Industrial Fuel Gas Demonstration Plant Program

Phase I
Mechanical Design

Volume II
Air Separation

Prepared For
The Department of Energy
Under Contract ET-77-C-01-2582

MEMPHIS LIGHT, GAS AND WATER DIVISION
P.O. BOX 430, MEMPHIS, TENNESSEE 38101

In Association with
FOSTER WHEELER ENERGY CORPORATION
INSTITUTE OF GAS TECHNOLOGY
DELTA REFINING COMPANY

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FUEL GAS DEMONSTRATION PLANT PROGRAM

SMALL-SCALE INDUSTRIAL PROJECT

MECHANICAL DESIGN

PHASE I VOLUME 2

MEMPHIS LIGHT, GAS AND WATER DIVISION
P. O. Box 430
Memphis, Tennessee 38101

Prepared for the

U.S. DEPARTMENT OF ENERGY

Assistant Secretary for Energy Technology
Office of Fossil Fuels

Under CONTRACT ET-77-C-01-2582

Industrial Fuel Gas Demonstration Plant Program

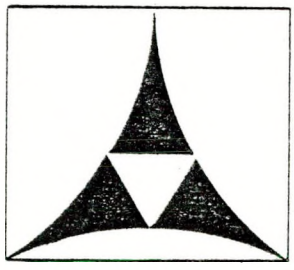
TASK III REPORT

DEMONSTRATION PLANT MECHANICAL DESIGN

VOLUME II

AIR SEPARATION

Prepared For
The Department of Energy
Under Contract ET-77-C-01-2582



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DEMONSTRATION PLANT MECHANICAL DESIGN

REPORT VOLUMES

Volume I	Overall Plant Description
Volume II	Air Separation
Volume III	Coal/Coke Treating & Feed Coal/Coke Handling Dock Facilities
Volume IV	Gasification Gas Cooling and Scrubbing Ash Treatment
Volume V	Gas Compression Gas Treating
Volume VI	Sour Water Stripping
Volume VII	Sulfur Recovery Tail Gas Treating
Volume VIII	Credit Generation
Volume IX	Utility Area
Volume X	Waste Water Treatment
Volume XI	Cooling Tower Flare
Volume XII	General Facilities Buildings

DEMONSTRATION PLANT MECHANICAL DESIGN

Volume II Table of Contents

Air Separation - Section 310

A - Combined with Process Flow Diagrams contained in Task II Report
B - Capital Investment Estimate prepared under Task III contained in Economic Assessment Report
C - Combined with Process Design (Task II Report)
D - Combined with Bid Package Terms & Conditions (Supply Subcontract), provided under separate cover.

Section 1.0

INTRODUCTION

1.1 Program Summary

The United States Department of Energy (DOE) awarded a contract to Memphis Light, Gas and Water Division (MLGW) which requires MLGW to perform process analysis, design, procurement, construction, testing, operation, and evaluation of a plant which will demonstrate the feasibility of converting high sulfur bituminous coal to industrial fuel gas with a heating value of 300 ± 30 Btu per standard cubic foot (SCF). The demonstration plant is to be based on the U-Gas process, with its product gas to be used in commercial applications in Memphis, Tennessee.

In order to perform this work, MLGW has established an industrial team, which includes:

MLGW - Memphis Light, Gas and Water Division, Memphis, Tenn.
The prime contractor and distributor of the industrial fuel gas.

FWEC - Foster Wheeler Energy Corporation, Livingston, N.J.
The engineer-construction manager.

IGT - Institute of Gas Technology, Chicago, Illinois.
The process developer.

DRC - Delta Refining Company, Memphis, Tenn.
To provide operating experience.

The contract specifies that the work is to be conducted in three phases. Phase I costs are financed entirely by DOE. Costs for Phases II and III will be shared equally by DOE and MLGW. The Phases are:

Phase I - Program Development and Conceptual Design
Phase II - Demonstration Plant Final Design, Procurement and Construction
Phase III - Demonstration Plant Operation

Under Task III of Phase I a Mechanical Design and Cost Estimate for the Demonstration Plant was completed. The output of this Task, in addition to the cost estimate, is comprised of the following items:

a. Drawings/Flowsheets
b. Equipment List
c. Procurement Requisitions
d. Instrumentation Data
e. Plot Plans
f. Building Sketches

This report, entitled "Demonstration Plant Mechanical Design", is intended to provide all engineering information necessary for the preliminary design of the plant. This report, which should be used in conjunction with the Task II report "Demonstration Plant Process Design" includes information on all plant units shown on Table 1.

This Task III report is provided in twelve volumes as shown on Page i.

This is Volume II, Air Separation Plant. Combined with the other volumes comprising the Demonstration Plant Mechanical Design Report and the Process Design (Task II) Report, the material meets the requirements for deliverables No. 17, 19, 21 and 24; as specified within Appendix A - Statement of Work.

Table 1

AREA DESIGNATIONS
FOR DEMONSTRATION PLANT

Area No.	Title	Section No.
2230	Process Units	-
2231	Air Separation	310
2232	Coal/Coke Treating & Feed	320
2233	Coal Gasification	330
2234	Gas Cooling & Scrubbing	340
2235	Gas Compression (Raw/Recycle Gas)	350
2236	Gas Treating	360
2237	Sour Water Stripping	370
2238	Sulfur Recovery	380
2239	Tail Gas Treating	390
2222	Credit Generation	220
2240	Support Facilities	-
2241	Coal/Coke Handling	410
2242	Ash Treatment	420
2243	Utility Area Steam Generation Raw Water Storage BFW Treatment Plant Air	430
2244	Waste Water Treatment	440
2245	Cooling Tower	450
2246	Flare	460
2247	General Facilities Long Term Coal Storage Long Term Ash & Solid Waste Storage Interconnecting Piping Roads & Fences Firewater System Power & Lighting, & Communication Sewers	470
2248	Buildings	480
2249	Dock Facilities	490

Note: Section numbers shown on Drawings are the last two digits of the area number, followed by a zero (e.g. Section 310 is Air Separation Unit). Area numbers have been established for Cost Control Purposes in Phase II.

1.2 Plant Summary

The Industrial Fuel Gas Demonstration Plant produces a nominal 50 billion BTU/Day of product gas, which is equivalent in energy output to approximately a 10,000 barrel/day oil refinery. The product gas has a heating value of 300 ± 30 BTU/SCF. 45 billion BTU/Day of this gas is available as send-out gas to IFG customers. The remaining 5 billion BTU/Day of this gas is further processed to pipeline quality (950 BTU/SCF) and deposited in the Memphis natural gas distribution system to generate BTU credit. The BTU credit can be withdrawn and used to satisfy IFG customer demand when the U-Gas production facility is totally or partially down for maintenance. By the use of the credit generation system the demand of IFG customers can thus be assured.

Drawing 2202-1-50-00104 is the plant block flow diagram showing the process sequence and process related support facilities of this demonstration plant. Each process unit as well as each process related support facility is described briefly in the following summary.

Section 310, Air Separation Plant
Compresses intake air and separates it into oxygen and nitrogen. The oxygen is compressed and sent to the gasifiers. A small portion of the nitrogen is returned for plant use. Liquid oxygen and nitrogen can also be produced to keep their respective storage tanks filled in order to provide the necessary reserve for an outage of the air separation plant.

Section 320, Coal/Coke Treating and Feed
Coal is crushed from 2" x 0" to 1/4" x 0" and dried to 2.5% moisture in a dryer mill. The dried, sized coal is stored in a coal silo. Sized coke received by the plant is also dried by a separate dryer and stored in a coke silo. Coal or coke is conveyed to the gasifier feeding systems from either the coal or coke silo. Dual conveying systems are provided to fill the gasifier feeding systems with one serving as a spare. Each gasifier has its own feeding system. The gasifier feeding system is a multi-feed hopper system, each consisting of a receiving hopper, two lock hoppers and two injection hoppers. Each injection hopper feeds into three pneumatic injection lines which transports coal or coke into the gasifier.

Section 330, Coal Gasification
Contains the coal gasifiers where steam and oxygen react with the coal in a fluidized bed at about 1875°F and 75 psig to produce hot, raw gas (CO, CO_2 and H_2). Within the reaction zone of the fluidized bed is an ash-agglomerating zone. The ash agglomerates drop into a water quench. Fines carried over with the hot, raw gas are returned to the gasifier through external cyclones.

Section 340, Gas Cooling and Scrubbing
Cools the gas from 1875°F to 450°F. For purposes of heat recovery, the gas passes in sequence through a high pressure steam generator, high pressure steam superheater, another high pressure steam generator, and a boiler feedwater preheater. After heat recovery the raw gas is quenched to saturation and passes through scrubbers. In the scrubbers particulate matter is removed by scrubbing with water. Sections 330 and 340 are four parallel trains and the balance of the plant is one train. Sour water from the knock-out drum, containing dissolved NH_3 and H_2S passes through a sour water stripper in Section 370; the overhead from the stripper goes to sulfur recovery. The water effluent goes to waste water treatment. The slurry water from the scrubber goes through a slurry water stripper. The slurry water after being stripped is clarified and filtered. The filter cake is sent to the steam generator for use as fuel. The filtrate water effluent is sent to waste water treatment.

Section 350, Gas Compression
Scrubbed gas is cooled, compressed to sufficiently high pressure and cooled again to go through gas treating and deliver the gas at 150 psig to the industrial fuel gas distribution header.

Section 360, Gas Treating
Receives the cooled gas from gas compression in Section 350. It then passes to a Selexol unit where H_2S and COS are removed to meet the product gas sulfur specification, and enough CO_2 is removed to obtain a constant heating value product gas. The product gas is then sent to Section 470 where it will be odorized and metered before being discharged to the industrial fuel gas distribution system.

Section 370, Sour Water Stripping
Receives sour water from Sections 340, 350 and 360. The major portions of ammonia and hydrogen sulfide are removed by means of steam stripping.

Section 380, Sulfur Recovery
Receives sour gas from Section 370 and acid gas from Section 360. It converts the sulfur compound in three catalytic stages of a Claus type sulfur recovery unit to achieve 96% sulfur recovery. Sulfur goes through condensers, seal pit and rundown pit, and storage tank before being loaded into tank trucks.

Section 390, Tail Gas Treating
Receives the tail gas from Section 380. It then goes to a Beavon unit package where remaining sulfur is converted to H_2S, and then removed in a Stretford Unit. The tail gas is reheated to achieve satisfactory buoyancy and discharged to the atmosphere.

Section 220, Credit Generation
Treats from 10% to 30% of the product gas from Section 360 to produce pipeline quality gas which will be deposited into the Memphis pipeline gas distribution system to generate a reserve of credit. This reserve which can be withdrawn during U-gas plant outage. Pipeline gas withdrawn from the Memphis pipeline gas distribution system will be adjusted to the U-gas heating value prior to its distribution to the U-gas customers.

Section 410, Coal/Coke Handling
Receives the incoming washed coal (2" x 0") from barges and transports it to a 14 day live coal storage pile. From there coal is transported to Section 320.

Section 420, Ash Treatment
Receives the agglomerated quenched ash slurry from the gasifiers (Section 330) and conveys it hydraulically to the dewatering bins. The dewatered ash is then discharged into trucks for disposal to the ash pile. The water from the dewatering bins is collected in the clarifier where clean water overflows into a sump tank while the underflow is pumped back to the dewatering bins. The clean water is then recycled to the gasifiers. A startup pump is provided for initial transport of slurry to the dewatering bins when the gasifier pressure is too low for conveying.

The non-process sections to support the process and to provide utilities to the process include the following functions:

Section 430, Utility Area which includes:
Steam Generation
Raw Water Storage
BFW Treatment

Section 440, Waste Water Treatment

Section 450, Cooling Tower

Section 460, Flare

Section 470, General Facilities which include:
Long Term Coal Storage for 90 days
Long Term Ash & Solid Waste Storage
Interconnecting Piping
Roads and Fences
Firewater System
Power, Lighting, and Communication
Sewers
Odorization and Metering Station

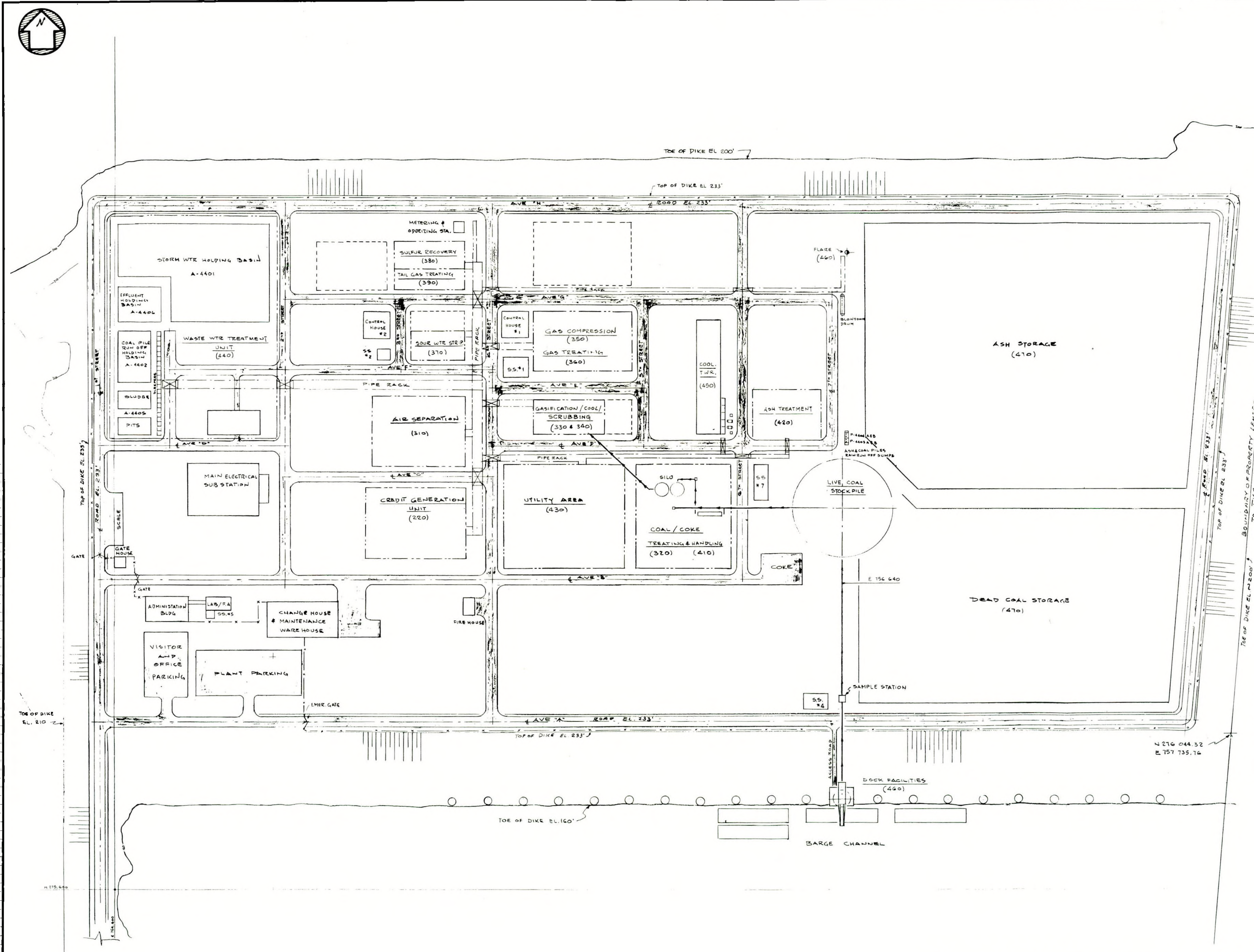
Drawing No. 2203-1-01-4701 is the Key Plot Plan for the Demonstration Plant. The site, which comprises approximately 134 acres, is located next to the T. H. Allen Steam Generating Station in Shelby County, Tennessee.

An in-depth discussion of the site selection and description can be found in the following separate documents:

a. "Site Evaluation and Selection Report" February 1979.

b. Environmental Analysis Report August 1979.

All sections of the plant are shown on the Key Plot Plan.


STORM WTR HOLDING BASIN
A-4401
EFFLUENT HOLDING BASIN A-4406
COAL PILE RUN OFF HOLDING BASIN A-4402
WASTE WTR TREATMENT UNIT (440)
SLUDGE
A-4405
PITS
METERING & ODORIZING STA.
SULFUR RECOVERY (380)
TAIL GAS TREATING (390)
CONTROL HOUSE #2
SOUR WTR STRIP (370)
PIPE RACK
AIR SEPARATION (310)
CONTROL HOUSE #1
GAS COMPRESSION (350)
GAS TREATING (360)
GASIFICATION / COOL / SCRUBBING (330 & 340)
COOL. TWR. (450)
ASH TREATMENT (420)
FLARE (460)
BLOWDOWN DRUM
ASH STORAGE (470)
MAIN ELECTRICAL SUBSTATION
CREDIT GENERATION UNIT (220)
UTILITY AREA (430)
SILO
COAL / COKE TREATING & HANDLING (320) (410)
LIVE COAL STOCKPILE
COKE
DEAD COAL STORAGE (470)
GATE HOUSE
GATE
SCALE
ADMINISTRATION BLDG
LAB/F.A.
CHANGE HOUSE & MAINTENANCE WAREHOUSE
FIRE HOUSE
VISITOR AND OFFICE PARKING
PLANT PARKING
EMER. GATE
SAMPLE STATION
DOCK FACILITIES (460)
BARGE CHANNEL
TOP OF DIKE EL 200'
TOP OF DIKE EL 233'
ROAD EL 233'
AVE "A"
AVE "B"
AVE "D"
AVE "F"
AVE "H"
TOE OF DIKE EL. 160'
TOE OF DIKE EL. 210
E 756 640
N 276 044.32
E 757 735.76
N 278 037.45
E 757 301.38
BOUNDARY OF PROPERTY LEASED TO TVA JAN 1963
GENERAL NOTES
LEGEND
PIPE WAY
UNIT BATTERY LIMIT
ROAD
PIPE WAY BRIDGE
SLEEPERS
FENCE
INTERCONNECTING CONVEYOR
SCALE IN FEET

UNIT TABULATION		
UNIT Nº	DESCRIPTION	ZONE Nº
220	CREDIT GENERATION	VII
310	AIR SEPARATION	VI
320	COAL/COKE TREATING & FEED	I & II
330	COAL GASIFICATION	II
340	GAS COOLING & SCRUBBING	II
350	GAS COMPRESSION	III
360	GAS TREATING	III
370	SOUR WATER STRIPPING	IV
380	SULFUR RECOVERY	V
390	TAIL GAS TREATING	V
410	COAL/COKE HANDLING	I
420	ASH TREATMENT	II & VIII
430	UTILITY AREA	IX
440	WASTE WATER TREATMENT	X
450	COOLING TOWER	XI
460	FLARE	XII
470	GENERAL FACILITIES	XIV
480	BUILDINGS	XIII
490	DOCK FACILITIES	I

B | FINAL ISSUE PHASE I TASK 3 | A | INITIAL ISSUE

INDUSTRIAL FUEL GAS DEMONSTRATION PLANT
MEMPHIS, TENN.
CONTRACT No. ET 77C-01-2582

MEMPHIS LIGHT, GAS AND WATER DIVISION
MEMPHIS, TENN.

DEPARTMENT OF ENERGY
COAL CONVERSION DIVISION
WASHINGTON, D.C.

FOSTER WHEELER ENERGY CORPORATION
110 SOUTH ORANGE AVE., LIVINGSTON N.J.

KEY PLOT PLAN
ALLEN PLANT SITE
SECTION 470

DRAWN BY: | SCALE: 1" = 100' | EST. NO. 15-2203 | DWG. NO-2203-1-01-4701

FORM NO. 135 28M

THIS DRAWING SUPERSEDES
THIS DRAWING SUPERSEDED BY

Section 2.0

UNIT DESCRIPTION - AIR SEPARATION

Air is compressed to approximately 85 psig and cooled to 100°F by means of Air Compressors (C-3101A/B) and Air Compressor Aftercooler (E-3102). Condensate from K.O. Drums D-3101A/B, D-3102, and D-3103A/B is routed to the cooling tower as make-up water. Compressed air from the Aftercooler K.O. Drum is fed to Air Separation Package (A-3101), and to the Credit Generation System (Section 220).

The Air Separation Package, consisting of heat exchangers and cryogenic distillation columns, produces gaseous oxygen (98 vol. %) as the primary product. Gaseous nitrogen (bone dry, 10 ppm O_2), liquid oxygen and liquid nitrogen are also produced in limited quantities.

The product oxygen leaving the Air Separation Package at a temperature of 94°F and a pressure of 2.7 psig is compressed to a pressure of 105 psig by the Oxygen Compressor (C-3102) for delivery to Coal Gasification (Section 330).

Product gaseous bone-dry nitrogen reports to the Plant Nitrogen Compressors (C-3103A/B) and to Gas Treating (Section 360) where it is employed as a stripping medium in the CO_2 Stripper (T-3604).

Liquid nitrogen, which will be produced continually, is stored in Liquid Nitrogen Storage Tank (TK-3101) for subsequent vaporization by either the Liquid Nitrogen Vaporization Package (A3102) or the Instrument Nitrogen Vaporization Package (A-3103). The Liquid Nitrogen Vaporization Package will provide gaseous nitrogen for start-up and shutdown of the plant.

When the Air Separation Package operates at less than its design capacity for gaseous oxygen production, it is capable of producing liquid oxygen for storing in the Liquid Oxygen Storage Tank (TK-3102). Gaseous oxygen, generated by vaporizing liquid oxygen in the Oxygen Vaporization Package (A-3104) will be used as an emergency back-up source of oxygen feed gas. The 1000 tons of storage capacity specified for liquid oxygen allows over 13 hours of back-up at full capacity (3 gasifiers).

3.0 DRAWINGS

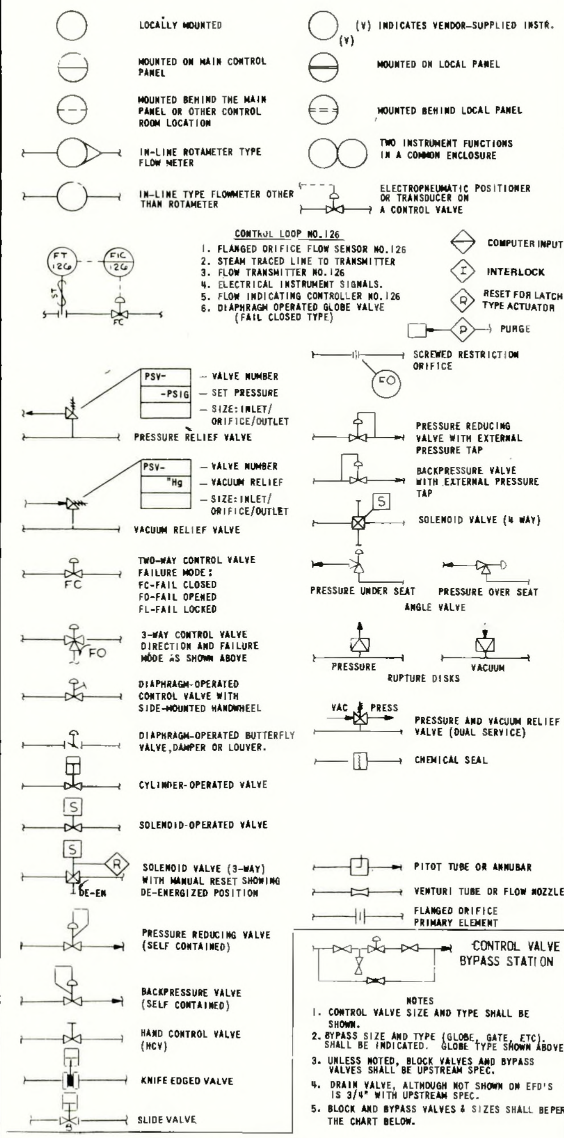
This section includes drawings as listed below, to further define the scope of this project.

Drawings	Number of Drawings
Symbol Drawing	1
Unit Plot Plan	1
Engineering Flow Diagrams(including Utility Flow Diagram)	6
Underground Piping	1
Materials of Construction	2
Line List	8
Piping Material Specification List*	2

*Note: This list identifies the piping materials specified on the Engineering Flow Diagrams.

INSTRUMENT AND CONTROL SYMBOLS

FOR I&C SYMBOLS NOT SHOWN SEE FWEC STD. 60A3



NOTES

1. CONTROL VALVE SIZE AND TYPE SHALL BE SHOWN.
2. BYPASS SIZE AND TYPE (GLOBE, GATE, ETC). SHALL BE INDICATED. GLOBE TYPE SHOWN ABOVE
3. UNLESS NOTED, BLOCK VALVES AND BYPASS VALVES SHALL BE UPSTREAM SPEC.
4. DRAIN VALVE, ALTHOUGH NOT SHOWN ON EFD'S IS 3/4" WITH UPSTREAM SPEC.
5. BLOCK AND BYPASS VALVES & SIZES SHALL BE PER THE CHART BELOW.

CONTROL VALVE BLOCK BYPASS VALVES

LINE SIZE:	1/2		3/4		1			
CONTROL VALVE SIZE	VALVE BLOCK	BYPASS (GLOBE)	VALVE BLOCK	BYPASS (GLOBE)	VALVE BLOCK	BYPASS (GLOBE)		
1/2	1/2	1/2	3/4	3/4	1	1		
3/4	-	-	3/4	3/4	1	1		
1	-	-	-	-	1	1		

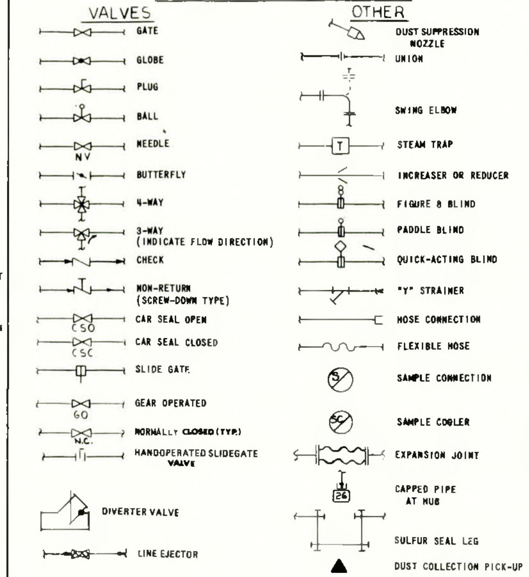
LINE SIZE:	1 1/2		2		3		4	
CONTROL VALVE SIZE	VALVE BLOCK	BYPASS (GLOBE)	VALVE BLOCK	BYPASS (GLOBE)	VALVE BLOCK	BYPASS (GLOBE)	VALVE BLOCK	BYPASS (GLOBE)
1/2	1 1/2	1 1/2	-	-	-	-	-	-
3/4	1 1/2	1 1/2	2	2	-	-	-	-
1	1 1/2	1 1/2	2	2	2	2	-	-
1 1/2	1 1/2	1 1/2	2	2	2	2	3	3
2	-	-	2	2	3	2	3	3
3	-	-	-	-	3	3	4	3
4	-	-	-	-	-	-	4	4

LINE SIZE:	6		8		10		12	
CONTROL VALVE SIZE	VALVE BLOCK	BYPASS (4 GLOBE) (6 GATE)	VALVE BLOCK	BYPASS (GATE)	VALVE BLOCK	BYPASS (GATE)	VALVE BLOCK	BYPASS (GATE)
2	4	4	-	-	-	-	-	-
3	4	4	6	6	-	-	-	-
4	6	4	6	6	8	8	-	-
6	6	6	8	6	8	8	10	10
8	-	-	8	8	10	8	10	10
10	-	-	-	-	10	10	12	10
12	-	-	-	-	-	-	12	12

NOTES:

a. ALL SIZES IN INCHES.
b. BLOCK AND BYPASS VALVES AND MANIFOLDS SHALL NOT BE LARGER THAN MAIN LINE SIZE.
c. INCREASE BYPASS VALVE BODY SIZE ONE SIZE WHERE CONTROL VALVE BODY IS BUTTERFLY DESIGN (ONLY WHEN GLOBE VALVES ARE USED AS BYPASS).
d. ON FLASHING SERVICE OR WHERE THE CONTROL VALVE OUTLET LINE SIZE IS GREATER THAN THE CONTROL VALVE INLET LINE SIZE, THE OUTLET PIPING FROM BOTH THE CONTROL VALVE AND BYPASS VALVE, AND THE DOWNSTREAM BLOCK VALVE ITSELF, SHALL BE NO SMALLER THAN ONE SIZE LESS THAN OUTLET LINE SIZE.

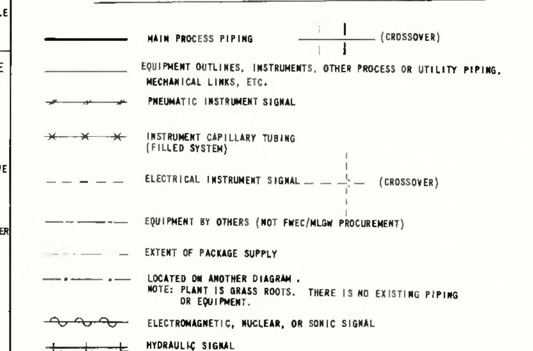
GENERAL PIPING SYMBOLS



GENERAL NOTES

1. ENGINEERING FLOW DIAGRAMS (EFD'S) DO NOT SHOW HIGH POINT VENTS, LOW POINT DRAINS, LOW POINT TRAPS, INSTRUMENT BLOCK VALVES ETC. REQUIREMENTS FOR THESE APPEAR IN THE JOB SPECIFICATIONS. ONLY PROCESS RELATED VENTS, DRAINS, TRAPS, ETC. ARE SHOWN.
2. DRAIN, VENT AND SAMPLE CONNECTIONS SHALL BE 3/4" UNLESS OTHERWISE NOTED.
3. CHANGES IN LINE SPEC AND/OR INSULATION SHALL BE INDICATED BY A PERPENDICULAR BREAKLINE WITH THE SPEC. NOTED ON EACH SIDE.
   (SEE EXAMPLES BELOW)
4. UNLESS OTHERWISE NOTED ALL VESSEL CONNECTIONS TO PIPING SHALL BE LINE SIZE AND SHALL MATCH THE PIPE SPEC.
5. ELECTRICAL SYMBOLS ARE NOT SHOWN ON THIS DWG.
   SEE JOB SPEC-2200-73B20.1 TO 73B20.4
6. CONTROL VALVES SHALL BE FLANGED WITH FACE TO FACE DIMENSIONS PER I.S.A.R.P 4,1 WHEREVER PRACTICABLE.

LINE TYPES USED FOR FLOW DIAGRAMS

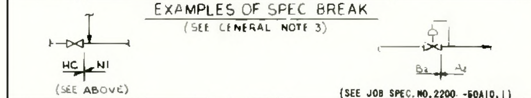


INSULATION DESIGNATIONS

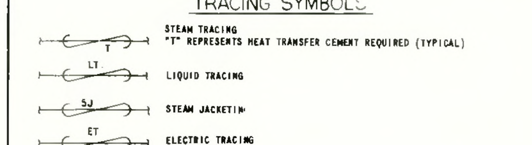
DESIGNATION	DESCRIPTION
AS	ANTI-SWEAT
CC	COLD CONSERVATION
CW	COATED & WRAPPED
ET	ELECTRICALLY TRACED
HC	HEAT CONSERVATION
LT	LIQUID TRACED
NI	NOT INSULATED
PP	PERSONNEL PROTECTION
PS	PROCESS STABILIZATION
SJ	STEAM JACKETED
ST	STEAM TRACED

EXAMPLES OF SPEC BREAK

(SEE GENERAL NOTE 3)



TRACING SYMBOLS

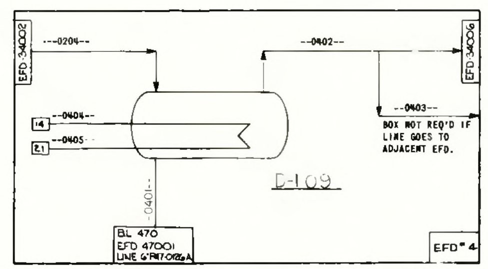


NOTES: 1. THE NORMAL TRACING MEDIUM FOR THIS CONTRACT IS: STEAM (REF FWEC ENGG STD 56A1)

LINE AND HEADER DESIGNATIONS

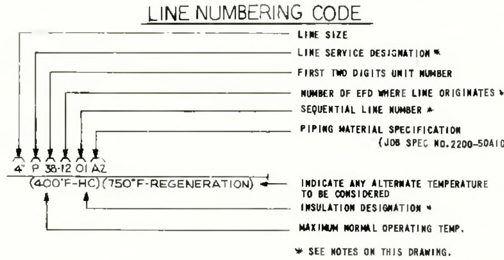
DESIGNATION	DESCRIPTION	DESIGNATION	DESCRIPTION
A	PROCESS AIR	TW	TREATED WATER
BD	BLOWDOWN	V	VENT
BH	BOILER FEED WATER (HP)	W	WASTEWATER
BL	BOILER FEED WATER (LP)	WC	CITY WATER
C	CONDENSATE	WS	WASTEWATER WITH SOLIDS
CA	CHEMICAL ADDITIVE	PA	PLANT AIR
CH	CONDENSATE, HIGH PRESSURE		
CK	COKE		
CL	CONDENSATE, LOW PRESSURE		
CM	CONDENSATE, MEDIUM PRESSURE		
CO	COAL		
CS	CARBONATE SOLUTION		
CW	COOLING WATER		
D	DRAIN		
DW	DRINKING (POTABLE) WATER		
FA	FLYASH		
FG	FUEL GAS		
FL	FLUSHING OIL		
FO	FUEL OIL		
FW	FIRE WATER		
G	CARBONATE VAPOR + STEAM		
GW	TEMPERED WATER		
GX	GASEOUS OXYGEN		
IN	INSTRUMENT NITROGEN		
LO	LUBE OIL		
LN	LIQUID NITROGEN		
LX	LIQUID OXYGEN		
N	INERT GAS (NITROGEN)		
NG	NATURAL GAS		
P	PROCESS FLUID (GAS, VAPOR, OR LIQUID)		
PO	PUMP OUT		
PS	PROCESS FLUID-WITH SOLIDS		
R	RELIEF VALVE DISCHARGE		
RF	REFRIGERANT FLUID (LIQUID OR VAPOR)		
RW	REFRIGERATED WATER		
SH	900 PSIG STEAM		
SL	85 PSIG STEAM		
SM	125 PSIG STEAM		
SO	SEAL OIL		
SS	SELEXOL SOLUTION		
SW	SERVICE WATER		
SX	50 PSIG STEAM		

LINE NUMBERING SEQUENCE



LINE NUMBERING SEQUENCE ON EFD'S SHALL BE FROM LEFT TO RIGHT AND LINES CONTINUING TO OTHER EFD'S SHALL TERMINATE ALONG SIDES AS INDICATED ABOVE. LINES CROSSING TO UNIT BATTERY LIMIT SHALL TERMINATE IN A "BL" BOX AT THE BOTTOM (PREFERRED LOCATION) OR TOP. THE BOX SHALL DESIGNATE AT WHICH UNIT LIMIT THE LINE ENTERS OR LEAVES THE UNIT AND ALSO IDENTIFY THE CONNECTING FLOW DIAGRAM AND LINE NUMBER. SEE LINE NUMBERING CODE BELOW FOR EXPLANATION.

LINE NUMBERING CODE



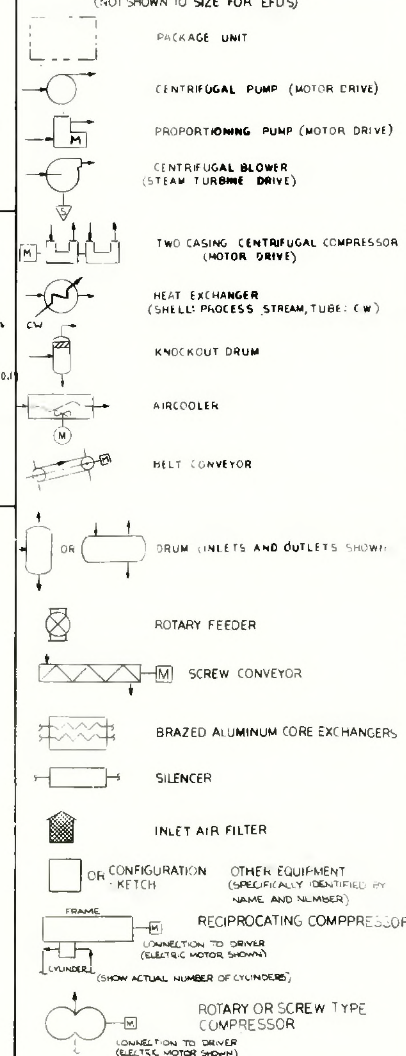
* SEE NOTES ON THIS DRAWING.

EQUIPMENT DESIGNATIONS

A	PACKAGE ITEM OR SYSTEM
B	BLOWER, FAN
BD	BLENDER
BR	BURNER
BV	SOLIDS DISCHARGER
C	COMPRESSOR
CL	CLARIFIER
CR	CONVEYOR
CT	COOLING TOWER
D	DRUM
DC	DUST COLLECTOR
DH	DEAERATOR
DP	DUST SUPPRESSOR
DR	DRYER
DS	DESUPERHEATER
DV	DIVERTING VALVE
E	HEAT EXCHANGER
EL	ELEVATOR (PASSENGER, SERVICE)
F	FILTER
FD	FEEDER
FL	FLARE
H	HEATER, FURNACE
HM	HOISTING MACHINE
J	EDUCTOR, EJECTOR
KT	SAMPLE CUTTER
LA	LOADING ARM
M	MIXER
P	PUMP
R	REACTOR
S	SEPARATOR, SCRUBBER, CYCLONE
SG	STEAM GENERATOR, BOILER
SK	SOLIDS STACKER
SL	SILENCER
SR	SIZE REDUCTION EQUIPMENT
SS	SAMPLING SYSTEM
T	TOWER
TK	TANK, SILO, HOPPER
UD	SOLIDS UNLOADER
WS	WEIGH SCALE

EQUIPMENT SYMBOLS

(NOT SHOWN TO SIZE FOR EFD'S)



REFERENCES
JOB SPECS-2200

50 B 12.1	"PIPING SYMBOLS, VALVES, AND ACCESSORIES"
60 A 1	"INSTRUMENTATION"
60 A3	"INSTRUMENTATION SYMBOLS AND IDENTIFICATION"
73 B 20.1 - 4	"ELECTRICAL POWER SYMBOLS"
50 A 10.1	"PIPING MATERIAL SPEC. INDEX"
56 A 1	"STEAM TRACING STANDARD FOR PIPING, VESSELS, AND EQUIPMENT"
78 A 3	"ELECTRICAL HEAT TRACING FOR PIPING INSTRUMENTS AND EQUIPMENT"

SELECTED PROJECT DOCUMENTS

1. THE DEMONSTRATION PLANT DESIGN BASIS"
2. "BASIC ENGINEERING DATA" FOR DEMONSTRATION PLANT
3. TASK I FINAL REPORT, "CONCEPTUAL DESIGN AND EVALUATION OF COMMERCIAL PLANT" VOL I - IV
4. FWEC DWG. 2201-1-50-00103, PLANT BLOCK FLOW DIAGRAM FOR COMMERCIAL PLANT.
5. FWEC DWG. 2201-1-01-1, KEY PLOT PLAN FOR COMMERCIAL PLANT.

UNIT NAMES AND NUMBERS

PROCESS UNITS

SECTION NUMBER	DESCRIPTION
310	AIR SEPARATION
320	COAL/COKE TREATING AND FEED
330	COAL GASIFICATION
340	GAS COOLING AND SCRUBBING
350	GAS COMPRESSION (RAW/RECYCLE GAS)
360	GAS TREATING
370	SOUR WATER STRIPPING
380	SULFUR RECOVERY
390	TAIL GAS TREATING
220	CREDIT GENERATION

SUPPORT FACILITIES

410	COAL/COKE HANDLING
420	ASH TREATMENT
430	UTILITY AREA STEAM GENERATION CITY WATER STORAGE BFW TREATMENT
440	WASTE WATER TREATMENT
450	COOLING TOWER
460	FLARE
470	GENERAL FACILITIES LONG TERM COAL STORAGE LONG TERM ASH AND SOLID WASTE STORAGE INTERCONNECTING PIPING ROADS AND FENCES FIREWATER SYSTEMS POWER LIGHTING COMMUNICATION AND SEWERS
480	BUILDINGS
490	DOCK FACILITIES

UNIT ENGINEERING FLOW DIAGRAM INDEX

(LATER)

REV	DESCRIPTION	DATE	FWEC	MLGW	DOE
B	FINAL ISSUE - PHASE I, TASK III	6-16-79	RRQ		
A	INITIAL ISSUE	8-31-79			

INDUSTRIAL FUEL GAS DEMONSTRATION PLANT
MEMPHIS, TENN.
CONTRACT No. ET 77C-01-2582

MEMPHIS LIGHT, GAS AND WATER DIVISION
MEMPHIS, TENN.

DEPARTMENT OF ENERGY
COAL CONVERSION DIVISION
WASHINGTON, D.C.

TASK II
15-2202
DEMO PLANT PROCESS DESIGN
TASK III
15-2203
DEMO PLANT PROCESS & MECH. DESIGN
UNIT NAMES AND NUMBERS
(SEE ABOVE)

FOSTER WHEELER ENERGY CORPORATION
110 SOUTH ORANGE AVENUE LIVINGSTON N.J.

ENGINEERING FLOW DIAGRAM
GENERAL NOTES, SYMBOLS AND DETAILS

EST. NO.		DRAWN BY L.B	5-21-79	SH. 1 OF 1
CONTRACT NUMBER	2203	DWG. NO 2203-1-50-1		B

THIS DRAWING SUPERSEDES 135-949-M REV. B
THIS DRAWING SUPERSEDED BY

260'-0"

200'-0"

FILTER HOUSE F-3101 A

FILTER HOUSE F-3101 B

LUBE OIL CONSOLE "A"

LUBE OIL CONSOLE "B"

LUBE OIL CONSOLE FOR C-3102

TROLLEY BEAM

C-3101 A

C-3101 B

C-3102

D-3101 A

D-3101 B

D-3102

D-3103 A

D-3103 B

E-3101 A (MIDLE)
E-3107 A (LOWER)

E-3102 (TOP)

E-3101 B (MIDLE)
E-3107 B (LOWER)

E-3102

E-3104

E-3105

E-3106

C-3103 A

C-3103 B

PLAT. EL. 106'-0"

PLAT. EL. 121'-3"

FLAME BARRIER

20'-0" WIDE PIPE RACK

A-3104

A-3102

A-3103

LIQUID NITROGEN FEED PUMPS

A-3101

REVERSING HEAT EXCHANGERS

EXPANDER

COLUMNS

ABSORBERS

FEED PUMP

TK-3102

TK-3101

LIMIT BATTERY

AVENUE "C"

MAIN PIPE RACK

4TH STREET

AVE. "D"

ELEVATION "A-A"
SCALE 1/8"=1'-0"

E-3102

EL. 144'-7"

PLAT. EL. 141'-3"

C-3101 A/B

EL. 135'-6"

PLAT. EL. 131'-3"

E-3107A/B

EL. 124'-3"

PLAT. EL. 121'-3"

(TYP.) EL. AT GRADE 100'-0"

NO.	ITEM	ELEVATION
D-3101 A/B	C-3101 A/B 1ST. STAGE INTERCOOLER K.O. DRUM	
D-3102	C-3101 A/B AFTER COOLER K.O. DRUM	
TK-3102	LIQUID OXYGEN STORAGE TANK	
E-3101 A/B	C-3101 A/B 1st. STAGE INTERCOOLER	
E-3102	C-3101 A/B AFTERCOOLER	
E-3103	C-3102 1ST. STAGE INTERCOOLER	
E-3104	C-3102 2ND STAGE INTERCOOLER	
E-3105	C-3102 3RD STAGE INTERCOOLER	
E-3106	C-3102 RECIRCULATION COOLER	
C-3101A	AIR COMPRESSOR A (MOTOR DRIVE)	
C-3101B	AIR COMPRESSOR B (TURBINE DRIVE)	

NO.	ITEM	ELEVATION
C-3102	OXYGEN COMPRESSOR	
C-3103 A/B	NITROGEN COMPRESSOR	
A-3101	AIR SEPARATION PACKAGE	
A-3104	LIQUID OXYGEN VAPORIZATION PKG.	
F-3101 A/B	C-3101 A/B INLET AIR FILTERS	
SL-3102 A/B	C-3101 A/B INLET SILENCER	
SL-3103 A/B	C-3101 A/B DISCHARGE SILENCER	
SL-3104 A/B	C-3101 A/B VENT SILENCER	
D-3103 A/B	C-3101 A/B 2ND STAGE INTERCOOLER K.O. DRUM	
E-3107 A/B	C-3101 A/B 2ND STAGE INTERCOOLER	

NO.	ITEM	ELEVATION

GENERAL NOTES

1- FWEC LOW POINT GRADE EL. OF 100'-0" IS EQUAL TO MLGW TRUE ELEV. OF 235'-0" -

2- COMPRESSORS, C-3101 A/B, C-3102 AND C-3103 A/B ARE ON CONCRETE PEDESTALS APPROX. ELEV. 108'-0" -

B	9-21-79	[illegible]	WB	A	8-9-79	INITIAL ISSUE

INDUSTRIAL FUEL GAS DEMONSTRATION PLANT
MEMPHIS, TENN.
CONTRACT No. ET 77C-01-2582

MEMPHIS LIGHT, GAS AND WATER DIVISION
MEMPHIS, TENN.

DEPARTMENT OF ENERGY
COAL CONVERSION DIVISION
WASHINGTON, D.C.

FOSTER WHEELER ENERGY CORPORATION
110 SOUTH ORANGE AVE., LIVINGSTON, N.J.

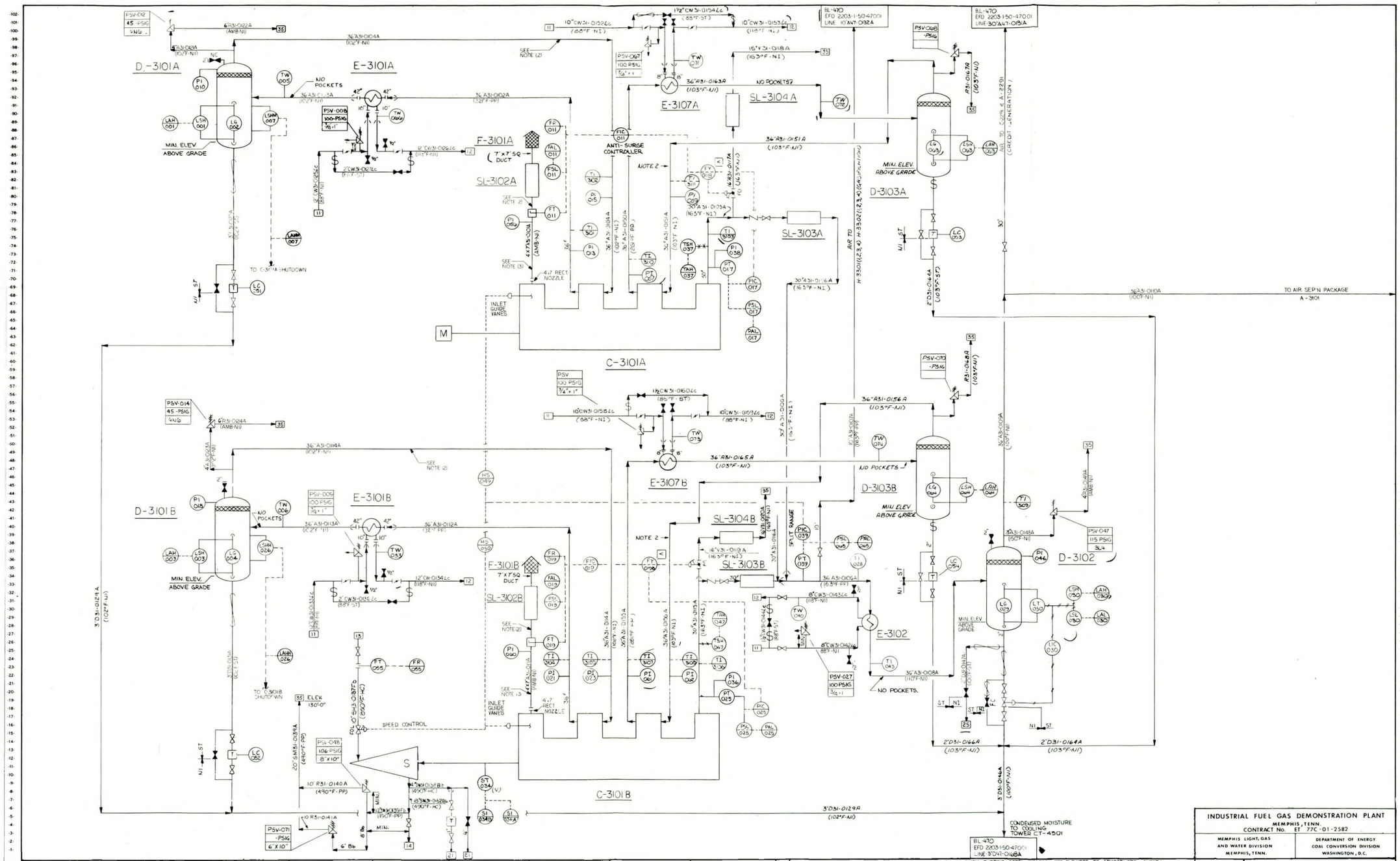
TASK III DEMONSTRATION PLANT

PLOT PLAN
AIR SEPARATION
SECTION 310

DRAWN BY: C.T. 7-11-79 | SCALE: 1"=10'-0" | EST. NO. 15-2203 | DWG. NO. 2203-1-01-3101

FORM NO. 135-28M

THIS DRAWING SUPERSEDES
THIS DRAWING SUPERSEDED BY



L E G E N D

- 11 COOLING WATER SUPPLY
- 12 COOLING WATER RETURN
- 13 900# STEAM
- 14 125 # STEAM
- 15 65# STEAM
- 16 50# STEAM
- 17 POTABLE WATER
- 18 PROCESS AIR
- 19 INSTRUMENT NITROGEN
- 20 H.P. CONDENSATE
- 21 L.P. CONDENSATE
- 22 TREATED WATER
- 23 NATURAL GAS
- 24 FUEL GAS
- 25 CLEAN WATER SEWER
- 26 OILY OR DIRTY WATER SEWER
- 27 PROCESS SEWER
- 28 SANITARY SEWER
- 29 FIRE WATER
- 30 FLUSHING WATER
- 31 PUMPOUT
- 32 PURGE GAS
- 33 BLOWDOWN
- 34 FLARE
- 35 TO ATMOSPHERE
- 36 INERT GAS (NITROGEN)
- 37
- 38 DEMINERALIZED WATER
- 39 SOUR WATER DRAIN
- 40 CITY WATER
- 41 BOILER FEED WATER (HP)
- 42 DISCHARGE TO GRADE
- 43 BOILER FEED WATER (LP)
- 44 SERVICE WATER
- 45 PROCESS GAS
- 46 GASEOUS OXYGEN
- 47 STEAM CONDENSATE (SRU)
- 48
- 49 SELEXOL DRAIN
- 50 BENEFIELD DRAIN
- 51
- 52
- 53
- 54
- 55

N O T E S

1) TURNDOWN CONTROL: I INLET GUIDE VANE ADJUSTMENT II C-3101A TURBINE SPEED CONTROL III BLOWOFF TO ATMOSPHERE SYSTEM MUST FUNCTION WITH EITHER ONE OR BOTH COMPRESSORS ON LINE.
2) THIS PIPING MUST MEET THE REQUIRMENTS OF JOB SPEC 2200-5046.
3) MINIMUM LENGTH OF STRAIGHT RUN TO C-3101A/B INLET 8'-0"

ITEM NO.	C-3101 A/B	ITEM NO.	F-3101 A/B
SERVICE	AIR COMPRESSOR	SERVICE	AIR COMP. INLET FILTER
S.G. AT P.T.	1.0 (AIR)	S.G.	1.0 (AIR)
DES.CFM AT INLET	92,452@ 95°F	DES. CFM	92,500@ 95°F
PRESS-PSIA	14.2	MAX ΔP	5.2" WG
MAX. DISCH. P.S.I.A.	105		
MATERIAL	CI	MATERIAL	CS
INSULATION	NI	INSULATION	NI

ITEM NO.	E-3101 A/B	E-3102	E-3107 A/B
SERVICE	AIR COMP. 1-ST. STAGE INTERCOOLER	AIR COMP. AFTERCOOLER	AIR COMP. 2-ND. STAGE INTERCOOLER
SHELL DES. P. & T.	100PSIG/170°F	100PSIG/170°F	100PSIG/170°F
TUBE DES. P. & T.	75PSIG/381°F	115PSIG / 213°F	95PSIG/311°F
SURFACE FT²	26,649	15,404	12,147
MATL. SHELL	CS	CS	CS
MATL. TUBE	CS	CS	CS
INSULATION	NI	NI	NI

ITEM NO.	D-3101A/B	D-3102	SL-3102 A/B	SL-3103 A/B	SL-3104 A/B	D-3103 A/B
SERVICE	1ST STAGE INT. COOL K.O. DRUM	AFTCOOL KNOCKOUT DRUM	AIR COMP INLET SILENCER	AIR COMP DIS. CHG. SILENCER	AIR COMP VENT SILENCER	2ND. STAGE INT. COOL K.O. DRUM
SIZE	11'-6 Ø x 23'-0" T.L.	12'-6 Ø x 25'-0" T.L.	5'-0 Ø x 15'-8" T.L.	2'-6 Ø x 8'-0" T.L.	4'-6" Ø x 16'-3" T.L.	10 Ø x 20' T.L.
DES PRESS-TEMP.	45PSIG/152°F	115PSIG/150°F				90PSIG / 153°F
OPER PRESS-TEMP.	20PSIG/102°F	90PSIG/100°F	ATM /95°F	100PSIG/163°F	100PSIG/163°F	64PSIG/103°F
MATERIAL	CS	CS	CS	CS	CS	CS
INSULATION	NI	NI	NI	NI	NI	NI

R E V I S I O N S

B	9-20-79	FINAL ISSUE PHASE I, TASK III	RB	
A	8-17-79	INITIAL ISSUE		R B

ITEM NOS. THIS DWG.
C-3101A
C-3101B
D-3101A
D-3101B
D-3102
E-3101A
E-3101B
E-3102
F-3101A
F-3101B
SL-3102A
SL-3102B
SL-3103A
SL-3103B
SL-3104A
SL-3104B
E-3107 A /B
D-3103A/B

INDUSTRIAL FUEL GAS DEMONSTRATION PLANT
MEMPHIS, TENN.
CONTRACT No. ET 77C-01-2582

MEMPHIS LIGHT, GAS
AND WATER DIVISION
MEMPHIS, TENN.

DEPARTMENT OF ENERGY
COAL CONVERSION DIVISION
WASHINGTON, D.C.

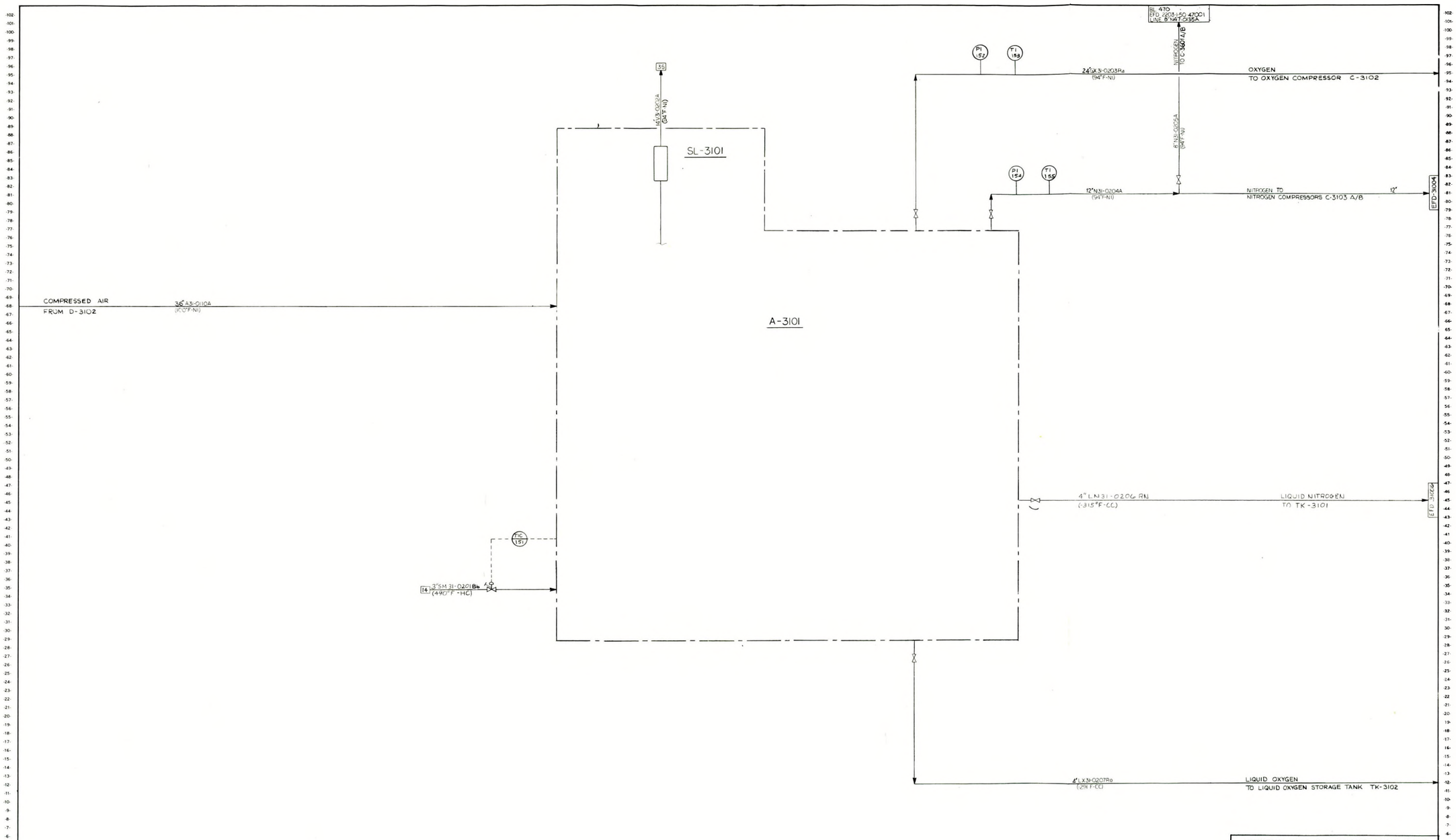
FOSTER WHEELER ENERGY CORPORATION
110 SOUTH ORANGE AVENUE, LIVINGSTON, N.J.

ENGINEERING FLOW DIAGRAM
AIR SEPARATION
SECTION 310

EST NO.
CONTRACT NUMBER 15-2203
DRAWN BY Viola 6-29-79 SH OF 6
DWG. NO.-2203-1-50-31001 B

THIS DRAWING SUPERSEDES

BRUNING 40-5353 23763-3
FORM-133-29M REV



LEGEND

- 11 COOLING WATER SUPPLY
- 12 COOLING WATER RETURN
- 13 900# STEAM
- 14 125# STEAM
- 15 85# STEAM
- 16 50# STEAM
- 17 POTABLE WATER
- 18 PROCESS AIR
- 19 INSTRUMENT
- 20 H.P. CONDENSATE
- 21 LP CONDENSATE
- 22 TREATED WATER
- 23 NATURAL GAS
- 24 FUEL GAS
- 25 CLEAN WATER SEWER
- 26 OILY OR DIRTY WATER SEWER
- 27 PROCESS SEWER
- 28 SANITARY SEWER
- 29 FIRE WATER
- 30 FLUSHING WATER
- 31 PUMP OUT
- 32 PURGE GAS
- 33 BLOWDOWN
- 34 FLARE
- 35 TO ATMOSPHERE
- 36 INERT GAS (NITROGEN)
- 37
- 38 DEMINERALIZED WATER
- 39 SOUR WATER DRAIN
- 40 CITY WATER
- 41 BOILER FEED WATER (HP)
- 42 DISCHARGE TO GRADE
- 43 BOILER FEED WATER (LP)
- 44 SERVICE WATER
- 45 PROCESS GAS
- 46 GASEOUS OXYGEN
- 47 DIRTY BACKWASH SEWER
- 48 STEAM CONDENSATE (SRU)
- 49 SELEXOL DRAIN
- 50 BENFIELD DRAIN
- 51
- 52
- 53
- 54
- 55

NOTES

ITEM NO.										
SERVICE										
S.G. AT P.T.										
DES. G.P.M. AT P.T.										
DES. DIFF. P.S.I.										
MAX. DISCH. P.S.I.G.										
MATERIAL										
INSULATION										

ITEM NO.									
SERVICE									
SHELL DES. P. & T.									
TUBE DES. P. & T.									
SURFACE									
MATL. SHELL									
MATL. TUBE									
INSULATION									

ITEM NO.	ITEM Nº	A-3101	SL-3101						
SERVICE	SERVICE	AIR SEPARATION PKG.	WASTE NITROGEN SILENCER						
SIZE									
DES. PRESS-TEMP.									
OPER. PRESS-TEMP.									
MATERIAL									
INSULATION		BY VENDOR	NI						

REVISIONS

B	9-20-79	FINAL ISSUE PHASE I, TASK III	RB
A	8-16-79	INITIAL ISSUE	RB

BRUNING 40-5353 23763-3

FORM-115-10M REV

INDUSTRIAL FUEL GAS DEMONSTRATION PLANT

MEMPHIS, TENN.
CONTRACT No. ET 77C-01-2582

MEMPHIS LIGHT, GAS
AND WATER DIVISION
MEMPHIS, TENN.

DEPARTMENT OF ENERGY
COAL CONVERSION DIVISION
WASHINGTON, D.C.

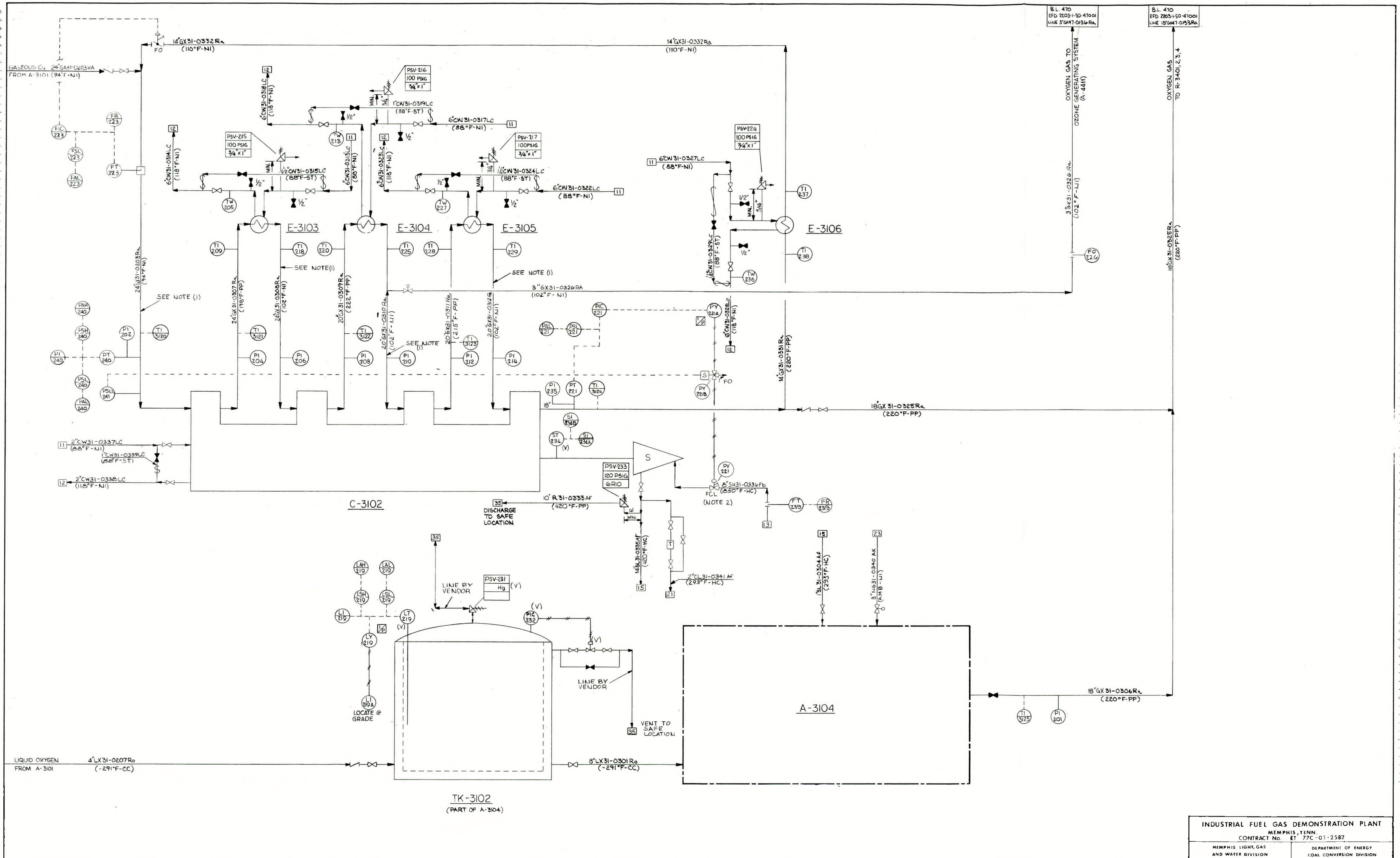
ITEM NOS. THIS DWG.
A-3101
SL-3101

FOSTER WHEELER ENERGY CORPORATION
110 SOUTH ORANGE AVENUE, LIVINGSTON, N.J.

ENGINEERING FLOW DIAGRAM
AIR SEPARATION
SECTION 310

EST. NO.		DRAWN BY: RKB	6-28-79	SH. 2 OF 6
CONTRACT NUMBER	15-2203	DWG. NO.-2203-1-50-31002		B

THIS DRAWING SUPERSEDES



LEGEND									
11 COOLING WATER SUPPLY	16 50 # EXHAUST STEAM	21 LP CONDENSATE	26 OILY OR DIRTY WATER SEWER	31 PUMP OUT	36 INERT GAS	41 BOILER FEED WATER (HP)	46 GASEOUS OXYGEN	51	
12 COOLING WATER RETURN	17 POTABLE WATER	22 TREATED WATER	27 PROCESS SEWER	32 PURGE GAS	37	42 DISCHARGE TO GRADE	47 DIRTY BACKWASH SEWER	52	
13 900# STEAM	18 PROCESS AIR	23 NATURAL GAS	28 SANITARY SEWER	33 BLOWDOWN	38 DEMINERALIZED WATER	43 BOILER FEEDWATER (LP)	48 STEAM CONDENSATE (SRU)	53	
14 125 # STEAM	19 INSTRUMENT NITROGEN	24 FUEL GAS	29 FIRE WATER	34 FLARE	39 SOUR WATER DRAIN	44 SERVICE WATER	49 SELEXOL DRAIN	54	
15 85# STEAM	20 H.P. CONDENSATE	25 CLEAN WATER SEWER	30 FLUSHING WATER	35 TO ATMOSPHERE	40 CITY WATER	45 PROCESS GAS	50 BENFIELD DRAIN	55	

NOTES
1. THIS PIPING MUST MEET THE REQUIREMENTS OF JOB SPEC. 2200-50A6.
2. PROVIDE OPEN LIMIT STOP AT MIN. FLOW ( ).

ITEM NO.	C-3102
SERVICE	OXYGEN COMPRESSOR
S.G. AT P.T.	.082 LB./FT^3
DES CFM	29,322
INLET PSIG	2.5
MAX DISCH. P.S.I.G.	105
MATERIAL	C.I.
INSULATION	NI

ITEM NO.	E-3103	E-3104	E-3105	E-3106
SERVICE	OXYGEN COMP. 1ST STAGE INTERCOOLER	OXYGEN COMP. 2ND STAGE INTERCOOLER	OXYGEN COMP 3RD STAGE INTERCOOLER	OXYGEN COMP. RECIRCULATION COOLER
SHELL DES. P. & T.	100 PSIG/168°F	100 PSIG/168°F	100 PSIG/168°F	100 PSIG/168°F
TUBE DES. P. & T.	38 PSIG/280°F	56 PSIG/250°F	85 PSIG/865°F	130 PSIG/266°F
SURFACE - FT^2	4900	4200	2840	853
MATL. SHELL	CS	CS	CS	CS
MATL. TUBE	304 SS	304 SS	304 SS	304 SS
INSULATION	NI	NI	NI	NI

ITEM NO.	TK-3102	A-3104
SERVICE	LIQUID OXYGEN STORAGE TANK	LIQUID OXYGEN VAPORIZATION PACKAGE
SIZE	32'Ø x 40' HIGH	1916 TONS LOX PER DAY
DES. PRESS-TEMP.		
OPER. PRESS-TEMP.		
STORAGE CAP.	1000 TONS LOX	
MATERIAL		
INSULATION	BY VENDOR	BY VENDOR

REVISIONS

B	9-20-79	FINAL ISSUE-PHASE I, TASK III	RB
A	8-17-79	INITIAL ISSUE	RB

ITEM NOS. THIS DWG.
A-3104
C-3102
E-3103
E-3104
E-3105
E-3106
TK-3102

INDUSTRIAL FUEL GAS DEMONSTRATION PLANT
MEMPHIS, TENN.
CONTRACT No. ET 77C-01-2582

MEMPHIS LIGHT, GAS AND WATER DIVISION
MEMPHIS, TENN.

DEPARTMENT OF ENERGY
COAL CONVERSION DIVISION
WASHINGTON, D.C.

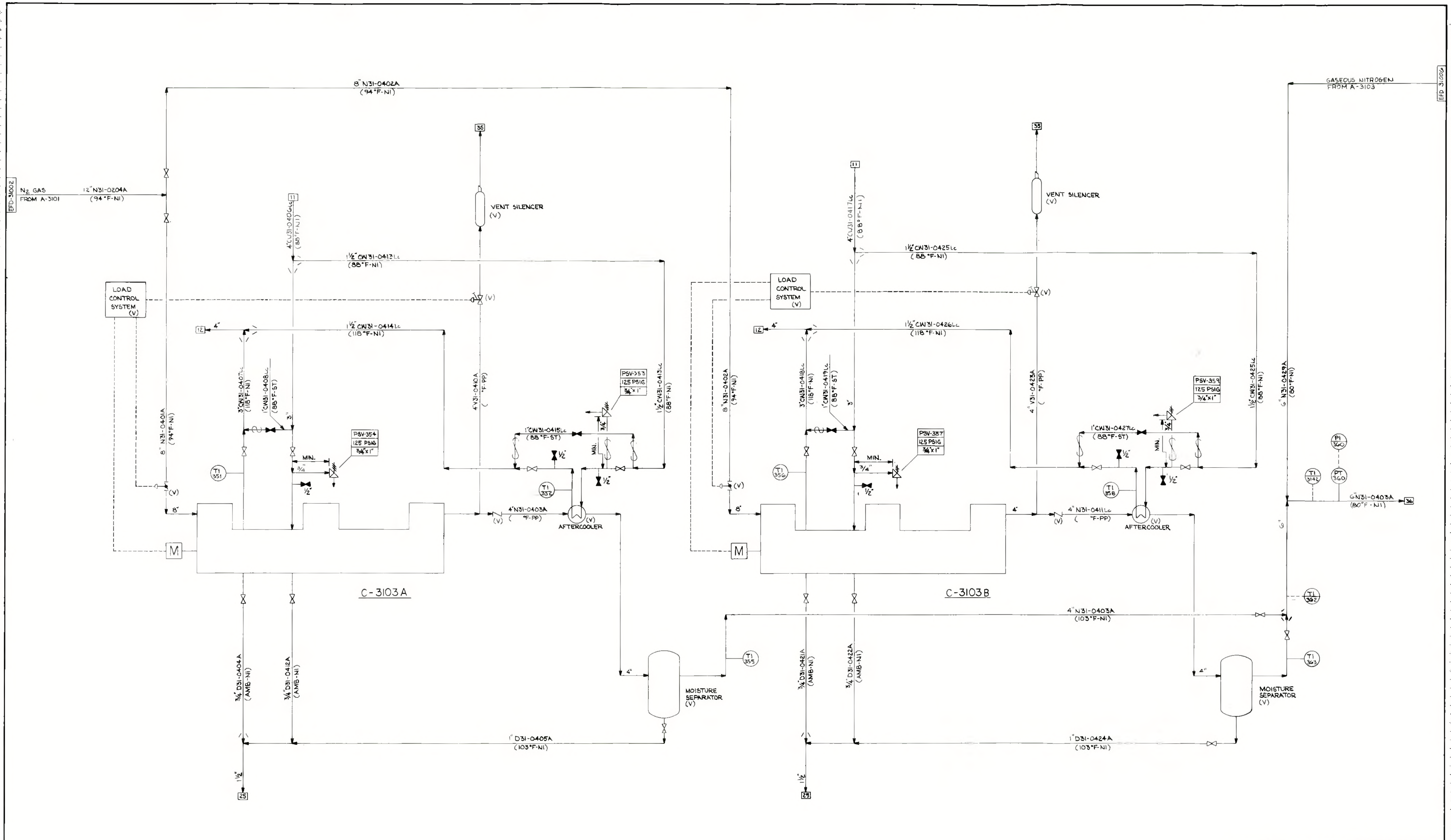
FOSTER WHEELER ENERGY CORPORATION
110 SOUTH ORANGE AVENUE, LIVINGSTON, N.J.

ENGINEERING FLOW DIAGRAM
AIR SEPARATION
SECTION 310

EST. NO. | DRAWN BY: C.T. 6-29-79 | SH. 3 OF 6
CONTRACT NUMBER 15-2203 | DWG. NO.-2203-1-50-31003 B

THIS DRAWING SUPERSEDES

BRUNING 40-5352 23763-3
FORM-125-25M REV.



LEGEND

11 COOLING WATER SUPPLY	16 50# STEAM	21 L.P. CONDENSATE	26 OILY OR DIRTY WATER SEWER
12 COOLING WATER RETURN	17 POTABLE WATER	22 TREATED WATER	27 PROCESS SEWER
13 900# STEAM	18 PROCESS AIR	23 NATURAL GAS	28 SANITARY SEWER
14 125# STEAM	19 INSTRUMENT NITROGEN	24 FUEL GAS	29 FIRE WATER
15 65# STEAM	20 H.P. CONDENSATE	25 CLEAN WATER SEWER	30 FLUSHING WATER

31 PUMPOUT · 32 PURGE GAS · 33 BLOWDOWN · 34 FLARE · 35 TO ATMOSPHERE · 36 INERT GAS (NITROGEN) · 37 DEMINERALIZED WATER · 38 SOUR WATER DRAIN · 39 CITY WATER · BOILER FEED WATER (HP) · DISCHARGE TO GRADE · BOILER FEED WATER (LP) · SERVICE WATER · PROCESS GAS · GASEOUS OXYGEN · STEAM CONDENSATE (SRU) · BENZENE DRAIN · BENFIELD DRAIN

NOTES

ITEM NO.	C-3103A/B
SERVICE	NITROGEN COMPRESSOR
S.G. AT P.T.	≈ 1.0 (N_2)
DES. CFM @ INLET	2386
SUCT. PRESS–PSIA	15.5
MAX. DISCH. PSIG	150
MATERIAL	CI
INSULATION	NI

REVISIONS

B	9-20-79	FINAL ISSUE PHASE I TASK III	
A	8-17-79	INITIAL ISSUE	RB

INDUSTRIAL FUEL GAS DEMONSTRATION PLANT
MEMPHIS, TENN.
CONTRACT No. ET 77C-01-2582

MEMPHIS LIGHT, GAS AND WATER DIVISION, MEMPHIS, TENN.
DEPARTMENT OF ENERGY, COAL CONVERSION DIVISION, WASHINGTON, D.C.

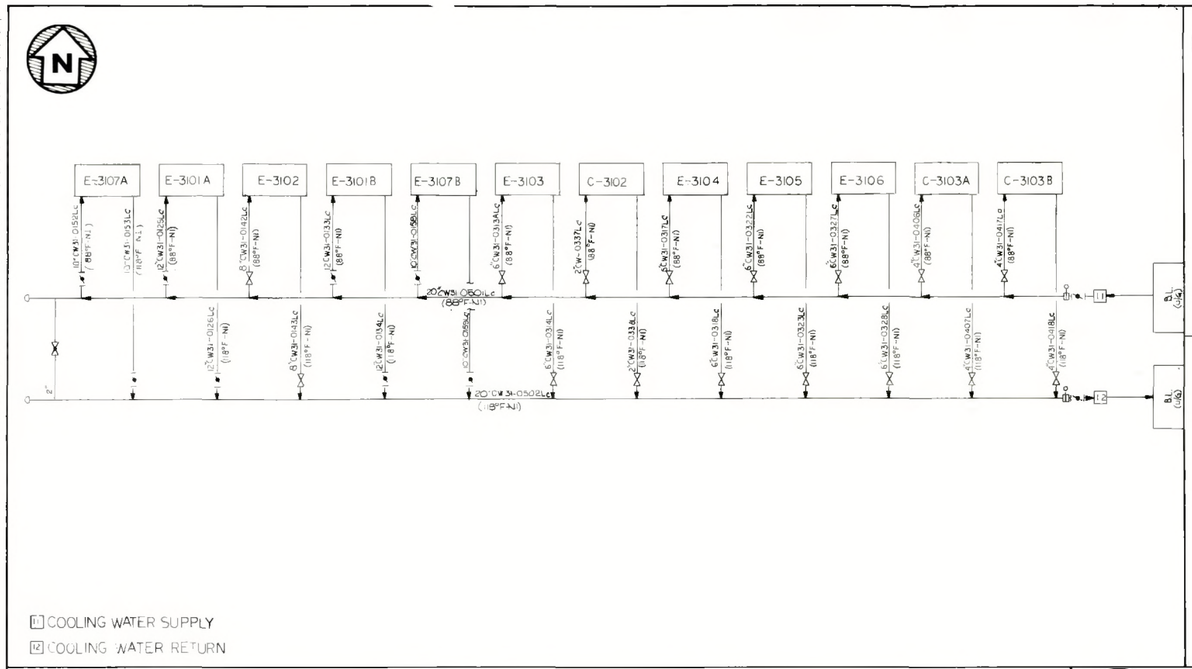
ITEM NOS. THIS DWG.: C-3103A, C-3103B

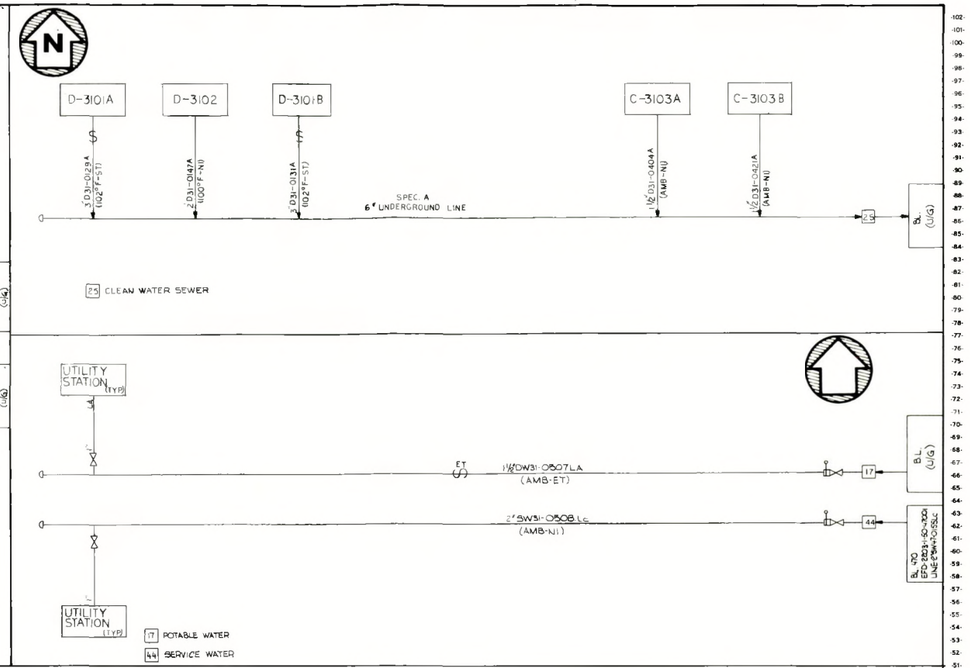
FOSTER WHEELER ENERGY CORPORATION
110 SOUTH ORANGE AVENUE, LIVINGSTON, N.J.

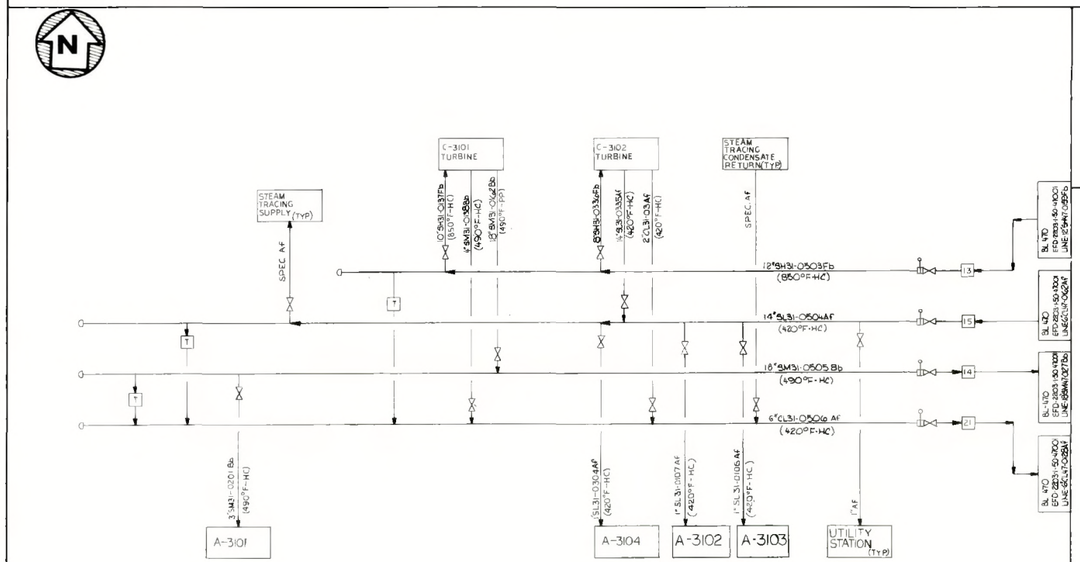
ENGINEERING FLOW DIAGRAM
AIR SEPARATION
SECTION 310

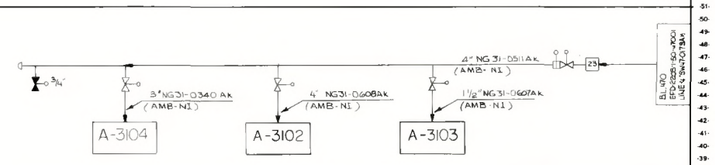
EST NO		DRAWN BY	C.T.	8-14-79	SH 4 OF 6
CONTRACT NUMBER	15-2203	DWG. NO. 2203-1-50-31004			B

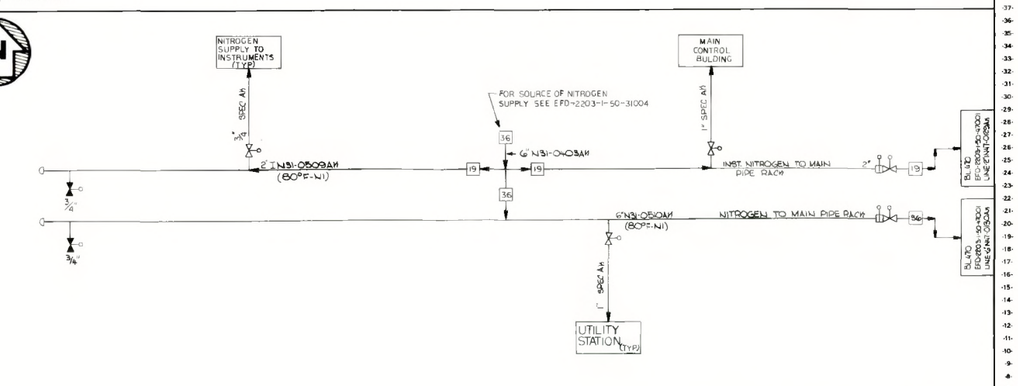
THIS DRAWING SUPERSEDES











LEGEND
- 11 COOLING WATER SUPPLY
- 12 COOLING WATER RETURN
- 13 900 # STEAM
- 14 125 # STEAM
- 15 65 # STEAM
- 16 50# STEAM
- 17 POTABLE WATER
- 18 PROCESS AIR
- 19 INSTRUMENT NITROGEN
- 20 M.P. CONDENSATE
- 21 LP CONDENSATE
- 22 TREATED WATER
- 23 NATURAL GAS
- 24 FUEL GAS
- 25 CLEAN WATER SEWER
- 26 OILY OR DIRTY WATER SEWER
- 27 PROCESS SEWER
- 28 SANITARY SEWER
- 29 FIRE WATER
- 30 FLUSHING WATER
- 31 PUMPOUT
- 32 PURGE GAS
- 33 BLOWDOWN
- 34 FLARE
- 35 TO ATMOSPHERE
- 36 INERT GAS (NITROGEN)
- 37
- 38 DEMINERALIZED WATER
- 39 SOUR WATER DRAIN
- 40 CITY WATER
- 41 BOILER FEED WATER (M.P.)
- 42 DISCHARGE TO GRADE
- 43 BOILER FEED WATER (L.P.)
- 44 SERVICE WATER
- 45 PROCESS GAS
- 46 GASEOUS OXYGEN
- 47 DIRTY BACKWASH SEWER
- 48 STEAM CONDENSATE (SRU)
- 49 SELEXOL DRAIN
- 50 BENFIELD DRAIN
- 51
- 52
- 53
- 54
- 55

NOTES

ITEM NO.
SERVICE
S.G. AT P.T.
DES. G.P.M. AT P.T.
DES. DIFF. P.S.I.
MAX DISCH. P.S.I.G.
MATERIAL
INSULATION

ITEM NO.
SERVICE
SHELL DES. P. & T.
TUBE DES. P. & T.
SURFACE
MATL. SHELL
MATL. TUBE
INSULATION

ITEM NO.
SERVICE
SIZE
DES. PRESS-TEMP
OPER. PRESS-TEMP
MATERIAL
INSULATION

REVISIONS

B	9/28/79	FINAL ISSUE-PHASE I, TASK III		A	9/11/79	INITIAL ISSUE	

INDUSTRIAL FUEL GAS DEMONSTRATION PLANT
MEMPHIS, TENN.
CONTRACT No. ET 77C-01-2582

MEMPHIS LIGHT, GAS
AND WATER DIVISION
MEMPHIS, TENN.

DEPARTMENT OF ENERGY
COAL CONVERSION DIVISION
WASHINGTON, D.C.

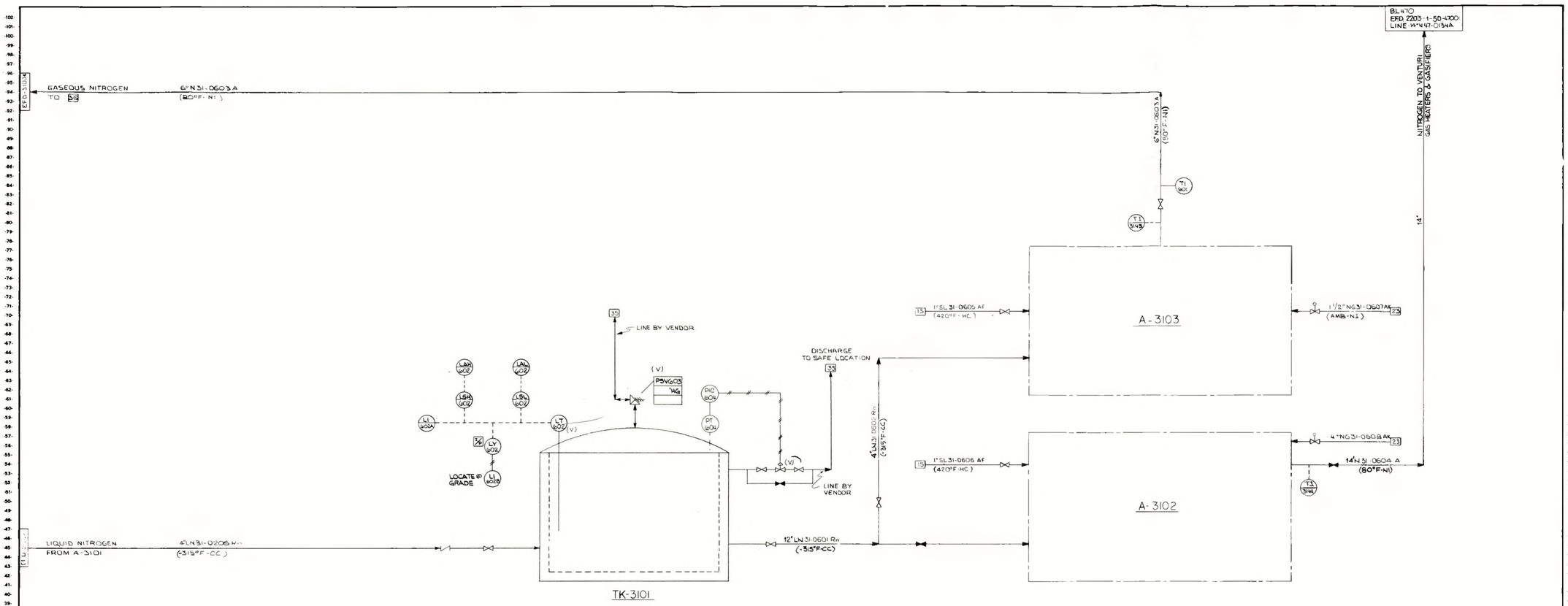
ITEM NOS. THIS DWG.
11 19
12 21
13 23
14 25
16 36
17 44

FOSTER WHEELER ENERGY CORPORATION
110 SOUTH ORANGE AVENUE, LIVINGSTON, N.J.

UTILITY FLOW DIAGRAM
AIR SEPARATION
SECTION 310

EST. NO.
CONTRACT NUMBER 15-2203
DRAWN BY: TOAD 8-22-79 SH 5 OF 6
DWG. NO.-2203-1-50-31005 B

THIS DRAWING SUPERSEDES



LEGEND
11 COOLING WATER SUPPLY
12 COOLING WATER RETURN
13 900# STEAM
14 125# STEAM
15 85# STEAM
16 50# STEAM
17 POTABLE WATER
18 PROCESS AIR
19 INSTRUMENT NITROGEN
20 H.P. CONDENSATE
21 L.P. CONDENSATE
22 TREATED WATER
23 NATURAL GAS
24 FUEL GAS
25 CLEAN WATER SEWER
26 OILY OR DIRTY WATER SEWER
27 PROCESS SEWER
28 SANITARY SEWER
29 FIRE WATER
30 FLUSHING WATER
31 PUMP OUT
32 PURGE GAS
33 BLOWDOWN
34 FLARE
35 TO ATMOSPHERE
36 INERT GAS (NITROGEN)
37
38 DEMINERALIZED WATER
39 SOUR WATER DRAIN
40 CITY WATER
41 BOILER FEED WATER (HP)
42 DISCHARGE TO GRADE
43 BOILER FEED WATER (LP)
44 SERVICE WATER
45 PROCESS GAS
46 GAS OXYGEN
47 DIRTY BACKWASH SEWER
48 STEAM CONDENSATE (SRU)
49 SELEXOL DRAIN
50 BENFIELD DRAIN
51
52
53
54
55

NOTES

ITEM NO.										
SERVICE										
S.G. AT P.T.										
DES. G.P.M. AT P.T.										
DES. DIFF. P.S.I.										
MAX. DISCH. P.S.I.G.										
MATERIAL										
INSULATION										

ITEM NO.									
SERVICE									
SHELL DES. P. & T.									
TUBE DES. P. & T.									
SURFACE									
MAT'L. SHELL									
MAT'L. TUBE									
INSULATION									

ITEM NO.	TK-3101	
SERVICE	LIQUID NITROGEN STORAGE TANK	
SIZE	68'φ×61' HIGH	
DES. PRESS-TEMP.		
OPER. PRESS-TEMP.		
CAPACITY-LN	3500 TONS	
MATERIAL		
INSULATION	BY VENDOR	

ITEM No.	A-3102	A-3103
SERVICE	LIQUID NITROGEN VAPORIZATION PACKAGE	INSTRUMENT NITROGEN VAPORIZATION PKG.
DELIVERY RATE	3650 TONS/DAY	600 SCFM
DELIVERY TEMP.	80°F	80°F
DELIVERY PRESS.	225 PSIG	100 PSIG
INSULATION	BY VENDOR	BY VENDOR

REVISIONS
B 10/5/79 FINAL ISSUE PHASE I, TASK III
A 9-20-79 INITIAL ISSUE CB

INDUSTRIAL FUEL GAS DEMONSTRATION PLANT
MEMPHIS, TENN.
CONTRACT No. ET 77C-01-2582

MEMPHIS LIGHT, GAS
AND WATER DIVISION
MEMPHIS, TENN.

DEPARTMENT OF ENERGY
COAL CONVERSION DIVISION
WASHINGTON, D.C.

ITEM NOS. THIS DWG.
A-3101
A-3102
TK-3101

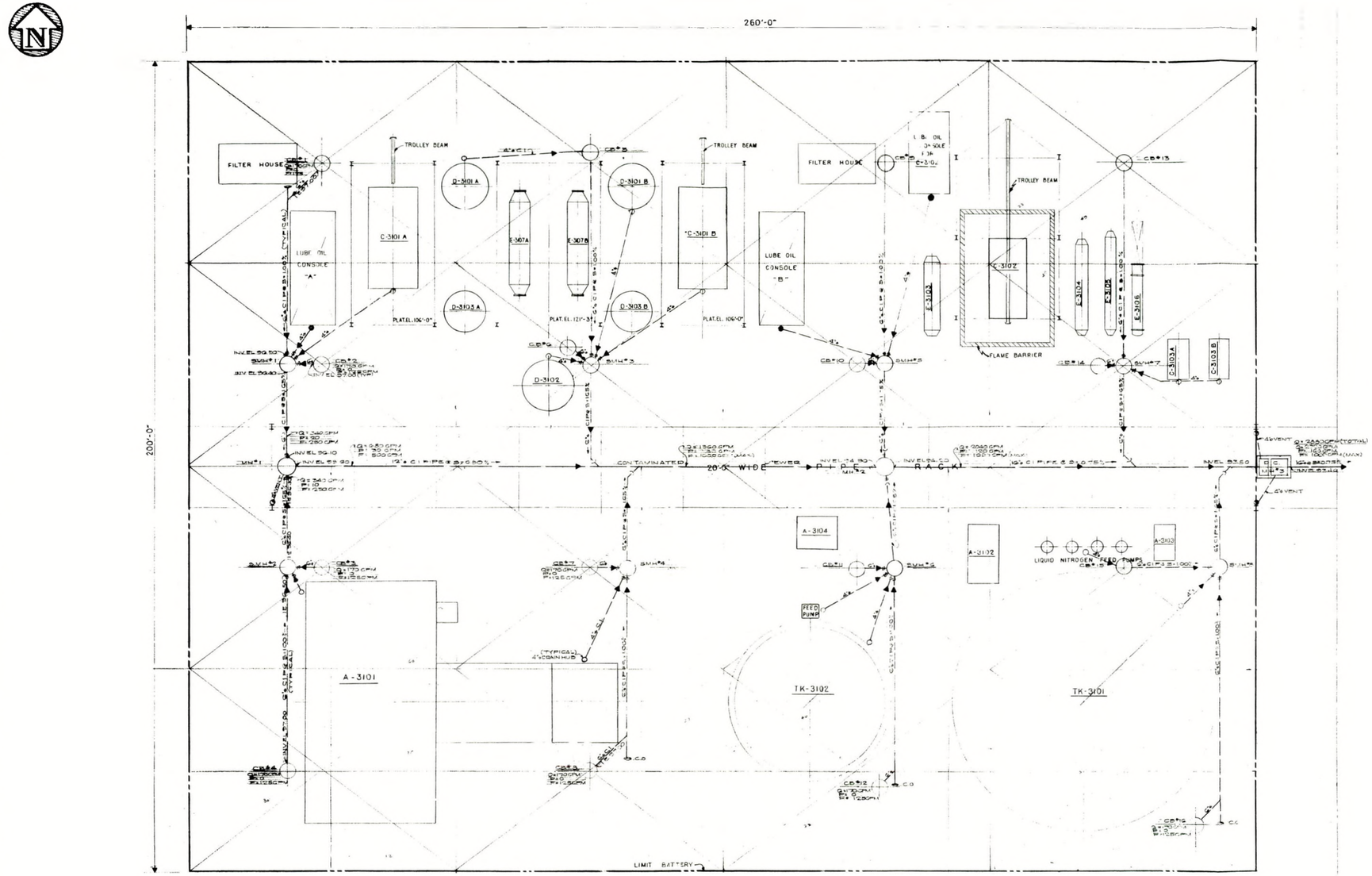
FOSTER WHEELER ENERGY CORPORATION
110 SOUTH ORANGE AVENUE, LIVINGSTON N

ENGINEERING FLOW DIAGRAM
AIR SEPARATION
SECTION 310

EST. NO.		DRAWN BY:	MIKE	8/16/79	SH 6 OF 6
CONTRACT NUMBER	15-2203	DWG. NO.	2203-1-50-31006	B	

THIS DRAWING SUPERSEDES

BRUNING 40-5353 23763-3
FORM-135-2M REV



NO.	ITEM	ELEVATION
D-3101 A/B	C-3101 A/B 1ST. STAGE INTERCOOLER K.O. DRUM	
D-3102	C-3101 A/B AFTER COOLER K.O. DRUM	
TK-3102	LIQUID OXYGEN STORAGE TANK	
E-3101 A/B	C-3101 A/B 1ST. STAGE INTERCOOLER	
E-3102	C-3101 A/B AFTERCOOLER	
E-3103	C-3102 1ST. STAGE INTERCOOLER	
E-3104	C-3102 2ND STAGE INTERCOOLER	
E-3105	C-3102 3RD STAGE INTERCOOLER	
E-3106	C-3102 RECIRCULATION COOLER	
C-3101A	AIR COMPRESSOR A (MOTOR DRIVE)	
C-3101B	AIR COMPRESSOR B (TURBINE DRIVE)	

NO.	ITEM	ELEVATION
C-3102	OXYGEN COMPRESSOR	
C-3103 A/B	NITROGEN COMPRESSOR	
A-3101	AIR SEPARATION PACKAGE	
A-3104	LIQUID OXYGEN VAPORIZATION PKG.	
F-3101 A/B	C-3101 A/B INLET AIR FILTERS	
SL-3102 A/B	C-3101 A/B INLET SILENCER	
SL-3103 A/B	C-3101 A/B DISCHARGE SILENCER	
SL-3104 A/B	C-3101 A/B VENT SILENCER	
D-3103 A/B	C-3101 A/B 2ND STAGE INTERCOOLER K.O. DRUM	
E-3107 A/B	C-3101 A/B 2 TAGE INTERCOOLER	

NO.	ITEM	ELEVATION

GENERAL NOTES

1- FWEC LOW POINT GRADE EL. OF 100'-0" IS EQUAL TO MLGW TRUE ELEV. OF 235'-0"

2- COMPRESSORS C-3101 A/B, C-3102, AND C-3103 A/B ARE ON CONCRETE PEDESTALS APPROX. ELEV. 106'-0"

NO.	DATE	REVISION
A	10-19-79	FINAL ISSUE-PHASE I- PHASE III

INDUSTRIAL FUEL GAS DEMONSTRATION PLANT
MEMPHIS, TENN.
CONTRACT No. ET-77C-01-2582

MEMPHIS LIGHT, GAS AND WATER DIVISION, MEMPHIS, TENN.

DEPARTMENT OF ENERGY COAL CONVERSION DIVISION, WASHINGTON, D.C.

FOSTER WHEELER ENERGY CORPORATION
110 SOUTH ORANGE AVE., LIVINGSTON, N.J.

DRAWN BY: [illegible] 7-31-79 SCALE: 1"=10'-0" EST. NO.

PLOT PLAN
UNDERGROUND PIPING
AIR SEPARATION
NOMPE 9-25-79
SECTION 310

15-2203 DWG. NO. 2203-53-3101

TASK III DEMONSTRATION PLANT

FORM NO. 135 28M

THIS DRAWING SUPERSEDES
THIS DRAWING SUPERSEDED BY

MATERIALS OF CONSTRUCTION NOTES

1. CORROSION DESIGN LIFE BASIS:
20 YEARS [illegible] VESSELS, DRUMS, PUMP CASING, PIPING, EXCHANGER SHELLS AND CHANNELS, AIR FAN HEADER
10 YEARS [illegible] EXCHANGER TUBING, PUMP INTERNALS, HEATER TUBES AND REMOVABLE INTERNALS.

2. NOMINAL CORROSION ALLOWANCE
1/8" ON VESSELS, DRUMS AND AIR FAN HEADERS CONSTRUCTED OF C.S. THRU 9CR.
1/8" ON EXCHANGER SHELLS, CHANNELS, AND PUMP CASING CONSTRUCTED OF C.S. THRU 9CR.
0.03" ON EQUIPMENT CONSTRUCTED OF ALLOY GREATER THAN 9CR.
0.05" ON CARBON STEEL THRU 9CR PIPING.
0.03 ON PIPING CONSTRUCTED OF ALLOY GREATER THAN 9CR.
CLADDING SHALL BE 3/64" MIN [illegible] ON VESSELS AT [illegible] TEMA [illegible] ON EXCHANGERS EXCEPT AS NOTED.
SUBSTITUTE CLADDING MATERIAL SHALL NOT BE ALLOWED WITHOUT APPROVAL OF TECHNICAL SERVICES.

ALL WELD PROCEDURES SHALL BE SUBMITTED TO FWEC FOR APPROVAL IMMEDIATELY AFTER PURCHASE OF EQUIPMENT.

MATERIAL [illegible]
- [illegible] BACK INFORMATION
FOR [illegible] CURVES API REPORT JUNE, 1977 [illegible] SAFETY [illegible]
- FOR [illegible] A.S. COOPER AND J.W. GORMAN JAN 1971 AND J.[illegible] CORROSION [illegible]
FOR [illegible] API REPORT [illegible]

FULLY [illegible] TO BE USED FOR EQUIPMENT AND PIPING [illegible] WET H2S HARDNESS [illegible] WELDS AND HAZ [illegible]

CARBON [illegible] WET H2S [illegible] STRESS RELIEVED [illegible] MINIMUM SPECIFIED [illegible] TENSILE STRENGTH [illegible]

COPPER [illegible] NOT PERMITTED FOR AMMONIA [illegible] SERVICE [illegible] MONEL ADMIRALTY [illegible]

8. COPPER [illegible] HEAT EXCHANGER TUBING SHALL BE [illegible]

9. CWM - [illegible] WIRE MESH
S - SULFUR
SR - STRESS RELIEVED
SS - STAINLESS STEEL
CA - CORROSION ALLOWANCE
CS - CARBON STEEL
CI - CAST IRON

[illegible] SERVICE
CATEGORY [illegible] CUSTOMER SHALL DESIGNATE THOSE LINES WHICH ARE CATEGORY M PER ANSI B31., CHAPTER [illegible] EXPOSURE TO SMALL QUANTITIES OF THE FLUID CAN PRODUCE SERIOUS HARM TO PERSONS ON BREATHING BODILY CONTACT. FOR CATEGORY M SERVICE THE REQUIREMENTS OF ANSI B31.[illegible] CHAPTER [illegible] SHALL APPLY.
ALL ACID GAS LINES SHALL BE PURGED WITH INERT GAS AFTER SHUT DOWN.

EQUIPMENT

[illegible]01
[illegible]01A/B
[illegible]01A/B
[illegible]02
[illegible]01A/B
[illegible]02
[illegible]01A/B
[illegible]01

[illegible]

[illegible]	D.O.E./MONSANTO
[illegible]	FWEC
[illegible]	FWEC
[illegible]	FWEC
[illegible]	FWEC
[illegible]	F[illegible]
[illegible] NO	[illegible]
[illegible]	FWEC
[illegible]AWSKI	FWEC

LEGEND

◇	MATERIAL BALANCE STREAM NUMBER
▭	TEMPERATURE °F
○	PRESSURE PSIG (UNLESS OTHERWISE INDICATED)

THIS DRAWING IS CONSISTENT WITH THE TASK II PROCESS DESIGN REPORT SUBMITTED IN AUGUST 1979. CHANGES MAY HAVE [illegible] IN SOME DETAILS BETWEEN THE MATER[illegible] TION DRAWING AND ISS[illegible] FLOW DIAGRAM INCLUDED AS [illegible] REPORT. ALTHOUGH THIS DRAWING [illegible] FOR THE PURPOSE OF IDENTIFYING MATERIALS OF CONSTRUCTION IT CORRESPONDS [illegible] AT AN EARLIER STAGE OF ENGINEERING [illegible] REASON, THIS DRAWING HAS [illegible]

[illegible] 79 INITIAL ISSUE

TASK III DEMONST[illegible]

INDUSTRIAL FUEL GAS DEMONSTRATION PLANT
MEMPHIS, TENN.
CONTRACT NO. E(49-18)-[illegible] 77C-01-258

MEMPHIS LIGHT GAS
AND WATER DIVISION
MEMPHIS, TENN.

DEPARTMENT OF ENERGY
COAL CONVERSION DIVISION
WASHINGTON, D.C.

FOSTER WHEELER ENERGY CORPORATION
9 SOUTH GRANGE AVE., LIVINGSTON, N.J.

MATERIALS OF CONSTRUCTION
AIR SEPARATION
SECTION 310

DRAWN BY [illegible] | SCALE [illegible] | EST. NO. | 5 2205 | DWG. NO. [illegible] | A

THIS DRAWING SUPERSEDES
THIS DRAWING SUPERSEDED BY

OXYGEN
FROM AIR SEPARATION PACKAGE (A-3101)

PFD 3101

3105 — 2.7 / 34

304L OR 316L 0.03"CA

NITROGEN
FROM AIR SEPARATION PACKAGE (A-3101)

3106 — 1.0 / 94

C.S. 0.05"CA

A-3105
PLANT NITROGEN PACKAGE

SHELL CHANNEL + T.S. C.S. 1/8"CA
TUBES C.S. 0.05"CA

C.S. 0.05"CA

C.S. 1/8"CA

M

C.S. OR C.I. 1/8"CA

220 / 352 — 3110

NITROGEN
TO PLANT USERS

C.S. 0.05"CA

C-3102
OXYGEN COMPRESSOR
26600 ICFM
6850 BHP
EFF=76.6

C.S. OR C.I. CASE 1/8"CA
STAINLESS STEEL INTERNALS

304L OR 316L 0.03"CA

13.1 / 196 — 102
3.2 / 222 — 102
59.3 / 215 — 102

304L OR 316L 0.03"CA

OXIGEN COMPRESSION INTERCOOLERS
SHELL C.S. 1/8"CA
CHANNEL & T.S. C.S. 5/16" 304L CLAD
TUBES 304 OR 316 0.03"CA

C.S. 0.05"CA

CW

E-3103
OXYGEN COMPRESSOR 1ST STAGE INTERCOOLER
3.45 MM BTU/HR.

E-3104
OXYGEN COMPRESSOR 2ND STAGE INTERCOOLER
4.33 MM BTU/HR

E-3105
OXYGEN COMPRESSOR 3RD STAGE INTERCOOLER
4.08MM BTU/HR

3111 — 440

105 / 216 — 304L OR 316L 0.03"CA

OXYGEN
WASTE WATER TREATMENT (SECTION 440)

PFD 4402

304L OR 316L 0.03"CA

VENDOR ITEM
MATERIALS TO BE REVIEWED BY TECHNICAL SERVICES

TK-3102
LIQUID OXYGEN STORAGE TANK

304 E.L.C. 0.03"CA OR 9% Ni STEEL OR Al 2024-T6 VENDOR RECOMMENDATION TO BE REVIEWED

-300

A-3104
LIQUID OXYGEN VAPORIZATION PACKAGE

105 / 216 — 312 / 3302

304L OR 316L 0.03"CA

OXYGEN
TO COAL GASIFICATION (SECTION 330)

PFD 3301

VENDOR ITEM
MATERIALS TO BE REVIEWED BY TECHNICAL SERVICES

A-3102
LIQUID NITROGEN VAPORIZATION PACKAGE

C.S. 0.05"CA

NITROGEN
TO CREDIT GENERATION (SECTION 220)

PFD 2202

LIQUID NITROGEN
FROM AIR SEPARATION PACKAGE (A-3101)

PFD 3101

308 — 0 / -320

304L OR 316L 0.03"CA

TK-3101
LIQUID NITROGEN STORAGE TANK

304ELC 0.03"CA OR Al 2024-T6 OR 9% Ni STEEL

304L OR 316L 0.03"CA

A-3103
INSTRUMENT NITROGEN VAPORIZATION PACKAGE

INST. N_2 DIST.

C.S. 0.05"CA

VENDOR ITEM
MATERIALS TO BE REVIEWED BY TECHNICAL SERVICES

MATERIALS OF CONSTRUCTION NOTES

1. CORROSION DESIGN LIFE BASIS:
   20 YEAR LIFE FOR VESSELS, DRUMS, PUMP CASING, PIPING, EXCHANGER SHELLS AND CHANNELS, AIR FAN HEADER.
   10 YEAR LIFE FOR EXCHANGER TUBING, PUMP INTERNALS, HEATER TUBES AND REMOVABLE INTERNALS.
2. NOMINAL CORROSION ALLOWANCE
   1/8" ON VESSELS, DRUMS AND AIRFAN HEADERS CONSTRUCTED OF CS THRU SCR.
   1/8" ON EXCHANGER SHELLS, CHANNELS, AND PUMP CASING CONSTRUCTED OF C.S. THRU SCR.
   0.05" ON EQUIPMENT CONSTRUCTED OF ALLOY GREATER THAN SCR.
   0.05" ON CARBON STEEL THRU 8C PIPING.
   0.05" ON PIPING CONSTRUCTED OF ALLOY GREATER THAN 9CR.
   CLADDING SHALL BE 3/64" MINIMUM OR WELDED AS PER ITEM "B" ON EXCHANGERS EXCEPT AS NOTED.
   SUBSTITUTE CLADDING MATERIAL SHALL NOT BE ALLOWED WITHOUT APPROVAL OF TECHNICAL SERVICES.
3. ALL WELD PROCEDURES SHALL BE SUBMITTED TO FWEC FOR APPROVAL IMMEDIATELY AFTER PURCHASE OF EQUIPMENT.
4. MATERIAL SELECTION BASIS:
   - PAST PLANT EXPERIENCE AND CORROSION RACK INFORMATION
   - FOR HYDROGEN RESISTANCE, NELSON CURVES API REPORT JUNE, 1977 WITH A 25% SAFETY FACTOR.
   - FOR H2S RESISTANCE, A.S. COOPER AND J.W. GRIMM JAN.1971 NACE J.R. McCOY COMMISSION 1976.
   - FOR SULFUR RESISTANCE, H.F. McCONOMY API REPORT 1965.
5. FULLY KILLED CARBON STEEL TO BE USED FOR EQUIPMENT AND PIPING EXPOSED TO WET H2S HARDNESS OF WELDS AND HAZ NOT TO EXCEED 200 HB
6. CARBON STEEL EQUIPMENT EXPOSED TO WET H2S TO BE STRESS RELIEVED IF MINIMUM SPECIFICATION TENSILE STRENGTH IS GREATER THAN 90,000.
7. COPPER OR COPPER BEARING ALLOYS ARE NOT PERMITTED FOR AMMONIA OR AMINE SERVICE (i.e. MONEL, ADMIRALTY ETC.) NO ALUMINUM, INCONEL, GALVANIZED STEEL.
8. COPPER ALLOY HEAT EXCHANGER TUBING SHALL BE ANNEALED.
9. DMM - CRINKLED WIRE MESH
   S - SULFUR CONTENT
   S.R. - STRESS RELIEVED
10. TOXIC SERVICE
    CATEGORY M - THE CUSTOMER SHALL DESIGNATE THOSE LINES WHICH ARE CATEGORY M PER ANSI B31-3 CHAPTER VII. (A TOXIC FLUID SERVICE EXISTS WHERE EXPOSURE TO SMALL QUANTITIES OF THE FLUID CAN PRODUCE SERIOUS HARM TO PERSONS ON BREATHING OR BODILY CONTACT).
    FOR CATEGORY M SERVICE THE REQUIREMENTS OF ANSI B31-3 CHAPTER VII SHALL APPLY
11. ALL ACID GAS LINES SHALL BE PURGED WITH INERT GAS AFTER SHUT DOWN.

LEGEND

- MATERIAL BALANCE STREAM NUMBER
- TEMPERATURE °F
- PRESSURE PSIG (UNLESS OTHERWISE INDICATED)

EQUIPMENT		
A-3102	C-3102	TK-3101
A-3103	E-3103	TK-3102
A-3104	E-3104	
A-3105	E-3105	

THIS DRAWING IS CONSISTENT WITH THE TASK II PROCESS DESIGN REPORT SUBMITTED IN AUGUST 1978. CHANGES MAY HAVE OCCURRED IN SOME DETAILS BETWEEN THE MATERIALS OF CONSTRUCTION DRAWING AND ISSUE B OF THE ENGINEERING FLOW DIAGRAM INCLUDED AS THE BASIS OF THIS REPORT. ALTHOUGH THIS DRAWING IS SUFFICIENT FOR THE PURPOSE OF IDENTIFYING MATERIALS OF CONSTRUCTION IT CORRESPONDS WITH OTHER DATA AT AN EARLIER STAGE OF ENGINEERING. FOR THIS REASON, THIS DRAWING HAS NOT BEEN REVISED.

REV	DATE	DESCRIPTION
A	6-4-79	INITIAL ISSUE

INDUSTRIAL FUEL GAS DEMONSTRATION PLANT
MEMPHIS, TENN.
CONTRACT No. ET 77C-01-2582

MEMPHIS LIGHT, GAS AND WATER DIVISION, MEMPHIS, TENN.
DEPARTMENT OF ENERGY, COAL CONVERSION DIVISION, WASHINGTON, D.C.

FOSTER WHEELER ENERGY CORPORATION
110 SOUTH ORANGE AVE., LIVINGSTON, N.J.

TASK III DEMONSTRATION PLANT

MATERIALS OF CONSTRUCTION
AIR SEPARATION
SECTION 310

DRAWN BY: K/M 4/79 | SCALE: NONE | EST. NO. | 15-2203 | DWG. NO. 22031-503-002 | A

FORM NO. 135-28M

THIS DRAWING SUPERSEDES
THIS DRAWING SUPERSEDED BY

75248 34%

BRUNING 44-131 20427-2

FORM NO. 135-906

FOSTER WHEELER ENERGY CORP. PROCESS PLANTS DIVISION	CONTRACT: 15-2203 SECTION: 310	LINE CLASSIFICATION LIST	CLIENT: MAGW / DOE LOCATION: MEMPHIS, TENN.	PAGE A OF

REVISION	ORIGINAL	1	2	3	4	5	6	7	8	9	10	11
DATE	8/17/79	10/2/79	10/22/79									

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2	/	/	/									
3	/	/	/									
4	/	/	/									
5	/	/	/									
6	/	/	/									
7	/	/	/									
8	/	/	/									

PAGE	REVISIONS 0	1	2	3	4	5	6	7	8	9	10	11

NOTES

1. LINES ARE DESIGNED FOR OPERATING TEMPERATURE AND PRESSURE UNLESS DESIGN CONDITIONS INDICATE OTHERWISE.
2. INSULATION THICKNESS IS BASED ON OPERATING TEMPERATURE UNLESS OTHERWISE NOTED.
3. PIPE WALL THICKNESS SHALL BE SHOWN ONLY WHEN IT IS NECESSARY TO CALCULATE PER PIPE SPEC.
4. PWHT MEANS POST WELD HEAT TREATMENT REQUIRED. SEE JOB SPECIFICATION -59A3.
5. FOR UTILITY HEADER NOMENCLATURE AND PIPING SERVICE DESIGNATIONS SEE STANDARD SYMBOLS AND DETAILS FLOW DIAGRAM LATEST REVISION.

FORM NO. 135-905

FOSTER WHEELER ENERGY CORP. PROCESS PLANTS DIVISION

CONTRACT: 15-2203 SECTION: 310

LINE CLASSIFICATION LIST

FLOW SHEET NUMBER & REVISION: 2203-1-50-31001 B

PAGE 1 OF 8

REVISION	ORIGINAL	1	2	3	4	5	6	7	8	9	10	11
DATE	8/17/79	9/20/79	10/22/79									

LINE NUMBER SIZE	SERIAL		SPEC	LINE EXTREMITIES FROM	TO	OPERATING TEMP °F.	OPERATING PRESS PSIG	DESIGN TEMP °F.	DESIGN PRESS PSIG	INSULATION TYPE	INSULATION THK	PLAN OR ISOMETRIC DRAWING NO.	PIPE WALL THK	FLU. CAT.	REMARKS	REV.
4"X7'	A	0101	A	F-3101A	C-3101A	AMB	-0.5			NI	—					2
36	A	0102	A	C-3101A	E-3101A	321	26			PP	3					2
36	A	0103	A	E-3101A	D-3101A	102	25			NI	—					2
36	A	0104	A	D-3101A	C-3101A	102	25			NI	—					2
30	A	0105	A	C-3101A	SL-3103A	163	90			NI	—					2
30-36	A	0106	A	SL-3103A	E-3102	163	90			NI	—					2
10	A	0107	A	A31-0106	H3301[2,3,4]	163	90			NI	—					2
36	A	0108	A	E-3102	D-3102	100	90			NI	—					2
36-30	A	0109	A	D-3102	C-2291	100	90			NI	—					2
36	A	0110	A	A31-0109	A-3101	100	90			NI	—					2
4"X7'	A	0111	A	F-3101B	C-3101B	AMB	-0.5			NI	—					2
36	A	0112	A	C-3101B	E-3101B	321	26			PP	3					2
36	A	0113	A	E-3101B	D-3101B	102	25			NI	—					2
36	A	0114	A	D-3101B	C-3101B	102	25			NI	—					2
30	A	0115	A	C-3101B	SL-3103B	163	90			NI	—					2
30	A	0116	A	SL-3103B	A31-0106	163	90			NI	—					2
16	V	0117	A	A31-0105	SL-3104A	163	90			NI	—					2
16	V	0118	A	SL-3104A	[35]	163	90			NI	—					2
16	V	0119	A	A31-0115	SL-3104B	163	90			NI	—					2
16	V	0120	A	SL-3104B	[35]	163	90			NI	—					2
4	A	0121	A	D-3101A	PSV-012	102	25			NI	—					2
6	R	0122	A	PSV-012	[35]	AMB	25			NI	—					2
4	A	0123	A	D-3101B	PSV-014	102	25			NI	—					2
6	R	0124	A	PSV-014	[35]	AMB	25			NI	—					2
12	CW	0125	Lc	[11]	E-3101A	88	70			NI	—					2
12	CW	0126	Lc	E-3101A	[12]	118	65			NI	—					2
2	CW	0127	Lc	CW31-0125 BYPASS	CW31-0126	88	70			ST	1½					2
		~~0128~~													DELETED	1
3	D	0129	A	D-3101A	D31-0196	102	25			ST/NI	1½					2
		~~0130~~													DELETED	1
3	D	0131	A	D-3101B	D31-0129	102	25			ST/NI	1½					2
		~~0132~~													DELETED	1
12	CW	0133	Lc	[11]	E-3101B	88	70			NI	—					2
12	CW	0134	Lc	E-3101B	[12]	118	65			NI	—					2

⑤ ← SEE NOTES—LINE CLASSIFICATION LIST INDEX → ① ① ① ① ② ③ ④

FORM NO. 135-905

FOSTER WHEELER ENERGY CORP. — PROCESS PLANTS DIVISION

CONTRACT: 15-2203 | SECTION: 310

LINE CLASSIFICATION LIST

FLOW SHEET NUMBER & REVISION: 2203-1-50-31001 B

REVISION	ORIGINAL	1	2	3	4	5	6	7	8	9	10	11
DATE	8/17/79	9/20/79	10/22/79									

LINE NUMBER SIZE	SERIAL	SPEC	LINE EXTREMITIES FROM	TO	OPERATING TEMP °F.	OPERATING PRESS PSIG	DESIGN TEMP °F.	DESIGN PRESS PSIG	INSULATION TYPE	INSULATION THK	PLAN OR ISOMETRIC DRAWING NO.	PIPE WALL THK	FLU CAT.	REMARKS	REV.
	0135													DELETED	1
2	CW 0136	Lc	CW31-0133	BYPASS CW31-0134	88	70			ST	1½					2
10	SH 0137	Fb	[13]	C-3101B TURBINE	850	890			HC	b					2
18	SM 0138	Bb	SM31-0162	[27]	490	120			HC	4					2
12-20	SM 0139	Bb/A	SM31-0138	[35]	490	120			PP	4					2
10	R 0140	A	PSV-048	SM31-0139	490	120			PP	4					2
10	R 0141	A	PSV-071	SM31-0139	490	120			PP	4					2
8	CW 0142	Lc	[11]	E-3102	88	70			NI	–					2
8	CW 0143	Lc	E-3102	[12]	118	67			NI	–					2
1½	CW 0144	Lc	CW31-0142	BYPASS CW31-0143	88	70			ST	1½					2
1	R 0145	A	PSV-027	[42]	AMB	ATM			NI	–					2
2-3	D 0146	A	D-3102	CT-4301	100	90			ST/NI	1½					2
2	D 0147	A	D31-0146	[25]	100	90			ST	1½					2
3	A 0148	A	A31-0109	PSV-047	100	90			NI	–					2
4	R 0149	A	PSV-047	[36]	AMB	90			NI	–					2
36	A 0150	A	C-3101A	E-3107	261	66			PP	3					2
36	A 0151	A	D-3103A	C-3101A	103	64			NI	–					2
10	CW 0152	Lc	[11]	E-3107A	88	70			NI	–					2
10	CW 0153	Lc	E-3107A	[12]	118	60			NI	–					2
2	CW 0154	Lc	CW31-0152	BYPASS CW31-0153	88	70			ST	1½					2
36	A 0155	A	C-3103B	E-3107B	211	66			PP	3					2
36	A 0156	A	D-3103B	C-3103B	103	64			NI	–					2
	0157													DELETED	1
10	CW 0158	Lc	[11]	E-3107B	88	70			NI	–					2
10	CW 0159	Lc	E-3107B	[12]	118	60			NI	–					2
2	CW 0160	Lc	CW31-0158	CW31-0159	88	70			ST	1½					2
	0161													DELETED	1
18	SM 0162	Fb	C-3101B TURBINE	[14]	490	120			HC	4					2
36	A 0163	A	E-3107A	D-3103A	103	64			NI	–					2
2	D 0164	A	D-3103A	D31-0146	103	64			ST/NI	1½					2
36	A 0165	A	E-3107B	D-3103B	103	64			NI	–					2
2	D 0166	A	D-3103B	D31-0146	103	64			ST/NI	1½					2

(5) ← SEE NOTES - LINE CLASSIFICATION LIST INDEX → (1) (1) (1) (1) (2) (3) (4)

FORM NO. 135-905

FOSTER WHEELER ENERGY CORP.
PROCESS PLANTS DIVISION

CONTRACT: 15-2203
SECTION: 310

LINE CLASSIFICATION LIST

FLOW SHEET NUMBER & REVISION: 2203-1-50-31002 B

REVISION	ORIGINAL	1	2	3	4	5	6	7	8	9	10	11
DATE	8/17/79	9/20/79	10/22/79									

LINE NUMBER				LINE EXTREMITIES		OPERATING		DESIGN		INSULATION		PLAN OR ISOMETRIC DRAWING NO.	PIPE WALL THK	FLU. CAT.	REMARKS	REV.
SIZE	SERIAL		SPEC	FROM	TO	TEMP °F.	PRESS PSIG	TEMP °F	PRESS PSIG	TYPE	THK					
3	SM	0201	Bb	[15]	A-3101	490	120			HC	3					2
14	V	0202	A	SL-3101	[35]	94	ATM			NI	-					2
24	GX	0203	Ra	A-3101	C-3102	94	5.3			NI	-					2
12	N	0204	A	A-3101	C-3103 A/B	94	1.3			NI	-					2
8	N	0205	A	N31-0204	C-3601 A/B	94	1.3			NI	-					2
4	LN	0206	Ra	A-3101	TK-3101	-315	6.1			CC	3½					2
4	LX	0207	Ra	A-3101	TK-3102	-291	34			CC	3½					2

(5) ← SEE NOTES–LINE CLASSIFICATION LIST INDEX → (1) (1) (1) (1) (2) (3) (4)

FORM NO. 135-905

FOSTER WHEELER ENERGY CORP. PROCESS PLANTS DIVISION | CONTRACT: 15-2203 | SECTION: 310 | **LINE CLASSIFICATION LIST** | FLOW SHEET NUMBER & REVISION: 2203-1-50-31003 B | PAGE 4 OF 8

REVISION	ORIGINAL	1	2	3	4	5	6	7	8	9	10	11
DATE	8/17/79	9/20/79	10/22/79									

LINE NUMBER				LINE EXTREMITIES		OPERATING		DESIGN		INSULATION		PLAN OR ISOMETRIC DRAWING NO.	PIPE WALL THK	FLU CAT	REMARKS	REV.
SIZE	SERIAL		SPEC	FROM	TO	TEMP °F	PRESS PSIG	TEMP °F	PRESS PSIG	TYPE	THK					
8	LX	0301	Ro	TK-3102	A-3104	-291	25			CC	3½					2
		0302													DELETED	1
		0303													DELETED	1
1	SL	0304	Af	[15]	A-3104	420	80			HC						2
		0305													DELETED	1
18	GX	0306	Ra	A-3104	P31-0325	220	105			PP	3					2
24	GX	0307	Ra	C-3102	E-3103	198	16			PP	2½					2
24	GX	0308	Ra	E-3103	C-3102	102	14			NI	–					2
20	GX	0309	Ra	C-3102	E-3104	222	36			PP	3					2
20	GX	0310	Ra	E-3104	C-3102	102	34			NI	–					2
20	GX	0311	Ra	C-3102	E-3105	215	60			PP	3					2
20	GX	0312	Ra	E-3105	C-3102	102	58			NI	–					2
6	CW	0313	Lc	[11]	E-3103	88	70			NI	–					2
6	CW	0314	Lc	E-3103	[12]	118	68			NI	–					2
1½	CW	0315	Lc	CW31-0313	BYPASS CW31-0314	88	70			ST	1½					2
1	R	0316	Lc	PSV-115	[13]	AMB				NI	–				DELETED	2
6	CW	0317	Lc	[11]	E-3104	88	70			NI	–					2
6	CW	0318	Lc	E-3104	[12]	118	68			NI	–					2
1	CW	0319	A	CW31-0317	BYPASS CW31-0318	88	70			ST	1½					2
		0320													DELETED	1
		0321													DELETED	1
6	CW	0322	Lc	[11]	E-3105	88	70			NI	–					2
6	CW	0323	Lc	E-3105	[12]	118	68			NI	–					2
1½	CW	0324	Lc	CW31-0322	BYPASS CW31-0323	88	70			ST	1½					2
18	GX	0325	Ra	C-3102	R3401,2,3,4	220	105			PP	3					2
3	GX	0326	Ra	P31-0310	A-4411	220	34			PP	1½					2
6	CW	0327	Lc	[11]	E-3106	88	70			NI	–					2
6	CW	0328	Lc	E-3106	[12]	118	66			NI	–					2
1½	CW	0329	Lc	CW31-0327	BYPASS CW31-0328	88	70			ST	1½					2
		0330													DELETED	1
14	GX	0331	Ra	P31-0325	E-3106	220	105			PP	3					2
14	GX	0332	Ra	E-3106	P31-0205	110	96			NI	–					2
10	GX	0333	Af	PSV-233	[35]	420	80			PP	4					2
		0334													DELETED	1

(5) ← SEE NOTES—LINE CLASSIFICATION LIST INDEX → (1) (1) (1) (1) (2) (3) (4)

FORM NO. 135-905

FOSTER WHEELER ENERGY CORP. — PROCESS PLANTS DIVISION

CONTRACT: 15-2203 | SECTION: 310

LINE CLASSIFICATION LIST

FLOW SHEET NUMBER & REVISION: 2203-1-50-31003 B

REVISION	ORIGINAL	1	2	3	4	5	6	7	8	9	10	11
DATE	8/17/79	9/20/79	10/22/79									

LINE NUMBER				LINE EXTREMITIES		OPERATING		DESIGN		INSULATION		PLAN OR ISOMETRIC DRAWING NO.	PIPE WALL THK	FLU. CAT.	REMARKS	REV
SIZE	SERIAL		SPEC	FROM	TO	TEMP °F	PRESS PSIG	TEMP °F	PRESS PSIG	TYPE	THK					
14	SL	0335	Af	C-3102 TURBINE	[15]	720	80			HC	4					2
8	SH	0336	Fb	[13]	C-3102 TURBINE	850	890			HC	6					2
2	CW	0337	Lc	[11]	C-3102	88	70			NI	–					2
2	CW	0338	Lc	C-3102	[12]	118	65			NI	–					2
1	CW	0339	Lc	CW31-0337 BYPASS	CW31-0338	88	70			ST	1½					2
3	NG	0340	Ak	[23]	A-3104	AMB	20			NI	–					2
2	CL	0341	Af	SL31-0335	[21]	293	50			HC	1½					2

(5) ← SEE NOTES–LINE CLASSIFICATION LIST INDEX → (1) (1) (1) (1) (2) (3) (4)

FORM NO. 135-905

FOSTER WHEELER ENERGY CORP. PROCESS PLANTS DIVISION | CONTRACT: 15-2203 | SECTION: 310 | **LINE CLASSIFICATION LIST** | FLOW SHEET NUMBER & REVISION: 2203-1-50-31004 B | PAGE 6 OF 8

REVISION	ORIGINAL	1	2	3	4	5	6	7	8	9	10	11
DATE	8/17/79	9/20/79	10/22/79									

LINE NUMBER SIZE	SERIAL		SPEC	LINE EXTREMITIES FROM	TO	OPERATING TEMP °F	OPERATING PRESS PSIG	DESIGN TEMP °F	DESIGN PRESS PSIG	INSULATION TYPE	INSULATION THK	PLAN OR ISOMETRIC DRAWING NO.	PIPE WALL THK	FLU CAT.	REMARKS	REV.
8	N	0401	A	N31-0204	C-3103A	94	1.3			NI	-					2
8	N	0402	A	N31-0401	C-3103B	94	1.3			NI	-					2
4-6	N	0403	A	C-3103A	[36]	103	150			NI	-					2
3/4-1½	D	0404	A	C-3103A	[25]	103	150			NI	-					2
1	D	0405	A	C-3103A SEPARATOR	D31-0404	103	150			NI	-					2
4-3	CW	0406	Lc	[11]	C-3103A	88	70			NI	-					2
3-4	CW	0407	Lc	C-3103A	[12]	118	65			NI	-					2
1	CW	0408	Lc	CW31-0406 BYPASS	CW31-0407	88	70			ST	1½					2
~~—~~	~~—~~	~~0409~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	DELETED	1
4	V	0410	A	N31-0403	[35]		150			NI	-					2
4	N	0411	A	C-3103B	N31-0403A	103	150			NI	-					2
3/4	D	0412	A	C-3103B	D31-0405	AMB	150			NI	-					2
1½	CW	0413	Lc	CW31-0406	C-3103A AFTERCOOLER	88	70			NI	-					2
1½	CW	0414	Lc	C-3103A AFTERCOOLER	CW31-0407	118	70			NI	-					2
1	CW	0415	Lc	CW31-0413 BYPASS	CW31-0414	AMB	70			NI	-					2
~~—~~	~~—~~	~~0416~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	DELETED	1
4-3	CW	0417	Lc	[11]	C-3103B	88	70			NI	-					2
3-4	CW	0418	Lc	C-3101B	[12]	118	65			NI	-					2
1	CW	0419	Lc	CW31-0417 BYPASS	CW31-0418	88	70			ST	1½					2
~~—~~	~~—~~	~~0420~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	DELETED	1
3/4-1½	D	0421	A	C-3103B	[25]	AMB	150			NI	-					2
3/4	D	0422	A	C-3103B	D31-0424	AMB	150			NI	-					2
4	V	0423	A	N31-0411	[35]		150			NI	-					2
1	D	0424	A	C-3103B SEPARATOR	D31-0421	103	150			NI	-					2
1½	CW	0425	Lc	CW31-0417	C-3103B AFTERCOOLER	88	70			NI	-					2
1½	CW	0426	Lc	C-3103B AFTERCOOLER	CW31-0418	118	70			NI	-					2
1	CW	0427	Lc	CW31-0425 BYPASS	CW31-0426	88	70			ST	1½					2
~~—~~	~~—~~	~~0428~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	DELETED	1
6	N	0429	A	A-3102	N31-0403	80	225			NI	-					2

(5) ← SEE NOTES--LINE CLASSIFICATION LIST INDEX → (1) (1) (1) (1) (2) (3) (4)

FORM NO. 135-905

FOSTER WHEELER ENERGY CORP.
PROCESS PLANTS DIVISION

CONTRACT: 15-2203
SECTION: 310

LINE CLASSIFICATION LIST

FLOW SHEET NUMBER & REVISION: 2203-1-50-31005 B

REVISION	ORIGINAL	1	2	3	4	5	6	7	8	9	10	11
DATE	9/14/79	9/28/79	10/22/79									

LINE NUMBER				LINE EXTREMITIES		OPERATING		DESIGN		INSULATION		PLAN OR ISOMETRIC DRAWING NO.	PIPE WALL THK	FLU CAT.	REMARKS	REV.
SIZE	SERIAL		SPEC	FROM	TO	TEMP °F	PRESS PSIG	TEMP °F	PRESS PSIG	TYPE	THK					
20	CW	0501	Lc	[11]	HEADER	88	70			NI	–					2
20	CW	0502	Lc		HEADER [12]	118	60			NI	–					2
12	SH	0503	Fb	[13]	HEADER	850	890			HC	6					2
14	SL	0504	Af	[15]	HEADER	420	80			HC	4					2
18	SM	0505	Bb		HEADER [14]	490	120			HC	4					2
6	CL	0506	Af		HEADER [21]	420	80			HC	3					2
1½	DW	0507	La	[17]	HEADER	AMB	85			ET	1½					2
2	SW	0508	Lc	[44]	HEADER	AMB	85			NI	–					2
2	IN	0509	Ak	[19]	HEADER	20	150			NI	–					2
6	N	0510	Ak	[36]	HEADER	80	60			NI	–					2
4	NG	0511	Ak	[23]	HEADER	AMB	20			NI	–					2

(5) ← SEE NOTES–LINE CLASSIFICATION LIST INDEX → (1) (1) (1) (1) (2) (3) (4)

FORM NO. 135-905

FOSTER WHEELER ENERGY CORP.
PROCESS PLANTS DIVISION

CONTRACT: 15-2203
SECTION: 310

LINE CLASSIFICATION LIST

FLOW SHEET NUMBER & REVISION: 2203-1-50-3100 6 B

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REVISION	ORIGINAL	1	2	3	4	5	6	7	8	9	10	11
DATE	9/20/79	10/2/79	10/22/79									

LINE NUMBER			LINE EXTREMITIES		OPERATING		DESIGN		INSULATION		PLAN OR ISOMETRIC DRAWING NO.	PIPE WALL THK	FLU. CAT.	REMARKS	REV.
SIZE	SERIAL	SPEC	FROM	TO	TEMP °F.	PRESS PSIG	TEMP °F.	PRESS PSIG	TYPE	THK					
12	LN 0601	Rn	TK-3101	A-3102	-315	25			CC	4½					2
4	LN 0602	Rn	LN-0601	A-3103	-315	25			CC	2½					2
6	N 0603	A	A-3103	[36]	80	100			NI	-					2
14	N 0604	A	A-3102	GASIFIERS	80	225			NI	-					2
1	SL 0605	Af	[15]	A-3103	-20	80			HC	1½					2
1	SL 0606	Af	[15]	A-3102	-20	80			HC	1½					2
1½	NG 0607	Ak	[23]	A-3103	AMB	20			NI	-					2
4	NG 0608	Ak	[23]	A-3102	AMB	20			NI	-					2

(5) ← SEE NOTES--LINE CLASSIFICATION LIST INDEX → (1) (1) (1) (1) (2) (3) (4)

PIPING MATERIAL SPECIFICATION LISTING

Pipe Spec	Service	Class	Material	Ca
A	General Service	150	CS	.050
A2	General Service	150	CS*	.050
Ad	Corrosive Service	150	CS	.125
Ad2	Corrosive Service	150	CS*	.125
Ae	Corrosive Service	150	CS/SS	.250/.030
Ae2	Corrosive Service	150	CS*/SS	.250/.030
Ae3	Corrosive Service	150	CS**/SS	.250/.030
Af	Steam	150	CS	.050
Afl	Power Piping Code	150	CS	.050
Ak	Fuel Gas, Non-Corr. Gases	150	CS	.050
An	Corrosive Services	150	CS	.1875
An2	Corrosive Services	150	CS**	.1875
Ar	Gasifier Effluent	150	Refrac. Lined	-
Ax	Sulfur	150	-	.125
Ay	Corrosive Service	150	CS-Polypro. Lined	-
Bb	Steam	300	CS	.125
Bbl	Power Piping Code	300	CS	.125
Bc	Gasifier Effluent	300	1¼Cr-½MO, Incoloy Clad.	-
Bd	Corrosive Service	300	CS	.125
Bf	Corrosive Service	300	C - ½MO	.125
Bf2	Corrosive Service	300	C - ½MO	.125
Bk	Fuel Gas, Non-Corr. Gases	300	CS	.050
Bn	Corrosive Service	300	1¼Cr-½MO	.125
Bn2	Corrosive Service	300	1¼Cr-½MO	.125
Db	Steam	600	CS	.125
Dbl	Power Piping Code	600	CS	.125
Dc	Gasifier Effluent	600	1¼Cr-½MO, Incoloy Clad.	-

PIPING MATERIAL SPECIFICATION LISTING (Cont'd.)

Pipe Spec	Service	Class	Material	Ca
Fb	Steam	1500	CS	.125
L	Category D	125	CS	.050
La	Drinking Water	125	Galv Steel	.050
Lc	Water	125	CS	.050
Lf	Firewater	125&175	CS	.063
Ra	Oxygen - Gaseous	150	304L	.030
Rh	General Service	150	304L	.030
Rn	Nitrogen - Liquid	150	304L	.030
Ro	Oxygen - Liquid	150	304L	.030
Rc	Corrosive Service	150	304	.030
Sh	General Services	300	304L	.030
Uc	Chemical Injection	600	304L	.030
Eb	Steam	900	CS	.125
Eb1	Power Piping Code	900	1¼Cr-½MO	.125
P	Chlorine Water Soln	Special	PVC	—

* Killed
**Killed W.316 Trim

4.0 EQUIPMENT LIST

Attached is a tabulation listing the equipment included in this unit. The item number corresponds to that called out on the Engineering Flow Diagram. The number shown under Engineering Flow Diagram (EFD) is the last digit of the appropriate EFD for reference.

FORM NO. 135-904

FOSTER WHEELER ENERGY CORP. PROCESS PLANTS DIVISION	CONTRACT: 15-2203 SECTION: 310	EQUIPMENT LIST	NAME OF UNIT: AIR SEPARATION	PAGE 1 OF 3

CLIENT: MLGW/DOE
LOCATION: MEMPHIS, TENNESSEE

	REVISION	ORIGINAL	1	2	3	4	5
	DATE	5/8/79	6/4/79	7/6/79	7/25/79	8/20/79	9/19/79

CLASS	ITEM NO.	DESCRIPTION	EFD	REQ'N. NO.	P. O. NO.		REV.
DRUMS	D-3101A	1st Stage Intercooler K.O. Drum	1	1131A			5
	D-3101B	1st Stage Intercooler K.O. Drum	1	1131A			5
	D-3102	Aftercooler K.O. Drum	1	1131B			1
	D-3103A/B	2nd Stage Intercooler K.O. Drum	1	1131C			5
TANKS	TK-3101	Liquid Nitrogen Storage Tank	6	1919B		Item Relocated from Area 470 to Area 310	5
	TK-3102	Liquid Oxygen Storage Tank	3	1919D			1

FORM NO. 135-904

FOSTER WHEELER ENERGY CORP. PROCESS PLANTS DIVISION	CONTRACT: 15-2203 SECTION: 310	EQUIPMENT LIST	NAME OF UNIT AIR SEPARATION	PAGE 2 OF 3

CLIENT: MLGW/DOE
LOCATION: MEMPHIS, TENNESSEE

					REVISION	ORIGINAL	1	2	3	4	5	
					DATE	5/8/79	6/4/79	7/6/79	7/25/79	8/20/79	9/19/79	
CLASS	ITEM NO.	DESCRIPTION	EED	REQ'N. NO.	P.O. NO.							REV.
EXCHANGERS	E-3101A	Air Compressor 1st Stage Intercooler	1	1211G								5
	E-3101B	Air Compressor 1st Stage Intercooler	1	1211G								5
	E-3102	Air Compressor Aftercooler	1	1211B								1
	E-3103	Oxygen Compressor 1st Stage Intercooler	3	1211C								1
	E-3104	Oxygen Compressor 2nd Stage Intercooler	3	1211D								1
	E-3105	Oxygen Compressor 3rd Stage Intercooler	3	1211E								1
	E-3106	Oxygen Compressor Recirculation Cooler	3	1211F								2
	E-3107A/B	Air Compressor 2nd Stage Intercooler	1	1211H								5
COMPRESSORS	C-3101A	Air Compressor A (Turbine Drive)	1	1321A								1
	C-3101B	Air Compressor B (Motor Drive)	1	1321A								1
	C-3102	Oxygen Compressor	3	1321B								1
	C-3103A	Nitrogen Compressor A	4	1321C								2
	C-3103B	Nitrogen Compressor B	4	1321C								2

FORM NO. 135-904

FOSTER WHEELER ENERGY CORP.
PROCESS PLANTS DIVISION

CONTRACT: 15-2203
SECTION: 310

EQUIPMENT LIST

NAME OF UNIT: AIR SEPARATION

CLIENT: MLGW/DOE
LOCATION: MEMPHIS, TENNESSEE

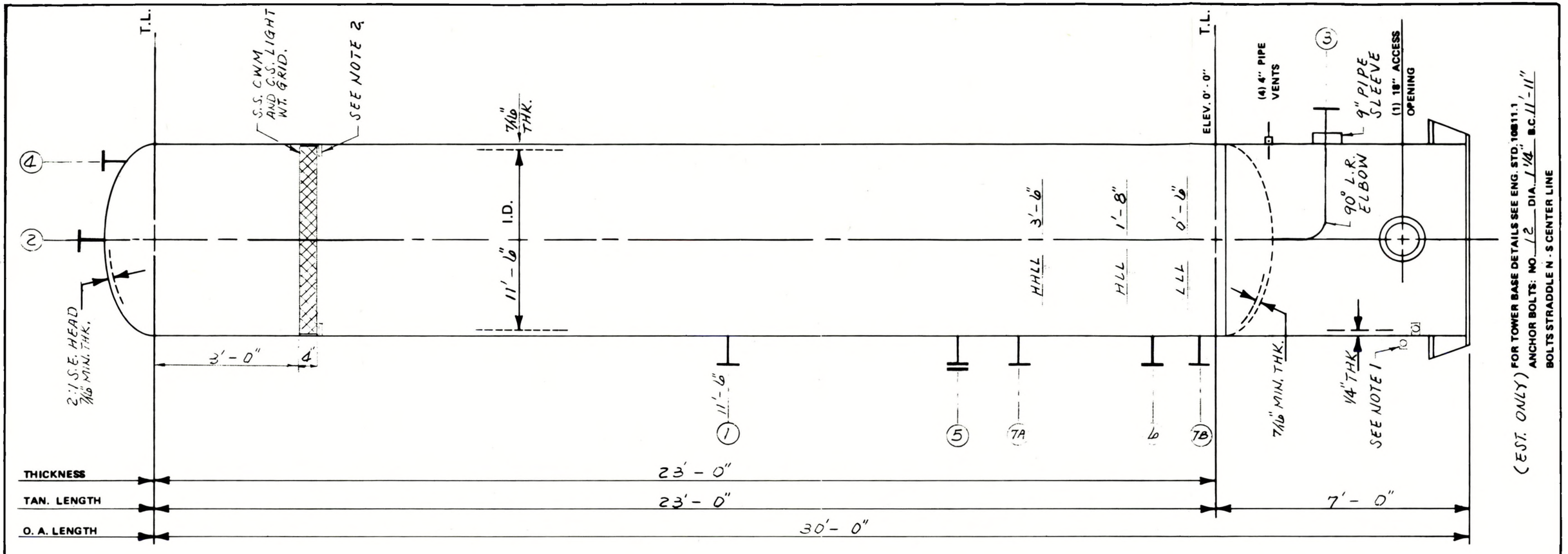
REVISION	ORIGINAL	1	2	3	4	5
DATE	5/8/79	6/4/79	7/6/79	7/25/79	8/20/79	9/19/79

CLASS	ITEM NO.	DESCRIPTION	EFD	REQ'N. NO.	P. O. NO.		REV.
MISC.	A-3101	Air Separation Package	2	1919A			1
	A-3102	Liquid Nitrogen Vaporization Pkg.	6	1919B		Item Relocated from Area 470 to Area 310	5
	A-3103	Instrument Nitrogen Vaporization Pkg	6	1919B		Item Relocated from Area 470 to Area 310	5
	A-3104	Liquid Oxygen Vaporization Package	3	1919D			1
							2
	F-3101A	Air Filter	1	1397A			1
	F-3101B	Air Filter	1	1397A			1
	SL-3101	Waste Nitrogen Silencer	2	1919A			1
	SL-3102A	C-3101A Inlet Silencer	1	1397A		PART OF F-3101 A/B Pkg.	4
	SL-3102B	C-3101B Inlet Silencer	1	1397A			4
	SL-3103A	C-3101A Discharge Silencer	1	1397A			4
	SL-3103B	C-3101B Discharge Silencer	1	1397A			4
	SL-3104A	C-3101A Vent Silencer	1	1397A			4
	SL-3104B	C-3101B Vent Silencer	1	1397A			4

5.0 EQUIPMENT AND MECHANICAL SPECIFICATION

This section contains equipment and mechanical specifications (requisitions) for items employed within this unit. Refer to the appropriate Equipment List for a complete cross reference of:

Class (type of equipment)
Item Number (indicated on Engineering Flow Diagram)
Description
Engineering Flow Diagram
Requisition Number



(EST. ONLY) FOR TOWER BASE DETAILS SEE ENG. STD. 10B11.1
ANCHOR BOLTS: NO. 12 DIA. 1 1/4" B.C. 11'-11"
BOLTS STRADDLE N - S CENTER LINE

NOTE:
1. 1/2" NUTS WELDED ON EDGE AND SPACED ON 24" CENTERS IN BOTH DIRECTIONS SEE ENG. STD. 10B-14.1
2. FOR 4" CWM SUPPORT RING. SEE ENG STD. 10B 15.1.

FORM NO. 135-104

FOSTER WHEELER ENERGY CORPORATION,
110 SOUTH ORANGE AVENUE, LIVINGSTON, NEW JERSEY

REV.	DATE	BY	DESCRIPTION
			REVISIONS

REFERENCE DRAWINGS, REQUISITIONS, STANDARDS
2203-4-11-2

DRAWN	P. S.	5/21/79
CHECKED		
APPROVED		

INTERCOOLER KO DRUM D-3101 A/B
AIR SEPARATION (SECTION 310)
MLGW/DOE

MEMPHIS TENNESSEE

CONTRACT NUMBER: 15-2203
REQUISITION NUMBER: 2231-1131-A
P.O NUMBER:
DRAWING NUMBER: 2203-4-11-1 0

NOTES

1 - THIS VESSEL AND ITS SUPPORTS HAVE NOT BEEN DESIGNED TO WITHSTAND A FLOODED OR HYDROSTATIC TEST CONDITION IN THE VERTICAL POSITION. CONTACT FOSTER WHEELER ENERGY CORPORATION PRIOR TO ANY REQUESTED FIELD TEST.

2 - VESSEL FABRICATOR TO SUPPLY AND INSTALL (AS MARKED)

- ☐ TRAYS (TRAYS SUPPLIED BY OTHERS)
- ☐ TRAY SUPPORTS
- ☐ INSULATION ATTACHMENTS
- ☐ FIREPROOFING ATTACHMENTS
- ☐ PLATFORM AND LADDER ATTACHMENTS
- ☐ PIPE SUPPORTS

3 - VESSEL MUST BE SHIPPED WITH ORIENTATION _____° MARK UP

RELEASES

DWG. REV.	DATE	ISSUED FOR
	DATE OF ORDER	PURCHASE SHELL AND HEAD MATERIAL. PREPARE BUT DO NOT SUBMIT SHOP DETAIL DRAWINGS.
		ISSUE CHECKED FOSTER WHEELER DRAWING. PURCHASE ALL OTHER MATERIALS. FINALIZE AND SUBMIT CHECKED SHOP DETAIL DRAWING WITHIN ONE WEEK OF RELEASE DATE. PROCEED WITH COMPLETE FABRICATION.
		FIELD CONSTRUCTION

NOZZLE CHART

CONN NO.	SIZE	ANSI RATING	SERVICE	NO REQ'D
1	36"	150# R.F.	VAPOR INLET	1
2	36"	150# R.F.	VAPOR OUTLET	1
3	3"	150# R.F.	LIQUID OUTLET	1
4	2"	150# R.F.	VENT	1
5	20"	150# R.F.	MANWAY	1
6	2"	150# R.F.	STEAMOUT	1
7			LG	2

REV.	DATE	BY	DESCRIPTION
2	10/5/79		
1	8/1/79	P.S.	REV. AS NOTED

REVISIONS

VESSEL DATA

1	ITEM NO: D-3101 A/B	NO. REQ'D: TWO		
2	SERVICE: INTERCOOLER KO DRUM			
3				
4	OPER. PRESSURE ABOVE LIQUID LEVEL	NORM:	20	PSIG
5		MAX:	20	PSIG
6	DESIGN PRESSURE	INT:	47	PSIG ⚠1
7		EXT:	—	PSIG
8	OPER. LIQUID HOLD - UP PRESS:		1.5	PSIG
9	OPER. PRESS. DROP THRU VESSEL:		0.1	PSIG
10	MAX. RELIEVING PRESS. AT TOP HD:		45	PSIG ⚠1
11	MAX. OPER. TEMPERATURE:		102	°F
12	DESIGN TEMPERATURE:		152	°F
13	SPECIFIC GRAVITY (PROCESS FLUID):		1.0	
14	WIND DATA: SPEC. 2200-40A1			
15				
16	EARTHQUAKE DATA: SPEC. 2200-40A1			
17	CODE: ASME SECT VIII DIV. 1 STAMPED: YES			
18	P.W.H.T. FOR CODE: NO FOR PROCESS: NO			
19	RADIOGRAPHED: SPOT			
20	JOINT EFFICIENCY: 85%			
21	CORROSION ALLOW. / CLAD TK: 0.125"			
22	MAT'L. SHELL: SA-285-C			
23	MAT'L. HEADS: SA-285-C			
24	MAT'L. SUPPORTS: SA-283-C			
25	MAT'L. FLANGES: SA-181-GR1			
26	MAT'L. NOZZLES: SA-106-A OR B			
27	EXTERNAL BOLTING: SA-193-B7 & SA-194-2H			
28	INTERNAL BOLTING: CARBON STEEL			
29	GASKETS: 1/16" THK. COMPRESSED ASBESTOS			
30	TYPE OF HEADS: ELLIPTICAL			
31	INSULATION: NO			
32	PAINT: PREPARATION:			
33	PRIMER:			
34	COATS:			
35	PARTS:			
36	SHIPMENT: ONE PIECE			
37				
38	EMPTY WGT: (EXC. REMOVABLE TRAYS):		29,700	LBS.
39	WATER (ONLY) WGT:		174,000	LBS.
40	REMOVABLE TRAY WGT:			LBS.
41	PACKING, CATALYST, ETC. WGT:			LBS.
42	INSULATION WGT:			LBS.
43	GUNITE WGT:		9,200	LBS.
44	OPER. LIQUID WGT:		36,000	LBS.

FOSTER WHEELER ENERGY CORPORATION, 110 SOUTH ORANGE AVENUE, LIVINGSTON, NEW JERSEY

REFERENCE DRAWINGS, REQUISITIONS, STANDARDS			
2203-4-11-1, ENG. STD. 10B14.1, 10B15.1 SPEC. 2200-10A1 11A1 1100A	DRAWN	P.S.	5/21/79
	CHECKED		
	APPROVED		

CONTRACT NUMBER: 15-2203

REQUISITION NUMBER: 2231-1131-A

P.O. NUMBER:

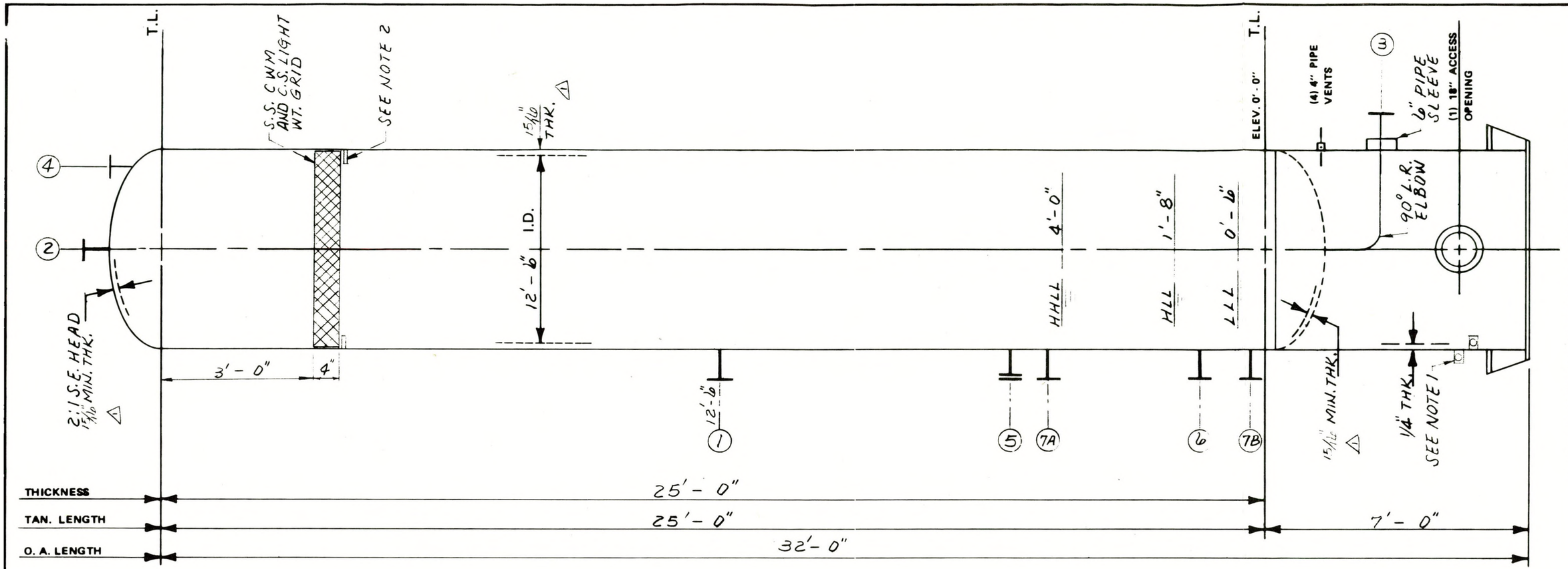
INTERCOOLER KO DRUM D-3101 A/B
AIR SEPARATION (SECTION 310)
MLGW/DOE

MEMPHIS TENNESSEE

DRAWING NUMBER: 2203-4-11-2

REV.: 2

FORM NO. 135 : 101



(EST. ONLY) FOR TOWER BASE DETAILS SEE ENG. STD. 10B11.1
ANCHOR BOLTS: NO. 12 DIA. 1 1/4" B.C. 12'-11"
BOLTS STRADDLE N - S CENTER LINE

NOTE:
1. ½" NUTS WELDED ON EDGE AND SPACED ON 24" CENTERS IN BOTH DIRECTIONS SEE ENG. STD. 10B 14.1.
2. FOR 4" CWM SUPPORT RING SEE ENG. STD. 10B 15.1.

FORM NO. 135 - 104

FOSTER WHEELER ENERGY CORPORATION,
110 SOUTH ORANGE AVENUE, LIVINGSTON, NEW JERSEY.

REV.	DATE	BY	DESCRIPTION
1	8/6/79	J.S.	REV. AS NOTED

REVISIONS

REFERENCE DRAWINGS, REQUISITIONS, STANDARDS
2203-4-11-4

DRAWN	P.S.	5/21/79
CHECKED		
APPROVED		

AFTER COOLER KO DRUM D-3102
AIR SEPARATION (SECTION 310)
MLGW / DOE

MEMPHIS TENNESSEE

CONTRACT NUMBER: 15-2203
REQUISITION NUMBER: 2231-1131-B
P.O NUMBER:
DRAWING NUMBER: 2203-4-11-3 | 1

NOTES

1 - THIS VESSEL AND ITS SUPPORTS HAVE NOT BEEN DESIGNED TO WITHSTAND A FLOODED OR HYDROSTATIC TEST CONDITION IN THE VERTICAL POSITION. CONTACT FOSTER WHEELER ENERGY CORPORATION PRIOR TO ANY REQUESTED FIELD TEST.

2 - VESSEL FABRICATOR TO SUPPLY AND INSTALL (AS MARKED)
- ☐ TRAYS (TRAYS SUPPLIED BY OTHERS)
- ☐ TRAY SUPPORTS
- ☐ INSULATION ATTACHMENTS
- ☐ FIREPROOFING ATTACHMENTS
- ☐ PLATFORM AND LADDER ATTACHMENTS
- ☐ PIPE SUPPORTS

3 - VESSEL MUST BE SHIPPED WITH ORIENTATION ________° MARK UP

RELEASES

DWG. REV.	DATE	ISSUED FOR
	DATE OF ORDER	PURCHASE SHELL AND HEAD MATERIAL. PREPARE BUT DO NOT SUBMIT SHOP DETAIL DRAWINGS.
		ISSUE CHECKED FOSTER WHEELER DRAWING. PURCHASE ALL OTHER MATERIALS. FINALIZE AND SUBMIT CHECKED SHOP DETAIL DRAWING WITHIN ONE WEEK OF RELEASE DATE. PROCEED WITH COMPLETE FABRICATION.
		FIELD CONSTRUCTION

NOZZLE CHART

CONN NO.	SIZE	ANSI RATING	SERVICE	NO REQ'D
1	36"	150# R.F.	VAPOR INLET	1
2	36"	150# R.F.	VAPOR OUTLET	1
3	2"	150# R.F.	LIQUID OUTLET	1
4	2"	150# R.F.	VENT	1
5	20"	150# R.F.	MANWAY	1
6	3"	150# R.F.	STEAMOUT	1
7			L.C.	2

REVISIONS

REV.	DATE	BY	DESCRIPTION
2	10/3/79		
1	6/31		[illegible]

VESSEL DATA

1	ITEM NO: D-3102 NO. REQ'D: ONE	
2	SERVICE: AFTER COOLER KO DRUM	
3		
4	OPER. PRESSURE ABOVE LIQUID LEVEL — NORM: 90	PSIG
5	OPER. PRESSURE ABOVE LIQUID LEVEL — MAX: 90	PSIG
6	DESIGN PRESSURE — INT: [illegible]	PSIG
7	DESIGN PRESSURE — EXT: —	PSIG
8	OPER. LIQUID HOLD - UP PRESS: 1.75	PSIG
9	OPER. PRESS. DROP THRU VESSEL: 0.1	PSIG
10	MAX. RELIEVING PRESS. AT TOP HD: [illegible]	PSIG
11	MAX. OPER. TEMPERATURE: 100	°F
12	DESIGN TEMPERATURE: 150	°F
13	SPECIFIC GRAVITY (PROCESS FLUID): 1.0	
14	WIND DATA: SPEC. 2200-40A1	
15		
16	EARTHQUAKE DATA: SPEC. 2200-40A1	
17	CODE: ASME SECT. VIII DIV. STAMPED: YES	
18	P.W.H.T. FOR CODE: NO FOR PROCESS: NO	
19	RADIOGRAPHED: SPOT	
20	JOINT EFFICIENCY: 85%	
21	CORROSION ALLOW. / CLAD TK: 0.125"	
22	MAT'L. SHELL: SA-285 C	
23	MAT'L. HEADS: SA-285-C	
24	MAT'L. SUPPORTS: SA-283-C	
25	MAT'L. FLANGES: SA-181-GR I	
26	MAT'L. NOZZLES: SA-106-A OR B	
27	EXTERNAL BOLTING: SA-193-B7 & SA-194-2H	
28	INTERNAL BOLTING: CARBON STEEL	
29	GASKETS: 1/16" THK. COMPRESSED ASBESTOS	
30	TYPE OF HEADS: ELLIPTICAL	
31	INSULATION: NO	
32	PAINT: PREPARATION:	
33	PRIMER:	
34	COATS:	
35	PARTS:	
36	SHIPMENT: ONE PIECE	
37		
38	EMPTY WGT: (EXC. REMOVABLE TRAYS): 62300	LBS.
39	WATER (ONLY) WGT: 224,000	LBS.
40	REMOVABLE TRAY WGT:	LBS.
41	PACKING, CATALYST, ETC. WGT:	LBS.
42	INSULATION WGT:	LBS.
43	GUNITE WGT: 9952	LBS.
44	OPER. LIQUID WGT: 46600	LBS.

REFERENCE DRAWINGS, REQUISITIONS, STANDARDS

2203-4-11-3, ENG. STD. 10B 14.1
SPEC. 2200-10A1 10B 15.1
11A1
1100A

DRAWN	P.S.	5/6/79
CHECKED		
APPROVED		

CONTRACT NUMBER: 15-2203

REQUISITION NUMBER: 2231-1131-B

P.O. NUMBER:

AFTER COOLER KO DRUM D-3102
AIR SEPARATION (SECTION 310)
MLGW / DOE

MEMPHIS TENNESSEE

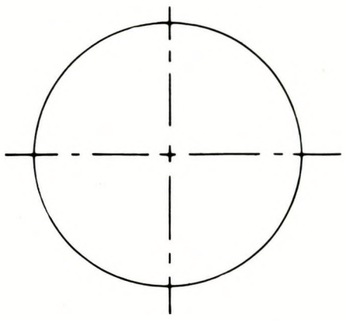
DRAWING NUMBER: 2203-4-11-4 REV. 2

FORM NO. 138-101

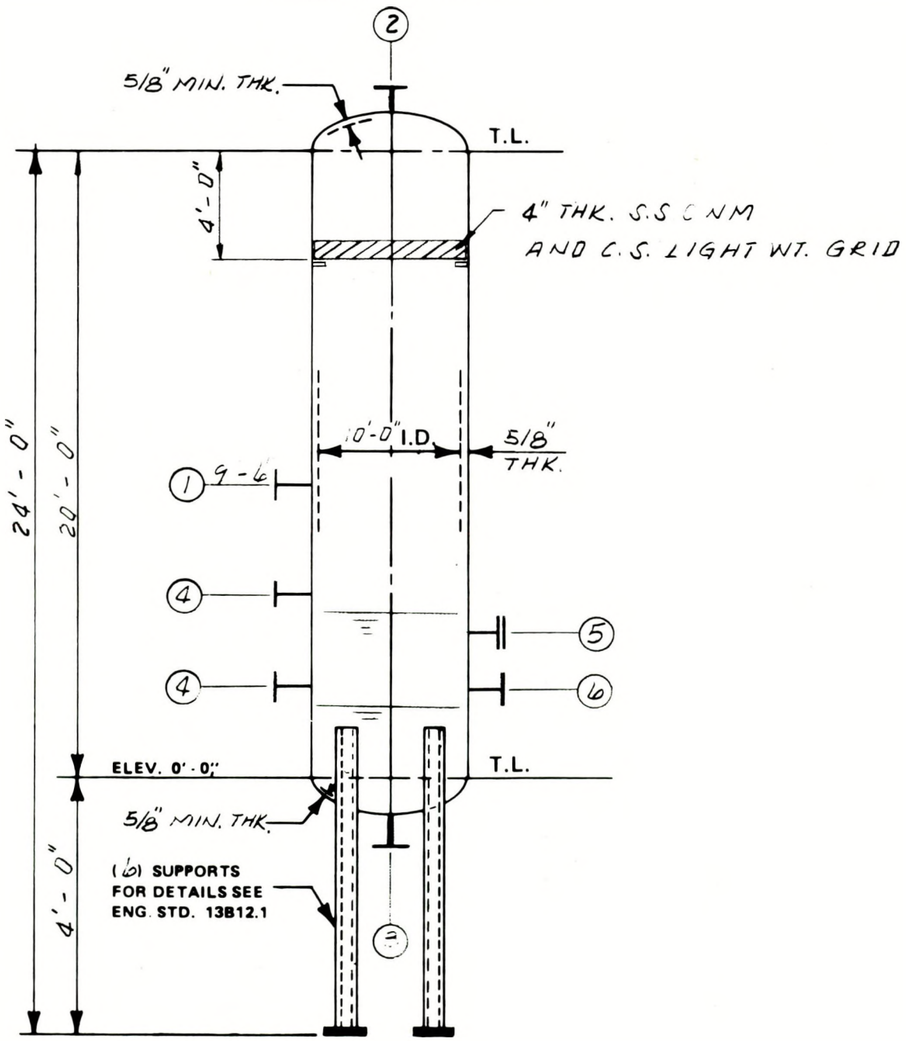
NOTES:

1 · VESSEL FABRICATOR TO SUPPLY AND INSTALL (AS MARKED)

- ☐ PLATFORM AND LADDER ATTACHMENTS
- ☐ INSULATION ATTACHMENTS
- ☐ PIPE SUPPORTS



ORIENTATION PLAN



FORV 135 106

RELEASES

DWG. REV.	DATE	ISSUED FOR
	DATE OF ORDER	PURCHASE SHELL AND HEAD MATERIAL. PREPARE BUT DO NOT SUBMIT SHOP DETAIL DRAWINGS.
		ISSUE CHECKED FOSTER WHEELER DRAWING. PURCHASE ALL OTHER MATERIALS. FINALIZE AND SUBMIT CHECKED SHOP DETAIL DRAWING WITHIN ONE WEEK OF RELEASE DATE. PROCEED WITH COMPLETE FABRICATION
		FIELD CONSTRUCTION

NOZZLE CHART

CONN NO.	SIZE	ANSI RATING	SERVICE	NO. REQ'D
1	36"	CODE DESIGN	VAPOR INLET	1
2	36"	CODE DESIGN	VAPOR OUTLET	1
3	2"	150# R.F.	LIQUID OUTLET	1
4			L.G. L.C.	2
5	20"	150# R.F.	MAN WAY	1
6	2"	150# R.F.	STEAM OUT	1

REV.	DATE	BY	DESCRIPTION
			REVISIONS

VESSEL DATA

1	ITEM NO: D-3103	NO. REQ'D: TWO		
2	SERVICE: SECOND STAGE INTERCOOLER			
3	K.O. DRUM			
4	OPER. PRESSURE ABOVE LIQUID LEVEL	NORM:	64	PSIG
5		MAX:	64	PSIG
6	DESIGN PRESSURE	INT:	91	PSIG
7		EXT:		PSIG
8	OPER. LIQUID HOLD-UP PRESS:		1.5	PSIG
9	OPER. PRESS. DROP THRU VESSEL:			PSIG
10	MAX. RELIEVING PRESS. AT TOP HD:		89	PSIG
11	MAX. OPER. TEMPERATURE:		103	°F
12	DESIGN TEMPERATURE		153	
13	SPECIFIC GRAVITY (PROCESS FLUID):		1.0	
14	WIND DATA: 2200 - 20AI			
15				
16	EARTHQUAKE DATA: 2200 - 40AI			
17	CODE: ASME EC. VIII DIV. 1 STAMPED: YES			
18	P.W.H.T. FOR CODE: NO FOR PROCESS: NO			
19	RADIOGRAPHED:		FCT	
20	JOINT EFFICIENCY:		85%	
21	CORROSION ALLOW./CLAD TK:		0.125"	
22	MAT'L. SHELL:		SA-285-C	
23	MAT'L. HEADS:		SA-285-C	
24	MAT'L. SUPPORTS:		SA-36	
25	MAT'L. FLANGES:		PER -.0AI	
26	MAT'L. NOZZLES:		PER -10AI	
27	EXTERNAL BOLTING:		SA-193-B7 & 194-2H	
28	INTERNAL BOLTING:		C.S.	
29	GASKETS: 1/16" THK. COMP. ASBESTOS			
30	TYPE OF HEADS: ELLIPTICAL			
31	INSULATION:		NO	
32	PAINT: PREPARATION:			
33	PRIMER:			
34	COATS:			
35	PARTS:			
36	SHIPMENT: ONE PIECE			
37				
38	EMPTY WGT.		33,000	LBS.
39	WATER(ONLY)WGT:		114,000	LBS.
40	INSULATION WGT:		—	LBS.
41	GUNITE WGT:		—	LBS.
42	OPER. LIQUID WGT:			LBS.
43				
44				

REFERENCE DRAWINGS, REQUISITIONS, STANDARDS			
ENG. STD. 13B 12.1, 10B 15.1 2200-.0AI, 1100A, 40AI	DRAWN	P.S.	9/2/79
	CHECKED		
	APPROVED		

SECOND STAGE COMPRESSOR INTERCOOLER
K.O. DRUM D-3103 A/B
AIR SEPARATION SECT-310
MLGW/DOE
MEMPHIS TENNESSEE

CONTRACT NUMBER	15-2203
REQUISITION NUMBER	2231-1131-C
P.O. NUMBER	
DRAWING NUMBER	2203-4-11-118
REV.	0

FORM NO. 135-128 A

ALTERNATE DESIGN

MATERIAL REQUISITION

FOSTER WHEELER ENERGY CORPORATION

110 SOUTH ORANGE AVENUE, LIVINGSTON, N. J.

SHELL & TUBE EXCHANGERS

CONTRACT NO. 15-2231	REQ'N. NO. 2231-1211 G	DATE 7/3/79
CUSTOMERS NAME MLGW/DOE	LOCATION MEMPHIS, TENNESSEE	

SUPERSEDED BY

CHANGE NO.	C-1	C-2	C-3	C-4	C-5	C-6
DATE	9/17/79					

SERVICE OF UNIT AIR COMPRESSOR INTERCOOLERS — ITEM NO. E-3101 A

1 SIZE 30-264 — TYPE NEN SPECIAL (HORIZ.) — CONNECTED IN —

1 SQ.FT.SURF./UNIT (~~GROSS~~) (EFF) 26,649 — SHELLS/UNIT ONE — SQ.FT.SURF./SHELL (~~GROSS~~) (EFF) 26,649

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	COOLING WATER		AIR	
1 TOTAL FLUID ENTERING	970,000	LB/HR	385,044	LB/HR
VAPOR		LB/HR		LB/HR
1 LIQUID	970,000	LB/HR		LB/HR
STEAM		LB/HR	13,755	LB/HR
NON-CONDENSABLES		LB/HR	371,289	LB/HR
FLUID (VAPORIZED)(CONDENSED)		LB/HR		LB/HR
1 STEAM CONDENSED		LB/HR	7,497	LB/HR
GRAVITY	0.993			
VISCOSITY C.P.	0.7 AVG			
MOLECULAR WEIGHT			28.35 WET ; 28.964 DRY	
SPECIFIC HEAT	0.998	BTU/LB-°F	0.249	BTU/LB-°F
THERMAL CONDUCTIVITY		BTU/HR-FT-°F		BTU/HR-FT-°F
LATENT HEAT		BTU/LB	STEAM = 1035.8	BTU/LB
TEMPERATURE IN	88	°F	331	°F
TEMPERATURE OUT	118	°F	102	°F
1 OPERATING PRESSURE, INLET	70	(~~PSIG~~)(PSIG)	40.6	(PSIA)(~~PSIG~~)
NO. PASSES PER SHELL	ONE		ONE	
VELOCITY		FT/SEC		FT/SEC
1 PRESSURE DROP - ALLOW. / CALC'D.	10 PSI / 3.1	PSI	1.2 PSI / 1.2	PSI
FOULING RESISTANCE, MIN.	0.001		0.002	

1 HEAT EXCHANGED - BTU/HR. 29,100,000 — MTD CORRECTED-°F 96.0

1 TRANSFER RATE - SERVICE 23.7 — CLEAN

CONSTRUCTION OF ONE SHELL

1 DESIGN PRESSURE	100	PSIG	75	PSIG
TEST PRESSURE	PER CODE	PSIG	PER CODE	PSIG
DESIGN TEMPERATURE	170	°F	381	°F

1 TUBES C.S. (A-214) NO. 6331 O.D. 0.75" BWG 14 (~~MIN~~) LENGTH 22' PITCH 15/16 Δ

1 SHELL C.S. I.D. 30" — SHELL COVER — — (INTEG)(REMOV)

CHANNEL OR BONNET C.S. — CHANNEL COVER —

TUBESHEET - STATIONARY C.S. — TUBESHEET - FLOATING —

BAFFLES - CROSS C.S. TYPE SEGM — FLOATING HEAD COVER —

1 BAFFLES - LONG — (~~TYPE~~) P= 23.6 "; h/D = 0.2 — IMPINGMENT PROTECTION YES

TUBE SUPPORTS C.S.

TUBE TO TUBESHEET JOINT

GASKETS

CONNECTIONS - SHELL SIDE IN 10" OUT 10" RATING 150 # RF

1 CONNECTIONS - TUBE SIDE (AXIAL) IN 42" OUT 42" RATING 150 # RF

CORROSION ALLOWANCE - SHELL SIDE 1/8" IN. TUBE SIDE 1/8" IN.

CODE REQUIREMENTS ASME SECT VIII DIV 1 & JOB SPEC. 2200-21A1 — TEMA CLASS R

REMARKS: (1) NOZZLE & SUPPORT LOCATION TO BE AS NOTED ON F.W. STD. 21B11.1

(2) FOR GENERAL NOTES REFER TO REQ'N. 2200-1200A WHICH IS AN INTEGRAL PART OF THIS REQ'N

(3) ONE ADDITIONAL DUPLICATE ITEM REQUIRED TAG E-3101 B

FORM NO. 135-128A

MATERIAL REQUISITION

FOSTER WHEELER ENERGY CORPORATION

110 SOUTH ORANGE AVENUE, LIVINGSTON, N. J.

SHELL & TUBE EXCHANGERS

CONTRACT NO. 15-2231	REQ'N. NO. 2231-1211B	DATE 6/7/79
CUSTOMERS NAME MLGW/DOE	LOCATION MEMPHIS, TENNESSEE	

SUPERSEDED BY

CHANGE NO.	C-1	C-2	C-3	C-4	C-5	C-6
DATE	6/14/79	6/29/79	9/17/79	9/26/79		

SERVICE OF UNIT AIR COMPRESSOR AFTERCOOLER — ITEM NO. E-3102

SIZE 64-240 — TYPE NEN SPECIAL (HORIZ) (~~VERT~~) — CONNECTED IN —

SQ.FT.SURF./UNIT (~~GROSS~~) (EFF) 15,404 — SHELLS/UNIT ONE — SQ.FT.SURF./SHELL (~~GROSS~~) (EFF) 15,404

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	COOLING WATER		AIR	
TOTAL FLUID ENTERING	460,000	LB/HR	748,760	LB/HR
VAPOR		LB/HR		LB/HR
LIQUID	460,000	LB/HR		LB/HR
STEAM		LB/HR	6,182	LB/HR
NON-CONDENSABLES		LB/HR	742,578	LB/HR
FLUID (VAPORIZED)(CONDENSED)		LB/HR		LB/HR
STEAM CONDENSED		LB/HR	1,838	LB/HR
GRAVITY	0.993 Avg			
VISCOSITY	0.7 C.P. Avg.			
MOLECULAR WEIGHT			28.66 WET ; 28.964 DRY	
SPECIFIC HEAT	0.998 Avg	BTU/LB-°F	0.249	BTU/LB-°F
THERMAL CONDUCTIVITY		BTU/HR-FT-°F		BTU/HR-FT-°F
LATENT HEAT		BTU/LB	1034	BTU/LB
TEMPERATURE IN	88	°F	163	°F
TEMPERATURE OUT	118	°F	100	°F
OPERATING PRESSURE, INLET	84.7	(PSIA)(~~PSIG~~)	90.3	(~~PSIA~~)(PSIG)
NO. PASSES PER SHELL	ONE		ONE	
VELOCITY		FT/SEC	62.4	FT/SEC
PRESSURE DROP - ALLOW. / CALC'D.	10 PSI / 1.3 PSI		3.0 PSI / 2.9 PSI	
FOULING RESISTANCE, MIN.	0.001		0.002	
HEAT EXCHANGED - BTU/HR. 13,800,000		MTD CORRECTED-°F	20.74	
TRANSFER RATE - SERVICE 43.2		CLEAN		

CONSTRUCTION OF ONE SHELL

DESIGN PRESSURE	100 PSIG	115	PSIG
TEST PRESSURE	PER CODE PSIG	PER CODE	PSIG
DESIGN TEMPERATURE	170 °F	213	°F

TUBES C.S. (A-214) NO. 4019 O.D. 3/4" BWG 14 (~~MIN~~) LENGTH 20' PITCH 15/16 Δ

SHELL C.S.	I.D. 64"	SHELL COVER -	(INTEG)(REMOV)
~~CHANNEL~~ OR BONNET C.S.		CHANNEL COVER -	
TUBESHEET - STATIONARY C.S.		TUBESHEET - FLOATING -	
BAFFLES - CROSS C.S.	TYPE: SEGM VERT CUT	FLOATING HEAD COVER -	
BAFFLES - LONG -	P = 27.5" H/D = 0.2	IMPINGMENT PROTECTION YES	

TUBE SUPPORTS C.S.

TUBE TO TUBESHEET JOINT

GASKETS

CONNECTIONS - SHELL SIDE IN 8" OUT 8" RATING 150 # RF

CONNECTIONS - TUBE SIDE (AXIAL) IN 36" OUT 36" RATING 150 # RF

CORROSION ALLOWANCE - SHELL SIDE 1/8" IN. TUBE SIDE 1/8" IN.

CODE REQUIREMENTS ASME SECTION VIII DIV. 1 & JOB SPEC. 2200-21A1 TEMA CLASS R

REMARKS: (1) NOZZLE & SUPPORT LOCATION TO BE AS NOTED ON F.W. STD. 21B11.1

(2) FOR GENERAL NOTES REFER TO REQ'N. 2200-1200-A WHICH IS AN INTEGRAL PART OF THIS REQ'N

4
4

FORM NO. 135-128A

MATERIAL REQUISITION

FOSTER WHEELER ENERGY CORPORATION

110 SOUTH ORANGE AVENUE, LIVINGSTON, N. J.

SHELL & TUBE EXCHANGERS

CONTRACT NO. 15-2231	REQ'N. NO. 2231-1211C	DATE 6/7/79
CUSTOMERS NAME MLGW/DOE	LOCATION MEMPHIS, TENNESSEE	

SUPERSEDED BY

CHANGE NO.	C-1	C-2	C-3	C-4	C-5	C-6
DATE	6/14/72					

SERVICE OF UNIT OXYGEN COMPRESSOR 1ST STAGE INTERCOOLER ITEM NO. E-3103

SIZE 47-192 TYPE NEN SPECIAL (HORIZ) (VERT) CONNECTED IN —

SQ.FT.SURF./UNIT (~~GROSS~~) (EFF) 4900 SHELLS/UNIT ONE SQ.FT.SURF./SHELL (~~GROSS~~) (EFF) 4900

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	COOLING WATER		98 VOL.% O_2 - 2 VOL.% N_2	
TOTAL FLUID ENTERING	114,900	LB/HR	162,510	LB/HR
VAPOR		LB/HR		LB/HR
LIQUID	114,900	LB/HR		LB/HR
STEAM		LB/HR		LB/HR
NON-CONDENSABLES		LB/HR	162,510	LB/HR
FLUID (VAPORIZED)(CONDENSED)		LB/HR		LB/HR
STEAM CONDENSED		LB/HR		LB/HR
GRAVITY	0.993 AVG.			
VISCOSITY C.P.	0.7 AVG.			
MOLECULAR WEIGHT			31.92	
SPECIFIC HEAT	0.998 AVG.	BTU/LB-°F	0.221	BTU/LB-°F
THERMAL CONDUCTIVITY		BTU/HR-FT-°F		BTU/HR-FT-°F
LATENT HEAT		BTU/LB		BTU/LB
TEMPERATURE IN	88	°F	198	°F
TEMPERATURE OUT	118	°F	102	°F
(1) OPERATING PRESSURE, INLET	70	(~~PSIA~~)(PSIG)	27.6	(PSIA)(~~PSIG~~)
NO. PASSES PER SHELL	ONE		ONE	
(1) VELOCITY		FT/SEC	78	FT/SEC
(1) PRESSURE DROP - ALLOW. / CALC'D.	10 PSI / 1.2	PSI	0.7 PSI / 0.7	PSI
FOULING RESISTANCE, MIN.	0.001		0.0005	

HEAT EXCHANGED - BTU/HR. 3,448,000 MTD CORRECTED-°F 37.9

TRANSFER RATE - SERVICE 18.6 CLEAN

CONSTRUCTION OF ONE SHELL

DESIGN PRESSURE	100 PSIG	38	PSIG
TEST PRESSURE	PER CODE PSIG	PER CODE	PSIG
DESIGN TEMPERATURE	168 °F	250	°F

(1) TUBES 304 S.S. (A-249) NO. 1193 O.D. 1.0" BWG 14 (~~AVG~~) MIN LENGTH 16' PITCH 1¼" Δ

SHELL C.S.	I.D. 47"	SHELL COVER —	(INTEG)(REMOV)
CHANNEL OR BONNET 304 S.S. CLAD		CHANNEL COVER —	
TUBESHEET - STATIONARY 304 S.S. CLAD		TUBESHEET - FLOATING —	
(1) BAFFLES - CROSS C.S.	TYPE SEGM. VERT CUT	FLOATING HEAD COVER —	
(1) BAFFLES - LONG —	P = 9 7/16 ; H/D = 0.2	IMPINGMENT PROTECTION YES	

TUBE SUPPORTS C.S.

TUBE TO TUBESHEET JOINT

GASKETS

CONNECTIONS - SHELL SIDE IN 4" OUT 4" RATING 150 # RF

CONNECTIONS - TUBE SIDE (AXIAL) IN 32" OUT 32" RATING 150 # RF

CORROSION ALLOWANCE - SHELL SIDE 1/8 IN. TUBE SIDE — IN.

CODE REQUIREMENTS ASME SECT VIII DIV 1 & JOB SPECS. 2200-21A1 TEMA CLASS R

REMARKS: (1) NOZZLE & SUPPORT LOCATION TO BE AS NOTED ON F.W. STD. 21811.1

(2) FOR GENERAL NOTES REFER TO REQ'N. 2200-1200A WHICH IS AN INTEGRAL PART OF THIS REQ'N

FORM NO. 135-128A

MATERIAL REQUISITION

FOSTER WHEELER ENERGY CORPORATION

110 SOUTH ORANGE AVENUE, LIVINGSTON, N. J.

SHELL & TUBE EXCHANGERS

CONTRACT NO. 15-2231	REQ'N. NO. 2231-1211D	DATE 6/8/79
CUSTOMERS NAME MLGW/DOE	LOCATION MEMPHIS, TENNESSEE	

SUPERSEDED BY

CHANGE NO.	C-1	C-2	C-3	C-4	C-5	C-6
DATE	6/14/72					

SERVICE OF UNIT OXYGEN COMPRESSOR 2ND STAGE INTERCOOLER ITEM NO. E-3104

SIZE 39-240 TYPE NEN SPECIAL (HORIZ) (~~VERT~~) CONNECTED IN —

SQ.FT.SURF./UNIT (~~GROSS~~) (EFF) 4204 SHELLS/UNIT ONE SQ.FT.SURF./SHELL (~~GROSS~~) (EFF) 4204

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	COOLING WATER		98 VOL.% O_2 - 2 VOL.% N_2	
TOTAL FLUID ENTERING	144,300	LB/HR	162,510	LB/HR
VAPOR		LB/HR		LB/HR
LIQUID	144,300	LB/HR		LB/HR
STEAM		LB/HR		LB/HR
NON-CONDENSABLES		LB/HR	162,510	LB/HR
FLUID (VAPORIZED)(CONDENSED)		LB/HR		LB/HR
STEAM CONDENSED		LB/HR		LB/HR
GRAVITY	0.993 AVG.			
VISCOSITY C.P.	0.7 AVG.			
MOLECULAR WEIGHT			31.92	
SPECIFIC HEAT	0.998 AVG.	BTU/LB-°F	0.222	BTU/LB-°F
THERMAL CONDUCTIVITY		BTU/HR-FT-°F		BTU/HR-FT-°F
LATENT HEAT		BTU/LB		BTU/LB
TEMPERATURE IN	88	°F	222	°F
TEMPERATURE OUT	118	°F	102	°F
(1) OPERATING PRESSURE, INLET	70	(~~PSIA~~)(PSIG)	45.7	(PSIA)(~~PSIG~~)
NO. PASSES PER SHELL	ONE		ONE	
(1) VELOCITY		FT/SEC	70.5	FT/SEC
(1) PRESSURE DROP - ALLOW. / CALC'D.	10 PSI / 1.2	PSI	1.1 PSI / 1.1	PSI
FOULING RESISTANCE, MIN.	0.001		0.0005	
HEAT EXCHANGED - BTU/HR.	4,329,000	MTD CORRECTED-°F	44.88	
TRANSFER RATE - SERVICE	22.95	CLEAN		

CONSTRUCTION OF ONE SHELL

DESIGN PRESSURE	100 PSIG	56	PSIG
TEST PRESSURE	PER CODE PSIG	PER CODE	PSIG
DESIGN TEMPERATURE	168 °F	275	°F

(1) TUBES 304 S.S.(A-249) NO. 813 O.D. 1.0" BWG 14 (~~MIN~~) LENGTH 20' PITCH 1¼ Δ

SHELL C.S. I.D. 39" SHELL COVER — (INTEG)(REMOV)

CHANNEL OR BONNET 304 S.S. CLAD CHANNEL COVER —

TUBESHEET - STATIONARY 304 S.S. CLAD TUBESHEET - FLOATING —

(1) BAFFLES - CROSS C.S. TYPE SEGM. VERT CUT FLOATING HEAD COVER —

(1) BAFFLES - LONG — P = 18¼"; H/D = 0.2 IMPINGMENT PROTECTION YES

TUBE SUPPORTS C.S.

TUBE TO TUBESHEET JOINT

GASKETS

CONNECTIONS - SHELL SIDE IN 4" OUT 4" RATING 150 # RF

CONNECTIONS - TUBE SIDE (AXIAL) IN 26" OUT 26" RATING 150 # RF

CORROSION ALLOWANCE - SHELL SIDE 1/8 IN. TUBE SIDE — IN.

CODE REQUIREMENTS ASME SECT. VIII DIV. 1 & JOB SPEC. 2200-21A1 TEMA CLASS R

REMARKS: (1) NOZZLE & SUPPORT LOCATION TO BE AS NOTED ON F.W. STD. 21811.1

(2) FOR GENERAL NOTES REFER TO REQ'N. 2200-1200A WHICH IS AN INTEGRAL PART OF THIS REQ'N

FORM NO. 135-128 A

MATERIAL REQUISITION

FOSTER WHEELER ENERGY CORPORATION

110 SOUTH ORANGE AVENUE, LIVINGSTON, N. J.

SHELL & TUBE EXCHANGERS

CONTRACT NO. 15-2231	REQ'N. NO. 2231-1211 E	DATE 6/8/79
CUSTOMERS NAME MLGW/DOE	LOCATION MEMPHIS, TENNESSEE	

SUPERSEDED BY

CHANGE NO.	C-1	C-2	C-3	C-4	C-5	C-6
DATE	6/14/79					

SERVICE OF UNIT OXYGEN COMPRESSOR 3RD STAGE INTERCOOLER ITEM NO. E-3105

SIZE 31-264 TYPE NEN SPECIAL (HORIZ) (~~VERT~~) CONNECTED IN —

SQ.FT.SURF./UNIT (~~GROSS~~) (EFF) 2841 SHELLS/UNIT ONE SQ.FT.SURF./SHELL (~~GROSS~~) (EFF) 2841

PERFORMANCE OF ONE UNIT

	SHELL SIDE	TUBE SIDE
FLUID CIRCULATED	COOLING WATER	98 VOL % O_2 - 2 VOL.% N_2
TOTAL FLUID ENTERING	135,900 LB/HR	162,510 LB/HR
VAPOR	LB/HR	LB/HR
LIQUID	135,900 LB/HR	LB/HR
STEAM	LB/HR	LB/HR
NON-CONDENSABLES	LB/HR	162,510 LB/HR
FLUID (VAPORIZED)(CONDENSED)	LB/HR	LB/HR
STEAM CONDENSED	LB/HR	LB/HR
GRAVITY	0.993 AVG.	
VISCOSITY C.P.	0.7 AVG.	
MOLECULAR WEIGHT		31.92
SPECIFIC HEAT	0.998 AVG. BTU/LB-°F	0.222 BTU/LB-°F
THERMAL CONDUCTIVITY	BTU/HR-FT-°F	BTU/HR-FT-°F
LATENT HEAT	BTU/LB	BTU/LB
TEMPERATURE IN	88 °F	215 °F
TEMPERATURE OUT	118 °F	102 °F
(1) OPERATING PRESSURE, INLET	70 (~~PSIA~~)(PSIG)	73.8 (PSIA)(~~PSIG~~)
NO. PASSES PER SHELL	ONE	ONE
(1) VELOCITY	FT/SEC	70.8 FT/SEC
(1) PRESSURE DROP - ALLOW. / CALC'D.	10 PSI / 1.6 PSI	1.8 PSI / 1.8 PSI
FOULING RESISTANCE, MIN.	0.001	0.0005

HEAT EXCHANGED - BTU/HR. 4077000 MTD CORRECTED-°F 42.88

TRANSFER RATE - SERVICE 33.47 CLEAN

CONSTRUCTION OF ONE SHELL

	SHELL SIDE	TUBE SIDE
DESIGN PRESSURE	100 PSIG	85 PSIG
TEST PRESSURE	PER CODE PSIG	PER CODE PSIG
DESIGN TEMPERATURE	168 °F	265 °F

(1) TUBES 304 S.S.(A-249) NO. 498 O.D. 1.0 BWG 14 (~~AVG~~) MIN LENGTH 22' PITCH 1¼" Δ

SHELL C.S.	I.D.	SHELL COVER —	(INTEG)(REMOV)
CHANNEL OR BONNET 304 S.S. CLAD		CHANNEL COVER —	
TUBESHEET - STATIONARY 304 S.S. CLAD		TUBESHEET - FLOATING —	
(1) BAFFLES - CROSS C.S.	TYPE SEGM. VERT. CUT	FLOATING HEAD COVER —	
(1) BAFFLES - LONG —	P = 16 3/8"; H/D = 0.2	IMPINGMENT PROTECTION YES	

TUBE SUPPORTS C.S.

TUBE TO TUBESHEET JOINT

GASKETS

CONNECTIONS - SHELL SIDE IN 4" OUT 4" RATING 150 # RF

CONNECTIONS - TUBE SIDE (AXIAL) IN 20" OUT 20" RATING 150 # RF

CORROSION ALLOWANCE - SHELL SIDE 1/8" IN. TUBE SIDE — IN.

CODE REQUIREMENTS ASME SECT. VIII DIV 1 & JOB SPEC. 2200-21A1 TEMA CLASS R

REMARKS: (1) NOZZLE & SUPPORT LOCATION TO BE AS NOTED ON F.W. STD. 21B11.1

(2) FOR GENERAL NOTES REFER TO REQ'N. 2200-1200A WHICH IS AN INTEGRAL PART OF THIS REQ'N

FORM NO. 135-128 A

MATERIAL REQUISITION

FOSTER WHEELER ENERGY CORPORATION

110 SOUTH ORANGE AVENUE, LIVINGSTON, N. J.

SHELL & TUBE EXCHANGERS

CONTRACT NO. 15-2231	REQ'N. NO. 2231-1211 F	DATE 6/25/79
CUSTOMERS NAME MLGW/DOE	LOCATION MEMPHIS, TENNESSEE	

SUPERSEDED BY

CHANGE NO.	C-1	C-2	C-3	C-4	C-5	C-6
DATE						

SERVICE OF UNIT OXYGEN COMPRESSOR RECIRCULATION COOLER ITEM NO. E-3106

SIZE 27-96 TYPE BEU (HORIZ) (~~VERT~~) CONNECTED IN —

SQ.FT.SURF./UNIT (~~GROSS~~) (EFF) 853 SHELLS/UNIT ONE SQ.FT.SURF./SHELL (~~GROSS~~) (EFF) 853

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	COOLING WATER		98 VOL.% O_2 + 2 VOL.% N_2	
TOTAL FLUID ENTERING	163,250	LB/HR	140,000	LB/HR
VAPOR		LB/HR		LB/HR
LIQUID	163,250	LB/HR		LB/HR
STEAM		LB/HR		LB/HR
NON-CONDENSABLES		LB/HR	140,000	LB/HR
FLUID (VAPORIZED)(CONDENSED)		LB/HR		LB/HR
STEAM CONDENSED		LB/HR		LB/HR
GRAVITY				
VISCOSITY				
MOLECULAR WEIGHT			31.92	
SPECIFIC HEAT		BTU/LB-°F	0.22	BTU/LB-°F
THERMAL CONDUCTIVITY		BTU/HR-FT-°F		BTU/HR-FT-°F
LATENT HEAT		BTU/LB		BTU/LB
TEMPERATURE IN	88	°F	216	°F
TEMPERATURE OUT	108	°F	110	°F
OPERATING PRESSURE, INLET	70	(~~PSIA~~)(PSIG)	119.5	(PSIA)(~~PSIG~~)
NO. PASSES PER SHELL	ONE		2	
VELOCITY		FT/SEC		FT/SEC
PRESSURE DROP - ALLOW. / CALC'D.	10 PSI / 3.5	PSI	10 PSI / 9.0	PSI
FOULING RESISTANCE, MIN.	0.001		0.0005	

HEAT EXCHANGED - BTU/HR. 3,265,000 MTD CORRECTED-°F 44.8

TRANSFER RATE - SERVICE 85.4 CLEAN

CONSTRUCTION OF ONE SHELL

DESIGN PRESSURE	100 PSIG	130	PSIG
TEST PRESSURE	PER CODE PSIG	PER CODE	PSIG
DESIGN TEMPERATURE	168 °F	266	°F

TUBES 304 S.S.(A-249) NO. 256 U O.D. 3/4" BWG 16 (~~MIN~~) LENGTH 8' ST. PITCH 15/16" Δ

SHELL C.S.	I.D.	SHELL COVER C.S.	(INTEG)(~~REMOV~~)
CHANNEL OR BONNET 304 S.S. CLAD		CHANNEL COVER —	
TUBESHEET - STATIONARY 304 S.S. CLAD		TUBESHEET - FLOATING —	
BAFFLES - CROSS C.S.	TYPE SEGM. VERT. CUT	FLOATING HEAD COVER —	
BAFFLES - LONG —	P = 10½"; h/D = 0.15	IMPINGMENT PROTECTION NO (SHELL INLET BEYOND BUNDLE)	

TUBE SUPPORTS C.S.

TUBE TO TUBESHEET JOINT

GASKETS

CONNECTIONS - SHELL SIDE IN 6" OUT 6" RATING 150 # RF

CONNECTIONS - TUBE SIDE IN 12" OUT 12" RATING 150 # RF

CORROSION ALLOWANCE - SHELL SIDE 1/8 IN. TUBE SIDE — IN.

CODE REQUIREMENTS ASME SECT. VIII DIV. 1 & JOB SPEC. 2200-21A1 TEMA CLASS R

REMARKS: (1) NOZZLE & SUPPORT LOCATION TO BE AS NOTED ON F.W. STD. 21B11.1

(2) FOR GENERAL NOTES REFER TO REQ'N. 2200-1200A WHICH IS AN INTEGRAL PART OF THIS REQ'N

FORM NO. 135-128 A

MATERIAL REQUISITION

FOSTER WHEELER ENERGY CORPORATION

110 SOUTH ORANGE AVENUE, LIVINGSTON, N. J.

SHELL & TUBE EXCHANGERS

CONTRACT NO. 15-2231	REQ'N. NO. 2231-1211 H	DATE 9/17/79
CUSTOMERS NAME MLGW/DOE	LOCATION MEMPHIS, TENNESSEE	

SUPERSEDED BY

CHANGE NO.	C-1	C-2	C-3	C-4	C-5	C-6
DATE	9-26-79					

1 SERVICE OF UNIT AIR COMPRESSOR 2ND STAGE INTERCOOLERS ITEM NO. E-3107A

SIZE 57-240 TYPE NEN SPECIAL (HORIZ) (~~VERT~~) CONNECTED IN -

SQ.FT.SURF./UNIT (~~GROSS~~) (EFF) 12,147 SHELLS/UNIT ONE SQ.FT.SURF./SHELL (~~GROSS~~) (EFF) 12,147

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	COOLING WATER		AIR	
TOTAL FLUID ENTERING	617,000	LB/HR	377,547	LB/HR
VAPOR		LB/HR		LB/HR
LIQUID	617,000	LB/HR		LB/HR
STEAM		LB/HR	6,258	LB/HR
NON-CONDENSABLES		LB/HR	371,289	LB/HR
FLUID (VAPORIZED)(CONDENSED)		LB/HR		LB/HR
STEAM CONDENSED		LB/HR	3,167	LB/HR
GRAVITY				
VISCOSITY				
MOLECULAR WEIGHT			IN 28.675 / OUT 28.82	
SPECIFIC HEAT		BTU/LB-°F	0.249	BTU/LB-°F
THERMAL CONDUCTIVITY		BTU/HR-FT-°F		BTU/HR-FT-°F
LATENT HEAT		BTU/LB	1028.4	BTU/LB
TEMPERATURE IN	88	°F	261	°F
TEMPERATURE OUT	118	°F	103	°F
OPERATING PRESSURE, INLET	70	(~~PSIA~~)(PSIG)	80.6	(PSIA)(~~PSIG~~)
NO. PASSES PER SHELL	ONE		ONE	
VELOCITY		FT/SEC	56.4	FT/SEC
PRESSURE DROP - ALLOW. / CALC'D.	10 PSI / 10 PSI		1.9 PSI / 1.9 PSI	
FOULING RESISTANCE, MIN.	0.001		0.002	

HEAT EXCHANGED - BTU/HR. 18,500,000 MTD CORRECTED-°F 40.61

TRANSFER RATE - SERVICE 37.51 CLEAN

CONSTRUCTION OF ONE SHELL

DESIGN PRESSURE	100 PSIG	[illegible]	PSIG
TEST PRESSURE	PER CODE PSIG	PER CODE	PSIG
DESIGN TEMPERATURE	170 °F	311	°F

TUBES C.S. (A-214) NO. 3159 O.D. 0.75" BWG 14 (~~AVG~~) MIN LENGTH 20' PITCH 15/16 Δ

SHELL C.S.	I.D. 57"	SHELL COVER -	(INTEG)(REMOV)
CHANNEL OR BONNET C.S.		CHANNEL COVER -	
TUBESHEET - STATIONARY C.S.		TUBESHEET - FLOATING -	
BAFFLES - CROSS C.S.	TYPE SEGM. VERT. CUT	FLOATING HEAD COVER -	
BAFFLES - LONG -	P=13" ; H/D ≃ 0.2"	IMPINGMENT PROTECTION YES	

TUBE SUPPORTS C.S.

TUBE TO TUBESHEET JOINT

GASKETS

CONNECTIONS - SHELL SIDE IN 8" OUT 8" RATING 150 # R.F.

CONNECTIONS - TUBE SIDE (AXIAL) IN 30" OUT 30" RATING 150 # R.F

CORROSION ALLOWANCE - SHELL SIDE 1/8 IN. TUBE SIDE 1/8 IN.

CODE REQUIREMENTS ASME SECT VIII DIV.1 & JOB SPEC. 2200-21A1 TEMA CLASS R

REMARKS: (1) NOZZLE & SUPPORT LOCATION TO BE AS NOTED ON F.W. STD. 21B11.1

(2) FOR GENERAL NOTES REFER TO REQ'N. 2200-1200 A WHICH IS AN INTEGRAL PART OF THIS REQ'N

(3) ONE ADDITIONAL DUPLICATE ITEM REQUIRED TAG E-3107 B

REQUISITION

FOSTER WHEELER ENERGY CORPORATION

CLIENT Memphis Light, Gas & Water Div	CONTRACT NO. 15-2200	REQUISITION NO.			DATE
SITE Memphis, Tennessee	ITEM NO. C-3101 A/B	2231-1321 A			6-1-79
MATERIAL Air Compressors		C1	11 Oct. 79	C4	
OR		C2		C5	
SERVICE		C3		C6	

I. SCOPE OF SUPPLY

Vendor shall furnish two (2) centrifugal or axial type air compressors, each with driver, lube oil console and accessory equipment in accordance with this requisition and applicable standards and specifications reference below.

Item	Driver Type
C-3101 A	Brushless synchronous motor with speed increasing gear.
C-3101 B	Non-condensing type multi-stage, multi-valve steam turbine.

Vendors scope of supply shall include the following items for each unit:

Compressor with driver (as specified)
Console type lube oil system
Fabricated steel baseplate(s)
Local panel
Instrumentation

Air intercooler(s), moisture separators, interconnecting air piping and anti-surge control systems will be furnished by others.

II. APPLICABLE STANDARDS AND SPECIFICATIONS

2200-32A1	Centrifugal Compressors
2200-38A3	Special Purpose Steam Turbines
2200-38A4	Special Purpose Gears
2200-38A5	Synchronous Motors
2200-38A7	Medium Voltage Induction Motors
2200-39A2	Lube & Seal Oil Systems
2200-1300A	General Notes Requisition

III. DESCRIPTION OF SERVICE

The air compressors and drives will be installed in an air separation plant operating in continuous, un-interrupted service. The equipment will be installed outdoors, unprotected from the weather, on a mezzanine type foundation.

FORM NO. 135-901

CHANGE NO. 1	DATE 11 Oct. 79	REQUISITION NO. 2231-1321 A

IV. ALTERNATE COMPRESSOR DESIGNS

The air compressors may be either integrally geared centrifugal or axial type or a combination axial-centrifugal design as recommended by the vendor for minimum power consumption.

Justification of incremental capital cost shall be evaluated on the basis of the following power costs:

Electric Power	- $.02/KWH
900 PSIG Steam	- $.50/1000 lbs (Includes $3.00/1000 lbs credit for 125 PSIG exhaust steam)
Plant Payout Period	- 20 years at 330 operating days per year

V. VENDOR DATA REQUIREMENTS

A. Model and type of compressor and driver units.

B. Performance data as noted by (*) on page 3.

C. Typical outline dimensions and weights.

D. Price estimate based on shipment in 1981.

Rev. (1) NO CHANGE ON THIS PAGE

FOSTER WHEELER

MATERIAL REQUISITION

CENTRIFUGAL COMPRESSORS

FOR MEMPHIS LIGHT GAS WATER FW REF. 15-2200
SITE MEMPHIS, TENN.
SERVICE AIR COMPRESSOR ITEM NO. C-3101 A/B
MFR.
SIZE AND TYPE NO. REQD. TWO (2)
DRIVER: ☒ MOTOR, ☒ STEAM TURBINE, ☐

REQUISITION NO.	DATE
2231 - [illegible]	[illegible]

SUPERSEDED BY

CHG.	DATE	CHG.	DATE
C1	11 OCT. 79	C4	
C2		C5	
C3		C6	

SPECIFICATIONS: CENTRIFUGAL COMPRESSORS AND ATTENDENT EQUIPMENT COVERED IN THIS REQUISITION SHALL BE FURNISHED IN ACCORDANCE WITH THE FOLLOWING SPECIFICATIONS:

☐ API STD 617, ☐ FW STD. 30A1, ☐ FW STD. 30A2.
☒ SEE PAGE 1
☐

INSTALLATION: UNIT WILL BE INSTALLED IN AN
☒ OUTDOORS-UNPROTECTED LOCATION,
☐ ENCL. BLDG., ☐
AT ☐ GRADE, ☒ MEZZANINE LEVEL.
BAROMETER 14.7 Psia. ALTITUDE 263 FT.
AMB. TEMP. 100 °F MAX., 17 °F MIN.

CONDITIONS OF SERVICE FOR EACH MACHINE (50% CAPACITY EA.)

	RATED	NORMAL		
GAS HANDLED (SEE ANALYSIS BELOW)	AIR	→		
RELATIVE HUMIDITY, %	50	50		
MOLECULAR WEIGHT (WET)	28.59	28.59		
Cp/Cv @ ____ °F	1.4	1.4		
COMPRESSIBILITY FACTOR @ INLET Z1	1.0	1.0		
COMPRESSIBILITY FACTOR @ DISCH Z2	1.0	1.0		
SCFM @ 14.7 Psia & 60 °F : ☒ DRY, ☐ WET.	81,151	68,259		
CFM @ INLET CONDITIONS @ 95 °F INLET	92,452	77,767		
WEIGHT FLOW, Lb/Min. (DRY)	6188	5205		
INLET PRESSURE, Psia	14.2	14.2		
INLET TEMPERATURE, °F	20 TO 95	20 TO 95 (COOL TO 103 °F)		
DISCH. PRESSURE, Psia	105.0	102.0		
* DISCH. TEMPERATURE, °F				
POLYTROPIC HEAD Ft.-Lb/Lb.			* VENDOR TO ADVISE	
* COMPRESSOR BHP				
* COMPRESSOR RPM				
* BHP REQUIRED AT DRIVER SHAFT				
* DRIVER RATED HP				
EST. SURGE CAPACITY @ RATED RPM, ICFM				
DISCH. TEMP. AT SURGE CAPACITY				
PERFORMANCE CURVE NO.				
* INTERSTAGE PRESSURE/TEMP.				

GAS ANALYSIS

COMPOSITION	MOL. WT.	MOL. %	MOL. %	MOL. %	MOL. %
ATMOSPHERIC AIR	28.59	100	(50% REL. HUM.)		

COMMENTS REGARDING GAS HANDLED: SUCTION & DISCHARGE PRESSURES SPECIFIED AT COMPRESSOR FLANGES.

FORM 135-82A REV. [illegible]

FOSTER WHEELER ENERGY CORP.

110 SOUTH ORANGE AVENUE, LIVINGSTON, N.J.

MATERIAL REQUISITION

CENTRIFUGAL COMPRESSORS PAGE 4 OF 13

FOR MLGW FW REF. 15-2200

SITE MEMPHIS, TENN

SERVICE AIR COMPRESSOR ITEM NO. C-3101 A/B

MATERIAL

SIZE AND TYPE NO. REQD. TWO (2)

DRIVER: ☒ MOTOR, ☒ STEAM TURBINE, ☐

GENERAL NOTES REQUISITION IS AN INTEGRAL PART OF THIS REQUISITION.

REQUISITION NO.	DATE
2231-132/A	5-1-79

SUPERSEDED BY

CHG.	DATE	CHG.	DATE
C1	11 OCT. 79	C4	
C2		C5	
C3		C6	

CONSTRUCTION DETAILS

MANUFACTURERS DATA: MODEL _____. CASING SPLIT: ☐ HORIZ., ☐ VERT. NO. STAGES _____.

IMPELLERS: TYPE: ☒ ENCLOSED - BACKWARD LEANING, ☐ _____. DIA. _____ IN.
CONSTRUCTION: ☐ CAST, ☐ RIVETED, ☒ WELDED, ☐ MILLED, ☐ _____. TIP SPEED _____ FPS

SPEED DATA: MAX. CONT. _____ RPM. FIRST CRITICAL _____ RPM. SECOND CRITICAL _____ RPM.

COMPRESSOR ROTATION: VIEWED FROM DRIVER END OF UNIT: ☐ CW, ☐ CCW.

MATERIALS OF CONSTRUCTION:
CASING: ☐ CAST STEEL, ☐ FORGED STEEL, ☒ CAST IRON, ☐ _____.
DIAPHRAMS: CAST IRON. INTERSTAGE LABYRINTHS: ALUMINUM.
IMPELLERS: AISI-4340. SHAFT: AISI-440. SLEEVES: AISI-410.
OTHER: _____.

TEMPERATURE AND PRESSURE LIMITATIONS:

MAX. WORKING TEMP:	SUCTION END _____ °F.	DISCH. END. _____ °F.
MIN. WORKING TEMP:	SUCTION END. _____ °F.	DISCH. END. _____ °F.
MAX. WORKING PRESS:	SUCTION END _____ Psig.	DISCH. END _____ Psig.
HYDRO. TEST PRESS:	SUCTION END _____ Psig.	DISCH. END _____ Psig

FLANGE RATINGS:

CONNECTION	SIZE (IN.)	ASA RATING	FACING	UP	DN	RT	LF	OTHER
MAIN SUCTION				☐	☒	☐	☐	
MAIN DISCHARGE				☐	☒	☐	☐	
				☐	☐	☐	☐	
				☐	☐	☐	☐	
				☐	☐	☐	☐	

ALL FLANGE ORIENTATIONS ARE VIEWED FROM THE DRIVER END OF THE UNIT. ALLOWABLE FLANGE LOADINGS SHALL BE INDICATED ON THE VENDORS CERTIFIED DRAWINGS.

SHAFT SEAL: ☒ LABYRINTH, ☐ RESTRICTIVE RING, ☐ LIQUID FILM, ☐ MECHANICAL (CONTACT).
MFR. SHALL GUARANTEE ZERO OIL LEAKAGE INTO COMPRESSOR CASING

SEALING MEDIUM: ☐ OIL, ☐ AIR, ☐ INERT GAS, ☒ NONE REQUIRED.

BEARINGS: BEARING HOUSING CONSTRUCTION: ☐ INTERNAL, ☒ EXTERNAL.
JOURNAL BEARING TYPE: ☐ BABBITTED SLEEVE, ☒ MFR'S STANDARD.
LUBE: ☒ FORCE FEED, ☐ RING OIL, ☐ _____.
THRUST BEARING TYPE ☐ SINGLE KINGSBURY, ☒ DOUBLE KINGSBURY, ☐ BALL,
☐ ROLLER ☐ _____.
LUBE: ☒ FORCE FEED ☐ RING OIL, ☐ _____.

CASING DRAINS: QUANTITY EACH STG. SIZE 3/4" MIN. VENDOR SHALL FURNISH
☐ VALVED, ☒ PLUGGED, ☐ BLIND FLANGE, ☐ _____ CONNECTIONS.

BASEPLATE: SUPPLIED BY ☒ COMPRESSOR VENDOR, ☐ _____.
TYPE: ☒ CONTINUOUS STRUCTURAL STEEL COMMON TO COMPRESSOR AND DRIVE UNIT.
☐ _____.
PROVIDED WITH DRIP PAN ☐ YES, ☒ NO.

COUPLINGS: SUPPLIED BY ☒ COMPRESSOR VENDOR, ☐ _____.

LOCATION:	HIGH SPEED			LOW SPEED	
MFG:	BENDIX OR EQUAL			KOPPERS	
TYPE:	FLEXIBLE	DIAPHRAM		HOLSET	
LUBE:	NONE			NONE	

COUPLING GUARDS: SUPPLIED BY ☒ COMPRESSOR VENDOR, ☐ _____.
TYPE: ☐ SHEET METAL, ☒ NON-SPARKING. CONSTANT SPEED AXIAL COMPRESSOR, IF USED, SHALL BE FURNISHED WITH 50% ADJUSTABLE STATOR VANES.

COMMENTS REGARDING CONSTRUCTION DETAILS:
REV. (1) NO CHANGE ON THIS PAGE

FOSTER WHEELER ENERGY CORP.
110 SOUTH ORANGE AVENUE, LIVINGSTON, N.J.

MATERIAL REQUISITION

CENTRIFUGAL COMPRESSORS PAGE 5 OF 12

FOR MLGW FW REF. 15-2200 REQUISITION NO. 2231-1321A DATE 6-1-79
SITE MEMPHIS, TENN
SERVICE AIR COMPRESSORS ITEM NO. C-3101 A/B
MATERIAL
SIZE AND TYPE NO. REQD. TWO (2)
DRIVER: [X] MOTOR, [X] STEAM TURBINE, [ ]
GENERAL NOTES REQUISITION IS AN INTEGRAL PART OF THIS REQUISITION.

SUPERSEDED BY

CHG.	DATE	CHG.	DATE
C1	11 Oct, 79	C4	
C2		C5	
C3		C6	

LUBE AND SEAL OIL SYSTEMS: A FORCE FEED LUBE OIL SYSTEM COMMON TO THE [X] COMPRESSOR, [X] GEAR, [X] DRIVER, WITH [ ] A COMBINED, [ ] A SEPARATE, [X] NO SEAL OIL SYSTEM, SHALL BE FURNISHED BY THE COMP. MFR. IN ACCORDANCE WITH 2200-39A2.

LUBE OIL SYSTEM

SYSTEM OPERATING PRESS. _____ Psig.
SYSTEM MAX. ALLOW OPER. PRESS. _____ Psig.
RESERVOIR: LOCATED [ ] IN BASE, [X] ON CONSOLE.
CAPACITY _____ GAL. RET. TIME _____ MIN.
TO BE FURNISHED WITH [X] ELECTRIC, [ ] STEAM HEATER, [ ] INSULATION SUPPORTS AND

MAIN LUBE OIL PUMP: LOCATED ON [ ] BASE, [X] CONSOLE AND DRIVEN BY [ ] _____ SHAFT, [X] INDUCTION MOTOR, [ ] STEAM TURBINE.
MFR. IMO . MODEL _____ .
TYPE SCREW . CASE MATL. C.S. .
GPM _____ . RPM _____ . BHP _____ .

AUX. LUBE OIL PUMP: LOCATED ON [ ] BASE, [X] CONSOLE AND DRIVEN BY [ ] _____ SHAFT, [X] INDUCTION MOTOR, [ ] STEAM TURBINE.
MFR. IMO . MODEL _____ .
TYPE SCREW . CASE MATL. C.S. .
GPM _____ . RPM _____ . BHP _____ .

RELIEF VALVES: [ ] INTEGRAL, [X] SEPARATE.

COOLERS: [X] TWIN, [ ] SINGLE, LOCATED ON [ ] BASE, [X] CONSOLE, _____ .
MFR. _____ . TYPE SHELL & TUBE .
CODE: [X] TEMA C, [ ] _____ .
SHELL: OD _____ IN. DES. PRESS. _____ Psig.
TUBES: OD _____ IN. BWG _____ .
MATL: SHELL C.S. . TUBES ADMIRALTY.

FILTERS: [X] TWIN, [ ] SINGLE. LOCATED ON [ ] BASE, [X] CONSOLE, [ ] _____ .
MFR. _____ . MODEL _____ .
CASE MATL. C.S . MICRON 25 (MAX) .
ELEMENT: [ ] CLEANABLE, [X] REPLACEABLE.

TRANSFER VALVES: MFR. KRAISSEL .
QUAN. ONE . TYPE _____ . MATL. C.S. .

SEAL OIL SYSTEM

SYSTEM OPERATING PRESS. _____ Psig.
SYSTEM MAX. ALLOW OPER. PRESS. _____ Psig.
RESERVOIR: LOCATED [ ] IN BASE, [ ] ON CONSOLE.
CAPACITY _____ GAL. RET. TIME _____ MIN.
TO BE FURNISHED WITH [ ] ELECTRIC, [ ] STEAM HEATER, [ ] INSULATION SUPPORTS AND

MAIN SEAL OIL PUMP: LOCATED ON [ ] BASE, [ ] CONSOLE AND DRIVEN BY [ ] _____ SHAFT, [ ] INDUCTION MOTOR, [ ] STEAM TURBINE.
MFR. _____ . MODEL _____ .
TYPE _____ . CASE MATL. _____ .
GPM _____ . RPM _____ . BHP _____ .

AUX. SEAL OIL PUMP: LOCATED ON [ ] BASE, [ ] CONSOLE AND DRIVEN BY [ ] _____ SHAFT, [ ] INDUCTION MOTOR, [ ] STEAM TURBINE.
MFR. _____ . MODEL _____ .
TYPE _____ . CASE MATL. _____ .
GPM _____ . RPM _____ . BHP _____ .

RELIEF VALVES: [ ] INTEGRAL, [ ] SEPARATE.

COOLERS: [ ] TWIN, [ ] SINGLE. LOCATED ON [ ] BASE, [ ] CONSOLE, _____ .
MFR. _____ . TYPE _____ .
CODE: [ ] TEMA C, _____ .
SHELL: OD _____ IN. DES. PRESS. _____ Psig.
TUBES: OD _____ IN. BWG. _____ .
MATL: SHELL _____ . TUBES _____ .

FILTERS: [ ] TWIN, [ ] SINGLE. LOCATED ON [ ] TWIN, [ ] CONSOLE, [ ] _____ .
MFR. _____ . MODEL _____ .
CASE MATL. _____ . MICRON _____ .
ELEMENT: [ ] CLEANABLE, [ ] REPLACEABLE.

TRANSFER VALVES: MFR. _____ .
QUAN. . TYPE _____ . MATL. _____ .

~~SOUR OIL TRAPS: REQD. [ ] YES, [ ] NO. LOCATED ON [ ] BASE, [ ] CONSOLE, [ ] BY PURCHASER. PIPING BY [ ] COMP. VENDOR, [ ] PURCHASER. SEAL OIL LOSS _____ GAL./DAY/SEAL MAX.~~
~~OVHD. SEAL OIL TANK: REQD. [ ] YES, [ ] NO. LOCATED _____ FT. ABOVE COMP. CENTER LINE. MTD. BY [ ] COMP. VENDOR, [ ] PURCHASER~~
CLARIFIER: REQD. [ ] YES, [X] NO. LOCATED ON [ ] BASE, [ ] CONSOLE, [ ] BY PURCHASER.
PIPING BY [ ] COMP. VENDOR, [ ] PURCHASER. BYPASS _____ GPM. MFR. _____ .
PIPING: [X] CARBON STEEL PICKLED AND CLEANED, [X] STAINLESS STEEL, DOWNSTREAM OF FILTERS .
[ ] STAINLESS STEEL DRAIN LINES, [ ] _____ .
OTHER:

Rev. 01 NO CHANGES ON THIS PAGE

FOSTER WHEELER CORPORATION

110 SOUTH ORANGE AVENUE, LIVINGSTON, N.J.

MATERIAL REQUISITION

CENTRIFUGAL COMPRESSORS PAGE 6 OF 12

FOR MLGW FW REF. 15-2200
SITE MEMPHIS, TENN.
SERVICE AIR COMPRESSORS ITEM NO. C-3101 A/B
MATERIAL
SIZE AND TYPE NO. REQD.
DRIVER: ☒ MOTOR, ☒ STEAM TURBINE, ☐
GENERAL NOTES REQUISITION IS AN INTEGRAL PART OF THIS REQUISITION.

REQUISITION NO.	DATE
2231-1321A	6-1-79

SUPERSEDED BY

CHG.	DATE	CHG.	DATE
C1	11 OCT. '79	C4	
C2		C5	
C3		C6	

INSTRUMENTATION

LOCAL COMPRESSOR PANEL: FURNISHED BY ☒ COMP. VENDOR, ☐ PURCHASER, ☐ NOT REQD.
PURCHASERS ELECTRICAL AND INSTRUMENT CONNECTIONS SHALL BE ☒ BROUGHT OUT TO TERMINAL BOXES BY THE COMP. VENDOR, ☐ MADE BY THE PURCHASER.

GAGES AND INDICATORS:

PRESSURE GAGES:	MFR.	MFR'S STD	SIZE AND TYPE	
TEMPERATURE GAGES:	MFR.		SIZE AND TYPE	
LEVEL INDICATORS:	MFR.		SIZE AND TYPE	
SIGHT FLOW INDICATORS:	MFR.		SIZE AND TYPE	
TACHOMETER:	MFR.		SIZE AND TYPE	
	MFR.		SIZE AND TYPE	

INSTRUMENTATION: COMPRESSOR VENDOR SHALL FURNISH THE FOLLOWING:

PRESSURE GAGES:	LOCAL	LOCAL PANEL
☒ OIL PUMP DISCHARGE	☒	☐
☒ LUBE OIL EACH LEVEL	☐	☒
☐ SEAL OIL EACH LEVEL	☐	☐
☐ SEAL OIL DIFF.	☐	☐
☒ BEFORE/AFTER FILTERS	☒	☐
☒ CONTROL OIL	☐	☒

	LOCAL	LOCAL PANEL
☒ MAIN STEAM INLET	☐	☒
☒ FIRST STAGE STEAM	☐	☒
☒ STEAM EXHAUST	☐	☒
☐	☐	☐
☐	☐	☐
☐	☐	☐

TEMPERATURE GAGES:		
☐ OIL OUTLET EACH BRG.	☒	☐
☐ OIL OUTLET EACH SEAL	☐	☐
☐ BEFORE/AFTER COOLERS	☒	☐

☐	☐	☐
☐	☐	☐
☐	☐	☐

SWITCHES: (SPDT)	ALARM	TRIP
☒ LOW LUBE OIL PRESS.	☒	☒
☐ LOW SEAL OIL PRESS.	☐	☐
☒ LOW OIL RES. LEVEL	☒	☐
☒ LOW CONTROL OIL PRESS.	☒	☐
☒ AUX. PUMP START	☒	☐

	ALARM	TRIP
☒ COMP. HIGH DISCH. TEMP.	☒	☐
☒ LUBE OIL SUPPLY TEMP.	☒	☐
☒ OIL FILTER HIGH ΔP	☒	☐
☒ RADIAL VIBRATION	☒	☐
☒ AXIAL ROTOR DISPL. (B-N SERIES 7200 MONITORS)	☒	☒

OTHER:

☐ REMOTE SHUTDOWN: ☒ ELECTRICAL, ☐ HYDRAULIC, ☐ PNEUMATIC.
☒ SIGHT FLOW EACH BEARING AND SEAL OIL RETURN LINE.
☐ OIL RESERVOIR LEVEL.
☒ RADIAL & THRUST BRG. TEMP. RTD'S.
☒ ANNUNCIATOR W/1ST OUT SEQUENCE INDICATION.
☒ BEARING TEMP. INDICATOR WITH ALARM AND TRIP SWITCHES.

ALARM CONTACTS SHALL ☐ OPEN, ☐ CLOSE TO SOUND ALARM. SHUTDOWN CONTACTS SHALL ☐ OPEN, ☐ CLOSE TO SHUTDOWN.

~~WHERE INDICATED BY (*),~~ ALARM LIGHTS SHALL BE FURNISHED BY THE COMPRESSOR VENDOR AND MOUNTED ON THE LOCAL PANEL WITH ALL NECESSARY RELAY DEVICES.

PURCHASERS ELECTRICAL AND INSTRUMENT CONNECTIONS WITHIN THE CONFINES OF THE BASEPLATE AND CONSOLE SHALL BE ☒ BROUGHT OUT TO TERMINAL BOXES, ☐ MADE DIRECTLY BY THE PURCHASER.

COMMENTS REGARDING INSTRUMENTATION: VENDOR SHALL FURNISH FOLLOWING ADDITIONAL INSTRUMENTATION:

1. BENTLEY-NEVADA X-Y PROXIMITY TYPE VIBRATION PROBES AT EACH RADIAL BEARING WIRED TO PROXIMATORS MOUNTED IN NEMA 4 ENCLOSURE.
2. TWO (2) B-N AXIAL ROTOR DISPLACEMENT PROBES WITH PROXIMATORS.

FOSTER WHEELER ENERGY CORPORATION

MATERIAL REQUISITION

110 SOUTH ORANGE AVENUE, LIVINGSTON, N.J. — CENTRIFUGAL COMPRESSORS — PAGE 7 OF 12

FOR MLGW — FW REF. 15-2200
SITE MEMPHIS, TENN
SERVICE AIR COMPRESSORS — ITEM NO. C-3101 A/B
MATERIAL
SIZE AND TYPE — NO. REQD. TWO (2)
DRIVER: ☒ MOTOR, ☒ STEAM TURBINE, ☐
GENERAL NOTES REQUISITION IS AN INTEGRAL PART OF THIS REQUISITION.

REQUISITION NO.	DATE
2231-132 A	5-1-79

SUPERSEDED BY

CHG.	DATE	CHG.	DATE
C1	11 OCT. 79	C4	
C2		C5	
C3		C6	

CONTROL

NORMAL OPERATING: C-3101A (MOTOR DRIVEN) CONSTANT SPEED CAPACITY CONTROL SYSTEM USING SUCTION THROTTLE VALVE IF CENTRIFUGAL TYPE OR BY VARIABLE STATOR VANES IF AXIAL TYPE.

C-3101 B (TURBINE DRIVEN) VARIABLE SPEED CAPACITY CONTROL.

SURGE CONTROL: BLOW-OFF TO ATMOSPHERE, ANTI-SURGE SYSTEM TO BE FURNISHED BY OTHERS.

INSPECTION AND TESTING

		WITNESSED:	
COMPRESSOR: ☒	SHOP INSPECTION.	☒ YES	☐ NO
☒	HYDROSTATIC TEST.	☐ YES	☒ NO
☒	IMPELLER OVERSPEED ____ % OF ____ RPM.	☐ YES	☒ NO
☒	DYNAMIC BALANCE OF ROTOR	☐ YES	☒ NO
☒	MECHANICAL RUN.	☒ YES	☐ NO
☒	PERFORMANCE TEST PTC-10	☒ YES	☐ NO
☐		☐ YES	☐ NO
☐		☐ YES	☐ NO
DRIVER: ☒	TURBINE - MECH RUNNING TEST	☒ YES	☐ NO
☒	MOTOR - NEMA COMMERCIAL TESTS	☒ YES	☐ NO
☐	VIBRATION TESTS	☒ YES	☐ NO
☐		☐ YES	☐ NO
CONSOLE: ☒	SHOP INSPECTION.	☒ YES	☐ NO
☒	RUNNING TEST	☒ YES	☐ NO
☐		☐ YES	☐ NO
OIL COOLERS: ☒	HYDROSTATIC TEST ____ Psig OIL SIDE. ____ Psig WATER SIDE.	☐ YES	☒ NO
INTERCOOLERS: ☐	HYDROSTATIC TEST ____ Psig AIR SIDE. ____ Psig WATER SIDE.	☐ YES	☐ NO

COMMENTS REGARDING TESTING:

REV. (1): NO CHANGE ON THIS PAGE

ORM 135-50

FOSTER WHEELER CORPORATION — SPECIAL ELECTRICAL MOTORS — PAGE 8 OF 12

F.W.C. CONTRACT 15-2200 | REQUISITION NUMBER 2231 - 132 A | DATE

FOR: MLGW

SITE: MEMPHIS, TENN.

MANUFACTURER:

SUPERSEDED BY CHANGE NO: C1 11 Oct. 79 | C2 | C3 | C4 | C5 | C6

APPLICABLE DOCUMENTS:

MOTOR SPECIFICATION (SEE PAGE 1)

PREP. FOR SHIPMENT

GENERAL NOTES

SITE DATA:

ALTITUDE 263 FT. BAROMETER 14.7

AMBIENT 100 °F. MAX. TO 17 °F. MIN.

ATMOSPHERE

INSTALLED ☐ INDOOR ☒ OUTDOOR ☐

AREA ☐ CL. __-GR. __-DIV. __. ☒ NON-HAZARDOUS.

ITEM NUMBERS	C-3101A	ITEM NUMBERS ACCESSORIES:	
TOTAL QUANTITY	ONE (1)		
DRIVEN EQUIPMENT	TURBO-COMPRESSOR	BASE	BY COMPR. VENDOR
TYPE (IND., SYNCH., ETC.)	SYNCHRONOUS	STATOR SHIFT	NO
HP NAMEPLATE RATING		SPACE HEATERS: WATTS	
SERVICE FACTOR		V. PH. HZ	/ / / /
RPM AT FULL LOAD/NO. POLES	/ /	TEMP. DETECT.: NUMBER	
VOLTS/PHASES/HERTZ	13800/3/60 / /	TYPE	RTD
ENCLOSURE	NEMA WP-II	AIR FILTERS: TYPE	
°C. RISE AT FULL S.F. LOAD		ARRANGE FOR FUTURE FILTERS	
TEMP. MEASUREMENT METHOD		MOUNT COUPLING HALF	YES
INSULATION CLASS	B	EXTENDED LEADS, INCHES	
INSUL. SPECIAL TREATMENT		ENCLOSED COLLECTOR RINGS	
SPECIAL HARDWARE		REQ'D. PURGE CFM	
		C.T. FOR AMMETER BY	VENDOR
FRAME NUMBER		MOUNTED BY	VENDOR
MOUNTING ASSEMBLY NUMBER			
ROTATE FROM END OPP. CPLG.		C.T. FOR DIFF. PROTECT. BY	VENDOR
BEARINGS TYPE	SLEEVE	MOUNTED BY	VENDOR
LUBRICATION	FORCE FEED	NUMBER REQ'D.	
END FLOAT (IF APPL.) INS.		TYPE	
N.E.M.A. DESIGN LETTER			
AMPS.: F.L./LOCKED ROTOR	/ /	SURGE PROTECTION BY	VENDOR
LOCKED ROTOR LIMIT, SECS.		MOUNTED BY	VENDOR
LB-FT^2 LOAD AT MOTOR SHAFT			
SECONDS TO ACCEL. ON __ %V.		LIGHTNING ARRESTORS BY	VENDOR
NO. ALLOW. STARTS COLD/HOT	/ /	MOUNTED BY	VENDOR
% EFFIC. 100%/75%/50% LOAD	/ / /	AMMETER FURNISHED BY	PURCHASER
% P.F. 100%/75%/50% LOAD	/ / /	MOUNTED BY	
%T. @ F.V. ST/MIN/BREAKON	/ / /	LOCATION	
		TYPE	
EXCITATION: TYPE	BRUSHLESS		
FURNISHED BY	MTR VENDOR		
ELECT. SUPPLY, REQ'D.			

TESTS: (W = WITNESSED)	
N.E.M.A. STD. COMMERCIAL	(W)
FULL PERFORMANCE	
SHAFT VIBRATION	(W)
TEST CERTIFICATES REQ'D.	YES

WEIGHTS: (LBS)	/
NET/GROSS	
MAX. ERECTION	
MAX. NORMAL MAINTENANCE	

REV. (1) NO CHANGE IN THIS PAGE

REQUISITION

FOSTER WHEELER ENERGY CORPORATION

CLIENT MLGW	CONTRACT NO. 15-2200	REQUISITION NO.			DATE
SITE MEMPHIS, TENN.	ITEM NO. C-3101A	2231-132 1A			6-1-79
MATERIAL SPECIAL PURPOSE GEARS		C1	11 Oct. '79	C4	
SERVICE AIR COMPRESSOR	NO. REQ'D. ONE (1)	C2		C5	
MFGR.	MODEL	C3		C6	

OPERATING CONDITIONS:

BRIVEN UNIT RATING _____ BHP AT _____ RPM
DRIVER CONTINUOUS RATING _____ BHP AT _____ RPM
CONTINUOUS SPEEDS: _____ MAX. & _____ MIN. RPM
MAX. LOAD TORQUE: _____ LB-FT AT _____ RPM
SPECIFIED SPEED IS FOR ☐ DRIVER ☐ DRIVEN UNIT
START: ☐ LOADED ☒ UNLOADED
WR^2 OF LOAD: _____ $LB\text{-}FT^2$ REFERRED TO DRIVER SHAFT
LOAD CHARACTER: ☒ SMOOTH ☐ MODERATE SHOCK
☒ PULSATING TORQUE AT STARTUP
DUTY: ☒ CONTINUOUS ☐ _____
MIN. SERVICE FACTOR 1.5 BASED ON MOTOR RATING
ASSEMBLY POSITION (PER API FIG. A-1): _____
ROTATION, VIEWED FROM THE DRIVER:
INPUT SHAFT ☐ CW ☐ CCW
OUTPUT SHAFT ☐ CW ☐ CCW
LOCATION: ☐ INDOOR ☒ OUTDOOR ☐ ROOF
WINTERIZATION: ☒ YES ☐ NO ,

SITE DATA:

AMBIENT TEMPERATURE: 100 °F MAX. TO 17 °F MIN.
UNUSUAL CONDITIONS: _____
AREA: ☐ CL. ___ -GR. ___ -DIV. ___ . ☒ NON-HAZARDOUS.
COOLING WATER: TYPE COOLING TOWER
INLET 88 °F, 75 PSIG. OUT 118 °F MAX. & 60 PSIG.

APPLICABLE DOCUMENTS:

(SEE PAGE 1)

SHOP TESTS:

	REQUIRED	WITNESSED
MECH'L RUN AT PART LOAD	X	X
FULL TORQUE		
SPARE GEAR TRAIN: _____		
SOUND LEVEL		
DISMANTLE-INSPECT-REASS'Y.		
CERTIFIED COPIES ALL TESTS	X	

COUPLINGS:

	HIGH SPEED	LOW SPEED
MANUFACTURER	RENDIX OR EQ.	KOPPERS
TYPE	FLEX. DIAPHR.	HOLSET OR EQ.
LUBRICATION	NONE	NONE
FURNISHED BY	COMPRESSOR	VENDOR
MOUNTED BY		
GUARD		

PERFORMANCE:

OUTPUT RATING: _____ HP MECHANICAL _____ HP THERMAL
ACTUAL SERVICE FACTOR _____ BASED ON _____
OVER-ALL RATIO: _____ TO 1.
HP LOSS: _____ AT RATED LOAD. _____ AT NO LOAD.
BREAKAWAY TORQUE: _____ LB-FT
MAX. HEAT REJECTION OF LUBE OIL _____ BTU/HR.
MAX. LUBE VISCOSITY PERMITTED FOR START _____ SSU
SOUND LEVEL:

CONSTRUCTION DETAILS:

NO. OF SPEED CHANGES: ☐ SINGLE ☐ DOUBLE ☐ _____
TYPE: ☐ HERRINGBONE ☐ DOUBLE HELICAL
☐ EPICYCLIC ☐ SINGLE HELICAL
TOOTH FORM: ☐ INVOLUTE ☐ _____

DETAILS:	PINION	INTERMED.	L.S. GEAR
PITCH DIAMETER			
FACE WIDTH			
ACTIVE WIDTH			
RMS FINISH			
HARDNESS			
FT/MIN. AT PITCH			
LB/INCH OF FACE			
FIRST CRITICAL RPM.			
BEARING TYPE			
BEARING SPLIT			
THRUST LOCATION (S)			
THRUST TYPE			

HUNTING TEETH: ☐ YES ☐ NO
OUTPUT SHAFT EXTENSION: ☐ CYLINDRICAL ☒ TAPERED
INPUT SHAFT EXTENSION: ☐ CYLINDRICAL ☐ TAPERED
LUBE SYSTEM: ☐ BY GEAR MFR. PER PAGE NO. _____
☐ BY OTHERS: GEAR USES ____ GPM AT ____ PSIG

WR^2 OF SET: _____ $LB\text{-}FT^2$ REFERRED TO DRIVER SHAFT.

MATERIALS:

CASING: _____

	PINION	INTERMEDIATE	LOW SPEED
GEAR RIM			
CENTER & HUB			
SHAFT			
BEARINGS			

MISCELLANEOUS:

☐ SUPPLY SPARE SET GEARING.
LBS. NET: GEAR _____. BASE _____. AUX. _____.
LBS. MAX. MAINTENANCE _____, FOR _____
BASE PLATE BY _____. GEAR MOUNTED BY _____

BY	P.O. NO.	SUPPLIER

REV. (1): No change this page.

FORM NO. 135-334

,URM 135-46

FOSTER WHEELER ENERGY CORPORATION

SPECIAL-PURPOSE STEAM TURBINES

FOR *MLGW* F.W. CONTRACT *15-2200*	REQUISITION NUMBER *2631-1321 A*		DATE
SITE *MEMPHIS, TENN*	SUPERSEDED BY CHANGE NO.		
ITEM NO. *C-3101 B* SERVICE *AIR COMPRESSOR*	C1 *11 OCT. 79*	C4	
DRIVEN EQUIP. *TURBO-COMPRESSOR*	C2	C5	
MFR. MODEL NO. REQ'D *(1)*	C3	C6	

OPERATING CONDITIONS

	BHP	RPM
RATED	*110%*	*105%*
NORMAL	*COMPR.*	*RATED POINT*

MAX. CONTINUOUS SPEED: *105%* RPM

TRIP SPEED: ______ RPM

CRITICAL SPEED: ______ RPM FIRST. ______ RPM SECOND

(1)

STEAM:	MAXIMUM	NORMAL	MINIMUM	*MECH. DESIGN*
THROTTLE PSIG		*890*		*1000*
THROTTLE °F.		*840*		*850*
EXHAUST, *PSIG*		*130*		

OTHER DATA:

STEAM RATES, BASIS OUTPUT SHAFT OF ☒ TURBINE ☐ GEAR

(* = GUAR. POINT)

OUTPUT	STEAM	LBS/BHP-HR
RATED	NORMAL	
RATED	WORST	
NORMAL	NORMAL	

PERFORMANCE CURVE NO.

MAXIMUM POSSIBLE STEAM FLOWS: LBS/HR

AT THROTTLE (WITH MAX. INLET PRESS.)

TO EXHAUST (EXT. & INDUCT. TURB. ONLY)

FROM EXTRACT. (WITH MAX. THROTTLE PRESS.)

ROTATION (VIEWED FROM H.P. INLET END): ☐ CW ☐ CCW

THRUST FROM DRIVEN EQUIP.: ☐ NORMAL ☐

DUTY: ☒ CONTINUOUS ☐

START-UP ☒ MANUAL ☐ EMERGENCY AUTOMATIC

LOCATION: ☐ INDOOR ☐ OUTDOOR ☐ SEMI-ENCL. BLDG.

☐ AT GRADE ☒ ON MEZZANINE

AREA: ☐ CL. __ -GR. __ -DIV. __ ☒ NON-HAZARDOUS

AMBIENT: *100* °F. MAX. TO *17* °F. MIN.

263 FT. ALTITUDE *14.7* BAROMETER

PROTECTION: ☐ WINTERIZED ☐ TROPICALIZED ☐ STANDARD

GEARS: BY ______ SEE ______ FOR DATA

EVALUATION: FOR PERIOD OF ______ HOURS

H.P. STEAM AT $ ______ /M LBS.

COOL-OFF TIME:

1 APPLICABLE DOCUMENTS: *(SEE PAGE 1)*

2 SPECIAL-PURPOSE TURBINES

3 GEN'L.-PURP. TURBS. (FOR AUX. SVC.)

4 INDUCTION MOTORS

5 OIL SYSTEMS

6 GEARS

7 GENERAL NOTES REQUISITION

11 CONSTRUCTION FEATURES:

12 TYPE: ☐ VERT. SHAFT ☒ HORIZ. SHAFT. ______ STAGES.

13 CASING SPLIT: ☒ AXIAL ☐ RADIAL

14 CASING MOUNT: ☐ FOOT ☒ CENTERLINE

15 FLOW TYPE: FIRST STAGE =

16 OTHER STAGES =

18 ROTOR: ☐ BUILT-UP ☒ SOLID

19 SPEED GOVERNOR: NEMA CLASS *D*. MFR. = *WOODWARD*

20 TYPE = *PGPL W/OVERSPEED TRIP TEST DEVICE*

21 OTHER GOV.: FOR ______ MFR. =

22 TYPE =

23 SPEED CHANGER: ☐ MANUAL ☐ AUTOMATIC

24 RANGE FROM *80* % TO *105* % OF RATED RPM.

25 ACTUATION SIGNAL = *PNEUMATIC*

26 NO. AUTO. VALVES: ______ MAIN INLET, LIFTED BY

27 , LIFTED BY

29 HAND NOZZLE VALVES:

30 TRIP VALVE: ☐ TRIP ONLY ☒ TRIP & THROTTLE

31 REMOTE TRIP REQ'D ACTUATED BY

33 BEARINGS:	THRUST	RADIAL
34 TYPE	*KBT*	*MFR. STD.*
35 MANUFACTURER		
36 CALC. LOAD. LBS.		
37 CAPACITY, LBS.		
38 LUBE METHOD		
39 COOLING JACKETS		

41 SHAFT SEALS, INTERSTAGE: ☒ LABYRINTH ☐

42 SHAFT SEALS, OUTER: ☒ LABYRINTH ☐

44 DESIGN MAX: H.P. INLET ______ PSIG & ______ °F.

45 H.P. CASING ______ PSIG & ______ °F.

46 I.P. CASING ______ PSIG

47 L.P. CASING ______ PSIG

48 COOL. JKTS. ______ PSIG

50 MAX. ALLOWABLE SPEED ______ RPM

51 MAX. ALLOWABLE TRIP SPEED ______ RPM

52 POTENTIAL MAX. POWER @ RATED RPM ______ BHP

FOSTER WHEELER ENERGY CORPORATION — SPECIAL-PURPOSE STEAM TURBINES — PAGE 11 OF 12

REQUISITION NUMBER	DATE
2231-132-2	6-1-79

FOR MLGW — F.W. CONTRACT/S-33,000
SITE MEMPHIS TENN.
ITEM NO. C-3101 B

SUPERSEDED BY CHANGE NO.

C1 (1 Oct. 79)	C3	C5	
C2	C4	C6	

ACCESSORIES:

- ☒ SEE PAGE ___ FOR SP. CHANGER, TRIP VALVE, REMOTE TRIP
- ☒ TRIP VALVE LIMIT SWITCHES: VALVE ☐ OPEN ☒ SHUT.
- ☐ TRIP VALVE DEVICE FOR TESTING WHILE OPERATING
- ☐ GOV. VALVE POSITION INDICATOR: ___
- ☐ INSULATION: MAT'L. = (BY PURCHASER)
- ☐ JACKET: MAT'L = ___
- ☐ EXHAUST SENTINEL VALVE, ___ PSIG SET
- ☐ EXHAUST FULL FLOW PSV, ___ PSIG SET
- ☐ EXTRACT FULL FLOW PSV, ___ PSIG SET
- ☐ NON-RETURN VALVE ☐ EXTRACTION ☐ EXHAUST
  AUX. FORCE CLOSING BY ___
- ☐ TACHOMETER TYPE: AIRPAX TACHTROL
  INDICATOR, NO. & TYPE TWO (2) REQUIRED (ONE (1) NEMA 4 LOCAL - ONE (1) REMOTE)
- ☒ SHAFT TURNING GEAR: (IF REQUIRED)
- ☒ STEAM STRAINER: ☐ SEPARATE ☐ IN T-T VALVE
- ☐ LOCAL PANEL: MOUNTED ON ☐ TURB. ☐ TURB. BASE ☐ SEPARATE FREESTANDING. (BY PURCHASER)
- ☒ BASE: (☒ BY DRIVEN EQUIP. MFR.)
  ☐ SOLEPLATES. ☐ FABR. STEEL, ☐ WITH DECK
- ☐ GOV. LIMIT DEVICE FOR ☐ LOAD ☐ EXTRACT. FLOW ☐ INITIAL STEAM PRESSURE
- ☐ HIGH EXHAUST TEMP. SWITCH ☐ ALARM ☐ TRIP
- ☐ HIGH EXHAUST TEMP. WATER INJECTION SYSTEM COMPLETE
- ☐ VACUUM BREAKER
- ☐ WATER WASH ORIFICE MIXER
- ☐ SPACE HEATERS FOR INSUL. & JACKET
- ☒ SHAFT SEAL SYSTEM: ☐ MANUAL ☒ AUTO. CONTROL
  VACUUM DEVICE ☒ STM. EJECT. ☐ WATER EDUCTOR ☐ FAN ☐ LIQUID RING COMPRESSOR
  CONDENSER ☐ DIRECT CONTACT ☒ SHELL & TUBE
  SURF ___ SQ. FT., ☒ TEMA-C ☐ TEMA-R,
  WITH ___ SHELL, ___ WATER BOXES
  & ___ TUBES ___ BWG X ___ O.D. X ___ L

UTILITIES REQ'D.: ___ GPM WATER
___ LBS/HR ___ PSIG STEAM
___ KW OF ___ V- ___ PH- ___ HZ

- ☒ VIBRATION DETECT. EQUIP.: B-N X-Y PROBES WITH PROXIMATORS AT EACH RADIAL BRG.
- ☒ AXIAL POSITION EQUIP.: TWO PROBES WITH PROXIMATORS

OIL SYSTEM:

TURBINE MFR'S. OIL REQUIREMENTS:	GPM	PSIG.
LUBRICATION		
CONTROL, STEADY STATE		
CONTROL, TRANSIENT		

VISCOSITY: ___ SSU @ 100°F & ___ SSU @ 210°F
___ SSU MAX. ALLOWABLE FOR START-UP.

MAX. ALLOWABLE FILTRATION: MICRONS
LUBRICATING OIL ___
CONTROL OIL (NOT OVER 25) ___

TURBINE MFR. TO SUPPLY SYSTEM COMPONENTS AS FOLLOWS:
- ☐ NONE (ALL COMPONENTS BY OTHERS)
- ☒ AS AGREED WITH MFR. OF DRIVEN EQUIPMENT
- ☐ TOTAL SYSTEM PER PAGE ___
- ☐ AT TURB. ☐ & GEAR ONLY (SINGLE IN/OUT CONNECTS). ☐ WITH ☐ WITHOUT LOCAL INSTRUMENTS
- ☐ PARTIAL SYSTEM PER PAGE ___

PIPING MATERIALS AT TURBINE (& GEAR):
L.O. PRESSURE LINES STAINLESS STEEL
CONTROL PRESS LINES " "
DRAIN LINES CARBON STEEL (PICKLED)

COUPLINGS:

FURNISHED BY	TURB.- COMPR. VENDOR	
MANUFACTURER		
MODEL NO.		
TYPE		
LUBE METHOD		
BORE TYPE, DRIVING HALF		
BORE TYPE, DRIVEN HALF		
MOUNT DRIVING HALF		
MOUNT DRIVEN HALF		

TYPE OF GUARD ___

OTHER REQUIREMENTS:

- ☒ TORSIONAL CRITICAL SPEED ANALYSIS BY COMPR. VENDOR
- ☒ LATERAL CRITICAL SPEED ANALYSIS BY " "
- ☒ SUPPLY ABOVE CALCULATIONS TO " "
- ☒ SUPPLY CAMPBELL DIAGRAMS TO PURCHASER
- ☒ REVIEW & COMMENT ON PURCHASER'S PIPING DRAWINGS
- ☒ REVIEW & COMMENT ON PURCHASER'S FOUND DRAWINGS
- ☐ ___
- ☐ SUPPLY SPARE ROTOR ASSEMBLY
- ☐ ___

Rev. 1 NO CHANGES ON THIS PAGE

FOSTER WHEELER ENERGY CORPORATION

MATERIAL REQUISITION

CENTRIFUGAL COMPRESSORS PAGE 12 OF 12

FOR MLGW FW REF. 15-2220
SITE MEMPHIS, TENN.
SERVICE AIR COMPRESSORS ITEM NO. C-3101A/B

REQUISITION NO.	DATE
2231-132, A	2-1-79

SUPERSEDED BY

CHG.	DATE	CHG.	DATE
C1	11 OCT. 79	C4	
C2		C5	
C3		C6	

UTILITY DATA

ELECTRICAL:

CLASSIFICATION: ☐ CLASS I - GROUP D, ☐ DIV. 1, ☐ DIV. 2, ☒ NON-HAZARDOUS.
MOTORS 150 HP AND BELOW: 460 VOLTS, 3 PHASE, 60 CYCLES.
MOTORS 200 HP THROUGH 6000 HP: 4000 VOLTS, 3 PHASE, 60 CYCLES.
MOTORS 6500 HP AND ABOVE: 13,800 VOLTS, 3 PHASE, 60 CYCLES.
ALARM SWITCHES: ☒ AC, ☐ DC. 120 VOLTS, 1 PHASE, 60 CYCLES.
SHUTDOWN SWITCHES: ☒ AC, ☐ DC 120 VOLTS, 1 PHASE, 60 CYCLES.
SWITCH ENCLOSURE: ☐ EXPLOSION PROOF, ☒ WEATHER PROOF, ☐ _____.

STEAM:

	MAIN COMP. DRIVE MAX.	MAIN COMP. DRIVE NOR.	MAIN COMP. DRIVE MIN.	GLAND SEAL EJECTORS MAX.	GLAND SEAL EJECTORS NOR.	GLAND SEAL EJECTORS MIN.
INLET Psig		890			130	
INLET TT °F		840			510	
EXH. Psig		130			ATM.	
In. HG. ABS.						

⊛ DENOTES CONDITIONS AT WHICH STEAM RATE IS TO BE GUARANTEED.

COOLING WATER: ☒ FRESH, ☐ SALT, ☐ _____.
AVAILABLE AT 75 Psig AND 88 °F. FOULING FACTOR .001 (WATER SIDE)
ALLOW TEMP. RISE 30 °F. ALLOW PRESSURE DROP 15 Psi.

INSTRUMENT AIR: AVAILABLE TO CONTROL DEVICES AT 100 Psig.

DRIVER AND UTILITY SUMMARY

MOTORS:

	QUAN.	MFR.	TYPE	ENCL.	HP	SF	RPM	
☒ COMPRESSOR DRIVE	ONE		SYNCH.	WP-II				
☒ LUBE PUMP DRIVES	TWO/UNIT		INDUCT	TEFC				
☐ SEAL PUMP DRIVE								
☐ _____								

STEAM TURBINES:

	QUAN.	MFR.	TYPE	STAGES	HP	RPM	WR	
☒ COMPRESSOR DRIVE	ONE		NON-COND					
☐ LUBE PUMP DRIVES								
☐ SEAL PUMP DRIVE								
☐ _____								

DRIVERS MARKED ☒ SHALL BE FURNISHED BY THE COMP. VENDOR. SEE PAGE _____ OF THIS REQ'N. FOR COMPLETE DETAILS OF THE MAIN COMPRESSOR DRIVE UNIT.

COOLING WATER CONSUMPTION:

LUBE OIL COOLERS ____ GPM ____ °F. RISE.
SEAL OIL COOLERS ____ GPM ____ °F. RISE.
INTER COOLERS ____ GPM ____ °F. RISE.
____ ____ GPM ____ °F. RISE.
____ ____ GPM ____ °F. RISE.

STEAM CONSUMPTION:

COMPRESSOR DRIVE ____ Lb/Hr.
EACH LUBE PUMP DRIVE ____ Lb/Hr.
EACH SEAL PUMP DRIVE ____ Lb/Hr.
____ ____ Lb/Hr.
____ ____ Lb/Hr.

COMMENTS REGARDING UTILITIES:

REQUISITION

FOSTER WHEELER ENERGY CORPORATION

CLIENT Memphis Light Gas & Water Div. CONTRACT NO. 15-2200	REQUISITION NO.			DATE
SITE Memphis, Tennessee ITEM NO. C-3102	2231-1321 B			6-12-79
MATERIAL Oxygen Compressor	C1	11 Oct. 79	C4	
OR	C2		C5	
SERVICE	C3		C6	

I. SCOPE OF SUPPLY

Vendor shall furnish one (1) horizontally split casing, multi-stage centrifugal type oxygen compressor, with synchronous motor driver and accessory equipment in accordance with this requisition and applicable standards and specifications referenced below.

Vendors scope of supply shall include following items:

(1)
Compressor
Steam Turbine
Fabricated Steel Baseplate
Console Type Lube Oil System
Local Panel
Instrumentation

Oxygen intercoolers, interconnecting oxygen piping and anti-surge control system will be furnished by others. Vendor may offer, however, compressor designs incorporating integral interstage coolers in which case the coolers (and piping if any) would be in his scope of supply.

II. APPLICABLE STANDARDS & SPECIFICATIONS

(1)

2200-32A1	Centrifugal Compressors
2200-38A3	Special Purpose Steam Turbines
2200-38A7	Medium Voltage Induction Motors
2200-39A2	Lube & Seal Oil Systems
2200-39A5	Clean Specification - Oxygen Compressors and Accessory Equipment.
2200-1300A	General Notes Requisition

III. DESCRIPTION OF SERVICE

The oxygen compressor unit will be installed in an air separation plant operating in continuous un-interrupted service. The equipment will be installed outdoors, unprotected from the weather, on a mezzanine type of foundation.

FORM NO. 135-901

CHANGE NO. 1	DATE 11 Oct, 79	REQUISITION NO. 2231-1321 B

IV. SPECIAL REQUIREMENTS

All parts of the compressor, auxiliary piping, intercoolers and interconnecting oxygen piping which are in contact with the product oxygen shall be cleaned, degreased and protected for shipment in accordance with FW Specification 2200-39A5.

V. ALTERNATE COMPRESSOR DESIGNS

The compressor may be either integrally cooled, single casing type or an externally cooled multi-casing design as recommended by the vendor for minimum power consumption.

Justification of incremental capital cost shall be evaluated on the basis of the following power costs:

Electric Power	- $.02/KWH
Plant Payout Period	- 20 years at 330 operating days per year

VI. VENDOR DATA REQUIREMENTS

A. Model and type of compressor and driver units.

B. Performance data as noted by (*) on page 3.

C. Typical outline dimensions and weights.

D. Price estimate based on shipment in 1981.

FOSTER WHEELER

MATERIAL REQUISITION

CENTRIFUGAL COMPRESSORS

FOR MEMPHIS LIGHT, GAS & WATER FW REF. 15-2200
SITE MEMPHIS, TENN.
SERVICE OXYGEN COMPRESSOR ITEM NO. C-3102
MFR.
SIZE AND TYPE _____ NO. REQD. ONE (1)
DRIVER: ☒ MOTOR, ☐ STEAM TURBINE, ☐ _____

REQUISITION NO.	DATE
2231-1321B	6-12-79

SUPERSEDED BY

CHG.	DATE	CHG.	DATE
C1	11 Oct. 79	C4	
C2		C5	
C3		C6	

SPECIFICATIONS: CENTRIFUGAL COMPRESSORS AND ATTENDENT EQUIPMENT COVERED IN THIS REQUISITION SHALL BE FURNISHED IN ACCORDANCE WITH THE FOLLOWING SPECIFICATIONS:

☐ API STD 617, ☐ FW STD. 30A1, ☐ FW STD. 30A2,
☒ SEE PAGE 1
☐ _____

INSTALLATION: UNIT WILL BE INSTALLED IN AN
☒ OUTDOORS-UNPROTECTED LOCATION,
☐ ENCL. BLDG., ☐ _____
AT ☐ GRADE, ☒ MEZZANINE LEVEL.
BAROMETER 14.7 Psia. ALTITUDE 263 FT.
AMB. TEMP. _____ °F MAX., _____ °F MIN.

CONDITIONS OF SERVICE FOR EACH MACHINE

	RATED	NORMAL	
GAS HANDLED (SEE ANALYSIS BELOW)	OXYGEN →		
RELATIVE HUMIDITY, %	DRY →		
MOLECULAR WEIGHT	31.92 →		
Cp/Cv @ _____ °F	1.39 →		
COMPRESSIBILITY FACTOR @ INLET Z1	1.0 →		
COMPRESSIBILITY FACTOR @ DISCH Z2	1.0 →		
SCFM @ 14.7 Psia & 60 °F : ☐ DRY, ☐ WET.			
CFM @ INLET CONDITIONS	29322	26552	
WEIGHT FLOW, Lb/Min.	2709	2445	
INLET PRESSURE, Psia	17.2	17.2	
INLET TEMPERATURE, °F	94	94	(COOL TO 103 °F)
DISCH. PRESSURE, Psia	119.5	119.5	
* DISCH. TEMPERATURE, °F			(SEE NOTE BELOW)
POLYTROPIC HEAD Ft.-Lb/Lb.			
* COMPRESSOR BHP			
* COMPRESSOR RPM			
* BHP REQUIRED AT DRIVER SHAFT			
* DRIVER RATED HP			
EST. SURGE CAPACITY @ RATED RPM, ICFM			
* DISCH. TEMP. AT SURGE CAPACITY			(SEE NOTE BELOW)
PERFORMANCE CURVE NO.			
* INTERSTAGE PRESS./TEMP -			

GAS ANALYSIS

COMPOSITION	MOL. WT.	MOL. %	MOL. %	MOL. %	MOL. %
OXYGEN	32	98.0			
NITROGEN	28	2.0			

COMMENTS REGARDING GAS HANDLED: SUCTION & DISCHARGE PRESSURES SPECIFIED AT COMPRESSOR FLANGES. COMPRESSOR STAGING SHALL BE SELECTED SUCH THAT THE DISCHARGE TEMPERATURE AT THE RATED CAPACITY DOES NOT EXCEED 325 °F AT ANY POINT.

FOSTER WHEELER ENERGY CORP.
110 SOUTH ORANGE AVENUE, LIVINGSTON, N.J.

MATERIAL REQUISITION

CENTRIFUGAL COMPRESSORS PAGE 4 OF 10

FOR MLGW FW REF. 15-2200
SITE MEMPHIS, TENN.
SERVICE OXYGEN COMPRESSOR ITEM NO. C-3102
MATERIAL
SIZE AND TYPE NO. REQD. ONE (1)
DRIVER: [X] MOTOR, [ ] STEAM TURBINE, [ ]
GENERAL NOTES REQUISITION IS AN INTEGRAL PART OF THIS REQUISITION.

REQUISITION NO.	DATE
2231-1321B	6-12-79

SUPERSEDED BY

CHG.	DATE	CHG.	DATE
C1	11 Dec. 79	C4	
C2		C5	
C3		C6	

CONSTRUCTION DETAILS

MANUFACTURERS DATA: MODEL _____. CASING SPLIT: [X] HORIZ., [ ] VERT. NO. STAGES _____.

IMPELLERS: TYPE: [X] ENCLOSED - BACKWARD LEANING, [ ] _____. DIA. _____ IN.
CONSTRUCTION: [ ] CAST, [ ] RIVETED, [X] WELDED, [ ] MILLED, [ ] _____. TIP SPEED _____ FPS

SPEED DATA: MAX. CONT. _____ RPM. FIRST CRITICAL _____ RPM. SECOND CRITICAL _____ RPM.

COMPRESSOR ROTATION: VIEWED FROM DRIVER END OF UNIT: [ ] CW, [ ] CCW.

MATERIALS OF CONSTRUCTION:
CASING: [ ] CAST STEEL, [ ] FORGED STEEL, [X] CAST IRON, [ ] _____.
DIAPHRAMS: CAST IRON. INTERSTAGE LABYRINTHS: BRONZE.
IMPELLERS: AISI-410 OR 17-4PH SHAFT: AISI-4140. SLEEVES: MONEL.
OTHER: _____.

TEMPERATURE AND PRESSURE LIMITATIONS:

MAX. WORKING TEMP:	SUCTION END	____ °F.	DISCH. END.	____ °F.
MIN. WORKING TEMP:	SUCTION END.	____ °F.	DISCH. END.	____ °F.
MAX. WORKING PRESS:	SUCTION END	____ Psig.	DISCH. END	____ Psig.
HYDRO. TEST PRESS:	SUCTION END	____ Psig.	DISCH. END	____ Psig

FLANGE RATINGS:

CONNECTION	SIZE (IN.)	ASA RATING	FACING	UP	DN	RT	LF	OTHER
MAIN SUCTION				[ ]	[X]	[ ]	[ ]	
MAIN DISCHARGE				[ ]	[X]	[ ]	[ ]	
				[ ]	[ ]	[ ]	[ ]	
				[ ]	[ ]	[ ]	[ ]	
				[ ]	[ ]	[ ]	[ ]	

ALL FLANGE ORIENTATIONS ARE VIEWED FROM THE DRIVER END OF THE UNIT. ALLOWABLE FLANGE LOADINGS SHALL BE INDICATED ON THE VENDORS CERTIFIED DRAWINGS.

SHAFT SEAL: [X] LABYRINTH, [ ] RESTRICTIVE RING, [ ] LIQUID FILM, [ ] MECHANICAL (CONTACT).
LABYRINTH CLEARANCES TO BE INCREASED APPROX 50% ABOVE NORMAL. MFR. SHALL GUARANTEE ZERO OIL LEAKAGE INTO COMPRESSOR CASING.

SEALING MEDIUM: [ ] OIL, [ ] AIR, [X] INERT GAS, [ ] NITROGEN INJECTION SYSTEM. TO BE FURNISHED COMPLETE WITH PRESSURE CONTROL VALVE, GAUGE(S) AND LOW ΔP ALARM SWITCH

BEARINGS: BEARING HOUSING CONSTRUCTION: [ ] INTERNAL, [X] EXTERNAL.
JOURNAL BEARING TYPE: [ ] BABBITTED SLEEVE, [X] MFR. STD. _____.
LUBE: [X] FORCE FEED, [ ] RING OIL, [ ] _____.
THRUST BEARING TYPE [ ] SINGLE KINGSBURY, [X] DOUBLE KINGSBURY, [ ] BALL,
[ ] ROLLER [ ] _____.
LUBE: [X] FORCE FEED [ ] RING OIL, [ ] _____.

CASING DRAINS: QUANTITY EA. STAGE. SIZE 3/4" MIN.. VENDOR SHALL FURNISH
[ ] VALVED, [X] PLUGGED, [ ] BLIND FLANGE, [ ] _____ CONNECTIONS.

BASEPLATE: SUPPLIED BY [X] COMPRESSOR VENDOR, [ ] _____.
TYPE: [X] CONTINUOUS STRUCTURAL STEEL COMMON TO COMPRESSOR AND DRIVE UNIT.
[ ] _____.
PROVIDED WITH DRIP PAN [ ] YES, [X] NO.

COUPLINGS: SUPPLIED BY [ ] COMPRESSOR VENDOR, [ ] _____.

LOCATION:	HIGH SPEED		LOW SPEED		
MFG:	BENDIX OR EQUAL		KOPPERS		
TYPE:	FLEX. DIAPHRAM		HOLSET		
LUBE:	NONE		NONE		

COUPLING GUARDS: SUPPLIED BY [X] COMPRESSOR VENDOR, [ ] _____.
TYPE: [ ] SHEET METAL, [X] NON-SPARKING, ALL PARTS IN CONTACT WITH THE PRODUCT

COMMENTS REGARDING CONSTRUCTION DETAILS: OXYGEN SHALL BE DEGREASED PER FW SPEC 2200-39A5.
Rev. (1) NO CHANGE ON THIS PAGE

FORM A25-82

FOSTER WHEELER ENERGY CORP.
110 SOUTH ORANGE AVENUE, LIVINGSTON, N.J.

MATERIAL REQUISITION

CENTRIFUGAL COMPRESSORS PAGE 5 OF 10

FOR MLGW FW REF. 15-2200
SITE MEMPHIS, TENN.
SERVICE OXYGEN COMPRESSOR ITEM NO. C-3102
MATERIAL
SIZE AND TYPE NO. REQD.
DRIVER: [X] MOTOR, [ ] STEAM TURBINE, [ ]
GENERAL NOTES REQUISITION IS AN INTEGRAL PART OF THIS REQUISITION.

REQUISITION NO. 2231-1321B DATE 6-12-79
SUPERSEDED BY

CHG.	DATE	CHG.	DATE
C1	11 OCT. 79	C4	
C2		C5	
C3		C6	

LUBE AND SEAL OIL SYSTEMS: A FORCE FEED LUBE OIL SYSTEM COMMON TO THE [X] COMPRESSOR, [X] GEAR, [X] DRIVER, WITH [ ] A COMBINED, [ ] A SEPARATE, [ ] NO SEAL OIL SYSTEM, SHALL BE FURNISHED BY THE COMP. MFR. IN ACCORDANCE WITH 2200-3992.

LUBE OIL SYSTEM

SYSTEM OPERATING PRESS. _____ Psig.
SYSTEM MAX. ALLOW OPER. PRESS. _____ Psig.
RESERVOIR: LOCATED [ ] IN BASE, [X] ON CONSOLE.
CAPACITY _____ GAL. RET. TIME _____ MIN.
TO BE FURNISHED WITH [X] ELECTRIC, [ ] STEAM HEATER, [ ] INSULATION SUPPORTS AND

MAIN LUBE OIL PUMP: LOCATED ON [ ] BASE, [X] CONSOLE AND DRIVEN BY [ ] _____ SHAFT, [X] INDUCTION MOTOR, [ ] STEAM TURBINE.
MFR. IMO . MODEL _____ .
TYPE SCREW . CASE MATL. C.S. .
GPM _____ . RPM _____ . BHP _____ .

AUX. LUBE OIL PUMP: LOCATED ON [ ] BASE, [X] CONSOLE AND DRIVEN BY [ ] _____ SHAFT, [X] INDUCTION MOTOR, [ ] STEAM TURBINE.
MFR. IMO . MODEL _____ .
TYPE SCREW . CASE MATL. C.S. .
GPM _____ . RPM _____ . BHP _____ .

RELIEF VALVES: [ ] INTEGRAL, [X] SEPARATE.

COOLERS: [X] TWIN, [ ] SINGLE, LOCATED ON [ ] BASE, [X] CONSOLE, _____ .
MFR. _____ . TYPE SHELL & TUBE .
CODE: [X] TEMA C, [ ] _____ .
SHELL: OD _____ IN. DES. PRESS. _____ Psig.
TUBES: OD _____ IN. BWG _____ .
MATL: SHELL C.S. . TUBES ADMIRALTY.

FILTERS: [ ] TWIN, [ ] SINGLE. LOCATED ON [ ] BASE, [X] CONSOLE, [ ] _____ .
MFR. _____ . MODEL _____ .
CASE MATL. C.S. . MICRON 25 (MAX.).
ELEMENT: [ ] CLEANABLE, [X] REPLACEABLE.

TRANSFER VALVES: MFR. KRAISSEL .
QUAN. ONE . TYPE _____ . MATL. C.S. .

SEAL OIL SYSTEM

SYSTEM OPERATING PRESS. _____ Psig.
SYSTEM MAX. ALLOW OPER. PRESS. _____ Psig.
RESERVOIR: LOCATED [ ] IN BASE, [ ] ON CONSOLE.
CAPACITY _____ GAL. RET. TIME _____ MIN.
TO BE FURNISHED WITH [ ] ELECTRIC, [ ] STEAM HEATER, [ ] INSULATION SUPPORTS AND

MAIN SEAL OIL PUMP: LOCATED ON [ ] BASE, [ ] CONSOLE AND DRIVEN BY [ ] _____ SHAFT, [ ] INDUCTION MOTOR, [ ] STEAM TURBINE.
MFR. _____ . MODEL _____ .
TYPE _____ . CASE MATL. _____ .
GPM _____ . RPM _____ . BHP _____ .

AUX. SEAL OIL PUMP: LOCATED ON [ ] BASE, [ ] CONSOLE AND DRIVEN BY [ ] _____ SHAFT, [ ] INDUCTION MOTOR, [ ] STEAM TURBINE.
MFR. _____ . MODEL _____ .
TYPE _____ . CASE MATL. _____ .
GPM _____ . RPM _____ . BHP _____ .

RELIEF VALVES: [ ] INTEGRAL, [ ] SEPARATE.

COOLERS: [ ] TWIN, [ ] SINGLE. LOCATED ON [ ] BASE, [ ] CONSOLE, _____ .
MFR. _____ . TYPE _____ .
CODE: [ ] TEMA C, _____ .
SHELL: OD _____ IN. DES. PRESS. _____ Psig.
TUBES: OD _____ IN. BWG. _____ .
MATL: SHELL _____ . TUBES _____ .

FILTERS: [ ] TWIN, [ ] SINGLE. LOCATED ON [ ] TWIN, [ ] CONSOLE, [ ] _____ .
MFR. _____ . MODEL _____ .
CASE MATL. _____ . MICRON _____ .
ELEMENT: [ ] CLEANABLE, [ ] REPLACEABLE.

TRANSFER VALVES: MFR. _____ .
QUAN. _____ . TYPE _____ . MATL. _____ .

~~SOUR OIL TRAPS: REQD. [ ] YES, [ ] NO. LOCATED ON [ ] BASE, [ ] CONSOLE, [ ] BY PURCHASER. PIPING BY [ ] COMP. VENDOR, [ ] PURCHASER. SEAL OIL LOSS _____ GAL./DAY/SEAL MAX.~~

~~OVHD. SEAL OIL TANK: REQD. [ ] YES, [ ] NO. LOCATED _____ FT. ABOVE COMP. CENTER LINE. MTD. BY [ ] COMP. VENDOR, [ ] PURCHASER.~~

CLARIFIER: REQD. [ ] YES, [X] NO. LOCATED ON [ ] BASE, [ ] CONSOLE, [ ] BY PURCHASER.
PIPING BY [ ] COMP. VENDOR, [ ] PURCHASER. BYPASS _____ GPM. MFR. _____ .

PIPING: [X] CARBON STEEL PICKLED AND CLEANED, [X] STAINLESS STEEL, DOWNSTREAM OF FILTERS.
[ ] STAINLESS STEEL DRAIN LINES, [ ] _____ .

OTHER:

Rev.(1) NO CHANGE ON THIS PAGE

FOR MLGW FW REF. 15-2200
SITE MEMPHIS, TENN.
SERVICE OXYGEN COMPRESSOR ITEM NO. C-3102
MATERIAL
SIZE AND TYPE NO. REQD.
DRIVER: ☐ MOTOR, ☐ STEAM TURBINE, ☐
GENERAL NOTES REQUISITION IS AN INTEGRAL PART OF THIS REQUISITION.

REQUISITION NO.	DATE
2231-1321B	6-12-79

SUPERSEDED BY

CHG.	DATE	CHG.	DATE
C1	11 Oct, '79	C4	
C2		C5	
C3		C6	

INSTRUMENTATION

LOCAL COMPRESSOR PANEL: FURNISHED BY ☒ COMP. VENDOR, ☐ PURCHASER, ☐ NOT REQD.
PURCHASERS ELECTRICAL AND INSTRUMENT CONNECTIONS SHALL BE ☒ BROUGHT OUT TO TERMINAL BOXES BY THE COMP. VENDOR, ☐ MADE BY THE PURCHASER.

GAGES AND INDICATORS:

PRESSURE GAGES:	MFR.	MFR'S. STD	SIZE AND TYPE	
TEMPERATURE GAGES:	MFR.		SIZE AND TYPE	
LEVEL INDICATORS:	MFR.		SIZE AND TYPE	
SIGHT FLOW INDICATORS:	MFR.		SIZE AND TYPE	
TACHOMETER:	MFR.		SIZE AND TYPE	
	MFR.		SIZE AND TYPE	

INSTRUMENTATION: COMPRESSOR VENDOR SHALL FURNISH THE FOLLOWING:

PRESSURE GAGES:	LOCAL	LOCAL PANEL
☒ OIL PUMP DISCHARGE	☒	☐
☒ LUBE OIL EACH LEVEL	☐	☒
☐ SEAL OIL EACH LEVEL	☐	☐
☐ SEAL OIL DIFF.	☐	☐
☒ BEFORE/AFTER FILTERS	☒	☐
☐ CONTROL OIL	☐	☐

	LOCAL	LOCAL PANEL
☒ MAIN STEAM INLET	☐	☒
☒ FIRST STAGE STEAM	☐	☒
☒ STEAM EXHAUST	☐	☒
☐	☐	☐
☐	☐	☐
☐	☐	☐

TEMPERATURE GAGES:		
☒ OIL OUTLET EACH BRG.	☒	☐
☐ OIL OUTLET EACH SEAL	☐	☐
☒ BEFORE/AFTER COOLERS	☒	☐

☐	☐	☐
☐	☐	☐
☐	☐	☐

SWITCHES: (SPDT)	ALARM	TRIP
☒ LOW LUBE OIL PRESS.	☒	☒
☐ LOW SEAL OIL PRESS.	☐	☐
☒ LOW OIL RES. LEVEL	☒	☐
☒ LOW CONTROL OIL PRESS.	☒	☐
☒ AUX. PUMP START	☒	☐

	ALARM	TRIP
☒ COMP. HIGH DISCH. TEMP.	☒	☐
☒ LUBE OIL SUPPLY TEMP.	☒	☐
☒ OIL FILTER HIGH ΔP	☒	☐
☒ RADIAL VIBRATION	☒	☒
☒ AXIAL ROTOR DISPL. (B-N SERIES 7200 MONITORS)	☒	☒

OTHER:

☐ REMOTE SHUTDOWN: ☒ ELECTRICAL, ☐ HYDRAULIC, ☐ PNEUMATIC.
☒ SIGHT FLOW EACH BEARING AND SEAL OIL RETURN LINE.
☐ OIL RESERVOIR LEVEL.
☒ RADIAL & THRUST BRG. TEMP. RTD's.
☒ ANNUNCIATOR W/1ST OUT SEQUENCE INDICATION.
☒ BRG. TEMP. INDICATOR W/ALARM AND TRIP SWITCHES.

ALARM CONTACTS SHALL ☐ OPEN, ☐ CLOSE TO SOUND ALARM. SHUTDOWN CONTACTS SHALL ☐ OPEN, ☐ CLOSE TO SHUTDOWN.

WHERE INDICATED BY (*), ALARM LIGHTS SHALL BE FURNISHED BY THE COMPRESSOR VENDOR AND MOUNTED ON THE LOCAL PANEL WITH ALL NECESSARY RELAY DEVICES.

PURCHASERS ELECTRICAL AND INSTRUMENT CONNECTIONS WITHIN THE CONFINES OF THE BASEPLATE AND CONSOLE SHALL BE ☐ BROUGHT OUT TO TERMINAL BOXES, ☐ MADE DIRECTLY BY THE PURCHASER.

COMMENTS REGARDING INSTRUMENTATION: VENDOR SHALL PROVIDE FOLLOWING ITEMS:
1. BENTLEY-NEVADA X-Y PROXIMITY TYPE VIBRATION PROBES AT EACH RADIAL BEARING WIRED TO PROXIMATORS MOUNTED IN NEMA 4 ENCLOSURE.
2. TWO (2) B-N AXIAL ROTOR DISPLACEMENT PROBES WITH PROXIMATORS.

Rev. (1): No change this page.

FOSTER WHEELER ENERGY CORPORATION

MATERIAL REQUISITION

110 SOUTH ORANGE AVENUE, LIVINGSTON, N.J. CENTRIFUGAL COMPRESSORS PAGE 7 OF 10

FOR MLGW FW REF. 15-3200
SITE MEMPHIS, TENN.
SERVICE OXYGEN COMPRESSOR ITEM NO. C-3102
MATERIAL
SIZE AND TYPE NO. REQD. ONE (1)
DRIVER: ☒ MOTOR, ☐ STEAM TURBINE, ☐
GENERAL NOTES REQUISITION IS AN INTEGRAL PART OF THIS REQUISITION.

REQUISITION NO.	DATE
2231-132 A	6-12-79

SUPERSEDED BY

CHG.	DATE	CHG.	DATE
C1	11 OCT, 79	C4	
C2		C5	
C3		C6	

CONTROL

NORMAL OPERATING: CONSTANT SPEED CAPACITY CONTROL SYSTEM USING SUCTION THROTTLE VALVE FURNISHED BY OTHERS

SURGE CONTROL: ANTI-SURGE SYSTEM TO BE FURNISHED BY OTHERS.

INSPECTION AND TESTING

		WITNESSED:	
COMPRESSOR:	☒ SHOP INSPECTION.	☒ YES	☐ NO
	☒ HYDROSTATIC TEST.	☐ YES	☒ NO
	☒ IMPELLER OVERSPEED _____ % OF _____ RPM.	☐ YES	☒ NO
	☒ DYNAMIC BALANCE OF ROTOR	☐ YES	☒ NO
	☒ MECHANICAL RUN.	☒ YES	☐ NO
	☐ PTC-10 PERFORMANCE TEST	☒ YES	☐ NO
	☒ OXYGEN CLEANING & PROTECTION FOR SHIPMENT	☒ YES	☐ NO
	☐	☐ YES	☐ NO
DRIVER:	☒ COMMERCIAL NEMA TESTS	☒ YES	☐ NO
	☒ VIBRATION TESTS	☒ YES	☐ NO
	☐	☐ YES	☐ NO
	☐	☐ YES	☐ NO
CONSOLE:	☒ SHOP INSPECTION.	☒ YES	☐ NO
	☒ RUNNING TEST	☒ YES	☐ NO
	☐	☐ YES	☐ NO
OIL COOLERS:	☒ HYDROSTATIC TEST	☐ YES	☒ NO
	_____ Psig OIL SIDE. _____ Psig WATER SIDE.		
INTERCOOLERS: (IF FURNISHED)	☒ HYDROSTATIC TEST	☐ YES	☒ NO
	_____ Psig AIR SIDE. _____ Psig WATER SIDE.		

COMMENTS REGARDING TESTING:

Rev. (1) NO CHANGE ON THIS PAGE

FORM

REQUISITION NUMBER	DATE
2231-1321 B	11 OCT. 79

FOR MLGW F.W. CONTRACT 15-2200
SITE MEMPHIS, TENNESSEE
ITEM NO. C-3102 SERVICE OXYGEN COMPRESSOR
DRIVEN EQUIP. CENTRIFUGAL COMPRESSOR
MFR. _____ MODEL _____ NO. REQ'D 1

SUPERSEDED BY CHANGE NO.

C1	11 OCT, 79	C4	
C2		C5	
C3		C6	

OPERATING CONDITIONS

	BHP	RPM	
RATED	110 %	105%	COMPR. RATED PNT.
NORMAL			

MAX. CONTINUOUS SPEED: 105% RPM
TRIP SPEED: _____ RPM
CRITICAL SPEED: _____ RPM FIRST. _____ RPM SECOND

STEAM:	MAXIMUM	NORMAL	MINIMUM
THROTTLE PSIG		890	
THROTTLE °F.		840	
EXHAUST, PSIG		95	

OTHER DATA:

STEAM RATES, BASIS OUTPUT SHAFT OF ☒ TURBINE ☐ GEAR
(* = GUAR. POINT)

OUTPUT	STEAM	LBS/BHP-HR
RATED	NORMAL	
RATED	WORST	
NORMAL	NORMAL	

PERFORMANCE CURVE NO. _____

MAXIMUM POSSIBLE STEAM FLOWS: LBS/HR
AT THROTTLE (WITH MAX. INLET PRESS.)
TO EXHAUST (EXT. & INDUCT. TURB. ONLY)
FROM EXTRACT. (WITH MAX. THROTTLE PRESS.)

ROTATION (VIEWED FROM H.P. INLET END): ☐ CW ☐ CCW
THRUST FROM DRIVEN EQUIP.: ☐ NORMAL ☐
DUTY: ☒ CONTINUOUS ☐
START-UP ☐ MANUAL ☐ EMERGENCY AUTOMATIC
LOCATION: ☐ INDOOR ☐ OUTDOOR ☐ SEMI-ENCL. BLDG.
☐ AT GRADE ☒ ON MEZZANINE
AREA: ☐ CL. ___ -GR. ___ -DIV. ___, ☒ NON-HAZARDOUS
AMBIENT: 100 °F. MAX. TO 17 °F. MIN.
263 FT. ALTITUDE 14.7 BAROMETER
PROTECTION: ☐ WINTERIZED ☐ TROPICALIZED ☐ STANDARD

GEARS: BY _____ SEE _____ FOR DATA

EVALUATION: FOR PERIOD OF _____ HOURS
H.P. STEAM AT $ _____ /M LBS.

COOL-OFF TIME: _____

APPLICABLE DOCUMENTS: (see page 1)

	SPECIAL-PURPOSE TURBINES
	GEN'L.-PURP. TURBS. (FOR AUX. SVC.)
	INDUCTION MOTORS
	OIL SYSTEMS
	GEARS
	GENERAL NOTES REQUISITION

CONSTRUCTION FEATURES:

TYPE: ☐ VERT. SHAFT ☒ HORIZ. SHAFT. _____ STAGES.
CASING SPLIT: ☒ AXIAL ☐ RADIAL
CASING MOUNT: ☐ FOOT ☒ CENTERLINE
FLOW TYPE: FIRST STAGE = _____
OTHER STAGES = _____

ROTOR: ☐ BUILT-UP ☒ SOLID
SPEED GOVERNOR: NEMA CLASS D. MFR. = WOODWARD
TYPE = PGPL W/OVERSPEED TRIP TEST DEVICE
OTHER GOV.: FOR _____ MFR. = _____
TYPE = _____
SPEED CHANGER: ☐ MANUAL ☐ AUTOMATIC
RANGE FROM 80 % TO 105 % OF RATED RPM.
ACTUATION SIGNAL = PNEUMATIC
NO. AUTO. VALVES: ___ MAIN INLET, LIFTED BY _____
, LIFTED BY

HAND NOZZLE VALVES: _____
TRIP VALVE: ☐ TRIP ONLY ☒ TRIP & THROTTLE
REMOTE TRIP REQ'D ACTUATED BY _____

BEARINGS:	THRUST	RADIAL
TYPE	KBT.	MFR. STANDARD
MANUFACTURER		
CALC. LOAD. LBS.		
CAPACITY, LBS.		
LUBE METHOD		
COOLING JACKETS		

SHAFT SEALS, INTERSTAGE: ☒ LABYRINTH ☐ _____
SHAFT SEALS, OUTER: ☒ LABYRINTH ☐ _____

DESIGN MAX:

H.P. INLET	_____	PSIG & ___ °F.
H.P. CASING	_____	PSIG & ___ °F.
I.P. CASING	_____	PSIG
L.P. CASING	_____	PSIG
COOL. JKTS.	_____	PSIG

MAX. ALLOWABLE SPEED _____ RPM
MAX. ALLOWABLE TRIP SPEED _____ RPM
POTENTIAL MAX. POWER @ RATED RPM _____ BHP

FORM 135-47

FOSTER WHEELER CORPORATION — SPECIAL-PURPOSE STEAM TURBINES —

REQUISITION NUMBER	DATE
2231-1321-3	11 Oct. 79

FOR MLGW — F.W. CONTRACT 15-2200

SITE MEMPHIS TENNESSEE

SUPERSEDED BY CHANGE NO.

ITEM NO. C-3102 OXYGEN COMPRESSOR

C1	11 Oct. 79	C3		C5	
C2		C4		C6	

ACCESSORIES:

- ☒ SEE PAGE 8 FOR SP. CHANGER, TRIP VALVE, REMOTE TRIP
- ☒ TRIP VALVE LIMIT SWITCHES: VALVE ☐ OPEN ☒ SHUT.
- ☐ TRIP VALVE DEVICE FOR TESTING WHILE OPERATING
- ☐ GOV. VALVE POSITION INDICATOR: _____
- ☐ INSULATION: MAT'L. = BY PURCHASER
- ☐ JACKET: MAT'L = _____
- ☐ EXHAUST SENTINEL VALVE, _____ PSIG SET
- ☐ EXHAUST FULL FLOW PSV, _____ PSIG SET
- ☐ EXTRACT FULL FLOW PSV, _____ PSIG SET
- ☐
- ☐ NON-RETURN VALVE ☐ EXTRACTION ☐ EXHAUST
  AUX. FORCE CLOSING BY _____
- ☒ TACHOMETER TYPE: AIRPAX TACHTROL
  INDICATOR, NO. & TYPE TWO REQUIRED; ONE NEMA 4 LOCAL, ONE REMOTE (IF REQ'D)
- ☐ SHAFT TURNING GEAR: _____
- ☒ STEAM STRAINER: ☐ SEPARATE ☐ IN T-T VALVE
- ☐ LOCAL PANEL: MOUNTED ON ☐ TURB. ☐ TURB. BASE
  ☐ SEPARATE FREESTANDING.
  BY PURCHASER
- ☒ BASE: (☒ BY DRIVEN EQUIP. MFR.)
  ☐ SOLEPLATES. ☐ FABR. STEEL, ☐ WITH DECK
- ☐ GOV. LIMIT DEVICE FOR ☐ LOAD ☐ EXTRACT. FLOW ☐ INITIAL STEAM PRESSURE
- ☐ HIGH EXHAUST TEMP. SWITCH ☐ ALARM ☐ TRIP
- ☐ HIGH EXHAUST TEMP. WATER INJECTION SYSTEM COMPLETE
- ☐ VACUUM BREAKER
- ☐ WATER WASH ORIFICE MIXER
- ☐ SPACE HEATERS FOR INSUL. & JACKET
- ☒ SHAFT SEAL SYSTEM: ☐ MANUAL ☒ AUTO. CONTROL
  VACUUM DEVICE ☒ STM. EJECT. ☐ WATER EDUCTOR ☐ FAN ☐ LIQUID RING COMPRESSOR
  CONDENSER ☐ DIRECT CONTACT ☒ SHELL & TUBE
  SURF _____ SQ. FT., ☒ TEMA-C ☐ TEMA-R,
  WITH _____ SHELL, _____ WATER BOXES
  & _____ TUBES ___ BWG X ___ O.D. X ___ L
- UTILITIES REQ'D.: _____ GPM WATER
  _____ LBS/HR ___ PSIG STEAM
  _____ KW OF ___ V-___ PH-___ HZ
- ☒ VIBRATION DETECT. EQUIP.: B-N ; Vert & Hor probes with proximators at each radial brg.
- ☒ AXIAL POSITION EQUIP.: Two probes with proximators

OIL SYSTEM:

TURBINE MFR'S. OIL REQUIREMENTS:	GPM	PSIG.
LUBRICATION		
CONTROL, STEADY STATE		
CONTROL, TRANSIENT		

VISCOSITY: ___ SSU @ 100°F & ___ SSU @ 210°F

___ SSU MAX. ALLOWABLE FOR START-UP.

MAX. ALLOWABLE FILTRATION: MICRONS

- LUBRICATING OIL
- CONTROL OIL (NOT OVER 25)

TURBINE MFR. TO SUPPLY SYSTEM COMPONENTS AS FOLLOWS:

- ☐ NONE (ALL COMPONENTS BY OTHERS)
- ☒ AS AGREED WITH MFR. OF DRIVEN EQUIPMENT
- ☐ TOTAL SYSTEM PER PAGE _____
- ☐ AT TURB. ☐ & GEAR ONLY (SINGLE IN/OUT CONNECTS).
  ☐ WITH ☐ WITHOUT LOCAL INSTRUMENTS
- ☐ PARTIAL SYSTEM PER PAGE _____

PIPING MATERIALS AT TURBINE (& GEAR):

L.O. PRESSURE LINES	STAINLESS STEEL
CONTROL PRESS LINES	" "
DRAIN LINES	CARBON STEEL (PICKLED)

COUPLINGS:

	TURB.-	
FURNISHED BY	COMPRESSOR VENDOR	
MANUFACTURER		
MODEL NO.		
TYPE		
LUBE METHOD		
BORE TYPE, DRIVING HALF		
BORE TYPE, DRIVEN HALF		
MOUNT DRIVING HALF		
MOUNT DRIVEN HALF		

TYPE OF GUARD _____

OTHER REQUIREMENTS:

- ☒ TORSIONAL CRITICAL SPEED ANALYSIS BY COMPR. VENDOR
- ☒ LATERAL CRITICAL SPEED ANALYSIS BY " "
- ☒ SUPPLY ABOVE CALCULATIONS TO " "
- ☒ SUPPLY CAMPBELL DIAGRAMS TO PURCHASER
- ☒ REVIEW & COMMENT ON PURCHASER'S PIPING DRAWINGS
- ☒ REVIEW & COMMENT ON PURCHASER'S FOUND DRAWINGS
- ☐ _____
- ☐ SUPPLY SPARE ROTOR ASSEMBLY
- ☐ _____

FOSTER WHEELER ENERGY CORPORATION

MATERIAL REQUISITION

CENTRIFUGAL COMPRESSORS PAGE 10 OF 10

FOR MLGW FW REF. 15-2200
SITE MEMPHIS, TENN
SERVICE _____ ITEM NO. C-3,02A/B

REQUISITION NO.	DATE
3221-1320	5-12-77

SUPERSEDED BY

CHG.	DATE	CHG.	DATE
C1	11 Oct. 79	C4	
C2		C5	
C3		C6	

UTILITY DATA

ELECTRICAL:

CLASSIFICATION: ☐ CLASS I - GROUP D, ☐ DIV. 1, ☐ DIV. 2, ☒ NON-HAZARDOUS.
MOTORS 150 HP AND BELOW: 460 VOLTS, 3 PHASE, 60 CYCLES.
MOTORS 200 HP THROUGH 6000 HP: 4000 VOLTS, 3 PHASE, 60 CYCLES.
MOTORS 6500 HP AND ABOVE: 13,800 VOLTS, 3 PHASE, 60 CYCLES.
ALARM SWITCHES: ☒ AC, ☐ DC. 120 VOLTS, 1 PHASE, 60 CYCLES.
SHUTDOWN SWITCHES: ☒ AC, ☐ DC 120 VOLTS, 1 PHASE, 60 CYCLES.
SWITCH ENCLOSURE: ☐ EXPLOSION PROOF, ☒ WEATHER PROOF, ☐ _____.

STEAM:

	MAIN COMP. DRIVE MAX.	MAIN COMP. DRIVE NOR.	MAIN COMP. DRIVE MIN.	AUX. DRIVES MAX.	AUX. DRIVES NOR.	AUX. DRIVES MIN.
INLET Psig		(NOT APPLICABLE)				
INLET TT °F						
EXH. Psig						
In. HG. ABS.						

⊛ DENOTES CONDITIONS AT WHICH STEAM RATE IS TO BE GUARANTEED.

COOLING WATER: ☐ FRESH, ☐ SALT, ☒ COOLING TOWER.
AVAILABLE AT 75 Psig AND 88 °F. FOULING FACTOR .001 (WATER SIDE)
ALLOW TEMP. RISE 30 °F. ALLOW PRESSURE DROP 15 Psi.

INSTRUMENT AIR: AVAILABLE TO CONTROL DEVICES AT 100 Psig.

DRIVER AND UTILITY SUMMARY

MOTORS:

	QUAN.	MFR.	TYPE	ENCL.	HP	SF	RPM	
☒ COMPRESSOR DRIVE	ONE		SYNCH	WPII				
☒ LUBE PUMP DRIVE	TWO		INDUCT.	TEFC				
☐ SEAL PUMP DRIVE								
☐ _____								

STEAM TURBINES:

	QUAN.	MFR.	TYPE	STAGES	HP	RPM	WR	
☐ COMPRESSOR DRIVE		(NONE)						
☐ LUBE PUMP DRIVE								
☐ SEAL PUMP DRIVE								
☐ _____								

DRIVERS MARKED ☒ SHALL BE FURNISHED BY THE COMP. VENDOR. SEE PAGE _____ OF THIS REQ'N. FOR COMPLETE DETAILS OF THE MAIN COMPRESSOR DRIVE UNIT.

COOLING WATER CONSUMPTION:

LUBE OIL COOLERS	____ GPM	____ °F. RISE.	
SEAL OIL COOLERS	____ GPM	____ °F. RISE.	
INTER COOLERS	____ GPM	____ °F. RISE.	
_____	____ GPM	____ °F. RISE.	
_____	____ GPM	____ °F. RISE.	

STEAM CONSUMPTION:

COMPRESSOR DRIVE	____	Lb/Hr.
EACH LUBE PUMP DRIVE	____	Lb/Hr.
EACH SEAL PUMP DRIVE	____	Lb/Hr.
_____	____	Lb/Hr.
_____	____	Lb/Hr.

COMMENTS REGARDING UTILITIES: _____

REQUISITION

FOSTER WHEELER ENERGY CORPORATION

CLIENT Memphis Light, Gas & Water Div.	CONTRACT NO. 15-2200	REQUISITION NO.			DATE
SITE Memphis, Tennessee	ITEM NO. C-3103 A/B	2231-1321-C			6/14/79
MATERIAL Plant Nitrogen Package		C1		C4	
OR		C2		C5	
SERVICE		C3		C6	

I. SCOPE OF SUPPLY

Two (2) integrally geared, multi-stage centrifugal nitrogen compressors, each complete with baseplate, motor driver, shaft driven lube oil pump, lube oil system with cooler, auxiliary standby oil pump, aftercooler with condensate separator having an automatic drain trap, intercoolers, manifolding of all water piping, full selective automatic control system, associated shutdown and alarm system and extra set of terminals for wiring out of the panel.

The compressor console panels will be located on the baseplate for each compressor and the minimum panel functions will be as follows:

1. Pressure control systems
2. Shutdown system
3. Alarm system and lights
4. Mfg. std. vibration monitoring and shutdown system
5. Low oil pressure trip switch and indicator light
6. High oil temperature, alarm switch and indicator light
7. High air temperature alarm for intercoolers
8. Main motor running indicator light
9. Auxiliary lube pump running indicator light
10. Compressor surge indicator light
11. High discharge air temperature indicator light

II. APPLICABLE STANDARDS AND SPECIFICATIONS

2200-1300A	General Notes for Mechanical Equipment
2200-38A6	Low Voltage NEMA Frame TEFC and XP Induction Motors
2200-39A3	Vendor Supplied Piping
2200-38A7	Medium Voltage and Non-NEMA Induction Motors

III. VENDOR DATA REQUIREMENTS

A. Model and type of compressor and driver.

B. Performance curve.

C. Typical outline dimensions and weights.

D. Price estimate based on shipment in 1981.

FORM NO. 135-901

BY G.J.B.	P.O. NO.	SUPPLIER

FOSTER WHEELER

MATERIAL REQUISITION

CENTRIFUGAL COMPRESSORS PAGE 2 OF 7

FOR MEMPHIS LIGHT, GAS & WATER DIV. FW REF. 15-2200
SITE MEMPHIS, TENN.
SERVICE PLANT NITROGEN PACKAGE ITEM NO. C-3103 A/B
MFR.
SIZE AND TYPE MO. REQD. TWO(2)
DRIVER: ☒ MOTOR, ☐ STEAM TURBINE, ☐
TWO(2)

REQUISITION NO.	DATE
2231-1321-C	6/14/79

SUPERSEDED BY

CHG.	DATE	CHG.	DATE
C1		C4	
C2		C5	
C3		C6	

SPECIFICATIONS: CENTRIFUGAL COMPRESSORS AND ATTENDENT EQUIPMENT COVERED IN THIS REQUISITION SHALL BE FURNISHED IN ACCORDANCE WITH THE FOLLOWING SPECIFICATIONS:

☒ 2200-1300-A ☒ 2200-38A6 ☒ 2200-38A7
☒ 2200-39A3
☐

INSTALLATION: UNIT WILL BE INSTALLED IN AN
☒ OUTDOORS-UNPROTECTED LOCATION,
☐ ENCL. BLDG., ☐
AT ☐ GRADE, ☒ MEZZANINE LEVEL.
BAROMETER 14.7 Psia. ALTITUDE 100 FT
AMB. TEMP. 98 °F MAX., 17 °F MIN.

CONDITIONS OF SERVICE FOR EACH MACHINE

	RATED
GAS HANDLED (SEE ANALYSIS BELOW)	NITROGEN
RELATIVE HUMIDITY, %	DRY
MOLECULAR WEIGHT	28
Cp/Cv @ 60 °F	1.4
COMPRESSIBILITY FACTOR @ INLET Z1	1.0
COMPRESSIBILITY FACTOR @ DISCH Z2	1.0
SCFM @ 14.7 Psia & 60 °F : ☒ DRY, ☐ WET.	2400
CFM @ INLET CONDITIONS	
WEIGHT FLOW, Lb/Min.	
INLET PRESSURE, Psia	15.5
INLET TEMPERATURE, °F	94 ①
DISCH. PRESSURE, Psia	164.5
DISCH. TEMPERATURE, °F	110
POLYTROPIC HEAD Ft.-Lb/Lb.	
COMPRESSOR BHP	
COMPRESSOR RPM	
BHP REQUIRED AT DRIVER SHAFT	
DRIVER RATED HP	
EST. SURGE CAPACITY @ RATED RPM, ICFM	
DISCH. TEMP. AT SURGE CAPACITY	
PERFORMANCE CURVE NO.	

GAS ANALYSIS

COMPOSITION	MOL. WT.	MOL. %	MOL. %	MOL. %	MOL. %

COMMENTS REGARDING GAS HANDLED: ① COMPRESSOR DRIVER TO BE SIZED FOR 17°F MIN. AMB. G.J.B. USING MINIMUM WATER TEMP OF 60°F.

FORM 135-82A

FOSTER WHEELER

MATERIAL REQUISITION

CENTRIFUGAL COMPRESSORS

FOR MEMPHIS LIGHT, GAS & WATER DIV. FW REF. 15-2200
SITE MEMPHIS, TENN.
SERVICE PLANT NITROGEN PACKAGE ITEM NO. C-3103 A/B

REQUISITION NO.	DATE
2231-1321-C	6/14/79

SUPERSEDED BY

CHG.	DATE	CHG.	DATE
C1		C4	
C2		C5	
C3		C6	

CONSTRUCTION DETAILS

MANUFACTURERS DATA: MODEL _____. CASING SPLIT: ☐ HORIZ., ☒ VERT., NO. STAGES _____.

IMPELLERS: TYPE: ☒ OPEN - BACKWARD LEANING, ☐ _____. DIA. _____ IN.
CONSTRUCTION: ☒ CAST, ☐ RIVETED, ☐ WELDED, ☐ MILLED, ☐ _____. TIP SPEED _____ FPS

SPEED DATA: MAX. CONT. _____ RPM. FIRST CRITICAL _____ RPM. SECOND CRITICAL _____ RPM.

COMPRESSOR ROTATION: VIEWED FROM DRIVER END OF UNIT: ☐ CW, ☐ CCW.

MATERIALS OF CONSTRUCTION:
CASING: ☐ CAST STEEL, ☐ FORGED STEEL, ☒ CAST IRON, ☐ _____.
DIAPHRAMS: _____. INTERSTAGE LABYRINTHS: NONE.
IMPELLERS: STAINLESS STEEL. SHAFT: AISI-8620. SLEEVES: NONE.
OTHER: _____.

TEMPERATURE AND PRESSURE LIMITATIONS:

MAX. WORKING TEMP:	SUCTION END _____ °F.	DISCH. END. _____ °F.
MIN. WORKING TEMP;	SUCTION END. _____ °F.	DISCH. END. _____ °F.
MAX. WORKING PRESS:	SUCTION END _____ Psig.	DISCH. END _____ Psig.
HYDRO. TEST PRESS:	SUCTION END _____ Psig.	DISCH. END _____ Psig

FLANGE RATINGS:

CONNECTION	SIZE (IN.)	ASA RATING	FACING	UP	DN	RT	LF	OTHER
MAIN SUCTION				☐	☐	☐	☐	
MAIN DISCHARGE				☐	☐	☐	☐	
				☐	☐	☐	☐	
				☐	☐	☐	☐	
				☐	☐	☐	☐	

ALL FLANGE ORIENTATIONS ARE VIEWED FROM THE DRIVER END OF THE UNIT. ALLOWABLE FLANGE LOADINGS SHALL BE INDICATED ON THE VENDORS CERTIFIED DRAWINGS.

SHAFT SEAL: ☐ LABYRINTH, ☐ RESTRICTIVE RING, ☐ LIQUID FILM, ☐ MECHANICAL (CONTACT).

SEALING MEDIUM: ☐ OIL, ☒ AIR, ☐ INERT GAS, ☐ _____.

BEARINGS: BEARING HOUSING CONSTRUCTION: ☐ INTERNAL, ☐ EXTERNAL.
JOURNAL BEARING TYPE: ☐ BABBITTED SLEEVE, ☐ _____.
LUBE: ☒ FORCE FEED, ☐ RING OIL, ☐ _____.
THRUST BEARING TYPE ☐ SINGLE KINGSBURY, ☐ DOUBLE KINGSBURY, ☐ BALL,
☐ ROLLER ☐ _____.
LUBE: ☒ FORCE FEED ☐ RING OIL, ☐ _____.

CASING DRAINS: QUANTITY ONE PER STAGE. SIZE 3/4". VENDOR SHALL FURNISH
☐ VALVED, ☒ PLUGGED, ☐ BLIND FLANGE, ☐ _____ CONNECTIONS.

BASEPLATE: SUPPLIED BY ☒ COMPRESSOR VENDOR, ☐ _____.
TYPE: ☒ CONTINUOUS STRUCTURAL STEEL COMMON TO COMPRESSOR AND DRIVE UNIT.
☒ CHOCK BLOCKS AND SHIMS FOR LEVELING.
PROVIDED WITH DRIP PAN ☐ YES, ☒ NO.

COUPLINGS: SUPPLIED BY ☒ COMPRESSOR VENDOR, ☐ _____.

LOCATION:	MOTOR-GEAR				
MFG:	THOMAS				
TYPE:	DBZ				
LUBE:	DRY				

J.B.

COUPLING GUARDS: SUPPLIED BY ☒ COMPRESSOR VENDOR, ☐ _____.
TYPE: ☐ SHEET METAL, ☐ NON-SPARKING, ☐ _____.

COMMENTS REGARDING CONSTRUCTION DETAILS: _____

FOSTER WHEELER ENERGY CORP.
110 SOUTH ORANGE AVENUE, LIVINGSTON, N.J.

MATERIAL REQUISITION

CENTRIFUGAL COMPRESSORS PAGE 4 OF 7

FOR MEMPHIS LIGHT, GAS & WATER DIV. FW REF. 15-2200
SITE MEMPHIS, TENN.
SERVICE PLANT NITROGEN PACKAGE ITEM NO. C-3103 A/B
MATERIAL COMPRESSOR AND SYSTEM COMPONENTS
SIZE AND TYPE NO. REQD. Two(2)
DRIVER: ☒ MOTOR, ☐ STEAM TURBINE, ☐

REQUISITION NO. 2231-1321-C DATE 6/14/79

SUPERSEDED BY

CHG.	DATE	CHG.	DATE
C1		C4	
C2		C5	
C3		C6	

LUBE AND SEAL OIL SYSTEMS: A FORCE FEED LUBE OIL SYSTEM COMMON TO THE ☒ COMPRESSOR, ☒ GEAR, SHALL BE FURNISHED BY THE COMP. MFR.

LUBE OIL SYSTEM

SYSTEM OPERATING PRESS. _____ Psig.
SYSTEM MAX. ALLOW OPER. PRESS. _____ Psig.

RESERVOIR: LOCATED ☒ IN BASE, ☐ ON CONSOLE.
CAPACITY _____ GAL. RET. TIME _____ MIN.
TO BE FURNISHED WITH ☐ ELECTRIC, ☐ STEAM HEATER, ☐ INSULATION SUPPORTS AND ☐

MAIN LUBE OIL PUMP: LOCATED ON ☒ BASE, ☐ CONSOLE AND DRIVEN BY ☒ BULL GEAR SHAFT, ☒ INDUCTION MOTOR, ☐ STEAM TURBINE.
MFR. _____. MODEL _____.
TYPE _____. CASE MATL. _____.
GPM _____. RPM _____. BHP _____.

AUX. LUBE OIL PUMP: LOCATED ON ☒ BASE, ☐ CONSOLE AND DRIVEN BY ☐ _____ SHAFT, ☒ INDUCTION MOTOR, ☐ STEAM TURBINE.
MFR. _____. MODEL _____.
TYPE _____. CASE MATL. _____.
GPM _____. RPM _____. BHP _____.

RELIEF VALVES: ☐ INTEGRAL, ☒ SEPARATE.

COOLERS: ☐ TWIN, ☒ SINGLE, LOCATED ON ☒ BASE, ☐ CONSOLE, _____.
MFR. _____. TYPE SHELL & TUBE.
CODE: ☐ TEMA C, ☐ _____.
SHELL: OD _____ IN. DES. PRESS. _____ Psig.
TUBES: OD 5/8 IN. BWG 16.
MATL: SHELL C.S. TUBES ADMIRALTY.

FILTERS: ☒ TWIN, ☐ SINGLE. LOCATED ON ☒ BASE, ☐ CONSOLE, ☐ _____.
MFR. _____. MODEL _____.
CASE MATL. C.S. MICRON 25(MAX).
ELEMENT: ☐ CLEANABLE, ☒ REPLACEABLE.

TRANSFER VALVE - PIPING PER FWEC 2200-39A3

SEAL OIL SYSTEM

SYSTEM OPERATING PRESS. _____ Psig.
SYSTEM MAX. ALLOW OPER. PRESS. _____ Psig.

RESERVOIR: LOCATED ☐ IN BASE, ☐ ON CONSOLE.
CAPACITY _____ GAL. RET. TIME _____ MIN.
TO BE FURNISHED WITH ☐ ELECTRIC, ☐ STEAM HEATER, ☐ INSULATION SUPPORTS AND ☐

MAIN SEAL OIL PUMP: LOCATED ON ☐ BASE, ☐ CONSOLE AND DRIVEN BY ☐ _____ SHAFT, ☐ INDUCTION MOTOR, ☐ STEAM TURBINE.
MFR. _____. MODEL _____.
TYPE _____. CASE MATL. _____.
GPM _____. RPM _____. BHP _____.

AUX. SEAL OIL PUMP: LOCATED ON ☐ BASE, ☐ CONSOLE AND DRIVEN BY ☐ _____ SHAFT, ☐ INDUCTION MOTOR, ☐ STEAM TURBINE.
MFR. _____. MODEL _____.
TYPE _____. CASE MATL. _____.
GPM _____. RPM _____. BHP _____.

RELIEF VALVES: ☐ INTEGRAL, ☐ SEPARATE.

COOLERS: ☐ TWIN, ☐ SINGLE. LOCATED ON ☐ BASE, ☐ CONSOLE, _____.
MFR. _____. TYPE _____.
CODE: ☐ TEMA C, _____.
SHELL: OD _____ IN. DES. PRESS. _____ Psig.
TUBES: OD _____ IN. BWG. _____.
MATL: SHELL _____. TUBES _____.

FILTERS: ☐ TWIN, ☐ SINGLE. LOCATED ON ☐ TWIN, ☐ CONSOLE, ☐ _____.
MFR. _____. MODEL _____.
CASE MATL. _____. MICRON _____.
ELEMENT: ☐ CLEANABLE, ☐ REPLACEABLE.

TRANSFER VALVES: MFR. _____.
QUAN. _____. TYPE _____. MATL. _____.

G.J.B.

OTHER:

FOSTER WHEELER ENERGY CORPORATION

MATERIAL REQUISITION

110 SOUTH ORANGE AVENUE, LIVINGSTON, N.J. CENTRIFUGAL COMPRESSORS 5 PAGE OF 7

FOR MEMPHIS LIGHT, GAS & WATER DIV. FW REF. 15-2200
SITE MEMPHIS, TENN.
SERVICE PLANT NITROGEN PACKAGE ITEM NO. C-3103A/B
MATERIAL COMPRESSOR AND SYSTEM COMPONENTS
SIZE AND TYPE _____ NO. REQD. TWO(2)
DRIVER: ☐ MOTOR,

REQUISITION NO.	DATE
2231-132I-C	6/14/79

SUPERSEDED BY

CHG.	DATE	CHG.	DATE
C1		C4	
C2		C5	
C3		C6	

CONTROL

NORMAL OPERATING: ELECTRO-PNEUMATIC CONTROL SYSTEM. SYSTEM CONTROL IS TO BE BY CONSTANT PLESSURE AND CONSTANT CAPACITY OPERATION. ALSO PROVIDE CONSTANT INLET DENSITY CONTROL WHICH PROVIDES DRIVER OVERLOAD PROTECTION BY MAINTAINING DESIGN PERFORMANCE ALL YEAR ROUND.

SURGE CONTROL: THE CONTROL SYSTEM SHALL ALSO INCLUDE ANTI-SURGE PROTECTION SYSTEM FOR THE COMPRESSOR WHICH INCORPORATES A FLOW SENSING ELEMENT AND SURGE SENSING DEVICE.

INSPECTION AND TESTING

			WITNESSED:	
COMPRESSOR:	☒	SHOP INSPECTION.	☒ YES	☐ NO
	☒	HYDROSTATIC TEST.	☐ YES	☒ NO
	☒	IMPELLER OVERSPEED 110 % OF MAX. CONT. RPM.	☐ YES	☒ NO
	☒	DYNAMIC BALANCE OF ROTOR	☐ YES	☒ NO
	☒	MECHANICAL RUN. & MFRS. STD. PERFORMANCE TEST. - 5 POINTS	☒ YES	☐ NO
	☒	CERTIFIED REPORTS OF ALL TESTS ARE REQUIRED TO BE FURNISHED TO THE PURCHASER.	☐ YES	☐ NO
			☐ YES	☐ NO
			☐ YES	☐ NO
DRIVER:	☒	MOTOR - STANDARD COMMERCIAL TESTS	☐ YES	☒ NO
	☐		☐ YES	☐ NO
	☐		☐ YES	☐ NO
	☐		☐ YES	☐ NO
CONSOLE:	☒	SHOP INSPECTION.	☒ YES	☐ NO
	☐		☐ YES	☐ NO
	☐		☐ YES	☐ NO
OIL COOLERS:	☒	HYDROSTATIC TEST _____ Psig OIL SIDE. _____ Psig WATER SIDE.	☐ YES	☒ NO
INTERCOOLERS:	☒	HYDROSTATIC TEST _____ Psig AIR SIDE. _____ Psig WATER SIDE.	☐ YES	☒ NO

COMMENTS REGARDING TESTING:

GJB

FOSTER WHEELER ENERGY CORPORATION

MATERIAL REQUISITION

CENTRIFUGAL COMPRESSORS 6 PAGE OF 7

FOR MEMPHIS LIGHT, GAS & WATER DIV. FW REF. 15-2200
SITE MEMPHIS, TENN.
SERVICE PLANT NITROGEN PACKAGE ITEM NO. C-3103 A/B

REQUISITION NO.	DATE
2231-1321-C	6/14/79

SUPERSEDED BY

CHG.	DATE	CHG.	DATE
C1		C4	
C2		C5	
C3		C6	

UTILITY DATA

ELECTRICAL:

CLASSIFICATION: ☐ CLASS I - GROUP D, ☐ DIV. 1, ☐ DIV. 2, ☒ NON-HAZARDOUS.
MOTORS 150 HP AND BELOW: 460 VOLTS, 3 PHASE, 60 CYCLES.
MOTORS 200 HP THROUGH 6000 HP: 4000 VOLTS, 3 PHASE, 60 CYCLES.
MOTORS 6500 HP AND ABOVE: 13,800 VOLTS, 3 PHASE, 60 CYCLES.
ALARM SWITCHES: ☒ AC, ☐ DC. 120 VOLTS, 1 PHASE, 60 CYCLES.
SHUTDOWN SWITCHES: ☒ AC, ☐ DC 120 VOLTS, 1 PHASE, 60 CYCLES.
SWITCH ENCLOSURE: ☐ EXPLOSION PROOF, ☒ WEATHER PROOF, ☐ _____.

STEAM:

	MAIN COMP. DRIVE MAX.	MAIN COMP. DRIVE NOR.	MAIN COMP. DRIVE MIN.	AUX. DRIVES MAX.	AUX. DRIVES NOR.	AUX. DRIVES MIN.
INLET Psig		NOT APPLICABLE				
INLET TT °F						
EXH. Psig						
In. HG. ABS.						

(A) DENOTES CONDITIONS AT WHICH STEAM RATE IS TO BE GUARANTEED.

COOLING WATER:

☐ FRESH, ☐ SALT, ☒ COOLING TOWER.
AVAILABLE AT 75 Psig AND 88 °F. FOULING FACTOR .001 WATERSIDE
ALLOW TEMP. RISE 30 °F. ALLOW PRESSURE DROP 15 Psi.

INSTRUMENT AIR:

AVAILABLE TO CONTROL DEVICES AT 100 Psig.

DRIVER AND UTILITY SUMMARY

MOTORS:

	QUAN.	MFR.	TYPE	ENCL.	HP	SF	RPM	
☒ COMPRESSOR DRIVE	TWO(2)		INDUCTION	WPII				
☐ LUBE PUMP DRIVE								
☐ SEAL PUMP DRIVE								
☒ STANDBY LUBE OIL PUMP DRIVE	TWO(2)		INDUCTION	TEFC				

STEAM TURBINES:

	QUAN.	MFR.	TYPE	STAGES	HP	RPM	WR	
☐ COMPRESSOR DRIVE			NOT APPLICABLE					
☐ LUBE PUMP DRIVE								
☐ SEAL PUMP DRIVE								
☐ _____								

DRIVERS MARKED ☒ SHALL BE FURNISHED BY THE COMP. VENDOR. SEE PAGE _____ OF THIS REQ'N. FOR COMPLETE DETAILS OF THE MAIN COMPRESSOR DRIVE UNIT.

COOLING WATER CONSUMPTION:

LUBE OIL COOLERS	____ GPM	____	°F. RISE.
SEAL OIL COOLERS	____ GPM	____	°F. RISE.
INTER COOLERS	____ GPM	____	°F. RISE.
____	____ GPM	____	°F. RISE.
____	____ GPM	____	°F. RISE.

STEAM CONSUMPTION:

COMPRESSOR DRIVE	NOT	Lb/Hr.
EACH LUBE PUMP DRIVE	____	Lb/Hr.
EACH SEAL PUMP DRIVE	APPLICABLE	Lb/Hr.
____	____	Lb/Hr.
____	____	Lb/Hr.

COMMENTS REGARDING UTILITIES: _____

GJB

FOSTER WHEELER ENERGY CORPORATION

SQUIRREL CAGE INDUCTION MOTORS

FORM 135-49

	REQUISITION NUMBER	DATE
F.W.C. CONTRACT 15-2200	2231-1321-C	6/14/79
FOR: MEMPHIS LIGHT, GAS & WATER DIV.	SUPERSEDED BY CHANGE NO.:	
SITE: MEMPHIS, TENN.	C1 C3 C5	
MANUFACTURER:	C2 C4 C6	

APPLICABLE DOCUMENTS:

MOTOR SPECIFICATION 2200-38A7
PREP. FOR SHIPMENT
GENERAL NOTES 2200-1300-A

SITE DATA:

ALTITUDE 100 FT. BAROMETER 14.7 PSIA
AMBIENT 98 °F. MAX. TO 17 °F. MIN.
ATMOSPHERE
INSTALLED ☐ INDOOR ☒ OUTDOOR ☐
AREA ☐ CL. -GR. -DIV. . ☒ NON-HAZARDOUS.

ITEM NUMBERS:	C-3103 A/B
MANUFACTURER	
TOTAL QUANTITY	TWO(2)
DRIVEN EQUIPMENT	CENTRIFUGAL COMPRESSOR
HP NAMEPLATE RATING (1)	
SERVICE FACTOR (1)	
RPM AT FULL LOAD / NO. POLES (1)	
VOLTS / PHASES / HERTZ	4000 / 3 / 60
ENCLOSURE	WPII
°C. RISE AT FULL S.F. LOAD (1)	
TEMP. MEASUREMENT METHOD	THERMISTORS
INSULATION CLASS	B
INSUL. SPECIAL TREATMENT (1)	(FOR ABRASIVE SERVICE)
SPECIAL HARDWARE	
FRAME NUMBER (1)	
MOUNTING ASSEMBLY NUMBER	
ROTATE FROM END OPP. CPLG.	
BEARINGS TYPE (1)	
LUBRICATION (1)	
END FLOAT (IF APPL.) INS.	
N.E.M.A. DESIGN LETTER	
AMPS.: F.L. / LOCKED ROTOR (1)	
LOCKED ROTOR LIMIT, SECS. (1)	
%EFFIC. 100% / 75% / 50% LOAD (1)	
% P.F. 100% / 75% / 50% LOAD (1)	
NOISE LEVEL (dba @ 3FT) (1)	

ACCESSORIES:	
BASE	BY COMPRESSOR VENDOR
SPACE HEATERS: WATTS (1)	
VOLTS / PH / HZ	
TEMP. DETECTORS: NUMBER (1)	
TYPE (1)	
AIR FILTERS	YES
MOUNTING COUPLING HALF	

TESTS: (W = WITNESSED)	
N.E.M.A. STD. COMMERCIAL	YES (NON-WITNESSED) (1) VENDOR SHALL FURNISH THIS INFORMATION WITH PROPOSAL
TEST CERTIFICATES REQ'D.	YES

GJB

WEIGHTS: (LBS)	
NET / GROSS (1)	
MAX. NORMAL MAINTENANCE (1)	

REQUISITION

FOSTER WHEELER ENERGY CORPORATION

CLIENT MEMPHIS LIGHT, GAS & WATER	CONTRACT NO. 15-2203	REQUISITION NO.			DATE
SITE MEMPHIS, TENN.	ITEM NO. A-3101	2231-1919A			6/8/79
MATERIAL AIR SEPARATION PLANT		C1	6/29/79	C4	
OR		C2	7/30/79	C5	
SERVICE		C3		C6	

I. GENERAL

A. Vendor shall design and furnish a complete Air Separation Plant to supply gaseous oxygen of 98% purity for the production of industrial fuel gas from coal. The plant will also supply (1) liquid oxygen to make up to storage from which it is vaporized to provide an alternate source of gaseous oxygen, (2) gaseous nitrogen for plant use and (3) liquid nitrogen to make up storage from which it is vaporized to provide instrument nitrogen, dilution gas for credit generation and backup for gaseous nitrogen.

B. Equipment shall be shop-assembled to the maximum extent possible without causing difficulties in transportation to the jobsite.

C. The scope of supply will not include the air, oxygen and nitrogen compressors. The battery limits of the plant will, therefore, terminate at the discharge of the air compressor downstream of the aftercoolers and compressor controls and at the suctions of the oxygen and nitrogen compressors. Refer to FWEC Process Flow Diagrams 2202-1-50-31101 and 31102 (enclosed).

D. All piping, instrumentation and electricals required within the Air Separation Plant Battery Limits to complete a fully operational installation shall be furnished by the vendor.

E. The Waste Nitrogen Silencer, Item SL-3101, plus all other required vent silencers shall be furnished by vendor.

F. The installation will be outdoors.

G. All equipment and/or material and their installation shall be in accordance with all local, state and federal codes, laws, rules and regulations applicable thereto. Any conflict between PURCHASER'S drawings, specifications, standards, etc., and applicable codes, etc., shall immediately be brought to the attention of PURCHASER.

II. PROCESS SPECIFICATIONS

A. The battery limit pressures relative to the compressors and directly at the Air Separation Plant have been assumed as follows and are to be confirmed by the vendor:

STREAM	TEMP. F.	PRESSURE, psia
1. Air into Air Separation Package	100	100
2. Oxygen Gas out of Air Separation Package	94	15.5

BY	P.O. NO.	SUPPLIER

STREAM	TEMP. F	PRESSURE, psia
3. Waste Nitrogen Gas out of Air Separation Package	94	15.5
4. Bone Dry Nitrogen Gas out of Air Separation Package	94	15.5
5. Liquid Oxygen (98%) out of Air Separation Package	-291	50
6. Liquid Nitrogen (10 ppm O_2) out of Air Separation Package	-315	50

B. Process Requirements

(2) 1. For each of the following cases, the plant must be capable of simultaneous production of the product quantities shown at the conditions respectively indicated:

a. Base Case (3 Gasifiers - 100% Plant Capacity)

	Rate	Purity	Pressure	Temp.
Gaseous O_2	1733 ST/D (100% O_2)	98% by vol.	15.5 psia	94 F
Gaseous N_2	600 ST/D	10 ppm O_2 Max. bone dry	15.5 psia (1)	94 F
Liquid N_2	200 ST/D(2)	10 ppm O_2 Max.	50 psig	-315 F

(1) Vendor is to state if nitrogen is readily available at some higher pressure.

(2) Liquid N_2 rate is a nominal value which may be adjusted, with FWEC approval, by the vendor.

b. ALTERNATE 1 (4 Gasifiers - 100% Plant Capacity)

	Rate	Purity	Pressure	Temp.
Gaseous O_2	1916 ST/D (100% O_2)	98% by vol.	15.5 psia	94 F
Gaseous N_2	600 ST/D	10 ppm O_2 Max. bone dry	15.5 psia (1)	94 F
Liquid N_2	200 ST/D(2)	10 ppm O_2 Max.	50 psia	-315 F

11-B-1 PROCESS REQUIREMENTS (cont'd.)

c. ALTERNATE 2 (4 Gasifiers - 100% Plant Capacity/99.5% O_2)

	Rate	Purity	Pressure	Temp.
Gaseous O_2	1916 ST/D (100% O_2)	99.5% by vol.	15.5 psia	94 F
Gaseous N_2	600 ST/D	10 ppm O_2 Max. bone dry	15.5 psia(1)	94 F
Liquid N_2	200 ST/D	10 ppm O_2 Max.	50 psia	-315 F

d. ALTERNATE 3 (LIQ. O_2 Production at Reduced Capacity)

	Rate	Purity	Pressure	Temp.
Gaseous O_2	By vendor	98% by vol.	15.5 psia	94 F
Gaseous N_2	600 ST/D	10 ppm O_2 Max. bone dry	15.5 psia(1)	94 F
Liquid N_2	200 ST/D(2)	100 ppm O_2Max.	50 psia	-315 F
Liquid O_2	100 ST/D	98% by vol.	50 psia	-291 F

e. ALTERNATE 4 (3 Gasifiers - 100% Plant Capacity/Max. Liq. O_2)

	Rate	Purity	Pressure	Temp.
Gaseous O_2	1733 ST/D (100% O_2)	98% by vol.	15.5 psia	94 F
Gaseous N_2	600 ST/D	10 ppm O_2 bone dry	15.5 psia	94 F
Liquid N_2	200 ST/D Max.	10 ppm O_2 Max.	50 psia	-315 F
Liquid O_2	Max. by Vendor	98% by vol.	50 psia	-291 F

f. ALTERNATE 5 (3 Gasifiers - 100% Plant Capacity/Max. Liq. N_2)

	Rate	Purity	Pressure	Temp.
Gaseous O_2	1733 ST/D (100% O_2)	98% by vol.	15.5 psia	94 F
Gaseous N_2	600 ST/D	10 ppm O_2 bone dry	15.5 psia	94 F
Liquid N_2	Max. by Vendor	10 ppm O_2 Max.	50 psia	-315 F

2. The air separation package shall be supplied by 2 air compressors each sized for 50% of the design air requirements as specified by the air separation package vendor. The air separation package must be capable of producing specification quality product streams, for all cases, with only one air compressor on line.

3. The required number of trains is one.

4. A material and utility balance (including export power) need only be provided for the base case.

5. Vendor must specify design requirements of air compressors including design flow rate and delivery pressure at battery limits of the air separation package.

III. AVAILABLE UTILITIES

A. Instrument Air: 80 psig @ ambient temperature

B. Steam: 85 psig saturated

C. Electric Power: 120 V, 1 ϕ, 60HZ
460 V, 3 ϕ, 60HZ
4000 V, 3 ϕ, 60HZ

IV. METEOROLOGICAL DATA

A. Design Ambient Air Conditions

1. Temperature: Summer - 100 F (DB), 80 F (WB)
Winter - 17 F

2. Relative Humidity: 50% (Summer)

3. Barometic Pressure: 14.5 psia

4. Prevailing Wind Direction: Summer - South (10mph)
Winter - North (10mph)

B. Seismic Zone: Zone 3, per ANSI A58.1

C. Design Wind Loads: Per ANSI A58.1

V. MECHANICAL SPECIFICATIONS

A. Materials of construction and corrosion allowances shall be as recommended by vendor in order to achieve a 20 year life for major equipment and a 10 year life for replaceable internals. (e.g. tower trays, exhcangers bundles, etc.)

B. The pertinent FWEC Job Specifications for the design of this equipment are as follows:

Spec. No.	Title
2200-01A1	Basic Engineering Data
-10A1	Welded Unfired Pressure Vessels
-11A1	Tower Trays & Other Internals
-21A1	Tubular Exchangers
-70A1	Electrical Standard
-83A1	Painting
-50A1	Piping
-88C1	Welding Requirements for Equipment and Piping
-46A1	Structural Steel
-95A2	Noise Control - Equipment
-97A1	Preparation of Material for Shipment
-1900A	General Notes Requisition for Miscellaneous Equipment

C. Mechanical Design Conditions

	Rate	Purity	Pressure	Temp.
Gaseous O_2	1916 ST/D (100% O_2)	99.5%	15.5 psia	94F
Gaseous N_2	600 ST/D	10 ppm O_2 Max bone dry	15.5 psia	94F
Liquid N_2	200 ST/D	10 ppm O_2 Max	50 psia	-315F
Liquid O_2	100 ST/D	98% by Vol.	50 psia	-291F

VI. EQUIPMENT SPECIFICATIONS

A. Vessels and Exchangers

Vendor shall supply overall dimensions for all vessels and exchangers being furnished by him. These items shall be designed, fabricated and stamped in accordance with the latest edition of the ASME Boiler and Pressure Vessel Code. Exchangers shall, in addition, be designed per TEMA requirements.

B. Rotating Equipment

Vendor is to state manufacturer, size and type of every item of equipment being furnished as part of his scope of supply, including weight information and utility consumption.

C. Civil

1. The vendor is required to supply all structural steel needed for the erection of the Air Separation Plant, including handrails, ladders and stairways.

2. Vendor shall furnish a layout and elevation drawing showing all equipment, major structural members, platforming, ladders, etc., necessary for assembly, operation and maintenance of the Air Separation Plant.

3. Foundations and anchor bolts will be by others.

D. Piping

1. Vendor shall furnish all piping between and within the components he supplies, including all process, instrumentation and utility valves.

2. Utility piping to vendor's equipment will be by others.

E. Instruments

1. All local instrumentation and controls necessary for safe and proper operation of the Air Separation Plant shall be furnished by vendor.

2. Electronic control instruments, recorders, indicators, annunciators, etc. with associated signal processing auxillaries for the air plant will be located in the control console in the main control room. This equipment will be furnished by others as part of an overall plant distributed control system.

All field transmitters will be furnished by the air plant vendor and subject to type approval by FWEC. Output from transmitters to the control room shall be 4-20 MADC from certified intrinsically safe devices. All outputs to the field from the control room shall be 4-20 MADC for connection to certified intrinsically safe devices furnished by the air plant vendor.

Air plant vendor will furnish full P. & I.D. drawings indicating vendor approved and recommended control system scheme for the air plant. FWEC will make comments where required and incorporate vendor's scheme in the plant distributed control system.

Local control loop items with no connection required to the control room will be 3-15 psig, pneumatic type and furnished by the air plant vendor.

3. Safety and relief valves shall be of a type approved by ASME for this service.

4. All important alarm and shutdown functions will be monitored by a visual alarm system located on the main control panel.

5. All instruments, control valves, etc., being furnished by the vendor shall be of manufacture and type suitable to Purchaser. Vendor shall furnish with his proposal a general scope of instruments and controls complete with manufacturer's names.

F. Electricals

1. All electrical apparatus supplied by vendor shall conform to NEC and NEMA codes.

2. All equipment and materials must be suitable for installation in an outdoor electrically unclassified area subject to a corrosive atmosphere.

3. Vendor shall, as far as possible, completely wire all the various components of the equipment being furnished. That wiring which is to be continued by Purchaser or connected into Purchaser's system shall terminate in junction boxes having suitable terminal strips.

4. Vendor shall furnish a wiring diagram which clearly indicates that position of the wiring and electrical items being furnished by him and that portion by Purchaser. All terminal points are to be adequately identified.

G. Insulation

All insulation for piping and equipment within the Air Separation Plant, necessary for its efficient operation, shall be furnished and installed by vendor.

H. Painting

Painting shall be according to Job Spec. 2200-83A1.

VII. GENERAL REQUIREMENTS OF VENDOR'S QUOTATION

Vendor shall furnish the following information with his proposal:

A. Material balance indicating quantities, temperatures and pressures of all process streams and all entering and leaving streams.

B. Expected utility consumptions and available expander-generator power output.

C. An engineering flow diagram showing all equipment, piping, instruments, etc.

D. A proposed Plot Plan and Elevation drawing per Section V-C-2 of this requisition.

E. A complete description of the Materials of Construction for all items being supplied.

F. Estimated field manhours required for erection of all vendor-supplied equipment, including testing, insulation and painting.

G. Estimated total installed weight and foundation dimensions. Vendor shall furnish foundation loadings and describe any special foundation design requirements.

H. A description of the extent of shop assembly of all items supplied.

I. An estimate for complete materials within the Air Separation Plant including all engineering services required for (1) specification procurement and manufacture of equipment, (2) design associated with the installation and interconnection of equipment at the jobsite and (3) plant commissioning, start-up and operator training.

J. A proposed schedule for delivery of drawings and equipment and for field erection of the plant.

K. In addition to the above, vendor shall comply with the requirements of General Notes Requisition 2200-1900A.

VIII. START-UP AND PERFORMANCE GUARANTEE

Vendor shall be responsible for providing start-up services for his equipment and shall guarantee that the unit fulfills FWEC process requirements.

REQUISITION

FOSTER WHEELER ENERGY CORPORATION

CLIENT Memphis Light, Gas & Water	CONTRACT NO. 15-2203	REQUISITION NO.			DATE
SITE Memphis, Tennessee	ITEM NO. A-3102, A-3103	2231-1919 B			6/12/79
MATERIAL Liquid Nitrogen Vaporization	TK-3101	C1	7/23/79	C4	
OR Packages		C2		C5	
SERVICE		C3		C6	

I. GENERAL

(1) A. Vendor shall design and furnish the following liquid nitrogen storage and vaporization systems to supply gaseous nitrogen. The systems will act as backup to a Main Air Separation Plant and will thus provide intermittent service.

1. Liquid Nitrogen Storage Tank - Item TK-3101
2. Instrument Nitrogen Vaporization Package - Item A-3103
3. Liquid Nitrogen Vaporization Package - Item A-3102

(1) B. Vaporization equipment shall be shop-assembled to the maximum extent possible without causing difficulties in transportation to the jobsite. The storage tank shall be field erected by Vendor.

C. All piping, instrumentation and electricals required for a fully operational installation shall be supplied by vendor.

D. The installation will be outdoors.

E. All equipment and/or material and their installation shall be in accordance with all local, state and federal codes, laws, rules and regulations applicable thereto. Any conflict between Purchaser's drawings, specifications, standards, etc., and applicable codes, etc., shall immediately be brought to the attention of Purchaser.

II. PROCESS SPECIFICATIONS

A. Liquid Nitrogen Storage Tank, TK-3101

1. Capacity: 12,000 tons of liquid nitrogen, bone dry, with 10 vppm of O_2.

2. Evaporation losses: Not to exceed 0.32% of storage capacity per day.

B. Instrument Nitrogen Vaporization Package, A-3103
(To include a liquid nitrogen delivery pump)

1. Delivery rate: 600 SCFM of gaseous N_2
2. Delivery pressure: 100 psig
3. Delivery temperature: 80°F
4. Vaporizer fuel: Natural gas

BY RB	P.O. NO.	SUPPLIER

C. Liquid Nitrogen Vaporization Package, A-3102
(To include three liquid nitrogen delivery pumps)

1.	Delivery rate:	6000 tons per day
2.	Delivery pressure:	225 psig
3.	Delivery temperature:	80°F
4.	Vaporizer fuel:	Natural gas
5.	Pump capacity:	4000 tons liquid N_2 per day for each of three pumps

III. AVAILABLE UTILITIES

A.	Instrument Air:	80 psig @ ambient temp.
B.	Steam:	85 psig saturated
C.	Electric Power:	120V, 1Ø, 60 Hz 460V, 3Ø, 60 Hz
D.	Natural Gas:	≈1000 Btu/ft^3

IV. METEOROLOGICAL DATA

A. Design Ambient Air Conditions

1.	Temperatures:	Summer 100°F (DB) 80°F (WB) Winter 17°F
2.	Relative Humidity:	50% (summer)
3.	Barometric Pressure:	14.5 psia
4.	Prevailing Wind Conditions:	Summer - South @ 10 mph Winter - North @ 10 mph

(1) B. Seismic Conditions: Per ANSI A58.1 - Seismic Zone 3

(1) C. Wind Loadings: Per Southern Building Code, 1976
See Job Spec. 2200-01A1 for details.

V. MECHANICAL SPECIFICATIONS

A. Materials of construction and corrosion allowances shall be as recommended by vendor in order to achieve a 20 year life for major equipment and a 10 year life for easily replaceable internals.

B. The applicable FWEC Job Specifications for the design of this equipment are as follows:

	Spec. No.	Title
	2200-01A1	Basic Engineering Data
	-10A1	Welded Unfired Pressure Vessels
	-11A1	Tower Trays & Other Internals
(1)	-50A1	Piping
	-21A1	Tubular Exchangers
	-70A1	Electrical Standard
	-83A1	Painting
(1)	-46A1	Structural Steel
	-88C1	Welding Requirements for Equipment and Piping
(1)	-97A1	Preparation of Material for Shipment
	-1900A	General Notes Requisition for Miscellaneous Equipment

In addition, these FWEC Engineering Standards apply:

(1) 95A2 - Noise Control - Equipment

VI. EQUIPMENT SPECIFICATIONS

A. Vessels and Exchangers

1. Vendor shall supply overall dimensions for a vessels and exchangers being furnished by him. These items shall be designed, fabricated and stamped in accordance with the latest edition of the ASME Boiler and Pressure Vessel Code. Exchangers shall, in addition, be designed per TEMA requirements.

(1) 2. TK-3101 shall have a pressure build-up coil to maintain a vapor pressure of 0.8 psig in the tank. Provision shall be made to fill the tank from the top in addition to the normal bottom fill. The tank shall be capable of supplying nitrogen to service during filling.

B. Rotating Equipment

Vendor is to state manufacturer, size and type of every item of equipment being furnished under his scope of supply, including weight information and utility consumption.

C. Civil

1. The vendor shall supply all structural steel needed for the erection of these packages, including handrails, ladders, and stairways.

2. Vendor shall furnish a layout and elevation drawing showing all equipment, major structural members, platforming, ladders, etc., necessary for proper assembly, operation and maintenance of the units.

(1) 3. Foundation and concrete work will be by others, but vendor shall furnish loading information and describe only special requirements of foundation design for this equipment.

D. Piping

1. Vendor shall furnish all piping between and within the components he supplies, including all process, instrumentation and utility valves.

2. Utility piping to vendor's equipment will be by others.

E. Instruments

(1) 1. All local instrumentation and controls necessary for safe and proper operation of these packages shall be furnished by vendor

(1) 2. Electronic control instruments, recorders, indicators, annunciators, etc., with associated signal processing auxillaries for the vaporizer packages will be located in the control console in the main control room. This equipment will be furnished by others as part of an overall plant distributed control system.

All field transmitters will be furnished by the vaporizer vendor and subject to type approval by FWEC. Output from transmitters to the control room shall be 4-20 MADC from certified intrinsically safe devices. All outputs to the field from the control room shall be 4-20 MADC for connection to certified intrinsically safe devices furnished by the vendor.

Vendor will furnish full P. & I.D. drawings indicating vendor approved and recommended control system scheme for the vaporizer packages. FWEC will make comments where required and incorporate vendor's scheme in the plant distributed control system.

Local control loop items with no connection required to the control room will be 3-15 psig, pneumatic type and furnished by the vendor.

3. Safety and relief valves shall be of a type approved by ASME for this service.

4. All important alarm and shutdown functions will be monitored by a visual alarm system located on the main control panel.

5. All instruments, control valves, etc., being furnished by the vendor shall be of manufacture and type suitable to Purchaser. Vendor shall furnish with his proposal a general scope of instruments and controls complete with manufacturer's names.

F. Electrical

1. All electrical apparatus supplied by vendor shall conform to NEC and NEMA codes.

2. All equipment and materials must be suitable for installation in an outdoor electrically unclassified area subject to a corrosive atmosphere.

3. Vendor shall, as far as possible, completely wire all the various components of the equipment being furnished. That wiring which is to be continued by Purchaser or connected into Purchaser's system shall terminate in junction boxes having suitable terminal strips.

4. Vendor shall furnish a wiring diagram which clearly indicates that position of the wiring and electrical items being furnished by him and that portion by Purchaser. All terminal points are to be adequately identified.

G. Insulation

All insulation for piping and equipment in these systems necessary for their efficient operation shall be furnished and/or installed by vendor.

H. Painting

Painting shall be according to Job Spec. 2200-83A1.

VII. GENERAL REQUIREMENTS OF VENDOR'S QUOTATION

Vendor shall furnish the following information with his proposal:

A. Material balance indicating quantities, temperatures, and pressures of all process streams and all entering and leaving streams.

B. Expected utility consumptions.

C. An engineering flow diagram showing all equipment, piping, instruments, etc.

D. A proposed Plot Plan and Elevation drawing per Section VI-C-2 of this Requisition.

E. A complete description of the Materials of Construction for all items being supplied.

F. Estimated field manhours required for erection of all vendor-supplied equipment, including testing, insulation and painting.

G. Estimated total installed weight and foundation dimensions. Vendor shall completely describe any special concrete work needed for this installation and to be provided by others.

H. A description of the extent of shop assembly of all items supplied.

I. An estimate for complete materials for all equipment described herein, including all engineering services required for (1) specification, procurement and manufacture of equipment, (2) design associated with the installation and interconnection of equipment at the jobsite, (3) plant start-up and (4) acceptance testing.

(1)

J. A proposed schedule for delivery of drawings and equipment and for field erection of the units.

K. In addition to the above, vendor shall comply with the requirements of General Notes Requisition 2200-1900A.

REQUISITION

FOSTER WHEELER ENERGY CORPORATION

CLIENT Memphis Light, Gas & Water CONTRACT NO. 15-2203		REQUISITION NO.			DATE
SITE Memphis, Tenn. ITEM NO. A-3104		2231-1919D			6/11/79
MATERIAL Liquid Oxygen Vaporization Package TK-3102	C1	7/25/79	C4		
OR	C2		C5		
SERVICE	C3		C6		

I. GENERAL

(1) A. Vendor shall design and furnish one Liquid Oxygen Storage and Vaporization System to supply gaseous oxygen. The system will act as a backup to a main air separation plant and will thuss see intermittent service.

(1) B. Vaporization equipment shall be shop-assembled to the maximum extent possible without causing difficulties in transportation to the jobsite. The storage tank shall be field erected by the vendor

C. All piping, instrumentation and electricals required for a fully operational installation shall be supplied by vendor.

D. The installation will be outdoors.

E. All equipment and/or material and their installation shall be in accordance with all local, state, and federal codes, laws, rules and regulations applicable thereto. Any conflict between Purchaser's drawings, specifications, standards, etc., and applicable codes, etc., shall immediately be brought to the attention of Purchaser.

II. SCOPE OF SUPPLY

Vendor shall supply the following equipment.

A. Liquid oxygen storage tank (Item TK-3102)

B. Liquid oxygen vaporization system (Item A-3104) including a liquid oxygen delivery pump.

III. PROCESS SPECIFICATIONS

A. Liquid Oxygen Storage Tank (TK-3102)

1. Capacity: 1000 tons of liquid oxygen of 98 volume % purity (2% N_2)

2. Evaporation Losses: not to exceed 0.2% of storage capacity per day.

B. Liquid Oxygen Vaporization Package (A-3104)

Package must be capable of delivering gaseous oxygen as follows:

Delivery Rate:	1916 tons per day
Delivery Pressure:	105 psig
Delivery Temperature:	220F

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BY R.B.	P.O. NO.	SUPPLIER

IV. AVAILABLE UTILITIES

A.	Instrument air:	80 psig @ ambient temp.
B.	Steam :	85 psig saturated
C.	Electric Power:	120V 1Ø, 60 HZ 460V 3Ø, 60 HZ
D.	Natural Gas :	1000 Btu/ft^3

V. METEOROLOGICAL DATA

A. Design Ambient Air Conditions

1.	Temperatures:	Summer 100F (DB) 80F (WB) Winter 17F
2.	Relative Humidity:	50% (summer)
3.	Barometric Pressure:	14.5 psia
4.	Prevailing Wind Conditions:	Summer - South @ 10 mph Winter - North @ 10 mph

(1) B. Seismic Conditions: per ANSI A58.1 - Seismic Zone 3

(1) C. Wind Loadings: per Southern Building Code, 1976 (See Job Spec. 2200-01A1 for details)

VI. MECHANICAL SPECIFICATIONS

A. Materials of construction and corrosion allowances shall be as recommended by vendor in order to achieve a 20 year life for major equipment and a 10 year life for easily replaceable internals.

B. The applicable FWEC Job Specifications for the design of this equipment are as follows:

Spec. No.	Title
2200-01A1	Basic Engineering Data
-10A1	Welded Unfired Pressure Vessels
-11A1	Tower Trays & Other Internals
(1) -50A1	Piping
-21A1	Tubular Exchangers
-70A1	Electrical Standard
-83A1	Painting
(1) -46A1	Structural Steel
-88C1	Welding Requirements for Equipment and Piping
(1) -97A1	Preparation of Material for Shipment

VI - B. MECHANICAL SPECIFICATIONS (Cont'd)

Spec. No.	Title
2200-1900A	General Notes Requisition for Miscellaneous Equipment

In addition these FWEC Engineering Standards apply:

(1) 95A2 - Noise Control - Equipment

VII. EQUIPMENT SPECIFICATIONS

A. Vessels and Exchangers

1. Vendor shall supply overall dimensions for vessels and exchangers being furnished by him. These items shall be designed, fabricated and stamped in accordance with the latest edition of the ASME Boiler and Pressure Vessel Code. Exchangers shall, in addition, be designed per TEMA requirements.

2. TK-3102 shall have a pressure build up coil to maintain a vapor pressure of 0.8 psig in the tank. Provision shall be made to fill the tank from the top in addition to the normal bottom fill. The tank shall be capable of supplying oxygen to service during filling.

B. Rotating Equipment

Vendor is to state manufacturer, size and type of every item of equipment being furnished under this scope of supply, including weight information and utility consumption.

C. Civil

1. The vendor shall supply all structural steel neeeded for the erection of this package including handrails, ladders, and stairways.

2. Vendor shall furnish a layout and elevation drawing showing all equipment, major structural members, platforming, ladders, etc., necessary for proper assembly, operation and maintenance of this unit.

(1) 3. Foundation and concrete work will be by others, but vendor shall furnish loading information and describe any special requirements of foundation design for this equipment.

D. Piping

1. Vendor shall furnish all piping between and within the components he supplies, including all process, instrumentation and utility valves.

2. Utility piping to vendor's equipment will be by others.

VII. EQUIPMENT SPECIFICATIONS (Cont'd.)

E. Instruments

(1) 1. All local instrumentation and controls necessary for safe and proper operation of this package shall be furnished by vendor.

(1) 2. Electronic control instruments, recorders, indicators, annunciators, etc. with associated signal processing auxillaries for the vaporizer will be located in the control console in the main control room. This equipment will be furnished by others as part of an overall plant distributed control system.

All field transmitters will be furnished by the vendor and subject to type approval by FWEC. Output from transmitters to the control room shall be 4-20 MADC from certified intrinsically safe devices. All outputs to the field from the control room shall be 4-20 MADC for connection to certified intrinsically safe devices furnished by the vendor.

Vendor will furnish full P. & I.D. drawings indicating vendor approved and recommended control system scheme for the vaporizer. FWEC will make comments where required and incorporate vendor's scheme in the plant distributed control system.

Local control loop items with no connection required to the control room will be 3-15 psig, pneumatic type and furnished by the vendor.

3. Safety and relief valves shall be of a type approved by ASME for this service.

4. All important alarm and shutdown functions will be monitored by a visual alarm system located on the main control panel.

5. All instruments, control valves, etc., being furnished by the vendor shall be of manufacture and type available to Purchaser. Vendor shall furnish with his proposal a general scope of instruments and controls complete with manufacturer's names.

F. Electrical

1. All electrical apparatus supplied by vendor shall conform to NEC and NEMA codes.

2. All equipment and materials must be suitable for installation in an outdoor, electrically unclassified area subject to a corrosive atmosphere.

3. Vendor shall, as far as possible, completely wire all the various components of the equipment being furnished. That wiring which is to be continued by Purchaser or connected into Purchaser's system shall terminate in junction boxes having suitable terminal strips.

4. Vendor shall furnish a wiring diagram which clearly indicates that portion of the wiring and electrical items being furnished by him and that portion by Purchaser. All terminal points are to be adequately identified.

G. Insulation

All insulation for piping and equipment in the Liquid Oxygen Vaporization Package necessary for its efficient operation, shall be furnished and/or installed by vendor.

H. Painting

Painting shall be according to Job Spec. 2200-83A1.

VIII. GENERAL REQUIREMENTS OF VENDOR'S QUOTATION

Vendor shall furnish the following information with his proposal:

A. Material balance indicating quantities, temperatures and pressures of all process streams and all entering and leaving streams.

B. Expected utility consumptions.

C. An engineering flow diagram showing all equipment, piping, instruments, etc.

D. A proposed Plot Plan and Elevation drawing per Section V-C-2 of this Requisition.

E. A complete description of the Materials of Construction for all items being supplied.

F. Estimated field manhours required for erection of all vendor - supplied equipment, including testing, insulation and painting.

G. Estimated total installed weight and foundation dimensions. Vendor shall completely describe any special concrete work needed for this installation and to be installed by others.

H. A description of the extent of shop assembly of all items supplied.

I. An estimate for complete materials for the Liquid Oxygen Vaporization Package, including all engineering services required for (1) specification, procurement and manufacture of equipment, (2) design associated with the installation and interconnection of equipment at the jobsite, (3) plant start-up and (4) acceptance testing. (1)

J. A proposed schedule for delivery of drawings and equipment and for field erection of the equipment.

K. In addition to the above, vendor shall comply with the requirements of General Notes Requisition 2200-1900A.

REQUISITION

FOSTER WHEELER ENERGY CORPORATION

CLIENT MLGW/DOE	CONTRACT NO.	REQUISITION NO.			DATE
SITE Memphis, Tennessee	ITEM NO. F-3101 A/B	2231-1397 A			6/1/79
MATERIAL Air Filter		C1		C4	
OR		C2		C5	
SERVICE		C3		C6	

I. SCOPE OF SUPPLY

Vendor shall furnish a total of two (2) air filters and accessories in accordance with this requisition. The vendors scope of supply shall consist of the following items:

A. Inlet filter plenum package consisting of three stage filtration, prefiltration is to be by louvered dust separation and is to be self cleaning type, second stage is to be disposable, adhesive-impregnated glass-fiber air filter, final stage shall be high efficiency cartridge filter.

B. The filter plenum enclosure shall include two (2) blow-in-doors with limit switch.

C. Prefilter shall be provided with TEFC motor(s) to drive secondary air fans (230/460/3/60).

D. High filter differential pressure switch.

E. Inlet silencer for 85 dba at 3 feet.

II. DESIGN DATA

A. Gas Handled - Air
B. Temperature - 95°F summer, 20°F winter
C. Pressure - 14.5 psia
D. Flow Rate - 92,500 ICFM (Wet)*
E. Relative Humidity - 50%
F. Maximum Allowable ΔP - 0.2 psi

III. VENDOR DATA REQUIREMENTS

A. Model and type of filter and silencer.

B. Pressure drop across filter and silencer.

C. Typical outline dimensions and weights.

D. Price estimate based on shipment in 1981.

* Final required flow rate to be confirmed later.

FORM NO. 135-901

BY G.J.B.	P.O. NO.	SUPPLIER

6.0 INSTRUMENT DATA

This section includes a tabulation of main control instrument data for this unit and an index of process fluid types.

Rev. 1 Oct. 1, 1979 RC

FOSTER WHEELER ENERGY CORPORATION
INSTRUMENT PROCESS DATA

JOB NO. 15-2201
PAGE 1 OF 2 (1)
REVISION 0
DATE Aug. 2, 1979
PREPARED BY R. Chan

ENG. FLOWSHEET NO. 2203-1-50-31001

(1) ITEM NUMBER OR SERVICE	(2) NOM LINE SIZE	(3) FLUID TYPE AND STATE	(4) NORMAL #/HR.	FLOW'S (5) MAX.	(6) MIN.	SP.GR.AT (7) 60°F	(8) COND.	(9) MOL. WT.	(10) VISC. CPS. TEMP.	(11) LIQ. VAPOR PRESS. PSIA	(12) LIQ. CRITICAL PRESS. PSIA	(13) VAPOR COMP. FACTOR	(14) VAPOR Cp/Cv	(15) NORM. OP TEMP. °F	PRESSURES AT NORM.FLOW (16a) UPSTREAM PSIA	(17a) DOWNSTREAM PSIA	PRESSURES AT MAX FLOW (16b) UPSTREAM PSIA	(17b) DOWNSTREAM PSIA	PRESSURES AT MIN.FLOW (16c) UPSTREAM PSIA	(17c) DOWNSTREAM PSIA	(18) DOWNSTREAM FLASHING	(19) TIGHT SHUTOFF	(20) A/P FAILURE	(21) REMARKS AND/OR ALARM AND SHUTDOWN SETTINGS	(22) REVISION
Temperature Instruments																										
TSH, TAH 047	30"	(14) Air												161										Set @ 410°F (Compressor Vendor to Confirm)	1
TSH, TAH 047	30"	(14) Air												163										Set @ 410°F (Compressor Vendor to Confirm)	1
Flow Instruments																									
FT, FIC 011	4"X7"	(14) Air	335625	120	80			28.5	0.03			1.0	1.4	AMB	14.7										0
FSL, FAL 011		(14) Air	335625	120	80			28.5	0.03			1.0	1.4	AMB	14.7									Set Point to be Determined by C-3101 Vendor	0
Antisurge Valve FCV011/ FCV017	16"	(14) Air						28.7	0.04			0.99	1.4	163	102.2	18.0					NO	YES	0	Design Flow Rate to be Determined by C-3101 Vendor	1
FY 011B																								Refer to PIC 017 & FIC 011	0
FY 019B																								Refer to FIC 019 & PIC 025	0
FT, FIC 019	4"X7"	(14) Air	335625	120	65			28.5	0.03			1.0	1.4	AMB	14.7										0
FSL, FAL 019		(14) Air	335625	120	65			28.5	0.03			1.0	1.4	AMB	14.7									Set Point to be Determined by C-3101 Vendor	0
Antisurge Valve FCV019/ FCV025	16"	(14) Air						28.7	0.04			0.99	1.4	161	102.2	18.0					NO	YES	0	Design Flow Rate to be Determined by C-3101 Vendor	1
FT, FR 055, 900# Steam to C-3101B Turbine	10"	(1) 900# STM	275000	120	50									840	915										1
Level Instruments																									
LSH, LAH 001		(1) Water												102	17.0									Set @ 80%	0
LSHH, LAHH 007		(1) Water												102	17.0									Set @ 100% (Compr. Vendor to Confirm)	0
LSH, LAH 003		(1) Water												102	17.0									Set @ 80%	0
LSH, LAHH 026		(1) Water												102	17.0									Set @ 100% (Compr. Vendor to Confirm)	0

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FOSTER WHEELER ENERGY CORPORATION
INSTRUMENT PROCESS DATA

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DATE Aug. 2, 1979
PREPARED BY R. Chan

ENG. FLOWSHEET NO. 2203-1-50-31001

(1) ITEM NUMBER OR SERVICE	(2) NOM. LINE SIZE	(3) FLUID TYPE AND STATE	(4) NORMAL #/HR.	FLOW # (5) MAX.	FLOW # (6) MIN.	SP.GR.AT (7) 60°F	SP.GR.AT (8) COND.	(9) MOL. WT.	(10) VISC. CPS. TEMP.	(11) LIQ. VAPOR PRESS. PSIA	(12) LIQ. CRITICAL PRESS. PSIA	(13) VAPOR COMP. FACTOR	(14) VAPOR Cp/Cv	(15) NORM. OP TEMP. °F	PRESSURES AT NORM.FLOW (16a) UPSTREAM PSIA	PRESSURES AT NORM.FLOW (17a) DOWNSTREAM PSIA	PRESSURES AT MAX FLOW (16b) UPSTREAM PSIA	PRESSURES AT MAX FLOW (17b) DOWNSTREAM PSIA	PRESSURES AT MIN./FLOW (16c) UPSTREAM PSIA	PRESSURES AT MIN./FLOW (17c) DOWNSTREAM PSIA	(18) DOWNSTREAM FLASHING	(19) TIGHT SHUTOFF	(20) AIR FAILURE	(21) REMARKS AND/OR ALARM AND SHUTDOWN SETTINGS	(22) REVISION
LT, LC 030		(1) Water												100	100.2	35.6									0
LCV 030	2"	(1) Water	1878	120	20									100	100.2	35.6									1
LSH, LAH 030		(1) Water												100	100.2									Set @ 80%	0
LSL, LAL 030		(1) Water												100	100.2									Set @ 20%	0
Pressure Instruments																									
PT, PIC 017	30	(14) Air												163	102.2										1
PSL, PAL 017		(14) Air													102.2									A-3101 Vendor to Advise Set Pt.	1
PT, PIC 025	30	(14) Air												163	102.2										1
PSL, PAL 025		(14) Air													102.2									A-3101 Vendor to Advise Set Pt.	1
PT, PIC 039	36"	14 Air												163	102.2										
PSL, PAL 039		14 Air												163	102.2									Set @ 95 PSIA (To be reviewed later)	1
PCV 039	10"	8900#STM	275000	120	50									840	915	905					NO	YES	O.L.	Speed Control of C-3101B Turbine	1
Misc. Instruments																									
ST 034																								Furnished by C-3101A Vendor	0
SI 014B, 034A																									0
Level Instruments																									
LC, 051 D-3101A	3"	(1) Water	7497	120	20									100	40.6	35.6									1
LC, 052 D-3101B	3"	(1) Water	7497	120	20									100	40.6	35.6									1
LC, 053 D-3103A	2"	(1) Water	1167	120	20									100	78.6	35.6								Dynamic Type Traps	1
LC, 054 D-3103B	2"	(1) Water	1167	120	20									100	78.6	35.6									1
LSH, LAH 063 D-3103A		(1) Water												100	78.6										1
LSH, LAH 064 D-3103B		(1) Water												100	78.6										1

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DATE 8-2-79
PREPARED BY R. Chan

ENG. FLOWSHEET NO. 2203-1-50-31002

(1) ITEM NUMBER OR SERVICE	(2) NOM LINE SIZE	(3) FLUID TYPE AND STATE	(4) NORMAL #/HR.	FLOW # (5) MAX.	FLOW # (6) MIN.	SP.GR.AT (7) 60°F	SP.GR.AT (8) COND.	(9) MOL. WT.	(10) VISC. CPS. TEMP.	(11) LIQ. VAPOR PRESS. PSIA	(12) LIQ. CRITICAL PRESS. PSIA	(13) VAPOR COMP. FACTOR	(14) VAPOR Cp/Cv	(15) NORM. OP TEMP. °F	PRESSURES AT NORM.FLOW (16a) UPSTREAM PSIA	PRESSURES AT NORM.FLOW (17a) DOWNSTREAM PSIA	PRESSURES AT MAX FLOW (16b) UPSTREAM PSIA	PRESSURES AT MAX FLOW (17b) DOWNSTREAM PSIA	PRESSURES AT MIN.FLOW (16c) UPSTREAM PSIA	PRESSURES AT MIN.FLOW (17c) DOWNSTREAM PSIA	(18) DOWNSTREAM FLASHING	(19) TIGHT SHUTOFF	(20) AIR FAILURE	(21) REMARKS AND/OR ALARM AND SHUTDOWN SETTINGS	(22) REVISION
Temperature Instruments																									
TIC 151																								A-3101 Vendor to provide oper.	0
TCV 151	3	(8)85#STM	120	120										328	100	90	100	90	100	90				A-3101 Vendor to confirm Cv & flow	1

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PREPARED BY R. Chan

ENG. FLOWSHEET NO. 2203-1-50-31003

(1) ITEM NUMBER OR SERVICE	(2) NOM LINE SIZE	(3) FLUID TYPE AND STATE	(4) NORMAL #/HR.	FLOW # (5) MAX.	FLOW # (6) MIN.	SP.GR.AT (7) 60°F	SP.GR.AT (8) COND.	(9) MOL. WT.	(10) VISC. CPS. TEMP.	(11) LIQ. VAPOR PRESS. PSIA	(12) LIQ. CRITICAL PRESS. PSIA	(13) VAPOR COMP. FACTOR	(14) VAPOR Cp/Cv	(15) NORM. OP TEMP. °F	PRESSURES AT NORM.FLOW (16a) UPSTREAM PSIA	PRESSURES AT NORM.FLOW (17a) DOWNSTREAM PSIA	PRESSURES AT MAX FLOW (16b) UPSTREAM PSIA	PRESSURES AT MAX FLOW (17b) DOWNSTREAM PSIA	PRESSURES AT MIN.FLOW (16c) UPSTREAM PSIA	PRESSURES AT MIN.FLOW (17c) DOWNSTREAM PSIA	(18) DOWNSTREAM FLASHING	(19) TIGHT SHUTOFF	(20) AIR FAILURE	(21) REMARKS AND/OR ALARM AND SHUTDOWN SETTINGS	(22) REVISION
Flow Instruments																									
FT, FR, FIC 223	24	** Oxygen	146938	120	65			32	0.02			0.997	1.4	94	17.4									Set point to be determined by	1
FSL, FAL 223		** Oxygen	146938	120	65			32	0.02			0.997	1.4	94	17.4									C-3102 Vendor "	1
FCV 223	14	** Oxygen	*	*	*			32	0.02			0.997	1.4	216	118	17.4					NO	YES	FO	*By C-3102 Vendor	0
FO 226		** Oxygen	450	120	30			32	0.02			0.997	1.4	102	45										0
FT, FR 239		(8) 900 STM	88000	120	50									840	915										1
Pressure Instruments																									
PT, PI PIC 221		** Oxygen												216	120										0
PSL, PAL 221		** Oxygen												216	120									Set @ 110 PSIA	0
PCV 221		(8) 900 STM	88000	120	50									840	915	905									1
PC 232		** Oxygen																						Furnished by TK-3102	0
PCV 232		** Oxygen																						Vendor	0
PSH, PAH 240	24"	** Oxygen												94	17.4										1
PSL, PAL 240	24"	** Oxygen												94	17.4									To be Determined by A-3101	1
PSLL 241	24"	** Oxygen												94	17.4									Final Design	1
Level Instruments																									
LT, LI 219		(6) LIQ O2					1.12							-297	14.7									Furnished by TK-3102 Vendor	0
LSH, LAH 219		(6) LIQ O2					1.13							-297	14.7									Set @ 80%	0
LSL, LAL 219		(6) LIQ O2					1.13							-297	14.7									Set @ 20%	0
LY 219		(6) LIQ O2					1.13							-297	14.7										0
Misc. Instruments																									
ST 234																								Furnished by C-3102 Vendor.	0
SI 234A, 234B																									0

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** Assume 100% Oxygen

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PREPARED BY R. Chan

ENG. FLOWSHEET NO. 2203-1-50-31006 (1)

(1) ITEM NUMBER OR SERVICE	(2) NOM LINE SIZE	(3) FLUID TYPE AND STATE	(4) NORMAL #/HR.	FLOW # (5) MAX.	FLOW # (6) MIN.	SP.GR.AT (7) 60°F	SP.GR.AT (8) CONC.	(9) MOL. WT.	(10) VISC. CPS. TEMP.	(11) LIQ. VAPOR PRESS. PSIA	(12) LIQ. CRITICAL PRESS. PSIA	(13) VAPOR COMP. FACTOR	(14) VAPOR Cp/Cv	(15) NORM. OP TEMP. °F	PRESSURES AT NORM.FLOW (16a) UPSTREAM PSIA	PRESSURES AT NORM.FLOW (17a) DOWNSTREAM PSIA	PRESSURES AT MAX FLOW (16b) UPSTREAM PSIA	PRESSURES AT MAX FLOW (17b) DOWNSTREAM PSIA	PRESSURES AT MIN.FLOW (16c) UPSTREAM PSIA	PRESSURES AT MIN.FLOW (17c) DOWNSTREAM PSIA	(18) DOWNSTREAM FLASHING	(19) TIGHT SHUTOFF	(20) AIR FAILURE	(21) REMARKS AND/OR ALARM AND SHUTDOWN SETTINGS	(22) REVISION
Level Instruments																										
LT 602		(6) LIQ N2				-	0.8							-320	14.7										Furnished by TK-3102 Vendor	1
LSL, LAL 602		(6) LIQ N2				-	0.8							-320	14.7										Set @ 20%	1
LSH, LAH 602		(6) LIQ N2				-	0.8							-320	14.7										Set @ 80%	1
LY						-	0.8																			
Pressure Instruments																										
PIC, PCV 604																									Furnished by TK-3101 Vendor	1

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LISTING OF PROCESS FLUID TYPES

Type Fluid	Fluid Definition or Property
1	Water and water solution having a freezing point of approximately 32°F.
2	Water which could accumulate in lead lines due to gravity separation (not because of steam out operations).
3	Corrosion liquids.
4	Liquids whose pour points are above the design or lowest average ambient temperature.
5	Liquids which may change in chemical composition due to a decrease in temperature from operating to design or lowest average ambient temperature.
6	Liquids which could vaporize at an operating pressure and at ambient temperature conditions.
7	Liquids which contain solids.
8	Steam
9	Corrosive vapors and gases.
10	Air, vapors and gases containing solids.
11	Wet Gas.
12	Dowtherm "A" Vapor.
13	Dowtherm "A" Liquid.
14	No Protection Required.*

*(For fluids such as dry gas, hydrocarbon gas, etc.)