REVISIONS

001	Initial Issue	01/01/87
002	Revision	04/25/88
003	Revision	11/30/90
004	Revision	09/24/91

OGDEN PROJECTS, INC.

TECHNICAL SPECIFICATION
FOR
CONTROL PANELS

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1.0 GENERAL

1.1 Scope

This specification, together with the attached control panel sketches covers the technical requirements of the main control panel suitable for mounting in the control room and of the local control panels suitable for mounting in the field, adjacent to the equipment they control.

The equipment furnished according to this Specification shall conform exactly to the requirements contained herein, unless modified in writing by a revision or an Addendum to this Specification.

2.0 TECHNICAL REQUIREMENTS

2.1 General

2.1.1 Main Control Panel

The Main Control Panel shall consist of separate sections for Boilers, Auxiliaries, Turbo-Generator, Electrical, etc.

Panel sections shall be of the bench board design, with the electronic, indicating, recording, and controlling instruments, alarms, pushbuttons and indicating lights mounted thereon. The panel shall have a sloping bench board section, a vertical section and a forward sloping section at the top.

The bench board section shall not exceed 24 inches in depth, to allow reaching and operating the instruments mounted on the vertical section.

The main control panel shall be NEMA 12.

2.1.2 Local Control Panels

The local control panels shall be of the vertical freestanding design, with the indicating, recording, and controlling instruments, alarms, pushbuttons and indicating lights mounted thereon.

The local control panels shall be NEMA 4.

2.2 Environment

Control room panels will be installed in an air conditioned control room. The normal operating conditions will be 75-F and 50% relative humidity. Temperature may vary between 50-F and 95-F, and the relative humidity between 50% and 100%. Panels and all instrument and devices furnished by Seller shall be designed to operate continuously under any of the above conditions without degraded performance.

2.3 Work, Materials and Services Provided by Seller

- Design and fabrication of a complete and functional control panel(s) assembly
- Installation and wiring of Purchaser supplied instruments, components, and control panel inserts
- Shop tests of the assembled panel
- Packaging and shipping panel to site
- Documentation and drawings

2.4 Work, Materials and Services Provided by Purchaser

- Panel layout drawings with graphic diagrams
- Control panel inserts
- Receiving, unpacking, inspection and storage of panel sections at site
- Installation of panel including mounting and connection of field wiring
- Field testing of panel as installed

2.5 Applicable Standards

The equipment furnished shall comply with the latest issue of the standards listed below.

Instrument Society of America

ISA RP60.6 Nameplates, Labels and Tags for Control Centers

ISA RP60.8 Electrical Guide for Control Centers

National Fire Protection Association

NFPA 70 National Electrical Code

National Electric Manufacturers Association

Standard NEMA enclosures

2.6 Construction

2.6.1 Main Control Panel

The control panel shall be fabricated of hot rolled steel, continuous-welded and bolted to a rigid self-supporting frame structure. The frame shall be a box type construction using 2" x 2" x " angle iron minimum.

The panel front mounting surface shall have a minimum thickness of 3/16 inch; all other panel sections shall be 11 gauge minimum. The panel shall be arranged for floor mounting and bottom cable entry. The bottom frame shall have four holes, each 3/4 inch, to accomodate 1/2 inch anchoring studs and provide for alignment. Four leveling legs, one in each corner of the bottom frame, shall also be provided. The panel(s) shall be provided with vibration dampeners.

Panel mounting surfaces shall be suitably reinforced and stiffened to prevent distortions due to the cantilever forces of installed instruments and other internal materials. Unistrut, or equal, members shall be provided inside the enclosure for the support of instruments, sub-panels, wiring, incoming cables, or other internal materials. These supports shall leave adequate clearance around the equipment for servicing or removal without interrupting the operation of neighboring devices.

Cutouts and openings provided shall be sized to equipment manufacturer's specifications. It shall be Seller's responsibilities to verify all cutout dimensions with the equipment manufacturer. All cutout edges shall be ground smooth.

The panels shall be square and plumb and the entire steel surface shall result in a workmanlike appearance; all seams shall be continuous-welded, and ground smooth. Scratches, bulges, recesses, etc. shall be ground and/or filled with metal putty to make them invisible on the finished panel.

The panel shall be totally enclosed with rear removable hinged metal doors, capable of opening 130 degrees. The hinged doors shall be provided with three point latch, recessed keylock and handles. Removable covers shall be furnished on the front of the panel to provide access under the benchboard. All equipment shall be capable of operating with the panel doors removed without any degradation of performance.

Ventilation louvers shall be located at the top and bottom of each door, and on the front access panels. Each vent shall be covered on the inside with a screen of sufficient open area to permit natural air circulation.

Internal fluorescent lighting and 120V, 20 amp utility receptacles shall be provided for each panel.

Panel dimensions shall conform to the overall dimensions shown on the attached sketch. Multiple sections shall be furnished when the panel length exceeds 10 feet or when the overall length is excessive for shipping, handling and installation.

Panels that consist of multiple sections shall be framed and fabricated so as to form a continuous panel when bolted together. Each panel section shall be self supporting and shall not rely upon adjacent sections for structural support. They shall be securely fastened together by bolting their adjacent frame members. Corner sections shall be provided if the panel layout drawing indicates "L" or "U" type panel arrangement. Panel sections shall line up within 1/16 inch without gaps and without trim strips.

The control panel benchboard shall be provided with a stainless steel wearing plate with rounded edges along the front edge and on the exposed edge of the board. The panel shall further be provided with a stainless steel kick-plate along the bottom.

Removable lifting lugs shall be provided on top of the panel to allow for four point lifting per section.

Rack mounted accessory items, relay cabinets, conduit, wireways and other appurtances, mounted on the rear of the panel, shall be supported by the rear steel framework. Panel face, removable panels, doors, etc. shall not be used to provide support structures. Panel structural steel or additional members shall not interfere with or otherwise hinder the accessibility of all instruments for maintenance or ease of removal.

2.6.2 Local Control Panels

The local control panels shall be of the freestanding design, fabricated of hot rolled steel continuous-welded and bolted to a rigid self-supporting frame structure.

Steel thickness and fabrication details shall be essentially the same as for the Main Control Panel, described in paragraph 2.6.1 above, with the exception of those described under this paragraph.

The panels shall be totally enclosed and of NEMA 4 construction, suitable for outdoor locations, adjacent to field equipment. Exposed devices on the panel shall be rated NEMA 4.

Panels shall be of the vertical design (no benchboard), and arranged for floor mounting and top cable entry.

Local panels shall not be designed to be mounted on, or supported from process equipment or piping. Rain shield shall be provided if the particular location requires.

2.7 Panel Wiring

Main Control Panel will have field cable entry from the bottom and local control panels will have field cable entry from the top. In either case, the Seller shall provide ample space for bringing and terminating the cables directly to the terminal blocks.

Panel wiring shall be provided to inter-connect electronic loop components, alarms, relays, annunciator, power supplies, switches, indicating lights and other control devices within the control panel.

The wiring will consist of electronic signal (4 to 20 mADC), control (120V AC, 125V DC), low level signal (millivolt) and power supply (24V DC, 120V AC). Each type of wiring shall be run in separate conduit or wireways, grouped and separated to eliminate electrical interference. Power or control wiring shall be separated from signal wiring by at least 6 inches. If the power wiring has to cross the signal wiring, the crossing shall be as close to right angles as possible.

All electrical wiring shall be arranged so that all conductors entering or leaving the control panel are terminated on barrier type terminal strips, located at the rear of individual panels. Separate terminal strips shall be provided for connecting electronic signal, low level signal, control AC and DC power supply wiring. Parallel terminal strips shall be separated by a minimum of 6 inches to allow for wireways, wire bundles, wire bends, visibility of wires and terminal numbers. Thermocouples shall be wired directly to the temperature instruments to prevent creating another intemediate junction.

Instrument input/output, switches, contacts, indicating lights and other components shall be individually wired to permit removal and testing without disconnecting other components in the same control loop or circuit. "Daisy chain" wiring of neutral or ground between instruments of different control circuits is not permitted. Wiring shall be continuous (without splices) between terminal points.

All wiring connections shall be terminated through insulated ring tongue lugs and not more than two wires shall be connected to one terminal. A heat shrink sleeve type wire marker, engraved with wire number, shall be permanently affixed to each wire at both ends.

The maximum length of uninsulated or unshielded stripped wire or cable to a termination shall be one inch.

Terminal strips shall be phenolic with screw terminals suitable for No. 12 AWG wire as a minimum. Twenty percent spare terminals shall be provided for each row of terminal strips. Terminal strips shall be furnished with fanning strips and termination designations. Each terminal block shall be permanently identified. The incoming terminal block for current transformer circuit shall be a shorting type.

Wire and cables shall be routed through conduit or plastic covered wireways. Wiring ducts shall be provided for Purchaser's incoming cables. Maximum fill of the wireways shall be 75 percent. Wireways shall include the necessary ducting, covers, fasteners, wire retainers as required. Branch wiring shall be grouped and tied with tie wraps for neatness.

Where not practical to run in wireway, wires shall be bundled, wrapped with self-locking wire ties that are secured to the panel with adhesive mountings. Wires or bundles shall be grouped in vertical or horizontal runs and installed in a pleasant and uniform appearance.

If prefabricated cables are used to interconnect components inside the panel, they shall be trimmed of excess length by re-formatting one of the connectors.

Panel wiring shall have stranded conductors with type of insulation, wire gage and rating as follows:

Service	Wire Size	Rating	Insulation
Instrument and Low Level Signal	No. 16 AWG	600 volt	SIS
Control Circuit and Power	No. 14 AWG	600 volt	SIS
Incoming Power (120VAC)	No. 12 AWG	600 volt	XHHW
Current Transformer Circuits	No. 10 AWG	600 volt	SIS

Panel wiring shall be color-coded; the following are acceptable colors:

Service	Color
Analog low level (4-20 mA, 1-5V, etc)	Positive (+) black Negative (-) white common (-) blue
120 V AC (hot)	black
120 V AC (neutral)	white
120 V AC (control circuit)	red
Annunciator	orange
Grounds (safety, instruments, shields)	green
125 V DC (control circuits)	yellow
Current Transformer Circuits	gray

Deviations from this color-code shall be approved by Purchaser before implementation.

2.8 Ground Bus

A copper isolated instrument ground bus " x 1" shall be furnished to ground signal shields, signal common and instrument power supply common. A solderless lug connector shall be furnished at the end of the panel for a 4/0 AWG stranded cable.

A copper panel ground bus, " x 1" shall be provided to ground instrument chassis, console frame, Purchaser's ground cable and any other device grounds. A solderless lug connector shall be furnished at the end of the panel for a 4/0 AWG stranded cable.

Both buses shall be run for the entire length of the panel and panel section.

2.9 Pushbuttons and Indicating Lights

Pushbuttons, selector switches and indicating lights shall be heavy duty, oil tight type. The pushbuttons and selector switches may have momentary and/or maintained contacts depending on circuit design. Contacts shall be rated at 10 amperes, 120V AC or 1 ampere, 125V DC, continuously.

Indicating lights shall be single lens low voltage type with built-in dropping resistor or transformer for low voltage lamps. Indicating lights on the panel graphic display shall have "push to test" pushbutton(s) which shall test a group of lights when pressed.

Color lens shall indicate the following:

Red	Motor Running Device Energized Valve or Damper Open (On-Off) Normal Path (3-Way Valve) Power - On	Blue	Supervisory or automatic indication
Green	System Ready Circuit Breaker Open Valve or Damper Closed (On-Off) Branch Flow Path (3-Way Valve)	Amber	Alarm indication
White	Permissive indication		

2.10 Power Supply Distribution

Power supply circuits shall be furnished for the local panel and each of the main panel sections as follows:

120V AC - Grounded from UPS for instrument power supply including recorder drives
120V AC - Grounded for miscellaneous AC control circuits and panel power
125V DC - Miscellaneous DC control circuits
120V AC - Lighting and convenience receptacles

"Wiremold" strips, spanning the length of the panel shall be furnished for each row of instruments. Each strip shall have plug receptacles for panel grounded electrical plugs and shall have a circuit breaker for disconnect purposes.

All instruments related to the same control loop shall be serviced from the same power supply circuit. Multiloop and individual power supplies furnished with instruments shall be mounted and fused.

A fuse shall be furnished for each power supply and individual control circuit.

24 volt DC instrument power supply and 125V DC power supply wiring shall be run in wireways separate from AC power. A common wireway may be used if they are separated by a barrier.

2.11 Relays

Relays used for interlocks and alarms shall be of 600 volts industrial type, rated for continuous duty. Contacts shall be convertible type, rated at 10 amperes, with molded coil to operate at 120 volts, 60 Hz or 125 volts D.C., as required. Contact form and quantity for each relay shall be as called for on the elementary diagram.

2.12 Graphic Display

Graphic displays shall schematically represent the process and equipment as shown on the layout drawing. The relative scale and arrangement of equipment symbols and process lines on graphic shall be as shown on the drawings. The size of the graphic display work shall be as required to fit on the upper sloping section of the control panel. Size and shape of the symbols and flow lines shall be proportionated to the size of the display work.

The symbols and flow lines shall be color coded with nameplates and inscriptions to identify the equipment and flow lines. Flow lines color code shall be as specified on the Purchaser's drawings. Seller shall supply color "chips" for the final selection of the graphic color code.

Flow lines at equipment symbols, interconnecting, primary process lines, secondary process lines and instrument line shall contact each other. Arrows shall show flow direction where lines are broken or discontinuous and where entering and leaving equipment. Corners on flow lines shall be mitered.

A red pilot light shall be mounted in the graphic symbol for each electrically driven piece of equipment to indicate when the equipment is running.

For the upper section of the control panels installed in the main control room, a mozaic tile graphic display work (Panelmatic or approved equal) shall be used. The mozaic tile graphic work shall be manufactured as a stand-alone insert, and mounted as such in the control panel. Sufficient surface shall be allowed on the balance of plant display work for future expansion of the plant, if so required in the project specific section of this specification.

For the benchboard sectoin of the control room panels, the graphic display work shall be laminated plastic attached to the panel using adhesive. Symbols shall be manufactured of 3/32 in. (total thickness) laminated, colored, phenolic bonded to phenolic base. Flow lines shall be 1/16 in. (total thickness) colored phenolic base. Seller shall describe the manufacturing method(s), materials used, method of attachment to the panel surface, etc. Catalog pages and/or photographs showing samples of Seller's graphic display work shall be submitted with bid.

Equipment symbols shall be identified with nameplates or with the identification marks inscribed directly on the symbol. Letter size shall be as follows:

- Equipment number - 5/32 in. high
- Equipment identification - 1/8 in. high

Instrument and other specific nameplates shall be as follows:

- Nameplates for panel mounted instruments - white with black letters.
- Nameplates for the identification of line endings - line color with contrasting letter colors.

Lettering shall be as follows:

- Line end nameplates - 5/32 in. high
- For instrument nameplates, see 2.14

2.13 Painting and Finishing

Panel shall be free of rust, scale, distortion and warpage. Surface shall be sandblasted with No. 00 grit, and shall be painted with two coats of rustproof primer and two coats of semi-gloss air dried lacquer. Panel color to be determined by Purchaser. Panel interior shall be primed and painted white.

2.14 Identification and Instrument Nameplates

Identification shall be provided for all equipment. A nameplate shall be furnished for each instrument or device located on the front of the panel. The size of the nameplates shall be as indicated on the drawings.

Nameplates shall be manufactured of 3/32 inch thick white laminate having a black core and engraved with the inscription listed on the panel drawing or nameplate list using 3/16 inch high characters with a 0.040 inch thick stroke. The characters shall be arranged symmetrically about the plate's vertical center line and formed by cutting through the laminate into the black core. Nameplate front surface edges shall be beveled to frame the nameplate with a border.

For control switches and indicating lights the nameplate shall be engraved with the operated equipment tag number and English descriptor only. The control switch instrument number shall not be engraved. For the other instruments for which a tag number is assigned, the nameplate shall be engraved with the tag number and English descriptor.

Each instrument on the back of the panel shall be identified wih an item number engraved on a black laminated nameplate having a white core. Auxiliary equipment shall be identified with the item number of the equipment it serves. Equipment flush mounted on the front of the panel shall be identified at the rear of the panel with item number only. Item number characters shall be 1/4 inch high.

Nameplates shall be fastened to the graphic sections of the control panel using permanent adhesive. Nameplates shall be fastened to the vertical and benchboard sections using two self tapping screws.

Nameplates shall not be attached to removable covers or instrument cases.

3.0 TESTS AND GUARANTEES

3.1 Panel Inspection

Test instrumentation, personnel and facilities shall be provided for shop tests of the panel. Panel inspection shall consist of checking general appearance, workmanship and conformance with the contract drawings. Nameplates, wire tags and similar markings shall be checked for proper location and identification.

3.2 Shop Tests

The panel shall be completely tested and checked out to assure a trouble-free, working installation in the field. Seller shall be responsible for all testing, repair, and re-testing as outlined in this specification.

Complete records shall be kept of all tests and test reports. These shall be made available to Purchaser for inspection and approval.

Shop demonstration may be witnessed by Purchaser. Seller shall notify the Purchaser at least two (2) weeks prior to testing in order that Purchaser representative may witness such tests at their discretion.

Point to point wiring continuity checks shall be performed prior to energizing the panel.

Shop tests shall consist of initial tests of all components and sub- assemblies along with a full functional test of the complete system and all auxiliary equipment. This test shall be performed with all equipment connected in the same manner as it will be in the field to permit verification of proper system operation. After complete assembly, each circuit shall be tested to ground, rung out and functionally tested under simulated service conditions. All wiring shall be checked by actual operating tests for accurate conformity to wiring diagrams and for continuity.

Seller shall supply testing and calibration facilities along with all dummy inputs and outputs necessary to simulate field conditions.

Functional and operational tests shall be performed for all devices such as recorders, annunciators, indicators and lights whether furnished by Seller or Purchaser. All indication, alarm and interlock circuit shall be tested to ensure proper operation. Recorder pens shall be set at zero, half scale and full scale using suitable test inputs. Alarm set points shall be adjusted, to values provided by the Purchaser, and actuated to alarm their corresponding annunciator points.

Control packages which are furnished by the Purchaser as panel inserts do not require calibration or functional testing.

Test procedures and type of test equipment shall be submitted to Purchaser for information.

Seller supplied components which are found to be defective or damaged shall be replaced without cost to Purchaser. If any Purchaser furnished component is found to be faulty, the Purchaser shall be notified for disposition.

3.3 Field Acceptance

Field acceptance tests for the control panel and all the devices mounted thereon will be performed by the Purchaser for installation and connection of all external wiring.

Services of an engineer may be required to provide technical direction for uncrating, installing and aligning of the control panel sections. Seller shall quote this item as an option.

4.0 SUPPLEMENTARY REQUIREMENTS

4.1 Packaging, shipping and Storage

Panels quoted shall be F.O.B. jobsite. The control panel sections shall be crated using a heavy skid and shall be cushioned to protect the finish of the instruments and panel face. Instruments mounted in cases or shelves shall be removed, and boxed in their original shipping cartons, with shipping stops in place, prior to transporting the panel.

Panels shall be capable of being shipped upright in an "air ride" van. They shall be lifted using removable lugs without causing frame distortion when raised.

4.2 Documents to be Furnished with Proposal

Sellers proposal shall include:

1. Catalogs, brochures and/or data sheets for Seller furnished equipment.
2. Total shipping weight and weight of each section.

3. Panel fabrication and assembly schedule from date of purchase order to delivery.

4. Services of an engineer for directing field installation and acceptance testing on a per diem basis.

4.3 Documents to be Furnished after Purchase

The Seller shall submit all drawings, sketches, schematics, and operation, maintenance, instruction manuals prepared for the fabrication and wiring of the panels, according to Attachment 1, (Document Submittal Schedule). The drawings submitted shall have the project title and purchase order number indicated on each page.

4.4 Nameplate Identification

Control panels shall be furnished with proper name tag, as shown on the technical documents and securely fastened to the front of the panel.

4.5 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.

Note to the User of the Specification

Replace this page with the following information and make it part of paragraph 4.4 when using this specification for a particular project:

Layout drawings of the control panels
Graphic schematics including color code for graphic lines and symbols
Control room arrangement
Elementary diagrams
Instrument loop diagrams
Control panel color
Layout and wiring drawings of control panel inserts
Instrument list of Purchaser furnished instrument and supplier.
Specification for the control panel installed equipment furnished
by the Seller
Nameplates engraving list
Annunciator engraving list

ATTACHMENT 1

DOCUMENTS SUBMITTAL SCHEDULE

Documents for Approval	Engineering Need Date*	Schedule Date for Certified Vendor Submittal**
Document Submittal Schedule	With the proposal	
- Equipment Outline & Building Clearance Drawings	30 days after Purchase Order	
- Equipment Loading Diagrams		
- General Arrangement Drawings of instruments (front and rear) and graphic displays		
- Point to point wiring drawings showing field and panel terminal connections	60 days after Purchase Order	
- Test Report	30 days after test	
Documents for Information		
- Storage and Handling Procedures	60 days before shipment	
- Installation, Operation and Maintenance Manuals	60 days before shipment	
- Shop test Program Procedure	60 days prior to test	
- Unloading Instructions	60 days before shipment	
- Priced Spare Parts List	At time of Purchase Order	

*Calendar days after award
**To be completed by Seller and finalized prior to award

ATTACHMENT 11.6

(NOT UTILIZED)

ATTACHMENT 11.7

OGDEN MARTIN SYSTEMS
of LEE, Inc.

SPEC NO. SC-318
ISSUE 002
DATE 04/20/91

TECHNICAL SPECIFICATION

FOR

INSTRUMENT INSTALLATION

Facility Name: LEE COUNTY RESOURCE RECOVERY FACILITY

Location: LEE COUNTY, FLORIDA

****

****

Specification Prepared By: A/E Name: OMSL

Address: FAIRFIELD, NJ

Telephone: 201 - 882-7071

A/E Approved for Release:

	Printed Name	Signature	Date
1.			
2.	R. TERRAMOCCIA	R. Terramoccia	11/19/91
3.			
4.			
5.			

Specification No. SC-318

OGDEN PROJECTS INC.

TECHNICAL SPECIFICATION
FOR
INSTRUMENT INSTALLATION

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Attachments: Instrument Installation Details

Instrument Air Supply	A-1
Air Distribution Manifold (5-Way)	A-2
Flow Transmitter Gas or Air	A-3
Flow Transmitter Steam	A-4
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Pressure Transmitter Steam Or Liquid	A-6
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15901 GENERAL

This specification together with Technical Data Sheets, Instrument Index, Location and Routing drawings, Installation Details and related drawings, as listed in the Appendix, provides the requirements for the following work to be done in a Waste to Energy plant. Any work or specification not covered under this specification shall be covered by project specific requirements.

Receive, inspect, store and maintain all instrumentation and control material and equipment furnished by Purchaser and Contractor for installation by Contractor.

Furnish and install all piping, tubing, fittings, instrument shutoff, test, equalizing, blowdown, drain and vent valves, valve manifolds, piping and tubing supports, appurtenances, and accessories for instrument, control and sampling tubing systems except as specified herein.

Furnish and install all instrument stands and brackets for instruments installed by Contractor.

Furnish and install all instrument blowback panels complete with all piping, tubing and valves.

Furnish and install all heat tracing and instrument enclosures for freeze protection for instruments not mounted indoors or in enclosed racks.

Furnish and install all bridals for level gauges, level switches, float operated controllers and transmitters, etc.

Quantities of materials required for installation shall be determined from instrument drawings, specifications, standards and field observation.

15902 APPLICABLE STANDARDS

The materials to be furnished shall be in accordance with the latest issue of the following Codes and Standards.

American National Standards Institute (ANSI)

ANSI B16.11	Forged Steel Fittings, Socket Welded and Threaded
ANSI B16.22	Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
ANSI B31.1	Code for Power Piping

American Society for Testing and Materials (ASTM)

ASTM A213	Seamless Ferritic and Austenitic Alloy Steel Boiler, Superheater and Heat Exchanger Tubes
ASTM B32	Solder Metal
ASTM B68	Seamless Copper Tube Bright Annealed

Instrument Society of America

ISA RP 60.9	Piping Guide for Control Centers
ISA RP 7.1	Pneumatic Control Circuit Pressure Test

15903 WAREHOUSING AND PROTECTION

Instruments and accessories shall be stored in the original shipping containers, above ground level, in bins or racks free from rain, or water contact, in a clean dry non-condensing environment where ambient temperatures remain between 32°F and 120°F.

All identification tags shall be left securely attached to the instrument and shall not be removed during installation. Care shall be taken to assure that the miscellaneous accessories are stored with the instrument with which they are associated.

Control valves, relief valves, rotameters, level devices and other instruments which will be installed in pipe lines or vessels are to be protected such that foreign matter cannot enter the end fittings, diaphragms, tubes or other internal parts of the instrument.

Tubing, pipe, fittings and valves used in the installation of pneumatic instruments shall be kept free of moisture and foreign matter. All ends shall be kept sealed during storage to assure that moisture and foreign matter do not enter.

15904 INSTALLATION OF INSTRUMENTS

The Instrument Index will list all drawings to be used in the installation of an instrument.

Instruments shall be mounted at the locations and elevations shown on the Piping Layout and Instrument Location Drawings giving easy access for maintenance and calibration so that test jacks, adjustments and the like are reached from the top, front or side and not from the bottom of the instrument.

Should the designated location or elevation of an instrument be found impractical or to result in interference with other equipment, Contractor shall select an alternate arrangement with Engineer's approval.

Instruments and primary instrument lines shall be installed from the root valve as shown on the attached Instrument Installation Details. These details shall be used as a guide for modifying, revising or developing new details for instruments and installations not included as part of these specifications.

Should the designated instrument connections on the piping layout drawings differ from those on the instrument, as furnished, the Contractor shall revise the connections to conform to the intent of the Instrument Installation Details.

Instruments shall be mounted plumb and level and in upright position unless otherwise indicated on the drawings. Impulse piping or electrical conduits shall not be used for support of instruments or accessories.

Field mounted instruments shall be mounted on racks, floor stands, structural steel or masonry structures. Floor stands shall not be mounted to deck grating. Instruments shall be grouped together by systems wherever possible. Tubing runs greater than 50 feet should be avoided. Instruments shall not be mounted on handrails nor vibrating equipment, and shall be provided with a clearance of not less than 3 inches between the handrail or railing and the mounting bracket. Where instruments are to be mounted on fire proofed members, the installer shall assure that the mounting hardware is in place prior to fire proofing. Mounting hardware attached to masonry shall be painted prior to mounting, to eliminate rust discoloration of the masonry.

Instruments connected to piping systems exceeding 200°F shall have a minimum of 2 feet of tubing between the piping system and the instrument body for each 100°F or part thereof in excess of 200°F.

All instruments shall be mounted no higher than six (6) feet, or lower than 24 inches, from the floor. Where possible, indicating instruments shall be mounted in the upper section of the instrument stand and non-indicating items in the lower.

The installation of all instruments shall consider maintenance and replacement. All maintenance, calibration and replacement operations on a given device shall be possible without interruption of service to adjacent equipment.

Unless furnished with permanent identification tags provided by the instrument supplier, all field and stand mounted instruments shall be tagged by Contractor with a 1-1/2 inch diameter Lamicoid tags with 1/4 inch lettering giving instrument tag number as identified on the Contract Drawings and in the Instrument Index. Tags shall be fastened securely with 24-gauge, minimum, stainless steel wire.

All pressure and differential pressure type instruments, such as transmitters, controllers, gauges and switches, shall be connected to two valve and three valve manifolds, respectively. In general, three-valve manifolds will be supplied with the differential pressure instrument. Where manifolds are not supplied, contractor shall be responsible for purchasing and installing the proper manifold.

Instrument cases shall be positioned such that doors may be fully opened, covers are fully removable, vent holes are not blocked and adjustment screws, valves, wiring and piping connections are accessible.

Instruments shall not be mounted adjacent to hot or vibrating equipment (except where directly attached to vessels) and shall not be mounted under drain points nor immediately above vent points.

Pressure gages, meters, transmitters, etc. shall be mounted for operating, calibration and maintenance convenience on steel supports, panels or racks and located near the equipment they serve. Pressure gages shall have a shut off valve between the gage and the line.

Pressure gages, switches, transmitters, etc. shall be installed as close as possible to the process connection with suitable block and bleed valves between the instrument and process tap. Pressure gages furnished with syphons or "pigtail" condensate seals, used for steam or other hot condensible vapors, shall be mounted above the process connection to allow for condensate drainage to the process. Pressure transmitters used in liquid or steam service shall be mounted below the process connection with all lines sloping towards the instrument to permit self venting.

Pressure transmitters used in all gas (clean or dirty) service shall be mounted above the process connection with all lines sloping towards the process connection to permit self draining of trapped condensate in the sensing lines. Under no circumstances shall dead legs be placed in any sensing line. Steam drum level measuring differential pressure transmitters shall be furnished with condensate seal pots. Transmitters that are remotely mounted from the process tap shall be provided with a block valve at the tap and another close to the instrument. Instruments or switches that are ganged together off a common tap shall have separate isolation valves at each device, to allow maintenance while the others stay in service.

Differential pressure transmitters may be installed either close coupled or remote mounted as shown on the Installation Details. Bypass equalizing valve manifolds shall be installed between the transmitter and orifice flange taps. Transmitters in steam service shall have leads with fill connection and drains to permit pre-filling the lines with condensate to protect the instrument from excessive temperatures. Care shall be taken to make both legs of the sensing line as close to the same elevations as possible.

Steam drum water columns with multiple level instruments shall be mounted on drum connection independent of any device requiring a flow of steam or water. The steam connection pipe shall slope down from the drum to the column. The water connection shall slope up from the column to the drum. The column shall be installed at an elevation that places the gage glass in correct relation to the normal working level. Water columns and piping shall be insulated. Right angle turns in the piping shall have crosses installed with plugs or blind flanges to provide for cleaning.

Orifice plates, pitot tubes, analyzer probes and other such in-line devices that can be damaged shall not be installed until pipe lines have been pressure tested, flushed and cleaned. Orifice plates shall be accurately centered with pipe and installed with the sharp flat edge on the upstream side. Devices such as welded and control valves and flow tubes and nozzles must be installed prior to pressure testing.

Control valve handwheels shall be positioned so that they are located on the accessible side of the valve. Positioners shall be mechanically free to operate with the instrument air turned on and the bypass closed.

Temperature sensors shall be installed with separable thermowells. The thermowells will be installed, by others, in such a manner to sense the temperature of the flowing fluid and minimize obstruction to flow. Temperature sensor assemblies shall be readily accessible and adaptable to each type of application in such a manner as to allow for quick, easy replacement and servicing without special tools or skills.

Sensors in ducts shall be located to sense correct temperature of the air only and not located in dead air spaces or positions obstructed by ducts, equipment, etc. The location shall be within the vibration and velocity limits of the sensing element. Where an extended surface element is required to properly sense the average temperature it shall be securely mounted within the duct in an approved manner and shall be positioned to measure the best average temperature. Elements shall be thermally isolated from brackets and supports to respond to air temperature only. Ducts shall be securely sealed where elements or connections penetrate ducts.

All pressure and differential pressure sensing instruments for furnace or flue gas applications shall have provisions for blowback from the instrument to the duct or furnace connection on each primary sensing line with instrument air.

Contractor shall make every effort to avoid vertical piping run to meter the flow in the following services:

1. Boiler feed water to individual boiler.
2. Boiler feed water from the discharge of pumps.
3. High pressure steam from each boiler.
4. High pressure steam main to turbine generator.
5. Export steam mains to utility users.

15905 INSTRUMENT RACKS

Instrument installation details shall be used as the basis for number, type and quantity required.

Transmitters, current-pneumatic transducers and other instruments located in close proximity to one another may be mounted on an instrument rack instead of separate supports. The rack shall be rigid and self supporting, framed with angle iron, primed and painted with rust inhibitive paint. All instruments shall be piped to air supply manifolds and wired to terminal strips, as required. The rack shall be installed as close as possible to the process area so as to minimize the primary tube runs.

Instruments that require an air supply shall be supplied from a common manifold. The manifold shall be one inch brass with 1/4 inch takeoff to each user plus 2 spares. Each takeoff shall have a 1/4 inch packless shut-off valve to isolate the instrument for service. A filter regulator with supply and output gage shall be furnished to reduce the air supply from 100 psig to 30 psig.

Wiring for electronic instruments shall be run in conduit and terminated at barrier type terminal strips, housed in a NEMA 4 enclosure. The barrier strips shall have screw terminals for No. 12 AWG wire minimum. Wiring shall be No. 14 AWG, rated at 600 volts with type SIS insulation.

Instrument Enclosures

Enclosures for field instrumentation shall consist of cabinets that are used to support and protect instruments and controls from the environment and provide convenience for operation.

All locally mounted instrument enclosures shall be made of galvanized sheet steel of code gauge thickness. The minimum overall size and depth of enclosures and clearances shall be in accordance with NEC standards or as indicated. Enclosures shall have continuous welded seams, back panel for equipment mounting, corrosion-resistant cover clamps and hardware, and oil-resistant gaskets. Enclosures shall be rated NEMA 4 for use in wet locations and NEMA 12 for dry locations.

After fabrication, each section or cabinet shall be thoroughly cleaned, inside and out, and given an immediate rust preventive treatment. Interior finish shall be white. The exterior finish shall be as specified by the Owner or his representative.

Enclosures for freeze protection shall be provided for all outdoor located instruments connected to instrument tubing systems which are not installed in enclosed instrument racks. The enclosures shall be NEMA Type 3 in accordance with ICS-6 and provided with thermostatically controlled electric heaters. Enclosures shall be O'Brian Corporation VIPAK or Owner approved equal.

Instrument Blowback Panels

Contractor shall furnish blowback panels in accordance with Instrument Installation Details. Contractor shall furnish all valves and fittings as indicated on the installation details, completely piped, and tubed by Contractor.

The panel shall be fabricated from steel sheet not less than 3/16" thick and shall be adequately reinforced and stiffened on inner surface to prevent warping. All joints shall be welded and ground smooth and properly cleaned to afford good bonding for subsequent painting.

The panel shall be fitted with necessary brackets to support, instruments, valves and tubing.

The panel shall have provision for blowback for each primary sensing line.

Prior to mounting equipment, Contractor shall paint instrument blowback panels with rust inhibitive paint.

Miscellaneous Accessories

Contractor shall supply miscellaneous accessories which are required for testing or operation of the systems, as well as to protect the instruments from damage. These items, as listed in the following paragraphs, do not necessarily include all the standard accessories that the Contractor shall provide for fully operational loops.

Pressure Snubbers

Pressure snubbers shall be provided for each pressure instrument connected to pump discharge lines. Snubbers shall be stainless steel.

Syphons

Pigtail, coil or gauge syphons shall be provided for all pressure instruments connected to steam service greater than 200°F where the tubing run does not provide a water seal for the instrument.

Syphons shall be stainless steel and have the same design conditions as the piping to which they are attached.

Settling Chambers

Settling chambers shall be provided for instruments where sediments can collect in the connecting tubing or instrument.

Settling chambers shall be carbon steel and have the same design conditions as the piping to which they are attached.

Condensate Chambers

Condensate chambers with blowdown valves shall be provided for all air and gas tubing to collect condensate.

15906 INSTALLATION OF PNEUMATIC PIPING AND TUBING

Instrument installation details shows typical instrument air supply lines and subheaders and branches with drain, take-off valves and filter regulator to each other.

Piping for pneumatic primary measuring instruments and controls shall be arranged, routed and installed in accordance with best engineering, efficient, functioning and pleasing appearance, without obstructing access for operation and maintenance. Where feasible, instrumentation and control piping shall be grouped and run together.

The installation of pneumatic piping and tubing shall conform to ISA-RP60.9 and the following requirements.

Lines in the air supply distribution system should be sized such that the maximum pressure drop from the air dryer to the most remote air user does not exceed 5 psi with 100 psig supply, when all users are taking air at approximately 2 to 5 SCFM. Branch piping to individual instrument shall be a minimum of 1/2 inch NPS. Air supply to individual instrument supplied from a common manifold or header may be either 1/4 or 3/8 OD copper tubing.

Header, branch and sub-branch piping material for the I.A. System shall be in accordance with the applicable piping specification. Continuations from the sub-branch to the instrument shall be in accordance with the Instrument Installation Details.

Supports for I.A. piping shall be from existing steel or existing pipe lines. Support members shall be sufficient to assure an adequate vibration free installation.

Threaded fittings shall be made up using Anaerobic pipe thread sealant with Teflon or equal. Care shall be taken to assure that the sealant is applied to the male thread only and does not enter the inside wall of the pipe.

Prior to connecting I.A. piping to the instrument or accessory, the lines shall be pneumatically blown free of moisture, loose scale and foreign matter.

15907 INSTALLATION OF TRANSMISSION AND CONTROL TUBING

Instrument tubing shall be run and hung below the electrical conduit cable trays where practical or in its own tray system where multiple runs in parallel are practical. When tubing leaves the trays, they shall be adequately supported 'U' channel type supports. Adequate support shall consist of supporting the tubing at the following spacings:

Vertical: Maximum 36" centers
Horizontal: Maximum 24" centers

Tubing shall be installed with sufficient flexibility to prevent undue stresses in tubing and at end connections caused by thermal expansion or vibration. Tubing shall not be fastened directly to concrete. Individual pneumatic transmission and control air shall be suitably supported by means of angle iron and 'U' channel. No more than 12" length tubing shall be unsupported.

Where tubing requires bending, care shall be taken to assure that a reasonable bending radius is maintained and tubing is not flattened nor pinched.

Cutting of tubing shall be done with a commercial tubing cutter. Ends shall be cut 90° to the wall of the tubing and shall be reamed to the original inside diameter of the tube. All "chips" or shavings shall be removed.

Tubing fittings for transmission and control tubing shall be as specified herein. Tubing fittings shall be made up using Anaerobic pipe thread sealant with teflon or equal.

Prior to tightening the tubing collar to the fitting, care shall be taken to assure that the tubing end is square, inserted fully through the ferrule into the tube fitting and is properly aligned with the fitting. Tightening of the collar shall be done with the proper sized wrench.

Where possible single tubes shall be grouped and run together in small carrier channels. Coiled tubing shall be fully straightened before installation.

Routing of single tubes, groups of single tubes shall be determined in the field. Care shall be taken in planning the installation that tubes are orderly grouped and their carrier channels are routed as directly as possible to the instruments.

Tubing bends shall be made with an approved tubing bender and terminations shall be made as discussed under bundled tubing installations above.

Carrier channels shall be rigidly mounted to permanent structural members and shall not be bracketed to equipment which may be removed for maintenance purposes.

Tubing shall be securely clamped to the carrier assuring that the tube is not pinched or damaged when clamped in place.

Where cutting of the carrier channel is required, raw edges shall be painted or coated with a material equal to the original finish.

15908 INSTALLATION OF INSTRUMENT PROCESS AND SAMPLING PIPING (OR TUBING)

The extent and arrangement of process piping or tubing beyond the primary block valve shall be as indicated on the Instrument Installation Details. Materials of construction for impulse piping or tubing, and associated valves and fittings are indicated on the Instrument Installation Details and specified herein.

All process connecting lines shall be pneumatically blown free of moisture, loose scale and foreign matter prior to connecting to the primary side of the instrument.

Where process connecting lines are indicated to be of rigid pipe construction, care shall be taken to assure that no stresses nor strains are exerted, on the instrument, due to improperly aligned or poorly supported piping. Impulse piping to remote located instruments shall be securely bracketed to existing members to relieve any vibration at the instrument.

Threaded fittings for impulse lines of rigid pipe or tubing shall be made up using Anaerobic pipe sthread sealant with teflon or equal. Where temperatures exceed 450°F thread compounds suitable for high temperature service may be used.

Where tubing and tube fittings of the non-flare compression type are used, care shall be taken to assure that the tubing is inserted fully into the fitting prior to tightening.

Process connecting lines shall be sloped in accordance with the Instrument Installation Details.

Wherever thermal expansion movement is indicated, the primary line shall be installed so that this movement is taken into consideration. The usual procedure is to provide either a 6 in. "Vee" bend at the point of expansion or a 3 ring loop (6 in. in diam. min.) on the line at the point of expansion.

Wherever vibration is indicated, a coil of two or three loops shall be provided in a horizontal plane in the primary line at the pressure source connection. Rubber inserts of 1/8 in. thick gasket material shall be placed between each tube clamp and tubing at all points affected by vibration.

15909 MATERIALS FOR INSTRUMENT PIPING AND TUBING

Primary Instrument and Sampling Tubing

All tubing for this service shall have a minimum outside diameter of 1/2 in. (except where noted) and shall conform to the following requirements:

ASTM A-213 Grade TP316
Seamless Stainless Steel
Cold Drawn Fully Tempered

Dimensions:

Actual O.D. Inches	Wall Thickness (inches) Up to 300°F, 500 PSI	Wall Thickness (Inches) Above 300°F, 500 PSI
3/8	0.049	0.065
1/2	0.049	0.065

The supplier of the tubing shall verify that all requirements of the material specifications have been complied with and that the tubing meets these requirements.

Weld repairs shall not be allowed on the tubing.

Instrument Air Supply and Pneumatic Control Tubing

All tubing for this service shall conform to the following requirements:

ASTM B68
Seamless Copper Tube
Drawn Temper for 1/2-inch and Larger Tubing
Light Drawn Temper for 1/4-inch and 3/8-inch Tubing

Dimensions:

Actual O.D. Inches	Wall Thickness Inches
1/4	0.035
3/8	0.035
1/2	0.049
5/8	0.049
3/4	0.065
1	0.065

The supplier of the tubing shall verify that requirements of the material specification have been complied with and that the tubing meets these requirements.

Tube Fittings

Compression tube fittings and compression tube end connections on valves shall be of the same manufacturer or shall be verified by Contractor to be interchangeable.

Stainless Steel Fittings

Compression Type Fittings: Fittings for those joints, where connection of a primary sensing line or a sampling line is made, shall be furnished in accordance with the following specifications:

Tube Size, O.D. inches:	1/4, 3/8, 1/2, 3/4
Type:	Compression
Rating:	5500 psi @ 72°F; 3200 psi @ 1000°F
Material:	316 Stainless Steel

The supplier of the compression type fittings shall certify that the fittings are suitable for use with 316 Stainless Steel tubing that is fabricated per ASTM A-213 with a maximum Rockwell Hardness of R_b90.

3/8-inch tube fittings may be used only for those parts of sampling systems that are located within a panel and/or a rack.

Brass Fittings

Compression Type Fittings: Fittings for those joints, where connection of an air supply line or a pneumatic control line to an instrument, or an air supply regulator is made, shall be furnished in accordance with the following specifications:

Tube Size, O.D. inches:	1/4, 3/8, 1/2
Type:	Compression
Material:	Brass

Pipe Fittings

Piping fittings may be used only with copper tubing that is one inch O.D. or larger.

Screwed IPS cast bronze or bar stock brass fittings, with a 150 psi rating, may be used for rigidity and strength in making up air supply connections at equipment, with unions to permit removal of equipment for service.

Instrument Valves

Instrument valves are normally specified with type, model number and manufacturer on the instrument installation details. In the absence of such detailed document, the following valves shall be selected for the appropriate services.

Globe Valves

The valves applicable to this section are the instrument valve, the test valve, and the backup root valve (when specified). The valves for these applications shall be furnished in accordance with the following specifications:

Rating: 6,000 psi @ 100°F, 3000 psi @ 1,000°F
Body Design: Globe
Body Material: 316 Stainless Steel
Construction: Screwed Bonnet, 316 Stainless Steel
Plug and Stem: Stainless Steel
Seat: Stainless Steel
Packing: Grafoil or equal
End Connections: Threaded
Sizes in inches: 3/8, 1/2, 5/8, 3/4

3/8-inch valves may be used only for those parts of sampling systems that are located within a panel and/or a rack.

Weld repair of defects on the pressure boundaries of a valve body shall not be allowed.

Needle Valves

The valves applicable to this section are the sample regulating valves. These valves shall be furnished in accordance with the following specifications:

Rating:	4,000 psi @ 100°F, 2,500 psi @ 700°F
Body Design:	Needle
Body Material:	316 Stainless Steel
Construction:	Screwed bonnet, 316 stainless steel
Plug and Stem:	Stainless Steel
Seat:	Stainless Steel
Packing:	Teflon
Sizes:	1/4, 3/8, 1/2
End Connections:	Threaded

Brass Valves

Instrument Air Supply: The valves applicable to this section are the individual instrument air supply shut-off valves. They shall be furnished in accordance with the following specifications:

Working Pressure: 3,500 psi @ 72°F
Body Material: Brass
Construction: Screwed Bonnet
Stem: Stainless Steel
Sizes: 1/4, 3/8, 1/2 inch
End Connections: Pipe to Pipe, pipe to tube, tube to tube

15910 FLUSHING, PURGING AND TESTING

Pneumatic piping and tubing shall be cleaned of all foreign material by pressurizing one end with clean, dry, oil free 20 psig air. The air shall flow freely out of the other end to indicate that the line is not plugged. Lines showing evidence of grease or oil shall be solvent cleaned.

Piping and tubing for instrument pressure leads to process mains and headers shall be cleaned of all foreign material by pressure flushing or by blowing with clean, dry, oil free compressed air.

Piping and tubing for instrument air supply and process sensing lines shall be tested in accordance with ISA RP 7.1. Signal air lines shall be pressure tested with clean, dry, oil free air and checked for leaks by applying a soap and water solution to all joints. There shall be no leaks. Lines shall be further tested for leaks by blocking in the system under pressure for a I5 minute period. The line will be considered satisfactory if the drop in pressure at the conclusion of the test period does not exceed 10 percent. Instruments shall not be directly connected to lines under test.

Piping and tubing for instrument pressure leads to process mains and headers shall be tested in accordance with requirements for pressure testing the line to which they are connected. If testing procedures would subject the instruments to pressures exceeding the range of the instruments, the instruments shall be isolated from the line under test.

Where instrument impulse lines are connected to process and utility piping, the impulse line shall be disconnected from the instrument and capped prior to system pressure testing. Pressure testing of instrument impulse lines shall be in accordance with the applicable piping test procedures.

Fragile devices such as pH electrodes, conductivity probes or other highly sensitive components shall be removed from the lines or vessels prior to systems pressure testing.

Where instruments are connected to vessels such as level gage glasses, ball floats, displacement level units care shall be taken to assure that the design pressure rating of the instrument is above the proposed test pressures.

All control valves and damper operators shall be cleared of dirt and debris and exercised/stroked for satisfactory operation. This includes checkout for rigid and correct mounting of limit switches, position transmitters, solenoid valves, air supply regulators, current-to-pneumatic converters, positioners, air cylinders, motor drives and connecting linkage.

15911 PREOPERATIONAL TESTS AND CALIBRATION

Preoperational tests and calibration shall be performed on all instruments, control loops and systems. All loop components, pneumatic drives, control valves, piping, tubing, and wiring shall have been permanently mounted and testing shall have been completed before the preoperational tests and calibration of instrument installations are initiated. All electrical wiring shall have been rung out and tested for continuity and integrity of connections and subjected to all other tests specified for that wiring. The tests and calibration shall be performed by the Contractor and shall be witnessed by the Purchaser.

Preoperational/Loop Tests

For purposes of preoperational checkout, all instrumentation shall be considered to fall into one of two groups:

a. Single-element installations, such as pressure gages, thermometers, self-contained control valves, etc.

b. Instrument loops, consisting of two or more separate devices. There are two kinds of instrument loops:

   b1. Functionally closed loops, loops without inputs to, or outputs from, other loops or devices. Such loops normally consist of one or more primary measuring devices, such as process-sensing transmitters, switches, etc., operating one or more final elements such as valves, indicators, recorders, etc. Between these primary and final elements there may be one or more intermediate devices such as power supplies, controllers, signal-actuated switches, air solenoid valves, electrical relays, and the like.

   b2. Functionally open loops, i.e., loops with inputs to, or outputs from, other control loops which must, for practical reasons, be checked out as separate control entities.

Each loop shall be checked as needed to verify that each and every component, mechanical and electrical, is undamaged and functional, and to verify loop integrity with respect to signal ranges and directions, as well as direction of action of final control elements; this shall be done without calibrating devices or making quantitative settings. These loop checks shall include the following:

1. Functionally closed loops should be finally checked by manipulating the primary sensing device(s) and observing response to the final control element(s). Where this is not practical, the loop shall be divided into two or more overlapping sections, and all devices of each section operated in concert to verify integrity of control action within that section.

2. Functionally open loops vary so widely in character that no single procedure can be specified for all cases, but the following criteria shall be followed as applicable:

2.1 Inputs from thermocouples shall be checked for reasonable "ball-park" magnitudes while warming or cooling the sensor to positively identify the correct leads. Other analog inputs shall be similarly checked while manipulating their source devices.

2.2 Switching devices shall be checked by manipulating that device and verifying that it actuates the correct relay in the correct direction.

2.3 Alarm circuits shall be checked by manipulating the switching device to sound the alarm and light up the correct display window through whatever circuitry and/or relays have been provided in the permanent installation.

2.4 Analog or on-off inputs from, or outputs to, other loops shall be checked by manipulating the sending device and verifying correct action by the receiving device, preferably while operating all loop components in concert.

The foregoing loop tests shall generally be made with increasing and decreasing signal inputs at approximately 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent of the full process variable range (head, level, pressure, etc.)

These procedures shall be supplemented with Manufacturer's instruction manual information covering functional testing of individual instruments and integrated instrument systems and services of manufacturers specialist engineers as required.

When the instrument or instrument loop has been checked out and readied for calibration, the event shall be recorded on a document bearing the date of verification and the signature(s) of the Contractor's representative who performed the inspection.

No instrument shall be calibrated to function at any range other than manufacturer's recommended range, nor shall it be subjected to loads of pressure, voltage, etc., beyond those for which the manufacturer has rated it.

All switching devices actuated by process variables, or electrical variables or analog signals, shall be set to open and close at the specified values of increase or decrease, and then cycled repeatedly over full range to verify repeatability.

All control loop instruments shall be adjusted for zero, linerity, and span across full range and their smooth performance shall be verified by repeated cycling across full range. All instruments shall be adjusted to their full design accuracy.

Every instrument shall be individually calibrated by applying measured inputs and measuring the outputs. In no case shall two or more instruments be gang calibrated, as, for example by feeding measured pressure into a transmitter and then adjusting the receiver gage to agree. This verification shall be known as the calibrated loop check.

After the several instruments of a loop have been individually calibrated, they shall be cycled repeatedly in concert by applying a series of measured dummy inputs to the primary device(s), and all loop elements shall be thus verified for quantitative agreement, correct action and prompt response.

Final control elements such as control valves, damper drives, motor-operated valves, and other power movers, shall be timed while stroking them full cycle at the fastest rate attainable through their permanent control systems, from shut to wide open and from wide open to shut. The stroking times shall be logged as part of the permanent record of calibration.

After an instrument has been calibrated, all pertinent valves and switches shall be positioned and tagged as needed for protection, and a distinctive tag or label shall be affixed to the instrument to indicate that it has been calibrated.

All instruments shall be calibrated in place with all mounting fasteners, piping, and wiring permanently attached and with all supports, ties and fasteners for both piping and wiring permanently installed and fully tightened. Devices which have been shop-calibrated prior to erection shall be subjected to full recheck after installation as needed to verify that installation and handling have not upset accuracy or functional integrity. No instrument shall be released as calibrated until it has been either calibrated in place or fully rechecked in place.

All calibrated loop checks shall be performed in place with all loop elements permanently mounted, piped and wired. No loop component shall be considered finally calibrated until this loop check has been completed and the satisfactory interaction of all loop components has been thus verified.

OMS shall have full access to all calibrating equipment and records for purposes of inspection, and shall be free to witness fully all calibrating equipment and records for purposes of inspection, and shall be free to witness fully all calibrating procedures, at any time and without previous notice or application.

Every instrument calibration shall be logged in writing, at the time the calibration work is performed, on a printed form developed by the Contractor for the purpose. The information thus logged shall include all applicable portions of the following:

a. Instrument Tag Number, service, and input/output range

b. Date of final calibration and/or calibrated loop check

c. Description of the procedure used

d. Shop numbers of all calibrating equipment used

e. All figures needed to describe settings, input/output values, and the points of range which have been checked.

f. Any appropriate notes and remarks

g. Signature of the technician performing the work, and the name(s) of all personnel assisting him.

If an instrument or loop has been calibrated and checked, but is subsequently recalled for repairs or changes, the Contractor shall amend all pertinent calibration records to record the event.

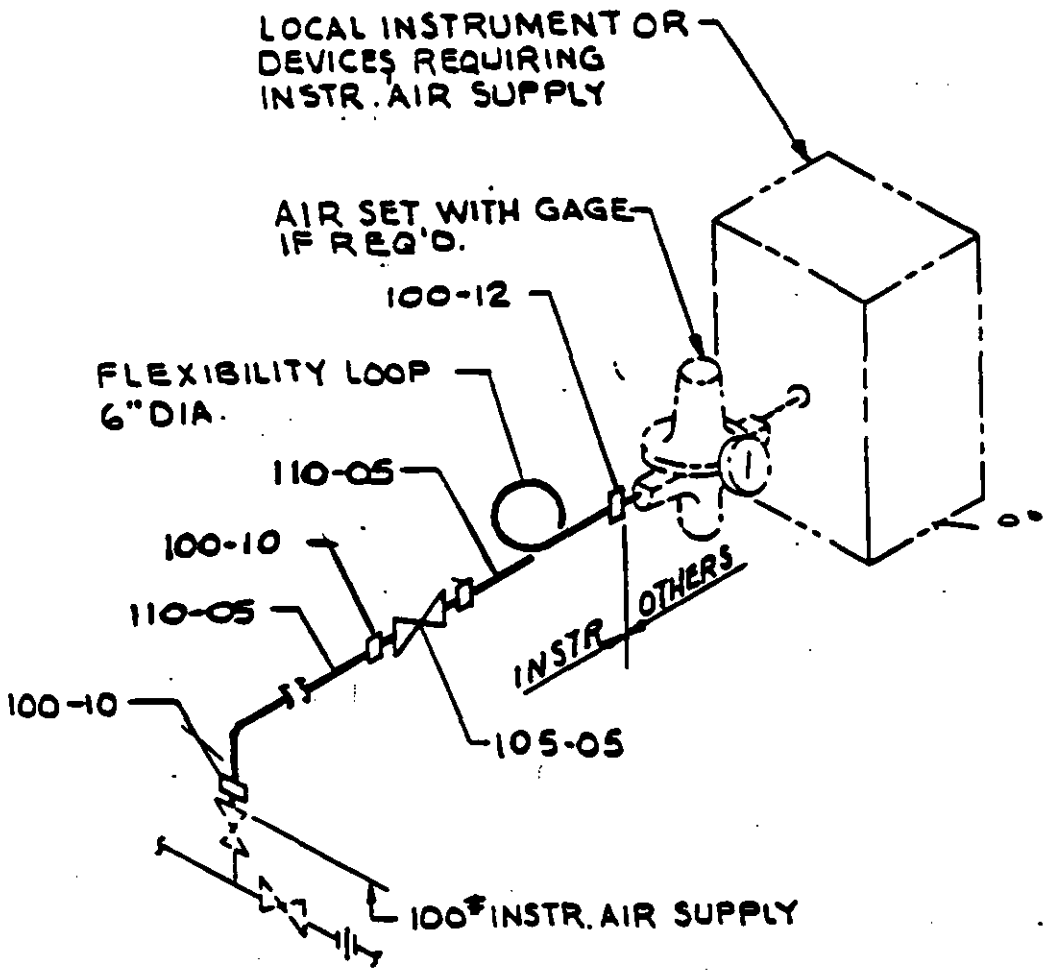
Upon completion of the preoperational tests and calibration work, the Contractor shall submit a complete report of that work (including calibration data logs for each instrument/loop) to OMS. The Contractor shall also submit progress reports to OMS during the installation work, at regular intervals.

NOTE TO THE USER OF THE SPECIFICATION

Replace this page with the following Instrument Installation Details

Drawing	Drawing No.
Instrument Air Supply	SC-118-1
Air Distribution Manifold (5-Way)	SC-118-2
Flow Transmitter Gas or Air	SC-118-3
Flow Transmitter Steam	SC-118-4
Flow Transmitter Liquid	SC-118-5
Pressure Transmitter Steam or Liquid	SC-118-6
Pressure Indicator Steam or Liquid	SC-118-7
Pressure Indicator Liquid or Gas	SC-118-8
Boiler Drum Level	SC-118-9
Control Valve with Positioner	SC-118-10
Control Valve with 3-Way Solenoid Valve	SC-118-11

TAG NO.



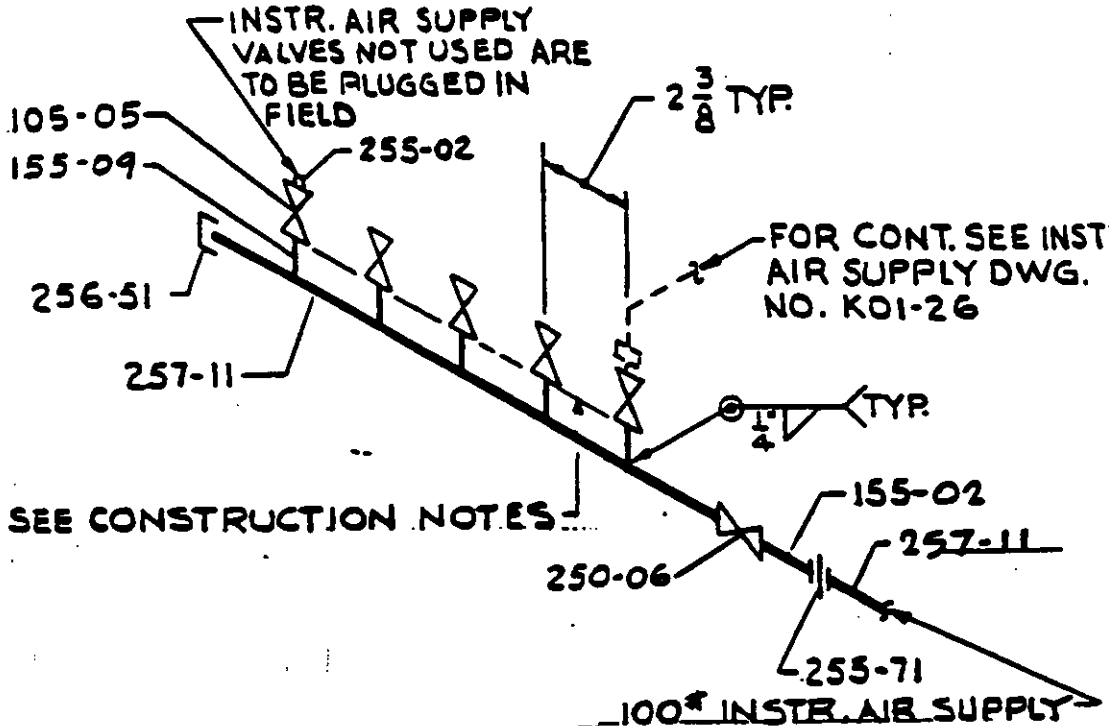
PART NO	QTY.	SIZE	DESCRIPTION
105-05	1	1/4	SCRD. FEMALE VALVE BRASS
100-12	1	1/2 x 1/4	MALE CONN. BRASS
110-05	25FT.	1/4	TUBING COPPER
100-10	3	1/4 x 1/4	MALE CONN. BRASS

ISSUE	DESCRIPTION	CHECKED APPROVED DATE
3		
2		
1	ORIGINAL ISSUE	

SC-318-1

INSTRUMENT AIR SUPPLY

TAG NO.



CONSTRUCTION NOTES

1- FINISH TO BE ANTI RUST TREATMENT AND TWO COATS OF BLACK ENAMEL.

2- HYDRAULIC TEST PRESSURE = 250 P.S.I.G.
WORK PRESSURE = 100 P.S.I.G.

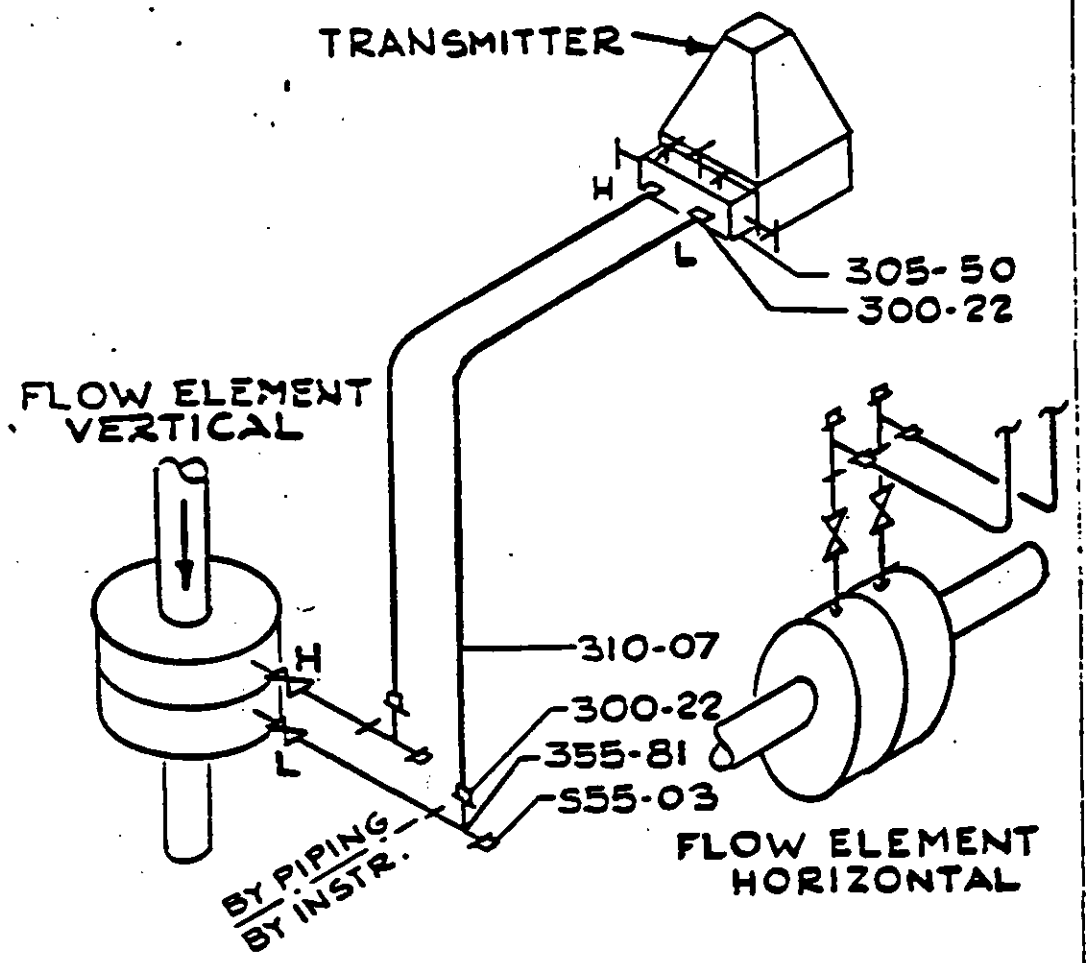
PART NO	QTY.	SIZE	DESCRIPTION	
255-71	1	1/2	SCRD. UNION	F.S.
155-02	1	1/2 x 3	NIPPLE T.B.E	C.S.
250-06	1	1/2	SCRD. GATE VALVE	F.S.
257-11	25FT	1/2	PIPE T.B.E	C.S.
256-51	1	1/2	SCRD. CAP	F.S.
155-09	5	1/4x2	NIPPLE T.O.E.	C.S
105-05	5	1/4	SCRD. FEMALE VALVE	BRASS
255-02	5	1/4	SCRD. SQUARE HEAD PLUG	C.S.

ISSUE	DESCRIPTION	CHECKED	APPROVED	DATE
3				
2				
1	ORIGINAL ISSUE			

SC-318-2

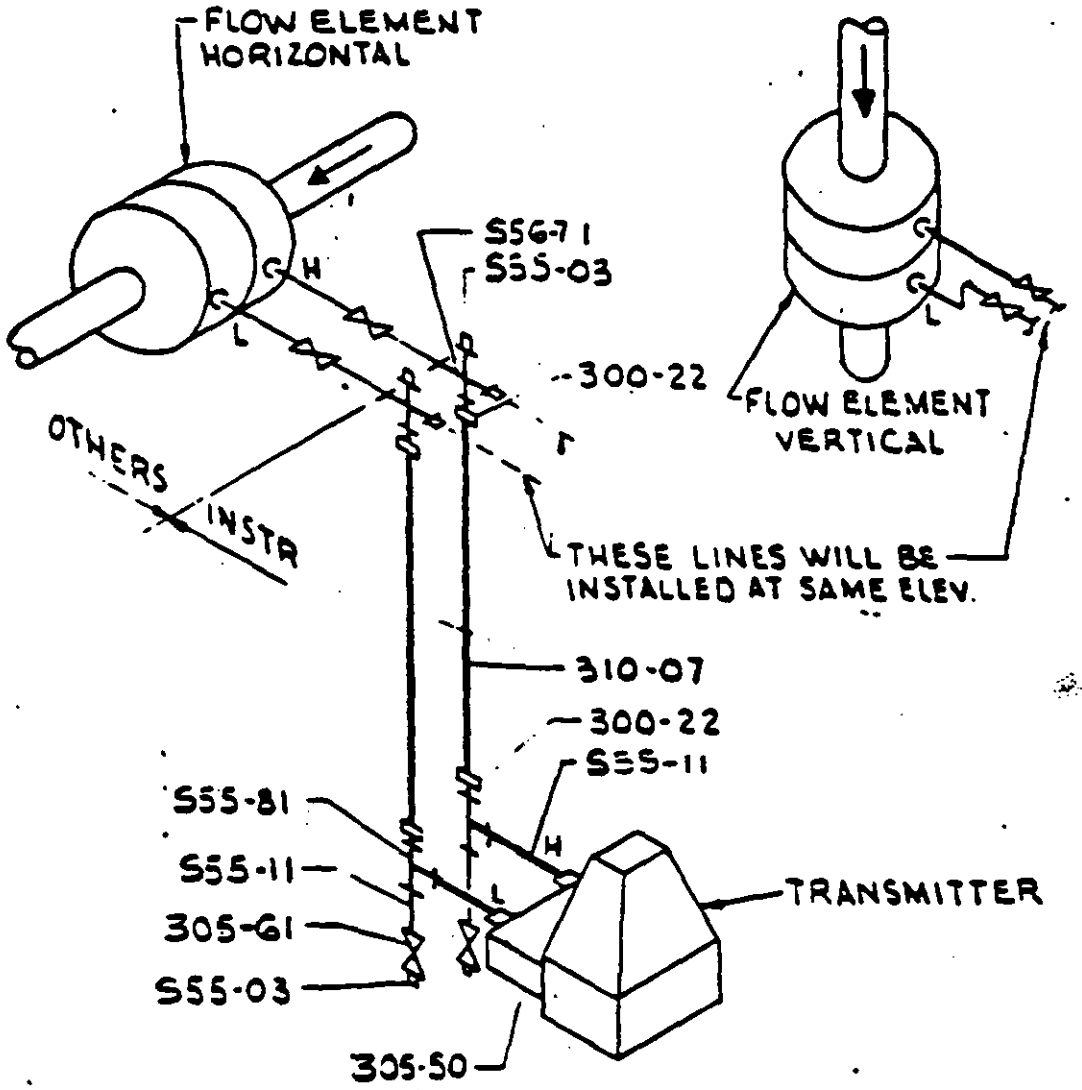
AIR DISTRIBUTION MANIFOLD (5 WAY)

TAG NO.



PART NO	QTY.	SIZE	DESCRIPTION
310-07	50FT	1/2	TUBING SS
300-22	4		MALE CONN. SS
355-81	2		SCRD. TEE SS
305-50	1		5 VALVE MANIFOLD SS.
S55-03	2	▼	PLUG SS

ISSUE		
3		SC-318-3
2		
1	ORIGINAL ISSUE	FLOW TRANSMITTER GAS OR AIR



TAG NO.
FT-

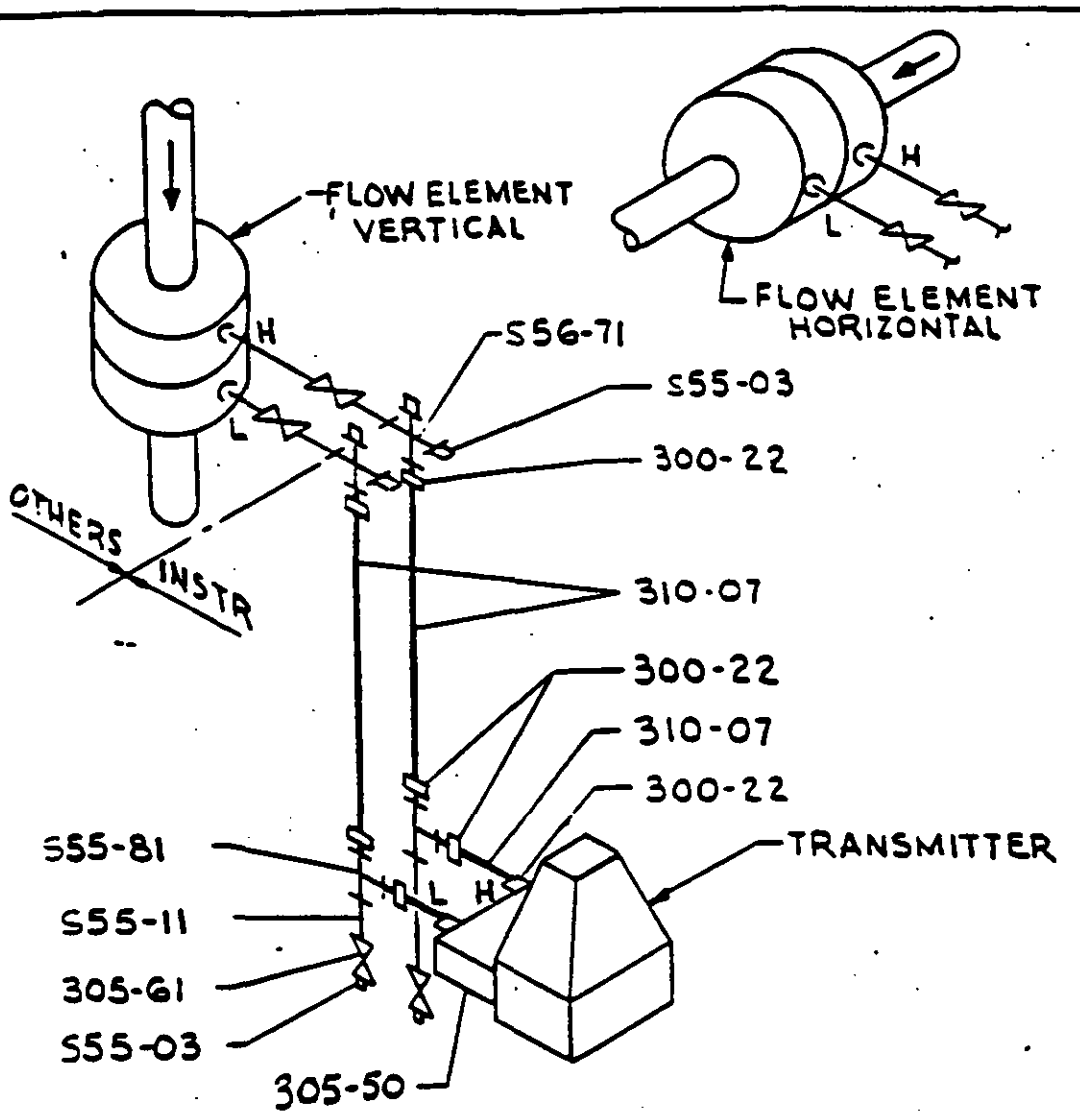
PART NO	QTY.	SIZE	DESCRIPTION	
S55-81	2	1/2	SCRD. TEE	SS
310-07	40 FT	1/2	TUBING	S.S.
300-22	4	1/2	MALE CONN	S.S.
S56-71	2	1/2	SCRD CROSS	SS
305-50	1	1/2	5 VALVE MANIFOLD	SS
S55-11	4	1/2x3	NIPPLE T&E	SS
305-G1	2	1/2	SCRD COCK	SS
S55-03	6	1/2	SCRD SQUARE HEAD PLUG	SS

ISSUE	DESCRIPTION	CHECKED	APPROVED
3			
2			
1	ORIGINAL ISSUE		

SC-318-4

FLOW TRANSMITTER STEAM

TAG NO.
FT-



PART NO.	QTY.	SIZE	DESCRIPTION	
305-50	1	1/2	5 VALVE MANIFOLD	S.S.
S55-03	6	1/2	SCRD. SQUARE HEAD PLUG	SS
305-61	2	1/2	SCRD. COCK	SS
S55-11	2	1/2	NIPPLE T.B.E.	SS
S55-81	2	1/2	SCRD. TEE	SS
300-22	8	1/2	MALE CONN	S.S.
310-07	40FT	1/2	TUBING	S.S.
S56-71	2	1/2	SCRD CROSS	SS

ISSUE	DESCRIPTION	CHG'D	APPD	DATE
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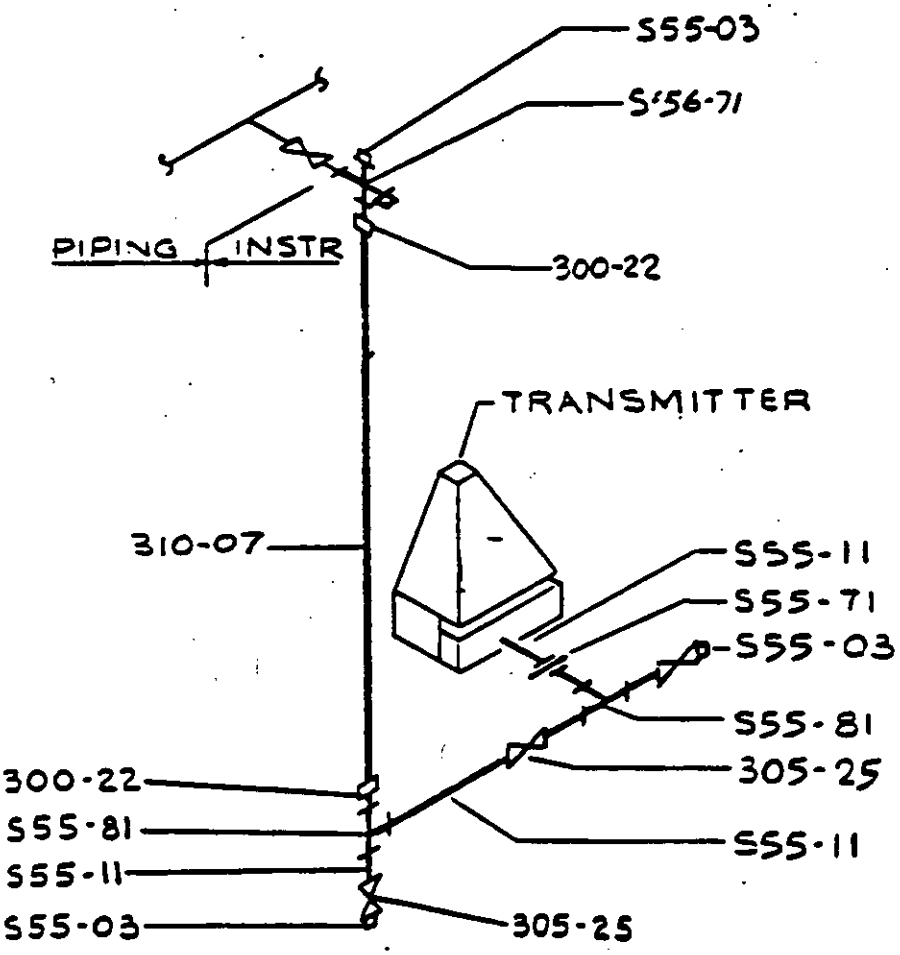
2				
1	ORIGINAL ISSUE			

SC-318-5

FLOW TRANSMITTER LIQUID

TAG NO.



PART NO	QTY.	SIZE	DESCRIPTION
300-22	2	½	MALE CONN S.S.
S55-71	1	½	SCRD. UNION S.S.
305-25	3	½	SCRD. FEMALE VALVE S.S.
310-07	20FT	½	TUBING S.S.
S55-11	6	½ x 3	NIPPLE T.B.E. S.S.
S55-81	2	½	SCRD. TEE S.S.
S55-03	3	½	SQUARE HEAD PLUG S.S.
S56-71	1	1/2	SCRD CROSS S.S.

ISSUE	DESCRIPTION	CHECKED	APPROVED	DATE
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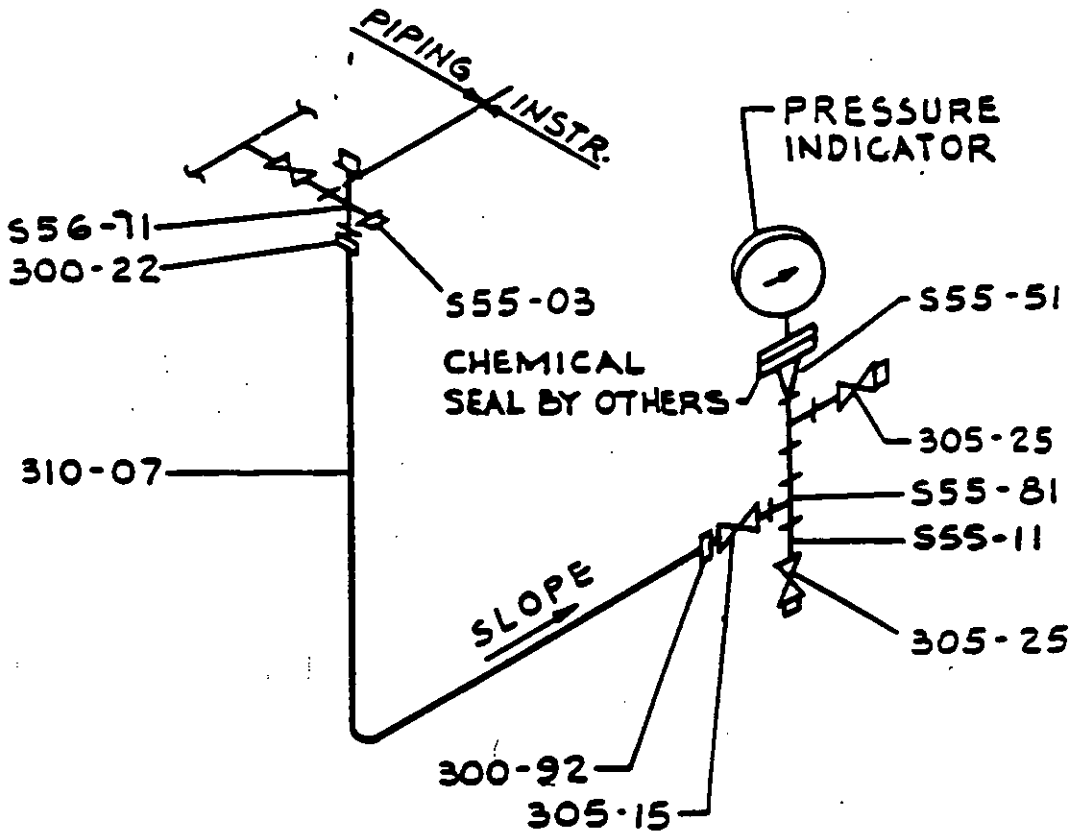
2				
1	ORIGINAL ISSUE			

SC-318-6

PRESSURE TRANSMITTER
STEAM OR LIQUID

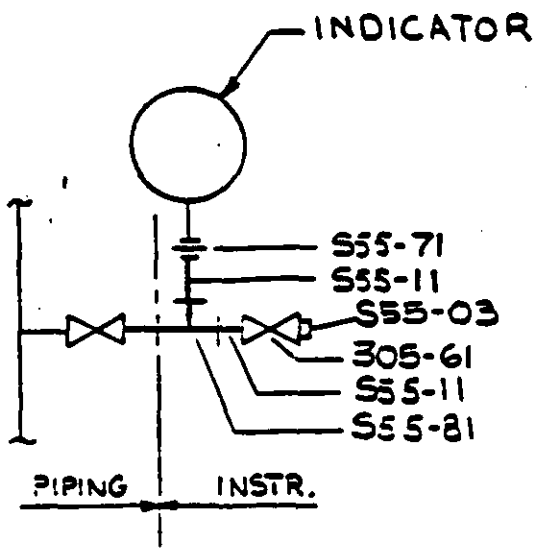
TAG NO.

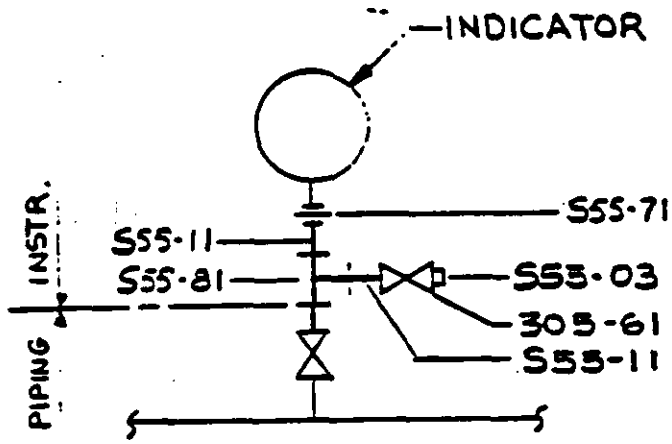


PART NO.	QTY.	SIZE	DESCRIPTION
310-07	25 FT	1/2	TUBING S.S
S55-51	1	3/4 x 1/2	CONC. SWAGE NIPPLE T.B.E. S.S.
S55-11	3	1/2	NIPPLE T.B.E. S.S.
S55-81	2	1/2	SCRD TEE S.S.
305-25	2	1/2	SCRD. FEMALE VALVE S.S.
305-15	1	1/2	SCRD. MALE VALVE S.S.
300-92	1	1/2	FEMALE CONN. S.S.
300-22	1	1/2	MALE CONN. S.S.
S55-03	4	1/2	SCRD. SQUARE HEAD PLUG S.S.
S56-11	1	1/2	SCRD. CROSS S.S.

3							PRESSURE INDICATOR STEAM OR LIQUID
2							
1	ORIGINAL ISSUE						SC-318-7
ISSUE	DESCRIPTION	CHKD	CDWR	APPROVED			

TAG NO.





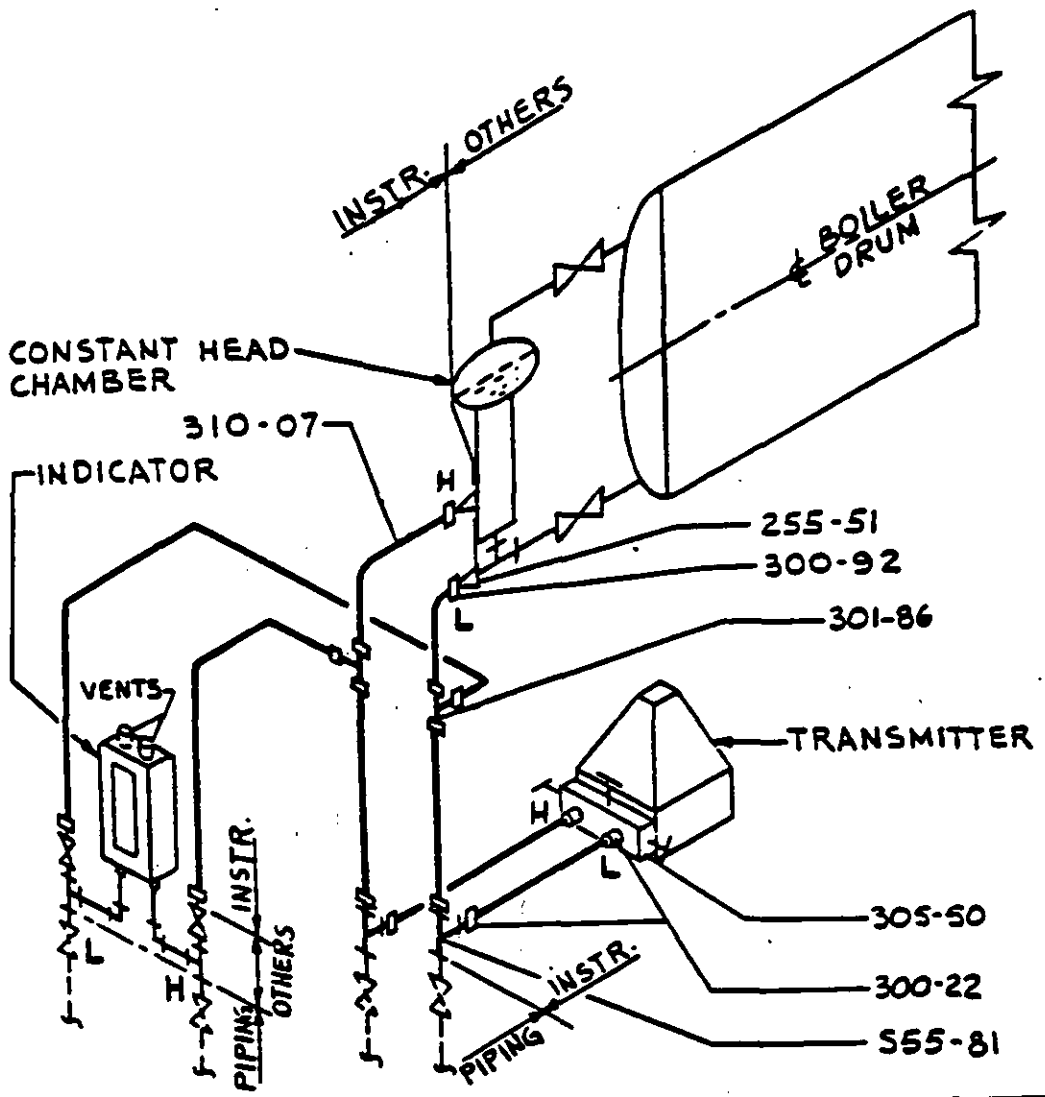
PART NO.	QTY.	SIZE	DESCRIPTION	
S55-71	1	½	SCRD. UNION	SS
S55-11	2	½ × 3	NIPPLE T.B.E	SS
S55-81	1	½	SCRD. TEE	SS
305-61	1	½	SCRD. COCK	SS
S55-03	1	½	PLUG	SS

ISSUE	DESCRIPTION	CHECKED & APPROVED
3		
2		
1	ORIGINAL ISSUE	

SC-318-8

PRESSURE INDICATOR
LIQUID OR GAS

TAG NO.
LT-



PART NO	QTY.	SIZE	DESCRIPTION	
305-50	1	½	3 VALVE MANIFOLD	S.S.
300-22	8	½	MALE CONN.	S.S.
555-81	2	½	SCRD. TEE	S.S.
255-51	2	¾ x ½	CONC. SWAGE NIPPLE	C.S
301 86	2	½	UNION TEE	S.S.
310 07	60 FT.	½	TUBING	S.S
300-92	2	½	FEMALE CONN.	S.S.

ISSUE	DESCRIPTION	CHECKED	APPROVED	DATE
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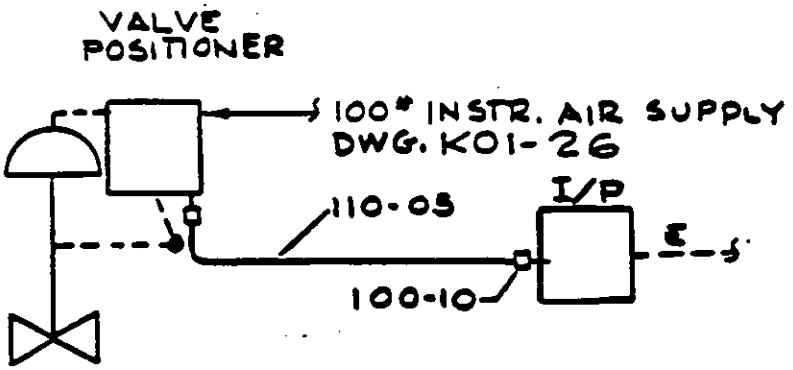
1	ORIGINAL ISSUE			

SC-318-9

BOILER DRUM LEVEL

TAG NO.



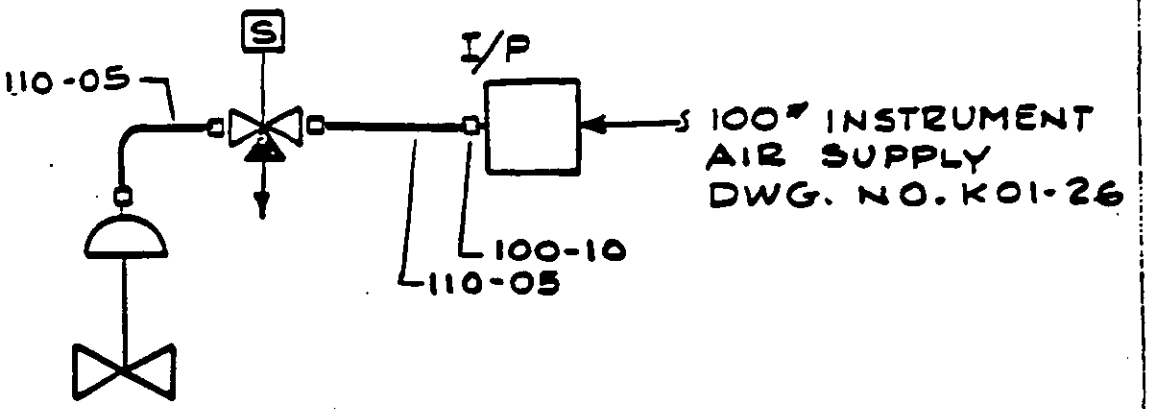
PART NO	QTY.	SIZE	DESCRIPTION
110-05	5 FT	1/4	TUBING - COPPER
100-10	2	1/4	MALE CONN. BRASS

ISSUE	DESCRIPTION	CHKD.	APPROVED
3			
2			
1	ORIGINAL ISSUE		

SC-318-10

PNEUMATIC DETAIL
CONTROL VALVE WITH POSITIONER

TAG NO.



PART NO	QTY.	SIZE	DESCRIPTION
110-05	10 FT	1/4	TUBING COPPER
100-10	4	1/4	MALE CONN. BRASS

ISSUE	DESCRIPTION	CHECKED & APPROVED
3		
2		
1	ORIGINAL ISSUE	

SC-318-11

PNEUMATIC DETAIL
CONTROL VALVE W/ 3WAY SOLENOID VALVE

ATTACHMENT 11.8

OGDEN MARTIN SYSTEMS
of LEE, Inc.

SPEC NO. SE-205
ISSUE 003
DATE 1/15/90

TECHNICAL SPECIFICATION

FOR

MOTOR CONTROL CENTERS

Facility Name: LEE COUNTY RESOURCE RECOVERY FACILITY

Location: LEE COUNTY, FLORIDA

****

****

Specification Prepared By: A/E Name: OMSL

Address: FAIRFIELD, NJ

Telephone: 201-882-9000

A/E Approved for Release:

	Printed Name	Signature	Date
1.	R. TYLER		2/25/93
2.			
3.			
4.			
5.			

REVISION

001	Initial Issue	01/01/87
002	Revision	08/14/87
003	Revision	01/15/90

OGDEN PROJECTS, INC.

TECHNICAL SPECIFICATION
FOR
MOTOR CONTROL CENTERS

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1.0 GENERAL

1.1 Scope

This Specification covers the requirements for furnishing, delivery, and testing of motor control centers.

2.0 TECHNICAL REQUIREMENTS

2.1 General

The type of enclosure, voltage, service, and accessories will be specified on the data sheets. When required, the data sheets will also specify the maximum ambient temperatures in which the equipment will operate at full capacity. The requirements of the data sheets supersede any conflicting requirements in the specification.

2.2 Applicable Standards

All equipment furnished under this Specification shall comply with, but shall not be limited to, the latest edition of the following standards and supplements thereto.

NEMA - National Electrical Manufacturers Association

ANSI/NEMA ICS1	General Standards for Industrial Control and Systems
ANSI/NEMA ICS2	Industrial Control Devices, Controllers and Assemblies
ANSI/NEMA ICS3	Industrial Systems
ANSI/NEMA ICS4	Terminal Blocks for Industrial Control Equipment and Systems
ANSI/NEMA ICS6	Enclosures for Industrial Controls and Systems
ANSI C89-2	Dry-type Transformers for NEMA General Purpose, Applications
NEMA AB1	Molded Case Circuit Breakers
NEMA WC-3	Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (ICEA S-19-81)

UL - Underwriters Laboratories

ANSI/UL94	Test for Flammability of Plastic Materials for Parts in Devices and Appliances
ANSI/UL489	Molded-Case Circuit Breakers and Circuit Breaker Enclosures
ANSI/UL508	Electric Industrial Control Equipment
UL845	Electric Motor Control Centers
NFPA70	National Electrical Code

Motor Control Center structures shall have a UL label. Each drawout unit shall have a UL label with the unit interrupting rating listed.

2.3 Enclosures

2.3.1 Indoor Enclosures

Each control center shall be totally enclosed, dead front, free-standing type designed for front mounting units or back to back mounting of units per the data sheets, with adequate space for maintenance.

Each motor control center shall consist of a number of vertical sections bolted or joined together. Vertical sections shall be approximately 90 in. high, 20 in. wide, and 20 in. deep. Each section shall be fabricated from leveled sheet steel not less than 12 gauge thickness, shaped and reinforced with formed steel members, and securely fastened together to provide a rigid, self-supporting structure.

A maximum of six unit compartments shall be built into each vertical section. Compartment locations shall be numbered from left to right when facing the front of the control center and lettered from top to bottom. This identification shall be used by the manufacturer in the preparation of drawings and in itemizing the equipment and accessories required by the data sheets. Individual starter units shall be isolated and baffled from all other components including adjoining starter units and adjacent buses and cable troughs.

The ends of each end vertical section shall be arranged to allow the future installation of similar sections and all sections shall be arranged to allow the removal, addition, interchange, or replacement of individual units as may be required.

All compartments designated "Spare" on the data sheets shall be furnished as completely wired units with overloads as specified, control power transformers, and blank nameplates on the doors.

A space designated as "Equipped Space" shall be furnished complete with doors and all other hardware required to permit completion by the addition of the starter unit or feeder tap unit.

Blank unassigned spaces shall be complete with vertical bus and removable covers in the front and rear, but shall not include stab-ins, framework, etc.

Each assembly shall be provided with full length floor channels or sills. Lifting angles shall be provided on the top of each motor control center shipping section.

Compartment doors shall be rigid, gasketed, and mounted on the vertical section with support independent of the starter unit. Air circuit breakers shall be manually operated by handles located on the outside of the unit door. Doors shall be designed to allow easy maintenance or replacement of all removable starters, circuit disconnects, and overcurrent protective devices, transformers, lighting panels, and similar devices from the front. Doors shall be removable by removing hinge pins.

Each compartment door shall be interlocked so that it normally cannot be opened while the breaker or switch is in the closed position, but it shall be possible to close the door when the breaker or switch is in either the open or closed position. An attempt at opening the door of a compartment containing a closed breaker shall not cause tripping of the breaker or opening the switch. A defeater mechanism shall be provided which will allow authorized personnel to open the compartment door with the breaker or switch in the closed position.

A vertical wire trough equipped with wire ties shall extend the full height of each section. It shall be easily accessible from the front for the installation and maintenance of power and control wiring.

Horizontal wire trougns shall be located at the top and bottom of each section, aligned and located to provide a continuous wireway of the same cross-sectional dimensions through the length of the assembled control center.

Provisions shall be made for entrance of incoming line, load feeder, and control circuit conductors. Where the incoming line is specified to be a bus duct or a throat connection, all required flanges, flexible connectors, bolting, material, conductors, and coordination shall be provided for complete connections.

2.3.2 Outdoor Enclosures

MCC's located outdoors shall be provided with a non-walk-in weatherproof housing. The enclosure shall be NEMA Type 3R. A front and rear hinged door shall be provided for each vertical section. There shall be

sufficient room to prevent interference between the enclosure and individual compartment doors. MCC compartment doors shall open wide enough to allow removal of a draw out unit without removing the door. Each outdoor enclosure shall have 120 volt fluorescent interior lights controlled from switches located at each end. A duplex ground fault interrupter convenience receptacle shall also be located at each end. Lights and receptacles shall be wired in EMT to a single connection point.

2.4 Bus Bars

Bus material shall be electrical grade copper with tin or silver plated joints and connectors.

A main horizontal bus located at the top of the control center shall be provided with insulating supports braced to withstand the rms symmetrical short circuit and continuous current rating indicated on the drawings. The bus supports shall be formed of a molded compound which shall have high dielectric strength, low moisture absorption, high impact strength, and a low creepage surface to resist arc tracking.

Each vertical section of front mounted motor control centers shall have a minimum 300 A vertical bus. Back to back mounted units shall have 600 A vertical bus in each vertical section.

The main bus shall be isolated from the horizontal wiring trough by means of removable barriers. The vertical bus shall be isolated from the removable combination starters and feeder tap units by means of barriers which are part of the motor control center stationary structure. Barriers shall be sheet steel or other material acceptable to the owner.

Each Motor Control Center shall have a ground bus in the bottom of the structure with a minimum capacity at least equivalent to a 1/4 in. by 1 in. copper bar extending the entire length of the structure. The ground bus shall be bonded to the metal enclosure of each vertical structure.

Ground connectors for attachment of each end of the ground or neutral bus to the external grounding system shall be two-hole long barrel compression type suitable for 4/0 AWG copper conductors. One connector shall be provided at each end of each motor control center ground bus.

2.5 Wiring

All wiring shall be stranded copper. Power wiring shall be black XLPE or EPR insulated and rated for a conductor temperature of 90°C. Control wiring shall be Type SIS, VW-1 rated, rated for a conductor temperature of 90°C. Control and alarm circuit wiring shall not be smaller than #14 AWG stranded. PVC or nylon materials shall not be used.

Suitable extra-flexible wiring shall be provided over door hinges or other locations where leads may be subjected to flexing.

Terminal blocks for control wiring shall be rated 600 volts and capable of carrying 25 amperes. Current transformer secondary terminal block shall be short circuiting type. The terminal blocks shall be pull apart type and shall accept ring type terminal lugs for #10 AWG and smaller. Terminal blocks for control cables shall have a minimum of 20 points and shall include a marking strip.

The Motor Control Center terminal blocks shall be so located as to be readily accessible from the front of the unit for ease of wiring installation and maintenance.

2.6 Branch Circuit Protection

Each unit shall include one 3 Pole Single Throw, 600 volt rated, molded case air circuit breaker.

Combination starter unit circuit breakers shall be of the magnetic trip-only type. Breakers used in feeder tap units shall be thermal magnetic type. If circuit breaker is mounted vertically, the operating handle shall be in the "up" position for "on" and the "down" position for "off."

Without considering starters and overloads, magnetic trip only circuit breaker combination starters, and also thermal magnetic breakers, shall be capable of interrupting 25,000 amps without the use of fuses or current limiters.

All breakers shall bear the label of Underwriters Laboratories, and shall be manually operated with quick-make, quick-break, trip-free mechanism of the toggle type. (The breakers shall be equipped with suitable arc quenching devices.) Main current carrying contacts shall be capable of carrying their rated current without exceeding the Underwriters Laboratories specified temperature rise. All circuit breakers shall be of the same manufacture.

Magnetic only type circuit breakers shall be furnished with an adjustable trip setting for selecting instantaneous trip points of fault protection.

2.7 Combination Starters

All combination magnetic full voltage starters furnished with the motor control center shall be 600 volt rated and include disconnecting and branch circuit overcurrent protective devices as previously specified in Section 2.6: 480 volt, three-phase, 60 hertz contactors with manual reset thermal overload relays; 120 volt AC operating coils; and 480 to 120 volt dry type control transformers complete with one secondary lead fused and the other secondary lead grounded. The secondary fuse shall be sized to prevent harmful overloads to the control transformer. Current limiting fuses shall be provided in both the primary leads per the National Electrical Code.

Contactors shall be capable of picking up at a minimum voltage of 85 volts and shall not drop out above 75 volts.

Control transformers shall have 60 hertz ratings permitting operation at a primary voltage from 440 to 480 volts at a voltage ratio of 4:1. Assuming 440 volts on the primary terminals, each control transformer shall maintain a minimum potential of 105 volts at its secondary terminals during starter coil inrush, while simultaneously serving an additional load of 100 volt-amperes at 50 percent power factor. Control transformer shall be mounted as part of the removable combination starter unit.

Control transformers shall be sized per the following volt-ampere ratings as a minimum for the starter sizes required.

Size 1	100 VA	Size 3	200 VA
Size 2	100 VA	Size 4	250 VA

All starter auxiliary contacts, interlocked contacts of relays operated by auxiliary contacts which are an integral part of the starter mechanism, local control devices, and indicating lamps where specified shall be wired to marked unit terminal blocks.

2.8 Overload Relays and Auxiliary Contacts

Three thermal overload relays of the bimetallic strip type shall be furnished with each combination motor starter. The relay shall be temperature compensated. Provisions shall be made for manually resetting the thermal relays without opening the starter door. Where overload relay contacts are used to trip the starter, they shall be connected on the hot side of the starter coil.

Overload heaters shall be furnished for all starters and sized in the range of 115 to 125 percent of full load current. The motor control centers shall be shipped with the overload heaters in the starter compartment but not installed.

The Purchaser's site office will verify heater sizing based on the actual full load current of each motor fed from the Motor Control Centers. The Seller shall exchange heater elements as needed without a return charge for a period of nine months from the delivery of the equipment.

In addition to a mechanical holding contact, mechanically operated auxiliary contacts shall be furnished mounted on the main contactor of each nonreversing starter and on each forward and each reversing main contactor of each reversing starter. All auxiliary contacts shall be independently wired to terminal blocks. The number and type of auxiliary contacts (N.C. or N.O.) and the internal wiring of all starters shall be as shown on the wiring diagrams provided as part of this specification regardless of whether Seller's standard is different.

2.9 Pilot Devices

When required, pushbuttons will be specified and defined in detail on the data sheets or project specific one line diagrams. Unless noted otherwise on the data sheets pushbuttons shall be momentary contact "START-STOP".

When required, indicating lights will be specified and defined in detail on the data sheets. Indicating lights shall be transformer type, full voltage for 120 volts AC operating voltage. Lamp and lens shall be replaceable from the front of the panel.

2.10 Incoming Power

2.10.1 Incoming Main Lugs

The incoming line to each Motor Control Center without current limiting reactors shall enter the first (left hand side) vertical section at the top or bottom of the unit as specified in Attachment 1. Two-hole, long barrel compression type cable lugs (Burndy YA-2N or approved equal), two per phase, shall be provided by the Seller for terminating the Purchaser's cable.

2.10.2 Current Limiting Reactors

When specified on the drawings or data sheets an incoming line current limiting reactor shall be furnished as part of the motor control center in a separate vertical section sized to accommodate the reactor. The reactor section shall be complete with lugs copper, long barrel compression type, two-hole, NEMA drilled, two per phase. Louvers shall be provided as required for heat dissipation. The reactor shall be furnished per the rating shown on the drawings. Reactors shall be dry type air core, self cooled.

2.11 Space Heaters

When furnished, space heaters shall be located at the bottom of each vertical section of motor control centers. Space heater capacity shall be as required to maintain the compartment and section internal temperature above the dew point. Normal use of the space heaters shall not change or discolor any painted surface. Space heaters shall not interfere with normal entrance of cables into the center. Space heaters shall be controlled by an adjustable thermostat, factory set to close on falling temperature and open on rising temperature. The Purchaser will provide a 120 volt, 60 hertz feeder for space heater service. The Seller shall provide all internal motor control center wiring and suitable branch circuit protection.

2.12 Fabrication

The control centers shall be assembled at the factory as completely as practicable for shipment. Size limitation requirements, if any, for field placement will be specified on the data sheets.

3.0 TESTS AND GUARANTEES

The motor control centers shall be tested by the Seller in accordance with NEMA ICS-2 and UL-845 together with any additional inspection and tests which may be required to ensure that the wiring is correct and that all equipment is in a satisfactory operating condition.

Each circuit shall be given a continuity test.

All power and control wiring shall be given a voltage test for one minute at a minimum of 1,500 volts.

The Seller shall notify the Purchaser at least two (2) weeks in advance of the date when tests are to be performed. The Purchaser reserves the right to inspect the equipment and witness all testing at the factory at no additional cost.

4.0 SUPPLEMENTARY REQUIREMENTS

4.1 Painting

After fabrication, all metal work shall be thoroughly cleaned, given a bonderizing or equivalent treatment, and immediately prime coated with a rust-resistant paint. The prime-coated surfaces shall be given two finish coats of ANSI No. 24 dark blue-gray paint for outdoor equipment and ANSI No. 61 light gray paint for indoor equipment. Touch-up paint shall be furnished by the Seller and shipped with the control centers.

4.2 Nameplates

Nameplates shall be provided for each compartment. Each nameplate shall be made of laminated plastic 3/32 in. minimum thickness, 1 in. high, and 3 in. wide. The plate shall be white with 3/16 in. high engraved black lettering. All four front edges shall have a 1/16 in. bevel. Each nameplate shall be fastened to the compartment door with two stainless steel self-tapping screws. Nameplate inscriptions will be specified on the data sheets or project specific one line diagrams. In addition, a nameplate shall be provided for each complete motor control center of the same material and construction, except that lettering shall be 1/2 inch high.

4.3 Cleaning and Shipping Requirements

The interior of all equipment shall be free of all foreign material, such as waste, mill scale, oil, grease, or other deleterious material. All openings shall be closed immediately after cleaning. It shall be the Seller's responsibility to keep the Purchaser's inspector so informed that he can personally satisfy himself that the requirements of this paragraph are being complied with.

After completion of factory assembly and testing, the equipment shall be disassembled into the minimum number of parts practicable. All equipment and materials shall be suitably crated, boxed, or otherwise prepared for shipment to prevent damage during handling and shipping.

All openings shall be properly sealed to prevent the entrance of dirt or debris. All parts which, of necessity due to physical size or arrangement, may be exposed to the weather shall be adequately protected by suitable weatherproofing. It shall be the responsibility of the Seller to take any other precautions required to reasonably ensure jobsite arrival of the equipment in an undamaged and satisfactory working condition.

All containers shall be plainly marked with purchase order number, item number, designation of the parts enclosed, shipping weight, and such additional identifying data as may be specified by the Purchaser. All individual parts and components shall be designated in such a manner as to facilitate installation in the field. The Seller shall furnish a complete list of all components and assemblies to be shipped separately.

4.4 Data and Drawings

The Seller shall submit drawings for the Purchasers' review in accordance with an agreed upon schedule. The drawings submitted shall be the following types:

Drawings with Bid Proposal

Physical outlines and cross sections to show the overall size, weights and space requirements

Drawings After Award of Purchase Order

Physical outlines cross sections and details to show the overall size, space requirements and weights.	Six (6) Weeks
Erection Drawings	Six (6) Weeks
Elementary and Wiring Diagrams	Eight (8) Weeks
Bills of Material	Eight (8) Weeks
Time-current curves for each type and size circuit breaker, tripping device and relay furnished by Seller.	Eight (8) Weeks

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 minumum:

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 or injury during installation, testing and operation.

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.

ATTACHMENT 1

DESIGN CONDITIONS AND PROJECT SPECIFIC REQUIREMENTS

1.0 Design Conditions

MCC No.:	_____	_____
Location:	___ Indoor ___ Outdoor	___ Indoor ___ Outdoor
Ambient Temp. Min./Max. °C	____/____	____/____
Space Heaters	___ Required ___ Not Required	___ Required ___ Not Required
Enclosure:	___ NEMA 1A Gasketed ___ NEMA 3R Non-Walk-In ___ _____	___ NEMA 1A Gasketed ___ NEMA 3R Non-Walk-In ___ _____
Construction:	___ Front Mounting Only ___ Back to Back	___ Front Mounting Only ___ Back to Back
Wiring:	___ NEMA Class 1 Type B ___ _____	___ NEMA Class 1 Type B ___ _____
Incoming Supply	___ Top ___ Bottom	___ Top ___ Bottom
Feeder & Control Cables	___ Top ___ Bottom ___ Top and Bottom	___ Top ___ Bottom ___ Top and Bottom
Voltage	___ 480v, 3Ph, 3w, 60 Hz ___ _____	___ 480v, 3Ph, 3w, 60 Hz ___ _____
Main Bus	___ 800 A ___ _____	___ 800 A ___ _____
Short Circuit Bracing:		
RMS Symmetrical	___ 42,000 A ___ _____ A	___ 42,000 A ___ _____ A
Current Limiting Reactor	___ Not Required ___ Required	___ Not Required ___ Required
Continuous Current	___ 800 A ___ _____	___ 800 A ___ _____
Ohms/phase	___ .01 ___ .005 ___ _____	___ .01 ___ .005 ___ _____

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.

ATTACHMENT 2

TECHNICAL DATA FURNISHED BY SELLER

Physical Data

MCC No.	Overall Dimensions W x D x H inches	Main Bus Rating AMPS
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Standard Vertical Section _____ W x D x H

Reactor Section _____ W x D x H

Wiring troughs:

Vertical, in. ____ x ____ x ____

Horizontal - top, in. ____ x ____ x ____

Horizontal - bottom, in. ____ x ____ x ____

NEMA Type _____

Air Circuit Breakers, Molded Case Magnetic /Thermal Magnetic

Manufacturer _____/_____

Max rated volts _____/_____

480 V symmetrical interrupting rating:

Type _____ 100 A frame, amp _____/_____

Type _____ 150 A frame, amp _____/_____

Type _____ 250 A frame, amp _____/_____

Terminal Blocks for Control

Manufacturer and type _____

Max number of terminals available
NEMA size 1____ 2____ 3____ 4____

Starters

Manufacturer _____

NEMA size: 1____ 2____ 3____ 4____

Rated service volts _____ _____ _____ _____

Max rated continuous amp

FVNR _____ _____ _____ _____

FVR _____ _____ _____ _____

Max rated motor duty, hp _____ _____ _____ _____

Control transformer rating, VA _____ _____ _____ _____

Coil Ratings

Coil Pick-Up, VA _____ _____ _____ _____

Coil Hold-In, VA _____ _____ _____ _____

Minimum Pick-Up Voltage, volts _____ _____ _____ _____

Drop-Out Voltage, volts _____ _____ _____ _____

Coil Rating, volts _____ _____ _____ _____

Auxiliary contacts:

	Inductive	Resistive
Max make rating, amp	_____	_____
Max break rating, amp	_____	_____
Max continuous rating, amp	_____	_____

Buses

Bus material _____

Main bus cross-sectional area _____

Vertical bus cross-sectional area _____

Ground bus cross-sectional area _____

ATTACHMENT 3

MOTOR CONTROL CENTERS
UNIT PRICES BY SELLER

Unit prices to permit addition or deletion to the basic assemblies specified. The prices to be added or deducted from the base price quoted.

	ADD	DEDUCT
Full vertical compartments with wiring troughs, bus, and blank covers (without module units) 600 amp bus	$_____	$_____
Plug-in units as specified under Starters, complete with hardware and doors. Assume no change in the structure sections.	$_____	$_____
One full-voltage reversing (FVR) combination starter unit complete - NEMA Size 1	$_____	$_____
One FVR combination unit complete - NEMA Size 2	$_____	$_____
One FVR combination unit complete - NEMA Size 3	$_____	$_____
One full-voltage nonreversing (FVNR) combination starter unit complete - NEMA Size 1	$_____	$_____
One FVNR combination unit complete - NEMA Size 2	$_____	$_____
One FVNR combination unit complete - NEMA Size 3	$_____	$_____
One FVNR combination unit complete - NEMA Size 4	$_____	$_____
One 100 amp frame, 2-pole ACB: 25 kA I.C.	$_____	$_____
One 100 amp frame, 3-pole ACB: 25 kA I.C.	$_____	$_____

		ADD	DEDUCT
Two 100 amp frame, 3-pole ACB: 25 kA I.C. (twin unit)		$	$
One 250 amp frame, 3-pole ACB: 25 kA I.C.		$	$
One set of two (2) extra auxiliary contacts, either N/C or N/O on any starter		$	
Two-unit pushbutton or selector switch		$	$
Single indicating light assembly		$	$
Increased rating control transformer, VA	50 VA	$	
	100 VA	$	
One 100 amp frame, 3-pole Mag-Only ACB 25 KA I.C.		$	$
One 250 amp frame, 3-pole Mag-Only ACB 25 KA I.C.		$	$

REPLACE THIS PAGE WITH THE FOLLOWING

Attachment 4 -	Terminal Block Wiring Diagram Full Voltage Non-Reversing Starter
Attachment 5 -	Terminal Block Wiring Diagram Full Voltage Reversing Starter
Attachment 6 -	Terminal Block Wiring Diagram Two Speed Reversing Starter
Attachment 7 -	Terminal Block Wiring Diagram Stoker Hydraulic Pump
Attachment 8 -	MCC One-Line Diagrams

ATTACHMENT 11.9

(NOT UTILIZED)

ATTACHMENT 11.10

OGDEN MARTIN SYSTEMS
of LEE, Inc.

SPEC NO. SE-210-LE
ISSUE 003
DATE 1/23/90

TECHNICAL SPECIFICATION

FOR

POWER, CONTROL AND INSTRUMENTATION CABLES

Facility Name: LEE COUNTY RESOURCE RECOVERY FACILITY

Location: LEE COUNTY, FLORIDA

****

This document and all information contained herein are the property of Ogden Martin Systems of LEE, Inc., and are not to be used except as expressly authorized in writing by said company.

****

Specification Prepared By: A/E Name: OMSL

Address: FAIRFIELD, NJ

Telephone: 201-882-7071

A/E Approved for Release:

	Printed Name	Signature	Date
1.	R. TERRAMOCCIA	R. Terramoccia	11/20/91
2.			
3.			
4.			
5.			

OGDEN PROJECTS, INC.

TECHNICAL SPECIFICATION
FOR
POWER, CONTROL AND INSTRUMENTATION CABLES

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1.0 GENERAL

1.1 Scope

This Specification details the requirements for the furnishing and delivery of power, control and instrumentation cables.

2.0 TECHNICAL REQUIREMENTS

2.1 General

Cable types specified herein shall be suitable for application and use in accordance with the applicable articles of the National Electrical Code permitting their installation in cable trays and raceways.

Cable insulation shall be thermosetting cross-linked polyethylene (XLPE) or ethylene propylene rubber (EPR). Cable jackets shall have thermosetting properties and shall be Neoprene, Hypalon or Thermosetting Chlorinated Polyethylene (CPE). ~~PVC or nylon materials shall not be used for insulation or jacketing purposes.~~

Cables shall be capable of operating under continuous, emergency and short circuit conditions without exceeding the conductor temperatures specified in the Project Specific Requirements.

All cables shall be approved for use in cable trays and be sunlight resistant, and shall have passed the requirements of the IEEE 383 flame test. Refer to Table 1 of IEEE-383 for the type of flame tests to be performed for cables.

Stranded conductors shall be Class B per ASTM B-8.

Copper conductors insulated with XLPE insulation shall be coated copper per ASTM B-33.

2.2 Applicable Standards

All wire and cable furnished under this specification shall conform with, but not be limited to, the latest issue of standards including addenda and supplements as listed below:

AEIC - Association of Edison Illuminating Companies

AEIC CS5 Specifications for Polyethylene and Cross-linked Polyethylene Insulated Shielded Power Cables

AEIC CS6 Specifications for Ethylene Propylene Rubber Insulated Shielded Power Cables

ASTM - American Society for Testing and Materials

ASTM B-3 Specification for Soft or Annealed Copper Wire

ASTM B-8 Specification for Concentric Lay Stranded Copper Conductors, Hard, Medium-Hard, or Soft

ASTM B-33 Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes

ICEA - Insulated Cable Engineers Association

ICEA S-19-81 (NEMA WC-3) Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

ICEA S-66-524 (NEMA WC-7) Cross-linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

ICEA S-68-516 (NEMA WC-8) Ethylene Propylene Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

IEEE - Institute of Electrical and Electronic Engineers, Inc.

IEEE-383 IEEE Standard for Type Test of Class 1E Electric Cables, Field Splices and Connections for Nuclear Power Generating Stations

NFPA - National Fire Protection Association

ANSI/NFPA 70 National Electrical Code

UL - Underwriters Laboratories

UL-44 Rubber Insulated Wire and Cable

UL-1072 Medium Voltage Solid Dielectric Cables

UL-1277 Type TC Power and Control Tray Cables

UL-1424 Power Limited Fire Protective Signalling Circuit Cable

ANSI - American National Standards Institute

ANSI C96.1 Temperature Measurement Thermocouples

2.3 Power Cables

2.3.1 Medium Voltage Circuits

a. Single Conductor Cables

Cables shall be rated 5 kV or 15 kV as required, be UL listed as type MV-90 and approved for use in cable tray. Cables shall be rated for a conductor temperature of 90°C in dry or wet locations. Cable shall have stranded copper conductor, extruded semiconducting conductor shield, flame retardant EPR insulation, extruded semiconducting insulation shield, uncoated 5 mil copper tape shield with 25% overlap, or copper drain wires and overall extruded neoprene, hypalon or chlorinated polyethylene jacket.

b. Three Conductor Cables

Cables shall be rated 5 kV or 15 kV as required and be UL listed as type MV-90 and approved for use in cable tray. The cables shall have stranded copper conductor with extruded semiconducting conductor shield, flame retardant EPR insulation, extruded semiconducting insulation shield, uncoated 5 mil copper tape shield with 25% overlap, and have non-hygroscopic and fire retardant filler material, ground conductor, binder tape and overall extruded neoprene, hypalon or chlorinated polyethylene jacket.

The individual conductors shall be phase identified.

2.3.2 Low Voltage Power Circuits

a. Single Conductor Cables

Single conductor cables shall be rated 600V for use in cable tray and have stranded copper conductors with XLPE or EPR insulation and neoprene, hypalon or thermosetting chlorinated polyethylene (CPE) jacket. Cables shall be rated for a conductor temperature of 90°C in dry locations and 75°C in wet locations.

b. Multiple Conductor Cables

Cables shall be rated 600V for use in cable tray ~~and have stranded copper conductors with XLPE or EPR insulation;~~ non-hygroscopic and fire retardant filler material, ground conductor, binder tape, and overall extruded neoprene, hypalon or thermosetting chlorinated polyethylene jacket. The individual conductors shall be phase identified by suitable marking on each insulated conductor. Cables shall be rated for a conductor temperature of 90°C in dry locations and 75°C in wet locations.

2.3.3 Lighting

All wire used in lighting shall be rated for 600V use, have copper conductors and be UL listed as type ~~XHHW, RHW,~~ or THHN. Wire sizes smaller than #8 AWG shall have solid conductors, wire sizes #8 AWG and larger shall have stranded conductors.

2.4 Control Cables

Cables for control, metering, indicating and alarm circuits shall be multiple conductor cables ~~rated 600V~~ for use in cable tray ~~and have stranded copper conductors with XLPE or EPR insulation~~, non-hygroscopic and fire retardant fillers, binder tape, and overall extruded neoprene, hypalon or thermosetting chlorinated polyethylene jacket.

Conductor identification shall be in accordance with ICEA S-68-516 Appendix K, Method 1, Table K-2.

2.5 Instrumentation Cables

All instrumentation cables for remote-control and signaling circuits ~~shall be 600V rated~~ and shall be listed for Class 1 circuit use and for use in cable tray.

2.5.1 Thermocouple Cables

a. Single pair thermocouple cable shall be ~~No. 16 AWG~~ solid alloy conductor ~~with XLPE or EPR insulation~~, twisted, with aluminum shielded mylar tape providing 100% coverage and tinned stranded copper drain wire, ~~and overall extruded neoprene, hypalon or thermosetting chlorinated polyethylene jacket~~.

   Conductors shall be color coded in accordance with ANSI C96.1.

b. Multipair thermocouple cable shall consist of No. ~~16 AWG~~ solid alloy conductor ~~with XLPE or EPR insulation~~, twisted pairs. Each pair shall be separately shielded with aluminum faced mylar tape providing 100% coverage and have a tinned stranded copper drain wire. The individual pairs shall be cabled together with non-hygroscopic and fire retardant fillers as required to form a circular cable, shielded with an overall aluminum faced mylar tape providing 100% coverage and a tinned stranded copper drain wire, and ~~have an overall extruded neoprene, hypalon or thermosetting chlorinated polyethylene jacket.~~

   Conductors shall be color coded in accordance with ANSE C96.1 and each individual pair numbered for group identification.

2.5.2 Electronic Instrument Cables

a. Single pair (or triad) electronic instrument cable shall be ~~No. 16 AWG stranded copper conductor with XLPE or EPR insulation,~~ twisted, with aluminum shielded mylar tape providing 100% coverage and a tinned stranded copper drain wire, and overall extruded neoprene, hypalon or thermosetting chlorinated polyethylene jacket.

Conductor identification shall be in accordance with ICEA S-68-516 Appendix K, Method 1, Table K-2.

b. Multipair electronic instrument wire shall consist of ~~No. 16 AWG stranded copper conductor with XLPE or EPR insulation,~~ twisted pairs or triads as required. Each pair (or triad) shall be separately shielded with aluminum faced mylar tape providing 100% coverage and have a tinned copper drain wire. The individual pairs (or triads) shall be cabled together with non-hygroscopic and fire retardant fillers as required to form a circular cable, shielded with an overall aluminum faced mylar tape providing 100% coverage and a tinned stranded copper drain wire, and have an overall extruded neoprene, hypalon or thermosetting chlorinated polyethylene jacket.

Conductor identification shall be in accordance with ICEA S-68-516 Appendix K, Method 1, Table K-2. Each individual pair (or triad) shall be numbered for group identification.

2.6 Cable Identification

The overall jacket of each cable shall be surface printed with the following minimum information:

Voltage rating
Number and size of conductors
Conductor material
Insulation type
UL Identification
UL Type cable designation
UL Ratings as applicable
Manufacturer's identification

3.0 TESTING AND GUARANTEES

Routine tests on factory reel lengths of cable furnished under this specification shall be provided.

4.0 SUPPLEMENTARY REQUIREMENTS

4.1 Reel Identification

Each reel of completed cable shall have a suitable metal tag firmly attached on both sides of the reel. Each tag shall indicate the following information:

Job No.
Purchaser's name
Number and size of conductors
Type of insulation
Type cable
Voltage rating
Shipping weight of cable and reel
Purchaser's reel number (if applicable)

4.2 Cleaning and Shipping Requirements

Cable reels and/or coils shall be suitably crated, boxed, or otherwise prepared for shipment to prevent damage during handling and shipping.

Cable ends shall be properly sealed to prevent the entrance of moisture. It shall be the responsibility of the Seller to take any other precautions required to resonably ensure jobsite arrival of cables in an undamaged and satisfactory working condition.

All containers shall be plainly marked with purchase order number, item number, designation of the cable, shipping weight, and such additional identifying data as may be specified by the Purchaser.

4.3 Data

Data with Bid Proposal

Descriptive bulletins for each type cable consisting of cable construction, materials, insulation, shield tape and jacket thickness, overall outside diameter etc.

Data with Delivery

Test data for each reel of cable

IEEE flame test reports for each construction

Installation data

Field dc Hi-Pot Test - volts

Field megger test - megohms per 1,000 feet

4.4 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.

ATTACHMENT 11.11

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: OMSL

Address: FAIRFIELD, NJ

Telephone: 201-882-9000

A/E Approved for Release:

	Printed Name	Signature	Date
1.			
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

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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: _____

PROJECT: _____

FURNISHED BY: _____

ATTACHMENT 2

SQUIRREL CAGE INDUCTION MOTORS BELOW 600 VOLTS

DATA FURNISHED BY SELLER

DRIVEN EQUIPMENT _____

MARK OR ITEM NO. _____

NO. REQUIRED _____

MAKE _____

FRAME NO. _____

HORSEPOWER, HP (at each speed) _____

RATED VOLTAGE, V _____

SERVICE FACTOR _____

ENCLOSURE _____

Type: Single Speed _____

Two Speed Single Winding _____

Other _____

FULL LOAD SPEED, RPM _____

FULL LOAD CURRENT, AMP _____

LOCKED ROTOR CURRENT, AMP _____

STARTING TORQUE, % FL _____

PULL-OUT TORQUE, % FL _____

EFF.-FULL LOAD, % _____

EFF.-3/4 LOAD, %

EFF.-1/2 LOAD, %

P.F.-FULL LOAD

P.F.-3/4 LOAD

P.F.-1/2 LOAD

P.F. AT STARTING

SHORT CIRCUIT AC TIME CONSTANT, SEC

X/R RATIO

SPACE HTRS., WATTS

NET WEIGHT, LB

MOUNTING ARRANGEMENT

BEARING TYPE

LOCKED ROTOR CODE LETTER

PERMISSIBLE STARTS PER HR WITH:

MOTOR AT AMBIENT TEMP.

MOTOR AT RATED TOTAL TEMP.

DESCRIPTION OF INSULATION SYSTEM

INSULATION CLASS

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, $LB\text{-}FT^2$

SOUND LEVEL, DB

ATTACHMENT 11.12

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

****

This document and all information contained herein are the property of Ogden Martin Systems of LEE, Inc., and are not to be used except as expressly authorized in writing by said company.

****

Specification Prepared By: A/E Name: OMSL

Address: FAIRFIELD, NJ

Telephone: 201-882-9000

A/E Approved for Release:

	Printed Name	Signature	Date
1.	R. POTTER		3-6-90
2.	R. TERRAMOCCIA		12-28-90
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

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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
		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
Westinghouse Electric Corp.

CLIENT _____

PROJECT _____

FURNISHED BY _____

ATTACHMENT 2

SQUIRREL CAGE INDUCTION MOTORS
ABOVE 2000 VOLTS

DATA FURNISHED BY SELLER

DRIVEN EQUIPMENT	_____
MARK OR ITEM NO.	_____
NO. REQUIRED	_____
MAKE	_____
FRAME NO.	_____
HORSEPOWER, HP	_____
RATED VOLTAGE, V	_____
SERVICE FACTOR	_____
ENCLOSURE	_____
FULL LOAD SPEED, RPM	_____
FULL LOAD CURRENT, AMP	_____
LOCKED ROTOR CURRENT, AMP	_____
STARTING TORQUE, % FL	_____
PULL-OUT TORQUE, % FL	_____
EFF.-FULL LOAD, %	_____
EFF.-3/4 LOAD, %	_____
EFF.-1/2 LOAD, %	_____

P.F.-FULL LOAD _____

P.F.-3/4 LOAD _____

P.F.-1/2 LOAD _____

P.F. AT STARTING _____

SHORT CIRCUIT AC TIME CONSTANT, SEC _____

X/R RATIO _____

SPACE HEATERS, WATTS _____

NET WEIGHT, LB. _____

MOUNTING ARRANGEMENT _____

BEARING TYPE _____

LOCKED ROTOR CODE LETTER _____

PERMISSIBLE STARTS PER HOUR WITH:

MOTOR AT AMBIENT TEMP _____

MOTOR AT RATED TOTAL TEMP _____

DESCRIPTION OF INSULATION SYSTEM _____

INSULATION CLASS _____

FULL LOAD TEMP. RISE _____

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, $LB\text{-}FT^2$ _____

SOUND LEVEL, DB _____

WINDING TEMP DETECTOR _____

BEARING TEMP DETECTOR _____

SURGE PROTECTION

ARRESTER _____

CAPACITOR _____

DESCRIPTION OF BEARING CONSTRUCTION

DESCRIPTION OF STATOR 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

ATTACHMENT 11.13

OGDEN MARTIN SYSTEMS
of LEE, Inc.

SPEC NO. SE-213-LE
ISSUE 005
DATE 10/11/90

TECHNICAL SPECIFICATION

FOR

ELECTRICAL INSTALLATION

Facility Name: LEE COUNTY RESOURCE RECOVERY FACILITY

Location: LEE COUNTY, FLORIDA

****

This document and all information contained herein are the property of Ogden Martin Systems of LEE, Inc., and are not to be used except as expressly authorized in writing by said company.

****

Specification Prepared By: A/E Name: OMSL

Address: FAIRFIELD, NJ

Telephone: 201-882-7071

A/E Approved for Release:

	Printed Name	Signature	Date
1.	R. TERRAMOCCIA	R. Terramoccia	11/20/91
2.			
3.			
4.			
5.			

OGDEN PROJECTS INC.

TECHNICAL SPECIFICATION
FOR
ELECTRICAL INSTALLATION

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1.0 General

The Contractor shall be responsible for determining from the Engineers' drawings, standards, and diagrams, drawings of the existing plant and by field observations (including measurements as necessary), the quantities of materials required for the electrical installation work.

The electrical installation shall conform with the latest requirements of the National Electrical Code and National Electrical Safety Code as a minimum.

The Contractor shall install, align, assemble and test all electrical equipment in accordance with engineering drawings, specifications and manufacturers' instructions. Where required, sills for switchgear, unit substations, motor control centers, panels or other equipment shall be installed, leveled and grouted in place. Shipping splits of electrical equipment shall be matched, lined up and all bus bars, wire and cable connections made up to form one continuous structure per Vendor drawings. The Contractor shall maintain all electrical equipment in accordance with manufacturers' recommendations from receipt of equipment on site until the equipment is accepted by OMS. This includes but is not limited to, suitable protection from weather, standing water, energizing space heaters, sealing cable ends, removal of dust and cleaning of bus insulators, switchyard steel, etc. prior to energization and acceptance of equipment by OMS.

Contractor shall also follow manufacturer's storage procedures (energizing space heaters, rotating shafts, etc.) for all motors in the facility including cooling tower motors, boiler associated motors, ID fan motors and refuse and residue cranes. Air Pollution Control System motors and Air Cooled Condenser will be stored and maintained by others.

1.1 Contractor's Drawings and Data

1.1.1 Equipment

Contractor shall furnish Owner, for review, approval, and release, technical data, drawings and/or catalog information for the following equipment and material:

- Wire and cable, HV terminations
- Panelboards
- Lighting fixtures, lamps
- Safety switches
- Power, lighting, and specialty transformers
- Cable trays
- Local control stations and indicating lights
- Communication equipment
- Heat tracing equipment and material
- Cathodic protection equipment and material
- Manholes and underground duct material
- Conduit and fittings

Contractor shall also submit storage, installation and operating manuals.

Drawings and data must be submitted for approval. All equipment and material must be approved before delivery.

1.1.2 Construction Details

Contractor shall furnish Owner, for review and approval before release, sketches of construction details where the sketches are needed to supplement the engineering drawings such as in congested conduit areas.

2.0 TECHNICAL

2.1 Raceways and Supports

The Contractor shall furnish and install all raceways and supports.

2.1.1 General

Raceways include cable tray, exposed and concealed metal and plastic conduit, underground duct, cable trench, and metal wireways. They will carry power, control, instrument, and signal cables and wires. Raceways for lighting cable and wire are covered by the Lighting subsection of this specification.

All raceways shall be installed and supported in accordance with the requirements of this specification and any applicable state or local codes.

For the purposes of this specification, washdown areas are the Tipping, Refuse, Residue, Water Treatment and Boiler Buildings including the charging floor and the Grizzly Area.

2.2 Cable Trays

The location, configuration, and identification of all major cable tray runs are shown on the Engineers' drawings.

The Contractor shall furnish and install the complete cable tray system. The tray system shall comply with the latest NEMA Standards VE1, ~~NEC~~, and the requirements stated below.

Cable trays for power and control cables shall be ladder type ~~and may be aluminum or hot dipped galvanized after fabrication and shall have 9" rung spacing.~~

Cable trays for ~~instrumentation and~~ thermocouple cables shall be solid bottom with solid covers all hot dipped galvanized. In order to facilitate securing instrumentation and thermocouple cables in vertical tray installations, Contractor may use ladder type tray and install covers on the bottom. As with all instrumentation trays, top covers shall be installed later. Both trays and covers shall be hot-dipped galvanized steel.

The longitudinal distance between tray supports shall be suitable for tray strength and loading and shall be based on the manufacturers requirements.

The vertical distance between stacked trays (bottom to bottom) shall be 16 inches minimum.

~~All vertical runs of cable trays shall be provided with solid steel~~ or aluminum covers as applicable where the tray passes between floors. The cover shall extend at least six (6) feet above the finish floor elevation.

Cable trays which run under floor gratings or access platforms, or parallel to walkways and in close proximity thereto, shall be provided with sheet steel or aluminum covers as applicable. Trays under gratings and walkways shall have these covers extended three (3) feet beyond the extremity of the walkway or grating.

Cable trays outdoors shall have solid covers. The tray and support systems for these trays shall be designed considering the effect of ice, snow and wind loadings, as applicable.

Where horizontal power cable trays are required to be continuously covered by solid covers for more than six (6) feet, the covers shall be raised approximately two (2) inches to provide ventilation. ~~All tray covers shall be of the same material as the trays they cover.~~

Bolted joints between tray sections shall be made up tight and rigid. Where trays are not continuous, bonding jumpers shall be provided to assure low resistance electrical continuity of the system.

Continuous tray runs shall be connected to the station grounding system as specified under "Grounding."

Where conditions require special lengths of tray, special fittings for support or grounding connections, tray shall be cut or sawed square and neatly. Any field cutting or drilling of galvanized cable tray shall be touched up with a protective coating such as "Cold Galvanizing Compound" manufactured by ZRC Company. No burning or welding shall be used.

Cut edges and sharp corners shall be deburred and holes reamed to provide smooth surfaces which will not damage cables or injure personnel. Similary, bolt ends and nuts shall not be installed inside the cable tray.

Where a tray run terminates at a junction box, switchboard or other enclosure, a suitable connector fitting shall be used to provide a rigid bolted joint.

Where cables leave tray and enter rigid metal conduit runs, the rigid conduit shall be clamped to the tray side rail, or shall be independently supported without contact with the tray. However, in the latter case, a grounding jumper shall be installed between separately supported conduit and tray.

Conduit clamps for attachment to tray shall be of a manufacturer's standard fitting for this purpose and shall be listed for equipment grounding use. Where cable exit through bottom of tray is required, a standard dropout fitting shall be used, if necessary to ensure that cable minimum bending radius is maintained

Cable trays shall be furnished for cable loading as follows:

Tray Width	NEMA Class Designation
6" - 30"	12A
36"	12B

~~Additionally, trays and supports shall be designed to support a 200 lb concentrated load mid-span per VE-1.~~

All tray fittings shall be minimum of 12" radius for control cable and 24" for power cable unless indicated otherwise on the drawings. All cable trays and fittings shall be furnished by the same vendor. Only non-adjustable tray fittings shall be used.

The following are acceptable cable tray suppliers:

Husky Products Inc.
T. J. Cope Inc.
B-Line Systems Inc.
P-W Industries Inc.
Globe Tray, Metal Products Div. U.S. Gypsum

2.3 Cable Tray Supports

The Contractor shall design, furnish and install the complete support system for the cable trays, including all hangers, braces, brackets, inserts, anchors, fabricated steel structures, hardware, and incidental materials.

Tray supports shall preferably be of the trapeze type, with trays in vertical rows. Contractor shall determine support location based on NEMA VE-1 and the tray manufacturer's recommendation.

Where hanger rods are used, they shall be continuous from top to bottom of a vertical row of trays.

The upper ends of trapeze hangers shall be supported by suspending from plates welded to the underside of building steel framing, studs welded directly to building steel, or by approved beam clamps.

Where overhead support for trapeze hangers cannot be provided, individual brackets may be used.

Trays shall be securely fastened to support members by a bolted clip or clamp on each side of the tray.

The tray support systems shall be assembled with steel bolts, nuts, and hardware. All such hardware, including hanger rods and coupler nuts, shall be galvanized. Lock washers, locknuts, or other locking devices shall be used, as required, to ensure that connections do not loosen due to vibration or temperature changes.

Cable trays and supports shall not be used as walkways or working platforms, nor as support for other platforms, pipe, or similar nonelectrical material or equipment.

2.4 Metal Conduit

A. General

The routing and location of conduit runs are generally not dimensioned on the drawings but shall be determined in the field to suit the locations of equipment, to conform to structural features and to avoid interferences. Conduit systems shall be routed so as not to interfere with the removal of equipment. Where exposed conduits are dimensioned on drawings, they shall be installed to a tolerance of ½ inch.

EMT with raintight compression connectors can be used in the Administration Building in concealed areas. EMT with raintight compression connectors can also be used in the turbine operating floor level and refuse building 8 feet or higher from floors and platforms not subject to mechanical damage for the following services:

a. Lighting
b. Convenience receptacles
c. Communications
d. Fire detection

Hot dipped ~~galvanized rigid steel conduit shall be used outdoors~~ and hot dipped galvanized or electroplated ~~intermediate metal conduit (IMC)~~ shall be used indoors. ~~Stub-ups from ductbanks and~~ all bends 45° and greater shall be rigid galvanized steel. All conduit shall be 3/4 in. NPS minimum size except that it is acceptable to use ½" conduit in the following areas, subject to compliance with the local codes:

a. Fire alarm system
b. Communication systems, except ½" conduit shall be the minimum size used for drops inside walls
c. Lighting circuits
d. CCTV systems

Each length shall bear the manufacturer's trademark or stamp. The couplings shall be of galvanized steel.

PVC coated rigid steel conduit and fittings shall be used at wet cooling towers and in corrosive indoor areas as defined on the engineers drawings.

Conduits shall be exposed whenever practical. In buildings, conduits shall be concealed in areas where walls have been surfaced with ceramic tile or plaster. Where hung ceilings are installed, conduits shall be run above the hung ceiling.

Conduit ends shall be plugged or capped at all times. Spare conduits shall remain plugged or capped upon completion of the work.

Conduit shall be laid out and installed in a neat manner with as few crossings as possible. Conduits shall be grouped whenever practical to run in banks rather than individually but sufficient clearance shall be maintained between layers for access to fittings.

Conduits, when run parallel to flues, steam pipes, or hot water pipes shall clear the pipes, etc. by a minimum of 12 in. In general, conduits shall be run above pipes.

All exposed conduit runs shall be installed with runs parallel or perpendicular to walls, structural members, or intersection of vertical planes and ceilings except where pitch is required for proper drainage. Conduit shall be securely fastened to the building or building steel by galvanized pipe straps, clamps and hangers placed at intervals per the NEC.

Standard one-hole malleable iron conduit clamps shall be used for a single conduit run. When the supports are anchored to concrete or brick, they shall be held in place by the use of machine bolt-type expansion shields. In outdoor and washdown areas, conduit spacers shall be installed under all conduits at supports to maintain a minimum clearance of 1/4 in. between walls, etc. All supports and spacers for conduit installed outdoors shall be hot-dip galvanized and all screws or bolts shall be galvanized. Heating of conduits to form bends shall not be permitted. Metallic conduits shall be grounded and electrically continuous for the entire run.

To remove any possibility of damage to wire insulation, all conduits shall be free of burrs and any other sharp edges throughout their entire length. If damage to wires can occur by pulling them around bends in any conduit run, additional conduit fittings or boxes shall be installed. There shall be a maximum of three 90 degree bends or equivalent in a run.

Conduit connections to all motors, instruments, solenoid valves, pressure switches, and equipment which may be moved or disconnected for servicing shall be made with liquid-tight flexible conduit not smaller than the corresponding conduit. Flexible conduit may also be used for short sections where required for difficult runs or where undue vibration is anticipated.

Conduit fittings (condulets) of the proper type and size shall be used throughout to provide the greatest accessibility to the conductors contained therein and to prevent damage to them. No conduit installation will be considered complete until covers and gaskets have been properly installed on all conduit fittings.

Pull boxes, or extra large conduit fittings (condulets) shall be used whenever necessary.

Field cut threads on galvanized conduit shall be coated with a protective coating such as "Cold Galvanizing Compound", manufactured by ZRC Company.

Conduit unions shall be installed in conduits connected to tapped equipment to avoid the necessity of disturbing the conduit assembly when removing equipment for maintenance. Running threads shall not be used.

All elbows for steel conduit shall be large radius elbows unless otherwise noted on the drawings.

Right angle turns may be made by manufactured elbows or symmetrical field bends. All field bends on conduit sizes larger than 1" shall be made on a hydraulic bending machine. Bends and offsets shall be avoided where possible but where necessary shall be made with an approved hickey or conduit-bending machine. Conduit or tubing which has been crushed or deformed in any way shall not be installed.

Approved expansion fittings shall be used wherever conduit crosses the expansion joints of the building.

All conduit terminations in indoor washdown areas or outdoors at outlet boxes, pull and junction boxes, motor control centers, unit substations, panelboards, motor starters, control devices, disconnect switches, etc., shall be made with insulated throat malleable iron, galvanized, watertight, conduit bushings and shall enter the box, device, etc. from other than the top. Other indoor conduit terminations shall be made with galvanized locknuts and insulated throat, malleable iron, and hot dip galvanized bushings.

Where conduits with tapered threads cannot be coupled with standard conduit couplings, O.Z. split couplings or Erickson couplings shall be used. Underground, or where coupling is to be covered with concrete, a watertight union shall be used.

Rigid steel conduits terminating at switchgear, motor control centers, etc. from below floor or underground shall be furnished with insulated throat, malleable iron, hot dip galvanized grounding bushings connected to equipment ground bus by means of suitably sized bare stranded copper cable.

All conduits shall be installed in such a manner as to avoid entrapment of moisture. Where this is impossible, contractor shall install suitable breather/drain fittings at the lowest point in the run. All conduit ends at cable trays in outdoor or washdown areas shall be sealed with a non-sagging compound approved for the cable installed to guard against water intrusion.

All conduit must be cleaned before the wires are pulled in.

B. <u>Conduit and Tray Markers</u>

All conduit and trays shall have alpha numeric markers in accordance with the Cable and Conduit Schedule and tray and conduit layout drawings.

Alpha numeric identification markers shall have lettering not less than 1/2 in. high. The following types are acceptable:

1. Flexible plastic marker with pressure-sensitive adhesive backing.

2. Markers may be stencilled directly on the clean surface of the conduit or tray using a compatible paint.

3. Vinyl plastic tags 3/32 in. thick, with 1/8 in. high lettering may be used for flexible conduit. A hole shall be provided for attachment by a standard cable tie or nylon cord.

2.5 Pull Boxes, Junction Boxes, Receptacles and Safety Switches

Pull boxes, junction boxes and safety switches shall be constructed of the proper gage metal as prescribed by UL 50, entitled "Electrical Cabinets and Boxes." Outdoor steel boxes and indoor boxes in washdown areas shall be NEMA 4, phosphatized steel, with polyester powder finish paint inside and out. Other indoor boxes shall be electroplated or painted and shall be steel, NEMA 12. Boxes in office areas shall be electroplated or painted steel, NEMA 1.

Except as noted on drawings, boxes shall be provided with screw mounted or hinged covers. Covers shall have captive nuts. Hinged doors shall be held closed by machine screws with captive nuts along the three nonhinged edges. Galvanized or cadmium plated screws may be used indoors in noncorrosive areas.

Receptacles in washdown areas shall be suitable for outdoor use.

Sectional switch and octagonal boxes shall be flush mounted in general purpose areas which have tiled or plastered finishes.

Terminal blocks shall be heavy duty, 30A, 600V, one piece molded with terminal barriers and marker strips.

Space heater safety switches shall be provided locally to motors having space heaters, e.g., cooling tower fan motors, and all motors 100 HP and greater.

Safety switches shall also be provided for all unit heaters.

NEMA 4 boxes with internal terminal strips shall be used for terminating solenoid operator pigtails. A surge suppressor (specified by Engineer) shall be provided and installed by Contractor in the box at each of these terminations on Facilities with a Distributed Control System.

2.6 Sleeves

All sleeves in floors, walls, roofs, etc. necessary for the installation of the electrical work shall be furnished and installed, by the Contractor.

All sleeves, floor and wall penetrations shall be sealed as required by the NEC section 300-21 by a system approved by Factory Mutual.

2.7 Conduit Supports

The Contractor shall furnish and install the complete support system required. This includes all hangers, brackets, inserts, anchors, steel structures and hardware. Conduit supports shall consist of clips and support fittings of standard heavy duty construction together with all necessary auxiliary structural members to provide a rigid support system. Support fittings and clips fabricated of sheet metal are not acceptable. All steel supporting members and hardware shall be protected against corrosion by galvanizing or by suitable corrosion resistant paint.

Conduits shall be securely fastened to support members by bolted clamps or U-bolts.

2.8 Duct Banks, Manholes, and Handholes

The underground duct bank system shall be furnished and installed by the Contractor, complete with manholes, handholes, and all accessories. He shall provide all materials required for the system in accordance with the drawings and bills of material, whether or not specifically shown or listed, and shall do all work for excavation and backfill, forms, reinforcing, concrete, and conduit and duct placement. Contractor shall refer to Specifications SS-404 Excavation and Backfill and SS-408 Concrete, as required. Red dye shall be raked into the top of the duct bank concrete after poured.

Plastic conduit shall be rigid PVC, Schedule 40 conforming to Federal Specification WC-1094A, NEMA TC-2 and UL-651. Refer to Excavation and Backfill specification and Concrete specification for details on excavation, backfill, and concrete requirements for plastic conduit duct banks. No direct buried conduit shall be installed unless specifically shown on the drawings.

No wood spacers or braces shall be used within the concrete encasement. Iron ties or strap shall not be used around single ducts and may be used only around the whole duct run. All duct banks shall be sloped towards manholes for drainage.

Manholes and handholes shall be furnished complete including all necessary inserts, pulling irons, drains or sumps, ground cables and connections, cover rings, and covers.

Reinforcement for manholes, handholes, and for duct banks shall be connected to the grounding system.

Where ducts turn up for termination at building walls, equipment foundations, or elsewhere, the last bend of the underground portion shall be galvanized rigid steel conduit and terminate six (6) inches above finished grade, foundation, etc. The transition from plastic to metal conduit shall be made by the use of approved watertight adapters. The underground portion of metal conduit elbows shall be painted with asphaltum at the point conduit exits concrete.

Cable tray and tray hangers or brackets used in manholes shall be galvanized steel. Cable brackets and other manhole hardware shall be of corrosion-resistant steel or shall be galvanized or otherwise properly protected against corrosion. All manhole hardware shall be grounded.

2.9 Miscellaneous Supports

Support structures shall be provided for isolated items of contactors, safety switches, small transformers, motor and other controls, pull boxes, and junction boxes. Miscellaneous supports for outdoor non-segregated bus duct shall be furnished by the Vendor for installation by the Contractor. Indoor non-segregated bus duct shall be hung from hangers supplied and installed by the Contractor.

For service in indoor or outdoor locations, supports shall be of hot-dipped galvanized members. Galvanized steel cut, drilled, or punched in the field shall have cut surfaces painted with zinc-rich, corrosion-resistant paint before assembly.

2.10 Cable and Wire

2.10.1 Construction

All cable shall be furnished in accordance with OMS Specification SE-210 "Power, Control and Instrumentation Cable".

On projects with Distributed Control Systems, all control inputs to the DCS will utilize twisted and shielded instrumentation cable routed in control raceway.

~~All lighting wire shall be No. 10 and No. 12, AWG solid.~~ No. 8 and larger shall be stranded copper and be in accordance with OMS Specification SE-210.

Lighting fixture wire shall be Type SF-1 silicone rubber and bear the label of the Underwriter's Laboratories.

Portable rubber cord type SJO shall be used to supply fluorescent fixture.

The following are acceptable insulated cable suppliers Substitutions to this list will not be acceptable:

1. Medium voltage (above 600V)

   Cablec Corp.
   Kerite Co.
   Okonite Co.
   Pirelli Cable Corp.

2. Low voltage (600V power, control cable, lighting)

   Cablec Corp.
   Continental Wire & Cable
   Essex Corp.
   Kerite Co.
   Okonite Co.
   Pirelli Cable Corp.
   Rockbestos Co.
   Dekoron (Samuel Moore)
   Brand Rex
   Collyer
   Rome

3. Low level cable (instrumentation & thermocouple)

   Boston Insulated Wire & Cable Co.
   Continental Wire & Cable
   Dekoron (Samuel Moore)
   Okonite Co.
   Pirelli Cable Corp.
   Rockbestos Co.

2.10.2 Installation of Cable and Wire

A. General

The Contractor shall inspect all cable shipments for damage to reels, lagging or packing material and for integrity of cable end seals and take appropriate action. Cable received with end seals damaged, defective, or missing shall be trimmed if necessary and shall have end seals replaced.

Upon receipt and inspection, cable shall be moved promptly to storage and stored according to the manufacturer's recommendation. Small wire packed on spools or in cartons shall be stored indoors or suitably protected for outdoor storage. Before a cable is pulled, the cable reel shall be stored at the temperature and length of time recommended by the cable vendor.

All ends of cable in storage shall be sealed to exclude moisture, and cut ends shall be immediately resealed.

Cable runs shall be continuous between terminal points. Cable installed before completion of the short end sections of the raceway through which it is routed shall have the ends coiled and protected against damage.

Cable damaged during handling or pulling operations shall be replaced by the Contractor without cost to OMS for material or labor.

Cables shall not be dragged over ground, floors, or obstructions, nor stored temporarily at point of use or elsewhere without protection against mechanical or other damage. When necessary, fire-proof blankets or other effective protection shall be used.

Where cable, conduct and/or cable tray penetrates a floor or wall which is fire rated, the penetration shall be sealed with a Factory Mutual approved system of equal fire rating. Control room penetrations require a one hour fire rating minimum. All other penetrations of non-fire walls/floors shall be sealed against air infiltration if an inner wall/floor and both air infiltration and moisture if an outside wall/floor.

Cable shall be installed in cable tray, conduit and underground ducts in accordance with the drawings, cable schedules, and this specification. The latest issues of schedules shall be used.

Pulling lines shall be manila or synthetic fiber rope. Wire and wire rope shall not be used. A dynamometer shall be used to monitor pulling tension on all heavy pulls, or when raceway configuration is long or complex. The lowest tension will result if the let-off reel is at the end nearest a conduit bend.

The maximum pulling tension on cable shall be based on the pull applied to conductors as follows:

Maximum for copper conductor - 0.008 lb per circular mil of conductor area

Pull applied to cable sheath with a basket grip shall not exceed 1,000 lbs nor the above for copper conductor, and the lesser of the two shall apply in this case.

The feed-in point for all cable pulls shall be attended during pulling. Cables shall be arranged to pull into the raceway smoothly, without kinks, twists, or snags, and shall be protected from abrasion or damage due to pulling over obstructions, sharp corners or rough floors.

Cable ends extending from raceways after pulling shall be protected against damage or excessively wet conditions, during the interval prior to final termination, testing, and connection to equipment.

B. Identification

Every cable, with the exception of those serving the lighting, and grounding systems, shall be identified by its alphanumeric code designation as shown on cable schedule.

Temporary markers shall be applied to the ends of cables when installed. They shall be attached to cable with, and completely covered by transparent, pressure sensitive, adhesive tape. Temporary markers may be removed when permanent markers are installed.

Permanent identification markers shall be applied to each cable at the terminal ends when final terminations have been completed and also at multicable junction boxes. Permanent identification markers shall also be applied to each 5 and 15 kV cable at pull boxes. Lettering shall be resistant to moisture and abrasion. Adhesive must be compatible with the surface on which it is used. The following types of permanent cable identification markers are acceptable:

1. Vinyl plastic tag, not less than 3/32 in. thick, with printed, embossed, or stamp impressed 1/8 in. high lettering, with hole for tying.

2. Wrap-around split-sleeve marker, rigid vinyl plastic, 1 1/2 in. wide, 1/8 in. high minimum lettering. The marker shall be sufficiently rigid to provide a positive grip on the cable or the overlap shall be cemented.

3. Metal or plastic straps provided with a transparent sleeve marker in which the cable identification marking elements may be inserted.

Additionally, a permanent identification marker having the cable number shall also be applied to each individual conductor of control and instrument cables at each termination to allow easy identification of the conductor. The marker shall be a non-sliding one piece plastic sleeve and shall be marked by machine.

C. Installation in Tray

Pulleys at corners shall have radii equal to or exceeding the minimum bending radius of the cable pulled, or shall be of three sheave type.

Cables shall be laid neatly in trays. Crosses shall be avoided insofar as possible and cables shall not be crowded at the inside or outside edge of horizontal tray elbows.

Cables shall be installed per NEC requirements. After installation, cables shall be tied to tray rungs. Cable in vertical tray runs in excess of the lengths in NEC Table 300-19(a) shall be supported by approved clamp type fittings or basket type cable grips and shall be tied to tray rungs with cable ties at intervals not exceeding 3 ft. Cable in vertical tray runs less than those in NEC Table 300-19(a) shall be tied to tray rungs with cable ties at intervals not exceeding 3 ft.

Power cables, control cables and instrumentation cables shall each be run in separate cable trays.

All cable installed in trays shall be protected against mechanical or fire damage from the time of installation until it is finally accepted by OMS. Cable trays in which cables have been installed shall be inspected and cleaned periodically during the construction period. Dirt, scrap materials, rubbish, and flammable refuse shall not be permitted to accummulate in trays. Cable in tray shall be protected against fire or damage due to sparks from adjacent or overhead welding.

D. Installation in Conduit and Duct

Conduits shall be thoroughly cleaned by blowing air through them or mandrels pulled through them before cable "drawing-in" operations begin. Attachments for pulling purposes shall be patented cable grips or other devices. Cable pulling lubricants used as an aid in pulling cable shall be compatible with the cable insulation and as recommended by the cable vendor. Grease or other lubricating material harmful to cable insulation shall not be used.

2.10.3 Cable Terminations

Cable terminations shall be made as specified below and in strict conformity with specific instructions provided by the cable manufacturer.

Only ratcheting or hydraulic type compression tools and fittings of the same manufacturer as the lug shall be used.

Tapes, varnishes, jointing, and oxide penetrating compounds and all materials used for terminating of cable shall be of the types and makes called for in the manufacturer's instructions.

Maximum care shall be used to avoid nicking conductor strands while stripping wire. Copper conductor shall not be wire brushed if it is tinned.

A. Power Cable

All 5 KV and 15 KV power cables shall be terminated with Raychem heat shrink stress cones following the manufacturer's instruction. Insulating heat shrink boots shall be installed over the stress cone and lug leaving no bare live parts or cable shields other than the ground pigtail. All three conductor cable shall be provided with cable breakout boots.

Particular care shall be used in the termination and grounding of cable shielding where used.

Cable splices are not acceptable. Connectors and terminal lugs for power cable shall be of full ring compression type.

The Contractor shall furnish all terminal lugs required.

~~Motors will be furnished without lugs on motor winding pigtails.~~ The Contractor shall furnish and install proper lugs.

Cable terminals having a long barrel and two or four hole pads shall be provided. Bolt hole spacing shall be NEMA standard to match drilling of equipment terminal pads. Only where space for two hole pads is not available will one hole terminals be accepted.

Joints between cable terminal pads and equipment terminal pads, buses, and other cable terminals shall utilize standard Unified National Coarse (UNC) bolting hardware. Each assembly shall include bolts, nuts, washers, and Belleville washers if either pad is aluminum. Only stainless steel Belleville washers are acceptable. Plated Belleville washers shall not be used under any circumstances.

a. Aluminum to Copper Surfaces: Field-furnished hardware shall be austenitic stainless steel.

b. Aluminum to Aluminum Surfaces: Field furnished hardware shall be austenitic stainless steel with Belleville washers.

c. Copper to Copper Surfaces: Silicon-bronze hardware shall be used, with Lock washers.

Termination of power cables at or within panels or enclosures shall ~~include clamping to provide support where required.~~

B. Control Cable

~~Control cable terminations and their conductor connections shall be in~~ strict accordance with the approved wiring diagrams. Conductor insulation shall be squarely and evenly cut. Cable jackets shall be stripped back to a point as close to the termination area as possible.

All control wires connected to terminal blocks shall be terminated with insulated compression lug connectors compatible with the terminal blocks supplied with the various panels and equipment. Ring tongue compression or locking spade compression terminals shall be used except on current transformer secondary circuits where ring tongue compression terminals must be used.

Splices in control cables are not acceptable. Terminal blocks shall be provided in all junction boxes. Control cables terminated on blocks at panels and racks and at equipment terminal boards shall be arranged with individual wires of sufficient length to permit forming and training them ~~neatly from end of cable jacket to terminal points.~~

~~C. Instrument and Signal Cables~~

The following procedure should be followed by the Contractor when installing shielded instrumentation and signal cables:

1. The cable jackets should be left intact in wireways of panels where possible. Single pair cable should exit the wireway with the jacket intact to within no more than 3" from their terminal point. Multi-pair cables should have the jacket intact until exit of the first pair from the wireway for termination.

2. Termination arrangements and shielding ground connection shall be applied only at point shown on the cable wiring diagrams.

Instrument and signal cables entering panels and racks for termination shall be neatly trained and formed. Low level conductors shall not be bundled with control conductors and shall not be random laid in wiring gutters.

Thermocouple connection heads at the thermocouples include terminal blocks with screws for connection of extension wires. Connections at the instrument and reference junction end of the extension wire circuits shall be made in accordance with the instrument manufacturer's instructions and drawings. Compression type terminals shall not be applied to thermocouple extension wires, nor shall the wires be connected to terminals or terminal blocks other than those provided with the ~~equipment.~~

2.11 Heat Tracing

Heat tracing shall be installed in accordance with the engineering specification and drawings and the manufacturer's recommendations. Heating cable or cables shall be installed axially on the pipe. Spiral wrapping of the cable around the pipe is not permitted.

Heat tracing panels shall be installed where shown on Contractor's Engineer-approved drawings. Panels shall be securely mounted, using metal channels where necessary to provide a mounting framework. Transformers shall be located within 3 feet of the panel. All heater cable power feeds for the heat tracing system shall be run in conduit; conduits shall be continuous and shall be installed directly into the panels, by field-punching knockouts. The top of the panels shall be located not higher than six feet above finished floor or grade elevation.

Ambient sensing thermostats shall be mounted on the panel, if the panel is located outdoors. For panels located indoors, Contractor shall locate ambient sensing thermostats outside the building in an Engineer-approved location.

Power wiring from the panel or junction box to the heat tracing cable on the pipe shall be connected to the trace in accordance with the heat tracing cable manufacturer's recommended method.

Heat tracing cable shall be installed on piping, valves, instruments, tubing, pumps, tanks, etc. in accordance with Engineer-approved installation drawings and manufacturer's recommendations.

Heat tracing cable shall be run straight along the pipe, one (1) or more cables per pipe may be used depending on the watts per foot required. The heat tracing cable shall be physically located away from top dead center of the piping to prevent mechanical damage due to personnel standing on pipes, etc.

Heat tracing cable shall be fastened to piping using fiberglass tape, in accordance with the manufacturer's recommendations.

Where heat tracing cable must be run past any piping discontinuity, including valves, flanges, pumps, etc., the cable shall be looped before it is wrapped around the valve, etc. in order to allow for unwrapping of the cable and removal of the valve, etc. without complete removal of the entire run of heating cable. This shall be in accordance with manufacturer's recommendations.

All heat tracing cable and material shall be in accordance with OMS Specification SE-209 Electric Heat Tracing-Freeze Protection.

2.12 Grounding

Ground cable, ground rods, copper bar, connectors, fittings, and hardware for the complete grounding system shall be as shown on the drawings and as specified. All grounding shall be in accordance with the NEC.

Grounding system connectors for above-grade connection to equipment or at testing points shall be full compression copper lugs, sized for the cables to be connected. Exothermic type connections shall be used for connecting to building steel.

Grounding system connections for below grade shall be made by the exothermic welding process, similar to the Cadweld system of molded jointing. Molds and thermite type welding powders shall be stored under dry and heated conditions. All surfaces to be welded shall be carefully cleaned of dirt, paint, rust, and scale. Structural steel surfaces shall be cleaned or ground to expose the base metal.

Ground grid test point connections and separable connections at major equipment, such as large power transformers, switchgear, 4 kv motors, motor control centers, etc., shall be made with two hole, deform compression type lugs bolted to copper bars or to equipment pads. Secondary type connections to equipment frames and structures, such as lighting transformers, panels, control boards, etc., may be made with

single hole compression lugs. All bolted joints shall have contact surfaces cleaned and shall be made up tight. Where bolted connections are made between aluminum and other metals, an approved joint compound shall be used on the mating surfaces. Hardware shall be of approved noncorrosive alloys or austenitic stainless steel. Cable lugs furnished with the equipment may be used for ground connections if they meet the specified requirements and are the proper size.

Ground bars and cables located on structural steel or concrete surfaces shall be run straight and parallel to building lines, supported close to surfaces. Nelson stud weld fasteners or equal may be used. For support on concrete surfaces, drilled-in anchors shall be used.

Ground electrode points and buried ground grids shall be installed as shown on drawings. Ground rods shall be driven vertically to rod length as shown on drawings and tops of rods shall be no less than 12 in. below finish-grade surface or below-ground floor slabs. Where ground cables enter a building below grade level they shall be shot with Thermite weld material to provide a barrier against seepage of groundwater through the interstices between strands.

Cable pigtails brought out of concrete for equipment and other connections shall utilize 600V green PVC insulation, shall extend beyond the proposed connection point and shall be protected from damage during construction.

Where exposed ground connections as finally installed may be subject to mechanical injury, they shall be properly protected. If pipe of magnetic material is used for protection, the cable shall be bonded to the pipe at each end. The use of nonmagnetic protective covering of adequate mechanical strength is preferred.

Wire mesh grill work or fence installed around isolated items of electrical equipment such as grounding transformers shall be effectively grounded whether or not such grounding is indicated on the drawings. Doors in such grill work and gates in outdoor grounded metal mesh fences shall be connected by a flexible copper jumper to the adjacent stationary grounded metal section.

Cable tray and metal conduit systems shall be grounded by copper cable connections to the ground grid or to building steel. Long runs of cable tray shall be grounded at each end and at intervals not exceeding 100 ft.

Where expansion joints are used in tray or conduit runs, flexible copper cable jumpers shall be used.

The ground cables are to be routed through wall and floor sleeves, lengths of conduit, and duct banks, as required, in order to make a continuous run.

Duct banks shall have a bare copper ground cable placed on top of the duct bank.

The ground bus or grounding lug of all transformers, generators, switchgear, motor control centers and distribution panels shall be directly connected to the plant grounding system. The generator, 15kV bus duct, 15kV switchgear, 5kV switchgear, 480V unit substations and 480V MCC's shall have two ground connections. All 4000V motors and motors supplied from 480V substations shall also have two ground connections. One shall be provided by the ground conductor in the feeder cable and the second shall be a supplementary ground connection directly connecting the motor frame to the plant ground grid via a copper ground cable. All other electrical equipment may be grounded through the rigid metal conduit system. Where cable tray is used, it shall be suitable for use as an equipment grounding conductor. Supplementary grounds shall be provided as indicated on the drawings.

Where motors or other devices are served by overhead metallic conduit terminating with flexible conduit, a copper cable jumper shall be used parallel to the flexible conduit to ensure ground path continuity unless the power cable contained inside includes a grounding conductor.

Power bus housings shall be connected to the station grounding system.

All metallic underground piping and fixed piping of the fire extinguishing system shall be connected to the station grounding system. All pipe joints having nonmetallic gaskets will be jumpered by a cable across each joint.

Metallic perimeter fences which cross under or run parallel to distribution or transmission lines will be grounded by providing driven ground rods at every other fence post extending 25 feet on both sides of the transmission line outer conductor. A buried ground conductor running parallel to and three (3) feet outside the fence shall be connected to the ground rods and bonded to the fence at 20 foot intervals. Insulation sections shall be provided at both ends of this section. This shall be accomplished by providing two (2) breaks at both ends 10 feet apart. A break shall consist of two (2) posts side by side such that when the final installation is completed a two (2) inch separating opening exists between the posts. The remainder of the perimeter fence shall have an insulating section at a minimum of 500 foot intervals.

Instrument racks and control panels which contain electronic equipment will be furnished with two ground buses. Cable shields will be grounded on one isolated bus, and equipment grounds will be tied to the other ground bus. The shield ground bus will be insulated from the cabinet. Shield ground bus shall be grounded with 600V insulated ground cable No. 2 AWG size to the common ground which is insulated from cabinet raceway and structure grounds.

Grounding of the equipment ground bus shall be made by directly connecting to the station grounding system.

~~The minimum size of stranded copper cable used for miscellaneous grounds~~ and ground jumpers not detailed on drawings shall be No. 6 AWG. ~~Not~~ less than No. 2 AWG ~~shall be~~ used for cable tray grounds, control and power panels.

Every other exterior ~~steel building column shall~~ be connected by bare copper cable ~~directly~~ to the station grounding system. Column grounds ~~shall be made~~ by exothermic welding not less than 1 ft above ~~the finished floor elevations.~~

Stack and cooling tower lightning protection will be furnished and installed by the vendor including lightning rods and minimum of two No. 4/0 AWG bare copper conductor downcomers to the ground grid. Contractor shall provide buried ground cable and shall make the connection to the vendor's lightning protection system. Contractor shall also ground all flagpoles.

~~Grounding cable shall be stranded soft-drawn bare copper wire in accordance with ASTM B3 and ASTM B189.~~

Grounding rods shall be sectional type copperweld, 3/4 inch diameter in 10 foot lengths.

2.13 Lighting

All equipment and material required for the lighting and receptacle systems shall be as outlined on the drawings, and as herein specified. Lighting systems include fixtures, lamps, receptacles, panelboards, switches, controls, wire, raceways, supports, transformers, fittings, material, and accessory equipment.

~~The lighting system shall consist of 120 volt incandescent and 277 volt high pressure sodium and fluorescent fixtures. In~~ areas where fixture mounting heights are 18 feet ~~or higher, high~~ bay fixtures shall be used. Fluorescent ~~fixtures~~ shall be used in electrical ~~room, control~~ room and ~~office areas.~~

The control room shall also have 125V D.C. incandescent emergency lighting fixtures served from the station battery. Emergency lighting and exit sign for other areas shall be provided from self contained battery pack units. Where local codes permit, self illuminated exit signs may be utilized.

In general, illumination levels, in average maintained footcandles, in the various areas shall be as follows:

	Footcandles	Fixture Type
~~Electrical rooms~~	~~40~~	~~F~~
Boiler area, ground floor and auxiliary burner area	30	HPS
Firing aisle	30	HPS
Other boiler platforms	20	HPS
Air Pollution Control (outdoor)	20	HPS
Battery room	25	I, Explosive Proof
Tipping floor	25	HPS
Charging floor	25	HPS
Control rooms - (normal a.c.)	75	F
- (emergency d.c.)	30	I
Turbine area	30	HPS
Inclined Conveyor Galleries	20	HPS or F
Residue Handling Equipment Platforms	20	HPS
Chlorination Building	20	*F
Water Treatment areas	30	HPS
Fire Pump House	20	*F
Scale House	70	*F
Administration Building	70	F
Maintenance shops	50	F
Storage areas	20	F
Outdoor switchyard	2	HPS
Roadways and parking areas	1	HPS

*120V Ballasts

Roadway and outdoor area lighting poles shall be aluminum or galvanized steel. Outdoor area and roadway lighting may be serviced with direct buried cable except for under roadways which shall be installed in Schedule 40 PVC rigid conduit. The installation lighting drawings are, in general, diagrammatic, with fixture and receptacle outlets shown and located approximately to scale but not dimensioned. It is the responsibility of the contractor to make material take offs. The Contractor shall also check the lighting drawings against field conditions for interferences and before installation shall bring any interferences to the attention of the Engineer.

Contractor shall install Cooling Tower lighting before Cooling Tower Contractor installs the Tower's lightning protection. Contractor shall coordinate with Cooling Tower Contractor to avoid conflicts and delays.

With the exception of recessed fixtures in lay-in type ceilings, provide supporting angle irons or channels to span bar joints in order to support light fixtures from structural members, and independent from ceiling and ceiling hangers. In all areas without hung ceilings, lighting fixtures shall be supported from structural slab, beams, or joists. When fixtures fall between beams or joists, unistrut channels for support shall be provided.

Where recessed fixtures are being installed in lay-in type ceilings, provide a wire hanger at each corner of each fixture. Wire hangers shall be of sufficient strength to provide proper structural support, and to prevent the ceiling from sagging. Hangers shall be suspended from building structural members.

The Contractor shall neatly fill in circuit designations on the panel-board directory as soon as each permanent connection is completed.

The installation and support of conduit, which are included under para. 2.4 of this Specification, shall also apply to lighting systems.

Lighting and fixture wire shall be installed as described in para. 2.10.2A.

Identification of lighting panel and power panel multiwire branch circuit conductors of different voltage levels shall be per Article 210-4 and 210-5 of the 1990 NEC. At least one such system shall utilize black , red and blue for phase conductors, white or natural gray for the neutral (grounded) conductor, and green for equipment ground.

Transformers - Power and Lighting

Lighting transformers shall be ventilated dry type, of voltages, phases, and ratings shown on the drawings with six 2-1/2% full capacity taps (2 above and 4 below rated primary voltage). Contractor shall adjust transformer taps as directed by Owner. Transformers shall be of the 150°C temperature class and conform with the standards of NEMA ST1 and UL506. Acceptable vendors are as follows:

General Electric Company
Westinghouse Electric Corp.
Jefferson Electric
Square D Company

Panelboards - Power and Lighting

Lighting and power panelboards shall be of deadfront type with solid neutral bus and ground bus, constructed in accordance with NEMA PB-1 and UL 67. Branch circuit breakers shall be thermal magnetic trip type, bolt-on construction. Minimum interrupting ratings shall be 10,000 amperes symmetrical for 120/208, 120/240 and 277/480 volts breakers. 20% spare single-pole breakers shall be provided.

Cabinets for panelboards shall be constructed of code gauge galvanized sheet steel and provided with not less than 4 in. wiring gutters at the sides and 6 in. at the top and bottom. Trims shall be fitted with hinged door having combination lock and latch. A directory holder, with glass or heavy plastic plate and metal frame, shall be mounted inside of each door with a neatly typed directory properly identifying each circuit. Acceptable vendors are as follows:

General Electric Co.
Westinghouse Electric Corp.
Square D Company
I-T-E

Lighting Fixtures

A. High intensity discharge fixtures (HID) shall be aluminum alloy, high pressure sodium type, 277V, enclosed and gasketed, suitable for outdoor/indoor locations as specified on lighting drawings. Fixtures shall be in accordance with ANSI Std. C1 - National Electrical Code and C78 - Standard for High Intensity Discharge Lamp Types, and, Underwriters' Laboratories, Inc. Std. No. UL 1572 - Standard for HID Electric Lighting Fixtures. Ballast housing shall be cast aluminum and prewired. Ballast shall have a Class H insulation system. Internal fixture wiring shall be suitable for 150°C minimum ambient temperature. Fixture and gasket shall be suitable for NEMA 4 or equal applications. All fixtures shall carry UL listing mark. Acceptable vendors are as follows:

Holophane
Appleton Electric Co.
Crouse-Hinds Co.
Associated Lighting Co.
Killark

B. Fluorescent fixtures for general office use shall be 2' x 4' recessed troffers, 2, 3 or 4 F40 rapid start lamps, 277V with high power factor ballast, as specified on lighting drawings. Enclosure shall have flat white steel door frame and acrylic lens. All fixtures shall carry UL listing mark. Acceptable vendors are as follows:

Day-Brite Lighting, Div. Emerson Electric Co.
Benjamin, Div. Thomas Industries Inc.
Blackburn, Div. FL Industries Inc.
Westinghouse Electric Corp.

Substitution to the above list will not be acceptable.

2.14 Communications

2.14.1 Telephone System

The Contractor shall install an empty conduit system for a telephone system to be installed by others. This conduit system shall be a separate conduit system from plant wiring.

The telephone conduit system shall consist of conduit for owners telephone handset stations, attendant console, telephone outlets, and Private Automatic Branch Exchange (PABX). Telephone outlets will be in offices, control room and at vital operating stations.

The raceway for trunk lines from the PABX to the public telephone system shall be in accordance with the local telephone company's requirements.

2.14.2 Public Address and Intercommunication System

The Intraplant Communication System shall employ a single paging zone and five private or party line channels and shall be provided by the Contractor. The intraplant communication shall consist of handset stations, speaker amplifiers, loudspeakers, jack stations for portable handsets and central control cabinet as required.

Stations shall be in various plant locations such as boiler area, turbine area, material handling area and at other locations indoor or outdoor as required.

A complete raceway system for the Intraplant Communication System will be required.

The minimum wire size for communication power shall be No. 14 AWG. Page line conductors, party and speaker line conductors shall be twisted pairs No. 16 AWG.

This system shall also be tied into the telephone system via an interface module provided by the Contractor.

Acceptable vendors are as follows:

Gai-Tronics Corp.
Femco, Division of Gulton Industries Inc.
Comtrol

3.0 TESTING & INSPECTION

General

Tests shall be conducted during the construction and preoperational periods, and the completion of records covering such work shall be the responsibility of the Contractor. All such tests and checks shall be made in strict accordance with applicable manufacturer and Engineers' instructions. The scope of testing and inspection is covered in the responsibilty matrix in the contract.

3.1 Motors

All motors, including those supplied with the boiler, cooling tower, ID Fan, Refuse and Residue Cranes shall have motor winding insulation resistance megger tested as soon as stored. They shall be tested again one week after heaters are first energized. Motors rated 50 HP and larger shall be retested at 60 day intervals thereafter.

The polarization index shall be determined for motors 150 horsepower and larger. If the polarization index of any motor, is below 2.5, the equipment shall be referred to the Engineers for decision of corrective steps to be taken. The polarization index is the ratio of the insulation resistance at 10 minutes to the insulation resistance measured at one minute and provides a measure of the amount of moisture and dirt in the insulation. For three-phase induction motors, the insulation resistance shall be measured between all stator leads connected together and ground. For machines having independently connected windings such as wound rotor motors, synchronous motors, d-c motors, etc., the insulation resistance between each winding and ground and between all independent winding shall be measured. After completion of tests, the windings tested shall be grounded at least one-half hour to drain charge.

All readings of insulation resistance and temperature of the machine and ambient humidity at the time of test shall be witnessed by the Engineers and recorded by the Contractor. Normal operating voltage shall not be applied to any machine before it has been tested and clearance given by the Engineers for application of line voltage.

The minimum acceptable 1 minute insulation resistance, in megohms at 40 C, shall be equal to the rated motor KV+1.

460V motors shall be meggered at 1000V DC phase to ground. 1.5 megohms at 40 C is the minimum acceptable insulation resistance.

If the test is made at other than 40C, the observed readings shall be corrected to 40 C in accordance with the paragraphs 4.33, 4.34, and figure 1 of IEEE No. 43, Recommended Guide for Testing Insulation Resistance of Rotating Machinery.

3.2 Wire and Cable Tests

Perform wire and cable tests prior to connecting to equipment, as follows:

1. Instrument, and thermocouple service

    a. Continuity and ground check

    b. Continuity tests of cable shield, when applicable

    c. Continuity and ground test of conductors, prior to connecting to equipment: shield, if any, grounded

       Continuity tests may be performed with circuit test ringers or telephone sets.

2. Power and Control

a. Continuity and ground check

b. Continuity tests of cable shield, sheath, or armor, when applicable

c. All power and control conductors shall be meggered as follows:

Normal Operating Voltage	Test Voltage Volts DC	Min. Acceptable Insulation Resistance in MegOhms for 1 Minutes
0 - 300V AC/DC	500 (Go-No Go)	N/A
301 - 600V AC (under No. 4 AWG)	1000 (Go-No Go)	N/A
301 - 600V AC (No. 4 AWG or larger	1000	2.0
Above 600V AC	5000	15

d. All medium voltage cable shall be given a high potential dc proof test, in addition to a megger test, prior to being energized and placed in service. The field test voltage applied shall not be more than 80% of factory applied dc potentials. Field acceptance proof tests shall be applied for 15 minutes at high voltage dc values, depending on the service voltage and insulation thickness as follows:

Rated Voltage Phase to Phase	DC Hi-Pot Test Wall-Mils	KV
5,000	90	25
5,000	115	35
15,000	175	55
15,000	220	65

After the voltage has been applied and the test level reached, the leakage current shall be recorded at one minute intervals. The cable is satisfactory as long as the leakage current is at or below the vendors leakage current acceptance value and decreases or stays steady after it has leveled off. If the leakage current starts to increase trouble may be developing and the test may be extended to see if the rising trend continues. Cable breakdown is indicated by an abrupt increase in the magnitude of leakage current and a decrease in the test voltage.

After the test allow the residual voltage to decay before applying manual grounds to discharge the cable.

Only qualified personnel shall run the high potential tests.

3.3 Equipment

Testing of major equipment will be done in accordance with the manufacturer's instructions.

Tests on electrical equipment will include measurements of insulation resistance, high potential dielectric withstand tests, operational tests of the equipment, and operational tests of control circuits and complete systems.

Equipment testing will apply to all items installed by the Contractor.

Motor starters, relays, timers, and similar electromechanical devices shall be energized and operated electrically without loads connected to ensure proper operation and freedom from sticking, binding, and misalignment.

3.4 Miscellaneous

Miscellaneous equipment not subject to special equipment tests, such as small motors and isolated control and sensing devices, shall as a minimum have insulation resistance megger tested before connection of cables.

All test voltages, including voltage ratings of meggers to be used, and all methods of testing used shall be in accordance with manufacturer's instructions.

3.5 Installation Check

Prior to operational testing, final checking of equipment, raceways, circuits, and connections is required.

The requirements for preoperational checking include, but are not limited to, the following items:

1. Phase rotation and voltage of power interconnections
2. Synchronizing circuits correctly wired
3. All fuse and circuit breaker ratings correct as specified or shown on drawings
4. All metering circuits correctly wired

5. All current transformer secondaries correctly wired to equipment or shorted

6. Control switchboards installed, connected, clean, and ready for operations

7. Switchgear in operating condition, clean, adjusted, and tested; all circuit breakers aligned and checked for proper operation

8. All relay shipping blocks removed

9. Thermal overload devices in motor starters of correct ratings and properly installed. (Heaters will be shipped separately. Contractor shall select and install them based on motor nameplate data and MCC manufacturer's instructions)

10. Protective relays properly set and adjusted

11. Transformers tested including oil dielectric tests, where required, oil levels and gas pressures correct, cooling systems connected and operable

12. All equipment properly grounded

13. Integrity of grounding system verified, including all ground connections tight

14. Power and control circuit connections completed and tight

15. All motors checked for rotation, properly lubricated, tested, clean, and ready for operation, with driven equipment connected or positively and safely disconnected, as may be required

16. Battery and charger systems correctly connected, batteries charged, electrolyte levels and specific gravities correct, systems in operation and tested

17. D-c distribution systems completed and checked

18. Valve operator and other limit switches correctly connected and adjusted

19. Conduit and trays properly installed in accordance with applicable documents and drawings

20. All metal raceway systems electrically continuous and correctly grounded

3.6 Operational Check

All equipment and all power, control, and instrument circuits will be operated and checked to ensure that operation conforms to the requirements of the Engineers' elementary diagrams, wiring diagrams, and specifications. Each component or subsystem shall be operated, checked out, and necessary corrections made and rechecked before operation of major systems is attempted.

3.7 Test Equipment

Testing equipment, in sufficient numbers, to be provided by the Contractor shall include, but shall not be limited to, meggers, dc high potential test set, ground test sets, timers, motor rotation indicator, and instruments. All equipment shall be in good operating condition and shall be properly maintained and calibrated.

Upon completion of testing, checking, and preliminary operation of each item of equipment, circuit, or system, the Contractor shall be responsible for any necessary maintenance and protection until the item is turned over to and accepted by the Purchaser's operating personnel. Where periodic testing is a part of prescribed maintenance, the Contractor shall continue to make such tests and to record results according to established procedures.

3.8 Protective Relays Settings and Calibration

The Contractor shall provide qualified personnel and supervision to perform calibration, setting and testing of all protective relays, alarm relays, timers and solid state overcurrent trip devices on all power circuit breakers in accordance with instructions provided by the Engineers.

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.

ATTACHMENT 11.14

OGDEN MARTIN SYSTEMS
of LEE, Inc.

SPEC NO. SM-104
ISSUE 008
DATE 10/18/91

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: OMSL

Address: FAIRFIELD, NJ

Telephone: 201-882-7071

A/E Approved for Release:

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3.			
4.			
5.			

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OGDEN PROJECTS INCORPORATED

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

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5.1 SE-211 Squirrel Cage Induction Motor 460V

5.2 SE-212 Squirrel Cage Induction Motor 2000V and over

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 vibration switch and, if furnished with water cooled sleeve bearings, RTD temperature detectors, with wells. The RTD type shall be 100 OHMS, platinum, 3 wire 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.)

- o 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 without exception, Bailey's air operated universal rotary actuator, type UP, with interconnecting linkage, levers, pneumatic positioner, I/P converter and airsets designed to accept purchaser 4-20 ma signal for modulating the inlet vanes. On loss of air, loss of power, or solenoid failure, actuators for forced draft fan and overfire air fan shall fail-close and, induced draft fan shall fail-open. Volume tanks, trip valves, and any other devices required to drive the actuator in its fail position shall be included and supplied with the actuators. Limit switches shall be provided on all inlet vane drives to indicate full open and full closed position. These actuators in conjunction with the inlet vanes 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 test block 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:

- No cracks or lack of fusion shall be acceptable.
- 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.
- All weld craters shall be filled to the full cross-section of the weld.
- 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.

FAN SPECIFICATIONS

ATTACHMENT 1

DESIGN CONDITIONS
AND PROJECT SPECIFIC REQUIREMENTS

1.0 Design Conditions

Project: LEE COUNTY RRF

Location: LEE COUNTY, FLORIDA

Number of Units: 2

Plant site conditions:

Elevation: 2 FT ASL

Earthquake Zone: 0 (SBCCI)

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	0	0	2	0	0
Fan Minimum Conditions					
Flow, acfm	—	—	(1,2)	— [redacted]	NA
Static Pressure Rise, in H_2O	— (1,3)	— (1,3)	(1,3)	— (1,3)	NA
Fan MCR Conditions Flow, acfm	—	—	(1,4)	—	— (1,5)

	Forced Draft	Overfire Air	Induced Draft	Seal Air	Reverse Air
Static Pressure Rise, in w.c.	N/A (1)	N/A (1)	(1)	N/A (1)	N/A (1)
Operating temp. -F	80	80	275	80	
Terminal Static Pressure in w.c.	16	18	1.0	16	(1)
Losses, in. w.c.:					
System	(1,6)	(1,6)	(1,6)	(1,6)	(1,6)
Boiler	N/A	N/A	2.0	N/A	N/A
APC System (EQUIP.)	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			(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	300	105	
Additional Design Criteria:					
Air or gas handled	Dusty Air	Dusty Air	Flue Gas	Clean Air	Flue Gas
Location (Indoor/Outdoor)			INDOORS		
Driving Motor V/pH/Hz	/ /	/ /	4000/3/60	/ /	/ /

(2) (NOTE CHANGE)

The power consumption will be evaluated on the basis of a capitalized value of $ 7600 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.

ATTACHMENT 2

TECHNICAL DATA SUPPLIED BY SELLER

	Forced Draft	Overfire Air	Induced Draft	Seal Air	Reverse Air
Manufacturer			TLT-Babcock		
Size and Model			1688B/1500		
Fan Performance					
MCR Conditions					
Flow, acfm			139,000		
Static Pressure Rise, in. w.c.			12.0		
Operating Temperature, F			275		
BHP			430		
Static Efficiency, %			60.2		
Guaranteed Test Block Conditions					
Flow, acfm			176,891		
Static Pressure Rise, in. w.c.			18.0		
Temperature, F			300		
BHP			601		
Static Efficiency, %			82.0		
Fan Design					
Single or Double Inlet			Single		

	Forced Draft	Overfire Air	Induced Draft	Seal Air	Reverse Air
Single or Double Width			Single		
Blading Design			CBI		
AMCA Arrangement			3		
Maximum Speed, RPM			900		
Required Driver Size, HP			600 (1.15 SF)		
Housings					
Material/gage, in.			A-36/0.375"		
Access Door			2		
Drains: No./Size			2/4"		
Inlet Boxes					
Included (yes or no)			Yes		
Inlet size			132.5" x 47.5"		
Material/gage, in.			A-36/0.375"		
Silencers			-		
Drains: No./Size			-		
Rotor (Wheel and Shaft)					
Weight, lb			5685		
Wheel Diameter, in.			101.0"		
WR^2, lb-ft.			31,112		
Tip speed, ft/min.			22,857		

	Forced Draft	Overfire Air	Induced Draft	Seal Air	Reverse Air
Type blading			CBI		
Blade Material/Grade			A514-TPA		
No. of blades, each side			12		
Wear plate material/grade			AR-400		
Wear plate, thickness			0.25"		
Shaft Material			AISI-104S		
Shaft Diameter at hub, in.			8.375"		
Shaft Diameter at bearings, in.			5.9"		
Shaft seals, type			Garlock		
First critical speed RPM			1678		
Rotor resonant speed RPM			1469		
Bearing					
Type, thrust			Roller/Pag		
Type, radial			Roller/Pag		
L-10 Life			Later		
Diameter, in.			150 mm		
Length bearing surface, in.			3.78"		
Lubrication method, rings/other			Oil		
Bearing cooling method, water/air			Air		

	Forced Draft	Overfire Air	Induced Draft	Seal Air	Reverse Air
Pedestals Material			A-36		
Sole Plates Material			A-36		
Inlet Vanes					
Type and No. of blades			12		
% Leakage in closed position			< 10%		
Max. torque, ft-lb			1,100		
Actuator Manufacturer			Bailey		
Actuator Type			Pneumatic		
Actuator Model			Later		
Actuator Torque, ft-lb			Later		
Coupling					
Manufacturer			Falk		
Size and type			1030 G/Gear		
Housing Liners					
Location			Scroll & Cheek		
Material/gage, in.			A-36/0.25"		
Insulation					
Material and thickness recommended			4" RLT		

Summary of Weights	Forced Draft	Overfire Air	Induced Draft	Seal Air	Reverse Air
Pier load, fan base rail, lb			29,082		
Pier load, on each pedestal, lb			2,841		
Approx. shipping weight, lb			30,000		
Miscellaneous					
Is equipment C.G. given: yes/no			No		
Are starting torque curves attached?			Yes		
Can wheel be oversped to 110%?			Yes		
Are performance curvesattached? yes/no			Yes		
Are fan foundation design criteria attached? yes/no			No		
Vibration					
Guaranteed vibration peak to peak on bearing cap, after final installation, mils			See Attached		

I.D. FAN NOISE (1)

DISCHARGE GAS STREAM

OCTAVE BAND CENTER FREQ., HZ.	63	125	250	500	1K	2K	4K	8K	TOTAL
TOTAL FAN SOUND POWER, dB.A	100	114	122	123	123	119	114	104	128
SOUND POWER AT FAN DISCH., dBA	96	112	119	119	118	113	107	96	124
Sound Pressure at Fan Disch. dBA	82	98	105	105	104	99	93	82	110
ATTENTUATION (dB.) DUE TO:									
•VANED TURNS (2)	Later	—	—	—	—	—	—	—	—
•UNVANED 45° STACK INLET	—	—	—	—	—	—	—	—	—
•STACK (3)	—	—	—	—	—	—	—	—	—
MULTIPLE FAN CORRECTION, dB. (4)	—	—	—	—	—	—	—	—	—
SOUND POWER AT STACK EXIT, dB.	—	—	—	—	—	—	—	—	—
SOUND PRESS. AT STACK EXIT, dB. (5)	—	—	—	—	—	—	—	—	— (6)

FAN CASING

SOUND POWER (W/O INSUL.), dB. A	92	110	115	105	95	87	77	63	117
SOUND PRESS. (W/O INSUL.), dBA (8)	68	82	86	81	74	71	66	60	88 (6)
SOUND POWER (W/INSUL.) dB.A(9)	92	108	112	97	84	71	61	47	111
SOUND PRESS. (W/INSUL.),dB.A(8,9)	67	78	82	74	67	63	57	51	84 (6)

NOISE AT BLADE PASSING FREQUENCY (BPF)

BPF, HZ. 176 2XBPF, HZ. 352

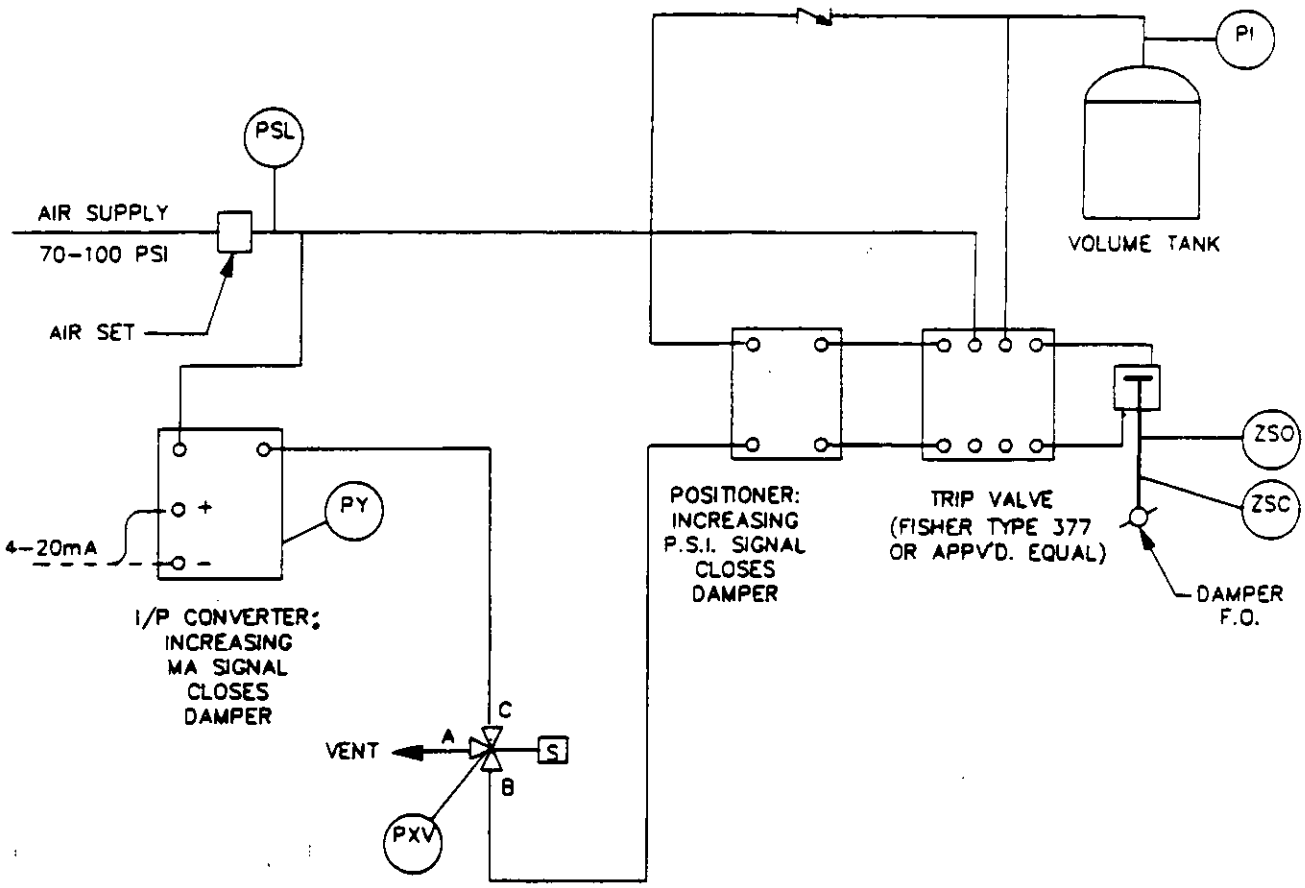
1/3 OCTAVE BAND CENTER FREQ., HZ. (7)	—	—	—	—	—	—
SOUND POWER IN FAN DISCH. GAS STREAM, dB.	—	—	—	—	—	—

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									
SOUND PRESSURE, dB. (8)									(6)
OVERFIRE AIR FAN									
SOUND POWER, dB									
SOUND PRESSURE, dB. (8)									(6)
SEAL AIR FAN									
SOUND POWER, dB									
SOUND PRESSURE, dB. (8)									(6)
REVERSE AIR FAN									
SOUND POWER, dB.									
SOUND PRESSURE, dB. (8)									(6)

NOTES:
(1) PROVIDE NOISE DATA AT FAN MCR OR TEST BLOCK, WHICHEVER IS HIGHEST.
(2) USE APC TRAIN WITH LEAST NO. OF TURNS; ____/____ 45°/90° TURNS USED.
(3) ____FT. HIGH STACK (FROM BREECHING); ____ FT. DIAMETER (STEEL [redacted] FLUE.
(4) 3 ~~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 COMPONENTS SHOWN SHALL BE FACTORY ASSEMBLED ON DAMPER DRIVE.
2. DAMPER SHALL HAVE LIMIT SWITCHES FOR OPEN AND CLOSED POSITIONS (DPDT CONTACTS, RATED 5A @ 120 VAC) TAGS: ZSO-[ ](OPEN), ZSC-[ ](CLOSED).
3. SOLENOID VALVE PXV-[ ] 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 OPEN ON LOSS OF AIR, OR CONTROL SIGNAL.

AN OGDEN COMPANY

ATTACHMENT 3-1

I.D. FAN VARIBLE INLET GUIDE VANE CONTROLS

(DOUBLE - ACTING CYLINDER ACTUATOR)

OGDEN PROJECTS, INC.

APPROVED: G.T. DATE: 6/18/91

DWG. NO. SM-104- 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			

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

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

SEP 10 1991

4APT-AEB

Mr. Clair H. Fancy, P.E., Chief
Bureau of Air Regulation
Florida Department of Environmental
Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

RE: Lee County, FL Energy Recovery Facility (Case No. PA90-30)

Dear Mr. Fancy:

This is to acknowledge receipt of your preliminary Prevention of Significant Deterioration (PSD) determination, and draft permit, included as part of the FDER Electric Power Plant Site Certification Review package, for the above referenced facility's proposed construction, received in our office on August 26, 1991. The proposed energy recovery facility will consist of three stoker waterwall combustion/steam generation units permitted to operate at a capacity of 660 tons per day (tpd) each, for a total facility capacity not to exceed 1980 tpd. Two units will be constructed initially, with the third unit being installed in the future. Each unit is capable of generating approximately 15 megawatts (MW) net.

Your determination proposes the use of a dry lime scrubber followed by a fabric filter (baghouse) for the control of particulates, acid gases and metals. NO_x emissions will be controlled by the selective noncatalytic reduction (SNCR) process. Mercury emissions will be controlled by injecting activated carbon, sodium sulfide, or a combination of both, into the flue gas prior to the dry scrubber and baghouse. To limit emissions of dioxins/furans, your determination proposes the use of proper combustion practices.

We have reviewed the package as submitted and have the following comments. As discussed with Mr. Mirza Baig of your staff, we are recommending the following changes to Appendix I, Recommended Conditions of Certification (reference pages 8 and 9). These changes should alleviate any compliance/enforcement questions concerning emissions standards and are as follows:

(1) Particulate Matter: Particulate emissions from the baghouse shall in no case exceed 0.010 grains/dry standard cubic foot, corrected to 7% oxygen, 5.34 lbs/hr/unit, and 21.3 tons/year per unit.

(2) PM_{10}: In no case shall they exceed 0.010 grains/dry standard cubic foot, corrected to 7% oxygen for the fraction of particles less than 10 microns in diameter, 5.34 lbs/hr/unit, and 21.3 tons/year per unit.

(3) VE: In no case shall visible emissions from each baghouse exhaust exceed 10% opacity (Six minute average).

(4) SO_2: 30 ppmdv corrected to 7% O_2, 24 hour daily geometric average or at least 80% removal efficiency, whichever is least restrictive. In no case shall they exceed 0.150 lb/MMBtu per unit, 41 lbs/hr/unit, and 163.3 tons/year per unit.

(5) NO_x: 180 ppmdv corrected to 7% O_2. 24-hour daily block average (midnight to midnight). In no case shall they exceed 0.29 lb/MMBtu, 80 lbs/hr/unit, and 320 tons/year per unit.

(6) Carbon Monoxide: 100 ppmdv, 4-hour block average beginning at midnight. In no case shall they exceed 0.099 lb/MMBtu, 26 lbs/hr/unit, and 108 tons/year per unit.

(7) VOC (Hydrocarbons): 37 ppmdv at 7% O_2. In no case shall they exceed 0.0211 lb/MMBtu, 5.80 lbs/hr/unit, and 23 tons/year per unit.

(8) HCl: 25 ppmdv at 7% O_2, or at least 95% removal, efficiency, whichever is least restrictive. In no case shall they exceed 0.0644 lb/MMBtu, 17.7 lbs/hr/unit, and 70.7 tons/year per unit.

(9) H_2SO_4 (sulfuric acid mist): In no case shall they exceed 0.0358 lb/MMBtu, 9.85 lbs/hr/unit and 39.3 tons/year per unit.

(10) Fl (fluoride): 5.0 ppmdv at 7% O_2. In no case shall they exceed 0.0035 lb/MMBtu, 0.96 lbs/hr/unit and 3.8 tons/year per unit.

(11) Pb (lead): In no case shall lead emissions exceed 0.0006 lb/MMBtu, 0.165 lbs/hr/unit, and 0.66 tons/year per unit.

(12) Be: In no case shall beryllium emissions exceed 1.35×10^{-7} lb/MMBtu, 3.7×10^{-5} lbs/hr/unit, and 14.7×10^{-4} tons/year per unit.

(13) Hg: In no case shall mercury emissions exceed 0.0006 lb/MMBtu, 0.165 lbs/hr/unit, and 0.66 tons/year per unit.

(14) As: In no case shall arsenic emissions exceed 9.1×10^{-6} lb/MMBtu, 2.5×10^{-3} lbs/hr/unit, and 0.01 tons/year per unit.

(15) Dioxins/Furans: In no case shall emissions of total tetra through octa-chlorinated dibenzo-p-dioxins and dibenzo-furans exceed 30.0 ng/dry standard cubic meter at 7% O^2. In no case shall they exceed 2.54×10^{-8} lb/MMBtu, 7.0×10^{-6} lbs/hr/unit, and 2.8×10^{-5} tons/year per unit.

(16) NH_3: In no case shall ammonia slip from exhaust gases exceed 50 ppmv.

(17) There shall be no visible emissions during the lime silo loading operations (in no case shall opacity exceed 5%).

(18) In no case shall emissions from the ash handling building baghouse exceed a particulate limit of 0.010 grains/dry standard cubic foot and visible emissions of 5% opacity.

Thank you for the opportunity to review and comment on the package. If you have any questions on these comments, please contact Mr. Scott Davis of my staff at (404) 347-5014.

Sincerely yours,

Jewell A. Harper, Chief
Air Enforcement Branch
Air, Pesticides, and Toxics
Management Division

United States Department of the Interior
NATIONAL PARK SERVICE
SOUTHEAST REGIONAL OFFICE
75 Spring Street, S.W.
Atlanta, Georgia 30303

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

N3615 (SER-ODN)

SEP [illegible] 1991

RECEIVED
SEP 0 9 1991
Division of Air
Resources Management

Mr. C. H. Fancy, P.E.
Deputy Chief
Bureau of Air Quality Management
Florida Department of Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Dear Mr. Fancy:

We have reviewed your Power Plant Site Certification Review and Lee County's certification application for a proposed 1800 tons per day resource recovery facility near Fort Myers, Florida. The proposed facility would be located approximately 61 km northwest of Big Cypress National Preserve (BICY) and 88 km northwest of Everglades National Park (EVER). As you know, EVER is a PSD class I air quality area, while BICY is designated a PSD class II area. Our comments on the best available control technology (BACT), air quality, and air quality related values (AQRVs) analyses with respect to the proposed project's potential impacts on these areas are discussed below. We ask that you consider these comments before making a final determination regarding the Lee County facility.

Regarding the BACT analysis, we agree that the emission control systems proposed for the Lee County facility (i.e., dry scrubbers/baghouses, thermal de-NO_x, proper furnace design and operation, and combustion control techniques) represent BACT. However, for sulfur dioxide (SO_2) and hydrogen chloride (HCl) control, we do not agree that the proposed 80 and 95 percent collection efficiencies reflect the best that can be achieved with the proposed scrubber/baghouse systems.

The Florida Department of Environmental Regulation (FDER) states that the BACT determination for the Lee County facility was made in accordance with the EPA's "top down" approach. The first step in this approach is to determine, for the emission source in question, the most stringent control available for a similar or identical source. If it is shown that this level of control is technically or economically infeasible for the source in question, then the next most stringent level of control is determined and similarly evaluated, and so forth.

Based on the information provided in the Lee County application, we believe that BACT for SO_2 and HCl emissions from resource recovery facilities are control systems designed for 90 and 98 percent collection efficiency, respectively. Table 4-6 of the Lee County application shows that for eight of the nine units for which HCl performance data were reported, the HCl control efficiency was 98.0 percent or greater (a high of 99.4 percent). Similarly, for SO_2 control, the reported efficiency for six of the listed units exceeded 90 percent (a high of 98.5 percent). In addition, Table 4-9 of the Lee County application provides a cost comparison of the various SO_2 control efficiencies. This table shows that the cost effectiveness of a 90 percent efficient system is $1,350 per ton of SO_2 removed. Furthermore, eight of the listed units in Table 4-6 had SO_2 control efficiencies greater than 85 percent, and Table 4-9 shows that the cost effectiveness of an 85 percent efficient system is only $1,169 per ton of SO_2 removed. A cost effectiveness of less than $2,000 per ton is generally considered reasonable. Therefore, based on the operating and cost data provided by Lee County, 90 and 85 percent efficient SO_2 control systems (both higher than the proposed 80 percent control system) are technologically and economically feasible. Consequently, under the "top down" approach, a 90 percent SO_2 control system constitutes BACT. Thus, we recommend that the FDER require Lee County to design their proposed scrubber/baghouse systems for 90 and 98 percent control of SO_2 and HCl emissions.

We have one final comment regarding the Lee County BACT analysis. Lee County correctly states that the proposed emission limits would comply with EPA's February 11, 1991, New Source Performance Standards (NSPS) for municipal waste combustors. However, the NSPS are set at levels which are expected to be met at a national level and set the "floor" for the BACT analysis. In other words, an emission limitation based on a BACT analysis cannot be less stringent than an applicable NSPS. However, based on the case-by-case, "top down" approach, oftentimes an emission limitation more stringent than a NSPS is warranted for a particular project. We believe such is the case for the Lee County project.

Regarding the air quality modeling analysis, as we recommended, Lee County placed modeling receptors in both BICY and EVER to assess potential air quality impacts of the proposed emissions at these areas. Because Lee County's predicted impacts were relatively minor, the FDER did not require Lee County to perform a cumulative class I increment or ambient analysis for EVER. As we indicated in past permit reviews, (i.e., Florida Power and Light-Martin (FPL)), from an air quality effects standpoint, we need to know the total pollutant levels that sensitive resources will experience, not just the increase from a proposed new source.

You may recall that in your response to our comments on the FPL project, you informed us that a cumulative, long-range transport class I analysis will be required for Phase II of the FPL facility.

The FPL analysis will provide a more complete assessment of the class I increments consumed at EVER. Considering the relatively small impacts at EVER from the Lee County project, and the fact that FPL has several other facilities in South Florida, we believe it is reasonable for you to require FPL to perform the cumulative modeling analysis. The incremental impacts, when added to the impacts from all other background sources, should then be used to evaluate the effects on the sensitive air quality related values in EVER. Please inform us as to when you expect FPL to begin this analysis. In addition, we suggest that FPL consult with us when developing the modeling protocol to ensure that the analysis will adequately address our data needs.

Regarding potential impacts on soils and vegetation, the FDER concludes that since the proposed project would not cause any exceedances of the secondary National Ambient Air Quality Standards (NAAQS), which were designed to protect vegetation from the adverse impacts of air pollutants, there would not be any effect on soils and vegetation. We wish to again clarify that there are documented effects below the NAAQS, and that compliance with the NAAQS does not ensure that there will be no negative impacts. There may be instances, and ongoing studies are confirming this, where adverse effects to AQRVs can occur at levels below the NAAQS.

As indicated above, AQRVs are affected not only by the incremental impacts of a proposed source, but by the total pollutant concentrations that they will experience. Therefore, to perform a proper AQRVs analysis, permit applicants should perform a cumulative air quality modeling analysis of all sources in the area, which incorporates any measured ambient levels.

Finally, based on the results of Lee County's VISCREEN visibility modeling analysis, we agree that the proposed emissions would have low potential for visibility impairment due to plume impacts in EVER or BICY.

If you have any questions regarding this matter, please call John Bunyak of our Air Quality Division in Denver at (303) 969-2071.

Sincerely,

C. W. Ogle

FOR Robert M. Baker
Regional Director
Southeast Region

cc: M. Davis
B. Andrews
M. Zinn
B. Green
D. Knowles, SDST
Q. Harper, EPA
CTF

CARLTON, FIELDS, WARD, EMMANUEL, SMITH & CUTLER, P. A.

ATTORNEYS AT LAW

ONE HARBOUR PLACE
P. O. BOX 3239
TAMPA, FLORIDA 33601
(813) 223-7000
FAX (813) 229-4133

FIRSTATE TOWER
P. O. BOX 1171
ORLANDO, FLORIDA 32802
(407) 849-0300
FAX (407) 648-9099

HARBOURVIEW BUILDING
P. O. BOX 12426
PENSACOLA, FLORIDA 32582
(904) 434-0142
FAX (904) 434-5366

FIRST FLORIDA BANK BUILDING
P. O. DRAWER 190
TALLAHASSEE, FLORIDA 32302
(904) 224-1585
FAX (904) 222-0398

CONCEPT II, TOWER B
P. O. BOX 18997
WEST PALM BEACH, FLORIDA 33416
(407) 585-3700
FAX (407) 585-4077

PLEASE REPLY TO:

July 10, 1991

Tallahassee

VIA HAND DELIVERY

Hamilton S. Oven, Jr.
Department of Environmental
Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 3299

Dear Buck:

Pursuant to our earlier discussion, I have prepared a draft notice for publication concerning the certification hearing for the Lee County resource recovery facility. I have tried to prepare this notice in compliance with the requirements of the Florida Electrical Power Plant Siting Act and the PSD requirements contained in Chapter 17-2, FAC. Nonetheless, I would greatly appreciate it if you could review this draft notice to ensure that it is satisfactory.

I will be out of town for the remainder of this week, but if you have any comments, please notify my secretary (Vickie Cantley). In the alternative, write on the draft notice and then call my office so that someone from my office can pick up your comments.

Please note that the wording in the notice is somewhat awkward because the notice must be published at least 45 days before the administrative hearing, but the DER report may not be available for public inspection until approximately 30 days before the certification hearing.

Lee County would like to publish this notice as expeditiously as possible, so your prompt attention to this matter would be greatly appreciated.

Thank you for your cooperation and assistance.

Sincerely,

David S. Dee

cc: Patty Adams (via hand delivery) ✓
Richard Donelan (via hand delivery)

DRAFT

NOTICE OF CERTIFICATION HEARING ON
LEE COUNTY'S APPLICATION TO CONSTRUCT
AND OPERATE AN ELECTRICAL POWER PLANT
(RESOURCE RECOVERY FACILITY) ON
A SITE TO BE LOCATED NEAR FORT MYERS, FLORIDA

1. On June 29, 1990, Lee County filed an application (DER File No. PA-90-30) for authorization to construct and operate an electrical power plant (resource recovery facility) near Fort Myers, in Lee County, Florida. Lee County's application now is pending before the Division of Administrative Hearings, the Florida Department of Environmental Regulation and other agencies, pursuant to the Florida Electrical Power Plant Siting Act, Chapter 403, Part II, Florida Statutes.

2. Lee County's proposed facility will be located on a site east of Fort Myers in central Lee County, Florida. The site is located on Buckingham Road and is approximately 2.5 miles east of the intersection of Interstate 75 and State Road 82. The facility will include a mass burn resource recovery (waste-to-energy) facility that will burn municipal solid waste to produce electrical energy. The facility also will include a steam generator, electrical generator, waste unloading facilities, and cooling tower. The facility will burn municipal solid waste at an initial rate of 1200 tons per day and will produce approximately 40 megawatts (MW) of electricity. The facility is designed so that it can be expanded in the future, if necessary, to combust 2400 tons per day and generate an ultimate site

capacity of 60 MW of electricity. The project's associated linear facilities will include one 138 kV transmission line which will connect the resource recovery facility with the Florida Power and Light Company's existing Buckingham substation.

3. The application is available for public inspection and copying at the following addresses:

State of Florida Department of Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

State of Florida Department of Environmental Regulation
South Florida District Office
2269 Bay Street
Fort Myers, Florida 33901-2896

Lee County/Fort Myers Public Library
2050 Lee Street
Fort Myers, Florida 33901

Lee County Utilities Department
2178 McGregor Boulevard
Fort Myers, Florida 33614

4. The Department of Environmental Regulation (DER) and other agencies are evaluating the application for the proposed power plant. The report and recommendations of the Florida Department of Environmental Regulation concerning this project will be available for inspection at the locations identified in paragraph no. 3, above, on or about August 1, 1991.

5. Certification of this power plant would allow construction and operation of a new source of air pollution which would consume an increment of air quality resources. The Department's review will result in an assessment of the prevention of significant deterioration (PSD) impacts and a

determination of the best available control technology (BACT) necessary to control the emission of air pollutants from this source. The County has proposed to use good combustion practices, a dry scrubber, a filter fabric baghouse, a selective noncatalytic reduction system, and a mercury control device as BACT.

6. Pursuant to Section 403.508, Florida Statutes, a certification hearing will be conducted by the Division of Administrative Hearings at the Sheraton Harbor Place, 2500 Edwards Drive, Fort Myers, Florida beginning on September 9, 1991, at 10 AM. The hearing will continue from day-to-day until completed. The Hearing Officer will receive comments and testimony from the parties, the public, and the affected agencies at the certification hearing. The Hearing Officer will take written or oral testimony on the effects of the proposed electrical power plant or any other matter appropriate to the consideration of the site. Need for the facility has been predetermined by the Florida Public Service Commission in a separate hearing.

7. Sections 403.508(4) and (5), Florida Statutes, provide as follows:

> (4)(a) Parties to the proceeding shall include:
> 1. The applicant.
> 2. The Public Service Commission.
> 3. The Department of Community Affairs.
> 4. The Department of Natural Resources.
> 5. The Game and Fresh Water Fish Commission.
> 6. The water management district.
> 7. The department.
> 8. The regional planning council.
> 9. The local government.

(b) Any party listed in paragraph (a) other than the department or the applicant may waive its right to participate in these proceedings. If such listed party fails to file a notice of its intent to be a party on or before the 90th day prior to the certification hearing, such party shall be deemed to have waived its right to be a party.

(c) Upon the filing with the hearing officer of a notice of intent to be a party at least 15 days prior to the date of the land use hearing, the following shall also be parties to the proceeding:

1. Any agency not listed in paragraph (a) as to matters within its jurisdiction.

2. Any domestic nonprofit corporation or association formed, in whole or in part, to promote conservation or natural beauty; to protect the environment, personal health, or other biological values; to preserve historical sites; to promote consumer interests, to represent labor, commercial, or industrial groups; or to promote comprehensive planning or orderly development of the area in which the proposed electrical power plant is to be located.

(d) Notwithstanding paragraph (e), failure of an agency described in subparagraph (c)1. to file a notice of intent to be a party within the time provided herein shall constitute a waiver of the right of that agency to participate as a party in the proceeding.

(e) Other parties may include any person, including those persons enumerated in paragraph (c) who have failed to timely file a notice of intent to be a party, whose substantial interests are affected and being determined by the proceeding and who timely file a motion to intervene pursuant to chapter 120 and applicable rules. Intervention pursuant to this paragraph may be granted at the discretion of the designated hearing officer and upon such conditions as he may prescribe any time prior to 30 days before the commencement of the certification hearing.

(f) Any agency, including those whose properties or works are being affected pursuant to s. 403.509(4), shall be made a party upon the request of the department or the applicant.

(5) When appropriate, any person may be given an opportunity to present oral or written communications to the designated hearing officer. If the designated hearing officer proposes to consider such communications, then all parties shall be given an opportunity to cross-examine or challenge or rebut such communications.

8. Those wishing to intervene in these proceedings should be represented by an attorney or other person who can be determined to be qualified to appear in administrative proceedings pursuant to Chapter 120, Florida Statutes, or Chapter 17-103.020, Florida Administrative Code.

9. If any party intends to use written direct testimony at the certification hearing, the written testimony must be made available for public inspection at the locations identified in paragraph no. 3, above, at least five days before the hearing.

10. Written comments, notices or petitions filed prior to the hearing may be sent to the Hearing Officer, Ms. Diane Kiesling, at the Division of Administrative Hearings, 1230 Apalachee Parkway, Desoto Building, Tallahassee, Florida 32399. All submittals should refer to DOAH Case No. 90-3942EPP. Copies of such submittals should be forwarded by U.S. Mail to all of the other parties to this proceeding, including the Department of Environmental Regulation and Lee County. For a list of parties and further information concerning the power plant siting process, contact Mr. Hamilton S. Oven, Jr., at the Florida Department of Environmental Regulation, 2600 Blair Stone Road, Twin Towers Office Building, Tallahassee, Florida 32399-2400 or call 904/488-1344.

11. Lee County's application for the proposed electrical power plant also is subject to U.S. Environmental Protection Agency (EPA) regulations for the Prevention of Significant Deterioration (PSD) of air quality, which are codified at 40 CFR 52.21 and Florida Administrative Code Chapter 17-2. In general, these regulations provide that a permit must be obtained from DER before construction may begin on a source of air pollution that is subject to PSD review. The permit can be issued only if the new construction has been determined by DER to comply with the requirements of the PSD regulations. These PSD regulations include a restriction on incremental increases in air quality due to the new source. The PSD regulations also require the application of Best Available Control Technology (BACT).

12. The DER has been granted a delegation of authority from EPA for the purposes of conducting the PSD review of this and other sources. Acting pursuant to that delegation of authority, the DER will prepare a draft permit which will be included in the DER staff analysis and report. DER cannot issue the permit unless DER makes a preliminary determination that the proposed construction will comply with all applicable PSD regulations.

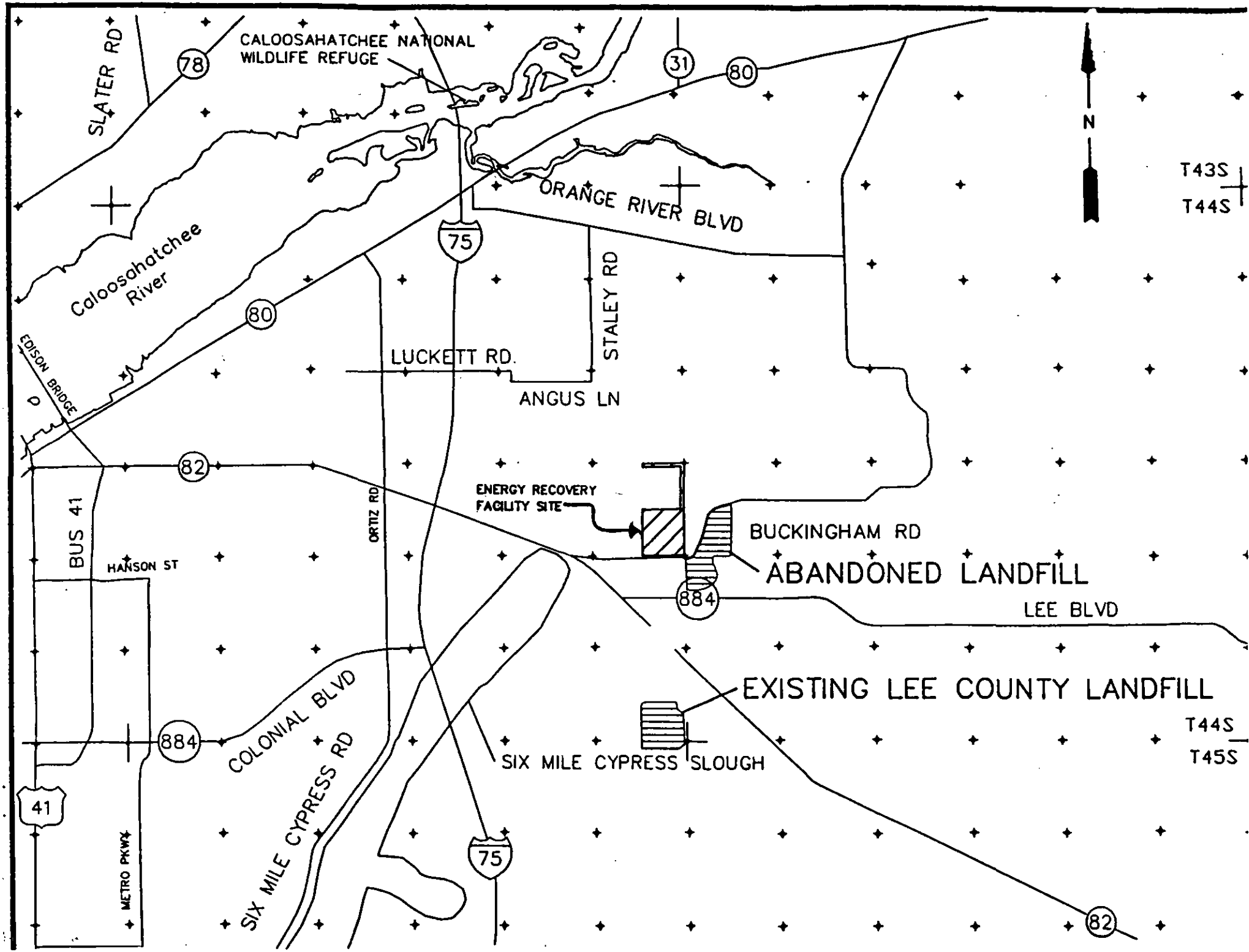
13. The County's application indicates that the proposed power plant will consume less than 3% of any applicable Class II PSD increment, as shown in the following table.

Pollutant	Averaging Period	Total Impact As a Percent of Class II Increment
Sulfur Dioxide (SO_2)	Annual	1.0
	24-hour	2.8
	3 hour	2.4
Total Suspended Particulate Matter (TSP)	Annual	0.13
	24-hour	0.9
Particulate Matter (PM_{10})	Annual	0.14
	24-hour	1.1
Nitrogen Dioxide (NO_2)	Annual	1.4

14. The proposed facility will be located approximately 88 kilometers from the nearest Class I area (the Everglades National Park). The application indicates that the proposed facility's maximum impact on the nearest Class I area will be less than 4% of the applicable Class I increments, as shown on the following table.

Pollutant	Averaging Time	Impact as % of PSD Class I Increment
SO_2	Annual	0.3
	24-hour	2.4
	3-hour	3.2
TSP	Annual	0.02
	24-hour	0.2
PM_{10}	Annual	0.02
	24-hour	0.2
NO_2	Annual	0.5

15. Lee County's application states that the construction and operation of the proposed facility will not cause a violation of any ambient air quality standard nor will it cause an exceedance of any PSD increment and, therefore, the DER should recommend approval of this project. Persons wishing to comment on this issue may do so at the certification hearing or by submitting written comments to the Hearing Officer and DER within 30 days after DER's report is received in the DER office in Fort Myers, Florida. As previously noted, the DER report and recommendations should be available for inspection at the DER office in Fort Myers and at the other locations identified in paragraph number 3, above, on or about August 1, 1991.


CALOOSAHATCHEE NATIONAL WILDLIFE REFUGE
SLATER RD
78
31
80
N
T43S
T44S
ORANGE RIVER BLVD
75
Caloosahatchee River
STALEY RD
80
EDISON BRIDGE
LUCKETT RD.
ANGUS LN
82
ENERGY RECOVERY FACILITY SITE
BUCKINGHAM RD
BUS 41
HANSON ST
ORTIZ RD
ABANDONED LANDFILL
884
LEE BLVD
EXISTING LEE COUNTY LANDFILL
COLONIAL BLVD
884
SIX MILE CYPRESS SLOUGH
T44S
T45S
41
METRO PKWY
SIX MILE CYPRESS RD
75
82

JUL-01-1991 17:25 FROM ... TO ... P.01

ENVIRONMENTAL ASSOCIATES INC.

AIR • WATER • SOLID WASTE CONSULTANTS

209 US Highway 22 East • Green Brook New Jersey 0882

DATE: July 1, 1991

FAX#: (904) 922-6979

TO: Clair Fancy

FROM: Donald F. Elias

PROJECT NAME: LCRR2-114

PAGES TO FOLLOW: 9

NOTES: Marked-up copy of Draft Permit conditions and tables of emissions

Clair

This was also faxed to Meri and Barry. Here's a copy for your files. Thanks for the help

Don

IF YOU SHOULD HAVE ANY QUESTIONS OR PROBLEMS, PLEASE CONTACT Beverly Or Don AT (908) 968-9600.

OPERATION

AIR

The construction and operation of a mass-burn Lee County Energy Recovery Facility in Fort Myers, Florida shall consist of ~~four~~ three Municipal Waste Combustors (MWC). ~~and is capable of generating 15 MW (net)~~ Each unit is rated at 600 TPD with the facility's total capacity not to exceed ~~2400~~ 1800 TPD of MSW and generating a total of ~~60~~ 45 MW (net). These mass-burn units shall be of Ogden Martin Stoker Waterwall Combustor design (or equivalent) with a maximum heat input of 250 MMBtu per hour or a total heat input for the facility of ~~1000~~ 750 MMBtu per hour based on municipal waste average heating value of 5000 Btu per pound. * with two units to be constructed initially and the third unit to be installed in future.

Each combustor (unit) is designed to produce a maximum of 152,000 pounds of steam per hour at 865 psig and 830°F. Each combustor shall be equipped with auxiliary burners to be fired by only propane gas. Emissions from each combustor shall be controlled by a ~~hydrated lime~~ dry scrubber followed by a baghouse, rated at 92,400 ACFM. NOx emissions shall be controlled by a ~~Thermal de-NOx~~ (SNCR) system. Mercury emissions shall be controlled by injecting activated carbon and/or sodium sulfide. This facility shall be allowed to operate continuously (8,760 hrs/yr).

Selective Non-Catalytic Reduction

The permittee must submit at least four copies of complete information as to the make and model numbers of MWC, all pollution control and continuous emissions monitoring devices ~~and related equipment, and obtain written approval from~~ the Department prior to ~~purchase and~~ installation. The permittee must also submit detailed stack drawings showing sampling locations, operation and maintenance manuals and calibration procedures, updated process flow diagrams showing mass/energy/heat balances and ammonia/activated carbon/sodium sulfide injector locations, if requested by the Department.

For information to

The permittee shall comply with the following specific conditions of certification:

1. Emission Standards

Stack emissions from each unit shall not exceed the following limitations:

a. Particulate Matter - Particulate emissions from the baghouse shall not exceed 0.010 grains/dry standard ft^3, corrected to 7% O_2; ~~0.194 lbs/ton of refuse~~ or ~~4.85~~ 5.34 lbs/hour per unit and ~~25~~ 64 tons/year from all ~~four~~ three units.

b. PM_{10} - ~~0.008~~ 0.010 gr/dscf, corrected to 7% O_2 for the fraction of particles less than 10 microns in diameter.

c. VE - Visible emissions from each baghouse exhaust shall not exceed 10% opacity. ~~If during the compliance test visible emissions observed is less than 5% opacity, the visible~~

whichever is least restrictive.

~~emission standard will automatically reduce to 5% opacity during normal operation until the next stack test is conducted showing compliance with 10% opacity.~~

d. SO_2 - ~~0.0678~~ 0.149 lbs/MMBtu per unit, ~~297~~ 223 490 tons/year from all ~~four~~ three units, 30 ppmdv corrected to 7% O_2, ~~3-hour~~ 24 hour block daily geometric average at least 80% removal efficiency.

e. NOx - ~~0.194~~ 0.292 lb/MMBtu, ~~81 lbs/hr per~~ 80 lbs/hr per unit, and ~~1420~~ 1065 959 tons/yr from all ~~four~~ three units. ~~200~~ 180 ppmdv corrected to 7% O_2, 24 hour average. A ~~thermal de-NOx~~ SNCR system ~~with at least 45% removal efficiency~~. block daily

f. CO - ~~50~~ 100 ppmdv at 7% O_2, 4-hour block average and ~~0.4928~~ 0.099 lb/~~ton of refuse~~ MMBtu.

g. VOC (Hydrocarbons) - ~~7~~ 37 ppmdv at 7% O_2 and ~~0.0040~~ 0.0211 lb/MMBtu.

h HCl - 25 ppmdv at 7% O_2 and ~~0.0322~~ 0.0643 lb/MMBtu OR 95% REMOVAL whichever is least restrictive.

i. H_2SO_4 (sulfuric acid mist) - ~~0.0318~~ 0.0358 lb/MMBtu ~~and at least 90% control efficiency~~.

j. Fl (fluoride) - ~~0.021~~ 0.0095 lb/MMBtu, ~~3.0~~ 5.0 ppmdv at 7% O_2.

k. Pb - Lead emissions shall not exceed ~~0.000070~~ 0.0006 lb/MMBtu ~~and 0.0007 lb/ton of refuse.~~

l. Be - Beryllium emissions shall not exceed 1.35×10^{-7} lbs/MMBtu ~~or 1.35×10^{-6} lbs/ton of refuse~~.

m. Hg - Mercury emissions shall not exceed ~~9.0×10^{-5}~~ 6.0×10^{-4} lbs/MMBtu ~~and 9.0 x 10^{-4} lbs/ton of refuse.~~

n. As - Arsenic emissions shall not exceed 9.1×10^{-6} lbs/MMBtu ~~and 9.1×10^{-5} lbs/ton of refuse.~~

o. Dioxins/Furans - Emissions of ~~2, 3, 7, 8-~~tetra thru octa-chlorinated dibenzo-p dioxins and dibenzofurans shall not exceed ~~2.0~~ 30 ng/NM^3 @ 7% O_2 or ~~1.58×10^{-9}~~ 2.54×10^{-8} lbs/MMBtu. total

p. NH_3 (ammonia) - Ammonia slip from exhaust gases shall not exceed 50 ppmv.

q. There shall be no visible emissions during the lime silo loading operations (i.e., less than 5% opacity).

r. Emissions from the ash handling building baghouse shall not exceed a particulate limit of 0.010 grains/dscf and visible emissions of 5% opacity.

s. ~~The maximum allowable particulate emissions from the cooling water tower will be based on a 0.004% drift rate (ratio of drift to the circulation rate).~~

2. Stack Testing/Continuous Emissions Monitoring/Record Keeping Requirements

a. Test Methods

The following EPA Methods shall be used to demonstrate compliance with emission standards mentioned in Specific Condition No. 1 as contained in 40 CFR 60, Appendix A and in accordance with F.A.C. Rule 17-2.700; or as approved by FDER

EPA Method	For Determination of
1	Selection of sample site and velocity traverses.
2	Stack gas flow rate when converting concentrations to or from mass emission limits.
3	Gas analysis when needed for calculation of molecular weight or percent O_2.
4	Moisture contact when converting stack velocity to dry volumetric flow rate for use in converting concentrations in dry gases to or from mass emission limits.
5	Particulate matter concentration and mass emissions.
201 or 201A	PM_{10} emissions.
~~5 (Modified)~~	~~Particulate emissions from cooling water tower when EPA Method 5 is used, a distilled water rinse shall be used in place of acetone, and the impinger catch shall be excluded from emission calculations. Water flow rate to the cooling tower shall be monitored continuously. An alternative method may be used if approved by EPA or the Department.~~
6, 6C, or 19	Sulfur dioxide emissions from stationary sources.
7, 7C, or 19	Nitrogen oxide emissions from stationary sources.
~~8~~	~~Sulfuric acid mist concentration and associate moisture.~~

9	Visible emission determination of opacity. - At least three one hour runs to be conducted simultaneously with particulate testing for the emissions from dry scrubber/baghouse, ~~cooling water tower~~ and ash handling building baghouse. - At least one lime truck unloading into the limo silo (from start to finish).
10	Carbon monoxide emissions from stationary sources.
12 or 101A	Lead concentration from stationary sources.
13A or 13B	Fluoride emissions from stationary sources.
23	Dioxin/furan concentration.
18, 25, or 25A	Volatile organic compounds concentration.
26	HCl emissions or other methods approved by EPA or DER.
101A or 108	Mercury, Antimony, Arsenic, and Cadmium emissions.
104	Beryllium emission rate and associated moisture content.

Note: Soot blowers shall be operated in a mode consistent with normal cleaning requirements of the system during the compliance testing. ~~The heating value of the MSW being combusted during compliance testing shall be determined/analyzed by at least three independent laboratories.~~

b. Continuous Emissions Monitoring

Continuous emission monitors with recorders shall be installed, calibrated, maintained and operated subject to approval by the Department for the following:

Carbon Monoxide, Oxygen, Opacity, and Sulfur Dioxide (for SO_2 one monitor shall be located upstream of the scrubber and one shall be located downstream of the baghouse), as specified in 40 CFR 60, Appendix B; ~~continuous monitoring device to weigh the amount of MSW being fed to the charging hopper/boiler/combustor~~; total steam production (lbs/hr, pressure, and temperature) and power generation (MW) for

each unit; ~~propane gas consumption by the auxiliary burners; ammonia injection rate and concentration (slipage)~~ in the exhaust gases~~; hydrated lime; activated carbon and/or sodium sulfide injection rates~~ and thermal couple to measure temperature ~~of combustion zone (1800°F and one second residence time)~~. furnace top (i.e. performed during different cyclical periods)

c. Testing Frequency

Compliance with emission standards contained in Specific Condition No. 2 shall be determined by conducting stack tests within ~~90~~ 180 days of completion of construction and initial operation and ~~quarterly~~ ANNUALLY thereafter~~, during the first year of operation. Future stack testing frequency shall be determined by the Department after reviewing first years stack testing reports and it may recommend stack testing on an annual basis.~~ These tests may be staggered throughout the year at the request of the Dept. Compliance testing for the flyash handling building (baghouse) and the lime silo loading operation (V.E. test) shall be conducted within ~~90~~ 180 days of completion of construction and initial operation and annually thereafter.

d. Record Keeping

Lee County ERF shall maintain a central file containing all measurements, records, and other data that are required to be collected pursuant to the various specific conditions of this permit. This file shall include but not be limited to: i) the data collected from in-stack monitoring instruments ~~and ground level monitors~~, ii) the records on MSW input rate, iii) the amount of propane gas burned, iv) the results of all source tests or performance tests, v) the amount of ammonia, activated carbon, sodium sulfide or other chemicals used, vi) calibration log book for all instruments, vii) maintenance/repair log book for any work performed which is subject to this permit. All measurements, records, and other data required to be maintained by LCERF shall be retained for at least two years following the date on which such measurements, records, or data are recorded and made available to the Department upon request.

for NOx control

3. Miscellaneous Requirements

a. Start-up and Shut-down Procedures

During start-up procedures, propane gas shall be used to preheat the combustion zone to achieve a furnace roof temperature of 1270°F and a minimum temperature of 1800°F (24 hour average) above the grate shall be achieved prior to the ignition of MSW being established.

During all shut-down procedures, propane gas shall be used to ensure that the temperature in the combustion zone does not drop below 1800°F while any MSW is still burning, as measured by a furnace roof temperature of 1270°F.

b. Operating Procedures

Operating procedures shall include good combustion practices and proper training and certification of all operators. The good combustion practices shall meet the guidelines established in 40 CFR 60, Subpart Ea and procedures as established by the equipment manufacturers. All operators (including supervisors) of air pollution control devices shall be properly trained and certified in accordance with the manufacturers guidelines. A list of all such certified personnel should be submitted to the Department, if requested

The emission standards for this facility shall apply at all times, except during periods of start-up, shut-down, or malfunctions, provided that the duration of start-up, shut-down, or malfunction shall not exceed 3 hours per occurrence. The start-up period commences when the affected facility begins the continuous burning of MSW and does not include any warm-up period when the affected facility is combusting only propane gas and no MSW is being combusted.

c. Odor Control

No objectionable odors are allowed from this facility pursuant to F.A.C. Rule 17-2.620. The truck access doors to the facility shall remain closed except during normal working shifts when MSW is being received near the storage pit area to allow vehicle passage. To minimize odors at the facility, a negative pressure shall be maintained on the tipping floor and air from within the building will be used as combustion air.

d. Auxiliary Burners

Auxiliary burners for each unit shall be fired by only propane gas and shall not exceed the 10% capacity factor as determined by 40 CFR 60.44b(d).

e. Baghouse Operations

All baghouses (except for lime silo dust collector) shall be equipped with pressure drop monitoring equipment. Baghouses shall have a maximum air to cloth ratio of 4.1. ~~A spare set of bags (of the total number) shall be maintained on the premises at all times.~~

f. Restriction for Type of Wastes Combusted

No sewage sludge or hazardous wastes shall be received or combusted at this facility without prior written approval from the Department. The facility shall establish a household battery collection program to minimize mercury emissions. Chromium compounds shall not be used as an additive in the cooling tower water.

g. Fugitive Emissions

Fugitive emissions at this facility shall be adequately controlled at all times. All roads shall be adequately paved ~~and vacuum swept~~ to keep free of visible dust. Speed limit signs shall be posted. Residue from the grates, grate siftings, and ash from the combustor/boiler and fabric filter hoppers shall be discharged into the ash quenching system so as to minimize visible dust. The ash/residue in the ash handling building shall remain sufficiently moist to prevent dust during storage and handling operations.

During Normal operations

TABLE 3-4

ESTIMATED EMISSION RATES FOR THE LEE COUNTY ERF

Pollutant	lb/hr/unit[a] (110%)	-----Whole Facility----- Controlled Emission Rate tons/yr[b] (100%)	lb/hr[a] (110%)
Particulate matter (PM)	5.34	64	16.0
Sulfur dioxide (SO_2)	40.98[c]	490	123[c]
Nitrogen dioxide (NO_2)	80.3[c]	959	241[c]
Carbon monoxide (CO)	27.23[d]	324	81.7[d]
Hydrocarbons (VOC)	5.80	69	17.4
Lead (Pb)	0.165	2.0	0.495
Arsenic (As)	2.5×10^{-3}	0.03	7.51×10^{-3}
Mercury (Hg)	0.22	2.6	0.66
Beryllium (Be)	3.7×10^{-5}	4.4×10^{-4}	1.11×10^{-4}
Fluoride (as HF)	0.96	11.5	2.89
Sulfuric acid (H_2SO_4)	9.85	118	29.5
Hydrogen Chloride (HCl)	17.68	212	53.0
Dioxin (Total tetra-octa PCDD & PCDF)	7.0×10^{-6}	8.3×10^{-5}	2.1×10^{-5}

[a]Short-term maximum emission rates based on 110% of design heat release rate (lb/MMBTU), 1650 tpd throughout of 6000 BTU/lb waste.

[b]Annual emission rate based on 100% of the design heat release rate firing 1800 tpd of reference waste at 5000 BTU/lb.

[c]NO_x and SO_2 lb/hr emission rates based on Table 3-2 24-hour average value for lb/MMBTU.

[d]CO lb/hr emission rate based on Table 3-2 4-hour average value for lb/MMBTU.

SOURCE: Camp, Dresser & McKee, Inc., 1991 (see Emission Factor Support Document, Attachment A of this volume, for basis for emission factors).

LEE0T.2/10

TABLE 3-2

CONTROLLED EMISSION FACTORS
FOR THE LEE COUNTY ENERGY RECOVERY FACILITY

Pollutant		Emission Factor lb/ton Refuse	Emission Factor lb/MMBtu*
Particulate Matter		0.194	0.0194
Sulfur Dioxide	(24-hour)	1.49	0.149
	(3-hour)	1.86	0.186
Nitrogen Oxides (as NO_2)			
	(24-hour)	2.92	0.292
	(1-hour)	3.56	0.356
Carbon Monoxide			
	(4-hour)	0.99	0.099
	(1-hour)	3.95	0.395
Non-Methane Hydrocarbons			
	(1-hour)	0.211	0.0211
Lead		0.006	6.0×10^{-4}
Sulfuric Acid Mist		0.358	0.0358
Hydrogen Chloride		0.643	0.0643
Fluoride (as HF)		0.035	0.0[illegible]
Beryllium		1.35×10^{-6}	1.35×10^{-7}
Mercury		8.0×10^{-3}	8.0×10^{-4}
Inorganic Arsenic		9.1×10^{-5}	9.1×10^{-6}
Asbestos		**	**
Vinyl Chloride		**	**
Total Reduced Sulfur		**	**
Reduced Sulfur Compounds		**	**
Benzene		**	**
Radionuclides		**	**
Dioxin (Total tetra-octa PCDD & PCDF)		2.54×10^{-7}	2.54×10^{-8}

SOURCE: Camp Dresser McKee Inc., 1991 (see Emission Factor Support Document, Attachment A of this volume).

*Based on a higher heating value of 5000 Btu/lb.

**Negligible emission rate, the numerical value of which is strongly dependent on the composition of the refuse incinerated. Lee County municipal solid waste is not expected to contain these compounds.

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.			

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OGDEN PROJECTS INCORPORATED

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

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5.1 SE-211 Squirrel Cage Induction Motor 460V
5.2 SE-212 Squirrel Cage Induction Motor 2000V and over

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 4400 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. -BDT

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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 1090	S P A C E R 1080		1060
MIR Frame	449T	444TS		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

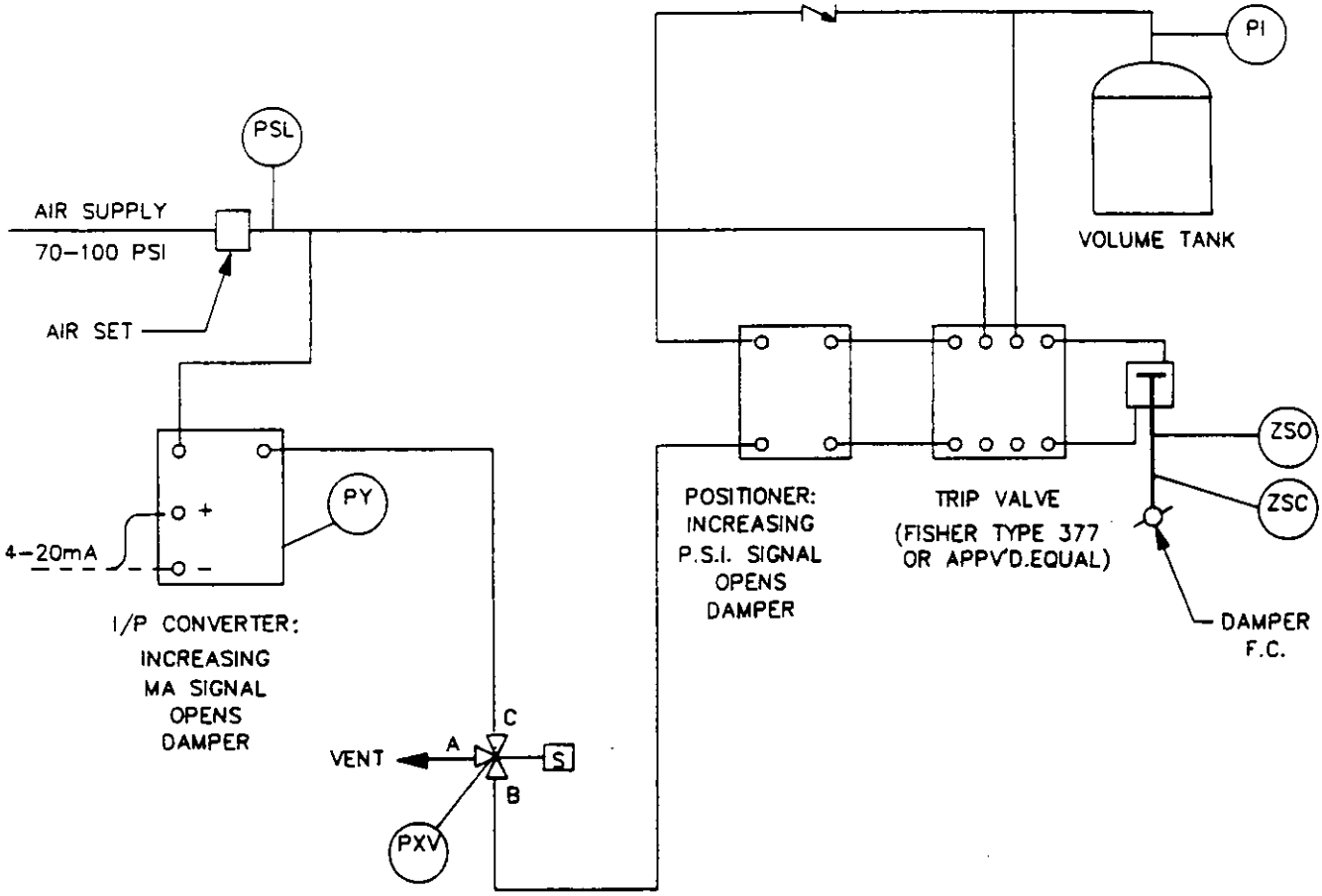
F.D., O.F.A., S.A. & R.A. FAN CASING NOISE (1)

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