Appendix 1

Emission Calculations and Vendor Supplied Equipment Information

Grain Handling Calculations
Renova Ethanol Plant
Heyburn, Idaho

Grain Receiving #1 (ES-1)

Grain Throughput (PW) =	237,965 ton/yr	
	54,330 lb/hr	
Baghouse #1 (C-1)		
Particulate Input =	7439.981 lb/hr	(engineering estimate from process design firm)
Emissions =	0.74 lb/hr	0.094 g/s
Control Efficiency =	99.99%	
Process Weight Rule		
Allowable emissions (E) =	16.79 lb/hr	E = 1.1 x PW^0.25 (from IDAPA 58.01.01.701.01(b))
Pass?	yes	E (16.05 lb/hr) > emissions (0.62 lb/hr)

Grain Receiving #2 (ES-2)

Grain Throughput (PW) =	237,965 ton/yr	
	54,330 lb/hr	
Baghouse #3 (C-2)		
Particulate Input =	1799.995 lb/hr	(engineering estimate from process design firm)
Emissions =	0.18 lb/hr	0.023 g/s
Control Efficiency =	99.99%	
Process Weight Rule		
Allowable emissions (E) =	16.79 lb/hr	E = 1.1 x PW^0.25 (from IDAPA 58.01.01.701.01(b))
Pass?	yes	E (16.05 lb/hr) > emissions (0.62 lb/hr)

Grain Milling and Cleaning (ES-3)

Grain Throughput (PW) =	237,965 ton/yr	
	54,330 lb/hr	
Baghouse #3 (C-3)		
Particulate Input =	479.9988 lb/hr	(engineering estimate from process design firm)
Emissions =	0.048 lb/hr	0.0060 g/s
Control Efficiency =	99.99%	
Process Weight Rule		
Allowable emissions (E) =	16.79 lb/hr	E = 1.1 x PW^0.25 (from IDAPA 58.01.01.701.01(b))
Pass?	yes	E (16.05 lb/hr) > emissions (0.62 lb/hr)

Biogas Fuel Calculations
Renova Energy
Heyburn Ethanol Plant

Biogas Fuel Information

Peak Daily Biogas Flow Rate (MMscf/day)	3.7151	
Peak Biogas Flow Rate (scfm)	2,580	
Average Biogas Methane Content (%v)[1]	60%	
Methane Molecular Weight (lb/mol)	16.0	
Methane Density (lb/ft^3)	0.0415	
"Natural Gas Equivalency" Flow Rate (scfm)[2]	1,548	
Biogas H_2S Content After Scrubber (%v)[1]	0.070%	
H_2S Molecular Weight (lb/mol)	34.1	
H_2S Density (lb/ft^3)	0.0885	
SO_2 Molecular Weight (lb/mol)	64.1	
Average Biogas Density (lb/ft^3)[1]	0.0760	
Natural Gas Heating Value (BTU/ft^3)	1,020	
Average Biogas Heat Content (BTU/ft^3)	612	
Max Daily Fuel Capacity (MMBTU/day)	2,274	
Max Biogas H_2S Content (lb/day)	230	
Biogas H_2S Emission Factor (lb/MMBTU)	0.0020	(assumes 98% destruction of H_2S by combust)
Max SO_2 Emission Rate (lb/day)	433	(assumes 100% conversion of H_2S to SO_2)
Biogas SO_2 Emission Factor (lb/MMBTU)	0.1903	

Miscellaneous Support Data

Pressure at Standard Conditions (atm)	1
Temperature at Standard Conditions (K)	293
Ideal Gas Constant (atm-ft^3/mol-K)	1.314
Heyburn Barometric Pressure (atm)	0.86

Notes:
(1) Biogas characteristics are averages of values provided by Mike McDermaid, ADI Systems, Inc.
(2) "Natural Gas Equivalency" calculated by multiplying Peak Biogas Flowrate by the Average Methane Conten

Air Pollutant Emissions
Biogas Combustion (Limited)
Boiler (ES-4)

Combustion Source Characteristics

Boiler Manufacturer	Superior Boilerworks
Burner Model	Webser HDR-RF-G-92.0-1500
Input Heat Capacity (MMBTU/hr)	73.65
Fuel	Biogas
Heating Value (BTU/scf)	612
Max Hourly Biogas Fuel Consumption (scf/hr)	120,335
Max Hourly Natural Gas Equivalent (scf/hr)	72,201
Unlimited Annual Biogas Fuel Consumption (scf/yr)	1,054,134,314
Limited Annual Biogas Fuel Consumption (scf/yr)	980,344,912

Stack Data

Stack Height (ft)	80.0
Stack Diameter (ft)	4.17
Exit Gas Temperature (°F)	425
Wet Actual Flow Rate (acfm)	25,359
Wet Standard Flow Rate (wscfm)	13,023
Dry Standard Flow Rate (dscfm)	10,691
Grain Loading Flow Rate (dscfm)	14,502
Stack Velocity (m/s)	9.44
Fd (dscf stack gas/BTU)	0.00871
Fw (wscf stack gas/BTU)	0.01061

Miscellaneous Support Data

Pressure at Standard Conditions (atm)	1
Temperature at Standard Conditions (K)	293
Ideal Gas Constant (atm-ft^3/mol-K)	1.314
Heyburn Barometric Pressure (atm)	0.86

Criteria Pollutants

Pollutant	Emission Factor[a]	Emission Factor Unit [d]	Potential Emissions (lb/hr)	Limited Potential Emissions (TPY)[c]	Potential Emissions (g/s)
PM_{10} (assume = PM)	7.6	lb/10^6 scf NG	0.549	2.24	0.069
SO_2	1.90E-01	lb/MMBTU	14.0	57.10	1.766
NO_x	0.0105556	lb/MMBTU	0.777	3.17	0.098
CO	0.0212963	lb/MMBTU	1.568	6.39	0.198
VOC	5.5	lb/10^6 scf NG	0.662	2.70	0.083
Lead	0.0005	lb/10^6 scf NG	6.02E-05	0.00	7.58E-06

Non-Criteria Pollutants with Significant Threshold

Pollutant	Emission Factor[a]	Emission Factor Unit	Potential Emissions (lb/hr)	Potential Emissions (TPY)[c]	Potential Emissions (g/s)
H_2S	2.03E-03	lb/MMBTU	1.49E-01	0.61	1.88E-02

PM Grain Loading Standard[b]

Pollutant	Potential Emissions (lb/hr)	Grain Load @ 3% Oxygen (gr/dscf)	PM Grain Standard[b] (gr/dscf)	Meets Standard?
PM	0.549	0.004	0.015	yes

Notes:

(a) Emission factors for CO and NOx supplied by the vendor (Perennial Engergy). Emission factors for PM10, VOC, and lead from AP-42 Chapter 1.4, "Natural Gas Combustion". Emission factors for SO_2 and H_2S calculated based on biogas H_2S content of 700 ppm_v, to provide a worst-case analysis 98% H_2S destruction was assumed for the H_2S emission calculations but 100% H_2S conversion was assumed for SO_2 calculations).

(b) IDAPA 58.01.01.677

(c) Annual potential emissions (TPY) estimated considering limited biogas consumption.

(d) Emission factors with units of "lb/10^6 scf" were used with the equivalent natural gas volume (not the actual biogas volume).

Air Pollutant Emissions
Natural Gas Combustion (Limited)
Boiler (ES-4)

Combustion Source Characteristics

Boiler Manufacturer	Superior Boilerworks
Burner Model	Webser HDR-RF-G-92.0-1500
Input Heat Capacity (MMBTU/hr)	73.65
Fuel	Natural Gas
Heating Value (BTU/scf)	1,020
Max Hourly Fuel Consumption (scf/hr)	72,201
Unlimited Annual Fuel Consumption (scf/yr)	632,480,588
Limited Annual Fuel Consumption (scf/yr) [c]	31,624,029

Miscellaneous Support Data

Pressure at Standard Conditions (atm)	1
Temperature at Standard Conditions (K)	293
Ideal Gas Constant (atm-ft^3/mol-K)	1.314
Heyburn Barometric Pressure (atm)	0.86

Stack Data

Stack Height (ft)	80.0
Stack Diameter (ft)	4.17
Exit Gas Temperature (°F)	425
Wet Actual Flow Rate (acfm)	25,359
Wet Standard Flow Rate (wscfm)	13,023
Dry Standard Flow Rate (dscfm)	10,691
Grain Loading Flow Rate (dscfm)	14,502
Stack Velocity (m/s)	9.44
Fd (dscf stack gas/BTU)	0.00871
Fw (wscf stack gas/BTU)	0.01061

Criteria Pollutants

Pollutant	Emission Factor[a]	Emission Factor Unit	Potential Emissions (lb/hr)	Potential Emissions (TPY)	Potential Emissions (g/s)
PM_{10} (assume = PM)	7.6	lb/10^6 scf	0.549	0.12	0.069
SO_2	0.6	lb/10^6 scf	0.0	0.01	0.005
NO_x	0.0972222	lb/MMBTU	7.160	1.57	0.902
CO	0.0214815	lb/MMBTU	1.582	0.35	0.199
VOC	5.5	lb/10^6 scf	0.397	0.09	0.050
Lead	0.0005	lb/10^6 scf	3.61E-05	0.00	4.55E-06

PM Grain Loading Standard[b]

Pollutant	Potential Emissions (lb/hr)	Grain Load @ 3% Oxygen (gr/dscf)	PM Grain Standard[b] (gr/dscf)	Meets Standard?
PM	0.549	0.004	0.015	yes

Notes:

(a) Emission factors for CO and NOx supplied by the vendor (Perennial Engergy). Emission factors for PM10, VOC, and lead from AP-42 Chapter 1.4, "Natural Gas Combustion". Emission factors for SO_2 and H_2S calculated based on biogas H_2S content of 700 ppm_v, to provide a worst-case analysis 98% H_2S destruction was assumed for the H_2S emission calculations but 100% H_2S conversion was assumed for SO_2 calculations).

(b) IDAPA 58.01.01.677

(c) Annual potential emissions (TPY) estimated considering limited natural gas consumption. Assumed natural gas operation 5% annually.

Example Calculations – Boiler Emission Estimates

1. Wet Standard Stack Flow Rate = (Q_{ws}) = (Fw) (Input Heat Capacity of Boiler)

$$F_{w(Natural\,Gas)} = 0.01061\,wscf\ stack\ gas\,/\,BTU \quad (40\,CFR\,60, App\,A, Meth.19, Table\,19-1)$$

For Superior Boiler:

$$Q_{ws} = (0.01061\,wscf\ stack\ gas\,/\,BTU)\left(73{,}650{,}000\frac{BTU}{hr}\right)\left(\frac{1hr}{60\min}\right) = 13{,}023 \text{ wscf/min}$$

2. Dry Standard Stack Flow Rate = (Q_{ds}) = (F_d) (Input Heat Capacity of Boiler)

$$F_d = (0.00871\,dscf\,/\,BTU) \quad (40\,CFR, App\,A, Meth19, Table\,19-1)$$

For Superior Boiler:

$$Q_{ds} = (0.00871\ dscf\,/\,BTU)\left(73{,}650{,}000\frac{BTU}{hr}\right)\left(\frac{1hr}{60\min}\right) = 10{,}691 \text{ dscf/min}$$

3. Dry Standard Stack Flow Rate Corrected

for 3% O_2 and Altitude = $(Q_{ds,O_2,AL}) = (Q_{ds})\left(\frac{20.9}{20.9-3}\right)\left(\frac{P_S}{P_A}\right)$

P_S = Standard Barometric Pressure = 760 mm Hg
P_A = Actual Barometric Pressure = 653.6 mm Hg (approximate barometric pressure for Heyburn, ID)

For Superior Boiler:

$$Q_{ds,O_2,AL} = (10{,}691\,dscf\,/\min)\left(\frac{20.9}{20.9-3}\right)\left(\frac{760\,mm\,Hg}{653.6\,mm\,Hg}\right) = 14{,}502 \text{ dscf/min}$$

4. Wet Actual Stack Flow Rate = (Q_{wa}) = $(Q_{ws})\left(\frac{P_S}{P_A}\right)\left(\frac{T_A}{T_S}\right)$

T_S=Standard Temperature= 273.15 K
T_A=Actual Temperature= 491.48 K (Superior Boiler stack gas)

For Superior Boiler:

$$Q_{wa} = (13{,}023\,wscf\,/\min)\left(\frac{760\,mm\,Hg}{653.6\,mm\,Hg}\right)\left(\frac{491.48K}{293.15K}\right) = 25{,}359 \text{ wscf/min}$$

5. Volume Fuel Combusted = (V_c) = (Product Consumption Rate)(Hours of Operation)

For Superior Boiler:

$$V_C = \left(30{,}768\,\frac{scf}{hr}\right)(8{,}760\ hour) = 269.5\ x10^6\ scf\ (assumes\ natural\ gas\ only\ fuel\ combusted)$$

6. Potential Emissions

Potential Emission Rate of Contaminant = (M_x) = (EF)(fuel consumption rate)
Fuel consumption rate for biogas converted to natural gas equivalency for use with natural gas emission factors.
EF = Emission Factor, provided by equipment vendor or from AP-42.
Annual potential to emit incorporates limitations on fuel biogas fuel combustion.

For Superior Boiler:

$$M_{PM_{10}} = \left(7.6\,\frac{lb}{10^6\,scf}\right)\left(72{,}201\,\frac{BTU}{hr}\right) = 0.549\,\frac{lb}{hr} = 0.069\,\frac{g}{s}$$

$$= \left(0.549\,\frac{lb}{hr}\right)\left(\frac{982{,}766{,}991\,\frac{scf}{yr}}{1{,}054{,}134{,}314\,\frac{scf}{yr}}\right)\left(24\,\frac{hr}{day}\right)\left(365\,\frac{day}{yr}\right)\left(2000\,\frac{lb}{ton}\right) = 2.24\,\frac{ton}{yr}$$

7. Particulate Matter Grain Emission Rate = $(PM_g) = \left(M_{pm}\left[\frac{g}{s}\right]\right)\left(\frac{15.43grain}{1g}\right)\left(\frac{60S}{1\min}\right)$

For Superior Boiler:

$$PM_g\left(0.069\,\frac{g}{s}\right)\left(\frac{15.43grain}{1g}\right)\left(\frac{60s}{1\min}\right) = 63.88\,\frac{grain}{\min}$$

8. Grain Loading Concentration Corrected to 3% O_2 and Altitude (C_{pm}) = $\frac{PM_g}{Q_{ds,O_2,AL}}$

For Superior Boiler:

$$C_{PM} = \frac{63.88\,\frac{grain}{\min}}{14{,}052\,\frac{dscf}{\min}} = 4\ x\,10^{-3}\,\frac{grain}{dscf}$$

HUGHES MACHINERY COMPANY
POWER PLANT AND INDUSTRIAL EQUIPMENT
Reply To:
2504 S. 156th Circle
Omaha, NE 68130
(402) 571-5004
Fax (402) 571-4945

QUOTATION

TO: RYAN AND ASSOCIATES
ATTN: DICK MEYER
PROJECT: IDAHO ETHANOL PROJECT
TERMS: Net 30

DATE: 10/30/06
QUOTE BY: Luke Van Camp

F.O.B. Factory

We are pleased to offer the following equipment for the subject project. No sales or use taxes included. Prices are included here in are firm. Hughes Machinery Company's warranty is limited to the warranties of the manufacturers of the equipment being furnished. Hughes Machinery can accept no liability for consequential damages. Hughes Machinery will make every effort to maintain required shipping schedules, however, we will not be responsible for costs associated with delays or shipment problems beyond our control. Back charges will not be accepted without prior written approval.

DESCRIPTION: SUPERIOR/WEBSTER BOILER BURNER PACKAGE TO BE SHIPPED AS ONE PACKAGE FROM THE SUPERIOR BOILER WORKS.

SUPERIOR APACHE 2-PASS SCOTCH BOILER

MODEL 8-X-11000-S200-WBCF-G RATED FOR 2,200BHP & 200 PSIG. DESIGN COMPLETE WITH:

- WATER COLUMN, 200 PSIG, MM 194
- ALWCO, 250 PSIG, PROBE IN SHELL TYPE, MANUAL RESET
- CHAIN OPERATED GAUGE AND TRY COCKS, 200 PSI
- PRESSURETROL CONTROLLER, 20-300#
- ASCO LOW FIRE HOLD
- STEAM PRESSURE GAUGE
- STACK THERMOMETER
- VENT GATE VALVE
- FEEDWATER GATE/CHECK MOUNTING
- FEEDWATER GATE/CHECK VALVE
- PNEUMATIC FEEDWATER VALVE
- 3 VALVE BY-PASS
- ASME BOTTOM BLOWDOWN VALVES
- SURFACE BLOWDOWN

- POWER SEQUENTIAL DAMPER CONTROLLER
- SAFETY RELIEF VALVES (SHIPPED LOOSE)
- DRIP PAN ELBOWS
- CHEMICAL FEED CONNECTION WITH DIFFUSER
- SEAL-TITE WIRING W/NBMA-4 JUNCTION BOX
- 2 @ 300# SPOOL PIECE 14" X 10"
- STEAM STOP/CHECK VALVES
- STEAM OS&Y GATE VALVES
- SEISMIC BRACKETS
- FACTORY FIRETESTING

WEBSTER BURNER

MODEL HDR-RF-G-92.0-1500, COMPLETE WITH:

- PREPIPED AND PREWIRED NATURAL GAS TRAIN
- DIGESTER GAS TRAIN TO INCLUDE:
  - (2) 6" LUBRICATED GAS VALVES
  - (1) 6" STAINLESS STEEL FISHER REGULATOR
  - (2) 6" MAXON 7000 GAS VALVES WITH KALREZ O-RINGS
  - (1) 6" REDUCED PORT FLOW PRESSURE SWITCH
  - (1) C437 HONEYWELL LOW GAS PRESSURE SWITCH
- 2" SIEMENS VGG NATURAL GAS TRAIN FOR BLEND WITH DIGESTER AND TRIM CONTROL
- FIREYE E300 EXPANSION MODULE
- FIREYE ED610 CARD WITH ED512-4 CABLE
- AIR INLET SENSOR (REQUIRED FOR HDR-RF BURNERS)
- REFRACTORY FRONTPLATE
- FIREYE PPC-5000 SYSTEM TO INCLUDE:
  - PPC5000 CONTROLLER
  - AH221245 O2 TRIM INTERFACE
  - LA221419-004 O2 PROBE ASSEMBLY
  - (3) NX20-1 SERVO MOTORS, 15 FT-LB, FOR FUEL VALVES
  - (2) NX50-1 SERVO MOTORS, 37 FT-BL, FOR AIR LOUVER BOX AND REGISTER
  - AH221244-002 EXPANSION BOARD FOR VFD INTERFACE
  - NXMB1 MODBUS COMMUNICATIONS
- VARIABLE SPEED DRIVE FOR BLOWER MOTOR

SUPERIOR BOILER TRAY TYPE DEAERATOR

SUPERIOR BOILER WORKS MODEL TC60T210-125 TRIPLEX TRAY DEAERATOR COMPLETE CONSISTING OF THE FOLLOWING :

DEAERATOR

(1) 60,000#/HR. .005 TRAY TYPE DEAERATOR TANK. HORIZONTAL STORAGE SECTION WILL BE 4'-0"x 13'-0" SHELL LENGTH AND VERTICAL DEAERATOR

SECTION WILL BE 3'-0"x 4'-6" SHELL LENGTH. THIS IS A TANKCAR TYPE CONFIGURATION. STORAGE CAPACITY IS 1,200 GALLONS OF DEAERATED WATER (12 MINUTES) TO OVERFLOW. VESSEL DESIGNED AND BUILT IN ACCORDANCE WITH THE *A.S.M.E.* CODE FOR 50 P.S.I.G. @ 400 DEGREES F. WITH A 1/8" CORROSION ALLOWANCE. VESSEL WILL HAVE INSULATION & LAGGING. ALL WELDS WILL BE GROUND SMOOTH. 100% X-RAY OF ALL LONGITUDINAL & CIRCUMFERENTIAL WELD SEAMS.

GUARANTEES :

- OXYGEN REMOVAL TO .005 cc/ltr. (7 PPB).
- TO DEAERATE AT ALL LOADS FROM 3% TO 100% OF RATED OUTLET CAPACITY.
- TO ELIMINATE TITRATABLE FREE CARBON DIOXIDE TO 0.
- TO HEAT WATER TO THE CORRESPONDING TEMPERATURE OF THE SATURATED STEAM CONTAINED WITHIN THE VESSEL.

THIS IS A COUNTERFLOW DESIGN WITH THE FOLLOWING :

- SA516-70 CARBON STEEL HEADS & SHELL
- #304 STAINLESS STEEL SPRAY VALVES
- #304 STAINLESS STEEL INTERNAL DIRECT CONTACT VENT CONDENSER
- #304 STAINLESS STEEL TRAY BOX
- #430 STAINLESS STEEL TRAYS WITH ALL RIVETED CONSTRUCTION
- TRAY LOADING IS 90#/HR. PER SQUARE INCH
- DEAERATOR ACCESS 18" ROUND MANHOLE WITH DAVIT
- STORAGE SECTION ACCESS 18" ROUND MANHOLE WITH DAVIT
- DOWNCOMER : 8" FLANGED

BOILER FEED PUMPS

(3) GRUNDFOS MODEL # CR32-6 (WITH INDUCER) CENTRIFUGAL BOILER FEED PUMPS EQUIPPED WITH HIGH TEMPERATURE MECHANICAL SEALS. EACH PUMP WITH A CAPACITY OF 110 GPM @ 510' TDH OF 227 DEGREE F. H2O. PUMPS WILL BE DRIVEN BY 25 H.P., 460V, 3 PHASE, 3500 RPM, T.E.F.C. MOTORS.

PUMPS WILL BE PIPED TO INDIVIDUAL TANK SUCTION CONNECTIONS WITH :
SHUTOFF VALVES 4"
STRAINERS 4"
EXPANSION COUPLINGS 4"

PUMP DISCHARGE PIPING INCLUDES :
SHUTOFF VALVES 3"
CHECK VALVES 3"
RECIRCULATION ORIFICES
PRESSURE GAUGES

TRIM ASSEMBLY

(1) WARREN MODULATING WATER INLET VALVE & THREE VALVE BYPASS /
STRAINER WITH WARREN EXTERNAL FLOAT CAGE FOR CONTROL OF TRANSFER
PUMPS (ON/OFF)
(1) SET SAFETY TYPE WATER GLASS GAUGES (AS REQUIRED FOR FULL WATER TRAVEL)
(1) WATER INLET PRESSURE GAUGE-PANEL MOUNTED
(1) STEAM SECTION PRESSURE GAUGE-PANEL MOUNTED
(1) STORAGE SECTION THERMOMETER-PANEL MOUNTED
(1) STEAM SECTION THERMOMETER-PANEL MOUNTED
(1) SAMPLING VALVE – ½"
(1) CHEMICAL FEED QUILL
(1) KUNKLE #6283FE SET @ 50 PSIG SENTINEL RELIEF VALVE
(2) KUNKLE 6010JJ SET @ 50 PSIG FULL CAPACITY (OF STEAM P.R.V.) RELIEF VALVE
(1) STRATAFLO #300 – 2-1/2" VACUUM BREAKER,
(1) 1-1/2" MANUAL VENT VALVE
(1) AUTOMATIC VENT VALVE SARCO TD52
(1) MAGNESIUM ANODE WITH WEEP HOLE
(1) MERCOID #123-153 HIGH LEVEL ALARM SWITCH,
(1) MERCOID #123-153 LOW LEVEL ALARM SWITCH & PUMP CUTOFF,
(1) WARREN #313 – 3" OVERFLOW TRAP (SHIPPED LOOSE)

PRESSURE REDUCING VALVE

(1) SPENCE SELF CONTAINED PILOT ACTUATED STEAM PRESSURE REDUCING VALVE
(SHIPPED LOOSE).

SYSTEM CONTROL PANEL

(1) SYSTEM CONTROL PANEL COMPLETE CONSISTING OF THE FOLLOWING :
(4) MAGNETIC STARTERS – NEMA RATED
(4) PUMP RUNNING LIGHTS
(4) PUMP RUN TIME METERS
(4) H.O.A. SELECTOR SWITCHES

(4) PUSH TO TEST BUTTONS
(4) FUSED DISCONNECT SWITCHES
(1) CONTROL CIRCUIT TRANSFORMER
AUXILLIARY CONTACTS
(2 SETS N.O. CONTACTS
(1) LOW WATER PUMP CUTOFF RELAY
(1) HIGH LEVEL ALARM LIGHT
(1) LOW LEVEL ALARM LIGHT
(1) ALARM HORN
(1) ALARM SILENCING SWITCH

ABOVE MOUNTED IN A N.E.M.A. #12 ENCLOSURE

PANEL WILL BE MOUNTED ON STEEL FRAME WITH WIRING TO MOTORS AND ALARM SWITCHES. PANEL INCLUDES COMPONENTS FOR FUTURE FORTH PUMP.

CRANE ENVIORNMENTAL WATER TREATMENT SYSTEM
SYSTEM BASED ON 60GPM FLOWRATE AND INCLUDES THE FOLLOWING EQUIPMENT:

- MULTI-MEDIA FILTER WITH SEQ. BACKWASH
- TWIN ALTERNATING SOFTNER SYSTEM
- BRINE TANK
- RO MEMBRANE SKID COMPLETE WITH CONTROLS AND PUMPS
- 1700GAL RO STORAGE TANK
- STAINLESS STEEL RO TRANSFER PUMPS

SCHEBLER STAINLESS STEEL STACK SYSTEM
STACK SYSTEM TO BE FREE STACK DESIGNED SHALL HAVE THE FOLLOWING FEATURES:

- 50" DIA 80' TALL
- 304 STAINLESS STEEL CONSTRUCTION
- SHIPPED IN TWO SECTIONS
- BALSE PLATE
- ACCES DOOR
- LIFTING LUGS
- DUCTING FROM THE BOILER
- FULL ENGINEERING CALCULATIONS

ENGINEERING
HUGHES MACHINERY WILL DEVELOP P&ID DRAWINGS FOR THE BOILER ROOM TO BE DRAWN AND STAMPED BY OTHERS. IN ADDITION HUGHES WILL SUPPLY 3 DAYS OF ASSISTANCE TO THE ENGINEERS FOR STEAM SYSTEM LAYOUT.

Modeled Emissions for Digester Gas / Natural Gas Fired Boilers

Mass Flow Rates Provided by S.T. Johnson Co.

PEI PERENNIAL ENERGY

FH-1250 Saskatoon Boiler
S.T. Johnson Co. Burner
1250 HP 54 MMBtuh

Constituent		Biogas				Natural Gas	
		lb/hr	lb/MMBtu			lb/hr	lb/MMBtu
CO_2		9882	183			6243	115.61111
CO		1.15	0.0212963			1.16	0.0214815
SO_2	*	36.34	0.672963			0	0
O_2		1734	32.111111			1758	32.555556
H_2O		5454	101			5226	96.777778
N_2		34290	635			34895	646.2037
NO_X		0.57	0.0105556			5.25	0.0972222

* Based on 4000 ppmv H2S in Digester Gas (Max. anticipated H2S concentrati

Air Pollutant Emissions
Biogas Combustion (Limited)
Electricity Generator #1 (ES-5)

Combustion Source Characteristics

Generator Manufacturer	Caterpillar	
Model	G3520C	
Input Heat Capacity (MMBTU/hr)		14.11
Break Horsepower (bhp)		2,248
Power Generation (ekW)		1,600
Fuel		Biogas
Heating Value (BTU/scf)		612
Max Hourly Biogas Fuel Consumption (scf/hr)		23,056
Unlimited Annual Biogas Fuel Consumption (scf/yr)		201,971,347
Limited Annual Biogas Fuel Consumption (scf/yr)		187,833,353

Stack Data

Stack Height (ft)	30.0
Stack Diameter (ft)	1.33
Exit Gas Temperature (°F)[c]	500
Wet Actual Flow Rate (acfm)	5,271
Wet Standard Flow Rate (wscfm)	2,495
Dry Standard Flow Rate (dscfm)	2,048
Grain Loading Flow Rate (dscfm)	2,779
Stack Velocity (m/s)	19.18
Fd (dscf stack gas/BTU)	0.00871
Fw (wscf stack gas/BTU)	0.01061

Miscellaneous Support Data

Pressure at Standard Conditions (atm)	1
Temperature at Standard Conditions (K)	293
Ideal Gas Constant (atm-ft^3/mol-K)	1.314
Heyburn Barometric Pressure (atm)	0.86

Criteria Pollutants

Pollutant	Emission Factor[a]	Emission Factor Unit	Potential Emissions (lb/hr)	Limited Potential Emissions (TPY)[b]	Potential Emissions (g/s)
PM_{10} (assume = PM)	7.71E-05	lb/MMBTU	1.09E-03	0.00	0.000
SO_2	1.90E-01	lb/MMBTU	2.69	10.94	0.338
NO_x	0.5	g/bhp	2.48	10.09	0.312
CO	2.25	g/bhp	11.15	45.42	1.405
VOC	0.118	lb/MMBTU	1.665	6.78	0.210
Lead	NA		#VALUE!	#VALUE!	#VALUE!

Non-Criteria Pollutants with Significant Threshold

Pollutant	Emission Factor[a]	Emission Factor Unit	Potential Emissions (lb/hr)	Potential Emissions (TPY)[b]	Potential Emissions (g/s)
H_2S	2.03E-03	lb/MMBTU	2.86E-02	0.12	3.60E-03

Notes:

(a) Emission factors for CO and NOx supplied by the vendor (Caterpillar). Emission factors for PM10 and VOC from AP-42 Chapter 3.2, "Stationary Internal Combustion Engines" Table 3.2-2. Emission factors for SO_2 and H_2S calculated based on biogas H_2S content of 700 ppm_v, to provide a worst-case analysis 98% H_2S destruction was assumed for the H_2S emission calculations but 100% H_2S conversion was assumed for SO_2 calculations).

(b) Annual potential emissions (TPY) estimated considering limited biogas consumption. Assumed 82% uptime, generating 1312 ekW.

(c) The discharge temperature for the generator exhaust was reduced from 758 to 500 °F to account for heat losses from exhaust manifold to discharge elevation.

Air Pollutant Emissions
Biogas Combustion (Limited)
Electricity Generator #2 (ES-6)

Combustion Source Characteristics

Generator Manufacturer	Caterpillar	
Model	G3520C	
Input Heat Capacity (MMBTU/hr)		14.11
Break Horsepower (bhp)		2,248
Power Generation (ekW)		1,600
Fuel		Biogas
Heating Value (BTU/scf)		612
Max Hourly Biogas Fuel Consumption (scf/hr)		23,056
Unlimited Annual Biogas Fuel Consumption (scf/yr)		201,971,347
Limited Annual Biogas Fuel Consumption (scf/yr)		187,833,353

Stack Data

Stack Height (ft)	30.0
Stack Diameter (ft)	1.33
Exit Gas Temperature (°F)[c]	500
Wet Actual Flow Rate (acfm)	5,271
Wet Standard Flow Rate (wscfm)	2,495
Dry Standard Flow Rate (dscfm)	2,048
Grain Loading Flow Rate (dscfm)	2,779
Stack Velocity (m/s)	19.18
Fd (dscf stack gas/BTU)	0.00871
Fw (wscf stack gas/BTU)	0.01061

Miscellaneous Support Data

Pressure at Standard Conditions (atm)	1
Temperature at Standard Conditions (K)	293
Ideal Gas Constant (atm-ft^3/mol-K)	1.314
Heyburn Barometric Pressure (atm)	0.86

Criteria Pollutants

Pollutant	Emission Factor[a]	Emission Factor Unit	Potential Emissions (lb/hr)	Limited Potential Emissions (TPY)[b]	Potential Emissions (g/s)
PM_{10} (assume = PM)	7.71E-05	lb/MMBTU	1.09E-03	0.00	0.000
SO_2	1.90E-01	lb/MMBTU	2.69	10.94	0.338
NO_x	0.5	g/bhp	2.48	10.09	0.312
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VOC	0.118	lb/MMBTU	1.665	6.78	0.210
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Non-Criteria Pollutants with Significant Threshold

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H_2S	2.03E-03	lb/MMBTU	2.86E-02	0.12	3.60E-03

Notes:

(a) Emission factors for CO and NOx supplied by the vendor (Caterpillar). Emission factors for PM10 and VOC from AP-42 Chapter 3.2, "Stationary Internal Combustion Engines" Table 3.2-2. Emission factors for SO_2 and H_2S calculated based on biogas H_2S content of 700 ppm_v, to provide a worst-case analysis 98% H_2S destruction was assumed for the H_2S emission calculations but 100% H_2S conversion was assumed for SO_2 calculations).

(b) Annual potential emissions (TPY) estimated considering limited biogas consumption. Assumed 82% uptime, generating 1312 ekW.

(c) The discharge temperature for the generator exhaust was reduced from 758 to 500 °F to account for heat losses from exhaust manifold to discharge elevation.

G3520C

GAS ENGINE TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED:	1200	FUEL:	NAT GAS
COMPRESSION RATIO:	11.3:1	FUEL SYSTEM:	CAT LOW PRESSURE WITH AIR FUEL RATIO CONTROL
AFTERCOOLER - STAGE 1 MAX. INLET (°F):	198		
AFTERCOOLER - STAGE 2 MAX. INLET (°F):	130	FUEL PRESS. RANGE (PSIG):	0.50 - 5.0
JACKET WATER - MAX. OUTLET (°F):	210	MIN. METHANE NUMBER:	80
COOLING SYSTEM:	JW+OC+1AC, 2AC	RATED ALTITUDE (FT):	2595
IGNITION SYSTEM:	ADEM3	AT AIR TO TURBO. TEMP. (°F):	77
EXHAUST MANIFOLD:	DRY	NOx EMISSION LEVEL:	0.5 g/bhp-hr
COMBUSTION:	LOW EMISSION	FUEL LHV (BTU/SCF):	905
EFFECTIVE SERIAL NUMBER:	GZL00141-Up	APPLICATION:	GENSET

RATING AND EFFICIENCY		NOTES	LOAD	100%	75%	50%
ENGINE POWER	(WITHOUT FAN)	(1)	BHP	2248	1686	1124
GENERATOR POWER	(WITHOUT FAN)	(2)	EKW	1600	1201	800
ENGINE EFFICIENCY	**(ISO 3046/1)**	**(3)**	**%**	**39.9**	**38.4**	**35.9**
ENGINE EFFICIENCY	(NOMINAL)	(3)	%	38.9	37.5	35.1
THERMAL EFFICIENCY	(NOMINAL)	(4)	%	38.7	40.1	42.0
TOTAL EFFICIENCY	(NOMINAL)	(5)	%	77.6	77.6	77.1

ENGINE DATA						
FUEL CONSUMPTION	**(ISO 3046/1)**	**(6)**	**BTU/bhp-hr**	**6383**	**6629**	**7084**
FUEL CONSUMPTION	(NOMINAL)	(6)	BTU/bhp-hr	6538	6791	7257
AIR FLOW (77 °F, 14.7 psi)		(7)	SCFM	5089	3840	2648
AIR FLOW		(7)	lb/hr	22564	17025	11741
COMPRESSOR OUT PRESSURE			in. HG (abs)	111	84.5	57.7
COMPRESSOR OUT TEMPERATURE			°F	395	323	231
AFTERCOOLER AIR OUT TEMPERATURE			°F	137	137	137
INLET MAN. PRESSURE		(8)	in. HG (abs)	100.7	75.7	51.9
INLET MAN. TEMPERATURE	(MEASURED IN PLENUM)	(9)	°F	137	137	137
TIMING		(10)	°BTDC	28	28	28
EXHAUST STACK TEMPERATURE		(11)	°F	758	827	890
EXHAUST GAS FLOW (@ stack temp.)		(12)	CFM	12361	9870	7154
EXHAUST MASS FLOW		(12)	lb/hr	23304	17601	12152

EMISSIONS DATA					
NOx (as NO2)	(13)	g/bhp-hr	0.50	0.50	0.50
CO	(14)	g/bhp-hr	2.25	2.32	2.34
THC (molecular weight of 15.84)	(14)	g/bhp-hr	8.52	9.44	11.11
NMHC (molecular weight of 15.84)	(14)	g/bhp-hr	1.28	1.42	1.67
CO2	(14)	g/bhp-hr	448	466	488
EXHAUST O2	(15)	% DRY	10.3	10.1	9.9
LAMBDA	(15)		1.91	1.85	1.79

HEAT BALANCE DATA					
LHV INPUT	(16)	BTU/min	244932	190789	135926
HEAT REJECTION TO JACKET	(17)	BTU/min	29322	25613	21735
HEAT REJECTION TO ATMOSPHERE	(18)	BTU/min	6372	5325	4278
HEAT REJECTION TO LUBE OIL	(19)	BTU/min	6005	5379	4612
HEAT REJECTION TO EXHAUST (LHV to 77°F)	(20)	BTU/min	80334	67144	50844
HEAT REJECTION TO EXHAUST (LHV to 350°F)	(20)	BTU/min	41900	37207	29255
HEAT REJECTION TO A/C - STAGE 1	(21)	BTU/min	17627	8396	1534
HEAT REJECTION TO A/C - STAGE 2	(22)	BTU/min	7970	5461	3284

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1. DATA REPRESENTS CONDITIONS OF 77°F, 29.6 IN HG BAROMETRIC PRESSURE, 30% RELATIVE HUMIDITY, 10 IN H2O AIR FILTER RESTRICTION, AND 20 IN H2O EXHAUST STACK PRESSURE. ENGINE EFFICIENCY AND FUEL CONSUMPTION SPECIFICALLY NOTED AS ISO 3046/1 ARE REPRESENTED WITH 5 IN H2O AIR FILTER RESTRICTION AND 0 IN H2O EXHAUST STACK PRESSURE. CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE. NO OVERLOAD PERMITTED AT RATING SHOWN.

EMISSION LEVELS ARE BASED ON THE ENGINE OPERATING AT STEADY STATE CONDITIONS AND ADJUSTED TO THE SPECIFIED NOx LEVEL AT 100% LOAD. EMISSION TOLERANCES SPECIFIED ARE DEPENDENT UPON FUEL QUALITY. METHANE NUMBER CANNOT VARY MORE THAN ± 3. PUBLISHED PART LOAD DATA IS WITH AIR FUEL RATIO CONTROL.

ENGINE RATING IS WITH 2 ENGINE DRIVEN WATER PUMPS. PUMP POWER IS NOT INCLUDED IN HEAT BALANCE DATA.

FOR NOTES INFORMATION CONSULT PAGE THREE.

FUEL USAGE GUIDE

CAT METHANE NUMBER	30	35	40	45	50	55	60	65	70	75	80	85 to 100
IGNITION TIMING	-	-	-	-	-	16	16	16	16	22	28	28
DERATION FACTOR	0	0	0	0	0	0.75	0.81	0.86	0.90	0.95	1.00	1.00

ALTITUDE DERATION FACTORS

AIR TO TURBO (°F)	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1.00	0.97	0.93	0.90	0.86	0.83	0.80	0.77	0.74	0.71	0.68	0.65	0.63
120	1.00	0.98	0.95	0.91	0.88	0.84	0.81	0.78	0.75	0.72	0.69	0.67	0.64
110	1.00	1.00	0.96	0.93	0.89	0.86	0.83	0.79	0.76	0.73	0.71	0.68	0.65
100	1.00	1.00	0.98	0.94	0.91	0.87	0.84	0.81	0.78	0.75	0.72	0.69	0.66
90	1.00	1.00	1.00	0.96	0.93	0.89	0.86	0.82	0.79	0.76	0.73	0.70	0.67
80	1.00	1.00	1.00	0.98	0.94	0.91	0.87	0.84	0.81	0.78	0.74	0.72	0.69
70	1.00	1.00	1.00	1.00	0.96	0.92	0.89	0.86	0.82	0.79	0.76	0.73	0.70
60	1.00	1.00	1.00	1.00	0.98	0.94	0.91	0.87	0.84	0.81	0.77	0.74	0.71
50	1.00	1.00	1.00	1.00	1.00	0.96	0.92	0.89	0.85	0.82	0.79	0.76	0.73

ALTITUDE (FEET ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°F)	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1.30	1.35	1.39	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42
120	1.24	1.29	1.33	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36
110	1.18	1.23	1.27	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
100	1.12	1.16	1.21	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23
90	1.06	1.10	1.14	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17
80	1.00	1.04	1.08	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11
70	1.00	1.00	1.02	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
60	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALTITUDE (FEET ABOVE SEA LEVEL)

FREE FIELD MECHANICAL & EXHAUST NOISE

100% Load Data			dB(A)	(dB)							
Free Field Mechanical	DISTANCE FROM THE ENGINE (FEET)	3.2	108.5	51.5	78.7	88.2	92.9	99.9	97.3	93.2	99.2
		22.9	91.6	34.6	59.0	68.1	74.0	83.0	79.4	75.1	85.2
		49.2	85.0	28.0	55.2	64.7	69.4	76.4	73.8	69.7	75.7
Free Field Exhaust	DISTANCE FROM THE ENGINE (FEET)	4.9	106.1	67.5	86.5	96.0	88.5	88.7	90.1	95.6	92.7
		22.9	92.7	54.1	73.1	82.6	75.1	75.3	76.7	82.2	79.3
		49.2	86.1	47.5	66.5	76.0	68.5	68.7	70.1	75.6	72.7
			Overal SPL	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 khz

Octave Band Center Frequency (OBCF)

FUEL USAGE GUIDE:

This table shows the derate factor required for a given fuel. Note that deration occurs as the methane number decreases. Methane number is a scale to measure detonation characteristics of various fuels. The methane number of a fuel is determined by using the Caterpillar Methane Number Calculation program.

ALTITUDE DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information along with the fuel usage guide chart to help determine actual engine power for your site.

INLET AND EXHAUST RESTRICTION CORRECTIONS FOR ALTITUDE CAPABILITY:

To determine the appropriate altitude derate factor to be applied to this engine for inlet or exhaust restrictions differering from the standard conditions listed on page 1, a correction to the site altitude can be made to adjust for this difference. Add 139 feet to the site altitude for each additional inch of H2O of exhaust stack pressure greater than spec sheet conditions. Add 279 feet to the site altitude for each additional inch of H2O of inlet restriction greater than spec sheet conditions. If site inlet restriction or exhaust stack pressure are less than spec sheet conditions, the same trends apply to lower the site altitude.

ACTUAL ENGINE RATING:

It is important to note that the Altitude/Temperature deration and the Fuel Usage Guide deration are not cumulative. They are not to be added together. The same is true for the Low Energy Fuel deration (reference the Caterpillar Methane Number Program) and the Fuel Usage Guide deration. However, the Altitude/Temperature deration and Low Energy Fuel deration are cumulative; and they must be added together in the method shown below. To determine the actual power available, take the lowest rating between 1) and 2).

1) (Altitude/Temperature Deration) + (Low Energy Fuel Deration)
2) Fuel Usage Guide Deration

Note: For NA's always add the Low Energy Fuel deration to the Altitude/Temperature deration. For TA engines only add the Low Energy Fuel deration to the Altitude/Temperature deration whenever the Altitude/Temperature deration is less than 1.0 (100%). This will give the actual rating for the engine at the conditions specified.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 77°F and 500 ft altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbocharger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the standard aftercooler heat rejection. Failure to properly account for these factors could result in detonation and cause the engine to shutdown or fail. For 2 Stage Aftercoolers with separate circuits, the 1st stage will collect 90% of the additional heat.

SOUND DATA:

Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3. SPL = Sound Pressure Level.

NOTES

1 ENGINE RATING IS WITH 2 ENGINE DRIVEN WATER PUMPS. TOLERANCE IS ± 3% OF FULL LOAD.

2 GENERATOR POWER DETERMINED WITH AN ASSUMED GENERATOR EFFICIENCY OF 95.45% AND POWER FACTOR OF 0.8 [GENERATOR POWER = ENGINE POWER x GENERATOR EFFICIENCY].

3 ISO 3046/1 ENGINE EFFICIENCY TOLERANCE IS (+)0, (-)5% OF FULL LOAD % EFFICIENCY VALUE. NOMINAL ENGINE EFFICIENCY TOLERANCE IS ± 2.5% OF FULL LOAD % EFFICIENCY VALUE.

4 THERMAL EFFICIENCY: JACKET HEAT + LUBE OIL HEAT + STAGE 1 A/C HEAT + EXH. HEAT TO 350°F.

5 TOTAL EFFICIENCY = ENGINE EFF. + THERMAL EFF. TOLERANCE IS ± 10% OF FULL LOAD DATA.

6 ISO 3046/1 FUEL CONSUMPTION TOLERANCE IS (+)5, (-)0% OF FULL LOAD DATA. NOMINAL FUEL CONSUMPTION TOLERANCE IS ± 2.5 % OF FULL LOAD DATA.

7 UNDRIED AIR. FLOW TOLERANCE IS ± 5 %

8 INLET MANIFOLD PRESSURE TOLERANCE IS ± 5 %

9 INLET MANIFOLD TEMPERATURE TOLERANCE IS ± 9°F.

10 TIMING INDICATED IS FOR USE WITH THE MINIMUM FUEL METHANE NUMBER SPECIFIED. CONSULT THE APPROPRIATE FUEL USAGE GUIDE FOR TIMING AT OTHER METHANE NUMBERS.

11 EXHAUST STACK TEMPERATURE TOLERANCE IS (+)63°F, (-)54°F.

12 WET EXHAUST. FLOW TOLERANCE IS ± 6 %

13 NOX TOLERANCES ARE ± 18 % OF SPECIFIED VALUE.

14 CO, CO2, THC, and NMHC VALUES ARE "NOT TO EXCEED".

15 O2% TOLERANCE IS ± 0.5; LAMBDA TOLERANCE IS ± 0.05. LAMBDA AND O2 LEVEL ARE THE RESULT OF ADJUSTING THE ENGINE TO OPERATE AT THE SPECIFIED NOX LEVEL.

16 LHV RATE TOLERANCE IS ± 2.5%.

17 TOTAL JW HEAT (based on treated water) = JACKET HEAT + LUBE OIL HEAT + STAGE 1 A/C HEAT + 0.90 x (STAGE 1 + STAGE 2) x (ACHRF-1). TOLERANCE IS ± 10 % OF FULL LOAD DATA.

18 RADIATION HEAT RATE BASED ON TREATED WATER. TOLERANCE IS ± 50% OF FULL LOAD DATA.

19 LUBE OIL HEAT RATE BASED ON TREATED WATER. TOLERANCE IS ± 20% OF FULL LOAD DATA.

20 EXHAUST HEAT RATE BASED ON TREATED WATER. TOLERANCE IS ± 10% OF FULL LOAD DATA.

21 STAGE 1 A/C HEAT (based on treated water) = STAGE 1 A/C HEAT + 0.90 x (STAGE 1 + STAGE 2) x (ACHRF-1). TOLERANCE IS ± 5 % OF FULL LOAD DATA.

22 STAGE 2 A/C HEAT (based on treated water) = STAGE 2 A/C HEAT + (STAGE 1 + STAGE 2) x 0.10 x (ACHRF - 1). TOLERANCE IS ± 5 % OF FULL LOAD DATA.

Loading Rack (ES-7) Emission Estimates
Renova Ethanol Plant
Heyburn, Idaho

$$L_L = 12.46 \frac{SPM}{T}$$ *(equation 1, AP-42 5.2-4)*

S =Satuartion factor	1		(table 5.2-1)
P = True vapor pressure	0.52	psi	(product characteristics)
M = molecular weight	50.2	lb/lb-mole	(TANKS 4.0.9d, denatured ethanol)
T = Average liquid temperature	45.8	°F	(TANKS 4.0.9d, denatured ethanol, Pocatello weather data)
	505.47	°R	

L_L = 0.643 lb/10^3 gal

Q = Product throughput 2.40E+07 gallons/yr

VOC emissions 15443.3 lb/yr
7.72 ton/yr

LDAR – ALCOHOL PLANT (FS-1) FUGITIVE VOC EMISSIONS

ESTIMATE OF VOC EMISSIONS FROM LEAKING PUMPS, VALVES, AND FITTINGS

SOCMI Average Emission Factors (From Table 2-1)

Equipment Type	Service	Emission Factor (kg/hr/source)	Emission Factor (lb/hr/source)
Valves	Gas	0.00597	0.01316
	Light Liquid	0.00403	0.00888
	Heavy Liquid	0.00023	0.00051
Pump Seals	Light Liquid	0.0199	0.04387
	Heavy Liquid	0.00862	0.01900
Compressor Seals	Gas	0.228	0.50265
Pressure Relief Valves	Gas	0.104	0.22928
Connectors	All	0.00183	0.00403
Open-Ended Lines	All	0.0017	0.00375
Sampling Connections	All	0.015	0.03307

Pump No.	No. Ext.	System Description	Quantity	VOC Type	VOC Conc.	VOC Weighting	No. Systems - Weighted
510		Stripper Rectifier Feed Pump	1	H	0.4	0.4	
511		Heads Pump	1	H	0.95	0.95	
513		Heads Vacuum Pump	1	H	0.95	0.95	
519		Beer Stripper #2 Product Pump	1	H	0.4	0.4	
536		Stripper/Rectifier Reflux Pump #1	1	H	0.92	0.92	
588		Ethanol Product Pump	1	H	1	1	
592		Mol Sieve Regenerant Pump	1	H	0.4	0.4	
596		Mol Sieve Vacuum Pump	1	H	0.4	0.4	
802		Ethanol Product Transfer Pump	1	H	1	1	
804		Recycle Pump	1	H	1	1	
806		Denaturant Pump	1	H	1	1	Heavy Liquid
808		Product Loadout Pump	1	H	1	1	Total Systems
		Mol Seive Piping	1	H	1	1	10.42

LDAR – ALCOHOL PLANT (FS-1) FUGITIVE VOC EMISSIONS
ESTIMATE OF VOC EMISSIONS FROM LEAKING PUMPS, VALVES, AND FITTINGS

403	A,B,C,D	Fermenter Pumps	4	L	0.0968	0.3872	
407		Ethanol Absorber Circulation Pump	1	L	0.04	0.04	
502		Beerwell Recirculation Pump	1	L	0.0968	0.0968	Light Liquid
503		Beer Transfer Pump	1	L	0.0968	0.0968	Total Systems
545		Beer Stripper Feed Pump	1	L	0.0968	0.0968	0.718
581A		Mol Sieve #1	1	G	1	1	Gas Total Systems
581B		Mol Seive #2	1	G	1	1	2

Leaking Components	Total Systems	Components Per System	Total Components	Est. Emissions (lbs/hr)	Est. Emissions (tons/yr)
Pump Seals - Light Liquid	0.718	1	0.72	0.031	0.138
Pump Seals - Heavy Liquid	10.420	1	10.42	0.198	0.867
Valves - Liquid Light	0.718	9	6.46	0.057	0.251
Valves - Liquid Heavy	10.420	11	114.62	0.058	0.255
Valves - Gas	2	15	30.00	0.395	1.729
Pressure Safety Valves - Vapor	2	2	4.00	0.917	4.017
Connectors	13.138	36	472.95	1.908	8.357
Open Pipes	13.138	3	39.41	0.148	0.647
Sample Connections	13.138	1	13.14	0.434	1.903
				Total Emissions	18.2 tons/yr

Assume credit for 80% reduction in fugitive emissions by active monitoring and maintenance: **Total Emissions = 0.2 x 18.2 tons/yr = <u>3.6 tons/yr</u>**

TANKS 4.0.9d
Emissions Report - Summary Format
Tank Indentification and Physical Characteristics

Identification

User Identification:	TK-801
City:	Heyburn
State:	Idaho
Company:	Renova Energy
Type of Tank:	Horizontal Tank
Description:	Shift Tank

Tank Dimensions

Shell Length (ft):		75.00
Diameter (ft):		10.10
Volume (gallons):		45,000.00
Turnovers:		22.40
Net Throughput(gal/yr):		1,007,897.99
Is Tank Heated (y/n):	N	
Is Tank Underground (y/n):	Y	

Paint Characteristics

Shell Color/Shade:
Shell Condition

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Pocatello, Idaho (Avg Atmospheric Pressure = 12.53 psia)

TANKS 4.0.9d
Emissions Report - Summary Format
Liquid Contents of Storage Tank

TK-801 - Horizontal Tank
Heyburn, Idaho

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Ethyl alcohol	All	45.79	45.79	45.79	45.35	0.3977	0.3977	0.3977	46.0700			46.07	Option 2: A=8.321, B=1718.21, C=237.52

TANKS 4.0.9d
Emissions Report - Summary Format
Individual Tank Emission Totals

Emissions Report for: Annual

TK-801 - Horizontal Tank
Heyburn, Idaho

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Ethyl alcohol	439.66	0.00	439.66

TANKS 4.0.9d
Emissions Report - Summary Format
Tank Indentification and Physical Characteristics

Identification

User Identification:	TK-803
City:	Heyburn
State:	Idaho
Company:	Renova Energy
Type of Tank:	Horizontal Tank
Description:	Off-spec Product

Tank Dimensions

Shell Length (ft):		75.00
Diameter (ft):		10.10
Volume (gallons):		45,000.00
Turnovers:		22.40
Net Throughput(gal/yr):		1,003,320.00
Is Tank Heated (y/n):	N	
Is Tank Underground (y/n):	Y	

Paint Characteristics

Shell Color/Shade:
Shell Condition

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Pocatello, Idaho (Avg Atmospheric Pressure = 12.53 psia)

TANKS 4.0.9d
Emissions Report - Summary Format
Liquid Contents of Storage Tank

TK-803 - Horizontal Tank
Heyburn, Idaho

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Ethyl alcohol	All	45.79	45.79	45.79	45.35	0.3977	0.3977	0.3977	46.0700			46.07	Option 2: A=8.321, B=1718.21, C=237.52

TANKS 4.0.9d
Emissions Report - Summary Format
Individual Tank Emission Totals

Emissions Report for: Annual

TK-803 - Horizontal Tank
Heyburn, Idaho

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Ethyl alcohol	437.66	0.00	437.66

TANKS 4.0.9d
Emissions Report - Summary Format
Tank Indentification and Physical Characteristics

Identification

User Identification:	TK-808
City:	Heyburn
State:	Idaho
Company:	Renova Energy
Type of Tank:	Horizontal Tank
Description:	Denaturant

Tank Dimensions

Shell Length (ft):		32.30
Diameter (ft):		10.00
Volume (gallons):		19,000.00
Turnovers:		31.83
Net Throughput(gal/yr):		604,739.00
Is Tank Heated (y/n):	N	
Is Tank Underground (y/n):	Y	

Paint Characteristics

Shell Color/Shade:
Shell Condition

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Pocatello, Idaho (Avg Atmospheric Pressure = 12.53 psia)

TANKS 4.0.9d
Emissions Report - Summary Format
Liquid Contents of Storage Tank

TK-808 - Horizontal Tank
Heyburn, Idaho

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Gasoline (RVP 13)	All	45.79	45.79	45.79	45.35	5.2887	5.2887	5.2887	62.0000			92.00	Option 4: RVP=13, ASTM Slope=3

TANKS 4.0.9d
Emissions Report - Summary Format
Individual Tank Emission Totals

Emissions Report for: Annual

TK-808 - Horizontal Tank
Heyburn, Idaho

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Gasoline (RVP 13)	4,721.25	0.00	4,721.25

TANKS 4.0.9d
Emissions Report - Summary Format
Tank Indentification and Physical Characteristics

Identification

User Identification:	TK-810
City:	Heyburn
State:	Idaho
Company:	Renova Energy
Type of Tank:	Horizontal Tank
Description:	Final Product Storage

Tank Dimensions

Shell Length (ft):		68.00
Diameter (ft):		10.00
Volume (gallons):		39,800.00
Turnovers:		67.00
Net Throughput(gal/yr):		2,666,667.00
Is Tank Heated (y/n):	N	
Is Tank Underground (y/n):	Y	

Paint Characteristics

Shell Color/Shade:
Shell Condition

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Pocatello, Idaho (Avg Atmospheric Pressure = 12.53 psia)

TANKS 4.0.9d
Emissions Report - Summary Format
Liquid Contents of Storage Tank

TK-810 - Horizontal Tank
Heyburn, Idaho

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Denatured Ethanol	All	45.79	45.79	45.79	45.35	0.5233	0.5233	0.5233	50.2044			47.25	
Ethyl alcohol						0.3977	0.3977	0.3977	46.0700	0.9500	0.6795	46.07	Option 2: A=8.321, B=1718.21, C=237.52
Gasoline (RVP 13)						5.2887	5.2887	5.2887	62.0000	0.0500	0.3205	92.00	Option 4: RVP=13, ASTM Slope=3

TANKS 4.0.9d
Emissions Report - Summary Format
Individual Tank Emission Totals

Emissions Report for: Annual

TK-810 - Horizontal Tank
Heyburn, Idaho

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Denatured Ethanol	1,024.83	0.00	1,024.83
Gasoline (RVP 13)	328.47	0.00	328.47
Ethyl alcohol	696.36	0.00	696.36

TANKS 4.0.9d
Emissions Report - Summary Format
Total Emissions Summaries - All Tanks in Report

Emissions Report for: Annual

Tank Identification				Losses (lbs)
TK-801	Renova Energy	Horizontal Tank	Heyburn, Idaho	439.66
TK-803	Renova Energy	Horizontal Tank	Heyburn, Idaho	437.66
TK-808	Renova Energy	Horizontal Tank	Heyburn, Idaho	4,721.25
TK-810	Renova Energy	Horizontal Tank	Heyburn, Idaho	1,024.83
Total Emissions for all Tanks:				6,623.41

Wetcake Storage (FS-17) VOC Emission Estimates

Assumptions:

Wetcake:	21,161	lb/hr
2 days worth in pile:	508	tons
Bulk density WDG:	35	lb/ft^3
Wetcake Moisture:	67	%
Volume in pile:	29,021	ft^3
Pile is Cone Shaped		
Diameter = Height of Cone Pile		
D = H =	48	ft
Surface Area of Pile:	4,053	ft^2
Ethanol in Wetcake:	0.019	%
~Thickness of Crust Formed:	2	in

Wetcake emitting volume =	675		
VOC emission =	4.47	lb/day	0.78 tons/yr

Cooling Tower Particulate Emission Estimates
Renova Energy Ethanol Plant
Heyburn, Idaho

Cooling Tower #1 (FS-19)

Manufacturer:	Marley	
Model:	W433A-4.0-2	
Recirc Rate (Q):	2800 GPM	(vendor supplied)
Drift Loss (DL):	0.001%	(vendor supplied)
	0.028 GPM	=Q x DL
	14.01 lb drift/hr	= DL(GPM) x 8.34 lb/gallon x 60min/hr
TDS:	1600 ppm_w	(assumption)
Particulate Emission Rate:	**0.022 lb PM/hr**	= DL(lb/hr) x TDS /1E6

Cooling Tower #2 (FS-20)

Manufacturer:	Marley	
Model:	W433A-3.0-3	
Recirc Rate (Q):	11400 GPM	(vendor supplied)
Drift Loss (DL):	0.001%	(vendor supplied)
	0.114 GPM	=Q x DL
	57.05 lb drift/hr	= DL(GPM) x 8.34 lb/gallon x 60min/hr
TDS:	1600 ppm_w	(assumption)
Particulate Emission Rate:	**0.091 lb PM/hr**	= DL(lb/hr) x TDS /1E6

SPX Cooling Technologies
Balcke | Hamon Dry Cooling | Marley

, / Tel: 801-308-0128 / Fax: 801-301-0131 / ronda.engstrom@holbrookassoc.com

MARLEY FIELD ERECTED COOLING TOWER

TO: Chimonas Enterprises
DATE: September 7, 2006
ATTN:
FROM: Ronda Engstrom
PROJECT: ~~2nd Tower~~ Unit #1

BUDGETARY SELECTION

DESIGN CONDITIONS:	Flow	2800.0 gpm
	Hot Water	82 °F
	Cold Water	72 °F
	Wet Bulb	67 °F
	Plume Abatement	
TOWER DESCRIPTION:	Model	W433A-4.0-2
	Number of Cells	2
	Pump Head	11.21 ft
	Fan Diameter	10 ft
	Motor Size	2 @ 30 Hp
	Brake Horsepower	2 @ 28.57 Hp
	Evaporation	28.5 gpm
	Drift Rate	0.0010 %
TOWER DIMENSION:	Tower Width	18.67 ft
	Tower Length	36.67 ft
	Tower Height	27.25 ft
	Fan Deck Height	21.25 ft
BASIN DIMENSION:	Basin Width	24 ft
	Basin Length	42 ft
BUDGET PRICE:	$197230 USD	

This budget price is based upon a scope that includes engineering, prefabrication of materials, freight to jobsite and supervision and labor to field assemble the above field erected cooling tower. The following are not included, and should be provided by the purchaser: Sales and/or use taxes, concrete cold water basin, anchor bolts, fire protection sprinkler system (if required by Owner's insurance underwriter), pumps, piping, valves, water make-up, motor starter, disconnects, and controls.

SPX Cooling Technologies
Balcke | Hamon Dry Cooling | Marley

, / Tel: 801-308-0128 / Fax: 801-301-0131 / ronda.engstrom@holbrookassoc.com

MARLEY FIELD ERECTED COOLING TOWER

TO:
2006
ATTN:

Unit #2

PROJECT:

DATE: September 7,

FROM: Ronda Engstrom

BUDGETARY SELECTION

DESIGN CONDITIONS:	Flow	11400 gpm
	Hot Water	97.3 °F
	Cold Water	87 °F
	Wet Bulb	67 °F
	Plume Abatement	
TOWER DESCRIPTION:	Model	W434A-3.0-3
	Number of Cells	3
	Pump Head	17.56 ft
	Fan Diameter	12 ft
	Motor Size	3 @ 20 Hp
	Brake Horsepower	3 @ 17.12 Hp
	Evaporation	101 gpm
	Drift Rate	0.0010 %
TOWER DIMENSION:	Tower Width	18.67 ft
	Tower Length	72.67 ft
	Tower Height	26.75 ft
	Fan Deck Height	20.75 ft
BASIN DIMENSION:	Basin Width	24 ft
	Basin Length	78 ft
BUDGET PRICE:	$282500 USD	

This budget price is based upon a scope that includes engineering, prefabrication of materials, freight to jobsite and supervision and labor to field assemble the above field erected cooling tower. The following are not included, and should be provided by the purchaser: Sales and/or use taxes, concrete cold water basin, anchor bolts, fire protection sprinkler system (if required by Owner's insurance underwriter), pumps, piping, valves, water make-up, motor starter, disconnects, and controls.