

Rancho Digester Gas Flare

PREPARED FOR: Brett Dingman/Las Virgenes Municipal Water District
PREPARED BY: Mike Damoth/CH2M HILL
Brian Whitaker/CH2M HILL
DATE: February 22, 2005
PROJECT NUMBER: 323424

Introduction

The Las Virgenes Municipal Water District (LVMWD) operates a digester gas flare at its Rancho Las Virgenes Solids Handling and Composting Facility (RLV) in Calabasas, California. The digester gas production at the facility currently exceeds the design capacity of the existing digester gas flare and needs upgrading and/or replacement.

The District would like to replace the existing flare with a new larger flare which will have a design capacity sufficient to meet the gas production requirements of the 12 mgd total wastewater flow to the Tapia Water Reclamation Facility as estimated in the LVMWD Master Plan. Additionally, piping and components which do not meet the revised design gas flow capacity requirements will need to be replaced.

The existing flare received a Permit To Operate from the South Coast Air Quality Management District (SCAQMD) based on its original design criteria and expected flows of 4500 scfh (75 scfm) averaged over a 24 hour period. Installation of a new larger flare will trigger a new permitting application process and fees and will require a new Permit To Construct and a modification of the existing Permit To Operate.

CH2M HILL was contracted to investigate the digester gas flare system and perform the following tasks:

- Review and evaluate the existing piping system and components
- Develop flare system design parameters including sizing criteria and peaking factors with sizing based on 12 mgd total wastewater flow to the Tapia Water Reclamation Facility as estimated in the LVMWD Sanitation Master Plan
- Obtain vendor flare information including sizes, options, turndown capabilities, and list pricing

This Technical Memorandum documents the findings for the Rancho Las Virgenes digester gas flare system study.

Project Background

The Rancho Las Virgenes digester gas flare consists of a single burner, enclosed, natural draft type flare installed in 1991. The flare is a John Zink ZTOF model, 3' - 6" diameter by 20' - 0" high and has a capacity of 4500 scfh (75 scfm) and is equipped with two 4-inch burners, UV flame scanner, automatic shutoff valve, and automatic air louvers with temperature control. The flare as permitted is allowed to provide a flow volume not to exceed 4500 scfh (75 scfm) averaged over a 24 hour period. Information on the existing flare and the flare Permit To Operate is presented in Appendix A.

The flare provides the ability to flare off excess digester gas from the two anaerobic digesters at the Rancho Las Virgenes Solids Handling and Composting Facilities. The digester gas is used for heating the digesters and is burned in a boiler to provide the necessary heat to the steam heating system. The digester gas also is intended to be used in the facility fuel cell cogeneration system which at the present time is out of service.

The digester gas production at the Rancho Las Virgenes facility has increased to a level which makes it necessary to replace the existing flare. Gas production currently exceeds the allowed capacity of the existing flare.

Facility Gas Production and Flare Sizing

The Rancho Las Virgenes Solids Handling and Composting Facility uses two 80 feet diameter mesophilic, cylindrical reinforced concrete, waffle bottom, pumped mixed digesters. Raw sludge is fed to the Rancho facilities from the Tapia Water Reclamation Facility and is fed to a sludge holding wet well and decanted prior to injection into the digesters.

The digester gas production for the facility for the previous 12 months is shown in Table 1-1 - Digester Gas Production Analysis. Based on 12 month average influent wastewater flows at the Tapia facility of 9.54 mgd gross and 8.52 mgd net, sludge flows to the Rancho facility average about 80,157 gpd. Total solids average 2.9 percent or about 19387 lb/day and volatile solids average 81 percent or about 15762 lb/day.

From Table 1-1, the amount of volatile solids destroyed averages 54 percent or about 8424 lb/day. The EPA Process Design Manual for Sludge Treatment and Disposal states that volatile solids reduction in anaerobic digesters ranges from 35 to 60 percent. The 54 percent destroyed falls within this range and was used in the digester gas production analysis.

The EPA Design Manual also states that the gas production for municipal sludges generally ranges from 12 to 17 CF per pound of volatile solids destroyed. Although, higher levels of fats, oils, and greases in the sludge will result in higher yields of gas per pound of volatile solid destroyed and may increase the upper range from 17 to more than 20 CF per pound of volatile solid destroyed.

The CH2M HILL Wastewater Treatment Design Guide recommends a gas production range of 12 to 18 CF per pound of volatile solids destroyed. This range was used in the calculated gas production analysis presented in Table 1-1. The Design Guide also acknowledges that

gas production rates will vary with the proportions of protein, carbohydrates, fats, and grease, etc.

Calculated gas production range for the facility based on the 12 month data is shown in Table 1-1 at typical gas production rates of 12 CF per pound of volatile solids destroyed and at 18 CF per pound of volatile solids destroyed. The calculated gas production range of the facility using the 12 month average is 101,093 CF/day (70 scfm) to 151,640 CF/day (105 scfm).

The gas production from each digester is metered and totalized to provide a measured digester gas production for the facility and averages 169,650 CF/day (118 scfm) for the 12 month data. This calculates to about 20 CF/day per pound of volatile solids destroyed. This is a higher rate gas production than the design guides and manuals referenced; but, may well be within an acceptable range given the type of sludge at the facility. It is recommended that the digester gas meters be checked for current calibration and for fouling which will affect the instrument output and readings.

The 12 month data at the 9.54 mgd average was used to estimate the parameters for the digester gas flare system at 12 mgd total flow to the Tapia Water Reclamation Facility as estimated in the LVMWD Sanitation Master Plan. The total solids at 12 mgd will average 2.9 percent and 24,388 lb/day and the volatile solids will average 81 percent and 19,828 lb/day. At 54 percent and 10,598 lb/day volatile solids destroyed, the gas production will range from 127,171 (88 scfm) to 190,757 (132 scfm) CF/day at 12 and 18 CF per pound of volatile solids destroyed, respectively. At 20 CF per pound of volatile solids destroyed, the gas production will be as much as 213,413 CF/day (148 scfm).

The gas production is also affected by the amount and uniformity of sludge fed into the digester. Gas production tends to peak early in the feed sludge residence time and then tapers off as the sludge is digested. Feeding large slugs of sludge into the digester can produce peak gas flows of up to 50 percent higher than the average flows. A uniform feeding at short intervals produces a more uniform gas production. It is not expected that the peak gas flows calculated in Table 1-1 will be affected as the Rancho facility introduces sludge at a controlled and uniform rate based on conversations with the plant staff.

The gas flow from the digester will also be affected by the sludge being fed to the digester. The sludge feed pump is sized at 300 gpm and will produce an effect of an additional 40 scfm when it is pumping into the digester. Although typical pumped flows are less than this, the effect of the full 300 gpm pumping rate was used in the analysis.

Using the 20 CF per pound of volatile solids destroyed upper range and the effect of the sludge pumping into the digester, the digester gas flare could see flows of up to 188 scfm (148 plus 40 scfm).

Based on the digester gas production analysis, the digester gas flare size is recommended to have a design capacity of 200 scfm. This size will meet the anticipated average gas flows for the 12 mgd Tapia design flow rate and allow for some additional instantaneous peak flows.

In order to meet the design capacity requirement of 200 scfm, there are two options which are to install a new flare with 200 scfm capacity to replace the existing flare or to install a

new flare with 125 scfm capacity and use the existing 75 scfm flare to provide a combined capacity of 200 scfm.

Piping System and Components

The digester gas piping system and components were reviewed and evaluated to determine their adequacy for the recommended gas production flow rate of 200 scfm. The gas piping system consists of 6" piping from each digester, a 6" mainline to the Energy Recovery Building, and 4" piping from the Energy Recovery Building to the flare.

Gas pressures in the digesters generally range from 18" WC to 22" WC and the digesters are protected from overpressure a pressure relief valve set at 24" to 25" WC and by a "J" seal set at about 27" WC. Gas pressure is measured where the gas piping enters the Energy Recovery Building and is about 18" WC at that point.

Digester gas piping system losses were calculated to determine if the piping is adequately sized for the recommended 200 scfm design gas flows. The results of the analysis are shown in Table 1-2 - Digester Gas Piping Losses. Equivalent piping lengths were used along with pressure loss graphs from the gas system manufacturer for the various components. The Spitzglass formula for low pressure gas (less than one pound gauge) was used for the calculations.

The digester gas piping loss analysis indicates that the pressure drop from the digesters to the flare is in the range of 18.4" WC at the design gas flow of 200 scfm. The recommended flare inlet gas pressure typically is in the range of 5"WC to 7"WC requiring a digester gas pressure of 23" WC to 25" WC.

The piping pressure drop is excessive especially considering the fact that the manufacturers pressure drops are for clean flame arresters and components. Should the flame arresters foul and become restricted or the piping become restricted because of excess water condensation, then the pressure drop will be even higher.

The 4" pipe and components section produces the greatest pressure drop and is recommended to be replaced with a 6" pipe and components.

Flare Proposals

Flare proposals for the 200 scfm gas production flow rate were solicited from several manufacturers and are presented in the Appendix B. The proposals are for an enclosed flare which will meet the South Coast Air Quality Control District requirements. Proposals were received from the following manufacturers:

- John Zink - 4' - 0" diameter by 40' - 0" high complete \$98,000
- Shaw LFG Specialties - 5' - 0" diameter by 20' - 0" high complete \$68,450
- Varec - 4' - 0" diameter by 45' - 6" high complete \$200,000

In addition to the above manufacturers, Flare Industries was solicited to provide a proposal for the 200 scfm flare but did not respond.

Turndown for the John Zink flare is about 3 to 1 with a flow range of 70 scfm to 200 scfm. Turndown on the Varec flare is about 4 to 1 with a flow range of 50 scfm to 200 scfm.

Flare proposals for the 125 scfm gas production flow rate were solicited from several manufacturers and are presented in the Appendix B. The proposals are for an enclosed flare which will meet the South Coast Air Quality Control District requirements. Proposals were received from the following manufacturers:

- John Zink - 3" - 6" diameter by 30' - 0" high complete \$95,000
- Shaw LFG Specialties - 4" - 0" diameter by 20' - 0" high complete \$63,850
- Varec will not provide a flare with this capacity as it is below their threshold.

In addition to the above manufacturers, Flare Industries was solicited to provide a proposal for the 125 scfm flare but did not respond.

Permitting

The existing flare received a Permit To Operate from the South Coast Air Quality Management District (SCAQMD) based on its original design criteria and expected flows of 4500 scfm (75 scfm) averaged over a 24 hour period. Installation of a new larger flare (125 or 200 scfm) will trigger a new permitting application process and fees and will require a new Permit To Construct and a modification of the existing Permit To Operate.

Because the new flare will have a significant increase in gas flows and resultant emissions, additional air quality rules may come into effect. The emission increase will likely trigger Rule 212(c) requiring a public notice, Rule 1303(b) requiring a more detailed air quality modeling analysis, and Rule 1401 requiring an assessment of health risk. Other air quality rules and requirements may also be come into play such as additional emission monitoring, testing, and reporting requirements.

Appendix A



PERMIT TO OPERATE

This initial permit must be renewed ANNUALLY unless the equipment is moved, or changes ownership
If the billing for annual renewal fee (Rule 301 f) is not received by the expiration date, contact the District

Legal Owner
or Operator

LAS VIRGENES MUNICIPAL WATER DISTRICT
4232 LAS VIRGENES RD
CALABASAS, CA 91302

ID 060192

Equipment Location 3240 LAS VIRGENES RD CALABASAS CA 91302 1922

Equipment Description

WASTE DIGESTER GAS FIRING SYSTEM CONSISTING OF THE FOLLOWING

- 1 ONE (1) DIGESTER GAS FLARE, JOHN ZINK MODEL LANDFILL ZTOF, 3'-6" D X 20'-0" H, 4,500 CFH CAPACITY, EQUIPPED WITH TWO 4-INCH SIZE BURNERS, UV FLAME SCANNER, AUTOMATIC SHUTOFF VALVE, AND AUTOMATIC AIR LOUVERS WITH TEMPERATURE CONTROL AND RECORDER
- 2 ONE (1) FLAME ARRESTER
- 3 TWO (2) BOOSTERS, ONE STANDBY, EACH WITH AN ELECTRIC MOTOR (COMMON TO APPLICATION NO 243076)

Conditions

- 1 OPERATION OF THIS EQUIPMENT SHALL BE CONDUCTED IN COMPLIANCE WITH ALL DATA AND SPECIFICATIONS SUBMITTED WITH THE APPLICATION UNDER WHICH THIS PERMIT TO OPERATE IS ISSUED, UNLESS OTHERWISE NOTED BELOW
- 2 THIS EQUIPMENT SHALL BE PROPERLY MAINTAINED AND KEPT IN GOOD OPERATING CONDITION AT ALL TIMES
- 3 THIS EQUIPMENT SHALL BE OPERATED AND MAINTAINED BY PERSONNEL PROPERLY TRAINED IN ITS OPERATION
- 4 ONLY DIGESTER GAS SHALL BE BURNED IN THIS EQUIPMENT, EXCEPT FOR THE PILOT FUEL WHICH SHALL BE NATURAL GAS
- 5 THE FLARE SHALL BE EQUIPPED WITH A TEMPERATURE INDICATOR AND RECORDER WHICH MEASURES AND RECORDS THE GAS TEMPERATURE IN THE FLARE STACK THE TEMPERATURE INDICATOR AND RECORDER SHALL OPERATE WHENEVER THE FLARE IS IN OPERATION
- 6 WHENEVER THE FLARE IS IN OPERATION, A TEMPERATURE OF NOT LESS THAN 1400 °F SHALL BE MAINTAINED IN THE FLARE STACK AS MEASURED BY THE TEMPERATURE INDICATOR AND RECORDER EXCEPT DURING THE START-UP PERIOD OF 10 MINUTES OF OPERATION

FILE



PERMIT TO OPERATE

CONTINUATION OF PERMIT TO OPERATE

- 7 THE THERMOCOUPLE USED TO MEASURE THE TEMPERATURE OF THE FLARE SHALL BE AT LEAST 2 FEET ABOVE THE FLAME ZONE AND 1 FOOT 9 INCHES BELOW THE TOP OF THE FLAME SHROUD AND AT LEAST 0 6 SECOND DOWNSTREAM OF THE BURNER
- 8 THE FLARE SHALL BE EQUIPPED WITH A FLAME FAILURE ALARM WITH AN AUTOMATIC BLOWER AND DIGESTER GAS SUPPLY VALVE SHUT-OFF SYSTEM WHICH HAS BEEN APPROVED BY THE EXECUTIVE OFFICER, TO ISOLATE THE FLARE FROM THE DIGESTER GAS SUPPLY LINE, SHUT-OFF THE BLOWER, AND NOTIFY A RESPONSIBLE PARTY OF THE SHUTDOWN
- 9 THE SAFETY SYSTEM SPECIFIED IN CONDITION NO 8 SHALL BE TESTED MONTHLY FOR PROPER OPERATION AND THE RESULTS SHALL BE RECORDED
- 10 PRIOR TO OPERATING THE EQUIPMENT, A FLOW INDICATION AND RECORDING DEVICE SHALL BE INSTALLED IN THE DIGESTER GAS SUPPLY LINE TO THE FLARE TO MEASURE (IN SCFM) AND RECORD THE QUANTITY OF DIGESTER GAS BEING BURNED IN THE FLARE THESE FLOW INDICATING AND RECORDING DEVICES SHALL OPERATE CONTINUOUSLY
- 11 THE TOTAL VOLUME FLOW RATE OF DIGESTER GAS BURNED IN THE FLARE AND THE BOILER SHALL NOT EXCEED 6600 SCFH AVERAGED OVER A 24 HOUR PERIOD
- 12 THE TOTAL VOLUME FLOW RATE OF DIGESTER GAS BURNED IN THE FLARE SHALL NOT EXCEED 4500 SCFH AVERAGED OVER A 24 HOUR PERIOD
- 13 THE BTU CONTENT OF DIGESTER GAS SHALL BE DETERMINED MONTHLY USING A BOMB CALORIMETER METHOD APPROVED IN WRITING BY THE EXECUTIVE OFFICER
- 14 ALL RECORDING DEVICES SHALL BE SYNCHRONIZED WITH RESPECT TO TIME OF DAY
- 15 THE FLARE SHALL BE EQUIPPED WITH A SUFFICIENT NUMBER OF VIEW PORTS TO ALLOW VISUAL INSPECTION OF THE FLAME ZONE WITHIN THE FLARE AT ALL TIMES PERMANENT AND SAFE ACCESS SHALL BE PROVIDED FOR ALL VIEW POINTS
- 16 THE SKIN TEMPERATURE OF THE FLARE SHROUD WITHIN FOUR (4) FEET OF ALL OF THE SOURCE TEST PORTS SHALL NOT EXCEED 250 °F IF A HEAT SHIELD IS REQUIRED TO COMPLY WITH THIS REQUIREMENT, ITS DESIGN SHALL BE APPROVED BY THE EXECUTIVE OFFICE PRIOR TO CONSTRUCTION THE HEAT SHIELD, IF REQUIRED TO COMPLY WITH THE TEMPERATURE REQUIREMENT SHALL BE IN PLACE WHENEVER A SOURCE TEST IS CONDUCTED BY THE DISTRICT
- 17 ANY BREAKDOWN OR MALFUNCTION OF THE DIGESTER GAS TREATING AND FLARING SYSTEM RESULTING IN THE EMISSION OF RAW DIGESTER GAS SHALL BE REPORTED TO THE SCAQMD DIRECTOR OF ENFORCEMENT WITHIN ONE HOUR AFTER OCCURRENCE AND IMMEDIATE REMEDIAL MEASURES SHALL BE UNDERTAKEN TO CORRECT THE PROBLEM AND PREVENT FURTHER EMISSIONS INTO THE ATMOSPHERE
- 18 THE EMISSIONS OF TOTAL NON-METHANE ORGANICS FROM THE FLARE SHALL NOT EXCEED 2 POUND PER DAY, AND 0 08 POUND PER HOUR

FILE



PERMIT TO OPERATE

CONTINUATION OF PERMIT TO OPERATE

- 19 THE EMISSIONS OF OXIDES OF NITROGEN FROM THE FLARE SHALL NOT EXCEED 4 POUND PER DAY, AND 0 17 POUND PER HOUR
- 20 THE EMISSIONS OF OXIDES OF SULFUR FROM THE FLARE SHALL NOT EXCEED 0 73 POUND PER DAY, AND 0 03 POUND PER HOUR
- 21 THE EMISSIONS OF CARBON MONOXIDE FROM THE FLARE SHALL NOT EXCEED 19 POUND PER DAY, AND 0 80 POUND PER HOUR
- 22 THE EMISSIONS OF TOTAL PARTICULATE MATTER FROM THE FLARE SHALL NOT EXCEED 5 POUND PER DAY, AND 0 21 POUND PER HOUR
- 23 ALL RECORDS SHALL BE KEPT FOR AT LEAST TWO (2) YEARS IN A FORM APPROVED IN WRITING BY THE DIRECTOR OF ENFORCEMENT AND MADE AVAILABLE TO THE EXECUTIVE OFFICER UPON REQUEST
- 24 IF THE EMISSION OF TOXICS AND POTENTIALLY TOXIC SUBSTANCES EXCEED THE CORRESPONDING VALUES USED IN THE HEALTH RISK ASSESSMENT DATED OCTOBER 1991, OR ANY OF THE OPERATING AND /OR STACK PARAMETERS USED IN THE HEALTH RISK ASSESSMENT ARE CHANGED WHICH WILL RESULT IN AN INCREASE IN GROUND LEVEL CONCENTRATIONS, THE APPLICANT SHALL SUBMIT A REVISED HEALTH RISK ASSESSMENT FOR SCAQMD APPROVAL WITHIN 45 DAYS AFTER NOTICE IS GIVEN FOR SUCH PREPARATION, UNLESS OTHERWISE APPROVED IN WRITING BY THE DISTRICT

NOTICE

IN ACCORDANCE WITH RULE 206, THIS PERMIT TO OPERATE OR COPY SHALL BE POSTED ON OR WITHIN 8 METERS OF THE EQUIPMENT

THIS PERMIT DOES NOT AUTHORIZE THE EMISSION OF AIR CONTAMINANTS IN EXCESS OF THOSE ALLOWED BY DIVISION 26 OF THE HEALTH AND SAFETY CODE OF THE STATE OF CALIFORNIA OR THE RULES OF THE AIR QUALITY MANAGEMENT DISTRICT THIS PERMIT CANNOT BE CONSIDERED AS PERMISSION TO VIOLATE EXISTING LAWS, ORDINANCES, REGULATIONS OR STATUTES OF OTHER GOVERNMENT AGENCIES

EXECUTIVE OFFICER

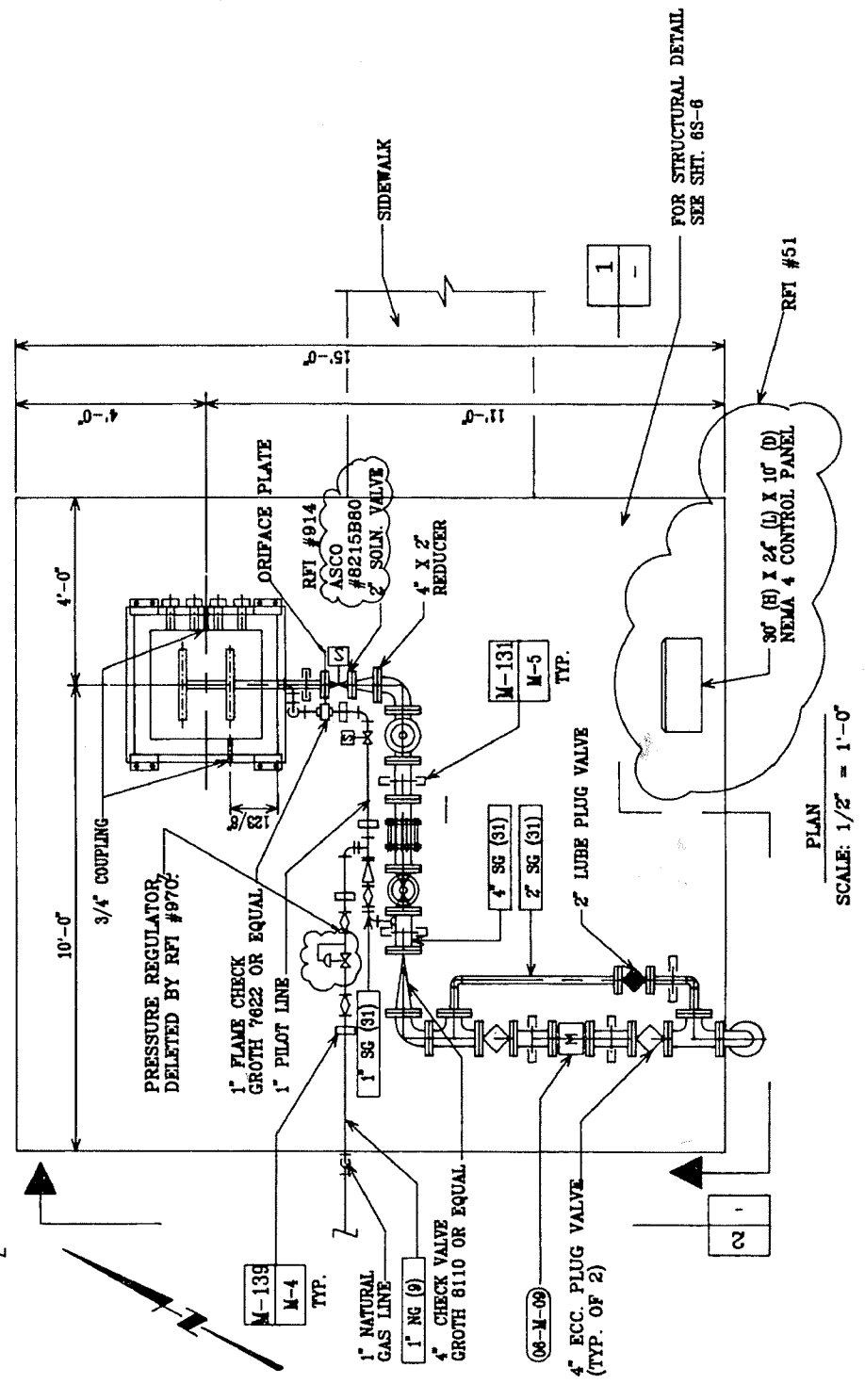
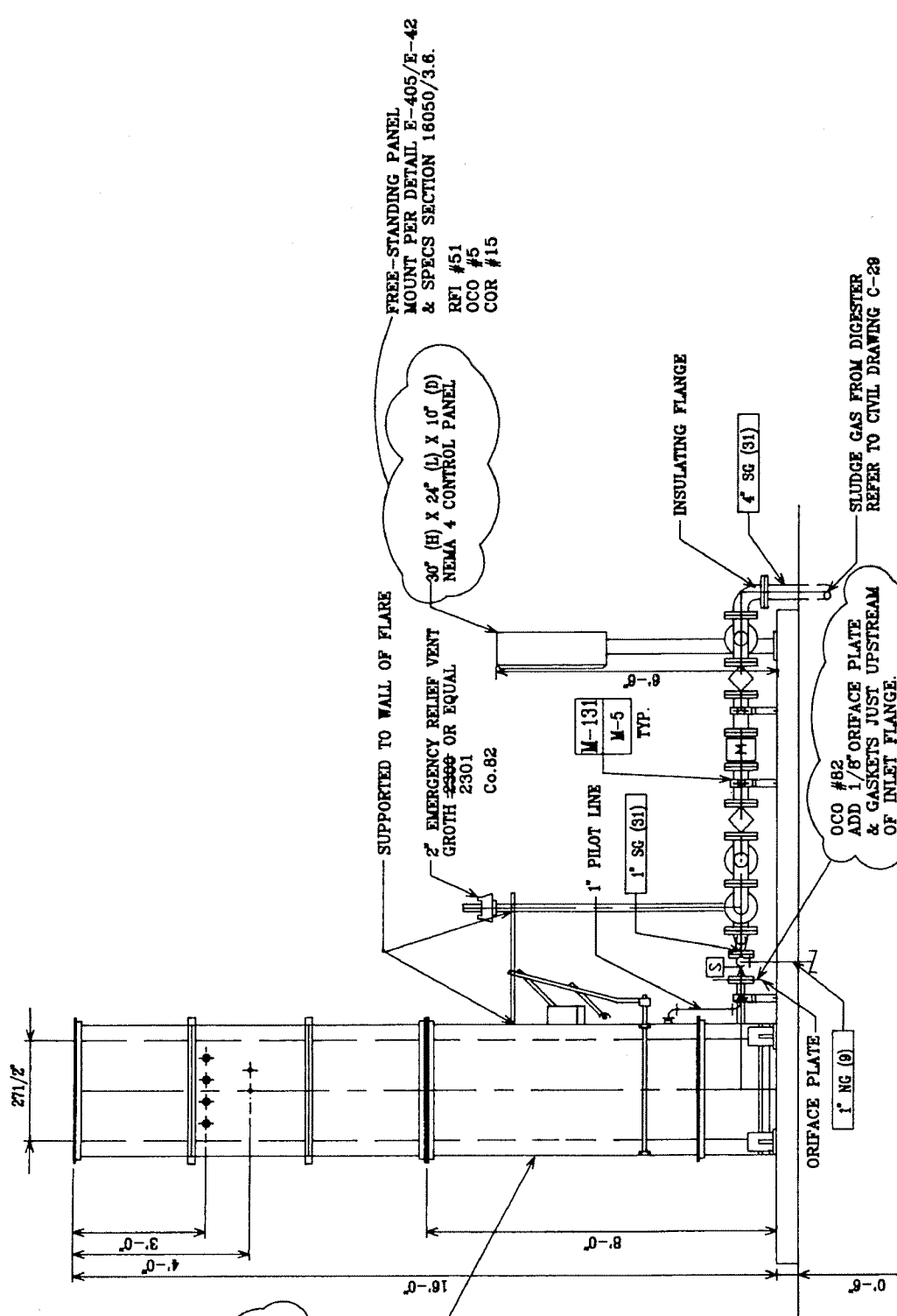
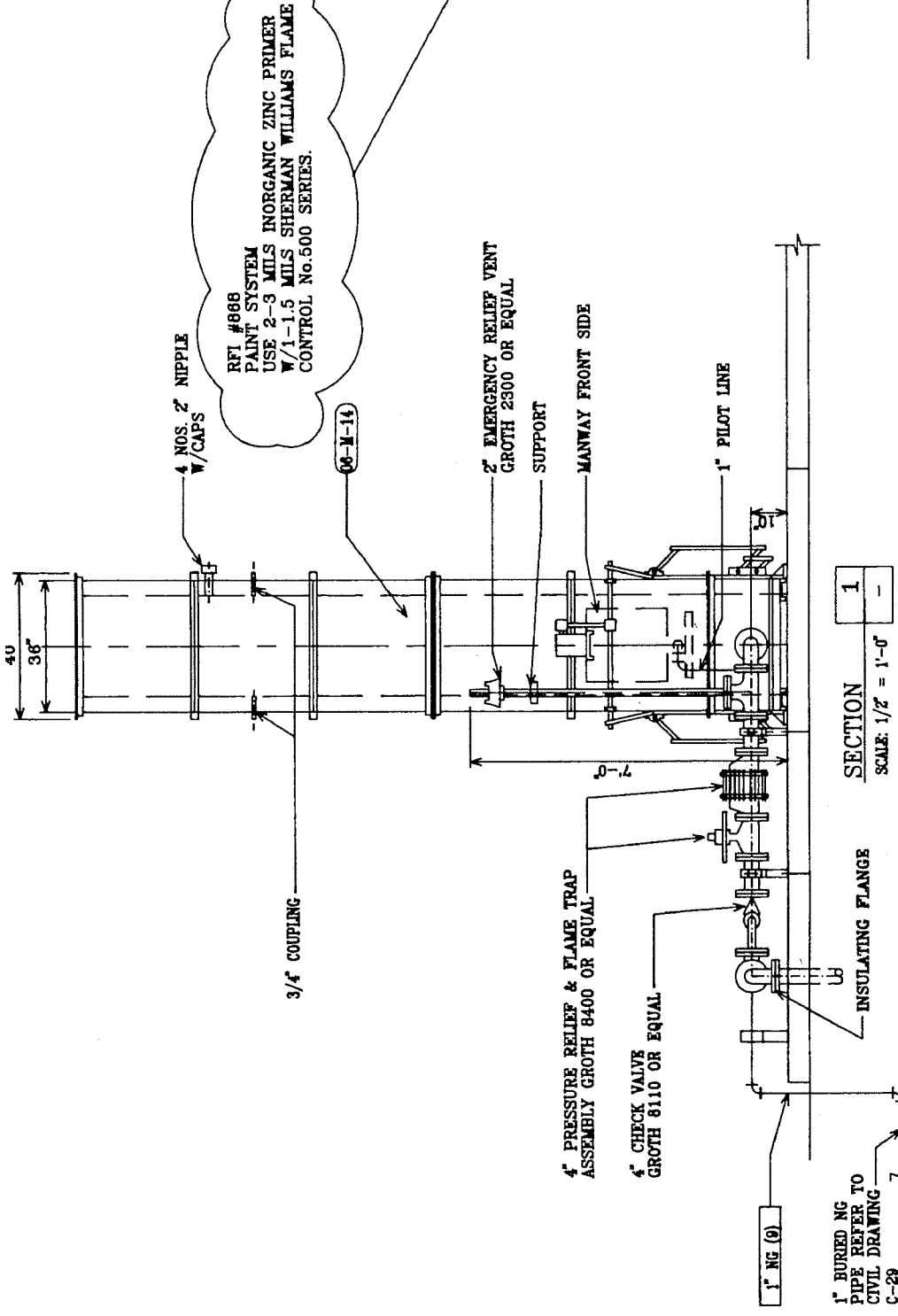
Dorris M Bailey

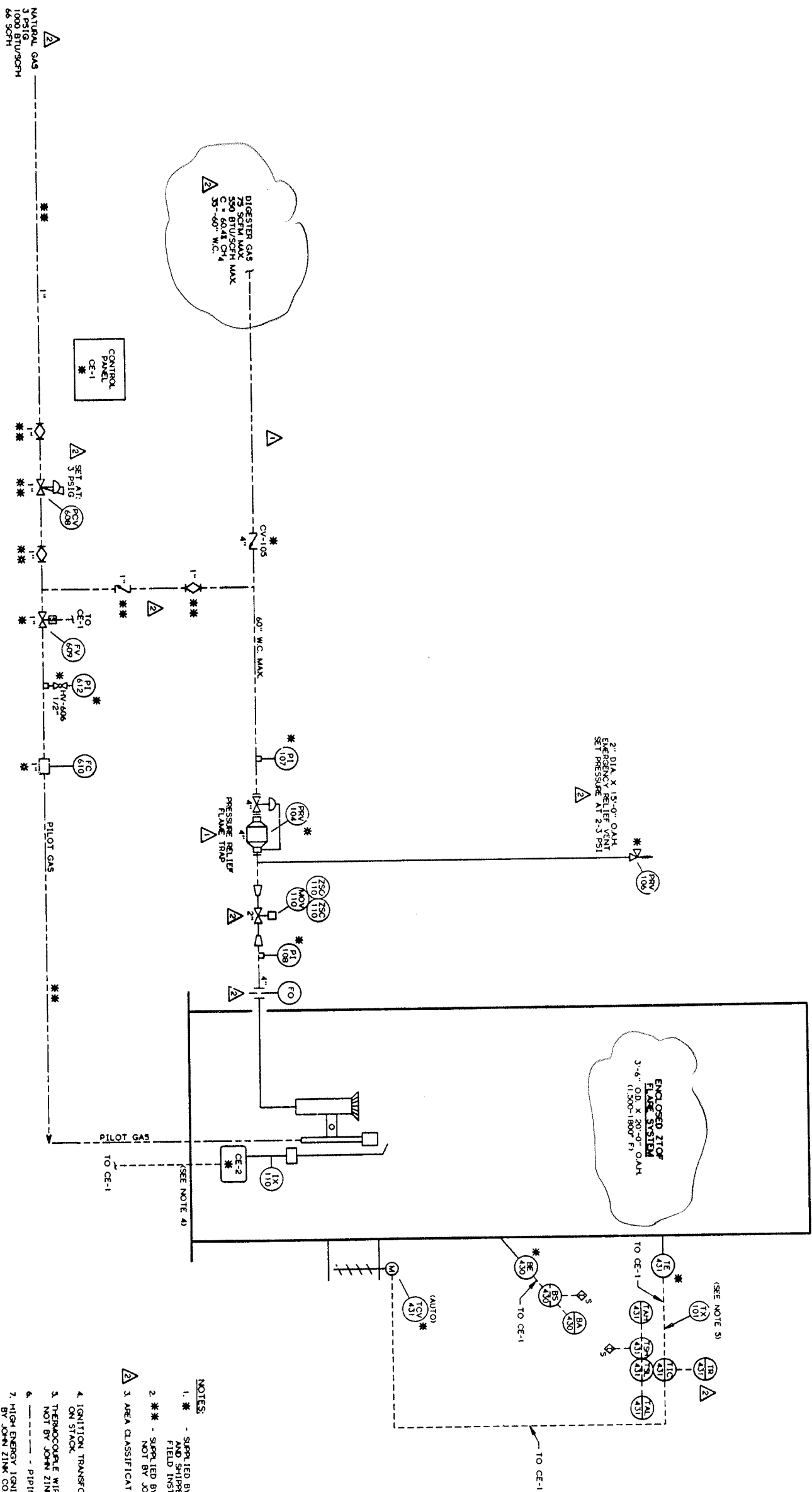
By Dorris M Bailey/PIRP
1/31/2002

SOUTH COAST
AIR QUALITY MANAGEMENT DISTRICT
CERTIFIED COPY *Doris M Bailey*

FILE







- NOTES:
- * - SUPPLIED BY JOHN ZINK CO. AND SHIPPED LOOSE. FIELD INSTALLED BY OTHERS.
 - ** - SUPPLIED BY OTHERS. NOT BY JOHN ZINK CO.
 - △ AREA CLASSIFICATION: CLASS 1, DIV. 2, G.E.D. (OUTSIDE 3'-0" OF FLARE)
 - IGNITION TRANSFORMER IS MOUNTED IN CE-2 ON STACK.
 - TERMO-COUPLE WIRE 15A TYPE "K" (BY OTHERS). NOT BY JOHN ZINK CO.
 - PIPING BY OTHERS.
 - HIGH ENERGY IGNITION CABLE 30' SUPPLIED BY JOHN ZINK CO. (INSTALLED BY OTHERS).

NO.		REVISION DESCRIPTION		DATE	BY	CHK	APP.	DATE
1		REVISION FOR CUSTOMER RE-APPROVAL		8-3-93	BAW			8-3-93
2		REVISION FOR CUSTOMER COMMENTS, VOR #12731		4-8-93	BAW			4-8-93

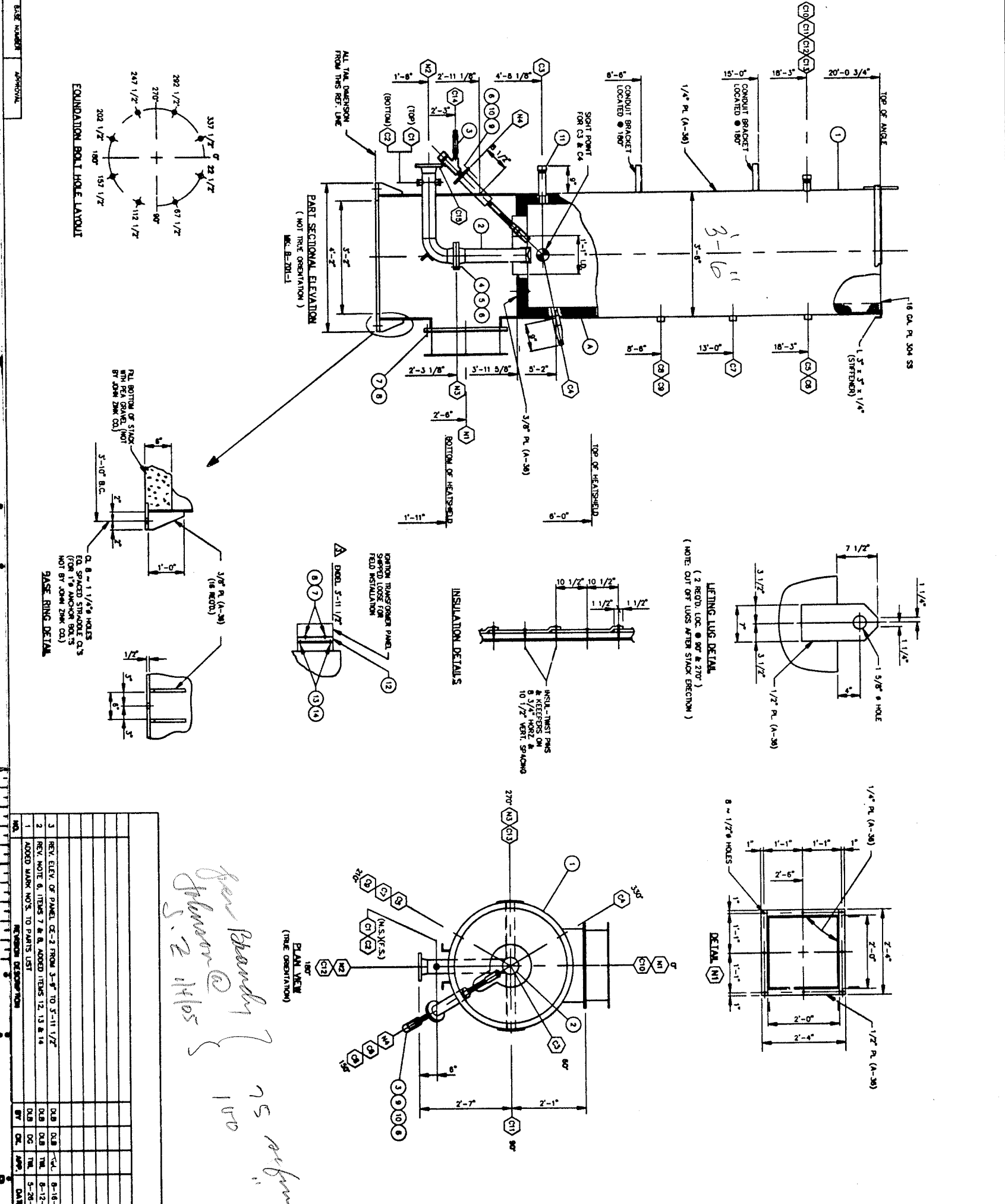
P.O. NO. P000222		DATE 3-19-93	
JOBITE CALABASKA, CA		DATE 3-24-93	
FOR WOKLEY CONSTRUCTION		DATE 3-19-93	
UNDERLAS VIRGENES		DATE 3-19-93	
MUNICIPAL WATER DIST		DATE 3-19-93	
PARIS AND SERVICE CALL (918) 234-2731 FAX (918) 234-2700		DATE 3-19-93	

JOHN ZINK		CERTIFIED	
A JOHN WILKINSON COMPANY		DATE 3-19-93	
PIPING & INSTRUMENT DIAGRAM		SCALE 1/8" = 1'-0"	
FOR ZTGF ENCLOSED FLARE SYSTEM		DRAWING NUMBER 7-250105-150	

DCDC-A00405-150

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100



ITEM QTY.	DESCRIPTION	MARK NO.	MATL.
1	FLAME STACK ASSEMBLY	B-101-1	
2	FLAME TP ASSEMBLY	B-102-1	
3	PILOT ASSEMBLY	B-202-1	
4	GASSET 4"-150 LB. P.F. x 1/8" THK	CA-150-4	C4401
5	STD BOLT 5/8" x 4" LG.	S-5-4	A-193-B7
6	HEX NUT 5/8"	HN-5	A-194-2H
7	HEX HEAD BOLT 3/8" x 1 1/2" LG.	H-3-1 1/2	A-307 ZMC RL
8	HEX NUT 3/8"	HN-3	A-307 ZMC RL
9	GASSET 3"-150 LB. P.F. x 1/8" THK	CA-150-3	C4401
10	STD BOLT 5/8" x 2 1/2" LG.	S-5-2 1/2	A-193-B7
11	SPRINT POINT	B-510-0005	P-HEX/AM
12	PANEL CE-2 ADAPTER BRACKET	B-202-1	
13	HEX HEAD BOLT 1/4" x 1" LG.	H-2-1	A-307 ZMC RL
14	HEX NUT 1/4"	HN-2	A-307 ZMC RL

ITEM	DESCRIPTION	MARK NO.	MATL.
M1	DANGER CONM. - SEE DETAIL		
M2	WASTE GAS CONM. - 4"-150 LB. P.F.		
M3	FLAME TP CONM. - 4"-150 LB. P.F.		
M4	PILOT BIC 3/8" RL FLAME W/ 3" - 1504 DRUMING		

ITEM	DESCRIPTION	MARK NO.	MATL.
C1	EMPOUNT GAS CONM. - 1" F.A.P.T. W/PLUG		
C2	DRUM - 1" F.A.P.T. W/PLUG		
C3	SPRINT POINT - 2" W.A.P.T.		
C4	SCRAMMER CONM. - 1" W.A.P.T.		
C5	TEMPERATURE CONM. - 1" F.A.P.T. (CA, C7 & C9 W/PLUG)		
C10-13	SAMPLE POINT - 4" W.A.P.T. W/CAP		
C14	PILOT GAS CONM. - 1/2" W.A.P.T.		
C15	PILOT CONDUIT CONM. - 1/2" F.A.P.T.		

ITEM	DESCRIPTION	MARK NO.	MATL.
W1	WINDLOAD PER ASCE 7-88		70 M.P.H.
S1	SEISMIC PER ASCE 7-88		ZONE 4
W	WIND @ BASE		3.78 K*
L	LOAD @ BASE		48.0 K-FT*
W	WIND @ BASE		3.17 K
L	LOAD @ BASE		250 F
W	WIND @ BASE		0.0

DESIGN DATA

WINDLOAD PER ASCE 7-88: 70 M.P.H.

SEISMIC PER ASCE 7-88: ZONE 4

WIND @ BASE: 3.78 K*

LOAD @ BASE: 48.0 K-FT*

WIND @ BASE: 3.17 K

LOAD @ BASE: 250 F

WIND @ BASE: 0.0

* SEISMIC LOAD GOVERNS DESIGN

LETTING NOTES

A. WIND CRANE AT TOP REQUIRES SPACED BAR (BY OPENING) BACKED WITH 2" THK. PRECER RT. & LB. DENSITY 2400 F (OR EQUAL) AND VERTICAL STAKE

B. AND VERTICAL STAKE

INSULATION LEGEND

A. 1" THK. PRECER RT. & LB. DENSITY 2400 F (OR EQUAL) BACKED WITH 2" THK. PRECER RT. & LB. DENSITY 2400 F (OR EQUAL) ON INCONEL PINS & KEEPERS

NOTES

1. BOLT HOLES TO STRAP/CLIP UNLESS NOTED

2. FLAME ASSTY IS NOT TO BE USED AS AN ANCHOR POINT FOR OUTDOOR PIPING

3. PRE-TENSION ANCHOR BOLTS BY THE TURN OF THE NUT METHOD / ASSC

4. CHL. WIRE & T.C. WIRE MUST BE RUN IN SEPARATE CONDUIT

5. TAG NO.'S TO BE PRECEDED BY JOHN ZINK SHOP ORDER NO.

6. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

7. SPAN/FAST PER SPEC. OF-10 & 12.3.1 W/AS D.F.1.1

8. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

9. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

10. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

11. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

12. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

13. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

14. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

15. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

16. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

17. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

18. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

19. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

20. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

21. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

22. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

23. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

24. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

25. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

26. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

27. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

28. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

29. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

30. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

31. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

32. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

33. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

34. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

35. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

36. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

37. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

38. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

39. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

40. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

41. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

42. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

43. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

44. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

45. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

46. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

47. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

48. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

49. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

50. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

51. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

52. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

53. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

54. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

55. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

56. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

57. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

58. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

59. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

60. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

61. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

62. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

63. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

64. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

65. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

66. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

67. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

68. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

69. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

70. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

71. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

72. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

73. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

74. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

75. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

76. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

77. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

78. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

79. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

80. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

81. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

82. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

83. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

84. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

85. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

86. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

87. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

88. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

89. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

90. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

91. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

92. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

93. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

94. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

95. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

96. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

97. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

98. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

99. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

100. FINISH (EXT. C.S. INSIDE OF SHIRT, & INT. OF FLOOR PLATE)

JOHN ZINK
A JOHN INDUSTRIES COMPANY
ENGINEERING AND CONSTRUCTION
ENCLOSURE GROUP/FLAME STACK ASSEMBLY
(5'-0" x 20'-0" WITH 1" - 4" TRS)

REVISION DESCRIPTION
NO. DATE BY CHK. APPR. DATE

1 5-28-93 JWB/MS
2 8-16-93 JWB/MS
3 8-16-93 JWB/MS
4 8-16-93 JWB/MS
5 8-16-93 JWB/MS
6 8-16-93 JWB/MS
7 8-16-93 JWB/MS
8 8-16-93 JWB/MS
9 8-16-93 JWB/MS
10 8-16-93 JWB/MS
11 8-16-93 JWB/MS
12 8-16-93 JWB/MS
13 8-16-93 JWB/MS
14 8-16-93 JWB/MS
15 8-16-93 JWB/MS
16 8-16-93 JWB/MS
17 8-16-93 JWB/MS
18 8-16-93 JWB/MS
19 8-16-93 JWB/MS
20 8-16-93 JWB/MS
21 8-16-93 JWB/MS
22 8-16-93 JWB/MS
23 8-16-93 JWB/MS
24 8-16-93 JWB/MS
25 8-16-93 JWB/MS
26 8-16-93 JWB/MS
27 8-16-93 JWB/MS
28 8-16-93 JWB/MS
29 8-16-93 JWB/MS
30 8-16-93 JWB/MS
31 8-16-93 JWB/MS
32 8-16-93 JWB/MS
33 8-16-93 JWB/MS
34 8-16-93 JWB/MS
35 8-16-93 JWB/MS
36 8-16-93 JWB/MS
37 8-16-93 JWB/MS
38 8-16-93 JWB/MS
39 8-16-93 JWB/MS
40 8-16-93 JWB/MS
41 8-16-93 JWB/MS
42 8-16-93 JWB/MS
43 8-16-93 JWB/MS
44 8-16-93 JWB/MS
45 8-16-93 JWB/MS
46 8-16-93 JWB/MS
47 8-16-93 JWB/MS
48 8-16-93 JWB/MS
49 8-16-93 JWB/MS
50 8-16-93 JWB/MS
51 8-16-93 JWB/MS
52 8-16-93 JWB/MS
53 8-16-93 JWB/MS
54 8-16-93 JWB/MS
55 8-16-93 JWB/MS
56 8-16-93 JWB/MS
57 8-16-93 JWB/MS
58 8-16-93 JWB/MS
59 8-16-93 JWB/MS
60 8-16-93 JWB/MS
61 8-16-93 JWB/MS
62 8-16-93 JWB/MS
63 8-16-93 JWB/MS
64 8-16-93 JWB/MS
65 8-16-93 JWB/MS
66 8-16-93 JWB/MS
67 8-16-93 JWB/MS
68 8-16-93 JWB/MS
69 8-16-93 JWB/MS
70 8-16-93 JWB/MS
71 8-16-93 JWB/MS
72 8-16-93 JWB/MS
73 8-16-93 JWB/MS
74 8-16-93 JWB/MS
75 8-16-93 JWB/MS
76 8-16-93 JWB/MS
77 8-16-93 JWB/MS
78 8-16-93 JWB/MS
79 8-16-93 JWB/MS
80 8-16-93 JWB/MS
81 8-16-93 JWB/MS
82 8-16-93 JWB/MS
83 8-16-93 JWB/MS
84 8-16-93 JWB/MS
85 8-16-93 JWB/MS
86 8-16-93 JWB/MS
87 8-16-93 JWB/MS
88 8-16-93 JWB/MS
89 8-16-93 JWB/MS
90 8-16-93 JWB/MS
91 8-16-93 JWB/MS
92 8-16-93 JWB/MS
93 8-16-93 JWB/MS
94 8-16-93 JWB/MS
95 8-16-93 JWB/MS
96 8-16-93 JWB/MS
97 8-16-93 JWB/MS
98 8-16-93 JWB/MS
99 8-16-93 JWB/MS
100 8-16-93 JWB/MS

Appendix B

December 15, 2004

CH2M HILL
2525 Airpark Drive
Redding, CA 96001

Attention: Michael L. Damoth, P.E.

Reference: Rancho Las Virgenes, Biogas Flare System
Budget Proposal for a ZTOF Enclosed Flare System
John Zink Reference BF-46942

Dear Michael,

With thousands of flares operating worldwide, John Zink is the leading supplier of industrial flares. This includes inventing the modern flare system over half a century ago and over 75 years experience in the combustion industry. To satisfy your applications, John Zink is pleased to offer our **ZTOF** Enclosed Flare System.

DESIGN CONDITIONS

Flare Gas Stream

Type:	Wastewater
Composition:	65 % CH ₄ (maximum) 35% CO ₂ , air, inerts
Flow Rate:	200 SCFM (maximum)
Waste Heat Release:	7,104,000 Btu/hr (maximum)

Mechanical

Design Wind Speed:	110 mph
Ambient Temperature:	-20 °F to 120 °F
Electrical Area Classification:	non-hazardous
Elevation:	sea level

Process

Smokeless Capacity:	100%
Operating Temperature:	1400 °F to 1800 °F (2000 °F shutdown)
Retention Time:	0.7 seconds at 1800 °F (minimum)
Flare Inlet Pressure:	5" H ₂ O (maximum, excluding flame arrester)
Ambient Pressure:	14.7 psia

NOTE: *Low methane concentrations may require auxiliary fuel to initiate combustion and maintain temperature.*

Utilities

Pilot Gas (intermittent):	22 SCFH of propane at 7-10 psig
Compressed Air:	None
Electricity:	120 V, 1 ph, 60 Hz
Auxiliary Fuel:	none (pilot only)

Expected Flue Gas

Operating Temperature	1600°F	1800°F
CO ₂ Volume %	5.2	6.0
H ₂ O Volume %	8.0	9.1
N ₂ Volume %	73.9	73.3
O ₂ Volume %	12.9	11.6

Expected Emission Range (Design Flow)⁽¹⁾

Operating Temperature	1600°F	1800°F
Overall Destruction Efficiency ⁽²⁾	98%	99%
NO _x , lb / MMBTU ⁽³⁾	0.10	0.12
CO, lb / MMBTU ⁽⁴⁾	0.20	0.15

⁽¹⁾ Expected emission rates at lower operating temperatures are available upon request.

⁽²⁾ Typical sulphur containing compounds are expected to have greater than 98% oxidation efficiency.

⁽³⁾ Excludes NO_x from fixed nitrogen.

⁽⁴⁾ Excludes CO contribution present in the gas.

NOTE: *Expected emissions are based on field tests of operating units and the higher heating value (HHV) of the gas. Destruction efficiency, NO_x, and CO emissions shown are valid for combustion of specified gas only. Expected emissions are not guaranteed unless expressly stated elsewhere in this proposal.*

SCOPE OF SUPPLY

Item 1, Enclosed ZTOF Flare

- One (1) 4'-0" diameter x 40'-0" overall height, A-36 carbon steel flare stack enclosure.
- Two (2) 1" layers of *A.P. Green* (or equal) ceramic fiber refractory on Inconel pins and keepers
- One (1) burner manifold assembly with 6" diameter flanged inlet connection.
- One (1) **V-Mix™** Biogas Burner with stainless steel anti-flashback tips and maximum flame stability through the full range of design flow rates.
- One (1) **Tru-Lite™** ignitor assembly for use during start-up cycles. This externally mounted pilot provides simple operation and can be removed for maintenance without entering the stack.
- One (1) bolted blade combustion air damper with opposed blade design, providing air turndown control. Galvanized finish and stainless steel press-fit bearings ensure smooth, long term operation.
- Two (2) 4" diameter NPT couplings with plug provided as sample ports at 90° apart located one-half stack diameter from the flare top for accurate emission testing.
- One (1) stainless steel rain cap consisting of overlapping tabs to provide weather protection at the refractory and flare shell interface.
- Four (4) thermocouple connections at various elevations for temperature monitoring.
- Exterior protection using SSPC-SP-6 sandblast and *Sherwin Williams* Zinc Clad II primer coating system, 4 mils DFT, for superior corrosion protection at shell temperatures to 750 °F.
- One (1) AISC designed, continuous base plate for high wind stability.
- Two (2) lifting lugs to assist in erection.
- Thermocouple conduit mounting brackets.

Item 2, Automatic Ignition and Control Station

Control Station Assembly

- One (1) self-supporting steel rack with electrical panels attached to the front side and pilot gas piping and instrumentation attached to the rear side.
- One (1) operator interface touch screen display for all setpoint changes, status, alarms, and shut down indications.
- One (1) weatherproof Flare Control Panel with a programmable logic controller for safe, overall system operation and control.
- One (1) Pilot Gas Control System including a pressure regulator, fail-closed shutdown valve, manual block valve, and pressure indicator.
- The control station assembly is completely piped and wired in a *UL* approved shop and functionally tested simulating actual operations.

Stack Mounted Controls

- One (1) dampers with automatically controlled louvers is provided as part of the automatic temperature control feature.
- One (1) Ignition Panel Assembly including a transformer, pilot spark electrode, and ignition wire.
- One (1) self-checking, ultraviolet flame scanner.
- One (1) purge air blower.
- One (1) high temperature shutdown thermocouple.
- Three (3) temperature monitoring thermocouples with location dependent on specific flow conditions. A selector switch is conveniently located inside the control panel to select the controlling thermocouple.

Item 3, Inlet Flame Arrester

- One (1) 6" diameter, eccentric *Enardo* Flame Arrester with aluminum housing, housing drain, and removable aluminum internals mounted at the flare inlet.

Item 4, Automatic Block Valve

- One (1) automatic block valve assembly consisting of a 6" diameter, butterfly valve and fail-closed pneumatic actuator. The valve has a carbon steel wafer body, 316 SS disk and shaft, and PTFE seal. The pneumatic actuator can be operated with either compressed air or compressed nitrogen from a cylinder.

OPTIONS

Item 5, Flow Meter

- One (1) thermal mass flow meter assembly with 316 stainless steel probe for 1" NPT mounting.

Item 6, Automatic Telephone Dialer

- One (1) panel mounted automatic dialer with eight universal inputs. The autodialer is capable of communicating via phone, fax, internet email, pager or computer for alarm notification. It is supplied with vendor software and is capable of online communication via modem and phone for retrieving real time information or historical data logging information. This unit also comes complete with a 10 hour battery backup.

Item 7, Access Ladder

- One (1) galvanized, safety ladder providing access to thermocouples. Equipment includes a ladder, safety rails, a safety harness, and personnel protection screening behind the ladder and around the thermocouple ports.

Item 8, Service Platform

- One (1) galvanized, 150° service platform, designed per *OSHA* requirements, providing access to the stack sample ports. A continuous band of personnel protection screening around the sample ports is included with this option.

Item 9, Control Panel Weather Hood

- One (1) fabricated steel hood designed to limit control panel exposure to the elements. It provides approximately 4' of overhang to the front and 2' to the rear. The hood is painted to match the rest of the control panel rack and comes with a fluorescent light assembly for enhanced visibility of the panel components at night.

Item 10, Industrial Surface Finish

- *Sherwin Williams* Kem High Temperature Aluminum Top Coat, coated 1 - 2 mils DFT. This coat is applied over the standard *Sherwin Williams* Zinc Clad II primer to provide an enhanced finish with superior protection up to 750 °F.

Item 11, Flare Foundation Template

- One (1) enclosed flare base plate foundation template constructed of 1/4" carbon steel plate to assist in setting and installing the anchor bolts in the field. The template is shipped prior to the flare, so that it can be utilized at the time the flare foundation is formed.

Item 12, Methane Analyzer

- One (1) microprocessor based analyzer utilizing dual wavelength, non-dispersive infrared absorption detection of total percent volume methane. The unit is field configurable with a 4 - 20 mA output signal and includes a digital readout, complete calibration setup, safety condensate trap, safety filter, sample gas pump and flow meter.

Item 13, Underwriters Laboratories Classification

- John Zink Company is dedicated to ensuring the highest level of quality and safety standards in its products. This performance level is reflected in all products and provides the opportunity to apply the *UL* listing symbol for Industrial Control Panels on motor starters and a *UL* classification symbol on Flare Control Panels. This option is provided for applications requiring *Underwriters Laboratories* Certification.

BUDGET PRICING \$98,000

Optional Pricing

4. One (1) Flowmeter	\$4,500
5. One (1) Automatic Telephone Dialer	\$3,500
6. One (1) Access Ladder	\$5,500
7. One (1) Service Platform	\$9,000
8. One (1) Control Panel Weather Hood	\$1,500
9. Industrial Surface Finish	\$1,500
10. One (1) Flare Foundation Template	\$1,000
11. One (1) Methane Analyzer	\$7,500
12. <i>Underwriters Laboratories</i> Classification	\$1,500

John Zink Field Service for start-up, training, or testing assistance is available for a rate of \$880 per day plus expenses.

PAYMENT AND TERMS SUMMARY

This offer is valid for a period ending 30 days from the offer's date and are contingent upon the attached John Zink Standard Terms and Conditions of Sale.

The shipping terms are F.O.B. point of manufacture. The price does not include any shipping and handling, or any taxes other than John Zink's contributions for unemployment insurance, old age retirement benefits, pensions, and annuities.

The price is based on the following terms of payment:

- 15% of order price due upon issuance of the order
- 50% of order price due upon issuance of general arrangement drawings

- 35% of order price due upon notification of availability for shipment

Payment is required in United States currency. A guaranteed form of payment acceptable to John Zink, such as, corporate or personal guarantees, payment by a confirmed, irrevocable letter of credit, or by three-party check may be required by John Zink.

DELIVERY SCHEDULE

Based on a release to purchase major materials at the time an order is accepted, John Zink offers the following delivery schedule:

- Initial general arrangement drawing submittal: 4-6 weeks after acceptance of the order.
- Completion of fabrication: 10-12 weeks after drawing submittal

An improved schedule may be arranged based on specific project requirements.

Shipping will be via common carrier. Portions of the unit will be shipped loose to reduce shipping costs and damage to the unit.

We look forward to working with you on this project, and if you require any additional information please do not hesitate to contact either Doug Andersen, our local sales representative, at 530.297.7075 or myself at 918.234.2961

Sincerely,

John Zink Company, LLC

Brandy Johnson
Sr. Application Engineer
Biogas Group

ZTOF Performance Summary

Stack Information		Process Information	
Outside Diameter (ft)	4	Fuel Flow Rate (SCFM)	200
Overall Height (ft)	40	Methane %	65
Floor Height (ft)	5	LHV (Btu/SCF)	592.15
Sample Port Height (ft)	38	Heat Release (MMBtu/hr)	7.1
Shell Thickness (in)	0.25	Heat Density (Btu/hr/ft ³)	19,672
Insulation Thickness (in)	2		
Inside Diameter (ft)	3.63		
Cross Sectional Area (ft ²)	10.32		
Volume to Top of Stack (ft ³)	361.2		
Volume to Sample Ports (ft ³)	340.6		

	<i>Temperature (F)</i>				
	1400	1500	1600	1700	1800
Fuel Flow (SCFM)	200	200	200	200	200
Required Air Flow (SCFM)	4,347	3,978	3,659	3,382	3,137
Total Exhaust Flow (SCFM)	4,547	4,178	3,859	3,582	3,337

	<i>Temperature (F)</i>				
	1400	1500	1600	1700	1800
Exhaust Flow (ACFM)	16,264	15,748	15,289	14,878	14,505

	<i>Temperature (F)</i>				
	1400	1500	1600	1700	1800
Furnace ACFS	271	262	255	248	242
Exit Velocity (ft/sec)	26.3	25.4	24.7	24.0	23.4
Retention to Top of Stack (sec)	1.33	1.38	1.42	1.46	1.49
Retention to Sample Ports (sec)	1.26	1.30	1.34	1.37	1.41

	<i>Temperature (F)</i>				
Exit Gas Composition	1400	1500	1600	1700	1800
CO ₂ (lbmol/hr)	31.6	31.6	31.6	31.6	31.6
H ₂ O (lbmol/hr)	50.3	49.5	48.9	48.3	47.8
N ₂ (lbmol/hr)	535.6	490.2	450.9	416.7	386.6
O ₂ (lbmol/hr)	101.3	89.2	78.8	69.7	61.7

	<i>Temperature (F)</i>				
Exit Gas Composition	1400	1500	1600	1700	1800
CO ₂ (Volume %)	4.4%	4.8%	5.2%	5.6%	6.0%
H ₂ O (Volume %)	7.0%	7.5%	8.0%	8.5%	9.1%
N ₂ (Volume %)	74.5%	74.2%	73.9%	73.6%	73.3%
O ₂ (Volume %)	14.1%	13.5%	12.9%	12.3%	11.7%

	<i>Temperature (F)</i>				
	1400	1500	1600	1700	1800
Total Exhaust Flow (DSCFM)	4,229	3,865	3,550	3,276	3,035
Exhaust Flow (DSCFM @ 3% O ₂)	1,829	1,776	1,730	1,690	1,655

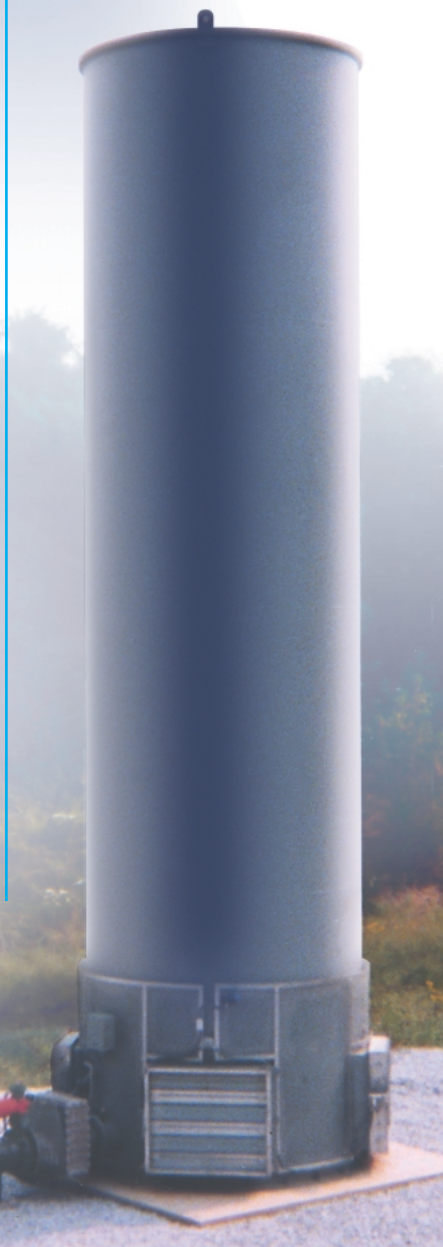
Advanced Flare Systems from the Leader in Flare Technology – John Zink Company.

John Zink Company offers one of the largest, most experienced technical staffs in the industry – more than 100 engineers, many with decades of experience.

With more than 450 biogas flares in operation and hundreds of patents to our name, it's no wonder John Zink Company is the industry leader in advanced biogas flaring systems.

Zink's flare technologies are developed at our world-renowned International Research and Development Test Center, where we offer the industry's most advanced facility with six types of flare-testing stations and capabilities that include emissions-monitoring and remote customer data transfer via the Web.

With engineering representatives, licensees and distributors in more than 60 countries, John Zink Company is everywhere you need us... for technical expertise, parts, service and support.



ZULE™ Zink Ultra Low-Emission Flare

- Lowest achievable NOx in the industry, more than a 75% reduction than standard enclosed flares
- Near-zero CO for operating temperatures as low as 1200°F
- Highest, consistently achievable destruction efficiency in the industry
- Patented design (U.S. Patent 6,231,334)

ZTOF® Enclosed Flare

- Capacities up to 6000 SCFM
- More than 300 units in U.S. operation
- 10:1 or greater turndown without external adjustments
- Greater than 98% destruction efficiency
- Widest operating range without rumbling or vibration
- Optional injection manifolds for inert gases from other equipment
- Turndown kits for new or existing enclosed flares

Condensate Injection

- High-pressure mechanical atomization for less maintenance than air-atomized systems
- Corrosion-resistance options
- Easily removable guns while flare stays in service

Leachate Evaporation

- Patented technology (U.S. Patent 4,838,184)
- Adaptable to existing enclosed flares

ZEF™ Elevated Flare

- Designed in accordance with EPA 40 CFR 60.18
- 40:1 or greater turndown without external adjustments

Fully Skidded Systems and Packages

- Factory-piped and wired to minimize installation and start-up costs
- Flare can be skid-mounted for a truly portable system
- Rental, blower, and condensate skids available

Advanced Biogas Technologies

- Compressor skids for high pressure and low dew-point applications, utilizing landfill gas for power
- Micro-turbine capabilities
- Heat recovery options



Zink Service and Support for the Life of Your System.

The experts at John Zink Company understand that a flare failure can bring your operations to a sudden, expensive halt. That's why Zink® offers an extensive parts inventory and the largest, most technically savvy service teams of its kind to return your flare to service – fast.

- Around-the-clock field service
- Preventative maintenance contracts
- Dedicated parts team
- Remote troubleshooting
- Rental equipment for temporary compliance
- Installation assistance
- Operation and start-up training
- More than 20 service technicians nationwide

Our field technicians are trained in the latest biogas flare technologies to evaluate existing systems for upgrades and retrofits, or to troubleshoot operations.

For more information, call our 24-Hour Parts and Service Hotline at

1-800-755-4252.



World Headquarters
Tulsa, Oklahoma USA
+1-918-234-1800
800-421-9242
Fax: +1-918-234-1968

In Europe
Luxembourg
+352-518991
Fax: +352-518611

In Asia-Pacific
Tokyo, Japan
+81-3-5435-8551
Fax: +81-3-3491-3584



CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

***John Zink Company LLC
Tulsa, Oklahoma, USA***

*has been approved by Lloyd's Register Quality Assurance
to the following Quality Management System Standards:*

ISO 9001:2000

The Quality Management System is applicable to:

***Design, Manufacture and Test of
Combustion and Air Pollution Control Equipment.***

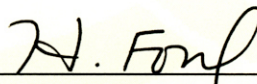
*This certificate is valid only in association with the certificate schedule bearing the same
number on which the locations applicable to this approval are listed.*

Approval
Certificate No: UQA 0113675

Original Approval: August 5, 2004

Current Certificate: August 5, 2004

Certificate Expiry: August 4, 2007



Issued by: LRQA, Inc. Houston



This document is subject to the provision on the reverse

This approval is carried out in accordance with the LRQA assessment and certification procedures and monitored by LRQA.
Further Clarification regarding the scope of this certificate and the applicability of ISO 9001:2000 requirements may be obtained by consulting the organization.
Macro Revision 12

LLOYD'S REGISTER QUALITY ASSURANCE

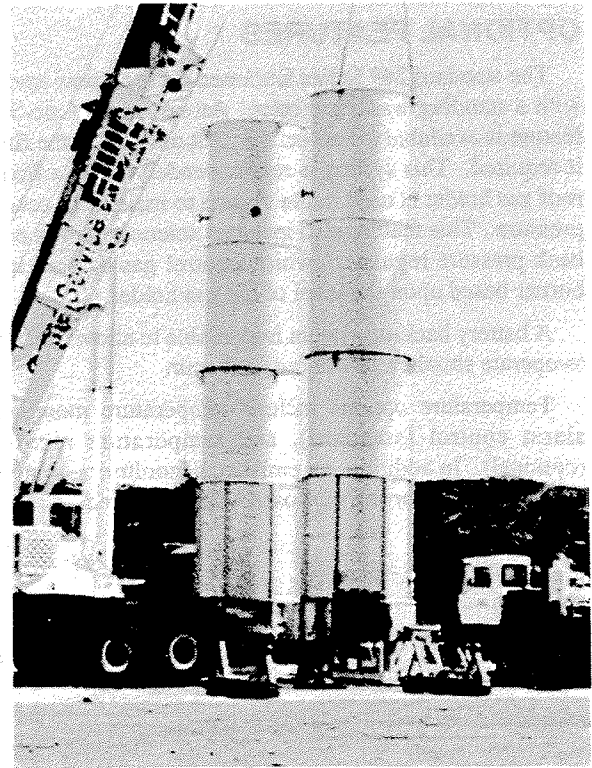
249 SERIES

PDS 249WT

10/94

ENCLOSED FLARE SYSTEM

- Low Operating Pressure
- 99.9% Destruction Efficiency
- Low NO_x Emissions
- High Turn Down Available
- No Visible Flame
- Low Operating Noise Level



INTRODUCTION

The Whessoe Varec 249 Series Enclosed Flare System is designed for burning excess waste gas generated in anaerobic digesters. The Whessoe Varec 249 is specifically designed for low pressure digester gas systems. It is used in areas where flare stack emissions are regulated or where it is desirable to hide the flame from the neighbors view.

OPERATION

An enclosed flare differs from a candle type (244W) flare in a number of ways. Whereas the combustion in a candle type flare takes place in the open atmosphere, the combustion in an enclosed flare takes place inside a combustion chamber or stack. These stacks can be anywhere from 4 to 15 feet in diameter and 30 to 50 feet tall. They can come in round or square configurations. Sizing of the flare is based on gas flow rate and destruction efficiency required.

By controlling the combustion atmosphere, an enclosed flare is capable of greatly improving the destruction efficiency under all operating conditions when compared to a candle type flare. The main factors used in calculating destruction efficiency rate are the retention time, controlled by the height of the stack, and the temperature, which is maintained by controlling the combustion air available. The

combustion air is controlled via a set of motorized shutters at the base of the stack. The modulation shutters, controlled by a thermocouple located near the top of the stack, maintains the desired operating temperatures. In this way, a minimum temperature can be maintained.

FEATURES

The Whessoe Varec 249 Series Enclosed Flare System has a number of unique features that make it ideal for digester gas. It has burners which have been specifically designed for gas with a pressure as low as 4" WC. The unique air mixing design of the burner provides for low NO_x emissions, as much as 50% lower than conventional enclosed flares.

The 249 Series uses a unique manifolding system to provide turn down ratios of 15:1 or higher. The turn down ratio is used to determine the minimum flow rate at which the flare will maintain efficiency standards, compared to the maximum flow rate. A high turn down ratio is important since most plants are designed for a much greater gas flow than they actually experience.

The unit is designed with a dual pilot fuel system. In normal operation the unit will use the waste gas as a pilot. Make-up gas (either LPG or natural gas) will be switched to automatically should the waste gas quality become too

249 SERIES ENCLOSED FLARE SYSTEM

poor to sustain the pilot flame. Whessoe Varec 386 Series Back Pressure Control Valves are supplied as standard to allow the burner to operate only when the pressure in the gas system shows that there is an excess.

OPTIONAL FEATURES

The standard 249 Series Enclosed Flare System operates with a standing waste gas pilot. An optional "Auto-Start" feature is available to turn on the pilot only when the flaring is required. This system is recommended where a floating roof gas holder is used in the system to maintain a constant pressure. This feature also includes solenoid valves on the back pressure regulators which control gas to flow to the burner based upon the level of the gas holder.

A battery back-up system is available to allow the burner to operate should a power outage occur.

Temperature options include temperature monitoring, alarm control (standard), and temperature recording (optional). In addition, an emissions monitoring system is available for reporting purposes where required.

The unit can also be supplied with an aluminum external facing to which artwork or painting may be applied to further enhance the aesthetics of the flare.

CONSTRUCTION

The 249 Series uses 310 stainless steel burners manifolded in the stack. The stack consists of mild steel, with 4 inches of refractory lining secured by stainless steel pins. The stack is coated with two coats of high temperature paint. All piping to the stack is mild steel construction as standard. Other materials are available at the customers request.

DESIGN REQUIREMENTS

Since each enclosed flare application is unique, the 249 Series is engineered specifically for each request. The attached inquiry sheet can be used to provide information to the factory for generation of the quotation and sample specifications.

FEATURE/BENEFITS

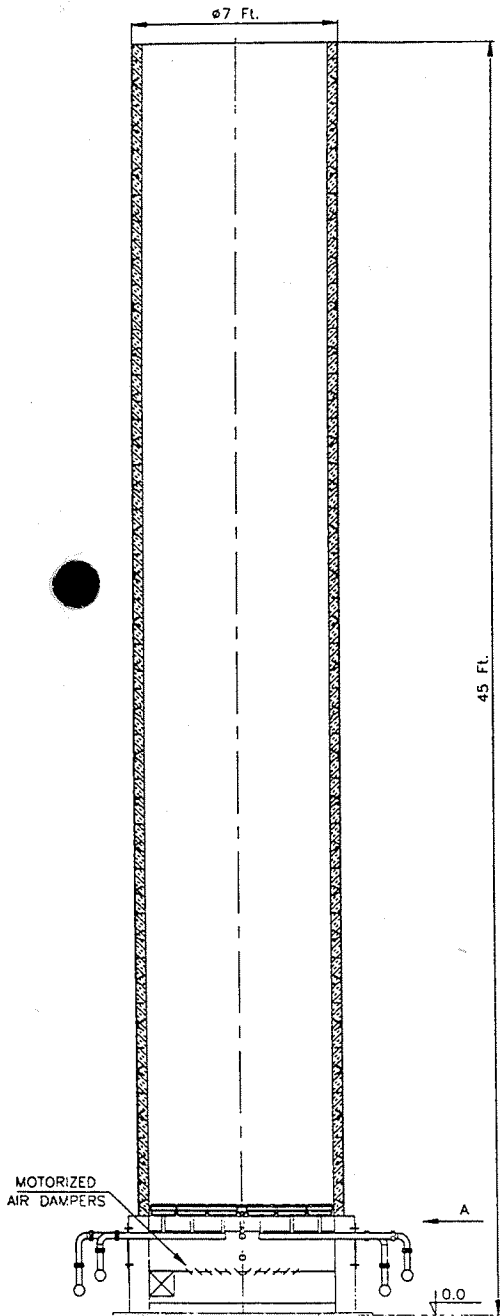
FEATURE

- LOW OPERATING PRESSURE
- 99.9% DESTRUCTION EFFICIENCY WITH LOW NO_x EMISSIONS
- HIGH TURN DOWN RATIO
- NO VISIBLE FLAME
- LOW OPERATING NOISE LEVEL
- ATMOSPHERIC OPERATION

BENEFIT

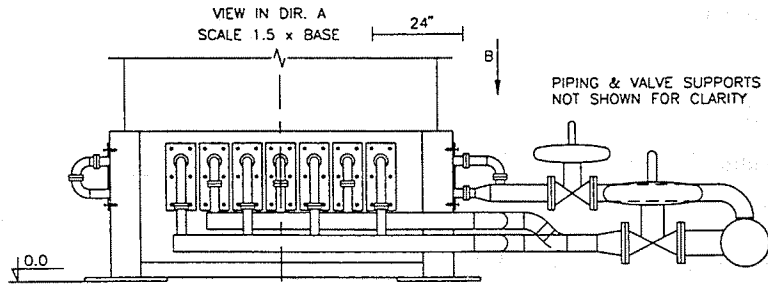
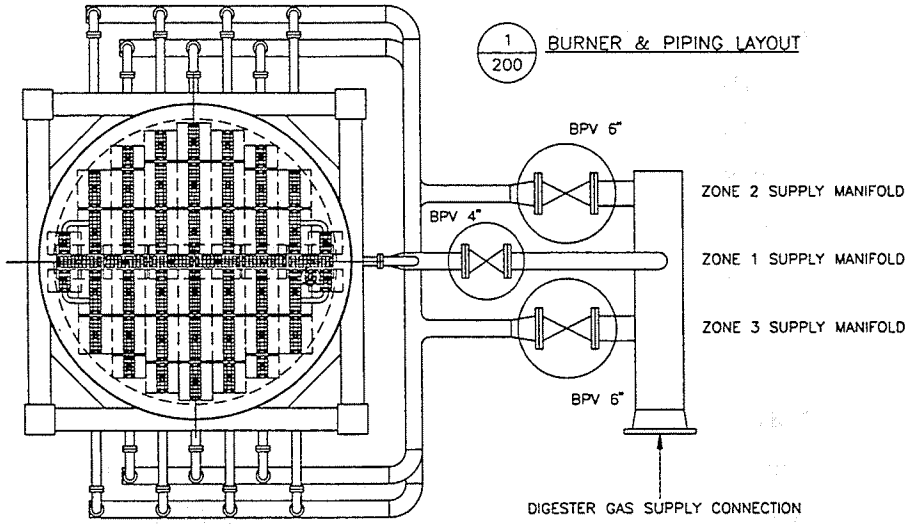
- No gas boosters required
- Meets stringent environmental regulations
- Excellent performance under widely varying operating conditions
- Enhanced aesthetics
- Worker safety enhanced
- No combustion air blowers required

249 SERIES DRAWING



24"

VIEW IN DIR. B
SCALE 1.5 x BASE
PLAN AND COMBUSTION CHAMBER & PIPING LAYOUT



WHESSOE VAREC 249 SERIES ENCLOSED FLARE SYSTEM
INQUIRY SHEET

PROJECT INFORMATION

Customer _____
Project _____
Engineer _____

OPERATING CONDITIONS

Gas Flow Rate Minimum _____ Maximum _____ Average _____
Gas Pressure Minimum _____ Maximum _____ Average _____

GAS COMPOSITION

CH4 _____ %
CO2 _____ %
H2S _____ %
Other _____ %
Other _____ %
Water Saturated Yes _____ No _____

EMISSIONS

Required Destruction _____ % (Standard is 99.9%)
NOx _____ lbs/MMBtu
CO _____ lbs/MMBtu
Ground Level SO2 _____ ppb

CONTROLS

Temperature Monitoring Yes _____ No _____
Temperature Control Yes _____ No _____
Battery Back-up Yes _____ No _____
Emissions Monitoring System Yes _____ No _____



Heighington Lane
Newton Aycliffe
Co Durham
DL5 6XZ
England
Phone: (44) (0325) 301100
Fax: (44) (0325) 300840

Rue de Bitche
62100 Calais
France
Phone: (33) 21 96 49 93
Fax: (33) 21 34 36 12

Representative Office
Henderson Industrial Park
203A Henderson Road
#12-02A
Singapore 0315
Phone: (65) 276-8186
Fax: (65) 276-8187

10800 Valley View Street
Cypress, CA 90630-5016
USA
Phone: (714) 761-1300
Fax: (714) 952-2701

Rancho Las Virgenes
Flare Sizing
Model 249 LC

Case	Max Flow scfm	Min Flow scfm	Turndown	Diameter feet	Height feet	Cost
1	75	No Bid				
2	125					
3	150	50	3:1	4	45.42	\$200,000.00
4	200	50	4:1	4	45.42	\$200,000.00

Varec Waste Gas Burners

1.0 DESCRIPTION AND SCOPE OF SUPPLY

Manufacturer shall supply an enclosed waste gas burner as specified herein, together with all accessories to make the unit complete and operable. The Ground Flare shall be an independent, freestanding, digester gas incinerator, capable of continuous combustion of the gases as outlined in the combustion parameters. The incinerator shall be designed to withstand the thermal shock conditions prevalent in a stand-by application.

The battery limits of the project start at the flange connecting each incinerator to the digester gas collection pipe. The other battery limits are determined as the exhaust to the atmosphere.

2.0 COMBUSTION PARAMETERS

2.1 Gas to be incinerated:
Digester Gas;

Nominal Composition

- Total Polluting Components as H ₂ S:	0.50%
- All combustibles as Methane	63.5%
- CO ₂ :	35.0%
- Water	0.10%
- Specific Gravity(relative to air)	0.89

Maximum Gas Flow Rate:	_____SCFH
Minimum Gas Flow Rate (5:1 Turndown) :	_____SCFH
Gas temperature:	ambient
Relative Humidity:	100%
Minimum Gas Pressure at Flare Manifold:	10 INCH WC @ Peak Flow Rate
Heating Value:	550 - 650 BTU/SCF

2.2 Specifications of Required Performance:	
Required destruction efficiency	99.5%
Maintained process temperature at test ports (at design flow rates)	1600° F
Minimum residence time at test ports	1.0 Seconds
Max. Nox Generation (one hour average)	0.060 lbs/MMBtu input
Max. CO concentration in the flue gas	0.300 lbs/MMBtu
Max. noise level measured at 3 feet from the shell	85 dBA
Max. Heat Flux Ratio (Cross sectional area of the combustion chamber)	1.5 MMBtu/ft ² /hour

3.0 DESIGN PARAMETERS

The incinerator shall consist of three major components; the sub-structure, combustion chamber and the gas distribution manifold. The Incinerator shall be designed for windloading as produced by wind gusts up to 100miles/Hr, shall be free-standing and shall be designed for seismic zone 4 conditions. The Incinerator shall be designed to accommodate modular component replacement.

3.1 Sub-structure

Sub-structure shall include combustion air inlet chamber, burner distribution headers with modular burner system, combustion chamber transition flange, and support members structurally designed to transfer the wind loading and the entire weight of incinerator to the foundation.

3.1.1 Combustion Air Inlet Chamber (Windbox)

The combustion air inlet chamber shall contain parallel blade damper (s), c/w cadmium plated bearings for high temperature operation. The damper shall be sized so that the maximum air velocity through the damper in the fully open position at peak flow conditions, shall not exceed 20 ft/sec.

The damper(s) shall be driven by a Honeywell M9185 damper motor(s) c/w a 4-20mA interface.

The windbox shall be lined with a minimum 2" thick ceramic fiber blanketing, to protect the base structure from the high radiant energy generated by the flame front.

The chamber shall include a minimum of two sealed sight ports, size of which shall not be less than 2" in diameter, to accommodate visual sighting of both the pilot and main burner flame.

3.1.2 Modular Burner System

The unit shall be supplied with a modular burner system to enable removal of burner sections by a single worker without the use of heavy lifting equipment and without entering the flare structure.

The burner manifolds shall be constructed of carbon steel sch.40 pipe. The burners shall be multiple orifice ribbon burners, type BFB or BFBA as manufactured by Nusco Combustion and must be constructed of type 310 stainless steel material.

Note

Burners of the multiple orifice ring and/or single orifice nozzle type are not acceptable.

3.1.3 Combustion Chamber Transition Flange

Shall be located on the top of the sub-structure at an elevation of not more than 6.5 feet above the foundation pad.

3.1.4 Support Members

Shall be constructed of HSS steel , with individual foot plates designed to secure the incinerator to the foundation. Each foot plate shall have a minimum of 4 , 1.25" diameter through holes to accommodate 1" diameter anchor bolts.

3.2 Staged Combustion System.

The distribution manifold system shall consist of either two or three burner zones to provide for staged combustion. Staging of the zones shall insure that the gas leaving the burner orifices will have sufficient energy to entrain adequate primary air for proper burner performance.

One or two of the burner zones shall be equipped with field adjustable back pressure regulators. The back pressure regulators shall be set to open when the pressure in the system indicates that more flare capacity is necessary.

The inlet of the flare shall be supplied with a flame trap assembly and an electrically actuated positive closure emergency shutdown (ESD) valve.

3.2.1 Back Pressure Regulators

Regulator valve shall be controlled by a large spring loaded diaphragm. Regulator shall provide tight shut-off. It shall maintain a back pressure within approximately 10% of the setting. The spring barrel shall include a glass enclosed pointer and scale to indicate setting. A spring adjusting screw shall permit setting adjustments without disassembling the diaphragm housing.

Construction shall be 356-T6 low copper cast aluminum body, diaphragm and spring housings, and diaphragm inner plate. Inner valve shall include low copper aluminum pallet with 304 SS stems and bushings. Diaphragm shall be molded Buna-N rubber with Nylon reinforcement. Setting spring shall be zinc plated steel. Flanges shall be drilled per ASA 125# FF dimensions. Maximum working pressure shall be 5 psig (34.5 kPa). Single port back pressure regulator shall be VAREC 386 Series.

3.2.2 Flame Trap Assembly

Shall be located as close as possible to the flame zone, thus reducing the detonation runnup distance.

Assembly shall include thermal shut-off valve and flame arrester. Unit shall be suitable for installing in horizontal or vertical piping.

Thermal valve shall include a fusible element designed to close the valve within 15 seconds upon reaching 260° F (127° C). Fusible element shall control a spring operated pallet. An isolated sight glass shall be provided so that pallet position can be determined without having to remove the valve from service. Fuse plug shall be gas tight and shall be removable for replacement of the fusible element.

Construction shall be low copper 356-T6 cast aluminum body and cover. Inner valve shall include low copper aluminum pallet assembly with 304 stainless steel compression spring. Sightglass shall be acrylic with neoprene gaskets. Thermal shut-off valve shall be VAREC 430 Series.

Net free area through the bank assembly shall be not less than three times the corresponding size standard pipe. Entire bank assembly shall slide easily out of the arrester housing to facilitate inspection and cleaning. Removing or replacing the bank assembly shall not require support for alignment, jack screw for extending the housing, and shall not place a strain on the connecting piping. Bank frame shall be extensible and shall be filled with corrugated rectangular shaped bank sheets. Sheets shall be arranged for individual removal. Flame arrester for vertical installation shall be self draining. Flame arresters for horizontal service shall include an offset housing with a 1/2" NPT drip trap connection at the low point.

Housing construction shall be 356-T6 low copper cast aluminum. Bank assembly shall include a low copper aluminum frame and low copper aluminum bank sheets. Flame arrester for vertical service shall be VAREC 5000 Series. Flame arrester for horizontal service shall be VAREC 5010 Series.

Thermal shut-off and flame arrester shall be factory assembled as one unit. Flanges shall be drilled to ASA 125# FF dimensions. Assembly shall be leak proof to 5 psig (34.5 kPa). Flame trap assembly shall be VAREC 450 Series.

3.2.3 Electrically Actuated Positive Closure Valve

Valve shall be a hard seated tricentric butterfly ESD valve complete with a fail in position actuator c/w proof of closure switch (POC).

Body	150 ANSI CARBON STEEL WAFER ASTM A 216 Gr WCB w/INTEGRAL SEAT
Disc	ASTM A 351 GR CF8M
Seal	316 STAINLESS STEEL

Actuator shall be a fail in position type supplied with a stand-alone dedicated UPS system. UPS System shall be designed with sufficient life to power the ESD valve to the closed position.

3.2.4 Pilot Gas Manifolds

Two individual pilot manifolds shall be supplied, one for LPG and the other for Digester gas, each c/w downstream hand valves and explosion proof solenoid valves.

The digester pilot line shall incorporate a Varec 5200 series flame check and a standard swing check valve.

The LPG pilot line shall be provided with a pressure regulator c/w integral low capacity relief valve, and a pressure indicating guage c/w isolation valve.

3.3 Combustion Chamber

3.3.1 Combustion Chamber Shell

Shall be constructed of W44 or A36 carbon steel . Stack shall have a minimum wall thickness of 0.250" for stack diameters of 6 feet or less and 0.375" for stack diameters greater than 6 feet. The internal surface of the shell shall be provided with a minimum 1/8" coating of HT Bitumastic for corrosion protection. The shell exterior shall be prepared by abrasive blast cleaning to SSPC-SP 10 standard and painted with two coats of Valspar high heat grey 37-F-4.

The stack shall be provided with a total of four (4) ANSI 150# 4" flanged test ports c/w blinds, located at 90° and 1/2 the internal diameter below the top of the stack.

A stainless steel flue gas sampling tube shall be located adjacent to a test port and extend into the combustion chamber a minimum of 24". This stainless steel sample tube shall be externally routed to near grade level.

The stack shall be flanged for connection to the substructure.

The chamber outlet shall have a internal stainless steel weather ring welded in place for refractory module protection.

The shell shall be provided with a 1 1/2" N.P.T. female connection , suitably located to facilitate installation of an stainless steel NCC IAXP-24 ignitor assembly.

3.3.2 Stack Insulation

The lower ten feet of the combustion chamber (high radiant heat zone) shall be supplied with high density HTA-HDHC silica ceramic fiber modules of 12 pound density.

The remainder of the combustion chamber shall be HTA 10 pound density silica ceramic fiber modules. The top of the modules shall be protected from rain by a 304 SS moisture guard.

Castable insulation or multi layered blanket construction with exposed anchoring pins are not acceptable in the combustion chamber.

3.4 Temperature Control System

Exit gas temperature measurement shall be provided by a duplex type K, ceramic protection tube thermocouple located adjacent to a test port. One thermocouple shall be wired to a temperature controller which will operate the modulating air dampers to maintain the temperature within the normal design parameters.

Temperature controller shall be Honeywell UDC 2000 , PIDA c/w current output and alarm contacts.

The second thermocouple, shall be wired to a terminal designation in the local control panel to act as a spare or calibration unit.

3.5 Certified Flame Supervision System

The certified flame supervision system shall be Eclipse, Honeywell, Fireye, or equivalent UL508 listed Flame Safeguard (FSG). The system shall come complete with a self-checking ultra violet flame scanner for sensing pilot and main flame.

3.6 Main Flame Monitoring

Monitoring of main flame shall be provided by a secondary flame monitor which shall sight only the main burner flame.

3.7 Control Panel Scope Of Supply

3.7.1 Enclosure

Enclosure shall be NEMA 4X stainless steel.

3.7.2 Pilot Lamps	<u>Color</u>
Power On	green
Burner System Enabled	green
Pilot Gas On	green
Ignition On (TFI)	amber
Main Flame Enabled	green
Main Flame On	green
High Temperature Alarm	red
Low Temperature Alarm	red
Flame Failure	red

3.7.3 Switches

Power On-Off
System Start
Pilot Selection LPG/Digestor
System Hand/Auto
Control Reset
Lamp Test

3.7.4 Voltage Free Status Contacts

Burner Enabled
Digester Pilot Gas On
LPG Pilot Gas On
Ignition On
Main Flame Enabled
Main Flame On

3.7.5 Voltage Free Alarm Contacts

High Temperature Alarm
Low Temperature Alarm
Flame Failure Alarm
UPS Failure Alarm

3.7.6 UPS System

The control panel shall be provided with a dedicated UPS, (separate from the ESD valve dedicated UPS), to provide power for the flame supervision and maintain control functions for a minimum of 15 minutes.

3.7.7 Indicating Lamps & Switches

Allen Bradley 800T or equivalent, NEMA Type 4/13, Watertight/Oiltight

4.0 THEORY OF OPERATION

4.1. When the “Hands -Auto (H..A.)” selector switch is in the “Auto” position, and upon receiving a permissive to start the flare, a start relay is energized.

4.2. The pilot gas selector switch will be in the either the LPG or Digester gas position.

4.3. On demand, a Trial for Ignition (TFI) will be started. During the TFI the selected pilot solenoid valve is opened and the ignition transformer is energized creating a spark at the pilot burner, at the same time the selected pilot supply valve, LPG or Digester gas opens.

4.4. The pilot is ignited and proved by the U.V. scanner. The TFI will be controlled by the flame safeguard (FSG). The TFI will last for 10 seconds. When the pilot is verified the ignition transformer is de energized.

4.5. The U.V. scanner will continue to sight and verify the pilot flame within the combustion chamber.

4.6. Should the UV fail to verify flame , a “Flame Failure” alarm will be enunciated and the flare main burners and pilot will shut down.

4.7. The inlet ESD valve will fail closed in the event of a “Flame Failure”.

4.8. In the event of a high temperature alarm condition , only the main ESD valve will close, the pilot will remain on.

4.9. Once the flame proven conditions have been satisfied the flare will be in a standby position and the ESD inlet valve will be permitted to open. The operation permissive may now open the ESD valve. From this point on the ESD functions as an on /off control valve for the main burner zones without the interruption of the standing pilot.

4.10. When the Control valve opens and gas is delivered to the burner manifold the combustion air dampers are in the open position and a three minute time delay bypassing the “Low Temperature” alarm will be in effect.

4.11. The temperature will increase in the combustion chamber during this time delay and the combustion air dampers will modulate closed or open to maintain the temperature setpoint for the ground flare.

4.12. Once the normal gas flows to the flare have been established the combustion air dampers will continue to modulate the excess cooling air to maintain normal operating conditions. If the volume of gas available or the specific heat of the gas enriches or diminishes, the temperature controller will react and modulate the dampers as required.

4.13. Once the low temperature alarm time delay has timed out and provided the flare is within the normal operating temperature range, no alarms will be enunciated.

4.14. Should the exit temperature of the flare decrease to 650° C the “Low Temperature Alarm” will be activated.

4.15. If the temperature increases to 1095°C, a “High Temperature Alarm” will be enunciated.



Corporate Headquarters:
LFG Specialties LLC
16406 US Route 224 E
Findlay, OH 45840-9761
Main: 419-424-4999
Fax: 419-424-4991

**BIOGAS ENCLOSED GROUND FLARE SYSTEM
MODEL EF420I4 or EF520I4**

LFG SPECIALTIES PROPOSAL NO. 020512

Date: February 11, 2005

**PRESENTED TO:
CH2M Hill
2525 Airpark Dr.
Redding, CA 96073
(530)229-3372**

**PRESENTED BY:
Robert Segovia, Applications Engineer
16406 US Route 224 E
Findlay, OH 45840
(419)425-6034**

**PROJECT REFERENCE:
Las Virgenes
Calabasas, CA**

EQUIPMENT QUOTE

LFG Specialties hereby proposes to furnish the Equipment and Services as described in this Proposal No. 020512 per the following and subject to the standard "Terms and Conditions of Sales" attached:

A. Equipment Scope:

LFG Specialties scope of equipment supply and brief description of the system is listed below. For a more detailed system description please see the attached technical specification.

1. One LFG Specialties enclosed flare system including:
 - One flare Model **EF42014** with peripheral equipment (capacity 21-125 SCFM of biogas at 0.788 – 4.725 MMBtu/hr)
 - One 4 in. Shand & Jurs Model 94307 flame arrestor
 - One 4 in. automatic electric header valve
 - One natural gas intermittent pilot assembly with automatic igniter system
 - Flame-Trol automatic flare controller
 - Three copies of O&M Manual, cut sheets, and drawings

2. One LFG Specialties enclosed flare system including:
 - One flare Model **EF52014** with peripheral equipment (capacity 34-200 SCFM of biogas at 1.26 – 7.56 MMBtu/hr)
 - One 4 in. Shand & Jurs Model 94307 flame arrestor
 - One 4 in. automatic electric header valve
 - One natural gas intermittent pilot assembly with automatic igniter system
 - Flame-Trol automatic flare controller
 - Three copies of O&M Manual, cut sheets, and drawings

B. Price Schedule

Price for the LFG Specialties Model EF42014 Enclosed Ground Flare System as described in Section A, item 1 FOB Findlay, OH, excluding tax, is **\$ 56,950.00**

Price for the LFG Specialties Model EF52014 Enclosed Ground Flare System as described in Section A, item 2 FOB Findlay, OH, excluding tax, is **\$ 61,550.00**

Three days of start-up assistance and training (travel and living expenses are included) **\$ 3,450.00**

*NOTE: Should the system not be commissioned by LFG Specialties, the warranty will be void.

Estimated shipping and handling from LFG Specialties shop to site (shipping to be charged at actual cost plus 15% handling fee) **\$ 6,900.00**

ALL PRICING IS FOB — FINDLAY, OHIO

Options:

1. Two days of on-site assistance during the stack test (travel and living expenses are included)

PRICE ADDER: \$ 5,850.00

2. One Raco Guard-It four channel Autodialer

PRICE ADDER: \$ 1,600.00

C. Delivery Schedule

LFG Specialties makes every effort to meet our Customers delivery requests and special requirements. Delivery for the flare system outlined in this Proposal No. 020512 is:

Submittal Drawings: 2 weeks after receipt of order for submittal drawings
Equipment Delivery: 6 to 10 weeks from receipt of approval for submittal drawings
* Actual delivery to be determined at time of submittal approval.

A storage fee of \$200.00 per week may be charged if the site cannot accept delivery of the unit by the scheduled delivery date.

D. Payment Terms:

Terms of payment to be 100% net due 30 days from date of invoice. Invoices will be issued on a progress basis according to the following schedule:

<u>Milestone</u>	<u>Amount</u>
Due Upon Submittal Approval	40% (invoiced at project setup)
Due Upon Shipment	50% (will invoice units scheduled to ship in current month)
Due Upon Startup Completion	10% (invoiced after technician provides service work order)

Prices are quoted firm for prompt acceptance and shipment per delivery schedule. Proposals are valid for 45 days from date of issue.

Prices do not include any taxes, duties or assessments.

E. Field Service Rates and Availability

LFG Specialties will furnish an on site advisor during any aspect of the installation or startup of our equipment deemed necessary by our customers in accordance with our standard "Terms and conditions of Sales". LFG Specialties recommends 3 days of start up assistance and training for enclosed flares. Additional field service time will be charged \$1,000.00 per day for field service engineers, plus travel expenses. Travel expenses to be charged at \$1.50/mile.

Service personnel should be scheduled two weeks in advance for standard installation start-up or service work. The Flare Installation sign off sheets must be signed and returned prior to the startup/service work being performed. Service personnel are available on an on call service for \$1,200.00/day plus \$1.50/mile and also 48 hour emergency service for \$1,500.00/day plus \$1.50/mile.

F. Equipment Warranty:

LFG Specialties guarantees the Equipment as outlined and specified in this Proposal No. 020512 for the period of eighteen (18) months from date of shipment or twelve (12) months from date of start-up, whichever occurs first.

Along with standard Material, Workmanship and Performance Warranties outlined in the standard "Terms and Conditions of Sales" attached, LFG Specialties guarantees the equipment to meet present E.P.A. emission standards when installed and operated in accordance with specified design conditions.

G. Quality Control Standards

LFG Specialties follows the Quality Control Procedures as outlined by the applicable national codes and standards adhered to in the design, engineering, manufacture, assembly and test of our equipment, including but not limited to:

Structural Design	-----	AISC
Drawings	-----	ANSI S5.1
Fabrication (welding)	-----	AWS
Electrical (components)	-----	UL
(wiring)	-----	NEC
Painting, Sandblast	-----	SSPL, SP-6

LFG Specialties does on occasion subcontract fabrication of subassemblies for our equipment. All subcontract work is carried out under LFG Specialties direction and inspected in accordance with our quality control standards.

The nondestructive testing of our equipment includes:

Welding	-----	100% visual inspection
Dimensional	-----	All dimensions to drawings, correct position and sizing of all connects
Piping	-----	100% visual inspection (in/out)
Painting	-----	Visual inspection/instrument check using microtest coating thickness gauge
Wiring	-----	Functional Check
Controls	-----	Functional check, process simulation

LFG Specialties also supplies full submittal documentation on the equipment; including mechanical and electrical drawings and component cut sheets. For equipment support, a complete Operation & Maintenance Manual is included with each unit.

H. Scope of Work:

LFG Specialties will furnish all the Equipment and Services as outlined in this Proposal No. 020512. Equipment will be fully fabricated, painted and tested as described in proposal at LFG Specialties facility, Findlay, Ohio.

Any material/instrumentation that may be damaged in shipment will be removed, tagged and boxed separately for shipment and re-assembly in field.

This proposal only covers the supply of Equipment and installation advisory service as defined. The following items are not included or should be constructed to be included in LFG Specialties scope of supply.

- Construction drawings. LFG Specialties drawings will outline field installation connections (location and size), foundation bolt layouts and loading data. All equipment layout, interconnect details and foundations are the responsibilities of Customer or Customer's Representatives.
- All installation and civil work including foundations, equipment erection, main and interconnecting piping and wiring including required equipment and materials are the responsibilities of Customer or Customer's Representatives.

- All permits/licenses required for installation and/or operation of the Equipment are the responsibility of Customer or Customer's Representatives. LFG Specialties will provide necessary manufacturers data on the equipment as required for permit/license applications.
- Compliance testing - All compliance/performance testing will be the responsibility of the Customer. LFG Specialties will have representative/s present for tests at Customer's request and expense. LFG Specialties fully guarantees the Equipment to meet E.P.A. emission standards when operated within the specified conditions.

LFG SPECIALTIES, L.L.C.

TERMS AND CONDITIONS OF SALES

DEFINITIONS: Within these "Terms and Conditions of Sales" the term "Seller" shall mean LFG Specialties, L.L.C. The term "Purchaser" shall mean the person, municipality, firm, or corporation to whom this quotation is addressed. The term "Equipment" means those articles, materials, supplies, drawings, data, or other property or services described herein.

WARRANTIES

A. "Material and Workmanship Warranty": LFG Specialties, L.L.C., the "Seller" warrants to the Purchaser that the Equipment of its own manufacture will be complete in all its parts, and for the Warranty Period specified, will under proper application and operation be free from defects in material or workmanship. The Seller warranty obligation shall be limited to the following:

- 1) Replacement or repair of any Equipment or parts which under normal and proper operating conditions are found and confirmed defective and are returned to the Seller's works within the Warranty Period, transportation charges prepaid.
- 2) Notwithstanding the above, the Seller shall have no obligation as a result of improper storage, installation, repairs or modifications not made by Seller, or as a result of removal, improper use or misapplication of the Equipment after it has been delivered to the Purchaser.
- 3) Purchaser shall be responsible for freight charges in connection with the return or replacement of any defective Equipment or parts.

B. "Performance Warranty": The Seller warrants that the Equipment of its own manufacture, when shipped and/or installed, will operate within any performance characteristics which are expressly specified herein as a performance guarantee. Any performance characteristics indicated herein, which are not expressly stated as guarantees, are expected "but not guaranteed". Should Purchaser be required or desire to conduct a field compliance/performance test to verify any performance guarantee, such test will be conducted by Purchaser, at his expense. Seller may be requested to have a representative/s present to witness such test in which case Purchaser shall reimburse Seller for the time and expense of such representatives at the Seller's service rates then in effect at the time of the test. Purchaser shall give Seller fifteen (15) days written notice prior to the date Purchaser intends to commence such test.

C. "Warranty as to Equipment not made by Seller": Equipment, parts and accessories made by other manufacturers and supplied hereunder by the Seller are warranted only to the extent of the original manufacturer's warranty to the Seller.

D. "Except as outlined herein, and to Title, it is expressly agreed":

- 1) "THAT THERE IS NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, NOR OTHER WARRANTY, EXPRESS, IMPLIED, OR STATUTORY, NOR ANY AFFIRMATION OF FACT, OR PROMISE BY THE SELLER WITH REFERENCE TO THE EQUIPMENT OR PARTS THEREOF, OR OTHERWISE, WHICH EXTENDS BEYOND THE DESCRIPTION OF THE EQUIPMENT AS SET FORTH HEREIN, AND
- 2) that the Purchaser acknowledges that it is purchasing the Equipment solely on the basis of the commitments of the Seller expressly set forth herein."
- 3) That the Seller shall have the sole and exclusive right to determine and confirm if warranties apply, and that in no event shall Seller's liability exceed the purchase price of the Equipment, less a reasonable charge for any utilization by Purchaser.

INSTALLATION AND ERECTION

The Equipment shall be transported, installed on a foundation, and connected at the Purchaser's expense, unless otherwise expressly agreed herein. Upon request of Purchaser, Seller will furnish a field service representative to assist Purchaser during the installation, erection and start up of the Equipment and instruction of its personnel, for which the Purchaser shall pay the then-current published rates per day plus actual living and traveling expenses. A day shall mean any one eight (8) consecutive hour shift, or part thereof.

Purchaser shall pay one and one-half times the current hourly rate for any time in excess of eight (8) hours per day and for the first (12) hours worked on Saturdays and double the current hourly rate for Sundays, locally observed holidays, and any time working in excess of (12) hours per day. Travel, working and standby time and travel and living expenses shall be charged from the time the Seller's representative leaves his home base or other equivalent starting point until his return thereto.

The field service representative furnished by Seller will be qualified to assist in the installation, erection and start up of the Equipment, but it is understood and agreed that, should Purchaser utilize the field service representative in any manner as a foreman, supervisor, etc., that said representative shall become for that purpose, the Purchaser's employee, for whom Purchaser shall be liable, shall maintain adequate insurance coverage and shall hold harmless and indemnify Seller from and against any and all claims arising out of said representative's acts or omissions while serving in such capacity.

DAMAGES

In no event shall the Seller be liable for special, consequential or incidental damages, nor for loss of anticipated profits nor for loss of use of the equipment or of any installation, system, operation or services into which the equipment or parts may be put, or with respect to which any service may be performed by Seller. This limitation on the Seller's liability shall apply to any liability for default under or in connection with the equipment, parts or services delivered hereunder, whether based on negligence, warranty, failure of or delay in delivery or otherwise.

CANCELLATION

Order shall not be subject to cancellation or modification, either in whole or in part, without the Seller's consent, and then only under terms that will reimburse the Seller for all applicable costs incurred, including but not limited, to costs of purchased materials, engineering and labor expenses, and a reasonable allowance for profit.

TITLES AND REMEDIES

Until full payment of all obligation by the Purchaser, the Seller reserves the title to all Equipment furnished hereunder. If the Purchaser defaults in payment or performance or becomes subject to insolvency, receivership, or bankruptcy proceedings or makes any assignment for the benefit of creditors, or without the consent of the Seller voluntarily or involuntarily sells, transfers, leases or permits any lien or attachment on the Equipment delivered hereunder, the Seller may treat all amounts then or thereafter owed by the Purchaser to be immediately due and payable and the Seller may repossess and Equipment by any means available under law.

CONFIDENTIALITY

All proposals, drawings, design data and technical information developed and/or provided by the Seller shall be considered "Confidential" and the sole property of the Seller. All such information disclosed to the Purchaser shall not be reproduced in whole, or in part, or used to furnish information to others, without the written permission of the Seller.

PURCHASER'S DRAWINGS AND SPECIFICATIONS

Seller is furnishing only the Equipment specified herein and does not assume any responsibility for other equipment and material not being supplied by Seller, nor the effect thereof on the overall operation of the system of which the Equipment is a part. Accordingly, any comments from the Seller regarding Purchaser's drawings are responsive only and Seller shall not be liable therefor.

SELLER'S DRAWINGS AND ENGINEERING DATA

Prints of Seller's and data representing the Seller's application of the purchased equipment to the requirement of the contract will be submitted for approval. Upon the return of such prints, within ten (10) working days, the requested changes, if any, will be made to correct misinterpretations. Certified prints of Seller's drawings will then be furnished. Any Purchaser-requested changes thereafter will be subject to added cost and delivery considerations.

DESIGN CHANGES

While the Seller reserves the right where possible, to include changes in design or material which are improvements, it cannot be responsible for including improvements, effected after beginning of production on Equipment. Design changes suggested by Purchaser after beginning of production shall require Seller's agreement, including agreements as to price and shipping schedules.

MISCELLANEOUS

- A. "Applicable Law" The definition of terms used, interpretation of this Agreement and rights of parties hereto shall be construed under and governed by the Uniform Commercial Code of the State of Ohio.
- B. "Acceptance" If this proposal constitutes an acceptance of an offer, such acceptance is expressly made conditional on Purchaser's assent solely to the terms of this proposal, and acceptance of any part of the Equipment or services covered hereunder shall be deemed to constitute such assent.
- C. This proposal is subject to change or prior sale of Equipment until accepted as an order by an officer of the Seller.

ACCEPTED BY:

BUYER:

SELLER:

LFG Specialties, L.L.C.
16406 US Route 224 East
Findlay, OH 45840-9761

By: _____
Date: _____

By: _____
Date: _____

Name Title

Name Title