MS-ST-03	ST. TO TEMP. CONT. VALVE	1 1/2"	–	B.W.	–		SST	PL-2100-00-58	
	MS-ST-04	ST. TO COND. AIR EJECT.	1/2"	–	B.W.	–		SST	PL-2100-00-58	
	MS-ST-05	ST. TO COND. AIR EJECT.	1/2"	–	B.W.	–		SST	PL-2100-00-58	
	MS-ST-06	ST. TO GLAND EXH. AIR EJECT.	1/2"	–	B.W.	–		SST	PL-2100-00-58	
	MS-ST-07	ST. TO GLAND EXH. AIR EJECT.	1/2"	–	B.W.	–		SST	PL-2100-00-58	
	MS-EJ-01	TURB. EXH. EXPANSION JOINT	16"	BELLOWS	FLANGED			SST	PL-2101-00-92	
	MS-EJ-02	COND. INLET EXPANSION JOINT	16"	BELLOWS	FLANGED			SST	PL-2101-00-92	
MS-17		STEAM DUMP VALVE	1"	GLOBE	FLANGED	MOTOR		SST	PL-2101-00-4	
MS-27		TEMPERATURE CONTROL	2 1/2"	GLOBE	FLANGED	ELECT. HYD.		SST	PL-2101-00-2	
	MS-ST-11	ST. TO TEMP. CONTROL VALVE	2 1/2"	—	B.W.			SST	PL-2100-00-58	
MS-36		GLAND SEAL RED. VALVE	1"	GLOBE	FLANGED	PROCESS ST.	CLOSED	SST	PL-2101-00-3	SET PTS. 600 PSIG/2 PSIG
MS-37		GLAND SEAL CONTROL VALVE	1"	GLOBE	FLANGED	PROCESS ST.	OPEN	SST	PL-2101-00-3	RANGE 2-3 PSIG
	MS-ST-09	STEAM TO GLAND SEAL SYS.	1"	–	B.W.			SST	PL-2101-00-3	
	MS-ST-10	ST. FROM GLAND SEAL SYSTEM	1"	–	B.W.			SST	PL-2101-00-3	

PIPE LIST

PIPE NO.	NOM. SIZE	SCHED.	MATERIAL	SERVICE	INSUL. THK.	FLOW	DESIGN PRESS.	TEST PRESS.	REMARKS
P-1	[illegible]	[illegible]	[illegible]	MAIN STEAM	[illegible]	[illegible]	[illegible]	[illegible]	
P-2	[illegible]	[illegible]	[illegible]	MAIN STEAM TO RELIEF VALVES	[illegible]	[illegible]	[illegible]	[illegible]	
P-3	[illegible]	[illegible]	[illegible]	MAIN STEAM RELIEF VALVE INLET	[illegible]	[illegible]	[illegible]	[illegible]	
P-4	[illegible]	[illegible]	[illegible]	MAIN STEAM RELIEF VALVE INLET	[illegible]	[illegible]	[illegible]	[illegible]	
P-5	[illegible]	[illegible]	[illegible]	STEAM TO TURBINE GENERATOR	[illegible]	[illegible]	[illegible]	[illegible]	
P-10	[illegible]	[illegible]	[illegible]	TURBINE GENERATOR EXHAUST TRUNK	[illegible]	[illegible]	[illegible]	[illegible]	
P-11	[illegible]	[illegible]	[illegible]	STEAM TO CONDENSER	[illegible]	[illegible]	[illegible]	[illegible]	
P-12	[illegible]	[illegible]	[illegible]	STEAM TO CONDENSER	[illegible]	[illegible]	[illegible]	[illegible]	
P-13	[illegible]	[illegible]	[illegible]	STEAM TO REDUCING STATION NO. 1	[illegible]	[illegible]	[illegible]	[illegible]	
P-14	[illegible]	[illegible]	[illegible]	REDUCING STATION NO. 1 BY PASS	[illegible]	[illegible]	[illegible]	[illegible]	
P-15	[illegible]	[illegible]	[illegible]	STEAM FROM REDUCING STATION NO. 1	[illegible]	[illegible]	[illegible]	[illegible]	
P-16	[illegible]	[illegible]	[illegible]	GAGE LINE TO GLAND EXHAUST PRESS. GAGE	[illegible]	[illegible]	[illegible]	[illegible]	
P-17	[illegible]	[illegible]	[illegible]	GAGE LINE TO SPACE HEAT EXCHANGER PRESS. GAGE	[illegible]	[illegible]	[illegible]	[illegible]	
P-19	[illegible]	[illegible]	[illegible]	AUXILIARY STEAM MAIN	[illegible]	[illegible]	[illegible]	[illegible]	
P-20	[illegible]	[illegible]	[illegible]	STEAM TO AIR EJECTORS	[illegible]	[illegible]	[illegible]	[illegible]	
P-21	[illegible]	[illegible]	[illegible]	STEAM TO CONDENSER AIR EJECTOR	[illegible]	[illegible]	[illegible]	[illegible]	
P-22	[illegible]	[illegible]	[illegible]	STEAM TO CONDENSER AIR EJECTOR	[illegible]	[illegible]	[illegible]	[illegible]	
P-23	[illegible]	[illegible]	[illegible]	STEAM TO GLAND EXHAUST AIR EJECTOR	[illegible]	[illegible]	[illegible]	[illegible]	
P-24	[illegible]	[illegible]	[illegible]	STEAM TO GLAND EXHAUST AIR EJECTOR	[illegible]	[illegible]	[illegible]	[illegible]	
P-25	[illegible]	[illegible]	[illegible]	STEAM TO TEMPERATURE CONTROL VALVE	[illegible]	[illegible]	[illegible]	[illegible]	
P-26	[illegible]	[illegible]	[illegible]	STEAM TO SPACE HEAT EXCHANGER	[illegible]	[illegible]	[illegible]	[illegible]	
P-27	[illegible]	[illegible]	[illegible]	TEMPERATURE CONTROL VALVE BY-PASS	[illegible]	[illegible]	[illegible]	[illegible]	
P-28	[illegible]	[illegible]	[illegible]	SPACE HEAT EXCHANGER VENT	[illegible]	[illegible]	[illegible]	[illegible]	
P-29	[illegible]	[illegible]	[illegible]	GAGE LINE TO REACTOR PRESS. DETECTORS	[illegible]	[illegible]	[illegible]	[illegible]	
P-30	[illegible]	[illegible]	[illegible]	GAGE LINE TO STEAM FLOW D/P SWITCH	[illegible]	[illegible]	[illegible]	[illegible]	
P-33	[illegible]	[illegible]	[illegible]	GAGE LINE TO STEAM FLOW D/P SWITCH	[illegible]	[illegible]	[illegible]	[illegible]	
P-34	[illegible]	[illegible]	[illegible]	STEAM FLOW D/P SWITCH EQUALIZING LINE	[illegible]	[illegible]	[illegible]	[illegible]	
P-35	[illegible]	[illegible]	[illegible]	GAGE LINE TO T.G. STEAM PRESS. DETECTORS	[illegible]	[illegible]	[illegible]	[illegible]	
P-36	[illegible]	[illegible]	[illegible]	GAGE LINE TO T.G. EXH. STEAM PRESS. DETECTORS	[illegible]	[illegible]	[illegible]	[illegible]	
P-37	[illegible]	[illegible]	[illegible]	GAGE LINE TO T.G. EXH. PRESS. RELIEF VALVE	[illegible]	[illegible]	[illegible]	[illegible]	
P-38	[illegible]	[illegible]	[illegible]	T.G. EXH. PRESS. RELIEF VALVE DISCHARGE	[illegible]	[illegible]	[illegible]	[illegible]	
P-39	[illegible]	[illegible]	[illegible]	GAGE LINE TO AUX. STEAM PRESSURE GAGE	[illegible]	[illegible]	[illegible]	[illegible]	
P-40	[illegible]	[illegible]	[illegible]	STEAM TO AUX. STEAM PRESS. RELIEF VALVE	[illegible]	[illegible]	[illegible]	[illegible]	
P-41	[illegible]	[illegible]	[illegible]	AUX. STEAM PRESS. RELIEF VALVE DISCH.	[illegible]	[illegible]	[illegible]	[illegible]	
P-42	[illegible]	[illegible]	[illegible]	MAIN STEAM T.G. BY-PASS	[illegible]	[illegible]	[illegible]	[illegible]	
P-43	[illegible]	[illegible]	[illegible]	POWERPLANT EXHAUST STACK DRAIN	[illegible]	[illegible]	[illegible]	[illegible]	
P-44	[illegible]	[illegible]	[illegible]	POWERPLANT EXH. STACK DRAIN TRAP BY-PASS	[illegible]	[illegible]	[illegible]	[illegible]	
P-45	[illegible]	[illegible]	[illegible]	REACTOR COMPLEX EXHAUST STACK DRAIN	[illegible]	[illegible]	[illegible]	[illegible]	
P-46	[illegible]	[illegible]	[illegible]	REACTOR COMPLEX EXH. STACK DRAIN TRAP BY-PASS	[illegible]	[illegible]	[illegible]	[illegible]	
P-47	[illegible]	[illegible]	[illegible]	MAIN STEAM RELIEF VALVE DISCHARGE	[illegible]	[illegible]	[illegible]	[illegible]	
P-48	[illegible]	[illegible]	[illegible]	MAIN STEAM RELIEF VALVE DISCHARGE	[illegible]	[illegible]	[illegible]	[illegible]	
P-49	[illegible]	[illegible]	[illegible]	MAIN STEAM RELIEF VALVE DISCHARGE HEADER	[illegible]	[illegible]	[illegible]	[illegible]	
P-51	1/2"	40	304 SST	MAIN STEAM RELIEF VALVE DISCHARGE DRAIN	STD	250	50	75	
P-52	1/2"	40	304 SST	MAIN STEAM RELIEF VALVE DISCH. DRAIN TRAP BY-PASS	STD	250	50	75	
P-56	2 1/2"	40	304 SST	EXTRACTION STEAM FROM TURBINE MAIN	STD	2,484	100	250	
P-57	3"	40	304 SST	EXTRACTION STEAM TO SPACE HEAT EXCHANGER	STD	2,484	50	75	
P-64	1"	40	304 SST	STEAM TO GLAND SEAL SYSTEM	STD	100	50	75	
P-65	1/2"	40	304 SST	STEAM TO GLAND SEAL BY PASS	STD	25	800	900	
P-66	1/2"	40	304 SST	STEAM FROM GLAND SEAL SYSTEM	STD	25	50	75	
P-67	1/2"	40	304 SST	STEAM FROM GLAND SEAL BY PASS	STD	25	50	75	

INSTRUMENT LIST (REF. ONLY)

INSTRUMENT NO.	INSTRUMENT NAME	SERVICE	MANUFACTURER NAME	MANUFACTURER CATALOG NO.	RANGE	SET POINT	ALARM POINT	TRIP POINT	EQUIP. SPEC. NO.	REMARKS
MS-TT-04	REACTOR STEAM TEMP.	STEAM								REF 5
MS-GA-01	REACTOR STEAM PRESS.	STEAM								
MS-PT-01	REACTOR STEAM PRESS.	STEAM								
MS-FS-01	MAIN STEAM FLOW NOZZLE	STEAM								
MS-DP-01	MAIN ST. FLOW D/P SENSOR	STEAM								
MS-GA-02	T.G. STEAM PRESSURE	STEAM								
MS-PT-02	T.G. STEAM PRESSURE	STEAM								
MS-GA-03	T.G. EXHAUST PRESS.	STEAM								
MS-PT-03	T.G. EXHAUST PRESS.	STEAM								
MS-TH-01	T.G. EXHAUST TEMP.	STEAM								
MS-RT-02	T.G. EXH. RELIEF VALVE DISCH. TEMP.	STEAM								
MS-GA-04	AUX. ST. PRESS.	STEAM								
MS-RT-03	AUX. ST. RELIEF VALVE DISCH. TEMP.	STEAM								
MS-RD-01	P.P. EXH. STACK RADIATION DETECTION	AIR AND VAPOR								
MS-RD-02	REAC. COMPLEX EXH. STACK RDTN DETECTION	AIR AND VAPOR								
MS-RT-01	REAC. RELIEF VALVE DISCH. TEMP.	STEAM								
MS-LS-01	REAC. WATER LEVEL	WATER								
MS-TT-03	AUX. ST. RELIEF VALVE DISCH. TEMP.	STEAM								
MS-PT-04	REACTOR ST. PRESS.	STEAM								
MS-GA-05	SPACE HX. PRESS.	STEAM								
MS-PR-01	T.G. EXH. PRESS. TRIP	STEAM								
MS-LS-02	REAC. WATER LEVEL	WATER								
MS-GA-06	T.G. GLAND SEAL PRESS.	STEAM								
MS-GA-07	T.G. GLAND EXHAUST PRESS.	STEAM								
MS-TT-01	REAC. RELIEF VALVE DISCH. TEMP.	STEAM								
MS-TT-02	T.G. EXH. RELIEF VALVE DISCH. TEMP.	STEAM								

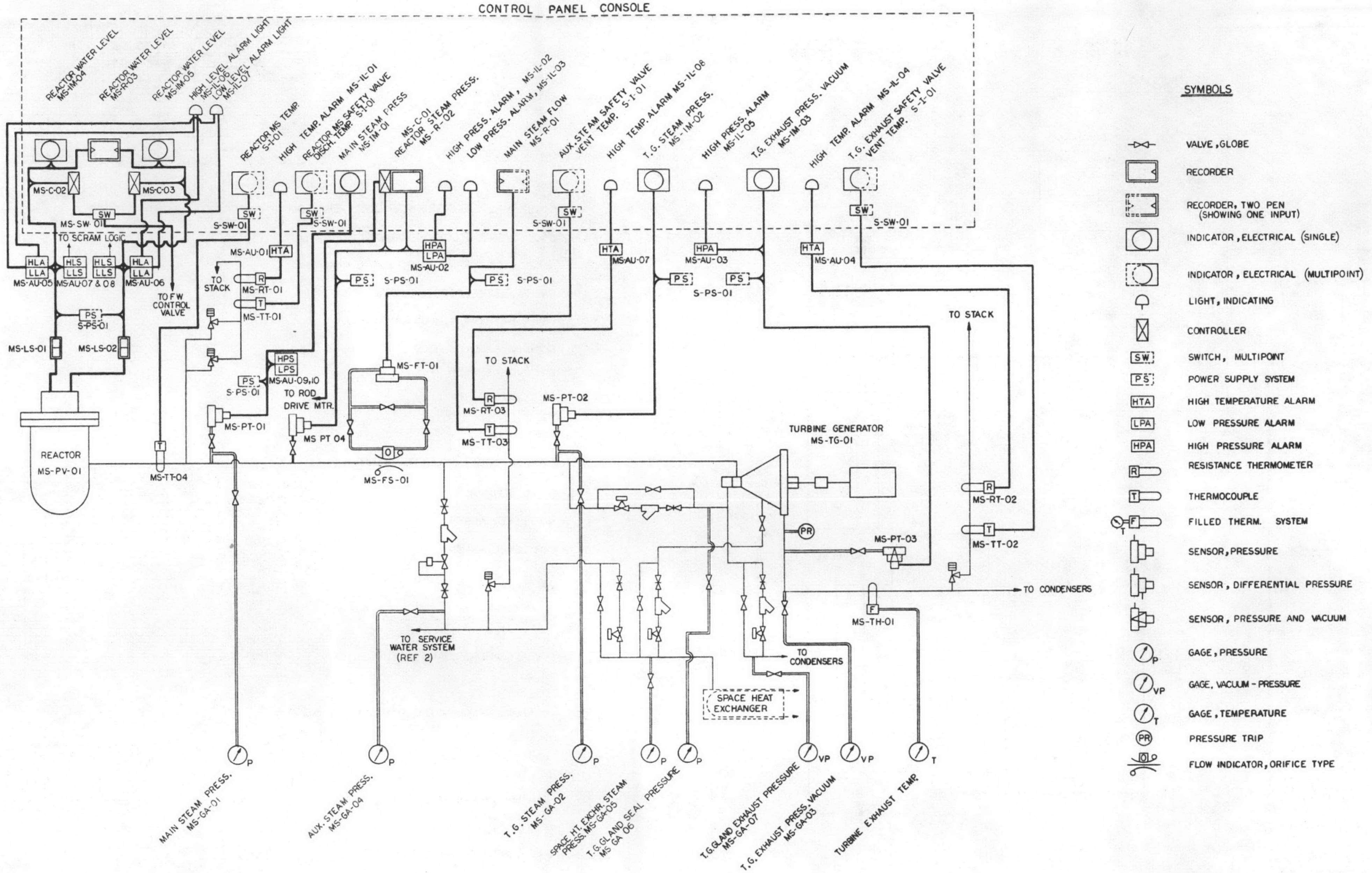
COMPONENTS LIST

COMPONENT NO.	UNIT	CHARACTERISTICS	EQUIP. SPEC. NO.	MFGR.	MFGR. REF. DWG.	WEIGHT	REMARKS
MS-PV-01	REACTOR VESSEL	8.0 MW		COMB. ENGRG.		19,500#	VESSEL 1 1/8 SA212B DES. PRESS. 720 PSI, DESIGN TEMP. 600°F 1/8 304L SS CLAD
MS-TG-01	TURBINE GENERATOR	1250 KW 3PH 2400/4160 V	PL-2101-00-3	GEN. ELECT. CO.	E-4066016-13CX	27,000#	TYPE DRUM MULTI-VALVE MULTI-STAGE TURBINE 10,000 RPM @ 15" HG ABS.

REFERENCE DRAWINGS

REF. NO.	DRAWING NO.	PROJECT NO.	TITLE
6	PL2J2120	2111	PLANT HEATING SYSTEM
5	PL2J2201	2101-11	MAIN STEAM PROCESS INSTR. DIAGRAM
4	PL2J2124	2107	LOW PRESSURE DRAIN SYSTEM DIAGRAM
3	PL2J2122	2106	HIGH PRESSURE DRAIN SYSTEM DIAGRAM
2	PL2J2119	2102	CONDENSATE SYSTEM DIAGRAM
1	PL2J2189	2110	SERVICE WATER SYSTEM DIAGRAM

MAIN STEAM SYSTEM DIAGRAM
Fig. 42



INSTRUMENT COMPONENT LIST

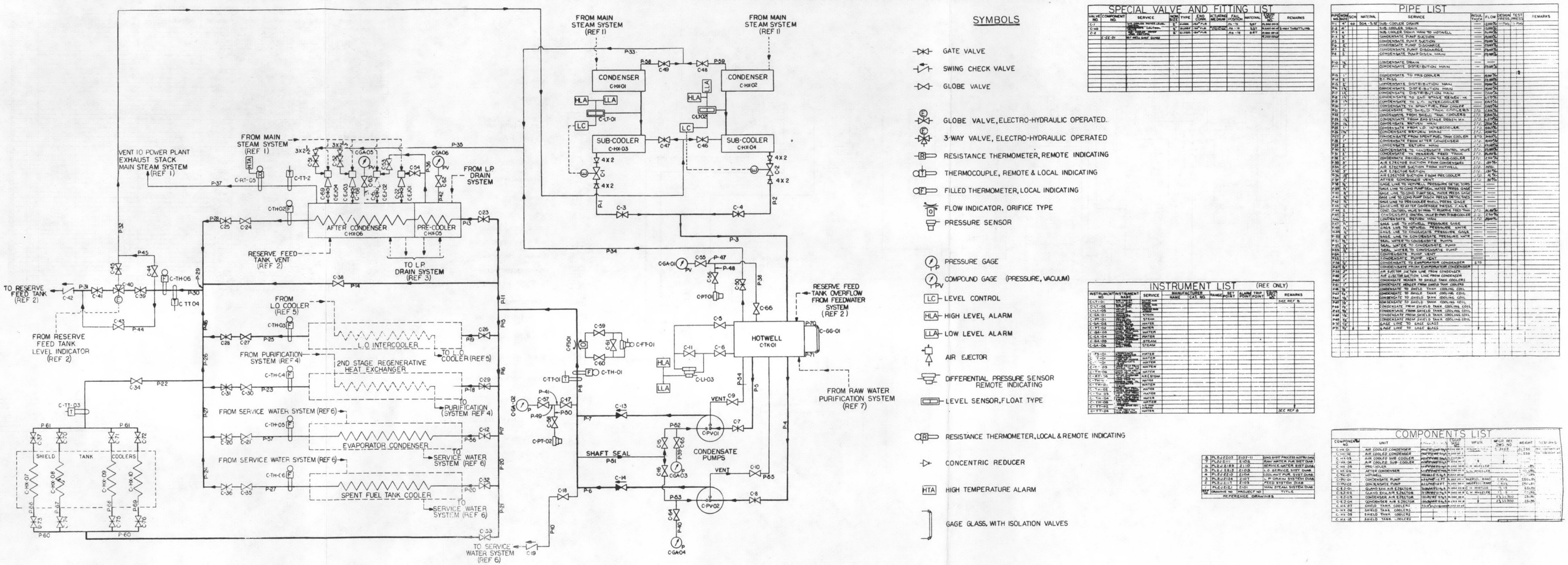
INST. NO.	TYPE	INPUT	RANGE	MFG.	MOD. NO.	OUTPUT	SET POINT CONTROL	SET POINT ALARM	MOUNTING INSERTION	MOUNTING CONNECTION	EQUIP. SPEC. NO.
MS-TT-04	SENSOR, TC.	MAIN STEAM	0°-500°F	MPLS. HONEYWELL	38 37 F	MV.			5"	3/4" NPT	2101-11-71
S-SW-01	SWITCH, SELECTOR	MV.		MPLS. HONEYWELL	364971	MV.					74
S-I-01	IND., ELEC.	MV.	0°-500°F	MPLS. HONEYWELL	105 X 11						75
MS-TT-01	SENSOR, TC.	REL. V. DISCH. TEMP.	0°-500°F	MPLS. HONEYWELL	38 37F	MV.			5"	3/4" NPT	71
MS-RT-01	RES. THERM.	REL. V. DISCH. TEMP.	0°-500°F	MPLS. HONEYWELL	BROWN CLASS 2				5"	3/4" NPT	70
MS-AU-01	ALARM UNIT		0°-500°F	MPLS. HONEYWELL	R 7082 C			400°F			72
MS-IL-01	LIGHT, IG.	12 V DC		ELDEMA CORP.	TYPE 1FH						68
MS-PT-01	SENSOR PRESS.	STEAM PRESS.	0-750 PSIG	FOXBORO	611	10-50 MA					76
S-PS-01	POWER SUPPLY					65 V DC					77
MS-R-02	RECORDER	10-50 MA		FOXBORO	6410-OF						78
MS-AU-02	ALARM UNIT		0-750 PSIG	FOXBORO	63			500 PSIG			79
MS-IL-02	LIGHT, IG.	12 V DC		ELDEMA	1FH						68
MS-IL-03	LIGHT, IG.	12 V DC		ELDEMA	1FH						68
MS-GA-01	GAGE, PRESS.	M. ST. PRESS.	0-750 PSIG	ASHCROFT	1379S					1/2" NPT	65
MS-FS-01	FLOW SENSOR	M. ST. FLOW	0-40,000 LB/HR	FOXBORO		DIFF. PRESS.				RF FLANGE	80
MS-FT-01			0-400" H_2O	FOXBORO	613	10-50 MA				1/2" NPT	81
AS-TT-03	SENSOR, TC	AUX. ST. REL. TEMP	0°-400°F	MPLS. HONEYWELL	38 37F	MV			5"	3/4" NPT	71
AS-RT-03	RES. THERM.	AUX. ST. REL. TEMP	0°-400°F	MPLS. HONEYWELL	BROWN CLASS 2				5"	3/4" NPT	70
MS-AU-07	ALARM UNIT	AUX. ST. REL. TEMP	0°-400°F	MPLS. HONEYWELL	R-708 2C			350°F			72
MS-IL-08	LIGHT, IG	AUX. ST. REL. TEMP		ELDEMA	1FH						68
MS-GA-04	GAGE, PRESS.	AUX. ST. PRESS.	0-300 PSIG	ASHCROFT	1379S					1/2" NPT	65
MS-PT-02	SENSOR, PRESS.	T.G. ST. PRESS.	0-700 PSIG	FOXBORO	611	10-50 MA				1/2" NPT	76
MS-IM-02	IND. METER	T.G. ST. PRESS	0-700 PSIG	FOXBORO	65AL						83
MS-GA-02	GAGE, PRESS.	T.G. ST. PRESS.	0-700 PSIG	ASHCROFT	1379S					1/2" NPT	65
MS-GA-05	GAGE, PRESS.	SP. HX. PRESS	0-50 PSIG	ASHCROFT	1379S					1/2" NPT	65
MS-PT-03	SENSOR, PRES.-VAC.	T.G. EXH. PRESS	30" HG. VAC. 30 PSIG	FOXBORO	613	10-50 MA				1/2" NPT	81
MS-AU-03	ALARM UNIT		30" HG. VAC. 30 PSIG	FOXBORO	63			15 PSIG			79
MS-IL-05	LIGHT, IG.			ELDEMA	1FH						68
MS-R-03	RECORDER	REACTOR WATER LEVEL	0-150"	FOXBORO	6420-OF						78
MS-GA-03	GAGE, PRESS.-VAC.	T.G. DISCH. PRESS.	30" HG. VAC. 30 PSIG	ASHCROFT	1379S					1/2" NPT	65
MS-TH-01	THERM, FILLED	T.G. EXH. TEMP.	0°-300°F	FOXBORO	CLASS IIA				5"	3/4" NPT	69
MS-TT-02	SENSOR, TC.	T.G. EXH. REL.	0°-300°F	MPLS. HONEYWELL	38 37F	MV			5"	3/4" NPT	71
MS-RT-02	RES. THERM.	T.G. EXH. REL.	0°-300°F	MPLS. HONEYWELL	BROWN CLASS-2				5"	3/4" NPT	70
MS-AU-04	ALARM UNIT	TG EXH REL.	0°-300°F	MPLS. HONEYWELL	R 7082 C						72
MS-IL-04	LIGHT, IG.	TG EXH REL.		ELDEMA	1FH						68
MS-C-01	CONTROLLER	TG EXH REL.	550-650 PSIG	FOXBORO	611	10-50 MA	600 PSIG				82
MS-R-01	RECORDER	MAIN STEAM FLOW	0-40,000 LBS/HR	FOXBORO	6420-OF						78
MS-IM-03	IND METER	TG EXHAUST	30" HG-30 PSIG	FOXBORO	65 PL						83
MS-GA-07	GAGE PRESS	TG GLAND EXH.	30" HG-15 PSIG	ASHCROFT	13795					1/2" NPT	65
MS-GA-06	GAGE PRESS	TG GLAND SEAL PRESS	30" HG-15 PSIG	ASHCROFT	13795					1/2" NPT	65
MS-LS-01	SENSOR, LEVEL	REACTOR WATER LEVEL	0-150"	FISHER-GOVERNOR	2500-249 P	10-50 MA				4" RF FLANGE	73
MS-LS-02	SENSOR, LEVEL	REACTOR WATER LEVEL	0-150"	FISHER-GOVERNOR	2500-249 P	10-50 MA				4" RF FLANGE	73
S-PS-01	POWER SUPPLY	INST POWER		POWER SOURCES	SERIES R66	65V-DC					77
MS-AU-05	ALARM UNIT	REACTOR WATER LEVEL	10-50 MA	FOXBORO	63			± 18"			79
MS-AU-06	ALARM UNIT	REACTOR WATER LEVEL	10-50 MA	FOXBORO	63			± 18"			79
MS-AU-07	ALARM UNIT	REACTOR WATER LEVEL	10-50 MA	FOXBORO	63			± 25"			79
MS-AU-08	ALARM UNIT	REACTOR WATER LEVEL	10-50 MA	FOXBORO	63			± 25"			79
MS-AU-09/10	ALARM UNIT	MAIN ST. PRESS.	10-50 MA	FOXBORO	63			± 80 PSIG			79
MS-IM-04	IND METER	REACTOR WATER LEVEL	0-150"	FOXBORO	65 PL						83
MS-IM-05	IND METER	REACTOR WATER LEVEL	0-150"	FOXBORO	65 PL						83
MS-C-02	CONTROLLER	REACTOR WATER LEVEL		FOXBORO	62		100"				82
MS-C-03	CONTROLLER	REACTOR WATER LEVEL		FOXBORO	62		100"				82
MS-IL-06	IND LIGHT	REACTOR WATER LEVEL		ELDEMA	1FH						68
MS-IL-07	IND LIGHT	REACTOR WATER LEVEL		ELDEMA	1FH						[illegible]
MS-SW-01	SWITCH SELECTOR	REACTOR WATER LEVEL	2 POS	ANEA	20905-C						[illegible]

REF. NO.	DWG. NO.	PROJECT NO.	NAME
2	PL2J2189	2110	SERVICE WATER SYSTEM
1	PL2J2121	2101	MAIN STEAM SYSTEM DIAGRAM

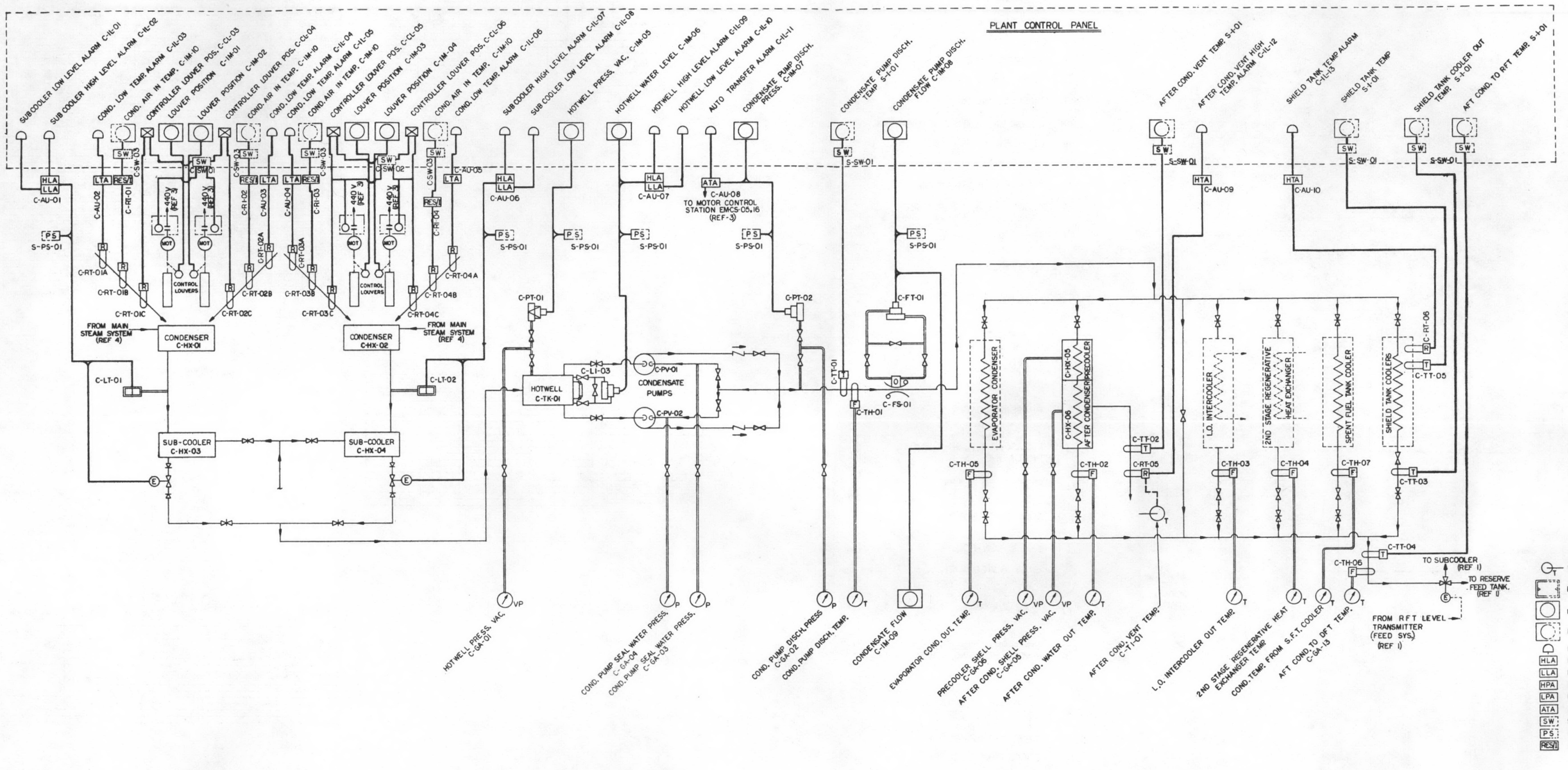
REFERENCE DRAWINGS

MAIN STEAM SYSTEM-PROCESS INSTRUMENTATION DIAGRAM

Fig. 43

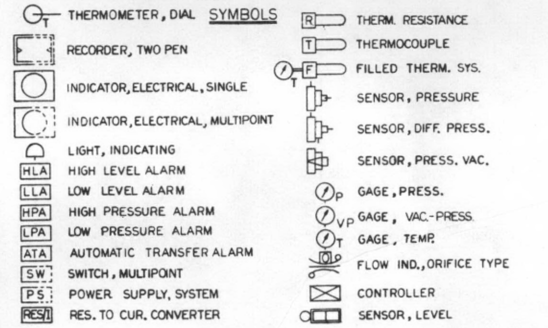


CONDENSATE SYSTEM DIAGRAM
Fig. 44



INSTRUMENT COMPONENT LIST

INST. NO.	TYPE	INPUT	RANGE	MFG.	MOD. NO.	OUTPUT	SET POINT CONTROL	SET POINT ALARM	MOUNTING INSERTION	MOUNTING CONNECT.	EQUIP. SPEC. NO.	REMARKS
C-IL-01	IG. LIGHT	C-AU-01		ELDEMA	IFH						2100-11-68	
C-IL-02	IG. LIGHT	C-AU-01		ELDEMA	IFH						68	
C-AU-01	ALARM UNIT	C-LT-01		FOXBORO	63			-2",6			79	
C-LT-01	LEVEL IND.	LEVEL, SUBCOOLER	0-12"	FISHER GOVERNOR	2500-249 P		4" ± 1"			1" NPT	73	
C-RI-03	RES. TO CUR. CONV.	C-RT-03B		M. HONEYWELL	1HB30	C-SW-02					88	
C-IL-07	IG. LIGHT	C-AU-06		ELDEMA	IFH						68	
C-IL-08	IG. LIGHT	C-AU-06		ELDEMA	IFH						68	
C-AU-06	ALARM UNIT	C-LT-02		FOXBORO	63	C-IL-07,08		-2",6"			79	
C-LT-02	LEVEL IND.	LEVEL, SUBCOOLER	0-12"	FISHER GOVERNOR	2500-249 P		4" ± 1"			1" NPT	73	
C-RI-04	RES. TO CUR. CONV.	C-RT-04B		M. HONEYWELL	1HB30	C-SW-03					88	
C-IL-03	IG. LIGHT	C-AU-02		ELDEMA	IFH						68	
C-AU-02	ALARM UNIT	C-RT-01A	0-100°F	M. HONEYWELL	R7082C			30°F			72	
C-RT-01A	RES. THERM	COND. AIR IN	0-100°F	M. HONEYWELL	L7033A1033						70	
S-SW-01	SWITCH MULTI-POINT											REF 5
C-RI-01	RES. TO CUR. CONV.	C-RT-01B		M. HONEYWELL	1HB30	C-SW-03					88	
C-RT-01B	RES. THERM.	COND. AIR IN	0-100°F	M. HONEYWELL	L7022A					FLANGE	70	
C-CL-03	CONTROLLER	C-RT-01C		M. HONEYWELL	R7087	C-SW-01	40°F				82	
C-RT-01C	RES. THERM.	COND. AIR IN	0-100°F	M. HONEYWELL	L7022A						70	
C-IM-01	INDICATOR, ELEC.	LOUVER POSITION	0-100%	INTERN. INST.	1145						83	
C-IM-02	INDICATOR, ELEC.	LOUVER POSITION		INTERN. INST.	1145						83	
C-CL-04	CONTROLLER	C-RT-02C		M. HONEYWELL	R7087	C-SW-01					82	
C-RT-02C	RES. THERM	COND. AIR IN	0-100°F	M. HONEYWELL	L7022A						70	
C-RT-02B	RES. THERM	COND. AIR IN	0-100°F	M. HONEYWELL	L7022A	C-RI-01					70	
C-IL-04	IG. LIGHT	C-AU-03		ELDEMA	IFH						68	
C-AU-03	ALARM UNIT	C-RT-02A	0-100°F	M. HONEYWELL	R7082C			30°F			72	
C-RT-02A	RES. THERM	COND. AIR IN	0-100°F	M. HONEYWELL	L7033A1033						70	
C-IL-05	IG. LIGHT	C-AU-04		ELDEMA	IFH						68	
C-AU-04	ALARM UNIT	C-RT-03A	0-100°F	M. HONEYWELL	R7082C	C-IL-05		30°F			72	
C-RT-03A	RES. THERM	COND. AIR IN	0-100°F	M. HONEYWELL	L7033A1033						70	
S-PS-01	POWER SUPPLY											REF 2
C-RI-02	RES. TO CUR. CONV.	C-RT-02B		M. HONEYWELL	1HB30	C-SW-03					88	
C-RT-03B	RES. THERM.	COND. AIR IN	0-100°F	M. HONEYWELL	L7022A	C-RI-03					70	
C-CL-05	CONTROLLER			M. HONEYWELL	R7087						82	
C-RT-03C	RES. THERM.	COND. AIR IN	0-100°F	M. HONEYWELL	L7022A						70	
C-IM-03	INDICATOR, ELEC.	LOUVER POSITION	0-90°	INTERN. INST.	1145						83	
C-IM-04	INDICATOR, ELEC.	LOUVER POSITION	0-90°	INTER. INST.	1145						83	
C-CL-06	CONTROLLER	C-RT-04C		M. HONEYWELL	R7087	C-LM-03	40°F				82	
C-RT-04C	RES. THERM	COND. AIR IN	0-100°F	M. HONEYWELL	L7022A	C-CL-06					70	
C-IL-06	IG. LIGHT	C-AU-05		ELDEMA	IFH						68	
C-AU-05	ALARM UNIT	C-RT-04A	0-100°F	M. HONEYWELL	R7082C			30°F			72	
C-RT-04B	RES. THERM	COND. AIR IN	0-100°F	M. HONEYWELL	L7022A	C-RI-04					70	
C-RT-04A	RES. THERM	COND. AIR IN	0-100°F	M. HONEYWELL	L7033A1033	C-AU-05					70	
C-IM-05	INDICATOR, ELEC.	C-PT-01	30"Hg V-30 PSIG	FOXBORO	65 PL						83	
C-PT-01	SENSOR, P-V	HOTWELL PRESS.	30"Hg V-30 PSIG	FOXBORO	613	C-IM-05				1/2" NPT	81	
C-GA-01	GAGE, P-V	HOTWELL PRESS.	30"Hg V-30 PSIG	ASHCROFT	1379S					1/2" NPT	65	
C-IM-06	INDICATOR, ELEC.	C-LT-03	0-35"	INTERN. INST.	2545						83	
C-LI-03	LEVEL IND.	HOTWELL LEVEL	0-35"	FOXBORO	613	C-IM-06				1/2" NPT	81	
C-IL-09	IG. LIGHT	C-AU-07		ELDEMA	IFH						68	
C-IL-10	IG. LIGHT	C-AU-07		ELDEMA	IFH						68	
C-AU-07	ALARM UNIT	C-LT-03		FOXBORO	63			12", 30"			79	
C-IL-11	IG. LIGHT	C-AU-08		ELDEMA	IFH						68	
C-AU-08	ALARM UNIT	C-PT-02		FOXBORO	63			30 PSIG			79	
C-PT-02	SENSOR, PRESS.	COND. PUMP DISCH. P.	0-60 PSIG	FOXBORO	611	C-IM-07				1/2" NPT	76	
C-GA-02	GAGE, PRESS.	COND. PUMP DISCH. P.	0-60 PSIG	ASHCROFT	1379S					1/2" NPT	65	
C-IM-07	INDICATOR, ELEC.	C-PT-02	0-60 PSIG	FOXBORO	65PL						83	
C-TT-01	SENSOR, TC.	CNDS. PUMP DISCH.	0-250°F	M. HONEYWELL	3837A	S-SW-01			5"	3/4" NPT	83	
C-TH-01	THERM. FILLED	CNDS. PUMP DISCH.	0-250°F	FOXBORO	CLASS II A 33				5"	3/4" NPT	69	
S-I-01	IND. GALVANOMETER											REF 5
C-FS-01	FLOW SENSOR	CNDS. PUMP DISCH.	0-70 GPM	FOXBORO	B1049	C-FT-06				LINE BY FLANGE	80	
C-FT-01	FLOW XMITTER	C-FS-01	0-250" H_2O	FOXBORO	613					1/2" NPT	81	
C-IM-08	INDICATOR, ELEC.	C-FT-01	0-70 GPM	FOXBORO	65PL						83	
C-TH-05	THERM. FILLED	EVAP. COND. OUT	0-250°F	FOXBORO	CLASS II A 33				5"	3/4" NPT	69	
C-GA-04	GAGE, PRESS.	CND. PUMP SEAL	0-25 PSIG	ASHCROFT	1379S					1/2" NPT	65	
C-GA-06	GAGE, P-V	PRECOOLER	30"Hg V-30 PSIG	ASHCROFT	1379S					1/2" NPT	65	
C-GA-05	GAGE, P-V	AFTER COND.	30"Hg V-30 PSIG	ASHCROFT	1379S					1/2" NPT	65	
C-TH-02	THERM. FILLED	AFTER COND. OUT	0-200°F	FOXBORO	CLASS II A 33				5"	3/4" NPT	69	
C-IM-09	IND. ELECT.	C-FT-01	0-70 GPM	FOXBORO	65 FS						83	
C-TT-02	SENSOR, TC.	AFTER COND. VENT	0-200°F	M. HONEYWELL	3837A	S-SW-01			5"	3/4" NPT	71	
C-RT-05	RES. THERM.	AFTER COND. VENT	0-250°F	M. HONEYWELL	BROWN CL. 2	C-AU-09			5"	3/4" NPT	70	
C-AU-09	ALARM UNIT	C-RT-05		M. HONEYWELL	R7082 C			200°F			72	
C-IL-12	IG. LIGHT	C-AU-09		ELDEMA	IFH						68	
C-TI-01	THERM. DIAL	AFT. COND. VENT	0-250°F	WESTON	4500						89	
C-TH-03	THERM. FILLED	L.O. INTER-CLR. OUT	0-200°F	FOXBORO	CLASS II A 33				5"	3/4" NPT	69	
C-GA-03	GAGE, PRESS.	CND. PUMP SEAL	0-25 PSIG	ASHCROFT	1379S					1/2" NPT	65	
C-TH-04	THERM. FILLED	REGEN. HT. EXCHR.	0-200°F	FOXBORO	CLASS II A 33				5"	3/4" NPT	69	
C-IM-10	IND. ELEC.	COND. AIR IN TEMP.	0-100°F	FOXBORO	65 PL						83	
C-TH-07	SENSOR, TC.	S.F.T. CLR. OUT	0-200°F	FOXBORO	CLASS II A 33				5"	3/4" NPT	69	
C-TT-03	SENSOR TC.	S.T. CLR. OUT	0-200°F	M. HONEYWELL	3837A	S-SW-01			5"	3/4" NPT	71	
C-TT-04	SENSOR TC.	COND. TO RFT	0-200°F	M. HONEYWELL	3837A	S-SW-01			5"	3/4" NPT	71	
C-TH-06	THERM. FILLED	COND. TO RFT	0-200°F	FOXBORO	CLASS II A 33				5"	3/4" NPT	69	
C-SW-01	SWITCH, SELECTOR	C-CL-03,04		GENERAL ELEC.	SBM	C-LM-01A,B					84	
C-SW-02	SWITCH SELECTOR	C-CL-05,06		GENERAL ELEC.	SBM	C-LM-02A,B					84	
C-SW-03	SWITCH SELECTOR	C-RC-01 TO 04		GENERAL ELEC.	SBM	C-IM-10					84	
C-RT-06	RES. THERM.	SHIELD TK. TEMP.	0-200°F	MPLS. HONEYWELL	BROWN CLASS 2	C-AU-10			5"	3/4" NPT	70	
C-AU-10	ALARM UNIT	C-RT-06		MPLS. HONEYWELL	R-7082 C	C-IL-13					72	
C-IL-13	IND. LIGHT	C-AU-10		ELDEMA	IFH				5"	3/4" NPT	68	
C-TT-05	SENSOR T.C.	SHIELD TK. TEMP.	0-200°F	MPLS. HONEYWELL	3837F	S-SW-01					71	

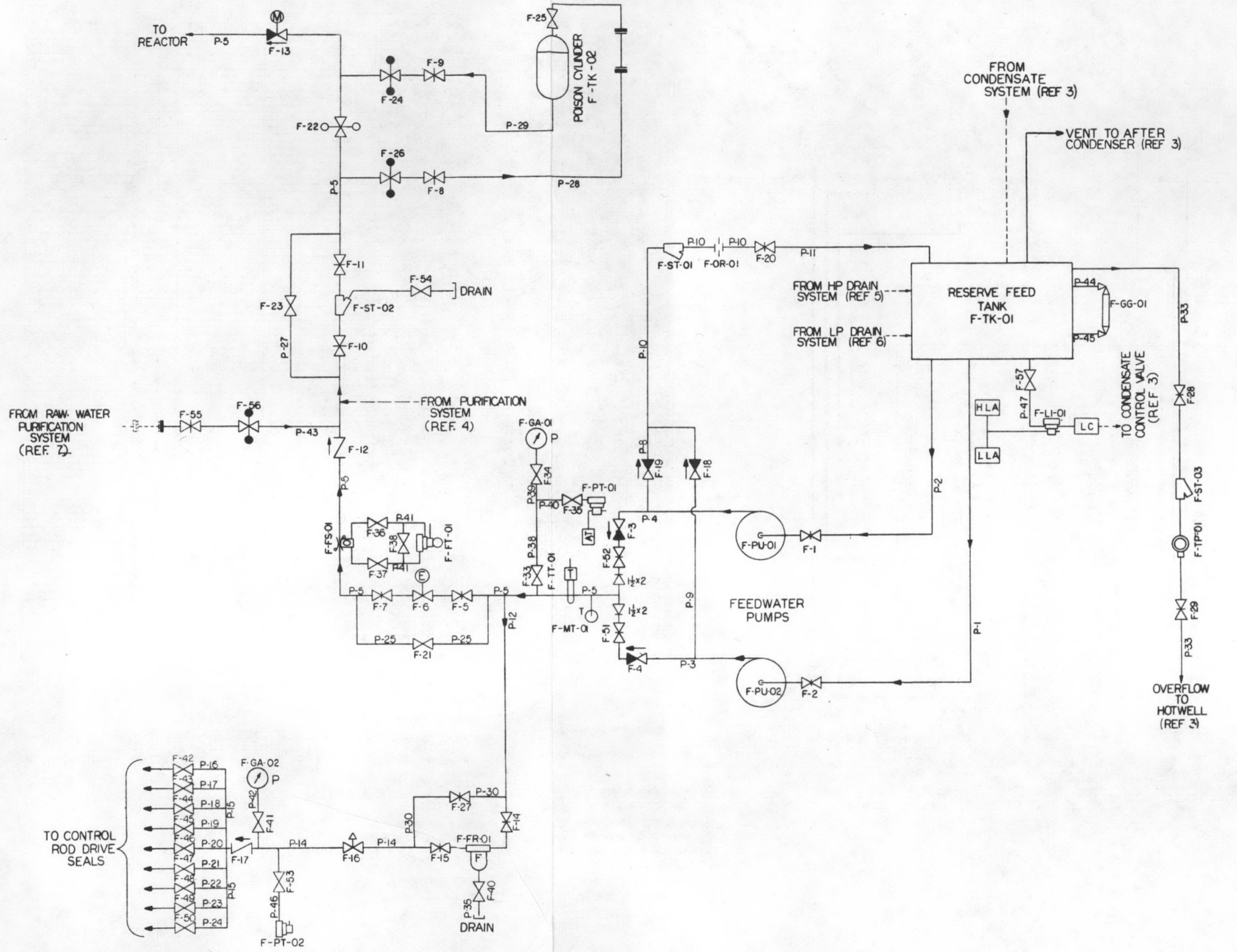


REF. NO.	DRAWING NO.	PROJECT NO.	TITLE
5	PL2J2121	2101-11	MAIN STEAM SYS-PRO. INSTR DIAG.
4	PL2J2121	2101	MAIN STEAM SYSTEM DIAGRAM
3	PL2J2229	2201-04	PLANT MOTOR SUPPLY MULTILINE DIAG.
2	PL2J2219	2201-03	AUX. & EMER. POWER-MULTILINE DIAG.
1	PL2J2119	2102	CONDENSATE SYSTEM DIAG.

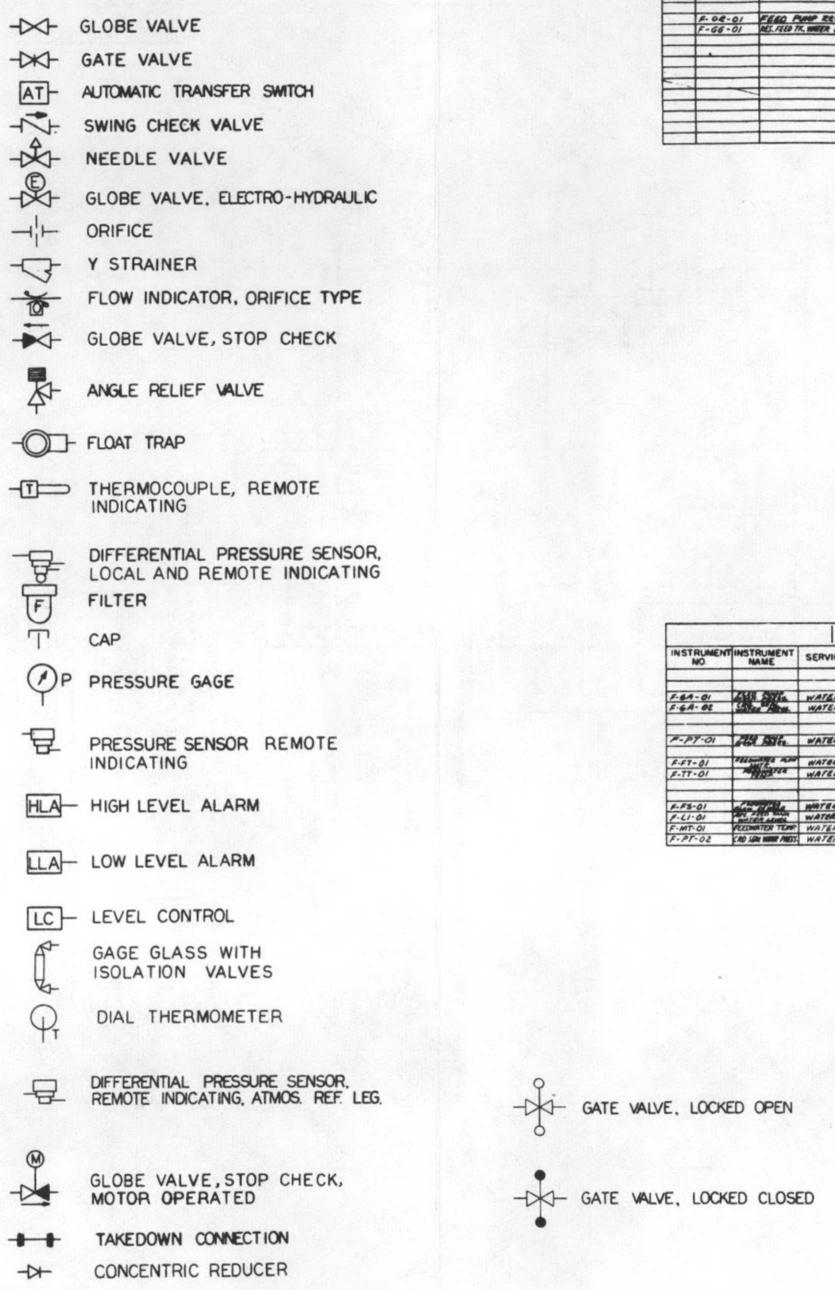
REFERENCE DRAWINGS

CONDENSATE SYSTEM PROCESS INSTRUMENTATION-ONE LINE DIAGRAM

Fig. 45



SYMBOLS



SPECIAL VALVE AND FITTING LIST

VALVE NO.	COMPONENT NO.	SERVICE	NOM SIZE	TYPE	END CONN.	ACTUAT. MEDIUM	FAIL POSITION	MAT'L	EQUIP SPEC. NO.	REMARKS
F-6		FEEDWATER CONTROL	1"	GLOBE	FLANGED	[illegible]	AS-IS	S. ST.	PL-2103-00-12	
F-13		FEEDWATER STOP	2"	STOP CHECK	FLANGED	MOTOR	AS-IS	↓	PL-2103-00-12	
	F-OR-01	FEED PUMP RECIRC.							PL-2103-00-12	[illegible]
	F-GG-01	RES. FEED TK. WATER LEVEL							PL-2100-00-65	

PIPE LIST

PIPE NO.	NOM SIZE	SCH.	MAT'L	SERVICE	INSUL. THICK.	FLOW	DESIGN PRESS.	TEST PRESS.	REMARKS
P-1	3"	40	304 S.ST.	FEED PUMP SUCTION	STD	[illegible] #/hr	30 PSIG	45 PSIG	
P-2	3"			FEED PUMP SUCTION		[illegible] #/hr	30 PSIG	45 PSIG	
P-3	1½"			FEED PUMP DISCHARGE		[illegible] #/hr	750 PSIG	1050 PSIG	
P-4	1½"			FEED PUMP DISCHARGE		[illegible] #/hr	750 PSIG	1050 PSIG	
P-5	2"			FEEDWATER MAIN		[illegible] #/hr	750 PSIG	1050 PSIG	
P-8	½"			FEED PUMP RECIRCULATION		[illegible] #/hr	750 PSIG	1050 PSIG	
P-9	½"			FEED PUMP RECIRCULATION		[illegible] #/hr	750 PSIG	1050 PSIG	
P-10	½"			FEED PUMP RECIRCULATION		[illegible] #/hr	750 PSIG	1050 PSIG	
P-11	½"			FEED PUMP RECIRCULATION		[illegible] #/hr	30 PSIG	45 PSIG	
P-12	½"			FEEDWATER TO CRD SEAL WATER FILTER		440 #/hr	750 PSIG	1050 PSIG	
P-14	½"			FEEDWATER TO CRD SEAL WATER DISTR. HDR.	STD	440 #/hr	750 PSIG	1050 PSIG	
P-15	½"			CRD SEAL WATER DISTRIBUTION HEADER	STD	440 #/hr	750 PSIG	1050 PSIG	
P-16	½"			SEAL WATER TO CRD. SEAL		48.9 #/hr	750 PSIG	1050 PSIG	
P-17	½"			SEAL WATER TO CRD. SEAL		48.9 #/hr	750 PSIG	1050 PSIG	
P-18	½"			SEAL WATER TO CRD SEAL		48.9 #/hr	750 PSIG	1050 PSIG	
P-19	½"			SEAL WATER TO CRD SEAL		48.9 #/hr	750 PSIG	1050 PSIG	
P-20	½"			SEAL WATER TO CRD SEAL		48.9 #/hr	750 PSIG	1050 PSIG	
P-21	½"			SEAL WATER TO CRD SEAL		48.9 #/hr	750 PSIG	1050 PSIG	
P-22	½"			SEAL WATER TO CRD SEAL		48.9 #/hr	750 PSIG	1050 PSIG	
P-23	½"			SEAL WATER TO CRD SEAL		48.9 #/hr	750 PSIG	1050 PSIG	
P-24	½"			SEAL WATER TO CRD SEAL		48.9 #/hr	750 PSIG	1050 PSIG	
P-25	2"			FEEDWATER CONTROL VALVE BY-PASS	STD	[illegible] #/hr	750 PSIG	1050 PSIG	
P-27	2"			FEEDWATER STRAINER BY-PASS		[illegible] #/hr	750 PSIG	1050 PSIG	
P-28	1"			POISON CYLINDER SUPPLY		[illegible] #/hr	750 PSIG	1050 PSIG	
P-29	1"			POISON CYLINDER EFFLUENT		[illegible] #/hr	750 PSIG	1050 PSIG	
P-30	½"			CRD SEAL WATER FILTER BY-PASS		440 #/hr	750 PSIG	1050 PSIG	
P-31	1"			RESERVE FEED TANK RELIEF VALVE INLET		[illegible] #/hr	30 PSIG	45 PSIG	
P-32	2"			RESERVE FEED TANK RELIEF VALVE DISCHARGE		[illegible] #/hr			
P-33	2"			RESERVE FEED TANK OVERFLOW		[illegible] #/hr	30 PSIG	45 PSIG	
P-35	½"			CRD SEAL WATER FILTER DRAIN			750 PSIG	1050 PSIG	
P-36	½"			FEEDWATER FILTER DRAIN			750 PSIG	1050 PSIG	
P-37	½"			GAGE LINE TO RESERVE FEED TK. PRESS. GAGE			30 PSIG	45 PSIG	
P-38	½"			FEED PUMP DISCHARGE PRESSURE GAGE LINE	STD		750 PSIG	1050 PSIG	
P-39	½"			GAGE LINE TO FEED PUMP DISCH. PRESS. GAGE			750 PSIG	1050 PSIG	
P-40	½"			GAGE LINE TO FEED PUMP DISCH. PRESS. XMTR.			750 PSIG	1050 PSIG	
P-41				FEEDWATER FLOW XMTR GAGE LINE			750 PSIG	1050 PSIG	
P-42	½"			CRD SEAL WATER PRESSURE GAGE LINE			750 PSIG	1050 PSIG	
P-43	½"			CONN. FROM RAW WATER PURIFICATION SYSTEM					
P-44	½"			GAGE LINE TO RESERVE FEED TANK GAGE GLASS			30 PSIG	45 PSIG	
P-45	½"			GAGE LINE TO RESERVE FEED TANK GAGE GLASS			30 PSIG	45 PSIG	
P-46	½"			GAGE LINE TO CRD SEAL WATER PRESSURE XMTR			750 PSIG	1050 PSIG	
P-47	½"			GAGE LINE TO RFT LEVEL XMTR			30 PSIG	45 PSIG	

INSTRUMENT LIST (REF. ONLY)

INSTRUMENT NO.	INSTRUMENT NAME	SERVICE	MANUFACTURER NAME	MANUFACTURER CAT. NO.	RANGE	SET POINT	ALARM POINT	TRIP POINT	EQUIP SPEC. NO.	REMARKS
F-GA-01	[illegible]	WATER								SEE REF 1
F-GA-02	[illegible]	WATER								
F-PT-01	[illegible]	WATER								
F-FT-01	FEEDWATER FLOW XMTR.	WATER								
F-TT-01	FEEDWATER TEMP.	WATER								
F-FS-01	[illegible]	WATER								
F-LI-01	RES. FEED TANK WATER LEVEL	WATER								
F-MT-01	FEEDWATER TEMP.	WATER								
F-PT-02	CRD SEAL WATER PRESS.	WATER								

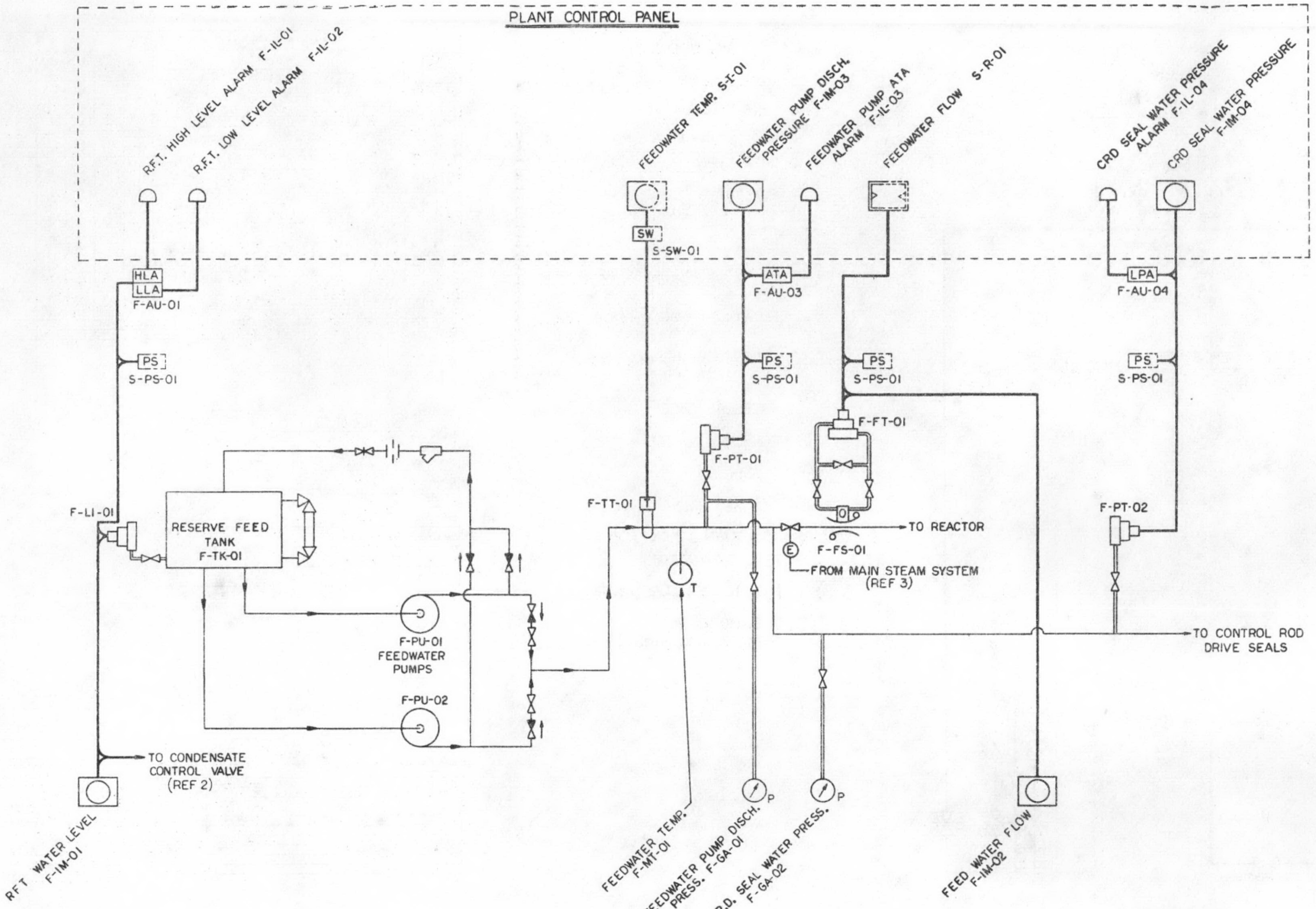
REFERENCE DRAWINGS

REF NO.	DRAWING NO.	PROJECT NO.	TITLE
7	PL2J2111	2105	RAWWATER PURIFICATION SYSTEM DIAGRAM
6	PL2J2124	2107	LOW PRESSURE DRAIN SYSTEM DIAGRAM
5	PL2J2122	2106	HIGH PRESSURE DRAIN SYSTEM DIAGRAM
4	PL2J2210	2104	COOLANT PURIFICATION SYSTEM DIAGRAM
3	PL2J2119	2102	CONDENSATE SYSTEM DIAGRAM
2	PL2J2121	2101	MAIN STEAM SYSTEM DIAGRAM
1	PL2J2206	2103-11	FEEDWATER SYS. PROCESS INSTRUMENTATION DIAG

COMPONENTS LIST

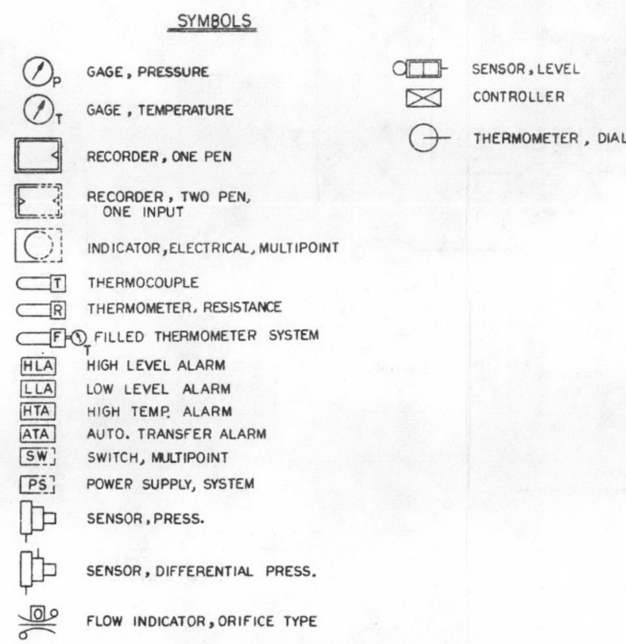
COMPONENT NO.	UNIT	CHARACTERISTICS	EQUIP SPEC. NO.	MFG'R.	MFG'R. REF. DWG.	WEIGHT	REMARKS
F-TK-01	RESERVE FEED TANK	660 GAL	PL-2103-00-16			1000#	
F-TK-02	POISON CYLINDER	7.5 GAL	PL-2103-00-17			350#	
F-PU-01	FEED PUMP	60 GPM 700 PSIG	PL-2103-00-15	INGERSOL-RAND	1½ VP-7	4000#	
F-PU-02	FEED PUMP	60 GPM 700 PSIG	PL-2103-00-15	INGERSOL-RAND	1½ VP-7	4000#	
F-FR-01	CRD SEAL WATER FILTER	10 GPM 700 PSIG	PL-2103-00-21			50#	

FEED SYSTEM
Fig. 46



INSTRUMENT COMPONENT LIST

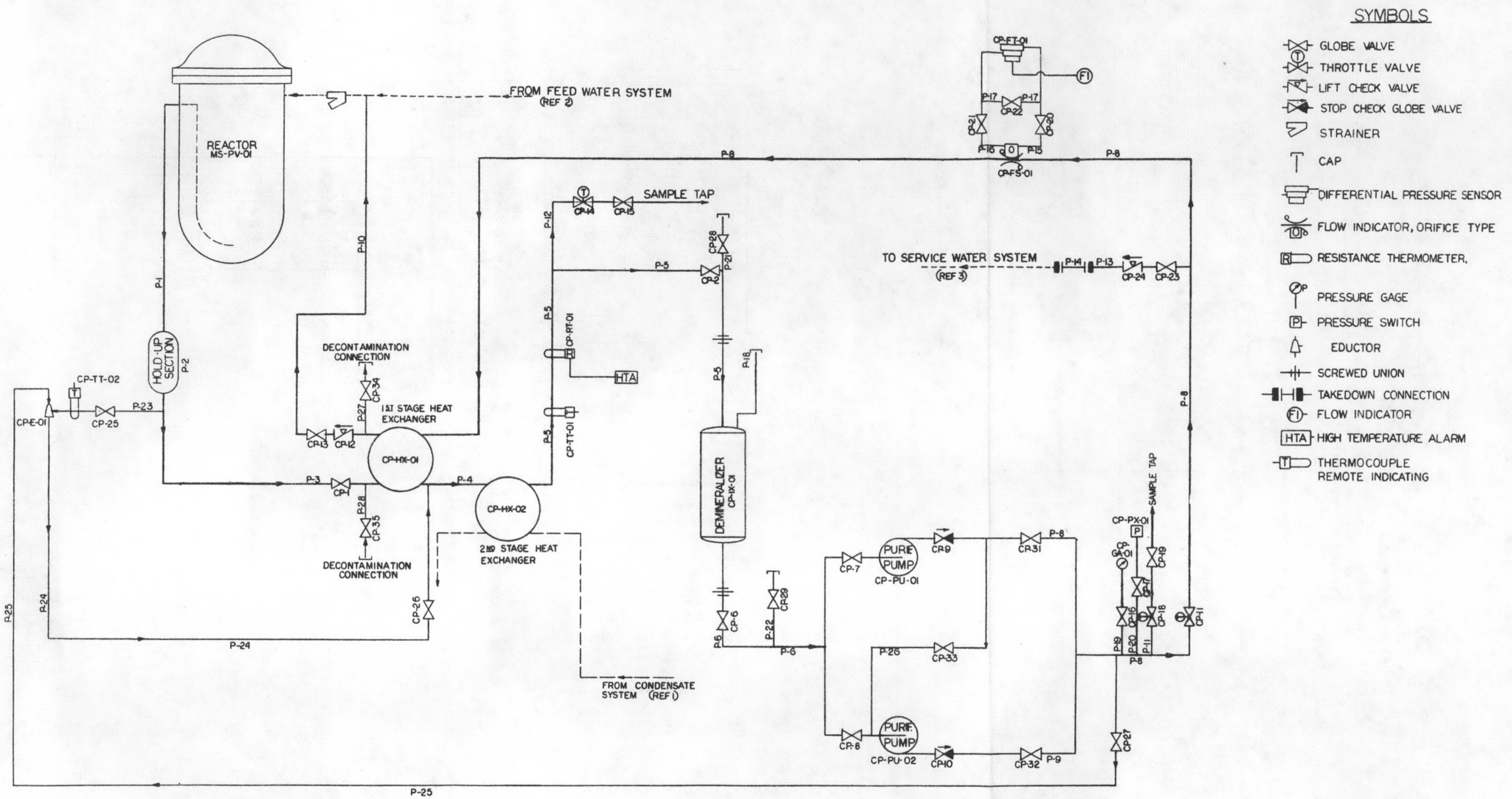
INST. NO.	TYPE	INPUT	RANGE	MFG.	MOD. NO.	OUTPUT	SET POINT CONTROL	SET POINT ALARM	MOUNTING INSERTION	MOUNTING CONNECT.	EQUIP. SPEC. NO.	REMARKS
F-IL-01	IG. LIGHT	F-AV-01		ELDEMA	IFH						2100-11-68	
F-IL-02	IG. LIGHT	F-AV-01		ELDEMA	IFH						2100-11-68	
F-AU-01	ALARM UNIT	F-LI-01		FOXBORO	63	F-IL-01, 02		3", 24"			2100-11-79	
F-LI-01	LEVEL IND.	RES. FEED TK. LEVEL	0-48"	FOXBORO	613	F-IM-01 F-AU-01					2100-11-81	
F-IL-04	IND. LIGHT	F-AV-04		ELDEMA	IFH						2100-11-68	
F-IM-01	IND. ELECT.	F-LI-01	0-40"	FOXBORO	65PS						2100-11-83	
F-IM-02	IND. ELECT.	F-FT-01	0-70GPM	FOXBORO	65PS						2100-11-83	
S-I-01	IND. GALV.											REF 4
S-SW-01	SWITCH MULTIPOINT											REF 4
S-PS-01	POWER SUPPLY											REF 5
S-R-01	RECORDER											REF 4
F-TT-01	SENSOR, TC.	FEED WATER TEMP.	0-200°F	M. HONEYWELL	3837A	S-SW-01			5"	1/4" NPT	2100-11-71	
F-MT-01	THERM. METAL.	FEEDWATER TEMP.	0-200°F	WESTON	4500				5"	1/2" NPT	2100-11-89	
F-IM-04	IND. ELECT.	F-PT-02	0-1000 PSIG	FOXBORO	65PL						2100-11-83	
F-AU-04	ALARM UNIT	F-PT-02		FOXBORO	63	F-IL-04		650 PSIG			2100-11-79	
F-IL-03	IG. LIGHT	F-AV-03		ELDEMA	IFH						2100-11-68	
F-AU-03	ALARM UNIT	F-PT-01		FOXBORO	63			600 PSIG			2100-11-79	
F-PT-01	SENSOR PRESS.	F.W. PUMP DISCH.	0-1000 PSIG	FOXBORO	611	F-AU-03				1/2" NPT	2100-11-76	
F-GA-01	GAGE, PRESS.	F.W. PUMP DISCH.	0-1000 PSIG	ASHCROFT	1379S					1/2" NPT	2100-11-65	
F-FT-01	SENSOR, P-V	F-FS-01	0-200" H_2O	FOXBORO	618	S-R-01 F-IM-02				1/2" NPT	2100-11-81	
F-FS-01	SENSOR, FLOW	FEEDWATER FLOW	0-70 gpm	FOXBORO	B1049	F-IT-01				LINE RF FLANGE	2100-11-80	
F-GA-02	GAGE, PRESS.	C.R.D. SEAL WATER PRESS.	0-1000 PSIG	ASHCROFT	1379S					1/2" NPT	2100-11-65	
F-PT-02	PRESS. XMTR.	C.R.D. SEAL WATER PRESS.	0-1000 PSIG	FOXBORO	611	F-IM-04 F-AU-04				1/2" NPT	2100-11-76	
F-IM-03	IND. ELECT.	F-PT-01	0-1000 PSIG	FOXBORO	65PL							



REF. NO.	DRAWING NO.	PROJECT NO.	TITLE
5	J2219	2201-03	ELECTRIC POWER AUX. AND EMERG.
4	J2201	2151-11	MAIN STEAM SYS. PROCESS INSTR.
3	J2121	2101	MAIN STEAM SYSTEM DIAG.
2	J2119	2102	CONDENSATE SYSTEM DIAG.
1	J2117	2103	FEEDWATER SYSTEM

REFERENCE DRAWINGS

FEED SYSTEM PROCESS INSTRUMENTATION-ONE LINE DIAGRAM
Fig. 47



PIPE LIST 1

PIPE NO.	NOM. SIZE	SCH.	MAT'L	SERVICE	INSUL. THICK.	OPRG. FLOW	DESIGN PRESS. PSIG	TEST PRESS. PSIG	REMARKS
P-1	1½"	40	304 SST	REACTOR OUTLET TO HOLDUP SECTION	STD	5 GPM	720	1080	
P-2	12"	40	304 SST	HOLDUP SECTION		5 GPM	720	1080	
P-3	1½"	40	304 SST	HOLDUP SECTION TO 1ST STAGE HEAT EXCHANGER		5 GPM	720	1080	
P-4	1½"	40	304 SST	1ST STAGE HEAT EXCHR. TO 2ND STAGE HEAT EXCHR.		5 GPM	720	1080	
P-5	1½"	40	304 SST	2ND STAGE HEAT EXCHANGER TO DEMINERALIZER INLET		5 GPM	720	1080	
P-6	1½"	40	304 SST	DEMINERALIZER OUTLET TO PUMP CP-PU-01		5 GPM	720	1080	
P-7	1½"	40	304 SST	PUMP CP-PU-02 INLET		5 GPM	720	1080	
P-8	1"	40	304 SST	DISCHARGE FROM PUMP CP-PU-01 TO 1ST STAGE HEAT EXCHR.		5 GPM	720	1080	
P-9	1"	40	304 SST	DISCHARGE FROM PUMP CP-PU-02		5 GPM	720	1080	
P-10	1"	40	304 SST	RETURN DISCH. FROM 1ST STAGE HEAT EXCHR. TO REACTOR FEEDLINE		5 GPM	720	1080	
P-11	½"	40	304 SST	DEMINERALIZER EFFLUENT SAMPLE LINE		.5 GPM	720	1080	
P-12	½"	40	304 SST	DEMINERALIZER INFLUENT SAMPLE LINE		.5 GPM	720	1080	
P-13	½"	40	304 SST	DRAIN LINE TO SERVICE WATER SYSTEM		5 GPM	720	1080	
P-14	½"	40	304 SST	DRAIN LINE TAKEDOWN CONNECTION	–	5 GPM	720	1080	
P-15	½"	40	304 SST	H.P. SUPPLY-FLOW METER DP TRANSMITTER	–	—	720	1080	
P-16	½"	40	304 SST	L.P. SUPPLY-FLOW METER DP TRANSMITTER	–	—	720	1080	
P-17	½"	40	304 SST	EQUALIZING BYPASS-FLOW METER DP TRANSMITTER	–	—	720	1080	
P-18	½"	40	304 SST	VENT LINE DEMINERALIZER CP-IX-01	–	—	720	1080	
P-19	½"	40	304 SST	PRESSURE GAGE INLET LINE	–	—	720	1080	
P-20	½"	40	304 SST	PRESSURE SWITCH INLET LINE	–	—	720	1080	
P-21	½"	40	304 SST	VENT LINE ON DEMINERALIZER INLET LINE	STD	—	720	1080	
P-22	½"	40	304 SST	VENT LINE ON DEMINERALIZER OUTLET LINE	STD	—	720	1080	
P-23	1½"	40	304 SST	EDUCTOR SUCTION	STD	5 GPM	720	1080	
P-24	1½"	40	304 SST	EDUCTOR OUTLET TO 2ND STAGE HEAT EXCHR.	STD	12.2 GPM	720	1080	
P-25	1½"	40	304 SST	MOTIVE WATER LINE TO EDUCTOR	STD	7.2 GPM	720	1080	
P-26	1"	40	304 SST	PUMP SERIES CONNECTION	STD	12.2 GPM	720	1080	
P-27	1"	40	304 SST	DECONTAMINATION CONNECTION	STD	5 GPM	720	1080	
P-28	1"	40	304 SST	DECONTAMINATION CONNECTION	STD	5 GPM	720	1080	

INSTRUMENT LIST (REF. ONLY)

INSTRUMENT NO.	INSTRUMENT NAME	SERVICE	REMARKS
CP-FT-01	FLOW METER DP SENSOR	PRIMARY COOLANT	SEE REFERENCE 4
CP-GA-01	PRESSURE GAGE		
CP-FS-01	PURIFICATION FLOW SENSOR		
CP-PX-01	PRESSURE SWITCH		
CP-RT-01	RESISTANCE THERMOMETER		
CP-TT-01	THERMOCOUPLE		
CP-TT-02	THERMOCOUPLE		

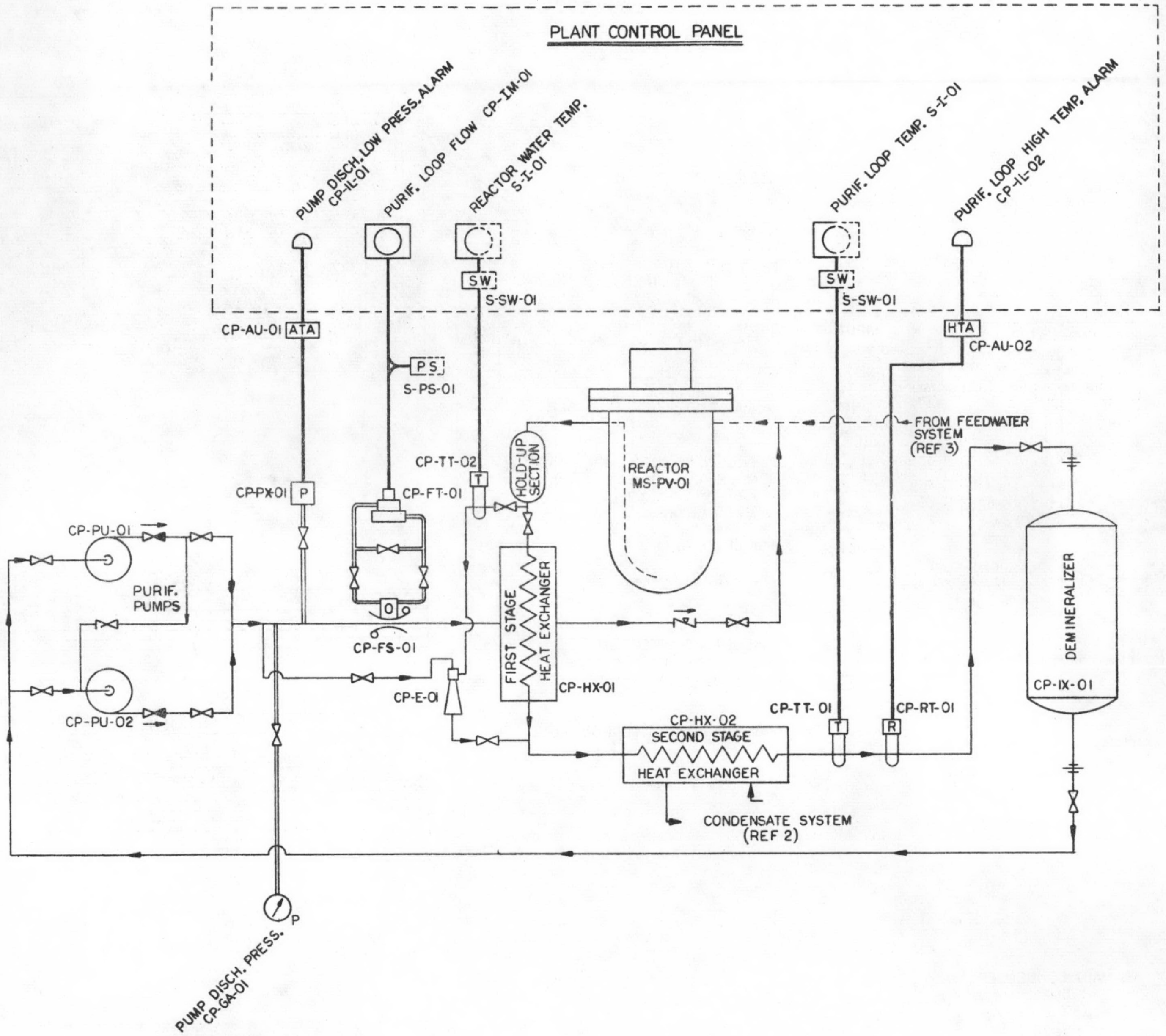
COMPONENTS LIST

COMPONENT NO.	UNIT	CHARACTERISTIC	EQUIP. SPEC. NO.	MFG'R.	MFG'R. REF. DWG.	WEIGHT	REMARKS
CP-HX-01	1ST STAGE HEAT EXCHANGER	4.38×10⁵ BTU/HR.	[illegible]	GRAHAM MFG.	124C4C – 12	150#	
CP-HX-02	2ND STAGE HEAT EXCHANGER	5.30×10⁵ BTU/HR.	[illegible]	GRAHAM MFG.	304C4C – 14L	300#	
CP-IX-01	DEMINERALIZER	RESIN VOL. 2.8 CU. FT.	R-2104-00-22	ILLINOIS WATER TREATMENT CO.		DEMIN. CHARGED 780#	
CP-E-01	EDUCTOR	LIFT CAP. 5 GPM	R-2104-00-27	SCHUTTE/KOERTING	FIG. 222-B	25#	
CP-PU-01	PURIFICATION PUMP	[illegible]	R-2104-00-28	CHEM PUMP	CFH-1½-¾	200#	
CP-PU-02	PURIFICATION PUMP	[illegible]	R-2104-00-28	CHEM PUMP	CFH-1½-¾	200#	

REFERENCE DRAWINGS

REF. NO.	DWG. NO.	PROJECT REF. NO.	TITLE
4	PL2J2207	2104-11	COOLANT PURIFI. SYST. INSTRUMENT DIAGRAM
3	PL2J2189	2110	CONDENSATE SYSTEM DIAGRAM
2	PL2J2117	2103	FEED WATER SYSTEM DIAGRAM.
1	PL2J2119	2102	SERVICE WATER SYSTEM DIAGRAM

COOLANT PURIFICATION
Fig. 48



INSTRUMENT COMPONENT LIST

INST. NO.	TYPE	INPUT	RANGE	MFG.	MOD. NO.	OUTPUT	SET POINT		MOUNTING		EQUIP. SPEC. NO.	REMARKS
							CONTROL	ALARM	INSERTION	CONNECT.		
CP-PX-01	PRESS. SWITCH	PURIF. PUMP DISCH.	0-750 PSIG	BARKSDALE	312	CP-AU-01	625 PSIG			1/4" NPT	2100-11-66	
CP-AU-01	ALARM UNIT	CP-PX-01		SQUARE D	8501 AP	CP-IL-01		615 PSIG	RACK		91	NO AUTO. TRANSFER
CP-IL-01	IG. LIGHT	CP-AU-01		ELDEMA	IFH				FLUSH		68	
CP-GA-01	GAGE, PRESS.	PURIF. PUMP DISCH.	0-750 PSIG	ASHCROFT	13795				SURFACE	1/2" NPT	65	
CP-FS-01	SENSOR, FLOW	PURIF. LOOP FLOW	0-10 GPM	FOXBORO	81049					LINE RF FLANGE	80	
CP-FT-01	FLOW XMTR.	CP-FS-01	0-100" H_2O	FOXBORO	613	CP-IM-01				1/2" NPT	81	
CP-IM-01	IND. ELECT.	CP-FT-01	0-10 GPM	FOXBORO	65PL						83	
CP-TT-01	SENSOR, TC.	PRIMARY COOLANT TEMP.	0-250° F	MPLS HONEY	3837F	MV			5"	3/4" NPT	71	
CP-AU-02	ALARM UNIT	CP-RT-01		MPLS HONEY	R7082C	CP-IL-02		170° F			72	PUR. PUMPS STOPPED ABOVE 170°F
CP-IL-02	IG. LIGHT	CP-AU-02		ELDEMA	IFH						68	
CP-RT-01	THERM., RES.	DEMIN. INLET TEMP.	0-250°F	MPLS HONEY		CP-AU-02			5"	3/4" NPT	70	
CP-TT-02	THERM., TC	REACTOR WATER	0-250°F	S-SW-01	3837F	S-SW-01			5"	3/4" NPT	71	
S-SW-01	SWITCH MULTIPOINT											REF 3
S-I-01	IND. GALVOMETER											REF 3
S-PS-01	POWER SUPPLY											REF 4

SYMBOLS

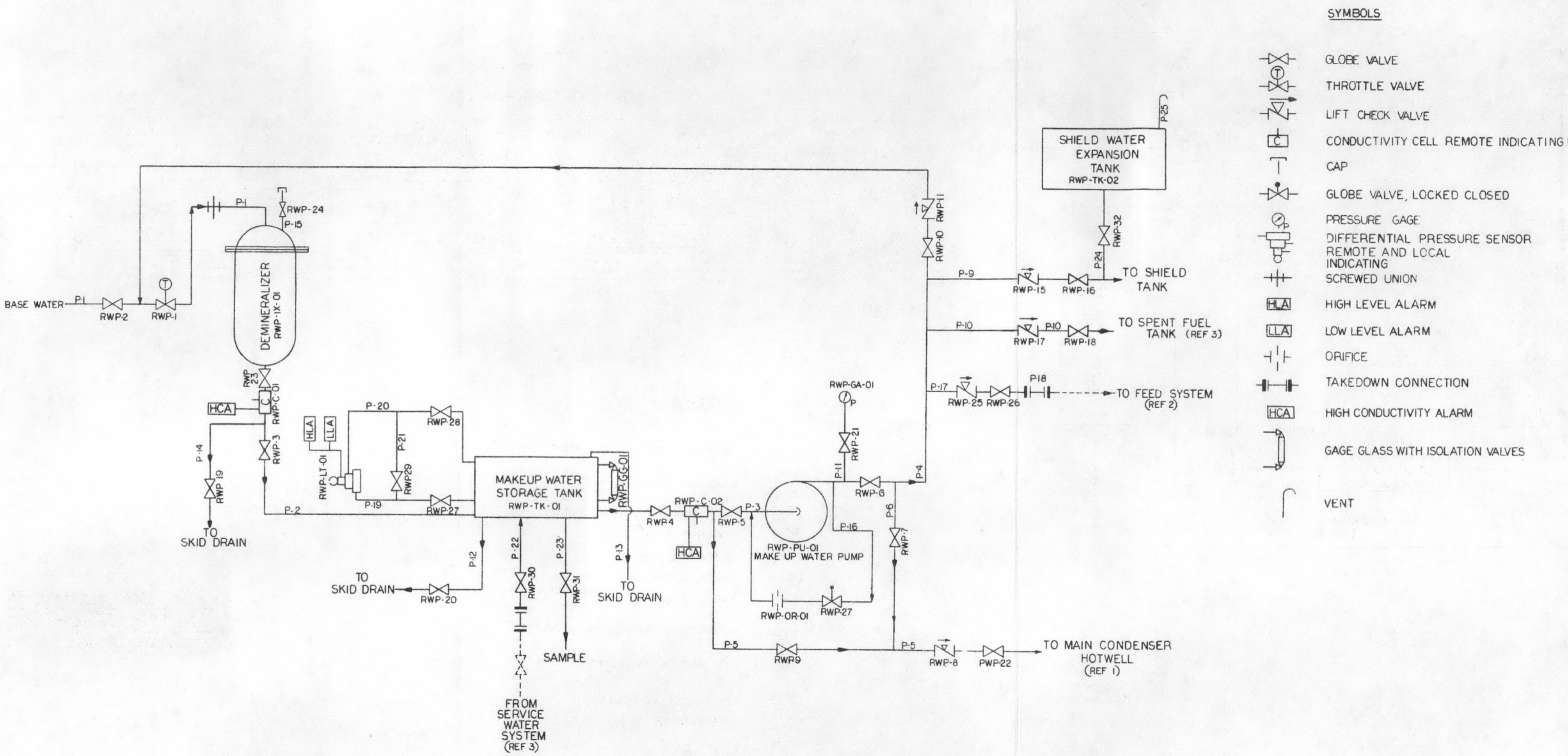
- INDICATOR, ELECTRICAL, MULTIPOINT
- INDICATOR, ELECTRICAL
- ATA AUTO. TRANSFER ALARM
- HTA HIGH TEMPERATURE ALARM
- SW SWITCH, MULTIPOINT
- PS POWER SUPPLY, SYSTEM
- P PRESSURE SWITCH
- SENSOR, DIFFERENTIAL PRESSURE
- FLOW INDICATOR, ORIFICE TYPE
- R RESISTANCE THERMOMETER
- T THERMOCOUPLE
- GAGE, PRESSURE
- LIGHT, INDICATING

REF. NO.	DRAWING NO.	PROJECT NO.	TITLE
4	PL2J2219	2201-03	AUX & EMERG. POWER MULTILINE DIAG.
3	PL2J2117	2101	FEEDWATER SYS. DIAG.
2	PL2J2119	2102	CONDENSATE SYS. DIAG.
1	PL2J2210	2104	COOLANT PURIFI. DIAG.

REFERENCE DRAWINGS

COOLANT PURIFICATION PROCESS INSTRUMENTATION-ONE LINE DIAGRAM

Fig. 49



PIPE LIST

PIPE NO.	NOM SIZE	SCH.	MATERIAL	SERVICE	INSL. THK.	OPER FLOW	DESIGN PRESS	TEST PRESS	REMARKS
P-1	½	10	304 SST	DEMINERALIZER INLET	–	5GMP	PSIG-100	PSIG-150	
P-2	½	10	304 SST	DEMINERALIZER OUTLET	–	5GMP	PSIG-100	PSIG-150	
P-3	1	10	304 SST	SUCTION - MAKE-UP WATER PUMP	–	5GMP	PSIG-100	PSIG-150	
P-4	½	10	304 SST	MAKE-UP WATER PUMP DISCHARGE HEADER	–	5GMP	PSIG-100	PSIG-150	
P-5	1	10	304 SST	VACUUM DRAG LINE TO MAIN CONDENSER HOTWELL	–	5GMP	PSIG-100	PSIG-150	
P-6	½	10	304 SST	CONNECTOR LINE TO VACUUM DRAG LINE	–	5GMP	PSIG-100	PSIG-150	
					–				
P-9	½	10	304 SST	SHIELD WATER SYSTEM SUPPLY LINE	–	5GMP	PSIG-100	PSIG-150	
P-10	½	10	304 SST	SPENT FUEL TANK SUPPLY LINE	–	5GMP	PSIG-100	PSIG-150	
P-11	½	10	304 SST	SUPPLY LINE - PRESSURE GAGE	–	—	PSIG-100	PSIG-150	
P-12	½	10	304 SST	TANK DRAIN LINE - MAKE-UP WATER STORAGE TANK	–	–	PSIG-100	PSIG-150	
P-13	½	10	304 SST	OVERFLOW LINE MAKE-UP WATER STORAGE TANK	–	–	PSIG-100	PSIG-150	
P-14	½	10	304 SST	DEMINERALIZER EFFLUENT DRAIN LINE	–	—	PSIG-100	PSIG-150	
P-15	½	10	304 SST	VENT LINE - DEMINERALIZER	–	–	PSIG-100	PSIG-150	
P-16	½	10	304 SST	PUMP RECIRCULATION LINE	–	0.25GPM	PSIG-100	PSIG-150	
P-17	½	10	304 SST	FEEDWATER SYSTEM SUPPLY LINE	–	5GPM	PSIG-100	PSIG-150	
P-18	½	10	304 SST	TAKE DOWN LINE FEEDWATER SYS. SUPPLY LINE	–	5GPM	PSIG-100	PSIG-150	
P-19	½	10	304 SST	HIGH PRESSURE SUPPLY - DP SENSOR	–	–	PSIG-100	PSIG-150	
P-20	½	10	304 SST	LOW PRESSURE SUPPLY - DP SENSOR	–	–	PSIG-100	PSIG-150	
P-21	½	10	304 SST	EQUALIZING PRESSURE LINE - DP SENSOR	–	–	PSIG-100	PSIG-150	
P-22	½	10	304 SST	MAKEUP WATER FROM SERVICE WATER SYSTEM	–	–	PSIG-100	PSIG-150	
P-23	½	10	304 SST	MAKEUP WATER STORAGE TANK SAMPLE TAP	–	–	PSIG-100	PSIG-150	
P-24	½	10	304 SST	SHIELD WATER SURGE LINE	–	–	PSIG-100	PSIG-150	
P-25	½	10	304 SST	SHIELD WATER VENT LINE	–	–	PSIG-100	PSIG-150	

SPECIAL VALVE AND FITTING LIST

VALVE NO	COMPONENT NO	SERVICE	NOM SIZE	TYPE	END CONN	ACTUATING MEDIUM	FAIL POSITION	MATERIAL	EQUIP SPEC NO	REMARKS
	RWP-GG-01	GAGE GLASS, MAKEUP WATER STORAGE TANK						SST	PL-2105-00-27	RANGE 0-66 in. GAGE GLASS TO CONTAIN ISOLATION VALVES

INSTRUMENT LIST

INSTRUMENT NO	INSTRUMENT NAME	SERVICE	REMARKS
RWP-C-01	CONDUCTIVITY CELL	MAKE-UP WATER	REFER TO INST. DIAG 2105-11 (PL2 J2208) FOR DETAILS
RWP-C-02	CONDUCTIVITY CELL	MAKE-UP WATER	↓
RWP-LT-01	LEVEL SENSOR	MAKE-UP WATER	↓
RWP-GA-01	PRESSURE GAGE	MAKE-UP WATER	↓

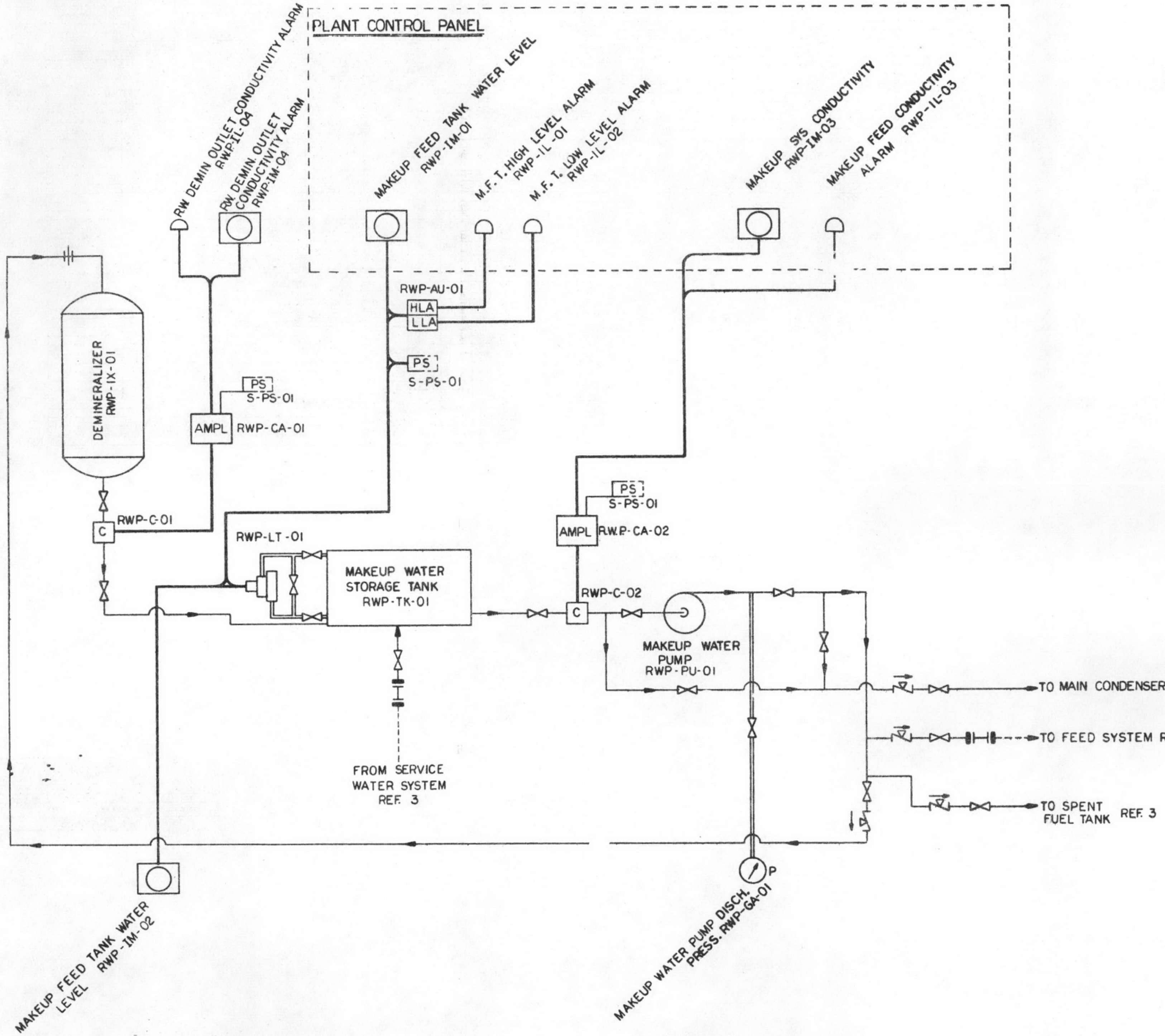
COMPONENTS LIST

COMPONENT NO.	UNIT	CHARAC-TERISTICS	EQUIP SPEC. NO.	MANUFACTURER	MANUFACTURER REF.	WEIGHT	REMARKS
RWP-IX-01	DEMINERALIZER	RESIN VOL: 3CU. FT.	PL-2105-00-31	ILLINOIS WATER TREATMENT		750 LBS	
RWP-OR-01	MAKE-UP WATER PUMP RECIRC. ORIFICE	ΔP - 23 PSI	PL-2105-00-30	INGERSOLL RAND		—	
RWP-PU-01	MAKE-UP WATER PUMP	CAP.: 5 GPM HEAD: 58 FT.	PL-2105-00-30	INGERSOLL RAND	3/4 KRVSA 1/2 B	70 LBS.	
RWP-TK-01	MAKE-UP WATER STORAGE TANK	CAP 50 GAL.	PL-2105-00-29			340 LBS.	
RWP-TK-01	SHIELD WATER EXPANSION TANK						

REFERENCE DRAWINGS

REF NO	DWG. NO	PROJECT NO	TITLE
3	PL2J2189	2110	SERVICE WATER SYSTEM DIAGRAM
2	PL2J2117	2103	FEED SYSTEM DIAGRAM
1	PL2J2119	2102	CONDENSATE SYSTEM DIAGRAM

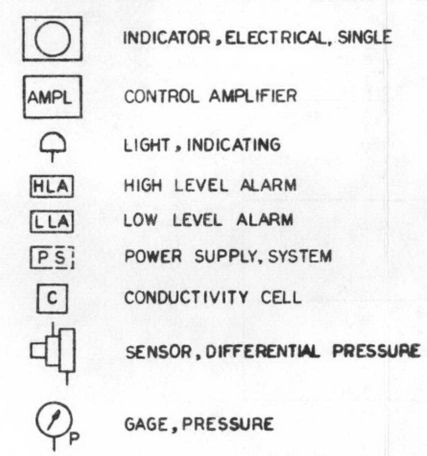
RAW WATER PURIFICATION
Fig. 50



INSTRUMENT COMPONENT LIST

INST. NO.	TYPE	INPUT	RANGE	MFG.	MOD. NO.	OUTPUT	SET POINT		MOUNTING		EQUIP. SPEC. NO.	REMARKS
							CONTROL	ALARM	INSERTION	CONNECT.		
RWP-C-01	COND. CELL	DEMIN. OUTPUT	4 MMHOS-.2 MMHOS	IND INST	CEL II SS-I				6"	1½" NPT	2100-11 - 86	
RWP-LT-01	LEVEL SENSOR	MAKEUP FEED TK. LEVEL	0-48"	FOXBORO	TYPE 613	10-50 MA				½" NPT	81	
RWP-AU-01	ALARM UNIT	MAKEUP FEED TK LEVEL		FOXBORO	63						79	
RWP-IM-01	IND. ELECT.	MAKE UP FEED TK LEVEL	0-48"	FOXBORO	65PL						83	
RWP-IL-01	IG. LIGHT	RWP-AU-01		ELDEMA	1FH						68	
RWP-IL-02	IG. LIGHT	RWP-AU-01		ELDEMA	1FH						68	
RWP-C-02	COND. CELL	MAKEUP FEED COND	4 MMHOS-.2 MMHOS	IND INST	CEL II SS-1				6"	1½" NPT	85	
RWP-IL-03	IG. LIGHT	MAKEUP FEED COND		ELDEMA	1FH						68	
S-PS-01	POWER SUPPLY											REF. 2
RWP-IL-04	IG. LIGHT	DEMIN. OUTPUT COND		ELDEMA	1FH						68	
RWP-GA-01	GAGE, PRESS.	MAKEUP DISCH. PRESS.	0-50 PSIG	ASHCROFT	1379S					½" NPT	65	
RWP-IM-02	IND. ELECT.	MAKEUP FEED TK WATER LEVEL	0-48"	FOXBORO	65PL						83	
RWP-CA-01	CONTROL AMPLIFIER	DEMIN, OUTPUT COND		IND INST	RA-4	10-50 MA		1.6 MMHOS			86	
RWP-CA-02	CONTROL AMPLIFIER	MAKE UP FEED COND		IND INST	RA-4	10-50 MA		2.0 MMHOS			86	
RWP-IM-03	IND METER	DEMIN. OUTLET COND.	4 MMHOS-.2 MMHOS	FOXBORO	65PL						83	
RWP-IM-04	IND METER	MAKE FEED COND.	4 MMHOS-.2 MMHOS	FOXBORO	65PL						83	

SYMBOLS

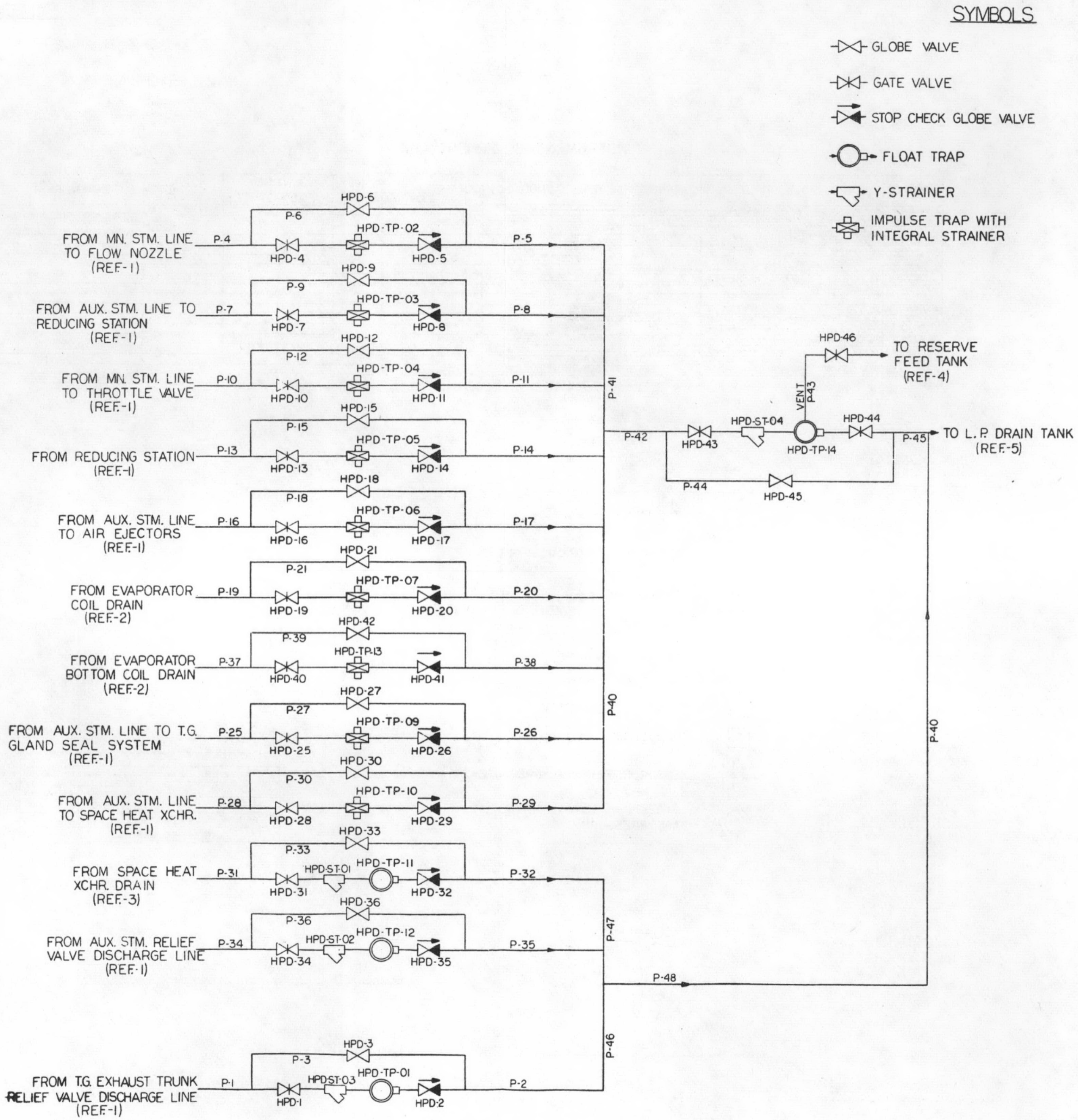


REF. Nº	DRAWING Nº	PROJECT Nº	TITLE
3	PL2J2189	2110	SERVICE WATER SYS. DIAGRAM
2	PL2J2219	2201-03	AUXILIARY AND EMERGENCY POWER MULTILINE DIAGRAM
1	PL2J2111	2105	RAW WATER PURIF. DIAG.

REFERENCE DRAWING

RAW WATER PURIFICATION PROCESS INSTRUMENTATION-ONE LINE DIAGRAM

Fig. 51



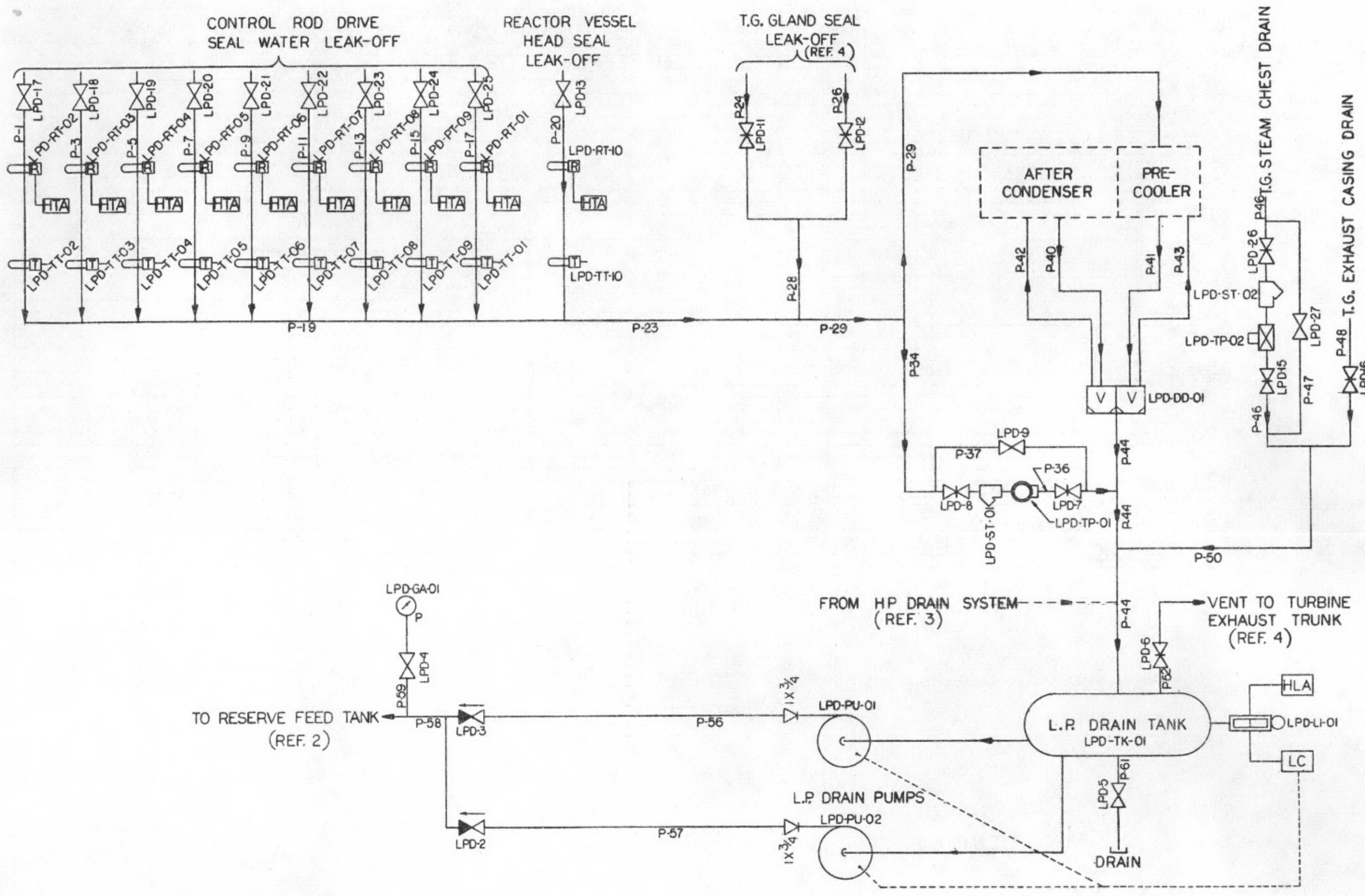
SPECIAL VALVE AND FITTING LIST										
VALVE NO.	COMPONENT NO.	SERVICE	NOM. SIZE	TYPE	END CONN.	ACTUATING MEDIUM	FAIL POSITION	MATERIAL	EQUIP. SPEC. NO.	REMARKS
	HPD-TP-01	STEAM AND CONDENSATE	1/2	FLOAT	SCR.			S.ST.	[illegible]	W/INTEGRAL STR.
	HPD-TP-02		1/2	IMPLUSE	SCR.					W/INTEGRAL STR.
	HPD-TP-03		1/2	IMPLUSE	SCR.					W/INTEGRAL STR
	HPD-TP-04		1/2	IMPLUSE	SCR.					W/INTEGRAL STR.
	HPD-TP-05		1/2	IMPLUSE	SCR.					W/INTEGRAL STR.
	HPD-TP-06		1/2	IMPLUSE	SCR.					W/INTEGRAL STR.
	HPD-TP-07		1/2	IMPLUSE	SCR					W/INTEGRAL STR.
	HPD-TP-09		1/2	IMPLUSE	SCR					W/INTEGRAL STR.
	HPD-TP-10		1/2	IMPLUSE	SCR.					W/INTEGRAL STR.
	HPD-TP-11		1	FLOAT	SCR.					
	HPD-TP-12		1/2	FLOAT	SCR.					
	HPD-TP-13		1/2	IMPLUSE	SCR.					W/INTEGRAL STR.
	HPD-TP-14		1	FLOAT	SCR.					

PIPE LIST									
PIPE NO.	NOM. SCH.	SCHED.	MATERIAL	SERVICE	INSUL. THK.	FLOW	DESIGN PRESS.	TEST PRESS.	REMARKS
P-1	1/2	40	304 S.ST.	T.G. EXH. RELIEF VALVE DISCH. DRAIN	—		150	225	
P-2	1/2			T.G. EXH. RELIEF VALVE DISCH. DRAIN TRAP DISCH.	—		150	225	
P-3	1/2			T.G. EXH. RELIEF VALVE DISCH. DRAIN TRAP BY-PASS	—		150	225	
P-4	1/2			STM. LINE TO FLOW NOZZLE DRAIN	STD		700	1050	
P-5	1/2			STM. LINE TO FLOW NOZZLE DRAIN TRAP DISCH.	STD		650	225	
P-6	1/2			STM. LINE TO FLOW NOZZLE DRAIN TRAP BY-PASS	STD		750	1050	
P-7	1/2			AUX. STM. LINE TO RED. STA. DRAIN	STD		750	1050	
P-8	1/2			AUX. STM. LINE TO RED. STA. DRAIN TRAP DISCH.	STD		150	225	
P-9	1/2			AUX. STM. LINE TO RED. STA. DRAIN TRAP BY-PASS	STD		750	1050	
P-10	1/2			MN. STM. LINE TO THROTTLE VALVE DRAIN	STD		750	1050	
P-11	1/2			MN. STM. LINE TO THROTTLE VALVE DRAIN TRAP DISCH.	STD		150	225	
P-12	1/2			MN. STM. LINE TO THROTTLE VALVE DRAIN TRAP BY-PASS	STD		750	1050	
P-13	1/2			RED. STA. DRAIN	STD		750	1050	
P-14	1/2			RED. STA. DRAIN TRAP DISCH.	STD		150	225	
P-15	1/2			RED. STA. DRAIN TRAP BY-PASS	STD		750	1050	
P-16	1/2			AUX. STM. LINE TO AIR EJECTORS DRAIN	STD		175	263	
P-17	1/2			AUX. STM. LINE TO AIR EJECTORS DRAIN TRAP DISCH.	STD		150	225	
P-18	1/2			AUX. STM. LINE TO AIR EJECTORS DRAIN TRAP BY-PASS	STD		175	263	
P-19	1/2			EVAPORATOR COIL DRAIN	STD		150	225	
P-20	1/2			EVAPORATOR COIL DRAIN TRAP DISCHARGE	STD		150	225	
P-21	1/2			EVAPORATOR COIL DRAIN TRAP BY-PASS	STD		150	225	
P-25	1/2	40	304 S.ST.	STM. LINE TO T.G. GLAND SEAL SYS. DRAIN	STD		750	1050	
P-26	1/2			STM. LINE TO T.G. GLAND SEAL SYS. DRAIN TRAP DISCH.	STD		150	225	
P-27	1/2			STM. LINE TO T.G. GLAND SEAL SYS. DRAIN TRAP BY-PASS	STD		750	1050	
P-28	1/2			STM. LINE TO SPACE HT. XCHR. DRAIN	STD		175	263	
P-29	1/2			STM. LINE TO SPACE HT. XCHR. DRAIN TRAP DISCH.	STD		150	225	
P-30	1/2			STM. LINE TO SPACE HT. XCHR. DRAIN TRAP BY-PASS	STD		175	263	
P-31	1			SPACE HT. XCHR. DRAIN	STD		150	225	
P-32	1			SPACE HT. XCHR. DRAIN TRAP DISCH.	STD		150	225	
P-33	1			SPACE HT. XCHR. DRAIN TRAP BY-PASS	STD		150	225	
P-34	1/2			AUX. STM. RELIEF VALVE DISCH. LINE DRAIN	STD		150	225	
P-35	1/2			AUX. STM. RELIEF VALVE DISCH. LINE DRAIN TRAP DISCH.	STD		150	225	
P-36	1/2			AUX. STM. RELIEF VALVE DISCH. LINE DRAIN TRAP BY-PASS	STD		150	225	
P-37	1/2			EVAP. BOTTOM COIL DRAIN	STD		150	225	
P-38	1/2			EVAP. BOTTOM COIL DRAIN TRAP DISCH	STD		150	225	
P-39	1/2			EVAP. BOTTOM COIL DRAIN TRAP BY-PASS	STD		150	220	
P-40	1			DRAIN HEADER	STD		150	225	
P-41	1			DRAIN HEADER	STD		150	225	
P-42	1			RETURN HEADER	STD		150	225	
P-43	1/2			VENT	STD		150	225	
P-44	1			TRAP BY-PASS	STD		150	225	
P-45	1			RETURN HEADER TO L.P. DRAIN TANK	STD		150	225	
P-46	1			DRAIN HEADER	STD		150	225	
P-47	1			DRAIN HEADER	STD		150	225	
P-48	1			DRAIN HEADER	STD		150	225	
P-49									

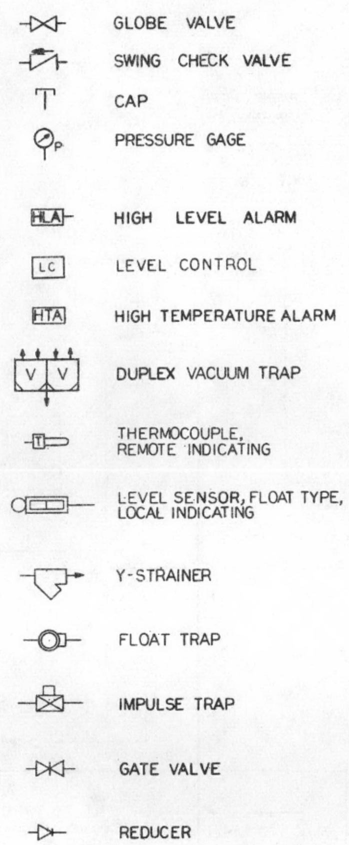
REF. NO.	DRAWING NO.	PROJECT NO.	TITLE
5	J2124	2107	L.P. DRAIN SYS. DIAG.
4	J2117	2103	FEEDWATER SYS DIAG.
3	J2120	2111	PLANT HEATING SYS DIAG
2	J2189	2110	SERVICE WATER SYS DIAG.
1	J2121	2101	MAIN STEAM SYS. DIAG.

REFERENCE DRAWINGS

HIGH PRESSURE DRAIN
Fig. 52



SYMBOLS



SPECIAL VALVE AND FITTING LIST

VALVE NO.	COMPONENT NO.	SERVICE	NOM SIZE	TYPE	END CONN.	ACTUATING MEDIUM	FAIL POSITION	MATERIAL	EQUIP. SPEC. NO.	REMARKS
	LPD-DD-01	WATER	NO. 2	FLOAT OPERATED	WELD	——	——	S.ST	[illegible]	
	LPD-TP-01	WATER	1	FLOAT OPERATED	WELD			S.ST		
	LPD-TP-02	WATER	3/4	IMPULSE	WELD			SST		

PIPE LIST

PIPE NO.	NOM SIZE	SCH.	MATERIAL	SERVICE	INSL THK	FLOW	DESIGN PRESS	TEST PRESS	REMARKS
P-1	1/2	40	304 S.ST	CRD SEAL WATER LEAK-OFF	STD		50 PSIG	75 PSIG	
P-3	1/2								
P-5	1/2								
P-7	1/2								
P-9	1/2								
P-11	1/2								
P-13	1/2								
P-15	1/2								
P-17	1/2								
P-19	1			CRD SEAL WATER RETURN HEADER					
P-20	1/2			REACTOR HEAD SEAL LEAK-OFF					
P-23	1 1/2			SEAL LEAK-OFF RETURN HEADER					
P-24	1 1/2			H.P. GLAND SEAL EXHAUST					
P-26	1 1/2			L.P. GLAND SEAL EXHAUST					
P-28	1 1/2			GLAND SEAL EXHAUST HEADER					
P-29	3			SEAL LEAK-OFF & GLAND EXHAUST HEADER					
P-34	1			SEAL LEAK-OFF & GLAND EXHAUST DRAIN					
P-36	1			SEAL LEAK-OFF & GLAND EXHAUST DRAIN					
P-37	1			SEAL-LEAK-OFF & GLAND EXHAUST TRAP BY-PASS					
P-40	1			AFTER CONDENSER DRAIN					
P-41	1			PRECOOLER DRAIN					
P-42	1/2			VENT					
P-43	1/2			VENT					
P-44	1 1/2			L.P. DRAIN HEADER					
P-46	1			T.G. STEAM CHEST DRAIN					
P-47	1			T.G. STEAM CHEST DRAIN TRAP BY PASS					
P-48	1			T.G. EXHAUST CASING DRAIN					
P-50	1			T.G. CASING DRAIN HEADER					
P-52	2			L.P. DRAIN TANK VENT					
P-56	1			L.P. DRAIN PUMP DISCHARGE					
P-57	1			L.P. DRAIN PUMP DISCHARGE					
P-58	1			L.P. DRAIN PUMP DISCHARGE					
P-59	1/2			L.P. DRAIN PUMP GAGE					
P-61	1/2	40	304 SST	L.P. DRAIN TANK DRAIN	STD		50 PSIG	75 PSIG	

INSTRUMENT LIST (REF. ONLY)

INSTRUMENT NO.	INSTRUMENT NAME	SERVICE	MANUFACTURER NAME	MANUFACTURER CAT. NO.	RANGE	SET POINT	ALARM POINT	TRIP POINT	EQUIP. SPEC. NO.	REMARKS
LPD-GA-01	L.P. DRAIN PUMP DISCH. PRESS.	WATER								SEE REF. 1
LPD-TT-10	REACTOR HEAD SEAL LEAK-OFF TEMP	WATER-AIR & VAPOR								
LPD-TT-02	CRD SEAL WATER LEAK-OFF TEMP	WATER-AIR & VAPOR								
LPD-TT-03										
LPD-TT-04										
LPD-TT-05										
LPD-TT-06										
LPD-TT-07										
LPD-TT-08										
LPD-TT-09										
LPD-TT-01	CRD SEAL WATER LEAK-OFF TEMP	WATER-AIR & VAPOR								
LPD-LI-01	L.P. DRAIN TANK WATER LEVEL	WATER								
LPD-RT-01	CRD SEAL WATER LEAK-OFF TEMP	WATER AIR & VAPOR								
LPD-RT-02										
LPD-RT-03										
LPD-RT-04										
LPD-RT-05										
LPD-RT-06										
LPD-RT-07										
LPD-RT-08										
LPD-RT-09										
LPD-RT-10	REACTOR HEAD SEAL LEAK-OFF TEMP	WATER AIR & VAPOR								

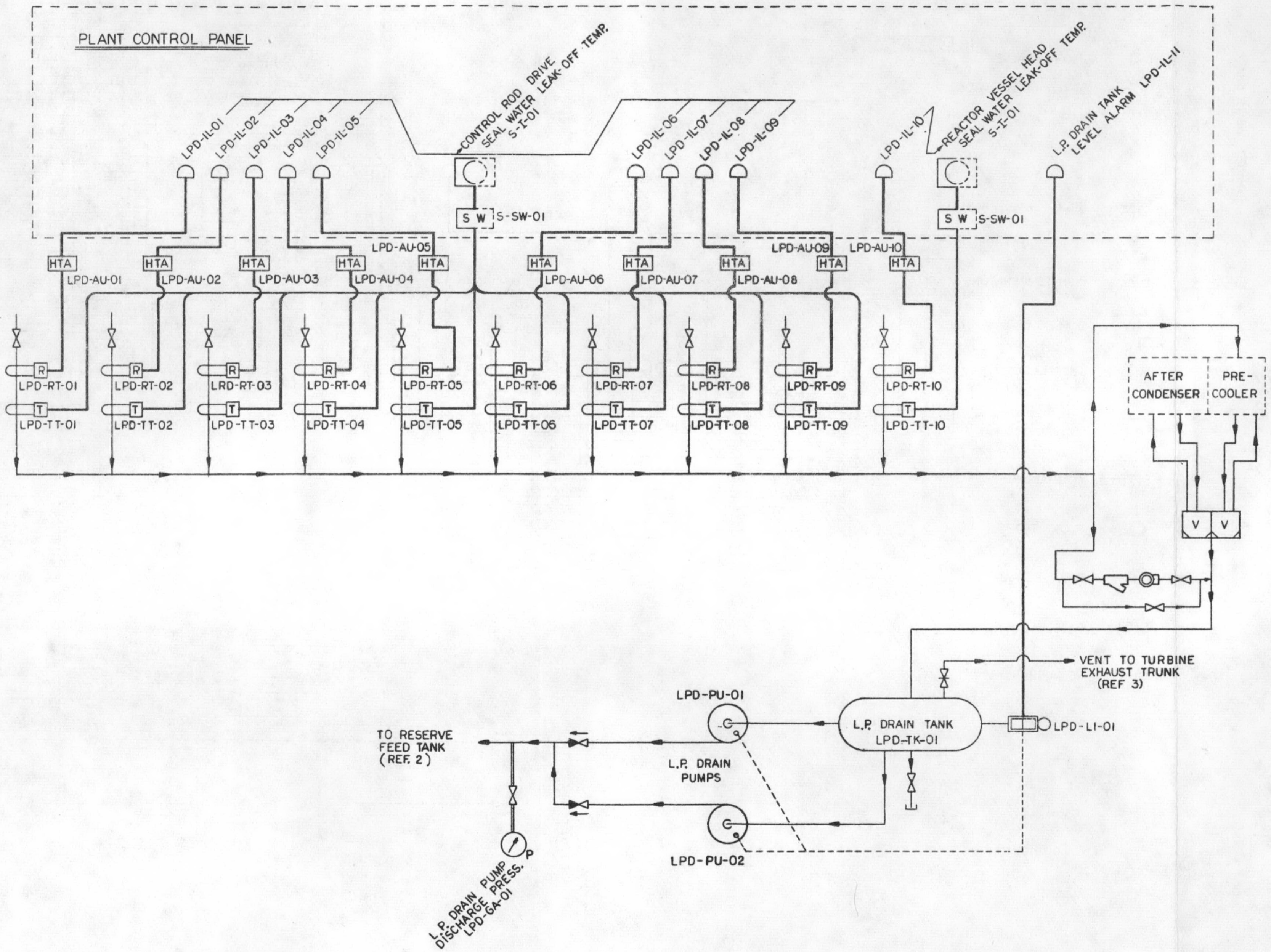
REFERENCE DRAWINGS

REF. NO.	DRAWING NO.	PROJECT NO.	TITLE
4	PL2J 2121	2101	MAIN STEAM SYS. DIAG.
3	PL2J 2122	2106	H.P. DRAIN SYS. DIAG.
2	PL2J 2117	2103	FEEDWATER SYS. DIAG.
1	PL2J 2124	2107-11	L.P. DRAIN PROCESS INST. LINE DIAG.

COMPONENTS LIST

COMPONENT NO.	UNIT	CHARAC-TERISTICS	EQUIP. SPEC. NO.	MANUFACTURER	MANUFACTURER REF. DWG.	WEIGHT	REMARKS
LPD-TK-01	L.P. DRAIN TANK	100 GAL.	[illegible]			600#	
LPD-PU-01	L.P. DRAIN PUMP	20 GPM @ 41 FT	[illegible]	[illegible]	IKEVSY.	110#	
LPD-PU-02	L.P. DRAIN PUMP	20 GPM @ 41 FT.	[illegible]	[illegible]	IKEVSY.	110#	

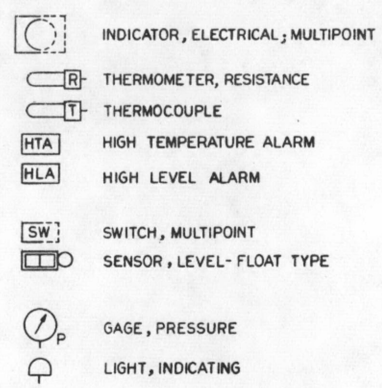
LOW PRESSURE DRAIN
Fig. 53



INSTRUMENT COMPONENT LIST

INST. NO.	TYPE	INPUT	RANGE	MFG.	MOD. NO.	OUTPUT	SET POINT CONTROL	SET POINT ALARM	MOUNTING INSERTION	MOUNTING CONNECT.	EQUIP. SPEC. NO.	REMARKS
LPD-RT-01	RES. THERM	CRD. SEAL WATER LEAK-OFF TEMP	0-500°F	M. HONEYWELL	BROWN CLASS A				4"	1/4 NPT	2100-11-70	
LPD-RT-02												
LPD-RT-03												
LPD-RT-04												
LPD-RT-05												
LPD-RT-06												
LPD-RT-07												
LPD-RT-08												
LPD-RT-09	RES. THERM				BROWN CLASS A						2100-11-70	
LPD-TT-01	SENSOR, TC.				3837F	MV					2100-11-71	
LPD-TT-02												
LPD-TT-03												
LPD-TT-04												
LPD-TT-05												
LPD-TT-06												
LPD-TT-07												
LPD-TT-08												
LPD-TT-09	SENSOR, TC	CRD SEAL WATER LEAK-OFF TEMP.			3837F	MV			4"	3/4 NTP	2100-11-71	
LPD-AU-01	ALARM UNIT				R 7082C			200°F	PANEL, SURFACE		2100-11-72	
LPD-AU-02												
LPD-AU-03												
LPD-AU-04												
LPD-AU-05												
LPD-AU-06												
LPD-AU-07												
LPD-AU-08												
LPD-AU-09	ALARM UNIT		0-500°F	M. HONEYWELL	R 7082C			200°F	PANEL, SURFACE		2100-11-72	
LPD-IL-01	IG. LIGHT			ELDEMA	1FH				PANEL, 1/4 D		2100-11-68	
LPD-IL-02												
LPD-IL-03												
LPD-IL-04												
LPD-IL-05												
LPD-IL-06												
LPD-IL-07												
LPD-IL-08												
LPD-IL-09	IG. LIGHT			ELDEMA	1FH				PANEL 1/4" D		2100-11-68	
LPD-RT-10	RES. THERM.	RVH SEAL WATER LEAK-OFF TEMP.	0-500°F	M. HONEYWELL	BROWN CLASS A						2100-11-70	
LPD-TT-10	SENSOR, TC.	RVH SEAL WATER LEAK-OFF TEMP.	0-500°F	M. HONEYWELL	3837F	MV					2100-11-71	
LPD-AU-10	ALARM UNIT		0-500°F	M. HONEYWELL	R 7082C			200°F			2100-11-72	
LPD-LI-01	SENSOR, LEVEL	LPD TANK LEVEL	0 - 15"	LIQUIDOMETER	216V			12"		2", 150#, RF FLG	2100-11-73	
LPD-IL-10	IG. LIGHT	[illegible] SEAL WATER LEAK-OFF TEMP.	0 - 500°F	ELDEMA	1FH						2100-11-68	
LPD-GA-01	GAGE, PRESS.	LPD TANK DISCH. PRESS.	0-25 PSIG	ASHCROFT	13795					1/2" NPT	2100-11-65	
S-I-01	INDICATOR, GALV.											REF 4

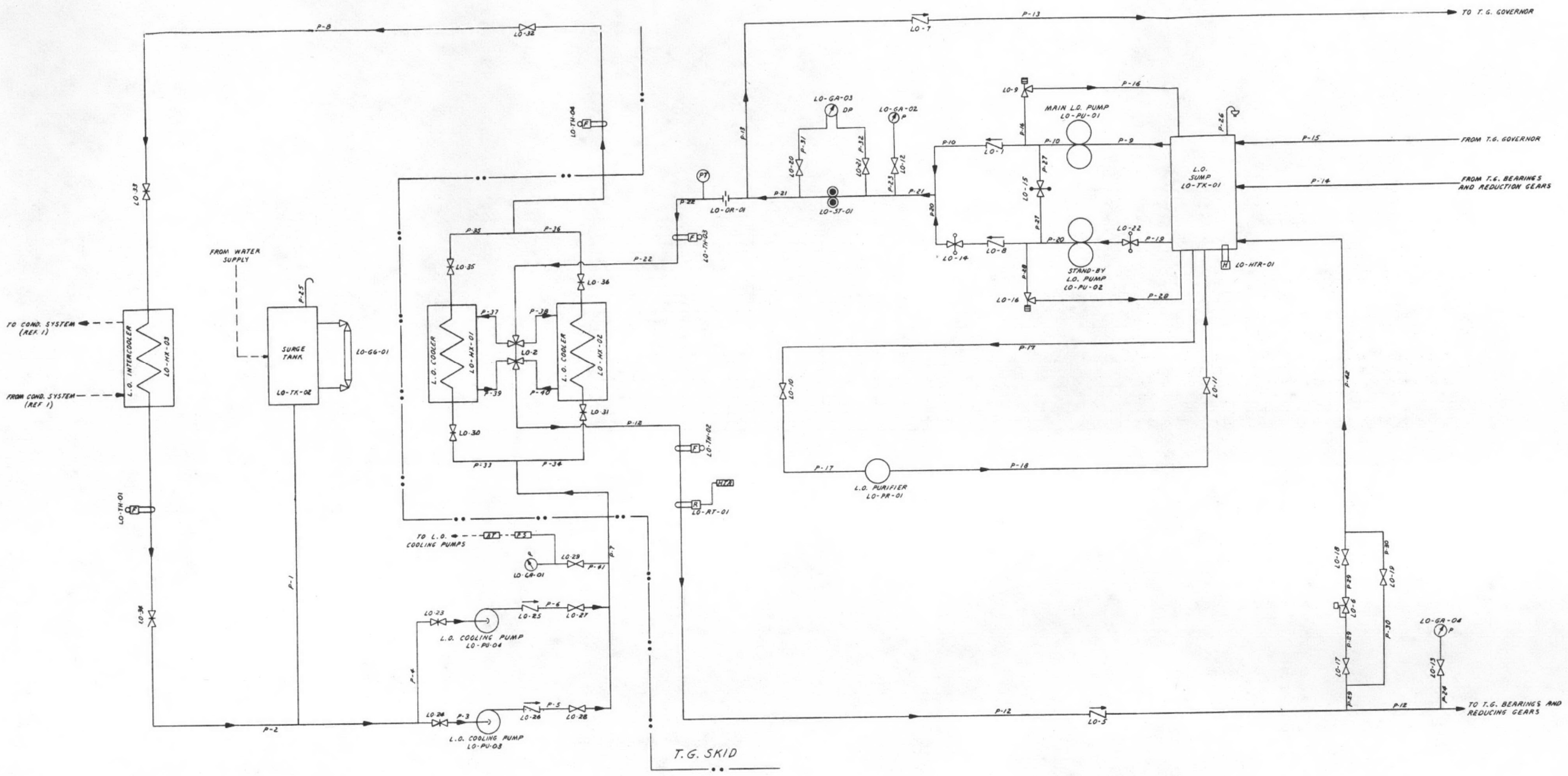
SYMBOLS

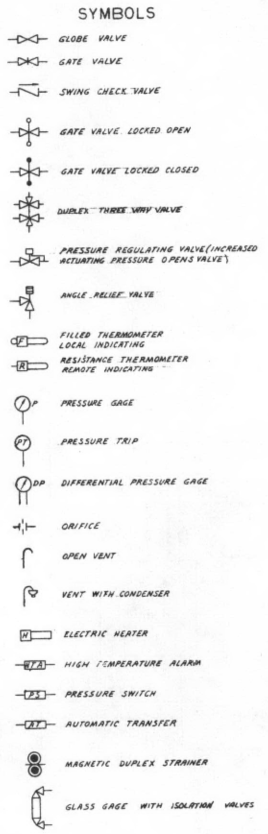


REF. NO.	DRAWING NO.	PROJECT NO.	TITLE
4	PL2J2201	2101-11	MAIN STEAM SYSTEM PROCESS INSTR.
3	PL2J2122	2106	HP DRAIN SYSTEM DIA
2	PL2J2117	2103	FEEDWATER SYSTEM DIAGRAM
1	PL2J2124	2107	LOW PRESSURE DRAIN SYSTEM DIAG.,

REFERENCE DRAWINGS

LOW PRESSURE DRAIN PROCESS INSTRUMENTATION–ONE LINE DIAGRAM
Fig. 54





SPECIAL VALVE AND FITTING LIST

VALVE NO.	COMPONENT NO.	SERVICE	NOM SIZE	TYPE	END CONN.	ACTUATING MEDIUM	FAIL POSITION	MATL.	EQUIP. SPEC. NO.	REMARKS
	LO-ST-01	L.O. STRAINER	2"	MAG.	B.W	—	—	C.S	PL-2101-00-03	FURN. WITH T.G. SET
	LO-OR-01	L.O. TO BEARINGS	11"		B.W	—	—			
LO-6		L.O. TO BRGS PRESS. REG.	2"		FLG	L.O	AS IS			
LO-9		MAIN L.O. PUMP RELIEF VALVE	1x2"		FLG	L.O	—			LIFT 120 PSIG
LO-16		STBY L.O. PUMP RELIEF VALVE	1x2"		FLG	L.O	—			LIFT 120 PSIG
LO-2		DUPLEX 3-WAY VAVLE	2	PLUG	FLG	MANUAL	—		[illegible]	
	LO-GG-01	SURGE TANK LEVEL								

PIPE LIST

PIPE NO.	NOM SIZE	SCHEDULE	MATERIAL	SERVICE	INSUL. THK.	FLOW	DES. PRESS	TEST PRESS	REMARKS
P-1	1"	40	CS	SURGE TANK CONNECTION	STD	6010#/HR	50 PSIG	75 PSIG	
P-2	1"			WATER FROM L.O. INTERCOOLER					
P-3	1"			L.O. COOLING PUMP SUCTION					
P-4	1"			L.O. COOLING PUMP SUCTION					
P-5	1"			L.O. COOLING PUMP DISCHARGE					
P-6	1"			L.O. COOLING PUMP DISCHARGE					
P-7	1"			COOLANT TO L.O. COOLER					
P-8	1"			COOLANT FROM L.O. COOLER					FURN. WITH T.G. SET
P-9	3"			MAIN L.O. PUMP SUCTION					
P-10	2"			MAIN L.O. PUMP DISCHARGE					
P-12	1"			L.O. TO BEARINGS AND REDUCTION GEARS					
P-13	2"			L.O. TO GOVERNOR					
P-14	3"			L.O. FROM BEARINGS AND REDUCTION GEARS					
P-15	3"			L.O. FROM GOVERNOR					
P-16	2"			MAIN L.O. PUMP PRESSURE RELIEF					
P-17	1"			L.O. TO PURIFIER					
P-18	1"			L.O. FROM PURIFIER					
P-19	3"			STAND-BY L.O. PUMP SUCTION					
P-20	2"			STAND BY L.O. PUMP DISCHARGE					
P-21	2"			L.O. PUMP DISCHARGE HEADER					
P-22	2"			L.O. TO COOLERS					
P-23	½"			GAGE LINE TO L.O. PUMP DISCH. PRESS. GAGE					
P-24	½"			GAGE LINE TO L.O. TO BEARING PRESS. GAGE					
P-25	½"			SURGE TANK VENT					
P-26	½"			L.O. SUMP VENT					
P-27	½"			L.O. PUMP PRIMING LINE					
P-28	2"			STAND-BY L.O. PUMP PRESS. RELIEF					
P-29	1"			L.O. TO BEARINGS BACK PRESS CONTROL					
P-30	1"			L.O. PRESS. REGULATING VALVE BY-PASS					
P-31	½"			L.O. STRAINER GAGE LINE					
P-32	½"			L.O. STRAINER GAGE LINE					
P-33	1"			COOLANT TO L.O. COOLER NO. 1	STD	6010#/HR	50 PSIG	75 PSIG	
P-34	1"			COOLANT TO L.O. COOLER NO. 2					
P-35	1"			COOLANT FROM L.O. COOLER NO. 1					
P-36	1"			COOLANT FROM L.O. COOLER NO. 2					
P-37	2"			L.O. TO L.O. COOLER NO. 1					FURN. WITH T.G. SET
P-38	2"			L.O. TO L.O. COOLER NO. 2					
P-39	2"			L.O. FROM L.O. COOLER NO. 1					
P-40	2"			L.O. FROM L.O. COOLER NO. 2					
P-41	½"			GAGE LINE TO L.O. COOLING PUMP DISCH. PRESS.	—	—	50 PSIG	75 PSIG	
P-42	2"			LO. REG. VALVE DRAIN					FURN. WITH T.G. SET

INSTRUMENT LIST (REF. ONLY)

INSTRUMENT NO.	INSTRUMENT NAME	SERVICE	MANUFACTURER NAME	MANUFACTURER CAT. NO.	RANGE	SET POINT	ALARM POINT	TRIP POINT	EQUIP. SPEC. NO.	REMARKS
LO-TH-04	L.O. COOLER WATER TEMPERATURE OUT	WATER								SEE REF 2
LO-TH-01	L.O. INTERCOOLER WATER TEMP. OUT	WATER								SEE REF 2
LO-TH-02	L.O. TEMPERATURE TO BEARINGS	LUBE OIL								FURNISED WITH T.G
LO-TH-03	L.O. PUMP DISCHARGE TEMPERATURE	LUBE OIL								
LO-GA-02	L.O. PUMP DISCHARGE PRESSURE	LUBE OIL								
LO-GA-04	L.O. PRESSURE TO BEARINGS	LUBE OIL								
LO-GA-03	PRESSURE DROP ACROSS STRAINER	LUBE OIL								
LO-GA-01	L.O. COOLING PUMP DISCHARGE PRESSURE	WATER								SEE REF 2
LO-RT-01	L.O TEMPERATURE TO BEARINGS	LUBE OIL								FURNISED WITH T.G. SET

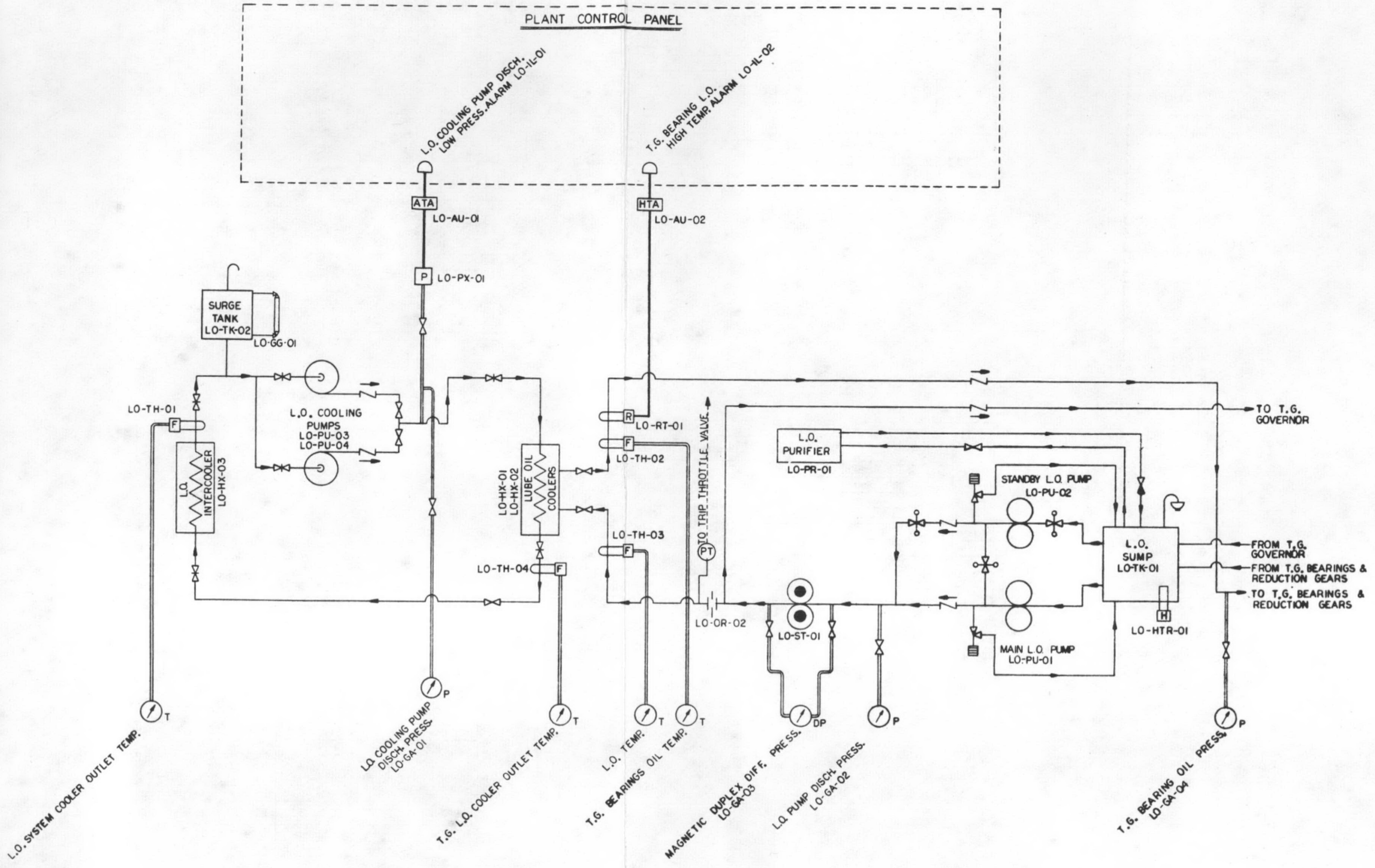
REFERENCE DRAWINGS

REF. NO.	DWG. NO.	PROJ. NO.	TITLE
2	J2213	2109-11	L.O. SERV. SYS. PROCESS INST. DIAGRAM
1	J2119	2102	CONDENSATE SYSTEM DIAGRAM

COMPONENTS LIST

COMPONENT NO.	UNIT	CHARACTERISTICS	EQUIP. SPEC. NO.	MFGR	MFGR. REF. DWG.	WT.	REMARKS
LO-HX-03	L.O. INTERCOOLER	1.5×10^{6} BTU/HR	PL-2109-00-36	GRAHAM	1554C 28	866#	
LO-TK-02	SURGE TANK	5 GAL	PL-2109-00-34			60#	
LO-PU-03	L.O. COOLING PUMP	12.5 GPM @ 58 FT	PL-2109-00-35	INGERSOL RAND	3/4 KRVS-1/2	75#	
LO-PU-04	L.O. COOLING PUMP	12.5 GPM @ 58 FT	PL-2109-00-35	INGERSOL RAND	3/4 KRVS-1/2	75#	
LO-HX-01	L.O. COOLER	1.5×10^{6} BTU/HR	PL 2101-00-03				FURN. WITH T.G. SET
LO-PU-01	MAIN L.O. PUMP						
LO-PU-02	STAND-BY L.O. PUMP						
LO-PR-01	L.O. PURIFIER			SHARPLES			
LO-TK-01	L.O. SUMP						
LO-HTR-01	L.O. HEATER						
LO-HX-02	L.O. COOLER	1.5×10^{6} BTU/HR					

LUBE-OIL SERVICE SYSTEM
Fig. 55



INSTRUMENT COMPONENT LIST

INST. NO.	TYPE	INPUT	RANGE	MFG.	MOD. NO.	OUTPUT	SET POINT CONTROL	SET POINT ALARM	MOUNTING INSERTION	MOUNTING CONNECT.	EQUIP. SPEC. NO.
LO-TH-01	THERM. FILLED	L.O. COOLER OUTPUT	0-200°F	FOXBORO	CLASS IIA				5"	3/4" NPT	2100-11-69
LO-PX-01	SWITCH, PRESS.	L.O. COOLING PUMP DISCH.	0-30 PSIG	ASHCROFT	13795					1/2" NPT	2100-11-65
LO-AU-01	ALARM UNIT	LO COOLING PUMP DISCH		SQUARE D	8501 AP			15 PSIG			2100-11-67
LO-IL-01	IG. LIGHT			ELDEMA	IFH						2100-11-68
LO-TH-04	THERM. FILLED	T.G. L.O. COOLERS OUTPUT	0-200°F	FOXBORO	CLASS IIA				5"	3/4" NPT	2100-11-69
LO-GA-01	COOL. PRESS. DISCH. PMP.			ASHCROFT	13795					1/2" NPT	2100-11-65
LO-RT-01	THERM. RES.	T.G. BEARING L.O. TEMP.	0-200°F	MPLS HONEYWELL	BROWN CLASS 2				5"	3/4" NPT	2100-11-70
LO-AU-02	ALARM UNIT	T.G. BEARING LO TEMP.		MPLS HONEYWELL	Z7082C			150°F			2100-11-72
LO-IL-02	IG. LIGHT	T.G. BEARING LO TEMP.		ELDEMA	IFH						2100-11-68
LO-TH-02	THERM. FILLED	T.G. BEARING L.O. TEMP.	0-200°F	FOXBORO	CLASS IIA				5"	3/4" NPT	2100-11-69
LO-TH-03	THERM. FILLED	L.O. COOLER INLET TEMP	0-200°F	FOXBORO	CLASS IIA				5"	3/4" NPT	2100-11-69
LO-GA-02	GAGE, PRESS.	L.O. PUMP PRESS	0-120 PSIG	ASHCROFT	13795					1/2" NPT	2100-11-65
LO-GA-03	GAGE, DIFF. PRESS.	MAGNETIC STRAINER	0-10 PSIG	ASHCROFT	13795					1/2" NPT	2100-11-65
LO-GA-04	GAGE, PRESS.	T.G. BEARING L.O. PRESS.	0-25 PSIG	ASHCROFT	13795					1/2" NPT	2100-11-65

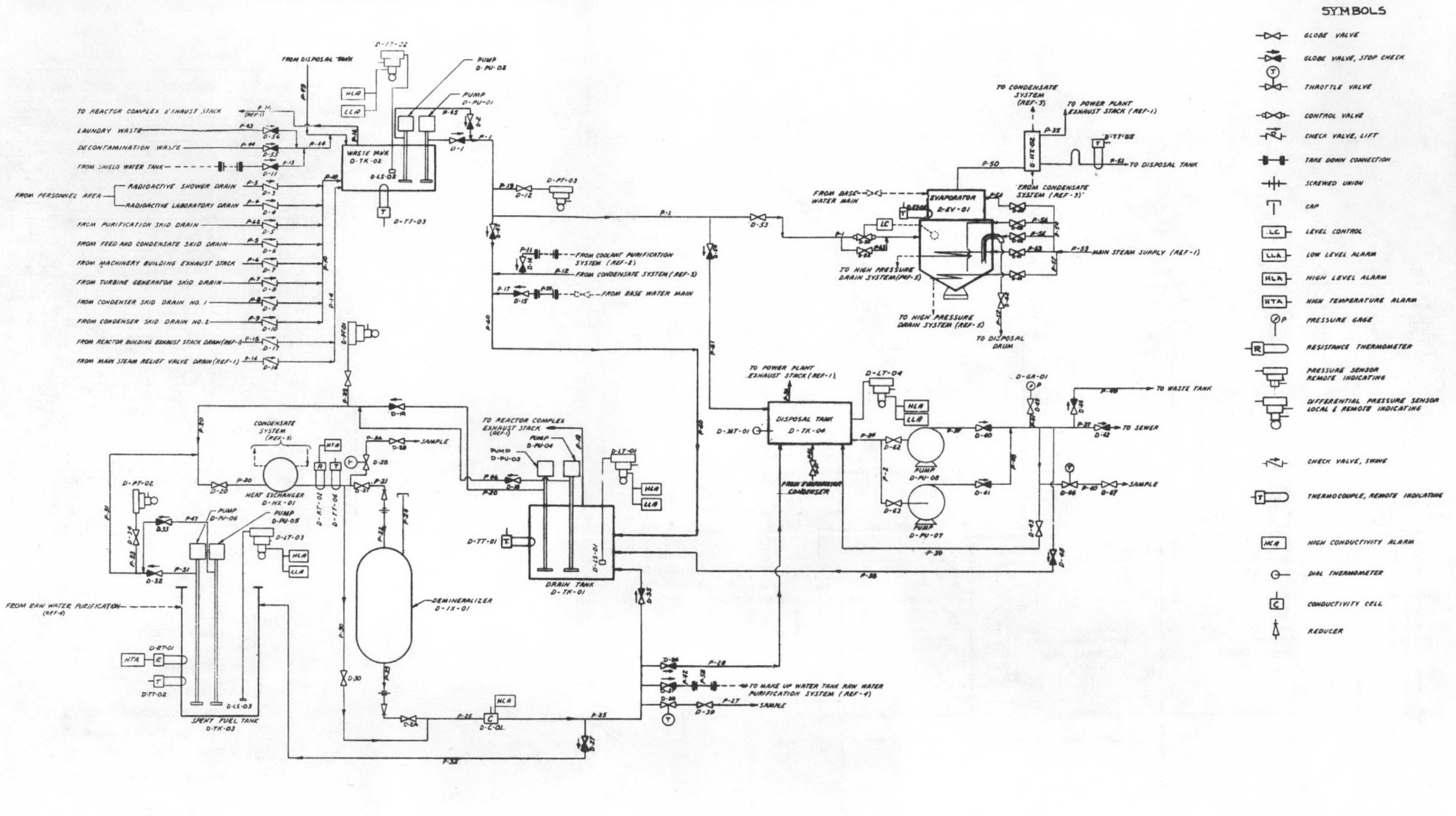
SYMBOLS

- HLA HIGH LEVEL ALARM
- LLA LOW LEVEL ALARM
- HTA HIGH TEMP. ALARM
- ATA AUTOMATIC TRANSFER ALARM
- P SWITCH, PRESSURE
- R THERMOMETER, RESISTANCE
- F FILLED THERMOMETER SYSTEM
- H HEATER, ELECTRIC
- LIGHT, INDICATING
- GAGE, PRESSURE
- GAGE, TEMPERATURE
- PT PRESSURE TRIP

REF. NO.	DRAWING NO.	PROJECT NO.	TITLE
1	PL2J2228	2109	L.O. SERVICE SYSTEM DIAGRAM

REFERENCE DRAWINGS

LUBE-OIL SERVICE SYSTEM PROCESS INSTRUMENTATION-ONE LINE DIAGRAM
Fig. 56



INSTRUMENT LIST (REF. ONLY)

INSTRUMENT NO.	INSTRUMENT NAME	SERVICE	REMARKS
D-C-01	CONDUCTIVITY CELL	CONDUCTIVITY DEMINERALIZER OUTLET	SEE REF 6
D-LT-01	DIFFERENTIAL PRESSURE SENSOR	DRAIN TANK, LIQUID LEVEL	
D-LT-02	DIFFERENTIAL PRESSURE SENSOR	WASTE TANK, LIQUID LEVEL	
D-LT-03	DIFFERENTIAL PRESSURE SENSOR	SPENT FUEL TANK, LIQUID LEVEL	
D-LT-04	DIFFERENTIAL PRESSURE SENSOR	DISPOSAL TANK, LIQUID LEVEL	
D-GA-01	PRESSURE SENSOR	DISPOSAL TANK, PUMP DISCHARGE PRESSURE GAGE	
D-MT-01	THERMOMETER	DISPOSAL TANK, TEMPERATURE	
D-PT-01	PRESSURE SENSOR	DRAIN TANK PUMP DISCHARGE PRESSURE	
D-PT-02	PRESSURE SENSOR	SPENT FUEL TANK, PUMP DISCHARGE PRESSURE	
D-PT-03	PRESSURE SENSOR	WASTE TANK PUMP DISCHARGE PRESSURE	
D-RT-01	RESISTANCE THERMOMETER	SPENT FUEL TANK, TEMPERATURE	
D-RT-02	RESISTANCE THERMOMETER	COOLER OUTLET, TEMPERATURE	
D-TT-01	THERMOCOUPLE	DRAIN TANK, TEMPERATURE	
D-TT-02	THERMOCOUPLE	SPENT FUEL TANK, TEMPERATURE	
D-TT-03	THERMOCOUPLE	WASTE TANK TEMPERATURE	
D-TT-04	THERMOCOUPLE	EVAPORATOR TEMPERATURE	
D-TT-05	THERMOCOUPLE	EVAPORATOR CONDENSER OUTLET TEMPERATURE	
D-TT-06	THERMOCOUPLE	COOLER OUTLET TEMPERATURE	
D-LS-01	LEVEL SENSOR	DRAIN TANK LIQUID LEVEL	
D-LS-02	LEVEL SENSOR	WASTE TANK LIQUID LEVEL	
D-LS-03	LEVEL SENSOR	SPENT FUEL TANK, LIQUID LEVEL	

COMPONENTS LIST

COMPONENT NO.	UNIT	CHARACTERISTIC	EQUIP. SPEC. NO.	MFGR	MFGR REF.	WEIGHT	REMARKS
D-HX-01	COOLER	CAP 150,000 BTU/HR	46	GRAHAM MFG.	134C4C-22L		
D-HX-02	EVAPORATOR CONDENSER	CAP 79,600 BTU/HR	45	GRISCOM RUSSELL	N60-1956		
D-IX-01	DEMINERALIZER	RESIN CAP. 2.8 CU. FT.	22	ILLINOIS WATER TREATMENT			
D-PU-01	WASTE TANK PUMP	CAP. 2 GPM HEAD 33 FT	43	INGERSOL RAND	½ KRV MOD. B		
D-PU-02	WASTE TANK PUMP	CAP 2 GPM HEAD 33 FT	43	INGERSOL RAND	½ KRV MOD. B		
D-PU-03	DRAIN TANK PUMP	CAP 7.5 GPM HEAD 68 FT	42	INGERSOL RAND	¼ KRVL - ½		
D-PU-04	DRAIN TANK PUMP	CAP 7.5 GPM HEAD 68 FT	42	INGERSOL RAND	¼ KRVL - ½		
D-TK-01	DRAIN TANK	CAP. 467 CU. FT.	39	COMB. ENG. INC.	PL2E2269 2301-06-03		
D-TK-02	WASTE TANK	CAP. 65 CU. FT.	40	COMB. ENG. INC.			
D-TK-03	SPENT FUEL TANK	CAP. 924 CU. FT.	41	COMB. ENG. INC.	PL2E2268 2301-06-02		
D-TK-04	DISPOSAL TANK	CAP. 100 CU. FT.	26	COMB. ENG. INC.			
D-PU-05	SPENT FUEL TANK PUMP	CAP 7.5 GPM HEAD 68 FT	44	INGERSOL RAND	¼ KRVL - ½		
D-PU-06	SPENT FUEL TANK PUMP	CAP 7.5 GPM HEAD 68 FT	44	INGERSOL RAND	¼ KRVL - ½		
D-PU-07	DISPOSAL TANK PUMP	CAP. 10 GPM HEAD 50 FT.	26	INGERSOL RAND	¼ KRVSA - ½ B		
D-PU-08	DISPOSAL TANK PUMP	CAP 10 GPM HEAD 50 FT	26	INGERSOL RAND	¼ KRVSA - ½ B		
D-EV-01	EVAPORATOR	CAPACITY 200 GPD	45	GRISCOM RUSSELL	N60-1956		

SPECIAL VALVE & FITTINGS LIST

VALVE NO.	COMPONENT NO.	SERVICE	NOM. SIZE	TYPE	END CONN.	ACTUATING MEDIUM	FAIL POSITION	MATERIAL	EQUIP. SPEC. NO.	REMARKS
D-50		EVAPORATOR FEED CONTROL	½"	GLOBE	[illegible]	FLOAT DIRECT OPERATED		304 SST	PL-2100-00-47	

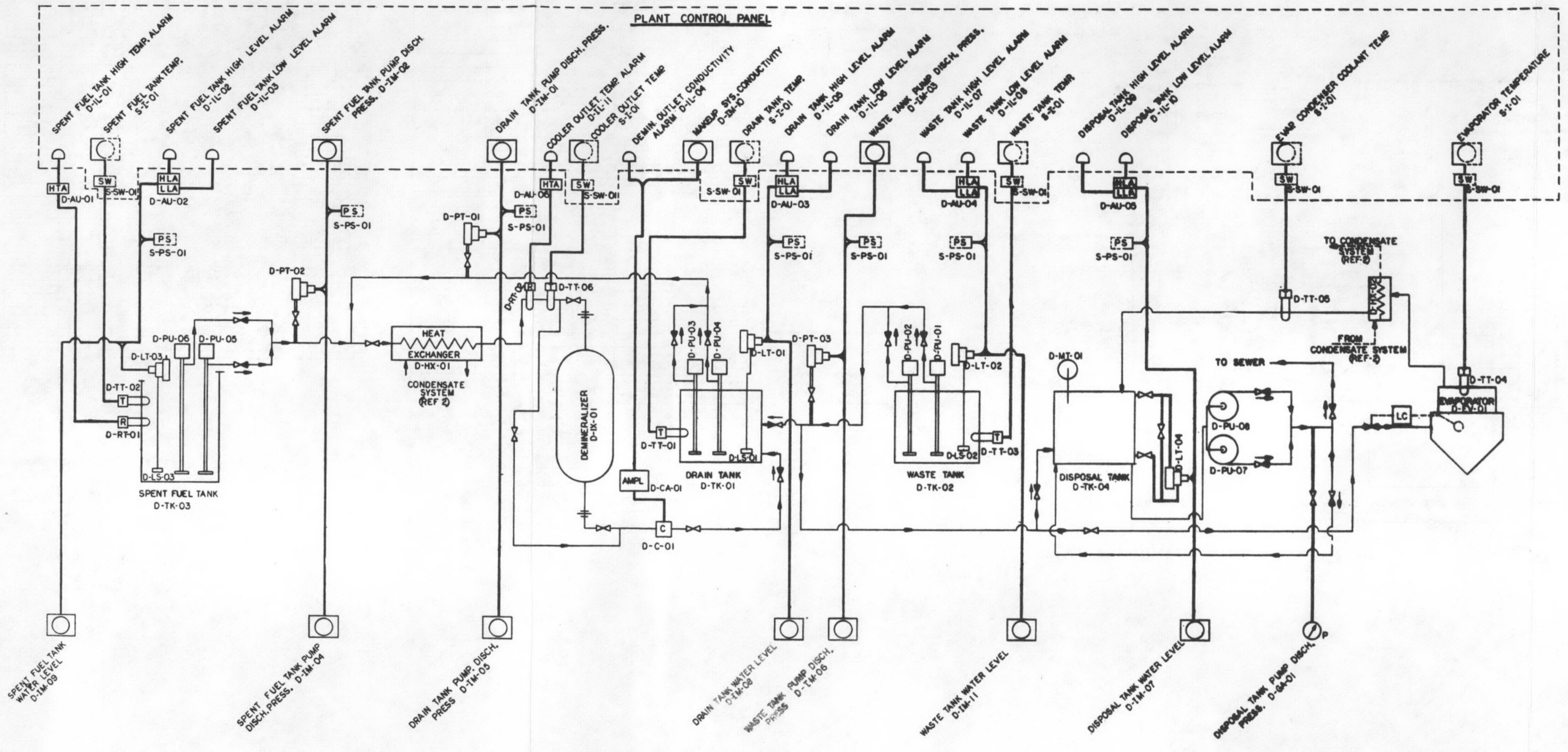
PIPE LIST

PIPE NO.	[illegible]	MAT'L	SERVICE	INSUL. THK.	FLOW	DES. PRESS.	TEST PRESS.	REMARKS
P-1	[illegible]	304 SST	DISCHARGE WASTE TANK PUMP D-PU-01	—	0.2 GPM	100 PSIG	150 PSIG	
P-2	1		INLET TO DISPOSAL TANK PUMP D-PU-07	—	10 GPM			
P-3	2 ½		RADIOACTIVE SHOWER DRAIN	—	12 GPM			
P-4	2 ½		RADIOACTIVE LABORATORY DRAIN	—	5 GPM			
P-5	½		FEED & CONDENSATE SKID DRAIN	—	NEG.			
P-6	½		MACHINERY BLDG EXHAUST STACK DRAIN	—	—			
P-7	½		TURBINE GENERATOR SKID DRAIN	—	NEG.			
P-8	½		CONDENSER SKID DRAIN NO. 1	—	NEG.			
P-9	½		CONDENSER SKID DRAIN NO. 2	—	NEG.			
P-10	2 ½		COMBINED DRAINS HEADER TO WASTE TANK	—	17 GPM			
P-11	½		PRIMARY COOLANT DISCH. FROM COOLANT PURIF. SYS.	STD	10 GPM			
P-12	½		PRIMARY COOLANT DISCH. FROM CONDENSATE SYS.	STD	10 GPM			
P-13	½		LINE FROM SHIELD WATER TANK TO WASTE TANK	—	5 GPM			
P-14	½		RELIEF VALVE LINE DRAIN	STD	—			
P-15	½		REACTOR BLDG. EXH. STACK DRAIN	—	—			
P-16	½		WASTE TANK VENT LINE	—	—			
P-17	½		BASE WATER TO DRAIN TANK	—	10 GPM			
P-18	½		DRAIN TANK VENT LINE	—	—			
P-19	½		PRESS. SENSOR SUPPLY WASTE TANK PUMP	—	—			
P-20	1		DRAIN TANK PUMP DISCHARGE D-PU-03	STD	10 GPM			
P-21	1		HEAT EXCHANGER TO DEMINERALIZER INLET	STD	10 GPM			
P-22	1 ½		DEMINERALIZER INLET	STD	10 GPM			
P-23	1 ½		DEMINERALIZER OUTLET	STD	10 GPM			
P-24	½		VENT LINE DEMINERALIZER	—	—			
P-25	1		DRAIN TANK RETURN LINE	STD	10 GPM			
P-26	½		DEMINERALIZER INLET SAMPLE LINE	STD	0.5 GPM			
P-27	½		DEMINERALIZER OUTLET SAMPLE LINE	STD	0.5 GPM			
P-28	½		DEMINERALIZER EFFLUENT TO DISPOSAL TANK	STD	10 GPM			
P-29	½		PRESSURE SENSOR SUPPLY DRAIN TANK PUMP	—	—			
P-30	1		DEMINERALIZER BY-PASS LINE	STD	10 GPM			
P-31	1		SPENT FUEL TANK PUMP DISCHARGE D-PU-06	STD	10 GPM			
P-32	1		RETURN LINE TO SPENT FUEL TANK	STD	10 GPM			
P-33	½		PRESSURE SENSOR SUPPLY SPENT FUEL TANK PUMP	—	—			
P-34	1		INLET TO DISPOSAL TANK PUMP D-PU-08		10 GPM			
P-35	1		EVAPORATOR CONDENSER VENT LINE	STD	—			
P-36	½		DISPOSAL TANK VENT LINE	—	—			
P-37	1		DISPOSAL TANK PUMP DISCHARGE D-PU-08	—	10 GPM			
P-38	½		DISPOSAL TANK RETURN TO DRAIN TANK	—	10 GPM			
P-39	½		DISPOSAL TANK RECIRCULATION LINE	—	10 GPM			
P-40	½		DISPOSAL TANK SAMPLE LINE	—	0.5 GPM			
P-41	½		PRESSURE SENSOR SUPPLY DISPOSAL TANK PUMP	—	—			
P-42	½		DEMINERALIZER EFFLUENT TO MAKE UP WATER TANK	—	5 GPM			
P-43	½		LAUNDRY WASTE TO WASTE TANK	—	5 GPM			
P-44	½		DECONTAMINATION FLUID WASTE TO WASTE TANK	STD	5 GPM			
P-45	½		DISCHARGE WASTE TANK PUMP D-PU-02		0.2 GPM			
P-46	1		DRAIN TANK PUMP DISCHARGE D-PU-04	STD	10 GPM			
P-47	½		SPENT FUEL TANK PUMP DISCHARGE D-PU-05	STD	10 GPM			
P-48	1		DISPOSAL TANK PUMP DISCHARGE D-PU-07		10 GPM			
P-49	½		RETURN LINE FROM DISPOSAL TANK TO WASTE TANK		5 GPM			
P-50	1 ½		EVAPORATOR OVERHEAD TO CONDENSER	STD	80 #/HR			
P-51	1		EVAPORATOR OVERHEAD TO DISPOSAL TANK	STD	0.2 GPM			
P-52	1 ½		EVAPORATOR BTMS CONCENTRATE	STD		200 PSIG	300 PSIG	
P-53	1		STEAM SUPPLY LINE TO EVAPORATOR COILS	STD	500 #/HR			
P-54	½		STEAM SUPPLY TO EVAPORATOR DEMISTING SECTION	STD	500 #/HR			
P-55	½		STEAM SUPPLY TO LIFT LINE	STD	500 #/HR			
P-56	½		STEAM LANCE TO EVAPORATOR BTMS	STD	100 #/HR			
P-57	½		STEAM SUPPLY TO EVAPORATOR BOTTOM HEATING COIL	STD	100 #/HR			
P-58	½		TAKE DOWN CONNECTION TO RAW WATER PURIF. SYS.		5 GPM	100 PSIG	150 PSIG	
P-59	½		TAKE DOWN CONNECTION TO BASE WATER MAIN		5 GPM			
P-60	½		INLET HEADER TO DRAIN TANK	STD	10 GPM			
P-61	½		WASTE TANK LINE TO DISPOSAL TANK		2 GPM			
P-62	½		PURIFICATION SKID DRAIN					
P-63	½		BY-PASS LINE EVAPORATOR FEED CONTROL VALVE		0.2 GPM			

REF. NO.	DRAWING NO.	PROJECT NO.	TITLE
6	PL2J2214	2110-11	SERV. WATER SYS. PROCESS INSTR. DIAGRAM
5	PL2J2122	2106	HIGH PRESS. DRAIN SYSTEM DIAGRAM
4	PL2J2111	2105	RAW WATER PURIFICATION SYS. DIAGRAM
3	PL2J2119	2102	CONDENSATE SYSTEM DIAGRAM
2	PL2J2110	2104	COOLANT PURIFICATION SYS. DIAGRAM
1	PL2J2121	2101	MAIN STEAM SYSTEM DIAGRAM

REFERENCE DRAWINGS

SERVICE WATER SYSTEM
Fig. 57



INST. NO.	TYPE	INPUT	RANGE	MFG.	MOD NO	OUTPUT	SET POINT CONTROL	SET POINT ALARM	MOUNTING INSERTION	MOUNTING CONNECT.	EQUIP. SPEC. NO.	REMARKS
S-I-01	IND. ELEC.										2100-11-	REF. 4
S-SW-01	SWITCH MULTI-POINT											REF. 4
D-IM-09	IND. ELEC.	D-LT-03	0-15'	FOXBORO	65FA						83	
D-LS-03	SENSOR LEVEL	SPENT FUEL TANK LEVEL	0-15'	BRISTOL	[illegible]	D-LT-03					90	
S-PS-01	POWER SUPPLY											REF. 2
D-RT-02	RES. THERM.	DRAIN INLET TEMP	0-200°F	MPLS HONEYWELL	[illegible]	D-AU-06			5"	1/2" NPT	71	
D-AU-06	ALARM UNIT	D-RT-02		MPLS HONEYWELL	[illegible]	D-IL-11		170°F			72	
D-IL-11	IND. LIGHT	D-AU-06		ELDEMA	1PH						68	
D-TT-06	THERM. T.C.	DRAIN INLET TEMP	0-300°F	MPLS HONEYWELL	[illegible]	S-SW-01			5"	1/2" NPT	71	
D-CA-01	CONTROL AMPLIFIER	D-C-01		INDUS. INST.	[illegible]	[illegible]					66	
D-IM-10	IND. ELEC.	D-CA-01		FOXBORO	65FA						83	
D-LS-01	SENSOR LEVEL	DRAIN TANK LEVEL	0-8'	BRISTOL	[illegible]	D-LT-01					90	
D-LS-02	SENSOR LEVEL	WASTE TANK LEVEL	0-8'	BRISTOL	[illegible]	D-LT-02				1/2" NPT	90	
D-IM-08	IND. ELEC.	D-LT-01	0-8'	FOXBORO	65FA					1/2" NPT	83	
D-IM-11	IND. ELEC.	D-LT-02	0-8'	FOXBORO	65FA						83	
D-IM-07	IND. ELEC.	D-LT-04	0-8'	FOXBORO	65FA						83	
D-MT-01	THERM. DIAL	DISPOSAL TANK TEMP	0-300°	WESTON	4600				5"	1/2" NPT	[illegible]	
D-TT-05	THERM. T.C.	EVAP. COND. OUTLET TEMP	0-250°	MPLS HONEYWELL	[illegible]	S-SW-01			5"	1/2" NPT	71	
D-GA-01	GAGE, PRESS.	DISP. TK. PUMP DISCH. PRESS.	0-50 PSIG	ASHCROFT	[illegible]					1/2" NPT	65	
D-TT-04	THERM. T.C.	EVAP. OVERHEAD TEMP	0-250°F	MPLS HONEYWELL	[illegible]	S-SW-01			5"	1/2" NPT	71	
D-TT-01	THERM. T.C.	DRAIN TANK TEMP	0-250°F	MPLS HONEYWELL	[illegible]	S-SW-01			5"	1/2" NPT	71	
D-RT-01	THERM. RES.	SPENT FUEL TANK TEMP	0-250°F	MPLS HONEYWELL	BROWN CLASS 2	D-AU-01			5"	1/2" NPT	70	
D-AU-01	ALARM UNIT	D-RT-01		MPLS HONEYWELL	[illegible]			200°F			72	
D-IL-01	IG. LIGHT	D-AU-01		ELDEMA	1PH						68	
D-LT-03	SENSOR LIMITER	D-LS-03	0-15'	FOXBORO	611					1/2" NPT	76	
D-AU-02	ALARM UNIT	D-LT-03		FOXBORO	63			2'-13'			72	
D-IL-02	IG. LIGHT	D-AU-02		ELDEMA	1PH						68	
D-IL-03	IG. LIGHT	D-AU-02		ELDEMA	1PH						68	
D-PT-01	SENSOR, PRESS.	DRAIN TK. PUMP DISCH.	0-60 PSIG	FOXBORO	611					1/2" NPT	76	
D-IM-01	IND. ELECT.	D-PT-01	0-60 PSIG	FOXBORO	65FA						83	
D-IM-03	IND. ELECT.	D-PT-01	0-60 PSIG	FOXBORO	65FA						83	
D-PT-02	SENSOR, PRESS.	S.F.T. PUMP DISCH.	0-60 PSIG	FOXBORO	611					1/2" NPT	76	
D-IM-02	IND. ELECT.	D-PT-02	0-60 PSIG	FOXBORO	65FA						83	
D-IM-04	IND. ELECT.	D-PT-02	0-60 PSIG	FOXBORO	65FA						83	
D-C-01	COND. CELL	DEMIN. OUTLET COND.	[illegible]	IND. INST.	[illegible]					1 1/2" NPT	66	
D-IL-04	IG. LIGHT	D-CA-01		ELDEMA	1PH						68	
D-TT-02	THERM. T.C.	S.F.T. TEMP	0-250°F	MPLS HONEYWELL	[illegible]						71	
D-LT-02	SENSOR LIMITER	D-LS-02	0-8'	FOXBORO	611						76	
D-AU-03	ALARM UNIT	D-LT-01		FOXBORO	63	D-IL-05,06		1'-7'			72	
D-IL-05	IG. LIGHT	D-AU-03		ELDEMA	1PH						68	
D-IL-06	IG. LIGHT	D-AU-03		ELDEMA	1PH						68	
D-PT-03	SENSOR, PRESS.	WASTE TK. PUMP DISCH.	0-60 PSIG	FOXBORO	611					1/2" NPT	76	
D-IM-05	IND. ELECT.	D-PT-03	0-60 PSIG	FOXBORO	65FA						83	
D-IM-06	IND. ELECT.	D-PT-03	0-60 PSIG	FOXBORO	65FA						83	
D-LT-01	SENSOR LIMITER	D-LS-01	0-8'	FOXBORO	611					1/2" NPT	76	
D-AU-04	ALARM UNIT	D-LT-02		FOXBORO	63			1'-6'			72	
D-IL-07	IG. LIGHT	D-AU-04		ELDEMA	1PH						68	
D-IL-08	IG. LIGHT	D-AU-04		ELDEMA	1PH						68	
D-TT-03	THERM. T.C.	WASTE TANK TEMP	0-250°F	MPLS HONEYWELL	[illegible]	S-SW-01			5"	1/2" NPT	71	
D-LT-04	SENSOR LIMITER	DISPOSAL TANK LEVEL	0-8'	FOXBORO	611	[illegible]					76	
D-AU-05	ALARM UNIT	D-LT-04		FOXBORO	63	D-IL-09,10		1'-7'			72	
D-IL-09	IG. LIGHT	D-AU-05		ELDEMA	1PH						68	
D-IL-10	IG. LIGHT	D-AU-05		ELDEMA	1PH						68	

SYMBOLS

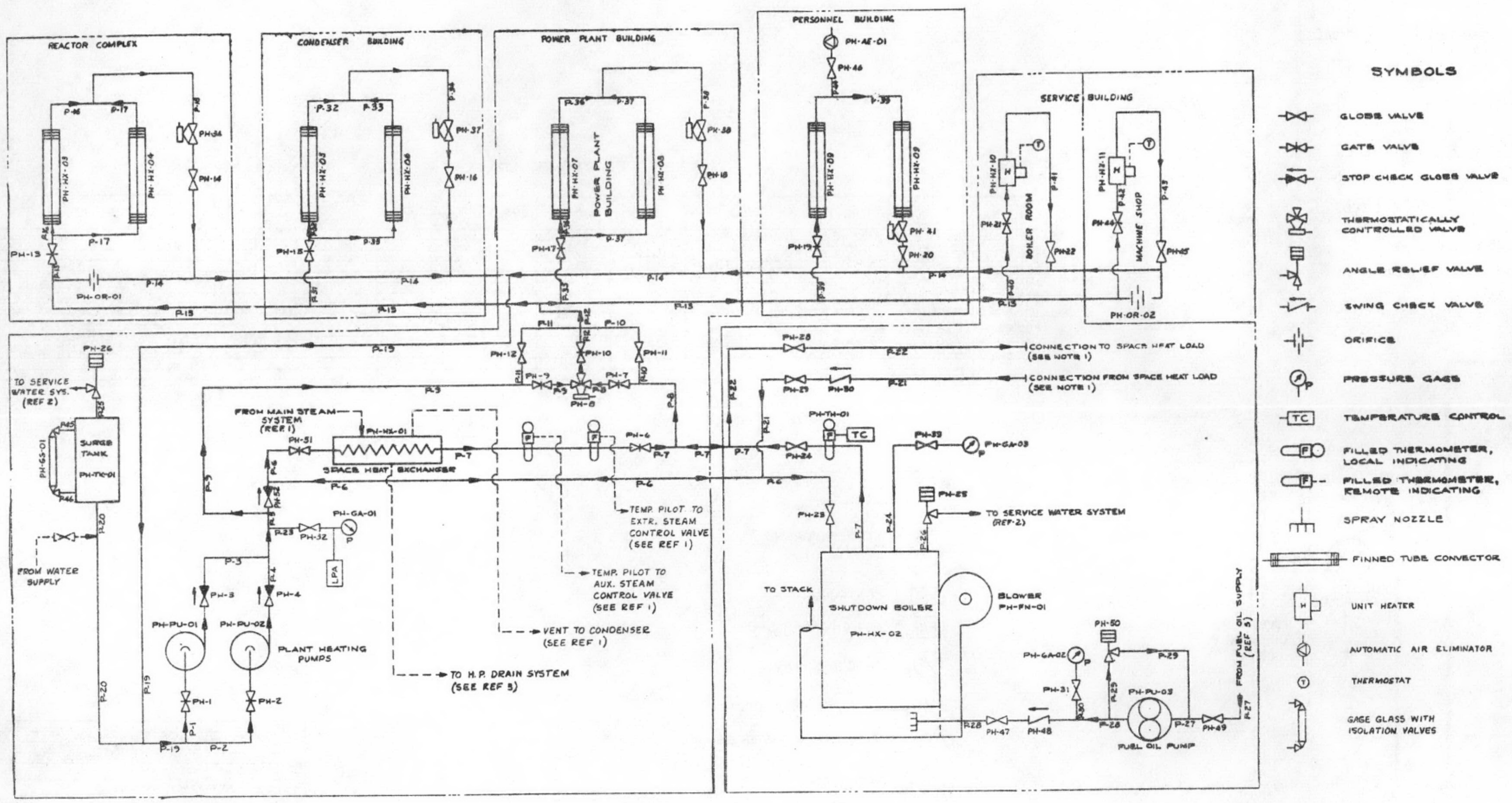
- SENSOR, LEVEL
- CONTROLLER
- HLA — HIGH LEVEL ALARM
- LLA — LOW LEVEL ALARM
- HTA — HIGH TEMPERATURE ALARM
- PS — POWER SUPPLY, SYSTEM
- SENSOR, PRESSURE
- T — THERMOCOUPLE
- R — THERMOMETER, RESISTANCE
- SW — SWITCH, MULTIPOINT
- INDICATOR, ELECTRICAL, SINGLE
- INDICATOR, ELECTRICAL, MULTIPOINT
- SENSOR, DIFFERENTIAL PRESSURE
- LIGHT, INDICATING
- C — CONDUCTIVITY CELL
- P — GAGE, PRESSURE
- SENSOR, LIQUID LEVEL
- AMPL — CONTROL AMPLIFIER

REF. NO.	DRAWING NO.	PROJECT NO.	TITLE
4	PL2J2201	2101-11	MAIN STEAM SYS. INST. DIAG.
3	PL2J2219	2201-03	AUX. & EMER. MULTILINE DIAG.
2	PL2J2118	2102	CONDENSATE SYS. DIAG.
1	PL2J2183	2110	SERVICE WATER SYS.

REFERENCE DRAWING

SERVICE WATER SYSTEM PROCESS INSTRUMENTATION-ONE LINE DIAGRAM

Fig. 58



SPECIAL VALVE AND FITTINGS LIST

VALVE NO.	COMPONENT NO.	SERVICE	NOM. SIZE	TYPE	END CONN.	ACTUATING MEDIUM	FAIL POSITION	MATERIAL	EQUIP SPEC NO.	REMARKS
PH-8		WATER	2	BLENDING & BODY	FLANGED	FILLED THERMOSTAT			PL-2111-00-61	
	PH-OR-01	WATER								16PM @ 10 PSI
	PH-OR-02	WATER								16PM @ 10 PSI
PH-34		WATER	1	TEMP REG.	UNION	FILLED THERMOSTAT	OPEN	BRONZE	PL-2111-00-61	
PH-37		WATER	1½	TEMP REG.	UNION	FILLED THERMOSTAT	OPEN	BRONZE	PL-2111-00-61	
PH-38		WATER	1	TEMP REG.	UNION	FILLED THERMOSTAT	OPEN	BRONZE	PL-2111-00-61	
PH-41		WATER	3/4	TEMP REG.	UNION	FILLED THERMOSTAT	OPEN	BRONZE	PL-2111-00-61	
	PH-GG-01	WATER							PL-2100-00-66	

PIPE LIST

PIPE NO.	NOM. SIZE	SCH.	MATERIAL	SERVICE	INSUL THK.	FLOW	DESIGN PRESS	TEST PRESS	REMARKS
P-1	2	40	C.S.	PLANT HEATING PUMP SUCTION	STD.	40 GPM	50 PSIG	75 PSIG	
P-2	2	40	C.S.	PLANT HEATING PUMP SUCTION	STD.	40 GPM	50 PSIG	75 PSIG	
P-3	2	40	C.S.	PLANT HEATING PUMP DISCHARGE	STD.	40 GPM	50 PSIG	75 PSIG	
P-4	2	40	C.S.	PLANT HEATING PUMP DISCHARGE	STD.	40 GPM	50 PSIG	75 PSIG	
P-5	2	40	C.S.	PLANT HEATING PUMP CONN. TO HEX. INLET MAIN	STD.	40 GPM	50 PSIG	75 PSIG	
P-6	3	40	C.S.	HEAT EXCHANGERS INLET MAIN	STD.	131 GPM	50 PSIG	75 PSIG	
P-7	3	40	C.S.	HEAT EXCHANGERS OUTLET MAIN	STD.	131 GPM	50 PSIG	75 PSIG	
P-8	2	40	C.S.	HOT WATER SUPPLY TO BLENDING VALVE	STD.	40 GPM	50 PSIG	75 PSIG	
P-9	2	40	C.S.	COLD WATER SUPPLY TO BLENDING VALVE	STD.	40 GPM	50 PSIG	75 PSIG	
P-10	2	40	C.S.	BLENDING VALVE BY-PASS—HOT LEG	STD.	40 GPM	50 PSIG	75 PSIG	
P-11	2	40	C.S.	BLENDING VALVE BY-PASS—COLD LEG	STD.	40 GPM	50 PSIG	75 PSIG	
P-12	2	40	C.S.	BLENDED WATER SUPPLY TO PLANT HTG. LOOP	STD.	40 GPM	50 PSIG	75 PSIG	
P-13	2	40	C.S.	PLANT HEATING SUPPLY MAIN	STD.	20	50 PSIG	75 PSIG	
P-14	2	40	C.S.	PLANT HEATING RETURN MAIN	STD.	20	50 PSIG	75 PSIG	
P-15	1	40	C.S.	REACTOR COMPLEX CONVECTOR SUPPLY LINE	STD.	5.2 GPM	50 PSIG	75 PSIG	
P-16	1	40	COPPER	REACTOR COMPLEX CONVECTOR LOOP	STD.	2.6 GPM	50 PSIG	75 PSIG	
P-17	1	40	COPPER	REACTOR COMPLEX CONVECTOR LOOP	STD.	2.6 GPM	50 PSIG	75 PSIG	
P-18	1	40	C.S.	REACTOR COMPLEX CONVECTOR RETURN LINE	STD.	5.2 GPM	50 PSIG	75 PSIG	
P-19	2	40	C.S.	COLD WATER RETURN FROM HEATING LOOP	STD.	40 GPM	50 PSIG	75 PSIG	
P-20	1	40	C.S.	SURGE TANK CONNECTION	STD.	~	50 PSIG	75 PSIG	
P-21	3	40	C.S.	CONNECTION FROM SPACE HEAT LOAD	STD.	91 GPM	50 PSIG	75 PSIG	
P-22	3	40	C.S.	CONNECTION TO SPACE HEAT LOAD	STD.	91 GPM	50 PSIG	75 PSIG	
P-23	½	40	C.S.	GAGE LINE TO PLANT HTG. PUMP DISCH PRESS. GAGE	STD.	~	50 PSIG	75 PSIG	
P-24	½	40	C.S.	GAGE LINE TO SHUTDOWN BOILER PRESS GAGE	STD.	~	50 PSIG	75 PSIG	
P-25	1	40	C.S.	RELIEF VALVE CONNECTION TO SURGE TANK	STD.	~	50 PSIG	75 PSIG	
P-26	1	40	C.S.	RELIEF VALVE CONNECTION TO SHUTDOWN BOILER	STD.	~	50 PSIG	75 PSIG	
P-27	½	40	C.S.	F.O. PUMP SUCTION		18 GPH			
P-28		40	C.S.	F.O. PUMP DISCHARGE		18 GPH			FURNISHED WITH SHUT DOWN BOILER
P-29		40	C.S.	F.O. PUMP RELIEF VALVE		~			FURNISHED WITH SHUT DOWN BOILER
P-30	½	40	C.S.	F.O. PUMP DISCHARGE PRESS. GAGE LINE		~			
P-31	1½	40	C.S.	CONDENSER BLDG CONVECTOR SUPPLY LINE	STD	12.2 GPM			
P-32	1	40	COPPER	CONDENSER BLDG CONVECTOR LOOP	~	6.1 GPM			
P-33	1	40	COPPER	CONDENSER BLDG CONVECTOR LOOP	~	6.1 GPM			
P-34	1½	40	C.S.	CONDENSER BLDG CONVECTOR RETURN LINE	STD	12.2 GPM			
P-35	1½	40	C.S.	POWER PLT. BLDG. CONVECTOR SUPPLY LINE	STD	11.4 GPM			
P-36	1	40	COPPER	POWER PLT. BLDG CONVECTOR LOOP	~	5.7 GPM			
P-37	1	40	COPPER	POWER PLT. BLDG CONVECTOR LOOP	~	5.7 GPM			
P-38	1½	40	C.S.	POWER PLT. BLDG CONVECTOR RETURN LINE	STD	11.4 GPM			
P-39	3/4	40	COPPER	PERSONNEL BLDG CONVECTION HTG LOOP	~	3.4 GPM			
P-40	1	40	C.S.	BOILER ROOM VENT HTR SUPPLY LINE	STD	2.3 GPM			
P-41	1	40	C.S.	BOILER ROOM VENT HTR RETURN LINE	STD	2.3 GPM			
P-42	1	40	C.S.	MACHINE SHOP VENT HTR SUPPLY LINE	STD	2.3 GPM			
P-43	1	40	C.S.	MACHINE SHOP VENT HTR RETURN LINE	STD	2.3 GPM			
P-44	½	40	C.S.	PERSONNEL BLDG CONV. HTG LOOP AIR VENT	STD	~			

INSTRUMENT LIST (REF. ONLY)

INSTRUMENT NO.	INSTRUMENT NAME	SERVICE	MANUFACTURER NAME	MANUFACTURER CAT. NO.	RANGE	SET POINT	ALARM POINT	TRIP POINT	EQUIP. SPEC. NO.	REMARKS
PH-GA-01	PLANT HTG. PUMP DISCH. PRESS.	WATER								SEE REF. 4
PH-GA-02	F.O. PUMP DISCH. PRESSURE	DIESEL OIL								FURNISHED WITH SHUT DOWN BOILER
PH-GA-03	SHUTDOWN BOILER SHELL PRESS.	WATER								FURNISHED WITH SHUT DOWN BOILER
PH-TH-03	SHUTDOWN BOILER OUTLET TEMP.	WATER								EQUIPPED W/ TEMP. CONTROLLER

COMPONENTS LIST

COMPONENT NO.	UNIT	CHARACTERISTICS	EQUIP. SPEC NO.	MANUFACTURER	MANUFACTURER REF.	WEIGHT	REMARKS
PH-HX-01	SPACE HEAT EXCHANGER	1.8x10⁶ BTU/HR	PL-2111-00-60	GRAHAM	30W4C4C-22L	810	
PH-HX-02	SHUTDOWN BOILER	2.0x10⁶ BTU/HR	PL-2111-00-53	CLEVER-BROOKS	CB-60	7,600	
PH-PU-01	PLANT HEATING PUMP	40 GPM @ 36 FT	PL-2111-00-51	INGERSOL-RAND	1½ RV	80	
PH-PU-02	PLANT HEATING PUMP	40 GPM @ 36 FT	PL-2111-00-51	INGERSOL-RAND	1½ RV	80	
PH-PU-03	FUEL OIL PUMP		PL-2111-00-53			—	FURNISHED WITH SHUT DOWN BOILER
PH-FN-01	BLOWER		PL-2111-00-53			-	FURNISHED WITH SHUT DOWN BOILER
PH-TK-01	SURGE TANK	69 GAL.	PL-2111-00-50			200#	
PH-HX-03	CONVECTION HEATER REACTOR COMPLEX	22,500 BTU/HR	PL-2111-00-52	TRANE			
PH-HX-04	CONVECTION HEATER REACTOR COMPLEX	22,500 BTU/HR	PL-2111-00-52	↓			
PH-HX-05	CONVECTION HEATER COND. BLDG.	98,020 BTU/HR	PL-2111-00-52				
PH-HX-06	CONVECTION HEATER COND. BLDG.	98,020 BTU/HR	PL-2111-00-52				
PH-HX-07	CONVECTION HEATER POWER PLT. BLDG.	48,840 BTU/HR	PL-2111-00-52				
PH-HX-08	CONVECTION HEATER POWER PLT. BLDG.	48,840 BTU/HR	PL-2111-00-52				
PH-HX-09	CONVECTION HEATER PERS. BLDG.	31,660 BTU/HR	PL-2111-00-52				
PH-HX-10	VENT HEATER, BOILER ROOM	[illegible]	PL-2111-00-52		72 H		FAN THERMOSTATICALLY CONTROLLED
PH-HX-11	VENT HEATER, BOILER ROOM	[illegible]	PL-2111-00-52		72 H		FAN THERMOSTATICALLY CONTROLLED

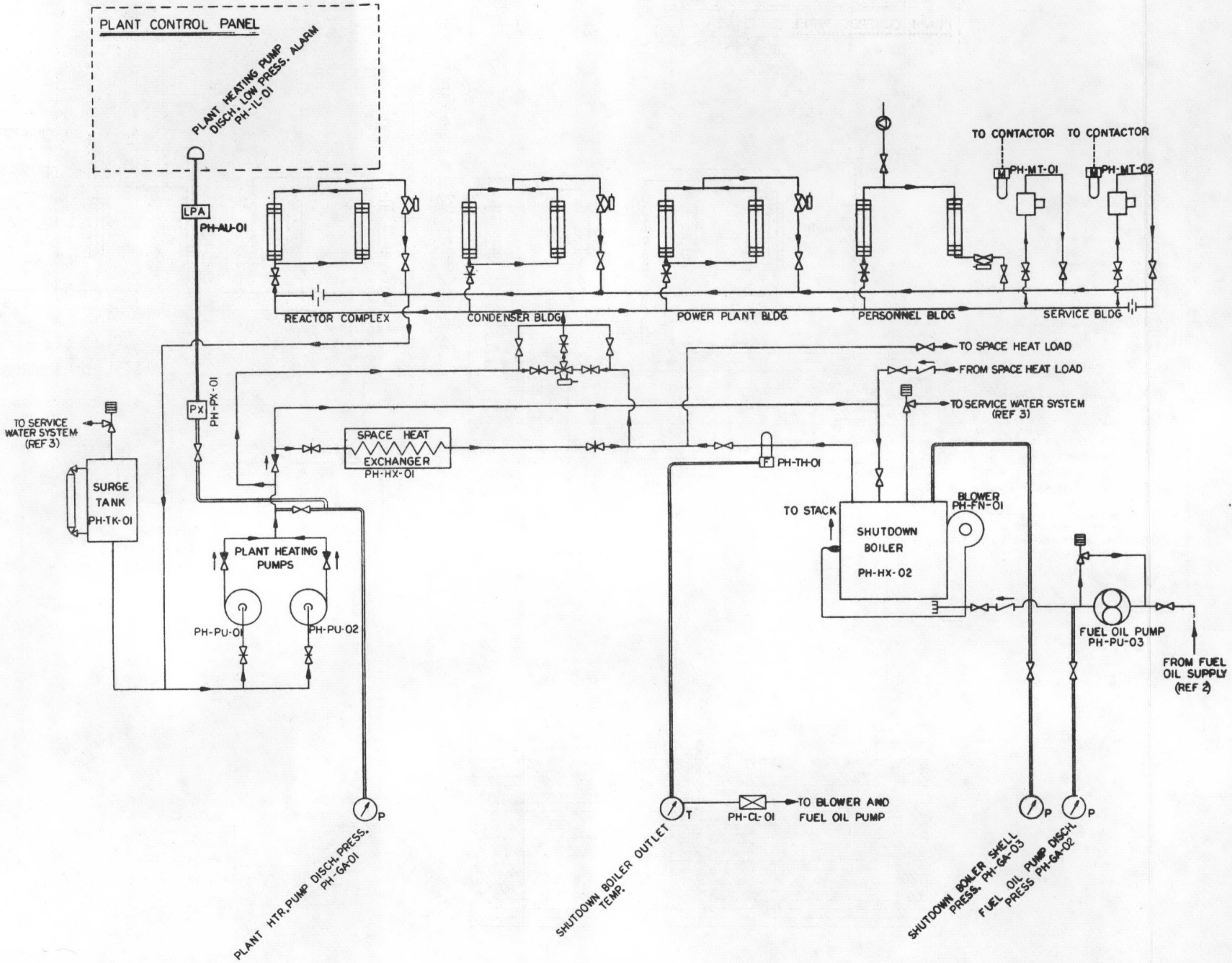
GENERAL NOTES

1. CIRCULATING PUMP & EXPANSION TANK FOR SPACE HEAT LOAD TO BE PROVIDED BY OTHERS

REF. NO.	DRAWING NO.	PROJECT NO.	TITLE
5		2112	F.O. SERVICE SYS. DIAGRAM
4	PL2J2211	2111-11	PLANT HEAT. SYS PROC. INST. SYS.
3	PL2J2122	2106	H.P. DRAIN SYS. DIAG.
2	PL2J2189	2110	SERVICE WATER SYS DIAG.
1	PL2J2121	2101	MAIN STEAM SYS. DIAG.

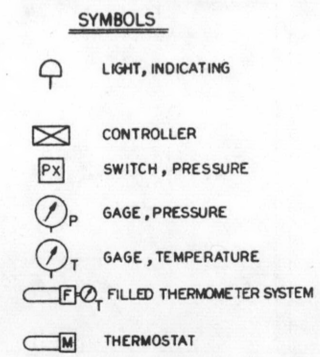
REFERENCE DRAWINGS

PLANT HEATING SYSTEM
Fig. 59



INSTRUMENT COMPONENT LIST

INST NO	TYPE	INPUT	RANGE	MFG	MOD NO	OUTPUT	SET POINT CONTROL	SET POINT ALARM	MOUNTING INSERTION	MOUNTING CONNECT	EQUIP SPEC NO	REMARKS
PH-PX-01	SWITCH, PRESS.	PLANT HT. PUMP DISCH.	0-60 PSIG	BARKSDALE	312			50 PSIG		¼" NPT	2100-11-66	
PH-AU-01	ALARM UNIT	PH PUMP LOW PRESSURE		SQUARE "D"	8501 AP						67	
PH-IL-01	IG. LIGHT			ELDEMA	1FH						68	
PH-GA-01	GAGE, PRESS.	PLANT HT. PUMP DISCH.	0-60 PSIG	ASHCROFT	13795					½" NPT	65	
PH-MT-01	THERMOSTAT	SERV. BLDG AIR TEMP	0-120°F									TO BE SUPPLIED BY VENDOR
PH-MT-02	THERMOSTAT	SERV BLDG AIR TEMP	0-120°F									TO BE SUPPLIED BY VENDOR
												OPERATES SPACE HX. RW. HTR. VALVES
PH-TH-01	THERMO. FILLED	SHUTDOWN BOILER OUT.	0-300°F	FOXBORO	CLASS II A					¾" NPT	60	FURNISHED WITH BOILER
PH-GA-03	GAGE, PRESS.	SHUTDOWN BOILER SHELL	0-60 PSIG	ASHCROFT	13795					½" NPT	65	
PH-GA-02	GAGE, PRESS.	F.O. PUMP DISH.	0-60 PSIG	ASHCROFT	13795					½" NPT	65	
PH-CL-01	CONTROLLER	SHUTDOWN BOILER TEMP		SQUARE "D"	8501 AP	230°F					67	FURNISHED WITH BOILER



REF NO	DRAWING NO	PROJECT NO	TITLE
3	PL2J2189	2110	SERVICE WATER SYSTEM
2		2112	FUEL OIL SERVICE SYSTEM.
1.	PL2J2211	2111	PLANT HEATING SYS.

REFERENCE DRAWING

PLANT HEATING SYSTEM PROCESS INSTRUMENTATION-ONE LINE DIAGRAM
Fig. 60

ITEM	DESCRIPTION	SYSTEM NO.	RATING	LOAD	FULL LOAD W	POWER FACTOR	FULL LOAD VA	DESIGN FULL POWER			START UP POWER			SHUT DOWN POWER			REMARKS
								DEMAND FACTOR	KW	KVA	DEMAND FACTOR	KW	KVA	DEMAND FACTOR	KW	KVA	
1	4160 VOLT AC LOADS								1,221,400			0	0	0	0	0	
2	STATION LOAD		1,000,000 W	1,000,000 W	1,000,000	0.8	1,250,000	1	1,000,000	1,250,000	0	—	—	0	0	0	
3	PLANT POWER CENTER TRANSFORMER	ME-T-01	300,000 VA					1	221,400		0	0		0	0	0	
4																	
5																	
6																	
7																	
8																	
9	480 VOLT AC LOADS								218723	240368		122530	141213		90985	109874	
10	#1 CONDENSER FAN A	C-F-01A	20 HP	20.5 HP	17385	0.96	18100	1.0	17385	18100	1.0	17385	18100	0	0	0	
11	#1 CONDENSER FAN B	C-F-01B	20 HP	20.5 HP	17385	0.96	18100	1.0	17385	18100	1.0	17385	18100	0	0	0	
12	#1 CONDENSER FAN C	C-F-01C	20 HP	20.5 HP	17385	0.96	18100	1.0	17385	18100	0	0	0	0	0	0	
13	#1 CONDENSER FAN D	C-F-01D	20 HP	20.5 HP	17385	0.96	18100	1.0	17385	18100	0	0	0	0	0	0	
14	#2 CONDENSER FAN A	C-F-02A	20 HP	20.5 HP	17385	0.96	18100	1.0	17385	18100	0	0	0	0	0	0	
15	#2 CONDENSER FAN B	C-F-02B	20 HP	20.5 HP	17385	0.96	18100	1.0	17385	18100	0	0	0	0	0	0	
16	#2 CONDENSER FAN C	C-F-02C	20 HP	20.5 HP	17385	0.96	18100	1.0	17385	18100	0	0	0	0	0	0	
17	#2 CONDENSER FAN D	C-F-02D	20 HP	20.5 HP	17385	0.96	18100	1.0	17385	18100	0	0	0	0	0	0	
18	#1 CONDENSER LOUVER MOTOR A	C-LM-01A	1/4 HP	0.25 HP	245	0.48	511	0.2	49	52	0.5	122	256	1.0	245	511	
19	#1 CONDENSER LOUVER MOTOR B	C-LM-01B	1/4 HP	0.25 HP	245	0.48	511	0.2	49	52	0.5	122	256	1.0	245	511	
20	#2 CONDENSER LOUVER MOTOR A	C-LM-02A	1/4 HP	0.25 HP	245	0.48	511	0.2	49	52	0	0	0	0	0	0	
21	#2 CONDENSER LOUVER MOTOR B	C-LM-02B	1/4 HP	0.25 HP	245	0.48	511	0.2	49	52	0	0	0	0	0	0	
22	#1 CONDENSER LEVEL CONTROL VALVE	C-1	1/3 HP	0.25 HP	287	0.61	471	0.2	57	94	0.5	143	236	1.0	287	471	
23	#2 CONDENSER LEVEL CONTROL VALVE	C-2	1/3 HP	0.25 HP	287	0.61	471	0.2	57	94	0	0	0	0	0	0	
24	CONDENSATE REGULATING VALVE	C-40	1/3 HP	0.25 HP	287	0.61	471	0.2	57	94	0.5	143	236	0.5	143	236	
25	#1 CONDENSATE PUMP	C-PU-01	5 HP	4.9 HP	4404	0.84	5243	1.0	4404	5243	1.0	4404	5243	1.0	4404	5243	
26	#2 CONDENSATE PUMP	C-PU-02	5 HP	4.9 HP	4404	0.84	5243	0	—	—	0	0	0	0	0	0	
27																	
28																	
29																	
30																	
31																	
32	#1 FEED PUMP	F-PU-01	60 HP	57.5 HP	46625	0.86	54215	1.0	46625	54215	1.0	46625	54215	1.0	46625	54215	
33	#2 FEED PUMP	F-PU-02	60 HP	57.5 HP	46625	0.86	54215	0	—	—	0	0	0	0	0	0	
34	FEED REGULATING VALVE	F-6	1/3 HP	0.25 HP	287	0.61	471	0.7	201	330	0.7	201	330	0.7	201	330	
35																	
36																	
37																	
38																	
39																	
40	#1 COOLANT PURIFICATION PUMP	CP-PU-01	1 1/2 HP	1.31 HP	2420	0.33	7325	1.0	2420	7325	1.0	2420	7325	1.0	2420	7325	
41	#2 COOLANT PURIFICATION PUMP	CP-PU-02	1 1/2 HP	1.31 HP	2420	0.33	7325	0	—	—	0	0	0	0	0	0	
42																	
43																	
44																	
45																	
46																	
47	#1 LOW PRESSURE DRAIN PUMP	LPD-PU-01	1/2 HP	0.36 HP	234	0.49	477	0.2	47	95	0.1	23	48	0.1	23	48	
48	#2 LOW PRESSURE DRAIN PUMP	LPD-PU-02	1/2 HP	0.36 HP	234	0.49	477	0	—	—	0	0	0	0	0	0	
49																	
50																	
51																	
52																	
53																	
54	STAND-BY LUBE OIL PUMP	LO-PU-02	7 1/2 HP	6.0 HP	5393	0.78	6914	0	—	—	1.0	5393	6914	1.0	5393	6914	
55	#1 LUBE OIL COOLANT PUMP	LO-PU-03	1/2 HP	0.36 HP	282	0.54	522	1.0	282	522	1.0	282	522	1.0	282	522	
56	#2 LUBE OIL COOLANT PUMP	LO-PU-04	1/2 HP	0.36 HP	282	0.54	522	0	—	—	0	0	0	0	0	0	
57	LUBE OIL PURIFIER	LO-PR-01	1/2 HP	0.36 HP	282	0.54	522	0.2	56	104	0	0	0	0	0	0	
58																	
59																	
60																	
61																	
62																	
63	MAKE-UP PUMP	RWP-PU-01	1/2 HP	0.2 HP	237	0.49	483	0.1	24	48	0	0	0	0	0	0	
64																	
65																	
66																	
67																	
68																	
69	WASTE TANK PUMP #1	D-PU-01	1/2 HP	0.05 HP	220	0.22	1000	0.1	22	100	0	0	0	0	0	0	
70	WASTE TANK PUMP #2	D-PU-02	1/2 HP	0.05 HP	220	0.22	1000	0	—	—	0	0	0	0	0	0	
71	DRAIN TANK PUMP #1	D-PU-03	1/2 HP	0.37 HP	389	0.62	627	0.1	39	63	0	0	0	0	0	0	
72	DRAIN TANK PUMP #2	D-PU-04	1/2 HP	0.37 HP	389	0.62	627	0	—	—	0	0	0	0	0	0	
73	SPENT FUEL TANK PUMP #1	D-PU-05	1/2 HP	0.37 HP	389	0.62	627	1.0	389	627	1.0	389	627	1.0	389	627	
74	SPENT FUEL TANK PUMP #2	D-PU-06	1/2 HP	0.37 HP	389	0.62	627	0	—	—	0	0	0	0	0	0	
75	DISPOSAL TANK PUMP #1	D-PU-07	1/2 HP	0.36 HP	379	0.62	610	0.1	38	61	0	0	0	0	0	0	
76	DISPOSAL TANK PUMP #2	D-PU-08	1/2 HP	0.36 HP	379	0.62	610	0	—	—	0	0	0	0	0	0	
77																	
78																	
79																	
80																	
81																	
82	#1 PLANT HEATING PUMP	PH-PU-01	3/4 HP	0.53 HP	534	0.70	763	0.8	427	610	0.8	427	610	0.8	427	610	
83	#2 PLANT HEATING PUMP	PH-PU-02	3/4 HP	0.53 HP	534	0.70	763	0	—	—	0	0	0	0	0	0	
84	FUEL PUMP - SHUT DOWN BOILER	PH-PU-03	3/4 HP	0.6 HP	605	0.71	852	0	—	—	0.8	484	682	0.8	484	682	
85	BLOWER - SHUT DOWN BOILER	PH-FN-01	3 HP	2.8 HP	2579	0.81	3184	0	—	—	0.8	2063	2547	0.8	2063	2547	
86																	
87																	
88																	
89																	
90																	
91																	
92	HOIST MOTOR - REACTOR COMPLEX CRANE		7 1/2 HP	6.0 HP	5393	0.78	6914	0	—	—	0	0	0	0	0	0	
93	HOIST MOTOR - POWER PLANT CRANE		7 1/2 HP	6.0 HP	5393	0.78	6914	0									
94	TRAVERSE MOTOR - REACTOR COMPLEX CRANE		3 HP	2.8 HP	2579	0.81	3184	0	—	—	0	0	0	0	0	0	
95	TRAVERSE MOTOR - POWER PLANT CRANE		3 HP	2.8 HP	2579	0.81	3184	0	—	—	0	0	0	0	0	0	
96																	
97																	
98																	
99																	
100																	
101	#1 AC/DC POWER CONVERTER	AE-CV-01	5000 W	3761	4346	0.94	4623	1.0	1382	1470	1.0	1599	1701	1.0	3930	4190	
102	#2 AC/DC POWER CONVERTER	AE-CV-02	5000 W	3761	4346	0.94	4623	0	0	—	0	0	0	0			
103																	
104																	
105																	
106																	
107																	
108	78V DIRECT CURRENT LOADS			3651					1050			1215			3858		
109	#1 BLOCKING RECTIFIER	AE-RE-01	40A @ 78V	128	131			0	0		0	0			0		
110	VOLTAGE REGULATOR - TRIP CIRCUITS	AE-VR-01	20A @ 78V	115	128	—	—	0	0		0	0			0		
111																	
112																	
113																	
114																	
115																	
116	#2 BLOCKING RECTIFIER	AE-RE-02	40A @ 78V	3082	3142	—	—	1.0	562	—	1.0	727	—	1.0	2920	—	
117	VOLTAGE REGULATOR - INSTR. & COMM.	AE-VR-02	20A @ 78V	326	362	—	—	1.0	362	—	1.0	362	—	1.0	362	—	
118																	
119																	
120																	
121																	
122																	
123	DC/AC POWER CONVERTER	AE-CV-03	3 KW	2502	2720	—	—	1.0	189	—	1.0	350	—	1.0	2620	—	
124	#1 ROD DRIVE MOTOR		1/8 HP	278	278	0.63	441	0	10	16	0.1	28	44	1.0	268	425	DC LOADS
125	#2 ROD DRIVE MOTOR		1/8 HP	278	278	0.63	441	0	10	16	0.1	28	44	1.0	268	425	
126	#3 ROD DRIVE MOTOR		1/8 HP	278	278	0.63	441	0	10	16	0.1	28	44	1.0	268	425	
127	#4 ROD DRIVE MOTOR		1/8 HP	278	278	0.63	441	0	10	16	0.1	28	44	1.0	268	425	
128	#5 ROD DRIVE MOTOR		1/8 HP	278	278	0.63	441	0.2	56	89	0.1	28	44	1.0	268	425	
129	#6 ROD DRIVE MOTOR		1/8 HP	278	278	0.63	441	0	10	16	0.1	28	44	1.0	268	425	
130	#7 ROD DRIVE MOTOR		1/8 HP	278	278	0.63	441	0	10	16	0.1	28	44	1.0	268	425	
131	#8 ROD DRIVE MOTOR		1/8 HP	278	278	0.63	441	0	10	16	0.1	28	44	1.0	268	425	
132	#9 ROD DRIVE MOTOR		1/8 HP	278	278	0.63	441	0	10	16	0.1	28	44	1.0	268	425	
133	PROCESS ALARMS																
134																	
135																	
136																	
137																	
138																	
139	#3 BLOCKING RECTIFIER	AE-RE-03	40A @ 78V	478	488	—	—	1.0	488	—	1.0	488		1.0	488	—	
140	VOLTAGE REGULATOR - 25V - NUCLEAR INSTR.	AE-VR-03	20A @ 78V	215	239	—	—	1.0	239	—	1.0	239		1.0	239	—	
141	VOLTAGE REGULATOR + 25V - NUCLEAR INSTR.	AE-VR-04	20A @ 78V	215	239	—	—	1.0	239	—	1.0	239		1.0	239	—	
142																	
143																	
144																	
145																	
146																	
147	FLUOR. LTG. - REACTOR COMPLEX		2400 W	2400	2400	0.95	2526	1.0	2400	2526	1.0	2400	2526	1.0	2400	2526	
148	FLUOR. LTG. - CONDENSER BUILDING		1200 W	1200	1200	0.95	1263	1.0	1200	1263	1.0	1200	1263	1.0	1200	1263	
149	FLUOR. LTG. - POWER PLANT BUILDING		8400 W	8400	8400	0.95	8842	1.0	8400	8842	1.0	8400	8842	1.0	8400	8842	
150	FLUOR. LTG. - PERSONNEL BUILDING		2400 W	2400	2400	0.95	2526	1.0	2400	2526	1.0	2400	2526	1.0	2400	2526	
151	FLUOR. LTG. - SERVICE BUILDING		2400 W	2400	2400	0.95	2526	1.0	2400	2526	1.0	2400	2526	1.0	2400	2526	
152																	
153																	
154																	
155																	
156																	
157	UT. XMFR. - PERSONNEL BUILDING	ES-T-01	3 KVA	1000	1020	0.93	1097	1.0	1020	1097	1.0	1020	1097	1.0	1020	1097	
158	UT. XMFR. - SERVICE BUILDING	ES-T-02	3 KVA	1000	1020	0.93	1097	1.0	1020	1097	1.0	1020	1097	1.0	1020	1097	
159	UT. XMFR. - POWER PLANT BUILDING	ES-T-03	3 KVA	1000	1020	0.93	1097	1.0	1020	1097	1.0	1020	1097	1.0	1020	1097	
160	UT. XMFR. - POWER PLANT BUILDING	ES-T-04	3 KVA	1000	1020	0.93	1097	1.0	1020	1097	1.0	1020	1097	1.0	1020	1097	
161	UT. XMFR. - REACTOR COMPLEX	ES-T-05	3 KVA	1000	1020	0.93	1097	1.0	1020	1097	1.0	1020	1097	1.0	1020	1097	
162	UT. XMFR. - CONDENSER BUILDING	ES-T-06	3 KVA	1000	1020	0.93	1097	1.0	1020	1097	1.0	1020	1097	1.0	1020	1097	
163																	
164																	
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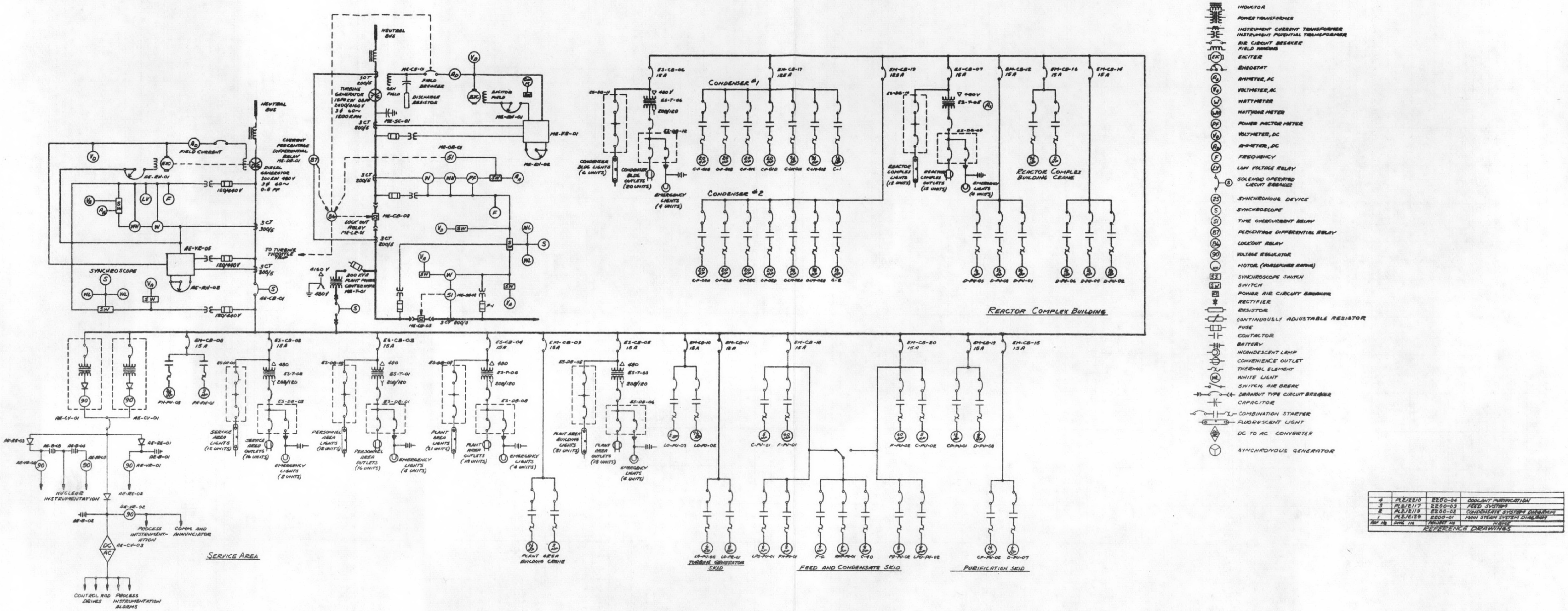
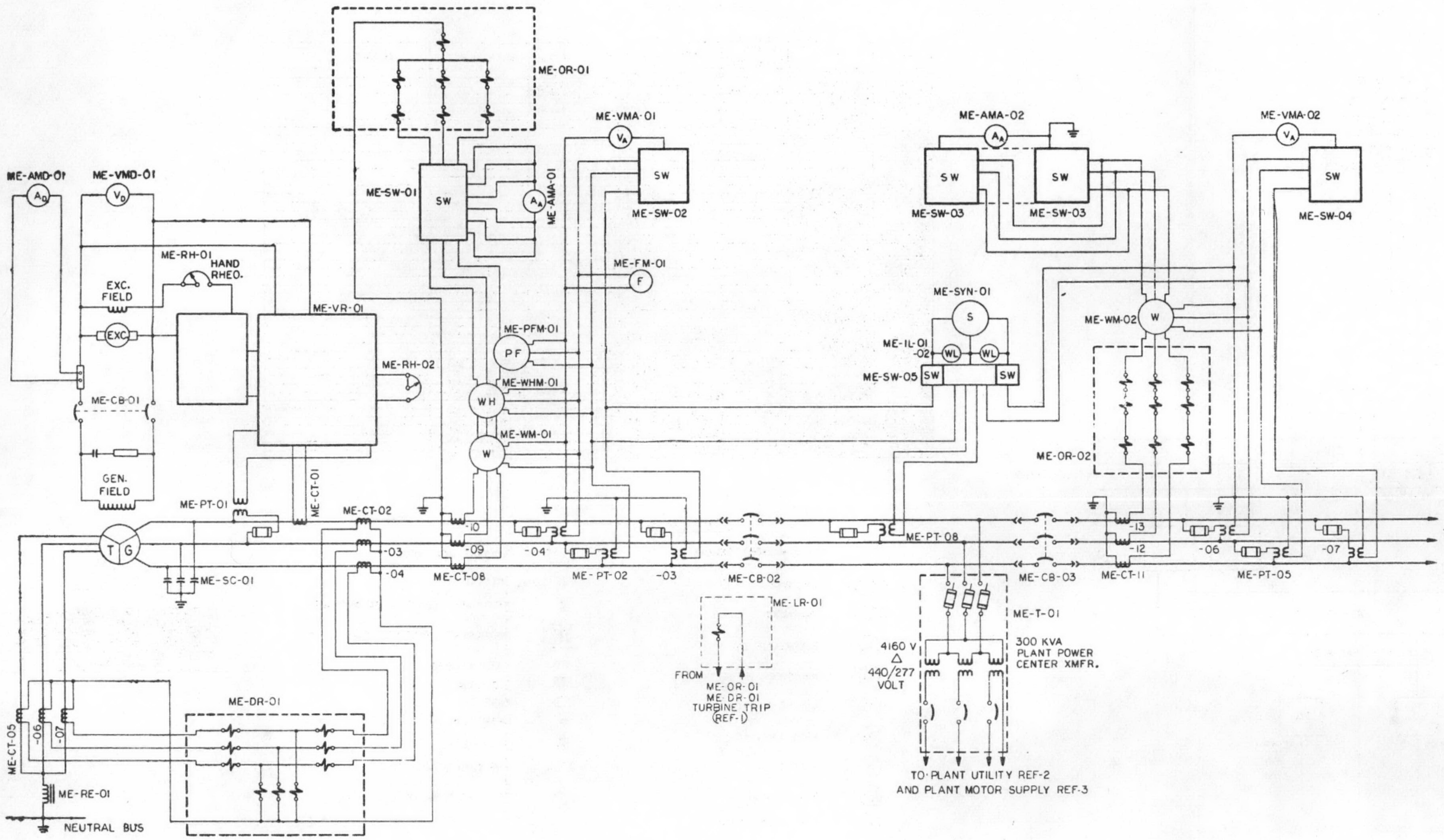
ELECTRIC POWER LOAD ANALYSIS

Fig. 61



ELECTRIC POWER-ONE LINE DIAGRAM
Fig. 62



SYMBOLS

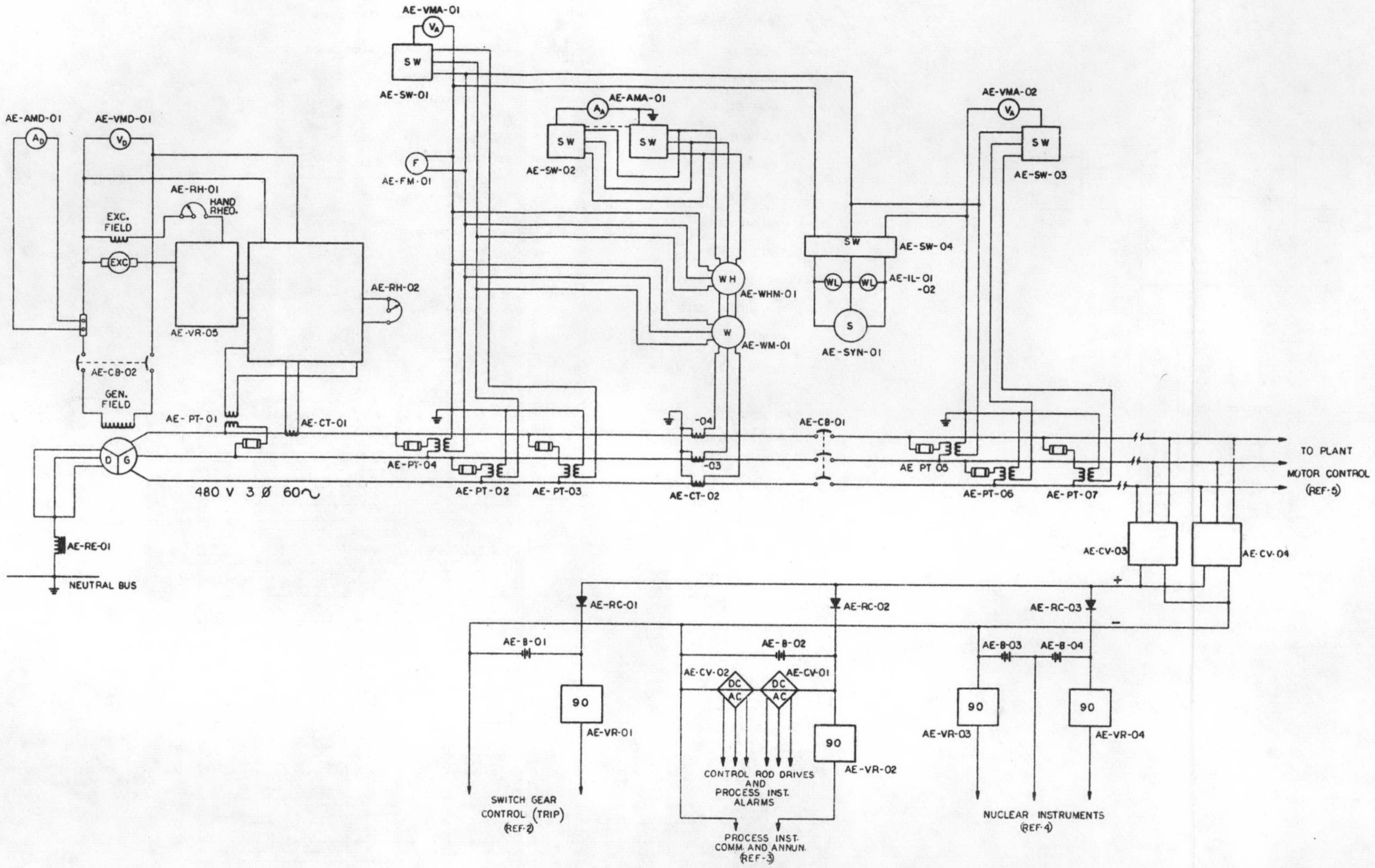
- SYNCHRONOUS GENERATOR
- EXCITER
- RHEOSTAT
- AMMETER, DC
- VOLTMETER, DC
- AMMETER, AC
- VOLTMETER, AC
- WATTMETER
- WATTHOUR METER
- POWER FACTOR METER
- FREQUENCY METER
- SYNCHROSCOPE
- INDICATING LIGHT, WHITE
- INSTRUMENT CURRENT TRANSFORMER
- INSTRUMENT POTENTIAL TRANSFORMER
- AIR CIRCUIT BREAKER
- FIELD WINDING
- RECTIFIER
- RESISTOR
- CONTINUOUSLY ADJUSTABLE RESISTOR
- FUSE
- CONTACTOR
- CAPACITOR
- SWITCH, AIR BREAKER
- DRAWOUT TYPE AIR CIRCUIT BREAKER
- RELAY COIL
- INDUCTOR
- SW — SWITCH

COMP. NO.	DESCRIPTION	RATING VOLT.	RATING CUR.	MFGR.	TYPE	LOCATION	DIM.	WGT.	REMARKS
ME-AMD-01	AMMETER, DC.			GENERAL ELECTRIC	AA-W/FORMS	ELECTRICAL SKID			
ME-VMD-01	VOLTMETER, DC.				DS 18				
ME-RH-01	RHEOSTAT				IC 3000				
ME-RH-02	RHEOSTAT				IC 3000				
ME-CB-01	CIRCUIT BRK.	600			AKF				6E# FIELD BREAKER
ME-PT-01	POTENTIAL XMFR.	35:1			JVM-3				
ME-CT-01	CURRENT XMFR.		200/5		JCS-0				
ME-CT-02			200/5		JCS-0				
ME-CT-03			200/5		JCS-0				
ME-CT-04			200/5		JCS-0				
ME-CT-05			200/5		JCS-0				
ME-CT-06			200/5		JCS-0				
ME-CT-07	CURRENT XMFR.		200/5		JCS-0				
ME-SC-01	CAPACITOR	4200			18 F				
ME-RE-01	REACTOR				CLT		30"W x 36"L x 76"H	1600 LBS	
ME-DR-01	DIFF. RELAY				IJD				
ME-OR-01	OVERCUR. RELAY				IJCV				
ME-SW-01	SWITCH, ROTARY				SBM				
ME-AMA-01	AMMETER, A.C.				AB-18				
ME-VMA-01	VOLTMETER, A.C.				AB-18				
ME-FM-01	FREQ. METER				AB-18				
ME-PFM-01	PWR. FACTOR METER				AB-18				
ME-WHM-01	WATT HR. METER				DS-63				
ME-WM-01	WATTMETER				AB 18				
ME-SW-02	SWITCH, ROTARY				SBM				
ME-CT-08	CURRENT XMFR.				JCS-0				
ME-CT-09	CURRENT XMFR.				JCS-0				
ME-CT-10	CURRENT XMFR.				JCS-0				
ME-PT-02	POTENTIAL XMFR.				JVM-3				
ME-PT-03	POTENTIAL XMFR.				JVM-3				
ME-PT-04	POTENTIAL XMFR.				JVM-3				
ME-CB-02	PWR. CK. BK.	4160	1200		AM-4.16-75		20"W x 66"L x 66"H	1600 LBS	
ME-SW-03	SWITCH, ROTARY				SBM				
ME-SYN-01	SYNCHROSCOPE				AB-18				
ME-IL-01	IG. LIGHT				CR-104				
ME-IL-02	IG. LIGHT				CR-104				
ME-SW-05	SWITCH				SBM				
ME-WM-02	WATTMETER				AB-18				
ME-OR-02	OVERCUR. RELAY				IAC				
ME-CB-03	PWR. CK. BK.	4160	1200		AM-4.16-75		20"W x 66"L x 66"H	1000 LBS	
ME-T-01	POWER XMFR.				AVR, WATS, AKS		55"W x 89"L x 76"H	5500 LBS	
ME-CT-11	CURRENT XMFR.				JCS-0				
ME-CT-12	CURRENT XMFR.				JCS-0				
ME-CT-13	CURRENT XMFR.				JCS-0				
ME-PT-05	POTENTIAL XMFR.				JVM-3				
ME-PT-06	POTENTIAL XMFR.				JVM-3				
ME-PT-07	POTENTIAL XMFR.	35:1			JVM-3				
ME-SW-04	SWITCH, ROTARY				SBM				
ME-AMA-02	AMMETER A.C.				AB-18				
ME-VMA-02	VOLTMETER A.C.				AB-18				
ME-VR-01	VOLTAGE REG.				609				
ME-PT-08	POTENTIAL XMFR.	35:1			JVM 3				
ME-LR-01	LOCKOUT RELAY				HEA				
						TOTAL EQUIPMENT WEIGHT		15,500 LBS	

REF. NO.	DRAWING NO.	PROJECT NO.	TITLE
4	PL2J2201	2101-11	MAIN STEAM SYS.
3	PL2J2229	2200-06	PLANT MOTOR SUPPLY DIAG.
2	PL2J2223	2200-08	PLANT UTILITY DIAG.
1	PL2J2217	2201	ELECTRIC POWER ONELINE

REFERENCE DRAWINGS

ELECTRIC POWER HIGH VOLTAGE-MULTILINE DIAGRAM
Fig. 63



COMP. NO.	TYPE	RATING VOLTS	RATING CUR.	MFGR.	MOD. NO.	LOCATION	DIM.	WGT.	REMARKS
AE-AMD-01	AMMETER, D.C.			GENERAL ELECTRIC	AB-18	ELEC SKID			
AE-VMD-01	VOLTMETER, D.C.				DA-18	ELEC SKID			
AE-CB-02	CIRCUIT BRK.	250 DC	100		AKF	SERVICE BLDG			
AE-RH-01	RHEOSTAT				IL-8000	ELEC SKID			
AE-RH-02	RHEOSTAT				IL-8000				
AE-PT-01	POTENTIAL XMFR.				JE-2				
AE-CT-01	CURRENT XMFR.				JK-9				
AE-RE-01	REACTOR	200 AC	100		CLLT				
AE-PT-02	POTENTIAL XMFR.				JE-2				
AE-PT-03					JE-2				
AE-PT-04					JE-2				
AE-PT-05					JE-2				
AE-PT-06					JE-2				
AE-PT-07	POTENTIAL XMFR.				JE-2				
AE-CT-02	CURRENT XMFR.				JK-9				
AE-CT-03	CURRENT XMFR.				JK-9				
AE-CT-04	CURRENT XMFR.				JK-9				
AE-VMA-01	VOLTMETER, A.C.				AB-18				
AE-SW-01	SWITCH, ROTARY				SBM				
AE-FM-01	FREQ. METER				AB-18				
AE-AMA-01	AMMETER, A.C.				AB-18				
AE-SW-02	SWITCH, ROTARY				SBM				
AE-WHM-01	WATTHOUR METER				DS-63				
AE-WH-01	WATT METER				AB-18	ELEC SKID			
AE-CB-01	CIRCUIT BRK.	600 AC	225		HES 2-16	SERVICE BLDG	20Lx22Wx19H		
AE-SW-04	SWITCH				SBM	ELEC. SKID			
AE-IL-01	IG. LIGHT				CR-104				
AE-IL-02	IG. LIGHT				CR-104				
AE-SYN-01	SYNCHROSCOPE				AB-18				
AE-VMA-02	VOLTMETER, A.C.				AB-18				
AE-SW-03	SWITCH, ROTARY			GENERAL ELECTRIC	SBM				
AE-RC-01	RECTIFIER			SARKES TARZIAN	30 SAP				
AE-RC-02	RECTIFIER			SARKES TARZIAN	30 SAP				
AE-RC-03	RECTIFIER			SARKES TARZIAN	30 SAP				
AE-B-01	BATTERY	78 DC	60 AH	NIFE-INC	KBI-60		48Lx20Wx18H	200	
AE-B-02		78 DC	60 AH		KBI-60		48Lx20Wx18H	200	
AE-B-03		30 DC	60 AH		KBI-60		24Lx20Wx18H	100	
AE-B-04	BATTERY	30 DC	60 AH	NIFE-INC	KBI-60		24Lx20Wx18H	100	
AE-VR-01	VOLTAGE REG.	65 DC		POWER SOURCES	SR4330		15Lx19Wx13H	60	
AE-VR-02		65 DC			SR4330		15Lx19Wx13H	60	
AE-VR-03		25 DC			SR4330		15Lx19Wx13H	40	
AE-VR-04	VOLTAGE REG.	25 DC		POWER SOURCES	SR4330		15Lx19Wx13H	40	
AE-CV-01,02	DC TO AC INVERTER	65 DC		INTERELECTRONICS	DK-2		12" CUBE	45	
AE-VR-05	VOLTAGE REG., GEN.			GENERAL ELECTRIC	GD-A		7Lx7Wx25H	62	
AE-CV-03	AC TO DC CONVERTOR	480 AC	75	INTERELECTRONICS	AX-2		12" CUBE	45	
AE-CV-04	AC TO DC CONVERTOR	480 AC	75	INTERELECTRONICS	AX-2	ELEC SKID	12" CUBE	45	

SYMBOLS

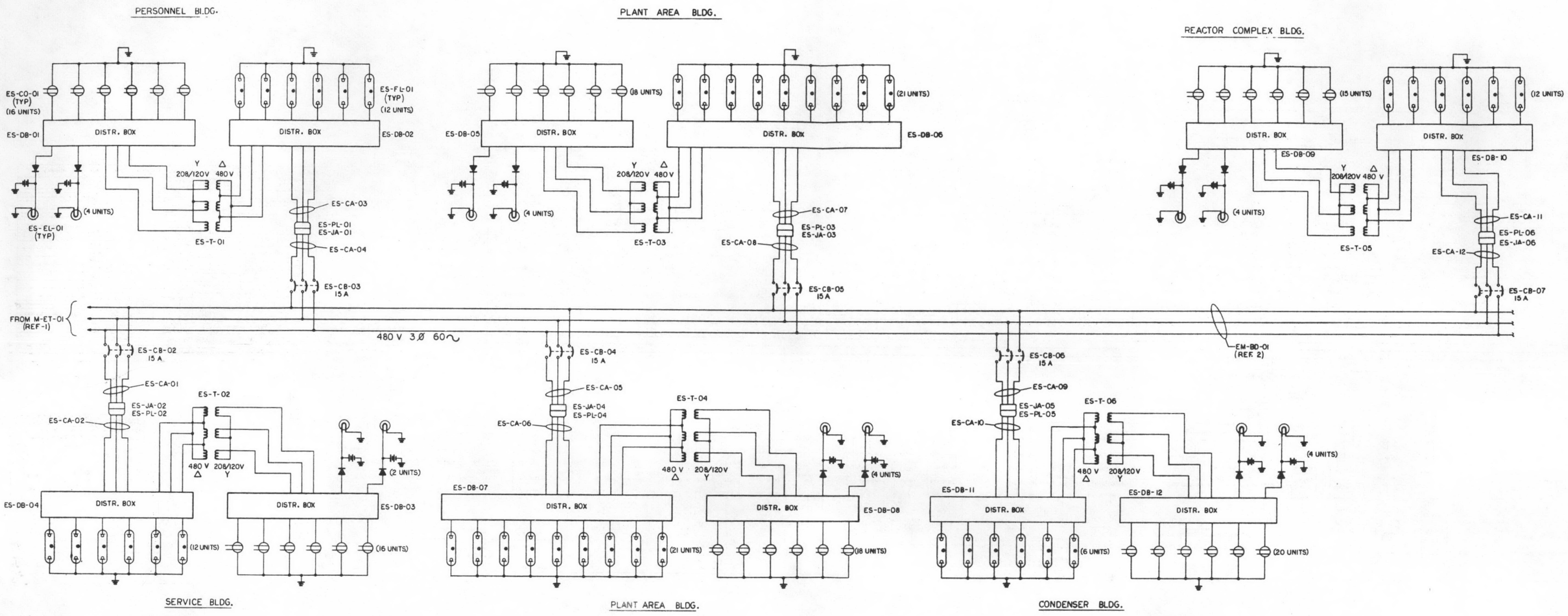
- SYNCHRONOUS GENERATOR
- EXCITER
- RHEOSTAT
- VOLTMETER, DC
- AMMETER, DC
- VOLTMETER, AC
- AMMETER, AC
- WATTMETER
- WATTHOUR METER
- FREQUENCY METER
- INDICATING LIGHT, WHITE
- SYNCHROSCOPE
- SWITCH
- VOLTAGE REGULATOR
- BATTERY
- INSTRUMENT CURRENT TRANSFORMER
- INSTRUMENT POTENTIAL TRANSFORMER
- FIELD WINDING
- INDUCTOR
- FUSE
- CAPACITOR
- RECTIFIER
- AIR CIRCUIT BREAKER
- DC TO AC CONVERTER

REF. NO.	DRAWING NO.	PROJECT NO.	TITLE
5	PL2J2229	2201-04	PLANT MOTOR SUPPLY MULTILINE
4	PL2J2126	2202	NUC. INST BLOCK DIAG.
3	PL2J2201	2100-11	MAIN STEAM SYS. PROCES INST.
2	PL2J2216	2201-01	ELEC HIGH VOLTAGE
1	PL2J2217	2201	ELEC POWER ONE LINE

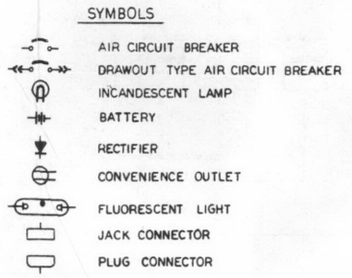
REFERENCE DRAWINGS

AUXILIARY AND EMERGENCY POWER-MULTILINE DIAGRAM

Fig. 64



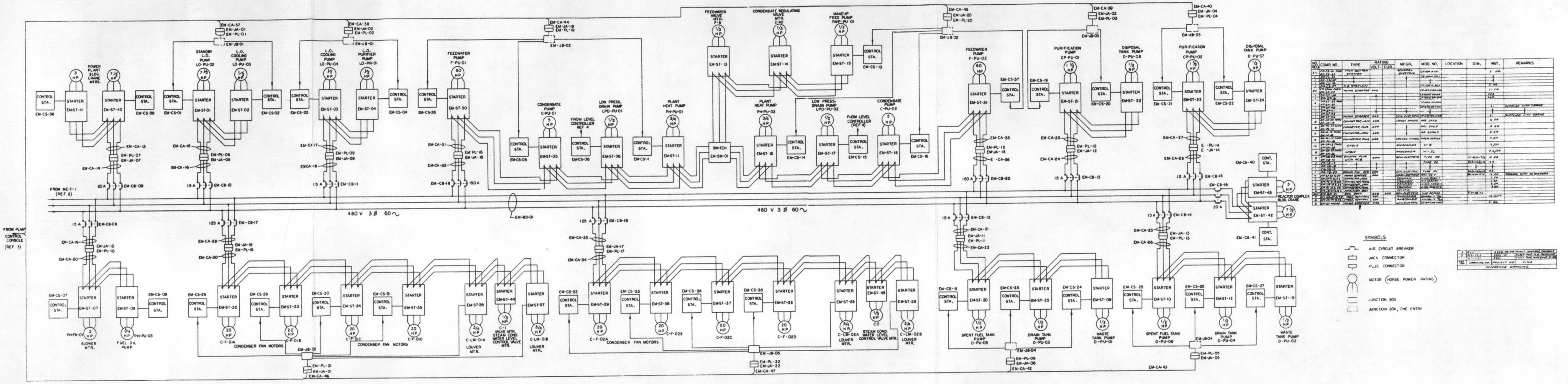
NO. REQ.	COMP. NO.	TYPE	RATING VOLT.	RATING CUR.	MFGR.	MOD. NO.	LOCATION	DIM.	WGT.	REMARKS
103	ES-CO-01	CONV. OUTLET	250	15	RESERVE					
84	ES-FL-01	FLUOR. LIGHTS	277		CISCO	GS 481				
22	ES-EL-01	EMERGENCY LIGHTS	120		NICAD	MOD. #7				
	ES-DB-01	DISTRIBUTION BOX	208/120	225	GEN. ELECT.	NAB-424L	PERS. BLDG	22¼X6½X34½	112	
	ES-DB-02		480/277			NHB-424AB	PERS. BLDG	22¼X6½X46½	167	
	ES-DB-03		208/120			NAB-424L	SERV. BLDG	22¼X6½X34½	112	
	ES-DB-04		480/277			NHB-424AB	SERV. BLDG	22¼X6½X46½	167	
	ES-DB-05		208/120			NAB-424L	P P BLDG	22¼X6½X34½	112	
	ES-DB-06		480/277			NHB-424AB	P P BLDG	22¼X6½X46½	167	
	ES-DB-07		480/277			NHB-424AB	PP BLDG	22¼X6½X46½	167	
	ES-DB-08		208/120			NAB-424L	PP BLDG	22¼X6½X34½	112	
	ES-DB-09		208/120			NAB-424L	REACTOR COMPLEX	22¼X6½X34½	112	
	ES-DB-10		480/277			NHB-424AB	REACTOR COMPLEX	22¼X6½X46½	167	
	ES-DB-11		480/277			NHB-424AB	COND. BLDG	22¼X6½X46½	167	
	ES-DB-12		208/120			NAB-424L	COND. BLDG	22¼X6½X34½	112	
	ES-T-01	TRANSFORMER	480/208	3 KVA		9T21Y6250	PERS. BLDG	19½X7X6½	77	
	ES-T-02						SERV. BLDG			
	ES-T-03						P P BLDG			
	ES-T-04						PP BLDG			
	ES-T-05						REACTOR COMPLEX			
	ES-T-06						COND. BLDG			
	ES-CA-01	CABLE, POWER	600	40	ANACONDA	G-8	SERV. BLDG		0.7#/FT	
	ES-CA-02						SERV. BLDG			
	ES-CA-03						PERS. BLDG			
	ES-CA-04						PERS. BLDG			
	ES-CA-05						P P BLDG			
	ES-CA-06						P P BLDG			
	ES-CA-07						PP BLDG			
	ES-CA-08						PP BLDG			
	ES-CA-09						COND. BLDG			
	ES-CA-10						COND. BLDG			
	ES-CA-11						REACTOR COMPLEX			
	ES-CA-12						REACTOR COMPLEX			
	ES-PL-01	CONNECTOR PLUG TYPE	600	30	CROUSE HINES	ARE3423	PERS. BLDG		3#	
	ES-PL-02						SERV. BLDG			
	ES-PL-03						P P BLDG			
	ES-PL-04						P P BLDG			
	ES-PL-05						COND. BLDG			
	ES-PL-06						REACTOR COMPLEX			
	ES-JA-01	CONNECTOR JACK TYPE				ARJ3463	PERS. BLDG		2#	
	ES-JA-02						SERV. BLDG			
	ES-JA-03						PP BLDG			
	ES-JA-04						PP BLDG			
	ES-JA-05						COND. BLDG			
	ES-JA-06						REACTOR COMPLEX			
	ES-CB-02	AIR CIRCUIT BREAKERS	600	15	GEN. ELECT	PE	SERV. BLDG	10"X7"X6"	19#	BUSWAY PLUG IN UNITS
	ES-CB-03						PERS. BLDG			
	ES-CB-04						P P BLDG			
	ES-CB-05						P P BLDG			
	ES-CB-06						COND. BLDG			
	ES-CB-07						REACTOR COMPLEX			



REF. NO.	DRAWING NO.	PROJECT NO.	TITLE
2	PL2J2229	2201-04	PLANT MOTOR SUPPLY MULTILINE DIAGRAM
1	PL2J2217	2201	ELECTRIC POWER ONE LINE

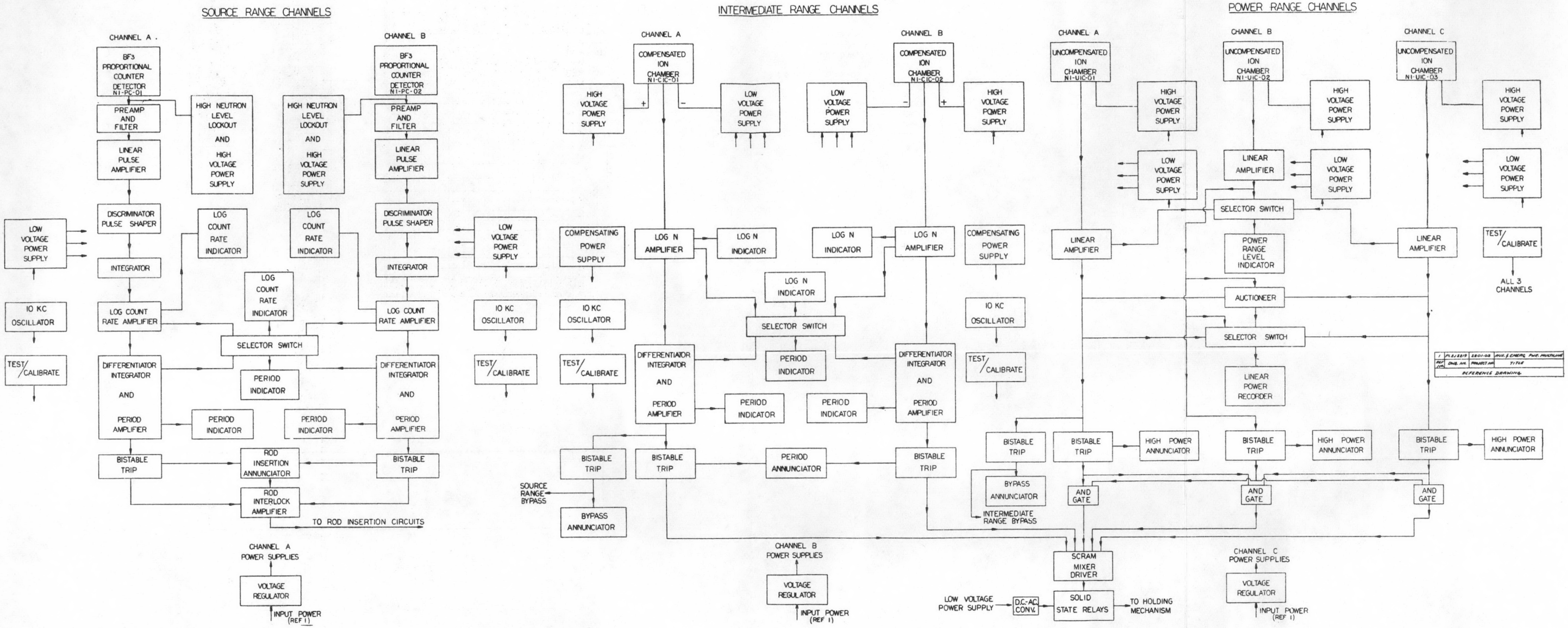
REFERENCE DRAWINGS

PLANT UTILITY ELECTRIC POWER LOW VOLTAGE–MULTILINE DIAGRAM
Fig. 65



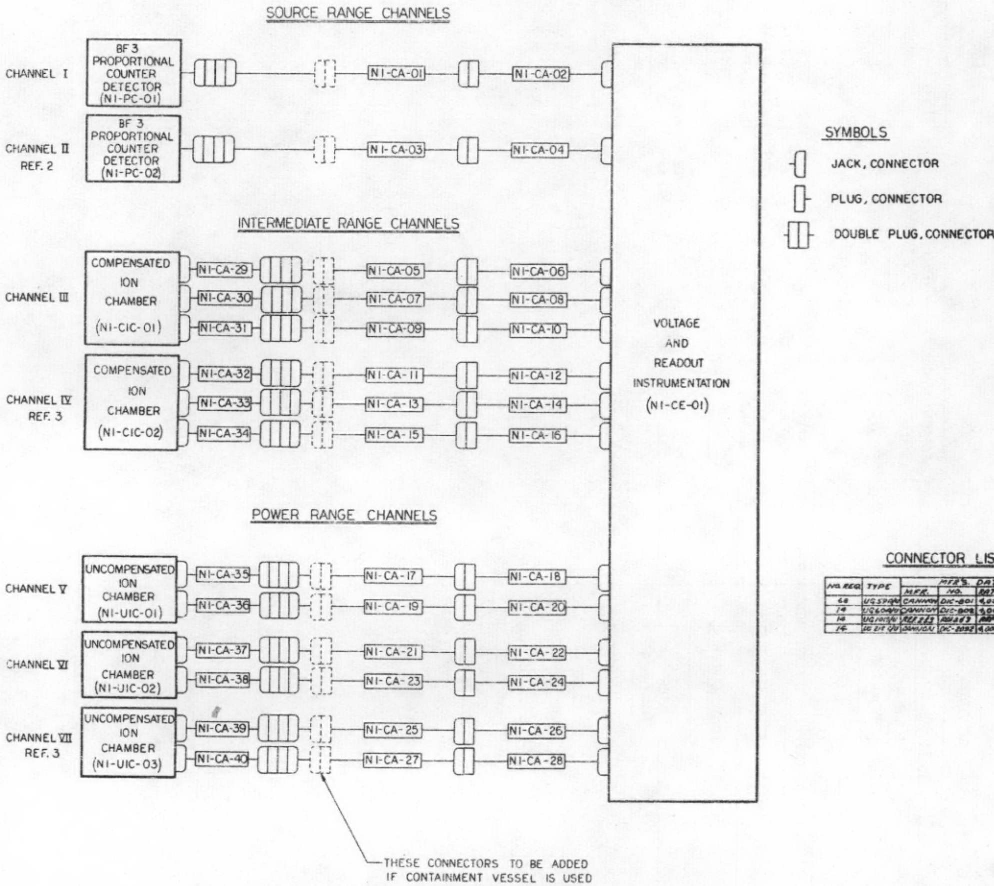
PLANT MOTOR SUPPLY ELECTRIC POWER LOW VOLTAGE-MULTILINE DIAGRAM

Fig. 66



NUCLEAR INSTRUMENTATION BLOCK DIAGRAM

Fig. 67



CABLE LIST

CABLE			MFR'S. DATE				CONDUCTOR		TERMINATION		LOCATION
NO.	SIZE	LENGTH	TYPE	NO.	RATING	INSULATION	NO.	SIZE			
NI-CA-01	0.405"D		RG 149/U	21-467	5,000 V	P -55°C TO +85°C	1	7/26 TC	UG 59 A/U	UG 59 A/U	
NI-CA-02									UG 60 A/U		ELECTRICAL SKID
NI-CA-03									UG 59 A/U		
NI-CA-04									UG 60 A/U		ELECTRICAL SKID
NI-CA-05									UG 59 A/U		
NI-CA-06									UG 60 A/U		ELECTRICAL SKID
NI-CA-07									UG 59 A/U		
NI-CA-08									UG 60 A/U		ELECTRICAL SKID
NI-CA-09									UG 59 A/U		
NI-CA-10									UG 60 A/U		ELECTRICAL SKID
NI-CA-11									UG 59 A/U		
NI-CA-12									UG 60 A/U		ELECTRICAL SKID
NI-CA-13									UG 59 A/U		
NI-CA-14									UG 60 A/U		ELECTRICAL SKID
NI-CA-15									UG 59 A/U		
NI-CA-16									UG 60 A/U		ELECTRICAL SKID
NI-CA-17									UG 59 A/U		
NI-CA-18									UG 60 A/U		ELECTRICAL SKID
NI-CA-19									UG 59 A/U		
NI-CA-20									UG 60 A/U		ELECTRICAL SKID
NI-CA-21									UG 59 A/U		
NI-CA-22									UG 60 A/U		ELECTRICAL SKID
NI-CA-23									UG 59 A/U		
NI-CA-24									UG 60 A/U		ELECTRICAL SKID
NI-CA-25									UG 59 A/U		
NI-CA-26									UG 60 A/U		ELECTRICAL SKID
NI-CA-27									UG 59 A/U		
NI-CA-28									UG 60 A/U		ELECTRICAL SKID
NI-CA-29									UG 59 A/U		REACTOR COMPLEX
NI-CA-30											
NI-CA-31											
NI-CA-32											
NI-CA-33											
NI-CA-34											
NI-CA-35											
NI-CA-36											
NI-CA-37											
NI-CA-38											
NI-CA-39											
NI-CA-40	0.405"D		RG 149/U	21-467	5,000 V	P -55°C TO +85°C	1	7/26 TC	UG 59 A/U	UG 59 A/U	REACTOR COMPLEX

CONNECTOR LIST

NO. REQ.	TYPE	MFR'S. DATA				NO. PINS
		MFR.	NO.	RATING	INSULATION	
68	UG 59 A/U	CANNON	DIC-801	4,000 V	REXOLITE	1
14	UG 60 A/U	CANNON	DIC-802	4,000 V	REXOLITE	1
14	UG 1013/U	REF 2&3	REF 2&3	REF 2&3	REF 2&3	REF 2&3
14	UG 217 C/U	CANNON	DIC-2092	4,000 V	REXOLITE	1

COMPONENT LIST

COMPONENT NO.	MFR'S. DATA							LOCATION
	MODEL	LENGTH	DIA.	NET WGT LBS.	INPUT	TEMP.	POWER REQ.	
NI-PC-01	WL-7087	39 1/2"	5 1/8"	26 3/4	[illegible]	175°F		
NI-PC-02	WL-7087	39 1/2"	5 1/8"	26 3/4	[illegible]	175°F		
NI-CIC-01	WL-6377	24"	3 1/16"	5 3/8	[illegible]	175°F		
NI-CIC-02	WL-6377	24"	3 1/16"	5 3/8	[illegible]	175°F		
NI-UIC-01	WL-6937	13 7/8"	3 1/16"	2 1/2	[illegible]	175°F		
NI-UIC-02	WL-6937	13 7/8"	3 1/16"	2 1/2	[illegible]	175°F		
NI-UIC-03	WL-6937	13 7/8"	3 1/16"	2 1/2	[illegible]	175°F		
NI-CE-01	TLS-160000	70"Hx22"W		600			800 W	ELEC. SKID

REF. NO.	DRAWING NO.	PROJECT NO.	TITLE
3	J2151	23-01-05-05	NUCLEAR INSTRUMENTATION WELL
2	J2150	2301-05-01	NUCLEAR INSTRUMENTATION WELL
1	J2125	2202	NUCLEAR INSTRUMENTATION BLOCK DIAGRAM

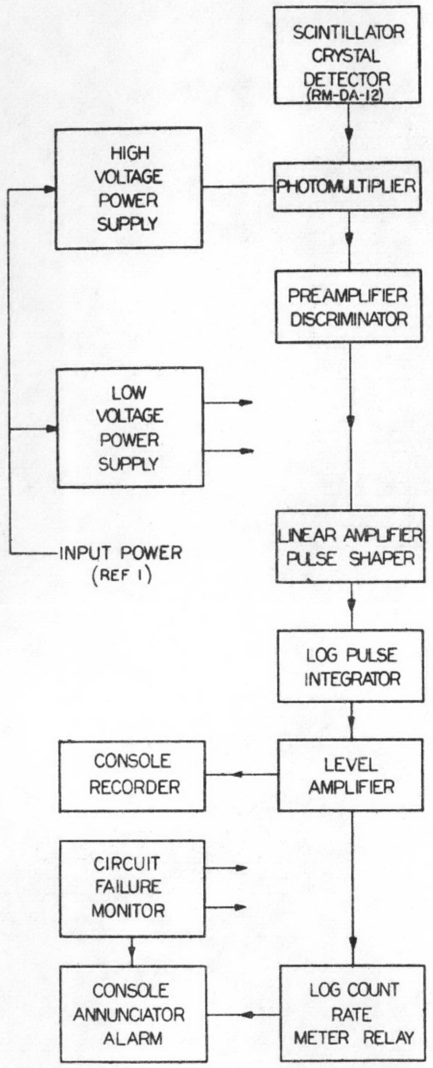
REFERENCE DRAWINGS

NUCLEAR INSTRUMENTATION CONDUIT AND CABLE

Fig. 68

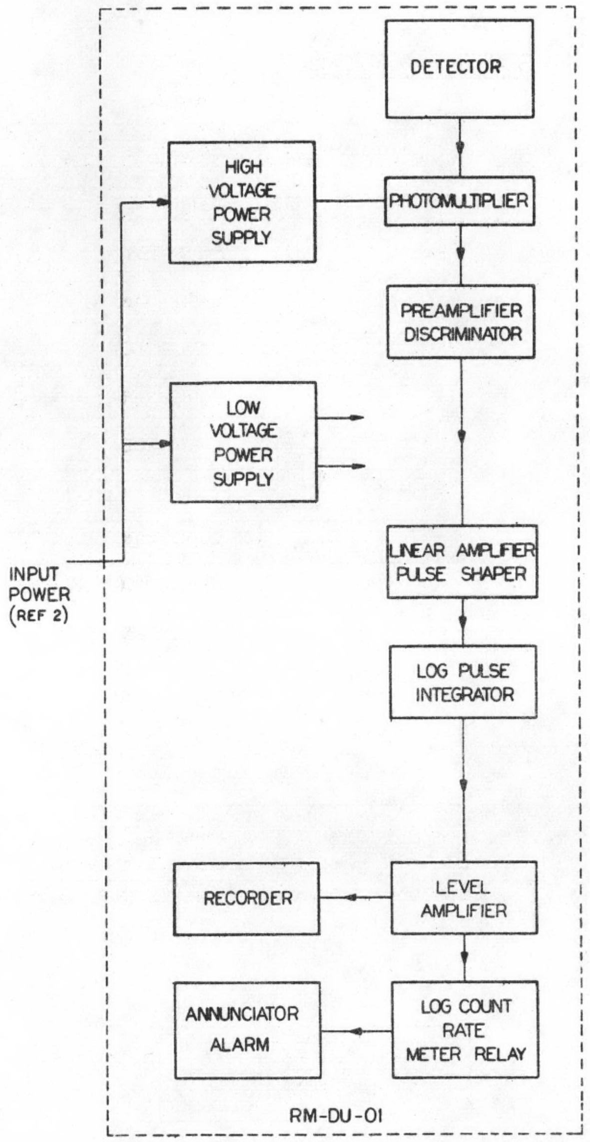
RADIOACTIVE GAS DETECTOR

AFTER CONDENSER VENT LINE



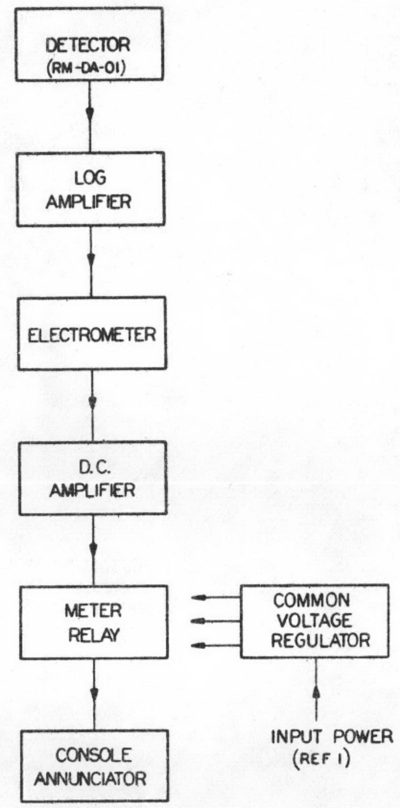
AIR PARTICLE DETECTOR

(PORTABLE UNIT)



STATION MONITORS

TYPICAL CHANNEL



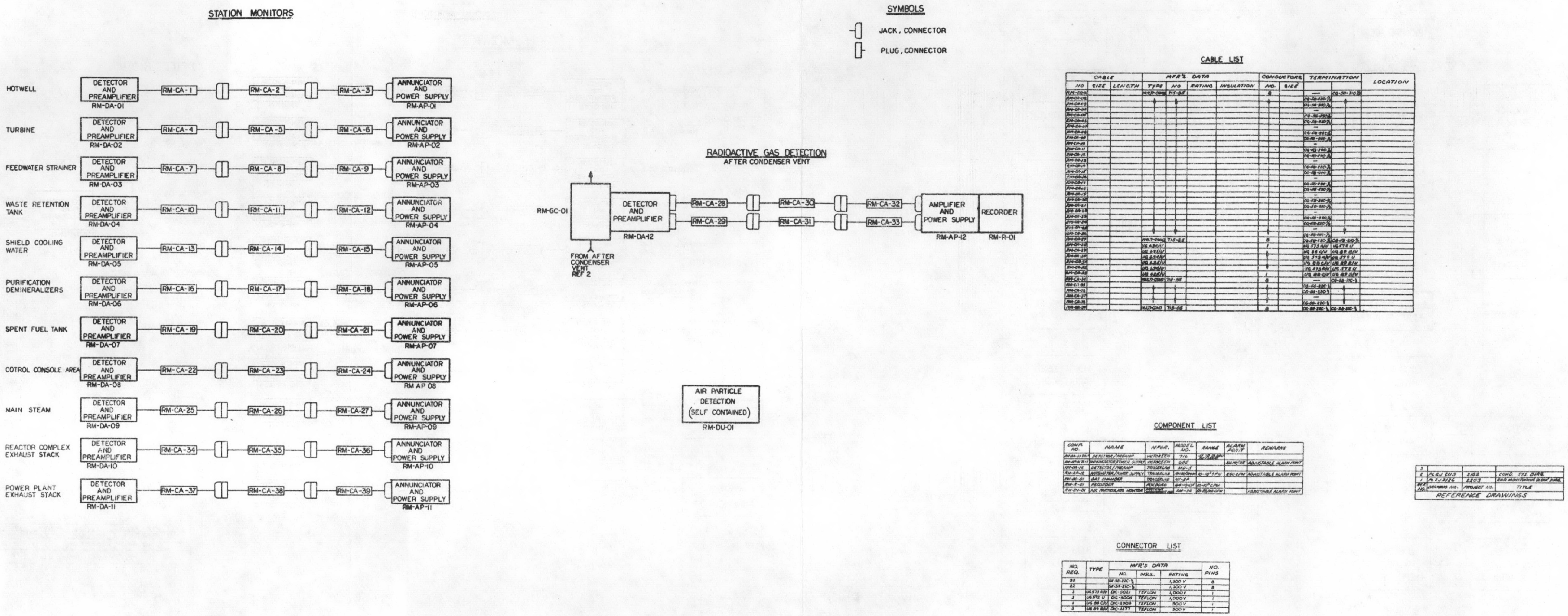
STATIONS	DETECTOR NO.
HOTWELL	RM-DA-01
TURBINE	RM-DA-02
FEEDWATER STRAINER	RM-DA-03
WASTE TANK	RM-DA-04
SHIELD COOLING WATER	RM-DA-05
PURIFICATION DEMINERALIZERS	RM-DA-06
SPENT FUEL TANK	RM-DA-07
CONTROL CONSOLE AREA	RM-DA-08
MAIN STEAM	RM-DA-09
REACTOR COMPLEX EXHAUST STACK	RM-DA-10
POWER PLANT EXHAUST STACK	RM-DA-11

REF NO.	DWG. NO.	PROJECT NO.	TITLE
2	PE2J 2223	2201-02	PLANT UTILITY MULTILINE
1	PE2J 2219	2201-02	AUX. & EMERG. POWER MULTILINE

REFERENCE DRAWING.

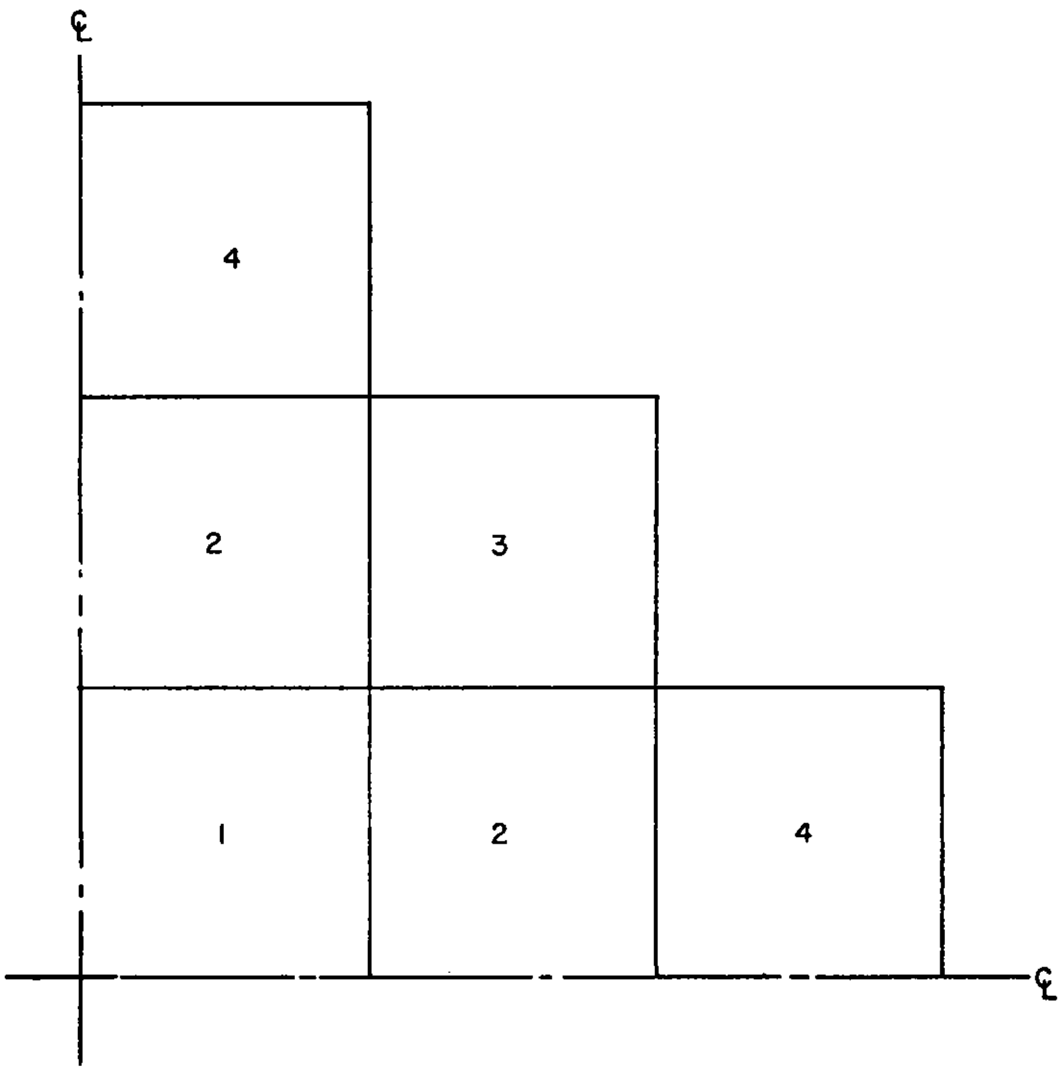
RADIATION MONITORING BLOCK DIAGRAM

Fig. 69



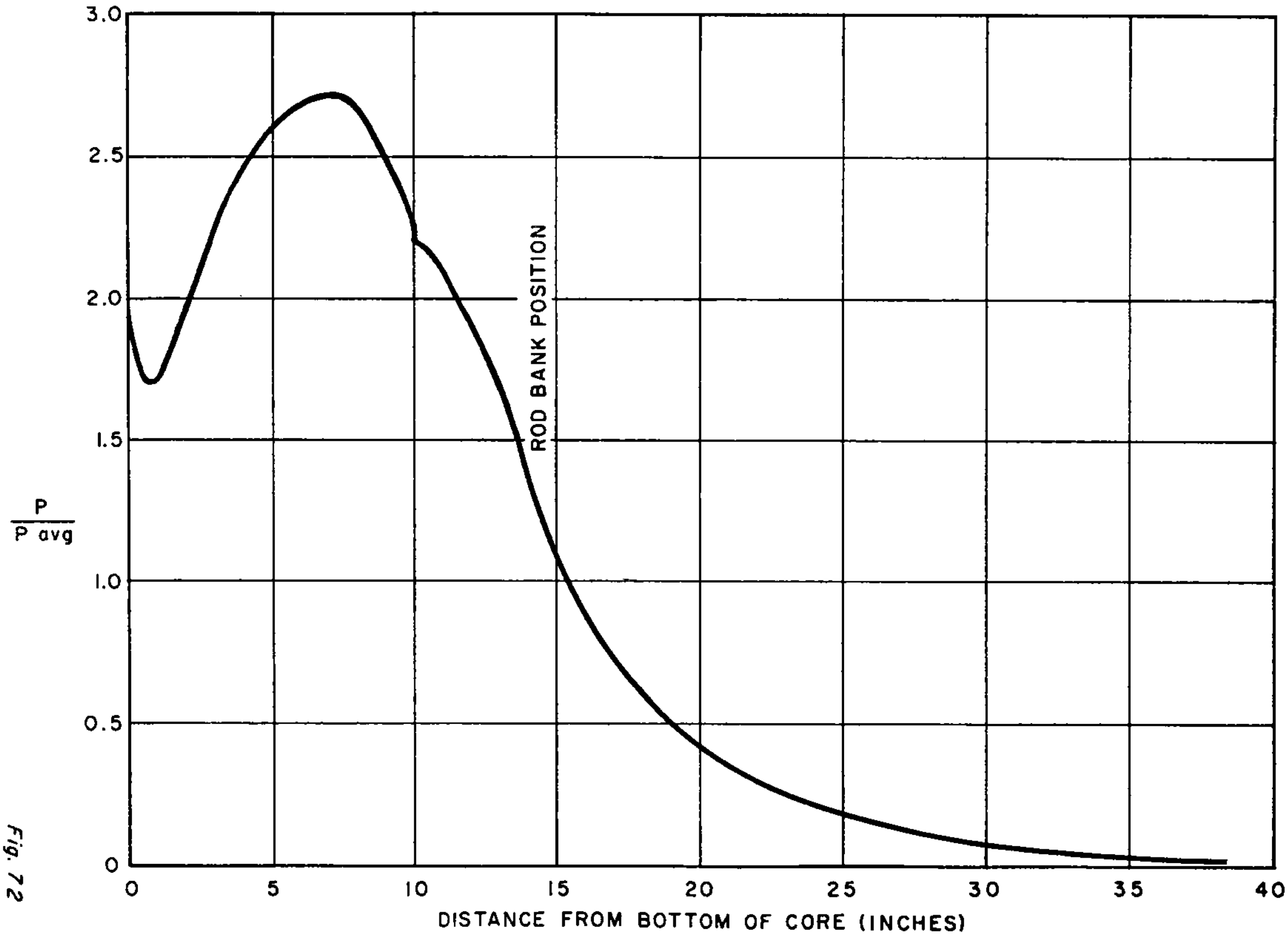
RADIATION MONITORING
CONDUIT AND CABLE
Fig. 70

ASSEMBLY No.	F' (R)
1	1.471
2	1.176
3	0.856
4	0.660



CORE QUARTER CROSS SECTION SHOWING ASSEMBLY NUMBERING SYSTEM AND RADIAL POWER PEAKING FACTOR (F' (R))

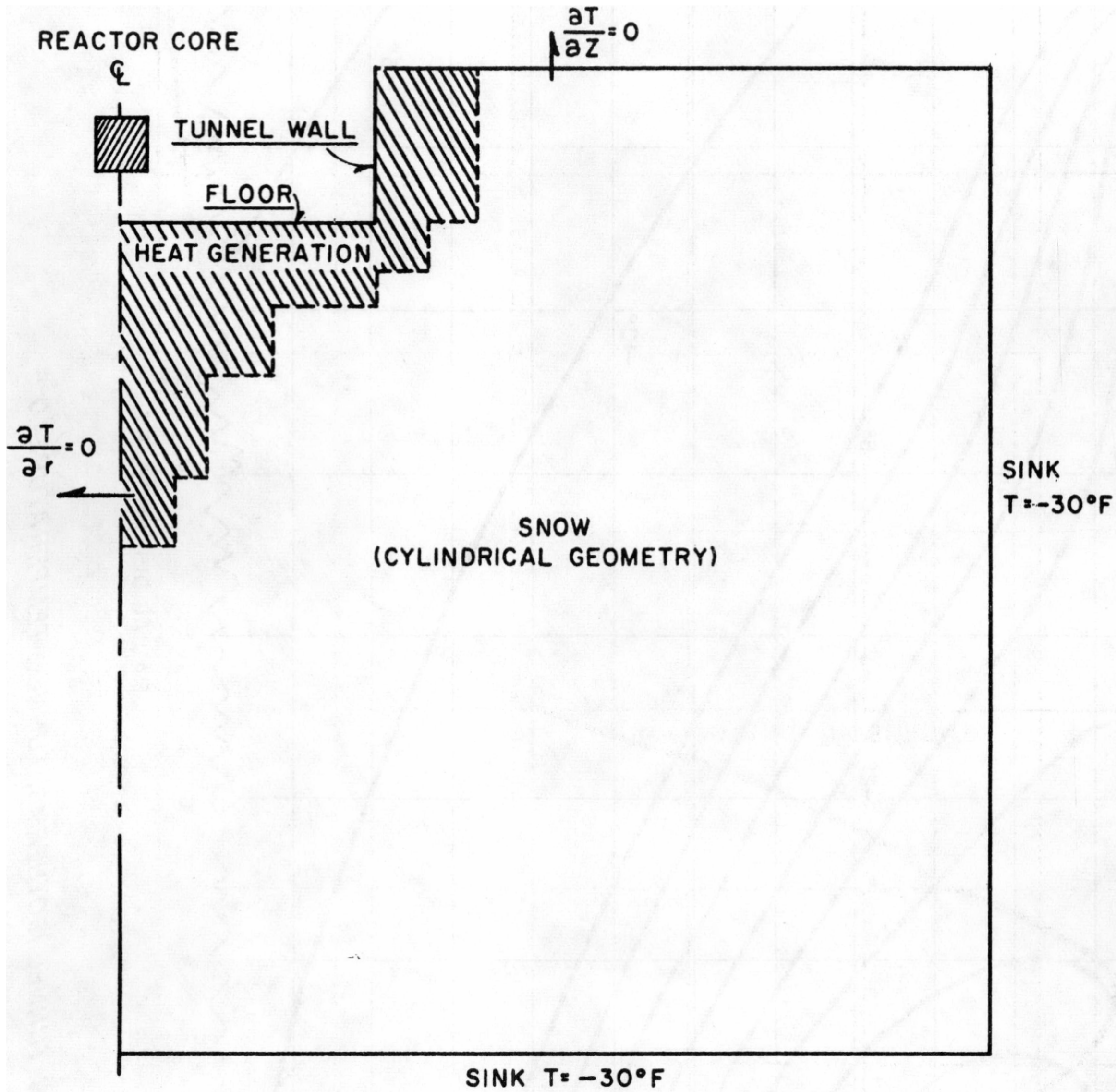
Fig. 71



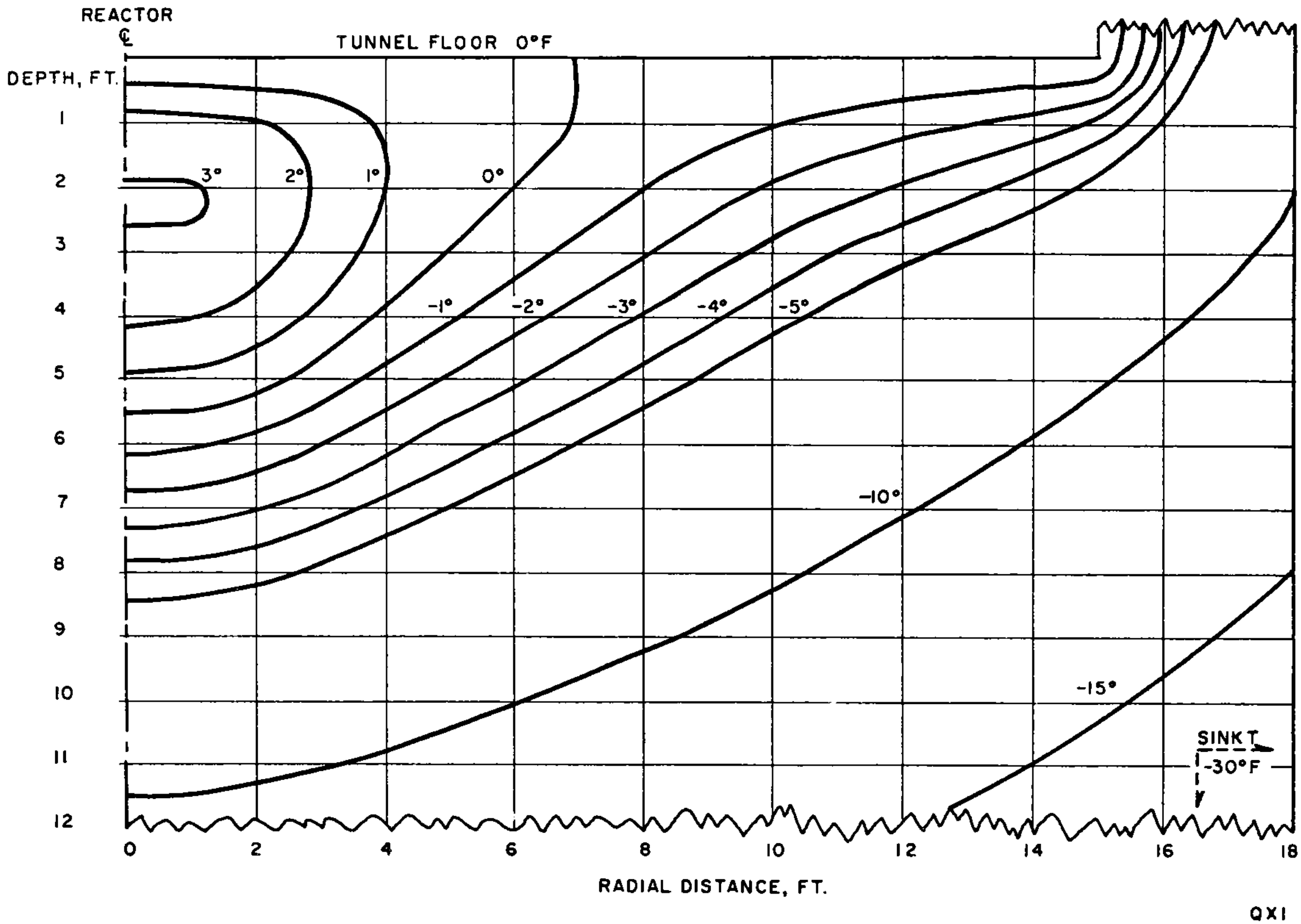
PL-2-AXIAL POWER DISTRIBUTION

Fig. 72

Fig. 72



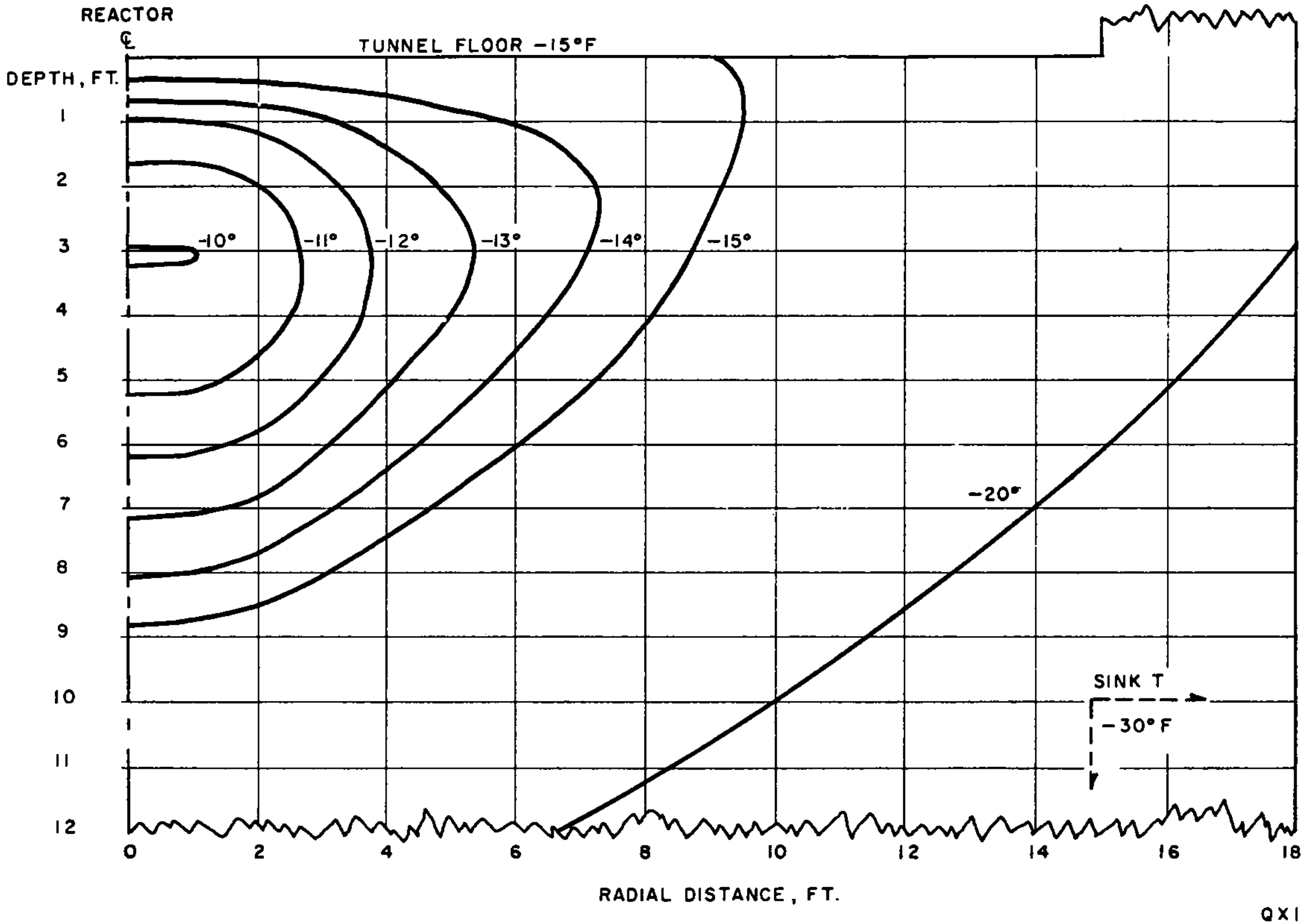
SNOW TUNNEL ISOTHERM CALCULATION MODEL
Fig. 73



SNOW TUNNEL ISOTHERMS, TUNNEL TEMPERATURE 0°F

Fig. 74

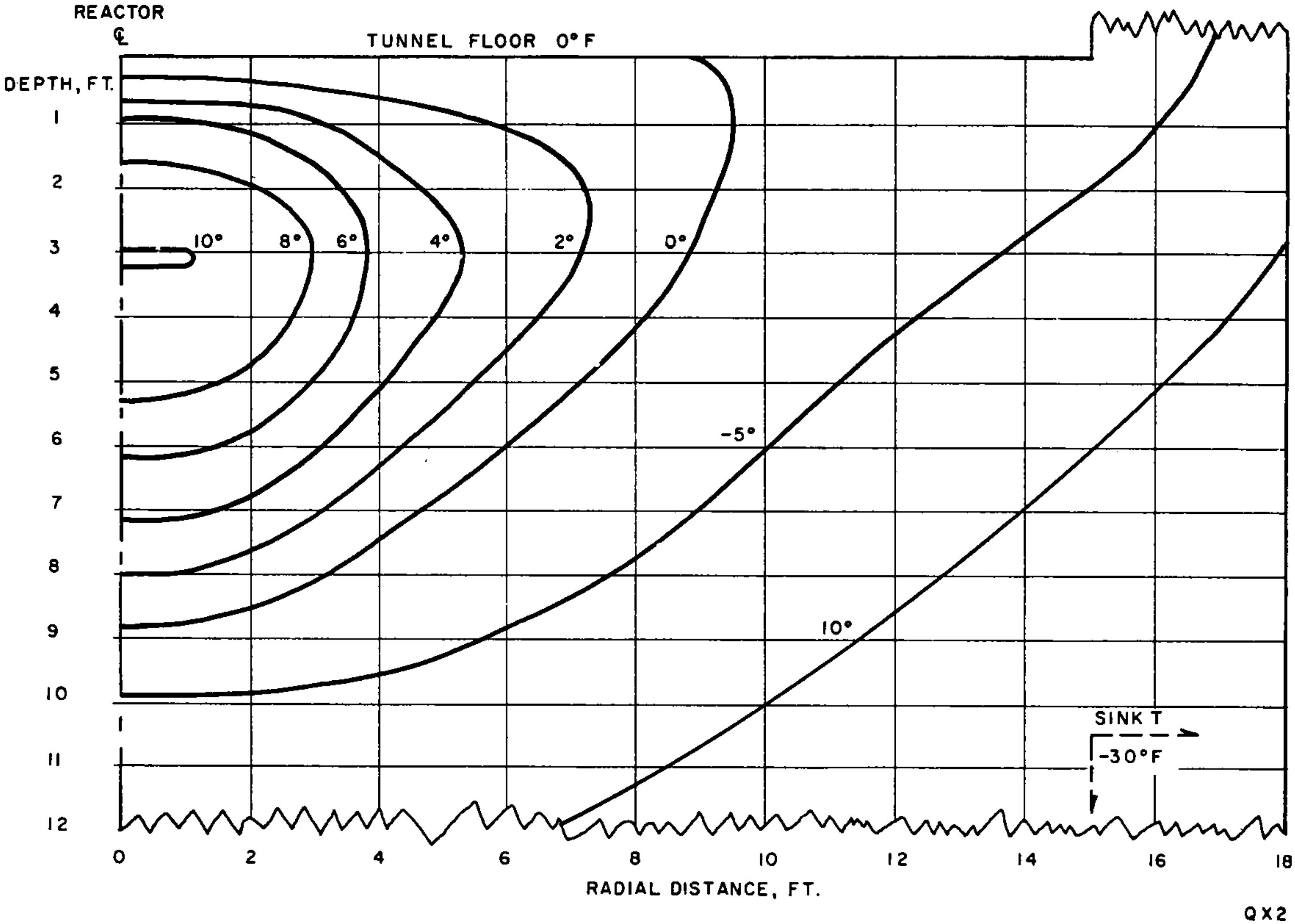
Fig. 74



SNOW TUNNEL ISOTHERMS, TUNNEL TEMPERATURE −15°F

Fig. 75

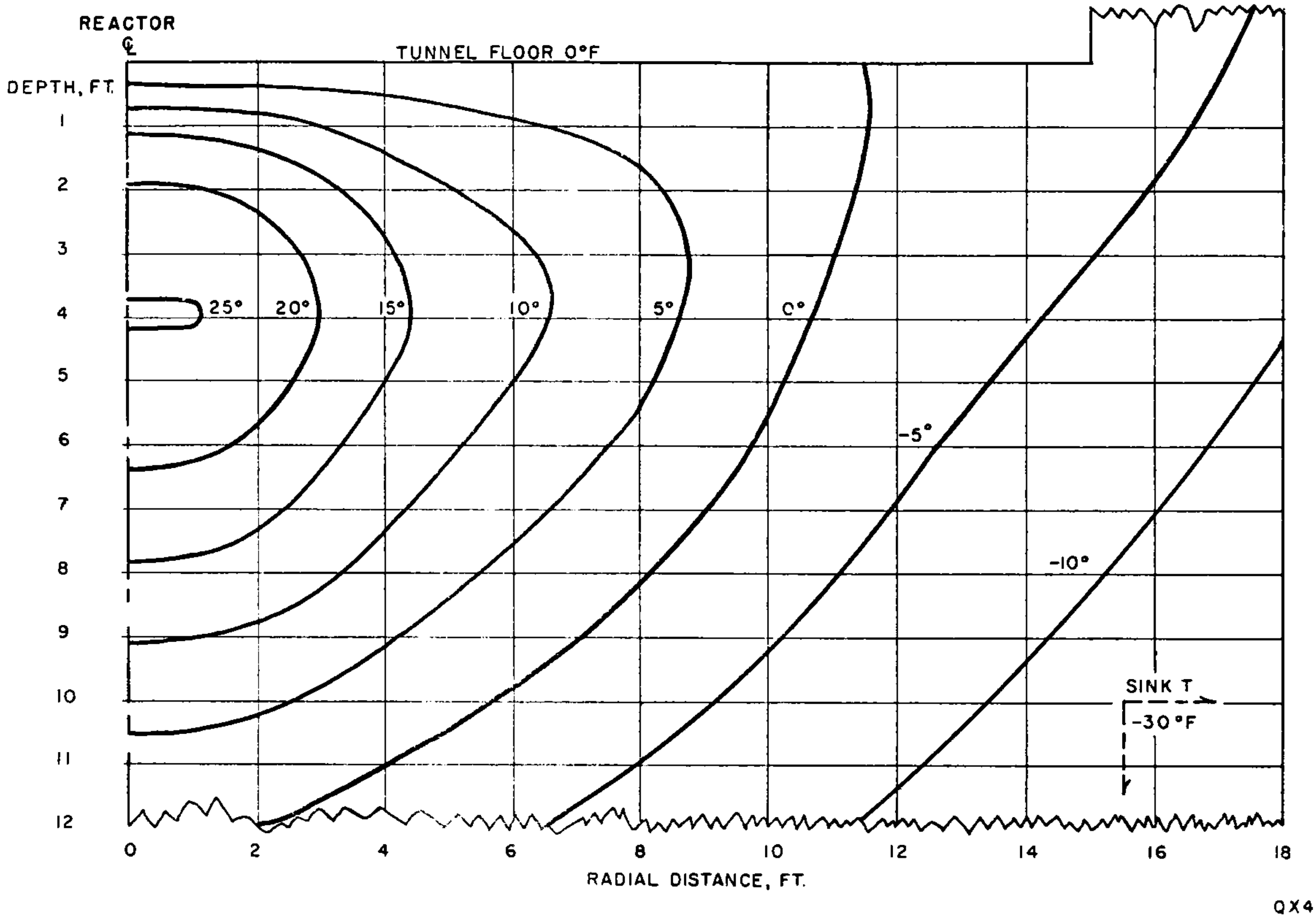
Fig. 75



SNOW TUNNEL ISOTHERMS, TUNNEL TEMPERATURE 0°F, HEAT GENERATION X2

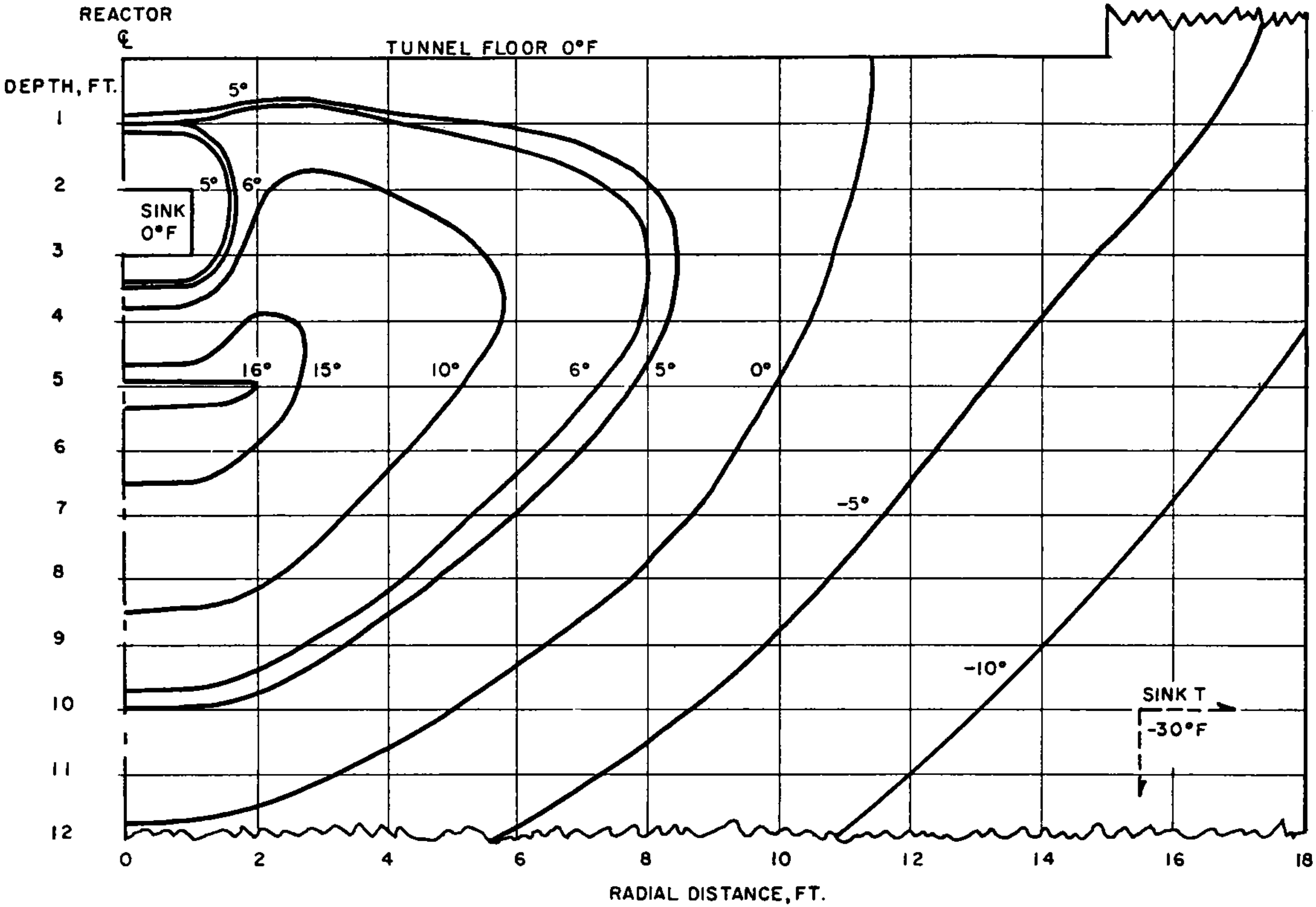
Fig. 76

Fig. 76



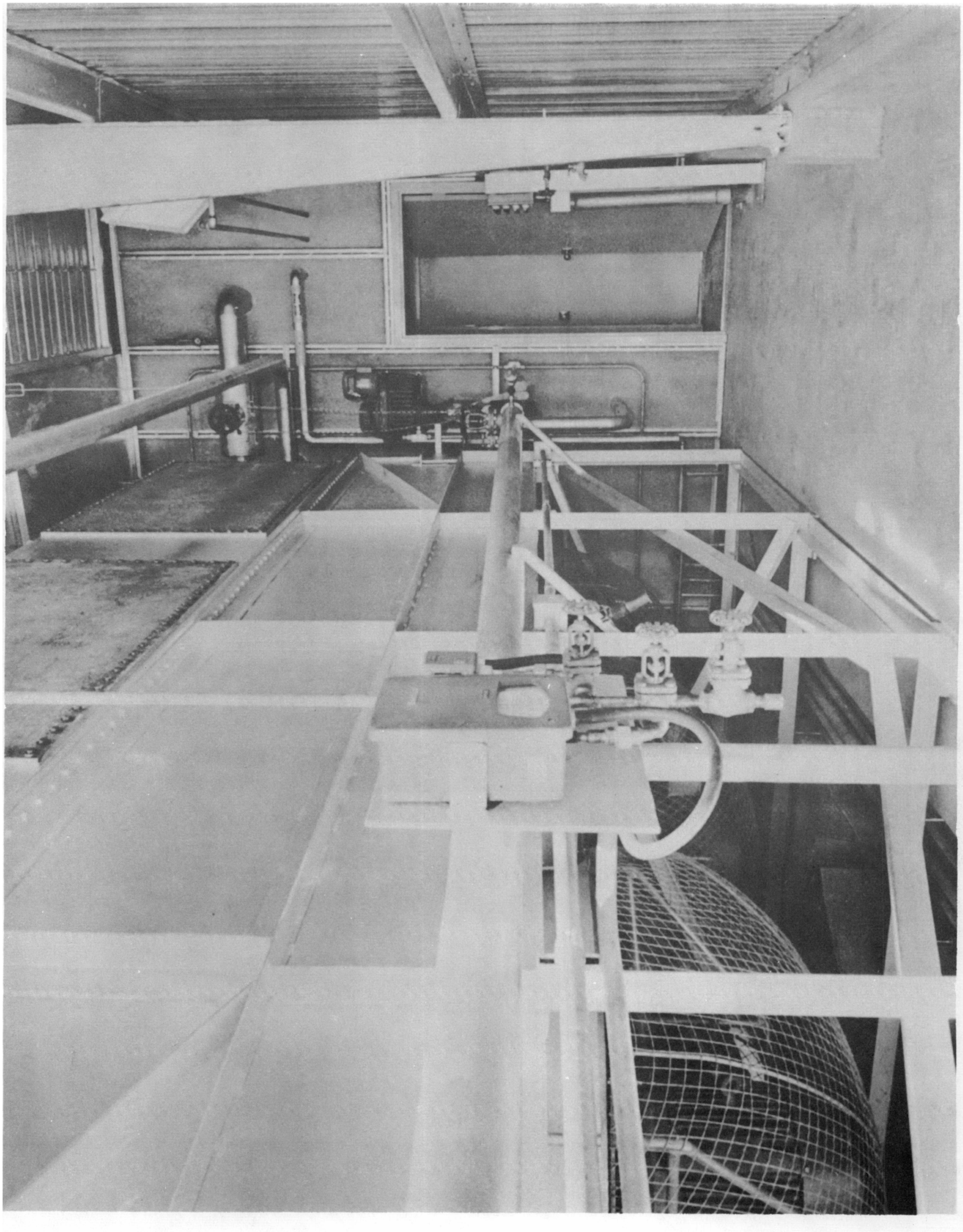
SNOW TUNNEL ISOTHERMS, TUNNEL TEMPERATURE 0°F, HEAT GENERATOR X 4
Fig. 77

Fig. 77



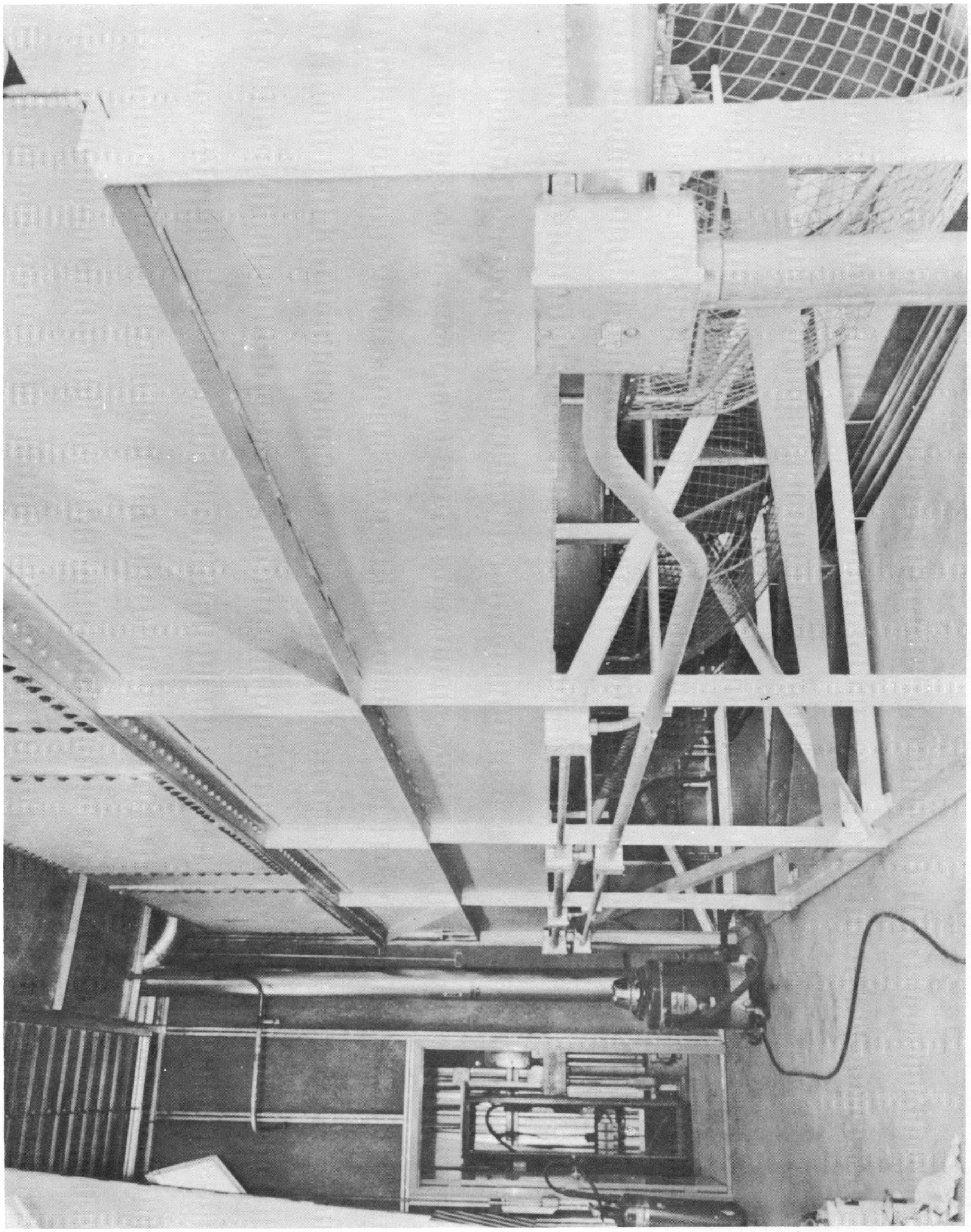
SNOW TUNNEL ISOTHERMS, TUNNEL TEMPERATURE 0°F, HEAT GENERATION X 4, WITH HEAT SINK

Fig. 78



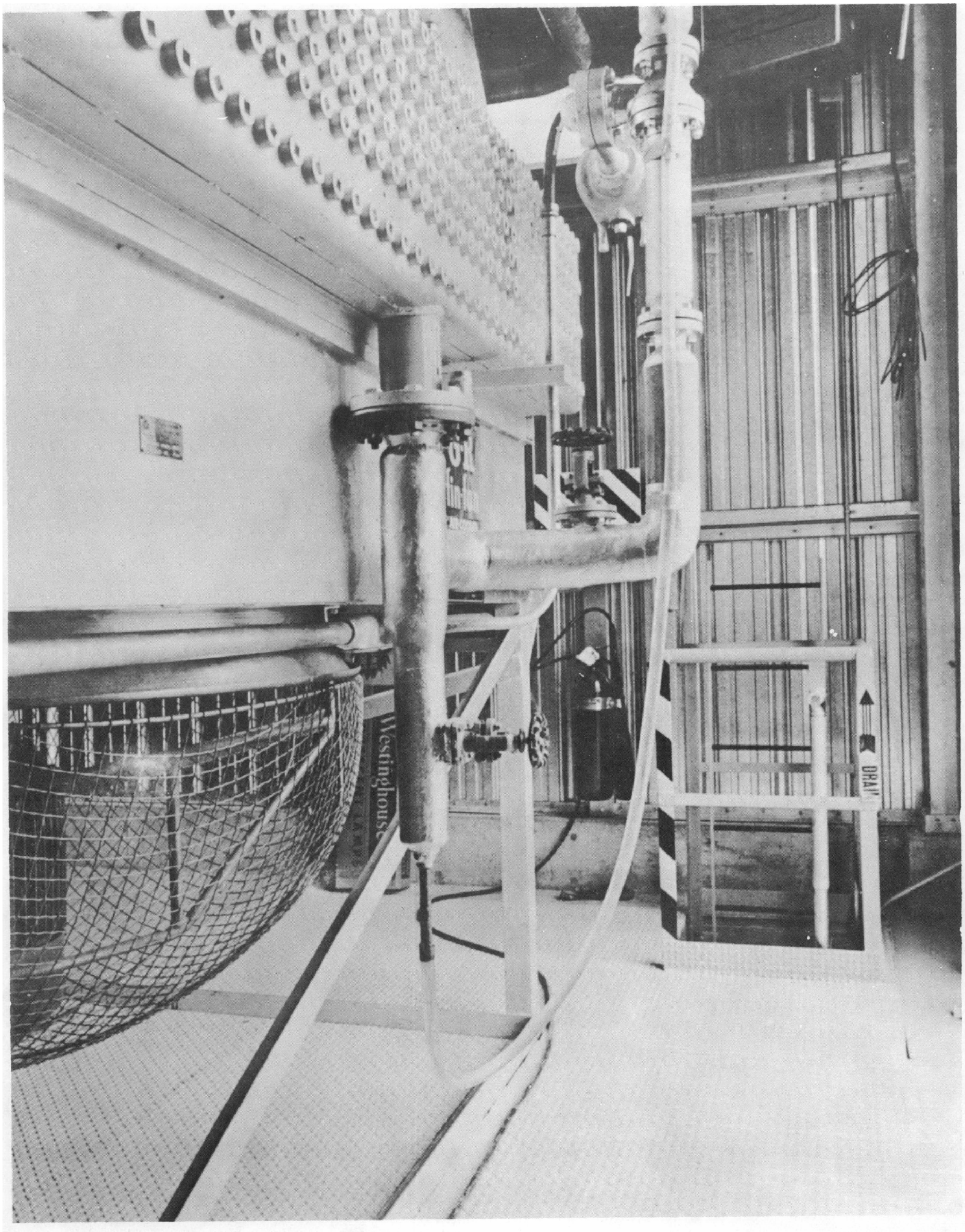
SL-1 INSTALLATION OF PL TYPE AIR-COOLED CONDENSER

Fig. 79



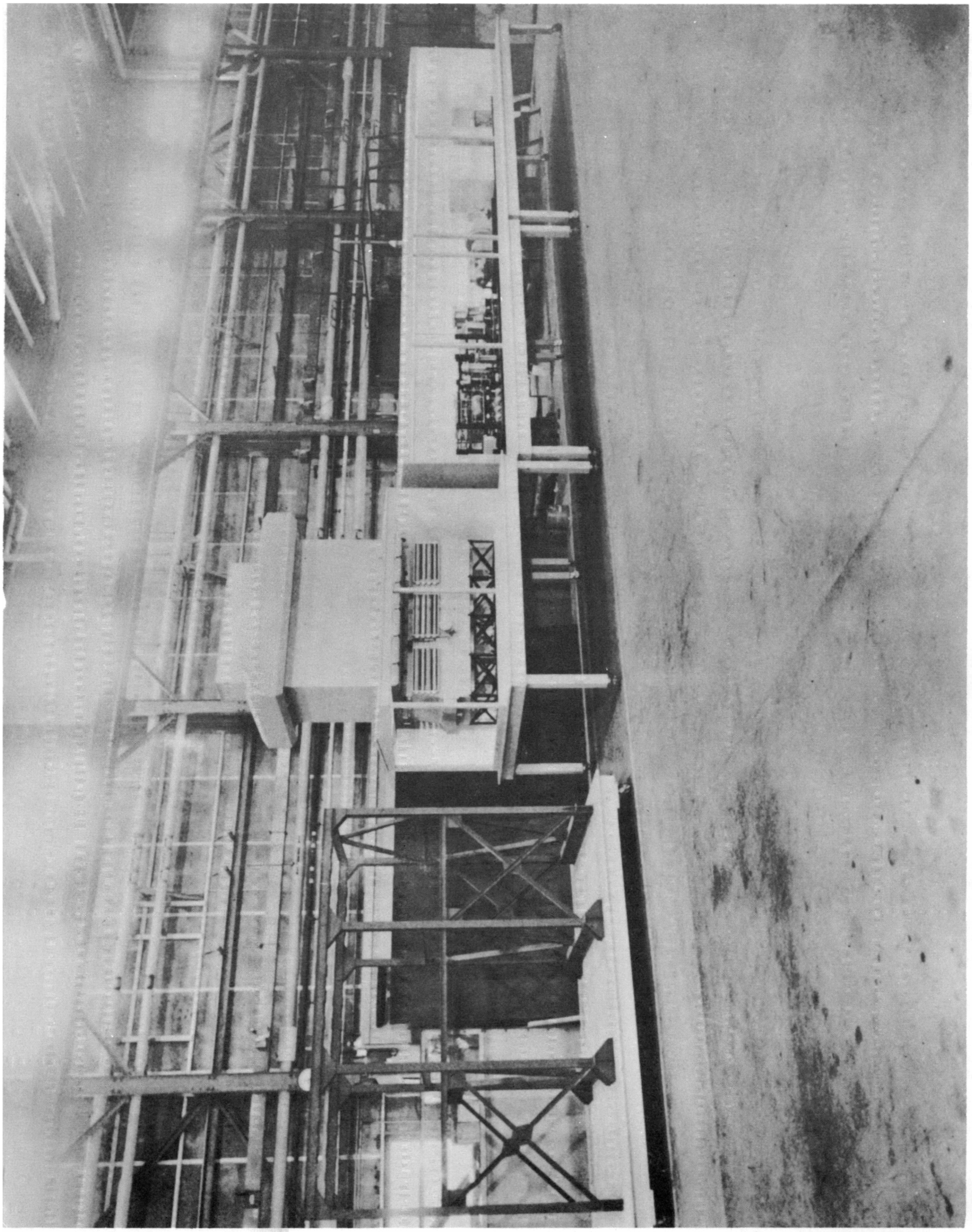
SL-1 INSTALLATION OF PL TYPE AIR-COOLED CONDENSER

Fig. 80

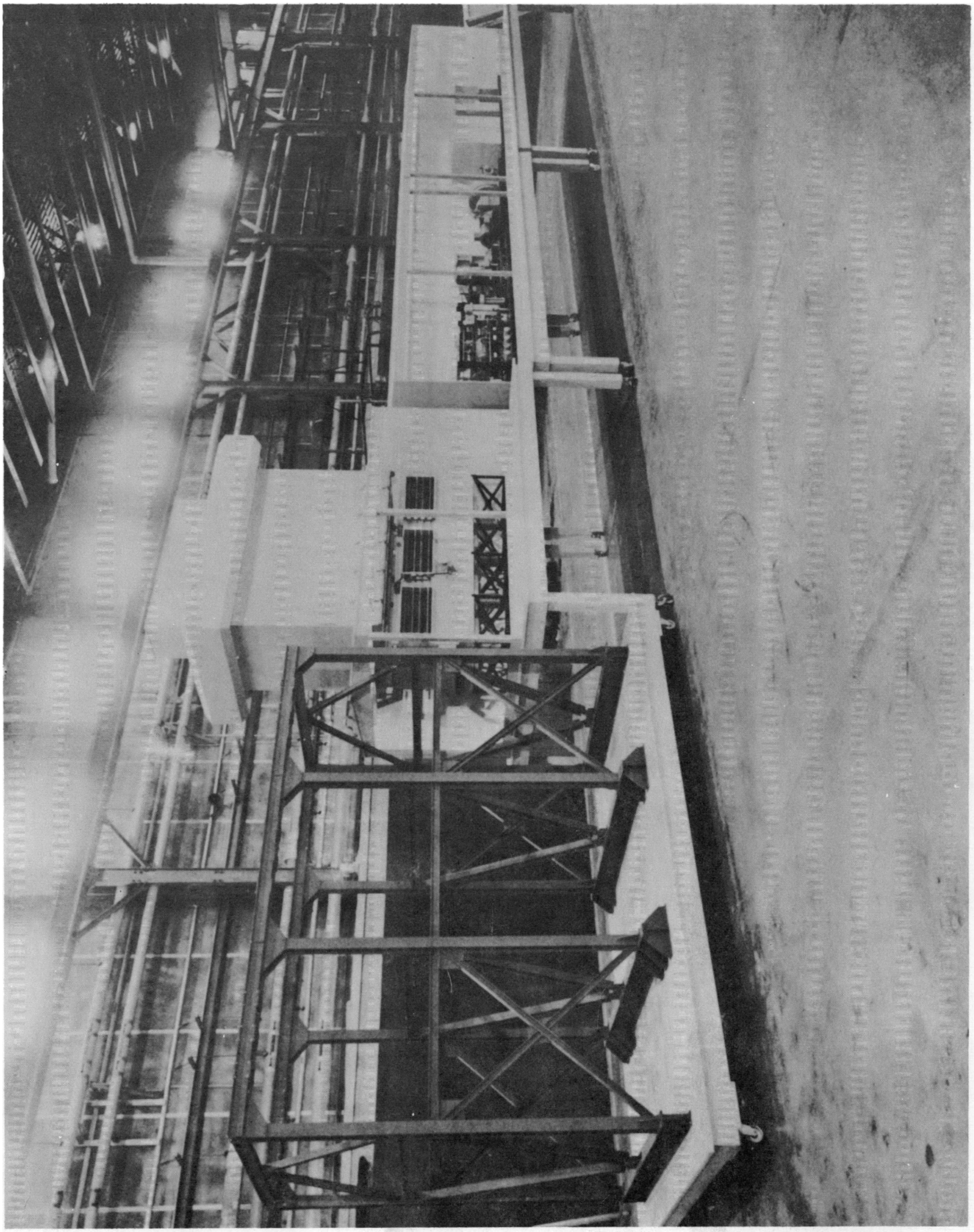


SL-1 INSTALLATION OF PL TYPE AIR-COOLED CONDENSER

Fig. 81

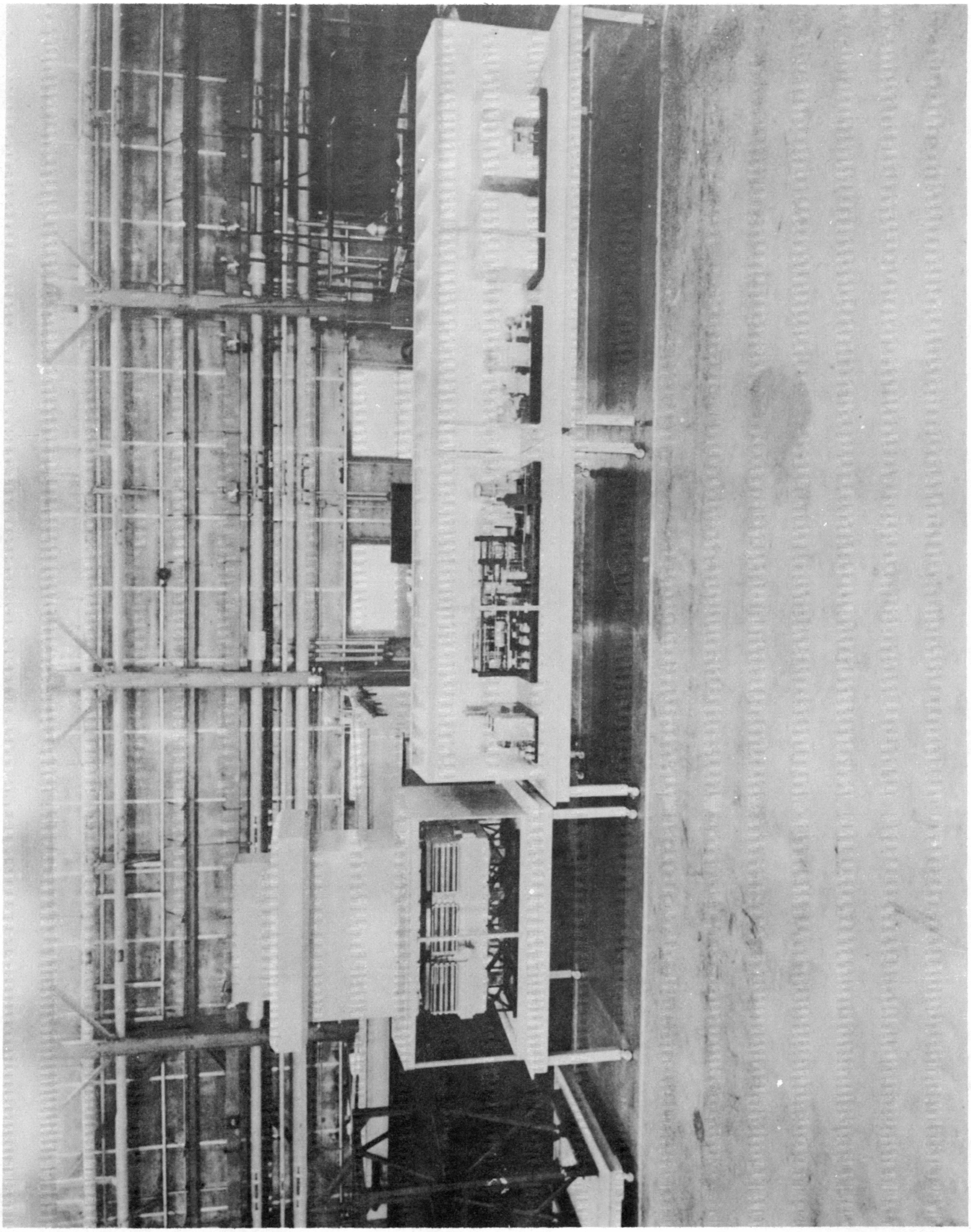


PL-2 1/4 SCALE MOCKUP
Fig. 82

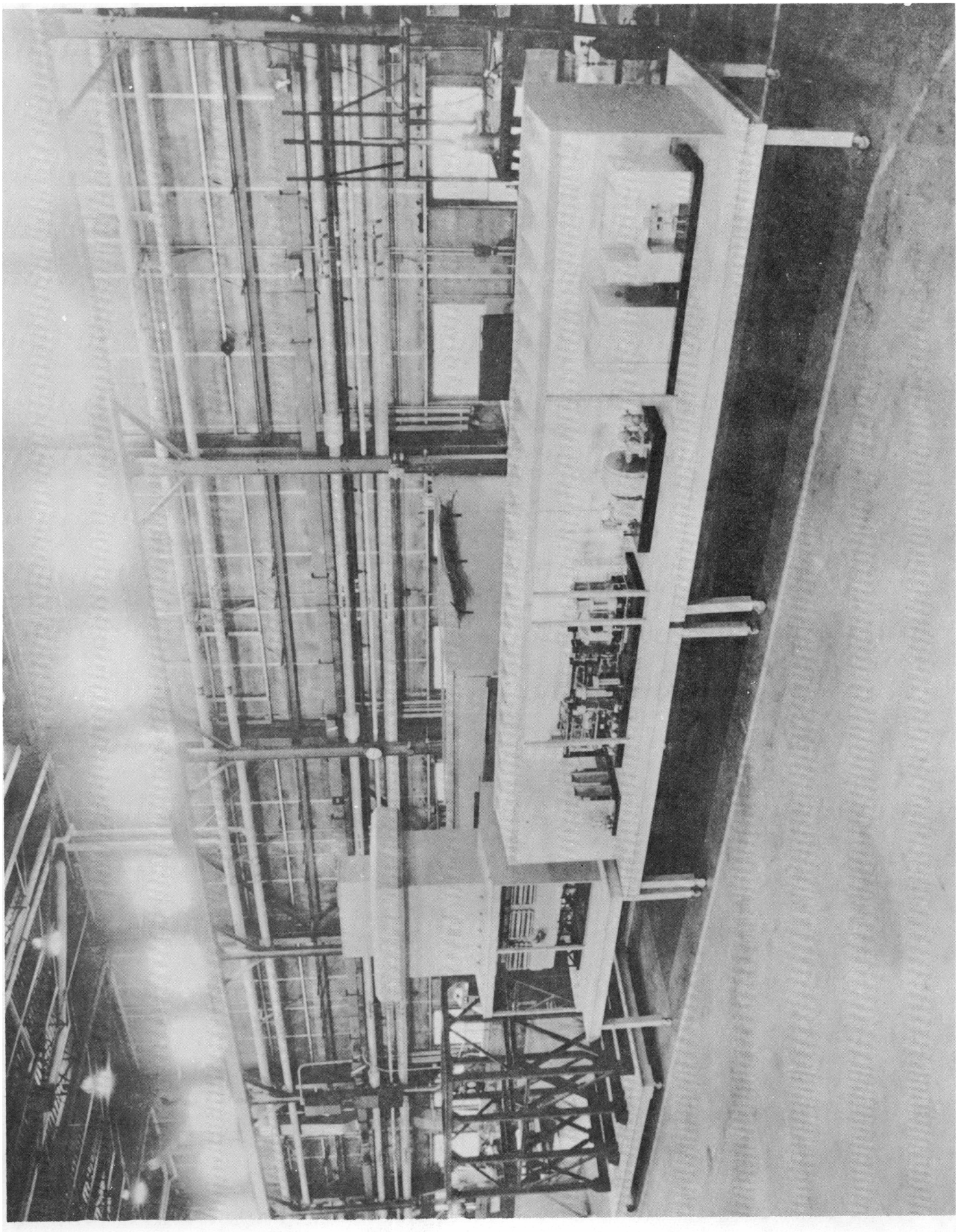


PL-2 1/4 SCALE MOCKUP

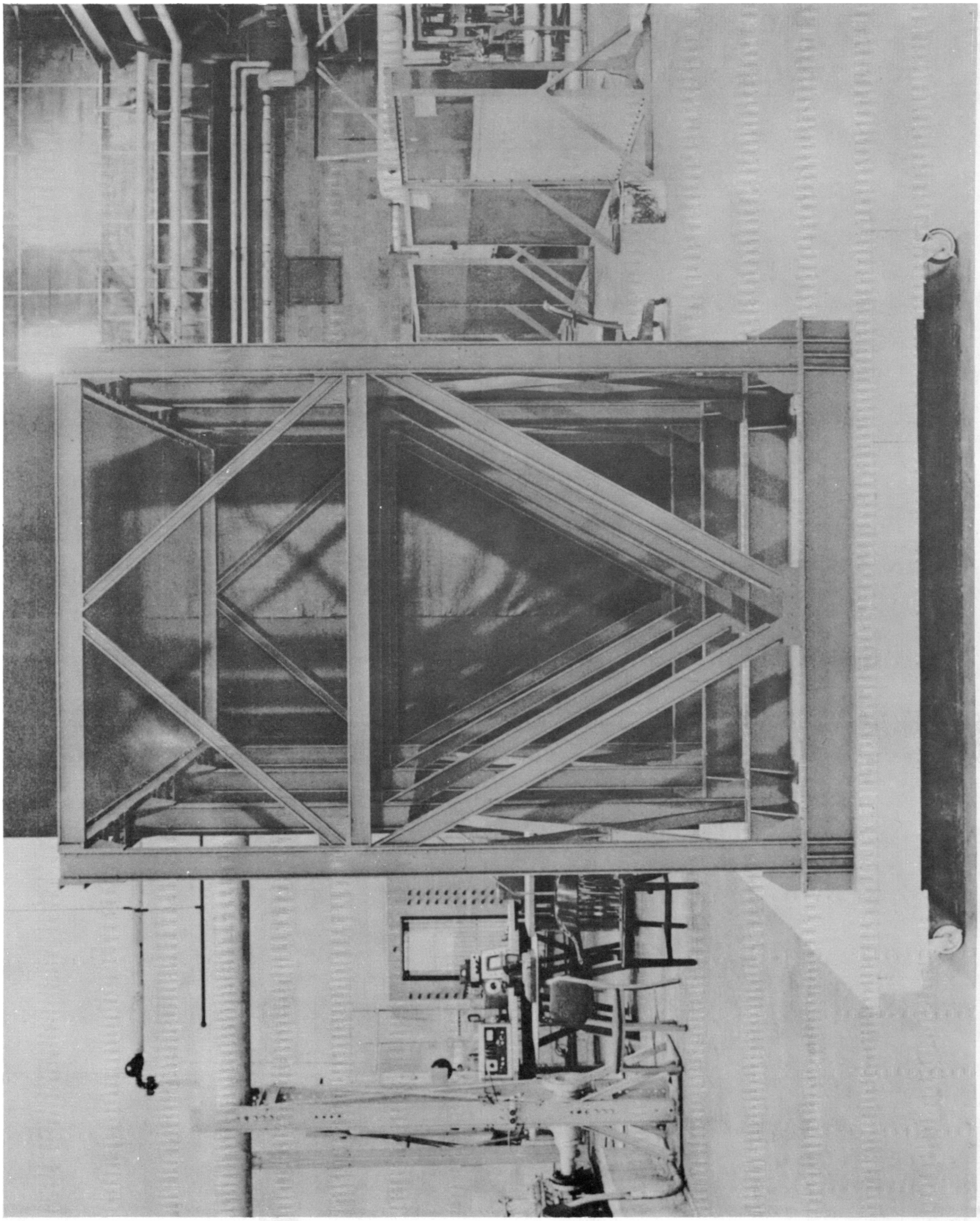
Fig. 83



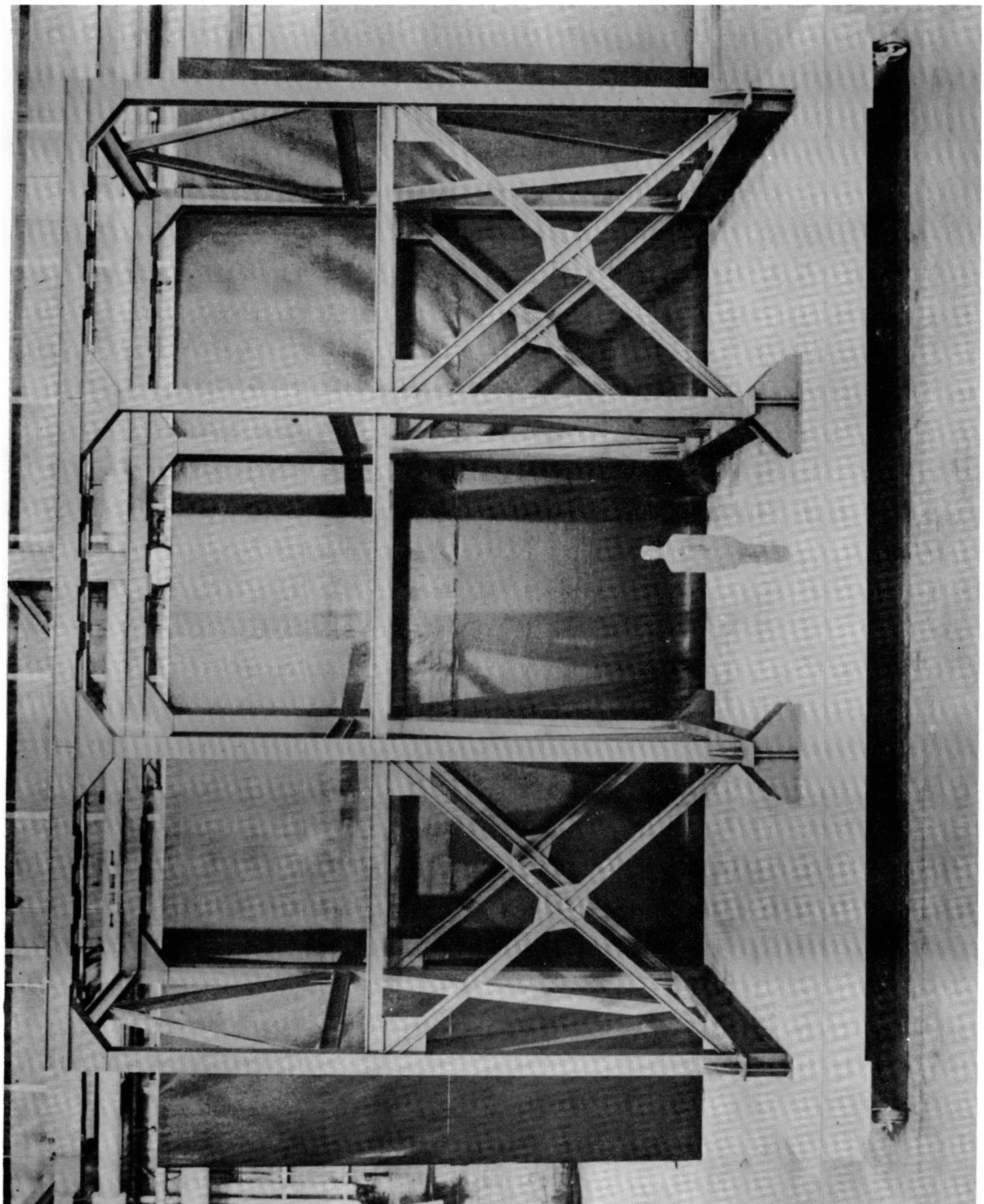
PL-2 1/4 SCALE MOCKUP
Fig. 84



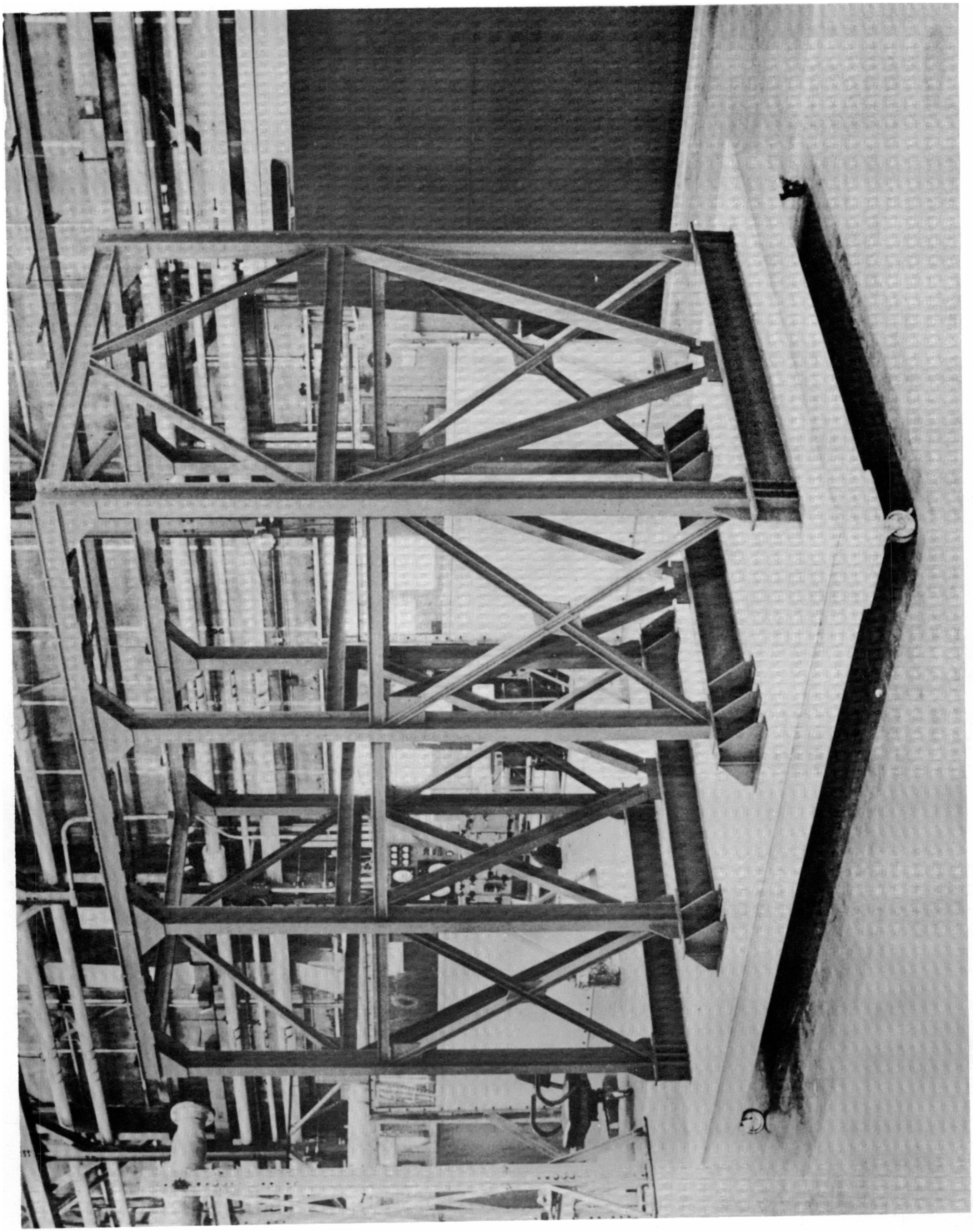
PL-2 1/4 SCALE MOCKUP
Fig. 85



PL-2 1/4 SCALE MOCKUP
Fig. 86



PL-2 1/4 SCALE MOCKUP
Fig. 87



PL-2 1/4 SCALE MOCKUP
Fig. 88