Category 14, AW47, Item 1

TEXAS UTILITIES SERVICES INC.
AGENT FOR
TEXAS UTILITIES GENERATING COMPANY
ACTING FOR
DALLAS POWER & LIGHT COMPANY
TEXAS ELECTRIC SERVICE COMPANY
TEXAS POWER & LIGHT COMPANY

COMANCHE PEAK STEAM ELECTRIC STATION
UNITS NO. 1 & 2

MAIN CONDENSERS
SPECIFICATION 2323-MS-23
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NEW YORK, NEW YORK

K-291

COMANCHE PEAK STEAM ELECTRIC STATION
SECTION 3- TECHNICAL SPECIFICATION
MAIN CONDENSERS

SECTION 3
TECHNICAL SPECIFICATION

3.0 INTRODUCTION

This section covers the technical and particular requirements for the main condensers to be installed at the Comanche Peak Steam Electric Station (CPSES), a two unit PWR nuclear power plant. It forms part of the total specification which includes Sections 1, 2, 3 and its appendices 1 thru 3. Rev.2

3.1 SCOPE OF WORK

This specification describes the design, fabrication and furnishing of one main condenser and all Seller furnished material, equipment and accessories. The Seller shall supply two main condensers for the two units of CPSES.

3.1.1 WORK INCLUDED

The Seller shall design, fabricate, test as required and deliver a complete condenser consisting of a single pass in two (2) shells complete with the following items:

a. Two (2) stainless steel LP turbine exhaust condenser expansion joints.

b. Internal provisions for the steam dump system.

c. Waterboxes.

d. Condenser fixed supports, exhaust neck and tubesheets.

e. Internal distribution pipes and deaerating spillways for condensate makeup and recirculation.

f. Supports for low pressure feedwater heaters in the condenser neck.

g. Equalizing pressure line for condenser neck interconnection.

h. Equalizing line between condenser hotwells.

i. One complete lot of connections for Purchasers piping and instruments.

j. All internal baffles and blow down headers as required to protect against tube impingement.

k. Sleeves and expansion joints for heater extraction line penetration at the condenser shells.

l. Spray valves or nozzles as required on spray headers.

m. Bolting and gasketing.

n. All miscellaneous accessories, appurtenances and tools as required.

o. Primer and protective coatings for all equipment.

p. Sparger system.

q. 8 plates each 2'-8" x 4'-8" x 1 5/8" machined to 125 RMS on one face. Each plate will have 8 holes each 3.75" diameter drilled through. Rev.2

3.1.2 FIELD TECHNICAL ASSISTANCE

a. Seller shall include 75 days service of qualified field representative capable of providing technical assistance for unloading, erection, installation, testing and placing in successful operation should the Purchaser require these services at the jobsite. Additional service time may be obtained at a per diem rate of two hundred dollars ($200.00).

b. Representative(s) qualifications shall be submitted to the Purchaser.

3.1.3 WORK NOT INCLUDED

The following will be furnished and/or installed by others:

a. Erection of main condenser, foundations, surrounding floors and platforms, including all items embedded in concrete

b. All external piping, valves, instrumentation and electrical specialties, except as specifically required herein to be furnished by the Seller

c. All internal extraction piping from the turbine extraction points to the feedwater heater inlets and to the interface nozzle connections (vendor furnished) of the condenser shells

including stainless steel lagging and expansion joints, all located in the condenser neck and at the condenser shell

d. All condenser tubing

e. Feedwater heaters installed in the condenser neck

f. Circulating water piping and valves to and from the condenser waterbox flanges

g. Venting equipment (vacuum pumps and their accessory equipment)

h. Finish painting

i. Embedded items such as foundation bolts. Seller to provide necessary dimensions and forces to complete design.

3.1.4 DELIVERY DATES

The equipment covered by this specification shall arrive at jobsite complete with all assemblies, subassemblies, parts, tools, and accessories no later than the dates indicated in the purchase order. | Rev.2

3.2 STANDARDS AND CODES

The equipment shall meet the applicable requirements of all Federal, State or Local Codes and the following U.S. Standards and legislation:

a. American Society of Mechanical Engineers (ASME)

b. American National Standards Institute (ANSI)

c. American Society for Testing and Materials (ASTM)

d. Tubular Exchange Manufacturer's Association (TEMA)

e. Heat Exchange Institute (HEI)

f. Steel Structures Painting Council (SSPC)

g. Occupational Safety and Health Act (OSHA)

h. American Iron and Steel Institute (AISI)

The latest edition of codes or standards in effect on the date of the order shall apply.

3.3 CONDITIONS OF SERVICE

3.3.1 ATMOSPHERIC AND SEISMIC CONDITIONS

a. The equipment will be subject to atmospheric conditions of fog, rain, 100 percent humidity, severe wind, dust and sandstorms and temperatures ranging from 0 to 110 F during erection and/or outdoor storage. Wind velocities normally range from 4 to 18 mph, but can reach velocities of 80 mph. The elevation of the plant site is approximately 810 feet above sea level.

b. The equipment located indoors will be subject to dust, 100 percent relative humidity, and temperature fluctuations ranging from 20 to 125 F. Freeze protection if required will be provided by others.

c. No seismic criteria are considered.

3.3.2 GENERAL

a. The condenser will operate in conjunction with an 1160 MWe turbine generator, will be installed indoors and designed in accordance with paragraph 3.4.

b. The turbine is a tandem compound, 1800 rpm machine with four flow exhaust. Each condenser shell serves one two flow exhaust section of the turbine. The two condenser shells will operate in parallel with back pressure being equalized between the shells.

c. The turbine generator will be subject to occasional load changes and periods of low load operation. The worst expected load change with respect to the condenser is a 50 percent instantaneous reduction in load in conjunction with a maximum steam dump 40 percent of maximum steam flow from the Nuclear Steam Supply System (NSSS) condition (see paragraph 3.3.2.d).

d. During the steam dump condition, the condenser will be subject to the following approximate duty:

1.	From Turbine Cycle:	Heat duty:	4693 x 10^6 BTU/Hr.
2.	From NSSS system (40% steam dump). Values are upstream of pressure reduction and attemperation	Flow: Temp.: Enthalpy:	6,400,000 lb/hr. 540.9 F 1191.5 BTU/lb.
3.	Maximum allowable condenser back pressure		6 in. Hg

Total required heat duty during steam dump shall be the sum of the turbine cycle heat duty plus the 40 percent steam dump from the NSSS system heat duty (after pressure reduction and attemperation).

The condenser entry pressure, temperature and enthalpy of the dumped steam from the NSSS system during the above condition shall be 265 psia, 406 F and 1191 Btu/16 respectively. The Purchaser shall provide accommodation to satisfy the Sellers inlet requirements. The expected back pressure under the dump condition is 4.96 Hg.

e. During normal reactor plant cooldown, the steam dump system will be used to control cooldown rate by bleeding steam from the steam generators directly to the condensers. Only one valve of the steam dump system will be operating under the above condition thereby having one of the condenser shells with a higher heat duty than the other.

f. The circulating water will be taken from the Squaw Creek Reservoir. The water will flow through trash racks and enter four screen wells where it will pass through travelling screens for debris removal. The water then passes into four 1/4 capacity circulating water pumps which take suction from the screen wells, and supply cooling water to the condenser. The circulating water will have a maximum expected temperature of 95 F and a minimum of 40 F at the inlet to the condenser.

g. Heaters No. 5 (A&B shells) and No. 6 (A&B shells) will each be contained in separate heater shells and will be located in

the condenser neck. The condenser will have the configuration shown on Sketch XB-2323-M-148 attached herein.

h. All feedwater heaters will be vented individually to the condenser.

i. Range of reservoir temperatures are given on a yearly basis on attached Sketch XA-2323-M-147. It is also noted that reservoir temperatures can approach 40 F, therefore the bidder shall include a range of 40 F to 95 F in his analysis.

3.3.3 WATER CHEMISTRY

The following is the anticipated analysis of water in the Squaw Creek Reservoir which is to be used as the source of cooling water for all condensers:

Substance	mg/1, as Calcium Carbonate (except as noted)
Calcium	560-940
Magnesium	80-410
Sodium	1810-2220
Bicarbonate	200-210
Carbonate	0-28
Sulfate	620-1040
Chloride	1630-2310
Silica, as Silicon Dioxide	8-68
Ammonia, as N	1-2
Phenolphthalein Alkalinity	0-8
Methyl Orange Alkalinity	200-238
Total Hardness	640-1350
Total Dissolved Solids	2450-3570

Based on this analysis, calculation of both stability and saturation indices indicate that the water will tend to form scale.

3.4 DESIGN CONDITIONS

The condenser shall be capable of continuous operation when operating in conjunction with the turbine-generator under the following design point conditions as given in the following Table 3.4-1 "Main Condenser Heat Loading".

TABLE 3.4-1
MAIN CONDENSER HEAT LOADING

MAIN CONDENSER	VALVES WIDE OPEN LOAD
Turbine Load Kw	1,206,443
Exhaust Condition	
Steam Flow, lb/hr	8,295,340
Steam Enthalpy, Btu/lb	1018.6
Heater Drains to Condensers	
Flow, lb/hr	1,749,857
Enthalpy, Btu/lb	99.3
Gland Seal Steam	
Flow, lb/hr (Steam/Drain)	7307/3103
Enthalpy, Btu/lb (Steam/Drain)	1078.8/120
Condensate from Hotwell (including 253,050 lbs/hr from auxiliary condensers)	
Flow, lb/hr	10,308,659
Enthalpy, Btu/lb	88.5
Main Condenser Heat Duty, 10^6 Btu/hr	7742
Absolute Pressure in Condenser	3.5 in Hg Absolute

The following specific design conditions shall be utilized in connection with the conditions stated in Table 3.4-1 for the sizing of the main condenser:

a.	Circulating water inlet temperature	95 F maximum
b.	Circulating water outlet temperature	110 F maximum
c.	Circulating water flow at valves wide open turbine load, approximately	1.03×10^6 gpm
d.	No. of passes per shell	one
e.	Circulating water inlet velocity (Tube)	7 fps
f.	Maximum pressure drop allowed (Flange to flange of waterbox)	12.44 ft. H_2O
g.	Hotwell storage capacity at maximum condensate flow.	4.94 minutes
h.	Turbine exhaust connection dimensions	Sketch XB-2323-M-148
i.	Tube cleanliness factor	85 percent
j.	Dimensional limitations	Sketch XB-2323-M-148
k.	Heat Balance Valves Wide Open	Kraftwerk Union AG 000286-V912-3N-300999-6
l.	Net Heat Rate Correction Curves to Back Pressure	Graph Kraftwerk Union AG V912-S-0122a
m.	L.P. Turbine Exhaust Loss Curve	Graph Kraftwerk Union AG V912-S-0122 i
n.	Range of reservoir temperatures on a yearly basis	Sketch XA-2323-M-147

3.5 PERFORMANCE GUARANTEES

a. The Seller guarantees the main condenser back pressure at the turbine flange in inches of mercury absolute for various circulating water inlet temperatures at the "Valves Wide Open" (7742 Million Btu/Hr) condition of the turbine-generator to be as follows:

	Circulating Water Inlet Temperature F	Back Pressure in. Hg absolute
a.	40	0.882
b.	50	1.070
c.	60	1.358
d.	70	1.766
e.	75	2.024
f.	80	2.323
g.	85	2.666
h.	90	3.058
i.	95	3.500

(above based on 85% cleanliness factor)

b. The Seller guarantees that the circulating water pressure drop through the condenser for the maximum circulating water flow will be 10.38 feet of water and from inlet nozzle to outlet nozzle to be 9.85 feet of water at 40 F.

c. The Seller guaranteees at all condensate flow conditions, dissolved oxygen in condensate from the condensate pump discharge will not exceed .005 cc/liter per PDL 1310-46.

3.6 DESIGN AND CONSTRUCTION REQUIREMENTS

3.6.1 GENERAL

a. The following detailed requirements are not intended to establish design, structural and performance characteristics to such an extent that omission of proper or conventional features or provisions shall be implied in any way, nor shall it relieve the Seller of furnishing all features he considers necessary or advisable for proper equipment startup and operation.

b. Each condenser shell shall be of the fixed support, center fixed horizontal, single pass, divided waterbox type.

c. The condenser will be supported on the turbine pedestal foundation mat. The Seller shall state his method of anchorage to the foundation mat.

d. The condenser shall be designed, fabricated, with applicable tests being performed, all in compliance with the HEI code "Suiface Condenser Structural Code" as mutually agreed between Seller and Purchaser.

3.6.2 SHELL, EXHAUST NECK AND HOTWELL

a. Each condenser shell, exhaust neck and hotwell shall be of welded steel construction, properly ribbed and stiffened for strength, and designed to prevent reverberation and amplification of vibrations from the turbine-generator unit. Dimensions of the steam inlet connections (above the expansion joints) shall be made to conform to the turbine steam exhaust outlets to which they will be welded.

b. Each shell shall be provided with suitable supports to insure uniform loading. Two low pressure heater shells (2 stages) will be installed by others in the neck of each condenser shell. The heaters will be furnished by others. The Seller shall cooperate fully with the Engineer, the heater supplier and the turbine manufacturer, to achieve a satisfactory and efficient arrangement of heaters and piping in the neck of the condensers.

c. Atmospheric relief diaphragms will be provided by others on the turbine exhaust hoods to relieve pressures in excess of five pounds per square inch gauge, therefore atmospheric relief valves will not be required on the condenser shells. Each condenser shell shall be designed to withstand safely an internal or external pressure of 15 psig and a hydrostatic test performed in the field in which the condenser shells will be flooded to 6 inches above the LP turbine connection in the neck in the field.

d. All flanges for joining the various parts of the condenser where bolts are used shall be accurately machined and made-up with suitable gaskets.

e. The hotwell shall be of the deaerating type and the dissolved oxygen in the condensate shall not exceed 0.005 cc/liter measured at the discharge of the condensate pump, at condenser design conditions with maximum circulating water temperature and receiving 250,000 lb/hr of makeup water with 14.3 ppm maximum dissolved oxygen based upon Purchaser supplying air removal equipment in compliance with paragraph S-29 of the HEI Code. During startups deaerated demineralized water will be used for makeup with a maximum oxygen content of 0.01 ppm. Seller shall state the operating range over which this oxygen removal performance will be achieved. The hotwell shall be of the flat type, extending the full length and width of the condenser. A vortex breaker shall be furnished at the condensate outlet.

f. The condenser hotwells shall have an operating range (height) of not less than 12 inches of substantially uniform crosssectional area between minimum and maximum operating levels. Total storage for two hotwells shall not be less than 3 minutes at minimum operating levels at maximum condensate flow.

g. The Seller shall provide all necessary technical data for the complete design and proper operation of the hotwell sparger system.

3.6.3 SUPPORT PLATES

a. An adequate number of support plates of steel of the same material as the shell and of proper thickness shall be provided to support the tubes and spaced to avoid tube vibration. Holes for the tubes shall be moline drilled and mechanically disc sanded and wire brush deburred.

b. The distance between the support plates throught the condenser shell is approximately 35.5 inches. The Seller shall submit his description of the method used in arriving at the above distance.

c. Consideration shall be given to load distribution along the edges, especially when point supported construction is used, so that tube hole distortion under load is avoided.

3.6.4 WATERBOXES

a. The waterboxes and waterbox covers shall be of welded steel construction, adequately spaced and internally lined. The waterboxes shall be furnished with flanged openings for circulating water inlet and discharge. Flanges shall be drilled and faced for 125 pounds ANSI standard. Suitable manhole covers shall be furnished on the waterboxes to permit easy access. The depth of the waterboxes shall be selected on the basis of a minimized approach velocity to the first row of tubes. Waterboxes and passages shall be designed for a working pressure of at least 40 psig. The inlet and outlet waterbox nozzle velocity shall not exceed 9.26 feet per second. Adequate provision shall be made for draining each waterbox and also for venting air and gases which may be pocketed in the waterboxes. Lifting lugs shall be provided on waterboxes. Lining of waterbox interiors shall be in accordance with paragraph 3.8.3.

The waterboxes shall be bolted to the tubesheet.

Tapped holes for waterbox bolting shall not penetrate to the steam side of the condenser.

Provisions for installing sacrificial anodes shall be included.

3.6.5 EXPANSION JOINTS

A stainless steel expansion joint connection piece between each condenser shell and turbine exhaust hood shall be furnished. The expansion joints shall have an adequate liner incorporated in its design to prevent erosion and turbulance from occurring in the area of the corrugations. The expansion joints will be designed with compatible weld end preparations for welding to the condenser neck and turbine exhaust opening. Seller shall assume responsibility for the satisfactory construction of this expansion joint. The Seller shall submit stress analysis of the expansion joint to substantiate his selection.

3.6.6 TUBE BUNDLES, TUBES AND TUBESHEETS

a. The velocity of the steam entering the tube bank, at design conditions, at 1.0, 2.6 and 3.5 in. Hg absolute pressure will be (later), 127, and 103 FPS respectively. The velocity through the tube bank, at design conditions, at 1.0, 2.6 and 3.5 in. Hg absolute pressure will be (later), 230 and 188 FPS respectively.

b. The Seller shall submit final detail drawings of his proposed tube bundles with their circumscribed area. Included should be the number of tubes per bundle, their size and effective pitch and the air removal section outline.

c. Condenser tubes will be furnished by others. The tubes will be 1-1/8-inch OD, 20 BWG, 90-10 copper nickel. Tubes exposed to steam impingement and tubes in the air removal section will be 1-1/8-inch OD, 18 BWG, 70-30 copper nickel.

d. Each air removal section shall be arranged so that the entire length of the tubes between tubesheets is active and the number of tubes is reduced to a minimum. The air removal section shall be sized so that the temperature of the air vapor mixture leaving the air removal section shall be at least 7.5 F below the saturation temperature corresponding to the absolute pressure at the steam inlet.

e. Tubes will be rolled into the tubesheets at each end. Adequate provisions shall be made to allow for differential expansion and drainage.

f. Tubesheets shall be 90-10 copper nickel. Tubesheets shall be welded to the condenser shell so that the waterboxes may be

removed without breaking the joints between the tubesheets and the shell. Tubesheets shall be properly stayed. Holes for tubes shall be drilled and reamed to insure accuracy and fit for the tubes, and edges shall be well rounded on the vacuum side to remove any burrs. Leak detection shall be provided by means of salinity troughs. The troughs shall be located directly below the tubesheets and extend their length. The troughs shall be a minimum of 12 inches wide, fabricated of 316 SS, 1/16-inch minimum thickness and shall allow for constant flow to conductivity cells (by others) with return to hotwell. Sufficient connections through the condenser shall be provided for each trough section to allow for rapid isolation of any leaks and return of monitored condensate to the hotwell.

g. Tubes shall be sloped for drainage.

h. Tubes on the periphery area that can be subject to pull out shall be protected by having grooved tube holes (two grooves) incorporated into the tubesheet holes. The Seller shall specify the tube holes that the above processes will be performed on. The tube holes will be noted on the drawing required in paragraph 3.6.6.b and complete description of the above grooving processes will be described in detail inclusive with the data requested in paragraph 3.6.6.e.

3.6.7 INTERNAL PIPING AND PIPING CONNECTIONS

a. Each condenser shall have openings for air removal, vacuum breaker valve connections, admission of condensate makeup and other piping connections and instrument connections as required. Stainless steel (18-8) baffled connections or blowdown headers shall be provided for receiving all drains and vents. Each condenser shall be fitted with internal inlet headers, drain troughs, spray pipes and deaerating spillways for the introduction of various drains and auxiliary condenser condensate. Internal condenser piping and fittings shall be of welded construction.

b. A deaerating spillway shall be provided for deionized makeup water introduction into one shell. The spillway shall be constructed from Type 316 stainless steel. Special attention shall be given to location and design of this feature to insure proper deaeration of the incoming makeup water. A perforated distributing header for condensate recirculation shall also be supplied and fabricated of stainless steel.

c. Provision shall be made in each condenser shell for the receiving and proper distribution of turbine bypass steam from the steam generator dump system. Adequate protection shall be provided to distribute the steam in a manner to avoid impingement and shock wave effects on the tube surface. A detailed description of the methods shall be submitted by the Seller.

d. The Seller shall provide orificed spray pipes on water distribution headers where required. The orifice flow area shall be equal to 1.5 times the pipe cross-sectional area. The orifices shall direct flow so as to impinge onto the condenser internal shell wall.

e. All external fittings welded to the outer condenser shell shall be carbon steel.

f. Each condenser shall be furnished with the required number of vacuum connections with protecting baffles.

g. All nozzle openings of 2-1/2 inches and larger shall be butt-welded. Connections 2 inches and smaller shall be socket-weld unless specified otherwise herein. The size and location of all nozzles on the condenser shall be arranged to best meet the requirements of the plant piping layout, and shall be subject to the approval of the Engineer.

h. A minimum of one (1) equalizing line between condenser hotwells sized to provide a differential of not more than 6-inch WG between condensate levels of the two hotwells.

i. Equalizing connection between condenser shells which shall be sized to permit the shutdown of 1/2 of one condenser shell and maintain vacuum in the condenser shells not exceeding 6-inch hg absolute. Circulating water temperature will range from 40 F to 95 F.

j. All condenser shells and waterboxes shall have all required connections for full ASME test. The Seller shall review the connections listed below, if more instrument connections are required, they shall be provided.

k. The connections for each two shell condenser shall include but not be limited to the following:

Connection	No. Required	Size (in)	
Circulating Water Inlet	4	108	
Circulating Water Outlet	4	108	
Vacuum Pump Suction	4	8	| Rev.2
Waterbox Vent.	8	4	
Waterbox Drains	8	6	
Condensate Outlet	1	48	
Steam Dump	12	14	
Manhole	16	20	
Manhole	4	18	
Waterbox Gauge Glass	16	3/4	| Rev.2
Thermocouple Points	40	1	
Pressure Transmitter Conn.	8	3/4	
Extraction Piping Pt Conn.	14	3/4	
Extraction Piping TE Conn.	14	1	
Condenser Shell Press. Conn.	8	3/4	
Condenser Shell Temp. Conn.	8	1	
Condenser Conductivity Measuring Cell Conns.	8	3/4	
Level Control Connections	2//4*	2//3*	
Drain Tank Outlet	2	20	
Reheater Drain Tank Outlets	2	20	
Heater Drain Tank Dump.	2	30	
Vacuum Breaker	1	12	| Rev.2
Condensate Makeup	4	12	
Feedwater Pump Recirculation	4	12	| Rev.2
Condensate Recirculation	2	12	
Condensate Pump Vent.	2	3	| Rev.2
Condensate Pump Vent. Startup	1	2	|
Extraction to Heater #4	2	30	
Heater #6 Drain Cooler	2	16	| Rev.2
Heater #6 Vent	2//2*	2//4*	|
Heater #5 Alternate Drain	2	16	
Test Well Conn.	8	1	
Pressure Test Conn.	8	3/4	
Waterbox Diff. Pressure	8	3/4	

*Note: // - Denotes two different sizes

Connection	No. Required	Size (in)	
Heater #5 Vent.	2//2*	2//4*	
Heater #4 Alternate Drain	2	12	
Heater #4 Vent	2	6	
Heater #3 Vent.	2	4	
Heater #2 Alternate Drain	2	30	
Heater #2 Vent	2	3	
Heater #1 Alternate Drain	2	24	Rev.2
Heater #1 Vent	2	3	
Drain Header #1 (Turbine Drain)	1	40	
Drain Header #2 (Turbine Drain)	1	36	
Drain Header #3 (Turbine Drain)	1	24	
Drain Header #4	1	16	
Drain Header #5	1	Later	
Drain Header #6	1	Later	
Drain Header #7	1	Later	
Drain Header #8	1	Later	
Spare Conn. #1	2	Later	
Spare Conn. #2	2	Later	
Spare Conn. #3	2	Later	
Spare Conn. #4	10	Later	
Spare Conn. #5	12	Later	
Aux. Condenser Condensate Inlet	2	Later	

Additional nozzles as required by the Purchaser shall be provided at no extra cost. The above nozzle sizes given are subject to minor change predicated on final design.

3.6.8 MATERIALS

a. Materials and Construction

The materials used in the construction of the pressure containing components or for structural parts associated with the strength of the completed condenser shall be as listed herein.

b. Design Stresses

Design stress levels which shall be used will concur with the ASME Pressure Vessel Code allowable stresses because this requirement is going to be specified in the future HEI structural code. It is noted, however, that the HEI code formulas for stress determination will differ from ASME Code formulas.

c. A corrosion allowance of 1/16 shall be used for all strength members.

d. Materials that will be in contact with the condensate or steam shall not contain other than trace amounts of low melting point elements, specifically lead, mercury and sulfur. This includes materials of construction, tools, and cutting lubricants used in fabrication and erection, cleaning, fluids, paints, corrosion preventatives, marking fluids and packing materials.

e. The Purchaser/Engineer consider the following materials to be satisfactory for this application:

1.	Condenser Shell	C.S.	ASME	A285 Gr. C
2.	Hotwell	C.S.	ASME	A285 Gr. C
3.	Support Plates	C.S.	ASME	A285 Gr. C
4.	Supports	C.S.	ASME	A285 Gr. C
5.	Condenser Neck	C.S.	ASME	A285 Gr. C
6.	Pipe Supports	C.S.	ASME	A53 Gr. B
7.	Waterbox	C.S.	ASME	A285 Gr. C
8.	Waterbox Covers	C.S.	ASME	A285 Gr. C
9.	Tube Sheets	90-10 Copper Nickel		
10.	Pipe Nozzles	C.S.	ASME	A106 Gr. B
11.	Spray Pipe	S.S. (316)		
12.	Deaerating Spillways	S.S. (316)		
13.	Drain Troughs	C.S.		
14.	Inlet Headers	C.S.	ASME	A106 Gr. B or A285 Gr. C
15.	Baffles	18-8	S.S. or C.S. as required	
16.	Expansion Joints	S.S.		
17.	Shellside Bolting	C.S.		
18.	Tube Side Bolting	S.S.		
19.	Waterbox to Tube Sheet Bolting	C.S.		

3.6.9 MISCELLANEOUS DETAILS

a. Seller shall furnish all bolts as required except for flange connections for erection of the condenser in the field by others. These items must be shipped to arrive at the site before condenser erection is started.

b. Grounding pads shall be provided at two locations on each condenser shell.

3.7 ASSEMBLY, INSPECTION AND TESTING

3.7.1 ASSEMBLY

The main condensers shall be assembled and aligned in the shop to the maximum extent possible to ensure proper fitup of all component parts prior to shipment. Before disassembly, components shall be match marked and piece marked to insure proper fitup and ease of assembly in the field.

3.7.2 INSPECTION

The Seller shall make available at the factory samples of tubesheet and support plate tube penetrations for Purchaser review. The Purchasers' inspectors may use these penetration samples as a standard for inspecting production penetrations.

3.7.3 TESTING

a. General

All testing of the equipment provided in this specification shall be in accordance with the latest applicable standards of the ASTM, ASME, IEEE, NEMA, ANSI and HEI in effect on date of the sale.

b. Shop Testing

Waterboxes shall be shop hydrostatically tested to 45 psig. If Seller desires to test waterboxes face to face, a tubesheet shall be placed between the waterboxes.

c. Field Tests

1. Static Testing

(a) Pressure Requirements

The completed condenser, specifically the pressure compartments comprised of the condenser shell and waterboxes, shall be subjected to a field hydrostatic test. The hydraulic pressure in the condenser shell shall be limited to that resulting from the static head of water at the elevation 6 inches above the turbine connection in the neck. The hydraulic pressure in the condenser waterboxes and tubes shall be 45 psig. The required test pressure shall be referenced to the highest point in the condenser waterbox.

(b) Temperature Requirements

The test pressure shall not be applied until the vessel and the contained liquid for hydrostatic test are at substantially the same temperature. When the test pressure is solely a function of static elevation, as is normally the case with the condenser shells, the vessel temperature shall be within 10 F of the temperature of the test liquid, except when both the vessel temperature and the temperature of the test liquid are 60 F or above.

The temperature of the test liquid used for vessels fabricated from impact tested materials shall not be less than the specified minimum impact test temperature.

The temperature of the test liquid used for vessels fabricated from materials for which the impact properties have not been required to be ascertained and/or certified shall not be less than 60 F.

2. Acceptance Tests

(a) Acceptance tests on the equipment will be conducted in the field to determine guarantee fulfillment as soon as possible after initial operation. The method and time of testing will be determined by the Purchaser.

(b) Seller shall make personnel available for witnessing acceptance tests as requested by Purchaser.

(c) The Purchaser will provide tools, materials, instrumentation as required and labor for preparation of acceptance tests.

(d) The Purchaser will provide personnel during the acceptance tests.

3.8 CLEANING, PAINTING AND PREPARATION FOR SHIPMENT

3.8.1 SURFACE PREPARATION AND COATING OF EXTERIOR SURFACES

The machined and exterior surfaces of the waterboxes and condenser shall be protected in accordance with the attached "General Painting Requirements for Mechanical Equipment", Specification 2323-GS-900, Appendix 2 with the exception of the items listed hereinafter. The equipment is classified as noncritical-temperatures less than 250 F.

3.8.2 SURFACE PREPARATION AND COATING OF INTERIOR SURFACES OF THE CONDENSER SHELL

a. The interior surfaces of the condenser shell shall be thoroughly cleaned of all rust, grease and mill scale.

b. Condenser support plates having tube penetrations shall be shot blasted prior to initiation of drilling processes for the tube penetrations. No shot blasting will be performed on the support plates after drilling.

c. Shell Oil Co. ENSIS 210 or an approved equal, which is a water soluble corrosion protective coating, will be applied to the interior of the condenser shell and all interior components with the exception of stainless steel components, the aluminum-bronze tube sheets and drilled tube supports. Rev.2

3.8.3 SURFACE PREPARATION AND COATING OF THE WATERBOX INTERIOR SURFACES

a. Waterbox interior surfaces shall be prepared in accordance with the "Steel Structure Painting Council Surface Preparation Specifications No. 5 White Metal Blast Cleaning". Surface profile shall be a minimum of 2-1/2 mils.

b. One coat of Flakeglas Polyester as Carboglas 1678, 25.0 mils dry film thickness per coat shall be applied directly to the blasted steel. | Rev.2

c. Solvents and thinners shall be of the type recommended by the coating manufacturer. No others are allowed. | Rev.2

d. Total dry film thidkness of the coating system shall be 25 mils minimum. | Rev.2

e. Coatings shall be stopped short of each field weld joint if applicable, but shall completely cover shop joints, flanges of waterbox connections and manhole flanges. | Rev.2

3.8.4 PREOPERATIONAL CHEMICAL CLEANING

a. The shell side at the condenser will be subjected to the following procedures after installation during preoperational cleaning of the feedwater cycle.

b. Flush with filtered well water and then drain. The anticipated well water analysis is as follows:

Substance	mg/l, as Calcium Carbonate (except as noted)
Calcium	5.0
Magnesium	5.0
Sodium	445.0
Bicarbonate	310.0
Carbonate	30.0
Chloride	40.0
Sulfate	75.0
Silica as Silicon Dioxide	10.0
Iron, as Fe	0.2
Turbidity as Jackson Units	30.0 max.
Total Dissolved Solid	455.0

c. Circulate a mixture of approximately 2000 ppm Na PO and 1000 ppm Na HPO in filtered well water at 200 F for 20-24 hours.

d. Displace above solution and flush with demineralized water containing cycle-hexylamine sufficient to bring the pH to approximately 9.4 and 100 ppm of hydrazine.

e. The preoperational chemical cleaning is subject to change.

3.8.5 PREPARATION FOR SHIPMENT

a. The shells shall be shipped in sections not more than 30 feet wide for clearance installation.

b. All external gasket surfaces and flange faces shall be thoroughly cleaned, greased or treated with soluble preservatives, and protected with suitable wood, metal or other substantial type covering to insure their full protection unless specified otherwise herein.

c. All nozzles or other openings shall be capped or otherwise protected after shop cleaning unless specified otherwise herein. Caps shall be tack welded or otherwise securely fastened.

d. All exposed threaded parts shall be greased, and closed with plastic plugs. Cast iron plugs are not acceptable. All female threaded openings shall be closed with forged steel plugs, unless otherwise specified.

e. Suitable blocking, straps, and skids shall be provided to protect equipment from damage in transit. Precautions shall be taken by the Seller to prevent corrosion of the equipment furnished by him while it is in transit to the work site and in outdoor storage awaiting erection. Outdoor atmospheric conditions are described in paragraph 3.3.1.a.

3.9 SPECIAL TOOLS

The Seller shall furnish one set of any special tools required for the operation and/or maintenance of the equipment furnished by him. Tools shall be new and of first class quality and shipped to the work site in a separate box clearly marked as to their intended use.

3.10 WELDING

3.10.1 GENERAL

a. All welding shall be in accordance with the attached, "General Welding Requirements for Shop Fabricated Equipment", Specification 2323-GS-901, Appendix 1. The condenser is classified as a non code item.

b. Condensers shall be designed in a manner to require a minimum of welding to be done in the field. No strength welds in the shell or structural welding that require stress relieving in the field will be permitted.

3.10.2 SPECIFIC REQUIREMENTS

The equipment supplied under this specification are nonnuclear code but the following shall apply:

a. All shop welders shall be in accordance with and qualified to the Seller's shop welding practices. The Seller shall provide field welding procedures and welder requirements for use of the condenser erector. These should be consistent with the Seller's shop practices.

b. The Seller shall define all welds specifying strength welds, welds subject to stress, and all other classification of welds he deems necessary in order of importance. These shall be shown in detail on the isometric drawing requested in paragraph 3.6.1.f.

3.11 NAMEPLATES

Each condenser shell shall be furnished with a stainless steel nameplate mounted in a convenient location. Data to be furnished shall be supplied later.

3.12 OPTIONS

The Purchaser reserves the right to exercise the following options:

3.12.1 OPTION B - WATERBOXES | Rev.2

Waterboxes designed for hydrostatic testing at 60 psig.

3.12.2 OPTION C - ALUMINUM BRONZE TUBESHEETS | Rev.2

The Seller shall supply the condensers with 1-1/8 inch thick aluminum bronze tubesheet instead of 1-1/4 inch thick copper nickel tubesheet.

SECTION 3

APPENDIX 1

SPECIFICATION 2323-GS-901
GENERAL WELDING REQUIREMENTS