SECTION 11405 - DIGESTER GAS COMBUSTORS

City of San Diego, CWP Guidelines

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NTS: Installation of digester gas combustors involves a multistep permitting process involving the San Diego Air Pollution Control District (APCD). Combustor performance and other criteria are project-specific parameters which APCD will establish in the Authorization to Construct. Criteria in this Section must be edited to match the Authorization.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing [two] enclosed waste gas combustors together with all accessories and appurtenances, complete and operable.

B. The arrangement of piping and equipment and foundations indicated on the Drawings may be modified as necessary for the specific model of combustor selected. The cost of all modifications, including design services, shall be the responsibility of the CONTRACTOR at no increase in cost to the OWNER. The DESIGN CONSULTANT shall review the proposed modification to the original design and shall be the sole judge as to type, function, and quality of the modification.

C. The area available for the combustor system and piping is limited to that indicated on the Drawings.

1.2 RELATED SECTIONS

A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

1. Section 11000 Equipment General Provisions
2. Section 11408 Digester Gas Handling Equipment
3. Section 13300 Instrumentation and Control
4. Section 16611 Uninterruptable Power System

1.3 CODES

A. The WORK of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:

1. Uniform Fire Code

2. Uniform Building Code

1.4 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted in accordance with Section 01300:

1. Manufacturer's product data and catalog cut sheets for combustor system components, layout and section drawings for all components, anchor bolt placement drawing, piping and instrumentation diagram satisfying ISA standards, identification and composition of materials used in the system.

2. Drawings of the air dampers.

3. Isometric diagrams of digester gas and pilot gas lines.

4. Layout and size of anchor bolts. Certificate signed by a structural engineer registered in California certifying that the system is designed for static, dynamic, wind, and seismic loads.

5. Wiring diagrams and logic diagrams.

6. Description of controls including logic diagrams and I/O schedule.

7. Manufacturer's certificate of compliance with air quality permit requirements. Manufacturer's design calculations for material balance, contact time, and operating temperature for both minimum and maximum operating conditions.

8. Information on at least one successfully performing installation of comparable size and complexity constructed in the recent past including contact name, address, and telephone number.

1.5 OWNER'S MANUAL

A. Comply with the requirements of Section 01300.

1.6 SERVICES OF MANUFACTURER

A. The OWNER will obtain construction and operating permits from the San Diego Air Pollution Control District (APCD). The manufacturer shall furnish burner system information requested by the CONSTRUCTION MANAGER to accompany permit applications.

B. **Inspection, Startup, and Field Adjustment:** An authorized service representative of the manufacturer shall visit the site to perform the following:

1. Installation of the equipment.

2. Inspection, checking, and adjusting the equipment.

3. Startup and field-testing for proper operation.

4. Performing field adjustments to ensure that the equipment installation and operation comply with the Specifications.

5. The representative shall certify in writing that the system is ready for operation.

C. Instruction of OWNER'S Personnel:

1. An authorized service representative of the manufacturer shall instruct the OWNER'S personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Training shall be specific to the models of burner systems provided.

2. The representative shall have at least 2 years' experience in training. A resume for the representative shall be submitted to the CONSTRUCTION MANAGER.

3. A total of [2] work days of instruction shall be performed. For the purposes of this paragraph, a work day is defined a an 8 hour period at the Site, excluding travel time.

4. Training shall be scheduled a minimum of 3 weeks in advance of the first session. Training sessions may be scheduled for first or second shift and may not be on consecutive days.

5. Training materials shall remain with the trainees.

6. The OWNER may videotape the training sessions for later use with the OWNER'S personnel.

PART 2 -- PRODUCTS

2.1 DIGESTER GAS COMBUSTORS

A. Combustor Schedule

Equipment Number	Description
[ ]	[Burner 1]
[ ]	[Burner 2]

B. **General:** Combustors shall be free-standing enclosed flame type specifically designed for long term continuous, long term intermittent, and standby operation, without any visible smoke or flame or instability over the entire operation range.

C. Gas to be burned

1. Source - [Excess wastewater solids digester gas]

2. Gas Composition

Nitrogen, dry percent	-	[0 to 1.5]
Methane, dry percent	-	[60 to 65]
Carbon Dioxide, dry percent	-	[34 to 40]
Hydrogen Sulfide, dry ppmv	-	[200 to 1000]
Water, saturated at	-	[60 to 95 degrees F]

3. Specific gravity, relative to air - [0.89]

4.	Net heating value, BTU/SCF	-	[500 to 600]
5.	Gas pressure, in. wc.	-	[4 to 6]
6.	Gas temperature, degrees F	-	[ ] to [ ]
7.	Maximum gas flow rate to each burner, SCFH	-	[ ]
8.	Minimum gas flow rate to each burner, SCFH	-	[ ]

D. Burner Performance

1.	Minimum gas residence time, sec	-	[0.6]
2.	Minimum flame temperature at the thermocouple, degrees F	-	[1500]
3.	Maximum flame temperature at the thermocouple, degrees F	-	[2000]
4.	Maximum noise level measured 3 feet from the stack, dBA	-	[85]
5.	Vibration from combustor	-	[none]

E. **Combustion Systems:** The combustion air and burner systems shall satisfy the burner performance criteria below within a maximum to minimum ratio of [5 to 1] based on heat release.

1. Back Pressure Regulators: Gas flow shall be controlled by a field adjustable diaphragm pressure regulator capable of maintaining back pressure within 10 percent of setting, An adjusting screw, glass enclosed pointer, and scale shall be provided. Construction shall be 356-T6 low copper cast aluminum body, diaphragm, spring housings, and diaphragm inner plate. Diaphragm shall be molded BUNA-N with nylon reinforcement.

2. Flame Trap Assembly: Provide a flame arrestor or flame trap and thermal shutoff valve as close to the flame zone as possible. The thermal shutoff valve shall contain either a replaceable fusible link which closes the valve within 15 seconds after the link temperature reaches 260 degrees F or a thermocouple and temperature switch which accomplishes the same.

3. Positive Closure Valve: Valve shall be a hard seat tricentric butterfly valve with "fail closed" position actuator and proof of closure switch.

4. Pilot gas manifold and burner system shall be propane-type. The LPG tank shall be provided with a pressure regulator with integral low capacity relief valve and pressure indicating gauge with manifold isolation valve.

5. Digester Gas Burner System: The burner shall produce high destruction efficiency, low NO_x emissions, and a stable flame over the range of flows and composition typical of

digester installations. No burner assist fuel shall be used.

F. Stack System

1. Structural Design Requirements: The stack system shall be [free-standing] [guyed], designed for wind loads up to 100 miles per hour and seismic restraints required for Zone 4.

2. Combustion Air Inlet Section: The windbox shall contain motor-driven parallel blade dampers with cadmium plated bearings or opposed blade dampers with stainless steel bearings. Surfaces of the windbox which are subject to damage from radiant energy from the flame shall be insulated with ceramic fiber. Maximum air velocity through fully open dampers shall not exceed 20 ft/sec at maximum burner rates. Air leakage through fully closed dampers shall not exceed 5 percent.

3. Combustion Section:

a. Shell of the combustion section shall be ASTM A 36 carbon steel with wall thickness of at least 1/4-inch for diameters up to and including 6 feet, and 3/8-inch for diameters 8 feet and larger. The ceramic fiber refractory shall be rated for minimum flame temperatures of 2400 degrees F and shall have sufficient thickness to allow a maximum temperature on the outside of the stack of 240 degrees F. The refractory shall have overlapping seams which allow for 5 percent shrinkage or shall be composed of modular bricks which form a tight seal at all temperatures. Refractory shall be anchored with inconel pins if pins are exposed to heat from combustion.

b. Four sample ports constructed of 4-inch pipe nipples and pipe caps shall be provided, [one-half internal diameter below the top of the combustion section], 90 degrees apart on the stack circumference.

c. A stainless steel rain guard shall protect the top of the stack and refractory from water entry or wind damage.

d. The exterior of the stack shall be protected by the manufacturer's standard high temperature coating. The top 2 feet of the exterior shall be coated with standard super high temperature resistant coatings.

e. The combustion section shall be provided with two 4-inch sight glass/inspection ports located 180 degrees apart on the circumference and easily accessible to an operator standing at grade. Sight glasses shall be designed to allow an operator to inspect the pilot and main burners without exposure to any surface hotter than 120 degrees F while the burner is operating at maximum capacity.

f. A heat shield of expanded metal shall be provided on the part of the stack lower than 7 feet above grade to protect operating personnel. No portion of the heat shield shall exceed 120 degrees F while the burner is operating at maximum capacity. The shield shall be rigid enough that a person falling against the shield cannot bend it to contact the hot stack surface.

G. Controls

1. Temperature

    a. Thermocouples: Three type K thermocouples inside ceramic protection tubes shall be provided. Thermocouples shall be wired to a thermocouple selector switch in the Local Control Panel.

    b. Controller: Indication, recording, and control functions shall be provided in the LCP. The controller shall operate the damper in the combustion air inlet section to control excess air.

2. Flame Supervision: Pilot and main flames shall be sensed by an ultraviolet flame scanner which can be externally removed from the burner system without first extinguishing the flame. No part of the scanner system shall be subject to damage from moisture or high radiant heat.

3. Flame monitoring: Include monitoring of the main burner flame.

4. Local Control Panel: All components shall comply with Section 13300.

    a. Provide a free-standing NEMA 4X panel constructed of Type 316 stainless steel for each burner. Identification terminal strips shall be provided for interconnection of external conductors. All push buttons and controller set points shall be accessible from the outside of the LCP without opening doors or panels. Power supply shall be [120 VAC] to the panel.

    b. Hand switches

        (1) Power on/off
        (2) Pilot gas sequence start
        (3) System mode hand/off/auto
        (4) Lamp test
        (5) Main gas sequence start

    c. Pilot lamps

(1) Power on	green
(2) Burner system enabled	green
(3) Pilot gas on	green
(4) Flame proved	green
(5) High temperature shutdown	red
(6) Low temperature alarm	red
(7) Flame failure	red

    d. Discrete output contacts from control panel to DCS

        (1) Burner enabled
        (2) Pilot gas on
        (3) Flame proved
        (4) High temperature alarm/shutdown
        (5) Low temperature alarm
        (6) Flame failure alarm

(7) UPS failure alarm

e. Control system operation and startup and shutdown sequencing shall be in accordance with Section 13300.

f. The pilot gas ignition transformer shall be installed in a NEMA 4X stainless steel housing separate from the LCP.

H. **Uninterruptable Power Supply (UPS):** The control panel shall be provided with a dedicated UPS capable of maintaining all burner control functions for at least 15 minutes after power failure. UPS shall comply with Section 16611.

2.2 MANUFACTURERS, OR EQUAL

A. **Qualifications:** The manufacturer shall have at least one installation of comparable size and complexity constructed in the recent past.

B. Manufacturers

John Zink Company

Whessoe Varec, Inc.

PART 3 -- EXECUTION

3.1 GENERAL

A. Digester gas burners shall be installed in accordance with the manufacturer's instructions and Section 11000.

3.2 STARTUP AND TESTING

A. In addition to requirements for startup and operational testing, the CONTRACTOR shall be responsible for operation of the burner system during stack tests performed by the OWNER and observed by the APCD.

** END SECTION **