TPA

Department of Environmental Protection

Jeb Bush
Governor

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000

David B. Struhs
Secretary

March 5, 2003

Mr. Lee McKee
Broward County Property Appraisers
115 South Andrews Avenue, Room 111
Ft. Lauderdale, Florida 33301

Re: Bio Energy Partners – Acct No. 0959080A

Dear Mr. Mckee:

I have reviewed the information submitted August 22, 2002, as supplemented by material received on February 21, 2003, from Marvin F. Poer & company and March 4, 2003, from Waste Management. In my opinion, the items in the steam turbine costs totaling $8,8483,039.83 are not primarily for the purpose of pollution control. The facilities used to collect and burn methane or landfill gas are considered to be "used primarily" for the purpose or pollution control and are therefore eligible for consideration under subsection 193.621, Florida Statutes.

Sincerely,

Hamilton S. Oven

Hamilton S. Oven, P.E.

cc: Ms Terry Blackwell
Mr. David Unger

WASTE MANAGEMENT, INC.

FAX TRANSMITTAL

From:

The Environmental Management Group
FAX: (713) 328-7411
PHONE: (713) 328-7333

TO: Hamilton Olen FROM: DAVID UNGER

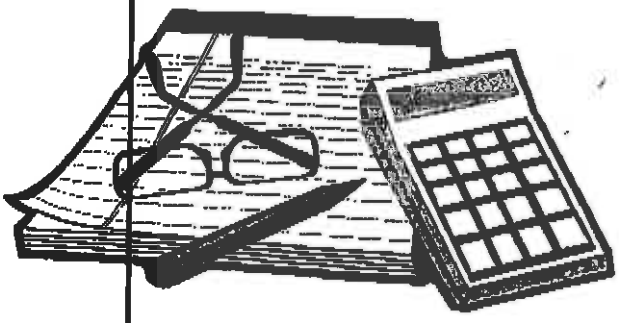
LOCATION: _____ DATE: 3/4/03

FAX #: 850-245-8003 # Pages Incl. Cover Page 2

A copy will be mailed to you today!

my phone # 713 328 7457

Thanks



March 4, 2003

Hamilton S. Oven, P.E.
Department of Environmental Protection
Marjory Stoneman Douglas Building
3900 Commonwealth Blvd
Tallahassee, FL 32399-3000

Dear: Mr. Oven

Here is the property cost breakout of the total **$9,165,674.03** for the Bio-Energy Partners Landfill Gas to Energy Plant located at 300 N.W. 48th Street, Pompano Beach, FL 33073. The costs are grouped into two categories, the landfill gas turbine costs, ($682,634.20), and the steam turbine costs, ($8,483,039.83). Per our conversation the Landfill Gas Turbine Costs qualify for the pollution control exemption.

Landfill Gas Turbine Costs

$ 555,723.00 Oct 1, 2001 Gas Turbine Lease Buyout, and

$ 87,880.00 Oct 1, 2001 Gas Turbine Lease Buyout, and

$ 35,427.20 Apr 1, 1999 Gas Turbine Gearbox, and

$ 3,596.00 Apr 1, 1999 Associated Gearbox charges

$ 682,634.20 = Total Landfill Gas Turbine Costs (Pollution Control Exemption)

Steam Turbine Costs

$ 7,973,457.56 Nov 30, 2000 Heat Recovery System / Steam Turbine

$ 415,550.87 Dec 31, 2000 Heat Recovery System / Steam Turbine (additional assets)

$ 94,031.40 Feb 28, 2001 Heat Recovery System / Steam Turbine (additional assets)

$ 8,483,039.83 = Total Steam Turbine Costs

If you need any additional information, please contact me at 713-328-7457. Thank you for your time and assistance.

Best Regards,

David C. Unger
Director of Plant Services

CC Lee McKee, Chief Appraiser, Commercial Property, Broward County

MARVIN F. POER & COMPANY

STATE & LOCAL TAX CONSULTING

ACCREDITED MEMBER
THE NATIONAL COUNCIL OF PROPERTY TAXATION

Via Overnight Courier

February 21, 2003

DEPARTMENT OF
ENVIRONMENTAL PROTECTION

FEB 24 2003

SITING COORDINATION

Mr. Hamilton Oven
Department of Environmental Protection
Citing Coordination Office
2600 Blairstone Rd.
Mail Stop 48
Tallahassee, FL 32399-2400

Re: Bio Energy Partners, Broward County, FL

Dear Mr. Oven:

Bio Energy Partners, c/o Waste Management Corporation, operates a landfill gas to energy facility in Broward County at 2700 NW 48th Street, Pompano Beach. This site is part of a voluntary assistance program with the U.S. Environmental Protection Agency. The company has installed equipment at the site to extract methane gas from the landfill that prevents emissions of methane gas to the environment. We feel this equipment qualifies as pollution control equipment and exempt from Ad Valorem tax. Mr. Lee McKee. CFA, ASA, Chief Appraiser, Commercial Personal Property Department, Broward County, has asked us to forward you the enclosed information on this facility.

The enclosures consist of the following:

1. A nine page schematic diagram of the operation of the facility.
2. A certified report prepared by Shaw EMCON/OWT, Inc. that describes the facility and it's operation.
3. Excerpts from the U.S. Environmental Protection Agency's web site relating to the Landfill Methane Outreach Program and its contribution to the environment. This plant is a part of this outreach program.

If you have any questions on the report prepared by Shaw, please contact Mr. Bruce Maillet at (508) 497-6108. If you have any other questions or need any additional information please call me at (404) 982-66817, x240.

As this matter is currently under appeal and scheduled for hearing on March 5, 2003 with the Broward County Value Adjustment Board, any assistance you could render to expedite a decision on this matter is greatly appreciated. I apologize for the limited time frame and appreciate your assistance.

Sincerely,

Terry Blackwell

MARVIN F. POER & COMPANY

Terry Blackwell
Senior Consultant

Shaw™ EMCON/OWT, Inc.

Ad Valorem Tax Assessment

A Report on the Applicability of the Ad Valorem Tax Assessment Criteria to the Pollution Control Equipment at Waste Management, Inc. of Florida's Central Sanitary Landfill and Recycling Facility

Prepared by:

EMCON/OWT, Inc

(A member of the Shaw Group of Companies)

Table of Contents

1. Introduction

Waste Management (WM) operates a municipal waste landfill in Broward County. The landfill has a significant pollution control system (PCS) in place that is required by the federal Clean Air Act and rules and regulations adopted there under. These regulations are implemented by Broward County under delegated authority from the Florida Department of Environmental Protection (FLDEP). In accordance with the guidelines of Chapter 62-8 of the Florida Statutes (Ad Valorem Tax Assessment Rules), this document has been submitted to provide information suitable for assessment.

2. Preparation

The information contained herein was prepared by EMCON/OWT, Inc (EMCON), based on data provided by WM. Preparation and certification of this document was performed as stipulated in Chapter 62-8.

June Franklin for
Bruce K Maillet
Director of Air Programs

June Franklin
Jucne K. Franklin, PE
Certifying Engineer

2/20/03
June Franklin

3. Executive Summary

Waste Management Inc. of Florida operates the Central Sanitary Landfill in Pompano Beach. The facility receives municipal solid Waste and deposits the waste in a permitted municipal waste landfill. Federal air pollution control rules at 40 CFR 60.750 and similar State and County rules regulate the facility. These rules were adopted under the Clean Air Act. The facility has a system of pollution control that allows the facility to comply with the stated rules. The pollution control system utilizes a gas collection system, a vacuum/blower system, and combustion devices consisting of special designed gas turbines designed to burn landfill gas. The facility utilizes this system to comply with the rules. A by-product of the system is electricity, which is supplied to the local electric grid.

The facility is eligible for "Ad Valorem Tax Assessment" under rules adopted at 62-8.

4. Facility Description

WM operates a municipal waste landfill in Broward County, Florida. The landfill, an integral part of the Broward County solid waste disposal system, disposes of approximately 8,000 tons of waste per day from the area. The facility has been in operation since the late 1960s. During that time various rules have been promulgated at the federal and State level regulating the landfill and its emissions. In 1996, the United States Environmental Protection Agency adopted rules under the Clean Air Act for Municipal Waste Landfills. The rules require landfills to implement pollution control activity as part of the state's plan to achieve and maintain ambient air quality standards that were designed to protect the public health and environment.

WM complied with these rules by installing and operating a landfill gas collection and control system (GCCS) to reduce the pollutants collected to more suitable levels. These requirements are found in 40 Code of Federal Regulations (CFR) 60.750, New source Performance standards for Municipal Solid Waste landfills

5. Pollutants Discharged

Landfills are disposal facilities in which waste is deposited in an area properly prepared and designated for waste collection. The landfill is filled and covered over time in a planned manner. During the initial phase of waste decomposition any oxygen present is consumed. At the point of oxygen depletion, the waste is continues to decompose anaerobically. The lack of oxygen allows methanogenic bacteria to attack the waste to produce LFG. One of the primary constituents of LFG is methane (CH_4). Additional LFG constituents are carbon dioxide (CO2), non-methane organic compounds, (NMOC) and some other trace gasses.

The methane and carbon dioxide are greenhouse gasses. The NMOC is a contributor to ground level ozone production (Ozone). Ozone is a criteria pollutant or one for which EPA has set ambient air quality standards as required by the Clean Air Act. As previously mentioned, the EPA and the States (in this case the State has delegated authority to Broward County) set rules for sources of NMOC and such rules were adopted by EPA under 40 CFR 60.750, New Source Performance Standards for Municipal Solid Waste Landfills (NSPS).

The Central Landfill is required to comply with the NSPS and has reduced the emissions from the landfill by installation of an approved air pollution control device. The landfill is the source of pollutants and has an air permit from Broward County Department of Planning and Environmental Control, number *0112094-011-AV.* This permit includes the PCS.

6. Pollution Control System

The selected and approved PCS installed at the Central Landfill was a GCCS. A GCCS consist of extraction wells, a piping network, compressors/blowers, and combustion equipment. The PCS operates on the capture of the landfill gas by the wells, which are under vacuum. The vacuum is produced by the compressors/blowers and is induced on the waste mass through LFG extraction wells drilled into the deposited waste. The LFG is transported via a piping network to the combustion equipment. The combustion equipment consists of three LFG driven turbines, a steam turbine, and a flare. The three LFG turbines and the steam turbine are used to destroy LFG collected, while generating electricity that is, subsequently, sold to the power grid. The turbines are specially designed by Solar Turbines, the manufacturer, to burn landfill gas. Landfill gas contains only about 50% methane as opposed to natural gas, which contains approximately 100% methane. The low amount of methane creates design issues, which Solar has accommodated to allow use of the turbines at landfills as pollution control devices. The flare serves as a back-up combustion device when the turbines are not available. The Broward County, Department of Planning and Environmental Protection approved the PCS (Permit No. 0112094-001-AV).

The control device is listed in the permit issued in October 2000 as "an active gas collection system, a desulfurization system, three stationary gas turbines, a steam driven turbine that is a heat recovery system and an open flare". The PCS meets the requirements of the NSPS. The use of the control system allows the facility to operate in compliance with the Federal, State and County air pollution control rules and programs.

7. Additional Support Documentation

The landfill operates a PCS for the reduction of the NMOC and other pollutants generated, including methane (CH_4). The CH_4 component of LFG is 23 times as potent a greenhouse gas as CO_2. The use of this type of PCS, was a suitable approach because it reduced NMOCs, as required by NSPS, and, as an additional environmental benefit, reduced the amount CH_4 emissions being discharged into the atmosphere.
The electricity produced from the LFG-driven turbines is supplied to the grid. This electricity offsets the need to produce a similar amount of electricity from fossil fuel, the predominant fuel source for electricity production in south Florida; thus, reducing the amount of CO_2 and other pollutants that would otherwise be emitted into the atmosphere.

The USEPA Landfill Methane Outreach Program (LMOP), a voluntary department within the EPA, has stated that the use of LFG to produce electricity is the best pollution control that can be achieved due to the indirect benefits.

LMOP specifically says:

> *"The demand for renewable energy, or 'green power', offers a number of opportunities to develop environmentally beneficial landfill gas (LFG) energy projects, which reduce emissions of greenhouse gas and other air pollutants from landfills while providing a cost-effective and readily available source of clean energy."*

LMOP states that generating green power from LFG results in a number of environmental benefits. Using this resource:

- *"Directly reduces greenhouse gas emissions.* MSW landfills are the largest human-generated source of methane emissions in the United States. Methane is a key contributor to global climate change"
- . An LFG energy project captures roughly 85% of the methane emitted from a MSW landfill. The greenhouse gas reduction benefits of a typical 5-megawatt (MW) LFG project equate to planting over 80,000 acres of forest per year or removing the annual emissions from

over 60,000 cars. Using these EPA figures, the Central Landfill PCS equates to planting more than 160,000 acres of forest or removing more than 120,000 cars.

- *Achieves additional reductions in greenhouse gas emissions and air pollution by offsetting the use of non-renewable resources.* Producing electricity from MSW LFG avoids the need to use non-renewable resources to produce the same amount of electricity. This can avoid power plant emissions of CO2 and pollutants such as sulfur dioxide (a major contributor to acid rain), particulate matter (a respiratory health concern), nitrogen oxides (which cause smog), and hazardous air pollutants.

- *Provides other local benefits.* Using MSW LFG to produce electricity also reduces landfill odors, reduces the risk of explosion hazards from gas accumulation in structures on or near the landfill, and creates jobs while taking advantage of a local resource.

9. Conclusions

Based on the guidelines of the Chapter 62-8 of the Florida Statutes and the type of PCS currently utilized, this facility qualifies for the Ad Valorem Tax Assessment. A copy of Chapter 62-8 has been attached.

ATTACHMENT A

CHAPTER 62-8 AD VALOREM TAX ASSESSMENT RULES-GUIDELINES FOR TAX ASSESSORS

CHAPTER 62-8 AD VALOREM TAX ASSESSMENT RULES - GUIDELINES FOR TAX ASSESSORS

62-8.001 Intent.

In accordance with Chapter 193, Florida Statutes, the Board publishes the rules contained herein for the consideration and guidance of the several city and county tax assessors of the State to assist them in making a determination as to what assessment should be made for ad valorem taxes with respect to pollution control devices.

Specific Authority 192.621(8) FS. Law Implemented 403.021(7), 193.621 FS. History–Formerly 28-8.01, 17-8.01, 17-8.001.

62-8.020 Definitions.

In construing this chapter, the words, phrases or terms shall have the following meaning:

(1) "used primarily" – that the use of a facility in the control or abatement of pollution or contaminants which outweighs its use for any other purpose;

(2) "salvage value" – the estimated fair market value, if any, which may be realized upon the sale or other disposition of a pollution control facility when it can no longer be used for the purpose for which it was designed;

(3) "pollution control facilities" – devices, fixtures or machinery which are used to remove, decrease, stop or mitigate, by physical or chemical action, pollutants or contaminants which are a part or entirely of liquid, solid or gases released to the ambient air and water.

Specific Authority 193.621(8) FS. Law Implemented 403.021(7), 193.621 FS. History–Formerly 28-8.02, 17-8.02, 17-8.020.

62-8.030 Request for Assistance.

(1) The several tax assessors may, prior to assessing pollution control facilities or devices for ad valorem taxes, request the Florida Pollution Control Board to evaluate applications and advise the assessor as to the validity of the request for an assessment under the provisions of Section 403.241, F.S.

(2) Prior to approving an assessment for ad valorem taxes under the provisions of Section 403.241, F.S., a tax assessor should require the applicant to submit with his applications a detailed list of pollution control devices being utilized by a facility; the cost of these devices; the function of the facility as it relates to pollution control and production. This information should be certified as being correct by a professional engineer registered in the State of Florida.

Specific Authority 193.621(8) FS. Law Implemented 403.021(7), 193.621 FS. History–Formerly 28-8.03, 17-8.03, 17-8.030.

62-8.040 Procedures.

In considering an assessment for ad valorem taxes under Section 193.621, Florida Statutes, the tax assessor may utilize the following guidelines in determining whether the facilities claimed are used primarily for pollution control purposes and subject to assessment under Chapter 193, Florida Statutes:

(1) If the person owning or responsible for operation of the facility secured approval of such equipment prior to its installation, in accordance with the rules and regulations of the Board.

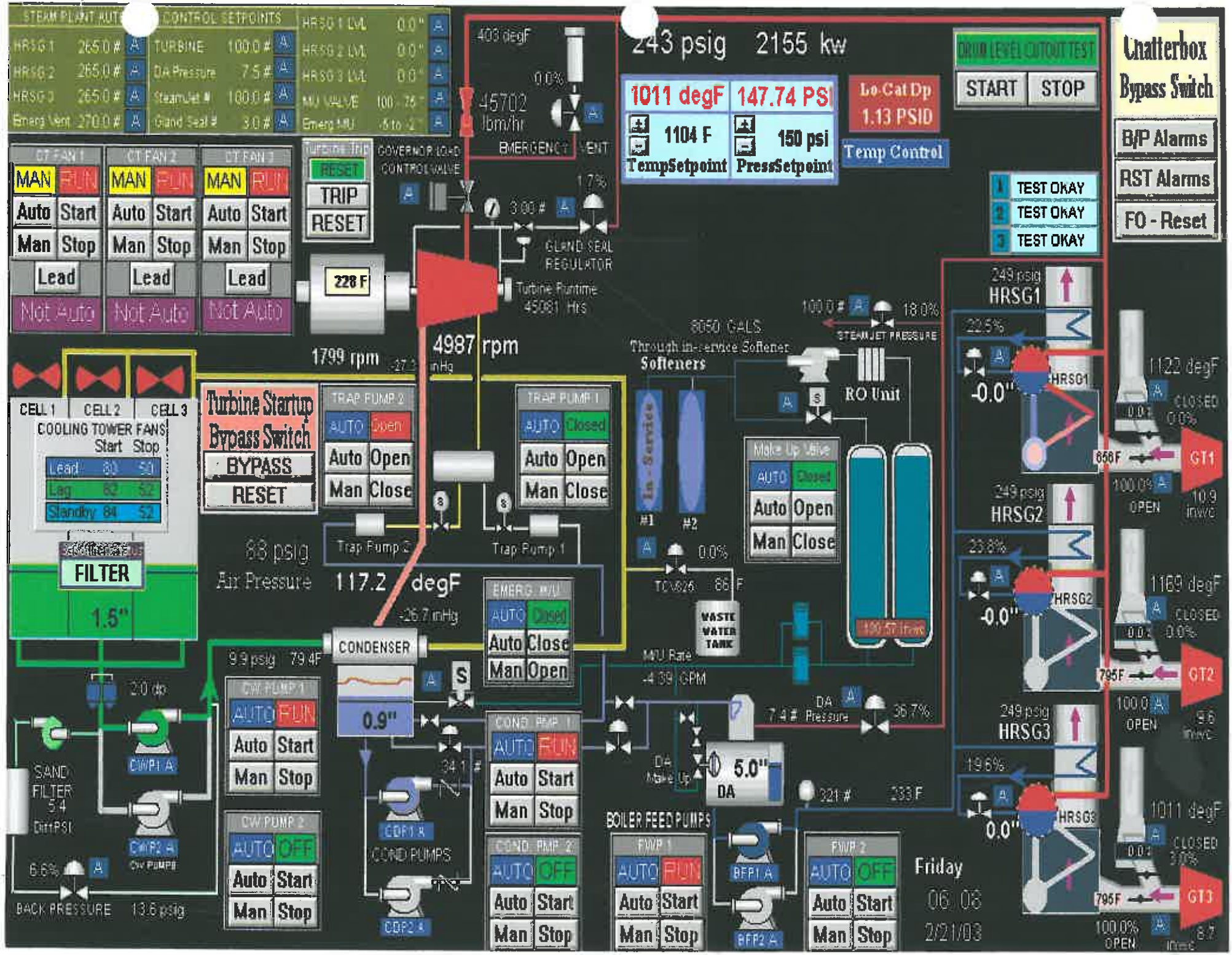
(2) Upon written request by a tax assessor, the Florida Pollution Control Board will determine the applicable use of a facility with respect to subsection 193.621(1), Florida Statutes. For this purpose the applicant must submit to the assessor, for submission to the Department, the following information prepared by a professional engineer registered in the State of Florida:

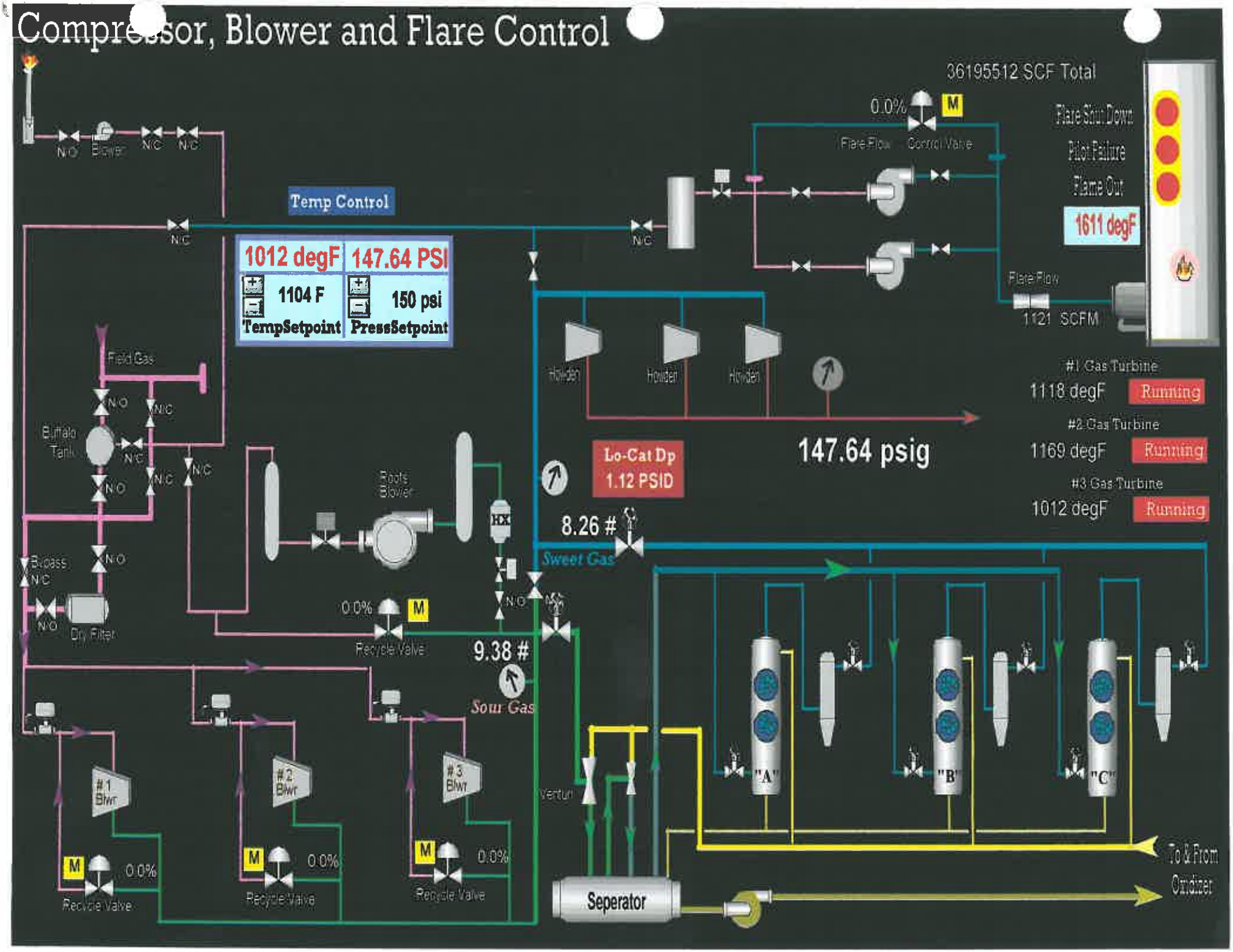
(a) Plans and specifications and related documents describing the equipment alleged to be used for pollution control. Plans or other information relative to the process which is controlled, adequate in scope to validate the claim for the proposed control equipment.

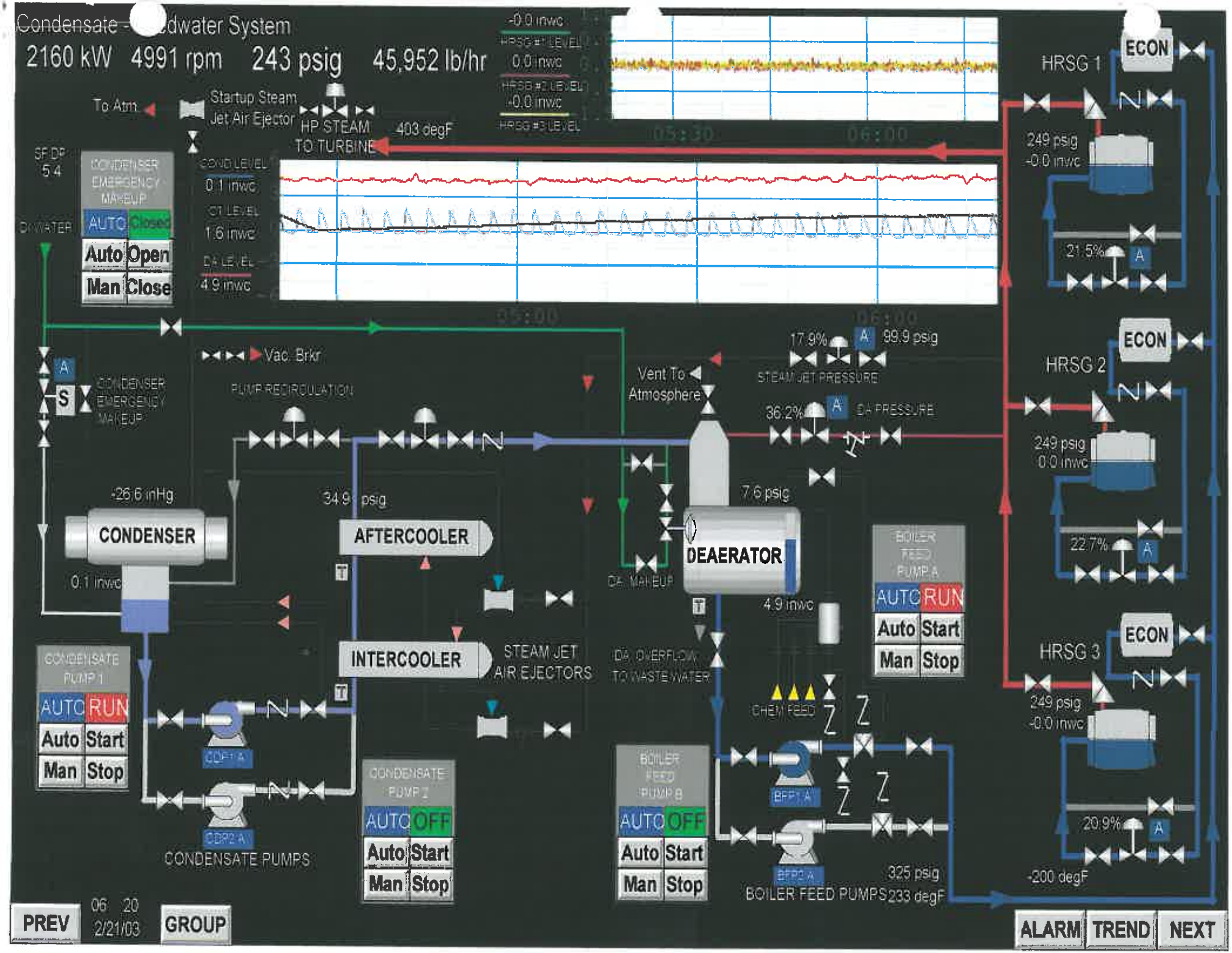
(b) A list of pollution control equipment which the applicant declares subject to assessment under Chapter 193, Florida Statutes, certified as to its true primary use by the engineer. The assessor may require on the equipment list the salvage value of each item.

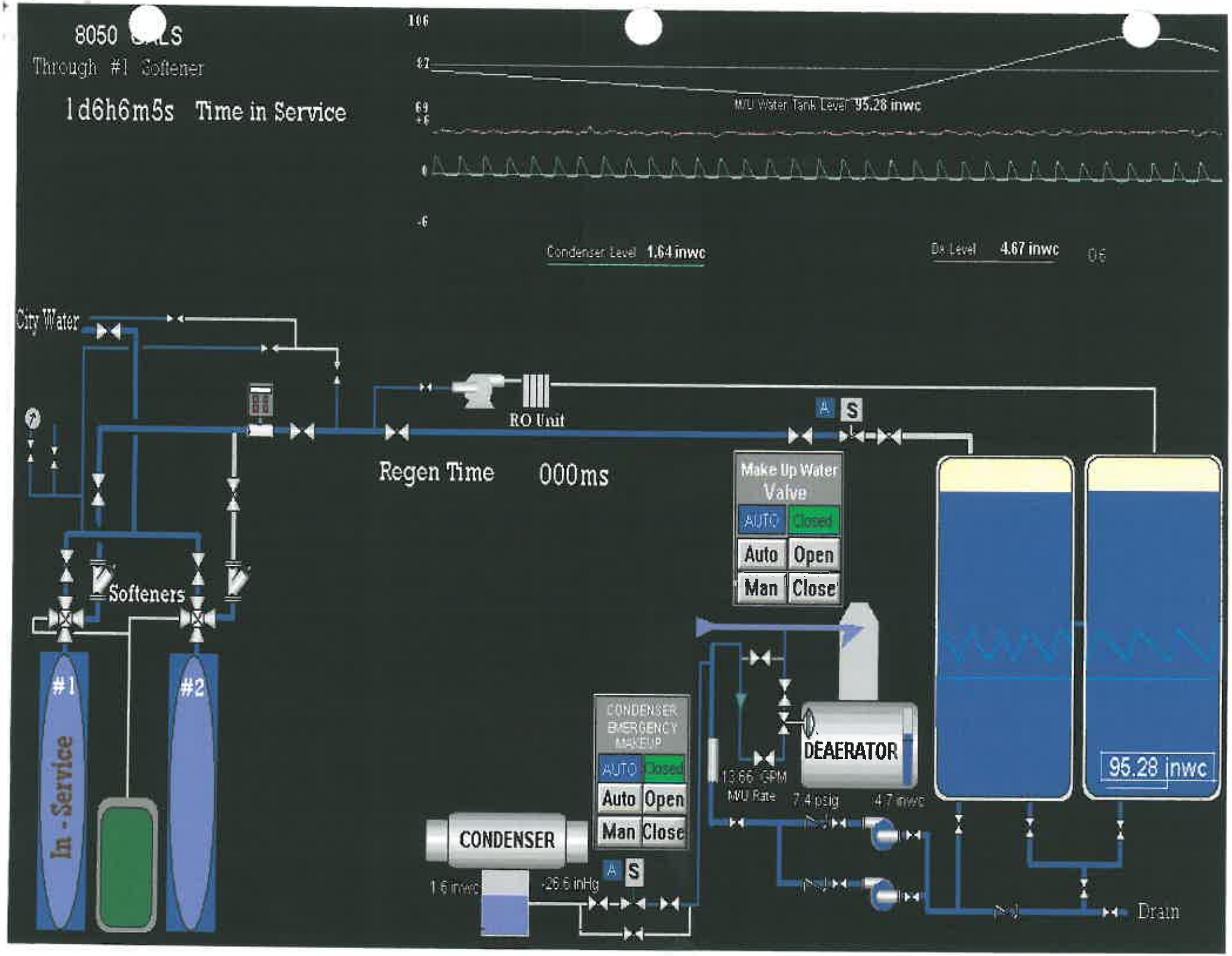
(3) Prior to demolition and reconstruction of a plant or installation the owner should have such demolition and reconstruction approved by the Department as necessary for the control of industrial contaminants in order to comply with phrase "in the necessary control of industrial contaminants." Such approval will be given by the Department only after review of information relative to the specific plant submitted by a professional engineer registered in the State of Florida. Such information shall be adequate in scope to determine the necessity for demolition in the control of contaminants, and shall include plans and specifications for the reconstruction. The Florida Pollution Control Board will provide advice and consultation to the several tax assessors upon request concerning the phrases "increase the capacity of efficiency" and "decrease the unit cost of production."

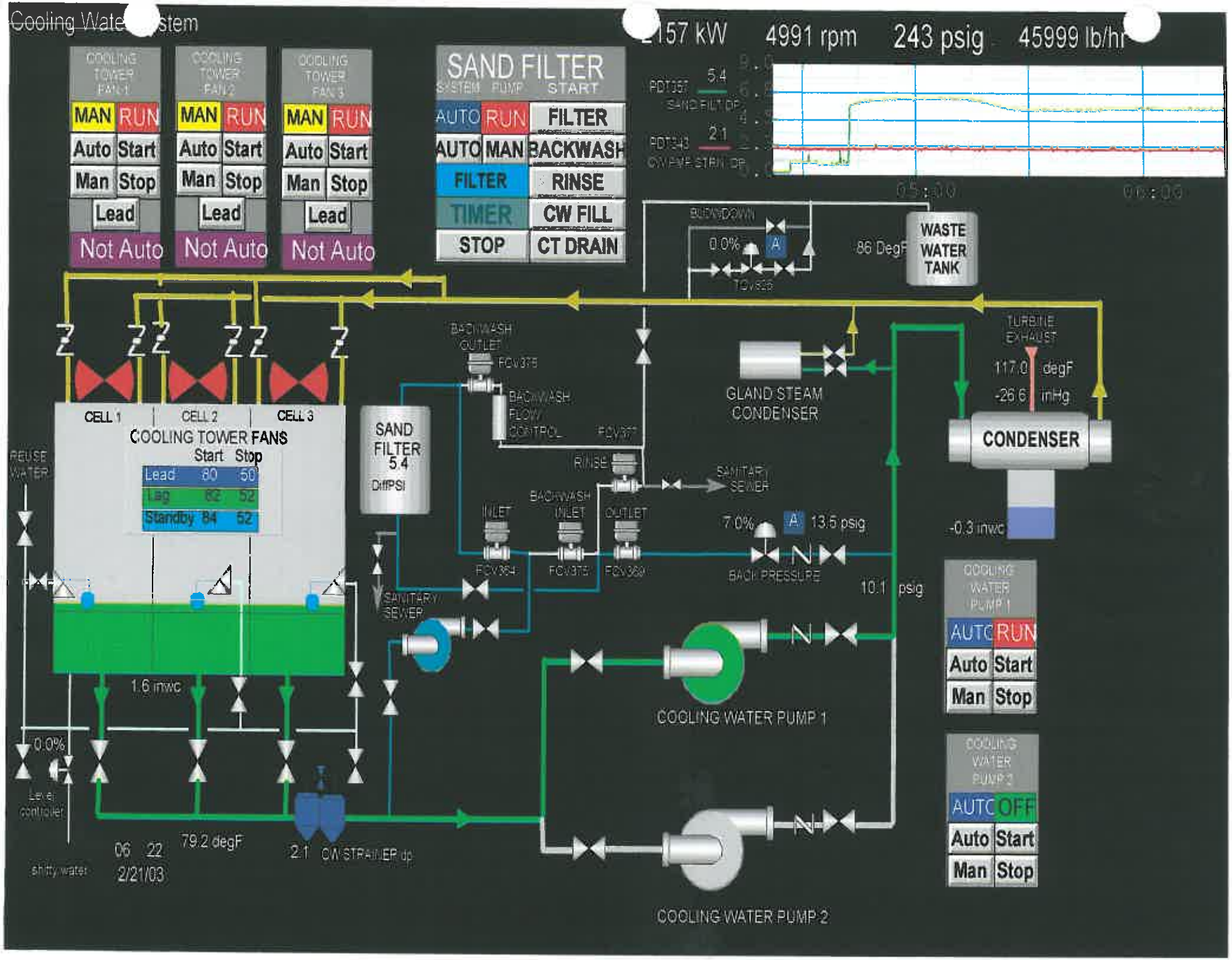
Specific Authority 193.621(8) FS. Law Implemented 403.021(7), 193.621 FS. History–Formerly 28-8.04, 17-8.04, 17-8.040.

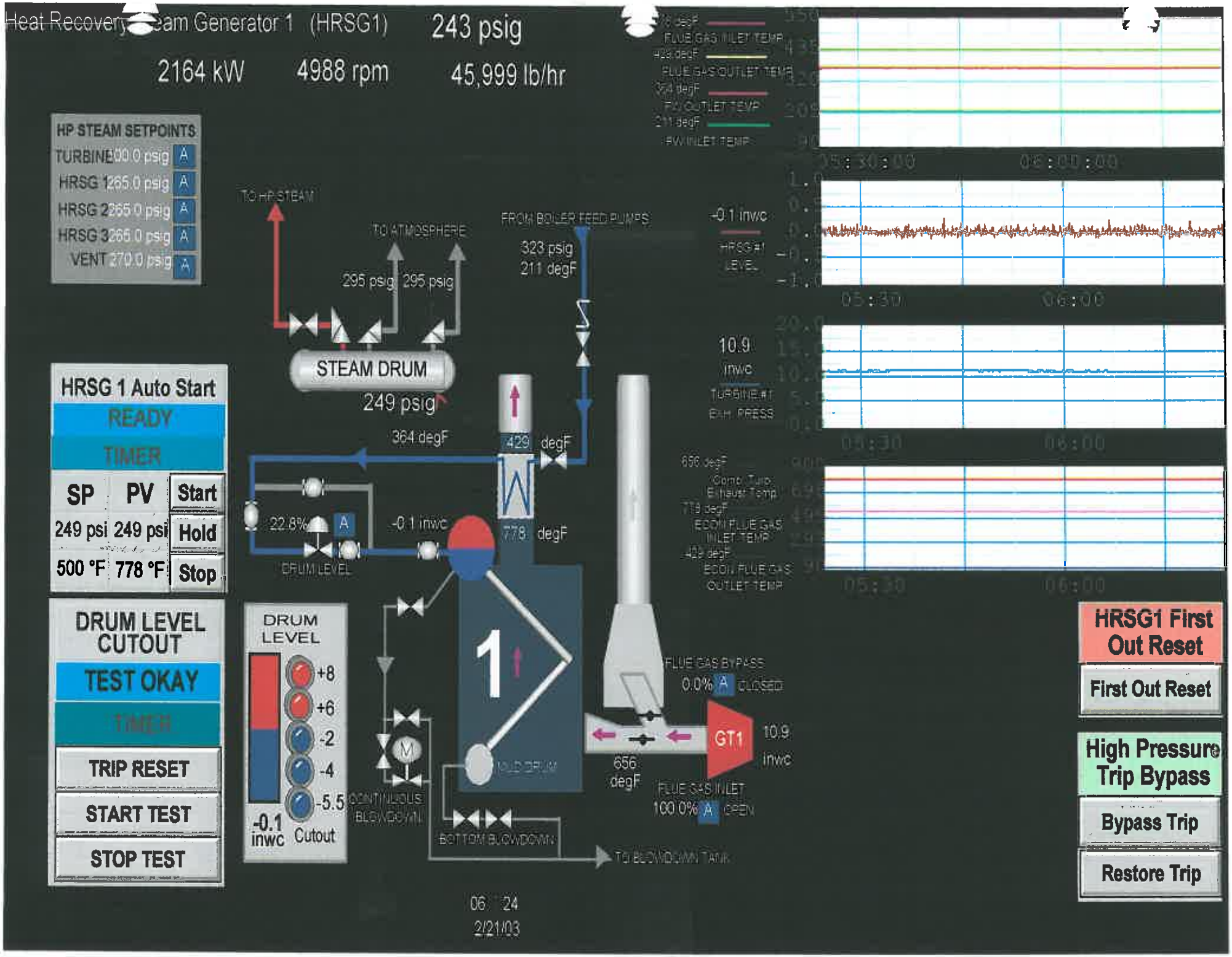

STEAM PLANT AUTO
CONTROL SETPOINTS
HRSG 1 265.0 #
HRSG 2 265.0 #
HRSG 3 265.0 #
Emerg Vent 270.0 #
TURBINE 100.0 #
DA Pressure 7.5 #
Steamjet # 100.0 #
Gland Seal # 3.0 #
HRSG 1 LVL 0.0"
HRSG 2 LVL 0.0"
HRSG 3 LVL 0.0"
MU VALVE 100 .76 "
Emerg MU .6 to .2
403 degF
0.0%
45702 lbm/hr
EMERGENCY VENT
243 psig 2155 kw
1011 degF
1104 F
TempSetpoint
147.74 PSI
150 psi
PressSetpoint
Lo-Cat Dp
1.13 PSID
Temp Control
DRUM LEVEL CUTOUT TEST
START
STOP
Chatterbox Bypass Switch
B/P Alarms
RST Alarms
FO - Reset
1 TEST OKAY
2 TEST OKAY
3 TEST OKAY
CT FAN 1
CT FAN 2
CT FAN 3
MAN
RUN
Auto
Start
Man
Stop
Lead
Not Auto
TRIP
RESET
GOVERNOR IO-D CONTROL VALVE
17%
3.00 #
GLAND SEAL REGULATOR
228 F
Turbine Runtime 45081 Hrs
1799 rpm
4987 rpm
inHg
8650 GALS
Through in-service Softener
Softeners
In-Service
#1
#2
0.0%
TCV826
86 F
100.0 #
18.0%
STEAMJET PRESSURE
RO Unit
Make Up Valve
AUTO
Closed
Auto Open
Man Close
249 psig
HRSG1
22.5%
-0.0"
HRSG1
1122 degF
CLOSED
0.0%
858F
GT1
100.0%
OPEN
10.9 inWC
249 psig
HRSG2
23.8%
-0.0"
HRSG2
1169 degF
CLOSED
0.0%
795F
GT2
100.0%
OPEN
9.6 inWC
249 psig
HRSG3
19.6%
0.0"
HRSG3
1011 degF
CLOSED
0.0%
795F
GT3
100.0%
OPEN
8.7 inWC
Turbine Startup Bypass Switch
BYPASS
RESET
TRAP PUMP 2
TRAP PUMP 1
Trap Pump 2
Trap Pump 1
CELL 1
CELL 2
CELL 3
COOLING TOWER FANS
Start Stop
Lead 80 50
Lag 82 52
Standby 84 52
FILTER
1.5"
88 psig
Air Pressure
117.2 degF
-26.7 inHg
EMERG MU
CONDENSER
0.9"
99 psig 79.4F
2.0 dp
CW PUMP 1
CW PUMP 2
CWP1 A
CWP2 A
CW PUMPS
SAND FILTER
5.4
Diff PSI
6.6%
BACK PRESSURE 13.6 psig
34.1 #
CDP1 A
CDP2 A
COND PUMPS
COND PMP 1
COND PMP 2
WASTE WATER TANK
MU Rate
-4.39 GPM
DA
7.4 # Pressure
35.7%
DA Make Up
5.0"
DA
221 #
333 F
BOILER FEED PUMPS
FWP 1
FWP 2
BFP1 A
BFP2 A
Friday
06 03
2/21/03

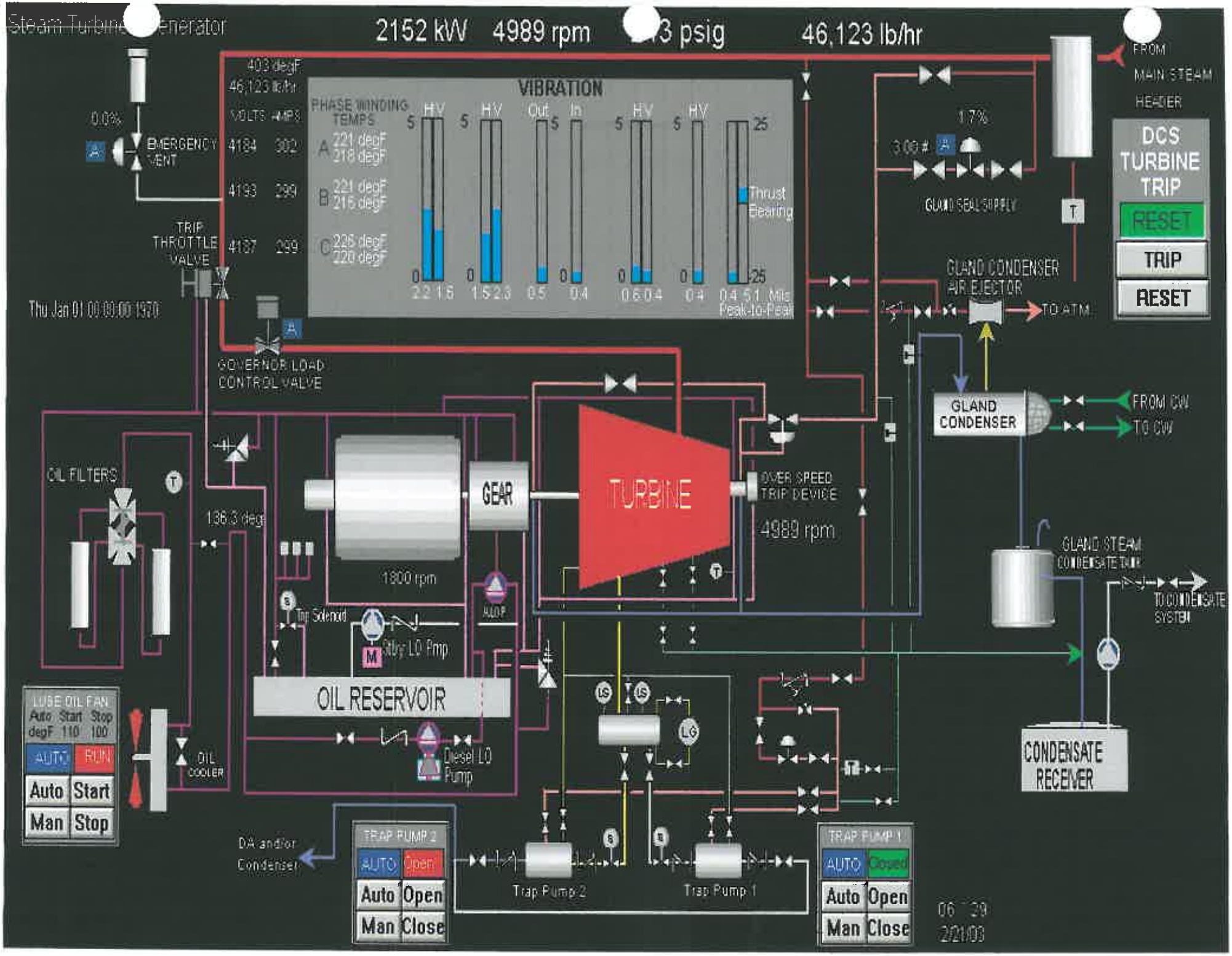

Compressor, Blower and Flare Control
36195512 SCF Total
0.0%
M
Flare Flow
Control Valve
Flare Shut Down
Pilot Failure
Flame Out
1611 degF
Flare Flow
1121 SCFM
Temp Control
1012 degF
147.64 PSI
1104 F
TempSetpoint
150 psi
PressSetpoint
N.C
N.O
Field Gas
Buffalo Tank
Bypass
Dry Filter
Roots Blower
HX
Howden
Howden
Howden
147.64 psig
Lo-Cat Dp
1.12 PSID
8.26 #
Sweet Gas
0.0%
Recycle Valve
9.38 #
Sour Gas
#1 Blwr
#2 Blwr
#3 Blwr
Venturi
"A"
"B"
"C"
Seperator
To & From Oxidizer
#1 Gas Turbine
1118 degF
Running
#2 Gas Turbine
1169 degF
Running
#3 Gas Turbine
1012 degF
Running


Condensate - dwater System
2160 kW 4991 rpm 243 psig 45,952 lb/hr
-0.0 inwc
HRSG #1 LEVEL
0.0 inwc
HRSG #2 LEVEL
-0.0 inwc
HRSG #3 LEVEL
05:30
06:00
To Atm
Startup Steam
Jet Air Ejector
HP STEAM
TO TURBINE
403 degF
SF DP
5.4
CONDENSER
EMERGENCY
MAKEUP
AUTO Closed
Auto Open
Man Close
COND LEVEL
0.1 inwc
CT LEVEL
1.6 inwc
DA LEVEL
4.9 inwc
DI WATER
Vac. Brkr
CONDENSER
EMERGENCY
MAKEUP
PUMP RECIRCULATION
Vent To
Atmosphere
17.9%
99.9 psig
STEAM JET PRESSURE
36.2%
DA PRESSURE
-26.6 inHg
CONDENSER
0.1 inwc
34.9 psig
AFTERCOOLER
INTERCOOLER
STEAM JET
AIR EJECTORS
DA MAKEUP
DEAERATOR
7.6 psig
4.9 inwc
DA OVERFLOW
TO WASTEWATER
CHEM FEED
CONDENSATE
PUMP 1
AUTO RUN
Auto Start
Man Stop
CDP1 A
CDP2 A
CONDENSATE PUMPS
CONDENSATE
PUMP 2
AUTO OFF
Auto Start
Man Stop
BOILER
FEED
PUMP B
AUTO OFF
Auto Start
Man Stop
BOILER
FEED
PUMP A
AUTO RUN
Auto Start
Man Stop
BFP1 A
BFP2 A
325 psig
BOILER FEED PUMPS 233 degF
HRSG 1
ECON
249 psig
-0.0 inwc
21.5%
HRSG 2
ECON
249 psig
0.0 inwc
22.7%
HRSG 3
ECON
249 psig
-0.0 inwc
20.9%
-200 degF
PREV
06 20
2/21/03
GROUP
ALARM
TREND
NEXT


8050 GALS
Through #1 Softener
1d6h6m5s Time in Service
106
82
69
56
0
-6
M/U Water Tank Level 95.28 inwc
Condenser Level 1.64 inwc
DA Level 4.67 inwc
City Water
RO Unit
A
S
Regen Time 000ms
Make Up Water Valve
AUTO Closed
Auto Open
Man Close
Softeners
#1
#2
In - Service
CONDENSER EMERGENCY MAKEUP
AUTO Closed
Auto Open
Man Close
CONDENSER
1.6 inwc
-26.6 inHg
13.66 GPM M/U Rate
7.4 psig
4.7 inwc
DEAERATOR
95.28 inwc
Drain


Cooling Water System
157 kW
4991 rpm
243 psig
45999 lb/hr
COOLING TOWER FAN 1
COOLING TOWER FAN 2
COOLING TOWER FAN 3
MAN RUN
Auto Start
Man Stop
Lead
Not Auto
SAND FILTER
SYSTEM PUMP START
AUTO RUN FILTER
AUTO MAN BACKWASH
FILTER RINSE
TIMER CW FILL
STOP CT DRAIN
PDT357 5.4
SAND FILT DP
PDT243 2.1
CW PMP STRN DP
BLOWDOWN
0.0%
TCV320
86 DegF
WASTE WATER TANK
BACKWASH OUTLET
FCV375
BACKWASH FLOW CONTROL
FCV377
GLAND STEAM CONDENSER
TURBINE EXHAUST
117.0 degF
-26.6 inHg
CONDENSER
-0.3 inwc
CELL 1
CELL 2
CELL 3
COOLING TOWER FANS
Start Stop
Lead 80 50
Lag 82 52
Standby 84 52
SAND FILTER 5.4 DiffPSI
RINSE
SANITARY SEWER
INLET
BACKWASH INLET
OUTLET
FCV364
FCV376
FCV369
7.0%
13.5 psig
BACK PRESSURE
10.1 psig
REUSE WATER
SANITARY SEWER
1.6 inwc
0.0%
Level controller
dirty water
06 22
2/21/03
79.2 degF
2.1 CW STRAINER dp
COOLING WATER PUMP 1
COOLING WATER PUMP 2
COOLING WATER PUMP 1
AUTO RUN
Auto Start
Man Stop
COOLING WATER PUMP 2
AUTO OFF
Auto Start
Man Stop


Heat Recovery Steam Generator 1 (HRSG1)
243 psig
2164 kW
4988 rpm
45,999 lb/hr
HP STEAM SETPOINTS
TURBINE 600.0 psig A
HRSG 1 265.0 psig A
HRSG 2 265.0 psig A
HRSG 3 265.0 psig A
VENT 270.0 psig A
TO HP STEAM
TO ATMOSPHERE
295 psig
295 psig
FROM BOILER FEED PUMPS
323 psig
211 degF
STEAM DRUM
249 psig
364 degF
429 degF
778 degF
22.8% A
DRUM LEVEL
-0.1 inwc
HRSG 1 Auto Start
READY
TIMER
SP PV Start
249 psi 249 psi Hold
500 °F 778 °F Stop
DRUM LEVEL CUTOUT
TEST OKAY
TIMER
TRIP RESET
START TEST
STOP TEST
DRUM LEVEL
+8
+6
-2
-4
-5.5
-0.1 inwc Cutout
CONTINUOUS BLOWDOWN
BOTTOM BLOWDOWN
TO BLOWDOWN TANK
FLUE GAS BYPASS
0.0% A CLOSED
GT1
656 degF
10.9 inwc
FLUE GAS INLET
100.0% A OPEN
-0.1 inwc
HRSG#1 LEVEL
10.9 inwc
TURBINE#1 EXH PRESS
656 degF
Comb. Turb. Exhaust Temp
778 degF
ECON#1 FLUE GAS INLET TEMP
429 degF
ECON. FLUE GAS OUTLET TEMP
05:30:00
06:00:00
05:30
06:00
HRSG1 First Out Reset
First Out Reset
High Pressure Trip Bypass
Bypass Trip
Restore Trip
06 24
2/21/03


Steam Turbine Generator
2152 kW
4989 rpm
46,123 lb/hr
FROM MAIN STEAM HEADER
VIBRATION
PHASE WINDING TEMPS
A 221 degF 218 degF
B 221 degF 216 degF
C 225 degF 220 degF
Thrust Bearing
EMERGENCY VENT
TRIP THROTTLE VALVE
GOVERNOR LOAD CONTROL VALVE
GLAND SEAL SUPPLY
GLAND CONDENSER AIR EJECTOR
TO ATM
DCS TURBINE TRIP
RESET
TRIP
RESET
GLAND CONDENSER
FROM CW
TO CW
OIL FILTERS
GEAR
TURBINE
OVER SPEED TRIP DEVICE
4989 rpm
1800 rpm
GLAND STEAM CONDENSATE TANK
TO CONDENSATE SYSTEM
OIL RESERVOIR
Diesel LO Pump
LUBE OIL FAN
Auto Start Stop
AUTO RUN
Auto Start
Man Stop
OIL COOLER
CONDENSATE RECEIVER
DA and/or Condenser
TRAP PUMP 2
AUTO Open
Auto Open
Man Close
Trap Pump 2
Trap Pump 1
TRAP PUMP 1
AUTO Open
Auto Open
Man Close

U.S. Environmental Protection Agency

Landfill Methane Outreach Program

Home
About LMOP
Database of Landfills and Energy Projects
Landfills Seeking Projects
LFG as Green Power
LMOP Partners
Join LMOP
Products and Services
Gasette
International Activity
Workshops/ Conferences
FAQ
Site Map
Contact Us

U.S. EPA's Landfill Methane Outreach Program (LMOP) is a voluntary assistance and partnership program that promotes the use of landfill gas as a renewable energy source. By preventing emissions of methane—a powerful greenhouse gas—through the development of landfill gas energy projects, LMOP helps businesses, states, and communities protect the environment and build a sustainable future.

Recent Additions

6th Annual LMOP Conference and Project Expo Presentations Available

LMOP Announces 2002 Award Winners

Workshops / Conferences

Proceedings / Presentations

Upcoming Events

National News

World Resources Institute publishes "Opportunities With Landfill Gas" (16 pgs., 928KB PDF) EXI Disclaimer

U.S. Environmental Protection Agency

Landfill Methane Outreach Program

About LMOP

The Benefits of Utilizing Landfill Gas

Landfill gas (LFG) emitted from decomposing garbage is a reliable and renewable fuel option that remains largely untapped at many landfills across the United States, despite its many benefits. Click on one of the entries below to find out more about LFG:

Converting Landfill Gas (LFG) to Energy

Landfill Gas Results from Decomposing Waste

LFG is created when organic waste in a landfill naturally decomposes. This gas consists of about 50 percent methane (CH_4), the primary component of natural gas, about 50 percent carbon dioxide (CO_2), and a small amount of non-methane organic compounds. Instead of allowing LFG to escape into the air, it can be captured, converted, and used as an energy source. Using LFG helps to reduce odors and other hazards associated with LFG emissions, and it helps prevent methane from migrating into the atmosphere and contributing to local smog and global climate change.

Using Landfill Gas Can Benefit the Local and Global Environment

LFG projects go hand-in-hand with community commitments to cleaner air, improved public welfare and safety, and reductions in greenhouse (global warming) gases. Converting LFG to energy also offsets the need for non-renewable resources such as coal and oil, and thereby reduces emissions of air pollutants from conventional resources such as sulfur dioxide, a major contributor to acid rain. Eliminating LFG emissions also reduces unpleasant odors and explosion threats at a landfill, making the area around the site a better place to live. LFG projects also help fight global climate change, since they eliminate emissions of methane, one of the most potent greenhouse gases.

Using Landfill Gas Can Benefit Communities

Using LFG is a win/win opportunity. LFG projects involve citizens in sustainable community planning, create partnerships, and promote common interests among local entities. For example, the Ecology Club at Pattonville High School in Maryland Heights, Missouri, came up with the idea to use gas from the nearby landfill to heat their school. The school paid $175,000 to run a 3,600 foot pipeline between the landfill and the school's two basement boilers. In turn, the landfill owner donated the methane to the school as a

way of "giving back to the community." The school anticipates that it will save $40,000 a year, and recapture its investment within five years.

Using Landfill Gas Can Benefit Environmental Compliance

Current EPA regulations under the Clean Air Act require many larger landfills to collect and combust LFG. There are several compliance options, including flaring the gas, or installing an LFG use system. Only LFG energy recovery or use offers communities and landfill owners the opportunity to reduce the costs associated with regulatory compliance by turning pollution into a valuable community resource.

Using Landfill Gas Can Benefit the Local Economy

LFG projects generate revenue from the sale of the gas. LFG use can also create jobs associated with the design, construction, and operation of energy recovery systems. LFG projects involve engineers, construction firms, equipment vendors, and utilities or end-users of the power produced. Much of this cost is spent locally for drilling, piping, construction, and operational personnel, helping communities to realize economic benefits from increased employment and local sales.

By linking communities with innovative ways to deal with their LFG, LMOP helps communities enjoy increased environmental protection, better waste management, and responsible community planning.

Calculating LFG Benefits

To determine the environmental and energy benefits of an LFG utilization project, LMOP compiled the following figures:

- 1 million tons of municipal solid waste in a landfill typically generates 300 cubic foot per minute (cfm) of landfill gas that could then generate 7,000,000 kilowatt hours (kWh) per year.
- 7,000,000 kWh is enough energy to power 700 homes for a year.
- Utilizing 300 cfm/year of landfill gas yields the same reduction in greenhouse gases as removing 6,100 cars from the road for one year.
- Similarly, utilizing 300 cfm/year has the same greenhouse gas impact as planting 8,300 acres of trees.

Want to figure out the greenhouse gas benefits for a specific LFG utilization project? Just replace the waste in a landfill in the first bullet above with the actual tons of waste in a particular landfill and calculate what the environmental and energy benefits will be for that project.

EPA's Landfill Methane Outreach Program (LMOP)

LMOP Promotes Landfill Gas as an Important Local Energy Resource

The Landfill Methane Outreach Program (LMOP), created as part of the United States' commitment to reduce greenhouse gas emissions under the United Nations Framework Convention on Climate Change, is a voluntary

United Nations Framework Convention on Climate Change, is a voluntary program designed to encourage and facilitate the development of environmentally and economically sound LFG projects. LMOP does this by educating local government and communities about the benefits of LFG recovery and building partnerships between state agencies, industry, energy service providers, local communities, and other stakeholders interested in developing this valuable resource in their community. Accomplishments since program launch in 1994 include the following:

- As of November 2002, LMOP has more than 320 Partners that have signed voluntary agreements to work with EPA to develop cost-effective LFG projects, including every major LFG project development company.
- LMOP has developed detailed profiles for over 1,300 candidate landfills in 31 states, and has data for more landfills in all states.
- There more than 340 operational LFG projects in the United States. In addition, about 200 projects are currently under construction or are exploring development options and opportunities. To date, LMOP has assisted in the development of over 220 LFG utilization projects – 30 out of the 31 projects that went on-line in 2001 alone. Together, these 220 projects are responsible for significant reductions in the emission of methane, a potent greenhouse gas. They also are preventing the emission of carbon dioxide, since using LFG for energy offsets the need to use other, more polluting fuels. In the year 2001, all operational LFG energy projects in the U.S. prevented the release of 14.5 million metric tons of carbon equivalent (MMTCE, the basic unit of measure of greenhouse gases) into the atmosphere. This reduction is the carbon equivalent of removing 11.7 million cars from the road for one year.

LMOP Brings Interested Parties Together on LFG Project Development

Through its Partnership programs, LMOP works with energy organizations, states, tribes, and local government, and the LFG industry and trade associations to promote the recovery and use of LFG. The LMOP Partnership programs help communities and landfill owner/operators learn more about landfill gas use. LMOP educates communities about the benefits of using LFG as an alternative energy source and helps them develop or participate in LFG projects that are considered technically and economically feasible. LMOP provides—free of charge—information, software tools, and marketing assistance, and access to technical experts to facilitate development of LFG projects. The program then promotes the success of LFG projects and participants.

Top of Page

LFG as Green Power

LFG Electricity Generation Technologies, Typical Costs, and NO_x Emissions

U.S. EPA created LMOP in 1994 to significantly reduce greenhouse gas (methane) emissions from municipal solid waste (MSW) landfills by encouraging the use of LFG for energy. LMOP works in voluntary partnership with states, communities, the landfill industry, utilities, and energy users, providing technical assistance for MSW LFG use projects. Since 1994, LMOP efforts have reduced landfill methane emissions by over 10 million metric tons of carbon equivalent (MMTCE). The greenhouse gas reduction benefits are equivalent to having planted 11 million acres of forest or removed the annual emissions from 8 million cars over the 7-year period.

In addition, EPA regulates certain landfills under the 1996 New Source Performance Standards and Emission Guidelines for Municipal Solid Waste Landfills. These standards apply to large landfills, and require the collection and combustion of LFG if the landfill has the potential to emit 50 mg/year or more of non-methane organic compounds. There are two compliance options: flare the gas, or install an LFG use system. Landfill gas-to-energy projects allow subject landfills to comply with this regulation while providing a clean, renewable resource.

Of the estimated 2,500 MSW landfills currently operating in the United States, approximately 340 have LFG utilization projects, 230 of which are electricity generation projects. Approximately 60 more projects are currently under construction. We estimate that over 600 more MSW landfills could turn their gas into energy, producing enough electricity to power over 1 million homes. The potential greenhouse gas (methane) reduction from these 600 landfills is over 14 MMTCE per year, which is equivalent to the greenhouse gas benefits of planting 18 million acres of forest per year.

MSW Landfill Gas Composition

LFG is generated when organic materials in MSW landfills are naturally decomposed by bacteria. The gas is approximately 50% methane, the primary component of natural gas. The other 50% of the gas is predominantly carbon dioxide, with small amounts of nitrogen and oxygen, and trace levels of non-methane organic compounds. All MSW landfills emit this gas in amounts that depend on a variety of factors, such as waste composition and the landfill size. LFG generation typically begins after waste disposal and can continue for 20 or 30 years after the landfill is closed. The gas can be used as fuel for an engine, turbine, or other device to produce electricity.

Environmental Benefits of Generating Electricity from LFG

Generating electricity from LFG creates a number of environmental benefits. Using this resource:

Directly reduces greenhouse gas emissions. MSW landfills are the largest human-generated source of methane emissions in the United States, releasing an estimated 58 MMTCE to the atmosphere in 1999 alone. Given that all landfills generate methane, it makes sense to use the gas for the beneficial purpose of energy generation rather than emitting it to the atmosphere. Methane is a very potent greenhouse gas that is a key contributor to global climate change (over 21 times stronger than CO_2.) Methane also has a short (10-year) atmospheric life. Because methane is both potent and short-lived, reducing methane emissions from MSW landfills is one of the best ways to achieve a near-term beneficial impact in mitigating global climate change. An LFG electricity project captures roughly 85% of the methane emitted from the MSW landfill. The captured methane is destroyed (converted to water and the much less potent CO_2) when the gas is burned to produce electricity. (CO_2 emissions from MSW landfills are not considered to contribute to global climate change because the carbon was contained in recently living biomass. The same CO_2 would be emitted as a result of the natural decomposition process. CO_2 from fossil fuel combustion contributes to global climate change because the carbon has been stored in the fossil fuels and would not be emitted if these fuels were not combusted.) The greenhouse gas reduction benefits of a typical 5 megawatt (MW) LFG project equate to planting over 80,000 acres of forest per year or removing the annual emissions from over 60,000 cars.

Indirectly reduces air pollution by offsetting the use of non-renewable resources. Producing electricity from MSW LFG avoids the need to use non-renewable resources such as coal, oil, or natural gas to produce the same amount of electricity. This can avoid power plant emissions of $CO_2$and criteria pollutants such as sulfur dioxide (which is a major contributor to acid rain), particulate matter (a respiratory health concern), nitrogen oxides (NO_x), and trace hazardous air pollutants.

It should be noted that MSW LFG electricity generation devices, like all combustion devices, generate some emissions of NO_x, which can contribute to local ozone and smog formation. Depending on the fuels and technologies used by the power plant and the landfill project, the NO_x emission reductions from the power plant may not completely offset the NO_x emitted from the LFG electricity project. However, the overall environmental improvement from MSW LFG electricity generation projects is significant because of the large methane reductions, hazardous air pollutant reductions, and avoidance of the use of limited non-renewable resources such as coal and oil that are more polluting than LFG.

Provides other local benefits. Collecting MSW LFG to produce electricity improves the air quality of the surrounding community by reducing landfill odors. Burning LFG to produce electricity also destroys most of the non-methane organic compounds that are present at low concentrations in uncontrolled LFG, thereby reducing possible health risks from these compounds. Gas collection can also improve safety by reducing explosion hazards from gas accumulation in structures on or near the landfill. Generating electricity from existing MSW landfills is also a relatively cost-effective way to provide new renewable energy generation capacity to supply community power needs, and can create jobs that help build the local economy.

LFG Project Sizes and Energy Conversion Technologies

In general, landfills that are still operational or closed within the last few years are the best candidates for electricity generation projects because LFG generation peaks shortly after closure, and then gradually declines over a number of years. Typically, the best candidates have at least 1 million tons of waste-in-place. However, successful projects have been developed at younger landfills with less waste-in-place by combining gas from multiple landfills, or by starting projects with a single reciprocating engine or microturbine and then adding additional electricity generation capacity as the landfill accepts more waste and the gas flow increases.

An MSW landfill with 1 million tons of waste-in-place can typically support an 800 kilowatt (kW) to 1 MW electricity generation project. Reciprocating engines are the most widely used LFG electricity generation technology. A reciprocating engine is usually the most feasible and cost-effective technique for landfills in the 1 to 5 MW size range, producing electricity at a cost of approximately 4 to 6 cents per kilowatt-hour (kWh). Costs vary depending on whether the MSW landfill already has a gas collection system and other site-specific factors. Gas turbines have been used at several large landfills (generally for projects larger than 5 MW). Microturbines with capacities of about 30 kW are a relatively new technology that has recently been applied at a few landfills, and could be used to generate relatively small amounts of electricity for use on-site.

In assessing achievable emission limits, each project will vary in terms of size, appropriate technology application, and operation conditions. It is important to consider operating experience with a given technology under the varying atmospheric temperatures and LFG compositions encountered at actual MSW landfills. Regardless of the technology used, LFG electricity generation projects must comply with state NO_x emission standards and undergo the proper state and local permitting processes.

Inclusion of LFG in Green Power Products and Green Pricing Programs

In addition to providing the environmental benefits outlined above, LFG is widely recognized as a valuable green power resource. LFG is already included in over 20 green pricing programs. (Per DOE's National Renewable Energy Laboratory: http://www.eren.doe.gov/greenpower/summary.shtml [EXIT disclaimer]). Currently, 12 states include LFG in their renewable portfolio standard (RPS) or goal. The advantages of using LFG in a green power offering include the following.

- Existing MSW landfills that can support electricity projects are available in every state.
- MSW landfills reliably generate electricity 24 hours a day, 7 days a week, for periods of 10 years or longer.
- LFG projects tend to be one of the more cost-effective forms of renewable energy generation. Costs to generate electricity from landfill gas typically range from 4 to 6 cents/kWh (for reciprocating engine projects). A green pricing premium that provides higher electricity sales revenues will help cover the higher costs of landfill gas electricity projects, increasing their economic feasibility and making them more competitive with fossil fuel electricity generation.
- Many utilities and green power providers have found that MSW LFG projects are a good building block for new green pricing programs. They can be used to leverage other, more expensive renewable resources, such as solar energy, by keeping the overall costs of mixed green power offerings (combining MSW LFG electricity with

wind, solar, and other renewable energy sources) within a range that consumers are willing to pay.

Additional Information on LFG Energy

Contact us for more information. We can provide information on MSW landfills in each state that are good candidates for energy projects, technical information and software to assess project options and economics, and access to a network of project partners and experts.

LFG Electricity Generation Technologies, Typical Costs, and NOx Emissions

These technologies currently are used to generate electricity from MSW LFG, reciprocating engines, gas turbines, microturbines, and boiler-steam turbine projects. The information below focuses on the landfill size for which each technology is most appropriate, the general cost range for LFG electricity projects, and typical nitrogen oxide (NO_x) emission levels for each technology.

Energy Conversion Technologies

Reciprocating Engines

Reciprocating Engines are by far the most common technology used to generate electricity from MSW LFG, representing 82 percent of LFG electricity projects.

Technology Description - LFG projects typically use 4-stroke lean-burn engines, that function similarly to automobile engines. These engines combust LFG with significant amounts of excess air to provide greater efficiency and lower NO_x emissions. For power generation, the engine is connected to a crankshaft that turns an electrical generator to produce electricity.

Applicability - Engine models used at landfills range in size from approximately 0.5 to 3 MW, and are generally used in projects with capacities ranging from 0.8 to 6 MW (many with more than one engine). Recently, some smaller models have been developed. Reciprocating engines are usually the most feasible and cost-effective electricity generation technology for landfills containing approximately 1 million to 5 million tons of waste, and have been used for landfills with up to about 10 million tons of waste. (An MSW landfill with 1 million tons of waste in place can typically support a 0.8 to 1 MW electricity project.)

Cost - The cost of LFG electricity generation projects using reciprocating engines is typically in the range of 4 to 7 cents per kilowatt hour (¢/kWh). These costs include capital, installation, and operating costs. Costs vary depending on whether an LFG collection system has already been installed and other site-specific technical factors, and how the project is financed (municipal versus private).

NO_x Emissions - In recent years, reciprocating engine manufacturers have

focused on minimizing NO_x emissions through improved combustion system design and operating techniques. For example, LMOP information collected in 1997 indicated that reciprocating engine NO_x emissions for several models ranged from 1 gram/brake horsepower hour (g/bhph) to over 2 g/bhph (approximately 3.2 lb/MWh to over 6.4 lb/MWh). In 2002, information provided by engine manufacturers, LFG project developers and operators indicates that at least four engine manufacturers and several project operators now have significant experience with designing and operating LFG-fired engines at the 1.0 g/bhph NO_x (3.2 lb/MWh) level. This level can typically be achieved at any MSW landfill, and is similar to the NO_x levels achieved when the same engine models fire natural gas.

Today, at least four engine manufacturers offer a NO_x performance level of 0.6 g/bhph on one or more of their new engine models. This is generally achieved by adding a precombustion chamber. These engine models tend to be 1.4 MW or greater, in size, and represent a first generation of lower NO_x engines for LFG use. The limited operating experience with this first generation of lower NO_x engines suggests that these engines will experience decreases in fuel efficiency of 2 to 10 percent, increases in capital cost of 2.5 to 10 percent, and increases in maintenance costs of 1 to 2 percent. Some operators are experiencing the need to make frequent adjustments as ambient temperatures and LFG composition change, increasing their engine operating costs.

If stringent NO_x emissions (0.6 g/bhph) levels are in place, development of LFG electricity projects, especially at small and medium-sized landfills, would be discouraged. This is due mainly to the lack of low NO_x engines less than 1.4 MW in size, and the fact that most projects in operation today (even larger sites) use engines in the 1 MW range. Even for landfills that could use the larger size engines, the lower NOx limits would increase the costs of LFG electricity projects.

Add-on NO_x controls that are occasionally used on natural gas-fired engines are generally not applicable to LFG-fired engines. These controls use catalyst-filled containers that are fitted on the engine exhaust to catalytically destroy NO_x emissions. However, LFG contains compounds, such as siloxanes, that will contaminate the catalyst and eliminate its ability to destroy NO_x.

Advantages - The relative advantages of reciprocating engines include their low capital cost, reliability, less fuel processing requirements than turbines, and size-suitability to moderately sized landfills.

Disadvantages - Include higher NO_x emissions and higher maintenance costs relative to other technologies.

Gas Turbines

Gas Turbines have been used at several large MSW landfills (generally for landfills with over 5 million tons of waste and projects that generate more than 5 MW of electricity).

Technology Description - Gas turbines heat large quantities of compressed atmospheric air, which expands in the power turbine to develop shaft horsepower to drive an electrical generator.

Applicability - The relatively high capital cost of turbines, higher fuel pressure requirements and lower power generation efficiency tends to render them less suited for small or moderately sized landfills, which represent the majority of the remaining potential LFG electricity projects.

Cost - The costs to generate electricity using turbines are typically about 10%, higher than reciprocating engine costs for landfills containing up to 5 million tons of waste. Turbines can become more economical for large landfills (those approaching 10 million tons of waste), with costs ranging from approximately 4 to 7 ¢/kWh for such landfills. Costs vary depending on whether an LFG collection system is already in place and other site-specific technical factors, and how the project is financed (municipal versus private).

NOx Emissions - The gas turbines that have been installed at large (>3 MW) landfill electricity projects, reliably meet NO_x emission limits between 25 and 35 ppm (at 15% oxygen), without increased costs or efficiency losses. This equates to 1.5 to 2.1 lb/MWh. Since turbine NO_x emissions are very sensitive to LFG conditions, manufacturers do not offer standard NO_x guarantees, but prefer to base each guarantee on the results of LFG analysis.

While literature reports the recent development of natural gas turbine technologies that produce lower NO_x emissions than traditional LFG electricity generation sources, these technologies were developed for natural gas. According to the turbine manufacturers, they are not suitable for LFG operation, because they require a very clean fuel with a very high heating value, unlike LFG.

Advantages - Gas turbines use large amounts of excess air and the gas/air mixture has a relatively short residence time in the combustion zone. These factors result in rapid cooling of the combustion reaction to temperatures that are not conducive to NO_x formation, leading to lower NO_x emissions than reciprocating engines. Another general advantage of turbines is their relatively low maintenance costs.

Disadvantages - A disadvantage for use in typical LFG electricity projects is that turbine models currently available for landfills tend to be larger than 3 MW.

Boilers with Steam Turbines

Boilers with Steam Turbines utilize the same systems as steam-electric power plants, and have been applied at only a few large landfills due to their capital intensive nature and size requirements.

Technology Description - Water is heated to produce steam, which is expanded in a turbine to spin a generator, which produces electricity.

Applicability - They are suitable for MSW landfills containing 15 million tons of waste in place or more, and typically produce at least 10 MW of electricity.

Cost - For these large size projects, the costs range from approximately 4 to 7 ¢/kWh of electricity produced.

NOx Emissions - The typical NO_x formation in a standard LFG-fired boiler is

NOx Emissions - The typical NOx formation in a standard LFG-fired boiler is 50 ppm (at 3% oxygen) or 1.0 lb/MWh. NO_x emissions can be controlled in LFG-fired boilers with the use of low NO_x burners (LNB) and flue gas recirculation (FGR). These technologies have been commonly used on LFG-fired boilers for several years and can reliably achieve NO_x emission levels below 30 ppm (at 3% oxygen) or 0.6 lb/MWh. LNB/FGR technologies (and to a lesser extent simple LNB technologies) add to both the capital and operating costs of boilers. These added costs are attributable to more complex burners and to greater fan size and power requirements (needed for conveying LFG and air through the burner).

Advantages - Boilers have high energy generation efficiencies and lower NO_x emissions than reciprocating engines.

Disadvantages - Must be built in much larger sizes to be cost-effective, so are not suitable for the majority of LFG electricity projects.

Microturbines

Microturbines are a recently commercialized technology that is currently being demonstrated at several MSW landfills, with the first LFG-fired units coming on line in 2001. Originally developed for natural gas applications, this technology is yet unproven using LFG.

Technology Description - They are based on the same design principles as much larger gas turbines, but generate much smaller amounts of electricity. For example, typical microturbine models generate 30 to 100 kW of electricity.

Applicability - Their size makes them generally best suited for relatively small applications, typically 1 MW or less.

Cost - Estimated costs for LFG microturbine electricity generation projects are generally 7 to 14 ¢/kWh. The lower end of the range would represent a landfill that has a gas collection system already in place (which is unlikely for small landfills) and generates power for on-site use, avoiding costs associated with connection to the power grid.

NOx Emissions - Due to the nature of their design, microturbines are capable of achieving low NO_x levels when firing LFG. Two manufacturers offers a NO_x performance guarantee of 9 ppm (at 15% oxygen). Lower NO_x emissions have been demonstrated in one microturbine test. NO_x emissions of 9 ppm for these turbines are approximately equivalent to 0.7 lb/MWh.

Advantages - Advantages of microturbines include lower NO_x emissions, portability, and low maintenance requirements relative to reciprocating engines.

Disadvantages - Disadvantages include high capital costs, high fuel pressure requirements, gas treatment requirements, and relatively low energy conversion efficiency.

Electricity Technology Efficiency

It is important to understand that efficiency, along with many other issues

such as cost and environmental protection factors, drive whether or not an LFG electricity project is developed. Electricity generation projects must consume a portion of their electricity production for cleaning and compressing the LFG for proper combustion in the reciprocating engine or turbine, reducing their net electricity generation. Gas turbines tend to be less efficient than reciprocating engines in terms of net electricity production from LFG, in that turbine projects can consume from 10 to 20 percent of their electricity production for LFG cleaning and compression, while reciprocating engine projects consume approximately 6 to 10 percent of their electricity production.

Summary

Table 1 summarizes the number of operational LFG electricity projects and typical capacities and costs of these projects.

Table 1. Comparison of LFG Electricity Technologies

	Reciprocating Engine	Gas Turbine	Micro-Turbine	Boiler
Number of LFG Projects[1]	176	29	3	8
Percent of Total Projects[1]	82	13	1	4
Average Project Capacity[1]	3 MW	6 MW	NA[5]	10 MW
Typical Project Capacity Range (MW)[1,2,3]	0.8 - 6 MW	3 -10 MW	NA[5]	10 MW
Approximate Costs for the Listed Project Size Range[3,4]	4 -7¢/kWh	4 -7¢/kWh[6]	7 -14¢/kWh	4-7¢/kWh[6]

MW = megawatt
kWh = kilowatt hour

[1] From *Landfill and Landfill Gas Utilization Database*. U.S. EPA , Landfill Methane Outreach Program. April 2002.

[2] LMOP contacts with manufacturers, project developers and operators, 2002.

[3] LMOP Project development handbook *Turning a Liability into an Asset: A Landfill Gas-to-Energy Project Development Handbook*. U.S. EPA, Landfill Methane Outreach Program. EPA/430/B-96-0004. September 1996. http://www.epa.gov/lmop/products/products.htm#1.

[4] LMOP Draft LFGcost Model, based on cost information collected in 2001.

[5] A capacity range for typical commercial projects is not available due to the small number and demonstration nature of the existing projects. Microturbines are expected to be most feasible for projects in the 0.03 to 0.5 MW size range.

[6] Note that the costs shown are for the specified project size range. The costs for smaller turbine and boiler projects would be significantly higher and the equipment may not be available.

Table 2 presents the typical NO_x emission rates discussed above in the units used by the manufacturers and operators of the technologies, and in common units of measure to allow comparison. It should be noted that there is a range of performance for any technology, and performance may vary depending on site-specific conditions. Table 2 presents emissions in terms of both lb/MWh(electric-gross) and lb/MWh(electric-net).

Table 2. Typical NO_x Emissions From Common LFG Electricity Technologies, Converted to Common Units of Measure*

Department of Environmental Protection

Jeb Bush
Governor

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000

David B. Struhs
Secretary

February 24, 2003

Ms. Terry Blackwell
Marvin F. Poer & Company
Four Executive Park East
Suite 100
Atlanta, Georgia 30329

Re: Bio Energy Partners, Broward County

Dear Ms. Blackwell:

I have reviewed the information submitted concerning the eligibility of equipment to qualify as pollution control equipment for *ad valorem* assessment pursuant to section 193.621, Florida Statutes. The information is helpful but does not meet the requirements of Florida Administrative Code Rule 62-8. Specifically the list required by section 62-8.030(2), F.A.C. was not provided. That section states: "Prior to approving an assessment for ad valorem taxes under provisions of 403.241, F.S, a tax assessor should require the applicant to submit with his application a detailed list of pollution control devices; the function of these devices; the cost of these devices; the function of the facilities as it relates to pollution control and production. This information should be certified as being correct by a professional engineer registered in the State of Florida."

Upon receipt of the appropriate list, I will render an opinion to Broward County. If you or your engineer has any questions, I may be contacted at (850) 245-8002 or at Hamilton.Oven@dep.state.fl.us .

Sincerely,

Hamilton S. Oven

Hamilton S. Oven, P.E.

cc: Lee McKee

TAX

Department of Environmental Protection

Jeb Bush
Governor

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000

David B. Struhs
Secretary

SITING COORDINATION OFFICE
FAX COVER SHEET

OFFICE TELEPHONE NO: 850-487-0472
FAX NO. 850-921-7250

DATE: 8/22/02

TO: Lee Mckee **FAX NO.** 954 357 6980

FROM: Buck Oven

COMMENTS: Preliminary thoughts

NUMBER OF PAGES FAXED (2)

WILLIAM MARKHAM, CFA, ASA

BROWARD COUNTY PROPERTY APPRAISERS

115 SOUTH ANDREWS AVENUE RM. 111

FT. LAUDERDALE, FLORIDA 33301

954-357-6830

FAX: 954-357-6980

FACSIMILE TRANSMITTAL SHEET

TO: Buck Owen

FROM: LEE McKEE [redacted]

COMPANY: DEP

DATE: 8/22/02

FAX NUMBER: 1-850-921-7250

TOTAL NO. OF PAGES INCLUDING COVER: 5

PHONE NUMBER: 1-850-487-0472

SENDER'S PHONE NUMBER: 1-954-357-6862

RE.

☐ URGENT ☐ FOR REVIEW ☐ PLEASE COMMENT ☐ PLEASE REPLY ☐ PLEASE RECYCLE

NOTES/COMMENTS:

Buck,

Thanks You For your HeLp.

Lee McKee

R. 8/83
(Replica)

RETURN OF POLLUTION CONTROL DEVICES FOR AD VALOREM TAX PURPOSES FLORIDA STATUTES CHAPTER 193.621

To the Property Appraiser William Markham, Broward County Property Appraiser
115 S Andrews Rm 111 Ft Lauderdale County, Florida, Broward County

Return is hereby made for the assessment of the following described property under Florida Statues as pollution control devices.

Description of Property

SEE ATTACHMENT - BIO ENERGY PARTNERS ACCOUNT NO. 0959080A
See Fixed Asset Listing Attached.

Description of Facility

SEE ATTACHMENT

Name and address of owner:

Bio Energy Partners
c/o Waste Management, Inc.
1001 Fannin
Suite 4000
Houston, TX 77002

The undersigned taxpayer hereby agrees to furnish such other reasonable information as the Appraiser may request in regard to the assessment requested herein.

Teresa Blackwell
Taxpayer's Signature:

This form must be filed with the County Property Appraiser before April 1st.

ORIGINAL TO BE RETAINED BY PROPERTY APPRAISER
COPY TO BE GIVEN TO TAXPAYER

WILLIAM MARKHAM - BROWARD
COUNTY PROPERTY APPRAISER
115 S ANDREWS ROOM 111
FT LAUDERDALE FL 33301-1899

39102

Tangible Personal Property Tax Return
Confidential §§193.074 F.S.
As Required by §§193.052 & 193.062 F.S. Return to County Property Appraiser By April 1 to Avoid Penalti
State of Florida, County of BROWARD--2002

ACCT# 0959 080 A ACCT# MUST APPEAR ON ALL RETURNS
MILLAGE 0012 USE 6752 269,014
2700 NW 48 ST POMP

Business Name (DBA - Doing Business As) and Mailing Address

+ 30 Day Filing Extension granted

APR 0 1 2002

waste

BIO ENERGY PARTNERS

C/O Marvin F. Poer & CO
P.O. Box 95727
Atlanta, GA 30347

0959080A

*Please Change address

Federal Employer Iden. No
Social Security Number
NAICS/SIC

If name and IS

This return subject to audit with all records kept by you.
Incomplete entries are subject to penalties.

1. Please give name and telephone number of Owner or Person in charge of this Business.
Name _____ Telephone _____
Corporate Name _____
2. Actual Physical Location of Property for Which this Return is Filed (Street Address - Not P.O. Box)
_____
3. Is your business or farm located within the incorporated limits of a City? Yes___ No___
What City? _____
4. Do You File a Tangible Personal Property Tax Return Under Any Other Name? Yes___ No___
Please Show name Exactly as it Appeared on Your most recent Personal Property Tax Bill or Other Current Tax Return. _____
5. Date you began business in this county: _____ Fiscal year: _____
5a. Although my fiscal year ended prior to December 31 of the past calendar year, this return reflects propert additions and deletions through December 31. Yes___ No___
6. Describe Type or Nature of Your Business: _____
7. Trade Level (Check as many as apply) Retail ☐ Wholesale ☐ Manufacturing ☐ Professional ☐ Service ☐ Agriculture ☐ Leasing/Rental ☐ Other ☐
8. Did you file a Tangible Personal Property Return in this county last Year? Yes___ No___
If so, under what name and where? _____
9. Former owner of the Business: _____
9a. If Business sold, to whom? _____
Date Sold _____

Personal Property Summary THIS IS A SUMMARY SCHEDULE ONLY. The Schedules on the REVERSE SIDE must be completed in detail and TOTALS entered below. ATTACH ITEMIZED LIST or DEPRECIATION SCHEDULE showing Original Cost & Date of Acquisition.	Taxpayer's Estimate of Fair Market Value	Original Installed Cost	Appraiser's Use only
10. Office Furniture & Office Machines & Library			
11. EDP Equipment, Computers, Word Processors			
12. Store, Bar & Lounge, and Restaurant Furniture & Equipment, Etc.			
13. Machinery and Manufacturing Equipment			
14. Farm, Grove, and Dairy Equipment			
15. Professional, Medical, Dental & Laboratory Equipment			
16. Hotel, Motel, & Apartment Complex			
16a. Rental Units - Stove, Refrig., Furniture, Drapes & Appliances			
17. Mobile Home Attachments (Carport, Utility Bldg., Cabana, Porch, Etc.)			
18. Service Station & Bulk Plant Equipment - Underground Tanks, Lifts, Tools			
19. Signs - Billboard, Pole, Wall, Portable, Directional, Etc.			
20. Leasehold improvements must be grouped by type, year of installation and description			
21. Pollution Control Equipment	450,000	9,165,666	
22. Equipment owned by you but rented, leased or held by others	SEE DR-492 - Return of Pollution Control Devic		
23. Supplies - Not Held for Resale			
24. Other - Please Specify			
TOTAL PERSONAL PROPERTY			

ATTACHED

Under penalties of perjury, I declare that I have read the foregoing tax return and the accompanying schedules and statements and that the facts stated in them are true. If prepared by someone other than the taxpayer, the preparer signing this return certifies that this declaration is based on all information of which he/she has any knowledge.

DATE 3-28-02 TITLE _____
SIGNED Jason E. Blackwell (TAXPAYER)
SIGNED Terry Blackwell (PREPARER)
ADDRESS CONSULTANT
MARVIN F. POER & COMPANY
PHONE NO. FOUR EXECUTIVE PARK EAST PREPARER'S I.D. # _____
SUITE 100

LESS EXEMPTION: ( ) WIDOW ( ) WIDOWER ( ) BLIND
( ) TOTAL DISABILITY ( ) OTHER

Taxable value

Deputy Penalty

Please sign and date your return, send the original to the county appraiser's office by April 1, unsigned returns cannot be accepted by the appraiser's office.

Notice: If you are entitled to a widow's, widower's or disability exemption on personal property (not already claimed on real estate) consult appraiser.

Schedules on Reverse Side must be completed in Full.

DR-405

Page 2 — Tangible Personal Property Tax Schedules (Enter Totals on Page 1)

ASSETS PHYSICALLY REMOVED DURING LAST YEAR
Property fully depreciated but continuing in service must be reported on the schedules below.

DESCRIPTION	AGE	YEAR ACQ.	TAXPAYER'S EST OF FAIR MKT VALUE	ORIGINAL INSTALLED COST	Retired, Sold, Traded, Etc.

LEASED, LOANED, AND RENTED EQUIPMENT - Please complete if you hold equipment belonging to others.

NAME AND ADDRESS OF OWNER OR LESSOR	DESCRIPTION	YEAR ACQUIRED	YEAR OF MFG.	RENT PER MONTH	RETAIL INSTALLED COST NEW	LEASE PURCHASE OPTION YES	NO

LINE _____ Enter Applicable Line Number (10-24) From Page 1

DESCRIPTION OF ITEM	AGE	YEAR PURCHASED	TAXPAYER'S ESTIMATE OF FAIR MARKET VALUE	TAXPAYER'S ESTIMATE OF Condition Good	Avg	Poor	ORIGINAL INSTALLED COST	APPRAISER'S USE ONLY Condition	
Enter TOTALS on Front - Continue on Separate Sheet if Necessary				X	X	X		X	

LINE _____ Enter Applicable Line Number (10-24) From Page 1

DESCRIPTION OF ITEM	AGE								
Enter TOTALS on Front - Continue on Separate Sheet if Necessary				X	X	X		X	

LINE _____ Enter Applicable Line Number (10-24) From Page 1

DESCRIPTION OF ITEM	AGE								
Enter TOTALS on Front - Continue on Separate Sheet if Necessary				X	X	X		X	

LINE 22 EQUIPMENT OWNED BY YOU BUT RENTED, LEASED, OR HELD BY OTHERS

LEASE NO.	NAME/ADDRESS OF LESSEE ACTUAL PHYSICAL LOCATION	DESCRIPTION	AGE	YEAR PURCHASED	RENT PER MONTH	TERM	TAXPAYER'S ESTIMATE OF FAIR MARKET VALUE	TAXPAYER'S ESTIMATE OF Condition Good	Avg	Poor	RETAIL INSTALLED COST NEW

Bio-Energy Partners
Fixed Assets 1/1/02

Description of Property

Profit Center	Account Type	Item Number	Item Description	Installed Cost	Begin Deprec	End Deprec	Asset Life in Months	Depreciation Monthly Exp	Depreciation Cumulative	Net Book Value	12/01 Month Deprec Exp
Central - 0339											
519	M & E		PURCHASE OF GEARBOX - SOLAR TURBINES	35,427.20	Apr-99	Sep-02	42	843.50	#REF!	#REF!	#REF!
519	M & E		ADDITIONAL CHARGES FOR SOLOR TURBINES	3,596.00	Apr-99	Sep-02	42	85.62	#REF!	#REF!	#REF!
519	M & E		HEAT RECOVERY SYSTEM - PRICE AS OF 11/30/00	7,973,457.56	Sep-00	Aug-10	120	66,445.48	#REF!	#REF!	#REF!
519	M & E		HEAT RECOVERY SYSTEM - Additional Assets as of 12/31/00	415,550.87	Dec-00	Aug-10	117	3,551.72	#REF!	#REF!	#REF!
519	M & E		HEAT RECOVERY SYSTEM - Additional Assets as of 2/28/01	94,031.40	Mar-01	Aug-10	114	824.84	#REF!	#REF!	#REF!
519	M & E		Turbine Lease B/O # 0528730 - 1 Turbine @ Turnkey II	555,729.00	Oct-01	Sep-09	96	5,788.78	#REF!	#REF!	#REF!
			Turbine Lease B/O # 0528734	87,880.00	Oct-01	Sep-09	96	915.42	#REF!	#REF!	#REF!
			TOTAL	9,165,566.03				79,448.36	#REF!	#REF!	#REF!

Description/Purpose of Facility

This equipment is used to extract methane gas from the landfill at this location.
The facility destructs the methane (a greenhouse gas) and converts it to electricity which is sold to Florida Power & Light Corp

Bio-Energy Partners
Fixed Assets 1/1/02

Description of Property

Profit Center	Account Type	Item Number	Item Description	Installed Cost	Begin Deprec	End Deprec	Asset Life in Months	Depreciation Monthly Exp	Depreciation Cumulative	Net Book Value	12/01 Month Deprec Exp
Central - 0339											
519	M & E	*	PURCHASE OF GEARBOX - SOLAR TURBINES	35,427.20	Apr-99	Sep-02	42	843.50	#REF!	#REF!	#REF!
519	M & E	*	ADDITIONAL CHARGES FOR SOLOR TURBINES	3,596.00	Apr-99	Sep-02	42	85.62	#REF!	#REF!	#REF!
519	M & E	**	HEAT RECOVERY SYSTEM - PRICE AS OF 11/30/00	7,973,457.56	Sep-00	Aug-10	120	66,445.48	#REF!	#REF!	#REF!
519	M & E	**	HEAT RECOVERY SYSTEM - Additional Assets as of 12/31/00	415,550.87	Dec-00	Aug-10	117	3,551.72	#REF!	#REF!	#REF!
519	M & E	*	Turbine Lease B/O # 0528730 - 1 Turbine @ Turnkey II	94,031.40	Mar-01	Aug-10	114	824.84	#REF!	#REF!	#REF!
519	M & E	*	Turbine Lease B/O # 0528734	555,723.00	Oct-01	Sep-09	96	5,788.78	#REF!	#REF!	#REF!
			TOTAL	87,880.00	Oct-01	Sep-09	96	915.42	#REF!	#REF!	#REF!
				9,165,556.03				79,468.36	#REF!	#REF!	#REF!

Description/Purpose of Facility

This equipment is used to extract methane gas from the landfill at this location.
The facility destructs the methane (a greenhouse gas) and converts it to electricity which is sold to Florida Power & Light Corp

* The Solar Turbines, if used to extract methane from a landfill, might be considered "primarily for the purpose of pollution control".

** Heat recovery system used to generate electricity - not for the purpose of pollution control