SPECIFICATION NO. HWS-6624

MECHANICAL INSTALLATION

FOR

STANDBY POWER HOUSE

BUILDING NO. 184-N

100-N PROJECT CAL-816
U. S. ATOMIC ENERGY COMMISSION
RICHLAND, WASHINGTON

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees nor any of their contractors, subcontractors, or their employees makes any warranty express or implied or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

Approved By: A. F. Filler / FOR Date: 9/1/60

Chief Mechanical Engineer
Burns and Roe, Inc.

Approved By: W. H. Dean Date: 9/1/60

FOR Chief Electrical Engineer
Burns and Roe, Inc.

Submitted By: A. J. Macdonald / gtb Date: 9/1/60

Project Manager
Burns and Roe, Inc.

Accepted By: M. H. Russell / jms Date: 9-19-60

Original Issue:
Burns and Roe, Inc.
Architect-Engineer
160 W. Broadway
New York, N. Y.

NOTICE

MN ONLY

PORTIONS OF THIS REPORT ARE ILLEGIBLE. It
has been transcribed from the best available
copy to permit the broadest possible avail-
ability.

1849

6624

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

Perm File

4-30-60

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

SPECIFICATION NO. HWS-6624

MECHANICAL INSTALLATION

STANDBY POWER HOUSE

BUILDING NO. 184-N

TABLE OF CONTENTS

<u>SECTION</u>		<u>PAGE</u>
1	<u>GENERAL SCOPE</u>	1
2	<u>RECEIPT, STORAGE AND INSTALLATION</u>	1
3	<u>EQUIPMENT TO BE INSTALLED</u>	
3.1	Scope	6
3.2	Surface Condenser, Condensate Pumps and Accessories	6
3.3	Feedwater Pumps and Accessories	9
3.4	Deaerating Heater and Accessories	10
3.5	Fuel Oil Heating and Pumping Set	11
3.6	Ignition Oil Pumps	12
3.7	Sump Pumps and Accessories	12
3.8	Instrument and Service Air Compress- ers, Receivers and Air Dryer	13
3.9	Combustion Control, Control Panels and Instrumentation	15
3.10	Service Water Pumps	20
3.11	Butterfly Valves For Water Service	20
3.12	Chemical Feed Equipment	20
4	<u>EQUIPMENT TO BE FURNISHED AND INSTALLED</u>	
4.1	Scope	21
4.2	Materials for Piping Systems	21

TABLE OF CONTENTS (CONTD)

<u>SECTION</u>		<u>PAGE</u>
4.3	Instrumentation and Controls	31
4.4	Pipe and Equipment Hangers, Supports, Anchors, and Guides	41
4.5	Valves	44
4.6	Specialties	47
4.7	Fabrication and Installation of Piping	61
4.8	Steam Systems	70
4.9	Feed Water, Condensate, Makeup and Fill Systems	71
4.10	Fuel Oil and Ignition Oil Systems	72
4.11	Compressed Air Systems	73
4.12	Service and Cooling Water System	74
4.13	Fire Protection System	74
4.14	Chemical Treatment Systems	82
4.15	HP and LP Drips, Drains and Heating Steam Returns	83
4.16	T.O. Lubricating Oil Purification System	84
4.17	Heating and Ventilating and Air Conditioning Systems	89
4.18	Safety Valve Vents, Drains, Miscellaneous Vents and Air Removal Systems	101
4.19	Boiler Blowdown System	102
4.20	Circulating Water System	103
4.21	Vacuum Priming Unit	103
4.22	Air Dryer Prefilter	105

SPECIFICATION NO. HWS-6624

MECHANICAL INSTALLATION

FOR

STANDBY POWER HOUSE

BUILDING NO. 184-N

TECHNICAL SECTIONS

1. GENERAL SCOPE

This specification covers the furnishing of piping, piping accessories, and certain specified mechanical equipment. Further it covers the provision of all labor, supervision, supplies, equipment and tools required for the handling, installation, painting, readying for operating and functional testing of all the equipment and systems described herein.

2. RECEIPT, STORAGE AND INSTALLATION

2.1 Receipt, Handling and Storage

All equipment and materials described in these specifications and on the drawings shall be received, unloaded and moved to final drawing designated locations or stored.

All non-Subcontractor furnished materials and equipment to be installed shall be checked against the bills of lading, shipping manifests and all papers showing shipment of material. Receipt and condition of shipments shall be reported to the Contractor.

All uncrating, unpacking, cleaning, degreasing, skid removal, protective covering, reocrating and pre-installation inspections shall be performed by the Subcontractor.

Ropes or slings attached to equipment for unloading and handling shall be rigged so that equipment weight is distributed to avoid abnormal strain on the equipment and prevent distortion or damage. Materials and equipment which are not weatherproofed upon receipt or which may be subject to damage if exposed to the elements shall be covered and protected with tarpaulins or other Contractor approved means.

2.2 Installation Procedure

2.2.1 General: Installation work shall include all rigging, setting, assembly, alignment and grouting necessary to prepare each system and each item of equipment and its integral parts for normal continuous service. Materials, piping systems and equipment shall be installed in the locations shown on the drawings.

In general, installation procedures shall adhere to procedures outlined in manufacturer's instruction books, or where instruction books are not supplied, standard installation practices shall be followed. The Subcontractor will be advised by the Contractor of the specific installation procedure to be followed for the various materials and for each piece of equipment to be installed, and the Contractor's approval shall be obtained prior to initiating the work.

Special attention shall be paid to all erection notes on the drawings, and all work shall be in strict conformance thereto. Where sealing compounds are required, these shall be provided by the Subcontractor.

2.2.2 Setting of Equipment: All equipment shall be set in place as shown on the drawings, as recommended in the instruction manuals, and as required by this specification. All equipment and piping shall be set exactly to the lines and elevations shown on the drawings. If any deviation from a set dimension arises, it shall be reported at once to the Contractor for decision as to further action to be taken.

All equipment shall be bolted down and grouted in place after alignment.

2.2.3 Alignment: After connecting piping has been installed, coupling halves connecting driving and driven portions of equipment shall be checked for alignment. Wherever misalignment is found, coupling halves shall be disconnected and the equipment realigned. All necessary drilling or doweling shall be performed by the Subcontractor.

Piping or ductwork connected to any equipment shall be supported by hangers or supports and shall be entirely free of any supporting assistance by the connected equipment.

2.2.4 Rotating Equipment: Coupling bolts for all rotating equipment shall not be installed permanently until the correct direction of rotation has been established. Accurate records shall be kept for the aligning of all rotating equipment. Wherever the equipment manufacturer has not provided a rotational direction arrow or marker, such shall be provided.

2.2.5 Lubrication: All lubricants, oils and greases required and specified or recommended by the manufacturers for installing the specified equipment and readying it for operation shall be provided and installed.

2.2.6 Recheck: Equipment subject to expansion and contraction due to handling of hot or cold fluids shall be rechecked after a functional operating test at design conditions. Tests shall extend for at least the period required for the equipment to attain steady state operating temperatures. If necessary, equipment shall be realigned as determined by the Contractor or manufacturers' representatives.

2.2.7 Inspection: All work and equipment will be inspected by the Contractor. Material or work required to permit inspection such as, but not limited to, unbolting of manhole covers and access doors, special scaffolding, removal of foreign matter, removal of belt guards, tightening of hold-down bolts and flanges, etc. shall be provided or performed.

2.2.8 Protection: All required protection of shafts, flanges and similar equipment parts by grease coating, as determined by the Contractor, shall be provided.

2.2.9 Safety: Belts, pulleys, chains, gears, couplings, projecting set screws, keys and other rotating parts on all equipment shall be fully enclosed or otherwise guarded in a manner approved by the Contractor. Openings shall be provided in guard enclosures to allow access to ends of shafts for speed measurement where required.

2.2.10 Identification Tags: Identification tags shall be provided and placed on all valves. Valve tags shall be brass having a minimum diameter of 1-1/4 inches and shall have black identification figures stamped thereon. Figure height shall be 1/4 inch minimum. Tags shall bear the valve numbers shown on the drawings.

Subcontractor furnished equipment shall be provided with nameplates indicating the equipment manufacturer's name and the model and serial numbers of the item.

2.2.11 Stenciling: All equipment shall be identified in accordance with the designations shown on the drawings. During installation this identification may consist of linen tags. Upon completion of final painting, however, the designation shall be stenciled on or adjacent to the piece of equipment as required by the Contractor.

2.2.12 Capacity Information: Prior to installation, manufacturer's published capacity information covering Subcontractor furnished equipment, including tables, curves and other required data, shall be submitted for approval to insure conformance with the design conditions noted on the drawings.

2.2.13 Base Plates and Bearing Plates: Base, bearing and leveling plates shall be supported by steel wedges or shims until the supported members have been plumbed and grouted. Projecting portions of shims or wedges, which would be exposed after grouting shall be removed prior to grouting. Entire bearing areas shall be grouted completely with a mixture of equal parts of Portland cement and sand mixed dry prior to adding only enough water to produce a grout, which, when used, shall stick together on being molded by a slight pressure of the hands, and which shall leave the hands damp. Grout not placed within one hour after adding water shall not be used. Grout shall not be retempered. Cement for grout shall be Portland cement conforming to Federal Specification SS-C-192, Type II, low alkali cement. If sand other than that available at the Hanford Central Batch Plant is used, it shall meet the requirements of Section 5, FINE AGGREGATE, of Hanford Standard Specification HWS-4799-3.

2.2.14 Accessories: All mechanical accessories required for the mechanical equipment herein specified shall be installed, whether furnished by the equipment manufacturer or by the Subcontractor, and whether or not shown on the drawings.

3. EQUIPMENT TO BE INSTALLED

3.1 Scope

This section designates all the equipment and accessories to be furnished to the Subcontractor for installation and readying for operation by him.

3.2 Surface Condenser, Condensate Pumps and Accessories

3.2.1 Surface Condenser

One (1) 18,000 sq. ft., 2-pass, bottom supported shop tubed and assembled condenser and accessories as manufactured by Worthington Corporation. The condenser extension neck will be shipped separate from the condenser. The extension neck is to be welded to the turbine before connection to the condenser. For ease of installation, however, it may be required that the condenser be in position prior to extension neck attachment to the turbine. After the extension is welded to the turbine the condenser shall be jacked up approximately 3 inches and the extension neck shall be welded to the condenser steam dome. Welding between condenser and turbine shall be closely coordinated with the turbine erector. It is imperative that instructions of both the turbine and condenser manufacturers be adhered to and permission to weld the condenser and turbine must be obtained from the Contractor.

The welds shall be made from within the condenser. Therefore, extreme care shall be taken to protect the tubes from damage from erection facilities or weld material. Special jacks required to position the condenser during welding shall be furnished by the Subcontractor.

After the welds have been completed and inspected, the condenser internals are to be thoroughly cleaned.

The siding in bent A, Column 3 to 4 below elevation 22 will not be erected until after the condenser is installed. The condenser is to be moved through this opening to its foundation and all special rigging required is to be supplied by the Subcontractor.

The water boxes may be installed after the condenser shell is in place and after permission is given by the Contractor to utilize the crane.

Special tools necessary for assembly of the condenser and accessories will be furnished with the equipment.

The condenser instrument and connection accessories shall be installed by the Subcontractor in accordance with the manufacturer's drawings.

Approximate weights for the unit are as follows:

Total shell with tubes	164,300 lbs.
Inlet and outlet water box (dry)	17,000 lbs.
Return Water Box (dry)	14,700 lbs.
Water Box covers	6,500 lbs. each

Unit exclusive of exhaust connection measures 29 feet long by 9 feet 2 inches wide by 11 feet 4 inches high.

3.2.2 Condensate Pumps

Two (2) 4-stage vertical condensate pumps, Worthington Model 12-QEBC, each complete with suction strainer and 60h.p. motor drive. Pump and motor mounting frames shall be mounted on Buyer's can type sumps.

Approximate weight for each pump and motor unit is 6,750 lbs. Overall unit height is 17 feet. Approximate unit diameter is 18 inches.

3.2.3 Steam Jet Air Ejector

One (1) twin element, Worthington Model 6-CTH 2-stage ejector complete with inter and aftercondensers. All the required bolts and nuts for support of the SJAE shall be furnished by the Subcontractor.

Accessories to be provided with the ejector, which shall be installed by the Subcontractor include:

- A) Air Meter
- B) Intercondenser Loop Seal Assembly
- C) Aftercondenser Drain Trap
- D) Steam Piping and Valves to Ejector Nozzles

Approximate weights for the unit:

Erected Weight, empty 6,500 lbs.

Shipping Weight 7,800 lbs.

~~Approximate~~ overall size is 8 feet by 6 feet by 5 feet.

3.2.4 Steam Hogging Ejector

One (1) Worthington Model 6-NPA steam hogging ejector for evacuation of the condenser steam space.

Approximate unit weight

400 lbs.

Approximate Size

5 feet high by 12 inch diameter.

3.3 Feedwater Pumps and Accessories

3.3.1 Feedwater Pumps

Three (3) Pacific Pumps Inc., 6"S Model BFACMB 3 stage, electric motor driven, direct connected pumps for mounting on structural steel bedplates. Pumps and base plates shall be placed and the Subcontractor shall mount the 800 hp motor drivers and secure the drivers to the pumps through the flexible couplings.

3.3.2 Accessories

Accessories provided with each unit, which shall be installed by the Subcontractor shall include:

- A) Recirculation breakdown orifice.
- B) Suction strainer.
- C) Inter-connecting cooling water and leakoff piping.
- D) Inter-connecting lubricating oil piping.

The orifice and strainer shall be installed in the piping systems by the Subcontractor.

Approximate weights and dimensions are as follows:

Complete unit on baseplate	13,000 lbs.
Barrel Head	600 lbs.
Barrel and baseplate	4,750 lbs.
Motor drive	6,000 lbs.
Heaviest piece to be handled	7,000 lbs.
Largest piece to be handled (baseplate) 14'6" x 4'2" x 4'9"	

3.4 Deaerating Heater and Accessories

3.4.1 Deaerating Heater and Storage Tank

One (1) 1,500,000 lb per hour deaerating heater and 19,000 gallon storage tank, as manufactured by Graver Water Conditioning Company, shall be independently mounted on structural steel members, the heater on Elevation 36'-0", and tank on Elevation 55'-0". After the units have been installed and anchored, the intercoming equalizing lines, downcomer and accessories are to be installed and connected to the equipment in accordance with the manufacturer's instructions.

The siding, penthouse roof, and if required heater supporting steel, will not be erected until after the storage tank is in place. After the storage tank has been installed, the heater supporting steel will be erected by the Superstructure Subcontractor. The heater is then to be installed. This portion of the work must be closely coordinated with all Subcontractors and after each phase of erection has been completed by this Subcontractor he shall so notify the Contractor.

Approximate weights and dimensions for the unit are as follows:

	Heater	Storage Tank
Erected weight, empty	38,000 lbs	48,000 lbs
Shipping weight	36,000 lbs	44,000 lbs
Length over heads	19'-0"	24'-6"
Diameter	9'-0"	12'-0"
Overall height	11'-0"	13'-3"

3.4.2 Accessories

Accessories to be installed by the Subcontractor shall include:

- A) Gauge glasses with piping and valves, Jerguson Type R-5.
- B) Relief Valves, Consolidated Type 1511.
- C) Drip pan elbows for relief valves (discharge piping to extend to a point 10 feet above the penthouse roof).
- D) 2 - 14 in. equalizing lines and expansion joints.
- E) 1 - 24 in. condensate pipe and expansion joint from heater.

3.5 Fuel Oil Heating and Pumping Set

Three (3) fuel oil pumps and two (2) heaters will be furnished on a common baseplate complete with supports for mounting pumps, electric drive motors, heaters, twin basket type suction and discharge strainers, shutoff valves, and interconnecting piping as an integral unit. Assembly Model EPHD-10020 will be entirely shop assembled by Walter H. Eagan, Inc., and shall terminate with connections for the following services:

- A) Oil inlet and outlet.
- B) Steam and condensate to each heater.
- C) Oil recirculation and oil reliefs.
- D) Instrument connections.
- E) Vents and drains.

Approximate weight and dimensions for the unit are as follows:

Erected weight	13,000 lbs.
Overall dimensions	8 ft. x 14 ft. x 7 ft.

3.6 Ignition Oil Pumps

Three (3) Warren Model 2-1/2, motor driven, direct connected pumping units, each mounted on a continuous bedplate.

Accessories for this equipment to be installed by the Subcontractor shall include:

- A) Y-Type suction strainers
- B) Pump relief valves

Approximate weight of each complete unit is 500 lbs.

3.7 Sump Pumps and Accessories

3.7.1 Pumps

One (1) duplex pumping set, Deming Model J-402-L, comprising two (2) vertical pumps for mounting in a 4'-0" x 8'-0" x 6'-0" deep floor drain sump to handle cooled boiler blowdown and miscellaneous power plant equipment drains. Pump assemblies, float switches, accessories and support plates shall be mounted on a sump pit cover plate. This cover plate is to be furnished and installed by the Subcontractor in accordance with Section 5 of this specification.

Approximate total shipping weight of the equipment is 1130 lbs.

3.7.2 Accessories

- A) 2-1/2 in. discharge piping to a point above sump cover plate.
- B) 2 - 18 in. x 26 in. support plates.
- C) Square D 9038, AG1 alternator with float and float rod.
- D) Size 0, Form 2 magnetic starters.
- E) Solenoid valves for fresh water lubrication of bearings.
- F) Square D 9018 high water alarm with 110/6 volt transformer and 2-1/2" alarm bell.
- G) 9036, Type GG2S1 standby float control and float rod.

3.8 Instrument and Service Air Compressors, Receivers and Air Dryer

3.8.1 Compressors

A) Three (3) Ingersoll-Rand Model XLE two-stage double-acting L-type, carbon ring, watercooled, 125 hp motor driven compressors to furnish plant instrument and breathing air requirements.

In addition to the accessories listed herein, the instrument compressors will be provided with a wall mounted panel complete with five (5) pressure switches. This panel is to be mounted by the Subcontractor, as shown on the drawings. All mounting bolts and nuts shall be provided by the Subcontractor.

B) One (1) Ingersoll-Rand Model XLE two-stage, double-acting, L-type, oil lubricated, water cooled, 125 hp motor driven compressor to furnish plant service air requirements.

3.8.2 Accessories

Each of the four (4) compressors will be provided with accessories to be installed by the Subcontractor, which shall include:

A) Inter-cooler complete with inter-connecting piping, safety valve, intermediate moisture separator with gauge glass and automatic trap.

B) Aftercooler complete with safety valve, final moisture separator with gauge glass and automatic trap. The aftercooler is a pipe line type to be installed by the Subcontractor in accordance with the drawings.

C) Inter-connecting cooling water piping between inter-cooler and cylinder jackets complete with manual control valve.

D) Excess discharge air temperature trip switch and inlet cooling water solenoid shut-off valve to be installed by the Subcontractor as shown on the drawings.

E) Air inlet filter silencer, Air Maze Model DA 145US.

3.7.3 Air Receivers

Two (2) vertical air receivers, one for each air system, complete with safety valves, steel base, drain valve and automatic trap, each approximately 54 inches in diameter by 14 feet long.

3.7.4 Air Dryer

Gas Drying Inc., dual absorber type air dryer provided with all accessories necessary for fully automatic operation.

All interconnecting piping will be provided by the manufacturer such that it shall only be required that the Subcontractor pipe to and from the air inlet and outlet connections and from the drain and trap outlets.

Approximate weights for each piece of equipment are, as follows:

Complete compressor unit on foundation	10,000 lbs.
Aftercooler and Separator	700 lbs.
Receiver	4,000 lbs.
Motor Drive	2,000 lbs.
Air Dryer	5,000 lbs.

Compressor and motor units each measure approximately 7 feet long by 6 feet wide by 7 feet high. Dryer measures approximately 6 feet wide by 9 feet high by 3 deep.

3.9 Combustion Control, Control Panels and Instrumentation

3.9.1 General

The panels, instruments, control devices and valves described herein will be furnished to the Subcontractor for installation.

Control devices, instruments, valves and panels shall be installed in accordance with the drawings. Where specific locations have not been detailed on the drawings, the Subcontractor shall locate, install and, where required, support these items. Locations shall allow ready accessibility for maintenance and adjustment and shall be subject to approval.

3.9.2 Instrument and Control System Components

A) Transmitters, Controllers and Primary Elements

Individual transmitters, controllers and primary elements to be furnished to the Subcontractor for installation by him include all items shown on the drawings which carry the prefix letter identifications FT, PT, LT, PG, LC and TR, and which are listed as being furnished under specifications other than HWS-6624. Transmitters and controllers will be furnished

complete with required supply air sets, which shall be installed by the Subcontractor as shown on the drawings. Installation of transmitters and controllers shall include, where applicable, the installation of associated primary elements. Primary elements such as flow nozzles (complete with rings, leveling pots, nipples and adaptors) serving transmission and control devices carry the designation numbers assigned to the associated controller or transmitter. Thermocouple primary elements which serve remote panel mounted multipoint recorders carry TR designations identical to their associated recorder points.

B) Flue Gas Oxygen Sampling Assembly and Transmitter

1. Analyser panel assembly and transmitter OAT-101
2. Complete primary element probe (for boiler flue mounting)

All of the components will be furnished to the Subcontractor piped and mounted on or within the panel. Piping to and from the probe and the panel shall be furnished and installed by the Subcontractor.

C) Flame Failure Devices

Flame detection primary elements for each of the eight main burners and for the auxiliary burner, for flame monitoring of both No. 6 main oil and No. 2 ignition oil.

D) Pressure switches shown on the drawings which carry the prefix letter identification PS, and which are listed as being furnished under specifications other than HWS-6624 will be furnished to the Subcontractor for installation.

E) Vane and Damper Power Operators

Power operators, including interconnecting drive linkages, which carry the prefix letter designation CD, and which are listed on the drawings as being furnished under specifications other than HWS-6624 will be furnished to the Subcontractor for installation.

F) Control and Solenoid Valves

All control and solenoid valves shown on the drawings and listed as being furnished under specifications other than HWS-6624 will be furnished to the Subcontractor for installation.

G) Mechanical Control Board

The mechanical control board will be a self-supporting free standing metal enclosed type unit furnished for control room mounting complete with integrally mounted indicators, recorders, control and alarm devices and internal interconnecting piping.

The board will have removable or hinged access doors along the front, sides and rear faces. The removable panels may be removed during installation of the unit. Panels shall be replaced by the Subcontractor after all external piping connections have been made to the control board.

Cases for the following instruments will be panel mounted on instrument internals, however, will be furnished separately for field mounting by the Subcontractor:

Turbine Vibration Recorder	-	Board Item 35
Turbine Speed Recorder	-	Board Item 40

In addition, the following encased instruments shall require field mounting on the panel by the Subcontractor:

Oxygen Recorder - Board Item 32

Temperature Recorder - Board Item 37

Temperature Recorder - Board Item 38

Anchor bolts, nuts and washers, channel sills and imbedded leveling steel will be provided in place by the Contractor. Vibration isolators of the rubber-in-shear type will be provided by the panel manufacturer for installation by the Subcontractor.

Overall dimensions of the control board are:

Width - 4'-0"

Height - 8'-1"

Length - 8'-9"

Panel weight is estimated at 8,000 lbs.

H) Automatic Programming and Flame Failure Control Panel

The programming control panel will be of the self-supporting, free standing, metal enclosed type with removable or hinged access doors on the rear face.

Tubing to and from external control devices will terminate at terminal blocks at the bottom of the board.

The panel is to be anchored to platform grating so that main grating members run perpendicular to the length of the panel. Anchor bolts, nuts, washers and miscellaneous steel as required for anchoring the panel is to be provided by the Subcontractor.

Overall panel dimensions are estimated to be:

Width - 1'-6"

Height - 7'-0"

Length - 6'-0"

Panel weight is estimated at 2,000 lbs.

I) Turbine Panel

Panel construction will be identical to the Programming panel described under H, above.

Internal pipe and tubing will terminate at blocks at the bottom of the board. Panel shall be floor mounted at the turbine as shown on the drawings.

Overall panel dimensions are estimated to be:

Width - 1'-6"

Height - 7'-6"

Length - 3'-0"

Panel weight is estimated at 800 lbs.

J) Water Monitoring Instrumentation and Recording Panel

The panel is free standing type, complete with all regulators, valves, thermometers, cooling coils and measuring devices mounted within or on the panel, and will be so furnished to the Subcontractor for installation.

Anchor bolts, nuts and washers as required shall be furnished and installed in place by the Subcontractor.

3.10 Service Water Pumps

Two (2) horizontal pump units Ingersoll-Rand type 3UV, 25 hp motor driven, direct connected and mounted on continuous bedplates.

Approximate unit weights and dimensions are as follows:

Complete unit on baseplate 650 lbs.

Overall length, width & height 5 ft. x 2 ft. x 2 ft.

3.11 Butterfly Valves for Water Service

The following rubber seated butterfly valves manufactured by Henry Pratt Company shall be installed in the piping systems as shown on the drawings:

<u>Quantity</u>	<u>Size</u>	<u>Operator</u>	<u>Tag No.</u>	<u>Approx. Weight</u>
1	36"	Manual	RWSV-101	1500 lbs.
1	36"	Motor	RWRV-102	2500 lbs.

3.12 Chemical Feed Equipment

The chemical feed equipment to be furnished to the Sub-contractor for installation will consist of the following components and accessories:

- A) One (1) hydrazine mixing tank with gauge glass and level switch and motor driven agitator.
- B) Two (2) hydrazine pumps and motors.
- C) One (1) morpholine mixing tank with gauge glass and level switch and motor driven agitator.
- D) One (1) morpholine pump and motor.

Where accessories are shipped disassembled, the Subcontractor is to mount same in accordance with the manufacturer's instructions.

The three pumps shall be installed on a common concrete support approximately 3'-0" wide x 6'-0" long. Anchor bolts, nuts and washers as required will be provided in place by the Contractor.

The mixing tanks will be self-supporting, approximately 30 inches in diameter and 5 ft. high. Anchor bolts, nuts and washers as required shall be furnished and installed by the Subcontractor.

4. EQUIPMENT TO BE FURNISHED AND INSTALLED

4.1 Scope

This section covers all piping, valves, specialties, supplies, instrumentation, controls, materials and equipment shown on the drawings and/or described in the applicable sections of this specification which shall be furnished and installed by the Subcontractor.

Where a manufacturer has been referred to for an item of equipment, alternate manufacturers are acceptable providing the minimum requirements as specified are met. Such alternate manufacturers are subject to approval.

4.2 Materials for Piping Systems

4.2.1 Applicable Publications

The following publications of the issues listed below but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references:

A) American Society for Testing Materials (ASTM)

- A 53-58T Welded and Seamless Pipe
- A 105-58T Forged or rolled steel pipe flanges, forged fittings, and valves and parts for high temperature service.
- A 106-58T Specification for Seamless Carbon Steel Pipe for High Temperature Service.
- A 120-57T Black and Hot Dipped Fine Coated (Galvanized) Welded and Seamless Steel Pipe for ordinary use.
- A 126-42 Gray Iron Castings for valves, flanges and pipe fittings.
- A 155-56T Electric Fusion Welded Steel Pipe for High Temperature Service.
- A 181-58T Forged or Rolled Steel pipe flanges, forged fittings, and valves and parts for general service.
- A 193-58T Alloy steel bolting materials for high temperature service.
- A 194-58T Carbon and Alloy steel nuts for bolts for high pressure and high temperature service.
- A 197-47 Cupola Malleable Iron
- A 210-58T Medium-Carbon Seamless Steel Boiler and Superheater Tubes
- A 212-57T High Tensile Strength Carbon Silicon Steel Plates for Boilers and other pressure vessels
- A 216-58T Carbon Steel Castings Suitable for Fusion Welding for High Temperature Service.
- A 234-58aT Factory made Wrought Carbon Steel and Ferritic Alloy Steel Welding Fittings.
- A 283-58 Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality (Plates 2 inches and under in Thickness).

- A 285-57T Low and Intermediate Tensile Strength Carbon Steel Plates of Flange and Firebox Qualities (Plates 2 inches and under in Thickness).
- A 307-58T Low Carbon Steel Externally and Internally Threaded Standard Fasteners.
- A 312-59T Seamless and Welded Austenitic Stainless Steel Pipe
- A 403-59T Factory Made Wrought Austenitic Steel Welding Fittings
- B 61-52 Bronze Castings, Steam or Valve
- B 68-58 Seamless Copper Tube, Bright annealed

B) American Standards Association (ASA)

- B1.1-1949 Unified and American Screw Threads for Screws, Bolts, Nuts and other threaded parts.
- B16.1-1948
with Rev.1953 Cast Iron Pipe Flanges and Flanged Fittings, Class 125.
- B16.3-1951
with Rev.1958 Malleable Iron Screwed Fittings, 150 lb.
- B16.5-1957 Steel Pipe Flanges and Flanged Fittings.
- B16.9-1958 Steel Butt Welding Fittings.
- B16.11-1946 Steel Socket Weld Fittings.
- B18.2-1955 Square and Hexagon Bolts and Nuts
- B31.1-1955 Code for Pressure Piping
- B36.10 Pipe Dimension
- B70.1 Refrigeration Flare Type Fittings (SAE SP-95).

C) American Water Works Association (AWWA)

- C201-50 AWWA Standard for Electric Fusion Welded Steel Water Pipe of sizes 30 inches and over.

- C202-49 AWWA Standard for Steel Water Pipe sizes up to but not including 30 inches.
- C203-57 AWWA Standard for Coal Tar Enamel Protective Coatings for Steel Water Pipe.
- C206-57 AWWA Standard for Field Welding of Steel Water Pipe Joints.
- C207-55 AWWA Standard for Steel Pipe Flanges.

D) Society of Automotive Engineers (SAE)

1960 Handbook

4.2.2 General

Materials and accessories for piping systems are covered by this section of the specification. Piping shall be in accordance with the classifications and descriptions specified herein and the design conditions for the individual systems described under relevant sections of this specification.

The nominal sizes for piping 14 inches and larger as shown on the drawings and specified herein refer to outside diameter. Specialties as required for particular systems are described in Section 4.6 of this specification, on the drawings or in the Instrumentation and Controls Section 4.3.

Materials provided shall be marked in accordance with the applicable material specifications. Carbon steel for welded pipe and fittings shall have a carbon content not greater than 0.35%. All fittings shall be compatible with the schedule or wall thickness of the pipe with which they are used. Valves shall be in accordance with Section 4.5 of this specification. Relief valves shall have the capacity and setting noted herein or on the drawings

and shall be designed and constructed in accordance with the ASME Boiler and Pressure Vessel Code.

Fabrication and installation of the systems shall be in accordance with the following sections of this specification:

Section 4.7 Fabrication and Installation of Piping

Section 4.4 Pipe and Equipment Hangers, Supports, Anchors and Guides.

4.2.3 Piping Classifications

A) Systems designated HP, HP-1, HPR, BD shall conform to the following table and notes: ...

<u>Nominal Size</u>	<u>Pipe</u>	<u>Joints</u>	<u>Flanges</u>	<u>Fittings</u>	<u>Unions</u>	<u>Bolting</u>	<u>Gaskets</u>
2" and Smaller	P-1	J-1	FL-1	F-1	U-1	B-1	G-1
2-1/2" through 14"	P-1	J-2	FL-1	F-3	-	B-1	G-1
16" through 24"	P-1 or P-4	J-2 or J-3	FL-1	F-3 or F-4	-	B-1	G-1
over 24"	P-4	J-3	FL-1	F-4	-	B-1	G-1

Notes: (1) All pipe 2" and smaller requiring threading for connection to equipment, specialties, instruments, controls, or accessories shall conform to P-2 and fittings shall conform to F-2.

(2) 18" pipe shall conform to P-3 or P-4.

B) Systems designated LP, LPR, FPS, Cond-5, MW, COND shall conform to the following table and notes:

<u>Nominal Size</u>	<u>Pipe</u>	<u>Joints</u>	<u>Flanges</u>	<u>Fittings</u>	<u>Unions</u>	<u>Bolting</u>	<u>Gaskets</u>
2" and smaller	P-7	J-1	FL-3	F-1	U-1	B-2	G-2
2-1/2" through 10"	P-7	J-4	FL-3	F-3	-	B-2	G-2
12" and 14"	P-8	J-4	FL-3	F-3	-	B-1	G-2
16" through 24"	P-8 or P-9 or J-3	J-4	FL-3	F-3 or F-6	-	B-2	G-2

Notes: (1) All piping 2" and smaller requiring threading for connection to equipment, specialties, instruments, controls or accessories shall conform to P-2; and fittings shall conform to F-2.

C) System designated FPD shall conform to the following table and Note (1) above:

<u>Nominal Size</u>	<u>Pipe</u>	<u>Joints</u>	<u>Flanges</u>	<u>Fittings</u>	<u>Unions</u>	<u>Bolting</u>	<u>Gaskets</u>
2" and smaller	P-1	J-1	FL-2	F-1	U-1	B-1	G-1
2-1/2" through 5"	P-1	J-2	FL-2	F-3	-	B-1	G-1
6"	P-2	J-2	FL-2	F-3	-	B-1	G-1
8" through 14"	P-5	J-2	FL-2	F-3	-	B-1	G-1

D) Systems designated F, R, AE, RWS, RWR, VT, SA, CAB, CAS shall conform to the following table and notes:

<u>Nominal Size</u>	<u>Pipe</u>	<u>Joints</u>	<u>Flanges</u>	<u>Fittings</u>	<u>Unions</u>	<u>Bolting</u>	<u>Gaskets</u>
2" and smaller	P-7	J-5	FL-3	F-5	U-2	B-2	G-2
2-1/2" through 10"	P-7	J-4	FL-3	F-3	-	B-2	G-2
12" and 14"	P-8	J-4	FL-3	F-3	-	B-2	G-2
16" through 24"	P-8 or P-9 or J-3	J-4	FL-3	F-3 or F-6	-	B-2	G-2
over 24"	P-9	J-3	FL-3	F-6	-	B-2	G-2

Notes: (1) Gaskets for systems designated RWS, RWR shall conform to G-3.

(2) Fittings 2" and smaller for systems designated RWS, RWR, GAS, CAB, AE shall conform to F-7.

E) Systems designated FOS FOR, IO, 9-MO, 12-HY, LO, VT-1 shall conform to the following table and note:

<u>Nominal Size</u>	<u>Pipe</u>	<u>Joints</u>	<u>Flanges</u>	<u>Fittings</u>	<u>Union</u>	<u>Bolting</u>	<u>Gaskets</u>
2" and smaller	P-7	J-1	FL-3	F-1	U-3	B-2	J-4
2-1/2" through 4"	P-7	J-4	FL-3	F-3	-	B-2	G-4

Note: (1) Flanges for system designated LO shall conform to FL-1.

4.2.4 Pipe Descriptions

A) ASTM Specification A-106 Grade B seamless pipe, nominal wall thickness in accordance with the following table and dimensioned as per ASA-B36.10.

- P-1 Schedule 40
- P-2 Schedule 80
- P-3 Extra Strong
- P-5 Schedule 60

B) P-4 ASTM Specification A-155 Grade KC-70 fusion welded pipe with no more than one full penetration longitudinal weld which shall be of the double vee butt groove type and fully radiographed. Wall thicknesses shall be in accordance with the following table.

<u>Nominal Pipe Size</u>	<u>Minimum Wall Thickness</u>
16"	3/8"
18", 20"	7/16"
24"	1/2"

Nominal Pipe SizeMinimum Wall Thickness

26", 28"

9/16"

30", 32"

5/8"

C) ASTM Specification A-155 Grade C55 fusion welded pipe with no more than one full penetration longitudinal weld which shall be of the double vee-butt groove type. Wall thickness shall be in accordance with the following table:

P-9 3/8" minimum wall

D) ASTM Specification A-53 Grade B seamless pipe, nominal wall thickness in accordance with the following table and dimensioned as per ASA-B36.10.

P-7 Schedule 40

P-8 Standard weight

4.2.5 Joints

J-1 Socket type fillet weld

J-2 Single-vee-groove butt weld with machine bored pipe ends, welded from one side, on a backing ring

J-3 Double-vee-groove butt weld, welded from both sides

J-4 Single-vee-groove butt weld, welded from one side, on a backing ring.

J-5 Screwed

4.2.6 Flanges

Forged carbon steel weld neck or slip-on flange, raised face unless otherwise noted on the drawings, ASTM Specification A-181 Grade II, faced, drilled and dimensioned per ASA-B16.5 and in accordance with the following pressure ratings:

FL-1 300 lb.

FL-2 400 lb.

FL-3 150 lb.

4.2.7 Fittings

A) Forged carbon steel ASTM Specification A-195 Grade II dimensioned per ASA-B16.11 and in accordance with the following pressure ratings:

F-1 2000 lb. socket welded

F-2 3000 lb. socket welded

B) F-3 Forged carbon steel butt welded ASTM Specification A-234 Grade A, dimensioned per ASA-B16.9 with wall thickness equal to pipe wall.

C) F-4 Fusion welded, mitered type, ASTM A-234 Grade WPB using plate of ASTM A-212 Grade B. Fittings may have two longitudinal welds and shall be made to the same wall thickness as the connecting pipe plus thickness allowance for thinning during fabrication. Longitudinal welds shall be fully radiographed.

D) Malleable iron screwed ends ASTM Specification A-197 dimensioned per ASA-B16.3 in accordance with the following pressure ratings:

F-5 300 lb.

F-7 150 lb.

E) F-6 Fusion welded, mitered type ASTM A-234 Grade WPA using plate of ASTM A-285 Grade C. Fittings may have two longitudinal welds and shall be made to the same wall thickness as the connecting pipe plus thickness allowance for thinning during fabrication.

4.2.8 Unions

A) Forged carbon steel female union integral ground seat ASTM Specification A-105 Grade II in accordance with the following pressure ratings:

U-1 3000 lb screwed.

U-3 2000 lb screwed.

B) Malleable iron female union ground joint with brass to steel seat ASTM Specification A-197 in accordance with the following pressure ratings:

U-2 300 lb screwed.

4.2.9 Bolting

B-1 Alloy steel studs ASTM A-193 Grade B14 and ASTM A-194 Class 2H nuts, threaded to ASA-B1.1 and dimensioned per ASA B18.2 heavy hexagon.

B-2 Commercial square head, carbon steel, machined bolts and nuts to ASTM A-307 dimensioned per ASA B18.2 heavy hexagon.

4.2.10 Gaskets

G-1 Flexitallic - Style CG or approved equal 0.175" thick compressed to 1/8" thickness.

G-2 Compressed asbestos, 1/16" thick, ring type for raised face flanges, Cranite or approved equal.

G-3 Rubber, ring type, Crane CC or approved equal; 1/16" thick for piping 10" and smaller, 1/8" thick for piping 12" and larger.

G-4 Johns-Manville "Seigelite" 711 or approved equal, ring type 1/16" thick.

4.3 Instrumentation and Controls

4.3.1 General: Instruments and controls specified herein and shown on the drawings, schematic and instrument lists shall be mounted, installed and connected in the locations shown on the drawings and in the manner recommended or required by the manufacturer. Instrument tubing and piping required for connecting and interconnecting all instruments and control devices shall be provided, installed, run and tested. Air supplies and connections for all instruments and controls shall be provided and installed. Air supplies for each device shall be routed and valued from a 100 psig control air header, all as shown on the drawings.

4.3.2 Tubing: Tubing and fittings shall be in accordance with Section 4.13 of this specification. Tubing shall be 1/4" minimum O.D.

Runs of concealed tubing shall be as short and direct as possible. Exposed tubing shall be run in straight lines parallel to the floor, ceilings, walls, beams, or columns with as few bends as possible. Bends shall be made only with an approved type of tubing. Where more than five (5) lines are run adjacent and parallel to one another tubing trays shall be used. Tubing runs outside trays shall be strapped together and shall be routed to afford maximum physical protection from mechanical damage. Exposed runs shall be protected by light weight angle iron. Before any tests are made on the instrument tubing or piping, pressure gages, flow transmitters and pressure switches shall be disconnected. All tubing shall be thoroughly blown out with clean, dry compressed air before any instruments are connected thereto.

All pneumatic tubing and sampling tubing shall be supplied.

4.3.3 Pressure Gages and Switches: Pressure gages and switches shall be provided and installed where indicated on the drawings. Gages and switches shall be of the bourdon tube type. Bourdon tubes shall be fabricated from beryllium copper or drawn phosphor bronze. Dial diameters shall not be less than 4-1/2 inches and shall have operating ranges as indicated below. Pressure gages and switches shall have iron or cast aluminum cases with black baked enamel finish and bottom connections. All units shall be equipped with overload stops. Gages shall be certified to have an accuracy of 1/2 of one percent of full scale reading. Gages and switches shall be provided with instrument valves as indicated on the drawings. Switches shall be designed for 125 V d-c operation. All switches shall be double pole single throw devices, with normally open fully adjustable contacts.

The following pressure switches shall be furnished and installed:

- A) Tag PS-101 Deaerator Low Pressure
Pressure range 0 to 60 psig
Requires over-range protection to 100 psig
Set to alarm at 10 psig on decreasing pressure.
- B) Tag PS-113 Main Steam Low Pressure
Pressure range 0 to 600 psig
Set to alarm at 400 psig on decreasing pressure.
- C) Tag PS-114 Feedwater Low Pressure
Pressure range 0 to 900 psig
Set to alarm at 550 psig on decreasing pressure.
- D) Tag PS-115 Lube Oil Pump Low Pressure
Pressure range 0 to 60 psig
Set to alarm at 25 psig on decreasing pressure.

- E) Tag PS-116 Service Water Pump Low Pressure
Pressure range 0 to 100 psig
Set to alarm at 40 psig on decreasing pressure.
- F) Tag PS-119 Atomizing Steam Low Pressure
Pressure range 0 to 160 psig
Set to alarm at 25 psig on decreasing pressure.
- G) Tag PS-120 Atomizing Air Low Pressure
Pressure range 0 to 100 psig
Set to alarm at 75 psig on decreasing pressure.

4.3.4 Thermometers: Thermometers of the separable socket type shall be provided and installed where indicated on the drawings and where specified herein.

Thermometers shall have 9 inch scales and stems of approved lengths required for representative indication of fluid temperatures. Thermometers shall be red reading mercury filled and have lens type tubing for easy reading. Thermometer forms shall be selected and thermometers shall be mounted in a manner so that they are readily readable. Ranges, stem lengths and extension necks shall be as indicated on the drawings. The thermometers shall be accurate to one minor scale division. Each thermometer shall be tested and certified. Sockets shall be 1" NPT of ASTM A182-F6.

4.3.5 Control Valves and Regulators: Control valves and regulators shall be supplied in accordance with Table "A". All valves and regulators must be approved. All valves and regulators shall be installed as shown on the drawings. Supply air sets shall be furnished and installed for all pneumatic valves. Valves bodies shall be rated for the pressures and temperatures specified under the design conditions for the systems in which they are to be installed.

TABLE "A"

Mark No.	MWV-106	MWV-1	CONDV-105	FEDF-110-1, & 2
End Connections, Size	4"	8"	6"	2"
End Connections, Style	125# FL.	125# FL.	125# FL.	S.W.E.
Body Material	A126 C.I. C.I.B	A126 C.I. C.I.B	A126 C.I. C.I.B	600# C. S. A126 C.I. C.I.B A216 WCB
Trim Material	316 SS	316 SS	S.S.	316 SS, Stainless Steel
Inner Valve	Double Seated	Double Seated	Double Seated	Single Seated
Inner Valve Characteristic	V-Port	Equal Percentage	Equal Percentage	Open-Flow
Action on Air Failure	Open	Open	Close	Open
Guide	Top & Bottom	Top & Bottom	Top & Bottom	Top & Bottom
Cooling Fins	No	No	No	No
Travel Indicator	Yes	Yes	Yes	Yes
Handjack	Yes	Yes	Yes	No
Positioning Relay	Yes	Yes	Yes	No
Fluid thru Valve	Water	Water	Water	Water
Fluid Temperature °F	100	100	100	150
Inlet Pressure Psig	35	40	50	800
Pressure Drop Psi	41	25	10	750 on opening and closing; 100 in service
Maximum Flow Rate #/Hr	225,000	1,000,000	550,000	200,000
Normal Flow Rate #/Hr	201,000	- -	300,000	200,000
Cv	97	400	340	150
Use	Normal Deaerator Level Control	Emergency Deaerator Level Control	Level Control Hotwell	Feedwater Pump Recirculation 3 valves regulated by computer and panel switches for level control

TABLE "A" (CONT'D)

Mark No.	FOSV-109	SAV-103	CASV-106 CASV-108	LFV 109
End Connections, Size	2"	6"	4"	2"
End Connections, Style	S.W.E.	125# Fl.	125# Fl.	300# Flanged
Body Material	A105 Cl.2 or A216 WCB	A126 Cl.B	C.I. A126 Cl.B	A105 Cl.2 or A216 WCB
Trim Material	SS	SS	SS	SS
Inner Valve	Single	Single	Double Seat	Double Seat
Inner Valve Characteristic	On-Off	On-Off	V-Port	V-Port
Action on Air Failure	Close	Close	Close	---
Guide	---	---	Top & Bottom	---
Cooling Fins	No	No	No	No
Travel Indicator	Yes	Yes	Yes	Yes
Handjack	Yes	No	No	No
Positioning Relay	No	No	No	No
Fluid thru Valve	#6 Oil	Air	Air	Steam
Fluid Temperature °F	180	70	70	350
Inlet Pressure Psig	100	115	100	55
Pressure Drop Psi	---	---	10	40
Maximum Flow Rate	---	---	700 scfm	3000 #/Hr
Normal Flow Rate #/Hr	---	---	---	2800
Cv	---	---	---	40
Use	On-Off Control	On-Off Control	Air Backup Provide and mount Press Controller on Yoke. Range 0-100 psig. Adjustable Proportional Band 1-100% required. Ad- justable set point over en- tire range.	Steam Pressure Reducing Regu- lator. Adjust- table range of control: 0 to 30 psig.

TABLE "A" (CONT'D)

Mark No.	HPV-112	HPV-101	HPV-107 & 108	HPV-118 HPV-119
End Connections, Size	8"	14"	10 x 12	1-3/4"
End Connections, Style	Weld	Weld	Weld	Flanged
Body Material	A105 Cl.2 or A216 WCB	A105 Cl.2 or A216 WCB	A105 Cl.2 or A216 WCB	A105 Cl.2 or A216 WCB
Trim Material	410 SS Stellite Seat & Disc	410 SS	410 SS Stellite Stem & Inner Seat Piston Operator	SS
Inner Valve	Double Seated	Double Seated	Double Seated Reduced 8" Trim	Single Seated
Inner Valve Characteristic	Equal Per- centage	Equal Per- centage	V-Port	Equal Per- centage
Action on Air Failure	Close	Close	Open	--
Guide	Top & Bottom	Top & Bottom	Top & Bottom	--
Cooling Fins	Yes	No	Yes	--
Travel Indicator	Yes	Yes	Yes	Yes
Handjack	Yes	Yes	Yes	No

Mark No.	TABLE "A" (CONT'D)			
	HPV-112	HPV-101	HPV-107 & 108	HPV-118 & 119
Positioning Relay	Yes	Yes	Yes	No
Fluid thru Valve	Steam	Steam	Steam	Steam
Fluid Temperature °F	460	303	460	460
Inlet Pressure Psig	450	55	450	450
Pressure Drop Psi	435	40	395	30
Maximum Flow Rate #/Hr	195,000	195,000	300,000	3,700
Normal Flow Rate #/Hr	175,000	175,000	300,000	3,100
Cv	280	1,850	--	--
Use	Pressure Control Standby to Deaerator	Pressure Control to Deaerator	Pressure Red. Main Steam. 2 Valves Re- quired	F.O. Temp. Regulator Complete with 1" NPT Separable Socket Gas Filled Bulb. Supply 1 Valve with 20 ft. of Capillary; Other with 15 ft. Temp. Control Range 120 to 220°F.

4.3.6 Level Switches: Level switches shall be supplied and installed as shown on the drawings. Switches shall be magnetically operated external float type. Cages shall be designed for 125# service at 250°F. Cages shall be AL26 CL. B. Ball floats shall be 304 S.S. Switches shall be adjustable SPDT rated for 125 V d-c operation. Units shall be Magtrol Model 126 C, or approved equal.

1. Mark L.S.-101 Deaerator High Level
2. Mark L.S.-102 Deaerator Low Level
3. Mark L.S.-103 Hotwell High Level
4. Mark L.S.-104 Hotwell Low Level

4.3.7 Feedwater Pump Recirculation Controls: The following components required for automatic feedwater pump recirculation shall be furnished and installed:

A) Three (3) orifice plates (Tag S-105-1, 2 and 3). These shall be sized for insertion in 8 inch schedule 80 lines. Tabs shall be marked on upstream sides with orifice data. Upstream operating pressure is 550 psig; temperature is 250°F. Plates shall be 304 S.S. designed for vena-contracta taps, and shall be supplied complete with leveling rods, nipples and adapters. Plates shall be sized for a flow of 1000 gpm each at a differential of 100 inches of water.

B) Three (3) indicating type flow transmitters to indicate actual flow. Flow transmitters must be designed for 900 psig at 250°F when either side is vented. Transmitters shall be provided with three (3) independently adjustable normally open 125 V d-c contacts (close on decrease in flow) which shall actuate solenoid valves to effect recirculation through valves FPDV-110-1, 2 & 3 and actuate the Buyer's low flow alarm circuit. Recirculation shall normally be actuated when individual

pump flow falls below 250 gpm, and shall be discontinued on the establishment of pump flow rates above 270 gpm. Low flow alarm contact shall be set to close at a nominal flow of 240 gpm.

C) Three (3) three-way air solenoid valves rated for 125 V ac service to actuate the air diaphragm recirculation valves specified under Table "A".

4.3.8 Auxiliary Steam Orifice Plate: One (1) orifice plate for auxiliary steam flow measurement. (Tag S-113) Tag shall be marked on upstream side with plate data. Plate shall be 304 SS, sized for insertion in a 4" Sch. 40 pipe. Upstream operating pressure is 450 psig; temperature is 460°F. Plate shall be sized for a flow of 8,000 lbs of steam per hour at 50 inches of water drop using vena-contra taps, and shall be supplied with nipples and adapters.

4.3.9 No. 2 Fuel Oil Meter: A wobble plate type meter shall be supplied and installed as shown on the drawings for the metering of No. 2 fuel oil. Meter shall be supplied with 1-1/2" screwed ends, and shall be provided with an integrator which shall have a protective cover. Maximum pressure drop at maximum rate of flow of 12 gpm shall be 5 psig. Oil metering temperature is 60°F.

4.3.10 Air Conditioning Controls: Control of the air conditioning unit shall be by means of an electrically operated thermostat. Thermostat shall be of the indicating air stream gas filled bulb type. It shall be arranged to start the conditioning compressor on increasing duct temperature. Range of temperature set point adjustment shall be at least from 60 to 90°F.

The packaged conditioning unit controls shall provide for interlocking of the fan and outside air damper, so that upon start of the circulation fan, the outside air damper shall open. Damper shall be spring loaded to close and shall close coincident with circulating fan shutoff.

4.3.11 Heating and Ventilation Controls: Electrically operated thermostats shall be furnished and installed as shown on drawings for unit heater fan actuation on decreasing temperature. Range of temperature settings shall be at least 55 to 85°F, with a 3°F maximum control differential.

Pneumatically operated thermostats shall be furnished and installed to pneumatically actuate steam supply valves serving unit heaters 12 through 17 inclusive, and all convectors as shown on the drawings. Thermostat control characteristics shall be as specified above.

The following pneumatic actuated control valves shall be supplied and installed as shown on the drawings. Valves shall be thermostat actuated as schematically shown on the drawings.

<u>Tag</u>	<u>Size</u>	<u>Number Required</u>
LPV-106	1-1/2"	4
LPV-107	3/4"	4

Valves designated LPV-106 shall have a pneumatic operator to match signal of thermostat and shall be of the modulating type. Inlet pressure shall be 15 psig, maximum downstream pressure shall be 10 psig. Capacities shall be as shown on the drawings.

Valves designated LPV-107 shall be pneumatically actuated open-shut valves. They shall be sized for a 15 psig inlet and 3 psig drop through the valve. Valve capacities shall be in accordance with the convector requirements given on the drawings.

Valve bodies shall conform to requirements specified under Section 4.5.7, Group VI.
1849

4.4 Pipe and Equipment Hangers, Supports, Anchors and Guides

4.4.1 General

This section covers the design, furnishing, and erection of all pipe supports.

For this specification, the term "pipe support" shall pertain to any means required to support the dead weight of a pipe, control its movement or provide restraint due to earthquake. Pipe shoes, pipe supports, pipe hangers, pipe anchors, pipe guides, pipe spring supports, pipe vibration dampeners, sway braces, beam clamps, pipe support brackets, structural members less than six feet in length required to support a pipe and all required nuts and bolts shall apply to the term "pipe support".

4.2 Design

The design of all pipe supports shall be in accordance with the requirements of the ASA Code for Pressure Piping B-31.1, Section 6, Chapter 1 and as supplemented by these specifications.

All pipe supports shall be designed to withstand a lateral force produced by an horizontal acceleration due to earthquake. The magnitude of the horizontal force shall be equal to 0.2 times the dead load sustained by the pipe support.

The dead load for earthquake design for all pipe supports shall be the sum of the following; the weight of the pipe filled with water plus included valves and flanges, plus the estimated weight of insulation.

All pipe supports using springs shall be provided with emergency stops designed to support the weight of the pipe when filled with water.

This is especially important for steam lines that will normally operate without this additional load.

Attachments to be welded to the pipe shall be held to a minimum and are to be used only when other means are impracticable. Such attachments, when required, shall be stress relieved. Shop stress relieving is preferred and shall be used whenever possible.

Required pipe anchors and guides are shown on the drawings. The detailed design of these anchors and guides shall be approved. Additional anchors and guides installed by the Subcontractor shall be approved for design and location.

Long vertical pipes shall be supported at a point of zero vertical movement whenever possible.

Vertical piping that must be supported by its horizontal runs shall have the supports so located that the sum of the cantilever lengths shall be equal to one half the allowable maximum spacing for horizontal supports.

Pipe subjected to a vertical movement of two inches or greater shall be supported by a constant support type spring.

It shall be the responsibility of the Subcontractor to locate and design all supports so as to avoid interference with other piping, electrical conduits and their supports, structural members and all other equipment.

The maximum load to be supported by any one pipe support shall be limited to 12,000 lbs.

4.4.3 Materials

All materials used in the fabrication of pipe supports shall conform to the requirements of the ASA Code for Pressure Piping Section 6, Chapter 1.

All welding shall be performed in compliance with Section IX of the ASME Boiler and Pressure Vessel Code.

All pipe supports, after fabrication, shall be given a protective coating of zinc chromate primer.

4.5 Valves

This section covers the service requirements and details of the valves and operators where specified, to be provided under this specification.

The valves are listed on the drawings and shall be in accordance with the classifications and descriptions specified herein and the design conditions for the individual systems described under Section 4.8 through Section 4.20 of this specification. Where a valve connects two systems having different design conditions the valve shall be in accordance with the system having the higher design conditions irrespective of valve mark number.

Technical terminology, codes and standards for the valves, motor operators and accessories shall be in accordance with Section 4.2 of this specification.

4.5.1 Materials

ASTM Specifications for materials appearing herein for each valve shall be considered minimum requirements. Alternate valve materials are acceptable providing the new materials meet the minimum requirements as specified for each valve. Such alternate materials must be approved.

4.5.2 Construction Features

a. All globe and gate valves shall have outside screw and yoke, except that bronze valves shall have rising stems.

b. Weld end valves shall have weld ends prepared as shown on the drawings.

c. Check valves shall be horizontal swing type with bolted bonnets for sizes 2-1/2" and larger, and lift type or horizontal swing type with bolted or union bonnet for sizes 2" and smaller.

d. Valves shall be designed for repacking at full rated pressure with valve open.

e. Gate valves shall have solid wedges, globe valves shall have swivel plugs unless otherwise noted on the valve list.

f. Bypasses are required on all gate and globe valves 8" and larger for 300 lb pressure rating valves and above. Bypasses shall consist of 1" Schedule 80 pipe and a 1" globe valve of same or higher pressure rating as the main valve.

g. Flanged end valves, of the same pressure rating and type, shall be substituted for weld end valves where the drawing shows the valve directly connected to a flanged connection on equipment.

h. Limit switches shall be provided on the valves as called for on the valve list. Switches shall be rated for 10 amperes at 120 volts AC.

i. Where chain operators are called for on the valve list, chain and sprocket chainwheel with chain guides shall be provided. Chainwheel shall replace the handwheel. The length of chain required shall be determined from the valve location given on the piping drawings.

j. Where bevel gearing is called for on the valve list, the pinion gear shaft shall be at right angle to the run of the valve unless otherwise noted on the piping drawings. Chain operators for bevel geared valves shall be in accordance with Item i above.

k. Valves with welding ends to be suitable for welding to piping material.

4.5.3 Testing

All valves shall be hydrostatically tested in accordance with ASA Standards for the test pressure specified for the individual system description under Section 4.8 through Section 4.20 of this specification.

4.5.4 Classifications of Gate, Globe and Check Valves

Unless otherwise noted in this specification or on the drawings, all gate, globe and check valves shall conform to the following table. In addition all gate and globe valves having motor operators shall also conform to the following table. Electrical motor operators shall be in accordance with Section 4.5.6 of this specification.

<u>Spec. Section</u>	<u>System Designation</u>	<u>Valves 2" and Smaller</u>	<u>Valves 2-1/2" and Larger</u>
4.8	HP	Group V	Group II
4.8	HP-1	Group V	Group III
4.8	LP	Group VI	Group III
4.9	FPD	Group V	Group I
4.9	FPS	Group V	Group III
4.9	COND	Group VI	Group III
4.9	COND-5	Group VI	Group III
4.9	MW	Group VI	Group IV
4.10	FOS	Group V	Group III
4.10	FOS-1	Group V	Group IV
4.10	FOR	Group V	Group III
4.10	IO	Group V	Group IV

<u>Spec. Section</u>	<u>System Designation</u>	<u>Valves 2" and Smaller</u>	<u>Valves 2-1/2" and Larger</u>
4.11	CAS	Group VI	Group IV
4.11	CAB	Group VI	Group IV
4.11	SA	Group VI	Group IV
4.12	RWS	Group VI	Group IV
4.12	RWR	Group VI	Group IV
4.13	F	Group VI	Group IV
4.14	9-MO	Group V	Group III
4.14	12-HY	Group V	Group III
4.15	HPR	Group V	Group II
4.15	LPR	Group VI	Group IV
4.16	LO	Group V	Group II
4.16	VT-1, LO-1	Group V	Group IV
4.17	LP	Group VI	Group IV
4.17	LPR	Group VI	Group IV
4.17	COND	Group VI	Group IV
4.18	DR	Group VI	Group IV
4.18	VT	Group VI	Group IV
4.18	AE	Group VI	Group IV
4.19	BD	Group V	Group II
4.20	RWS	Group VI	Group IV
4.20	RWR	Group VI	Group IV

4.5.5 Valve Descriptions

Group I

Size Range:	2-1/2" and larger		
Class:	400# or 600#		
Type:	OS & Y		
Body & Bonnet:	Cast Carbon Steel ASTM-A-216 Gr WCB		
Body Joint:	Bolted		
Seat & Disc. Facing:	Stellite		
Stem:	13% Chrome Steel ASTM-A-182 F-6		
End Connection:	Butt Welding or flanged		
Mfg. & Fig. No.	Gate	Globe	Check
a. Edwards	611	618	690
b. Lunkenheimer	1500	1467	1495
c. Pacific	450	460	480
d. Powell	4003/6003	4031/6031	4061/6061
e. Walworth	5218/5232	5288/5350	5347/5295.

Group II

Size Range: 2-1/2" and larger

Class: 300#

Type: OS & Y

Body & Bonnet: Cast Carbon Steel ASTM A-216 Gr WGB

Body Joint: Bolted

Seat & Disc Facing: Stellite

Stem: 13% Chrome Steel ASTM A-182 F-6

End Connection: Butt Welding or Flanged

Mf. & Fig. No.	Gate	Globe	Check
a. Edwards	311	6518	6597
b. Lunkenheimer	1938	1600	1491
c. Pacific	350	360	380
d. Walworth	5206	5281	5344

Group III

Size Range:	2-1/2" and larger		
Class:	150#		
Type:	OS & Y		
Body & Bonnet:	Cast Carbon Steel ASTM A-216 Gr WCB		
Body Joint:	Bolted		
Seat & Disc Facing:	13% Chrome Steel ASTM A-182 F-6		
Stem:	13% Chrome Steel ASTM A-182 F-6		
End Connection:	Butt Welding or Flanged		
Mfg. & Fig. No.	Gate	Globe	Check
a. Lunkheimer	1751	1755	1759
b. Pacific	150	160	180
c. Powell	1503	1531	1561
d. Walworth	5202	5275	5341

Group IV

Size Range:	2-1/2" and larger		
Class:	125#		
Type:	OS & Y		
Body & Bonnet:	Iron ASTM - A-126 Cl. B		
Body Joint:	Bolted		
Seat & Disc Facing:	Bronze B-61		
Stem:	Bronze B-61		
End Connection:	Flanged		
Mfg. & Fig. No.	Gate	Globe	Check
a. Lunkenheim	1430	1123	1790
b. Powell	1793	241	559
c. Walworth	726	906	928

Group V

Size Range:	2" and smaller	
Class:	600#	
Type:	OS & Y	
Body and Bonnet:	Forged Carbon Steel ASTM-A-105 Gr. II	
Body Joint:	Bolted or Union	
Seat & Disc Facing:	13% Chrome Steel ASTM A-182-F-6	
Stem:	13% Chrome Steel ASTM A-182-F-6	
End Connection:	Socket Welding	Screwed
Mfg. & Fig. No.	Globe	Check
a. Edwards	848/448Z	4638/2678
b. Hancock	5500	5540
c. Lunkenheimer	1775	_____
d. Pacific	3661/3662	3680/3681

Group VI

Size Range:	2" and smaller	
Class:	200#	
Type:	Rising Stem	
Body & Bonnet:	Bronze ASTM B-61	
Body Joint:	Union	
Seat & Disc Facing:	Bronze ASTM B-61	
Stem:	Bronze ASTM B-61	
End Connection:	Screwed	
Mfg. & Fig. No.	Globe	Check
a. Hancock	4620	4570
b. Lunkenheim	407	414
c. Powell	110	560
d. Walworth	245	420

4.5.6 Electrical Equipment

Valve operating units shall be provided on all motor operated valves called for in the valve list and shall include a high starting torque motor, reduction gear, adjustable limit switches, adjustable torque switches, a hand wheel for manual operation, an integrally mounted mechanical position indicator and a slide wire position transmitter. Each valve operating unit shall be provided as a completely wired integral unit. A valve control unit shall be provided with each electrically operated valve and shall include a push button station with indicating lights and a reversing controller. Reversing controllers may be mounted as an integral part of the valve operating unit if this is the manufacturer's standard, otherwise reversing controllers shall be provided as separate, enclosed units. The push button and indicating lights shall be mounted in an enclosure separate from both the reversing controller and the valve operating unit. The valve operating units shall be as made by Philadelphia Gear Works, Inc., Hupp Aviation Company or approved equal. The valve control units shall be General Electric, Square-D, Philadelphia Gear Works, Inc., Cutler Hammer or approved equal. Provisions on valve operating and control units shall be included for valve position indicating lights and actuators at remote locations.

The valve operating unit shall open or close the valve against design flow conditions indicated on the valve schedule. Minimum stem speed shall be 4"/min for globe valves and 12"/min for gate valves.

Adjustable torque responsive switches shall assure power cut-off in the event that motors are overloaded when the valve movements are restricted. They shall be operative for both opening and closing directions of travel and shall be separately adjustable for torque in either direction.

Adjustable geared limit switches shall prevent overtravel of the valve disc in either direction of travel.

Six additional separately adjustable geared limit switch contacts shall also be provided; three contacts shall close in the valve closed position and three contacts shall close in the valve fully open position. Switches shall be rated for 10 amperes at 120 volts AC.

Voltage supply for slide wire position transmitters will be 125 volts DC.

Provisions shall be made to allow automatic disengagement of the handwheel when the motor is energized.

The high starting torque motors shall be of totally enclosed, ball bearing construction for operation on a 440 volt, 3 phase, 60 cycle AC system. The motors shall be designed for across the line starting.

All motors shall conform to the standards of the AIEE and NEMA and shall meet with the requirements of the American Standards Association. Motor insulation shall be Class "A".

Alternating current valve motor reversing controllers shall be provided, each equipped with a 440-110 volt control transformer. One side of the 110 volt control transformer secondary shall be fused, and the other wired to an external terminal block for connection to ground.

Reversing controllers and pushbuttons shall be provided with a double line break type of control. Reversing controllers shall be completely wired, with overload relays with manual reset, and with two mechanically interlocked contactors, each with two normally open

electrical interlock contacts. All motor reversing controllers shall conform to NEMA standards.

Each pushbutton station shall include a closing, an opening, and a stop button, and a red and green indicating light to show valve position. The red light shall be energized when the valve is fully open. The green light shall be energized when the valve is in the fully closed position. Both lights shall be energized in the intermediate positions.

4.5.7 Special Valve

The following valve shall be furnished and installed by the Subcontractor and forms part of system designated AE.

One (1) 3" bolted gland type, transflo pattern, 3 way, 2 port semi steel lubricated plug valve having body material conforming to ASTM A126 with 125 lb. ASA flanged ends and handwheel.

Mark No. AEV-104

4.5.8 Relief Valve

Relief valve for system designated LP shall be furnished and installed by the Subcontractor and shall conform to the following:

Mark No.	LPV-110
Fluid	Steam
Relieving Capacity	2500 #/Hr.
Set Pressure	30 psig
Outlet Pressure	Atmos
Model	1905 JC
Size	2 x 3
Ends	Flanged(150# Inlet & 150# Outlet)
Make	Consolidated or approved equal.

4.5 Spigots

All spigots shall be provided and installed as indicated in drawings and shall be designed for the pressures, temperatures, and fluid of the particular system in which they are installed.

All spigots shall be color coded in accordance with the particular system in which they are installed.

4.6.1 Sight Flow Indicators

Sight flow indicators shall be furnished and installed in the cooling water return lines from all coolers, which connect into the closed cooling water return system. Indicators shall have brass bodies with screw-in connections, rotating wheel, glass covers and gaskets on both sides as manufactured by the OPW Corporation or approved equal.

4.6.2 Strainers

All strainers except S-124 shall be Y-pattern type with stainless steel screens. The flow shall be into the screen basket and out through the perforations. The bodies shall have arrows clearly cast on the sides to indicate direction of flow. End connections shall be either screwed, socket weld or flanged in accordance with the end requirements of the fittings for the particular systems given in Section 4.2. Net free area of the screen shall be at least 4 times that of the entering pipe. Strainers shall be Zurn Fig. No. K540 or approved equal.

A) Steam strainers for systems designated HF, HFR, BD shall be cast carbon steel body with 1/16" screen perforations.

B) Steam strainers for systems designated LP, LPR shall be bronze body with 1/16" screen perforations.

C) Oil strainers for systems designated FOS, FOR, IO shall be cast carbon steel body with 1/16" screen perforations.

D) Water strainers for systems designated RWS, RWR shall be bronze body with 1/16" screen perforations.

E) Strainer designated S-124 for installation at the water inlet to the service water pumps shall be a duplex gate type stainer, semi-steel body, stainless steel baskets with 5/32" diameter perforations, designed for 125 lb operating pressure, flanges faced and drilled to 125 lb ASA standard, as manufactured by Zurn Fig. No. 570 FBS, Elliot Type AL or approved equal.

Maximum flow through the strainer will be 1,000 gpm, and the pressure loss through the strainer when 50% clogged shall not exceed 2.0 psi .

4.6.3 Expansion Joints

Expansion joints marked S-131 shall be of the flanged rubber bellows spool type for installation in the systems designated RWS and RWR as shown on the drawings.

Flanges shall be split retaining ring type drilled for 125 lb ASA and fabricated of galvanized steel.

All joints shall have a face to face dimension of 12 inches and shall be designed for a lateral displacement at installation and during operation of not less than 1/8 inch.

Each joint shall be designed for the conditions specified in Section 4.20 of this specification.

Expansion joints shall be similar to U.S. Rubber Company number CH4200 or approved equal.

Expansion joints marked S-110 shall be of the non-equalizing type, with two (2) stainless steel bellows, flanges faced and drilled to 125 lb ASA standard. Joint shall be designed for a working pressure of 50 psig, Fig. No. 8 Zallea or approved equal.

4.6.4 Air Outlets

Quick disconnects for installation in system designated SA and marked service air outlets on the drawings shall be Hansen Manufacturing Company or approved equal steel sockets with 150 psig design pressure rating and the following requirements:

- A - Hansen Type 3-R 26 female threads for 1/2" pipe
- B - Hansen Type 3-R 31 female threads for 3/4" pipe
- C - Hansen Series 6000 No. 6600 female threads for 1" pipe

4.6.5 Water Separator

The water separator designated by S-109 is to be installed in the 10" primary flash pipe vent. Connections are to be bottom inlet top outlet, flanged, faced and drilled to 125 lb ASA standard. The water separator drain connection shall be 1-1/2" screwed.

The normal pressure in the flash pipe will be approximately 1-1/2 psig. Maximum flow of saturated steam through the separator will be approximately 50,000 lbs per hr.

4.6.6 Sump Pit Cover Plate

The following sump pit cover plate shall be furnished and installed by the Subcontractor as shown on the drawing.

The clear opening of the sump pit is 4'-0" x 8'-0". The imbedded curb angles for supporting the cover plate are 2 x 2 x 1/4".

The cover plate shall be 4'-3" x 8'-3", reinforced as required for a floor loading of 300 lbs per sq. ft. Subcontractor shall provide and bolt the cover plate to the imbedded angles with 3/8" diameter bronze tap bolts, with flattened heads, at a maximum spacing of 2'-6". Subcontractor shall field drill, tap and countersink the imbedded angles and cover plate as required for bolting.

The cover plate material shall conform to Specification ASTM A7. Openings shall be provided in the cover for installation of the sump pumps and accessories. A hinged manhole cover shall also be provided at the northwest corner of the sump pit cover.

4.6.7 Traps

A. All traps for system designated HPR which bear Mark No. S-114 shall be of the inverted bucket type having forged steel bodies with 1" socket weld inlet and outlet connections, and stainless steel mechanisms.

Traps shall be Armstrong #315 or approved equal with capacities equal to or greater than that indicated in Armstrong Catalog J.

B. Traps for the heating and ventilating system shall be as follows:

1. Traps in return lines from the convectors shall be of the thermostatic type having cast iron bodies and caps with screwed connections, renewable stainless steel valve head and seat, phosphor bronze thermostatic element, protecting shield. Traps shall be designed to discharge condensate at the capacities listed under trap ratings on the drawings.

2. Traps in return lines from the unit heaters shall be of the float-thermostatic type having semi-steel bodies and caps with screwed connections, stainless steel float, brass mechanism, renewable stainless steel valve head and seat. Traps shall be designed to discharge condensate at the capacities listed under trap ratings on the drawings.

4.7 Fabrication and Installation of Piping

4.7.1 General

This section covers the fabrication, installation and testing of all the piping described in this specification and shown on the drawings.

Piping provided and installed by the Subcontractor shall extend to and connect to equipment shown on the drawings.

Piping shall terminate outside the building, as indicated on the drawings. It shall then be connected to the respective service, if already installed, or capped and left ready for connection.

4.7.2 Applicable Publications: The following publications, of the issues listed below but referred to herein by basic designation only, form a part of this specification to the extent indicated by the references:

A) American Standards Association (ASA)

B2.1 Pipe Threads

B31.1 Code for Pressure Piping

B) American Water Works Association (AWWA)

C-201-50 AWWA Standard for Electric Fusion Welded Steel Water Pipe of Sizes 30 inches and over.

C-202-49 AWWA Standard for steel water pipe Sizes up to but not including 30 inches.

C-203-57 AWWA Standard for Coal Tar Enamel
Protective Coatings for Steel Water Pipe.

C-206-57 AWWA Standard for field welding of steel
water pipe joints.

C) HANFORD WORKS STANDARD (HAFO)

HW-4926-S Standard specification for Welding
Carbon Steel.

HW-5311-S Standard specification for identifi-
cation of Piping Systems.

4.7.3 Materials

Materials for piping systems shall be in accordance with
Section 4.2 of this specification.

4.7.4 Fabrication

All pipe and fittings shall be round in section and manu-
factured within the tolerances specified by the American Society for
Testing Materials (ASTM), the American Standards Association (ASA),
or the American Water Works Association (AWWA), as applicable. Fittings
shall be compatible with the wall thickness or schedule of pipe as
given in Section 4.2 of this specification. The nominal diameter
of steel pipe 14 inches and larger shall be the outside diameter.
All piping 24 inches and smaller in diameter shall be fabricated in
accordance with ASA B-31.1. All piping over 24 inches designated
HP shall be fabricated in accordance with ASA B-31.1. All other piping
30" and larger in diameter shall be fabricated in accordance with
AWWA Standard C-201.

Piping 2 inches and smaller shall be fabricated in place.
Piping larger than 2 inches shall be prefabricated.

Screwed connections will be permitted above ground for those systems which specify welded joints where it is necessary to connect to either equipment, specialties, valves or instruments having screwed connections.

All joints shall be made leaktight. The threads of all screwed joints shall conform to ASA B-2.1. A lubricant or pipe compound shall be applied to the male end of all threaded joints.

Pipe ends shall be accurately beveled by machining and/or grinding.

Stress relieving of all welded joints shall be applied in accordance with ASA-B-31.1.

In all cases where a flat face cast iron flange is to be matched to a raised face flange, the raised face of the matching flange shall be removed by machining.

Fabricator may substitute nozzle welds for tees or laterals provided reinforcement is applied where required by the applicable code and such reinforcement does not prevent the testing of these welds covered under Section 4.7.8 of this specification.

All piping 2-1/2 inches and larger for the system designated HP shall be proportionately cut short throughout the system at the rate of 0.018 inches per foot and shall be cold sprung that amount during installation of the piping.

4.7.5 Welding

A) General

Welding, including repair welding, shall be performed in accordance with the provisions of ASA B31.1 Section 6, Code for Pressure Piping except as modified herein.

B) Performance Qualification

Welder and welding operator qualifications shall be in accordance with the provisions of Specification HWS-4900-S "Standard Specification for Qualifying Welders", latest revision, for welding of pipe.

C) Procedure Qualification

Procedure qualification shall apply in accordance with the provisions specified under the ASA B31.1 Code for Pressure Piping Section 6.

D) Weld Ends

Ends of pipe and fittings shall be prepared for welding in accordance with the "Weld End Detail" drawing, Section 4.2.5 of this specification and the following table.

<u>Weld Joint Description per Section 4.2.5</u>	<u>Joint type per Weld End Detail Drawing</u>
J-1 Socket type fillet weld	I
J-2 Single-vee-groove butt weld with machine bored pipe ends, welded from one side, on a backing ring.	II
J-3 Double-vee-groove butt weld, welded from both sides	III
J-4 Single-vee-groove butt weld, welded from one side, on a backing ring	IV

Backing rings shall be of the split type with chamfered, knock-off spacer nuts for type IV weld joints and of the solid, flat machined type for type II weld joints. The upstream edge of all back-up rings shall be continuously welded to the pipe. Back up rings shall be made from the same material as the pipe to which they are welded.

Branch connections in piping designed for 600 psig pressure or greater shall be made using full penetration welds capable of being fully radiographed.

4.7.6 Installation

All piping shall be installed as shown on the drawings.

The work shall be performed in the following sequence:

- A) Excavation where required to accomodate the buried piping.
- B) Installation of piping including testing and inspection of welded field joints as covered under Section 4.7.8 of this specification.
- C) Flushing out of piping with sanitary or process water to remove debris and foreign matter.
- D) Hydrostatic test of all lines.
- E) Air purging for at least ten minutes with dry oil-free air.

All piping systems shall be kept clean during all phases of work. Open ends of uncompleted piping systems shall be protected to prevent the entrance of foreign material.

Burrs shall be removed from mating threads before assembly. Pipe shall be reamed for burr removal to the nominal inside diameter after cutting.

Valves shall neither be fully open nor fully closed while they are being welded into a system.

All valves and specialties shall be installed as shown on the drawings.

4.7.7 Pipe Hangers, Supports Anchors and Guides

Pipe hangers, supports anchors and guides shall be in accordance with Section 4.4 of this specification.

4.7.8 Inspection and Testing

A. General

Inspection by the Subcontractor shall include examination of joints prior to welding, inspection for defects during welding, and for defects, undercuts, overlay and reinforcement after welding, as specified herein.

All piping shall be hydrostatically tested at the test pressures noted in Sections 4.8 through 4.20 of this specification. Tests shall be in conformance with the Piping Codes and the following general requirements.

1. Prior to applying pressure to piping or equipment, all necessary measures shall be taken to prevent distortion of the piping or equipment by means of restraining devices.

2. All piping, valves, fittings, joints, seams and all potential leak sources shall be examined during testing. All detectable leaks shall be repaired. Defective welded joints shall be repaired.

3. All repaired piping shall be retested.

4. Duration of test shall be at least 30 minutes with no visible leaks and without loss of pressure.

5. All chips, dirt, and debris shall be removed from piping prior to testing.

6. Air shall be expelled from lines prior to applying hydrostatic test pressure.

7. Sanitary water or process water only shall be used for hydrostatic testing and oil free air or nitrogen shall be used for pneumatic testing.

8. Pressure in piping undergoing test shall be raised to the specified test pressure at a rate not to exceed 200 psi per minute.

9. Welded or screwed joints and connections and all other potential leak sources which will be hydrostatically tested shall be painted with powdered blue chalk and water mixture and allowed to dry prior to testing and before filling lines with water. Joints to be pneumatically tested shall be coated with a soap solution prior to testing. Upon completion of testing, all chalk and soap shall be removed.

10. Testing water shall be removed from piping after testing and disposed of.

B. Visual Inspection

The appearance of all welds shall be smooth and uniform. All welds shall blend smoothly into the parent metal. Sharp changes in section at the toe of any weld shall be eliminated by grinding, taking care to avoid thinning of the parent metal. In addition all welds shall be free of the following defects.

1. Cracks of any description in the weld or parent metal.
2. Slag inclusions or gas holes.
3. Cold laps in the deposited weld metal.
4. Undercutting at the edges of the weld; nor shall any of the finished face of the weld in the area of fusion of welded joints lie below the surface of the adjoining parent metal.
5. Unfilled weld craters.
6. Spaltic metal which may have been ejected from the metal arc.
7. Evidence of damage to the weld through oxidation.

C. Radiographic Examination

1. Full radiographic examination of the following welds shall be in accordance with the provisions of the ASME Unfired Pressure Vessels Code, Section VIII, Paragraph UW-51.

a. All longitudinal welds for piping fabricated in accordance with ASTM Specification A-155 Grade KC 70.

b. All longitudinal welds for fittings fabricated in accordance with ASTM Specification A-234 Grade WPB using plate of ASTM A-212 Grade B.

2. Spot (random) radiographic examination of welds, after completion of fabrication, shall be in accordance with the provisions of HWS-5766-S, "Standard Specification for Radiographic Spot Examination of Welded Joints". Such radiographic examination shall be applied to the welds selected by the Contractor to the following extent.

a. Not less than 10 percent of all the welds in the systems designed for more than 500 psig pressure.

b. Not less than 10 percent of all the welds in any pipe 24 inch and larger.

c. Not less than 5 percent of all the welds in pipes smaller than 24 inches with design pressures of 500 psig or less.

D. Magnetic Particle Examination

All welds which require full radiographic examination by these specifications shall also receive magnetic particle examination in accordance with the provisions of ASTM publication, E-109, "Tentative Method for Dry Powder Magnetic Particle Inspection".

Magnetic particle examination shall be performed at the following stages of welding.

1. On completion of each root loge.

2. On the face of the completed weld and the parent metal one (1) inch on each side of the completed weld.

Cracks and crack-like indications exposed by magnetic particle testing shall not be permitted and shall be considered unsound. Such indications shall be removed by chipping, grinding or machining to sound metal.

4.7.9 Identification: After it has been tested, piping shall be identified in accordance with Hanford Works Standard HW-5311-S and the following additional requirements.

a. All piping shall carry a legend in accordance with HW-5311-S. Piping 4" in diameter or less shall also be painted with a solid color as specified. Piping over 4" in diameter need only carry the legend.

4.8 Steam Systems

The steam is distributed throughout the building in a main high pressure system, auxiliary high pressure system, and a low pressure system.

4.8.1 Main Steam System

The main steam system designated (HP) extends from the steam generator outlet through the two main pressure reducing stations to the turbine-generator, the line to the heat exchanger building, deaerator pressure reducing valve station, building heating pressure reducing valve station and pressure reducing station for yard facility.

4.8.2 Auxiliary Steam System

The auxiliary steam system designated (HP) supplies steam to the turbine-generator condenser steam jet air ejector and hogging ejector, the heat exchanger building, fuel oil heating facilities, deaerator auxiliary pressure reducing station, atomizing steam, soot blowing system and O₂ sampling system.

4.8.3 Steam For Yard Facility

The system designated (HP-1) extends from the yard facility pressure reducing station to a point outside the building.

4.8.4 Low Pressure System

The low pressure system designated (LP) extends from the downstream side of the main and auxiliary pressure reducing stations to the deaerator and downstream side of the building heating pressure reducing station to the unit heaters and convectors.

Included as part of this heating system is the steam piping to the switchgear building.

4.8.5 Design Conditions

	<u>HP</u>	<u>HP-1</u>	<u>LP</u>
Normal Operating Pressure, psig	53 to 500	150	15
Temperature, F	310 to 470	375	330
Design Pressure, psig	600	175	100
Temperature, F	500	400	400
Test Pressure, psig	900	263	150

4.9 Feedwater, Condensate, Make-up and Fill Systems

These systems serve the turbine-generator, steam generator and heat exchanger building requirements and are distributed in high, medium and low pressure systems.

4.9.1 Feedwater System

The feedwater system extends from the deaerator to the feedwater pump suction and is designated (FPS). The pump discharge designated as (FPD) extends to the steam generator, the line to the heat exchanger building and the pump recirculation lines.

4.9.2 Condensate System

The condensate system designated (COND) extends from the condenser hotwell through the two (2) condensate pumps to the deaerator. Included as part of this system are the air ejector drains, condensate recirculation, condensate pump seal lines, deaerator drain and condensate to the turbine seal system and the chemical solution tanks. Condensate from the heat exchanger building is returned to the deaerator and is designated as (COND-5).

4.9.3 Make-up and Fill Systems

These systems designated (MW) serve the normal and emergency

makeup requirements of the deaerator and the fill requirements for the condenser hotwell, air ejector inter-condenser loop seal and sealing water for the condensate pumps at start-up.

4.9.4 Design Conditions

	<u>FPS</u>	<u>FPD</u>	<u>COND/COND-5</u> <u>1.5" Hga</u>	<u>MW</u>
Normal Operating Pressure, psig	55	740	To 100	110
Temperature, F	250	250	80 to 120	150
Design Pressure, psig	150	900	150	150
Temperature, F	300	300	150	200
Test Pressure, psig	225	1350	225	225

4.10 Fuel Oil and Ignition Oil Systems

These systems serve the burners and burner ignitors of the steam generator.

4.10.1 Fuel Oil System

The fuel oil supply system designated (FOS-1) enters the building passes to the heating and pumping set and then to the burners. The return line designated (FOR) collects the returns from the burners and heating and pumping set and leaves the building.

4.10.2 Ignition Oil System

The ignition oil system designated (IO) extends from the ignition oil day tanks to the three ignition oil pumps; from the pumps to the burner ignitors and returns to the day tank.

4.10.3 Design Conditions

	<u>FOS & FOR</u>	<u>IO & FOS-1</u>
Normal Operating Pressure, psig	10 to 180	-5 to 85
Temperature, F	120 to 220	-10 to 115
Design Pressure, psig	200	125
Temperature, F	250	120
Test Pressure, psig	300	188

4.1. Compressed Air Systems

The compressed air systems serve the service, instrument and breathing air requirements for the entire plant from the central compressor station in the power house.

4.1.1. Instrument Air System

The control air system designated (CAS) extends from the three control air compressors to a receiver. From the receiver the air is passed through a desiccant dryer and serves the power house and a line leaving the building.

4.1.2. Breathing Air System

The breathing air system designated (CAB) extends from the instrument air receiver to the line to the heat exchanger and reactor buildings.

4.1.3. Service Air System

The service air system designated (SA) extends from the one service air compressor to a receiver. From the receiver the air serves the power house, the steam generator atomizing air and a line leaving the building.

4.1.4. Design Conditions

	<u>CAS, CAB, SA</u>
Normal Operating Pressure, psig	115
Temperature, F	85
Design Pressure, psig	125
Temperature, F	100
Test Pressure, psig	188

4.12 Service and Cooling Water System

The service and cooling water system designated RWS & RWR is a closed system having its supply and return connections in the supply and return lines of the circulating water for the turbine generator condenser. The service water pumps acting as booster pumps to circulate the required quantity of water are also of sufficient capacity to serve as a back-up for the power house fire protection system. In addition, the system is to provide water for the various services as shown on the drawings.

4.12.1 Design Conditions

	<u>RWS</u> <u>RWR</u>
Normal Operating Pressure, psig	60
Temperature, F	60
Design Pressure, psig	125
Temperature, F	100
Test Pressure	188

4.13 Fire Protection System

4.13.1 Scope

This section covers the service requirements, components, and details of the fire protection system to be provided, furnished and installed by the Subcontractor.

4.13.2 Codes and Standards

Technical terminology, codes and standards for the equipment shall be in accordance with Section 4.2 herein and the following:

- A) National Fire Protection Association
- E) National Board of Fire Underwriters
- C) Underwriters' Laboratories, Inc.
- D) American Waterworks Association Standard Spec. C-100
- E) Federal Spec. . CC-1-76 Gages
- F) Federal Spec. . WW-V-51 Bronze Valves-Angle, Check & Globe
- G) Federal Spec. . WW-V-54 Bronze Valves - Gate

Specifications for materials appearing herein are to be considered as minimum requirements. Alternate materials are acceptable providing the new materials meet the minimum requirements as specified. Where a manufacturer's figure number is specified, it is to be understood that alternates are acceptable. Such alternate materials and manufacturers are subject to approval.

4.13.3 Water Supply

The water supply for the system will be from the plant fire water maintained under pressure such that a minimum of 60 psig will be available at the powerhouse valve station. Should any failure in respect this water supply, a secondary source of water is available from the two service water pumps located in the powerhouse capable of providing the powerhouse fire protection system with approximately 1000 gpm of water at 60 psig pressure.

The size of the supply mains from both the plant system and the service water pumps will be 6 inches.

4.13.4 Systems Description

A) Deluge Systems

The Subcontractor shall layout, design, furnish and install

Monitor switches are to be provided on gate valves installed immediately ahead of each deluge valve and in other locations where the closing of such valves would prevent the functioning of the system. The closing of any one of these gate valves is to sound the trouble alarm. Means are to be provided so that each system and/or section of each system in operation can be manually shut-off; gate valves are to be provided for this purpose and are also to be equipped with monitor switches. They are to be located outside the fire area in readily accessible locations for prompt operation and are to be of the C.S. & Z. type.

The air source for the pneumatic operation of the system is to be obtained from the plant control air system. Since the pressure in the plant control air system will be approximately 80-100 psig, a pressure reducing valve station is to be provided to supply and maintain the required air pressure to the fire system.

The air copper tubing is to be housed in protective steel tubing as a protection against mechanical injury.

The spray nozzles are to be of the open head type, positioned to provide coverage throughout the entire area where oil can possibly escape to or from any part of the oil system. The distribution shall be such that the discharge rate shall not be less than 0.25 gpm per square foot.

All the electrical equipment and devices provided are to be suitable for 125-volt d.c. service.

Actuation of either system deluge valve shall sound a hydraulically operated local water motor gong.

B) Sprinkler Systems?

The Subcontractor shall layout, design, furnish and install all components and accessories to provide sprinkler systems for the following areas and equipment:

- 1) Three (3) ignition oil pumps
- 2) Each lubricating oil reservoir for the three feed-water pumps
- 3) H₂ and CO₂ bottle shed
- 4) Office and lunchroom

Each of the sprinkler systems shall be designed to operate on the fixed temperature principal. A paddle-type waterflow indicator shall sound an alarm, and light a pilot light on the push-button panel, at the time of any system operation.

Alarm valves equipped with monitor switches are to be provided for each sprinkler system. Alarm valves shall be designed so that actuation of any sprinkler system will light a corresponding signal light on the push-button panel.

The nozzles are to be positioned to provide complete coverage throughout each sprinkler system area.

C) Hose Stations

Two (2) hose reels shall be provided at Columns B5. Each fire hose reel shall be provided complete with swinging wall hose reel with red enamel finish; wall brackets; 50 feet of 1-1/2 inch single jacket, cotton rubber lined, mildew resistant, all weather treated fire hose; pin lug brass hose coupling for attachment to 1-1/2" NST male connection hose valve; and detachable 1-1/2" polished bronze-non-adjustable water fog nozzle.

Fog nozzle shall be designed for operation at pressures from 60 to 115 psig. If necessary, restriction orifices shall be provided to reduce nozzle reaction to permit hose play by a single operator.

The hose shall carry both National Board of Fire Underwriters and Factory Mutual Laboratories labels.

4.13.5 System Components

The fire protection systems shall consist of but not be limited to the following items:

A) Deluge valves, as made by "Automatic Sprinkler Corp.", "Grinnell Corp." or approved equal, complete with all accessories, including:

1. Deluge Electric Air Panel, without air pump.
2. Mercury Checks.
3. Single-Acting Release.
4. Manual Pull Handle.
5. Weight Switch, double pole-double throw.
6. Compensating Vents.
7. Solenoid for Electric Operation.
8. Manual Reset Handle.

B) Wall-mounted, Central-Station Push-Button Panel, complete with all accessories, including:

1. Electric Push-Button Stations.
2. Pilot lights.
3. "Automatic-Manual" toggle switch with red light.

C) Pneumatic Rate-of-Rise Heat-actuated Devices.

D) Monitor Switch.

E) Strainer.

F) Portable Horn

1) Electric Control.

H) Electric Indicator, Panel Type, Central Station.

I) Water Spray Fire Fog Nozzles, Full cone type.

J) Electric Fire Alarm.

K) Spray-Type, Automatic Sprinklers.

L) Water Motor Alarm Long.

M) Hose Reels, 100 to 150 ft., 1-1/2" Cotton, Rubber-lined hose.

N) Single-Jacker, Cotton, Rubber-lined Hose, 1-1/2" in size
50 ft. lengths.

O) Angle Hose Valves, 1-1/2" size.

P) Hose Nozzle.

Q) Gate Valves and Alarm Valves.

4.13.6 Piping, Valves and Fittings

The Subcontractor is to provide and install all the piping, valve, fittings, hangers and accessories required for the fire systems and shall install same in accordance with NBFU Pamphlet Nos. 13 and 14. Flow diagrams or schematics prepared by the Subcontractor shall be approved.

Reduction in pipe sizes shall be made with one piece fittings, Bushings may not be used. The piping is to be supported, where required, off existing steel members. Should additional supporting steel be required for the hangers, this material shall be provided and installed by the Subcontractor. Provision is to be made in the piping systems for blowing out the systems prior to use or whenever required.

The Subcontractor shall size the pipe and equipment for the systems, subject to approval.

Material shall be in accordance with the following:

Air System to Pressure Reducing Station

Piping and Fittings - Per Section 4.2.3(D)
Valves - Bronze ASTM-61, screwed,
OS&Y, 200#

Tubing

All copper tubing for the fire protection system shall conform to the following:

General: Tubing shall be used for sizes up to but not including 3/4 inch.

Material: Copper tubing per ASTM B-63 bright annealed, seamless.

Fitting Material: Forged brass or stress relieved brass bar stock SAE-88 and SAE-72.

Fitting type: 45 degree flared End per ASA-B70.1

Wall Thickness (inch)

1/8 inch OD	.030
3/16 inch OD	.030
1/4 inch OD	.030
5/16 inch OD	.035
3/8 inch OD	.035
1/2 inch OD	.035
5/8 inch OD	.049

4.13.7 Design Conditions

The design conditions for the system designated (F) and all other systems connected thereto and described above shall be as follows:

Normal Operating Pressure	60 psig
Temperature	80 F

feedwater outlet.

4.14.2 Hydrazine System

The hydrazine system designated (12-HY) extends from the tank through the pumps and is injected into the downcomer between the deaerating heater and the storage tank.

4.14.3 Design Conditions

Normal Operating Pressure, psig	40
Temperature, F	80
Design Pressure, psig	75
Temperature, F	100
Test Pressure, psig	112

4.15 H. P. and L. P. Drips, Drains and Heating Steam Returns

4.15.1 H. P. Drips and Drains

The high pressure returns designated (HPR) collect the drips and drains from the main steam system and extend from the drip connections or drip pockets through the steam traps and collection headers to the deaerator storage tank. Also designated by (HPR) are the drips and drains from the auxilliary steam system serving the fuel oil system and extend from the drip connections through the steam traps and collection headers to waste outside of the power house.

4.15.2 L. P. Drips and Drains

The low pressure returns designated (LPR) collect the drains from the unit heaters and convectors and extend from the connections on these units through steam traps to the condensate return unit receiver described in Section 4.17.

4.15.3 Heating Steam Returns

Condensate from the heating system is collected in the condensate return unit receiver and then pumped to the deaerator storage tank. This system is designated (COND) and the design conditions are given in Section 4.3.4. Also designated (COND) and included as part of this system is the heating steam return from the switchgear building to the receiver of the condensate return unit.

4.15.4 Design Conditions

	<u>HPR</u>	<u>LPR</u>
Normal Operating Pressure, psig	55 to 450	15
Temperature, F	345 to 456	330
Design Pressure, psig	600	75
Temperature, F	500	350
Test Pressure	900	112

4.16 T. G. Lubricating Oil Purification System

4.16.1 Scope

This section covers the design requirements of the turbine oil conditioning system.

Technical terminology, codes and standards for the conditioning system shall be in accordance with Section 4.3.7 of this specification.

4.16.2 Equipment Components

The conditioning system shall consist of but not be limited to the following components:

A. One Dry-Type Conditioner #2 Bowser Fig. 832-P consisting of three compartments as follows:

1. A pre-precipitation compartment having a holding capacity

of 33 gallons and fitted with automatic water ejector for removal of free water.

2. A primary filtration compartment for removal of contaminants prior to storage, having removable filter units with two sets of cloth bags, one set being a spare.

3. A storage compartment sized for 150 gal of oil flow-back. Contained therein shall be a secondary filter, Bowser Fig. 836-10, with 2 sets of cellulose cartridges, one set being a spare, for particle selection down to a minimum of two microns in size and for removing vapor haze for dry oil delivery to the turbine oil reservoir.

4. A vapor extractor to prevent condensation of atmospheric moisture from the air above the oil in all three compartments of the conditioner.

5. Two 4-1/2 inch, 0-60 psi pressure gauges for mounting on the inlet and outlet lines of the polishing filter.

B. A vacuum vented sight overflow, 2" Bowser Fig. 825-2.

C. A line sight flow indicator, 1" Bowser Fig. 55A.

D. Two positive displacement, herringbone gear type, filtered lube oil pumps, Bowser 1/2" Fig. 840-AM.

E. A single compartment oil storage tank of 1200 gal. capacity Bowser Fig. 363.

Each pump shall be complete from suction to discharge together with required accessories and shall include:

1. Common bedplate for pump and electric motor drive with sloping drip pocket.

2. Electric motor driver.

3. Coupling and coupling guard between pump and motor.

Coupling shall be Thomas or approved equal.

4. External pump relief valve.

4.16.3 Design Conditions

The oil conditioning system shall be designed for the following:

A. Conditioner

The conditioner shall be designed to continuously purify a minimum of 250 gallons per hour of turbine oil in accordance with recommendations of the "Turbine Oil Committee" of the ASTM.

The oil will flow by gravity to the conditioner and be returned to the turbine oil reservoir by the circulating oil pumps

B. Pumps

The circulating oil pumps shall be designed for the following:

Suction Head, ft	flooded
Discharge Head, ft	50 ft, minimum

Normally, one pump will operate continuously for oil purification with the other pump as standby. When transferring oil from the storage tank to the turbine oil reservoir the pumps will operate in parallel.

4.16.4 Construction Features

A. The conditioner shall be a triple compartmented, all welded rectangular steel container, and shall have:

1. A precipitation compartment containing a series of 16 mesh screen baffles through which the oil passes in an upward

path. The free water precipitated from the oil is to settle down to a hopper type tank bottom from which it is to be ejected automatically.

2. A filtration compartment containing cloth covered filtering units with the oil flow from outside through to the inside of the filter elements. A head gauge, graduated in inches, shall be provided on the outside to indicate necessity for changing bags. This unit shall be so designed that the filter elements may be removed one at a time when fouled, for clean bag replacement.

3. A storage compartment in which shall be located secondary polishing filters through which the oil is pumped from this compartment to the turbine oil reservoir. The oil is to flow radially inward through the filters.

The filters shall have two by-passes: One through a relief valve or automatic by-pass to open at a preset differential pressure; the other to be a manual by-pass including two valves on either side. As the filter is constantly operating under pressure it cannot be cleaned unless isolated from the line. These secondary filters shall handle flow from the two pumps when functioning as transfer medium from storage tank to reservoir.

B. On the top of the conditioner, on two opposite sides, shall be located screened louvres to admit air to replace that extracted by the vent fan.

C. The line flow sight shall be of bronze with a clear vision double window of heavy plate glass. This fitting shall have a nozzle on the inlet side to prevent the oil from contacting glass and shall have

Female threads on inlet and discharge sides.

D. The oil storage tank shall be made of 3/16 inch min. plate steel welded throughout and provided complete with floating suction, thermometer, protected glass oil gauge, inlet, drain, cleanout, deep suction, vent and fill connections, test cock, 15 inch manhole with removable cover, steam coil and a flame arrester for tank vent.

4.16.5 Motors

All motors shall be explosion proof, squirrel cage induction type with continuous duty rating. Motors below one-half horsepower capacity shall be rated 110 volts, 60 cycles, single phase. Motors one-half horsepower and larger in capacity shall be rated at 440 volts, 60 cycles, three-phase.

Motor windings shall be insulated with NEMA class A materials. When operating at continuous full load current, the motor temperature rise shall be limited to 55C by thermometer above an ambient temperature of 40C. Motors shall be capable of across the line starting and shall have normal starting torque and low starting current characteristics unless other characteristics are required by the application.

4.16.6 Painting

The conditioner and storage tank shall be sandblasted and finished in Metalastic Grey rust resistant paint or approved equal on all external surfaces.

The internal surfaces shall be freed of all foreign matter such as rust and moisture by sandblasting and given two coats of corrosion preventive sealer impervious to oxidation and rust inhibitors

contained in the turbine oil. "Rust-Ban" shall be used for the storage tank and "Heresite" for the condenser.

4.16.7 Piping

The system is designated by (LO & LO-1) and the vents by (VT-1) with the following design conditions:

	<u>LO</u>	<u>LO-1</u> <u>VT-1</u>
Normal operating pressure, psig	25	15
Temperature, F	180	180
Design pressure, psig	300	75
Temperature, F	200	200
Test pressure, psig	450	113

4.17 Heating, Ventilation and Air Conditioning Systems

4.17.1 General

A. Equipment to be furnished and installed by the Subcontractor shall include all components of the heating, ventilating and air conditioning systems as shown on the drawings and as specified herein.

These components shall include, but not be limited to, unit heaters, convectors, fans, packaged air conditioner, ductwork, piping and piping accessories for water, steam and condensate lines. Systems shall be designed for continuous operation and shall conform to the requirements specified in pamphlet No. 90 of the National Board of Fire Underwriters. Equipment, pipe and duct arrangements shall provide clearances for entry, servicing and maintenance, as approved by the Contractor.

B. Standard products: The equipment to be furnished under these specifications shall be standard manufactured products. Where

two or more units of the same class of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the system need not be the products of the same manufacturer.

C. Workmanship: Equipment and material shall be installed in accordance with the drawings, with these specifications and with manufacturers' recommendations. Workmanship will be inspected periodically and shall be subject to the approval of the Contractor.

D. Prevention of Rust: If not otherwise specified, all surfaces of ferrous sheetmetal covered in this section shall be given a rust-inhibiting treatment. The rust-inhibiting treatment shall consist of hot-dip galvanizing after fabrication, or bonderizing followed by the application of a rust-inhibiting primer and finish paint.

E. Applicable Publications: The following publications, referred to hereinafter by basic designation only, form a part of this specification to the extent indicated by the references thereto.

1. Federal Specifications:

QQ-I-716 & Am-3	Iron and Steel, Sheets, Zinc-coated (Galvanized)
QQ-I-359	Aluminum Alloy, Plate and Sheets
QQ-S-636 & Am-2	Steel, Carbon (Low-Carbon) Sheets and Strips
CCC-D-761 & Am-2	Duck: Cotton, Plied-Billing- Yarns and Single-Yarns (Flat Duck)

2. Air Moving and Conditioning Association, Inc.

Bull. No. 110	Standards, definitions, Terms and Tests Codes for Centrifugal, Axial and Propeller Fans
---------------	---

Bull. No. 116

Standard Code for Testing Centrifugal, axial and propeller fans

Bull. No. 10

Standard Code for Testing and Rating Steam Unit Heaters

3. Institute of Boiler and Radiator Manufacturers

I B R

I B R Testing and Rating Code for Finned Tube (Commercial) Radiation

4. Air Conditioning and Refrigeration Institute

ARI Standard 210-58

Standard for Testing and Rating Air Conditioning Units Having Capacities Below 135,000 BTU/HR

5. Hydraulic Institute

Standards of the Hydraulic Institute

6. National Board of Fire Underwriters

Pamphlet No. 90A

Air Conditioning, Warm Air Heating, Air Cooling and Ventilating Systems.

4.17.2 System Descriptions

A. Refrigerated Air Conditioning shall be provided for the control room, office and lunch room by ducted air supplied by an air conditioner consisting of fan, motor and drive. Refrigerated air cooling coil, drain pan, hermetic refrigerant compressor, water cooled refrigerant condenser, condenser water flow control, permanent type cleanable filters, equipment casing, all assembled in a factory built and tested package.

B. Enclosed Finned Tube Convactor

Radiators shall provide for heating of the control room, control room corridor, office, lunch room, locker room, toilet and stair wells as shown on the drawings.

C. Steam Unit Heaters shall be installed in all other heated spaces as shown on the drawings.

4.17.3 Air Conditioning Unit

The control room, office, lunchroom air conditioner shall be provided and installed as shown on the drawings. It shall be a single, standard factory built and tested, vertical, self contained, water cooled package air conditioner having a net sensible heat cooling capacity of not less than 69,000 BTU/HR, with an Air flow of 3000 CFM at 87° F DB and 61° F W.B. and cooled with not more than 1-1/2 GPM/Ton of 70° F water. The unit shall have a certified rating of not less than 92,000 BTU/HR. Total cooling capacity when rated in accordance with ARI Standard 210-58 covering units below 135,000 BTU/HR. Electrical characteristics shall be in accordance with electrical requirements of these specifications.

Unit shall be equipped with an adjustable, automatic condenser water flow regulating valve actuated by refrigerant condensing pressure, and having a capacity of 10 GPM through condenser at water supply pressure of 50 psig minimum, 80 psig maximum and at 70° F inlet temperature. Valve shall completely stop water flow when refrigerant compressor stops, and shall be installed with inlet shut off valve and strainer.

Fan shall be statically and dynamically balanced, galvanized or cadmium plated steel multi-blade type with wheel assembly securely welded or riveted and running on a shaft mounted on self aligning oil lubricated bronze or babbitt sleeve bearings with oil reservoirs. Fan shall be driven through a variable pitch motor pulley and V-belt

drive adjusted to give 3000 CFM air flow at 0.25" water external pressure and having a capacity load factor not less than 150%. Drive shall have a speed adjustment range not less than 7% of the speed for the above conditions. Fan motor shall be not less than 1 HP.

The refrigerant cycle shall be a complete hermetically sealed factory built, tested and refrigerant charged system consisting of motor compressor unit, condenser, air cooling coil with refrigerant flow control, piping, high-low pressure safety cutout and having a full working lubricating oil and refrigerant charge. It shall be designed and built for the type of service intended herein. Compressor shall be equipped with suction and oil strainers, suction and discharge refrigerant shutoff valves, oil sight glass, and compressor operation shall be independent of direction of compressor rotation. Air cooling coil shall be draw through type with aluminum fins mechanically bonded to seamless copper tube, with all air (both outside and recirculated) passing through the coil.

Filters shall be permanent, cleanable, viscous coated type having a face area not less than 10 square feet and a depth not less than 1", shall be readily accessible and easily removed for service, shall filter all fresh and recirculated air and shall be mounted so as to prevent wetting of the filter by condensate from the cooling coil.

The unit shall be in a chassis and enclosing cabinet of cold rolled steel bonderized, coated inside and out with rust resistant primer and finish coat of paint. Enclosure shall be fully insulated with fiber glass insulation on the inside of the cabinet as required to

protect the unit from "sweating." Inlet and discharge ducts shall be connected to the unit through flexible, fire, vermin and mildew proofed 8 oz. canvas connectors as shown on drawings, and circulated air shall be limited to air passing through the duct system. Cabinet shall have easily removed front panel which will provide access for complete servicing of the unit.

4.17.4 Finned Convactor Radiators

Finned type convactor radiators, complete with supports, enclosures, end trim, dampers and valve access panels shall be provided and installed in accordance with the convactor schedule and with the drawings. Units complete with enclosures shall be rated and installed in accordance with the Institute of Boiler and Radiator Manufacturers Code for Finned Tube Radiation.

The convactor radiator heat transfer units shall consist of $1\frac{1}{4}$ " IPS steel tubing with rigid steel of minimum thickness of .032 inch. Fins shall be securely bonded to or imbedded in the outside surfaces of the tubes. Tubing shall be steel pressure tubing manufactured and tested in conformance with ASTM Specification A-214. The finished finned tube assembly shall be designed for operation on 55 psig steam which has been reduced from a 600 psig saturated condition without desuperheating.

The finned elements shall be supported in accordance with the manufacturer's recommendations with supports spaced not more than 6 feet apart. Units shall be pitched not less than 1 inch in 20 feet for complete condensate drainage. The finished assemblies shall provide for expansion and contraction and shall be supported by noise-free

slide hangers.

Covers and end trim shall be not less than 18 gauge, zinc coated, rust resistant, phosphate treated steel with factory applied and baked prime coat. Covers shall have smoothly rounded edges, with no sharp burrs or feathers, and shall be firmly supported top and bottom with only one concealed screw per support. Covers shall have an open bottom for air inlet and shall have a manual dampered, louvered outlet at the top, placed at an angle of approximately 45 degrees. Dampers shall have heat shielding composition knobs providing for securely maintained intermediate adjustment of damper position. Cover shall have a hinged panel or door with latch for access to the steam supply valve.

4.17.5 Unit Heaters

A. General: Unit heaters shall have capacities not less than those shown on the drawings. The unit heaters shall be rated in accordance with the code of the Air Moving and Conditioning Association and shall have a B.T.U. capacity not in excess of 125 percent of that specified. Orifice plates may be provided to reduce the B.T.U. output where required. Unit heater selection shall be made for each space in accordance with sound rating classifications established by the Air Moving and Conditioning Association, Inc. Unit Heaters shall be Modine Mfg. Co. models as listed on drawing schedule or approved equal.

B. Propeller-type unit heaters shall be designed for suspension and arranged for horizontal or vertical discharge of air as indicated on the drawings. The casings shall be of rigid construction and shall be finished with lacquer or enamel. Air deflectors shall be

provided. Vertical-discharge-type heaters shall operate at speeds not in excess of 1,800 revolutions per minute, except for units of 50,000 B.T.U. capacity or less may operate at speeds up to 2,300 revolutions per minute. Horizontal-discharge-type unit heaters shall have discharge or face velocities not in excess of the following:

Up to 2,000 B.T.U. capacity 1,000 feet per minute
2,000 to 5,000 B.T.U. capacity 1,200 feet per minute
3,000 B.T.U. and over 1,000 feet per minute

C. Heating Element: Heating coils and radiating fins shall be of nonferrous alloy. The heating elements shall be free to expand or contract without developing leaks and shall be pitched for drainage. The elements shall be designed for use with steam reduced from 100 psig saturated to 50 psig without desuperheating but shall be structurally capable of withstanding 100 psig saturated steam. The elements shall be tested under 1 1/2 times static pressure of 200 psig.

D. Motors: Motors shall be sized to operate fans at their specified speed. They shall be provided with a means for manual selection such as 'ON', 'OFF' and 'AUTOMATIC' operation. Other features of the motors shall be as noted in the 'General Notes' of this specification.

E. Automatic Thermostatic Control: The Unit Heaters shall be controlled by thermostats located where shown on the drawings and as described under Section 4.17.5.

4.17.6 Condensate Return Unit

A duplex condensate return unit, Amtrol Model # 50 D-1 type or approved equal, shall be provided and installed as shown on the drawings. It shall consist of two complete motor driven pumping units

mounted integrally with a cast iron receiver and equipped with all necessary controls to provide for receiver level controlled alternate operation of pumps. Level controls shall be operated on 110 volt AC. Pumps shall be end suction type with bronze impellers, stainless steel shafts and hardened mechanical seals. Impellers shall be statically and dynamically balanced and shall be designed to permit field replacement of impellers without need for special balancing procedures. Pump casings shall be high density gray cast iron, split in the plane of the impeller and so constructed that pumps can be disassembled without disturbing piping connections. Float control parts shall be of brass, bronze, copper, stainless steel or approved equivalent materials which will not corrode or experience excessive wear. Float controls shall be readily accessible for maintenance or replacement. Float level shall be adjustable and external indication of water level in the receiver shall be provided. Receiver shall be provided with threaded IPS connections as indicated on the drawings with receiver drain located and installed to provide complete drainage of the tank. Pump seals shall be provided with 1/2" IPS drain lines routed to the floor drain.

4.17.7 Instrumentation and Controls

Instruments and controls shall be as specified in Section 4.3.

4.17.8 Piping

All piping shall be in accordance with Section 4.2 of this specification.

4.17.9 Electrical Equipment: All motors shall be normal torque, low starting current type for across the line starting, unless otherwise required for the specific application they shall comply with NEMA standards with respect to design, rating, application and tests. Motors shall be drip-proof, with windings impregnated for protection against moderate amounts of moisture, light acids and abrasive or conducting dust, with General Electric Company #1007, Westinghouse Special #1, Allis-Chalmers #A7 or approved equal.

All motors shall be rated for operation in an ambient temperature of 40C with maximum temperature rise of 40C as measured by thermometer, and shall have class "B" insulation. Motors shall have service factor in accordance with NEMA standards. The motors shall be selected to match the speed and horsepower requirements of the load. In sizing the motor, the service factor shall be kept in reserve and not utilized. Motor mounts for belt driven fans shall be adjustable so that the belt tension can be changed. Motors shall have ball bearings, permanently lubricated.

All motors 1/3 horsepower and smaller shall be rated at 115 volts, single phase, 60 cycle alternating current. All motors rated 1/2 horsepower and over shall be rated at 440 volts, 3 phase 60 cycles alternating current.

4.17.10 Sheetmetal Ductwork

All sheetmetal used in the construction of ductwork shall be made of aluminum or galvanized steel conforming to Federal Specification QQ-A-359 or QQ-T-716, as applicable and shall be of the sizes shown on the drawings. Gauge and seams shall be as follows:

<u>Width of Greater Dimension</u>	<u>U.S. S. Ga. Galv. Steel Regular Duct</u>	<u>B & S Ga. 3S Aluminum Regular Duct</u>	<u>Transverse Joint</u>
up to 12"	24	22	1" angle
13" to 30"	24	22	1" "
31" to 48"	22	20	1-1/2" "
49" to 60"	20	18	1-1/2" "
61" to 90"	18	16	1-1/2" "
91" and up	16	14	2" "

All duct transverse joints shall be of pocket slip design formed as a standing seam, in accordance with the above tables. When either duct transverse dimension exceeds 30 in., the joints shall be reinforced with 1/8 in. x 1-3/8 in. bank iron core. Joints shall be

lapped in the direction of air flow. Ducts of 91 inches or greater in either transverse dimension shall be provided with gasketed 2-inch angle transverse joints. Rivets or bolts at joints shall be placed on fixed maximum 4-inch centers. The connecting flange of all branch takeoffs from the main ducts or larger branches shall be gasketed and secured to the larger duct with sheetmetal screws or rivets to form an air tight connection.

Ducts shall be constructed using corner located Pittsburgh lock seams, all seams hammered and made air tight. Ducts of 30 inches or greater in either transverse dimension shall be constructed of nominal four foot sections. Ducts less than 30 inches in the greatest transverse dimension shall be constructed of sections not exceeding eight feet in length.

An angle or channel frame shall be installed around each duct access door opening. Each door opening framing member parallel to the duct run shall be extended to and riveted or welded to the two nearest duct transverse joint bracings, when the door opening exceeds 12 in. x 12 in. All door opening framing members shall have a minimum stiffness equivalent to the adjacent transverse joint bracing and shall be line riveted to the duct on maximum 4 in. centers. All duct and access floor opening structural stiffeners or frames shall be installed externally, preventing any projection into the duct air stream.

All duct panels 12 inches or larger shall be diagonally cross broken.

Particular care shall be exercised to prevent any loose metal, dirt or scrap from getting into the ductwork system during installation.

The systems shall be checked after installation and all foreign matter shall be removed; small particles by vacuum cleaning.

Curved elbows shall be provided except as specified below, and shall be unvaned with a minimum center line radius equal to $1\frac{1}{2}$ times the duct width. Curved elbows with two or three splitters will be permitted where there is not room for unvaned elbows. The throat radius of such elbows shall be as large as space permits, with a minimum of 3 inches. Splitters shall be so located and shall have such radius that the center line radius of each section of the elbow is not less than the width of that section. Square vaned elbows shall be used where space does not permit curved elbows and shall have riveted double thickness shop fabricated turning vanes, fitted into side strips and screwed or riveted to duct elbows in the field in accordance with manufacturer's installation directions. The short radius of each vane shall be $2\frac{1}{4}$ in. and the long radius shall be $4\frac{1}{2}$ in.

All ducts shall be supported from the building structure by fastening hangers with either lag screws, expansion shields, concrete inserts, or bolts. Hangers shall be spaced on 8 foot centers or less with a hanger no farther than 1 foot on each side of any change of direction or louver damper. The hangers shall be $\frac{3}{8}$ in. threaded rods for ductwork up to 46 inches in width. Wider ducts shall be supported by $1\frac{1}{2}$ in. x $1\frac{1}{2}$ in. x $\frac{3}{16}$ in. angle iron supports rigidly fastened to the duct reinforcement. Perforated band or wire shall not be used for supporting ductwork.

All flexible connections as indicated on the drawings shall be made with 15 ounce fireproof-treated cotton canvas conforming to

Federal Specification CCC-D-761, not installed taut. Flexible connections shall be held in place by 2 in. x 1/8 in. band iron conforming to Federal Specification QQ-S-636, drawn together with 1/4 inch bolts. The location and/or length of the connections shall allow ease of replacement. All flexible connections shall be bridged with a braided copper strap soldered to metal on each side of the connection.

4.18 Safety Valve Vents, Drains, Miscellaneous Vents and Air Removal System

4.18.1 Safety Valve Vents and Drains

The safety valve vents for the steam systems designated by (VT) extend from the safety valve discharges through drip pan elbows if required as shown on the drawings to a point above the power house roof.

The deaerator heater relief valves discharge piping to a point ten feet above the roof level will be provided by the deaerator manufacturer for installation by the Subcontractor.

Drains from the drip pan elbows for the steam generator relief valves designated by (DR) will be provided and installed to a point above the basement floor, by the steam generator manufacturer. Piping for the continuation of these drains to the floor trench shall be furnished and installed by the Subcontractor.

Drains from the drip pan elbows for the deaerator heater relief valves also designated by (DR) extend from the drip pans to the equipment drain connection on the basement floor.

4.18.2 Miscellaneous Vents

The miscellaneous vents are designated by (VT) and extend from the equipment connections to a point above the roof or through the power

house wall as shown on the drawings.

4.18.3 Air Removal System

The condenser air removal system designated (AE) extends from the connections on the condenser to the steam jet air ejector and hogging ejector to a point above the roof. Also from the water boxes through priming valves to the vacuum priming unit.

4.18.4 Design Conditions

	<u>DR</u> <u>VT</u>	<u>AE</u>
Normal Operating Pressure, psig	15	0.5" HgA
Temperature F	330	120
Design Pressure, psig	75	100
Temperature F	350	200
Test Pressure, psig	112	150

4.19 Boiler Blowdown System

The steam generator blowdown system designated (BD) includes the continuous surface blowdown, water wall header blowdown, lower drum manual blowdown, water column and gage glass blowdown, primary and secondary flash piping. The system extends from the connections on the steam generator except for the water column and gage glasses which will be provided with drain piping to a point above the basement floor by the steam generator manufacturer.

4.19.1 Design Conditions

	<u>BD</u>
Normal Operating Pressure, psig	450 max
Temperature, F	459

	<u>BD</u>
Design Pressure, psig	600
Temperature, F	500
Test Pressure	900

4.20 Circulating Water System

The system serves the turbine generator surface condenser, the supply and return designated (RWS) and (RWR). The lines enter the building through the basement floor. The scope of this specification extends from the connections on the condenser to a point 6" above the basement floor.

4.20.1 Design Conditions

	<u>RWS, RWR</u>
Normal Operating Pressure	25 to 50 ft. abs
Temperature, F	60 to 120
Design Pressure, psig	80
Temperature, F	200
Test Pressure, psig	120

4.21 Vacuum Priming Unit

4.21.1 Scope

The Subcontractor shall furnish and install, as shown on the drawings and in accordance with the manufacturer's instructions, the condenser water box vacuum priming unit as specified herein.

4.21.2 System Components

The unit shall be CSM, Series 40, Size S-2310S28, Nash Vacuum Priming and Drip Pump, or approved equal and shall consist of but not be limited to the following components:

- A. Motor driven water pump having a capacity of 23 gpm from 15" vacuum against 10 psig.
- B. Float switch for actuation of water pump.
- C. Motor driven air pump having a capacity of 28 cfm at 20" vacuum.
- D. Vacuum switch for actuation of air pump.
- E. Cast iron receiver with all the above equipment mounted thereon.
- F. Silencer.
- G. Relief valve and discharge check valve.
- H. Pressure gauge.
- I. Two (2) priming valves with 2" strainers.
- J. Magnetic starters and controls mounted and wired on the receiver.

4.21.3 Electrical Equipment

A. Motor Drive Units

Each pump shall be provided with a squirrel cage induction motor drive unit. Motors shall be designed for full voltage start, low starting current having the capacity and torque characteristics for starting and continuously operating the driven equipment under the conditions specified herein. All motors one-half horsepower and above shall be rated 440 volts, 3-phase, 60 cycles. Motors 1/3 horsepower and smaller shall be rated 110 volts, single-phase, 60 cycles. Motors 15 hp and above shall be provided with sleeve bearings. Motors below 15 hp shall be provided with grease lubricated ball bearings.

All motors shall be open, drip-proof type having a service

factor of 1.15. In sizing the motor, the service factor shall be kept in reserve and not utilized. Insulation shall be class "A" for 40C temperature rise by thermometer above a 40C ambient temperature as defined by NEMA. Motor windings shall be impregnated for protection against moderate amounts of moisture, light acid conditions and abrasive or conducting dust with General Electric Co. #1007 or approved equal.

B. Combination Starters

Each pump shall be provided with a combination magnetic starter consisting of magnetic contactor with thermal overload protection and unfused disconnect switch. Starters for 440 volt motors shall be provided with a control power transformer and 110 volt control circuit. Size 1 starters shall be the minimum size acceptable.

C. Control Devices

Each pump shall be controlled by a manual-off-automatic three position control switch of the heavy duty type, mounted in a NEMA type 1 enclosure. Float and vacuum switches shall be rated a minimum of ten amperes at 110 volts a.c.

4.22 Air Dryer Prefilter

The Subcontractor shall furnish and install in accordance with the drawings and the manufacturer's instructions, one (1) dessicant type prefilter for the removal of oil contaminants from the service air line to the air dryer. The prefilter shall be "Sorbitrol" Model No. G Gas Drying Incorporated or approved equal.

The prefilter will be operative only when air from the oil lubricated service air compressor is required to supplement the plant

Instrument air system.

4.22.1 Design Conditions

Capacity, acfm	700
Operating Pressure, psig	115
Operating Temperature, F	100 Max
Design Pressure, psig	125
Oil Vapor Removal Capacity, lbs.	10.5 Min
Inlet & Outlet Connections, Flanged	150 lb.

SPECIAL CONDITIONS
FOR
SPECIFICATION NO. HWS-6624

TABLE OF CONTENTS

<u>SECTION</u>		<u>PAGE</u>
1.	APPROVAL	SC1
2.	WORK NOT INCLUDED	SC1
3.	DRAWINGS	SC2
4.	PERFORMANCE CURVES AND BROCHURES	SC2

SPECIAL CONDITIONS
FOR
SPECIFICATION NO. HWS-6624
MECHANICAL INSTALLATION
STANDBY POWER HOUSE BUILDING NO. 184-N

The following sections cover additional requirements not covered by the Standard Terms and Conditions.

1. APPROVAL

Unless otherwise indicated herein, all items requiring approval shall be approved by Burns and Roe, Inc., Architect-Engineers.

2. WORK NOT INCLUDED

- a. Furnishing and installing the Turbine Generator and all Turbine Generator Accessories other than those covered under Section 4.16.
- b. Furnishing and installing the Steam Generator and Accessories.
- c. Furnishing the Service Condenser, Condensate Pumps and Accessories.
- d. Furnishing the Feed Water Pumps and Accessories.
- e. Furnishing the Deaerating Heater, Storage Tank and Accessories.
- f. Furnishing the Fuel Oil Heating and Pump Set.
- g. Furnishing the Ignition Oil Pumps.
- h. Furnishing Sump Pumps and Accessories.
- i. Furnishing Instrument and Service Air Compressors, Receivers, Air Dryer and Accessories.
- j. Furnishing the Combustion Controls, Control Panels and Associated Instrumentation with the exception of Instrument and Control Devices covered under Section 4.3.

- k. Furnishing Service Water Pumps.
- l. Furnishing Butterfly Valves for Water Service.
- m. Furnishing Chemical Feed Equipment (Pumps, Tanks and Accessories).
- n. Furnishing Lube Oil for the Turbine Generator and Associated Lube Oil System covered under Section 4.16.

3. DRAWINGS

The Subcontractor shall submit the following for approval:

- a. Outline and connection drawings covering all equipment furnished by him.
- b. Schematic diagrams and drawings showing all piping provided by the Subcontractor which is described in this specification but not shown on the drawings.
- c. Schematic control diagrams covering the Air Conditioning, Heating and Ventilating, Fire Protection and Lube Oil Purification Systems.
- d. Shop fabricated piping and hanger details.
- e. The location of each pipe support shall be indicated and dimensioned on a print of the piping arrangement plan and on one sectional view of the piping. Design sketches shall be attached to the marked piping arrangement prints. All pipe supports shall have distinguishing mark numbers which shall be indicated on both design sketch and the marked piping arrangement prints.

4. PERFORMANCE CURVES AND BROCHURES

Performance curves and brochures shall be submitted by the Subcontractor for approval. These shall demonstrate compliance with the requirements of the drawings and specifications and shall include information covering design rating, construction details, component materials and performance characteristics. Brochures shall be provided for the following:

- a. Valves

- b. Traps
- c. Expansion Joints
- d. Controls
- e. Lube Oil Purifier, Pumps and Vapor Extractor
- f. Unit Heaters and Convector
- g. Air Conditioning Units
- h. Ventilating Fans
- i. Air Filters
- j. Heating System Condensate Return Unit
- k. Vacuum Priming Unit
- l. Air Dryer Prefilter

AMENDMENT NO. 2

TO

SPECIFICATION NO. HWS-6624

MECHANICAL INSTALLATION

FOR

STANDBY POWERHOUSE

BUILDING 184-N

100-N PROJECT GAZ-816

U. S. ATOMIC ENERGY COMMISSION

REHLMAND, WASHINGTON

Approved by: *R. J. Feltm* / FOR Date: *1/18/61*
Chief Mechanical Engineer
Burns and Roe, Inc.

Approved by: *[Signature]* Date: *1/18/61*
FOR Chief Electrical Engineer
Burns and Roe, Inc.

Submitted by: *[Signature]* Date: *1/19/61*
Project Manager
Burns and Roe, Inc.

Accepted by: *[Signature]* Date: *2/1/61*
General Electric Company

Date: January 17, 1961

NOTICE TO SELLER:

This Amendment contains changes and additions to and shall form a part of Specification No. HWS-6624. Whenever this Amendment modifies a portion of a paragraph of the specification, the remainder of the paragraph shall remain in force.

Burns and Roe, Inc.
Architect-Engineer
160 W. Broadway
New York, N. Y.

2/16/61

AMENDMENT NO. 1
TO
SPECIFICATION NO. HWS-6624
MECHANICAL INSTALLATION
FOR
STANDBY POWERHOUSE
BUILDING 184-N

A. Scope

1-Page 1, Section 1

In the third line change "provision" to "furnishing."

B. Receipt, Storage and Installation

1-Page 2, Section 2.2.1

Change first sentence of second paragraph as follows:

"In general, installation procedures shall adhere to procedures outlined in manufacturer's instruction books."

2-Page 2, Section 2.2.2

In second line add "manufacturer's" before "instruction."

3-Page 3, Section 2.2.3

In second line of second paragraph delete "entirely."

Add the following at end of second paragraph:

"except that allowed by the manufacturer."

4-Page 3, Section 2.2.5

In second line delete "specified or"

5-Page 4, Section 2.2.6

Delete the following from the last sentence:

"or manufacturer's representatives"

attachment to the turbine. After the extension neck is welded to the turbine the condenser is to be jacked up in accordance with the manufacturers instructions (approximately 3 inches), the extension neck welded to the steam dome and the condenser then lowered to its support pedestals. Welding between condenser and turbine shall be closely coordinated with the turbine erector. It is imperative that instructions of both the turbine and condenser manufacturers be adhered to and permission to weld the condenser and turbine must be obtained from the Contractor.

After the condenser has been installed, the two (2) condensate pump suction connections shall be welded to the condenser hotwell.

2-Page 8, Section 3.2.2

Add the following to the first paragraph:

"Suction strainer shall be installed in the pump suction piping as shown on the piping drawings."

3-Page 9, Section 3.3.1

Revise to read:

"Three (3) Pacific Pumps Inc., 6" S Model BFACMB 3 stage, electric motor driven, direct connected pumps mounted on structural steel bedplates. The units shall be furnished to the Subcontractor completely assembled for installation on the pump foundations.

After each unit has been installed, aligned and mechanical running tests completed, the Subcontractor shall drill and dowel the motor feet to the baseplate with a minimum of two dowels placed at diagonally opposite corners."

4-Page 9, Section 3.3.2

Delete Items C and D.

5-Page 10, Section 3.4.1

Line 5 - Change "intercoming" to "interconnecting."

6-Page 12, Section 3.7.1

Last line - change "Section 5" to "Section 4.24".

7-Page 13, Section 3.8.1

a) Revise first sentence of paragraph A as follows:

A) Three (3) Joy Manufacturing Company Class WN 112-E, Type OL two stage double-acting Y-type, carbon ring, watercooled, 150 hp motor driven compressors to furnish plant instrument and breathing air requirements.

b) Revise paragraph "B" as follows:

B) One (1) Joy Manufacturing Company Class WN 112-E, two stage double-acting Y-type, oil lubricated, water cooled, 150 hp motor driven compressor to furnish plant service air requirements.

8-Page 14, Section 3.8.2

a) Revise "A" as follows:

A) Intercooler automatic moisture trap.

b) Delete "C" in its entirety.

9-Page 18, Section 3.9.2

a) Revise Item H to read:

H) Automatic Programming and Flame Failure Control Panel

The programming control panel will be of the self-supporting, free-standing, metal enclosed type with hinged access doors on the front and rear faces.

The panel is to be anchored, anchor bolts, nuts, washers, miscellaneous steel and vibration isolators as required for anchoring the panel is to be provided by the Subcontractor.

Overall panel dimensions are:

Width - 2'-0"

Height - 7'-0"

Length - 6'-0"

Panel weight is estimated at 3,000 lbs.

10-Page 20, Section 3.12

Delete in its entirety and substitute the following:

"The chemical feed equipment to be furnished to the Subcontractor for installation will consist of the following components and accessories:

A) One (1) hydrazine dual compartmented mixing tank, with accessories mounted thereon, approximately 4.25 ft. wide x 8 ft. long x 7 ft. high on 1.5 ft. supporting legs.

B) One (1) morpholine and one (1) lithium hydroxide mixing tanks, each dual compartment, with rapid mixer for each compartment and accessories mounted thereon, overall tank dimensions of 4 ft. wide x 8 ft. long x 4 ft. high on 1.5 ft. supporting legs.

C) Eight (8) duplex chemical injection pumps with pneumatic piston stroke positioners. Approximate weight for each unit is 750 lbs.

D) Chemical Injection and Control Panel

The panel will be of the self-supporting, free standing, metal enclosed type with hinged access doors on the rear face.

Tubing and wiring to and from external control devices will terminate at bulkhead fittings at the top of the board.

Anchor bolts, nuts, washers and miscellaneous steel as required for anchoring the panel is to be provided by the Subcontractor.

Approximate dimensions of the control panel:

Width - 1'-6"

Height - 6'-0"

Length - 4'-0"

Panel weight is estimated at 1,500 lbs.

E) Water Sampling Recording Panel

The panel construction features will be as described for the chemical injection control panel under D) above.

Overall panel dimensions are estimated to be:

Width - 2'-0"

Height - 6'-0"

Length - 8'-0"

Panel weight is estimated at 3,000 lbs.

D. Equipment to be Furnished and Installed

1-Page 27, Section 4.2.3

a) Revise "E" as follows:

"E) Systems designated FOS, FOR, IO, MO, HZ-1, HY-2, HE-3, and LH-1 shall conform to the following table and notes."

b) Add note (2) as follows:

"(2) Gaskets for MO, HZ, HY and LH shall be G-1."

c) Add "F" as follows:

"F) Systems designated HY-1, HE-2 and LH-2 shall conform to the following table."

<u>Nominal Size</u>	<u>Pipe</u>	<u>Joints</u>	<u>Flanges</u>	<u>Fittings</u>	<u>Unions</u>	<u>Bolting</u>	<u>Gaskets</u>
2" and smaller	P-2	J-1	FL-4	F2	U-1	B-1	G-1

2-Page 29, Section 4.2.6

Add the following:

"FL-4 1500 lb."

3-Page 31, Section 4.3.2

In second line change Section 4.13 to Sections 4.2 and 4.7.

4-Page 32, Section 4.3.3

a) Revise third sentence as follows:

"Bourdon tube material shall be phosphur bronze for all systems except IO, LO, LO-1, MO, LH and HZ which shall be stainless steel. Gages shall be Manning, Maxwell and Moore Fig. 1379, or approved equal."

b) Delete Item D - PS-115

c) Add the following pressure switches:

H) 3-Feedwater Pump Low Lube Oil pressure switches

Pressure Range 0 to 35 psig

Field set alarm point on decreasing pressure

Tag PS-102 for pump 1-1

Tag PS-125 for pump 1-2

Tag PS-126 for pump 1-3

I) Tag PS-127 Low Service Water Pressure

Pressure Range 0 to 125 psig

Set at 50 psig on decreasing pressure

J) Tag PS-128 Low Fire System Pressure

Pressure Range 0 to 125 psig

Set at 55 psig on decreasing pressure.

5-Page 33, Section 4.3.5

After the fourth sentence add the following:

"Air sets shall have a reduced pressure range of 5 to 35 psig with an inlet pressure of 100 psig, Fisher type 67 FRT, or approved equal."

6-Page 34, Section 4.3.5, Table "A"

- a) Change Mark No. MWV-1 to MWV-101
- b) HPV-118 and HPV-119 change size to 1".
- c) HPV-107 and HPV-108 to be deleted.
- d) Add following valves to Table "A".

Mark No.	HPV-114-1	HPV-124-1	RWSV-119
Size	2"	1½"	6"
End Connections	300# SWE	300# SWE	125# Flg
Body Material	A-105 Gr II or A-216 WCB	A-105 Gr II or A-216 WCB	A-126 CI
Trim Material	316 SS Stellite Seat	316 SS Stellite Seat	316 SS
Inner Valve	Double Seated	Single Seated	Single Seated
Action On Air Failure	Close	Open	Open
Travel Indicator	Yes	Yes	Yes
Handjack	Yes	Yes	No
Positioning Relay	No	No	No
Fluid	Steam	Steam	Water
Fluid Temp. F	460	460	80
Inlet Press, psig	450	450	-
Outlet Press, psig	150	250	-

Mark No.	HPV-114-1	HPV-124-1	RWSV-119
Max. Flow, #1 hr	15,000	7,500	500,000
Norm. Flow, #1 hr	7,500	4,000	-
CV	20	10	
Use	F.O. Storage Heating Pressure Reducing Station	Atomizing Steam Pressure Reducing Station	Backup for either service water or Fire Systems. Actuated thru 3-way manually reset solenoid valve.

7-Page 46, Section 4.5.4

Revise 4.14 as follows:

	System Designation	Valves 2" and Smaller
4.14	HY-1, HZ-2, LH-2	Group VII
4.14	MO, HZ-1	Group V
4.14	HY-2, HZ-3, LH-1	Group V

8-Page 53, Section 4.5.5

Add Group VII as follows:

Group VII

Size Range:	2" and smaller
Class:	1500#
Type:	Rising Stem
Body and Bonnet:	Forged Carbon Steel A-105 Gr II
Body Joint:	Bonnet less or Welded
Seat and Disc Facing:	Stellite
Stem	13% Chrome Steel A-182-F-6
End Connection:	Socket Welded
Mfg. & Fig No.	Globe - Y Pattern
a. Powell	1314 A

9-Page 55, Section 4.5.6

Change first paragraph to read:

"Adjustable geared limit switches shall prevent overtravel of the valve disc in the open direction of travel."

10-Page 56, Section 4.5.6

Add the following at the end of the section:

"All manually operated valves shown on the drawings as having limit switches shall be provided with a geared type limit switch in a weathertight housing. The limit switch shall be similar to those described above and shall have at least two contacts for red and green indicating lights and an interlock contact to close in the full open position of the valve."

"Motor operators shall be sized for a maximum pressure differential as follows:

Feedwater Valves (FPDV)	875 psig
Steam Valves (HPV)	450 psig

11-Page 56, Section 4.5.7

Add the following valve:

"One (1) 6" condenser vacuum breaker valve having body material conforming to ASTM A-126 with 125 lb. ASA flanged ends.

Mark No. AEV-107

12-Page 60, Section 4.6.6

Change first line to read:

"The cover plate shall be 4'-3" x 8'-3" x 3/8", ..."

13-Page 61, Section 4.6

Add "Section 4.6.8 - Chain Railing" as follows:

"A chain railing supported by posts, welded to the boiler roof

deck, shall be installed between the boiler roof access platforms to provide a four foot wide guarded passageway over the boiler roof.

The post shall be $1\frac{1}{4}$ inch extra strong steel or wrought iron pipe continuously welded to a 4" x 4" x $\frac{1}{4}$ " steel base plate. The baseplate shall be welded to the boiler roof plate by continuous weld of a thickness equal to the boiler roof plate. The height of the post above the roof deck shall be 3'-5". Posts shall be equally spaced not to exceed 6'-0" center to center.

Posts shall be interconnected with a chain a safety latch hook, in accordance with Hanford Standard AC-2-10, so that access to the boiler roof may be had by removal of the chain from between any two posts.

14-Page 78, Section 4.13.4 (B)

a) Delete item 3

b) Revise 4) to read:

"Office and locker room."

c) Revise third paragraph to read:

"Alarm valves are to be provided for each sprinkler system and shall be designed so that actuation of any sprinkler system shall sound the hydraulically operated local water motor gong."

15-Page 79, Section 4.13.4

Add Item C as follows:

D) H₂ Bottle Shed System

The Subcontractor shall layout, design, furnish and install all components and accessories to provide a deluge system for the H₂ bottle shed area.

The system is to be as described for the deluge systems under "A" except that it shall be an electrically operated system initiated by an electric thermostat - fixed temperature device.

16-Page 82, Section 4.14

Delete in its entirety and substitute the following:

4.14 Chemical Injection Equipment

The equipment is to provide chemical treatment for the primary, secondary and graphite cooling loops of the reactor and the feedwater cycle of the steam generator.

The equipment is described under Section 3.12.

4.14.1 Morpholine System

The morpholine system designated (MO) extends from the tank through the pumps and is injected into the deaerator storage tank feedwater outlet. Also two (2) lines extend to a point outside of the building.

4.14.2 Hydrozine System

The hydrazine system designated (HZ-1) extends from the tanks through the pumps and is injected into the downcomer between the deaerating heater and storage tank. Also two (2) lines extend to a point outside of the building.

The hydrazine system designated (HZ-2 and HZ-3) extends from the pump discharges to a point outside of the building.

4.14.3 Lithium Hydroxide System

The lithium hydroxide system designated (LH-1) extends from the tanks through the pumps to a point outside the building.

4.14.4 Hydrogen Systems

The hydrogen systems designated (HY-1) and HY-2 extends from the bottle shed into the building and then to a point outside of the building.

4.14.5 Design Conditions

Line	HY-1	HY-2	MO
Designation	HZ-2 LH-2	LH-1 HZ-3	HZ-1
Operating Pressure, psig	1700	160	70-600
Operating Temp, F	70	70	70
Design Pressure, psig	2000	250	700
Design Temp, F	100	100	100
Test Pressure, psig	3000	375	1050

17-Page 85, Section 4.16.2

Change "5E" to read:

"A single compartment oil storage tank of about 1200 gal. capacity Bowser Fig. 363 having the following dimensions:

Height	6'-0"
Width	4'-6"
Length	6'-6"

18-Page 97, Section 4.17.6

Add the following:

"The receiver shall be provided with two (2) 1½" IPS connections in addition to that required for the heating steam returns."

19-Page SC1, Section 2

Add "o" as follows:

o. Installation of valve HPV-103-1.

AMENDMENT NO. 2
TO
SPECIFICATION NO. HWS-6624
MECHANICAL INSTALLATION
FOR
STANDBY POWERHOUSE
BUILDING 184-N

A. Page 6, Amendment #1, Item D 1

Revise "E" as follows:

- a) Change HE-3 to HZ-3
- b) Add HZ-4, LO and VT-1

Revise "F" as follows:

- a) change HE-2 to HZ-2

B. Page 8, Amendment #1, Item D 7

Revise 4.14 as follows:

Add HZ-4 to HY-2, HZ-3, LH-1 Group V

C. Page 37, Table A, Valve HPV-101

Add the following:

"Maximum inlet pressure 115 psig"

D. Page 41, Section 4.4

Delete in its entirety and substitute the following:

"4.4 Pipe and Equipment Hangers, Supports, Anchors and Guides

4.4.1 General

This section covers the design, furnishing, and erection
of all pipe supports.

For this specification, the term "pipe support" shall pertain to any means required to support the dead weight of a pipe, control its movement or provide restraint due to earthquake. Pipe shoes, pipe supports, pipe hangers, pipe anchors, pipe guides, pipe spring supports, pipe vibration dampeners, sway braces, beam clamps, pipe support brackets, supplementary structural members required to support a pipe all concrete insert devices and all required nuts and bolts shall apply to the term "pipe support."

4.4.2 Design

The design of all pipe supports shall be in accordance with the requirements of the ASA Code for Pressure Piping, B31.1, Section 6, Chapter 1 and as supplemented by this specification.

All pipe supports shall be designed to withstand a lateral or vertical force produced by an horizontal or vertical acceleration due to earthquake. The magnitude of the horizontal or vertical force shall be equal to 0.2 times the dead load sustained by the pipe support.

The dead load for earthquake design for all pipe supports shall be the sum of the following; the weight of the pipe filled with water plus any included valves and flanges, plus the weight of insulation.

The maximum dead load to be supported by any one pipe support shall be limited to 6,000 lbs. in order to minimize result of failure of any one pipe support. Structural members of any trestle required and furnished by Subcontractor is excluded from this load limitation.

Where the building structural element load limitation will be exceeded due to earthquake effect on pipe load, the pipe supports are

to be designed to remove and isolate earthquake shock of piping load from the building structure, limited only by the configuration of the piping system and equipment connections.

The Subcontractor shall be limited in his pipe support design by the following dead weight loading and seismic loading limitations on the building structural elements:

Piping shall be supported in such a manner that the movement in any beam or girder due to piping load, shall not exceed the movement obtained from the piping load limitation (pounds per square foot of floor area) shown on the structural drawings. This shall govern the following which is given as a guide:

In general, the concentrated load at the mid-point of a beam shall not exceed one-half of the total uniform dead weight pipe loading limitation above allowed for the beam, with the understanding that this is the only pipe loading on the beam. At the quarter point of a beam, the concentrated load shall not exceed two-thirds of the total uniform dead weight pipe loading limitation above allowed for the beam, with the understanding that this is the only pipe loading on the beam.

Concentrated load on girders shall not exceed the total piping load distributed to the point of concentration.

Seismic loading on beams and girders shall not exceed 0.1 times the dead weight loading (heretofore specified) in any direction. Lateral seismic loads shall be framed or braced into the floor structural elements or bracing system, but not into secondary members. Any lateral connection perpendicular to the wear axis of beams and

girders shall be framed into such members as near the top of the member as possible.

Where the limitations of the building structure elements make it necessary to distribute the pipe weight, constant support hangers shall be used as necessary, regardless of pipe movement, to control the pipe weight loaded on some element of the building structure. In addition spring loaded shock units shall be used as necessary to control distribution of earthquake loads or to eliminate undesirable piping vibration.

Complete calculations shall be submitted by the Subcontractor that will show piping weight distribution on the building structure, and a separate calculation showing distribution of the earthquake load, together with a graphic representation of the building structure showing both loadings and summation of the loading on all elements of the building structure involved. No hangers will be approved prior to submittal of calculations and approval of method and completeness of such calculations. Approval of calculations will not relieve the Subcontractor of the responsibility of the correctness of his work.

No pipe weight shall be supported on a post type support and transmitted to the floor except where it can be shown that the overhead building structural element will be overloaded and the structure load limitation can only be met through the addition of a post type support. In the case of post type support being approved, the Subcontractor shall furnish the complete unit including the base designed for weight distribution as specified by the Contractor for the conditions prevailing in the particular area. The footing and anchor bolts shall be

designed and supplied by the Subcontractor. The design, with calculations, shall be submitted for approval.

Where concrete building structural elements are involved, the Subcontractor shall supply, locate, and cast in place steel insert in sufficient quantity and distribution to take care of the complete piping support requirements. All insert devices shall be in the forms and cast in place integrally with the pour. No drilled in insert devices will be allowed in any face of part of the concrete structural members. In order to insure that means will be available for supporting pipe the Subcontractor shall provide placement drawings sufficiently in advance of construction to show all necessary inserts for supporting the piping.

Copies of working isometric drawings, for each piping system containing 2-1/2" size piping and larger, and also including smaller sizes of spring supported lines, shall be submitted for approval. No hangers will be approved for any piping system prior to submittal of an isometric drawing for that system. The information shown on these isometrics must be complete and contain at least the following data:

Piping system identification and location; size and schedule of pipe; temperature; length of pipe runs, branches, legs; dimensioned location and weights of valves; dimensioned location of all hangers, type of hanger; size of hanger with manufacturer's catalog number; hanger mark number with cross-reference to hanger detail sheet and hanger steel sheet; calculated pipe movement at each hanger; movement hanger is designed for; calculated weight carried by hanger; weight hanger is designed for; calculated weight remaining at equipment or

end connections; movement at equipment or end connections.

In addition, copies of all design calculations upon which the design and selection of hangers, anchors, guides, supplementary steel, etc., is based, including all weight and movement calculations shall be submitted for approval.

Each pipe support shall be shown complete on a separate sheet 8-1/2" X 11" size, additional sheets of same size for list of material and supplementary steel for the pipe support may be used. The detail sheets of pipe supports shall be complete and contain at least the following information:

Complete location of pipe support with reference to nearest building column and beam.

Complete arrangement and details of pipe support.

Complete detail of attachment to building structural element.

Complete list of material with ASTM specification numbers.

Listing of references such as piping isometric, piping drawings, etc.

Movement range capability of hanger and calculated pipe movement at hanger joint.

Weight capability of hanger and calculated pipe weight at hanger joint.

Identifying mark number for pipe support and identification of piping system.

All pipe supports using springs shall be provided with emergency stops designed to support the weight of the pipe when filled with water, including lines that will normally operate without this additional load.

Attachments to be welded to the pipe shall be held to a minimum and are to be used only when other means are unsatisfactory. Shop stress relieving is preferred and shall be used whenever possible.

Required pipe anchors and guides if any, are shown on the drawings. The Subcontractor shall design and detail all anchors and guides and submit same for approval. No additional anchors and guides may be added by the Subcontractor without approval.

Long vertical pipes shall be supported at a point of zero vertical movement whenever possible, location is subject to approval.

Vertical piping that must be supported by its horizontal runs shall have the supports so located that the sum of the cantilever lengths shall be equal to one half the allowable maximum spacing for horizontal supports.

Pipe subjected to a vertical movement of one inch or greater shall be supported by a constant support type spring hanger.

In addition, constant support hanger or hangers shall be provided where movement is less than one inch, to prevent overstress to pipe connections.

The constant support hangers shall be of a design that will not exceed 4 percent deviation of lead for full movement. The constant support hangers shall not interfere with work spaces and necessary clearances. Vertical type constant supports in which the spring mechanism can be in the vertical position, Bergen Model CSV or approved equal, are to be used where constant support hangers are required. No substitution with a variable type spring hanger will be allowed because of space or clearance considerations in place of the selection of a

make of constant support that will fit the space considerations.

Constant supports shall provide for field adjustment of a minimum of 10% of the specified load, and shall have at least 1/2" travel reserve above calculated movement. Removable hydrostatic test stops shall be provided.

Covering on insulated piping shall be protected from damage at all hanger locations. Saddles, bases or suitable metal shields secured to the covered pipe shall be used. Pipe clamps for insulated pipe shall have the load bolt located outside of the insulation.

All screw or equivalent adjustments on hangers shall have locking features. All hanger parts shall be fabricated and assembled so that they will not be disengaged by movement of the supported piping. All hangers, including rigid hangers, shall provide a means of vertical adjustment after erection.

At points of support subject to horizontal movement, means shall be provided for this movement in the form of swing of long hanger rods with linkage, rollers, or trolleys. Hanger rods shall not at any time be subjected to bending or stresses other than tension. Where noticeable lateral or axial movements are anticipated, hanger assemblies shall be offset 100% of the expected movement in the cold position to insure proper vertical alignment when the piping system is in operation.

It shall be the responsibility of the Subcontractor to locate and design all supports so as to avoid interference with other piping, electrical conduits and their supports, structural members and all other equipment.

All piping that has vertical movement less than one-inch shall be hung with variable spring hangers of an approved design. Piping systems where movements is not present shall be hung or supported by rigid hangers or supports unless seismic or connection restrictions require flexible supports.

The required strength of all supporting equipment, except springs shall be based on the weight of the pipe, the weight of medium transported, or the medium used for testing, whichever is heavier, and the weight of the insulation covering, if used.

All pipe support designs, springs, rods and parts shall be adequate to fully sustain the pipe in the normal hot or operating condition position, allow free and ample expansion or contraction - except where anchored - prevent excessive stress resulting from transferred weight being induced into the pipe or onto connecting equipment.

Hangers shall be spaced as far apart as economically possible, with due consideration to insure that the building structural elements are not overloaded and the sag of the pipe between supports is within limits that will permit drainage and also avoid excessive bending stresses from concentrated loads. The recommendations of the code for pressure piping shall be observed.

Rigid riser supports shall be designed so that the load is always equalized, and at no time can one side of the support be completely unloaded by the riser moving out of plumb, thereby transferring the entire load to the opposite side. They shall also be designed to carry additional loads of a magnitude equal to the supporting force of hangers immediately adjacent, in the event of failure of

such hangers.

All springs shall be provided with means to prevent misalignment, buckling, eccentric loading and excessive spring stresses. The construction shall be such that the complete release of the piping load will be impossible in the case of spring failure or misalignment. All spring devices shall have permanent metal nameplates attached, indicating identifying marking and proper position of the spring with respect to the hot and cold position of the piping system, using engraved or raised lettering.

For variable spring hangers, any over-or-under support shall occur, if possible, when the pipe is cold or out of operation. This variation shall not exceed 20% over nor 15% under the actual load. Variable spring hangers shall be of the enclosed, helical spring type.

All hangers shall be furnished with approved beam clamps, rods, pipe clips and all other material required for the attachment of the hangers to the building structure, or supplementary hanger supporting steel, as the case may be. Welding to the structural members for hanger support shall be made only under the supervision of the Contractor. Drilling in the flanges of structural members shall be restricted to those portions of the members between each quarter point and each end. Welding is permitted along the entire length of the flanges of structural members provided the weld runs parallel to the axis of the member. Welding perpendicular to the axis of members shall be restricted to those portions between each quarter point and each end.

Anchors and/or guides for pipe lines or other purposes shall be furnished when specified, shown or required for holding the pipe line

in position or alignment. All anchors shall be designed for rigid fastening to the structure either directly or through brackets. Anchors or guides shall be capable of withstanding the forces imposed by expansion, contraction and seismic loading.

Brackets shall be made of welded steel and shall be designed for maximum load conditions. When medium or heavy brackets are bolted to walls, back plates of adequate size and thickness shall be furnished to distribute the load against the wall. Where the use of back plates is not practicable, the brackets shall be fastened to the wall in an approved manner.

4.4.3 Materials

All materials used in the fabrication of pipe supports shall conform to the requirements of the ASA Code for Pressure Piping B31.1, Section 6, Chapter 1.

All welding shall be performed in compliance with Section IX of the ASME Boiler and Pressure Vessel Code.

The Contractor shall be allowed to select samples from the materials used for the fabrication of the hangers. From these samples, tensile test specimens may be made and tested by the Contractor. Materials which fail to comply with the requirements of these specifications will be rejected and hangers already fabricated or in process of fabrication will be condemned.

Helical springs shall be tested in accordance with ASTM A125. Any springs which fail to meet the requirements of the tests shall be rejected.

All hangers, anchors, supports and similar devices shall be given one shop coat of pure red lead and linseed oil. Parts that will be in contact with or in the immediate vicinity of high temperature piping shall be given a shop coat of paint resistant to that temperature. All field welding, other than field pipe welds, made by the Subcontractor shall be thoroughly cleaned by wire brushes, and given a prime coat of Dereka red #505 paint or approved equal.

E. Page 26, Section 4 2.3 D

After CAS add:

"and miscellaneous turbine piping,"

F. Page 37, Table "A",

1) Revise MWV-101 as follows:

Fluid Temp. °F	150
Inlet Pressure psig	70
Pressure Drop psig	45
Max. Flow Rate #/hr.	2,000,000
Cv	

2) Revise MWV-106 as follows:

Fluid Temp. F	150
---------------	-----

AMENDMENT NO. 3
TO
SPECIFICATION NO. HWS-6624
MECHANICAL INSTALLATION
FOR
STANDBY POWERHOUSE
BUILDING 184-N

100-N PROJECT CAI-816

U. S. ATOMIC ENERGY COMMISSION

RICHLAND, WASHINGTON

Approved By: *A. J. E. Elin* /FOR Date: 10/2/61
Chief Mechanical Engineer
Burns and Roe, Inc.
Submitted By: *W. J. E. Elin* Date: 10/2/61
Project Engineer
Burns and Roe, Inc.
Accepted By: *W. J. E. Elin* Date: 10-6-61
General Electric Company

Date: September 28, 1961

NOTICE TO SELLER:

This Amendment contains changes and additions to and shall form a part of Specification No. HWS-6624. Whenever this Amendment modifies a portion of a paragraph of the specification, the remainder of the paragraph shall remain in force.

BURNS and ROE, Inc.
Architect-Engineer
160 W. Broadway
New York, N. Y.

AMENDMENT NO. 3
TO
SPECIFICATION NO. HWS-6624
MECHANICAL INSTALLATION
FOR
STANDBY POWERHOUSE
BUILDING 184-N

A. ADD SECTION 4.23 AS FOLLOWS:

4.23 Hydrogen Injection Equipment and Accessories

Equipment for the injection of free hydrogen and for the purging of the hydrogen injection lines shall be provided as follows:

4.23.1 Primary Coolant Supplementary Hydrogen Injection and Graphite Coolant Automatic Hydrogen Injection Systems

Injection supplies of hydrogen and purge supplies of carbon dioxide will be from gas cylinders located in separate hydrogen and carbon dioxide sheds adjacent to the standby powerhouse structure.

a) Three (3) single row, wall type manifolds, each sized to serve three (3) Size 1A hydrogen cylinders. Two (2) manifolds shall serve the primary coolant injection system and one (1) manifold shall serve the graphite coolant injection system. All three (3) manifolds shall be interconnected by shut-off valves and shall form one continuous manifold header.

b) One (1) single row, wall type manifold, sized to serve four (4) Size 1 carbon dioxide purge cylinders.

c) Each of the four (4) manifolds shall be forged brass,

comprising 1" NPT fittings and tubing rated for 2500 psig service pressure. They shall be provided with the following accessories and connections:

- 1) One (1) 3/8" heavy duty copper tubing pigtail for each manifold with handle for connection to the cylinders.

- 2) Station valves between pigtails and manifolds.

- 3) Two (2) pressure gages with shut-off cocks, one mounted in each of the primary coolant hydrogen injection supply manifolds.

- 4) One (1) dual stage, dual gage regulator, mounted in the graphite coolant hydrogen injection supply manifold. Delivery pressure range shall be 5 to 250 psig. Regulator shall be as manufactured by the Matheson Co. or approved equal.

- 5) One single stage, dual gage regulator, mounted in the carbon dioxide purge manifold. Delivery pressure range shall be 5 to 50 psig. Regulator shall be as manufactured by the Matheson Co. or approved equal. A check valve shall be provided at the inlet to the regulator.

- 6) Each of the primary coolant hydrogen injection system manifolds shall be provided with a 1" outlet connection. In addition, each manifold shall be provided with a spare 1" capped connection.