OGDEN MARTIN SYSTEMS OF LEE, INC.

40 LANE ROAD
P.O. BOX 2615
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(201) 882-9000

VIA FIRST CLASS MAIL

February 12, 1993

Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Attention: C.H. Fancy, P.E.

Reference: Lee County Solid Waste Resource Recovery Facility
Ft. Myers, Florida
Project C-1033, Our Ref. LE0300L

Subject: MUNICIPAL WASTE COMBUSTERS SPECIFICATION
POWER PLANT SITE CERTIFICATION (PPSC) NO. 90-3942EPP

Dear Mr. Fancy,

On behalf of Lee County, the permittee, Ogden Martin Systems of Lee, Inc. hereby submits four (4) copies of complete specification information for the Municipal Waste Combusters. This information is being submitted pursuant to the Power Plant Site Certification for the Lee County Solid Waste Resource Recovery Facility, Case No. 90-3942EPP, Appendix A, Item XIV.A.

This specification titled "TECHNICAL SPECIFICATION FOR MUNICIPAL SOLID WASTE STEAM GENERATORS SPEC NO. SM-101, ISSUE 011, DATE 10-31-91, REVISION 3, DATED 2/5/93" effectively provides the make and model number information as required.

pja/2666

Please contact me at (201) 882-7246 if you have any questions or require further information. Please note that the specification for the air pollution control equipment shall follow shortly. Specifications for continuous emissions monitoring and stack drawings will be submitted at a later date.

Very truly yours,

L. Peter Young
Assist. V.P. - Project Management

cc: P. Barbaccia/D. Knowles (w/att.) - South District
L. Sampson (w/att.) - Lee County
D. Markley (w/att.) - Malcolm Pirnie
D. Cerrato (w/att.) - Malcolm Pirnie
L. Ware (w/att.) - UE&C
J. Kowal
J. Treshler (w/att.)
pf 5.1 FDER

pja/2666

OGDEN MARTIN SYSTEMS
of LEE, Inc.

SPEC NO. SM-101
ISSUE 011
DATE 10-31-91

TECHNICAL SPECIFICATION

FOR

(MSW) MUNICIPAL SOLID WASTE STEAM GENERATORS

Facility Name: LEE COUNTY SOLID WASTE RESOURCE RECOVERY FACILITY

Location: LEE COUNTY, FLORIDA

****

****

Specification Prepared By:

Name: OGDEN MARTIN SYSTEMS, INC

Address: 40 LANE ROAD
FAIRFIELD, NJ 07007

Telephone: 201 - 882 - 9000

Approved for Release:

	Printed Name	Signature	Date
1.	R. TERRAMOCCIA	R Terramoccia	6/25/92
2.	R. TERRAMOCCIA	R. Terramoccia	10/26/92
3.	R. TERRAMOCCIA	R. Terramoccia	2/5/93
4.			
5.			

Revision

001	Initial Issue	01/01/87
002	Revision	07/01/87
003	Revision	10/21/87
004	Revision	10/29/87
005	Revision	11/04/87
006	Revision	05/26/88
007	Revision	08/05/88
008	Revision	09/14/89
009	Revision	10/09/90
010	Revision	01/31/91
011	Revision	10/31/91

OGDEN PROJECTS, INC.

TECHNICAL SPECIFICATION
FOR
MSW STEAM GENERATORS

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1.0 GENERAL

1.1 Scope

This Specification covers requirements for the design, manufacture, delivery, erection, field adjustment, calibration and testing of bulk municipal refuse fired steam generators complete with accessories. Refuse will be fired on Martin stokers furnished by the Purchaser and erected by the Contractor.

The Contractor shall establish the boiler configuration, the heating surface requirements and tube geometry using the enclosed Martin data sheets and drawing. If the Contractor's proposed heating surface requirements are different from those presented in the Martin data, the Contractor shall provide the Purchaser with complete technical details of the differences as well as complete proposals for both schemes.

The Contractor shall include in his scope the building support steel, purlins, girts, roof deck support steel, roof trusses, parapet, misellaneous steel at wall openings/penetrations, roof access hatch framing and silencer support framing, etc., for the boilerhouse envelopes which shall be integrated with the boiler support steel. The steel shall be erected on foundations supplied by the Purchaser.

The Attachments including all Specifications are part of this Boiler Specification and shall govern the purchase of material, equipment or services specified herein.

Where conflicts exist between the requirements of this Specification and the attachments, they shall be brought to the attention of the Purchaser for final resolution.

1.2 Work to be Provided

1.2.1 Furnished and Installed by the Contractor

The Contractor shall furnish and install equipment and materials consisting of but not limited to the following:

Prime Paint Coat on all Structural Steel, Uninsulated Pipe, Ductwork and Supports
Steam Generator Pressure Parts
Steam Purifier
Superheater
Attemperator(s)
Economizer
Air Heater(s) (Steam Coil)

Inner Casing
Insulation and Lagging
Refractory
Boiler Structures
Building Steel - including girts and subgirts designed to meet spacing requirements of Owner's siding and roof deck support steel
Accessory Structures
Platforms and Ladders
Framing for Doors, Louvers, A/C Ducts, Silencers and Roof Hatches
Ash Hoppers
Framing and Support for Elevator and Lobby, if Required
Framing and Supports for Ducts, Piping, Conveyors, Electrical Cable, etc.
Penetrations in roof and walls
Ash Chute(s) from Boiler Convection Pass Hopper to Stoker Ash Chute Area
Ash Dischargers Bypass or Diverter Gate Support
Air Ducts, Dampers and Flow Elements
Desuperheater Control Valves
Trim, Piping and Valving
Miscellaneous Boiler Instrumentation
Safety Valves and Power-Activated Relief Valves (including vent stacks, silencers, Vents, Drains)
F.D. Fan(s) (including flow control equipment as specified)
F.D. Fan Drive(s)
O.F.A. Fan(s) (including flow control equipment as specified)
O.F.A. Fan Drive(s)
O.F.A. Fan Supports (as required)
Seal Air Fan(s)
Seal Air Fan Drive(s)
Seal Air Fan Silencer
Fan Silencer Support(s)
Fan Pedestal Concrete Fill (if required)
Fan Isolation/Vibration Dampers (if required)
Soot Blowers (complete system, including insert panel, controls, piping and starters)
Auxiliary Fuel Burner(s) (complete system including piping and fuel safety valves, vent piping to roof and ignition system)
Auxiliary Fuel Burner Purge System (including fans, motors, if required)
Burner Fuel and Air Flow Positioning System
Burner Management System
Lagging, Insulation and Setting
Stoker Casing Enclosure and Seals, including Stoker Support Beams
Erection Supervision (including boil-out and refractory curing)
Field Erection Labor

Service Representative
Test Engineer
Freight
Unloading, Storage and Handling of Contractor Installed Equipment
Plywood Covering of Stokers
Special Tools
Hydrostatic Testing
Spare Parts (optional price)

1.2.2 Services

Erection Service

The Contractor shall receive, unload, store and remove from storage, erect, install and prepare for operation all equipment and materials furnished by the Contractor and stoker system equipment supplied by the Purchaser for erection by the Contractor. The Contractor shall follow all instructions by the stoker supplier (Martin GmbH) including covering the finished stokers with plywood protection before refractory installation and regarding storage and handling of stoker system equipment.

The Contractor shall furnish all supervision, labor, tools, rigging, and incidental material necessary for the complete installation of the specified materials and equipment.

Start-Up and Testing Services

The Contractor shall furnish all labor, supervision, materials and equipment required to perform hydrostatic testing of equipment furnished under this Specification.

The Contractor shall furnish service and testing advisors to assist the Purchaser for the following functions and durations. Costs for addition and deletion of service advisor time shall be included in the proposal:

1. Chemical Cleaning - 5 man-days per steam generator

2. Startup and Field Operations Tests - 30 man-days per steam generator.

1.3 Work by Others

1.3.1 Furnished and Installed by the Purchaser

The Purchaser will furnish and install the following materials and equipment:

Ash handling chutes, valves and conveyors (except convection pass chute(s)
Flue gas ducts (from economizer outlet flange)
Starters (except for sootblowers)
Wiring (except for superheater thermocouple wiring from headers to junction box)
Building siding

Building roof deck and framing for roof penetrations (except for silencers and access hatches)
Miscellaneous roof framing for smoke hatches, ducts and exhaust fans.
Elevator
Foundations and anchor bolts
Boiler cleaning (boil-out, including special chemicals and disposal thereof)
I.D. Fan(s) (including flow control equipment as specified)
I.D. Fan Drive(s)
Grouting
Finish painting of all structural steel

1.3.2 Furnished by the Purchaser and Installed by the Contractor

The Purchaser will furnish the following materials and equipment for installation by the Contractor.

Martin Stoker components basically consisting of:

Refuse feed hopper and chute assembly
Chute shutoff gates
Stoker grate assemblies
Feed rams/tables
Ram ash discharger and connecting piece
Hydraulic cylinders for stoker, ash discharger, overfire and underfire air dampers (including hydraulic piping)
Hydraulic pumping station
Electronic and hydraulic control cabinets
Undergrate air control system including dampers, orifices, pressure gauges and piping
Undergrate air hoppers and air plenums
Overfire air nozzles
Automatic central lubrication system

1.4 Terminal Points

It is the intent of this Specification that the Contractor shall furnish and install all piping, valves, instruments, and other appurtenances within the jurisdictional limits of the ASME, Section I, Boiler and Pressure Vessel Code, latest edition, as well as other scope items detailed herein.

In addition to the above requirements, the following shall also apply.

The Contractor's supply shall terminate at the points listed below:

A. Water Connections

1. Inlet to chemical feed valve(s).
2. Outlet of water wall and economizer blow-off valves.
3. Outlet of continuous blowdown valve(s).
4. Outlet of gauge glass and water column drain valves. These valves are located at the operating level.
5. Outlet of pressure test valve at the economizer.
6. Feedwater regulating station at feedwater block and by-pass valve (valves included in Contractor's scope)
7. Outlet of intermittant bottom drum blowdown valve(s).
8. Inlet to desuperheater spray regulator.
9. Safety valve drip pan and stack drains to operating/grade level.

B. Steam Connections

1. Outlet of superheater up to and including the second stop/check valve and the free-blow drain valve.
2. Silencer outlet of drum and superheater safety valves.
3. Silencer outlet of power activated relief valve.
4. Silencer outlet of drum and superheater vents.
5. Outlet of all vents (double valved by Contractor).
6. Outlet of all drains (double valved by Contractor).
7. Outlet of steam sampling valves.
8. Outlet of pressure test shut-off valves at drum and superheater.
9. Pressure and temperature connections as specified herein.
10. Inlet and outlet connections of steam coil airheater(s).
11. Outlet of traps and strainers or drain valves in sootblower piping.
12. Outlet of boiler drum trim shut-off and drain valves, as specified.
13. Sootblower piping connection to main steam pipe or to interstage (including flow element and taps).

C. Air Inlet Connections

1. Forced Draft (FD) and Overfire Air fan (OFA) inlet ducts and screens at top of refuse receiving pit.
2. Forced draft fan duct connections to Purchaser supplied stokers.
3. Seal air fan inlet(s) and silencer(s).
4. Auxiliary burner FD fan(s) inlet(s) including dampers.

D. Flue Gas Connections

1. Economizer outlet duct, complete with flange.

E. Ash Connections

1. Outlet discharge flanges at ash hoppers for superheater and economizer.
2. Stoker discharge chute.

F. Stoker Equipment

1. Brickwork, tile, refractory, insulation, lagging, casing enclosure for stoker(s), including insulation for the siftings hoppers, all to be supplied and installed by Contractor.

2. Seal air pipe system terminal connections at stoker transverse frame.

3. Connection for driving beam support roller seal air pipe system below stoker.

4. Openings for 3' x 4' access door, observation ports at stoker discharge rear wall and furnace side walls (waterwalls).

G. Electrical

1. Sootblower panel insert, motor starters and pushbutton stations with local disconnect switches.
2. 125 volt D.C. power relief valve controller connection.
3. Forced draft fan motor.
4. Overfire air fan motor.
5. Seal air fan motor.
6. Auxiliary fuel burner forced draft fan motor.
7. Auxiliary fuel burner purge air fan motor.
8. Auxiliary fuel burner panel and/or inserts.
9. Instrument and control terminal strips

H. Auxiliary Burner Fuel

1. Flanged valves, at inlet connection to burner front package (gas or fuel oil)

2. Atomizing air inlet connection (if applicable)

Note: If steam is used for fuel atomization the Contractor shall design and install the complete steam system.

1.5 Applicable Codes, Standards and Specifications

The latest edition and addenda of the following publications, effective on the date of Contract Award, are part of this Specification and, whether referred to by title or by designation only, are applicable to the extent indicated by the specific reference.

ASME - American Society of Mechanical Engineers

ASME I	Boiler and Pressure Vessel Code, Section I, Power Boilers, and all addenda thereto
ASME II	Boiler and Pressure Vessel Code, Section II, Material Specifications, and all addenda thereto
ASME IX	Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications, and all addenda thereto
ASME PTC 4.1	Power Test Code - Steam Generating Units

ASTM - American Society for Testing and Materials

ASTM	Material Specifications
ASTM	Special Technical Publication 442, Manual on Water
D-1066	Standard Method of Sampling Steam
D-2186	Standard Methods of test for Deposit Forming Impurities in Steam
D-3370	Standard Methods of Sampling Water
A-123	Standard Specification for Zinc (Hot-Galvinized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips
B-209	Aluminum Alloy Steel and Plate

ANSI - American National Standards Institute

B 16.5	Steel Pipe Flanges and Flanged Fittings

B 31.1 Code for Pressure Piping, Power Piping

Other standards not listed herein but referenced in this specification shall be the edition specified in Appendix F of ANSI B31.1.

AWS - American Welding Society

AWS D1.1 Structural Welding Code

ABMA - American Boiler Manufacturers Association

Industry Standards

NFPA - National Fire Protection Association

NFPA 85A Prevention of Furnace Explosions in Fuel Oil - Natural Gas - Fired Single Burner Boiler Furnaces

NFPA 85B Prevention of Furnace Explosions in Natural Gas - Fired Multiple Burner Boiler-Furnaces

NFPA 85D Boiler-Furnaces

NFPA 85G Prevention of Furnace Implosions in Multiple Burner Boiler - Furnaces

AISC - American Institute of Steel Construction

Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings

Code of Standard Practice for Steel Buildings and Bridges

Building Code

All applicable requirements of the local, state and national building codes shall apply for the state in which construction will be performed

OSHA - Occupational Safety and Health Act

29 CFR 1910 Occupational Safety and Health Standards

29 CFR 1926 Safety and Health Regulations for Construction

SSPC - Steel Structures Painting Council

SSPC-SP6 Commercial Blast Cleaning

ASHRAE - Handbook and Standards

NEMA - National Electrical Manufacturers Association

NEC - National Electrical Code

IEEE - Institute of Electrical and Electronic Engineers

IPCEA - Insulated Power Cable Engineers Association

NESC - National Electric Safety Code

UL - Underwriter's Laboratory, Inc.

Should there be a conflict between various codes and/or specifications the Contractor shall refer it to Purchaser for resolution, but in principle it will be resolved in this order:

ASME Pressure Vessel Code
Other legal requirements, including state and local building codes
This specification
The more stringent requirements, should two or more specifications or areas within a specification differ in degree of severity

2.0 TECHNICAL REQUIREMENTS

2.1 Design Requirements

The steam generator and auxiliary equipment shall be designed to meet all general conditions and requirements of this specification, and the project specific requirements listed in the Design Conditions.

The steam generator shall be designed and fabricated in accordance with ASME Boiler and Pressure Vessel Code, Section I., latest edition. All boiler external piping being provided and not falling

within the scope of ASME Boiler and Pressure Vessel Code Section I shall be designed and fabricated in accordance with ANSI B31.1. The steam generators shall be of welded-wall, balanced draft design, suitable for continuous operation while fired by municipal solid waste (MSW) with the fuel and flue gas compositions as stated in the Martin Furnace Design Data.

The steam generators and auxiliary equipment shall be designed for indoor or outdoor installation as stated in the Design Conditions.

The design of the unit shall ensure maximum economizer flue gas outlet temperature rise of 75°F after 4,000 hours of continuous operation without shutdown for manual cleaning of fireside surfaces.

2.1.1 Furnace Pressure (Structural)

The furnace and boiler enclosure shall be designed as per NFPA 85G or 20 inches w.g., whichever is more stringent.

2.1.2 Martin Design Data

A set of Martin design data (Attachment 4) has been included with this Specification. It contains the following sections:

a) Furnace Design Data
b) Boiler Design Data
c) Stoker Capacity Diagram
d) Boiler Sketch
e) Load Plan

2.2 Pressure Part Materials - Tubes, Headers and Drums

The following minimum requirements are specified for the boiler pressure part materials:

	Dia. (in. O.D.)	Minimum Thk (in.)	Material (min. reqmts.)
Furnace waterwall	*	0.180	SA-178 A
Furnace Arch (above refractory)	*	0.220	SA-178 A
Furnace Exit Screen	As Req'd	0.380	SA-178 A or SA-106 B
Convection Evaporator	*	0.180	SA-178 A
Secondary Superheater T-11**	*	0.180	SA-210 A1/SA-213
Primary Superheater A1**	*	0.180	SA-178 A/SA-210

			& SA-213 T-11
Superheater enclosure	As Req'd	0.180	SA-178 A
Economizer	*	0.150	SA-178 A
All waterwall headers***	10 (min.)	Per ASME	SA-106 B
Superheater headers	10 (min.)	Per ASME	As Req'd**
Economizer header	6 (min.)	Per ASME	SA-106 B
Steam drum	54 (min. I.D.)	Per ASME	SA-299 or
Water drum	36 (min. I.D.)	Per ASME	SA-515 GR 70 or SA-516 GR 70

* Per attached Martin Boiler Design Data

** Use of carbon steel materials is permissible up to a 750°F metal temperature. Above that temperature, a Cr-Mo material must be used.

*** Chillwall tube headaers may be 8 inches O.D.

All waterwall, evaporator, economizer and superheater headers shall be provided with inspection nipples with welded caps or welded hand hole plates as appropriate.

Vents and drains shall be provided on all high and low points of boiler pressure parts.

Tube shields shall be provided at the following locations:

Inlet to curtain wall panel, (dividing wall) first into second pass (1 row, full length of the exposed part of the first tube)

Inlet to convection banks including screen tubes (2 rows, full length)

Convection bank evaporator tubes facing sootblower, whole length and around outside bend if less than 6 feet from sootblower.
Inlet to superheater (2 rows, full length)

Economizer-inlet only (1 row, full length)

First tubes on either side of every sootblower cavity immediately facing the sootblowers (each tube bank and screen, full-length, except in the economizer where only the first row at the inlet shall be provided with tube shields).

Tube Shield Requirements:

Manufacturer:	Helmick or Purchaser approved equal
Material:	According to temperature (stainless steel) 3rd pass evaporator shall be minimum Type 310 stainless steel. Superheater and economizer shall be minimum Type 304 stainless steel.
Style:	-F and 180 degrees for straight tubes -CCI or CCO for curved tubes
Thickness:	Ten (10) Gauge
Length:	Maximum 48 inches per shield
Installation:	To ensure a tight fit, a clamping device must be used while the clips are welded to the shields. Each shield shall be tack-welded to the tube at one clip location only. Shields must cover the pipe also at the location of any tube welds. Max. 24" between clips. Sootblower supports or guides shall not be welded to tube shields

2.3 Steam Generating Section

2.3.1 Boiler Drums

The boiler drums shall be of fusion welded construction, complete with dished ends, 16 x 12 inches eliptical manholes and hinged covers in each end.

The steam drums shall be equipped with drum internals consisting of vortex type steam separators and steam dryers designed to ensure the steam purity (total dissolved solids in the steam) in accordance with the ABMA recommendations and this specification.

The required steam purity is to be achieved at all boiler loads and full steam drum water level operating range, when the boiler water quality is maintained within ABMA recommended limits. All drum internals shall be secured by bolts with acorn style nuts.

The steam drum shall be fitted with, at least, the following nozzles and connections:

a) Feed water nozzle
b) Chemical injection
c) Continuous blowdown
d) Intermittant blowdown
e) Safety valves
f) Water column with gage glass and remote reading level device
g) Probe water column
h) Water level transmitter
i) Pressure gauge and switch
j) Pressure transmitter
k) Saturated steam connection (to the superheater)
l) Spare nozzles (2 x 2 inches NPS, location on shell vertical centerline-saturated steam)

The feedwater and the chemical injection nozzles are to be fitted with thermal sleeves to minimize the local thermal stresses. The feedwater, blowdown and chemical injection shall be provided with suitably drilled, internal distribution pipes.

In general, most pipe connections to the steam drum nozzles shall be provided with butt-weld ends. Flanged connections are only required for safety valves, and probe water column, items e), and g).

2.3.2 Furnace and Waterwalls

The multiple pass unit shall be enclosed by gas-tight, fully welded waterwalls. These walls shall be shop fabricated, welded, panel type, tube-and-web design. The tubes shall be attached to the respective headers by welding. All bottom headers will be equipped with drains. The minimum drain size is 1-1/2 inches NPS. If required due to the relief tube layout, the top headers shall be provided with vents.

Should other design be offered as an alternative, for example, at the boiler bank side walls or superheater roof, the Contractor shall clearly identify this in his proposal together with detailed explanation of this alternative offer.

To minimize the slag and ash accumulation, the screens between first and second radiant passes shall be arranged with inlet headers and formed from a small number of relatively large bore pipes (minimum 4 inches in diameter) arranged with wide spacing (1-2 feet).

The furnace waterwalls shall be covered with SiC refractory up to a height of not less than 30 feet above the grate. To support this refractory, closely spaced stainless steel studs shall be shop welded onto the wall panels, as follows:

Stud material	430 SS
Stud dimensions	3/8 inch/diameter x 3/4 inch/long
Stud density	660/sq meter

In addition, 2 7/8 inches long 430 stainless steel Y-anchors (130/sq meter) and 4 1/4 inches long, 430 SS Y-anchors (also 130/sq meter) will be welded to the front wall ignition roof to support the castable alumina refractory.

The lower front wall header shall be provided with Y-anchors in sufficient number and size to support a 2 inch thick refractory liner.

Two inch long 430 SS Y-anchors (260/sq. meter) shall be welded to the chilled tube wall to side wall intersection. This intersection shall be designed to keep the uncooled area to an absolute minimum.

Proper studding shall be provided for all wall openings and penetrations. The studded areas shall be provided with a protective coating which must be carefully and completely removed by appropriate means (e.g., sandblasting) before the refractory may be applied.

The waterwall surface that forms the rear sidewalls and rear stoker roof, from 3 feet below the lower panel bend that houses the overfire air nozzles to the chill tube and bridgewall headers, shall be bare.

For all headers exposed to direct heat from combustion, the necessary protection shall be provided, including studs, bracing, anchors, sleeves, etc.

A suitable number of access door and observation port openings as well as sufficient number of scaffold cable openings in the roof of the first and second boiler passes shall be provided. Openings shall also be provided for the furnace temperature and pressure probes and the auxiliary fuel burner(s). The burner openings shall be water cooled and fitted with suitably reinforced rings and mounting flanges with minimum thickness of 1/4 inch and 3/8 inch respectively.

As a minimum, the following doors and observation ports are necessary in the first boiler pass:

	Up to 3 Stoker Runs	More than 3 Stoker Runs
Martin supplied observation ports	One side only: one near rear overfire air nozzles; two near burner at "end of refractory" level (angled to look down) Ignition door, near feed table edge	LH and RH side, same locations
Contractor supplied observation ports	As many as require to observe burner flame in from wall and opposite of burner(s)	
Contractor supplied access door near screen and header between 1st and 2nd pass (could be in 2nd pass also)	One side only	LH and RH side, same locations
Martin supplied access doors to stoker	One in rear wall	Two in rear wall
Martin supplied observation ports in rear wall	One stoker run Two stoker runs Three stoker runs Four stoker runs Five stoker runs Six stoker runs	0 1 2 2 3 4

High pressure overfire air nozzles shall be installed in the lower front and rear walls. These stainless steel nozzles will be supplied by the Purchaser and the Contractor shall provide the necessary waterwall openings and to install these nozzles.

Boiler buckstays and hangers shall be designed for independent support of each unit and also for applicable seismic loading. The buckstays and hangers shall allow free and unrestricted expansions under all operating conditions. Boiler bumpers and guides off boiler support steel shall also be provided.

Contractor shall provide chill wall restraints, tied to the stoker casing frame.

2.3.3 Convection Evaporator

In order to control the thermal performance of the unit, a convection evaporator is required. This evaporator shall be situated in the third boiler pass and arranged for upward flue gas flow.

The evaporator shall be arranged with adequate spacing to minimize fouling, for ease of cleaning and access. The necessary supports and spacers shall be designed to minimize metal temperatures, allow for sufficient expansion/thermal movements under all operating conditions and to minimize the dust accumulation. The design shall also ensure that the longitudinal and transverse alignments are kept during operation. Tubes shall be adequately braced to prevent excessive lateral movement during sootblowing.

The evaporator shall be of natural circulation design and shall be fully drainable. The minimum drain size is 1-1/2 inches NPS. Evaporator tubes must slope a minimum of 2 degrees.

Inlet and outlet of evaporator banks for two drum boilers shall be furnished with off-set screen tubes, arranged in-line.

The Contractor shall supply sufficient number of access door and sootblower openings and instrument connections, as required for operation, cleaning and monitoring of the unit.

As a minimum, each sootblower cavity shall be equipped with an access door that allows entry to the cavity for sootblower inspection. All access doors shall be positioned to facilitate entry into the boiler and be located near supporting surfaces (e.g. headers, tube banks, ledges, hoppers, etc) and the lower ledge of the door be not less than 1 foot or more than 3 feet above an access platform, unless a dedicated ladder with a step is provided to allow for easy access. Each access door shall have a handhold at the outside and the inside of the boiler. Access doors shall have integrated refractory where needed. Blocking of the opening with refractory bricks is not allowed.

2.3.4 Boiler Circulation System

The correct design of the circulation system is the sole responsibility of the Contractor. All sections, including downcomers, feeders, risers, relief tubes, all headers, distributors and collectors and drum separators shall be properly sized with low restrictions for high flow (circulation) rates to ensure low metal temperatures, especially of the radiant tube sections.

Boiler water shall enter downcomers arranged at the low point of the drum. To ensure steam free circulating water, steam and water separators shall be used and the incoming feed water shall be distributed to allow all downcomers to obtain proportioned flow. Downcomers larger than 10 inches NPS shall be fitted with anti-vortex devices. The downcomer system shall be fully drainable with minimum drain size of 1-1/2 inch NPS.

Due consideration shall be given to achieve proper circulation in the radiation and convection evaporating sections operating in parallel with different flow characteristics. If necessary, separate downcommers and relief pipes, header membranes (separating discs), orifices, distributors, etc. shall be provided.

2.4 Superheater

A multistage superheater shall be provided. It shall be arranged downstream of the convection evaporator for maximum protection from corrosion by hot fluegasses and ash particles. The superheater shall be designed to maintain the outlet steam temperature over the specified control range (steam generation).

2.4.1 Superheater Tube Banks

The tube banks shall be designed for high steam velocities to ensure proper steam distribution and to minimize superheater tube metal temperatures. The minimum steam mass flow rate shall be 220,000 lb/sq ft.-hr at MCR condition. The multistage design is required to ensure proper thermal performance under all operating conditions. Individual superheater tube banks shall not exceed 5 feet overall depth, measured between first and last tube centerlines in the direction of the gas flow.

The superheater shall be arranged with adequate spacing to minimize fouling, for ease of cleaning and access. The necessary supports and spacers shall be designed to minimize metal temperatures, allow for sufficient expansion/thermal movements under all operating conditions and to minimize the dust accumulation (e.g. design crossbracing and tube spacers at different elevations). The design

shall also ensure that the longitudinal and transverse alignments are kept during operation. Tubes shall be adequately braced to prevent excessive lateral movement during sootblowing.

The Contractor shall supply sufficient number of access door and sootblower openings and instrument connections, as required for operation, cleaning and monitoring of the unit.

As a minimum, each sootblower cavity shall be equipped with an access door that allows entry to the cavity for sootblower inspection. All access doors shall be positioned to facilitate entry into the boiler and be located near supporting surfaces (e.g. headers, tube banks, ledges, hoppers, etc.).

2.4.2 Spray Attemperator(s)

The Contractor shall furnish the required number of interstage, spray type, attemperator(s) as specified. In general, units with the final steam outlet temperature up to 750°F will use single stage attemperator and units with steam temperature above 750°F will use two stage attemperators.

These interstage attemperators shall be complete units with spray water assemblies, including spray nozzle(s) and orifice plate(s) as required and alloy steel, shop assembled spray header liner(s).

The Contractor shall furnish desuperheater control valve(s) including 4-20 mA I/P converters and airsets.

2.5 Economizer

Each boiler shall be provided with a bare tube economizer of counter flow design, preferably arranged with fluegas downflow and water upflow. The economizer shall be fully drainable and all tubes shall be attached to the headers by welding. Minimum drain size shall be 1-1/2 inch NPS. It shall have a gas-tight steel casing, minimum of 3/16 inch thick.

The economizer tube banks shall be designed for high water velocities to ensure proper water distributions and prevent steaming. The minimum water mass flow rate shall be 400,000 lb/sq. ft.-hr at MCR conditions. It should be noted that the individual economizer tube banks shall not exceed 5 feet overall depth, measured between first and last tube centerlines in the direction of the gas flow.

The economizer shall be arranged with adequate spacing for cleaning and access. The necessary supports and spacers shall be designed to minimize metal temperatures, allow for sufficient

expansion/thermal movements under all operating conditions and to minimize the dust accumulation. The design shall also ensure that the longitudinal and transverse alignments are kept during operation. Tubes shall be adequately braced to prevent excessive lateral movement during sootblowing.

The Contractor shall supply sufficient number of access door and sootblower openings and instrument connections, as required for operation, cleaning and monitoring of the unit. If hangers, supports or other obstacles limit access to certain areas, additional doors will be needed to allow unobstructed access to all parts of the economizer.

As a minimum, each sootblower cavity shall be equipped with an access door that allows entry to the cavity for sootblower inspection. All access doors shall be positioned to facilitate entry into the boiler and be located near supporting surfaces (e.g. headers, tube banks, ledges, hoppers, etc.).

2.6 Boiler Appurtenances, Instrumentation, Valves and Piping

The Contractor shall supply all specified boiler mountings and fittings, instrumentation, valves and piping within all terminal points of supply. All items shall be selected for the specified pressure and temperature conditions and in accordance with the ASME, Section I or ANSI B31.1 as applicable. The trim shall be selected for a minimum of 125% of the normal operating pressure (psig).

All instruments that are inserts to be mounted in the Purchasers control panels shall be shipped directly to the Purchaser's panel manufacturers shop. Examples include the miniature multi-light level indicator and sootblower insert panel.

2.6.1 Boiler Appurtenances and Instrumentation

All instrument locations must be provided with access and platforms for ease of maintenance or observation.

Steam Drum Instrumentation

- Pressure:

  One pressure tap and valve shall be provided for use by others to monitor drum pressure. An additional tap, valve and pressure gage shall be furnished and installed for local readout of drum pressure. Separate instrumentation and taps are to be provided as required for the auxiliary burner safety system.

- Level

  Drum level trim and accessories shall be furnished as specified below and as illustrated on Attachment 3. Gage glass isolation valves are to be of the angle, outside screw type.

Quantities below are typical for one (1) steam generator.

Near End:

Quantity		Item
1	a)	Direct vision illuminated water gauge with gauge valves and blowdown valves.
1	b)	Electro Eye-Hye system (or equal) consisting of the following:
1	b1)	Multi probe electrolev flanged water column with isolation, blowdown valves and NEMA 4 junction box.
2	b2)	Multi-light indicators with a range of not less than the trip point and not more than +3, -1.5 inches wider than the high and low trip ranges, one (miniature) to be located in control room and one (standard) to be mounted on the operating floor.
1	b3)	NEMA 4 control unit with optional test switch and relays. Unit shall have relays and contacts for the following outputs: Hi-Hi, Hi,Lo and Lo-Lo Alarms and cut-offs
4	b4)	Primary isolating valves.
1		Holding switch (located next to the blowdown valve of item b1) to prevent trip when blowing down.

Far End:

Quantity		Item
1	a)	Probe safety column consisting of the following:
1	a1)	Water column with isolation and blowdown valves
1	a2)	One set of probes positioned in water column cap

1 a3) NEMA 4 control unit with relays and supply transformer; following outputs (as dry contacts) are required:

LWL Output (4 contacts)
HWL Turbine Trip (1 contact)

1 b) One holding switch (located next to the blowdown valve of item a1) to prevent trip when blowing down the water column

1 c) Direct vision illuminated watergauge with gage valves and blowdown valves

2 d) Isolating valves (for water column connection)

2 e) Isolating valves (for feedwater level transmitter connection)

Furnace and Fluegas Instrumentation

Temperature taps - All temperature taps shall be 2 inch NPT and shall penetrate horizontally from outside of the lagging or vertically from above the roof, into the flue gas path.

Taps shall be provided at the following locations:

a) One on each side just above the refractory (max. 3 ft). Exact location(s) per the stoker manufacturer (Martin GmbH).

b) One on each side just above the bull nose. Exact location per the stoker manufacturer (Martin GmbH).

c) A specific number of taps across the roof of the first pass above the nose, equally spaced; the quantity based upon the following: boiler width-less than 20 ft, three taps; up to 40 ft, four taps; and up to 60 ft, five taps. The taps must be accessible from the top of the penthouse roof to be able to exchange thermocouples while the boiler is in operation. The taps shall be tapered at the bottom to guide the probes to the opening in the membrane wall roof.

d) On one side near the bottom of the second pass before the convection section. Exact location(s) to be provided by stoker manufacturer.

e) On one side before and after each superheater tube bank.

f) On one side before and after each economizer tube bank.

For items (d), (e), and (f), the temperature taps shall be on one side of the steam generator unless the steam generators are equipped with stokers of more than 3 runs in which case temperature taps shall be provided on both sides.

Pressure taps - All pressure taps shall be 2 inch NPT and shall penetrate from the outside of the lagging into the gas path at a 45° angle downward. The instrument connection on the outside will terminate in a 2" x 2" x 1" tee with a plug in order to allow for rodding out. It is essential that the tee and the instrument are not more than 5 feet above the access platform.

Taps shall be provided at the following locations:

a) One on each side just above the refractory (max. 3 ft). Exact location per the stoker manufacturer (Martin GmbH).

b) One on each side above the nose at a point where the furnace pressure is expected to be approximately zero.

c) One at each location designated under item d), e) and f) for temperature taps

Oxygen - 4 inch flanged connection with access and maintenance platform shall be provided upstream of the economizer in the center and on top of the inlet duct in conformance with Martin's instructions.

Metal Temperatures - Metal temperature thermocouples are to be installed in accordance with the boiler manufacturers recommendation. As a minimum, thermocouples shall be located at the superheater sections before each attemperator and at the final section. Thermocouples shall be wired out to a NEMA 4 junction box for monitoring by others.

Refractory Temperature - Thermocouples shall be buried near the top of the refractory. The number shall be as required by the refractory supplier to monitor the curing process. They shall be brought out to an accessible location on the main firing aisle (elv. 28.5) and terminated in a NEMA 4 junction box. They shall be clearly identified and protected as necessary.

CO Test Taps

To perform CO testing, furnace sampling penetrations are required on each boiler sidewall above the refractory, at two elevations. Each elevation shall contain three individual sampling points; at the center line of the furnace and the two quarter points. The location of these six (6) penetrations per sidewall shall be accessible from platforms or walkways. Each sampling point will

consist of 1/4 inch, schedule 40 carbon steel pipe welded to the tube fin. The tube fin penetration must be large enough to allow 1/4 inch stainless tubing to pass through (Refer to Attachment 11).

Air and Gas Duct Instrumentation

All taps shall be 1" NPT for flow, pressure and temperature.

Pressure - The following pressure taps shall be provided:

a) FD fan discharge pressure
b) Air heater inlet and outlet pressure
c) Underfire air pressure just prior to the stoker duct work interface point
d) Overfire air fan discharge pressure
e) OFA ducts, downstream of each damper and in each OFA header.

Temperature - Temperature taps shall be provided at the steam coil air heater inlet and outlet.

Flow - Flow elements shall be provided at the following locations:

a) FD fan inlet ductwork
b) OFA fan inlet ductwork

Flow elements shall be of low loss, venturi type with adequate (ASME) straight run and measurement taps furnished. The Contractor shall inform the Purchaser should insufficient straight run be available, so the Purchaser can arrange site calibration.

Feedwater and Steam Line Instrumentation

Temperature - The following temperature test points are to be provided complete with thermowells, cap and chain.

a) Economizer inlet
b) Superheater outlet

The following local temperature indicators complete with wells are to be provided:

a) Economizer inlet
b) Economizer outlet
c) Attemperator(s) inlet
d) Attemperator(s) outlet
e) Superheater outlet

The following temperature points are to be monitored by others. Thermowells for 1/4 inch diameter elements are to be provided by Contractor for the following:

a) Economizer inlet
b) Economizer outlet
c) Superheater inlet
d) Attemperator(s) inlet
e) Attemperator(s) outlet
f) Superheater outlet

Pressure - All pressure connections shall be 3/4 inch NPT complete with isolation valves.

The following local pressure indicators are to be provided.

a) Drum pressure
b) Superheater outlet

The following taps are to be provided for use by others.

a) Drum pressure (transmitter)
b) Superheater outlet (test tap and transmitter tap)
c) Economizer inlet (test tap)

Separate taps shall be provided for burner controls and power operated relief valves as required.

Steam and Water Sampling

Sampling probes shall be installed to sample the following:

a) Boiler blowdown (Stainless steel)
b) Saturated steam (stainless steel)
c) Superheated steam (stainless steel)

All steam probes shall be per ASTM D 1066

Damper Drives

The following dampers shall have drives furnished and installed, in accordance with the requirements of the fan specification SM-104, Attachments 3-2 & 3-3. They shall include inter-connecting linkages, current to pneumatic converters, positioners, limit switches for damper position indication, tubing, filter, regulators, solenoids and any accessories as required to have the dampers fail to the defined position. Drives shall be manufactured by Bailey Controls.

a) FD fan inlet vane, fail close.
b) OFA fan inlet vane, fail close.

The overfire air distribution dampers will be fitted with drives furnished by Purchaser. Contractor shall furnish the interconnecting linkages and the supports and mounting brackets in

accordance with Martin's drawings and instructions for these drives. All dampers and drives have to be provided with access for maintenance.

Fan Instrumentation

Fan instrumentation shall be furnished and installed in accordance with the requirements of the fan specification, SM-104.

2.6.2 Valves and Piping

A full complement of trim piping and valving shall provided. All boiler blowdown, vents and drains, including drains from drum instruments and all sampling lines, shall be double-valved, with the downstream valve located at the stoker operating level, grouped together for ease of operator access.

Feedwater piping shall be furnished from the economizer to a point in the piping at the inlet to the feedwater block and bypass valves (boiler external piping). Feedwater line sizing shall be in the range of 12 fps to 15 fps (max.).

Steam line sizing shall be in the range of 100 fps to 120 fps (max.).

Safety valves shall be furnished in accordance with ASME Section I with capacities certified by National Board of Boiler and Pressure vessel inspectors. All safety valves shall be flanged and furnished with vent stacks, silencers and drip pans. These valves shall be of rugged construction with tight shut-off. Thermally compensated design shall be used to ensure stability of set pressure and to minimize temperature distortion. The safety valves shall be Consolidated "Maxiflow", Crosby "HC/HCA" or Purchaser approved equal. A 125V D.C. electrically controlled relief valve and manual block valve shall be furnished at the superheater outlet piping, in addition to the code required relief valves. The relieving capacity of the electrically controlled valve shall not be less than 20 percent of the steam generator maximum continuous rating. The valve shall be provided with controls and subpanel for remote mounting by the Purchaser and shall be Crosby type "Pressurmatic" or Purchaser approved equal and shall be furnished with vent stack and silencer.

Silencers must be properly sized to avoid excessive back pressure on the safety valve causing improper valve action or reducing relieving capacity. Vent stacks, silencers and related piping shall be properly supported to avoid excessive loading on the valve discharge flanges.

All valves are to be selected for the intended service. Gate valves shall be used unless otherwise specified or agreed by Purchaser. Drain and vent valves shall be Hancock, Rockwell-Edward, Yarway, or Purchaser approved equal. Continuous blowdown valves shall be Yarway "Hy-drop" throttling valve designed for continuous blowdown rates of 0.2% to 2.0% of MCR steam flow (typical). Intermittent bottom blow-off valves for steam drum, bottom drum (for two drum boilers), and waterwall headers, shall be Yarway "Unit Tandem", Edward "Univalve" tandem blow-off valves, or approved equal. All valves shall be of the back-seat type and supplied with bolted bonnet, rising stem and stainless steel trim, repairable or replaceable without removing valve from the line. Valves two (2) inches and smaller, except control valves, shall be as a minimum 600 lb. std. forged steel with socket weld ends. Valves two and a half (2-1/2) inches and larger, shall be as a minimum 600 lb. std. cast steel with raised face flange or butt-weld ends. Four (4) inches and larger steam valves shall be provided with an integral valved by-pass for warm up. Safety valves shall be supplied with test gags. Feedwater and main steam non-return valve shall be furnished and be Rockwell-Edwards or Purchaser approved equal. Angle type check valves shall be furnished as required by the arrangement of the piping.

As far as possible, all valves supplied shall be of a single manufacturer. All valves of a single classification shall be identical and interchangeable.

The selection of pneumatic valve operators shall be subject to approval by the Purchaser. A handwheel and a position indicator shall be provided for manual operation of control valves. Interlocking shall be provided to prevent engagement of the handwheel when the operator is energized. Control valves shall be supplied with open and close limit switches for remote control and indication. Control valves shall be Fisher Controls or Purchases approved equal.

Pipe material shall be seamless, carbon steel ASTM A-106 B or ASTM A-53 B, or chrome-moly ASTM A335 P11, subjected to pressure and temperature limitations. Piping two (2) inch and smaller shall be as a minimum schedule 80. Pipes two (2) inches and smaller shall have socket weld joints and all pipes two and a half (2-1/2) inches and larger shall have butt-weld joints.

Fittings two (2) inches and smaller shall be 3,000 lb. forged carbon steel ASTM A-105 II, or forged alloy steel, ASTM A182 F11, socket type. Fittings two and a half (2-1/2) inches and larger shall be forged carbon steel ASTM A-234 WPA or WPB, or forged alloy steel, ASTM A182 F11, butt-weld joints.

All butt weld connections shall be provided with butt-weld ends in accordance with ANSI B 16.25.

The Contractor shall verify all flap gate valve sizes and dimensions with the Engineer for interfacing with the boiler steel, platform and stoker equipment.

2.6.3 Vents and Drains

Vents must be terminated through the roof. Drains (including safety valve drip pan drain and sootblower drains) shall be brought to a common "zero expansion" header at operating/grade level unless specifically requested otherwise.

Superheater and drum vents shall be routed into the nearest safety valve vent silencer or a separate silencer shall be mounted on each superheater and drum vent line.

2.7 Casing, Hoppers and Ducting

The Contractor shall supply all casing, hoppers and ducting with expansion joints within the scope of supply limits. These shall be of welded steel plate construction, designed and fabricated, including all supports, in accordance with applicable rules of the AISC. All material required to support these casings, hoppers and ducting, including all brackets, hangers, frames, etc., shall also be supplied by the Contractor.

2.7.1 Casing/Ducting

The Contractor shall include the economizer casing, boiler penthouse, and stoker front, sides and rear casing. Stoker casing shall be in accordance with Martin GmbH drawings and instructions.

The casing/ducting which is in direct contact with fluegas, i.e., economizer casing, shall be designed for the maximum expected flue gas temperature and for full internal design pressure. The maximum flue gas temperature must be assumed in the maximum fouled condition (e.g., + 75°). Carbon steel material is permissible up to a maximum expected flue gas temperature of 750°. For higher temperatures, appropriate alloy steels must be applied. It shall be adequately stiffened by externally welded steel reinforcements. The deflection of the casing stiffeners shall not exceed 1/360 of the span and the deflection of the plates shall not exceed 1/120 of the span between stiffeners. It shall be seal welded as required to obtain gas-tight design.

All plates used shall be of suitable carbon (A-36) or alloy steel, manufactured in accordance with ASTM specifications and shall not be less than 3/16 inch in thickness.

2.7.2 Hoppers

The Contractor shall furnish ash hoppers for the convection, superheater and economizer passes. Hoppers shall be of pyramidal configuration with minimum valley angle of 55 degrees. Hoppers shall be furnished with access doors, poke holes and strike plates. Hopper outlets shall be provided with 16 inch square openings for the convection pass hoppers and 12 inch square openings for all other hoppers. Minimum 3/8 inch thick square flanges shall be provided for connection to and to support the Purchaser's ash removal equipment. The hoppers shall be designed as a minimum for full ash loading based on density of 90 lb/cu. ft.

Convection pass hoppers shall connect through the rear membrane wall roof with a flanged insulated duct or be ducted into the rear furnace wall, in accordance with Martin's drawings and instructions. In each case the hopper exit opening and the connecting ductwork shall be no less than 16 x 16 inch inner dimension.

All plates used shall be A-36 carbon steel, manufactured in accordance with ASTM specifications and shall not be less than 1/4 inch in thickness. Alloy steel (A387 Grade 11, Class 1 or better) suitable for the maximum design temperature shall be used for the superheater hoppers.

The clearance between the economizer hopper(s) and ground floor elevation shall be minimum 16 feet for single hoppers and minimum 18 feet for multiple hoppers.

Where multiple hoppers are required across the width of the unit, the number of these shall be minimized as far as the minimum valley angle of 55 degrees allows.

2.7.3 Air Ducts and Dampers

Combustion air ducts with air intake screens shall be provided, which extend from the refuse pit intake to the forced draft (FD) and overfire air (OFA) fan inlets. The inlet duct shall be provided with a sealed penetration through the refuse storage/boiler area separation wall and an inlet screen of wire mesh (wire 1/8 inch diameter, mesh opening 3/8 inch square). The penetration detail shall be coordinated with the Purchaser to insure proper interface with building steel and siding. Ducting shall be 3/16 inch thickness (minimum) and designed with either single inlet which then splits into individual ducts to the FD and OFA fans, or completely independent inlet ducts to the fans. In either case, ducts shall be sized for a maximum local intake velocity through the screen of 800 fpm and maximum transport velocity of 3,000 fpm. The intake plenum shall allow for gradual increase in velocity to keep pressure drop to a minimum.

All ducts shall be adequately stiffened by externally welded steel reinforcements. Internal stiffeners are not acceptable. The deflection of the duct stiffeners shall not exceed 1/360 of the span and the deflection of the plates shall not exceed 1/120 of the span between stiffeners. Ducts shall be seal welded as required to obtain air-tight design. Turning vanes shall be furnished if required by the Contractor's design to reduce pressure loss.

The Contractor shall furnish flow balancing dampers in individual ducts to the overfire air nozzles. Each damper shall be provided with a control lever and linkage for connection to Purchaser furnished hydraulic activators. Dampers shall be equipped with end stops at their open end position. The Contractor shall provide all mounting hardware and installation including the mounting brackets to support the drive cylinders in accordance with Martin drawings and instructions. Dampers shall be of the multiple opposed blade type, with flanged connections to the ductwork.

Overfire air ducts shall be designed for low pressure drop. Velocities in the overfire air ducts shall not exceed 2000 fpm when 60% of the overfire air fan capacity is supplied to either the front or the rear row of nozzles. All stokers with more than 2 grate runs must feed the overfire air headers from each side of the boiler or have branch headers designed with a continuously reduced cross-section to assure even pressure aross the boiler width. Special arrangements must be made to ensure equal flow to all nozzles, e.g., gradually decreasing header size or multiple feed to header. Headers shall not be fed in line with nozzle centerline to avoid "blow through." Headers shall be fed perpendicular to the nozzle centerlines.

The sealing air from the seal air fan shall be supplied to one connection on each side of the stoker transverse frame, to the stoker observation ports (peepholes) and to the wallboxes of all retractable, and rotary sootblowers in the superheater and boiler convection passes. The sealing air to the filter for the driving beam support rollers may be supplied from the FD fan discharge. For stokers with 4 runs or more, seal air is required to be supplied to both sides of the stoker in separate air supply ducts or pipes.

Manual dampers shall also be furnished in the seal air distribution ductwork for balancing and isolation of flow paths.

All dampers shall be marked on the outside to clearly indicate the position of each damper blade and endstops shall be provided to avoid overturning of the blades.

2.8 Steam Coil Air Heater

The Contractor shall provide for each unit, for installation in the underfire air duct, a minimum of five (5) drainable steam coil air heater assemblies, mounted in airtight heavy duty frame casings, with removable core feature. The assemblies shall be arranged in series to provide at least five (5) separate stages of heating. A ductwork section with a minimum 18" x 48" quick opening type access door for cleaning shall be provided between the second and third stages. In addition, minimm 18" x 48" quick opening type access doors shall be provided in ductwork upstream of the first stage, and downstream of the last stage. Also, air heaters must be cleanable without removing the coils from the ductwork. Four inch diameter, capped drains in the ductwork shall be provided at the low point of the heater, spaced every 3 ft. across the width of the duct.

Finned steel tubes shall be schedule 40, with .036" minimum thickness steel fins, 4 fins per inch maximum. Tubes shall be arranged with in-line pitch. Offset tube arrangements are not acceptable.

Steam coil design shall be horizontal coils. Vertical coils, if required due to space and arrangement restrictions, shall be subject to Purchaser's approval.

Horizontal coils shall be inclined with internal steam distribution tubes. Flanged single inlet and outlet connections for each heater coil stage shall be provided on the same side of the coil. Coils shall be horizontally removable from the end opposite the piping connections. Piping, valves, traps, etc. for the steam supply and condensate return lines will be furnished by the Purchaser.

The steam coil air heater shall be designed to operate with the turbine extraction steam conditions specified in the Design Conditions. The following criteria shall also be used for coil design:

Air side fouling factor	-	0.01 $hr\text{-}ft^2\text{-}^\circ F/Btu$
Steam side fouling factor	-	0.001 $hr\text{-}ft^2\text{-}^\circ F/Btu$
Maximum allowable face velocity	-	900 ft/min.

For boilers with heated overfire air the Contractor shall furnish and install a similar type air heater and duct arrangement in the overfire air duct with a minimum of 4 separate stages.

The steam coil air heater(s) shall be designed to preheat the underfire combustion air (UFA) and overfire air (OFA) flow specified in Attachment 1, Design Conditions as follows:

HHV of Refuse	Temperature of UFA	
	Inlet	Outlet
up to 5250 Btu/lb	60°F	300°F
5250-5500 Btu/lb	60°F	250°F
over 5500 Btu/lb	60°F	200°F

Steam coils shall be manufactured by Armstrong-Hunt, Yuba Heat Transfer, Aerofin or Purchaser approved equal.

2.9 Lagging, Insulation and Setting

The Contractor shall furnish and install the complete brickwork, refractory, insulation and lagging for each steam generator and stoker unit.

2.9.1 Insulation and Lagging

All hot surfaces, including the boiler settings, and hot air ducts, plenums, piping, all hoppers including stoker siftings hopper, those parts of the Martin stoker supply as indicated on Martin's drawings, etc. shall be insulated and aluminum lagged. Outside skin temperature shall be no more than 130°F based on 80°F ambient temperature. Hot piping and equipment which are not in operation which are potentially subject to contact by personnel shall be insulated and lagged for personnel protection. Setting, ductwork and equipment lagging shall be 0.040 inch ribbed aluminum. For outdoor boiler units, lagging shall be provided with a shop applied enamel finish in a color and panel configuration to be determined by the Purchaser.

Piping insulation shall be mineral wool or fiberglass suitable for the operating temperature of the piping. Insulation shall be finished with aluminum jacketing.

Insulation used for covering valves, flanges, water columns, cross tees and watergauge valves shall be a removable jacket made of fiberglass blankets, suitable for the operating temperature.

2.9.2 Setting

Furnace waterwalls shall be covered with minimum 87% gunnited silicon carbide refractory to a thickness of 7/8 inch from the tangent of the tubes, up to a height of 30 feet above the Martin grate at the center of the furnace. The waterwall surface that

forms the rear sidewalls and stoker roof from 3 feet below the lower panel bend that houses the overfire air nozzles to the chill tube and bridgewall headers, shall be bare.

Thermocouples shall be buried in the silicon carbide lining, as required by the refractory supplier, to monitor the curing process. The Contractor shall furnish and install these thermocouples.

The suppliers of this system shall be Dyko, Didier Taylor, Norton or Purchaser approved equal. All SiC refractory shall be applied over SiC sleeves, which shall have a minimum density of 150 lb/cu. ft. and be installed on 3/8" dia. x 3/4" lg. stainless steel studs welded at 660 per sq. meter.

Shop installed refractory around the overfire air nozzles shall have provisions for anchoring field-installed refractory.

For the other refractory in the stoker area, the following shall be furnished and installed:

- The feed table side walls up to the end of the feed table, shall have minimum 85% SiC bricks. Brickwork in the entire feed table area shall be of the interlocking type. Adequate expansion joints and dense anchoring must be provided to withstand the extreme service expected in this area.

- The ignition roof shall be provided with 3 inch of 70% castable alumina (Al_2O_3) up to the overfire air nozzles and SiC (1 inch thick) at the nozzles and from the nozzles to the corner and up the front wall. The nozzle row shall have sufficient anchoring between the nozzles to install the refractory across the whole row in the form of a single wave.

- The area immediately below the feed table at the front of the grate shall have 85% high alumina special shaped firebricks with adequate expansion joints, e.g., every third joint to be filled with compressible material instead of mortar.

- The area immediately below the chill tubes shall be provided with special shaped firebricks. The fire bricks in the area of the first three stoker sections shall be minimum 85% SiC. The remainder shall be 85% high alumina. Adequate insulation between these bricks and the support frame is essential. Expansion joints must be provided as required.

- The areas from the lower sidewall chill headers to the rear wall and down to the ash chute, and the rear wall itself, shall be provided with castable refractory or low duty firebrick.

. The areas behind the chill tubes and special sidewall shapes shall have high duty firebrick, insulating firebrick, and high temperature block insulation.

All firebricks and refractory shall be properly designed and installed. Special attention shall be given to anchorage and expansion. Attention must be given specifically to the fact that the flow of refuse along the refractory will exert additional forces that require to be compensated by adequate anchoring of the refractory. All design drawings shall be submitted for information and review.

Low duty firebrick is defined as a fireclay brick having a PC value not lower than 15 nor higher than 28. High duty firebrick is defined as a fired clay brick having a PC value not lower than 29 nor higher than 31-1/2.

Hoppers for the convection passes shall be lined internally with refractory suitable for the maximum temperatures expected and for the mechanical strength required to withstand impact from falling slag. The refractory lining for the hopper for the second furnace pass shall be suitable for water washing without deterioration. The surface of the lining of the hoppers must be very smoothly trowelled to allow fly ash to glide through the hopper easily. As an alternate, hoppers may be fabricated from material suitable for the maximum expected gas temperatures, without refractory lining, but adequately insulated.

2.10 Sootblowing System

The Contractor shall provide a completely automated, sequential sootblowing system for each boiler, including sootblowers, wall boxes, motor starters and pushbuttons with local disconnect switches, solid state control system and panel, all necessary steam supply and condensate piping, valves, fittings, hangers, thermal drain valves, etc.

The sootblower system shall be designed to operate with superheated steam, taken from the superheater outlet piping down-stream of the Purchaser's flow element.

The sootblowing system shall be supplied by Diamond Power, or Copes Vulcan.

2.10.1 Sootblowers and Piping

Retractable blowers shall be provided for the convection evaporative surface (third pass) and superheater sections which are exposed to flue gas temperatures in excess of 1000-1200°F. The remaining superheater banks and the economizer may have rotary blowers, typically two blowers per section, including two blowers

at the superheater outlet. Sootblower materials shall be suitable for the temperatures and gas compositions normally encountered when bulk firing municipal solid waste.

Retractable sootblowers shall have steel box beam construction with an open bottom to enclose the drive mechanism, motor, lance and other moving parts for complete protection.

Rotary, lane sootblowers shall not be mounted further than 6 inches from the tube bank that they have to clean. Sootblower mounts and guides shall not be attached to the tube shields.

All sootblowers in the superheater and boiler convection passes shall be provided with a positive pressure, cooling/sealing air system. This air shall be obtained from the seal air fan system.

The piping system which is provided for the steam supply and drainage, shall be designed to allow for the thermal expansion of the piping system and the boiler. It shall be routed in a serpentine, downward arrangement, with shortest possible flanged connections to the individual sootblowers. Sootblower drains shall terminate at the stoker level with an isolation valve. A provision shall be made for removal of the condensate during the blowing cycle without interruption of the blowing.

Piping materials shall conform to the pressure and temperature limitations of ANSI B31.1 and ASME.

2.10.2 Sootblower Control System

Sootblowers shall have sootblower manufacturer's standard 460 volt electric motor drives. A NEMA 4 motor starter shall be furnished and installed local to each sootblower. Individual, blower mounted manual pushbuttons shall be provided. Sootblower pushbuttons, limit switches, etc. and motor shall be completely factory wired to the motor starter. Motor starter shall be furnished and wired complete with all necessary relays and auxiliary contacts required for interlocks and control. Terminal blocks shall be provided and wired to accept all remote power and control cables. Local disconnect switches with an external handle to disconnect power and control voltages shall be furnished, installed and wired to starters.

The Contractor shall furnish complete factory-fabricated sootblower sequencing control insert panels, suitable for mounting in a panel board. Insert panel color shall be as determined by the Purchaser. Factory to install in the subpanel enclosure all timing devices, relays and other devices as required for system control and operation with all wiring connected to terminals for field wiring

connections. Control system shall be the manufacturer's microprocessor or programmable controller system as approved by the Purchaser.

Three-way switches (Auto/Bypass/Manual) or electronic equivalent shall be provided for each sootblower.

The sootblower system and control panels shall be furnished with the following capabilities:

1. Reprogramability of blowing sequence to allow Operator to vary selected sootblower sequence from the panel.

2. Manual initiation of the automatic cycle.

3. Manual blow of any selected sootblower.

4. Deletion of any sootblower or combination of sootblowers from the cycle.

5. Manual stop of the automatic cycle at any point with provision for the completion of any sootblowers in operation.

6. Blowing failure alarm.

7. Forward and reverse travel indication for long retractable sootblowers.

8. Automatic retract of long retractable sootblowers upon motor overload.

9. Provision of separate SPDT "Sootblowing in Progress" dry contact for interface with flue gas cleaning control equipment.

10. Automatic warmup and condensate draining system based on thermal drain valve temperature indication. Use of warmup timing device may be incorporated, but shall not replace or override temperature sensing for control of warmup.

11. Blower operation elapsed time function, to alarm and stop blower sequence if a sootblower takes excessive time to complete its blowing cycle.

12. Variable space timer (0-60 minutes), to permit varying the time between sootblower operation in the sequence.

13. Reverse of all long retractable sootblowers and sequence stop, upon boiler trip.

2.11 Auxiliary Fuel System

The Contractor shall provide auxiliary burner(s) for each of the steam generators. The burner(s) shall be utilized for warmup, shutdown and temperature maintenance dictated by environmental permit conditions, and will be located in the side walls of the furnace within the SiC refractory area and rated for a continuous heat input as defined in the Design Conditions. The burner(s) shall be located 26.5 feet above the grate. The Contractor shall verify that the burner(s) is capable of raising combustion gases temperature to 1800°F for a combustion gas residence time of at least two seconds at all loads as well as during startup and shutdown. If this is not possible with the burner elevation stated above, the Contractor shall propose an alternate location to Ogden Martin Systems, Inc.

2.11.1 Auxiliary Fuel Burner(s)

The burner(s) and burner equipment shall be of a rugged and heavy duty design, entirely suitable for continuous power plant service. They shall also be suitable for service in place but not in operation. The design and all materials shall be chosen to minimize maintenance. Parts subject to severe wear or deterioration shall be replaceable with a minimum of dismantling. All valves or controls shall be mounted outside the burner front and air housing.

The Contractor shall provide a completely prewired burner front package with the necessary combustion control drive unit(s), safety controls and alarm systems, fuel shut-off safety valves, windbox and burner throat, combustion air fan with motor drive and control louvers, etc. The Contractor shall provide a pressure regulator upstream of the fuel control valve train for each gas fired burner. Fuel piping and electrical connection external to the burner front will be provided by the Purchaser. A minimum of two viewports for flame viewing shall be furnished.

The auxiliary burner system shall be provided with a low capacity continuous burner purge/cooling air system utilizing air from the burner purge air fan or from the seal air fan.

The burner design shall provide positive and uniform mixing of the air and fuel at all loads, and shall produce sufficient turbulence to preclude stratification. Burner(s) shall be designed to burn fuel(s) as specified in the Design Conditions.

If fuel atomization is required, an air atomizing design shall be provided utilizing compressed air at 80 psig.

The burner lighting equipment shall be suitable for an entirely automatic purging and light-off procedure, after a manual initiation. For natural gas fired burners, spark ignited gas

pilots shall be used for burner lightoff. For oil fired burners, the ignitors shall be high-energy spark ignitors capable of lighting off the atomized oil without the use of a pilot.

The ignition transformers shall be of the air-cooled type. The high tension wiring from the transformers to the electrodes at the burners shall be furnished and shall have special insulation suitable for the temperatures encountered in this application. The entire ignition system shall be impervious to radio interference. Filters or other equipment required to prevent such interference shall be included.

The ignitor system shall be furnished complete, including all transformers and high tension wiring.

2.11.2 Auxiliary Fuel Burner Control System

The auxiliary burner system, including the control system shall be designed and installed in accordance with the National Fire Protection Association standards, as follows:

-	NFPA 85-A	For single burner boilers
-	NFPA 85-B	For multiple burners boilers (gas fired)
-	NFPA 85-D	For multiple burners boiers (oil fired)
-	NFPA 70	For electrical equipment and wiring

The Contractor shall provide a complete Burner Management System (BMS) as part of the burner front package. The Burner Management System shall be a PLC or microprocessor based system that can be reprogrammed at the site if need be and shall be housed in a NEMA 4 locally installed enclosure. The local enclosure shall have mounted on it the required hardware (switches, lights, alarms, etc.) for locally operating the burner(s).

The BMS shall include the following:

a) Safety control and alarm systems (SCA), designed to act automatically and independently of any other control systems or human operator action. The SCA system shall execute the automatic burner purge, all required function in preparation to light-off, light-off procedure, and safety fuel shut-off.

   The SCA system includes flame scanners and all required monitoring instrumentation.

b) Combustion Control System (CCS), designed to modulate fuel and air at the optimal ratio between 10% and 100% of full burner load, to maintain a set temperature in the furnace. Separate actuators shall be provided for the combustion air damper and fuel control valve.

The furnace temperature controller will be furnished by the Purchaser, will have its own process variable input (furnace temperature) and setpoint, and will send out two 4-20 mA signals to the CCS. These signals shall be passed on to the air and fuel actuators without any alteration.

However, Contractor shall override the Purchaser's signal during purge and light-off procedure in order to develop the correct fuel and air quantities.

The BMS shall accept a remote on/off signal from the control room and a remote permissive signal "boiler purge completed"; the permissive signal shall be used to allow the burner light-off sequence to be initiated only after the boiler purge is completed.

The BMS shall provide the following information to the control room, by means of dry contacts:

- burner starting sequence in progress
- burner on/off
- burner tripped
- burner fail to light
- one common trouble alarm from the local panel.

The Contractor shall identify the hazardous area classification for the electrical equipment and wiring in accordance with Article 500 of NFPA 70 (National Electrical Code). In addition, the hazardous area boundary shall be provided so that interface connections by Purchasers can meet the hazardous area requirements. If the Contractor's design is such that the burner enclosure(s) and/or immediate areas are not considered hazardous, Contractor shall provide a statement to this effect.

A complete description of the features of the burner management system shall be provided, including wiring diagrams, control loops, debugging procedures, check-out procedures, interlocks, etc. Contractor shall also provide a description of operation during the period of transition of firing one fuel to another fuel, (i.e., fuel gas to refuse) or cofiring of different fuels.

2.12 Structural Steel

The structural steel shall be designed in accordance the code prevailing in the jurisdiction of the project and with the following parameters:

Structural Design Parameters	Applicable requirements of the local, state and national building code shall apply

For enclosed boilers:

Roof	Decking, insulation, etc.	10 psf
	Piping support	20 psf
Siding	Panels, insulation, etc.	6 psf
Other loads for:	Boiler and appurtences, piping and trim, ductwork, electrical raceways, cable tray, lighting fixtures and electrical enclosures and boxes, deaerator, elevators, ash diverter gates, roof fans, ash screw conveyor, lime feed system, etc., as specified.	
Wind loads:	Applicable state and local codes with all amendments	
Seismic	Applicable state and local codes with all amendments	

2.12.1 Support Steel

The Contractor shall furnish and erect boiler and boilerhouse support steel (including girts, purlins, parapet and roof trusses for enclosed boilers) as an integrated design, based on the tentative boiler layout per the attached Martin Boiler Design Drawings and Preliminary Boilerhouse Sketch. Girts shall be furnished from grade elevation to the parapet or roof line for the three outside boiler enclosure walls. Girts shall also be furnished to support the wall separating the boiler enclosure, beginning at the charging hopper floor elevation up to the roof line. A 3 foot wide by 7 foot high clear walkway shall be provided behind the Martin feed hoppers at the charging floor elevation. (Refer to Attachment 12). If space restrictions exist above the unit roof, then the building roof steel shall be arranged such that beams frame into (in-lieu of bearing upon) girders to afford the maximums headroom for maintenance operations. The boilerhouse building may or may not be structurally independent from adjacent buildings. The refuse bulding structural frame will be designed to stand and act as an independently supported structure for both vertical and horizontal forces attributed to dead, live, erection, operating, wind and seismic loading conditions. To facilitate this concept, a double column row shall be employed at the refuse/boiler building interface without a load transfer interconnection. The APC and turbine buildings may however, at OMS's option, frame into the boiler building if considered possible. When this option is exercised, the Contractor will be given load points in the Project Specific Requirements for the design of his structure. The

Contractor shall acknowledge that the interconnection points are included in his bid.

If the Contractor requires a larger building envelope due to his own design requirements for the boilers, then the building steel should be correspondingly increased and OMS advised. The support steel shall be sized to take into account steam, feedwater and condensate piping loads; duct loads for ductwork from the economizer outlet to the air pollution control equipment inlet; screw converyors, smoke hatches, vent silencers, roof appurtenances and load for the Purchaser furnished equipment listed in the Design Conditions. The Contractor shall provide all primary steel for support of such Purchaser furnished equipment. The bracing system shall also be arranged to allow access at grade for at least a 5 cubic yard front end loader in each column bay (12' x 12' opening). Further, the Contractor will coordinate and arrange his steelwork to account for water storage tanks, ash handling equipment and other equipment that may be located with the Boiler Enclosure.

All structural steel design drawings shall be sealed by a professional engineer currently registered in the state where the work will be constructed. Shop detail drawings shall also be prepared under the direct supervision of a currently registered professional engineer. A final set of shop drawings shall be submitted to OMS for record purposes.

The boiler building support steel shall include framing for openings for roof access hatch(es), relief valve vent stacks and silencers, screw conveyors, vibrating conveyor(s), piping and electrical trays, economizer outlet ducts and doors; including those for access to APC scrubber penthouse (one) and scrubber inlet duct test platforms (one per boiler). Spacing of roof purlins for Purchaser's roof decking shall not be more than 5'-0".

The Contractor shall provide framing and support for the elevator shaft, machine room, doors, blockwalls around the elevator, when the elevator is located in the boiler building. In addition, the lobby floor at elevation 30 feet and 62.5 feet shall be concrete on metal deck or floor plate.

The Contractor shall furnish adequate support steel to ensure that vibration due to overfire air fan operation is eliminated. If additional materials such as concrete platforms and mass concrete vibration dampers are required, the Contractor shall furnish and install all such materials.

2.12.2 Platforms and Walkways

The Contractor shall provide a complete set of platforms with galvanized grating, stairs and walkways to enable access to the boiler, stoker, sootblowers, ash dump valves at all hoppers,

elevator landings, and other appurtenances. Platforms shall be designed based on a minimum width of 2'-6" for walkways and on each side of sootblowers and around other pieces of equipment. In addition, all platforms shall meet or exceed all OSHA requirements. Wherever possible, platform elevations shall be established such that it shall not be necessary to walk over or duck under the sootblowers.

Stairs and platforms shall be provided, as required, to allow easy access to fans, auxiliary burners, airheaters, sootblowers, all boiler hopper access doors, poke holes, dampers and impact plates, all boiler access doors, all Purchaser and Contractor supplied observation and inspection ports, all temperature and draft connections, drum instrumentation, relief valves, boilerhouse roof, spray attemperation station(s), oxygen analyzers, deaerator flash and storage tank(s) and other locations which have to be reached either regularly or occasionally. In addition, the Contractor shall provide all platforming required for access to Martin supplied equipment including the feed chute access platform. The feedchute access platform shall be located adjacent to the feedchute between the boiler and the feedchute and shall run the entire length of the feedchute at an approximate elevation of 45'. Platforms at the boiler hoppers shall be located not less than four (4) feet and not more than five (5) feet below the hopper outlet flange for installation and maintenance of the flap gate valve. Hopper doors shall be accessible with small step-up platforms at each hopper.

Boiler platforms on both sides of each steam generator shall be extended to meet adjacent building floor elevations at the charging and operating floors. Contractor shall also provide structural support at the rear of the boiler for connection of a 30 foot long walkway to access the flue gas cleaning system. In addition, Contractor shall supply support steel, access to and platform for each scrubbers' inlet duct test ports. This platform will be approximately 10 feet by 10 feet and cantilevered off boiler steel. Stairs shall be provided as required to match building elevations and to avoid obstacles, if present. Platforms shall be extended to the rear of the boiler to match-up with flue gas cleaning system scrubber penthouse and duct access platform.

Each boiler shall be provided with full stair tower access from grade to roof on at least one side. Crossover platforms shall be provided on the rear of the boiler at a minimum of three elevations including the stoker viewing level (approximate elevation 20'-0"), the steam outlet level (for access to Purchaser furnished steam flow element), and at one intermediate level as defined by the Purchaser during the design development.

Handrails and posts shall be angle 2-1/2 x 2-1/2 x 1/4 inch (OSHA approved) or square or round rails and posts. Posts shall be spaced no greater than 8 feet-0 inches on centers. Top rail and intermediate rails shall be spaced in accordance with local codes. All grating shall be banded at edges of openings. Banding strips shall be at least the same thickness and depth as the bearing bars to which they are welded. When openings between grating and protruding elements exceed 1", the a 1/4" minimum toe plate thickness shall be provided and have a vertical height of 4" from its top edge to the level of the floor.

2.13 Welding

All boiler pressure parts welding shall be performed in accordance with ASME, Boiler and Pressure Vessel Code, Section I and/or ANSI B31.1. All structural steel welding shall conform with AWS D1.1.

Welding procedures, welders and welding operators shall be qualified in accordance with ASME, Section IX and/or ANSI B31.1, as applicable. All welding procedures shall be written in accordance with the codes specified and shall include materials used, wall thicknesses, joint design details, welding voltage and current to be used, etc.

The shop welding procedures shall be available for Purchaser's review at the manufacturing location. The field welding procedures will be submitted to the Purchaser.

2.14 Access Doors and Other Wall Openings

Access doors

A sufficient number of access doors shall be provided to facilitate inspection and maintenance work. These shall be provided as a minimum at the following locations:

a) Stoker discharge rearwall (large door, 3 x 4 feet, supplied by Martin).
b) To each section of convection evaporator, superheater and economizer and all sootblower locations.
c) To the sides and top of the penthouse.
d) To the sides of all ash hoppers.
e) Furnace pass at screen tube inlet.

The standard design 18 x 18 inch or 18 inch I.D. round doors (or nearest larger size) shall be ASTM A-48 C1 30 cast iron. All ash hopper doors shall be 24 x 24 inch, fabricated from A-36 plate. All the doors shall be hinged, quick opening type and with grooved faces to accommodate suitable fire box quality door gasket to ensure gas-tight sealing. The door frames shall be fabricated of

suitably reinforced steel plate. All doors in high temperature zones shall be refractory lined. Separate plugs or refractory bricks are not acceptable.

Access doors shall be located and oriented to allow unobstructed access and supply of necessary inspection and maintenance materials, including sky climbers, scaffolds, tubing, etc. For boiler width greater than 25 feet, access doors shall be provided on both sides. Hand holds shall be provided outside and inside and footholds shall be provided as required to ensure safe entrance and exit.

Access doors/openings for on-line water-wash cleaning

To allow access to the convection heating surfaces for water washing of the tubes during boiler operation, doors and openings shall be provided in the sidewalls. These doors shall be the same access doors as provided for access to the tube banks (e.g. 18 x 18 inch square or 18 inch I.D. round) or in those locations where such doors are not required for personnel access they shall be 12 x 4 inch rectangular inspection doors. All doors shall be located immediately adjacent to the sootblowers. Each sootblower shall have a door at its side or below or above it, whichever way is most convenient to access the tube banks with the water lances. These doors shall be adjacent to the bull nose in the second pass, adjacent to each sootblower in the third pass evaporation section, the superheater and economizer tube banks. Final location shall be approved by the Purchaser.

Observation Ports

An adequate number of observation ports shall be provided to ensure unobstructed furnace monitoring. There would be typically about 12 ports in the furnace (first pass) and rear wall, however, the final number will be determined during the Contract finalization (see also Section 2.3.2).

Observation ports with glass and hinged protection shield shall be provided in the first boiler pass to observe the auxiliary burner(s) and the refuse fire. The observation ports and ignition doors supplied by Martin for the furnace and rear wall shall be installed according to Martin's drawings and instructions. The observation ports at the end of refractory level shall be angled for a downward view of the fire while maintaining view of the refractory top line.

The standard design 8 x 6 inches, hinged doors shall be ASTM A-48 C1 30 cast iron. The door frames shall be steel plate type. To ensure tight closure, the faces of the door are grooved to accommodate suitable quality door gasket. All doors shall be refractory lined and provided with suitably protected glass ports.

Cable Connections

To allow installation of suspended scaffolds (sky climbers) in the furnace (first pass) and second pass, a sufficient number of permanent cable openings shall be incorporated to allow inspection of all 4 walls in each pass. Safety rope openings shall be provided in addition. These openings shall consist of minimum 2 inch OD pipes, extended through the penthouse and provided with capped ends.

Wall Openings

All necessary wall openings for sootblowers, access doors and observation ports, auxiliary burner(s), and instrument and test connections shall be provided.

The burner openings shall be provided with a minimum of suitably reinforced 1/4 inch steel plate and with 3/8 inch thick mounting flanges. The tubes in and around the burner opening shall be formed to provide for a cooled burner throat.

2.15 Boiler Fans

If required in the Design Conditions, Contractor shall provide system fans and associated inlet vanes and drives. Design requirements shall be as contained in the enclosed fan specification (Attachment 5) and the Design Conditions. Acceptable suppliers of these fans include Howden, TLT Babcock, American Davidson, Buffalo Forge, Garden City.

2.16 Motors

All motors provided by Contractor shall conform to the requirements of Purchaser's motor specifications (Attachment 6).

2.17 Electrical

The Contractor's physical layouts shall show and dimension the required clear access and working space about all electrical equipment in accordance with Article 110-16 of the NEC. In no case shall the minimum clear distance be less than 3 feet for 0-150 volt enclosed equpment and 3 feet for 151-600 volt enclosed equipment. The minimum width of the working space shall not be less than 30 inches.

All electrical equipment enclosures, juction boxes and wiring devices shall be NEMA 4. All conduit and wiring devices shall be arranged for side or bottom entry. Top entry into electrical enclosures is not acceptable.

2.18 Nameplates and Tags

Boiler nameplates (two) shall be attached to a bracket welded onto the boiler drum and furnace waterwalls. It shall include the Contractor's (manufacturer's) name, place and year of manufacture, boiler serial number, maximum allowable working pressure and heating surface. Minimum acceptable size is 6 x 8 inches.

The Contractor shall furnish identification tags for valves and instruments. The tags shall be 16 gauge yellow brass plate, 3/4 x 2 inches with 1/8 inch hole for attachment. Tags shall be engraved with 3/16 inch numbers. All tags shall be securely attached, using stainless steel wire.

The tag numbers shall be alpha-numeric combination conforming to the project standard symbols and identifications. Tag numbers will be assigned by the Purchaser.

2.19 Painting and Finishing

The types of surface preparation, priming, finish painting and galvanizing required for the Contractor's scope of supply shall be in accordance with the Purchaser's Painting Specification SA-550 (Attachment 10).

2.20 Erection Requirements

2.20.1 General Erection Requirements

All erection of equipment and materials as defined in this specification shall be performed by the Contractor. This shall include uncrating, receiving, unloading, storage, protection, necessary moving from storage, rigging, drilling, doweling, setting, welding, assembly, aligning, cleaning, testing and any other work necessary to prepare the steam generator and all its auxiliary equipment and accessories, hereinafter called equipment, for normal continuous service. Materials, piping and electrical systems and equipment shall be installed in the locations shown on approved drawings.

Installation procedures shall conform with the procedures prescribed by the Contractor and shall be under technical direction of his field erection representatives. For subcontracted or Purchaser furnished equipment, procedures outlined in

manufacturer's instruction manuals for the equipment shall be followed. For equipment not supplied with instruction manuals, Contractor shall follow standard practices acceptable to Purchaser or the manufacturer's representatives.

The Contractor shall be responsible for locating and setting all equipment furnished under this contract, and for verification of all dimensions and measurements. No allowance will be made to the Contractor for any expense caused by his failure to make a thorough field check. Expansion markers shall be permanently installed at the appropriate location and the design cold and hot positions shall be clearly indicated.

Prior to placing equipment, the Contractor shall inspect and clean, or prepare, the surfaces of all foundations, anchor bolts, sole plates, equipment, etc., to assure satisfactory setting of the equipment. Once foundations are turned over to the Contractor, responsibility of the foundation is assumed by the Contractor (i.e., freeze damage, etc.).

All equipment shall be put in a condition suitable for initial operation, as attested to in writing, by signoff of the Contractor's start-up advisor and the Purchaser's start-up engineer.

Concrete foundations shall be cleaned of all laitance and dirt by chipping and saturating with water for four hours prior to grouting (grouting by others).

All construction shall be performed in accordance with the OSHA requirements of 29 CFR 1926.

2.20.2 Storage and Protection During Erection

Immediately upon arrival of equipment at the jobsite, the Contractor shall thoroughly inspect and determine that all equipment or material is free of damage and complete.

The Contractor shall assume all responsibility for the care, inventory control, safeguarding, weather protection, fire protection, and temporary lay up of all equipment and materials at all times until the installation is accepted by the Purchaser for operation. The Contractor shall protect the equipment and material so that there is no deterioration that could adversely affect the useful life or the suitability of the equipment or material for the purpose for which it was furnished.

All equipment stored outdoors shall be kept clean at all times during storage, handling, installation and after installation until initial operation. In the storage area, it shall be stored on sleepers or otherwise so that it does not contact the earth. When handled, it shall not be dragged along the ground. Electrical and electronic equipment shall be specially handled with heated indoor storage. Interim storage on site of Martin-furnished equipment shall be in accordance to Manufacturer's instruction given in Attachment 8.

The Contractor shall unload, store, protect, and turn over to the Purchaser all tools furnished with the equipment. Any tools furnished with the equipment and used for erection purposes shall be either replaced or cleaned and reconditioned to the satisfaction of the Purchaser before being turned over to the Purchaser.

Specifically, the stokers shall be covered with plywood for protection as soon as the stoker grate bars are installed. This cover shall be installed according to Martin's instructions and, as a minimum, consist of layered plywood sheets with rungs nailed on to allow walking. Heavy plastic foil shall be installed between the stoker grate surface and the wood cover.

2.20.3 Structural Erection Requirements

Erection shall be in accordance with the AISC Specification and OMS Specification No. SS-410 (Attachment 9).

The Contractor shall furnish and install all shims which may be required.

Structural steel members shall be cleaned and deburred at punched holes, sheared edges, etc., to provide a smooth level bearing surface. When specified, friction reducing bearing plates shall be provided and installed in accordance with the equipment and plate manufacturer's recommendations.

Shims for concrete supports shall be random size steel plates and bars. Shims shall be located adjacent to all anchor bolts and at sufficient intermediate points to assure complete alignment of equipment.

Shims for structural steel supports shall be steel plates cut to suit the full bearing surface being supported. The composite thickness of shims between equipment and base plates or sole plates shall be not less than 1/8 in. All base plates and sole plates shall be set to accommodate the 1/8 in. of shims.

After final alignment and torquing of anchor bolts, locking jam nuts shall be installed for all bolts and shall be drawn up firmly. The Contractor shall cut off and deburr all anchor bolts which have a projection beyond the locking nut of more than half the bolt diameter.

2.20.4 Alignment of Equipment

The Contractor shall set and align all rotating equipment and drivers in accordance with the manufacturer's instructions or recommendations. The couplings shall be left loose during alignment. If the equipment and the driver were shipped as a complete unit, the coupling shall be loosened before the alignment.

After all piping and ductwork have been connected to the equipment, and initial operation is imminent, the Contractor shall check the alignment, realign if necessary, and make-up the coupling.

After the equipment has run at normal operating temperature, the Contractor shall recheck the alignment. Then, the Contractor shall final torque all equipment and drivers to the base plates.

2.20.5 Piping Erection Requirements

All piping furnished with the boiler shall be erected, pressure tested and cleaned by the Contractor. Non-boiler external pipe shall be hydrostatically tested in accordance to ANSI B31.1. Fuel piping shall be pneumatically air tested prior to operation. The Contractor shall furnish, install and adjust all hangers and pipe supports for this piping.

2.20.6 Electrical Erection Requirements

The receiving inspection of motors shall include checking to assure that oil was drained from the bearings before shipment, and that protective coatings on bare machined metal surfaces such as shafts and couplings remain intact.

While in storage, oil shall be added for bearing lubrication. The rotors of horizontal shaft motors shall be turned at weekly intervals, to prevent bowing of the shaft. The rotors of vertical shaft motors shall be rotated several turns at weekly intervals, to maintain the oil coating on bearing surfaces and to prevent fretting of bearings. In addition, motor winding pigtails and other motor terminals shall be protected against moisture. A log of all rotations shall be maintained by the Contractor with copy provided to the Purchaser. Motor space heaters shall be energized.

3.0 TESTING, GUARANTEE, QUALITY CONTROL

3.1 Examinations and Tests

The Contractor shall perform examination and testing in accordance with written procedures. Procedures shall be available to the Purchaser for review and approval, at the Purchaser's discretion. For work requiring written procedures, no work shall be performed

until the procedures have been approved by the Purchaser, or approval has been waived. Waiver of approval does not relieve the Contractor of any responsibility for full performance of his obligations. Inspections and test required by local building officials or code shall be to Contractor's account.

Examinations and tests shall be performed by the Contractor and his subsuppliers in the shop, to the greatest extent possible. The

Contractor shall furnish advisors for any of the tests listed below even if they are not performed by the Contractor.

The Purchaser or his representatives shall have free access to the Contractor's plant at all times when the work and tests on the contract materials are in progress, and the Contractor shall notify the Purchaser in advance of all such tests to have a representative present at any such tests at his discretion.

The examinations and tests required by this specification are as follows:

3.1.1 Nondestructive Tests

All nondestructive tests (NDT) shall be performed in accordance with written procedures, which shall be available to the Purchaser. All NDT shall be performed by personnel certified to the applicable quality levels as defined in the procedures.

All NDT results shall be appropriately documented.

3.1.2 Hydrostatic Tests

All hydrostatic testing shall be performed by the Contractor in accordance with written procedures incorporating the requirements of ASME I. All shop fabricated pressure part assemblies shall be hydrostatically shop tested to the extent feasible or in accordance with Contractor's shop practice. Such testing shall take place prior to painting. A final hydrostatic test shall be performed in the field, held for at least one hour and witnessed by the Purchaser. No leakage indications are permissible. The Contractor shall furnish his hydrostatic test procedure to the Purchaser for approval. The Contractor shall be responsible for all supplies and procedures necessary to conduct this test, including but not limited to providing and disposing of the appropriate quality water, filling and draining of pressure parts, notifying appropriate parties, interfacing with the general contractor, the Purchaser and any other affected parties on site, etc.

Unless otherwise specified or permitted by the applicable code, tests shall be made after all heat treatment and weld repairs have been completed.

Corrosion-resistant castings and/or welds shall not be painted prior to testing.

3.1.3 Field Tests

The Contractor shall be responsible for furnishing advisors or Manufacturer's service representatives for all required operating tests of his equipment. The Purchaser will furnish personnel for

observing and recording test data, and will operate the boiler in accordance with the Contractor's recommended procedures.

Field tests shall:

1. Demonstrate that the equipment operates in a stable, commercially satisfactory manner and in accordance in all respects with the requirements of this specification.

2. Demonstrate that all equipment meets the applicable guarantees enumerated in the Performance Guarantees Section 3.2 and Attachment 1, Design Conditions, of this specification.

Boiler efficiency will be calculated by the heat loss method based on combustion analysis, using the ASME-PTC4.1 abbreviated test form. Radiation losses will be established based on Contractor's data.

For the tests, the boiler will be commercially clean and properly operated, and the excess air during each test will be as close as reasonably attainable to that used for the guarantee basis. "Commercially Clean" is defined as the condition of the boiler after it has operated continuously in normal service for at least 21 days but not more than 60 days since the last cleaning in accordance with the manufacturer's instructions. At the end of this period, without shutting down, and without special cleaning or conditioning of any kind, the boiler shall be considered as "Commercially Clean".

3.1.4 Inspections

The following are the notification points for which a minimum of five (5) working days prior notification is required:

1. Boiler - Hydrostatic Test
2. Shipping Release for major boiler components and fans
3. Start of refractory placement
4. Rotation and bumping of all fan motors

3.2 Performance Guarantees

The Contractor shall provide performance guarantees as specified in the Design Conditions. Contractor shall also complete the guarantee section of Equipment Data Sheets.

Contractor shall provide and install on-line cleaning devices, including the addition of retractable sootblowers in the open downpass following the furnace pass and/or the addition or modification of other sootblowers, and/or shall supply and install or delete, as appropriate, economizer heat transfer tube surface, at no additional cost to Purchaser, if necessary to meet the performance guarantees.

3.3 Quality Control

Quality Assurance/Quality Control manuals and Quality Control Reports shall be subject to Purchaser's approval.

A QA/QC inspection program shall be established and regular inspections shall be performed and/or reports submitted to the Purchaser, concerning overall system quality matters, including but not limited to such items as centering of boiler and stoker, spacing, arrangement of equipment studding, refractory, conformance of equipment with drawings and specifications, welding procedures and qualifications, structural steel connections testing, safety relief valve testing, etc.

3.4 Material Safety Data Sheets

Contractor, as part of its operating manuals shall provide Material Safety Data Sheets as required by Federal law.

4.0 SUPPLEMENTAL REQUIREMENTS

4.1 Data and Drawings Required

The Contractor shall provide the following information with his proposal:

- Detailed description of his offering
- The Contractor must state that he fully complies with this Specification other than specifically stated in a list of exceptions. Such a list of exceptions shall clearly state each exception, referenced to item and page number, reason for taking exception, cost and/or schedule impact if exception is not granted and any other clarification deemed necessary.
- Foundation loads and footprint*
- Layout drawing**
- Fan Curves (preliminary) for all proposed fans
- Construction Schedule

- Equipment Data Sheets
- Motor Horsepower Consumption
- Sootblower Location Drawing
- Recommended Spare Parts List

* Footprint shall show preliminary foundation loads for all cases including wind, seismic, operating, dead, live and hydrotesting of equipment to within ±10% of the loading and ±12 inches of the ultimate column locations.

** Layout drawings shall include overall building dimensions (for enclosed boilers), column locations, boiler, fan and air heater arrangement, and duct and hopper arrangement. The number and location of hopper connections shall be clearly shown. Adequate space shall be allotted for removal of sootblowers, fan wheels, heater coils, etc.

After award the information and data below, as a minimum, shall be submitted to the Purchaser for "Review" or for "Information" as specified.

Documents for Approval		Submittal Req'd By (Days after Award)
Document Submittal Schedule		15
Delivery, Fabrication, & Construction Schedule		30
Boiler Pressure Parts, Outline and Arrangement Drawings, including all drawings needed for interfacing with stoker equipment	Preliminary	30
	Final	60
General Arrangement of each Platform Level		45
Trim List		45
General Arrangements of Boiler Fans and other Equipment		30
Loading Diagrams		30
Foundation Baseplate and Anchor Bolt Arrangement Drawings		30
Piping Flow Diagrams		60

Nozzle Loading Diagrams	60
Air & Gas Flow Diagrams	60
Water and Steam Flow Diagrams	60
Refractory Installation Drawings	90
Electrical Wiring Interface Diagrams	90
Burner Control Logic Diagrams	90
Hydrostratic Test Procedure	60 days prior to hydrostatic test
Examination and Test Procedures	90
Fan Curves (final)	90
Motor Curves	90
Certificate, signed and stamped by P.E., licensed in State of boiler location stating that the boiler has been constructed in accordance with the drawings and specifications	After hydrostatic test, but prior to boil-out
Test Reports	15 days after test
"As Built" Drawings	Prior to contract close-out, but not later than 30 days after first refuse fire

Documents for Information

Installation Drawings	180
Storage & Handling Procedures	60 days before shipment
Installation, Operations and Maintenance Manuals (10 sets) *	120 days before boil out
Spare Parts List	120 days after award

Test Program Procedure	90 days prior to operation
Quality Control Manual	60
Quality Control Reports	Every 60 days until mechanical completion
Material Safety Data Sheets	With O&M manuals
Area Classification Drawing	60
Bill of Materials	45
Sootblower Control Logic Diagram	90

* Installation, operation and maintenance manuals shall include availability of key system components, particularly of foreign manufacturers.

ATTACHMENT 1

DESIGN CONDITIONS AND PROJECT SPECIFIC REQUIREMENTS

Purchaser OGDEN MARTIN SYSTEMS OF LEE, INC.

Project LEE COUNTY SOLID WASTE RESOURCE RECOVERY FACILITY

Site Location LEE COUNTY, FLORIDA

1.0 DESIGN CONDITIONS

1.1 Scope

Quantity of Steam Generators Required 2

Boiler Support (X) Top ( ) Bottom

Primary Fuel MSW

Wind 100 MPH, EXPOSURE C Code SBCCI, LATEST EDITION

Seismic Zone 0 Code SBCCI, LATEST EDITION

1.2 Design Data and Conditions (Per Unit)

Note: MCR = Maximum Continuous Rating

Fuel Firing Rate at MCR, TPD 600

Fuel Higher Heating Value (HHV)

Design HHV, Btu/lb 5000

Range HHV, Btu/lb 3640 - 6000

MCR Steam Conditions at superheater non-return valve outlet

Minimum Capacity, lb/hr 169,270

Pressure, psig	865
Temperature, °F	830
Feedwater Inlet Temp. to Economizer, °F	300
Overfire Air Temperature, °F	300
Underfire Air Temperature, °F	300
Excess Air at economizer outlet @ MCR, %	100
Site Elevation (above MSL), ft.	2

Steam Generator Location (X) Indoors, ( ) Outdoors

Drums (X) Single, ( ) Two

Air Ducts and Dampers

Refuse Pit Air Intake - Estimated height above grade, ft.	APPROX. 95

Steam Coil Air Heater (SCAH)

Inlet Steam

Steam Source	T/G EXTRACTION
Pressure, psig	120
Temperature, °F	APPROX. 460

[redacted] Air	OFA	UFA
MCR Air Flow, lb/hr	102,860	240,010
MCR Air Flow, ACFM @ 80°F	23,480	54,780

Air Flow @ HHV<5250 Btu/lb, lb/hr	N/A
Air Flow @ HHV=5250-5500 Btu/lb, lb/hr	N/A

Air Flow @ HHV>5500 Btu/lb, lb/hr	N/A
Air Inlet Temperature, °F	80
Coil Operating Pressure, psig	120
Coil Design Pressure, psig	200
Coil Operating Temperature, °F	APPROX. 350
Coil Design Temperature, °F	650

Auxiliary Burner(s)

Rated continuous heat input % of MCR heat input	2 BURNERS @ 20% EACH
NOx Emission Requirement, ppmdv @ 7% O_2	150
Co Emission Requirement, ppmdv @ 7% O_2	50
Fuel Burned	PROPANE

Is the economizer outlet ducted to a fluegas scrubber, (Yes/No)	YES

1.3 Structural Steel and Boilerhouse Enclosure

Elevator-enclosed and supported by boilerhouse steel, (Yes/No)	NO
Capacity, lb.	N/A
Scrubber inlet duct test port platforms required, (yes/No)	YES

Other Purchaser furnished equipment to be supported from boilerhouse steel/platforms approximate dead load, lb.

Lighting Fixtures	Yes	LATER
Electrical Raceway (tray/conduit)	Yes	LATER
Steam and Water Piping	Yes	LATER
Ash Diverter Gate	(Yes	LATER

Fly Ash Screw Conveyors	(Yes [redacted]	300 LB/FT
Deaerator	(Yes [redacted]	APPROX. 400,000 LB
Lime Silo & Blower	[redacted] No)	N/A
Ductwork Load From Economizer to Scrubber	(Yes [redacted]	LATER
Continuous blowdown tank and heat exchanger	(Yes [redacted]	APPROX. 10,000 LBS
Closed cooling water surge tank	(Yes [redacted]	12,500 LBS

2.0 BOILER FANS

[redacted]

Refer to the attached Fan Specification.

2.1 Fans to be furnished by Contractor

FD Fan	(Yes/No)	YES
OFA Fan	(Yes/No)	YES
Seal Air Fan	(Yes/No)	YES

2.2 Forced Draft Fan

NOT APPLICABLE

MCR Conditions:

Flow: _____ ACFM

Static Pressure: 16" w.g. static plus losses in duct system and air heater (fouled)

Operating Temperature: _____ to 80°F

BHP _____ HP

Test Block Conditions:

Flow: 115% x Design Flow

Static Pressure: 16" w.g. plus 144% x system losses at design flow

Temperature: Operating temperature + 25°F = 105°F

BHP _____ HP

Motor Size Selected _____ HP

NOT APPLICABLE

2.3 Overfire Air Fan

MCR Conditions:

Flow: _____ ACFM

Static Pressure: 18"w.g. static plus losses in duct system

Operating Temperature: _____ to 80°F

BHP _____ HP

Test Block Conditions:

Flow: 115% x Design Flow

Static Pressure: 18"w.g. plus 144% x system losses at design flow

Temperature: Operating Temperature + 25°F = 105°F

BHP _____ HP

Motor Size Selected _____ HP

2.4 Seal Air Fan

MCR Conditions:

Flow:	_____ ACFM (350 ACFM per grate run) plus any boiler required seal air for burner purge air, sootblowers, inspection ports, etc.
Static Pressure:	16" w.g. static plus losses in duct system
Operating Temperature:	_____ to 80°F
BHP	_____ HP

Test Block Conditions:

Flow:	115% x Design Flow
Static Pressure:	16" w.g. plus 144% x system losses at design flow
Temperature:	Operating temperature + 25°F = 105°F
BHP	_____ HP
Motor Size Selected	_____ HP

NOT APPLICABLE

3.0 PROJECT SPECIFIC REQUIREMENTS

The attached Project Specific Requirements, if any, are additions, deletions and/or revisions to the preceding Specification requirements and shall be considered as part of this Specification. In the event of conflict, the Project Specific Requirements shall govern.

3.1 Loads from Adjacent Buildings

a) T-G Enclosure

__X__ Applicable
____ Not Applicable

b) APC Enclosure

__X__ Applicable
____ Not Applicable

The boiler bulding design shall provide for loads from adjoining T-G and APC enclosures interfacing with and attaching to the Boiler enclosure/structure. Loads and locations are given below and shown on [redacted] (Attachment 2):

LOAD TABLE

Load Point	Elevation	Column Lines	Vertical * Loads DL	Vertical * Loads LL	Horizontal * Loads E-W	Horizontal * Loads N-S	Remarks
"A"	110	E.9/13	35	30		1.0/LF	(1)
"B"	110	D.9/13	35	30			
"C"	110	E.1/13	35	30			
"D"	110	D.1/13	35	30		1.0/LF	(2)
"E"	25	C.6/13	40	30	40	0.5/LF	(3)
	55	C.6/13	50	60	7.4		(4)
	60	C.6/13	25	15	23		(5)
	25	C.6/12	100	120			
	55	C.6/12	40	60	7.4	4	(4)
	60	C.6/12	20	30			
	25	C.6/11	100	150			
	55	C.6/11	25	30	7.4	2	(4)
	60	C.6/11	20	30			
	25	C.6/10	40	40			
	60	C.6/10	25	15			

NOTES:

* ALL LOADS IN KIPS

(1) N-S HORIZONTAL LOADING APPLIES FROM EL. 0' TO 110'

(2) N-S HORIZONTAL LOADING APPLIES FROM EL. 25' TO 110'

(3) N-S HORIZONTAL LOADING APPLIES FROM EL. 0' TO 25'

(4) E-W & N-S T/G CRANE LOADS

(5) E-W WIND LOAD AT ROOF HORIZONTAL TRUSS

LOADING FOR CONCRETE SLAB BETWEEN COLUMNS C.6/D.1 AND 11/12 IS 250 LB/FT^2 (TOTAL)

3.2 Page 2, Section 1.2.1:

A selective non-catalytic reduction system (Thermal DeNOx) will be furnished by the Purchaser and will be used to inject a mixture of air and ammonia into the boiler at one of two injection zones. The Vendor shall furnish and install the valving, flexible hoses, piping, supports, nozzles, boiler penetrations, platforming and access to platforming associated with this system. Refer to Attachment 14, which is typical for a boiler of the indicated width. The number of nozzles and width of the system will be modified as required for the width of the Lee boiler.

3.3 Page 6, Section 1.4.D.1:

Contractor shall provide a bolt hole pattern for the economizer outlet flange which is consistent with a pattern provided by the Purchaser.

3.4 Page 12, Section 2.2:

Tube shields shall cover all tube welds which are exposed to direct flue gas impingement. Tube welds shall be positioned to prohibit direct impingement by sootblowing steam.

3.5 Page 12, Section 2.3.1:

Boiler drum manholes shall be 16 inches round.

Spare drum connections shall be double valved and capped.

3.6 Page 14, Section 2.3.2:

The furnace waterwalls shall be sandblasted per SSPC-SP-6 prior to applying refractory.

3.7 Page 17, Section 2.4.1:

Primary superheater tube banks of 5 foot - 5 inches deep will be allowed in lieu of the 5 foot maximum depth specified.

3.8 Page 23, Section 2.6.1, Air Flow Measurement:

A venturi section shall be used to monitor the total air flow for underfire and overfire air flow. An independent flow measurement of overfire air shall also be provided utilizing an annubar type device.

3.9 Page 25, Section 2.6.2:

As opposed to the capacity requirement specified, the electromatic valve on the superheater outlet header shall be capable of passing a minimum of 10 percent of the boiler full load capacity, in complete accordance with ASME Code, Section 1.

3.10 Page 27, Section 2.6.2:

The design, materials of construction and installation of pipe hangers, supports, guides, restraints and anchors shall be in accordance with ANSI B31.1 and MSS Standard SP-58 in effect as of June 27, 1989, whichever is most stringent.

3.11 Page 27, Section 2.7.1:

The penthouse construction shall be all welded steel construction.

3.12 Page 28, Section 2.7.2:

The overall boiler arrangement will incorporate a total of 2 economizer hoppers, 4 superheater hoppers and 2 convection pass hoppers per boiler.

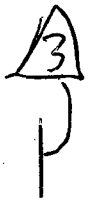
3.13 Page 28, Section 2.7.3:

The allowable velocity through the combustion air intake screen shall be 1000 fpm in lieu of the 800 fpm specified.

3.14 Page 29, Section 2.7.3 (third paragraph):

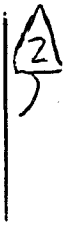
Air supply to OFA nozzles shall utilize a single header arrangement which is reduced in size to ensure equal flow to all nozzles.

3.15 Page 31, Section 2.8:



The overfire air steam coil air heaters shall be horizontal units, located at an elevation of approximately 20 feet and coordinated with overfire air fan placement. Air side drain connections from the air heaters shall be routed to grade. All air preheaters shall be designed and manufactured per ASME, Section VIII, Division 1.

3.16 Page 31, Section 2.9.2:



The waterwalls shall be covered with tile refractory for a height of 15 feet from the grate as measured from the center of the furnace. The waterwalls shall be covered with gunnited refractory as specified from a height of 15 feet to 30 feet as measured from the center of the furnace.

3.17 Page 32, Section 2.9.2:

The ignition roof shall be provided with 1-inch thick 85% SiC material up to the overfire air nozzles in lieu of 3- inches of 70% Al_2O_3.

3.18 Page 34, Section 2.10.1:

A pressure gauge shall be provided at each sootblower to monitor sootblowing steam pressure. Hardware for each steam pressure measurement shall be as follows:

a) Pressure gauge Grade 1a (+/- 1.0% accuracy), range 0-600 psig, 4 1/2-inch dial size, stainless steel Bourdon tube and socket, 1/2 NPT bottom connection.
b) Stainless steel pigtail siphon.
c) Instrument valve, stainless steel, globe, grafoil packing, 1/2 FNPT connections.

Source shall be Ashcroft or Ametek - US Gauge Division.

3.19 Page 36, Section 2.11:

Propane piping train shall be of all welded construction.

3.20 Page 36, Section 2.11.1:

Burner purge air shall be provided by independent burner purge air fans.

Auxiliary burner forced draft and purge air fans shall be provided with TEFC motors in accordance with Attachment 6.

3.21 Page 37, Section 2.11.2:

The actuator for the burner forced draft fan vortex damper shall be as manufactured by Bailey Controls.

The propane piping systems at each burner front shall be classified as follows:

a) Class 1, Group D, Division 1 - 5 feet in all directions.
b) Class 1, Group D, Division 2 - 5 feet to 15 feet in all directions.

3.22 Page 39, Section 2.12.1:

The top of the boiler enclosure parapet shall not exceed 110'-0". The boiler enclosure roof shall be sloped at least 1/4-inch per foot front to rear. The minimum parapet height shall be 1'-0" above the roof, unless otherwise required by the local building official. The roof, including metal deck, insulation and single membrane roofing is approximately 6-inches thick. Therefore, the top of the boiler vendors lowest purlin must not exceed an elevation of 106'-6".

The primary boiler enclosure siding will be uninsulated vertical ribbed panel equivalent to H.H. Robertson HR5-36. The top 25 feet of the boiler enclosure will be sided with uninsulated flush metal panel equivalent to Steelite concealed fastener panels CFP III. Accordingly, alternate girt spacing will be required at the top 25 feet. In addition, a translucent panel will be provided between the upper 25 feet and the primary siding. The translucent panel will be approximately 3.5 to 7 feet in height and requires a girt at the top and the bottom.

Exterior wall girts will not be required as follows since the air pollution control equipment will be enclosed: (Refer to Attachment 2)

a) At column line 13 between columns D.1 and E.9 from elevation 0 to 102 feet.
b) At column line 13 between columns C.6 and D.1 from elevation 0 to 25 feet.

3.23 Page 40, Section 2.12.1:

Permanent platforming in the area of the ash dischargers shall be supported from above to maximize access capabilities below these platforms.

3.24 Page 42, Section 2.12.2:

In addition to the areas specifically referenced, the Vendor shall provide access to and access platforming for Purchaser supplied boiler blowdown equipment, closed cooling water surge tank, and deaerator equipment. This shall include interconnecting caged ladder between deaerator storage and air removal sections.
Platforming for deaerator is defined as follows: (Refer to Attachment 2)

a) Drawing M201 between columns C.6/D.1 and 11/13 at el. 45 feet.
b) Drawing M202 between columns C.6/D.1 and 11/13 (approx. 16 feet by 32 feet) at el. approx. 58 feet.

Further, clearance shall be provided for demineralized water and neutralization tanks shown on Drawing M200. Approximately 35 feet should be allowed for the demineralized water storage tank and 25 feet for the neutralization tank.

Control valve station platforming will be a concrete slab between columns C.6/D.1 and 11/12 at elevation 25 feet. This floor slab decking and concrete will be by Purchaser. Structural steel framing and supports, including access to this platform shall be by the boiler vendor. Boiler vendor shall provide steel beam framing in this area such that clear span does not exceed 6 feet.

3.25 Page 43, Section 2.14 (Access doors):

Access doors shall be provided in each run of ductwork of 24 inch square or round diameter, or greater.Doors shall be located on both sides of turning vanes and between each piece of equipment. Access doors shall be equipped with quick tightening clamp bolts.

3.26 Page 44, Section 2.15:

The Martin data sheets, Attachment 4, indicate fan sizing criteria which differs from Specification SM-104, Attachment 5. Attachment 5 shall be the governing document with regard to fan sizing criteria.

3.27 Page 44, Section 2.17:

The following electrical requirements shall be complied with:

a) All electrical equipment/devices shall be UL listed.
b) Conduit shall be intermediate metallic type.
c) All 600 volt conductors for 480 volt power shall be copper, with thermosetting ethylene propylene rubber or cross linked polyethylene insulation and a neoprene, hypalon or CPE jacket. PVC or nylon materials shall not be used.
d) Control, metering and alarm circuits shall be multiple conductor color coded in accordance with ICEA Table K-2. Instrumentation wiring shall be shielded, single-pair or multi-pair cable as required by the instrumentation equipment. PVC or nylon materials shall not be used.

3.28 Page 52, Section 4.1:

Drawing submittal for the following information shall be as follows:

a) Boiler column loading - gravity weights (10-15% accuracy): 30 days prior to Notice to Proceed.
b) Separate hydrotest load (flooded): 30 days prior to Notice to Proceed.
c) Live loads on platforms: 30 days prior to Notice to Proceed.
d) Structural steel drawings showing vertical bracing: 30 days prior to Notice to Proceed.
e) Complete loading information including wind, seismic, snow, etc.: At Notice to Proceed.

3.28 Attachment 12:

The feed chute support bracket shall be modified to a cantelevered support integral to the charging floor to increase access space between the feed hopper and the dust wall.

END OF PROJECT SPECIFIC REQUIREMENTS

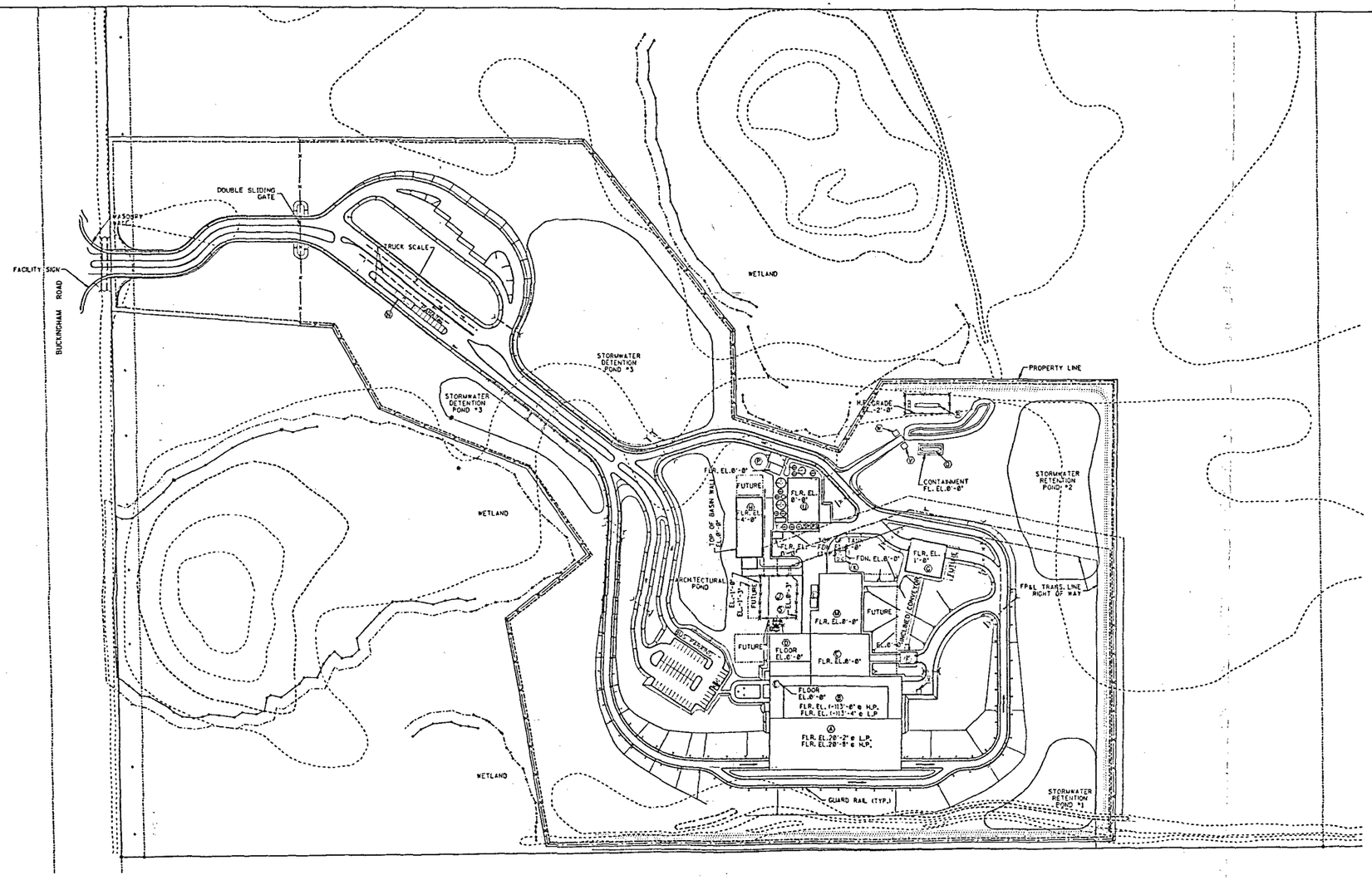
ATTACHMENT 2

PRELIMINARY BOILERHOUSE SKETCH

The attached sketch represents the preliminary layout of the boilerhouse. Contractor shall adhere to this layout to the greatest extent possible. Any required deviation from the preliminary layout must be clearly defined in the Proposal. Modifications to the layout after contract award will not be accepted.

DRAWINGS ATTACHED INCLUDE:

7102-E-210000 REV. C - PLOT PLAN
7102-E-210101 REV C - G/A EL. 0'-0" & 14'-3"
7102-E-210201 REV C - G/A EL. 28'-6 & 45'-0"
7102-E-210301 REV C - G/A EL. 62'-0"
7102-E-210401 REV C - G/A EL. 94'-5" & 89'-0"
7102-E-210901 REV C - G/A SECTION A-A



REFERENCE DRAWINGS:

E-210001 G.A. RESIDUE HANDLING BUILDING
E-210002 G.A. GRIZZLY BUILDING
E-210004 G.A. WASTE WATER TREATMENT BUILDING

(A) TIPPING AREA
(B) REFUSE PIT AREA
(C) BOILER AREA
(D) TURBINE/GENERATOR AREA
(E) FACILITY ADMINISTRATION AREA
(F) GRIZZLY BUILDING
(G) RESIDUE HANDLING BUILDING
(H) COOLING TOWER
(J) FP&L SWITCHYARD
(K) STACK
(L) SETTLING BASIN
(M) APC AREA
(N) SCALE HOUSE
(P) FIRE WATER TANK & PUMP HOUSE
(Q) AMMONIA STORAGE
(R) PROPANE STORAGE
(S) SWITCHYARD
(T) CHLORINATION BUILDING
(U) WATER TREATMENT BUILDING
(V) AMMONIA UNLOADING STATION
(W) PROPANE UNLOADING STATION
(X) DIESEL OIL TANK & FUELING STATION

NOTES:
1. BOILER FINISH FLOOR EL.0'-0" = 24'-3".

REVISIONS
A-09/04/92-PRELIMINARY 30% ISSUE FOR CLIENT REVIEW & COMMENTS.
B-12/04/92-ADDED DIESEL OIL TANK & REFERENCE DRAWINGS, RELOCATED AMMONIA STORAGE & UNLOADING STATION, REVISED ELEVATIONS & WATER TREATMENT AREA, DELETED CHLORINATION BUILDING.
C-02/08/93-ADDED CHLORINATION BUILDING 90% ISSUE FOR CLIENT REVIEW & COMMENTS.

2108090GA.DGN 02/03/93

REV	DISCIPLINE	CKD BY
C	STRUCTURAL	
	MECH POWER	
	ELECT & I&C	
	PROCESS	

DISCIPLINE	CKD BY
HOT & CONTROL	
MECH & MARINE	
CIVIL & CONSTRUCTION	
CADD	

SUBCONTRACT OR PURCHASE ORDER	FOR BIDDING	FOR AWARD	FOR CONSTRUCTION

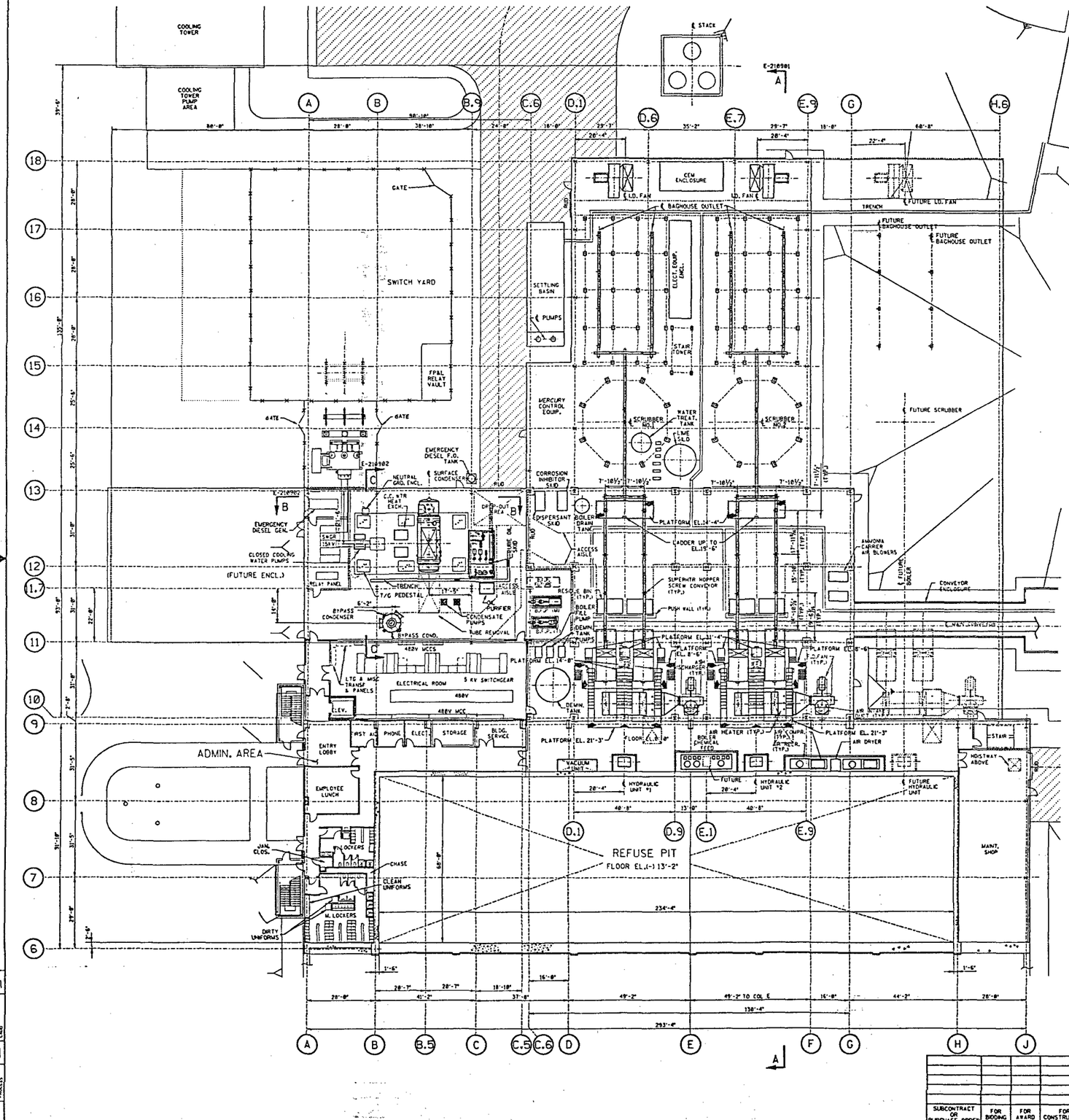
United Engineers & Constructors
A Raytheon Company

GENERAL ARRANGEMENT
PLOT PLAN
LEE COUNTY SOLID WASTE RESOURCE RECOVERY FACILITY

OGDEN MARTIN SYSTEMS OF LEE, INC.

DRAWN	DATE	REVISED	DATE
D.L.B.	12/04/92		
CHECKED	DATE	PROJECT NO.	SCALE
	2/4/93	C-1033	1"=100'-0"
APPROVED	DATE	DRAWING NO.	SH. #	REV.
	2/4/93	7102-E-210000		C

MICROSTATION



REVISIONS
A-09/04/92-PRELIMINARY 30% ISSUE FOR CLIENT REVIEW & COMMENTS.
B-12/04/92-REVISED ASH SCREW CONVEYORS, F.D. FAN, LUBE OIL SKID ARRGT. & PER CLIENT COMMENTS. EL. 8'-8"&24'-3" WAS 25'-8".
C-02/08/93-REVISED F.D. FAN AIR HEATER, BOILER FEED PUMPS, CONDENSATE PUMPS & ADMIN. AREA, ADDED OIL PURIFIER 90% ISSUE FOR CLIENT COMMENTS & REVIEW.

REV	DISCIPLINE	LEAD BY	DISCIPLINE	LEAD BY
C	STRUCTURAL	J.P.S.	MECH. & CONTROL	—
	MECH. POWER	L.G.D.	MECH. CONSTRUCTION	—
	ELECTRICAL	L.G.D.	CIVIL	—
	PROCESS	—		

SUBCONTRACT OR PURCHASE ORDER	FOR BIDDING	FOR AWARD	FOR CONSTRUCTION

United Engineers & Constructors
A Raytheon Company

GENERAL ARRANGEMENT PLAN
FLOOR EL.0'-0" & EL.14'-3"
LEE COUNTY SOLID WASTE RESOURCE RECOVERY FACILITY

OGDEN MARTIN SYSTEMS OF LEE, INC.

DRAWN	DATE	SCANNED	DATE
D.L.B.	12/04/92		
CHECKED	DATE	PROJECT NO.	SCALE
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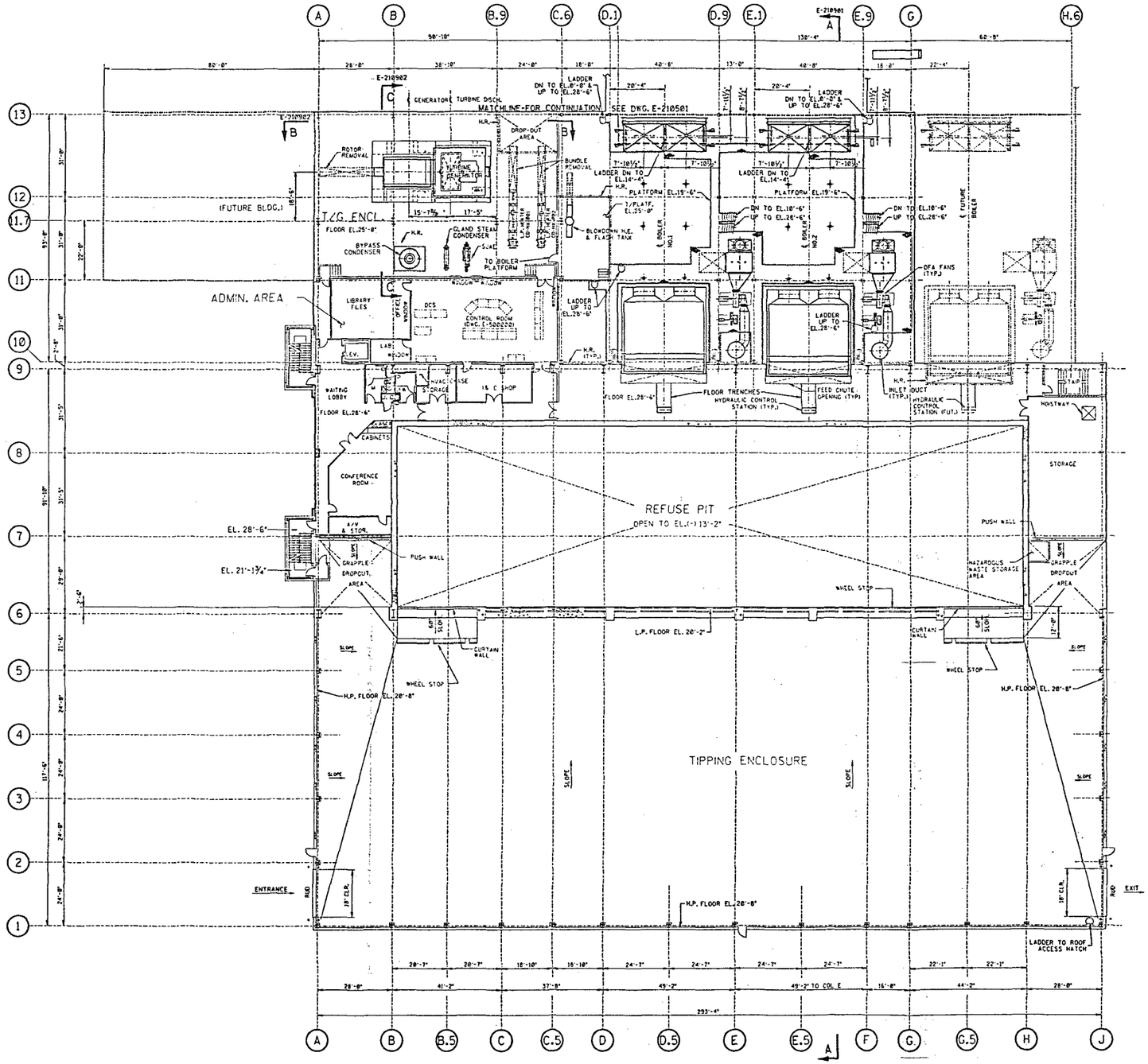
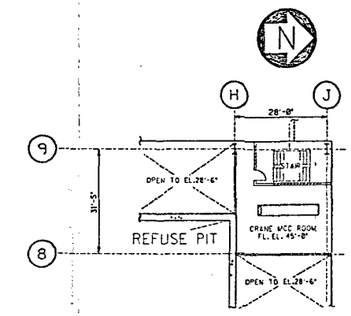
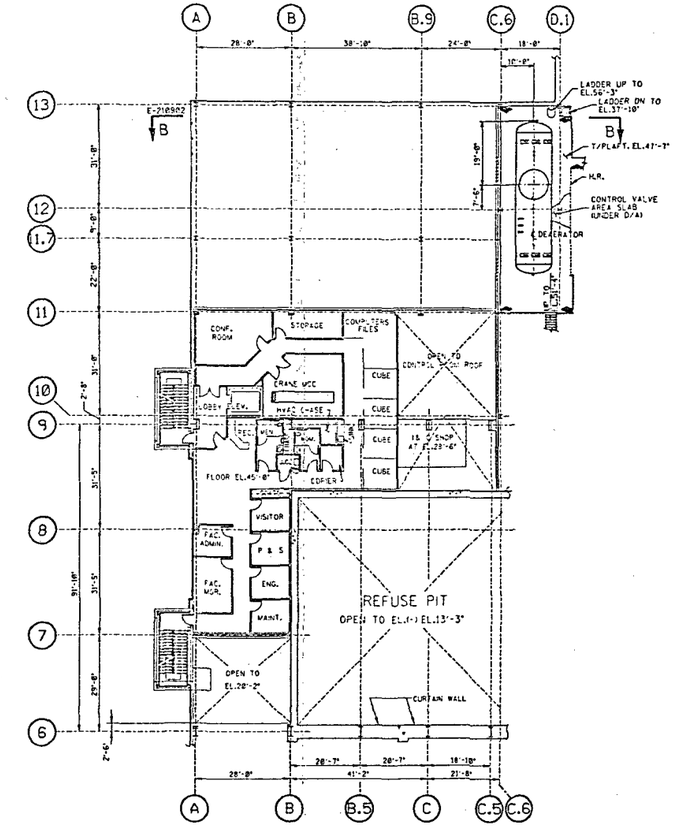
APPROVED	DATE	DRAWING NO.	SHT. #	REV.
[illegible]	4/4/93	7102-E-210101		C

MICROSTATION

2101G14.DGN 02/03/93







PARTIAL PLAN EL.45'-0"

REVISIONS
A-09/04/92-PRELIMINARY 30% ISSUE FOR CLIENT REVIEW & COMMENTS.
B-12/04/92-REVISED PER CLIENT COMMENTS.
C-02/08/93-REVISED DEAERATOR STORAGE TK., ADMIN. AREA & OVER FIRE AIR HEATER. RELOCATED CLAND STM COND & SJAE 90% ISSUE FOR CLIENT REVIEW & COMMENTS.

NOT.	DISCIPLINE	DES BY	DISCIPLINE	DES BY
	STRUCTURAL		HOT & CONTROL	
	MECH PIPING		MECH SERVICES	
	ELECTRICAL		CIVIL/ARCH	
	PROCESS			

SUBCONTRACT OR PURCHASE ORDER	FOR BIDDING	FOR AWARD	FOR CONSTRUCTION

United Engineers & Constructors
A Raytheon Company

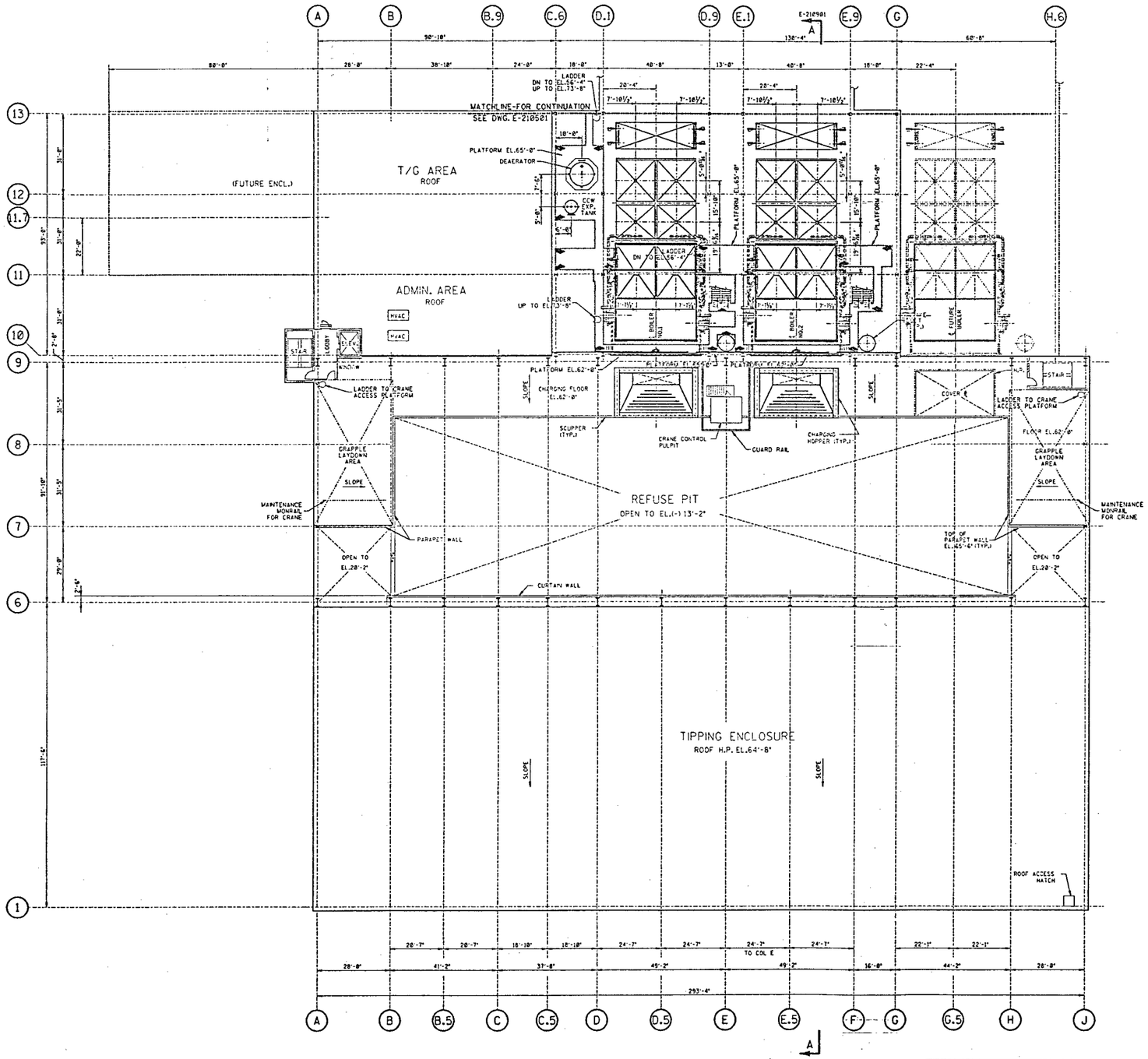
GENERAL ARRANGEMENT PLAN
FLOOR EL. 28'-6" & EL. 45'-0"
LEE COUNTY SOLID WASTE RESOURCE RECOVERY FACILITY

OGDEN MARTIN SYSTEMS OF LEE, INC.

DRAWN	DATE	DESIGNED	DATE	
D.L.B.	12/04/92			
CHECKED	DATE	PROJECT NO.		SCALE
[illegible]	2/8/93	C-1033		1/8"=1'-0"
APPROVED	DATE	DRAWING NO.		SHT. # / REV.
[illegible]	2/8/93	7102-E-210201		C

MICROSTATION

2102E1CA.DGN TI 02/03/93



NOTE:

1. PROVIDE ACCESS TO ALL ROOF AREAS, EITHER BY MANDOOR FROM ADJACENT STRUCTURE OR WHEN NO ADJACENT STRUCTURE, LADDER AND ROOF HATCH. EXTERIOR LADDERS TO ACCESS ROOF AREAS ARE NOT ACCEPTABLE.

REVISIONS
A-09/04/92-PRELIMINARY 30% ISSUE FOR CLIENT REVIEW & COMMENTS.
B-12/04/92-REVISED PER CLIENT COMMENTS.
C-02/26/93-REVISED DEAERATOR, ADDED CCW EXPANSION TANK. 90% ISSUE FOR CLIENT REVIEW & COMMENTS.

REV.	DISCIPLINE	DES BY	DISCIPLINE	DES BY
C	STRUCTURAL	[illegible]	INST. & CONTROL	—
	MECH POWER	AJD	MECH SERVICES	—
	ELECTRICAL	[illegible]	CONSTRUCTION	—
	PROCESS	—	CHEM	—

SUBCONTRACT OR PURCHASE ORDER	FOR BIDDING	FOR AWARD	FOR CONSTRUCTION

United Engineers & Constructors
A Raytheon Company

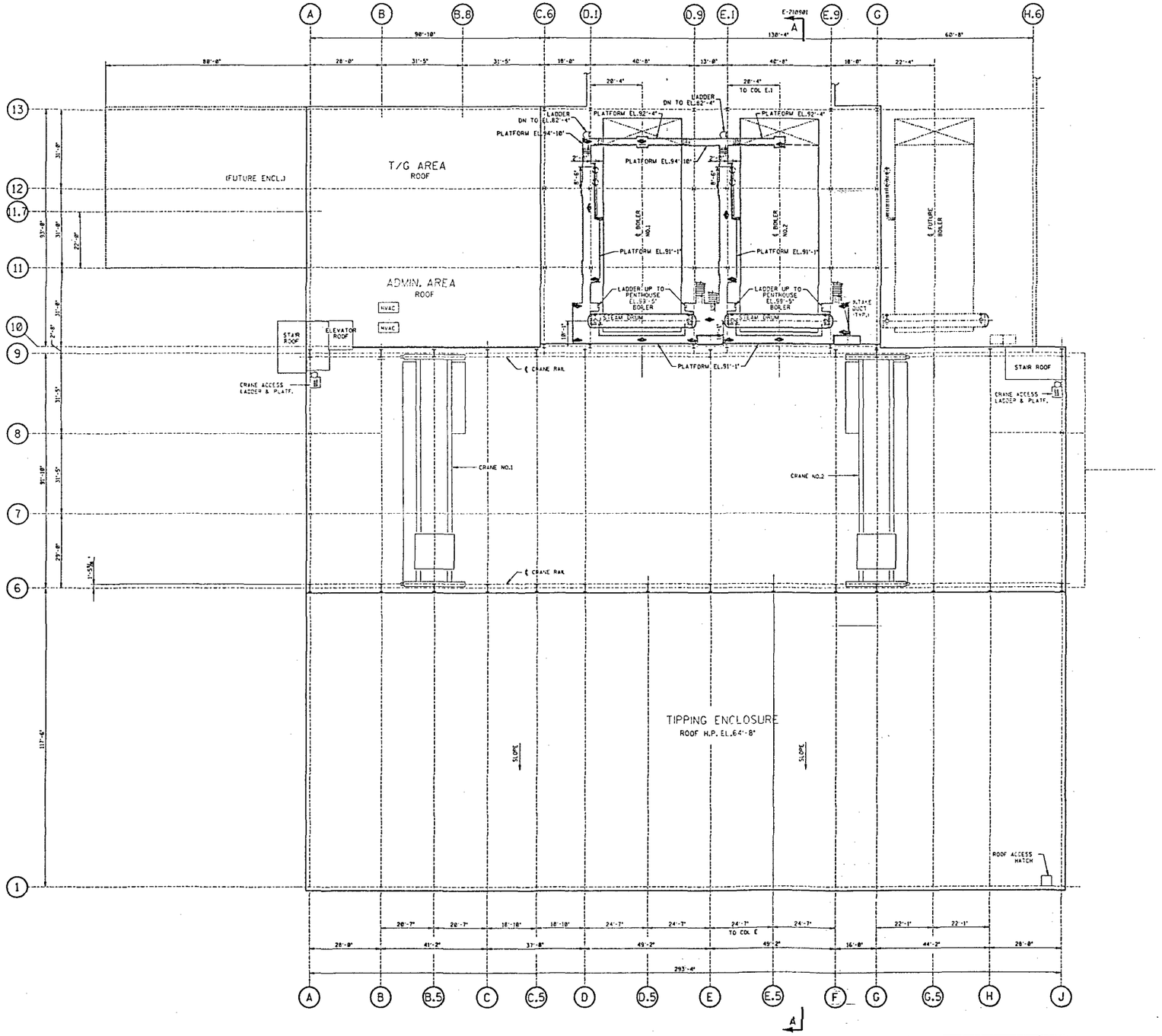
GENERAL ARRANGEMENT PLAN
CHARGE FLOOR EL. 62'-0"
LEE COUNTY SOLID WASTE RESOURCE RECOVERY FACILITY

OGDEN MARTIN SYSTEMS OF LEE, INC.

DRAWN	DATE	RECEIVED	DATE
D.L.B.	12/04/92		
DESIGNED	DATE	PROJECT NO.	SCALE
[illegible]	2/4/93	C-1033	1/16"=1'-0"
APPROVED	DATE	DRAWING NO.	REV.
[illegible]	2/4/93	7102-E-210301	C

MICROSTATION

210301G4.DGN 02/03/93



REV.	DISCIPLINE	2ND ST. ENGINEER	COD ST.
C	STRUCTURAL	M.P.	—
	MECH. POWER	M.P.	—
	ELECTRICAL	M.P.	—
	PROCESS	—	—
	PROJ. & CONTROL	—	—
	MECH. SERVICES	—	—
	CONSTRUCTION	—	—
	CADD	—	—

REVISIONS
A-09/04/92-PRELIMINARY 30% ISSUE FOR CLIENT REVIEW & COMMENTS.
B-12/04/92-REVISED PER CLIENT COMMENTS.
C-02/08/93-REVISED PER CLIENT COMMENTS. 90% ISSUE FOR CLIENT COMMENTS & REVIEW.

SUBCONTRACT OR PURCHASE ORDER	FOR BIDDING	FOR AWARD	FOR CONSTRUCTION

United Engineers & Constructors
A Raytheon Company

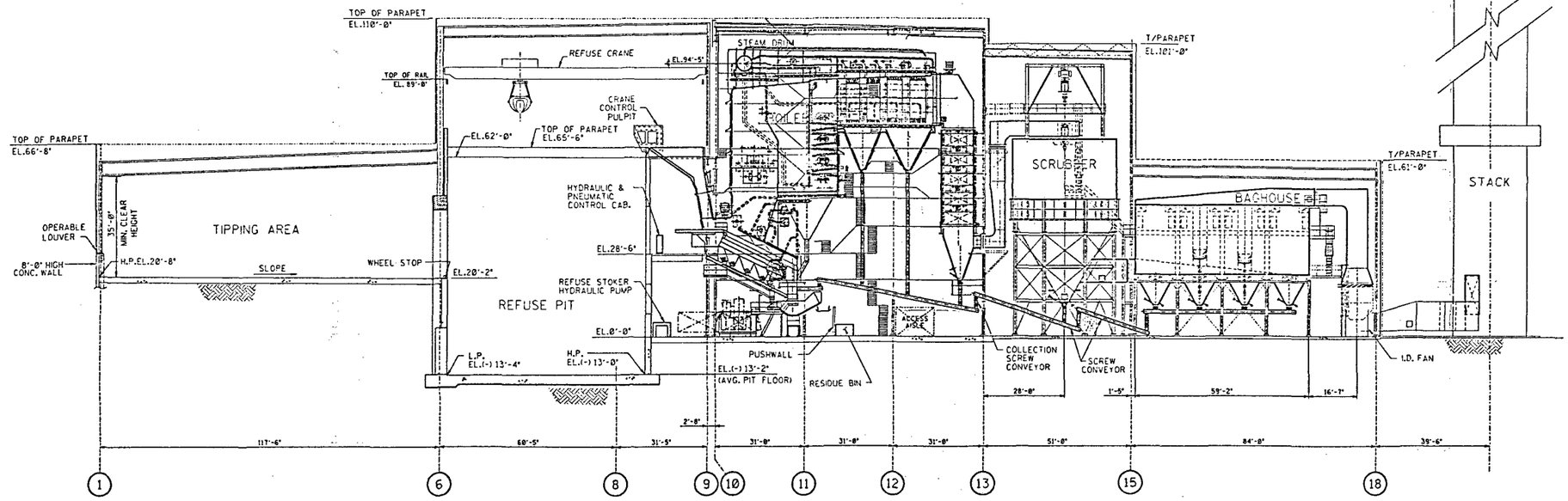
GENERAL ARRANGEMENT PLAN
STEAM DRUM EL. 94'-5" & REFUSE CRANE EL. 89'-0"
LEE COUNTY SOLID WASTE RESOURCE RECOVERY FACILITY

OGDEN MARTIN SYSTEMS OF LEE, INC.

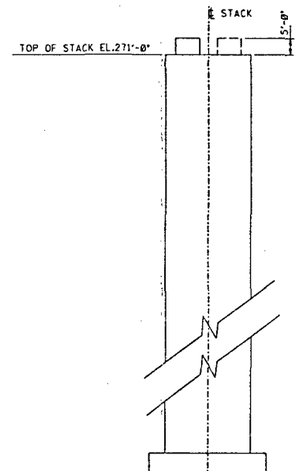
DRAWN	DATE	DESIGNED	DATE
D.L.B.	12/04/92		
CHECKED	DATE	PROJECT NO.	SCALE
	4/14/93	C-1033	1/8"=1'-0"
APPROVED	DATE	DRAWING NO.	SH. #	REV.
	4/14/93	7102-E-210401		C

MICROSTATION

210401GALDGN 12/03/93



SECTION A-A



REVISIONS

A-09/04/92-PRELIMINARY 30% ISSUE FOR CLIENT REVIEW & COMMENTS.

B-12/04/92-REVISED BOILER AREA, SCRUBBER, BAGHOUSE, I.D. FAN & SCREW CONVEYORS

C-02/08/93-REVISED ARC AREA & SCREW CONVEYORS, REFUSE CRANE ELEVATION. 90% ISSUE FOR CLIENT REVIEW & COMMENTS.

2109016A.DGN 02/03/93

REV	DISCIPLINE	ADD BY	DISCIPLINE	ADD BY
C	STRUCTURAL	JHD	MTL & CONTROL	—
	MECH POWER	JHD	MECH SERVICES	—
	ELECTRICAL	JHD	CONSTRUCTION	—
	PROCESS	JHD	CODD	—

SUBCONTRACT OR PURCHASE ORDER	FOR BIDDING	FOR AWARD	FOR CONSTRUCTION

United Engineers & Constructors
A Raytheon Company

GENERAL ARRANGEMENT
SECTION A-A
LEE COUNTY SOLID WASTE RESOURCE RECOVERY FACILITY

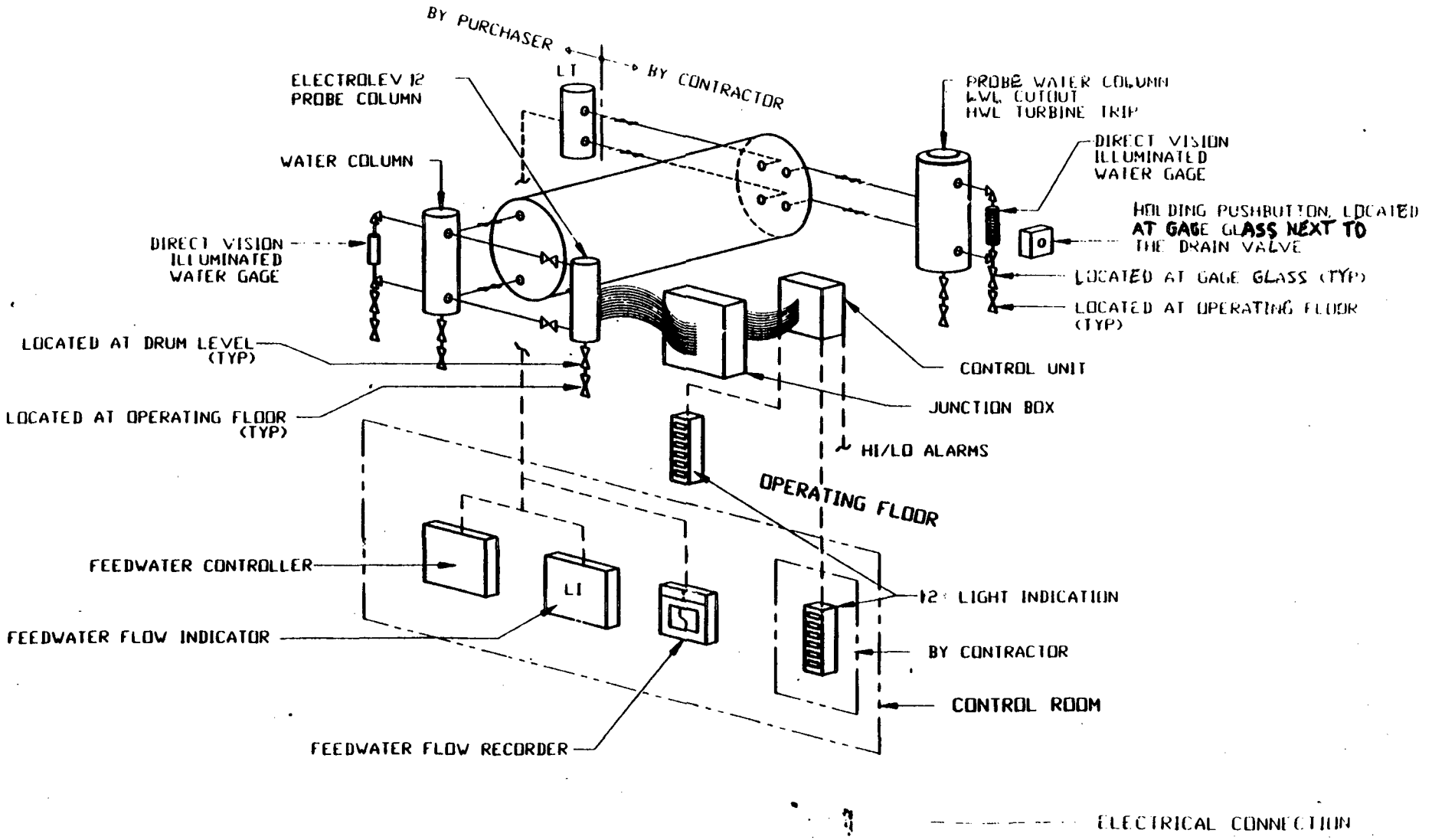
OGDEN MARTIN SYSTEMS OF LEE, INC.

DRAWN	DATE	REVISED	DATE
D.L.B.	12/04/92		
CHECKED	DATE	PROJECT NO.	SCALE
	2/4/93	C-1033	1/8"=1'-0"
APPROVED	DATE	DRAWING NO.	SHT. OF	REV.
	2/4/93	7102-E-210901		C

MICROSTATION

8 7 6 5 4 3 2 1

E D C B A



AN OGDEN COMPANY	ATTACHMENT 3 DRUM LEVEL TRIM AND ACCESSORIES	OGDEN PROJECTS, INC DATE 4/91 SHT 1 OF 1 REV 0

ATTACHMENT 4

MARTIN DESIGN DATA

The following Martin Design Data Sheets are included as part of this specification:

a) Furnace Design Data Sheets No. 4P 9919/10 (6 sheets)

b) Boiler Design Data Sheets No. 4P 9919/21 (6 sheets)

[redacted]

d) Boiler ~~Sketch No.~~ Layout. 1A000191/a

e) Load Plan No.* 4P 9919/12

* REFER ALSO TO MARTIN DWG. 1A000235

MARTIN GMBH FÜR UMWELT- UND ENERGIETECHNIK		4P 9919 10
Date: February 20, 1990	Name: Ho/Ze	Sheet No. 1
Project: LEE COUNTY, FL (~~3~~ 2 x 600 tpd)		Design case, MCR

F U R N A C E D E S I G N D A T A

Number of Units:	in operation	~~3~~ 2
	standby	-

	Units of Measurement			
	US-units	Metric units	US-units	Metric units
Refuse throughput per unit	%		100	
Refuse-throughput per unit	tpd	t/day	600	544.32
Calorific value, HHV (LHV)	Btu/lb	kcal/kg	5,000	2,470
Max. gross heat release per unit	10^6 x Btu/h (HHV)	Gcal/h (LHV)	250.0	56.02

GRATE:

Martin Stoker Grate (German and foreign patents, patent pending)

Number of runs			4	
Stoker width	ft, inch	mm	29'-5 9/16"	8,980
Number of steps			13	
Total grate area	sqft	m^2	693.2	64.4

ASH DISCHARGER:

Martin Ash Discharger (German and foreign patents)

Inlet section (inside)	ft, inch	mm	3'- 3 3/8" x 7'-10 1/2"	1,000x2,400
Max. ash ejecting capacity	tons/h	t/h	9.9	9.0
Number per Stoker			2	

MARTIN GMBH FÜR UMWELT- UND ENERGIETECHNIK				4P 9919 10
Date: February 20, 1990	Name: Ho/Ze			Sheet No. 2
FUEL DATA	US-units	Metric units	US-units	Metric units
Refuse throughput per unit	%		100	
Refuse throughput per unit	lb/h	kg/h	50,000	22,680
HHV (LHV)	Btu/lb	kcal/kg	5,000	2,470
Ash	%		20.9	
Water	%		20.7	
Combustibles	%		58.4	
ULTIMATE ANALYSIS:				
Carbon, C	%		28.5	
Hydrogen, H	%		3.8	
Oxygen, O	%		25.1	
Nitrogen, N	%		0.5	
Chlorine, Cl	%		0.4	
Sulfur, S	%		0.1	
Phosphorus, P	%		-	
Fluorine, F	%		-	
Iron, oxidizable, Fe	%		-	
Ash	%		20.9	
Water	%		20.7	
Total	%		100.0	
HEAT INPUT AND GRATE LOADING				
Gross heat input:				
Refuse	$x10^6$ Btu/h	Gcal/h	250.0	56.02
Sewage sludge	"	"	-	-
Waste oil	"	"	-	-
Auxiliary firing	"	"	-	-
Preheated air	"	"	18.4	4.63
Total heat input	"	"	268.4	60.65
Grate heat release, refuse and sludge only	Btu / sqft,h	kcal/m²h	360.646	869.870
Grate load performance	lb / sqft,h	kg/m², h	72.13	352.17

MARTIN GMBH FÜR UMWELT- UND ENERGIETECHNIK				4P 9919 10
Date: February 20, 1990		Name: Ho/Ze		Sheet No. 3
	US-units	Metric units	US-units	Metric units
Refuse throughput per unit	%		100	
Refuse throughput per unit	lb/h	kg/h	50,000	22,680
HHV (LHV)	Btu/lb	kcal/kg	5,000	2,470
HEAT LOSSES AND EFFICIENCIES				
Loss by unburned material in residue	%	%	2.47	2.78
Heat loss by hot clinker	%	%	0.51	0.57
Heat loss due to radiation	%	%	0.48	0.54
Loss by sensible heat in flue gases	%	%	24.86	15.34
Unaccounted for losses	%	%	1.50	1.69
Total efficiency (calc.)	%	%	71.68	80.77
Total efficiency (guar.)	%	%	70.18	79.08
Stoker efficiency (calc.)	%	%	97.02	96.65
Stoker efficiency (guar.)	%	%	96.44	96.00
AIR AND FLUE GAS DATA (US-units referred to 68° F)				
CO_2 (maximum)	% by volume		19.77	
CO_2 in furnace (dry)	% by volume		9.82	
CO_2 in system exit (dry)	% by volume		-	
Excess air rate: Furnace	% by vol.	-	100	2.0
" air rate: System exit	% by vol.	-	-	-
Specific air quantity in furnace, wet	scuft/lb	Nm^3/kg	91.791	5.3400
Specific flue gas quantity				
Furnace, wet	scuft/lb	Nm^3/kg	103.182	6.0027
System exit, wet	scuft/lb	Nm^3/kg	-	-
Specific gravity of flue gases				
Furnace, wet	lb/scuft	kg/Nm^3	0.0742	1.2760
System exit, wet	lb/scuft	kg/Nm^3	-	-
Underfire air (- %)	SCFM	Nm^3/h	See sheet	No. 5
Overfire air (- %)	SCFM	Nm^3/h	See sheet	No. 5
Auxiliary firing	SCFM	Nm^3/h	-	-
Combustion air quantity (total), wet	SCFM	Nm^3/h	76,502	121,110
Flue gas quantity:				
Furnace, wet	SCFM	Nm^3/h	85,996	136,140
System exit, wet	SCFM	Nm^3/h	-	-
Flue gas composition (system exit) see page 6.				

MARTIN GMBH FÜR UMWELT- UND ENERGIETECHNIK				4P 9919 10
Date: February 20, 1990	Name: Ho/Ze		Sheet No. 4	
	US-units	Metric units	US-units	Metric units
Refuse throughput per unit	%		100	
Refuse throughput per unit	lb/h	kg/h	50,000	22,680
HHV (LHV)	Btu/lb	kcal/kg	5,000	2,470
AIR AND FLUE GAS TEMPERATURES				
Ambient air	°F	°C	80	26.67
Underfire air	°F	°C	300	148.89
Overfire air	°F	°C	300	148.89
Air for auxiliary firing	°F	°C	-	-
Air for waste oil burning	°F	°C	-	-
Combustion temperature in furnace area (flame end)	°F	°C	-	-
Flue gas temperature:				
Boiler exit	°F	°C	425	218.33
Dust arrestor exit	°F	°C	-	-
AIR AND FLUE GAS PRESSURES				
Neg. pressure in furnace	in WG	mm WG	-	-
Draught loss across boiler	in WG	mm WG	-	-
Underfire air pressure at grate inlet	in WG	mm WG	~ 16	~ 400
Overfire air pressure at nozzle inlet	in WG	mm WG	~ 18	~ 460
FLY ASH DATA				
Dust burden of flue gases in furnace, as found by calculation (68 °F)	gr/scuft	g/Nm³	-	-
Ditto (design figure)	gr/scuft	g/Nm³	-	-
Dust burden of flue gases entering dust arrestor as found by calculation (68 °F)	gr/scuft	g/Nm³	1.7143	4.21
Dust burden of flue gases entering dust arrestor as found by calculation (design figure) (68 °F)	gr/scuft	g/Nm³	2.0360	5.00
Dust burden of flue gases leaving dust arrestor (design figure) (68 °F)	gr/scuft	mg/Nm³	-	-

MARTIN GMBH FÜR UMWELT- UND ENERGIETECHNIK				4P 9919 10
Date: February 20, 1990		Name: Ho/Ze		Sheet No. 5
	US-units	Metric units	US-units	Metric units
Refuse throughput per unit	%		100	
Refuse throughput per unit	lb/h	kg/h	50,000	22,680
HHV (LHV)	Btu/lb	kcal/kg	5,000	2,470
F A N D E S I G N				
F.D. FAN (80 % of combustion air)				
Calculated air quantity	SCFM	Nm³/h	61,201	96,888
Margin for fluctuations in c.v.	%		15	
Margin required by DIN	%		-	
Total margin	%		15	
Design air quantity	SCFM	Nm³/h	70,381	111,421
Design air temperature	°F	°C	~ 104	~ 40
Air pressure under grate	in WG	mm WG	~ 16	~ 400
Design capacity	CFM	m³/h	75,186	127,737
Design stat. pressure	in WG	mm WG	-	-
I.D. FAN				
Flue gas quantity at fan inlet	SCFM	Nm³/h	85,996	136,140
Margin for fluctuations in c.v.	%		15	
Margin required by DIN	%		-	
Total margin	%		15	
Design flue gas quantity	SCFM	Nm³/h	98,895	156,561
Design temperature	°F	°C	572	300
Design capacity	CFM	m³/h	193,362	328,512
Design static pressure	in WG	mm WG	-	-
OVERFIRE AIR FAN (35 % of combustion air)				
Calculated overfire air quantity	SCFM	Nm³/h	26,776	42,389
Margin for fluctuations in c.v.	%		15	
Margin required by DIN	%		-	
Total margin	%		15	
Design overfire air quantity	SCFM	Nm³/h	30,792	48,747
Design temperature	°F	°C	~ 104	~ 40
Overfire air pressure at nozzle inlet	in WG	mm WG	~ 18	~ .460
Design capacity	CFM	m³/h	32,894	55,885
Design static pressure	in WG	mm WG	-	-

MARTIN GMBH FÜR UMWELT- UND ENERGIETECHNIK				4P 9919 10
Date: February 20, 1990		Name: Ho/Ze		Sheet No. 6
	US-units	Metric units	US-units	Metric units
Refuse throughput per unit	%		100	
Refuse throughput per unit	lb/h	kg/h	50,000	22,680
HHV (LHV)	Btu/lb	kcal/kg	5,000	2,470
WATER CONSUMPTION EXCLUDING FLUE GAS COOLING				
Ash discharger quenching bath	lb/tons	kg/t	-	-
Ash discharger quenching bath	lb/h	kg/h	~ 3,110	~ 1,410
Feed chute water jacket	lb/h	kg/h	-	-
Hydraulic fluid cooling	lb/h	kg/h	~ 4,410	~ 2,000
Total	lb/h	kg/h	-	-
FLUE GAS COMPOSITION (System exit):				
wet:				
CO_2	% by volume		8.537	
O_2	% by volume		9.189	
N_2 + Ar	% by volume		69.242	
H_2O	% by volume		12.979	
SO_2	% by volume		0.011	
HCl	% by volume		0.042	
HF	% by volume		-	
dry:				
CO_2	% by volume		9.817	
O_2	% by volume		10.566	
N_2 + Ar	% by volume		79.617	
Max. content of noxious gases in wet flue gases (theoretical):				
SO_2	ppm		117	
HCl	ppm		421	
HF	ppm		-	

Martin GmbH fuer Umwelt-und Energietechnik,Leopoldstr. 248,D-8Muenchen

BOILER DESIGN DATA	Date: 02-05-1992	Name: Flr	Sheet: No: 1	4P 9919 21

Project: LEE COUNTY Fl. M.C.R. 600 tpd - 5000 Btu/lb
Our No.: 9919 (DISTRAL Doc. January 15/92)

	Units of Measurement			
	US-units	Metric units	US-units	Metric units
Refuse throughput per unit	%	%	100.00	100.00
Refuse quantity per unit	sht/h	t/h	25.00	22.68
	lb/h	kg/h	50,000	22,680
Calorific value of refuse	Btu/lb	kcal/kg	5,000	2,470
Ash	%	%	20.90	20.90
Moisture	%	%	20.70	20.70
Combustible matter	%	%	58.40	58.40
Design pressure (approx.)	psig	atue	1,095	77.0
Drum pressure (approx.)	psig	atue	996	70.0
Live steam pressure	psig	atue	865	60.8
Live steam temperature	F	C	830	443
Saturated steam temperature	F	C	546	285
Feedwater temperature	F	C	300	149
Flue gas temperature at boiler outlet	F	C	425	218
Preheated air temperature	F	C	300	149
Ambient temperature	F	C	80	27
Boiler efficiency ,calcul .	%	%	73.61	82.24
,guarant.	%	%	72.11	80.56
Steam output,calcul.	lb/h	kg/h	172,554	78,270
guarant. (2 % blow-down considered)	lb/h	kg/h	169,049	76,680
Quantity of injected water (calculated)				
First stage: SH1-SH2 :	lb/h	kg/h	3,880	1,760
Second stage: SH2-SH3 :	lb/h	kg/h	4,365	1,980
Total (steam temp. control)	lb/h	kg/h	8,245	3,740
Part load	%	%	80	80
Gross heat release			250.00	56.02
Heat input from preh. air	10^6x Btu/h	Gcal/h	18.36	4.63
Total heat input			268.36	60.65
Combustion air quantity	SCFM	Nm3/h	76,502	121,110
Flue gas quantity,Furnace	SCFM	Nm3/h	85,997	136,140
Flue gas quantity system exit	SCFM	Nm3/h	85,997	136,140

Martin GmbH fuer Umwelt-und Energietechnik,Leopoldstr. 248,D-8Muenchen

Project: LEE COUNTY Fl.	Date: 02-05-1992	Name: Flr	Sheet: No: 2	4P 9919 21

	US-units	Metric units	US-units	Metric units
Refuse throughput per unit	%	%	100.00	100.00
Refuse quantity per unit	lb/h	kg/h	50,000	22,680
Calorific value of refuse	Btu/lb	kcal/kg	5,000	2,470
FURNACE (1st pass)				
Tube diameter	inch	mm	3	76.20
Tube pitch (monowall)	inch	mm	4	101.60
Height of silicon carbide coat on monowall (approx.)	ft-inch	m	30- 0	9.14
Flue gas temp. at refuse feed table edge (approx.)	F	C	2,012	1,100
Flue gas velocity at refuse feed table edge (approx.)	fps	m/s	13.68	4.17
Flue gas temperature at flame end	F	C	1,899	1,037
Flue gas veloci. at flame end	fps	m/s	13.06	3.98
Furnace wall temperature (approx.)	F	C	1,742	950
Fouling factor	-	-	1.00	1.00
RADIANT FURNACE CHAMBER (1st pass)				
Flue gas temperature at inlet	F	C	1,899	1,037
Flue gas velocity at outlet	fps	m/s	12.11	3.69
Flue gas temp. at outlet	F	C	1,724	940
Fouling factor	-	-	0.50	0.50
PASSAGE THROUGH SCREEN TUBES (between 1st and 2nd pass)				
Tube diameter	inch	mm	-	-
Tube pitch , transverse	ft-inch	mm	-	-
longitudinal	ft-inch	mm	-	-
Flue gas temperature at inlet	F	C	-	-
Flue gas temp. at outlet	F	C	-	-
Average flue gas velocity	fps	m/s	-	-
Fouling factor	-	-	-	-

Martin GmbH fuer Umwelt-und Energietechnik,Leopoldstr. 248,D-8Muenchen

Project: LEE COUNTY Fl.	Date: 02-05-1992	Name: Flr	Sheet: No: 3	4P 9919 21

	US-units	Metric units	US-units	Metric units
Refuse throughput per unit	%	%	100.00	100.00
Refuse quantity per unit	lb/h	kg/h	50,000	22,680
Calorific value of refuse	Btu/lb	kcal/kg	5,000	2,470
RADIANT FURNACE CHAMBER (2nd pass) 1 curtain wall /boiler center				
Tube diameter	inch	mm	3	76.20
Tube pitch	inch	mm	4	101.60
Flue gas temperature at inlet	F	C	1,724	940
Flue gas temp. at outlet	F	C	1,515	824
Average flue gas velocity	fps	m/s	16.73	5.10
Fouling factor	-	-	0.60	0.60
EVAPORATION SURFACE in the 3-rd pass				
Tube diameter	inch	mm	2 3/ 4	69.85
Tube pitch, transverse	ft-inch	mm	1- 0	304.80
longitudinal	inch	mm	4	101.60
Flue gas temperature at inlet	F	C	1,515	824
Flue gas temp. at outlet	F	C	1,245	674
Average flue gas velocity	fps	m/s	21.13	6.44
Fouling factor	-	-	0.65	0.65
RADIANT FURNACE CHAMBER (3rd pass)				
Tube diameter	inch	mm	3	76.20
Tube pitch	inch	mm	4	101.60
Flue gas temperature at inlet	F	C	1,245	674
Flue gas temp. at outlet	F	C	1,218	659
Average flue gas velocity	fps	m/s	14.96	4.56
Fouling factor	-	-	0.70	0.70

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Project: LEE COUNTY Fl.	Date: 02-05-1992	Name: Flr	Sheet: No: 4	4P 9919 21

	US-units	Metric units	US-units	Metric units
Refuse throughput per unit	%	%	100.00	100.00
Refuse quantity per unit	lb/h	kg/h	50,000	22,680
Calorific value of refuse	Btu/lb	kcal/kg	5,000	2,470
PASSAGE THROUGH SCREEN TUBES (3rd pass / superheater)				
Tube diameter	inch	mm	-	-
Tube pitch, transverse	inch	mm	-	-
longitudinal	inch	mm	-	-
Flue gas temperature at inlet	F	C	-	-
Flue gas temp. at outlet	F	C	-	-
Average flue gas velocity	fps	m/s	-	-
Fouling factor	-	-	-	-
SUPERHEATER 3				
Tube diameter	inch	mm	1 1/ 2	38.10
Tube pitch, transverse	inch	mm	5	127.00
longitudinal	inch	mm	5	127.00
Flue gas temperature at inlet	F	C	1,218	659
Flue gas temp. at outlet	F	C	1,083	584
Steam temperature at inlet	F	C	703	373
Steam temperature at outlet	F	C	830	443
Average steam velocity	fps	m/s	70.28	21.42
Average flue gas velocity	fps	m/s	13.22	4.03
Fouling factor	-	-	0.74	0.74
SUPERHEATER 2				
Tube diameter	inch	mm	1 1/ 2	38.10
Tube pitch, transverse	inch	mm	5	127.00
longitudinal	inch	mm	5	127.00
Flue gas temperature at inlet	F	C	1,083	584
Flue gas temp. at outlet	F	C	964	518
Steam temperature at inlet	F	C	644	340
Steam temperature at outlet	F	C	748	398
Average steam velocity	fps	m/s	61.12	18.63
Average flue gas velocity	fps	m/s	11.88	3.62
Fouling factor	-	-	0.75	0.75

Martin GmbH fuer Umwelt-und Energietechnik,Leopoldstr. 248,D-8Muenchen

Project: LEE COUNTY Fl.	Date: 02-05-1992	Name: Flr	Sheet: No: 5	4P 9919 21

	US-units	Metric units	US-units	Metric units
Refuse throughput per unit	%	%	100.00	100.00
Refuse quantity per unit	lb/h	kg/h	50,000	22,680
Calorific value of refuse	Btu/lb	kcal/kg	5,000	2,470
SUPERHEATER 1				
Tube diameter	inch	mm	1 1/ 2	38.10
Tube pitch, transverse	inch	mm	5	127.00
longitudinal	inch	mm	5	127.00
Flue gas temperature at inlet	F	C	964	518
Flue gas temp. at outlet	F	C	757	403
Steam temperature at inlet	F	C	546	285
Steam temperature at outlet	F	C	680	360
Average steam velocity	fps	m/s	50.23	15.31
Average flue gas velocity	fps	m/s	10.40	3.17
Fouling factor	-	-	0.76	0.76
ECONOMIZER				
Tube diameter	inch	mm	2	50.80
Tube pitch, transverse	inch	mm	4	101.60
longitudinal	inch	mm	4	101.60
Flue gas temperature at inlet	F	C	757	403
Flue gas temp. at outlet	F	C	425	218
Feedwater temp. at inlet	F	C	300	149
Feedwater temp. at outlet	F	C	495	257
Average flue gas velocity	fps	m/s	18.31	5.58
Average feedwater velocity	fps	m/s	2.33	0.71
Fouling factor	-	-	0.77	0.77
VOLUMES AND HEAT RELEASES				
Volume of 1st boiler pass	cuft	m^3	27,794	787
Heat release of 1st boiler pass	Btu / cuftxh	kcal / m^3xh	8,995	71,181
Volume of all radiant furnace chambers	cuft	m^3	41,073	1,163
Heat release of all radiant furnace chambers	Btu / cuftxh	kcal / m^3xh	6,087	48,168

Martin GmbH fuer Umwelt-und Energietechnik,Leopoldstr. 248,D-8Muenchen

Project: LEE COUNTY Fl.	Date: 02-05-1992	Name: Flr	Sheet: No: 6	4P 9919 21

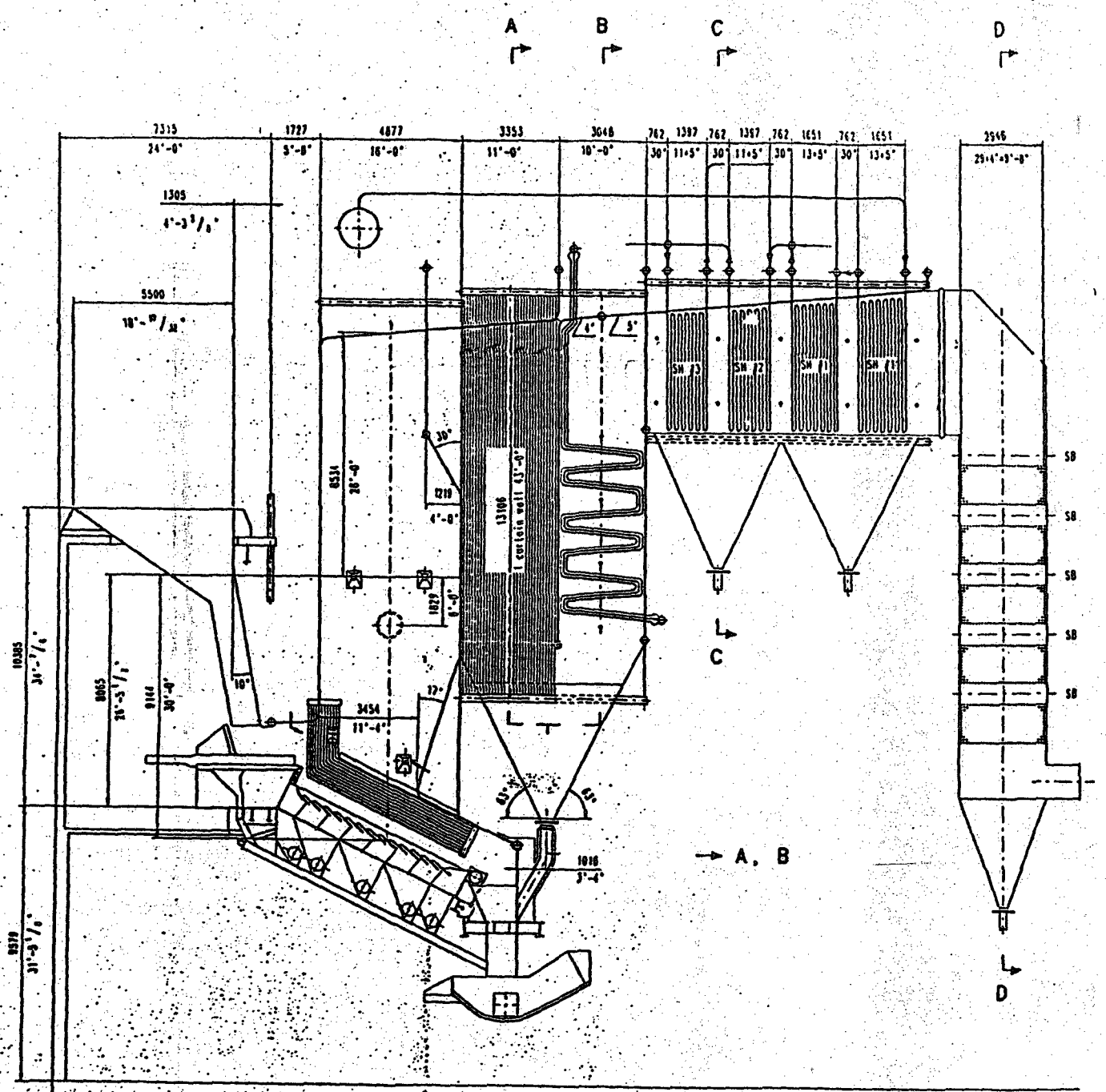
	US-units	Metric units	US-units	Metric units
Refuse throughput per unit	%	%	100.00	100.00
Refuse quantity per unit	lb/h	kg/h	50,000	22,680
Calorific value of refuse	Btu/lb	kcal/kg	5,000	2,470
HEATING SURFACES (approx.) (as used for calculation)				
Furnace (1st pass), proj.	sqft	m^2	2,680	249
Radiant furnace chamber (1st pass), proj.	sqft	m^2	2,734	254
Screen between 1st and 2nd pass	sqft	m^2	0	0
Radiant furnace chamber (2nd pass), proj.	sqft	m^2	3,940	366
Evaporation surface in the 3rd pass	sqft	m^2	5,640	524
Radiant furnace chamber (3rd pass), proj.	sqft	m^2	1,033	96
Screen between 3rd pass and superheater	sqft	m^2	0	0
Monowalls in superheater area, proj.	sqft	m^2	2,056	191
Superheater 3	sqft	m^2	5,070	471
Superheater 2	sqft	m^2	5,156	479
Superheater 1	sqft	m^2	12,325	1,145
Economizer	sqft	m^2	33,724	3,133
Total, approx.	sqft	m^2	74,358	6,908

Comments:

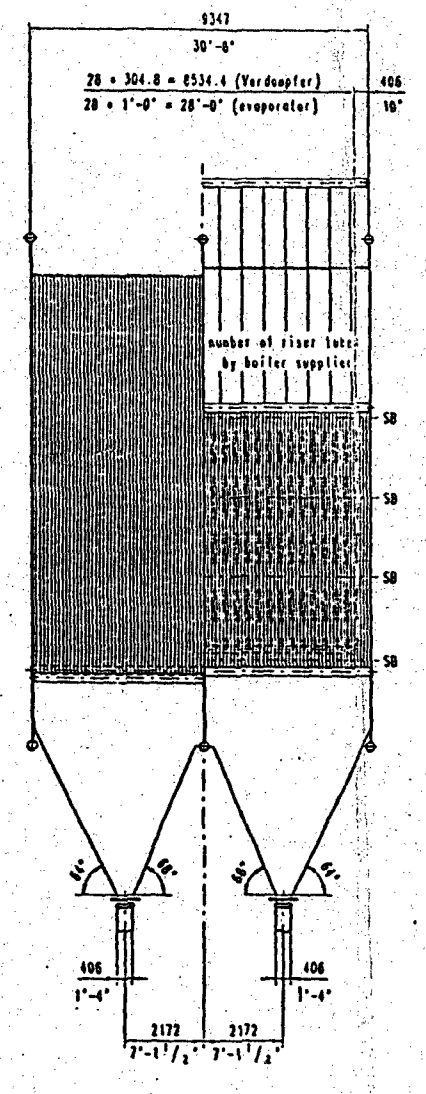
Boiler losses (US - units) :

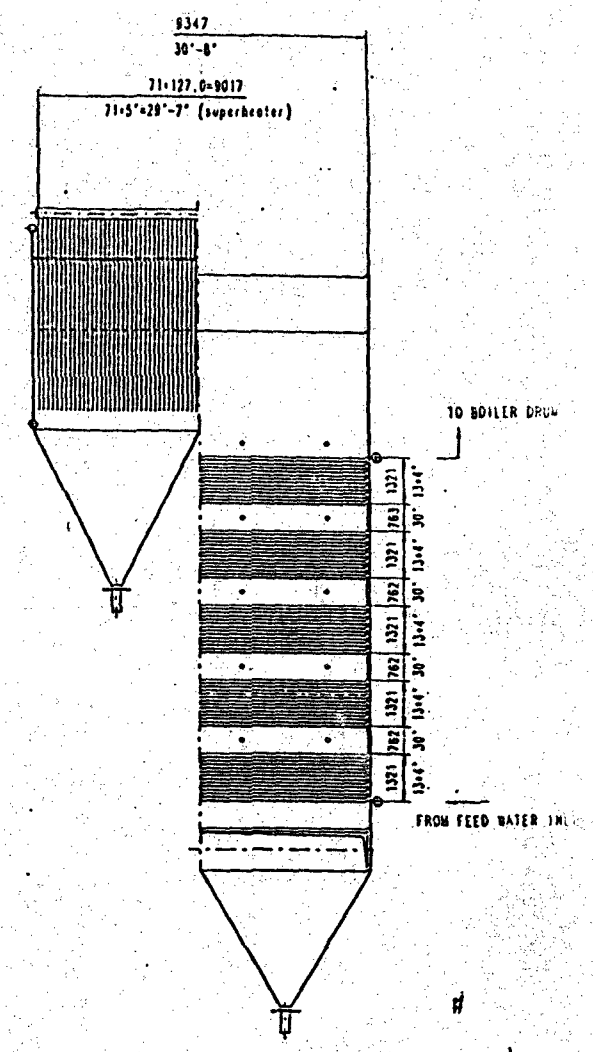
Heat loss due to radiation : 0.45 %
Loss by sensible heat in flue gases : 23.16 %
Unaccounted for losses : 1.50 %

Corresponding drawings No. DEC 90004-0108-0001/Rev.P and 90004-0109-0002 from 01/15/92



HALF SECTIONS





MARTIN stoker:	13 steps
stoker width:	8,980 mm = 29'-5 1/2"
steam rate:	172,554 lb/h
steam temperature:	830 °F
steam pressure:	865 psig
boiler width:	30'-8" = 92 + 4"
evaporator:	29 sections
superheater:	72 flows
economizer:	30 flows

Maßstab (1:96) 1/8"=1'-0"

a U.S. 10/08/90: evaporator, hopper 2nd/3rd pass

b

c

d

e

f

MARTIN GMBH für Umwelt- und Energietechnik Leopoldstr. 248, 8000 München 40

Gez. Sütterlin Schmidt

Gepr.

Datum Name

Auftrags Nr. 00919

BOILER LAYOUT DRAWING

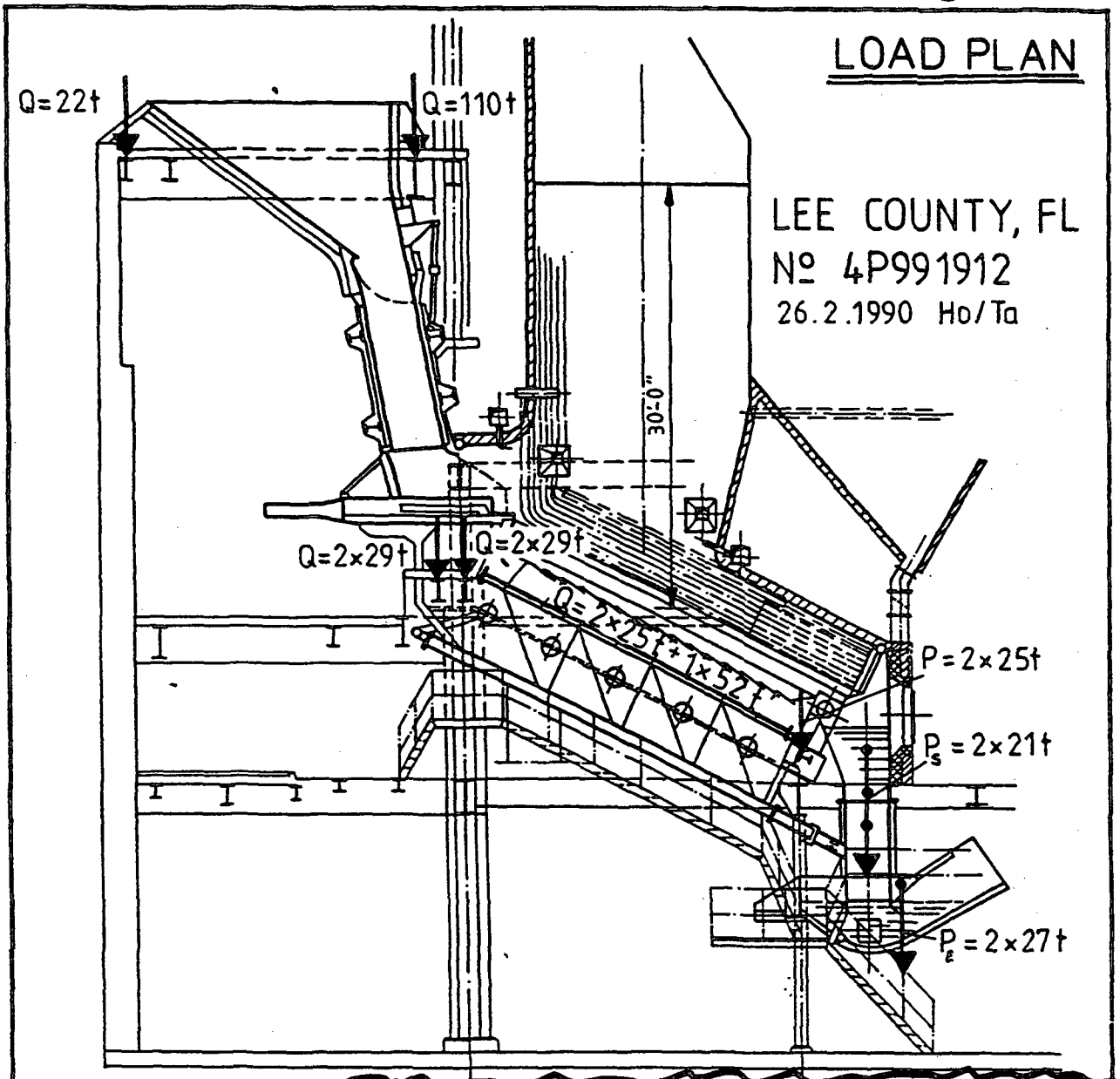
600 TPD + 3 UNITS - 5,000 BTU/LB

Anlagenname: RESOURCE RECOVERY FACILITY LEE COUNTY

Zeichnungs-Nr. A000191

MARTIN GMBH für Umwelt- und Energietechnik

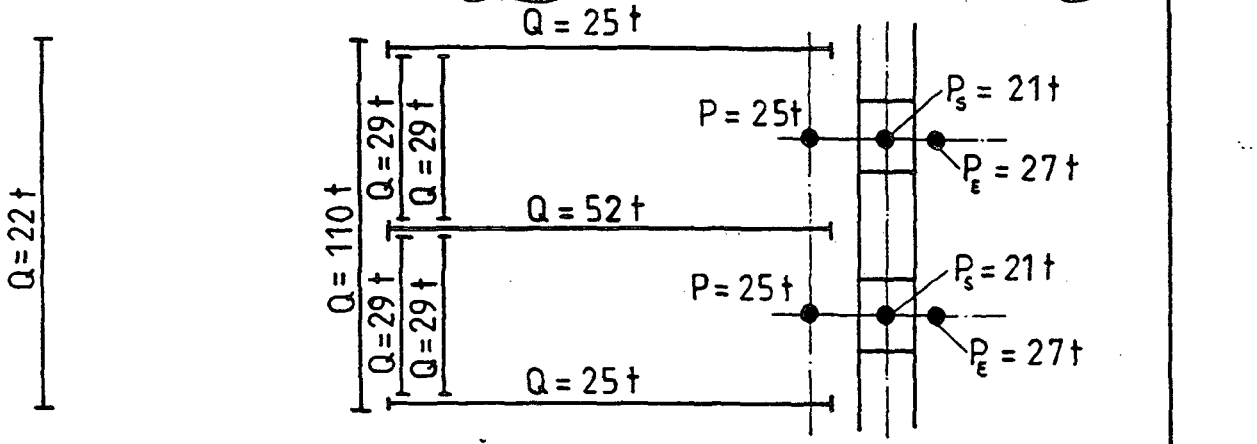
LOAD PLAN



LEE COUNTY, FL
№ 4P991912
26.2.1990 Ho/Ta

t = "sht"

REFER ALSO TO MARTIN DWG.
1A000235



D-8000 München 40, Leopoldstraße 248, Telefon 089/35031-0, Telex 5215717

ATTACHMENT 5

FAN SPECIFICATION

The following fan specification(s) are included as part of this boiler specification. Contractor shall complete all Fan Data Sheets included in these specification(s), and furnish them with his proposal.

Fan specification(s) included are:

SM-104 - Forced Draft, Induced Draft, Overfire, Seal and Reverse Air Fans

OGDEN MARTIN SYSTEMS
of LEE, Inc.

SPEC NO. SM-104
ISSUE 007
DATE 06/26/91

TECHNICAL SPECIFICATION

FOR

FORCED DRAFT, INDUCED DRAFT, OVERFIRE AIR, SEAL AIR AND REVERSE AIR FANS

Facility Name: LEE COUNTY RESOURCE RECOVERY FACILITY

Location: LEE COUNTY, FLORIDA

****

****

Specification Prepared By:

A/E Name: OMS

Address: FAIRFIELD, NJ

Telephone: 201-882-7071

A/E Approved for Release:

	Printed Name	Signature	Date
1.	R. TERRAMOCCIA	R. Terramoccia	10/30/91
2.			
3.			
4.			
5.			

REVISIONS

Issue 001	Initial Issue	01/01/87
Issue 002	Revision	07/24/87
Issue 003	Revision	04/29/88
Issue 004	Revision	05/13/88
Issue 005	Revision	08/01/90
Issue 006	Revision	12/28/90
Issue 007	Revision	06/26/91

OGDEN PROJECTS INCORPORATED

TECHNICAL SPECIFICATION
FOR
FORCED DRAFT, INDUCED DRAFT, OVERFIRE AIR,
SEAL AIR AND REVERSE AIR FANS

TABLE OF CONTENTS

TABLE OF CONTENTS CONT'D

REFER TO ATTACHMENT 6 OF SM-101

1.0 GENERAL

This Specification defines the requirements for design, fabrication, testing and delivery of forced draft (F.D.), induced draft (I.D.), overfire air (O.F.A.), and seal air fans and reverse air fans.

1.1 Work to be Provided

The Seller shall provide the fans indicated in Attachment 1.

Each fan shall be complete with driver, inlet boxes, silencer, if required, variable inlet vanes, actuator and bearing pedestals.

Field service supervision shall be provided for installation, field balancing and startup.

1.2 Work by Others

The following work will be provided by the Purchaser, unless otherwise indicated in Attachment 1.

Work by others shall include unloading and erection of the fans at the jobsite. Erection shall include setting the fans, foundations and anchorbolts, fan field assembly, connecting all ductwork, power and control wiring, insulation, lagging and field touch-up painting. For fans furnished as part of a larger system (e.g., boiler, air pollution control), the erection shall be in the system vendor's scope.

2.0 TECHNICAL REQUIREMENTS

2.1 General Design Criteria

Units shall be designed to ship in a minimum number of pieces with a minimum amount of field assembly.

The mechanical design temperature shall be 600-F for ID and Reverse Air fans and 150-F for other fans.

For the I.D. fan, the overall A-weighted sound level of the fan (without insulation) and motor shall not exceed 85/60 dBA at 3/50 feet, respectively. Also, for the I.D. fan, the sound level for the 1/3 octave bands containing the blade passing frequency (BPF) and its first harmonic (2XBPF) shall not deviate from the noise at their adjacent 1/3 octave bands by more than 5dB.

The overall A- weighted sound level of fan (without insulation) and motor shall not exceed 90 dBA for other fans. Noise is as defined and measured in accordance with AMCA 300 standard.

Fan performance shall be based on the static pressure differential from the inlet of the fan inlet box or silencer (if furnished), to the fan outlet (or evase outlet if furnished). Silencer and inlet losses, including control system losses, shall be added by the fan vendor to the specified static pressure differential.

Performance curves shall have a continuous rising pressure characteristic from the test block condition as specified in Attachment I, to 20 percent or less of the test block flow. Performance curves, corrected for the specified gas at the specified conditions, shall be based on performance tests of actual or prototype equipment, including evase, if any, and inlet box(es).

The rated speed of the fans shall not exceed the following:

ID Fan	900 RPM
FD Fan	1200 RPM
OFA Fan	1800 RPM
Seal Air Fan	1800 RPM
Reverse Air Fan	1200 RPM

Fan drive motors for reverse air forced draft, overfire air, and seal air shall be sized based on a service factor of 1.0. Fan drive motors for ID fans may be sized with a service factor of 1.15 to meet test block conditions provided that MCR conditions are within the motor's nominal rating.

Field performance testing for all fans shall be in accordance with AMCA 203.

ID fans will operate downstream of air pollution control equipment. Typically, the ID and reverse air fans will operate in an environment with less than 0.15 grains/ACF of particulates. During upset or start-up conditions, the fan will be subjected to gas with about 4.0 grains/ACF.

The FD fan and overfire air inlet duct is located above the plant refuse pit. This location creates a continuously dusty service for these fans.

The seal air fan inlet is in the boiler house and the air handled is low in particulates.

Fan performance and design data are shown in Attachment 1. For fans purchased as part of a larger system, the system vendor shall specify system specific design data on Attachment 1 not furnished by the Purchaser. Energy efficiency will be a consideration in determining the successful bidder. Minimum allowable fan efficiency at MCR conditions is 80% for Reverse Air, ID, FD and OFA fans.

2.2 Codes and Standards

The latest edition of the following standards, codes, or specifications shall form a part of this specification.

AFBMA

Std-9	Load Ratings and Fatigue Life for Ball Bearings
Std-11	Load Ratings and Fatigue Life for Roller Bearings

AMCA

Publ. 201	Fans and Systems
Publ. 203	Field Performance Measurements
Std 210	Laboratory Methods of Testing Fans for Rating Purposes
Std 2404	Drive Arrangements for Centrifugal Fans

ANSI

B1.1	Unified Inch Screw Threads (UN and UNR Thread Forms)
B2.1	Pipe Threads (Except Dryseal)
B16.5	Steel Pipe Flanges and Flanged Fittings
S2.19	Balance Quality of Rotating Rigid Bodies

PTC 11 Large Industrial Fans

ASTM

E 125 Reference Photographs for Magnetic Particle Indications on Ferrous Castings

E 709 Magnetic Particle Examination

NEMA Standard MG-1: Electric Motors

NFPA Bulletin No. 70, National Electrical Code, Article 500, "Hazardous (Classified) Locations," and Article 501, "Class I Locations"

OSHA Occupational Safety and Health Standards of the U.S. Department of Labor

SSPC

SP 3

PA 1 Shop, Field, and Maintenance Painting

2.3 Housing and Inlet Box Requirements

The fan housings and inlet boxes shall be fabricated of sufficient thickness and braced to prevent aerodynamic and mechanical vibration and to be free from leakage. ID fan inlet box bracing shall be sized and located so as not to interfere with concrete bearing pedestals including a minimum of 3 inches of insulation installed over fan housing stiffeners. Housing and box joints shall permit rotor removal without disturbing duct connections. The base supports of the induced draft fan housing shall permit thermal expansion without damage to the concrete foundation. Each housing and inlet box shall be provided with one, 2-1/2 in. drain connection and one, hinged, gastight, access door (24 inch by 24 inch). The drain shall be provided with a horizontal drain pipe extended beyond housing.

All inlets, outlets, housing joints, and access doors shall be gasketed to provide a gastight seal under all operating conditions.

Removable wire mesh screens shall be provided for open inlet fans.

Silencers shall be provided, if required, to meet specified noise level requirements.

2.4 Flow Control

Forced draft, overfire air fan and induced draft fan flow shall be controlled by variable inlet vanes with all moving parts outside of gas stream (e.g. - Howden "center operated"). Inlet vane controls shall be provided in accordance with Attachment 3. Gas flow shall be controlled down to 20 percent of Test Block capacity. The fans shall be capable of stable operation across the operating range of the equipment when in automatic control.

The operating mechanisms for all fan inlet vanes shall be designed for minimum lost motion and each shall terminate at a single point for the attachment of the Seller's operating unit. The design of the mechanisms shall allow replacement of parts without dismantling or removing other components and shall be located completely outside the air/gas stream.

The operating mechanisms shall be so arranged that the inlet vane can be secured in any position. Threaded connections should be provided in the operating mechanism to facilitate field adjustment of inlet vane position. Each vane shaft shall be clearly marked with the damper position. The mechanism shall have end stops to prevent the vanes from overturning. If possible, the operating mechanism shall be mounted on the Seller's equipment. The operating mechanism must be easily accessible for maintenance.

Maximum allowable leakage through the inlet vane control damper in the fully closed position shall be less than 10% of required Test Block flow, at test block static pressure.

Inlet vanes and their shafts shall not vibrate or flutter at any load.

2.5 Rotors

Fans shall have backwardly curved blades for Reverse Air, ID, FD and OFA service. Solid nose airfoil blades may be provided as an option. DWDI fans shall have offset blades.

Fan wheels shall be statically and dynamically balanced to the values shown in ANSI-S2.19 for G2.5 with a certified test report furnished to the Purchaser.

In the final installation, the maximum allowable vibration measured on the bearing cap, in mils peak to peak, shall be 1910 divided by fan RPM.

Shafts shall be forged or hot rolled SAE 1045 steel and shall be ultrasonically tested prior to assembly with a certified report furnished to the Purchaser.

Fans shall be of stiff shaft design. The first rotor critical speed shall be at least 50 percent higher than the operating speed for forced draft and induced draft units. The installed resonance of the system, including the rotor, bearings, bearing oil film, pedestals and sole plates but not the concrete foundation shall have a design resonance at least 25 percent higher than maximum operating speed.

A certified copy of the first critical speed and stiffness calculation, assuming an infinitely rigid foundation, shall be furnished.

Reverse air, forced draft, overfire air and induced draft wheels shall be designed to minimize erosion using either blade liners or scalloped wheel design with liners. The wheel construction, including liners, shall be of weldable material to permit repair welding in the field.

As a general guideline, induced draft fans with test block specific speed below approximately 35,000 shall be furnished with single inlet, single width wheel design. ID fans with test block specific speed of 35,000 and greater shall be furnished with double inlet, double width wheels if efficiency or first cost doesn't dictate otherwise. All other fans shall be single inlet single width design, unless otherwise specified in Attachment 1.

2.6 Impeller

Impeller shall be welded construction and welds shall meet the requirements of AWS D14.6

All impeller materials shall be certified to ASTM standards.

Impeller shall be designed not to exceed an average of 50% of material stress levels across any section and must withstand the stresses induced by across the line starting.

All impellers with a tip speed greater than 25,000 FPM shall be stress relieved.

All impeller welds to be examined by magnetic particle or dye penetrant test.

Impeller hub to be shrunk and keyed to shaft.

Impeller blade reinforcing rings are not permitted.

2.7 Bearings and Pedestals

Antifriction bearings shall be self-aligning, shall be in accordance with ANSI/AFBMA 9 and 11, and shall be provided based on the following criteria:

DN factor less than 200,000 (the DN factor is the product of bearing size (bore) in millimeters and the rated speed in revolutions per minute).

L-10 life factor of 100,000 hours or greater (the rating life is the number of hours at rated bearing load and speed that 90 percent of the group of identical bearings will complete or exceed before the first evidence of failure).
Load factor less than 2,700,000 (load factor is the product of rated horsepower and rated speed in revolutions per minute).

In all other cases self-aligning water cooled sleeve bearings shall be used. Sleeve bearings shall be horizontally split and provided with oil ring lubrication or other positive type of lubrication, inspection ports and oil sight indicators.

Each fan bearing shall be provided with a non-contacting vibration switch and, if furnished with water cooled sleeve bearings, temperature detectors of T/C design. The vibration switch type should be PMC/BETA Model Number 440D or approved equal and shall have two settings, one for alarm and one for fan trip.

Bearings shall be suitable for the maximum loads, speeds, temperatures, and operating conditions specified. Seals shall be provided for prevention of oil, grease, and water leakage, and the entrance of foreign matter.

Fan arrangements shall be as follows; all fans shall be direct drive.

Forced Draft Fan	- AMCA Arrangement 3
Overfire Air Fan	- AMCA Arrangement 7
Induced Draft Fan	- AMCA Arrangement 3
Seal Air Fan	- AMCA Arrangement 8
Reverse Air Fan	- By APC Equipment Vendor

The design of the bearings and pedestals shall allow removal of the bearings without removal of the rotor.

2.8 Couplings

All steel, limited end float, gear-type flexible couplings shall be furnished between the fan and drive capable of transmitting the maximum power developed by the driver. Spacer coupling will be required on the fans if removal of the driver side fan bearing cannot be accomplished without disturbing the driver. OSHA-type coupling guards shall be furnished.

2.9 Fan Foundations

The Seller shall supply the Purchaser with the following for use in the design of the fan foundations:

- Total weight of fan and driver
- Weight of fan rotors, lb (including rotors, couplings, shaft, etc.)
- Stiffness of the fan shafts, bearings, bearing pedestals, and sole plates

- o Damping in the bearing oil film
- o Maximum unbalance force in the fan rotor
- o Operating and critical speeds
- o Maximum anticipated vibration levels (peak-to-peak) at the bearing housings, at operating speed.
- o Center of gravity of equipment weight.

2.10 Insulation

The Seller shall include in his proposal his recommended insulation material, thickness, and application method. Insulation shall be by others. For fans furnished as part of the Air Pollution Control (APC) System (e.g., I.D. and R.A. fans), the APC Vendor shall provide the insulation and lagging.

2.11 Instrumentation and Control (Ref. Attachment 3)

The Seller shall furnish and deliver air operated actuators with interconnecting linkage, levers, air sets and I/P converters designed to accept Purchaser's 4-20 MA signal for modulating the inlet vanes. Actuators for forced draft fan and overfire air fan shall be fail-closed type. Induced draft fan shall have fail-open actuator. Limit switches shall be provided on all inlet vane drives to indicate full open and full closed position. These actuators shall be capable of achieving:

Proper operation up to the maximum air and flue gas flow

Safe and reliable operation of the fans

5:1 turn down on gas flow with stable operation when on automatic control

All instruments (e.g. - limit switches, temperature elements, vibration switches, solenoid valves, I/P converters, pressure switches, etc.) shall be wired to a terminal box.

2.12 Structural Requirements

The Seller shall furnish the fans complete with support steel, base plates and bracing.

The fan and its supports shall be designed structurally for the following load conditions:

- o The entire static load of the fan including casing, inlet boxes, VIVs, evase (if provided), etc.

- o Seismic forces shall be accounted for in the design of the fan supports.

- o Dynamic loads due to unbalance caused by mechanical failure or dust buildup.

- o Proper provision shall be made for impact loads from machinery, expansion forces, and all erection loads.

- o The fan housing shall be stiffened and braced to withstand air and flue gas pressure in such a manner as to prevent detrimental distortion, deformation or an objectionable level of vibration.

Design shall consider the most severe load combinations which could occur.

OMS uses sleeved anchor bolts to facilitate alignment and equipment erection. Therefore, vendor design must provide an adequate edge distance between the centerline of anchor bolt and the recommended face of concrete pier and/or equipment clearance line.

All components shall be designed so that each can expand and contract under the operating cycle of temperatures and pressures without damage to itself or to any adjoining component.

All shop connections shall be welded or bolted.

All field connections shall be bolted.

2.13 Welding

2.13.1 AWS Welding

The welding, welding procedure qualification, welder qualifications, and post welding heat treatment of welds shall be in accordance with AWS D14.6. Post weld heat treatment of welds shall apply only to the wheel.

Welds performed on the fan wheels shall be subjected to nondestructive examination. The nondestructive tests shall be performed in accordance with the fan Seller's written procedures for the manufacture of this class of fan. The nondestructive tests, procedures, personnel qualifications, and acceptance standards shall be in accordance with AWS.
Tack welds which do not become an integral part of a weld shall be removed, the surface ground smooth and the area visually inspected.

Materials used for run-off tabs and backing bars shall be of the same nominal chemical composition and metallurgical structure as the base metal. All run-off tabs and backing bars shall be removed, the area ground smooth and the area visually inspected.

Only low-hydrogen type covered electrodes shall be used as weld filler metal on carbon steels if shielded metal arc welding (SMAW) is the welding process selected for production.

2.13.2 Noncode Welding

All noncode welds shall meet the following criteria:

- o No cracks or lack of fusion shall be acceptable.
- o The sum of diameters of porosity shall not exceed 3/8 in. in any 6 sq in. of weld surface with the dimension along the centerline of the weld not exceeding 6 in. The maximum size of any one pore shall not exceed 3/32 in. Where the weld area is less than 6 sq in. or the length of the weld at the centerline is less than 6 in., the acceptable sum of porosity diameters shall be scaled proportionally.
- o All weld craters shall be filled to the full cross-section of the weld.
- o Undercut which exceeds 1/32 in., or 10 percent of the thinner member whichever is less, shall not be acceptable. Weld reinforcement shall be 0-in. to 1/8 in. maximum between abutting surfaces and shall have a gradual transition (30 deg maximum) to the plane of the base metal surfaces.

2.14 Shop Cleaning and Painting

Cleaning of surfaces which are not to be painted or coated shall be done according to the Seller's best recommended practice.

Parts or subassemblies that may have crevices or inaccessible surfaces after assembly shall be cleaned as well as practicable prior to assembly.

All internal surfaces shall be cleaned of all particulate contaminants such as sand, metal chips, weld slag, etc. Additionally, the surface shall be free of organic contaminants such as oils, paint, and preservatives as determined by a visual examination.

External noncorrosion-resistant metallic surfaces of forced draft, overfire air and seal air fans shall have surface preparation and be primed and finished in accordance with the Manufacturer's standards, unless otherwise specified. Induced draft and reverse air fans shall have Manufacturer's standard surface preparation and be primed with 3 mils dry coat of inorganic zinc.

2.15 Induction Motors

All motors shall conform to Purchaser's Induction Motor Specifications SE-211 and SE-212. An Induction Motor Data Sheet (Attachment No. 1 to Specifications SE-211 and SE-212) shall be completed and submitted to the Purchaser for each motor supplied.

Motors shall be capable of starting fans with air at the design winter ambient temperature specified on pg. A1-1.

3.0 TEST AND GUARANTEE

3.1 Inspection and Test

The Seller shall provide the following shop tests:

1. Shop assembly to confirm that all dimensions and clearances are within design tolerances.

2. Static and dynamic balancing of rotors as per Section 2.5.

The following are the mandatory inspection points for which prior notification is required:

1. Shop assembly
2. Release for shipment.

Purchaser may chose to observe the tests and/or the inspections; vendor to provide a minimum of two weeks advance notice of tests/inspections.

3.2 Guarantee

The Seller shall guarantee the fan performance at test block and MCR as shown below.

Guaranteed Item	Allowable Variation From Stated Value
Capacity, acfm	2.5%
Static pressure, in w.g.	5.0%
Brake Horsepower, HP	5.0%

The Seller shall also guarantee that the operation of the fan across the entire range of operation from maximum turndown to test block conditions will be stable when the fan is in automatic control with a suitable dynamic control signal.

The Seller shall furnish a written statement guaranteeing that the fan as furnished and installed, is free from fault in design, workmanship and materials, and of sufficient capacity to fulfill the operating conditions and meet guarantee points specified. Should any defect in design, material, workmanship, or operating characteristics develop during the first two years of operation, the Seller agrees to furnish, at no cost to the Purchaser, all necessary alterations, repairs, replacements, and labor to correct defect.

4.0 SUPPLEMENTARY REQUIREMENTS

4.1 Preparation for Shipment

The interior and exterior of the equipment shall be prepared as stated in the Shop Cleaning and Painting Section 2.14.

Flange faces shall be protected with securely fastened wooden covers. Threaded openings shall be closed with plugs or caps.

It shall be the responsibility of the Seller to take all precautions required to ensure jobsite arrival of all equipment and materials in an undamaged condition. This includes protection against deterioration such as excessive rusting of ferritic parts due to exposure to the elements while in transit or storage at the jobsite. The vendor shall assume that all equipment will be stored for a minimum of 60 days in open field conditions at the job site.

Packaging shall be adequate to prevent contamination, mechanical damage, or deterioration of the item supplied as defined in the requirements listed below. These requirements are applicable immediately after manufacture.

Items not immediately packaged after manufacture shall be protected from contamination.

Items shall be inspected for cleanliness immediately before packaging. Any entrapped water shall be removed.

Items shall be packaged in suitable containers, crates, or on skids.

The outermost covering shall be clearly marked with the complete vendor identification which shall include weight.

All items subject to corrosion shall be suitably protected.

When shipping by open carrier, items shall be covered by fire-retardant materials, e.g., tarpaulins, to prevent contamination from road, dust, dirt, salt spray, and other forms of contaminants. Cover installation shall be made so that air circulates under the cover preventing condensation.

Any special storage requirements, specified by the Seller, shall be forwarded to the jobsite with each shipment to which they are applicable.

Units not properly protected, and which are found to be in a damaged and/or rusted condition at the jobsite, shall be subject to rejection and replacement in an acceptable condition by the Seller.

4.2 Supervisor for Erection and Start-up

The Seller shall include, as an option, in his proposal the services for an installation and start-up supervisor and field balancing, which may be needed by the Purchaser. This shall be based on single-shift, 8 hour days.

4.3 Tools

The Seller shall furnish one complete set of special tools or fixtures required for maintenance and operation shall be furnished.

4.4 Proposal Data by Seller

The Seller shall complete and submit with his proposal the data sheets contained in Attachments 1 and 2 of this Specification including preliminary fan performance curves, not to exceed foundation loads, and general arrangement drawings. Fan performance curves shall be temperature corrected for the test block and MCR temperatures, and shall show constant efficiency curves and inlet vane position curves, plotted from zero to fully open. Actual operating horsepower for test block and MCR conditions shall be noted.

Proposal shall include any exceptions to this specification. All exceptions shall be specified and reference the exact specification sections with which the proposed equipment is not in compliance. Exceptions shall include a detailed description of the alternative design. No blanket exceptions will be allowed.

FAN SPECIFICATIONS

ATTACHMENT 1

DESIGN CONDITIONS
AND PROJECT SPECIFIC REQUIREMENTS

1.0 Design Conditions

Project: LEE COUNTY

Location: LEE COUNTY, FLORIDA

Number of Units: 2

Plant site conditions:

Elevation: 0 FT ASL

Earthquake Zone: 0

Design Winter Ambient Temperature: 35°F

Instrument Air:

supply pressure (psig): 70

operating temperature (-F): 60

dew point (-F): -20

The fans shall be designed to meet the following performance:

	Forced Draft	Overfire Air	Induced Draft	Seal Air	Reverse Air
Number of fans to be furnished by the Seller	2	2	N/A	2	N/A
Fan Minimum Conditions					
Flow, acfm	41,530	11,870		1,400 (1,2)	NA
Static Pressure Rise, in H_2O	(1,3)	(1,3)	(1,3)	(1,3)	NA
Fan MCR Conditions Flow, acfm	54,650	23,400	↓ (1,4)	1,400	N/A (1,5)

	Forced Draft	Overfire Air	Induced Draft	Seal Air	Reverse Air
Static Pressure Rise, in w.c.	(1)	(1)	N/A (1)	(1)	N/A (1)
Operating temp. °F	80	80		80	
Terminal Static Pressure in w.c.	16	18		16	(1)
Losses, in. w.c.:					
System	(1,6)	(1,6)	(1,6)	(1,6)	(1,6)
Boiler	N/A	N/A		N/A	N/A
APC System	N/A	N/A	(1,7)	N/A	(1,7)
Total Pressure Losses, in w.c.	(1)	(1) (1)	(1)	(1)	(1)
Test Block Conditions:					
Flow, acfm	74,000	34,530	(1,8)	(1,9)	(1)
Static Pressure Rise, in w.c.	(1,10)	(1,11)	(1,12)	(1,11)	(1,10)
Temperature, °F	105	105		105	
Additional Design Criteria:					
Air or gas handled	Dusty Air	Dusty Air	Flue Gas	Clean Air	Flue Gas
Location (Indoor/Outdoor)	INDOORS	INDOORS		INDOORS	
Driving Motor V/pH/Hz	460/3/60	460/3/60	/ /	460/3/60	/ /

The power consumption will be evaluated on the basis of a capitalized value of $ — per kw.

NOTES:

1. Boiler/APC system supplier shall fill-in data

2. I.D. fan minimum flow shall be based on minimum operation as defined in Attachment 2 of the Air Pollution Control (APC) Specification SM-105, pg A2-2.

3. F.D., O.F.A., I.D., and Seal Air fan pressures at minimum flow are to be the lowest expected value for the fixed portion of the pressure drop plus the variable portion of the pressure drop at the minimum flow.

4. I.D. fan MCR flow shall be based on the baghouse exit flow (Ref. Specification SM-105, Section 7.4f(i) of Attachment 7) corresponding to the Expected Continuous economizer outlet flow shown in Attachment 2 of SM-105; in-leakage shall be included.

5. For Seal Air fan MCR flow, Ref. Boiler Specification SM-101, pg. A1-4.

6. System losses shall include duct, entrance/exit, flow element, damper and steam coil air heater (dirty) losses, as applicable.

7. The APC system losses shall be based on actual flows (including inleakage) corresponding to the Expected Continuous economizer outlet flow shown in Attachment 2 of SM-105; these losses shall be actual (i.e., not guaranteed). The pressure drop across the baghouse shall be the average of the cleaning and non-cleaning modes.

8. The I.D. fan T.B. flow shall be 1.09 X T.B. Temp. °R divided by MCR Temp. °R X the design baghouse exit flow (Ref. SM-105, section 7.4 g of Attachment 7).

9. The Seal Air fan T.B. flow shall be 1.15 x MCR flow.

10. The Reverse Air Fan T.B. pressure shall be 1.1 x MCR pressure.

11. The F.D., O.F.A. and Seal Air fan T.B. pressure shall be the MCR terminal static pressure plus 1.32 x MCR system losses.

12. The I.D. fan T.B. pressure shall be the sum of the maximum guaranteed Air Pollution Control System pressure drop (i.e. - with one baghouse compartment off-line for cleaning) as shown in Section 7.1.bii of Attachment 7 of SM-105 and 1.44 x (MCR terminal point static pressure + a design boiler loss of 3.0).

2.0 PROJECT SPECIFIC REQUIREMENTS

The attached Project Specific Requirements, if any, are additions, deletions, and/or revisions to the preceding Specification requirements and shall be considered as part of this Specification.

2.1 FD, OFA AND SA FANS SHALL BE PROVIDED WITH SPLIT HOUSINGS AND ANTI-FRICTION BEARINGS.

2.2. ALL MOTORS SHALL HAVE A MINIMUM SERVICE FACTOR OF 1.1.

TECHNICAL DATA SUPPLIED BY SELLER

	Forced Draft	Overfire Air	Induced Draft	Seal Air
Manufacturer	BUFFALO FORGE			CO.
Size and Model	1320 L-25	890 L-25	N/A	50-4 CB
Fan Performance				
MCR Conditions				
Flow, acfm	54,650	23,420	N/A	2,985
Total Static Pressure, in. w.c.	20.0	22.48	N/A	18.0
Operating Temperature, °F	80	80	N/A	80
BHP	223	107	N/A	14.4
Static Efficiency, %	77	76.6	N/A	58.7
Guaranteed Test Block Conditions				
Flow, acfm	74,000	34,500	N/A	3,432
Static Presure, in. w.c.	21.28	23.94	N/A	18.64
Temperature, °F	105	105	N/A	105
BHP	302	156	N/A	16.5
Static Efficiency, %	79.9	81.3	N/A	61.0
Fan Design				
Single or Double Inlet	S	S	N/A	S
Single or Double Width	S	S	N/A	S
Blading Design	BC	BC	N/A	RADIAL
AMCA Arrangement	3	7	N/A	8
Maximum Speed, RPM	1311	1966	N/A	2041
Required Driver Size, HP	350	200	N/A	20

← OR TLT BABCOCK WITH MIN. REQUIREMENTS AS DEFINED BY THESE DATASHEETS. -RBT

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	Forced Draft	Overfire Air	Induced Draft	Seal Air
Housings				
Material/gage, in.	.375	.250	N/A	.250
Access Door	12 x 18	12 x 6	N/A	4 x 8
Drains: No./Size	1-1/2"	1-1/2"	N/A	1"
Inlet Boxes				
Included (yes or no)	Y	Y	N/A	N
Inlet size	32.5 98.5	22 66	N/A	---
Material/gage, in.	.375	.250	N/A	---
Silencers	NO	NO		YES
Drains: No./Size	1-1/2"	1-1/2"	N/A	---
Rotor (Wheel and Shaft)				
Weight, lb	2080	731	N/A	165
Wheel Diameter, in.	63.50	44.0	N/A	33.35
WR, lb-ft.	4590	890	N/A	
Tip speed, ft/min.	19380	20500	N/A	15490
Type balding	BC	BC	N/A	RADIAL
Blade Material/Grade	A242-1	A242-1	N/A	A242-1
No. of blades, each side	16	16	N/A	10
Wear plate material/grade	A283D	A283D	N/A	NO
Wear plate, thickness	.2500	.2500	N/A	NO
Shaft Material	A576 1045	A576 1045	N/A	A576 1045
Shaft Diameter at hub, in.	4.00	3.25	N/A	1.6875
Shaft Diameter at bearings, in.	3.4375	2.6875	N/A	1.6875

	Forced Draft	Overfire Air	Induced Draft	Seal Air
Shaft seals, type	COMP	COMP	N/A	COMP
First critical speed RPM	1593	2492	N/A	2492
Rotor resonant speed RPM	1639	2375	N/A	2463
Bearing				
Type, thrust	ROLLER		N/A	ROLLER
Type, radial	ROLLER		N/A	ROLLER
L-10 Life	150,000			PLUS
Diameter, in.	3.4375	2.8675	N/A	1.6875
Length bearing surface, in.	---	---	N/A	---
Lubrication method, rings/other	GREASE		N/A	GREASE
Bearing cooling method, water/air	N/A	N/A	---	N/A
Pedestals				
Material	A283	A283	N/A	---
Sole Plates				
Material	A283	A283	N/A	---
Inlet Vanes/Dampers				
Type and No. of blades	14	10	N/A	---
% Leakage in closed position	APPROX 10	APPROX. 10	N/A	---
Max. torque, ft-lb	236	105	N/A	---
Actuator Manufacturer	BAILEY PNEUMATIC		N/A	---
Actuator Type	W/I-P	CONV.	N/A	---
Actuator Model	UP-20301000		N/A	---
Actuator Torque, ft-lb	450 @ 100 psi	450 @ 100 psi		---

	Forced Draft	Overfire Air	Induced Draft	Seal Air
Coupling				
Manufacturer	F A L K	F A L K	F A L K	F A L K
Size and type	T-31	S P A C E R		
MTR Frame	1090 449T	1080 444TS		1060 256T
Housing Liners				
Location	---	---	N/A	---
Material/gage, in.	---	---	N/A	---
Insulation				
Material and thickness recommended	---	---	N/A	---
Summary of Weights				
Pier load, fan base rail, lb	L A T E R	L A T E R	L A T E R	
Pier load, on each pedestal, lb	L A T E R	L A T E R	L A T E R	
Approx. shipping weight, lb	10,450	5,325	N/A	1,412
Are starting torque curves attached?	L A T E R	L A T E R	L A T E R	
Can wheel be oversped to 110%?	YES	YES	N/A	YES
Are performance curves attached?	YES	YES	N/A	YES
Are fan foundation design criteria attached?	NO	NO	N/A	NO
Sound Level				
Total Sound Pressure Levels, dBA	85	82		69
Vibration				
Guaranteed vibration peak to peak, on bearing cap, after final installation, mils	1.50	1.0	N/A	1.0

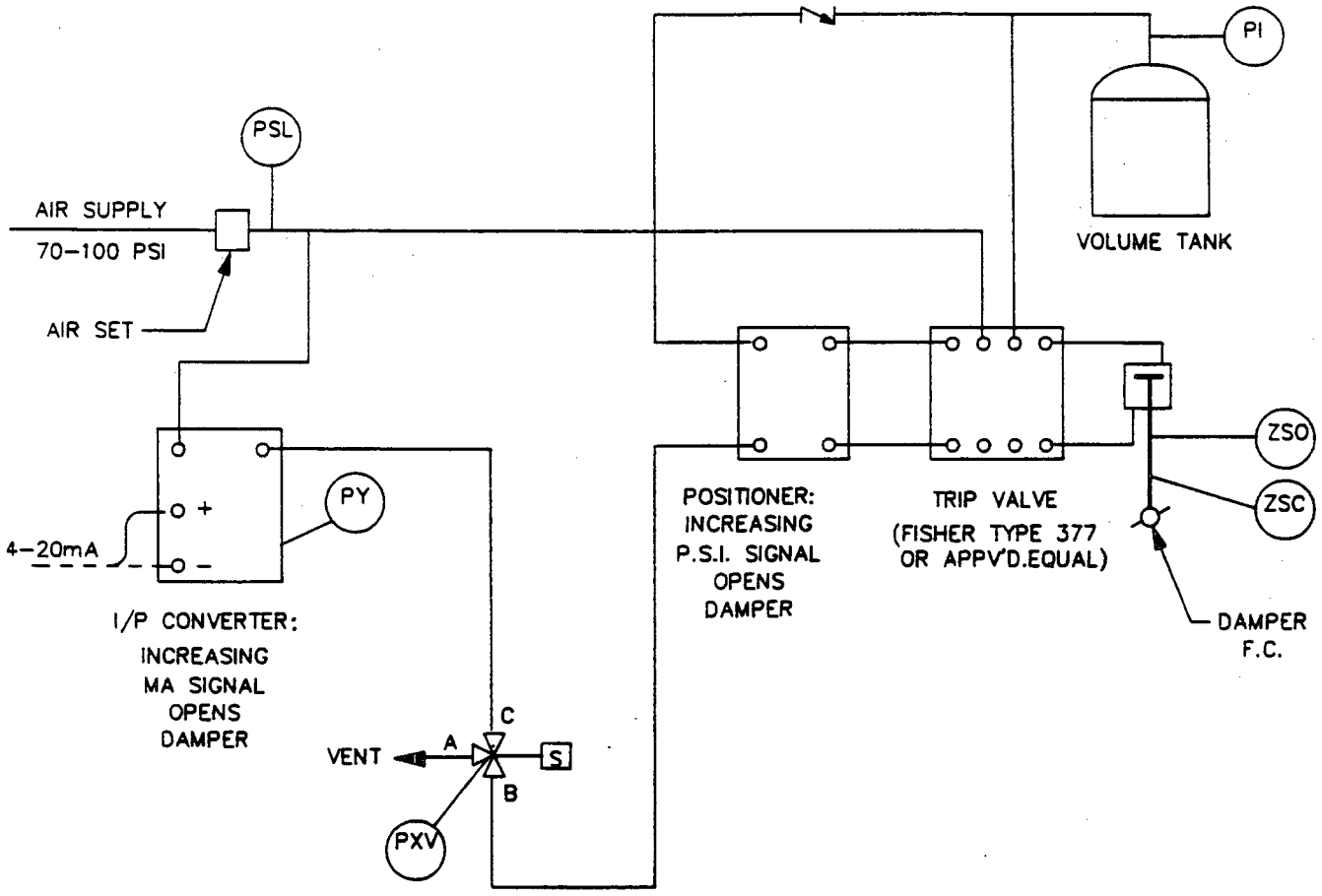
F.D., O.F.A., S.A. & R.A. FAN CASING NOISE (1)

OCTAVE BAND CENTER FREQ., HZ.	63	125	250	500	1K	2K	4K	8K	TOTAL
FORCED DRAFT FAN									
SOUND POWER, dB.	107	102	103	99	97	93	89	85	____
SOUND PRESSURE, dB. (8)	94	89	90	86	84	80	76	72	88 (6)
OVERFIRE AIR FAN									
SOUND POWER, dB.	105	100	98	100	95	91	87	83	____
SOUND PRESSURE, dB. (8)	94	89	87	89	84	80	76	72	89 (6)
SEAL AIR FAN									
SOUND POWER, dB.	117	105	101	91	90	84	82	81	____
SOUND PRESSURE, dB. (8)	107	95	91	81	80	74	72	71	87 (6)
REVERSE AIR FAN									
SOUND POWER, dB.	N/A								
SOUND PRESSURE, dB. (8)	N/A								(6)

NOTES:

(1) PROVIDE NOISE DATA AT FAN MCR OR TEST BLOCK, WHICHEVER IS HIGHEST.
(2) USE APC TRAIN WITH LEAST NO. OF TURNS; N/A / N/A 45°/90° TURNS USED.
(3) N/A FT. HIGH STACK (FROM BREECHING); N/A FT. DIAMETER (STEEL/BRICK) FLUE.
(4) N/A FANS INCLUDING FUTURE FAN (IF APPLICABLE).
(5) ASSUME HEMISPHERICAL SPREADING IN A FREE FIELD; SOUND LEVELS TO BE 3 FT. FROM STACK AND 45° FROM VERTICAL UP VECTOR.
(6) A-WEIGHTED AVERAGE.
(7) PROVIDE 1/3 OCTAVE BANDS WHICH CONTAIN THE BPF AND 2XBF PLUS THEIR ADJACENT 1/3 OCTAVE BANDS.
(8) ASSUME A PLANE 3 FT. FROM FAN CASING.
(9) PROVIDE THIS DATA ONLY IF FAN CASING NOISE W/O INSULATION EXCEEDS SPEC. LIMIT.

A3-1



NOTES:

1. VENDOR SHALL FURNISH DAMPER DRIVE WITH THE COMPONENTS SHOWN ON THIS SKETCH. ALL CONPONENTS SHOWN SHALL BE FACTORY ASSEMBLED ON DAMPER DRIVE.
2. DAMPER SHALL HAVE LIMIT SWITCHES FOR OPEN AND CLOSED POSITION (DPDT CONTACTS, RATED 5A @ 120 VAC) TAGS: ZSO-[ ] (OPEN), ZSC-[ ] (CLOSED).
3. SOLENOID VALVE PVX-[ ] POWER IS 120 VAC. WHEN ENERGIZED-OPEN IN CB DIRECTION, DE-ENERGIZED-OPEN IN AB DIRECTION.
4. ALL ELECTRICAL COMPONENTS (IE-LIMIT SWITCHES, SOLENOID VALVES, ETC.) SHALL BE WIRED TO A COMMON JUNCTION BOX.
5. PSL-[ ] SHALL BE DPDT RATED FOR 5A @ 120 VAC.
6. DAMPER SHALL FAIL CLOSED ON LOSS OF AIR, OR CONTROL SIGNAL.

AN OGDEN COMPANY	ATTACHMENT 3-2 FD & OFA FAN VARIBLE INLET GUIDE VANE CONTROLS (DOUBLE – ACTING CYLINDER ACTUATOR)	OGDEN PROJECTS, INC. APPROVED: DATE: DWG. NO. SM-104-2 REV. 1

ATTACHMENT 4

DOCUMENTS SUBMITTAL SCHEDULE
(Days or Weeks after Award)

Documents for Approval		Engineering Need Date	Schedule Date for Certified Vendor Submittal
- Document Submittal Schedule		10 Days	
- Equipment Arrangement Drawings	(1)		
- Nozzle Location and Sizes			
- Equipment Load Diagram	(2)		
- Anchor Bolt Sizes and Locations			
- Inlet Vane Control System Schematic			
- Vendor Supplied Instrument List			
- Motor List & Electrical Power Service Requirements			
- Wiring Diagrams			
- Performance Curves	(3)		
- Test Report	(4)	30 days After Test	
- Calculations	(5)		
- Predicted Sound Pressure Levels (dB) Through Housing, Inlet & Outlet, at 3 ft. distance, per Octave Band			
- Design/Fabrication Schedule			

APPLICABLE TO AGREEMENT BETWEEN BOILER AND FAN VENDORS

DOCUMENTS SUBMITTAL SCHEDULE

Documents for Information	Engineering Need Date	Schedule Date for Certified Vendor Submittal
- Fabrication and Erection Drawings	120 days Before Shipment	_____
- Storage and Handling Procedures	60 days Before Shipment	_____
- Installation, Operation and Maintenance Manuals	60 days Before Shipment	_____
- Priced Spare Parts List	60 days Before Shipment	_____
- Test Program Procedure	90 days Prior to Operation	_____
As-Built Drawings	30 days After Start-up	_____
- Special Tool List	60 days Before Shipment	_____
- Loading Diagram w/A.B Location Plan	30 days	_____

NOTES:

1. This shall include:

   a. All physical outlines, as required, to show the overall size and space requirements (including that for dismantling and maintenance).

   b. Elevations, locations, and clearances required by the access doors, and any other appurtenancs of the fans for the purpose of designing the access platforms and support steel framing.

   c. Cross sections and details, as required, to satisfy the Purchaser that all components are in conformance with the intent of the Specification and are satisfactory from the standpoint of design and physical arrangement.

   d. Details of fan inlet and outlet flanges

2. This shall include the information requested in Section 2.9.

3. Predicted Performance Curve shall be based on actual test curves of similar fan with similar rotor diameter and RPM.

4. Test Reports to include:

   a) Static and Dynamic Balance per Section 2.5
   b) Rotor Material Report per Section 2.5

5. Calculations to include first critical speed and stiffness calculation per Section 2.5 and data requested in Section 2.9

ATTACHMENT 6

MOTOR SPECIFICATION(S)

The following motor specification(s) are included as part of this boiler specification. Contractor shall complete all Motor Data Sheets included in these specification(s), and furnish them with his proposal.

Motor specification(s) included are:

SE-211 - Squirrel Cage Induction Motors Below 600 Volts

SE-212 - Squirrel Cage Induction Motors Above 2000 Volts

OGDEN MARTIN SYSTEMS
of LEE, Inc.

SPEC NO. SE-211
ISSUE 004
DATE 1/10/90

TECHNICAL SPECIFICATION

FOR

SQUIRREL CAGE INDUCTION MOTORS BELOW 600 VOLTS

Facility Name: LEE COUNTY RESOURCE RECOVERY FACILITY

Location: LEE COUNTY, FLORIDA

****

****

Specification Prepared By:

A/E Name: OMS

Address: FAIRFIELD, NJ

Telephone: 201-882-9000

A/E Approved for Release:

	Printed Name	Signature	Date
1.	R Tyler		1/10/92
2.			
3.			
4.			
5.			

REVISION

001	Initial Issue	01/01/87
002	Revision	08/14/87
003	Revision	01/30/89
004	Revision	01/10/90

OGDEN PROJECTS, INC.

TECHNICAL SPECIFICATION
FOR
SQUIRREL CAGE INDUCTION MOTORS - BELOW 600 VOLTS

TABLE OF CONTENTS

1.0 GENERAL

1.1 Scope

This specification covers the furnishing, delivery and testing of electrical squirrel cage induction motors rated below 600 volts, either horizontal or vertical type. Motors offered with sleeve type bearings shall be brought to the attention of the Purchaser.

Motors below 1/2 hp shall be rated 115 volts, single phase, 60 Hz.

Motors 1/2 Hp and larger shall be rated 460 volts, three phase, 60 Hz.

Motors which are supplied as component parts of equipment requiring special design are excluded from this specification; however, this specification is to be considered as a minimum standard for such motors.

2.0 TECHNICAL REQUIREMENTS

2.1 General

Motors shall be properly designed and constructed to withstand the maximum service conditions in its mounting position without loss of lubricant and shall be suitable for either clock-wise or counterclockwise rotation unless prohibited by the motor standard design.

When the motors are furnished with the driven equipment, the driven equipment supplier shall be responsible for mounting the driven equipment and the motor as a complete unit, correctly aligned and coupled with the coupling or sheave specified on the driven equipment data sheet.

When the motors are shipped separately, the motor half of the coupling or sheave will be furnished, finish-bored, and key-seated by the driven equipment supplier in accordance with the motor requirements. The motor half-coupling or sheave will be shipped to the field.

Motor manufacturer shall cooperate with driven equipment vendor in establishing the critical speed of the combined equipment.

In the event of conflict between the purchase specifications and the standards listed below, the purchase specifications will take precedence. Where the equipment being quoted does not agree with the purchase specifications, the Seller shall take specific exception in writing.

2.2 Applicable Standards

All motors shall be manufactured in accordance with the latest edition of the following applicable standards except as modified herein.

ANSI - American National Standards Institute

ANSI/AFBMA Std. 9	Load Ratings and Fatigue Life for Ball Bearings
ANSI/AFBMA Std. 11	Load Ratings and Fatigue Life for Roller Bearings

IEEE - Institute of Electrical and Electronics Engineers

ANSI/IEEE 43	Recommended Practice for Testing Insulation Resistance of Rotating Machinery
ANSI/IEEE 112	Test Procedure for Polyphase Induction Motors and Generators
IEEE 85	Test Procedure for Airborne Sound Measurements on Rotating Electric Machinery

NEMA - National Electrical Manufacturers Association

ANSI/NEMA MG1	Motors and Generators

2.3 Electrical Requirements

All motors shall be NEMA Design B, standard, normal efficiency motors unless otherwise stated on Attachment 1 and shall be rated for continuous operation at an ambient temperature of 40°C and an altitude of up to 3,300 feet above sea level. Any special torque requirements shall be noted on the data sheets.

Locked rotor current shall not exceed 6.5 times full load current at rated voltage unless specifically approved by the Purchaser. Motor safe stall time at maximum voltage shall be greater than the accelerating time at minimum voltage.

Motors shall be suitable for operating at rated load with either a 10 percent voltage variation above or below rated value or with a frequency variation of 5 percent above or below normal, or with the sum of the voltage and frequency variations equal to or less than 10 percent provided the frequency variation does not exceed 5 percent. Motors 200 HP and larger shall be capable of starting and accelerating the driven equipment with 80% voltage at the motor terminals. All motors shall be designed for across-the-line starting. Motors shall be suitable for the following starting duty:

1. Two starts in succession, coasting to rest between starts, with the motor initially at ambient temperature, or

2. One start with the motor initially at a temperature not exceeding its rated load operating temperature.

Motors shall be provided with a ground terminal post, located inside the motor terminal box, for connecting the Purchaser's grounding conductor included with the motor feeder. Motors shall also have a ground pad on the motor frame for direct connection to ground.

2.4 Insulation System

Winding insulation shall be NEMA Class B or Class F with motor temperature rise limited to Class B. The winding shall be treated to make the insulation moisture, oil and chemical resistant and capable of withstanding abrasive particles and conductive dust. Any special insulation treatment for other operating conditions or locations shall be stated in Specific Project Requirements.

2.5 Service Factor

Motors supplied with a service factor greater than 1.0 shall not be sized to run in the service factor margin during normal or maximum brake horsepower conditions. For ID Fans a service factor of 1.15 should be provided to meet test block conditions provided that normal operating conditions are satisfied without running in the service factor margin.

2.6 Mechanical Requirements

Motor enclosures shall be as specified in Attachment 1. Motors used for cooling tower fans, circulating water pumps located in cooling tower basin, ash handling areas and water treatment areas shall be of the TEFC type as a minimum. In special cases approval by the Purchaser is required. Motors shall be furnished with cast iron frame, end brackets, and conduit box. When cooling fans are included in the motor design, they shall be of the nonsparking type. If aluminum fans are used, stainless steel bolts shall be provided in the hubs.

If belt or chain drive is used, slide rails shall be provided by the Seller.

Conduit terminal boxes shall be provided with threaded conduit connections and so constructed that conduit entrance may be made from the top, bottom, or either side. Terminal box shall be located on the right hand side when viewed from the non-driving end. Sheet steel terminal boxes are not acceptable for use on NEMA frame size motors. Individual conduit terminal boxes shall be provided for main leads, space heaters, and temperature detection equipment. All leads shall be properly identified. Multipurpose conduit boxes are not acceptable.

All conduit terminal boxes shall be adequately sized to terminate field wiring. At a minimum the main lead terminal boxes on NEMA frame size motors shall be one size larger than standard. On non-NEMA frame motors the main lead terminal box shall be adequately sized to terminate multiple feeder cables and conduits.

All motor winding leads shall be brought into conduit terminal boxes and terminated with crimp type solderless connectors. Cable terminations shall be clearly and permanently marked. Stator leads into the winding, space heater and temperature detector leads into the motor shall be sealed to prevent intrusion of foreign material.

Motors for cooling tower fans and motors 100 Hp and larger located outdoors shall be provided with space heaters to maintain motor temperature 5 to 10°C above the ambient temperature to prevent condensation when the motors are not running. Heaters shall be designed to operate at 115V single phase.

All vertical motors shall be provided with NEMA P mounting flanges. Vertical motors shall have a drip shield.

Motors shall generate noise sound pressure levels of not over 85 dBA, measured in accordance with IEEE-85 test procedures, unless otherwise stated in the data sheets. Supplier shall advise if the 85 dBA sound pressure level requires mechanical modifications or a larger frame than normally used.

The direction of rotation of single directional motors shall be clearly indicated by means of an arrow located on the non-driving end shield of the motor. A painted arrow is not acceptable.

Motors weighing 50 lbs or more shall be provided with one or more lifting eye bolts, rings or lugs capable of supporting the weight of the motor.

Totally enclosed motors shall have at least one drain hole.

2.7 Bearings

Antifriction ball bearings are preferred for standard NEMA frame motors. Antifriction bearings shall be designed for a minimum L10 life of 100,000 hours under continuous duty at rated load and speed, calculated in accordance with ANSI/AFBMA Std. 9.

Motors for belt-driven equipment or requiring side thrust shall be provided with antifriction bearings designed for the particular application.

Vertical motors shall be furnished with ball or roller bearings for thrust and guide bearings. The thrust bearings shall be capable of withstanding the maximum up and down thrust at startup and throughout the full range of the driven equipment.

If horizontal motors are operated in the vertical position, the motor vendor must certify in writing that his motor is suitable for this type of operation. No shielded bearings shall be acceptable unless the grease chamber is on top of the bearing when the motor is operated in its operating position. Slingers or other suitable bearing seals shall be provided on all horizontal motors operated with shaft extension in the up position to keep moisture out of bearings.

2.8 Single Phase Motors

Motors for process service shall be capacitor start type having a high starting torque and low starting current characteristics. Motors shall be totally enclosed type.

Motors for non-process applications such as exhaust fans and blowers shall be either permanent dual capacitor type or split phase type.

All single phase motors shall have grease-lubricated ball bearings.

Motors shall have a threaded conduit connection.

3.0 TESTS

3.1 General

All motors shall be tested in accordance with the test procedures specified in ANSI/NEMA MG1-12.

4.0 SUPPLEMENTARY REQUIREMENTS

4.1 Surface Preparation and Painting

Surfaces shall be primed in accordance with the Seller's standard prior to painting. Finish coats shall be in accordance with Seller's standard.

4.2 Nameplates

Motor nameplates shall be of stainless steel construction and be securely attached to the motor by means of stainless steel screws.

Motors shall be equipped with nameplates containing the following data:

a. Manufacturer's data: horsepower, volts, phases, full-load speed, full-load amperes, frequency, locked-rotor code letter, temperature rise, service factor, class of insulation system,

type of enclosure, serial number, and frame size. Multi-speed or dual voltage motors shall be provided with nameplate information showing wiring diagram and connection for each voltage and/or speed. Motors provided with space heater shall have a nameplate indicating space heater wattage and voltage level.

b. Mechanical data: the oil level measured from the base of the oil ring for lubricated sleeve-bearing motors provided with constant level oilers; the oil pressure required for pressure-lubricated bearing motors; the minimum endplay for horizontal sleeve-bearing motors; and bearing number.

4.3 Cleaning and Shipping Requirements

The interior of enclosures shall be free from all foreign material such as oil, grease, or other deleterious material.

When an identifying number is assigned a motor on the data sheets, a metal tag bearing this identification shall be attached to the motor before shipment, in a location where the tag will be observable when the motor is installed.

Each box or crate shall be identified with equipment identification number(s), as-shipped weight, and purchase order number and shall contain a detailed packing list. All openings shall be properly protected to prevent the entrance of dirt or debris and all parts that may be exposed to the weather shall be protected by weatherproofing.

The Seller is responsible to ensure jobsite arrival of the equipment in an undamaged and satisfactory working condition.

4.4 Data and Drawings

The Seller shall submit drawings for the Purchasers' review in accordance with the following schedule. The drawings submitted shall show the following:

Description	No. of Weeks After Purchase Order Date
1. All physical outlines, as required, to show the overall size and space requirements (including that for dismantling and maintenance) and the interrelationship of the various components.	Six Weeks
2. Cross sections and details, as required, to satisfy the Purchaser that all components conform with specification requirements including design and physical arrangement.	Six Weeks

Description	No. of Weeks After Purchase Order Date
3. All information required for the design and location of all connecting Purchaser-furnished structural, mechanical, and electrical items such as foundations, steel supports, cables, conduit, etc.	Six Weeks
4. Weight of the equipment and distribution on the foundation support of the static, impact, wind and other loads.	Six Weeks
5. Wiring diagrams.	Eight Weeks
6. Complete bills of material.	Eight Weeks
7. Details of special features including long-term storage and maintenance procedures	Eight Weeks

For each motor larger than 60 hp, the Seller shall forward to the Purchaser the following motor curves eight weeks after the purchase order date:

1. Stator temperature versus continuous horsepower.

2. Time versus current showing maximum safe stall time and acceleration time versus current at 80, if applicable, 90 and 100 percent volts, based on load WK^2, and starting from normal load rated temperature conditions.

3. Speed versus torque and current at 80, if applicable, 90 and 100 percent volts, with the driven equipment curve superimposed.

4. Temperature detector calibration (if detectors are specified).

All curves shall indicate purchaser's tag number, purchase order number, motor specification number and WK^2.

4.5 Installation, Operating, and Maintenance Instructions

The Seller shall provide 10 sets of operating, installation and maintenance instructions. These shall be completely self-contained and include the following as a minimum:

The purchase order number.

Unique equipment identification (e.g., serial or model number).

All necessary requirements and procedures to operate, install, and maintain equipment in the as-shipped condition.

Preventive maintenance requirements for the life of the equipment.

A list of warnings and essential actions to avoid serious damage to injury during installation, testing and operation.

A recommended lubrication and service schedule (for the life of the equipment) and shelf life of materials and parts, if appropriate.

A list of any special tools and instructions for alignment, levelling, etc., when required.

A parts identification list shall be included or provided separately. It shall provide details of all equipment, including sectional and/or outline drawings or illustrations identifying each numbered part and location in relation to the equipment as a whole.

Any drawing provided as part of the operation, installation and maintenance instructions shall be consistent with those approved by the Purchaser.

4.6 Spare Parts

Seller shall provide a list of recommended spare parts with pricing at the time of bid.

ATTACHMENT 1

PROJECT SPECIFIC REQUIREMENTS

The attached Project Specific Requirements, if any, are additions, deletions, and/or revisions to the preceding specification requirements and shall be considered as part of this specification.

1. This Specification Applies To:

   _____ all motors 1/2 hp and larger

   _X_ motors 1/2 hp up to and including 250 hp

2. Efficiency Rating _X_ Normal _____ High

3. Enclosure Type:

Indoor	_____	TEFC or ODP
	_X_	TEFC
Outdoor	_____	TEFC or WPI
	_X_	TEFC
_____ Special	_____	Type

ATTACHMENT 1

PROJECT SPECIFIC REQUIREMENTS

Motors shall be manufactured by:

General Electric Company
Louis-Allis Company
Reliance Electric
Siemens Inc.
Toshiba

CLIENT: Ogden Martin Systems Of Lee County

PROJECT: Lee County, Florida

FURNISHED BY: Distral S.A.

ATTACHMENT 2

SQUIRREL CAGE INDUCTION MOTORS BELOW 600 VOLTS

DATA FURNISHED BY SELLER

DRIVEN EQUIPMENT		Overfire Air Fan
MARK OR ITEM NO.		
NO. REQUIRED		12
MAKE		Reliance Electric or Equivalent
FRAME NO.		44STS
HORSEPOWER, HP (at each speed)		200
RATED VOLTAGE, V		460
SERVICE FACTOR		1.15
ENCLOSURE		TEFC-XFX
Type: Single Speed	X	
Two Speed Single Winding		
Other		
FULL LOAD SPEED, RPM		1784
FULL LOAD CURRENT, AMP		221
LOCKED ROTOR CURRENT, AMP		1325
STARTING TORQUE, % FL		119
BREAKDOWN TORQUE, % FL		237
EFF.-FULL LOAD, %		96.0

EFF.-3/4 LOAD, %	96.4
EFF.-1/2 LOAD, %	96.3
P.F.-FULL LOAD	88.2
P.F.-3/4 LOAD	86.2
P.F.-1/2 LOAD	80.0
P.F. AT STARTING	
SHORT CIRCUIT AC TIME CONSTANT, SEC	
X/R RATIO	
SPACE HTRS., WATTS	225
NET WEIGHT, LB	1890
MOUNTING ARRANGEMENT	F-1
BEARING TYPE	A/F
LOCKED ROTOR CODE LETTER	F
PERMISSIBLE STARTS PER HR WITH:	
MOTOR AT AMBIENT TEMP.	2
MOTOR AT RATED TOTAL TEMP.	1
DESCRIPTION OF INSULATION SYSTEM	
INSULATION CLASS	F
FULL LOAD TEMP. RISE	80°F
ACCEL. TIME, FULLY LOADED	
WITH 100% V, SEC.	
WITH 80% V, SEC.	
WITH % V, SEC.	
SAFE STALL TIME AT 100% VOLTAGE, SEC.	
WK^2 OF ROTOR, $LB\text{-}FT^2$	46
SOUND LEVEL, DB	80

CLIENT: Ogden Martin Systems Of Lee County

PROJECT: Lee County, Florida

FURNISHED BY: Distral S.A.

ATTACHMENT 2

SQUIRREL CAGE INDUCTION MOTORS BELOW 600 VOLTS

DATA FURNISHED BY SELLER

DRIVEN EQUIPMENT		Seal Air Fan
MARK OR ITEM NO.		
NO. REQUIRED		2
MAKE		Reliance Electric or Equivalent
FRAME NO.		256T
HORSEPOWER, HP (at each speed)		20
RATED VOLTAGE, V		960
SERVICE FACTOR		1.15
ENCLOSURE		TEFC-Xt
Type: Single Speed	X	
Two Speed Single Winding		
Other		
FULL LOAD SPEED, RPM		1755
FULL LOAD CURRENT, AMP		25
LOCKED ROTOR CURRENT, AMP		144
STARTING TORQUE, % FL		155
BREAKDOWN TORQUE, % FL		237
EFF.-FULL LOAD, %		86

EFF.-3/4 LOAD, %	87.6
EFF.-1/2 LOAD, %	87.7
P.F.-FULL LOAD	85.5
P.F.-3/4 LOAD	78.5
P.F.-1/2 LOAD	68.2
P.F. AT STARTING	
SHORT CIRCUIT AC TIME CONSTANT, SEC	
X/R RATIO	
SPACE HTRS., WATTS	----
NET WEIGHT, LB	320
MOUNTING ARRANGEMENT	F-1
BEARING TYPE	A/F
LOCKED ROTOR CODE LETTER	G
PERMISSIBLE STARTS PER HR WITH:	
MOTOR AT AMBIENT TEMP.	2
MOTOR AT RATED TOTAL TEMP.	1
DESCRIPTION OF INSULATION SYSTEM	
INSULATION CLASS	F
FULL LOAD TEMP. RISE	
ACCEL. TIME, FULLY LOADED	
WITH 100% V, SEC.	
WITH 80% V, SEC.	
WITH % V, SEC.	
SAFE STALL TIME AT 100% VOLTAGE, SEC.	
WK^2 OF ROTOR, $LB\text{-}FT^2$	1.45
SOUND LEVEL, DB	80dBA

OGDEN MARTIN SYSTEMS
of LEE, Inc.

SPEC NO. SE-212
ISSUE 004
DATE 1/10/90

TECHNICAL SPECIFICATION

FOR

SQUIRREL CAGE INDUCTION MOTORS ABOVE 2000 VOLTS

Facility Name: LEE COUNTY RESOURCE RECOVERY FACILITY

Location: LEE COUNTY, FLORIDA

****

****

Specification Prepared By: A/E Name: OMS

Address: FAIRFIELD, NJ

Telephone: 201-882-7071

A/E Approved for Release:

	Printed Name	Signature	Date
1.	R. Tyler	R Tyler	1/10/92
2.			
3.			
4.			
5.			

REVISION

001	Initial Issue	01/01/87
002	Revision	08/14/87
003	Revision	01/30/89
004	Revision	01/10/90

OGDEN PROJECTS, INC.

TECHNICAL SPECIFICATION
FOR
SQUIRREL CAGE INDUCTION MOTORS ABOVE 2000 VOLTS

TABLE OF CONTENTS

1.0 GENERAL

1.1 Scope

This specification covers the requirements for squirrel cage induction motors, either horizontal or vertical, medium voltage, 300 hp and larger.

Motors 300 Hp and larger shall be rated 4000 volts, three phase, 60 Hz unless otherwise indicated on Attachment 1.

All conflicts between the requirements of this specification, supplement sheets, data sheets and standards listed below shall be referred to the Purchaser for clarification before proceeding with the manufacture of the affected parts.

Motors which are supplied as component parts of equipment requiring special design shall comply with this specification where practicable.

No modifications of or deviations from this specification may be made, unless authorized by the Purchaser in writing. Any exceptions to these specifications shall be clearly noted in the Seller's proposal.

It is not the intent to specify all details of design and construction. Motors shall be constructed and equipped with accessories in accordance with the Seller's standard practices when such practices do not conflict with the specification.

2.0 TECHNICAL REQUIREMENTS

2.1 Applicable Standards

All motors shall be manufactured in accordance with the latest edition of the following standards including all supplements, except as modified herein or on the data sheets.

ANSI - American National Standards Institute

ANSI/AFBMA Std. 9	Load Ratings and Fatigue Life for Ball Bearings
ANSI/AFBMA Std. 11	Load Ratings and Fatigue Life for Roller Bearings

IEEE - Institute of Electrical and Electronics Engineers

ANSI/IEEE 43	Testing Insulation Resistance of Rotating Machinery
IEEE 85	Test Procedure for Air Borne Sound Measurements on Rotating Electric Machinery

IEEE 112 Test Procedure for Polyphase Induction Motors and Generators

NEMA - National Electrical Manufacturers Association

ANSI/NEMA MG1 Motors and Generators

2.2 Electrical Design Features

2.2.1 Voltage and Frequency Variation

Without injurious heating, motors shall start and accelerate a load to running speed that meets the torque characteristics and inertia requirements of 2.2.2 and meets the voltage and frequency variations specified in NEMA MG1.20.45. For loads with other characteristics, the starting voltage and frequency limits may be different.

Performance within these voltage and frequency variations will not necessarily be in accordance with the standards established for operation at rated voltage and frequency.

2.2.2 Load Requirements

The motor manufacturer shall obtain load speed torque requirements and total load inertia referred to the motor shaft from the driven equipment manufacturer.

2.2.3 Starting Capabilities

Motors shall be designed for across-the-line starting and shall be capable of accelerating the connected load to full load speed with 80% voltage at its terminals. Motors shall be suitable for the following starting duty:

1. Two starts in succession, coasting to rest between starts, with the motor initially at ambient temperature, or

2. One start with the motor initially at a temperature not exceeding its rated load operating temperature.

2.2.4 Torque Current Requirements

Alternating current motors operating with rated terminal voltage and rated frequency shall have torque values in accordance with the applicable NEMA standards.

Locked rotor current of polyphase squirrel cage induction motors shall have the lowest value consistent with good performance and economical design for their torque current class, and shall not exceed 650 percent of rated full load current at motor rated horsepower and voltage.

Motor safe stall time at maximum voltage shall be greater than the accelerating time at minimum voltage.

2.2.5 Temperature Requirements

Motors shall be rated for continuous operation in an ambient temperature not exceeding 40°C at an altitude not exceeding 3300 ft above mean sea level unless stated otherwise in the data sheets.

The limiting observable temperature rise of insulated windings of induction motors for continuous ratings, when operated at rated load under rated operating conditions shall not exceed the value for Class B rise in NEMA Standard MG-1-20.40.

2.2.6 Insulation

All motors shall be provided with a vacuum pressure impregnated, epoxy sealed insulation system for the complete wound stator. Qualification tests of the sealed insulation system proposed shall have been made on models typical of the Seller's line of motors. The qualification tests shall conform to the procedures set forth in NEMA Standard MG-1.

Motors shall have all insulated windings treated for protection against severe moisture, oil, abrasive and conducting dust, and sulphur fumes, in combination with weak acid or alkali dust or fumes.

The insulation system(s) (stator and rotor) shall withstand the negative or positive, 1.0 microsecond to crest (2.3 pu rated peak line to ground operating voltage) switching surges originating from an ungrounded power system and applied to the motor terminals once a month during the specified life of the motor. Feeds to motors will be supplied using vacuum breakers or vacuum contactors.

Seller shall advise Purchaser in writing if externally connected protective devices are needed to meet the above requirement and shall also obtain Purchaser's approval for use of such devices. (The motors will be connected by cables to their supply buses thus no direct exposure to lightning waves is possible.)

Any junction in motor insulation, such as at coil connections or between slot and end winding sections, shall have protection equivalent to that of the slot sections of coils. The entire windings of all motors when finished shall have a homogeneous sealing, tough, protective surface.

2.2.7 Temperature Detector (Stator Winding)

Motors 1500 Hp and larger shall be equipped with six detectors embedded in the stator winding at locations where highest temperatures are expected. The resistance temperature detectors shall be three-wire copper having a DC resistance of 10 ohms at 25°C.

Leads from the temperature detectors shall be brought out to a terminal box, separate from the main power and space heater leads. Provisions for grounding of RTD's shall be provided in the terminal box. Terminal leads shall be identified so that location of each detector can be determined by reference to motor outline drawing.

2.3 Mechanical Design Features

2.3.1 Materials

Enclosure parts may be made of cast iron, cast steel, sheet steel, or steel plate. Parts made of sheet steel or steel plate shall have a minimum thickness of 1/8 in.

2.3.2 Enclosures

Motor enclosures shall be as specified in Attachment 1.

2.3.3 Requirements for Weather-Protected Type I Motors

Weather Protected Type I motors shall conform to NEMA MG1.1.25H.

Terminal boxes shall be watertight. These boxes shall be made of cast iron, or steel sheet, and shall have hubs or threaded openings for rigid conduit. Boxes made of steel sheet shall have a minimum wall thickness of 1/8 in.

All internal parts of the motor exposed to the cooling air, such as air deflectors and fans, shall be made of corrosion-resistant material or have corrosion-resistant platings or treatments.

Drain holes shall be provided at all locations in the enclosure where water might collect.

The bearing housing at the shaft-extension end of grease-lubricated motors shall have a rotating labyrinth-type seal whose rotating parts are made of bronze or similar corrosion-resistant metal. The bearing housing at the shaft-extension end of oil-lubricated motors shall have a seal to prevent moisture or dirt from entering the housing along the shaft. Housings for ball bearings or roller bearings shall have inside bearing caps.

All bolts, studs, other fastening devices, and balance washers of the motor shall be made of corrosion-resistant material or be plated or treated with corrosion-resistant material.

2.3.4 Requirements for Totally Enclosed Motors

Totally enclosed motors shall conform to NEMA MG1.1.26B and MG1.1.26J (totally enclosed, fan-cooled, guarded).

Enclosures shall completely enclose the motors. Designs in which the stator laminations form a part of the enclosure or in which the stator laminations are otherwise exposed to external cooling air are not acceptable.

External cooling fans shall be made of a corrosion-resistant, ductile material and shall conform to the following:

a. For totally enclosed, fan-cooled motors, fans made of brass, bronze, aluminum, stainless steel, and malleable iron, are acceptable.

b. Aluminum fans shall be made of an aluminum alloy containing not more than 0.2 percent copper.

Fan covers shall be made of cast iron, or steel sheet. Covers made of steel sheet shall have a minimum thickness of 1/8 in. The air-intake opening shall be guarded by either a grill cast or formed integrally with the cover or by a metal screen made of corrosion-resistant material.

Sheet metal covers or wrappers used to form air passages over the motor enclosure shall be made of steel of 1/8 in. minimum thickness.

All bolts, studs, and other fastening devices on the outside of the motor enclosure shall be made of corrosion-resistant material or be plated or treated with corrosion-resistant material.

Terminal boxes shall conform to Weather Protected Type I requirements.

Shaft seals shall conform to Weather Protected Type I requirements.

Totally enclosed motors shall have combination drain and breather, Crouse-Hinds type ECD to minimize condensation and drain accumulated condensate.

2.3.5 Balance and Vibration

Motors shall be dynamically balanced. The use of solder or similar deposits shall not be acceptable. Parent metal removed to achieve

dynamic or static balance shall be drilled out in such a manner as to not effect the structural strength of the rotor; chiseling or sawing shall not be permitted.

2.3.6 Bearings

Bearings shall be conservatively sized, suitable for continuous service under the conditions specified, and sealed against the entrance of dirt and the escape of lubricant.

Bearings shall be insulated to prevent the passage of shaft currents through the bearings, wherever necessary.

Sleeve bearings shall be furnished for horizontal motors wherever available and applicable. Sleeve bearings and housings shall be of the split type. Sleeve bearing housings shall be provided with means for visual inspection of oil rings and level.

Bearing housings shall be provided with drain plugs.

If forced or flood oil lubricating system is required, the pumping system, including all pumps, piping, and controls, will be furnished by the Seller. Upon loss of auxiliary backup lubricating oil pump during a shutdown, the motor shall be capable of decelerating to a safe stop without damaging the bearings.

Antifriction bearings may be furnished on horizontal motors if standard for motor size, enclosure, and speed.

Grease lubricated bearings shall be lubricated prior to shipment. Bearings requiring periodic regreasing shall have provisions for inservice positive lubrication with means to prevent damage due to overgreasing. Bearings of the completely sealed or the prelubricated type shall not have provisions for inservice lubrication.

Ball or roller bearings shall be used for guide bearings on vertical motors. Sleeve guide bearings may be furnished, if required by the application. The thrust bearing may be of the Kingsbury or antifriction type.

Antifriction bearings shall be designed for a minimum L-10 service life of 100,000 hours for the design speed and applied load condition.

Three wire RTD's shall be provided for all sleeve bearing motors. RTD's shall be copper having a DC resistance of 10 ohms at 25°C.

2.3.7 Endplay and Coupling

Horizontal sleeve-bearing motors shall have a total endplay of at least 1/2 in. The running center of the rotor shall not shift from either side of stator geometric center by more than 3/32 in.

Flexible couplings used with horizontal sleeve-bearing motors will be of the limited end-float type with the end-float limited to not more than 1/4 in. The Seller shall coordinate with the driven equipment manufacture the exact float of the coupling used.

When the limited end-float coupling is used, the motor shall have a permanent indicator to show the allowable limits of motor movement after coupling installation and alignment. The indication method shall be durable, adjacent to a shaft shoulder, and shall show the allowable excursion of the shoulder.

Unless specified otherwise, all motor half-couplings shall be mounted on motor shafts with either a taper or cylindrical fit and be keyed. Cylindrical fits shall be in accordance with ANSI B4.1, Class FN1.

2.3.8 Vertical Motor Requirements

Solid-shaft vertical motors are preferred for all applications except those in which the connection to the driven equipment is a sectional shaft that may unscrew and lengthen during reversal of rotation. Hollow-shaft vertical motors with special couplings (see below for further details) to protect the motor against reverse rotation damage shall be used for these applications.

Vertical motors shall comply with other requirements of this specification and the following:

a. Motors shall have thrust bearings designed to carry the maximum axial thrusts (up and down) imposed by the driven equipment.

b. Hollow-shaft vertical motors used in applications employing a sectional drive shaft with screwed joints shall have special couplings as follows:

   1. All motors, shall be equipped with nonreverse ratchets (preferred) or with self-releasing couplings designed to permit lengthening of the drive shaft and to disconnect the motor from the driven equipment upon reversal of rotation.

   2. The bases for motors meeting NEMA dimensions shall be Type P.

2.3.9 Marking of Terminal Leads

The method of marking leads shall be permanent and suitable for the life of the motor. Leads shall have at least one identification marker within 6 in. of stator frame.

2.3.10 Sound Level Requirements

The maximum sound level for motors furnished under this specification shall not exceed 85 dBA at 5 ft from any surface of a motor.

The Seller shall provide the maximum octave band sound pressure levels and the maximum A-weighted sound level on the appropriate data sheet for the motor. If the motor does not meet the sound level requirement, the Seller shall provide noise data for the motor with noise control options to meet the specified sound level. In either case, only the A-weighted sound level shall be warranted.

2.4 Accessories

2.4.1 Space Heaters

Space heaters are to be supplied on all motors. Space heaters with a total rating of up to 1800 watts shall be connected for single phase, 115V service.

Space heaters rated above 1800 watts shall be three phase 208V service.

Space heaters shall be completely wired, with leads brought out to a separate terminal box. The terminal box will be provided with a threaded pipe tap for external field connection.

2.4.2 Grounding

A tapped hole shall be furnished in the motor terminal box for connection of ground conductor, along with a means for connecting the motor frame directly to the Purchaser's ground grid. This grounding shall be as follows:

> A noncorrodible metal pad welded or brazed to the motor frame having NEMA drilled threaded holes at and mating hexagonal head cap screws or bolts with lockwashers.

2.4.3 Terminal Boxes

Motor terminal boxes shall be of adequate size to permit terminating motor leads and other wiring at the motor. Minimum dimensions and useable volumes shall be not less than those given in NEMA MG 1-20.62. Allowance shall be made for conduit hubs or cable glands, reasonable cable bending radii, 12 inches for stress cones plus insulation and terminal lug requirements. Separate terminal boxes shall be furnished for space heater leads and RTD leads. Terminal boxes shall be adequately sized to mount and enclose all devices mounted within. Terminal points

and nameplates of all accessories shall be accessible without removing motor leads or other wiring. Cable terminations shall be clearly and permanently marked.

2.4.4 Miscellaneous

Motor shafts shall be marked to indicate magnetic center.

For single directional motors, an arrow or arrows indicating the direction of rotation shall be provided on the motor frame. A painted arrow is not acceptable.

Motors shall be provided with one or more lifting eyebolts, rings, or lugs cabable of supporting the weight of the motor.

Motors larger than 2500 Hp shall be provided with, but not limited to, three current transformers for differential protection, surge capacitors and lightning arresters.

3.0 TESTS AND GUARANTEES

3.1 Routine Tests

Each motor shall be given a routine (commercial) test to demonstrate that it is free from mechanical and electrical defects. This test shall be conducted in accordance with the latest edition of IEEE 112. This test shall include:

a. Measurement of no-load current (each phase).

b. Measurement of no-load speed.

c. A determination of locked-rotor current.

d. A high-potential test.

e. An insulation resistance test by megohmmeter.

f. Measurement of winding resistance.

g. Inspection of bearings and oil supply (when furnished). Antifriction and bracket-type sleeve-bearing inspection shall consist of a no-load run observation to ensure bearing operation without excessive noise, heating, or vibration and a check for lubrication leaks.

   Where accessible, the condition of the lubricant shall be examined after the run.

4.0 SUPPLEMENTARY REQUIREMENTS

4.1 Surface Preparation and Painting

Surfaces shall be primed in accordance with the Seller's standard prior to painting. Finish coats shall be in accordance with Seller's standard.

4.2 Nameplates

Motor nameplates shall be of stainless steel construction and be securely attached to the motor by means of stainless steel screws.

Motors shall be equipped with nameplates containing the following data:

a. Manufacturer's data: horsepower, volts, phases, full-load speed, full-load amperes, frequency, locked-rotor code letter, temperature rise at the service factor, service factor, class of insulation system, type of enclosure, serial number, frame size, space heater wattage and voltage level.

b. Mechanical data: the oil level measured from the base of the oil ring for lubricated sleeve-bearing motors provided with constant level oilers; the oil pressure required for pressure-lubricated bearing motors; the minimum endplay for horizontal sleeve-bearing motors; and bearing number.

4.3 Cleaning and Shipping Requirements

The interior of enclosures shall be free from all foreign material such as oil, grease, or other deleterious material.

When an identifying number is assigned to the motor by the Purchaser, a nameplate tag bearing this identification shall be attached to the equipment before shipment, in a location where the tag will be observable while the motor is in operation.

All openings shall be properly protected to prevent the entrance of dirt or debris. All parts that may be exposed to the weather shall be protected by weatherproofing.

All equipment and materials shall be crated, boxed, or otherwise prepared for shipment to prevent damage during handling and shipping. Each box or crate shall be identified with equipment identification number(s), as-shipped weight and purchase order number and shall contain a detailed packing list.

4.4 Data and Drawings

The Seller shall submit drawings for the Purchasers' review in accordance with the following schedule. The drawings submitted shall show the following:

	Description	No. of Weeks After Purchase Order Date
1.	All physical outlines, as required, to show the overall size and space requirements (including that for dismantling and maintenance) and the interrelationship of the various components.	Six Weeks
2.	Cross sections and details, as required, to satisfy the Purchaser that all components conform with specification requirements including design and physical arrangement.	Six Weeks
3.	All information required by the Purchaser for the design and location of all connecting Purchaser-furnished structural, mechanical, and electrical items such as foundations, steel supports, cables, conduit, etc.	Six Weeks
4.	Weight of the equipment and distribution on the foundation support of the static, impact, wind and other loads.	Six Weeks
5.	Wiring diagrams.	Eight Weeks
6.	Complete bills of material.	Eight Weeks
7.	Details of special features including long-term storage and maintenance procedures.	Eight Weeks

For each motor, the Seller shall forward to the Purchaser the following motor curves eight weeks after the Purchase Order date:

1. Stator temperature versus continuous horsepower.

2. Time versus current showing maximum safe stall time and acceleration time versus current at 80, 90 and 100 percent volts, based on load WK^2, and starting from normal load rated temperature conditions.

3. Speed versus torque and current at 80, 90 and 100 percent volts, with the driven equipment speed-torque curves superimposed.

4. Temperature detector calibration.

All curves shall indicate purchaser's tag number, purchase order number, motor specification number and WK^2.

4.5 Installation, Operating, and Maintenance Instructions

The Seller shall provide 10 sets of operating, installation and maintenance instructions. These shall be completely self-contained and include the following as a minimum:

- The purchase order number.
- Unique equipment identification (e.g., serial or model number).
- All necessary requirements and procedures to operate, install, and maintain equipment in the as-shipped condition.
- Preventive maintenance requirements for the life of the equipment.
- A list of warnings and essential actions to avoid serious damage to injury during installation, testing and operation.
- A recommended lubrication and service schedule (for the life of the equipment) and shelf life of materials and parts, if appropriate.
- A list of any special tools and instructions for alignment, levelling, etc., when required.

A parts identification list shall be included or provided separately. It shall provide details of all equipment, including sectional and/or outline drawings or illustrations identifying each numbered part and location in relation to the equipment as a whole.

Any drawing provided as part of the operation, installation and maintenance instructions shall be consistent with those approved by the Purchaser.

4.6 Spare Parts

Seller shall provide a list of recommended spare parts with pricing at the time of bid.

ATTACHMENT 1

PROJECT SPECIFIC REQUIREMENTS

The attached Project Specific Requirements, if any, are additions, deletions, and/or revisions to the preceding specification requirements and shall be considered as part of this specification.

1. Enclosure Type:

	Indoor	____	TEFC or ODP
		_X_	TEFC
	Outdoor	____	TEFC or WPI
		____	TEFC
____	Special	____	Type

ATTACHMENT 1

PROJECT SPECIFIC REQUIREMENTS

Motors shall be manufactured by:

General Electric Company
Louis-Allis Company
Reliance Electric
Siemens Inc.
Toshiba
Westinghouse Electric Corp.

CLIENT Ogden Martin Systems of Lee County

PROJECT Lee County, Florida

FURNISHED BY Distral S.A.

ATTACHMENT 2

SQUIRREL CAGE INDUCTION MOTORS
ABOVE 2000 VOLTS

DATA FURNISHED BY SELLER

DRIVEN EQUIPMENT	Forced Draft Fan
MARK OR ITEM NO.	
NO. REQUIRED	12
MAKE	Reliance Electric or Equivalent
FRAME NO.	E 5012Z
HORSEPOWER, HP	350
RATED VOLTAGE, V	4000
SERVICE FACTOR	1.15
ENCLOSURE	TEFC-XT
FULL LOAD SPEED, RPM	1191
FULL LOAD CURRENT, AMP	45
LOCKED ROTOR CURRENT, AMP	325
STARTING TORQUE, % FL	119.5
BREAKDOWN TORQUE, % FL	229
EFF.-FULL LOAD, %	94.6
EFF.-3/4 LOAD, %	94.5
EFF.-1/2 LOAD, %	93.6

P.F.-FULL LOAD	85.1
P.F.-3/4 LOAD	81.7
P.F.-1/2 LOAD	73.5
P.F. AT STARTING	
SHORT CIRCUIT AC TIME CONSTANT, SEC	
X/R RATIO	
SPACE HEATERS, WATTS	REQD.
NET WEIGHT, LB.	Approx. 5000 lb
MOUNTING ARRANGEMENT	Horizontal
BEARING TYPE	Anti Friction
LOCKED ROTOR CODE LETTER	G
PERMISSIBLE STARTS PER HOUR WITH:	
MOTOR AT AMBIENT TEMP	
MOTOR AT RATED TOTAL TEMP	
DESCRIPTION OF INSULATION SYSTEM	VPI - Enduraseal
INSULATION CLASS	F
FULL LOAD TEMP. RISE	B
ACCL. TIME FULLY LOADED	
WITH 100% VOLTAGE, SEC	
WITH 80% VOLTAGE, SEC	
WITH % VOLTAGE, SEC	
SAFE STALL TIME AT 100% VOLTAGE, SEC.	
WK^2 OF ROTOR, $LB-FT^2$	
SOUND LEVEL, DB	85
WINDING TEMP DETECTOR	
BEARING TEMP DETECTOR	

SURGE PROTECTION

ARRESTER — Not Included

CAPACITOR — Not Included

DESCRIPTION OF BEARING CONSTRUCTION

DESCRIPTION OF STTOR WINDING INSULATION SYSTEM AND TREATMENT

ROTOR MATERIAL, COPPER OR [ALUMINUM]

DATA FOR ALTERNATIVE MOTORS WITH IMPROVED NOISE TREATMENT IF PREDICTED OVERALL SOUND PRESSURE LEVEL IS ABOVE 85 dBA

(3) DIE CAST ALUMINUM ROTOR

The die cast aluminum rotor provides a rugged assembly that captures laminations, bars, end rings, and cooling fans (integral die cast aluminum) into one homogeneous assembly. This lightweight rugged assembly improves starting and heat dissipation for longer life. The low inertia, die cast aluminum rotor takes advantage of the unique heat-dissipating qualities of aluminum to shed heat fast. It also allows fast acceleration of heavy loads without undue stress on the rotor cage.

This rotor cage is integrally cast with the rotor laminations, intimate contact of the cage with the core slot aid the transfer of heat generated in the rotor bar to the rotor iron. Rotor iron acts like a heat sink, absorbing heat from the bars approximately three times faster than rotors with copper bar.

Heat is also dissipated fast at the end of the rotor, from a rotor fan integrally cast with the bars and end rings.

Where special applications exist copper bar rotors can be provided.

A key factor affecting motor performance and reliability lies in the proper design (method) of bearing lubrication.

The lubrication system is essential for the reduction of friction, generated heat dissipation, contamination prevention and protection of bearing surfaces from corrosion.

The Reliance Electric PLS/Positive Lubrication System (patent pending) is a uniquely designed open bearing (non-shielded) positive lubrication system that delivers long, reliable bearing and motor life, regardless of mounting position.

PLS helps resolve two major causes of motor bearing failure -- 1) improper lubrication/relubrication, and 2) corrosion, PLS delivers optimum bearing performance by providing positive lubrication in horizontal, shaft up and shaft down mountings.

Cooler Bearing Operating Temperatures -- Open bearing (non-shielded) contruction (1) minimizes friction, allowing cooler bearing operation.

Positive Lubrication/Relubrication In Any Mounting Position -- Exclusive grease channeling window (2), withg minimum grease path entry (3), channels grease directly into bearing track and avoids premature relief out shaft bore or drain plug.

Minimizes Corrosion -- Small clearance on either side of grease window uniformly distributes grease to both inboard and outboard reservoirs (4) to protect bearing surfaces during motor storage, long idle times and start-up. Bearing system is completely greased during motor assembly.

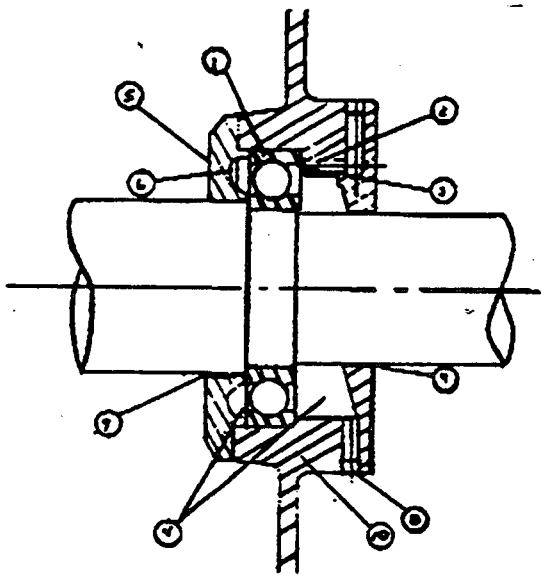
Restricts Inboard Contaminants -- Inner bearing cap (5) with anti-churning vanes (6) and close running shaft tolerances (7) minimize contaminant entry into bearings, and grease migration into motor.

Prohibits Overgreasing During Lubrication/Relubrication -- Grease relief port (8) accurately indicates completion of lubrication/relubrication. (If port is plugged during lubrication, PLS design will relieve grease along the shaft (9).

A Thermal Sensor Provision -- Permits the addition of various sensing devices such as an RTD or thermocouple.

Flexible Bearing Housing -- The Bearing Housing is designed to permit the use of insulated bearings if required as well as roller bearings for special applications or customer requirements.

Heavy Cast Sections -- Case Sections (10) are all heavy walled for rugged support and mechanical and dimension stability.



ATTACHMENT 7

TECHNICAL DATA SUPPLIED BY CONTRACTOR

PERFORMANCE GUARANTEES

1. Steam output, based on firing the specified refuse fuel, 300 °F feedwater, 300 °F underfire and [redacted] °F overfire air, 100 % excess air — 169,270 lb/hr
   (300)
   Steam output, based on firing the specified auxiliary fuel with the burner at 100% burner load, 300 °F feedwater — 80,000 lb/hr

2. Superheated steam pressure at the steam non-return valve outlet — 865 psig

3. Maximum steam impurity leaving the superheater, based on appropriate ABMA boiler water concentrations for the normal operating pressure — 0.5 ppm

4. Total boiler steam/water side pressure drop at MCR, from feedwater terminal point to main steam terminal point — 220 psi

5. Maximum flue gas exit temperature rise from 425 °F to no more than 500 °F after 4000 hours accumulated operation and no manual cleaning of fireside surfaces — YES [redacted]

6. Control range of 80% of steam flow as guaranteed in item 1 above, while maintaining the outlet steam temperature of 830 °F plus or minus 10°F (FOR MSW) — YES [redacted]

7. Maximum total fan motor power consumption (kW) when operating at 100%, as per item 1 above — 270 kW

8. Economizer water flow mass rate (minimum water mass flow rate 400,000 lb/sq. ft-hr) — 400,000 lb/sq. ft-hr

COMBUSTION/STEAM GENERATION UNITS

1.	Number of Units	Two (2)
2.	Type	Single Drum, Natural Circulation
3.	Manufacturer	Distral S.A.
4.	Maximum Continuous Rating (MCR) Solid Waste Capacity	600 TPD

Note: All data in Items 4 through 24 shall be per Steam Generation Unit

5.	Design Data (MCR)	
	a) Continuous steam output	169,270 lb/hr
	b) Blowdown	3,450 lb/hr
	c) Steam pressure (at superheater non-return valve outlet)	865 psig
	d) Steam temperature (at superheater non-return valve outlet)	830 °F
	e) Feedwater temperature	300 °F
6.	Boiler Design Pressure/Economizer	1095/1250 psig

7. Heat Loss Calculation Summary

Item	Btu/hr	%
a. Heat Input	268,463,445	100.00
b. Heat Output	193,888,390	72.22
c. Losses:		
i Dry Gas:	61,612,360	22.95
ii Moisture:	7,973,364	2.97
iii Residue:	966,468	0.36
iv Convection & Radiation:	4,026,952	1.50
v Manufacturer's Margin:		
Total Losses	74,579,144	27.78
d. Boiler Efficiency		72.22

8. Boiler Drum(s) Description

	Dia. (in ID)	Minimum Thickness (in)	Max. Metal Temp.	Material
Top Drum	60	3.125	600	SA516Gr70
Bottom Drum, if applicable	N/A	N/A	N/A	N/A

9. Tube Description

Furnace waterwalls (1st pass)	3	0.180	650	SA178A
Furnace arch (above refractory)	3	0.220	650	SA178A
Furnace exit screen	6.625	0.432	650	SA106B
Radiant Furnace Chamber (2nd pass)	3	0.180	650	SA178A
Convection Evaporator	2.75	0.180	650	SA178A
Primary Superheater I	1.5	0.180	680	SA210A1
Primary Superheater II	1.5	0.180	720	SA210A1
Secondary Superheater I	1.5	0.180	800	SA213T11
Secondary Superheater II	1.5	0.180	900	SA213T11
Superheater Enclosure	3	0.180	650	SA178A
Economizer	2	0.150	500	SA178A

10. Waterwall Tube Pitch

	(in)
Furnace Waterwalls (1st pass)	4
Radiant Furnace Chamber (2nd pass)	4
Superheater Enclosure	5

11. Header Description

	Dia. (in OD)	Minimum Thickness (in-min)	Material
Sidewall	10.75/8.625(*)/6.625(**)	0.9844/ 0.793"-0.756	SA106B
Front and Rear Waterwall	10.75	0.984"	SA106B

(*) Upper Sidewall
(**) Chill Tubes Wall

	Dia. (in OD)	Minimum Thickness (in)	Material
Furnace Exit Screen	8.625	0.793	SA106B
Convection Evaporator	Outlet 8.625 Inlet 10.75	0.710 0.875	SA106B
Primary Superheater I	10.75	0.629	SA106B
Primary Superheater II	10.75	0.629	SA106B
Secondary SuperheaterI	10.75	0.629	SA106B/335P11
Secondary Superheater II	10.75	0.629	SA335P11
Superheater Enclosure	Upper 6.625 Lower 8.625	0.756 0.793	SA106B
Economizer Inlet	6.625	0.492	SA-106B
Economizer Outlet	6.625	0.492	SA-106B

12. Tube Shield Description

Evaporative Section
Superheater Inlet Screen
Superheater
Economizer

Installed at first two rows of evaporator and screen tubes at first two rows of superheater, at first row of economizer; at first row of either side of soot blower cavities.

13. Volumes

Volume of 1st furnace pass	26,417	ft^3
Volume of all radiant passes	47,435	ft^3

14. Heating Surfaces Summary (projected)

Furance (1st pass)	2,517	ft^2
Radiant Furance Chamber (1st pass)	2,512	ft^2
Radiant Furnace Chamber (2nd pass, 3rd pass)	5,233	ft^2
Superheater Enclosure	2,040	ft^2
Total Projected Heating Surface	12,443	ft^2

15. Heating Surfaces Summary (Circumferential)

Screen between 1st and 2nd pass	146	ft^2
Screen between 2nd and 3rd pass	N/A	ft^2
Convection Evaporator	5637	ft^2
Screen between Evaporator and Superheater	177	ft^2
Primary Superheater I	6219	ft^2
Primary Superheater II	6108	ft^2
Secondary Superheater I	5150	ft^2
Secondary Superheater II	5069	ft^2
Economizer	33720	ft^2
Total Circumferential Heating Surface	62226	ft^2

16. Weight of the Steam Generator (each)

Boiler drum(s)	97.5	kips
Waterwalls, downcomers, risers, etc.	469.0	kips
Convection evaporator	50.7	kips
Superheaters	203.7	kips
Economizer	216.8	kips
Structural steel (buckstays, etc.)	125.0	kips
Casings, hoppers, ducts	198.8	kips
Lagging, insulation, and setting	314.6	kips
Valves, trim, piping, instruments, sootblowers, oil burners, miscellaneous	80.8	kips
Subtotal	1756.9	kips
Water content (full)	322.6	kips
Estimated ash deposits (load)	1718.0	kips
Total for each steam generator	3797.5	kips

Boilerhouse Support Steel (total for all units)	1418	kips
Platforms and walkways (total for all units)	1098	kips
Estimated square footage of all platforms required (information only)	15620	ft^2

17. Performance Data

	MCR	C.P.
MCR = Maximum Continous Rating C.P.= Control Point (80% of MCR)		
Air pressure drop after 4000 hours of continuous operation without shutdown for cleaning, in. wg.	4	2.56
Fluegas pressure drop after 4000 hours of continuous operation without shutdown for cleaning, in. wg.	1.66	1.06
Pressure drop from economizer inlet to drum (friction + static), psi	38	30
Pressure drop from drum to S.H. outlet header, psi	134	85.8
F.W. piping and valve pressure drop from terminal point to boiler, psi	8	6.4
M.S. piping and valve pressure drop from boiler to terminal point, psi	7	4.5
Highest safety valve setting, psig	1103	

3

3

CONVECTION EVAPORATOR		MCR	C.P.
Tube diameter	in.	2.75	
Tranverse pitch	in.	12.0	
Longitudinal pitch	in.	4"	
No. of tubes wide	—	29	
No. of tubes deep	—	21	
Average effective tube length	ft.	10	
Total heating surface	ft^2	5637	
Fluegas inlet temperature	°F	1506	

		MCR	C.P.
Fluegas outlet temperature	°F	1251	
Boiler water temperature	°F	550	
Free gas area	ft^2	237.7	
Average fluegas velocity	fps	21.09	
Fluegas draft loss	in.wg.	0.00	
Water mass flow rate	lb/sqft-hr	----	
Average (cold) water velocity	fps	----	
Fouling factor	--	0.65	

PRIMARY SUPERHEATER I

Tube diameter	in.	1.5	
Transverse pitch	in.	5	
Longitudinal pitch	in.	5	
No. of tubes wide	--	72	
No. of tubes deep	--	14	
Average effective tube length	ft,	15.09	
Total heating surface	ft^2	6,219	
Fluegas inlet temperature	°F	858	
Fluegas outlet temperature	°F	770	
Steam inlet temperature	°F	550	
Steam outlet temperature	°F	596	
Free gas area	ft^2	370.8	
Average fluegas velocity	fps	9.42	
Fluegas draft loss	in.wg.	0.03	
Steam mass flow rate	lb/sqft-hr	315,475	
Average steam velocity	fps	40.79	
Fouling factor	--	0.76	

PRIMARY SUPERHEATER II

Tube diameter	in.	1.5	
Transverse pitch	in.	5	

		MCR	C.P.
Longitudinal pitch	in.	5	
No. of tubes wide	—	72	
No. of tubes deepo	—	14	
Average effective tube length	ft.	15.09	
Total (projected) heating surface	ft^2	6107.8	
Fluegas inlet temperature	°F	963	
Fluegas outlet temperature	°F	858	
Steam inlet temperature	°F	596	
Steam outlet temperature	°F	674	
Free gas area	ft^2	365	
Average fluegas velocity	fps	10.30	
Fluegas draft loss	in.wg.	0.03	
Steam mass flow rate	lb/sqft-hr	315,475	
Average steam velocity	fps	48.65	
Fouling factor	—	0.76	

SECONDARY SUPERHEATER I

Tube diameter	in.	1.5	
Transverse pitch	in.	5	
Longitudinal pitch	in.	5	
No. of tubes wide	—	72	
No. of tubes deep	—	12	
Average effective tube length	ft.	14.75	
Total heating surface	ft^2	5150.4	
Fluegas inlet temperature	°F	1079	
Fluegas outlet temperature	°F	963	
Steam inlet temperature	°F	642	
Steam outlet temperature	°F	743	
Average fluegas velocity	fps	11.30	
Fluegas draft loss	in.wg.	0.03	
Steam mass flow rate	lb/sqft-hr	322577	
Average steam velocity	fps	57.06	
Fouling factor	—	0.75	

SECONDARY SUPERHEATER II

Tube diameter	in.	1.5	
Transverse pitch	in.	5	
Longitudinal pitch	in.	5	
No. of tubes wide	—	72	
No. of tubes deep	—	12	
Average effective tube length	ft.	14.7	
Total heating Surface	ft^2	5069	
Fluegas inlet temperature	°F	1217	
Fluegas outlet temperature	°F	1079	
Steam inlet temperature	°F	698	
Steam outlet temperature	°F	830	
Average fluegas velocity	fps	12.46	
Fluegas draft loss	in.wg.	0.03	
Steam mass flow rate	lb/sqft-hr	331,240	
Average steam velocity	fps	67.78	
Fouling factor	—	0.74	

ECONOMIZER

Tube diameter	in.	2	
Transverse pitch	in.	4	
Longitudinal pitch	in.	4	
No. of tubes wide	—	92	
No. of tubes deep	—	70	
Average effective tube length	ft.	9.67	
Total heating Surface	ft^2	33,720	
No. of tube sections (bans)	—	5	
Fluegas inlet temperature	°F	770	
Fluegas outlet temperature	°F	425	
Water inlet temperature	°F	300	
Water outlet temperature	°F	501	
Free gas area	ft^2	154.9	
Average fluegas velocity	fps	18.57	

		MCR	C.P.
Fluegas draft loss	in.wg.	0.59	
Water mass flow rate	lb/sqft-hr	476,428	
Average water velocity	fps	2.45	
Fouling factor	---	0.77	

3

18. Preliminary Trim List

Items	Qty	Size	Mfgr/Model	Set Point
Safety Valves			Consolidated	
Drum safety valves	2	1.5/2.5	1717A/1737A	1071/1103
Superheater safety valves	1	1.5	1717C	920
Superheater power-activated relief valve	1	2	25121VX	900
Major boiler valves				
Feed valve	1	4"	(*) 4016Y	
Feed check valve	1	4"	4094Y	
Main steam stop/check valve	1	10"	4006Y	
Main steam valve	1	10"	4016Y	
Sootblower steam valve	1	2"	1048Y	

Miscellaneous valves

Items	Qty	Size	Mfgr/Model
Drum vent	2	1-1/2	1048Y
Chemical feed	2	1/2	1048Y/36174
Pressure gauge/transmitter	1	1/2	1048Y
Test gauge-3 way			
Steam and water sampling	4/2	1/2/1	1048Y
Water level transmitter	4	1"	1048Y
Water column	2	1-1/2	VOGT
Water column drain	2	3/4	1048Y
Gauge glass	2	1-1/2	Reliance

(*) All Valves by Edward Unless Otherwise Stated.

Gauge glass drain	2	3/8	1048Y
Probe water column	2	1	VOGT
Probe water column drain	2	1	1048Y
Main steam line drain	2	1	1048Y
Superheater drain	8	1	1048Y
Waterwalls drain	36	1-1/2	36124
Economizer drain	2	1	1048Y
Attemperator vent	4	1	1048Y
Main steam line vent			1048Y
Sootblower drain (with thermostat control	4	1	Copes V600

18.1 Preliminary Valve and Additional Trim List

Items	Qty	Size	Mfgr/Model

19. Steam Coil Air Heater

Manufacturer	LINCHBURG [redacted] -RLT	LINCHBURG [redacted] -RLT	
Effective Heating Surface	10582	4630	sq.ft.
Operating Steam Pressure	120	120	psig
Operating Steam Temperature	350	350	°F
Inlet Air Flow	54770	23470	ACFM
Inlet Air Temperature	80	80	°F
Outlet Air Temperature	300	300	°F
Air Pressure - loss	1.5	1.5	in wg
Steam Flow	13,782	6,038	lb/hr

Design Pressure	200	200 psig
Design Temperature	650	650 °F
Material and ASTM Designation	C.S.	C.S.
Bare or Finned, and Fins per inch	Finned - 4	Finned - 4
Fin Type: Parallel, Spiralwound	Helical	Helical
Fin material	C.S.	C.S.
Number of heating sections	6	5
Coils: self-draining, removable	Yes	Yes
Coil Arrangement: vertical or horiz	Horizontal	Horizontal
Air Side Fouling Factor	0.01	0.01 hr-ft^2-°F/Btu
Steam Side Fouling Factor	0.001	0.001 hr-ft^2-°F/Btu
Maximum Face Velocity	690	690 fpm
Casing and Access Section Thickness		gauge
Access Door Size	18" x 48"	18" x 48" in.

20. Sootblowers

Location	Qty	Make	Model	Type	Material	HP Each
Evaporator	8	(*)	T20E	Retract	Alloy S.	0.6
Convection Section						
Superheater	8		T20E	Retract	Alloy S.	0.6
	12		D5E	Rotary	Hyvuloy	1/8
Economizer	20		D5E	Rotary	Steel	1/8

(*) All by Copes Vulcan

Blowing steam flow, lbs/hr	T120, 6480, D5E, 15700
Blowing steam-total quantity, lbs per cycle	T20, 8288, D5E, 5573
Sootblowing duration, min.	T120, 4.8, D5E, 0.70
Steam pressure to sootblowers	Psig 450 at S.B Head, 150 Blowing Press
Are the following furnished:	
Supports	Yes
All necessary valves	Yes
All necessary piping	Yes
Provisions for future sootblowers in second furnace pass	Yes
Are the locations of base and future sootblowers clearly shown on outline and section arrangement drawings	Yes
Sootblower Control Panel	
Manufacturer	Copes Vulcan
Model	Msc.
Additional Features	

Contractor shall attach additional descriptions as required to clearly describe offeing.

21. Attemperation

No. of stages	2
Superheat load control point	80 %
Superheater outlet temperature	830 °F
Control description:	Spray

Contractor shall include additional descriptions as reqired to clearly describe offering.

22. Auxiliary Burner(s)

No. of burners per steam generator	Two	
Design heat input per burner	50	MBTU/hr
Fuel oil Type/No.	N/A	
Fuel consumption at design heat input	N/A	
Fuel pressure required at Purchaser's supply point	N/A	
Atomizing medium	N/A	
Atomizing medium consumption at design heat input	N/A	SCFM(air)
lb/hr(steam)	N/A	
Atomizing medium pressure required at Purchaser's supply point		psig
Propane		
Fuel consumption at design heat input	39683	SCFH
Fuel pressure required at Purchaser's supply point	15	psig

Burner Description:

0124E
DISTRAL S.A.
DEC-91-002

AUXILIARY BURNERS

DISTRAL S. A. shall furnish for each boiler two (2) flexi-pak lox NOx auxiliary burner package assemblies, one for each furnace side wall, by Peabody or Purchaser approved equal. The supply per burner is as follows:

1 - Windbox fabricated of 1/4" steel plate with open back for welding to the boiler front plate. The following forced draft fan will be fitted for mounting on top of the windbox.

1 - Northern centrifugal forced draft fan, direct connected to a 15 HP, 1800 RPM, TEFC electric motor. The fan will be complete with inlet screen and air control vortex. The capacity will be 10,688 SCFM at 8.79" W.C. at sea level.

1 - Bailey Model UP10 rotary actuator for forced draft fan vortex.
1 - Burher purge/cooling blower direct connected to a 1750 RPM, T.E.F.C. motor. *

The following equipment will be mounted, piped and wired on the windbox, as far as practicable, except where noted:

1 - Peabody type ISC, forced draft burner suitably arranged for balanced furnace firing.
1 - Gas care type gas burner.
1 - FPM gas-electric ignitor with transformer, electrode and flexible gas hose.
1 - Throat sweep

Ignitor Gas Train

1 - Ignitor shut-off valve
2 - Maxon solenoid shut-off valves
1 - Maxon vent solenoid shut-off valve
1 - Fisher Y-600 pressure regulating valve
1 - "Y" type strainer
1 - Leak test cock.
1 - 1-1/2" pressure gauge

* INCLUDING INLET ISOLATION VORTEX WITH BAILEY ROTARY ACTUATOR.

Gas Train Steel/Welded Train

1 - Low pressure switch.
2 - Maxon automatic safety shut-off valves with end switches.
1 - Maxon vent solenoid shut-off valve.
1 - Leak test cock.
1 - Fisher 1098 EGR-GIL Series pressure regulating valve.
1 - Burner shut-off cock.
1 - High pressure switch.
2 - 3-1/2" pressure gauges.

Flame Safeguard Equipment

1 - NEMA-4 electrical control cabinet with the following mounted and wired to terminal strip:

- 1 - Flame proving relay, Peabody micro-computer controller.
- 1 - Allen-Bradley programmer controller including:
  - 1 - Microprocessor CPU
  - 1 - Set, inputs
  - 1 - Set, outputs
- 1 - Cable I/O expander chasis.
- 1 - Set, output modules, isolated.
- 1 - Set, output modules, relay.
- 1 - Set, status light, ready, purging, ignitor on, module failure, flame proven, flame failure.
- 1 - Flame strength indicator.
- 1 - Alarm Horn.
- 1 - Combustion air flow switch.
- 1 - High steam pressure operating limit switch.
- 1 - Flame scanner, Peabody FV-03.
- 1 - Purge air flow switch.
- 1 - Excess high steam pressure operating limit switch.

Electric Positioning Combustion Controls

(4-20 MA Signals By Others)

1 - Maxon gas control valve with low fire interlock and actuator.
1 - Bailey Model UP10 rotary actuator.
[redacted].
1 - "Manual-Automatic" selector switch.

24. Access Doors and Observation Ports

Item	Location	No.	Dimensions
Access Doors*	Stoker Enclosure	2	36" x 48"
	Furnace-1st pass	2	18" DIA.
	Evaporator-2nd pass	-	N/A
	Evaporator-3rd pass	6	18" DIA
	2nd/3rd pass hopper	2	24" x 24"
	Superheater	6	18" DIA.
	Superheater hoppers	4	24" x 24"
	Economizer	10	24" x 24"
	Economizer hopper	2	24" x 24"
	Air Ducts	2	24" x 24"
	FG Ducts	2	24" x 24"
Observation Ports	Stoker Enclosure	6	8" x 6"
	Furnace-1st pass	6	8" x 6"

25. Economizer Outlet Connection

Flange connection dimension (L X W) 3'-10" x 30'-8" ft.

Centerline elevation 32'-5 7/8"

Distance from outlet flange to rear wall center line 1 ft.

26. Specification Compliance:

Other than those exceptions/clarifications listed here, the Contractor confirms full compliance with the specifications, including all attachments. All exceptions/clarifications listed below must include the applicable Specification Section, reference and explanation. If an exception represents a more cost effective design, the Contractor must bid to the Specification and provide a cost option.

* Exclusive of water wash connections and air heater access doors.
- RLT

ATTACHMENT 8

STORAGE OF MARTIN STOKER EQUIPMENT

The following requirements are part of SM-101, Technical Specification for MSW Steam Generators, and shall be complied with by the Boiler Supplier.

1. Large Components:
Large components (such a longitudinal frames, intermediate longitudinal frames, transverse frames, compartment walls, driving beams, transition pieces, grate siftings hoppers, siftings discharge ducts, ash dischargers and feed chutes) shall be covered with well-fastened tarpaulins to protect them against rain water. Tarpaulins shall be brought to grade and tucked neatly under equipment. The storage ground must be dry. Components shall be laid out on top of beams to avoid contact with soil.

Prior to storage, surface coating and paint shall be checked for good condition. Any damage occurred during transport shall be repaired so that rust formation is avoided.

The components shall not be stored on top of each other. Should stock piling be required, beams shall be inserted between components to avoid deformation and to ensure good ventilation.

All roller bearings and spherical bearings which remain fitted during storage are to be checked for sufficient filling with grease. "Exposed" bearing points shall be wrapped in oil paper.

The protective film on machined, uncoated surfaces shall be checked for good condition, and repaired if necessary.

2. Hydraulic cylinders:
Cylinders which remain fitted shall be checked to ensure that the piston rod has entered the cylinder completely and cannot be moved out.

An anti-corrosive film is applied to the piston rod protruding from the cylinder and its machined surfaces in the workshop. Nevertheless, all these points shall be treated with anti-corrosive agent. The spherical bearings must be filled with a sufficient amount of the appropriate type of grease.

Cylinders filled with oil and sealed are not to be exposed to direct sunlight or temperatures exceeding 120°F.

Hydraulic cylinders shipped in cases must remain in their original packing. They must, however, be checked for damage or exposure to moisture during shipping. If cases are wet, they shall be dried and repacked.

Cases shall be stored in a dry and ventilated room.

3. Pneumatic cylinders:
Pneumatic cylinders are shipped loosely packed in cases. Cylinder insides are slightly oiled and sealed. Cylinders shall remain in their original packing if it is still in good condition and shall be stored in a dry and ventilated room.

4. Driving beam support rollers:
Support rollers are either shipped loose, packed in cases, or must be disassembled and packed on site.

Support rollers shipped loose or in cases, shall remain in their original packing, and shall be stored in a dry room. If the original packing is not in good condition, or if rollers must be packed at site, storage crates must be weather tight.

5. Feed ram support rollers:
These rollers shall be removed,placed in weather tight storage crates and stored in a dry room.

6. Driving beam guide rollers:
These rollers shall remain in place.

7. Undergrate air damper control gear and other components shipped as loose items:
The bearing points shall be greased and the components stored in a dry and ventilated room.

8. Grate and feeder surface elements:
These items are delivered on pallets provided with a protective foil. Each panel contains a bag of drying medium. If this has become ineffective due to sea transport, the foil must be removed. The pallets shall be loaded with the castings and stored in a dry and ventilated room.

9. Seal air and pneumatic piping:
These are to be stored in a dry and ventilated room.

10. Hydraulic Pumping Station:
The hydraulic pumping station will be delivered seaworthy-packed and the tank will be filled with sloshing oil up to its head. If the packing is undamaged, the hydraulic pumping station shall be stored in a dry and ventilated room for no more than 6 months.

11. Hydraulic Pneumatic Cabinets:
Hydraulic-pneumatic cabinets are shipped seaworthy- and vacuum-packed. Units shall be stored in a dry and ventilated room for no more than 6 months.

12. Hydraulic Piping:
Piping up to nominal 1/2-inch is galvanized, with ends sealed with plastic plugs. Larger pipe sizes are protected with anti-corrosive coating and sealed ends. Fittings and mounting brackets are galvanized. Devices such as pressure counterbalance valves are wrapped in oil paper and shipped separately. All pipe shall be inspected for plugs and proper coating and repaired as necessary.

13. Electronic Cabinets:
Electronic cabinets are shipped seaworthy and vacuum-packed. Packing shall be inspected for damage and repaired if necessary. Units shall be stored in a dry and ventilated room.

ATTACHMENT 9

STRUCTURAL STEEL SPECIFICATION

The following structural steel specification, SS-410 Structural Steel, is included as part of this boiler specification. Contractor shall comply with all requirements of this specification.

OGDEN MARTIN SYSTEMS
of LEE, Inc.

SPEC NO. SS-410
ISSUE 006
DATE 5/17/91

TECHNICAL SPECIFICATION

FOR

STRUCTURAL STEEL

Facility Name: LEE COUNTY RESOURCE RECOVERY FACILITY

Location: LEE COUNTY, FLORIDA

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Specification Prepared By:

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Address: FAIRFIELD, NJ

Telephone: 201-882-7071

A/E Approved for Release:

	Printed Name	Signature	Date
1.	R. TERRAMOCCIA	R. Terramoccia	10/30/91
2.			
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5.			

REVISIONS

001	Initial Issue	1/01/87
002	Revision	8/28/87
003	Revision	11/03/87
004	Revision	9/29/89
005	Revision	2/28/90
006	Revision	5/17/91

OGDEN MARTIN SYSTEMS, INC.

TECHNICAL SPECIFICATION
FOR
STRUCTURAL STEEL

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1.0 GENERAL

1.1 Work Included

The Contractor shall provide all labor, supervision, equipment, tools, materials, and services to furnish, shop detail, fabricate, shop coat paint deliver, unload, store, handle, and erect the following items as shown on the Engineer's drawings and as specified herein:

1. Structural steel framing and bracing for all buildings, structures supporting equipment, pipe, tray and duct supports.

2. Miscellaneous steel framing and assemblies including clips, angles, plates, and stiffeners.

3. Grating and raised pattern floor plate platforms, complete with curbs, railings, toe plate, banding, sleeves and stiffeners.

4. Stairways including stringers, handrail, landings, hangers, posts, bracing, treads with non-skid nosing, connecting clip angles, including concrete filled treads.

5. Ladders, safety cages, top hoops, self-closing safety gates, guide and support clips.

6. Roof purlins, wall girts, eave struts, sill angles, sag rods and roof parapets.

7. Crane girders, rails, rail clamps and splice bars with fasteners, traction plates, electrical support brackets and beams and crane end stops.

8. All lifting beams; hitch plates, monorails, hoists and davits attached to steel framing.

9. Base, splice & cap plates for columns and bearing plates for beams including setting and shimming material at the required elevations.

10. Door, louver, window, lintel, smoke hatches, floor openings, roof access openings, vents, T-G silencers, skylights, pipe penetrations and HVAC framing constituting a part of the steel framing.

11. Bolts, washers, nuts, and direct tension indicators, where applicable, for all shop and field connections and drilled-in concrete anchors.

12. Weld for shop and field connections.

13. Surface preparation, painting, galvanizing where specified herein, and field touch-up of painted and galvanized items and field painting of bolts after erection.

14. Other remaining items necessary to complete construction.

15. Steel framing and shaftway structural steel for elevator(s).

1.2 Work Not Included

The following associated items and work will be furnished and/or performed by others:

1. Supply and installation of anchors bolts, sleeves, plates, and other embedments which are to be set in concrete.

2. Supply and installation of grout for equipment and column base plates.

3. Supply and installation of elevators with guideways/guiderails.

1.3 Related Work

Other specifications related to work in this specification include, but are not limited to, the following:

Specification No. SS-408 - Concrete
Specification No. SA-550 - Painting Ferrous Metals Included in Subcontractor's Work

1.4 References

The following documents relating to the work are referenced herein. The issue date of the document (including addenda) in effect on the date of Invitation to Bid shall apply. If there appeàrs to be a conflict between this specification and a referenced document, the matter shall be referred immediately to OMS for resolution.

AISC - American Institute of Steel Construction

AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings

AISC Code Standard Practice for Steel Buildings and Bridges

AISC Manual of Steel Construction

ASME - American Society of Mechanical Engineers

ASME/ASTM A17.1B Safety Code for Elevators

ASTM - American Society for Testing and Materials

ASTM A1	Carbon Steel Tee Rails
ASTM A3	Steel Joint Bars, Low, Medium, and High Carbon (Non-Heat Treated)
ASTM A36	Structural Steel Shapes and Plates
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless (Types E or S, Grade B)
ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A307	Carbon Steel Externally Threaded Standard Fasteners
ASTM A325	High-Strength Bolts for Structural Steel Joints
ASTM A386	Zinc Coating (Hot-Dip) on Assembled Steel Products
ASTM A500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes (Grade B)
ASTM A501	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A569	Steel, Carbon (0.15 Maximum, Percent) Hot-Rolled Sheet and Strip Commercial Quality
ASTM A572	High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality (Grade 50 KSI)
ASTM A759	Carbon Steel Crane Rails

AWS - American Welding Society

AWS D1.1	Structural Welding Code

RCSC - Research Council on Structural Connections of the Engineering Foundation

RCSC	Structural Joints Using ASTM A325 or A490 Bolts Specification

1.5 Quality Assurance

1.5.1 Welding

Welds shall be tested by nondestructive methods as specified in the Welding section herein.

1.6 Submittals

The Contractor shall comply with the submittal of the following documents and drawings:

TITLE	OMS	ENGR
CMTR - Structural Steel and Bolts	1	1
NDT Reports	1	1

CMTR - Certified Mill Test Reports
OMS - OMS's Site Representative
ENGR - Engineers
NDT - Non Destructive Test

The Contractor's fabricator shall provide shop drawings, bolt lists and other information as may be required by the contract documents.

Shop drawings (including erection plans) shall show fabrication details in English units, bolted and welded connections (including grooves & back-up bars) for both shop and field welds, copes, blocking and shop notes.

Shop drawings shall be furnished progressively as completed and all such drawings and bolt/material lists shall bear OMS's project number and the name (or item number) of the structure to which they apply. Weight of shipments shall be based on AISC Code of Standard Practice, (AISC Manual of Steel Construction). The Contractor shall furnish OMS's site representative with a copy of the packing lists.

All shop detail and erection drawings, including calculations for special connections (where appropriate) shall be prepared under the supervision of a registered professional engineer, checked before submittal and approved by the engineer before fabrication commences.

A complete copy of all shop drawings shall be kept on file at the site by the contractor and made available on request by OMS or the Engineer.

1.7 Product Handling

1.7.1 Provisions for Storage

All items shall be stored on cribbing or equivalent to avoid trapping water and to allow air circulation.

Items shall be handled in a manner which is consistent with safe and sound material handling practices.

1.7.2 Shipping Requirements

For all items, packaging shall be adequate to prevent contamination, mechanical damage or deterioration during the field storage period. Structural steel members shall be cleaned, painted and identified by erection marks. Bolts, nuts, and washers shall be shipped in closed containers to exclude moisture.

2.0 PRODUCTS

2.1 Materials

All material shall be new.

Structural steel shall conform to ASTM A36 and shall be a domestic source (exceptions will require OMS's prior written approval).

High-strength steel shall conform to ASTM A572, Grade 50. Structural tubing shall conform to ASTM A501. Steel pipe shall conform to ASTM A53, Type E or S, Grade B.

2.2 Design and Workmanship

2.2.1 General

The AISC Specification and Code are hereby incorporated into this specification and shall apply except as otherwise specified herein or in related documents, or approved in writing by OMS.

The type of construction used for the structural steel framing, in general, shall be Type 2, ("simple framing") as defined in the AISC Specification. Type 1 construction, ("rigid-frame") shall also be used where design conditions dictate.

Steel construction projecting inside of elevator enclosure walls shall conform to ASME/ANSI A17.1b.

2.2.2 Design of Connections

Shop connections shall be either welded (preferred) or high strength bolted (A325). Field connections shall be high strength bolted unless otherwise specified on the Engineers drawings. Also where indicated on the Engineers drawings, connections may be made with ASTM A307 bolts or with high strength bolts for light, miscellaneous framing such as handrailing, ladders & cages, stair treads, purlins and girts.

High strength bolts, unless otherwise noted, shall be bearing type with bolt threads included in the shear plane.

Connections with repeated reversal and vibratory loads shall be friction-type connections and shall have no less than two (2) bolts per connection.

All connections shall be designed in accordance with the AISC specifications. The connection details shall be shown on the design drawings except as follows:

- Framed beam shear connections shall be designed and detailed by the Steel Fabricator in accordance with AISC Type 2 construction provided the beam shear loads at the connections do not exceed one-half of the total allowable uniform load for beams laterally supported, (as given in the AISC "Manual of Steel Construction") plus any axial load that may be shown on the drawings.

- The connections at ends of tension or compression members for bracing members shall develop the force due to the design load, but not less than 50 percent of the effective strength of the member, based upon the kind of stress that governs the selection of the member. Working points for designing and detailing of the connections shall be shown on the design drawings.

- When the loads acting on the connections are given on the design drawings, the Fabricator shall design and detail the connections.

- The Contractor shall be responsible for the design of connections not shown on the drawings and as such, is also responsible for the coordination of the connections and their effect on other building components or systems.

Where connections are to be field welded, holes for erection bolts shall be placed in the end connections and the members to which they are to be attached. Erection bolts shall be furnished by the Fabricator.

2.3 High Strength Bolts

2.3.1 Material

High strength bolts, washers and nuts shall conform ASTM A325. High strength alloy bolts, washers and nuts shall conform to ASTM A490.

2.3.2 Use

A minimum of one hardened washer per bolt shall be placed under part turned when tightening A325 or A490 bolts.

All bolts in any connection shall be installed with all nuts on the same side unless interferences will not permit. Vertical bolts shall be installed with nuts on the lower side, except where space restrictions make this impossible.

2.3.3 Inspection

The inspection of high-strength bolts shall conform to all provisions of Section 6 of the RCSC Specification and AISC Code.

2.4 Plate and Angle Curbs

All plate and angle curbs shall have neat close joints and shall be butted at corners. The maximum clearance at joints shall be 1/8 inch.

2.5 Structural Steel Stairs

Stair widths shall be no less than 2'-6" or greater if required by code.

Exposed ends of stair stringers shall be cut with a saw or other approved method and ground smooth. Ends of stair stringers in public areas shall be capped with a steel plate.

American Stair Products "speed stair" is an acceptable alternate subject to OMS and the engineers approval for manufacturer's component option list for treads, landings, rails, posts and risers.

2.6 Floor Grating and Stair Treads

Steel floor grating (preferred) and stair grating treads (with raised pattern plate non-skid nosing) shall be of welding quality mild carbon steel conforming to ASTM A569. Steel floor grating and stair treads, in the depths indicated on the Contractor's drawings, shall be of welded construction, rectilinear in pattern, with 3/16 inch thick longitudinal bearing bars spaced 1 3/16 inches on centers, and cross members 3/16 inch minimum thickness spaced 4 inches on centers. Grating and stair treads (including raised pattern plate nosing) shall be hot dipped galvanized in accordance with ASTM A123.

Exception: Concrete filled, metal pan stair treads (with closed riser) and landings shall be provided for enclosed fire escape stair towers and public stairs as shown on the Engineer's drawings.

Serrated grating and stair treads shall be provided in exterior applications for northern climates where ice and snow conditions prevail.

Grating shall be furnished and installed in reasonable sized sections, avoiding patchwork, with due regard for neat appearance and safety of finished product. Longitudinal and cross bars in adjacent sections shall be in line when erected end-to-end.

Grating shall be fabricated and erected to fit around protruding structural members, equipment and piping.

All grating shall be banded at edges of openings. Banding strips shall be at least the same thickness and depth as the bearing bars to which they are welded. When openings between grating & protruding elements exceeds 1", then a 1/4"

minimum toe plate thickness shall be provided and have a vertical height of 4" from its top edge to the level of the floor.

Manufacturing standards and tolerances of the NAAMM Manual shall be followed.

Removable sections of grating (as identified on the drawings) shall be fastened to the supporting steel with four (4) sturdy 14 gauge galvanized saddle type clips using 1/4 inch diameter studs bolts or self tapping machine bolts, together with nuts and washers. Clips shall have a 5/16 inch diameter by 1/2 inch slotted hole. Stair treads shall be fastened to the stair stringers with 3/8 inch diameter bolts and nuts.

Permanently installed grating shall be welded in the field as shown on the drawings or in the shop for shop assembled pieces.

2.7 Raised Pattern Floor Plate

Raised pattern floor plate (where a closed flooring is required) shall conform to ASTM A36 with a symmetrical raised diamond pattern. The plate shall be smooth-cut or finished to provide smooth, straight edges. Removable floor plates shall be fastened to the supporting steel using the Floor-Fast system by Struct-Fast Inc., Wellesley Hills, MA, or approved equal.

Permanently installed raised pattern floor plate shall be welded in the field as shown on the drawings or in the shop for shop assembled pieces. Stiffening ribs are to be provided where required by design.

2.8 Railing

Guardrail, handrail and posts shall be of pipe construction and designed to resist governing code specified loadings and "openings" between rails that may be enforced by the local building official. Railing shall be located as shown on the Engineers drawings with posts spaced not greater than 8 feet-0-inches on centers.

For "Fire-Rated Stair Towers" and applications in areas of public use, handrailing shall also be of pipe construction and designed to satisfy code and local regulations.

When governing code specified loadings are not given, then the following shall apply: the anchoring of posts and framing of members for railings of all types shall be of such construction that the completed structure shall be capable of withstanding a load of at least 200 pounds applied in any direction at any point on the top rail. Engineer to verify railing design is adequate to resist applied forces.

Handrailing & toe plates shall be shop fabricated into complete assemblies for ease of field erection.

All projecting cut edges and welds on railing to be ground to a smooth finish.

2.9 Ladders, Cages and Self Closing Safety Gates

Ladders shall be provided for access from one structure level to another where operations require infrequent travel, non-routine access to equipment and where stairs are impractical due to space limitations. The refuse and turbine generator cranes serve as only two examples where ladders must be provided to mount equipment for servicing.

Ladders and cages shall conform to ASTM A36.

Self closing safety gates shall be made from 3/4" diameter bar material and fabricated to rest on the cage hoop or rail as shown on the Engineers drawings.

Ladders shall be provided with top hoop only when they extend less than 20' above grade.

Ladder rungs shall be spaced at 1'-0" c.c. (max.).

Provide cages on ladders of more than 20'-0" above grade or as required for safety.

All projecting cut edges on ladders & cages to be rounded to a smooth finish.

Ladder cages shall be shop assembled & attached to ladders as permitted by shipping limitations.

2.10 Crane Rails

Crane rails and standard accessories shall conform to ASTM A1, No. 1 modified rail, for rails weighing less than 104 pounds per yard, and ASTM A759 for rails weighing 104 pounds per yard or more. Joint bars shall conform to ASTM A3.

Crane rail splices shall have tight joints using bolted splice bars, ASTM A325 bolts & nuts with alloy spring washers furnished to A.R.E.A. specifications. Refuse crane rail clamps shall be floating type clamps with double bolts unless otherwise specified. Turbine generator crane may be a single bolt rail type clamp (appropriately sized and spaced) due to its limited service. Splices and clamps shall be in accordance with the AISC Manual.

Clamps, connections and their spacing shall be selected to withstand side thrust equal to 20% of the sum of the trolley weight and the lifted load.

Note: Gantrex crane rail clips are an acceptable fastening system alternate.

2.11 Identification of High-Strength Steel

Shop drawings shall identify each structural member that is to be made of steel other than ASTM A36 material (i.e., high-strength steel). The ASTM number and a color code shall be marked on the original pieces, and maintained until after application of piece marks on the members.

Members which are killed and normalized shall be identified at the mill as being heat treated by painting serial codes or other mill identification so that the material can be easily identified during fabrication.

2.12 Welded Plate Girders

The plate girders, as shown on the Engineers' drawings, shall be designed for welded fabrication.

Girders shall be completely shop fabricated and shipped in one piece when feasible. When shipment or erection requirements dictate, field joints shall be located subject to approval by the Engineers. Web and flange splices shall be complete penetration groove welds. The flanges shall be single thickness plates joined to the web by continuous welds.

2.13 Welding

2.13.1 General

All welding, welding procedures and qualifications, welder qualifications, and weld material shall be in accordance with AWS D1.1, local laws, ordinances, and the additional requirements herein. Welding procedures and qualifications shall be maintained and readily accessible in the shop where welding is being performed.

Welding electrodes shall be E-70 series.

In addition to the requirements of AWS D1.1, all welding materials shall be stored in a controlled access, clean, dry area that is weathertight and is maintained at a temperature between 40-F and 140-F.

2.13.2 Inspection, Tests, and Repair of Welds

All welds shall be visually inspected to the requirements of AWS D1.1.

Weld inspection shall be performed by an AWS Certified Inspector, or Assistant Welding Inspector(s), under the supervision of the AWS Certified Inspector. Alternatively, a program for self certification of welding inspectors may be implemented provided the program is written and supervised by an AWS Certified Inspector in compliance with the requirements of AWS D1.1. The Weld Inspection Program, including the Inspector's certification records, shall be maintained and readily accessible in the shop where welding is being performed.

Complete penetration groove welds in the following locations shall be tested by radiographic or ultrasonic methods after completion:

1) Flange splices of beams, girders, and columns, or chord splices of trusses, and splices subject to stress reversal.

2) Web splices of beams, girders, and columns at one-sixth of the depth of the web beginning at the point or points of maximum tension, and 25 percent of the remainder of the web depth.

3) Any additional locations shown on the Engineers' drawings.

Note: To avoid expensive field testing, complete penetration groove welds, where required, shall be performed in the shop (unless directed otherwise). Field bolted splices shall be the preferred method.

Magnetic particle testing may be used instead of radiographic or ultrasonic testing when approved by the Engineers.

For welded plate girders, fillet welds and partial or complete penetration groove welds occurring at the intersection of webs and flanges, or used for attaching cover plates to flanges, shall be tested by the magnetic particle method after completion. At least one foot of every 10 feet of accumulated weld length of each size shall be tested.

All welds found deficient shall be repaired in accordance with AWS D1.1.

2.14 Protective Coating

2.14.1 General

All steel material furnished under this specification, excluding fasteners, galvanized surfaces, machined surfaces, or surfaces to be bonded to concrete, shall be cleaned and coated as required herein.

Material used to mark steel after painting shall be the same paint used as the general shop coat, tinted to suit with a tinting material as recommended by the paint manufacturer. Materials used for piece marking shall not be of a type which will bleed through when a touch up coat is applied.

All coating material containers shall be labeled to show the name of the manufacturer, the product trade name or designation, and color.

2.14.2 Material

Refer to Technical Specification for Painting Ferrous Metals, SA-550.

2.14.3 Surface Preparation

Refer to Technical Specification for Painting Ferrous Metals, SA-550.

2.14.4 Mixing and Thinning

Refer to Technical Specification for Painting Ferrous Metals, SA-550.

2.14.5 Shop Application

Refer to Technical Specification for Painting Ferrous Metals, SA-550.

Surfaces adjacent to edges of joints to be field welded shall be kept free of paint within 4 inches of the edge, the unpainted weld area being protected with one coat of Carbo-Weld 11 manufactured by the Carboline Company, St. Louis, Missouri. This protective coating need not be removed prior to welding. Such surfaces shall, subsequent to welding, be prepared and coated in the same manner as specified for the appropriate standard painting system.

The condition of contact surfaces of friction-type connections shall conform to the requirements of the RCSC Specification for the type of coating used.

Milled surfaces shall be coated with a rust-preventive material similar to Tectyl 506G, manufactured by Ashland Petroleum Company, Ashland, KY, or approved equal. Coating shall be applied after inspection and prior to being placed outdoors. Where later removal of this coating is required, SSPC SP1 cleaning methods and recommendations shall be followed.

2.14.6 Galvanizing

Where galvanizing is called for, all steel shapes, plates and bars shall be hot dip galvanized according to ASTM A123; all steel and iron hardware and thread components according to ASTM A153. Embrittlement control shall be according to ASTM A143.

All welds on assembled items to be galvanized (if specified) shall be continuously seal welded, i.e. all around the contact perimeter.

2.15 Signs

Allowable floor loading signs shall be marked on plates of approved design by OMS and securely affixed in a conspicuous place in each space to which they relate as required by OSHA (1910.22).

3.0 EXECUTION

3.1 Workmanship

The recommendations and procedures prescribed in the AISC Code shall govern the erection work unless otherwise specified herein.

3.2 Anchor Bolts

Prior to erecting steel, anchor bolts shall be checked to assure that they are correctly aligned and that elevations are correct. Any deviation from the intended line and grade shall be brought to the attention of the Engineers when discovered. The implementation of the required corrective action is necessary before the commencement of erection operations.

3.3 Erection Tolerances

The erection tolerances as listed in the AISC Code shall apply unless otherwise specified herein or indicated on the Engineers' drawings.

3.4 Crane Rails

Crane rail splices, on opposite girders, shall be staggered. Rail and girder splices shall not coincide. The two runway rails must be parallel along their entire length.

Crane runway rails shall be straight, parallel, level, and at the specified elevation given on the drawings. Appropriate survey equipment shall be used to prepare a drawing showing as-built runway rail elevations, plan locations and distances between rails and submitted to OMS for approval.

3.5 Festooned Cable Support Beam (Refuse Crane)

To provide a proper trolley running operation, ends of trolley beam flanges shall be straightened (squared) to correct standard mill rolling tolerances. Unless the Manufacturer dictates otherwise the I-Beam joints shall be welded all around lower flange continuing up web of beam at least 50% of depth with a root opening equal to 25% of web thickness. Grind weld smooth and flush all around joint for optimum transition of trolley wheels.

The I-Beam track may be supported by any suitable framework to suspend the entire weight of the Festoon System using bolt fasteners or welding at 5 foot increments (or Vendor recommendations) throughout beam length. The recommended minimum factor of safety is five (5).

3.6 Erection Alignment of Structures

When all the columns, beams, bracing, and struts of a tier within a given erection sequence have been set in place, the joints shall be made secure by the insertion of a number of erection bolts equal to at least 30 percent of the total number of bolts in the connection. A minimum of two bolts shall be installed in every connection. The structure shall be plumbed and the connection holes faired up with enough driftpins to maintain dimensions and plumbness.

After all of the members in a tier have been aligned and the columns plumbed, all remaining connections shall be installed with high-strength fasteners and tightened.

Each tier shall be secured in the foregoing manner.

Anchor bolts shall be snug tightened as soon as columns are set and shall be fully tightened after the first tier is plumbed. All baseplates within a given erection sequence will be grouted promptly after setting, or before the second tier is erected, unless otherwise approved by the Engineers.

Shim packs adequately sized to support the weight of the first tier shall be used if the base plate is not grouted prior to erection of the first tier. Shim packs shall not be placed near the edge of shear keys. Base plate leveling bolts shown on the Engineers' drawings shall not be used for support.

3.7 Bracing

The bracing shown on the Engineers' drawings shall be designed to provide a stable structure upon the completion of erection.

The Contractor shall design and install all additional temporary bracing or guying required to meet loading imposed during erection, consistent with the erection sequence used, or required at the end of any work period to ensure safe and stable conditions. Additional temporary bracing of this nature shall be reviewed by the Engineers. However, the Engineers' review shall not relieve the Contractor from full responsibility for the stability of the structure during erection.

3.8 Sag Rods

Sag rods serving as an intermediate support for purlins and girts (arranged in its weak axis direction) shall be located the minimum gage distance from the roofing and siding it supports.

4.0 PROJECT SPECIFIC REQUIREMENTS

The attached Project Specific Requirements, if any, are additions, deletions, and/or revisions to the preceding specification requirements and shall be considered as part of this specification.

4.1 Add the following sections:

3.9 Cuts, Alterations, and Holes for Other Trades

Neither the fabricator nor the erector will cut, drill or otherwise alter his work, or the work of other trades, to accommodate other trades, unless such work is clearly specified in the contract documents. Whenever such work is required, the Contractor is responsible for furnishing complete information as to materials, size, location and number of alterations for the Design Engineer's review and written approval.

3.10 Misfabrications

Incorrectly fabricated, damaged or otherwise misfittings or non-conforming materials or conditions shall be reported to the owner prior to remedial or corrective action. Any such action shall require approval.

4.2 Add the following to Section 2.3.2:

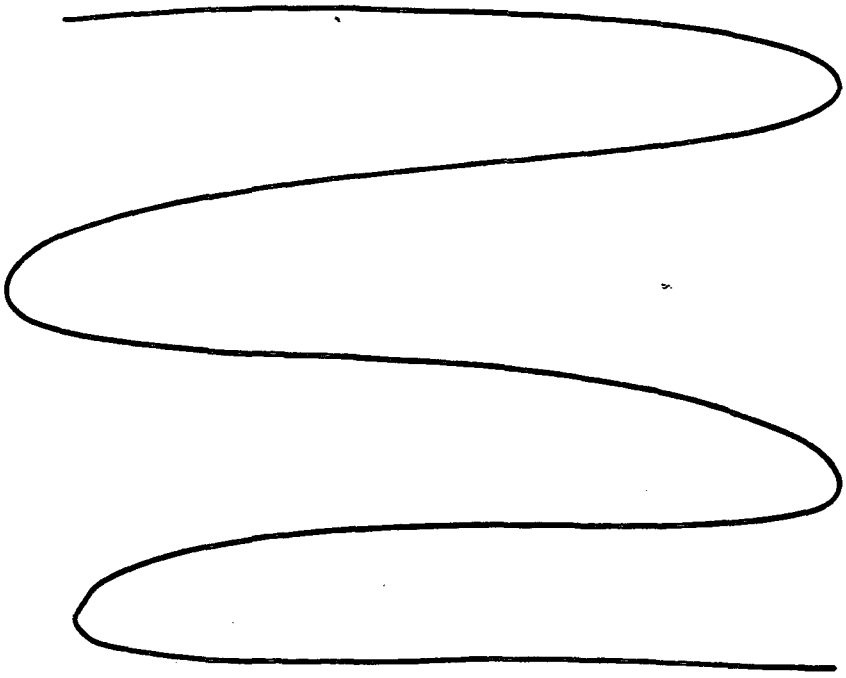
All equipment connections to structural steel shall be high strength bolted (A325). Unmarked bolts or bolts of foreign manufacturer without valid test certificate shall not be used.

4.3 Add the following to Section 1.5:

The contractor shall [redacted] engage a recognized independent testing laboratory (certified by the appropriate state or local agency), approved by OMS, to conduct routine testing and installation of bolting and welding.

Testing shall be in accordance with Section 6 of the RCSC Specification and AISC Code.

End of Project Specific Requirements



ATTACHMENT 1
DOCUMENT SUBMITTAL SCHEDULE

Documents for Approval	Engineering Need Date for Vendor Data	Schedule Date for Certified Vendor Submittal	Actual Vendor Submittal Date
- Certified Mill Test Reports for Structural Steel and Bolts	Upon Receipt of Reports	_____	_____
- Non-Destructive Test Reports	7 Days After Test	_____	_____
- Shop Detail Drawings	90 Days Before Shipment	_____	_____
- Bolt Lists	90 Days Before Shipment	_____	_____
- Crane Runway Survey (As per Section 3.4)	7 Days After Completion	_____	_____
- High Strength Bolt Installation Report	7 Days After Completion	_____	_____

ATTACHMENT 10

PAINTING SPECIFICATION

The following painting specification, SA-550 Painting Ferrous metals included in Subcontractor's Work, is included as part of this boiler specification. Contractor shall comply with all requirements of this specification.

OGDEN MARTIN SYSTEMS
of LEE, Inc.

SPEC NO. SA-550
ISSUE 002
DATE 08/15/90

TECHNICAL SPECIFICATION

FOR

PAINTING FERROUS METALS
INCLUDED IN SUBCONTRACTOR'S WORK

Facility Name: LEE COUNTY RESOURCE RECOVERY FACILITY

Location: LEE COUNTY, FLORIDA

****

****

Specification Prepared By: A/E Name: OMS

Address: FAIRFIELD, NJ

Telephone: 201-882-9000

A/E Approved for Release:

	Printed Name	Signature	Date
1.	K.J. WALLS		1/10/92
2.	K.J. WALLS		10/26/92
3.			
4.			
5.			

REVISIONS

001	Initial Issue	08/16/89
002	Revision	08/15/90

TECHNICAL SPECIFICATION
FOR
PAINTING FERROUS METALS
INCLUDED IN SUBCONTRACTOR'S WORK

TABLE OF CONTENTS

1.0 General

1.1 Scope

This Specification establishes the minimum requirements for the furnishing of all labor, materials, tools and equipment, the coordination of work with that of other trades, and the performing of services for the coating of ferrous metals as shown on the plans and specified herein, including both shop and field applied systems. This Specification shall be worked with Specification SA-502, Painting. Reference to other industry standards for compliance shall be interpreted as an integral part of this Specification.

1.1.1 Work Included

Work shall include but is not limited to the surface preparation and application of prime and finish coats and touch-up of paint systems on ferrous metals. Items receiving coatings shall include but are not limited to:

- Structural Steel
- Miscellaneous steel angles, channel, plates, braces, brackets, embedments, etc.
- Equipment Supports
- Ducts as required
- Pipes
- Stair stringers and pans
- Handrails and Guardrails
- Hollow metal doors and frames, and industrial doors
- Electrical cabinets
- Louvers
- Equipment furnished without shop finish

1.2 Related Work

Items of work related to work of this Specification, but not included within its scope shall be furnished or performed under the General Contractor's responsibilities. These items include, but are not limited to:

- Shop finished equipment
- Removal and reinstallation of fixtures, equipment and systems by others when required

Other specifications related to work in this Specification include but are not limited to the following:

SA-502 Painting

1.3 References

1.3.1 Abbreviations

Abbreviations listed below, when used in this Specification, shall have the following meanings:

ANSI	American National Standards Institute
CFR	Code of Federal Regulations
SSPC	Steel Structures Painting Council

1.3.2 Codes and Standards

Work under this specification shall be performed in accordance with applicable sections of the following codes, standards, publications and practices, and to the extect referenced, form a part of this specification. Date of issue in effect at the time of Notice to Proceed shall apply.

ANSI A13.1	Scheme for the identification of piping systems
29 CFR 1910 & 1926	Occupational Safety and Health Act (OSHA)
SSPC-SP-1	Solvent Cleaning
SSPC-SP-3	Power Tool Cleaning
SSPC-SP-6	Commercial Blast Cleaning

1.4 Quality Assurance

All stages of work including surface preparation, priming and finish coating of surfaces, materials, equipment, workmanship, and touch-up shall be subject to inspection by a representative of Purchaser for conformance to the applicable SSPC specifications, the manufacturer's instructions, and this specification.

All components of each paint system, specified herein, shall be by one manufacturer. The paints of one manufacturer shall not be used over the paint of another and shall not be intermixed with each other unless approved by OMS.

1.5 Submittals

In compliance with all provisions and conditions of the Contract, the following items and documents shall be submitted per the document submittal schedule in Attachment 1.

1.5.1 Engineering Documents

- Technical data sheets on each product to be used.
- A paint schedule indicating the total system (material, thickness, etc) to be applied including surface preparation for each substrate type.

- Color selection charts with the full range of manufacturer's standard colors for selection by Purchaser.
- Material Safety Data Sheets for coatings, solvents, etc.
- Manufacturer's instructions for mixing, thinning, application and storage of the coating materials

1.5.2 Verification Documents

Written Certification that all coatings comply with the provisions of this specification. Alternate manufacturer's will only be considered upon submittal of complete technical and company data and approval by Purchaser.

1.6 Product Shipping, Handling and Storage

All coating materials shall be delivered to the job site in original, sealed and unopend containers bearing the Manufacturer's name, paint type designation, batch number, color and shelf life.

Coatings shall be stored in an area that is well ventilated and free from excessive heat, sparks, flame or the direct rays of the sun. Ambient temperature of stroage areas shall be maintained within the range specified in the coating manufacturer's printed instructions unless otherwise specified.

1.7 Scheduling

It shall be the responsibility of the contractor to provide schedules for the painting of surfaces and to coordinate the coating work with the work of all other trades.

1.8 Safety

The Contractor shall observe all OSHA, state and local laws, ordinances and regulations pertaining to health and safety. The precautions indicated on the paint containers with regard to fire and safety, as well as the laws of the state in which the project is located, shall be oberved.

2.0 Products

2.1 Acceptable Manufacturers

Subject to compliance with this specification and the painting schedule herein, the following coating manufcaturers are acceptable to provide the materials for the work:

a) Carboline Company
b) Cook Paint and Varnish
c) Glidden
d) Hampel's Industrial Coatings
e) Keeler and Long
f) Pratt and Lambert
g) Sherwin/Williams Company
h) Tnemec

The above manufacturer's provide the quality of paint, and are of the stature to provide the specified coatings for this project. The brand names and designations used in the specified Paint systems indicate the required type and quality of the coatings to be furnished.

2.2 Materials

Materials supplied shall be per the Paint Systems as listed in section 3.12. When required, all coatings shall be mixed in strict accordnace with the manufacturer's written instructions, and thinning shall not be permitted unless specified in those instructions. Thickness of coatings shall comply with manufacturer's recommendations. Where a range of thickness is presented in the technical data, the thicker coat shall be applied.

All tools and equipment necessary for surface preparation and application of coatings such as compressors, spray equipment, sandblaster, power tools, brushes, etc., shall be maintained in good working order.

Any false work (scaffolding, ladders, etc.) required for surface preparation and/or painting shall be designed by the Contractor for loads not less than those established by the state or local building codes and (OSHA) 29 CFR 1910 and 29 GFR 1926. The cable trays, conduit, piping, etc, shall not be used for support or access unless prior approval is obtained from OMS.

3.0 Execution

3.1 Coordination

It shall be the responsibility of the Contractor to coordinate with all material and equipment suppliers furnishing items that are to be shop primed and field finshed in order to ensure compatibility of the prime and finish coats. It is imperative that the paint systems specified herein be followed.

3.2 Job Conditions

3.2.1 Atmospheric Conditions

Paint shall not be applied when the surfaces are at a temperature of over 120°F unless the paint is specifically formulated for application at elevated temperatures. When painting in hot weather, precautions shall be taken to assure that the specified dry film thickness (DFT) of paint is obtained.

Paint shall not be applied in rain, snow, fog or mist, or when the relative humidity is such as to cause condensation on surfaces. All surfaces shall be completely dry before, and while being painted.

Forced ventilation shall be provided to keep fume levels at safe levels and shall be exhausted outdoors. Spark producing motors or implements shall not be used in areas when fume concentrations may occur.

3.2.2 Fire Protection

Oily rags and other waste which may constitute a fire hazard, shall be removed daily or stored in U.L. labeled metal containers with automatic closing covers.

The Contractor shall provide portable fire extinguishers of suitable type and sufficient number to permit placing at least one (1) extinguisher in any area where coating with fume-creating or flammable products is in progress, and where coatings are stored and mixed. No smoking shall be permitted in these areas and the Contractor shall be responsible for policing the work.

3.3 Color Selection

With the exception of standard colors for pipe identification or designated safety hazards, the colors will be selected specifically for this project and shall be presented separately in a color schedule.

Regardless of the source utilized in the selection of colors for the Project, the Contractor shall be responsible for assuring that all finish paints match the specified colors. If required, the Contractor shall submit samples of the specified color and the color selected by the Contractor to the Purchaser for color match analysis.

3.4 Protection of Adjacent Surfaces

All hardware, hardware accessories, machined surfaces, nameplates, lighting fixtures and similar items on or in contact with surfaces to be painted shall be removed, masked or otherwise protected prior to surface preparation and painting operations. All protective covers shall be removed upon completion of paint application.

3.5 Surface Preparation

Surfaces shall be prepared for coating in accordance with SSPC specifications and preparation technique for each surface shall be indicated in the painting schedule by the Contractor.

The anchor profile provided on steel shall be not less than that specificed by SSPC-SP-6.

After blast cleaning, dust, loose particles and spent abrasives shall be removed from the prepared surfaces by compressed air or vacuum cleaning, and the cleaned surfaces shall be primed as soon as possible after blasting and always before surface starts to rust. Cleaned surfaces shall not be allowed to stand overnight before coating.

Where applicable, dirt, dust, oil, grease and similar contaminants shall be removed by solvent cleaning in accordance with SSPC-SP-1.

3.6 Mixing

All ingredients shall be thoroughly mixed before use and agitated frequently during application to keep the paint in suspension. Mechanical mixers and agitated pressure pots shall be used as required.

Paints shall be thinned only when necessary for good application properties, and only with the recommended thinner, in amounts recommended by the paint manufacturer.

Catalysts or other types of multipackaged paints shall be mixed in strict accordance with manufacturer's recommendations and instructions.

3.7 Application

In general, the Manufacturer's specifications regarding the mixing, thinning, application, drying and general handling of the various materials shall be followed as being supplementary to this Specification.

Spray application may be used at the Contractor's option in non-enclosed areas when the spraying can be closely controlled to prevent spattering any other property.

Effective oil and water separators shall be used in all compressed air lines to remove oil or moisture from the air before it is used. Separators shall be placed as close as practical to the equipment. The effectiveness of the separators shall be tested by means of the "white blotter test." The test shall be performed prior to blasting or spray coating, and at intervals of four (4) hours during the work. Tests shall be at full operating pressure and velocity.

Nozzle sizes and pressure settings for spray equipment shall comply with the manufacturer's recommendations.

When coatings are applied by spraying, each coat shall be sprayed in two directions at right angles to each other, to obtain complete coverage. Care shall be exercised during spraying to avoid excessive evaporation of the volatile constituents, loss of material into the air, and the bridging over of crevices and corners.

Areas inaccessible to the spray gun shall be coated by brush and if not accessible by brush, daubers or sheepskins. Brushes shall be used to work coatings into cracks, crevices, and blind spots which cannot be adequately coated by spray.

When coatings are applied by brush or roller, the surface shall be cross-brushed or cross-rolled to secure uniformity of surface and the specified paint film thickness.

Film thickness of the coating being applied shall be periodically checked using a wet film thickness gauge. Dry film thickness shall be calculated from wet film thickness and volume solids and as recommended by the Coating Manufacturer. In addition, each coat shall be visually inspected for holidays and thin spots before the next coat is applied.

Steel which has been coated shall not be handled, worked on, or otherwise disturbed until the coating is completely set. Sufficient time shall elapse between coats to permit them to dry hard. All coats of coated surfaces shall be unscarred and completely integral at the time of application of all succeeding coats.

Prior to application of the finish coat, all visible rust resulting from construction damage, or other coating or surface defects, shall be removed and the surface prepared to the requirements of SSPC-SP3 Power Tool Cleaning and the prepared surface re-primed per Purchaser approved repair procedure.

3.8 Testing of Materials

The dry film thickness (dft) of non-metallic paints applied to magnetic surfaces shall be measured nondestructively using the "Elcometer" thickness gauge, as marketed by Gardmer Laboratories, or similar magetically operated testers. Non-metallic paints applied to nonmagnetic surfaces shall be measured using a battery powred, pentrating - needle type thickness gauge such as the "Gardner Thickness Gauge", also marketed by Gardner Laboratories.

3.9 Inspection

All work performed under this Contract shall be subject to inspection by Purchaser.

All definiencies, defects and damage revealed by the inspection and cased by test methods used shall be propmtly reparied or corrects, using the applicable type, grade and color of finish coat material, and preparation methods.

Any part of the paint system which is defective shall be corrected. The method of repairing damaged areas shall be in accordance with the requirements listed for the original system. Damage to adjacent systems painted by other shall be corrected in the same manner. Field touch-up of shop primer shall be with the same paint as the original primer.

3.10 Touch-Up

All shop-primed and shop-topcoated steel shall be touched up in the field as required, prior to final field, topcoating. Touch-up shall include any damaged or masked areas.

Field touchup shall be done after final erection or assembly, unless otherwise specified.

3.11 Clean-Up

All surfaces not coated under this specification, or those previously coated, shall be carefully protected during coating work.

Any unspecified coatings which are found during inspection shall be thoroughly cleaned and the original finish restored at the Contractor's expense.

Name and data plates on equipment shall not be painted and shall be left clean and legible upon completion of the project.

3.12 Paint System

The paint system descriptions provided herewith outline the generic paint system names. The paint system numbers are then utilized in the approved coating Manufacturer's system schedule and the Application Schedule to dictate the coating system for each type of substrate.

Ferrous Metal:	Prep:	SSPC-SP-6
	Prime:	Recoatable Polyamide Epoxy
	Topcoat:	100% Acrylic Gloss
Examples of Approved	System:	Mfgr. - Sherwin Williams
	Prime:	B67H5/B67V5
	Topcoat:	B66 Series DTM Acrylic Gloss

3.13 Project-Specific Requirements

The attached Project Specific Requirements, if any, are additions, deletions and/or revisions to the requirements of this Specification and shall be considered a part of this Specification.

3.13.1 CHANGE ALL REFERENCES TO SA-502 TO SA-550

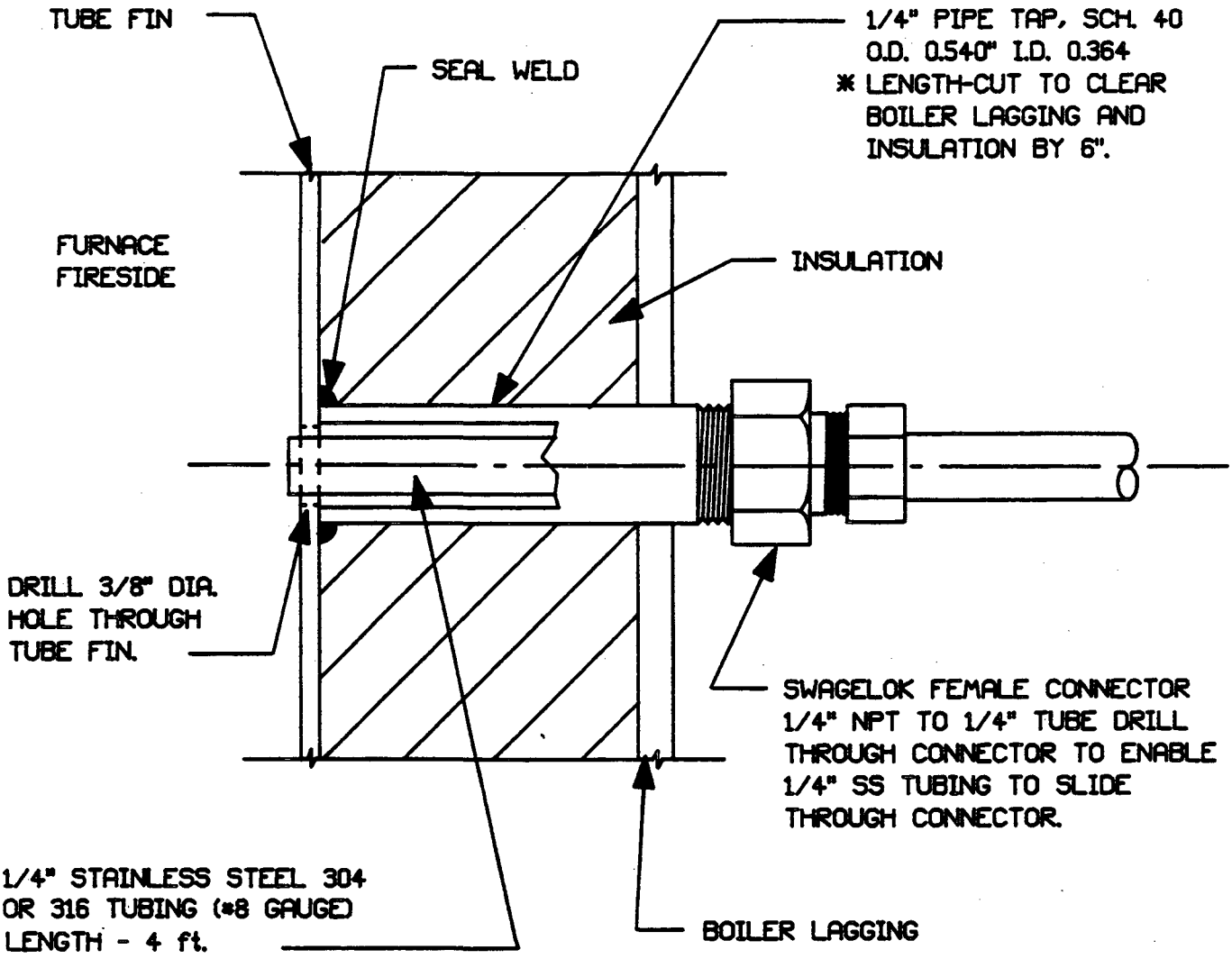
ATTACHMENT 1

DOCUMENTS SUBMITTAL SCHEDULE

Documents for Approval	Engineering Need Date For Vendor Data*	Schedule Date For Certified Vendor Submittal**
A. _____		
Technical Data Sheets	30	
Color Charts	30	
Paint Schedule	30	
Mixing/Application Instructions	30	
B. Documents for Information		
Certificate of Compliance	45	
Material Safety Data Sheets	30	

* Calendar days after award

** To be completed by seller and finalized prior to award



NOTE: CONTRACTOR SHALL INSTALL PIPE, TAP AND CAP.
PURCHASER WILL PROVIDE PROBE AND FITTINGS.

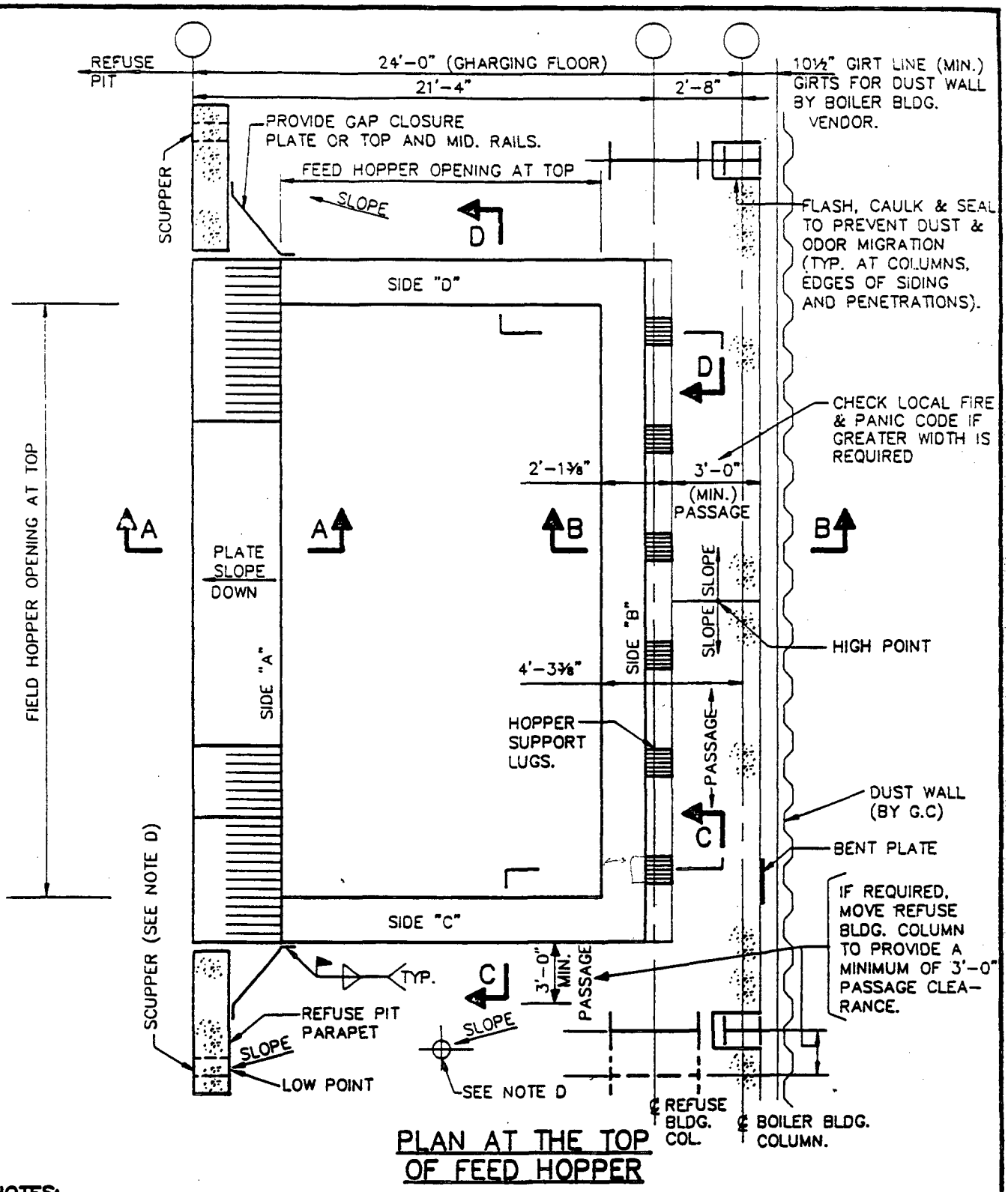
AN OGDEN COMPANY	ATTACHMENT 11 FURNACE SIDEWALL TEST TAP PENETRATION	OGDEN PROJECTS, INC. APPROVED: [signature] DATE: 10-9-90 DWG. No. REV. 1

ATTACHMENT 12

REFUSE FEED HOPPER SUPPORT AND PASSAGEWAY

The following sketches are included as part of this boiler specification. Contractor shall comply with all requirements of these sketches.

Sketches included are: RS-412A, RS-412B and RS-412C - Martin Feed Hopper Support and Passageway at Charging Floor.



PLAN AT THE TOP OF FEED HOPPER

NOTES:

A) FEED HOPPER SUPPORTED ON SIDES A & B ONLY.

B) THERE ARE NO ANCHOR BOLTS CONNECTING FEED HOPPER & SUPPORT BEAM/CONCRETE.

C) SIDE "B" CARRIES MAXIMUM HOPPER LOAD

D) WHEN SCUPPERS ARE NOT PERMITTED BY RFP & SERVICE AGREEMENT, USE FLOOR DRAINS.

(ALL ELEVATIONS REFERENCED TO DATUM 0'-0" BOILER FLOOR.)

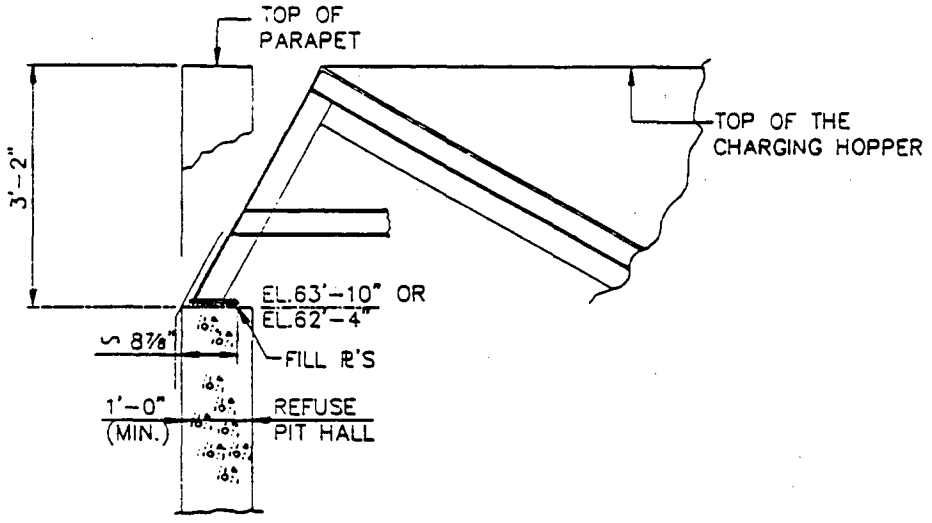
REVISION
1 DATUM 0'-0" SUBSTITUTED FOR 100'-0".

AN OGDEN COMPANY

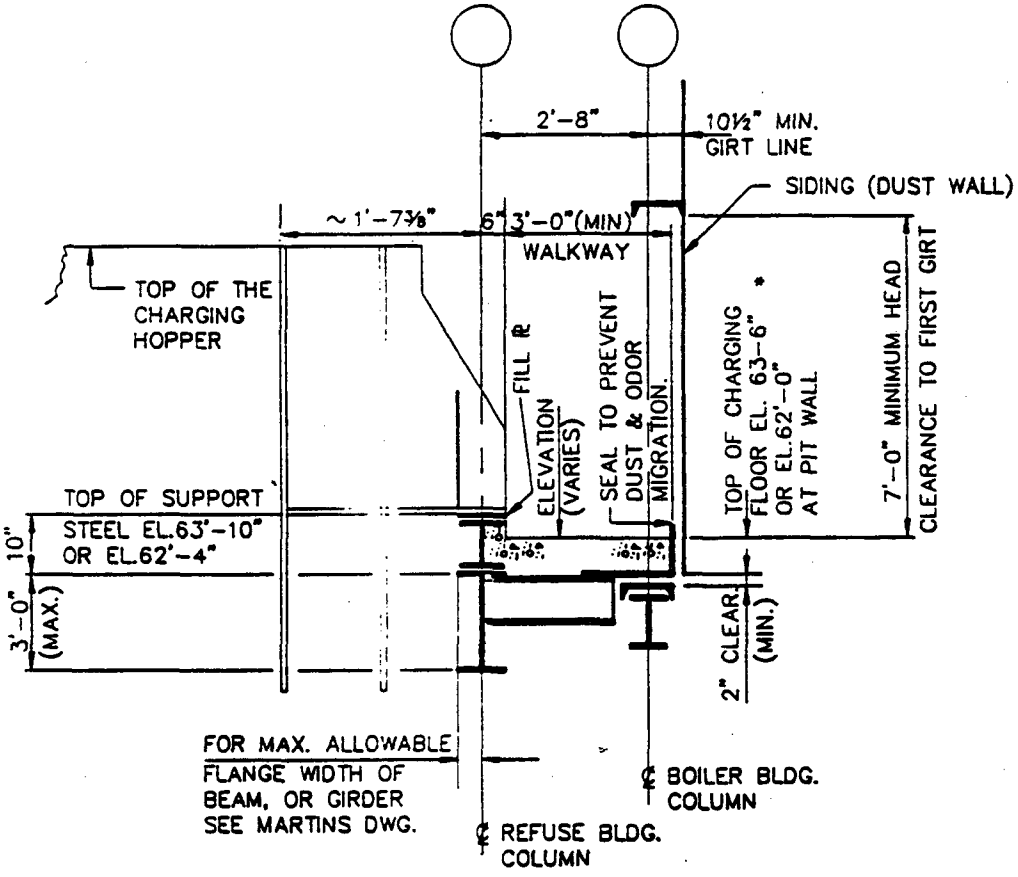
MARTIN REFUSE FEED HOPPER SUPPORT AND PASSAGE WAY AT CHARGING FLOOR

OGDEN PROJECTS, INC.

APPROVED: PJM	DATE: 8/26/91
DWG. NO. RS-412A	REV. 1



SECTION A-A



SECTION B-B

NOTES:

* ELEVATION VARIES WITH NUMBER STOKER STEPS
15 STEPS ELEV.=63'-6"
18 STEPS ELEV.=62'-0"

WORK THIS STANDARD WITH RS-412A & C

1	DATUM 0'-0" SUBSTITUTED FOR 100'-0".

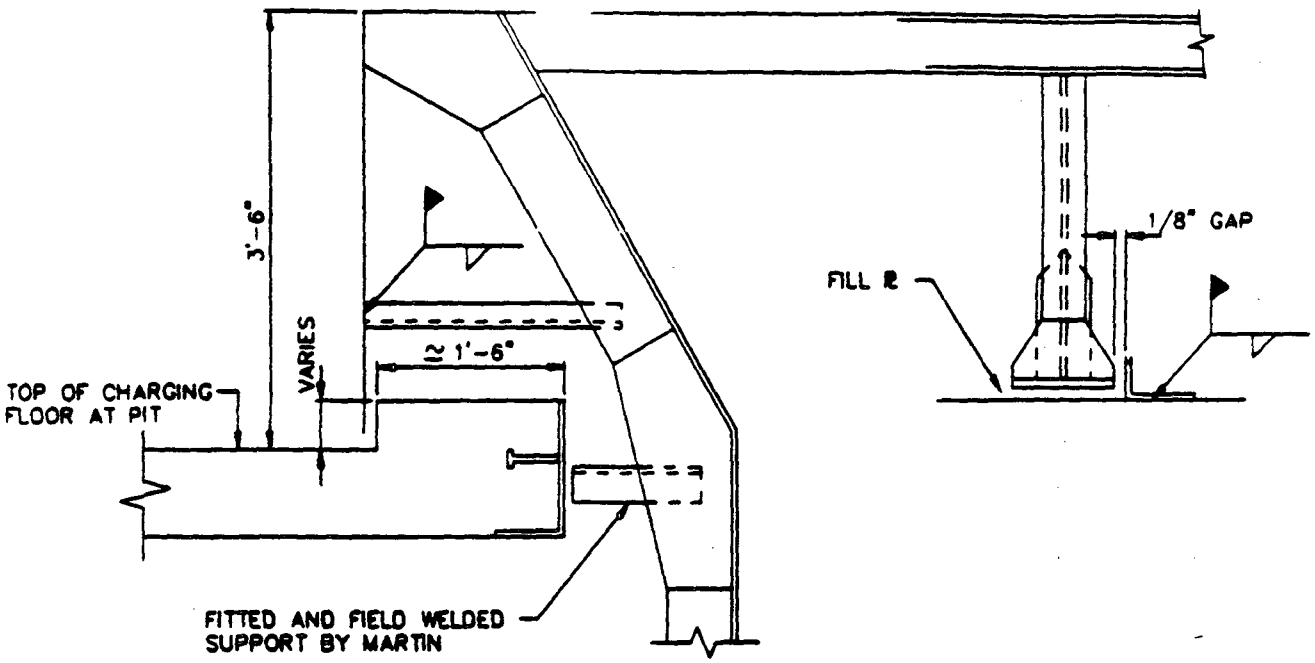
REVISION

AN OGDEN COMPANY

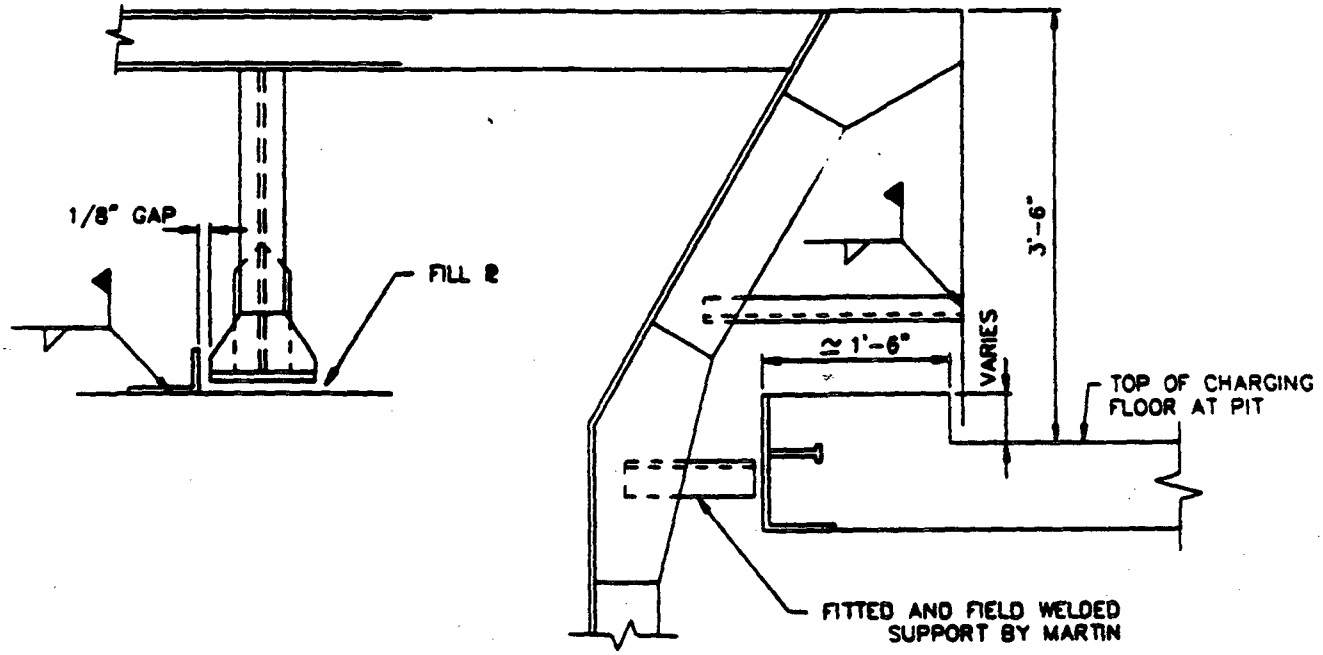
MARTIN REFUSE FEED HOPPER SUPPORT AND PASSAGE WAY

OGDEN PROJECTS, INC.

APPROVED: PJM	DATE: 8/30/91
DWG. NO. RS-412B	REV. 1



SECTION C-C



SECTION D-D

AN OGDEN COMPANY

MARTIN REFUSE FEED HOPPER SUPPORT AND PASSAGE WAY

OGDEN PROJECTS, INC.

APPROVED	DATE
PJM	5/19/86
DWG. NO. RS-412C	REV. 0

ATTACHMENT 13

INSTRUCTIONS REGARDING ERECTION OF THE MARTIN STOKER

The following guidelines are part of SM-101, Technical Specification for MSW Steam Generators, and shall be complied with by the Boiler Supplier:

1. Measure and check the grate supporting structure. Fix grate datum point.

2. Hang the undergrate hopper below grate.

3. Fit and bolt the grate front together.

4. Install shop-assembled grate runs. Fit in clinker dam supports and clinker rollers of the field assembled grate runs (for grate with 3 or more runs).

5. Put into place undergrate hoppers and underfire air plenum bottom plates (for grates with 3 or more runs).

6. Fit and bolt bulkheads, grate driving beams, and carrier beams (partly shop-assembled) of the field assembled grate runs.

7. Level out grate front and grate.

8. Weld grate front, grate, and undergrate hopper.

9. Assemble and bolt division plate supports, feed rams, and transition piece.

10. Erect chute as follows:

    a) Rear wall upper part.
    b) Side wall upper and center parts. Upper part and center part bolted and welded on the ground.
    c) Bracing beam.
    d) Rear wall center parts with chute gates (for grates with 4 or more runs).
    e) Front wall. Right-hand side front wall upper part, intermediate piece, and center part assembled and welded on the ground. Proceed the same way for left-hand side.
    f) Hang up buckstays for water jacket front wall on bracing beam or platform (for wide grates).
    g) Mount segments of water jacket front wall.
    h) Mount segments of water jacket rear wall.
    i) Mount water jacket side walls.

k) Buckstays for water jackets rear and front walls (for wide grates). Chute bolted and welded together.

11. Fit in grate structure and adjust as required.

12. Mount division plates and compensation blocks between grate runs, side plates and compression plates, top guide assembly for grate driving beams in the field-assembled grate runs, heat shields, seal air lines to driving beam support rollers.

13. Put into place ash discharger connecting piece, ash discharger, and ash pit. Complete sifting discharge ducts.

14. Assemble and adjust grate surface.

15. Fit underfire air control system.

16. Run piping systems as follows:

    a) Chute water jacket supply and drain lines.
    b) Hydraulic pump, cabinets, and piping.
    c) Compressed-air piping and cylinders.
    d) Pressure indicating lines and gauges.
    e) Grease pump and lines.
    f) Cooling air lines in grate front.

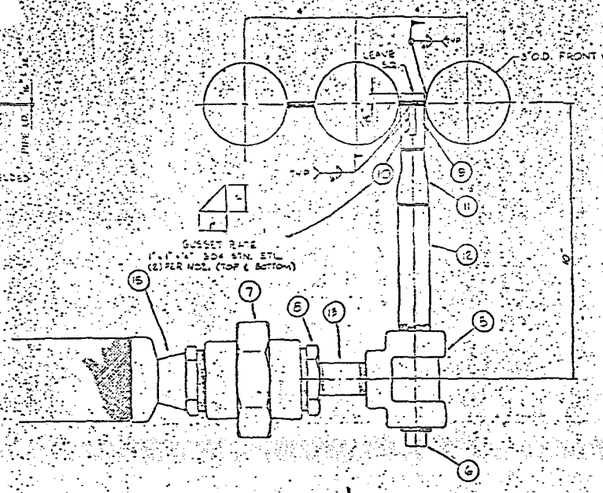
17. Electric systems:

    a) Limit switch and magnets.
    b) Local pushbutton stations.
    c) Measuring transducers for angle of rotation.
    d) Transmitters.
    e) Control cabinets.

18. Touch-up painting.

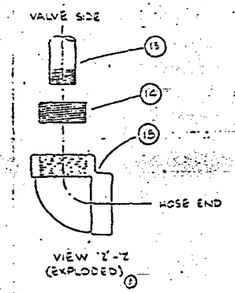
19. Measures to protect ready-mounted grate:

    a) Cover grate surface with wood.
    b) Secure all hydraulic cylinders with piston rods in entered position.
    c) Secure chute damper in closed position (from top).



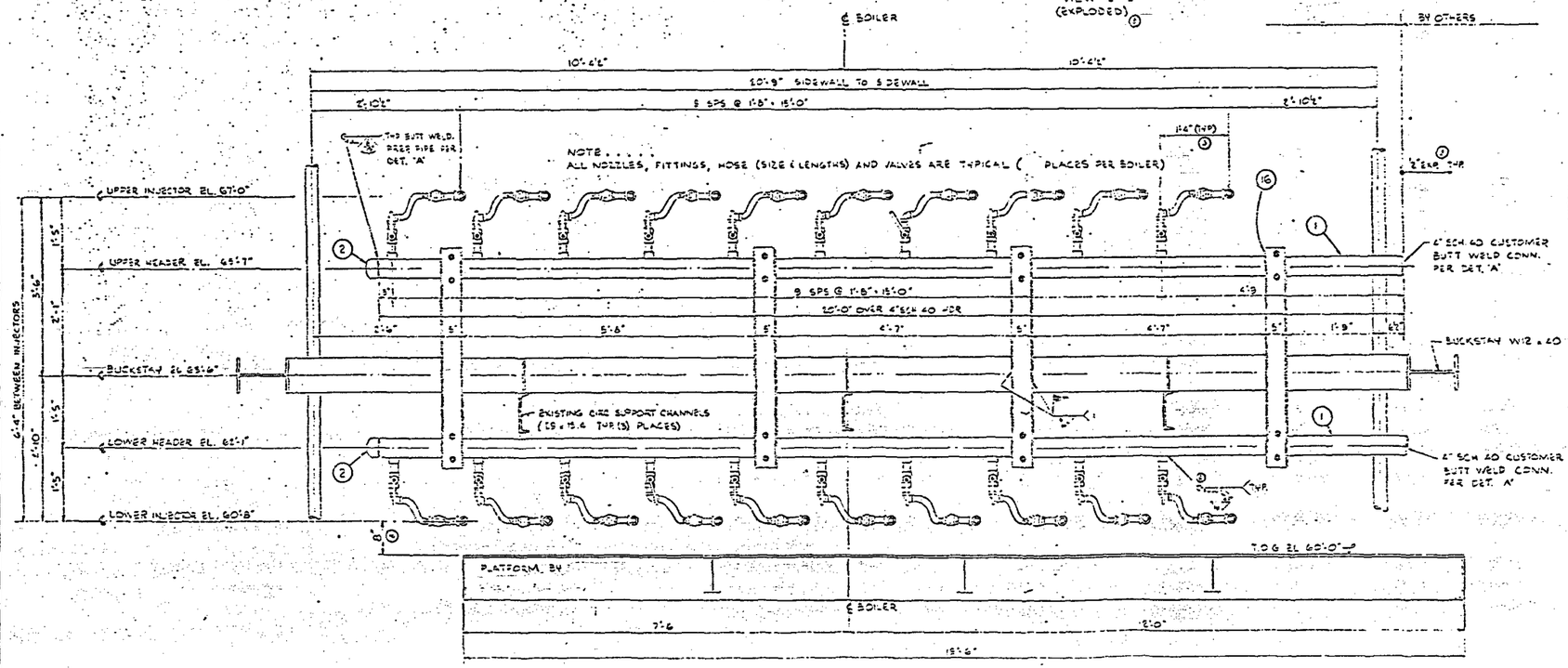
NOTE....
1. ACCESS TO HEADER AND NOZZLE LOCATION WILL BE RESTRICTED BY (3) CIRCULATOR SUPPORT CHANNELS HUNG OFF THE BUCKSTAY AT THE FRONT OF THE BOILER.
2. BORE SIZE FOR 1" THREDOLET IN HEADER = 1.06"
* 3. QUANTITIES SHOWN ARE FOR (1) UNIT.

NOTE:
CUT 4 3/8" HOLE THRU WELD WALL MEMBRANE FOR NOZZLE PENETRATION.

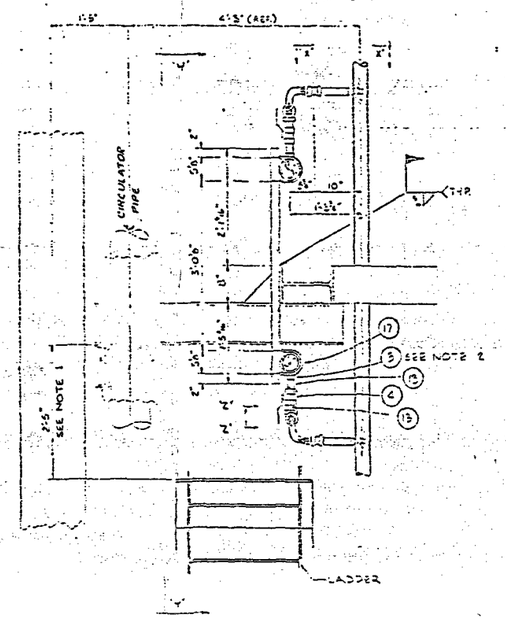


ITEM NO.	QTY	DESCRIPTION
1	2	PIPE, (HEADER) 4" SCH. 40 x 20'-0" LG. SA-106-B
2	2	CAP, 4" SCH. 40, SA-234 WPB, BUTT WELD.
3	20	THREDOLET, 3-4 x 1" 3000#, A-105 F.S.
4	20	BALL VALVE, 1" STL., SCR ENDS, TEFLON SEATS, JAMESBURN NO. 33-T1000TL, OR EQUAL
5	20	TEE, 1"-3000#, A-105 SCR.
6	20	PLUG, 1" SQ HD. I.P.S. A-105 SCR.
7	20	UNION, FEMALE, 2"-3000# A-105 F.S. SCR.
8	10	BUSHING, HEX HEAD, 2" x 1"-3000# A-105 F.S. SCR.
9	20	PIPE, 1/2" SCH 40 S.S. STAINLESS STL. NOZZLE x 2" LG.
10	40	GUSSET PLATE, 1" x 1" x 4" STN. STL. 304
11	20	REDUCER, CONCENTRIC 1" x 2". S.S. STN. STL. OR 304 STN STL, B/W
12	20	PIPE NIPPLE, 1" SCH 80 x 5 1/2" LG. SA-106-B (T.O.E.)
13	60	PIPE NIPPLE, 1" SCH. 80 x 3" LG. SA-106-B (THREADED)
14	20	FLUSH BUSHING, 2" x 1"-3000# A-105 F.S.
15	20	HOSE, FLEXIBLE, 2" I.D. x 210" LG. FLEXONICS TYPE 461, 304 STN. STL. W/MALE PIPE ENDS, OR EQUAL
16	4	CHANNEL, C8 x 6.7 LB A-36
17	8	U-BOLT W/NUTS, FIGURE 206, 4" PIPE 5.25, POWER PIPING, OR EQUAL
18	20	ELBOW, 2"-3000# 90° A-105 F.S. SCREWED

DESIGN CONDITIONS:
MEDIA: AIR & AMMONIA MIXTURE
DESIGN PRESSURE: 50 PSIG
DESIGN TEMPERATURE: 650° F



FRONT VIEW BOILER 1 @ Y-Y AS SHOWN
BOILER 2 OPPOSITE SHOWN



RIGHT HAND SIDE ELEVATION BOILER 1

ATTACHMENT 14