SOLID WASTE AUTHORITY OF PALM BEACH COUNTY
NORTH COUNTY RESOURCE RECOVERY FACILITY SITE

REQUEST FOR AN AMENDMENT LEADING TO A MODIFICATION OF POWER PLANT SITE CERTIFICATION PA84-20

Third Revision to Include Project Updates

BIOSOLIDS PELLETIZATION FACILITY

Volume II of II

Submitted to:
Florida Department of Environmental Protection
Siting Coordination Office
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301

Prepared for:
Solid Waste Authority of Palm Beach County
7501 North Jog Road
West Palm Beach, Florida 33412

Prepared by:
Camp Dresser & McKee Inc.
1601 Belvedere Road, Suite 211 South
West Palm Beach, Florida 33406

May 2005

4/29/05

Alex H. Makled, P.E., DEE
Florida Registered Engineer
Engineer Number 45935

Contents

Figures

Tables

DEP Form No. 62-210.900(3) - Form
Effective: 2/11/99

Department of Environmental Protection

Division of Air Resources Management

APPLICATION FOR AIR PERMIT - NON-TITLE V SOURCE
APPLICATION NUMBER: 721-1

I. APPLICATION INFORMATION

Identification of Facility

1. Facility Owner/Company Name: SOLID WASTE AUTHORITY OF PBC	
2. Site Name: SOLID WASTE AUTHORITY OF PBC/NCRRF	
3. Facility Identification Number: 0990234	
4. Facility Location: Street Address or Other Locator: 7501 N. JOG ROAD City: WEST PALM BEACH County: PALM BEACH Zip Code: 33412	
5. Relocatable Facility? No	**6. Existing Permitted Facilility?** Yes

Application Contact

1. Name and Title of Application Contact: ALEX MAKLED - Senior Vice President
2. Application Contact Mailing Address: Organization/Firm: CDM Street Address: 1601 BELVEDERE ROAD SUITE 211 SOUTH City: WEST PALM BEACH State: FL Zip Code: 33406
3. Application Contact Telephone Numbers: Telephone: (561) 689 - 3336 Fax: (561) 689 - 9713

Application Processing Information (DEP Use)

1. Date of Receipt of Application:	
2. Permit Number:	

DEP Form No. 62-210.900(3) - Form
Effective: 2/11/99

Application Number: 721-1

Purpose of Application

Air Operation Permit Application
This Application for Air Permit is submitted to obtain:

Non-Title V air operation permit revision to address one or more newly constructed or modified emissions units.

Current construction permit number:
Operation permit number to be revised: PSDFL108E

Air Construction Permit Application
This Application for Air Permit is submitted to obtain:

Air construction permit to construct or modify one or more emissions units.

DEP Form No. 62-210.900(3) - Form
Effective: 2/11/99

Application Number: 721-1

<u>Owner/Authorized Representative</u>

1. **Name and Title of Owner/Authorized Representative:**
   JOHN BOOTH - Executive Director

2. **Owner/Authorized Representative Mailing Address:**
   Organization/Firm: SOLID WASTE AUTHORITY OF PALM BEACH COUNTY
   Street Address: 7501 NORTH JOG ROAD
   City: WEST PALM BEACH State: FL Zip Code: 33412

3. **Owner/Authorized Representative Telephone Numbers:**
   Telephone: (561) 640 - 4000 Fax: (561) 683 - 4067

4. **Owner/Authorized Representative Statement:**
   I, the undersigned, am the owner or authorized representative of the facility addressed in this application. I hereby certify, based on information and belief formed after reasonable inquiry, that the statements made in this application are true, accurate and complete and that, to the best of my knowledge, any estimates of emissions reported in this application are based upon reasonable techniques for calculating emissions. The air pollutant emissions units and air pollution control equipment described in this application will be operated and maintained so as to comply with all applicable standards for control of air pollutant emissions found in the statutes of the State of Florida and rules of the Department of Environmental Protection and revisions thereof. I understand that a permit, if granted by the Department, cannot be transferred without authorization from the Department, and I will promptly notify the Department upon sale or legal transfer of any permitted emissions unit.*

John Booth 5/2/05
Signature Date

*Attach letter of authorization if not currently on file.

DEP Form No. 62-210.900(3) - Form
Effective: 2/11/99

Application Number: 721-1

Professional Engineer Certification

1. **Professional Engineer Name:** ALEX MAKLED
   Registration Number: 45935

2. **Professional Engineer Mailing Address:**
   Organization/Firm: CDM
   Street Address: 1601 BELVEDERE ROAD SUITE 211 SOUTH
   City: WEST PALM BEACH State: FL Zip Code: 33406

3. **Professional Engineer Telephone Numbers:**
   Telephone: (561) 689 - 3336 Fax: (561) 689 - 9713

4. **Professional Engineer Statement:**
   I, the undersigned, hereby certify, except as particularly noted herein, that:*

   (1) To the best of my knowledge, there is reasonable assurance that the air pollutant emissions unit(s) and the air pollution control equipment described in the Application for Air Permit, when properly operated and maintained, will comply with all applicable standards for control of air pollutant emissions found in the Florida Statutes and rules of the Department of Environmental Protection; and

   (2) To the best of my knowledge, any emission estimates reported or relied on in this application are true, accurate, and complete and are either based upon reasonable techniques available for calculating emissions or, for emission estimates of hazardous air pollutants not regulated for an emissions unit addressed in this application, based solely upon the materials, information and calculations submitted with this application.

   If the purpose of this application is to obtain an air construction permit for one or more proposed new or modified emissions units (check here [X], if so), I further certify that the engineering features of each such emissions unit described in this application have been designed or examined by me or individuals under my direct supervision and found to be in conformity with sound engineering principles applicable to the control of emissions of the air pollutants characterized in this application.

   If the purpose of this application is to obtain an initial air operation permit or operation permit revision for one or more newly constructed or modified emissions units (check here [X], if so), I further certify that, with the exception of any changes detailed as part of this application, each such emissions unit has been constructed or modified in substantial accordance with the information given in the corresponding application for air construction permit and with ~~all~~ provisions contained in such permit.

Signature 4/28/05 | Date 4/28/05

(seal)

*Attach any exception to certification statement.

DEP Form No. 62-210.900(3) - Form
Effective: 2/11/99

Application Number: 721-1

Scope of Application

EU ID	Description of Emissions Unit	Permit Type	Enter Processing Fee For Each EU
New	Biosolids Pelletization Facility Dryer Train #1	AC1A	
New	Biosolids Pelletization Facility Dryer Train #2	AC1A	

Application Processing Fee

Check one: ○ Attached - Enter Total Amount: ◉ Not Applicable

Note: Submit any required permit application fee, which you must calculate according to 62-4.050(4), F. A. C.. Contact the appropriate Permitting Office if you have any questions.

DEP Form No. 62-210.900(3) - Form
Effective: 2/11/99

Application Number: 721-1

Construction/Modification Information

1. Description of Proposed Project or Alterations: An application for modification of SWA`s PSD permit, PSD-FL-108(E), to address new emission units pertaining to a new Biosolids Pelletization Facilty (BPF). This facility will treat 337.5 wtpd of sludge in each of two dryer trains. This addition will result in increased air pollutant emission rates for the facility as a whole.
2. Projected or Actual Date of Commencement of Construction: 9/14/2005
3. Projected Date of Completion of Construction: 11/1/2006

Application Comment

This application contains modifications to the previous permit application submitted in October 2003. This application is for a PSD permit modification ONLY. A Title V permit revision application will be submitted separately once the facility is in operation.

Department of Environmental Protection
Division of Air Resource Management

APPLICATION FOR AIR PERMIT - NON-TITLE V

4/27/2005 4:28:55 PM

--- Detail Report ---

Application not submitted. Data current as of 4/27/2005

I. APPLICATION SECTION

APPLICATION IDENTIFICATION INFORMATION

Application Number: 721-1
Application Name: SWA BPF
Air Operation Purpose: NON-TITLE V AIR OPERATION PERMIT REVISION TO ADDRESS ONE OR MORE NEWLY CONSTRUCTED OR MODIFIED EMISSIONS UNITS.
Air Construction Purpose: AIR CONSTRUCTION PERMIT TO CONSTRUCT OR MODIFY ONE OR MORE EMISSIONS UNITS.
Current Construction Permit #:
Operation Permit # to be Revised: PSDFL108E
Description of Proposed Project Alterations: An application for modification of SWA's PSD permit, PSD-FL-108(E), to address new emission units pertaining to a new Biosolids Pelletization Facilty (BPF). This facility will treat 337.5 wtpd of sludge in each of two dryer trains. This addition will result in increased air pollutant emission rates for the facility as a whole.
Construction Commencement Date: 9/14/2005
Projected Construction Completion Date: 11/1/2006
Application Comment: This application contains modifications to the previous permit application submitted in October 2003. This application is for a PSD permit modification ONLY. A Title V permit revision application will be submitted separately once the facility is in operation.

Are you requesting a multi-unit or facility-wide emissions cap for one or more pollutants?
NO

SCOPE OF APPLICATION

EU ID	Description	Permit Type
New	Biosolids Pelletization Facility Dryer Train #1	AC1A
New	Biosolids Pelletization Facility Dryer Train #2	AC1A

Note: Submit any required permit application fee, which you must calculate according to 62-4.050(4), F. A. C.. Contact the appropriate Permitting Office if you have any questions.

APPLICATION CONTACT INFORMATION

First Name: ALEX
Last Name: MAKLED
Job Title: Senior Vice President
Name of Organization/Firm: CDM
Telephone: 561 - 689 - 3336
Fax: 561 - 689 - 9713
E-mail: makledah@cdm.com
Street Address: 1601 BELVEDERE ROAD SUITE 211 SOUTH

City: WEST PALM BEACH
State: FL
Zip: 33406

PROFESSIONAL ENGINEER INFORMATION

PE UserName: MAKLEDAH
Registration Number: 45935
First Name: ALEX
Last Name: MAKLED
Job Title: Senior VicePresident
Name of Organization/Firm: CDM
Telephone: 561 - 689 - 3336
Fax: 561 - 689 - 9713
E-mail: MAKLEDAH@CDM.COM
Street Address: 1601 BELVEDERE ROAD SUITE 211 SOUTH

City: WEST PALM BEACH
State: FL
Zip: 33406

OWNER/AUTHORIZED REPRESENTATIVE INFORMATION

First Name: JOHN
Last Name: BOOTH
Job Title: Executive Director
Name of Organization/Firm: SOLID WASTE AUTHORITY OF PALM BEACH COUNTY
Telephone: 561 - 640 - 4000
Fax: 561 - 683 - 4067
E-mail: jbooth@swa.org
Street Address: 7501 NORTH JOG ROAD

City: WEST PALM BEACH
State: FL
Zip: 33412

II. FACILITY SECTION

FACILITY IDENTIFICATION INFORMATION

Owner/Company Name: SOLID WASTE AUTHORITY OF PBC
Site Name: SOLID WASTE AUTHORITY OF PBC/NCRRF
Description of Location:
Street Address: 7501 N. JOG ROAD
City: WEST PALM BEACH
County: PALM BEACH
ZIP: 33412
Relocatable: NO
Facility Status: A - ACTIVE
Comment: SWA proposes to add a biosolids pelletization facility that would utilize gas from the Class I Landfill.

FACILITY LOCATION AND TYPE

Facility UTM Coordinates: Zone: 17 East(km): 584.49 North(km): 2961.26
Facility Latitude: Degrees: 26 Minutes: 46 Seconds: 18
Facility Longitude: Degrees: 80 Minutes: 8 Seconds: 30
Facility SIC Codes: **Primary:** 4953 - ELECTRIC, GAS AND SANITARY SERVICES
SANITARY SERVICES
REFUSE SYSTEMS
Governmental Facility Code: 3 - COUNTY
Facility Major Group SIC: 49 - ELECTRIC, GAS AND SANITARY SERVICES

FACILITY CONTACT INFORMATION

First Name: RAY
Last Name: SCHAUER
Job Title: Director of Engineering
Name of Organization/Firm: SOLID WASTE AUTHORITY OF PALM BEACH COUNTY
Telephone: 561 - 640 - 4000
Fax: 561 - 683 - 4067
E-mail: rschauer@swa.org
Street Address: 7501 NORTH JOG ROAD

City: WEST PALM BEACH
State: FL
Zip: 33412

FACILITY REGULATORY CLASSIFICATIONS

Small Business Stationary Source? Not Applicable
Synthetic Non-Title V Source? No
Synthetic Minor Source of Pollutants Other than Hazardous Air Pollutants (HAPs)? No
Synthetic Minor Source of HAPs? No
One or More Emission Units Subject to NSPS? Yes
One or More Emission Units Subject to NESHAP Recordkeeping or Reporting? Yes
Regulatory Classifications Comment: Applicable rules are discussed in Volume II, Section 3.0, Air Quality Regulations

RULE APPLICABILITY ANALYSIS

List of Applicable Regulations. 1. Title V Core List (dated 03/01/02) 2. 40 CFR Subpart WWW - Standards of Performance for Municipal Solid Waste Landfills 3. 40 CFR Subpart E - National Emissions Standards for Hazardous Air Pollutants (NESHAP) - Mercury 4. 40 CFR 64 - Compliance Assurance Monitoring Rule 5. 40 CFR 63 Subpart AAAA - National Emission Standards for Municipal Solid Waste Landfills

FACILITY POLLUTANT INFORMATION

Code	Description	Class.	Comment
CO	Carbon Monoxide	A	
DIOX	Dioxin/Furan	B	
FL	Fluorides - Total (elemental fluorine and floride compounds)	B	
H021	Beryllium Compounds	B	
H027	Cadmium Compounds	B	
H058	Dibenzofurans	C	
H106	Hydrogen chloride (Hydrochloric acid)	A	
H114	Mercury Compounds	B	
H165	2,3,7,8-Tetrachlorodibenzo-p-dioxin	C	
NMOC	Nonmethane Organic Compounds from MSW Landfill	C	
NOX	Nitrogen Oxides	A	
PB	Lead - Total (elemental lead and lead compounds)	B	
PM	Particulate Matter - Total	A	
PM10	Particulate Matter - PM10	A	
SO2	Sulfur Dioxide	A	
VOC	Volatile Organic Compounds	B	

FACILITY SUPPLEMENTARY ITEMS

Supplementary Item	Applicable?	Waiver Requested?	Attachment?
AREA MAP SHOWING FACILITY LOCATION	Yes	No	Yes
FACILITY PLOT PLAN	Yes	No	Yes
PRECAUTIONS TO PREVENT EMISSIONS OF UNCONFINED PARTICULATE MATTER	Yes	No	Yes
PROCESS FLOW DIAGRAM	Yes	No	Yes
SUPPLEMENTAL INFORMATION FOR CONSTRUCTION PERMIT APPLICATION	Yes	No	Yes

FACILITY SUPPLEMENTARY ATTACHMENTS

Supplementary Item	Electronic?	Attachment Description	Electronic File Name	Uploaded?
AREA MAP SHOWING FACILITY LOCATION	Yes	Area Map	C:\Documents and Settings\mercadoyi\My Documents\Solid Waste Authority\Permit Applications\LRF_BPF Facilities\Figure A-1 Volume II.pdf	Yes
FACILITY PLOT PLAN	Yes	Facility Plot Plan - Figure B-1	C:\Documents and Settings\mercadoyi\My	Yes

			Documents\Solid Waste Authority\Permit Applications\LRF_BPF Facilities\Figure B-1 Volume II.pdf	
FACILITY PLOT PLAN	Yes	Facility Plot Plan - Figure B-2	C:\Documents and Settings\mercadoyi\My Documents\Solid Waste Authority\Permit Applications\LRF_BPF Facilities\Figure B-2 Volume II.pdf	Yes
FACILITY PLOT PLAN	Yes	Facility Plot Plan - Figure B-3	C:\Documents and Settings\mercadoyi\My Documents\Solid Waste Authority\Permit Applications\LRF_BPF Facilities\Figure B-3 Volume II.pdf	Yes
PRECAUTIONS TO PREVENT EMISSIONS OF UNCONFINED PARTICULATE MATTER	Yes	Appendix D - Precautions to prevent emission of unconfined particulate matter	C:\Documents and Settings\mercadoyi\My Documents\Solid Waste Authority\Permit Applications\LRF_BPF Facilities\Appendix D.pdf	Yes
PROCESS FLOW DIAGRAM	Yes	Process Flow Diagram - Figure C-1	C:\Documents and Settings\mercadoyi\My Documents\Solid Waste Authority\Permit Applications\LRF_BPF Facilities\Figure C-1 Volume II.pdf	Yes
SUPPLEMENTAL INFORMATION FOR CONSTRUCTION PERMIT APPLICATION	Yes	Emissions Calculations - Appendix E	C:\Documents and Settings\mercadoyi\My Documents\Solid Waste Authority\Permit Applications\LRF_BPF Facilities\Revised Calcs\Appendix E.pdf	Yes
SUPPLEMENTAL INFORMATION FOR CONSTRUCTION PERMIT APPLICATION	Yes	Emissions Calcs (2)	C:\Documents and Settings\mercadoyi\My Documents\Solid Waste Authority\Permit Applications\LRF_BPF Facilities\Revised Calcs\Appendix E (2).pdf	Yes
SUPPLEMENTAL INFORMATION FOR CONSTRUCTION PERMIT APPLICATION	Yes	Emissions Calcs (3)	C:\Documents and Settings\mercadoyi\My Documents\Solid Waste Authority\Permit Applications\LRF_BPF Facilities\Revised Calcs\Appendix E (3).pdf	Yes
SUPPLEMENTAL INFORMATION FOR CONSTRUCTION	Yes	Emissions Calcs (4)	C:\Documents and Settings\mercadoyi\My Documents\Solid Waste	Yes

PERMIT APPLICATION			Authority\Permit Applications\LRF_BPF Facilities\Revised Calcs\Appendix E (4).pdf	
SUPPLEMENTAL INFORMATION FOR CONSTRUCTION PERMIT APPLICATION	Yes	Emissions Calcs (5)	C:\Documents and Settings\mercadoyi\My Documents\Solid Waste Authority\Permit Applications\LRF_BPF Facilities\Revised Calcs\Appendix E (5).pdf	Yes

III. EMISSIONS UNIT SECTION

NEW EU #1: DESCRIPTION AND DETAIL INFORMATION

Type of EU:	THIS EU INFORMATION SECTION ADDRESSES, AS A SINGLE EMISSIONS UNIT, A SINGLE PROCESS OR PRODUCTION UNIT, OR ACTIVITY, WHICH PRODUCES ONE OR MORE AIR POLLUTANTS AND WHICH HAS AT LEAST ONE DEFINABLE EMISSION POINT (STACK OR VENT).
EU Description:	Biosolids Pelletization Facility Dryer Train #1
EU Status:	C - CONSTRUCTION
Initial Startup Date:	12/31/2006
EU Major Group SIC:	49 - ELECTRIC, GAS AND SANITARY SERVICES
Package Unit Manufacturer:	BAKER RULLMAN
Generator Nameplate Rating:	
Incinerator Dwell Temp:	
Incinerator Dwell Time:	
Incinerator Afterburner Temp:	
EU Comment:	

NEW EU #1: CONTROL EQUIPMENT/METHOD INFORMATION

Control Equipment/Method Name	Description
WET SCRUBBER HIGH EFFICIENCY (95.0-99.9%)	This impingement tray scrubber (scrubber/condenser) will simultaneously remove particulate matter and ammonia, and will condense water vapor.
VENTURI SCRUBBER	This venturi scrubber with cyclonic separator will remove residual particulate.
THERMAL OXIDIZER	A Regenerative thermal oxidizer at the end of the process will be used for VOC, NH3, CO and H2S control. Low NOx burners will

be used.

LOW NOX BURNERS

NEW EU #1: OPERATING CAPACITY AND SCHEDULE

Maximum Heat Input Rate: 42 mmBtu/hr
Maximum Incineration Rate:
Maximum Process or Throughput Rate: 338
Maximum Process or Throughput Rate Units: WET TONS/DAY
Maximum Production Rate:
Maximum Process or Throughput Rate Units:
Requested Maximum Operating Schedule: 24 hours/day 7 days/week 52 weeks/year 8760 hours/year
Operating Capacity and Schedule Comment: Landfill Gas will be used as the primary fuel. Natural gas will be available as backup fuel.

NEW EU #1: POINT (STACK/VENT) INFORMATION

Identification of Point on Plot Plan or Flow Diagram? RTO Exhaust Stack
Emission Point Type Code: 1 - A SINGLE EMISSION POINT SERVING A SINGLE EMISSIONS UNIT
Discharge Type Code: V - A STACK WITH AN UNOBSTRUCTED OPENING DISCHARGING IN A VERTICAL, OR NEARLY VERTICAL DIRECTION
Stack Height: 138 feet
Exit Diameter: 2.5 feet
Exit Temperature: 194 Fahrenheit
Actual Volumetric Flow Rate: 15000 acfm
Water Vapor: 16.1 %
Maximum Dry Standard Flow Rate:
Nonstack Emission Point Height:
Emission Point UTM Coordinates:
Emission Point Comment:

NEW EU #1: SEGMENT (PROCESS/FUEL) INFORMATION

SCC Code: 10300811
Units: Million Cubic Feet Landfill Gas Burned
Description 1: External Combustion Boilers
Description 2: Commercial/Institutional
Description 3: Landfill Gas
Description 4: Landfill Gas
Is this a Valid Segment? YES

Segment Description (Process/Fuel Type): Combustion of LFG gas from Class I Landfill to fire the sludge dryers used in the biosolids pelletization facility. Natural gas will serve as a backup fuel.
Maximum Hourly Rate:
Maximum Annual Rate:
Estimated Annual Activity Factor:
Maximum % Sulfur:
Maximum % Ash:
Million Btu per SCC Unit: 500
Segment Comment:

NEW EU #1: POLLUTANT POTENTIAL/ESTIMATED EMISSIONS INFORMATION

Pollutant Code: CO
Pollutant Description: Carbon Monoxide
Is this a Valid Pollutant? YES
Include in the Facility Emissions Cap? NO
Pollutant Regulatory Code: EL - EMISSION-LIMITED POLLUTANT
Primary Control Device:
Secondary Control Device:
Total % Efficiency of Control:
Potential Emissions: 3.37 lb/hour 14.75 tons/year
Synthetically Limited: N
Emission Factor: 3.37
Emission Factor Units: LB/HR
Emission Factor Reference: VENDOR INFORMATION
Emissions Method Code: 2 - CALCULATED BY USE OF MATERIAL BALANCE AND KNOWLEDGE OF THE PROCESS.
Calculation of Emissions: Refer to Appendix E
Pollutant Comment:

Pollutant Code: NOX
Pollutant Description: Nitrogen Oxides
Is this a Valid Pollutant? YES
Include in the Facility Emissions Cap? NO
Pollutant Regulatory Code: EL - EMISSION-LIMITED POLLUTANT
Primary Control Device:
Secondary Control Device:
Total % Efficiency of Control:
Potential Emissions: 5.6 lb/hour 24.51 tons/year
Synthetically Limited: N
Emission Factor: 5.6
Emission Factor Units: LB/HR
Emission Factor Reference: VENDOR INFORMATION
Emissions Method Code: 5 - CALCULATED USING EMISSION FACTOR OTHER THAN

AP-42/FIRE SYSTEM.
Calculation of Emissions: Refer to Appendix E.
Pollutant Comment:

Pollutant Code: PM10
Pollutant Description: Particulate Matter - PM10
Is this a Valid Pollutant? YES
Include in the Facility Emissions Cap? NO
Pollutant Regulatory Code: EL - EMISSION-LIMITED POLLUTANT
Primary Control Device: WET SCRUBBER HIGH EFFICIENCY (95.0-99.9%)
Secondary Control Device:
Total % Efficiency of Control:
Potential Emissions: 2.42 lb/hour 10.61 tons/year
Synthetically Limited: N
Emission Factor: 2.42
Emission Factor Units: LB/HR
Emission Factor Reference: VENDOR INFORMATION
Emissions Method Code: 5 - CALCULATED USING EMISSION FACTOR OTHER THAN AP-42/FIRE SYSTEM.
Calculation of Emissions: Refer to Appendix E
Pollutant Comment:

Pollutant Code: SO2
Pollutant Description: Sulfur Dioxide
Is this a Valid Pollutant? YES
Include in the Facility Emissions Cap? NO
Pollutant Regulatory Code: EL - EMISSION-LIMITED POLLUTANT
Primary Control Device:
Secondary Control Device:
Total % Efficiency of Control:
Potential Emissions: 4.45 lb/hour 19.5 tons/year
Synthetically Limited: N
Emission Factor: 4.45
Emission Factor Units: LB/HR
Emission Factor Reference:
Emissions Method Code: 5 - CALCULATED USING EMISSION FACTOR OTHER THAN AP-42/FIRE SYSTEM.
Calculation of Emissions: Refer to Appendix E
Pollutant Comment: Given uncertainty on WPB sludge quality with respect to volatile sulfur compounds, the requested permit emission rate is 4.45 lb/hr per dryer/RTO.

Pollutant Code: VOC
Pollutant Description: Volatile Organic Compounds
Is this a Valid Pollutant? YES
Include in the Facility Emissions Cap? NO
Pollutant Regulatory EL - EMISSION-LIMITED POLLUTANT

Code:	
Primary Control Device:	THERMAL OXIDIZER
Secondary Control Device:	
Total % Efficiency of Control:	98
Potential Emissions:	1 lb/hour 4.39 tons/year
Synthetically Limited:	N
Emission Factor:	1
Emission Factor Units:	LB/HR
Emission Factor Reference:	
Emissions Method Code:	5 - CALCULATED USING EMISSION FACTOR OTHER THAN AP-42/FIRE SYSTEM.
Calculation of Emissions:	Refer to Appendix E
Pollutant Comment:	

NEW EU #1: POLLUTANT ALLOWABLE EMISSIONS INFORMATION

*** NO POLLUTANT ALLOWABLE EMISSIONS INFORMATION FOUND FOR THIS EU ***

NEW EU #1: VISIBLE EMISSIONS INFORMATION

*** NO VISIBLE EMISSIONS INFORMATION FOUND FOR THIS EU ***

NEW EU #1: CONTINUOUS MONITOR INFORMATION

*** NO CONTINUOUS MONITOR INFORMATION FOUND FOR THIS EU ***

NEW EU #1: SUPPLEMENTARY ITEMS

Supplementary Item	Applicable?	Waiver Requested?	Attachment?
COMPLIANCE TEST REPORT Previously submitted?NO Submittal Date:	No	No	No
DESCRIPTION OF STACK SAMPLING FACILITIES	Yes	No	Yes
DETAILED DESCRIPTION OF CONTROL EQUIPMENT	Yes	No	Yes
FUEL ANALYSIS OR SPECIFICATION	No	No	No
OPERATION AND MAINTENANCE PLAN	Yes	No	Yes
OTHER INFORMATION REQUIRED BY RULE OR STATUTE	No	No	No
PROCEDURES FOR STARTUP AND SHUTDOWN	No	No	No
PROCESS FLOW DIAGRAM	Yes	No	Yes
SUPPLEMENTAL INFORMATION FOR CONSTRUCTION PERMIT APPLICATION	Yes	No	Yes

NEW EU #1: SUPPLEMENTARY ATTACHMENTS

Supplementary Item	Electronic?	Attachment	Electronic File Name	Uploaded?

Description				
DESCRIPTION OF STACK SAMPLING FACILITIES	Yes	Appendix G, Figure G-1	C:\Documents and Settings\mercadoyi\My Documents\Solid Waste Authority\Permit Applications\LRF_BPF Facilities\Figure G-1.pdf	Yes
DETAILED DESCRIPTION OF CONTROL EQUIPMENT	Yes	Appendix H - Detailed Description of Control Equipment		No
OPERATION AND MAINTENANCE PLAN	Yes	Appendix I - O&M plan for RTO	C:\Documents and Settings\mercadoyi\My Documents\Solid Waste Authority\Permit Applications\LRF_BPF Facilities\rto.pdf	Yes
OPERATION AND MAINTENANCE PLAN	Yes	Appendix I - O&M for Scrubber	C:\Documents and Settings\mercadoyi\My Documents\Solid Waste Authority\Permit Applications\LRF_BPF Facilities\scrubber.pdf	Yes
PROCESS FLOW DIAGRAM	Yes	Same as Appendix C	C:\Documents and Settings\mercadoyi\My Documents\Solid Waste Authority\Permit Applications\LRF_BPF Facilities\Figure C-1 Volume II.pdf	Yes
SUPPLEMENTAL INFORMATION FOR CONSTRUCTION PERMIT APPLICATION	Yes	Emissions Calculations - Same as Appendix E		No

NEW EU #2: DESCRIPTION AND DETAIL INFORMATION

Type of EU: THIS EU INFORMATION SECTION ADDRESSES, AS A SINGLE EMISSIONS UNIT, A SINGLE PROCESS OR PRODUCTION UNIT, OR ACTIVITY, WHICH PRODUCES ONE OR MORE AIR POLLUTANTS AND WHICH HAS AT LEAST ONE DEFINABLE EMISSION POINT (STACK OR VENT).

EU Description: Biosolids Pelletization Facility Dryer Train #2

EU Status: C - CONSTRUCTION

Initial Startup Date: 12/31/2006

EU Major Group SIC: 49 - ELECTRIC, GAS AND SANITARY SERVICES

Package Unit Manufacturer: BAKER RULLMAN

Generator Nameplate Rating:	
Incinerator Dwell Temp:	
Incinerator Dwell Time:	
Incinerator Afterburner Temp:	
EU Comment:	

NEW EU #2: CONTROL EQUIPMENT/METHOD INFORMATION

Control Equipment/Method Name	Description
WET SCRUBBER HIGH EFFICIENCY (95.0-99.9%)	This impingement tray scrubber (scrubber/condenser) will simultaneously remove particulate matter and ammonia, and will condense water vapor.
VENTURI SCRUBBER	This venturi scrubber with cyclonic separator will remove residual particulate.
THERMAL OXIDIZER	A Regenerative thermal oxidizer at the end of the process will be used for VOC, NH_3, CO and H_2S control. Low NOx burners will be used.
LOW NOX BURNERS	

NEW EU #2: OPERATING CAPACITY AND SCHEDULE

Maximum Heat Input Rate:	42 mmBtu/hr
Maximum Incineration Rate:	
Maximum Process or Throughput Rate:	338
Maximum Process or Throughput Rate Units:	WET TONS/DAY
Maximum Production Rate:	
Maximum Process or Throughput Rate Units:	
Requested Maximum Operating Schedule:	24 hours/day 7 days/week 52 weeks/year 8760 hours/year
Operating Capacity and Schedule Comment:	Landfill Gas will be used as the primary fuel. Natural gas will be available as backup fuel.

NEW EU #2: POINT (STACK/VENT) INFORMATION

Identification of Point on Plot Plan or Flow Diagram?	RTO Exhaust Stack
Emission Point Type Code:	1 - A SINGLE EMISSION POINT SERVING A SINGLE EMISSIONS UNIT
Discharge Type Code:	V - A STACK WITH AN UNOBSTRUCTED OPENING DISCHARGING IN A VERTICAL, OR NEARLY VERTICAL DIRECTION

Stack Height: 138 feet
Exit Diameter: 2.5 feet
Exit Temperature: 194 Fahrenheit
Actual Volumetric Flow Rate: 15000 acfm
Water Vapor: 16.1 %
Maximum Dry Standard Flow Rate:
Nonstack Emission Point Height:
Emission Point UTM Coordinates:
Emission Point Comment:

NEW EU #2: SEGMENT (PROCESS/FUEL) INFORMATION

SCC Code: 10300811
Units: Million Cubic Feet Landfill Gas Burned
Description 1: External Combustion Boilers
Description 2: Commercial/Institutional
Description 3: Landfill Gas
Description 4: Landfill Gas
Is this a Valid Segment? YES
Segment Description (Process/Fuel Type): Combustion of LFG gas from Class I Landfill to fire the sludge dryers used in the biosolids pelletization facility. Natural gas will serve as a backup fuel.
Maximum Hourly Rate:
Maximum Annual Rate:
Estimated Annual Activity Factor:
Maximum % Sulfur:
Maximum % Ash:
Million Btu per SCC Unit: 500
Segment Comment:

NEW EU #2: POLLUTANT POTENTIAL/ESTIMATED EMISSIONS INFORMATION

Pollutant Code: CO
Pollutant Description: Carbon Monoxide
Is this a Valid Pollutant? YES
Include in the Facility Emissions Cap? NO
Pollutant Regulatory Code: EL - EMISSION-LIMITED POLLUTANT
Primary Control Device:
Secondary Control Device:
Total % Efficiency of Control:
Potential Emissions: 3.37 lb/hour 14.75 tons/year
Synthetically Limited: N
Emission Factor: 3.37
Emission Factor Units: LB/HR
Emission Factor VENDOR INFORMATION

Reference:
Emissions Method Code: 2 - CALCULATED BY USE OF MATERIAL BALANCE AND KNOWLEDGE OF THE PROCESS.
Calculation of Emissions: Refer to Appendix E
Pollutant Comment:

Pollutant Code: NOX
Pollutant Description: Nitrogen Oxides
Is this a Valid Pollutant? YES
Include in the Facility Emissions Cap? NO
Pollutant Regulatory Code: EL - EMISSION-LIMITED POLLUTANT
Primary Control Device:
Secondary Control Device:
Total % Efficiency of Control:
Potential Emissions: 5.6 lb/hour 24.51 tons/year
Synthetically Limited: N
Emission Factor: 5.6
Emission Factor Units: LB/HR
Emission Factor Reference: VENDOR INFORMATION
Emissions Method Code: 5 - CALCULATED USING EMISSION FACTOR OTHER THAN AP-42/FIRE SYSTEM.
Calculation of Emissions: Refer to Appendix E.
Pollutant Comment:

Pollutant Code: PM10
Pollutant Description: Particulate Matter - PM10
Is this a Valid Pollutant? YES
Include in the Facility Emissions Cap? NO
Pollutant Regulatory Code: EL - EMISSION-LIMITED POLLUTANT
Primary Control Device: WET SCRUBBER HIGH EFFICIENCY (95.0-99.9%)
Secondary Control Device:
Total % Efficiency of Control:
Potential Emissions: 2.42 lb/hour 10.61 tons/year
Synthetically Limited: N
Emission Factor: 2.42
Emission Factor Units: LB/HR
Emission Factor Reference: VENDOR INFORMATION
Emissions Method Code: 5 - CALCULATED USING EMISSION FACTOR OTHER THAN AP-42/FIRE SYSTEM.
Calculation of Emissions: Refer to Appendix E
Pollutant Comment:

Pollutant Code: SO2
Pollutant Description: Sulfur Dioxide
Is this a Valid Pollutant? YES
Include in the Facility Emissions Cap? NO
Pollutant Regulatory EL - EMISSION-LIMITED POLLUTANT

Code:
Primary Control Device:
Secondary Control Device:
Total % Efficiency of Control:
Potential Emissions: 4.45 lb/hour 19.5 tons/year
Synthetically Limited: N
Emission Factor: 4.45
Emission Factor Units: LB/HR
Emission Factor Reference:
Emissions Method Code: 5 - CALCULATED USING EMISSION FACTOR OTHER THAN AP-42/FIRE SYSTEM.
Calculation of Emissions: Refer to Appendix E
Pollutant Comment: Given uncertainty on WPB sludge quality with respect to volatile sulfur compounds, the requested permit emission rate is 4.45 lb/hr per dryer/RTO.

Pollutant Code: VOC
Pollutant Description: Volatile Organic Compounds
Is this a Valid Pollutant? YES
Include in the Facility Emissions Cap? NO
Pollutant Regulatory Code: EL - EMISSION-LIMITED POLLUTANT
Primary Control Device: THERMAL OXIDIZER
Secondary Control Device:
Total % Efficiency of Control: 98
Potential Emissions: 1 lb/hour 4.39 tons/year
Synthetically Limited: N
Emission Factor: 1
Emission Factor Units: LB/HR
Emission Factor Reference:
Emissions Method Code: 5 - CALCULATED USING EMISSION FACTOR OTHER THAN AP-42/FIRE SYSTEM.
Calculation of Emissions: Refer to Appendix E
Pollutant Comment:

NEW EU #2: POLLUTANT ALLOWABLE EMISSIONS INFORMATION

*** NO POLLUTANT ALLOWABLE EMISSIONS INFORMATION FOUND FOR THIS EU ***

NEW EU #2: VISIBLE EMISSIONS INFORMATION

*** NO VISIBLE EMISSIONS INFORMATION FOUND FOR THIS EU ***

NEW EU #2: CONTINUOUS MONITOR INFORMATION

*** NO CONTINUOUS MONITOR INFORMATION FOUND FOR THIS EU ***

NEW EU #2: SUPPLEMENTARY ITEMS

Supplementary Item	Applicable?	Waiver Requested?	Attachment?
COMPLIANCE TEST REPORT Previously submitted?NO Submittal Date:	No	No	No
DESCRIPTION OF STACK SAMPLING FACILITIES	Yes	No	Yes
DETAILED DESCRIPTION OF CONTROL EQUIPMENT	Yes	No	Yes
FUEL ANALYSIS OR SPECIFICATION	No	No	No
OPERATION AND MAINTENANCE PLAN	Yes	No	Yes
OTHER INFORMATION REQUIRED BY RULE OR STATUTE	No	No	No
PROCEDURES FOR STARTUP AND SHUTDOWN	No	No	No
PROCESS FLOW DIAGRAM	Yes	No	Yes
SUPPLEMENTAL INFORMATION FOR CONSTRUCTION PERMIT APPLICATION	Yes	No	Yes

NEW EU #2: SUPPLEMENTARY ATTACHMENTS

Supplementary Item	Electronic?	Attachment Description	Electronic File Name	Uploaded?
DESCRIPTION OF STACK SAMPLING FACILITIES	No	Appendix G, Figure G-1	N/A	N/A
DETAILED DESCRIPTION OF CONTROL EQUIPMENT	No	Appendix H - Detailed Description of Control Equipment	N/A	N/A
OPERATION AND MAINTENANCE PLAN	No	Appendix I - O&M plan for RTO	N/A	N/A
OPERATION AND MAINTENANCE PLAN	No	Appendix I - O&M for Scrubber	N/A	N/A
PROCESS FLOW DIAGRAM	No	Same as Appendix C	N/A	N/A
SUPPLEMENTAL INFORMATION FOR CONSTRUCTION PERMIT APPLICATION	No	Emissions Calculations - Same as Appendix E	N/A	N/A

Section 2
Project Overview and Summary of Air Quality Impacts

2.1 Introduction and Site Location

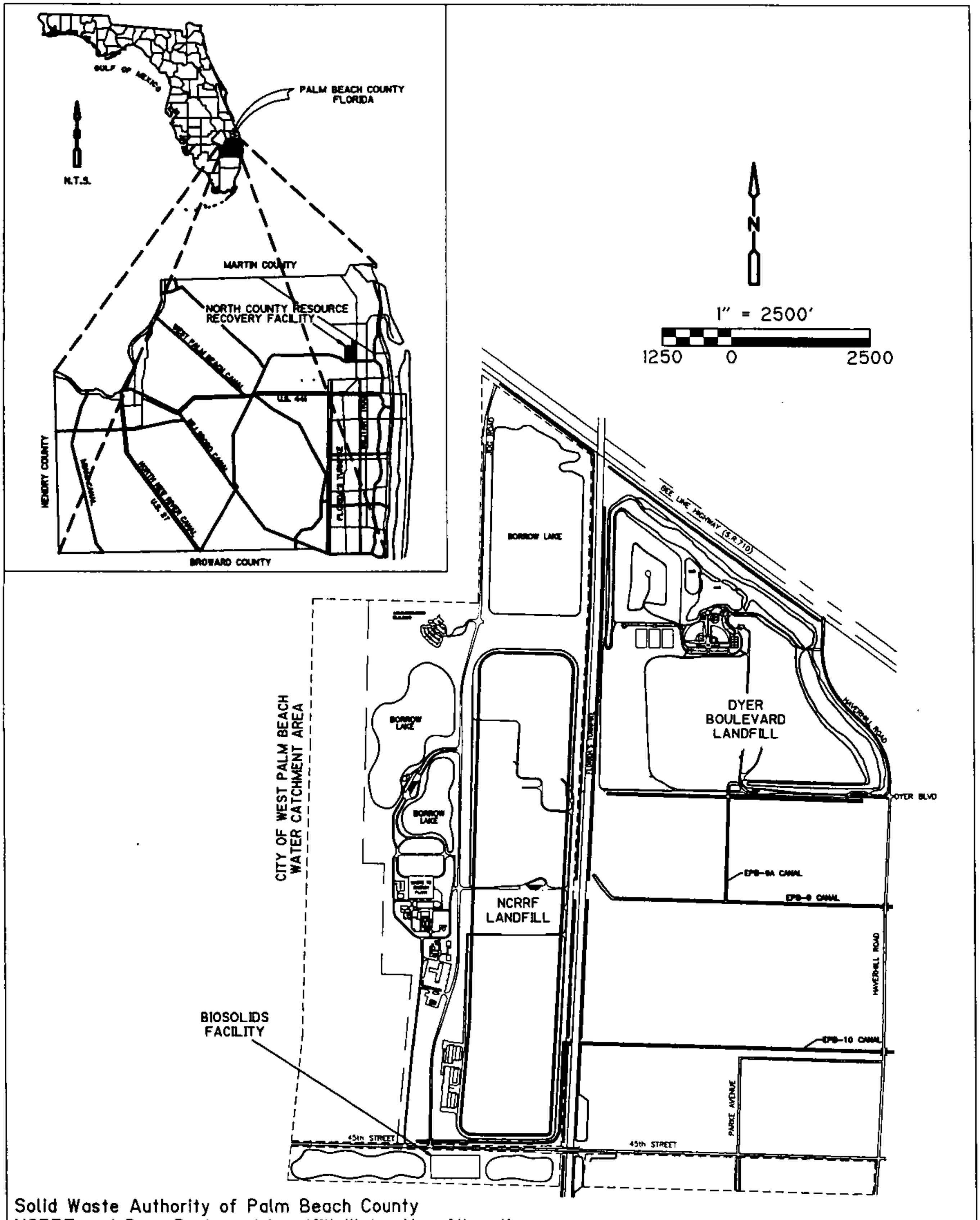
The Solid Waste Authority of Palm Beach County (SWA) is responsible for processing and disposing of the municipal solid waste collected in all 37 Palm Beach County municipalities and the unincorporated areas of Palm Beach County.

The SWA currently operates a 2,000 ton per day Waste-to-Energy (WTE) facility at the North County Resource Recovery Facility (NCRRF) located at 7501 North Jog Road in West Palm Beach. The location of the NCRRF is shown on **Figure 2-1** and **Figure 2-2**.

In addition to the WTE facility, the NCRRF contains the following additional air emissions sources: the Class I and III Landfills, ash handling facilities, lime and chemical storage silos, Materials Recycling Facility, auto spray booth, and Composting Facility. These are primarily insignificant or unregulated air emissions sources themselves. However, because they are on the same site as the NCRRF, all of the emissions units at the NCRRF are together regulated as a "major" source of air pollutants under Chapters 62-212.400, Florida Administrative Code (FAC), Prevention of Significant Deterioration (PSD), and 62-213, FAC, Operating Permits. The NCRRF permits include PSD Permit No. PSD-FL-108, A, B, C, D, and E; Title V Air Operating Permit No. 0990234-004-AV for the landfills' gas collection and control systems; and Minor Air Pre-Construction Permit No. 0990234-004-AC for a new 3,500 standard cubic feet per minute (scfm) flare at the Class I Landfill. This volume presents the text of the application and the Electronic Permit Submittal and Processing System (EPSAP) forms for the PSD permit modification for the addition of a new Biosolids Pelletization Facility (BPF) at the NCRRF.

The BPF will be located on the SWA's 8-acre parcel immediately across 45th Street (to the south) from the rest of the NCRRF. Although this parcel is across a publicly owned right-of-way from the rest of SWA's property, it was included as part of the NCRRF in the initial Power Plant Site Certification (PPSA No. PA84-20). The BPF will combust landfill gas (with natural gas as a back-up fuel) in two 337.5-wet tons per day (wtpd) rotary dryers (675 wtpd total at 20 percent solids) to dry wastewater sludge and then screen the dried sludge into marketable fertilizer pellets. The preliminary site plan for this facility is shown in **Figure 2-3**. This project has the following environmental benefits:

- It provides for re-use and recycling of materials that are currently disposed of as waste, thereby preserving resources and extending the life of existing waste disposal space; and
- It reclaims and uses the energy in collected landfill gas, which is currently being burned off in a flare.



Solid Waste Authority of Palm Beach County
NCRRF and Dyer Boulevard Landfill Water Use Allocation

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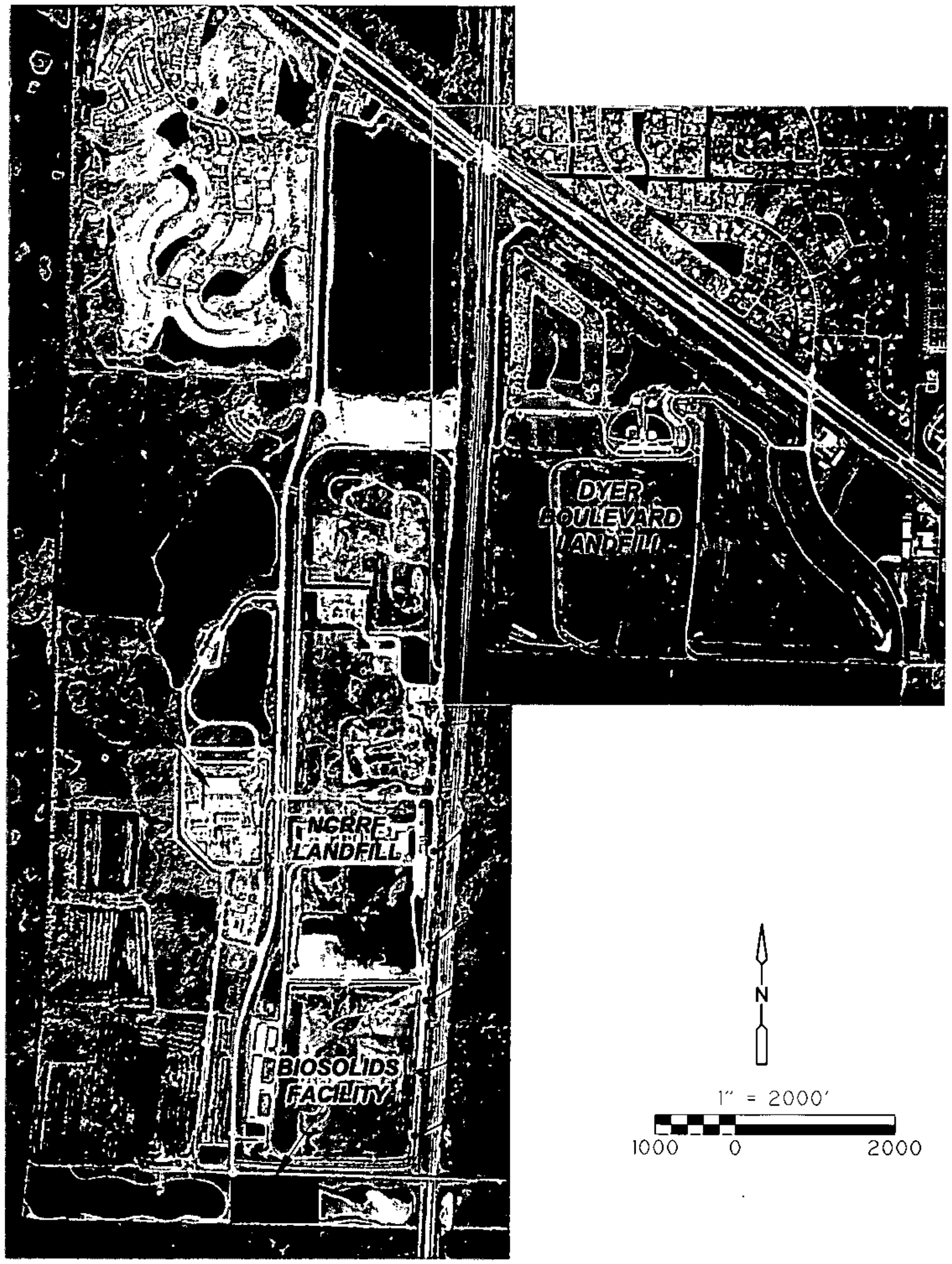
CDM

Figure 2-1
Site Location Map

J:\2678\LimeBiosolids\PPSA 2005\FigD-4_aerial 02/03/05 11:28:12 1:45:48 burwinkelsb

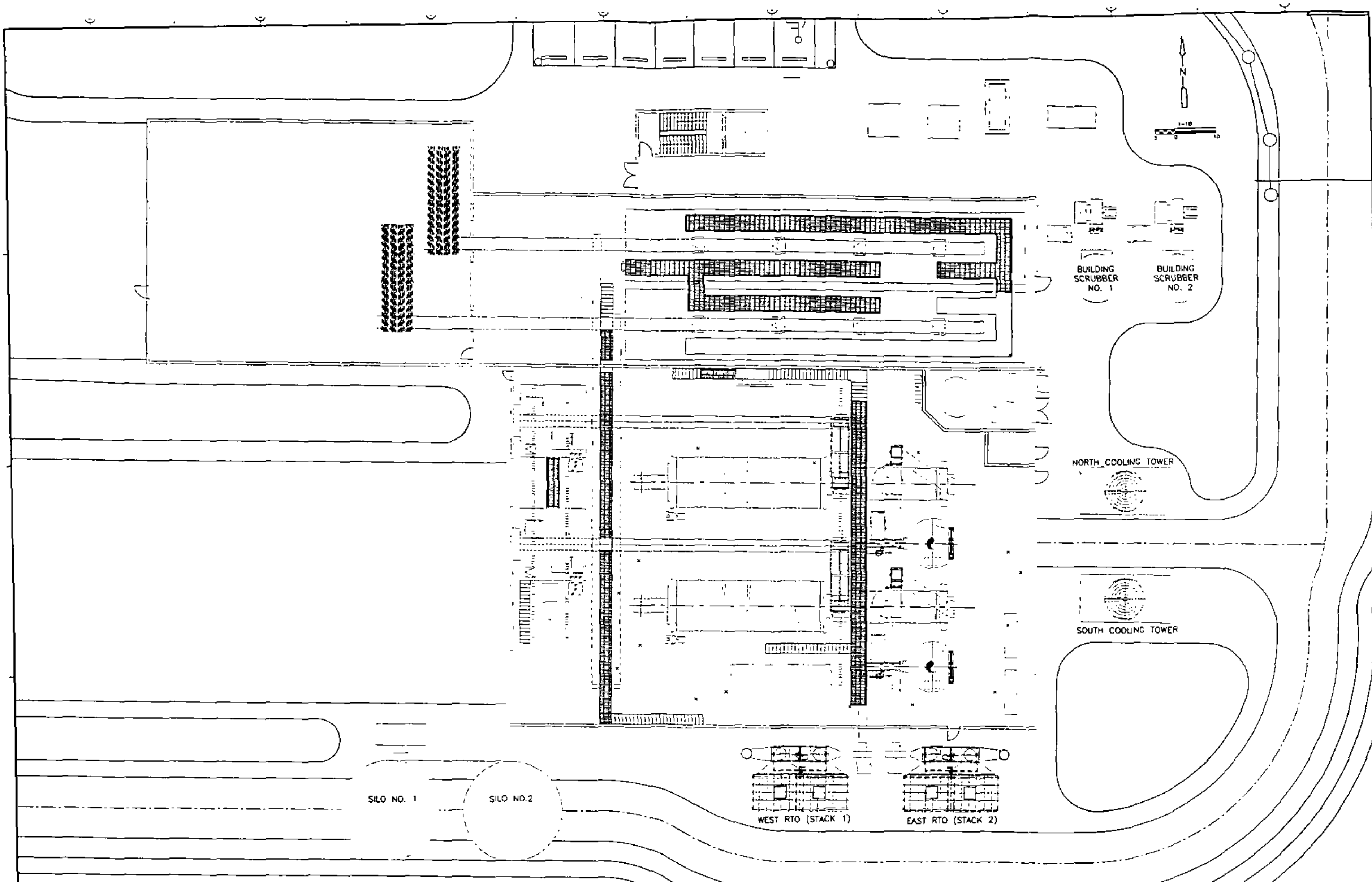


Solid Waste Authority of Palm Beach County
NCRRF and Dyer Boulevard Landfill Water Use Allocation

Flight date: 4/15/98

Figure 2-2
Aerial Photograph

CDM



CDM Camp Dresser & McKee Inc.

SOLID WASTE AUTHORITY
PALM BEACH COUNTY FLORIDA

BIOSOLIDS PELLETIZATION FACILITY
PPSA PERMIT APPLICATION, MAY 2005

PROPOSED SITE PLAN

FIGURE 2-3

2.2 Description of Proposed New Facility

2.2.1 Biosolids Pelletization Facility

The BPF will combust 34.2 MMBtu/hr (million British thermal units per hour) of landfill gas under typical operating conditions (34.1 MMBtu/hr of natural gas) in each of the two 337.5-wet tons per day (wtpd) rotary dryers (designed to combust up to 40 MMBtu/hr each) to dry wastewater sludge and then screen the dried sludge into marketable fertilizer pellets. An additional 2 MMBtu/hr is required for each regenerative thermal oxidizer (RTO) making the total design capacity of each train 42 MMBtu (84 MMBtu total for the BPF). Hot combustion gases (about 841° F at the dryer inlet) will flow through a rotating drum with the biosolids, driving off water, and volatile organic compounds (VOCs). At the dryer exhaust end, a cyclonic separator will remove the pellets and heavier dust particles from the gas stream and send these to screens for size sorting. The exhaust gases, containing products of combustion (nitrogen oxide (NO_X), carbon monoxide (CO), and sulfur dioxide (SO_2)), particulate matter (PM), and VOCs, will then go through a tray condenser and venturi scrubber. These devices will remove PM and some SO_2. The gases will then go through a RTO to combust the VOCs before exiting the exhaust stack. **Figure 2-4** illustrates the process flow.

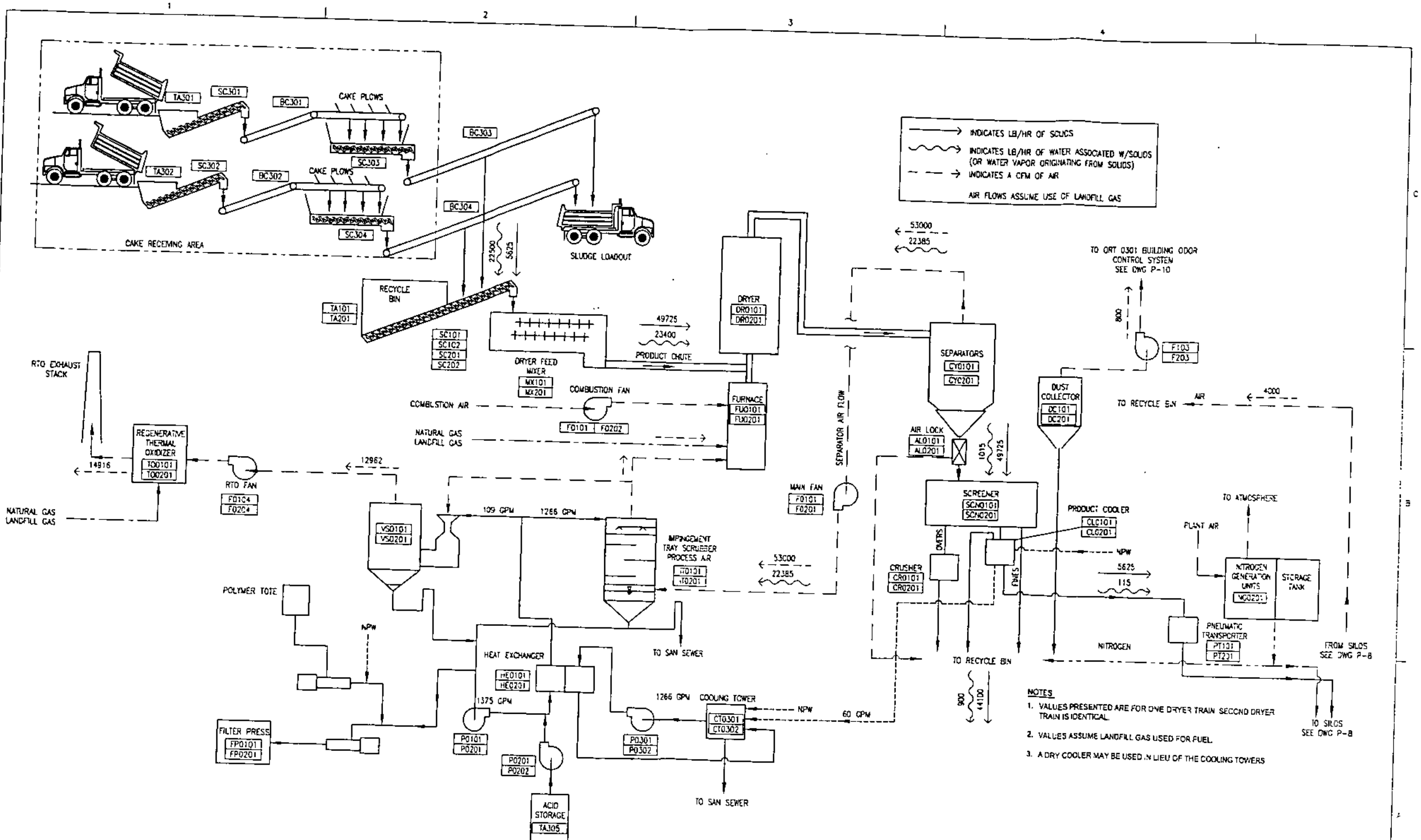
Each biosolids dyer train will have the following additional air emissions sources:

- exhaust vent on one recycle material bin,
- exhaust from one fertilizer pellet storage silo, and
- one cooling tower.

All of these are potential sources of PM emissions. Each of two recycle bins will be ventilated through a fugitive dust control baghouse and then through a building odor scrubber. Dusty air resulting from silo filling operations will be ducted to the recycle bin baghouses, mentioned above. The locations of these sources are shown on Figure 2-3.

2.2.2 Landfill Gas Flares

The Class I Landfill has an existing landfill gas collection and control system that combusts the gas in a 3,500 scfm open flare. During operation of the BPF, the flare will be "turned-down" and the Class I Landfill would supply the approximately 2,800 scfm of landfill gas needed by the BPF at the design capacity (84 MMBtu/hr of landfill gas with a heat content of 500 British thermal units per standard cubic feet (Btu/scf). The Class I Landfill is shown in Figure 2-2. It extends from 45th Street to the extension of Dyer Road (north of the scale houses). The gas would be provided to the BPF project through a pressurized line under 45th Street.



HDR
HDR Engineering, Inc.

ISSUE	DATE	DESCRIPTION
B	12/5/04	REV 2
A	5/25/04	REV 1

PROJECT MANAGER	E. DeLaFOREST
CIVIL	R. TRAVIS
STRUCTURAL	W. KIANON
ARCHITECT	S. BIRCH
MECHANICAL	B. SPOTT
ELECTRICAL	J. HARRISON
I&C	D. PENNER
PROCESS	E. ANDREWS
PROJECT NUMBER	000000000010162

BIOSOLIDS PROCESSING FACILITY

SWA Solid Waste Authority of Palm Beach County

Figure 2-4
Process Flow Diagram

FILENAME
SCALE NONE
SHEET

Class I Landfill build-out conditions, as depicted in Figure B-3 (Volume II), were used to determine maximum Class I Landfill gas production. The 3,500-scfm Class I Flare will not be sufficient to handle all the gas produced by the Class I Landfill at build-out. The capacity of this flare could be reached sometime between 2010 and 2015. Two more flares, a 2,000-scfm flare and a 1,000-scfm flare would be needed at the Class I Landfill by about 2020, the approximate build-out year. The 6,500-scfm capacity of the three flares together (and without the BPF) could handle the expected maximum Class I Landfill gas generation rate of about 6,000 scfm. In addition, the three flares could be used in combinations of one or two to handle smaller gas flows as the BPF comes on-line (between about 2006 and 2007), and are drawing off the 2,800 scfm of gas that this facility needs. All three flares would be open flares, installed near each other at a flare station just north of the Composting Facility (see Figure 2-2).

The 3,500-scfm Class I flare is exempt from major source PSD permitting, because it qualified as a "pollution control project." Rule 62-212.400(2)(a) 2., FAC exempts "pollution control projects" from PSD permit application requirements. Paragraph c. of this section exempts emissions from landfill gas collection and control projects "that would occur solely as a result of a project undertaken for the purpose of complying with the non-methane organic compound emission reduction requirements of 40 Code of Federal Regulations (CFR) Part 60, Subpart Cc or WWW, adopted and incorporated by reference at Rule 62-204.800, FAC, provided the owner or operator demonstrates to the Department that such increase would not cause or contribute to a violation of any ambient air quality standard, maximum allowable increase, or visibility limitation."

Since the 3,500-scfm flare on the Class I Landfill was installed solely to meet the requirements of the New Source Performance Standards for Municipal Solid Waste Landfills, referenced in the quote above, and was not functionally linked to the BPF project, it qualifies for the PSD exemption. Qualifying for a PSD exemption also requires, however, that the flare's air pollutant emissions not cause or contribute to a violation of any ambient air quality standard, maximum allowable increase (PSD Increment), or visibility limitation. For these reasons, the dispersion modeling in this revised PSD Permit modification application includes the air pollutant emission increases for the new 3,500-scfm Class I Flare, the proposed 1,000-scfm, and 2,000-scfm Class I flares, in addition to those for the BPF. The 1,000-scfm and 2,000-scfm flares have been included:

- to determine if they can also meet the conditions of the exemption from PSD permitting;
- to address concerns raised by Florida Department of Environmental Protection (FDEP), both for the current BPF project and when permitting was done for the decommissioned 1,800-scfm flare (March, 1999), about how much landfill gas would be generated at landfill build-out, and about granting incremental approvals for each landfill gas collection and control system expansion; and

- to give the SWA maximum flexibility on when they could install the 1,000-scfm and 2,000-scfm flares and on how to operate the Class I Landfill gas collection and control system. The current proposed plan is to install the 1,000-scfm and 2,000-scfm flares at about the same time as the BPF. Each flare has a turndown ratio of 10:1 (that is, they can operate at flows down to 1/10th of their maximum design flow rate). Having a range of flare sizes also available at the Class I Landfill Flare Station would allow the SWA to combust possibly large swings in leftover gas flow to the flares as the BPF comes on- (and off-) line. The three flares could be used in any combination of one, two, or three to handle fluctuating flows and all three together could handle the Class I Landfill expected build-out flow by themselves, if the BPF project was not built.

All three flares, the 3,500-scfm Class I flare as well as the proposed 1,000-scfm and 2,000-scfm flares, have been included in the dispersion modeling to evaluate their combined air pollutant concentration impacts with those of the BPF and to determine if they qualify for the PSD permitting exemption.

2.3 Air Quality Impact Assessment

An air quality impact assessment was conducted for criteria air pollutant emissions from the BPF and the three Class I Landfill gas flares described above. (Note that the 1,800-scfm Class I flare was decommissioned and replaced by the 3,500-scfm Class I flare, so the potential-minus-actual net emissions increase was modeled for the 3,500-scfm flare.) The Industrial Source Complex, Short-Term, Version 3 (ISCST3) dispersion model was used to predict the potential air quality impacts, in accordance with the modeling protocol submitted to the FDEP on May 13, 2002. A comparison was conducted of the maximum predicted ground-level concentrations and the background concentrations to the Florida and National Ambient Air Quality Standards. This comparison demonstrated that the BPF and flare projects together would not violate ambient air quality standards. In fact, maximum ground-level concentrations due to this project alone will be no more than 2 percent of any of the standards. When BPF and flare concentrations are added to existing background pollutant concentrations, the resulting maximum concentration will be no more than 67 percent of any of the standards. A comparison of the maximum air quality impacts to the PSD Class II increments demonstrated that the BPF and flare projects will have an insignificant impact on Class II increment consumption by consuming no more than 8 percent of any applicable increment.

An analysis was also conducted of project impacts at the nearest Class I (pristine) air quality area: the Everglades National Park, 128 kilometers (km) (80 miles) south-southwest of the SWA's facilities. The results show that less than 0.2 percent of any Class I increment will be consumed there and that visibility (clarity of the air) at this area will not be impaired. A similar analysis was conducted for the Big Cypress National Preserve, which although not an officially designated Class I Area, is a sensitive area slightly nearer to the project parcel: 112 km (70 miles) southwest of the SWA's facilities. The modeled results for this location show that the projects would consume no more than 0.4 percent of any Class I increment and will not impair visibility. A detailed discussion of air quality impacts from the proposed BPF and flares is provided in Sections 7 and 8 of this Volume.

The dispersion modeling impact analyses for the combined net emissions increases due to the BPF and three Class I Landfill flares together show that the flares "would not cause or contribute to a violation of any ambient air quality standard, maximum allowable increase, or visibility limitation." Therefore, the 3,500-scfm flare, 1,000-scfm flare, and 2,000-scfm flare all qualify for the exemption from PSD permit application requirements in Rule 62-212.400(2)(a) 2., FAC, as discussed in Section 2.2.2, above. Because the flares are exempt from PSD permitting requirements, they are not considered in any of the analyses in this PSD application, except for the dispersion modeling. They are not included, for example, in the Best Available Control Technology (BACT) evaluation in Section 5. The flares also are not included in the evaluation of whether or not PSD pre-construction monitoring is required. The SWA plans to submit a separate minor modification preconstruction air permit application to the FDEP for the 1,000 and 2,000-scfm Class I Landfill flares.

The predicted pollutant ground-level concentrations from the BPF are compared to PSD de minimis monitoring levels in Table 7-4. The highest predicted impacts are below the de minimis monitoring levels. Therefore, in accordance with guidance in 40 CFR 51.166(i)(8) and as allowed under Rule 62-212.400(3)(e), FAC, the SWA requests that the FDEP concur with the determination that pre-construction monitoring is not required for the BPF project.

The proposed BPF and Class I flares maximum expected emission rates, based on regulatory requirements, vendor information, and the results of the BACT analysis (for the BPF), are summarized in **Table 2-1**. The basis for these emission rates is described in Section 4 Air Pollutant Emissions, Section 5 BACT Review, and in **Appendix E** of this Volume, the Emission Factor Support Document.

Table 2-1 presents two sets of emission rate totals: one for the BPF and three Class I flares combined, and one for the BPF alone. The combined BPF/flare total is not based on the total of their combustion capacities. Rather, the emissions total reflects the fact that at build-out, only 6,500 scfm of gas will be available. When the BPF is using its 2,800 scfm of landfill gas, the flares will be burning only the remaining 3,700 scfm (and not operating at their 6,500-scfm capacity). This diversion of landfill gas to the BPF will actually result in lower emission rates for some pollutants (volatile organic compounds and carbon monoxide) that the "no-build" condition of all the gas going to the flares, because the BPF dryer burners are more efficient combustion units than are the flares. This first "combined" total is compared with the PSD Significant Net Emissions Increase thresholds to indicate which pollutants would be included in the dispersion modeling analysis. The dispersion modeling was conducted for CO, NO_X, SO_2, and PM_{10}. Since the dispersion modeling demonstrated that the flares can be exempt from PSD permitting, the second total for the BPF alone is compared with the

Table 2-1 SWA Biosolids Pelletization Facility, and Class I Landfill Flares Proposed Maximum Potential Controlled Emission Rates and PSD Applicability

PSD Pollutant		Biosolids Pelletizing Facility (BPF)					Flares				
		Two Rotary Dryers [a]	Two Recycle Bins with Baghouse[b]	Two Cooling Towers [c]	Emergency Generator Engine	BPF Subtotal (tons/year)	3,500-scfm, 1,000-scfm, and 2,000-scfm Flares[d]	Existing 1,800-scfm Flare to be Replaced [i]	BPF and Flares TOTAL [e]	BPF Only TOTAL	PSD Significant Net Emissions Increase [f]
Carbon Monoxide (CO)	Basis	3.37 lb/hr each	---	---	8.5 g/bhp-hr each	---	0.37 lb/MMBtu	750 lb/10^6 dscf CH_4			
	Tons/Year	*29.5*	---	—	*4.19*	*33.7*	*362.7*	*-101.6*	**261.1**	33.7	100
Nitrogen Oxides (NO_x)	Basis	5.60 lb/hr each	---	---	6.9 g/bhp-hr each	---	0.068 lb/MMBtu	40 lb/10^6 dscf CH_4			
	Tons/Year	*49.1*	—	—	*3.4*	*52.5*	*38.0*	*-5.4*	**85.1**	**52.5**	40
Sulfur Dioxide (SO_2)	Basis	4.45 lb/hr each	---	---	0.183 g/bhp-hr each	---	190 ppmv sulfur in gas	190 ppmv sulfur in gas			
	Tons/Year	*39.0*	—	—	*0.09*	*39.1*	*30.7*	*-8.6*	**61.2**	39.1	40
Particulate Matter (total) (PM)	Basis	2.42 lb/hr each	0.010 gr/dscf actual	3333 ppm in drift	0.697 g/bhp-hr each	---	17 lb/10^6 dscf CH_4	17 lb/10^6 dscf CH_4			
	Tons/Year	*21.2*	*0.6*	*5.50E-01*	*2.00E-01*	*22.6*	*9.1*	*-2.3*	**29.4**	22.6	25
Particulate Matter < 10 Microns (PM_{10})	Basis	2.42 lb/hr each	0.010 gr/dscf actual	3333 ppm in drift	0.697 g/bhp-hr each	---	17 lb/10^6 dscf CH_4	17 lb/10^6 dscf CH_4			
	Tons/Year	*21.2*	*0.6*	*2.74E-01*	*2.00E-01*	*22.3*	*9.1*	*-2.3*	**29.1**	**22.3**	15
Volatile Organic Compounds (VOC)	Basis	1.0 lb/hr each	---	---	0.97 g/bhp-hr each	---	98% DRE	98% DRE			
	Tons/Year	*8.8*	---	---	*0.48*	*9.3*	*2.4*	*-0.7*	11.0	9.3	40
Lead (Pb)	Basis	7.3E-04 lb/hr each	---	---	---	---	---	---			
	Tons/Year	*6.39E-03*	—	---	---	*6.39E-03*	—	—	6.39E-03	6.39E-03	*0.6*
Mercury (Hg)	Basis		---	---	---	---	---	---			
	Tons/Year	*8.08E-03*	---	—	—	*8.08E-03*	---	—	8.08E-03	8.08E-03	0.1 [g]
Hydrogen Sulfide (H_2S)	Basis	---	---	---	---	---	---	---			
	Tons/Year	—	---	---	---	*0.00*	---	—	0.00	0.00	10
Total Hazardous Air Pollutants (HAPs)	Tons/Year	0.51	---	---	---	*0.51*	0.48	-0.14	0.85	0.51	25 [g]

Notes: See Section 4 and Appendix E for bases and calculations. Section 4 also describes air pollution control equipment. For conservatism, all PM is assumed to be PM10.

(a) Biosolids dryer emission rates are from upper-bound vendor estimates (see Appendix E) for all pollutants except NOx and total HAPs. NOx emission rate is BACT for a low-NOx burner (see Section 5). Total HAP emission rates are based on AP-42 for landfill gas, and on vendor estimates of sludge metals content.

(b) PM emission rates from the biosolids pellet recycle bin are based on vendor-guaranteed PM outlet concentration for baghouse and design air flow rate.

(c) PM emission rate is based on AP-42 for cooling towers, and design water circulation rate.

(d) Flare emission rate calculations are based on AP-42 for all pollutants. The flares are required to achieve a 98% destruction removal efficiency (DRE) for NMOC. 3-flare total shown is net of the 2,800 scfm gas flow to the BPF, except for CO. For CO, all gas is shown going to the flares.

(e) The flares only combust landfill gas not being used by the BPF. Therefore, the total maximum potential emission rates are not the sum of the maximum potential emission rates of the the BPF, and 3 Flares, but are based on the worst-case operating condition for each pollutant. The worst case for CO and total HAPs is all landfill gas going to the Flares with the BPF not operating. For all other pollutants the worst case is the BPF operating at capacity, with the Flares combusting only the remaining gas flow rate of 3,700 scfm. The total also reflects the reduction in actual emissions resulting from decomissioning the existing 1,800-scfm flare.

(f) Rule 62-212.400, F.A.C., Table 212.400-2.

(g) The Clean Air Act Amendments Section 112(b)(6) exempts listed HAPs from PSD review.

PSD Significant Net Emissions Increase thresholds to indicate which pollutants would be included in the BACT analysis. Table 2-1 shows that BACT is only required for NO_X and PM emissions. Therefore, Section 5 considers NO_X and PM only in the control equipment evaluations for the BPF.

Section 3
Air Quality Regulations

3.1 Introduction

The proposed new Biosolids Pelletization Facility (BPF) to be added at the North County Resource Recovery Facility (NCRRF) will be designed to meet all applicable federal and state rules and regulations. This facility will provide environmental benefits by processing wastewater sludge for beneficial re-use and by reclaiming energy in landfill gas that is normally simply flared. The proposed facility will be designed to provide greater control of air pollutant emissions than is required.

The BPF will have two identical trains that will process 337.5 wet tons per day (wtpd) each (wet ton defined as 20 percent solids content), equivalent to 67.5 dry tons per day (dtpd) each, of wastewater sludge to produce fertilizer pellets. Each train will have its own dedicated air pollution control equipment and exhaust stack. The air pollution control equipment on each train will include a separator cyclone at the dryer exhaust end to remove the pellets and heavier dust particles from the dryer gas. The exhaust gases, containing products of combustion (nitrogen oxide (NO_X), carbon monoxide (CO), and sulfur dioxide (SO_2)), particulate matter (PM), and volatile organic compounds (VOCs) driven off the sludge, will then go through a tray condenser and venturi scrubber. These devices will remove PM and some SO_2. The gases will then go through a regenerative thermal oxidizer (RTO) to combust VOCs before exiting the exhaust stack. The BPF will also have a lo-NO_X burner for the control of NO_X emissions. Each train's burner will combust up to 40 MMBtu/hr (million British thermal units per hour); its RTO will combust an additional 2 MMBtu/hr. Each train, therefore, will burn 42 MMBtu/hr of landfill gas and the BPF as a whole, 84 MMBtu/hr. The cooling towers will use potable water to minimize emissions of dissolved salts. Each of two recycle bins will be ventilated through a fugitive dust control baghouse and then to a building scrubber. Dusty air resulting from silo filling operators will be ducted to the recycle bin baghouses.

The landfill gas burners at the BPF will themselves serve as air pollution devices for controlling the emissions of non-methane organic compounds (NMOCs) from landfill gas. They will be designed to provide a 98 percent destruction removal efficiency for NMOCs, as required by the New Source Performance Standards (NSPS) for Municipal Solid Waste (MSW) Landfills, 40 Code of Federal Regulations (CFR) 60 Subpart WWW.

The BPF facility is considered a modification to the NCRRF Prevention of Significant Deterioration (PSD), as described in Section 3.4, below. The maximum potential emissions of NO_X and PM from the BPF will exceed the PSD "significant increase" threshold in Rule 62-212.400, Florida Administrative Code (FAC), Table 212.400-2, which makes the BPF subject to the PSD review requirements under 62-212.400, FAC. As shown in **Table 3-1**, however, no other air emissions from this project will exceed the PSD thresholds.

Table 3-1 SWA Biosolids Pelletization Facility, and Class I Landfill Flares Proposed Maximum Potential Controlled Emission Rates and PSD Applicability

PSD Pollutant		Biosolids Pelletizing Facility (BPF)					Flares				
		Two Rotary Dryers [a]	Two Recycle Bins with Baghouse[b]	Two Cooling Towers [c]	Emergency Generator Engine	BPF Subtotal (tons/year)	3,500-scfm, 1,000-scfm, and 2,000-scfm Flares[d]	Existing 1,800-scfm Flare to be Replaced [i]	BPF and Flares TOTAL [e]	BPF Only TOTAL	PSD Significant Net Emissions Increase [f]
Carbon Monoxide (CO)	Basis	3.37 lb/hr each	---	---	8.5 g/bhp-hr each	---	0.37 lb/MMBtu	750 lb/10^6 dscf CH_4			
	Tons/Year	*29.5*	—	---	*4.19*	*33.7*	*362.7*	*-101.6*	**261.1**	33.7	100
Nitrogen Oxides (NO_x)	Basis	5.60 lb/hr each	---	---	6.9 g/bhp-hr each	---	0.068 lb/MMBtu	40 lb/10^6 dscf CH_4			
	Tons/Year	*49.1*	---	---	*3.4*	*52.5*	*38.0*	*-5.4*	**85.1**	**52.5**	40
Sulfur Dioxide (SO_2)	Basis	4.45 lb/hr each	---	---	0.183 g/bhp-hr each	---	190 ppmv sulfur in gas	190 ppmv sulfur in gas			
	Tons/Year	*39.0*	---	---	*0.09*	*39.1*	*30.7*	*-8.6*	**61.2**	39.1	40
Particulate Matter (total) (PM)	Basis	2.42 lb/hr each	0.010 gr/dscf actual	3333 ppm in drift	0.697 g/bhp-hr each	---	17 lb/10^6 dscf CH_4	17 lb/10^6 dscf CH_4			
	Tons/Year	*21.2*	*0.6*	*5.50E-01*	*2.00E-01*	*22.6*	*9.1*	*-2.3*	**29.4**	22.6	25
Particulate Matter < 10 Microns (PM_{10})	Basis	2.42 lb/hr each	0.010 gr/dscf actual	3333 ppm in drift	0.697 g/bhp-hr each	---	17 lb/10^6 dscf CH_4	17 lb/10^6 dscf CH_4			
	Tons/Year	*21.2*	*0.6*	*2.74E-01*	*2.00E-01*	*22.3*	*9.1*	*-2.3*	**29.1**	**22.3**	15
Volatile Organic Compounds (VOC)	Basis	1.0 lb/hr each	---	---	0.97 g/bhp-hr each	---	98% DRE	98% DRE			
	Tons/Year	*8.8*	---	---	*0.48*	*9.3*	*2.4*	*-0.7*	11.0	9.3	40
Lead (Pb)	Basis	7.3E-04 lb/hr each	---	---	---	---	---	---			
	Tons/Year	*6.39E-03*	—	---	---	*6.39E-03*	---	---	6.39E-03	6.39E-03	*0.6*
Mercury (Hg)	Basis		---	---	---	---	---	---			
	Tons/Year	*8.08E-03*	—	---	---	*8.08E-03*	---	---	8.08E-03	8.08E-03	0.1 [g]
Hydrogen Sulfide (H_2S)	Basis	---	---	---	---	---	---	---			
	Tons/Year	—	---	---	---	*0.00*	—	---	0.00	0.00	10
Total Hazardous Air Pollutants (HAPs)	Tons/Year	0.51	---	---	---	*0.51*	0.48	-0.14	0.85	0.51	25 [g]

Notes: See Section 4 and Appendix E for bases and calculations. Section 4 also describes air pollution control equipment. For conservatism, all PM is assumed to be PM10.

(a) Biosolids dryer emission rates are from upper-bound vendor estimates (see Appendix A) for all pollutants except NOx and total HAPs NOx emission rate is BACT for a low-NOx burner (see Section 5).
Total HAP emission rates are based on AP-42 for landfill gas, and on vendor estimates of sludge metals content.

(b) PM emission rates from the biosolids pellet recycle bin are based on vendor-guaranteed PM outlet concentration for baghouse and design air flow rate.

(c) PM emission rate is based on AP-42 for cooling towers, and design water circulation rate.

(d) Flare emission rate calculations are based on AP-42 for all pollutants. The flares are required to achieve a 98% destruction removal efficiency (DRE) for NMOC.
3-flare total shown is net of the 2,800 scfm gas flow to the BPF, except for CO. For CO, all gas is shown going to the flares.

(e) The flares only combust landfill gas not being used by the BPF. Therefore, the total maximum potential emission rates are not the sum of the maximum potential emission rates of the the BPF, and 3 Flares, but are based on the worst-case operating condition for each pollutant. The worst case for CO and total HAPs is all landfill gas going to the Flares with the BPF not operating.
For all other pollutants the worst case is the BPF operating at capacity, with the Flares combusting only the remaining gas flow rate of 3,700 scfm. The total also reflects the reduction in actual emissions resulting from decomissioning the existing 1,800-scfm flare.

(f) Rule 62-212.400, F.A.C., Table 212.400-2.

(g) The Clean Air Act Amendments Section 112(b)(6) exempts listed HAPs from PSD review.

The 3,500-scfm landfill gas flare installed and the two additional landfill gas flares proposed to be installed at the Class I Landfill are "contemporaneous" projects with the BPF, as described in Section 3.4, below. A separate cumulative emission rate total for the BPF and three flares is shown in Table 3-1. The combined BPF/flare total is not based on the total of their combustion capacities. Rather, the emissions total reflects the fact that at build-out, only 6,500 scfm of gas will be available. When the BPF is using its 2,800 scfm of landfill gas, the flares will be burning only the remaining 3,700 scfm (and not operating at their 6,500-scfm capacity). This diversion of landfill gas to the BPF will actually result in lower emission rates for some pollutants (volatile organic compounds and carbon monoxide) that the "no-build" condition of all the gas going to the flares, because the BPF dryer burners are more efficient combustion units than are the flares. The flares are exempt from PSD permit application requirements (see Section 2.2.2), so they are included in this application's dispersion modeling analysis only.

This section will discuss the air quality regulations promulgated by the United States Environmental Protection Agency (EPA) and Florida Department of Environmental Protection (FDEP) applicable to the proposed projects.

3.2 Applicable Regulations

The proposed BPF project has been reviewed for applicability to and compliance with the requirements in the CFR and FAC listed below. All of the 40 CFR citations shown have also been incorporated by reference into the FAC at Rule 62-204.800, FAC.

40 CFR 50	_	National Primary and Secondary Ambient Air Quality Standards
40 CFR 51	_	Subpart I - Prevention of Significant Deterioration of Air Quality
40 CFR 52	_	Subpart K - Approval and Promulgation of Implementation Plans, Florida.
40 CFR 60	_	Subpart WWW - Standards of Performance for Municipal Solid Waste Landfills
40 CFR 61	_	Subpart E - National Emission Standard for Hazardous Air Pollutants (NESHAP) - Mercury
40 CFR 63	_	Subpart B - Requirements for Maximum Achievable Control Technology (MACT) Determinations for Major Sources in Accordance with Clean Air Act Sections 112(g) and 112(j)
	_	Subpart AAAA - NESHAP for MSW Landfills
40 CFR 64	_	Compliance Assurance Monitoring Rule
40 CFR 70	_	State Operating Permit Programs (Title V Air Operating Permits)

14 CFR 77	_	Federal Aviation Administration: Objects Affecting Navigable Airspace
62-210 FAC	_	Stationary Sources - General Requirements
62-212 FAC	_	Stationary Sources - Preconstruction Review
62-296 FAC	_	Stationary Source - Emission Standards
62-297 FAC	_	Stationary Source - Emissions Monitoring

3.3 Florida State Program Authority

The State of Florida has been delegated full authority by the EPA to administer the State Implementation Plan (SIP). Additionally, the FDEP has accepted delegation from the EPA to issue permits for new and modified sources and thereby satisfy requirements of PSD regulations (40 CFR Part 51.166). The EPA's role in permitting the proposed source includes a review of assessment protocols for compliance with the SIP and guidance for policy decisions on an as-needed basis.

3.4 Prevention of Significant Deterioration, Non-Attainment New Source Review and Title V Applicability

The Clean Air Act (CAA) was amended in 1977 to incorporate a PSD program. To carry out the policies of the 1977 CAA amendments, the EPA adopted revised PSD regulations on August 7, 1980. These revised regulations contained the PSD increments mandated by Congress and identified the types of emission sources subject to the PSD regulations (40 CFR 51.166, incorporated at 62-212.400, FAC).

For PSD purposes, a major stationary source is defined by the EPA in two main ways. One definition of a major stationary source includes any source belonging to a list of 28 specified categories which has the potential to emit 100 tons per year (tpy) or more of any criteria pollutant regulated under the CAA. The NCRRF is classified, for PSD purposes, as a municipal waste incinerator capable of charging more than 50 tons of refuse per day, which is one of the 28 major source categories, in Section 169 of Title I of the CAA. Since the existing NCRRF has the potential to emit more than 100 tpy of at least one regulated pollutant, the NCRRF together with all other SWA-controlled emissions units on the same property and in the same major two-digit Standard Industrial Classification (SIC) Code, is an existing major stationary source for PSD purposes. The NCRRF and other air emissions sources (the Class I and III Landfills, ash handling facilities, lime and chemical storage silos, Materials Recycling Facility, auto spray booth, and Composting Facility), have the following major-source air permits and approvals:

- PSD Permit No. PSD-FL-108, originally issued December 12, 1986. This permit has been modified as listed below:
  - PSD-FL-108A, January 14, 1992 - upgrades to NCRRF
  - PSD-FL-108B, February 21, 1996 - Class I and III Landfill gas system expansion
  - PSD-FL-108C, August 14, 1997 - a waiver for testing for beryllium and fluorides at the NCRRF
  - PSD-FL-108D, May 11, 1999 - Class I and III Landfill gas system expansion
  - PSD-FL-108E, September 11, 2002 - Change in Class III Landfill surface methane monitoring frequency
- Title V Air Operating Permit, Permit No. 0990234-003-AV, originally issued October 30, 2000.
- Air Construction Permit, Permit No. 0990234-008-AC, originally issued on March 22, 2004.

A modification to an existing major stationary source is subject to PSD regulations if it is located in a Section 107 attainment area and it is a major modification. The project parcel and vicinity are currently considered to be in attainment with air quality standards for all criteria pollutants (40 CFR 81.310 and Rule 62-204, FAC). A major modification is a physical change in or change in the method of operation of a major stationary source which will result in a "significant net emissions increase" of a regulated pollutant. In this case, the physical change is the addition of the BPF. Each proposed modification at the NCRRF is required to take into account all other permitted air emission increases and decreases that have occurred in the 5 years prior to the proposed modification. These sources are considered "contemporaneous." Since the BPF, the new 3,500-scfm flare, and the two proposed flares at the Class I Landfill could all be built within 5 years of each other, they must be considered together in the PSD applicability determination. Similarly, the decommissioning of the existing 1,800-scfm flare at the Class I Landfill occurred with the addition of the new 3,500-scfm flare. The rules for calculating the "net emissions increase" for these projects state that maximum potential emission rates be used for the new sources and actual annual average emission rates (over the most recent 2 years) be used for the calculation of decreases for the decommissioned sources.

The calculated net emissions increases for all PSD pollutants are shown in Table 3-1. The maximum potential annual emission rates presented in Table 3-1 for the new sources were calculated with the assumption that each unit could operate 365 days per year at 100 percent load. Two totals are presented. The first is for all of the "contemporaneous" projects: the BPF, the Class I Landfill 3,500-scfm flare, the 1,000-scfm flare, and the 2,000-scfm flare. Comparison of this first total with the PSD

Significant Net Emissions Increase thresholds (Rule 62-212.400, FAC, Table 212.400-2) indicates that an air quality impact assessment (dispersion modeling analyses) is required for these projects for SO_2, CO, NO_X, and PM_{10} emissions. These analyses are presented in Sections 7 and 8 of this application. They show that the combined impacts of the contemporaneous projects would not cause or contribute to exceedance of any ambient air quality standard, PSD Increment, or visibility impairment criterion. This allows the proposed flares to qualify for a "pollution control project exemption" from further PSD permit requirements (see Section 2.2.2).

The second emission rate total shown in Table 3-1 is for the BPF only. Table 3-1 shows that the net emissions increase for the BPF project will exceed the PSD Significant Net Emissions Increase threshold for NO_X and PM. The BPF project, therefore, is subject to all PSD requirements with respect to these emissions.

In general, a PSD permit application must contain the following basic components:

- A complete description of the nature and operation of the source;
- A Best Available Control Technology (BACT) review for those pollutants emitted at or above the "significant net emissions increase" rates;
- An analysis of existing ambient air quality;
- An impact assessment for those pollutants emitted at or above "significant net emissions increase" rates demonstrating that emissions from the new source will not cause a violation of ambient air quality standards or PSD increments; and
- An assessment of the project's impact on air-quality-related values, including soils, vegetation, and visibility.

This permit application volume addresses these requirements. Section 5 presents the BACT analysis (for the BPF). As shown in Table 3-1, a formal BACT analysis is required for NO_X and PM emissions, so only analysis for these pollutants are presented. Section 6 reviews existing ambient air quality and meteorology near the NCRRF. Air quality modeling analyses are performed in Section 7 to show that applicable ambient air quality standards and PSD increments will be met for all of the comtemporaneous projects. The air quality modeling analyses are also required for SO_2, CO, NO_X and PM_{10} emissions. Section 8 presents the additional impact analyses (all contemporaneous sources) required as part of the PSD review.

A source modification is subject to non-attainment new source review (NSR) if the modification results in a significant net emission increase of a pollutant for which the source is major and for which the area is designated as non-attainment. Since the project parcel and all nearby areas are considered to be in attainment of the Ambient Air Quality Standards (AAQS) for all criteria pollutants, the NSR requirements do not apply.

The Title V Air Operating Permit Program (40 CFR 70) is also administered by the FDEP, and incorporated into their rules in Chapter 62-213, FAC. A modified major source is not required to have this permit before construction but to apply for the Title V permit revision within 180 days after commencing operation (Chapter 62-213.420(1)(a)(4), FAC). The Title V permit collects into one document all of the pre-construction permit requirements; all other air regulatory requirements; and provides consolidated monitoring, record keeping, testing, reporting, and enforcement provisions. The definition of a "source" is similar to that in the PSD rules: a single permit is issued for all emissions units having the same two-digit SIC Code located on contiguous or adjacent property and under common control. A Title V Operating Permit modification is required for any new or modified emissions units at the major source, whether the change itself is major or minor. A Title V permit revision application must include a listing of all applicable air regulatory requirements. The Title V application will be submitted under separate cover within 180 days of the commencement date of the BPF.

3.5 Ambient Air Quality Standards

The current federal and state AAQS are enumerated in the baseline air quality discussion in Section 6. As noted above and discussed in Section 6, ambient air quality in the project parcel's vicinity is currently better than the AAQS for all pollutants. Facility compliance with AAQS after the proposed improvements is demonstrated in the air quality modeling analysis in Section 7.

The EPA promulgated new National Ambient Air Quality Standards (NAAQS) in July 1997 for PM less than 2.5 microns in diameter ($PM_{2.5}$) and a more stringent 8-hour-average ozone standard of 0.08 parts per million (ppm) to replace the current 1-hour-average standard of 0.12 ppm. The American Trucking Association challenged these new standards in court. On May 14, 1999, United States Court of Appeals (D.C. Circuit) issued an opinion that the process for setting these standards was unconstitutional and that the standards were unenforceable. As a result, the new standards were held in abeyance. The EPA appealed this decision to the United States Supreme Court. On February 27, 2001, the United States Supreme Court overturned the D.C. Circuit Court ruling and found that:

- EPA has the right to establish health-based standards;
- EPA need not consider cost when setting standards; and
- EPA must revise its implementation policy for the new 8-hour ozone standard

The EPA designated attainment areas for the 8-hour ozone NAAQS and issued a Phase 1 implementation rule on June 15, 2004. (A proposed rule on January 27, 2005, reconsiders some of this implementation, however.) The 1-hour ozone standard is being phased out and will be replaced by the 8-hour standard on June 15, 2005. The EPA designated attainment areas for the $PM_{2.5}$ standard on December 17, 2004, but has not yet issued implementation rules for this standard. The EPA will retain both PM_{10} and $PM_{2.5}$ as NAAQS.

Because procedures for implementing the new $PM_{2.5}$ and 8-hour ozone NAAQS are still being developed by the EPA, this PSD Permit modification application does not contain a compliance demonstration for these two standards.

3.6 New Source Performance Standards - Standards of Performance for Municipal Solid Waste Landfills (40 CFR 60 Subpart WWW)

These rules apply to the collection of landfill gas at the Class I and III Landfills and to the destruction (removal) of NMOCs in the landfill gas before it is emitted to the air. Landfill Gas (LFG) collected from the Class I Landfill is currently being combusted at a 3,500-scfm flare that commenced operation on June 9, 2004, under Air Construction Permit No. 0990234-008-AC. Gas collected from the Class I Landfill will be combusted in the BPF at the existing 3,500-scfm flare and in the two proposed Class I Landfill flares. These sources will be regulated as control devices for the landfill gas. Control devices for emissions of landfill gas are required to reduce NMOC concentrations by 98 weight-percent (40 CFR 60.752(b)(2)(iii)(B)). Because the proposed flares are exempt from PSD permitting, the SWA will be submitting a separate minor preconstruction air permit application for them. The applicability of this rule to the flares will be addressed in that application.

The BPF burners would qualify as "enclosed combustion devices" for the control of NMOC emissions (40 CFR 60.752(b)(2)(iii)(B)). Enclosed combustion devices are required to reduce NMOC by 98 weight percent or reduce the outlet NMOC concentration to less than 20 ppm by volume, dry basis (ppmvd), as hexane, corrected to 3 percent oxygen, whichever is less stringent. Compliance with either the reduction standard or concentration standard is based on an initial stack test required under 40 CFR 60.8 and using test methods in 40 CFR 60.754(d). The SWA proposes to meet these requirements for the BPF burners.

3.7 National Emission Standards for Mercury (40 CFR 61 Subpart E)

Applicability of the EPA NESHAPs, in 40 CFR 61, to the projects was reviewed and is summarized below. These federal NESHAPs are adopted in the state regulations by reference in Rule 62-204.800(9)(b). There is one NESHAP that will be applicable to the BPF. The National Emission Standard for Mercury (NESHAP Subpart E at 40 CFR 61.50 et. seq.) is applicable to existing and new plants that incinerate or dry wastewater treatment plant sludge. The BPF will be subject to these standards.

The rule limits emissions of mercury from sludge drying plants to not exceed 7.1 pounds of mercury per 24-hour period.

The BPF will control mercury emissions from drying the sludge by having hot exhaust gases containing volatilized gaseous mercury go through a tray condenser in each of the two trains to condense the gaseous mercury into PM. The tray condenser will be followed by a venturi scrubber to remove the PM. Each BPF dryer is proposed to have a mercury emissions limit at its stack of 9.23×10^{-4} pounds per hour. This is equivalent to about 0.044 pounds per day of mercury emissions for both trains, significantly below the 7.1 pounds per day NESHAP.

Compliance with the mercury emissions limit is required to be demonstrated with an initial stack test by Method 101A conducted in accordance with 40 CFR 60.8. Stack samples are required to be taken over a period or periods as are necessary to determine the maximum emissions that will occur in a 24-hour period. The rule allows for an alternative demonstration of compliance by sludge sampling and analysis for mercury, in accordance with Method 105. Mercury emissions for a 24-hour period are then calculated as a function of mercury concentration in the sludge and the measured sludge charging rate for 24 hours.

If the initial stack test or sludge sampling indicate that mercury emissions could exceed 3.5 pounds per day, then stack testing or sludge sampling is required to be conducted at least once per year. Otherwise, the initial stack test is the only required testing.

3.8 Maximum Achievable Control Technology Requirements

The CAA Amendments of 1990 contained changes to Section 112 of the Act to control hazardous air pollutant (HAP) emissions from major sources of HAPs. A major source is one that has the potential to emit 10 tons per year of a single HAP or 25 tons per year of any combination of HAPs. The NCRRF is an existing major source of HAPs. HAPs expected to be emitted by the proposed projects are shown in Appendix E. Table 3-1 shows that the proposed projects' maximum potential emissions of these pollutants will be well below the 10 ton per year threshold for any individual HAP and below the 25 ton per year threshold for all HAPs. Therefore, although the NCRRF is a major source of HAPs, the proposed modifications are minor sources of HAPs.

On December 27, 1996, the EPA promulgated rules in 40 CFR 63 Subpart B requiring case-by-case control technology determinations, in accordance with CAA Section 112(g)(2)(B), for constructed or reconstructed major sources of HAPs, unless an emission limitation established under CAA Section 112 will be met. Since neither the NCRRF or the proposed projects are constructed or reconstructed major sources of HAPs, this rule does not apply.

3.8.1 National Emissions Standards for Municipal Solid Waste Landfills (40 CFR 63 Subpart AAAA)

The new NESHAP for MSW Landfills, 40 CFR 63 Subpart AAAA, were promulgated on January 16, 2003. These rules have the same applicability criteria (for non-bioreactor landfills) as do the NSPS for MSW Landfills, described in Section 3.6, above. This new MSW MACT standard does not contain any emissions limits beyond what is required by the NSPS but references and incorporates the NSPS, and adds some to the NSPS by containing new monitoring, recordkeeping, and reporting requirements. These primarily apply to the Class I and Class III Landfill gas collection and control systems. The applicability of this rule to the proposed Class I Landfill flares will be addressed separately in a separate minor preconstruction air permit application for them.

The BPF burners would be regulated as enclosed combustion control devices for the Class I LFG under this MACT rule, however, just as they are under the MSW Landfill NSPS. The NSPS requires that the enclosed combustion device be operated within the temperature range established at the most recent performance test in which compliance was demonstrated with the 98 percent NMOC destruction efficiency (or NMOC outlet concentration of 20 ppmdv at 3 percent) (40 CFR 60.752(b)(2)(iii)(B)(2)). The NSPS also require that enclosed combustion devices have a temperature monitoring device with a continuous recorder to monitor that the burners are operated within the compliance temperature range (40 CFR 60.756(b)(1)) and that the burner is out of compliance in any 3-hour period in which the average burner temperature was more than 28° C below the average temperature during the compliance test (40 CFR 60.758(c)(1)(i)). The new MACT standards add to this by providing definitions of acceptable data quality for the continuous temperature monitoring device and by defining what a deviation is (40 CFR 63.1965). The new MACT standards also require reporting of deviations for out-of-range monitoring parameters (temperature at the enclosed combustion devices) every 6 months in a semi-annual compliance report (40 CFR 63.1980). The new MACT standards require the preparation of a Startup, Shutdown, and Malfunction (SSM) Plan for the Class I and Class III Landfill gas collection and control systems (40 CFR 63.1955(c)). Since the BPF burners would be part of the control system for the Class I Landfill, they would have to be included in the SSM Plan for the Class I Landfill.

3.9 Compliance Assurance Monitoring Rule

The Compliance Assurance Monitoring (CAM) Rule, 40 CFR 64 was written to provide a "reasonable assurance" of continuous compliance with emissions limitations or standards in cases where the underlying requirement for an emissions unit does not require continuous emissions monitoring and for units that are part of major sources that have Title V operating permits. The rule applies to a pollutant-specific emissions limit for a unit at a major source required to have a Title V permit, if the unit satisfies all of the following criteria:

1) The unit is subject to an emissions limitation, other than an exempt (defined below) emissions limitation;

2) The unit uses a control device to achieve compliance with the emissions limitation; and

3) The unit has potential pre-control device emissions of the regulated air pollutant that will equal or exceed the amount, in tons per year required for a source to be classified as a major source (100 tons per year for criteria air pollutants and 10 tons per year for an individual HAP).

The exempt emissions limitations include any NESHAPs or NSPS proposed after November 15, 1990. (The other exemptions are not relevant to this project.)

The BPF rotary dryer will be required to meet emissions limits for mercury (based on the Mercury NESHAP), opacity (based on FDEP requirements), for NO_X (based on BACT requirements), and for PM (based on BACT requirements).

The Mercury NESHAP was promulgated in October 1975, so Criterion 1 applies. As described in Section 3.7, above, the BPF's tray condenser and venturi scrubber will serve to remove mercury from the flue gas. So, a control device is used to meet the emissions limit, and Criterion 2 applies. The uncontrolled mercury emission rate from each BPF dryer would be 0.42 tons per year, based on a maximum sludge feed rate of 67.5 dry tons per day, and a Class AA biosolids maximum mercury concentration of 17 ppm. Since this is well below 10 tons per year, Criterion 3 does not apply, and a CAM plan is not required for mercury emissions.

Each BPF rotary dryer will have a BACT-based emission limit for NO_X (see Section 5). This limit is not exempt, so Criterion 1 applies. If the proposed low-NO_X burner were considered a control device, Criterion 2 will apply. However, as shown in Section 5, the uncontrolled NO_X emission rate from each BPF dryer will be 35 tons per year. Therefore, Criterion 3 is not met, and a CAM plan is not required for NO_X emissions.

Each BPF rotary dryer will also have a BACT-based emission limit for PM (see Section 5). This limit is not exempt, so Criterion 1 applies. Since PM will be controlled by the impingement tray scrubber and venturi scrubber, Criterion 2 will apply. As shown in Section 5, the uncontrolled PM emission rate from each BPF dryer will be 788 tons per year. This exceeds the 100-ton-per-year major source threshold, so Criterion 3 is met, and a CAM plan is required for PM emissions. As required by 40 CFR 64, the CAM plan for PM emissions will be submitted to FDEP with the Title V permit modification application for the BPF.

Both of the BPF's rotary dryers will be subject to Florida's Visible Emissions Standard for process sources of 20 percent opacity (see Section 3.10, below). Although this limit is not exempt, the CAM Rule appears to apply only to federally enforceable emissions limitations (40 CFR 64.1 Definition of "emission limitation").

In conclusion, a CAM plan will not be required for this facility.

3.10 Federal Aviation Administration Requirements for Objects Affecting Navigable Airspace

Federal Aviation Administration (FAA) regulations in 14 CFR 77 govern stack heights and lighting of stacks and other tall structures near airports. The rules require that the FAA be notified for any proposed new construction that:

- would be greater than 200 feet in height above ground level; or
- would be of greater height than an imaginary surface extending outward and upward at one of the following slopes:
  - 100 to 1 for a horizontal distance of 20,000 feet from the nearest point to the nearest runway with at least one runway longer than 3,200 feet;
  - 50 to 1 for a horizontal distance of 10,000 feet from the nearest point of the nearest runway with its longest runway no more than 3,200 feet in actual length.

The notification is required to be submitted to the FAA regional office on FAA Form 7560-1 Notice of Proposed Construction or Alteration. The FAA regional office then reviews the form and responds with its requirements for lighting and/or height limitations.

The tallest structure associated with the proposed project will be the BPF dryer/RTO stack. The proposed new stacks for each dryer/RTO will be 138 feet above ground level. Since this is less than 200 feet, the first criterion for providing FAA notice does not apply. The nearest airport, West Palm Beach International Airport, is approximately 7 miles southeast of the NCRRF. The West Palm Beach Airport has at least one runway longer than 3,200 feet. Seven miles is 36,960 feet, which exceeds the 20,000-foot distance in the second criterion. Therefore, these two stacks will not be subject to FAA notice requirements.

3.11 Florida Air Regulations

Florida's air regulations concerning air permits are contained in Rules 62-210, 62-212, and 62-213, FAC. Specifically, Section 62-210.300 FAC, requires appropriate permits prior to modification "to any source which emits or can reasonably be expected to emit any air pollutant...unless exempted pursuant to Department rules or statutes." Compliance with these air permit requirements are discussed in Section 3.4, above.

As discussed in Sections 3.6 and 3.7 above, NSPS and NESHAP requirements for the proposed projects are adopted, mostly by reference, into the FAC under 62-204.800. Other air quality requirements in the FAC applicable to the facilities after the proposed improvements are discussed below. These requirements are contained either in Rule 62-296, FAC, which contains Emission Standards for Stationary Sources, or in Rule 62-297, FAC, which contains Emission Monitoring Requirements for Stationary Sources.

The BPF must meet the Florida General Pollutant Emission Limiting Standards in FAC Rules 62-296.320(1) (Volatile Organic Liquids), 62-296.320(2) (Odors), 62-296.320(3) (Open Burning), 62-296.320(4)(b) (Process Source Opacity), 62-296.410 (Combustion Source Opacity) and 62-296.320(4)(c) (Fugitive Dust). The PM emissions limiting standards of Rule 62-296.320(4)(a), FAC, do not apply to the BPF (or to the flares) because they qualify for the exemption given to units that "salvage materials by burning."

Rule 62-296.320(1), FAC states that "No person shall store, pump, handle, process, load, unload, or use in any process or installation, VOCs or organic solvents without applying known and existing vapor emission control devices or systems deemed necessary and ordered by the Department." None of the proposed facilities will store or use volatile organic solvents. The BPF will be equipped with a 500-kW, 895-hp diesel engine emergency generator. The generator will have a 1,500-gallon No. 2 fuel oil storage tank. No. 2 fuel oil has a low Reid vapor pressure (approximately 0.005 psia), so the storage tank will not be required to have a vapor emission control device. The generator itself would be used for emergency purposes only, and with a fuel consumption rate of 31.5 gallons per hour, and a maximum potential use of 500 hours per year, would be exempt from the permitting requirements of Chapter 62-210 and 62-212, because it satisfies the criteria of 62-210.300(20) (b), FAC.

The BPF will have an enclosed wastewater sludge receiving area with an odor control device, likely a wet scrubber packed tower, on its exhaust vent. In addition, the standard operating procedure at the sludge receiving area will specify that the roll-up doors be kept closed whenever they are not actively being used. The RTO on the sludge dryer exhaust will control VOCs and odors driven off the sludge by the dryer. These measures will meet the requirements of Rule 62-296.320(2), FAC, which prohibits the discharge of objectionable odors. No other units at the proposed projects will be odor sources.

The general Visible Emissions Standard, Rule 62-296.320(4)(b), FAC, sets a limit of 20 percent opacity for process sources and this limit will apply for the BPF dryers.

Rule 62-296.410(2), which limits visible emissions from carbonaceous fuel-burning equipment, will set an opacity limit of 20 percent (except that 40 percent opacity is permissible for not more than 2 minutes in any hour) for the BPF burners, which will have a heat input capacity of 40 MMBtu/hr each. Since the process source opacity limit of 20 percent all the time is more stringent and more directly applicable to a source that will have both process and combustion emissions, this combustion-source opacity limit will not apply.

The NCRRF Title V permit incorporates the provisions limiting open burning and the generation of fugitive dust and these will apply to the BPF project, as well.

As discussed in Section 6, the entire State of Florida is either classified as attainment or considered to be in attainment (i.e., unclassifiable) with respect to the NAAQS for all pollutants. In addition, Palm Beach County is not part of any maintenance areas for lead or PM. Therefore, the proposed projects are not subject to the Reasonably Available Control Technology (RACT) requirements for these pollutants in Rule 62-296, FAC. The NO_X RACT provisions of Rule 62-296.500(b), FAC, do apply to facilities in Palm Beach County. However, new or modified NO_X emitting facilities subject to major-source PSD permitting and preparing a BACT analysis are exempt from these requirements. Since the BPF will be meeting NO_X BACT (see Section 5), these rules do not apply.

3.12 Conclusions

The proposed BPF will comply with the EPA NSPS (40 CFR 60, Subparts HH and WWW), EPA NESHAP (40 CFR 61 Subpart E and 40 CFR 63 Subparts AAAA and AAAAA), EPA's CAM Rule (40 CFR 64), and with Florida air regulations for permits and certificates (Rules 62-210, 62-212, and 62-213, FAC), and Florida general emissions limiting standards (Rule 62-296, FAC). In addition, the project will meet PSD requirements, including BACT for NO_X and PM emissions (see Section 5) and the NAAQS (see Section 7).

Section 4
Air Pollution Emissions

4.1 Introduction

This section describes the types of air emissions expected from the Biosolids Pelletization Facility (BPF) and from the three Class I Landfill flares that are included in the dispersion modeling analyses in Sections 7 and 8 of this volume. Estimated emission rates are based on:

- test data and guarantees provided by equipment vendors,
- the results of the Best Available Control Technology (BACT) analysis in Section 5,
- meeting emissions limits described in Section 3, and
- where no other information is available, on United States Environmental Protection Agency, Compilation of Air Pollutant Emission Factors, Report No. AP-42, Volume 1, Fifth Edition ("AP-42").

Table 3-1 in Section 3 summarizes these emissions estimates. Emission rate calculations are presented in greater detail in Appendix E.

4.2 Biosolids Pelletization Facility

The BPF will combust 84 million British thermal units per hour (MMBtu/hr) of landfill gas (and natural gas) in two 337.5-wet tons per day (wtpd) rotary dryers (40 MMBtu/hr each) to dry sewage sludge and then screen the dried sludge into marketable fertilizer pellets.

Hot combustion gases (about 850° F at the dryer inlet) will flow through the dryer with the biosolids, driving off water, and volatile organic compounds (VOCs) in the sludge. At the dryer exhaust end, a pre-separator and polycyclone will remove the pellets and heavier dust particles from the gas stream and send these to screens for size sorting. The exhaust gases, containing products of combustion (nitrogen oxide (NO_X), carbon monoxide (CO), and sulfur dioxide (SO_2)), particulate matter (PM_{10}) (including trace quantities of metals), and VOCs, will then go through a tray condenser and venturi scrubber. These devices will remove PM_{10} and some SO_2. The gases will then go through a 2 MMBtu/hr regenerative thermal oxidizer (RTO) to combust the VOCs before exiting the exhaust stack.

4.2.1 Nitrogen Oxides

As discussed above, BACT is required for NO_X emissions from the BPF. The BACT analysis is presented in detail in Section 5. For the BPF, BACT was found to be a low-NO_X burner for the dryer. Based on estimates provided by Maxon, Inc., and on review of recent air permits granted for similar facilities, each dryer burner is expected to have a maximum potential to emit 0.049 pounds of NO_X per million British Thermal Unit (MMBtu) of landfill gas heat input. Based on assumed continuous operation, some additional conversion of ammonia (driven off the sludge) to NO_X in the RTOs, and calculations shown in Appendix E, each dryer will emit 24.5 tons per year (tpy) of NO_X.

4.2.2 Carbon Monoxide

An estimated maximum potential CO emission rate of 3.37 lb/hr was obtained for one 300-wtpd BPF dryer (see Appendix E). While a specific vendor has not been selected for the project, review of recently granted air permits for other biosolids dryers suggests that this CO emission rate will be achievable by other vendors. The resulting annual emission rate will be 14.76 tpy for each of the two dryers.

4.2.3 Sulfur Dioxide

Estimated maximum potential SO_2 emmission rate of 4.45 lb/hr was based on an assumed 190 parts per million (ppm) sulfer concentration in landfill gas. Landfill gas contains sulfer compounds that will be converted to SO_2 emissions by the dryer burner. Although the venturi scrubber will remove some of the SO_2 emissions from the exhaust gases, no credit has been taken for this in the calculations for the purposes of estimating the maximum potential to emit. The resulting annual emission rate will be 19.5 tpy for each of the two dryers.

4.2.4 Total Volatile Organic Compounds

The dominant source of VOCs in the BPF dryers will be those organic compounds driven off of the sludge as it is heated and dried. A small amount of additional VOCs will be from compounds in the landfill gas fuel not completely combusted by the burner. Both sets of VOCs from the dryer will be treated by the proposed RTO on each dryer exhaust. The RTO will have a guaranteed VOC removal efficiency of 98 percent, or 25 ppmv as methane, whichever is greater. This will more than meet the Municipal Solid Waste (MSW) Landfill New Source Performance Standards (NSPS) requirements, since the dryer burner itself will destroy approximately 98 percent of the landfill gas non-methane organic compounds (NMOC) and the RTO will then destroy 98 percent of what remains. Estimated maximum potential VOC emission rate of 1.0 lb/hr is based on vendor guarantees for full gas concentration at the dryer RTO exit. The resulting annual VOC emission rate will be 4.4 tpy for each of the two dryers.

4.2.5 Particulate Matter and PM_{10}

PM emissions from a biosolids dryer are primarily due to dust being carried through the dryer along with the dried pellets in the exhaust gas. Combustion of landfill gas will produce an additional small amount of PM. A polycyclone on each dryer exhaust will remove the pellets and heavier particles. After leaving the polycyclone, the exhaust gases will pass through a tray condenser to cool them down (and condense volatilized metals onto the particles), condense water vapor and remove ammonia. The equipment vendor, Sly® Emtrol®, has guaranteed that the tray scrubber/ condenser alone will reduce at least 97 percent of the inlet PM. With an estimated inlet (uncontrolled) PM emission rate of 180 lb/hr, the outlet from the condenser would be 5.4 lb/hr. About 35% of this flow would go to the venturi scrubber, RTO and stack; the remaining 65percent would be returned to the dryer (not emitted). The vendor has proposed to not take any credit for the additional removal that would be provided by the venturi scrubber. The resulting PM_{10} emission rate from each train's venturi scrubber and RTO would be 2.42 lb/hr (see Appendix E). The resulting annual emission rate will be 10.6 tpy for each of the two dryers.

Each dryer train's screens and recycle material (undersized pellets) bin will be a source of dust emissions. These are proposed to be controlled by a baghouse on the recycle material bin exhaust vent. The pellet storage silo for each train (two total) will have their exhaust ducted to each train's recycle bin. The dusty air resulting from the pneumatic conveying of the pellets to the silos and filling the silos will, therefore, be controlled by the recycle bin baghouses. The vendor-guaranteed PM exhaust concentration for each baghouse is 0.010 grain per dry standard cubic foot (gr/dscf). It was assumed that the recycle material bin exhaust vents will operate continuously. The resulting annual PM and PM_{10} emission rate will be 0.3 tpy per train. This baghouse exhaust will be vented to the building's odor control scrubber, so PM emissions to outdoor ambient air from the recycle bins and silos are expected to be negligible. For conservatism, no credit was taken in the emissions calculations or dispersion modeling for the additional PM removal provided by the odor control scrubber. Pellets will be conveyed to trucks in an enclosed area to minimize fugitive dust emissions.

Each of the two dryer trains will have its own small cooling tower. It is anticipated that only about 0.06 lb/hr of PM_{10} would be emitted from each tower as dissolved solids in the mist. A conservative estimate of PM_{10} emission rates have been made based on the cooling tower's design water flow, evaporation rates and drift rates provided by the cooling tower equipment supplier. The resulting annual PM_{10} emissions rate will be 0.274 tpy for each cooling tower, as presented in Appendix E.

4.2.6 Hazardous Air Pollutants

The BPF will burn landfill gas containing trace quantities of hazardous VOCs and mercury. Typical concentrations of these compounds in landfill gas were taken from AP-42, Section 2.4, Table 2.4-1, and are shown in Appendix E. In calculating emission rates for these compounds, it was assumed that each BPF dryer burner will meet the required destruction efficiency of 98 percent for NMOC (see VOC discussion, above), and that this will also be the expected overall destruction efficiency for individual VOC Hazardous Air Pollutants (HAPs). Credit was not taken for the additional removal that will be provided by the RTO. For mercury emissions, it was assumed that all of the mercury (less than one tenth of a pound per year) in the landfill gas would pass through the burner.

In addition, the wastewater sludge entering the dryer will contain trace amounts of heavy metals including arsenic, cadmium, chromium, lead, mercury, and nickel.

These metals are assumed to remain attached to the particulate matter leaving the dryer. Metals will be removed, along with the PM, in each train's impingement tray scrubber/condenser and venturi scrubber. For most metals, the BPF vendor has estimated metals emissions rates based on the worst-case metals concentration in the feed sludge, and at the worst-case PM emissions rate. These emissions rates are shown in Appendix E. The metals emission rates were added to the emission rates of other HAPs from the combustion of landfill gas.

Appendix E shows that each BPF dryer's resulting total annual emission rate of all HAPs combined will be less than 1 tpy (0.25 tpy).

4.3 Landfill Gas Flares

The BPF will have a design capacity landfill gas demand of 2,800 standard cubic feet per minute (scfm), or about 84 MMBtu/hr of landfill gas with a heat content of 500 British thermal units per standard cubic foot (Btu/scf). The Class I Landfill gas collection system would provide this gas through pressurization equipment and a 4,500-scfm pressurized line under 45th Street.

Class I Landfill gas is currently collected and combusted in a 3,500 scfm flare which is located north of the Compost Facility.

Although the BPF could demand up to 2,800 scfm of the Class I Landfill gas, the SWA has considered installation of two additional flares, a 1,000 scfm flare and a 2,000 scfm flare, to handle future landfill gas system expansions and/or build-out conditions of up to 6,000 scfm. This will provide redundancy if the BPF project is delayed, not built to capacity, and/or for when it is off-line, as well as gas turn-down capability.

As discussed in Sections 2 and 3, the flares are independent projects from the BPF, and exempt from PSD permitting but they are contemporaneous with the BPF projects. In addition, to qualify for the exemption from PSD permitting, the flares must be shown not to cause or contribute to any exceedance of an ambient air quality standard, allowable increase, or visibility limitation. For these reasons, the flares have been included in the dispersion modeling for the BPF project and their emission rates discussed here.

4.3.1 Total Volatile Organic Compounds

The flares will be required to meet the NSPS for MSW Landfills emissions limit for NMOC of 98 percent removal (see Subsection 3.6 in Section 3). Because all three flares are open flares, this NMOC removal efficiency cannot readily be confirmed with emissions testing. An assumption is built into NSPS that open flares complying with the performance specifications in 40 CFR 60.18 provide the 98 percent removal (40 CFR 60.752(b)(2)(iii)(A) and 61 FR 9906, March 12, 1996). Since all of the Class I Landfill flares fulfill and will continue to fulfill these requirements, 98 percent removal efficiency was used in calculating VOC emission rates.

The NMOC inlet concentration of 595 ppm by volume (ppmv) (as hexane) was taken from AP-42, Section 2.4. It was conservatively assumed that NMOC represents VOCs, even though not all NMOCs are VOCs. Appendix E shows the calculation. The resulting annual VOC emission rates from the flares are listed below:

- 3,500-scfm flare: 2.3 tpy
- 1,000-scfm flare: 0.6 tpy
- 2,000-scfm flare: 1.3 tpy
- Existing 1,800-scfm flare: -0.7 tpy, based on existing 2-year actual average flow of 1,034 scfm. Since this flare is being replaced, its emissions are subtracted from those above.

The total net increase in VOC emissions from the flares would be 3.6 tpy. However, if the BPF was drawing 2,800 scfm of gas, this total would be 1.7 tpy.

4.3.2 Nitrogen Oxides

Nitrogen oxides are produced as a secondary emission from the combustion of landfill gas. The NO_X emission rate for the decommissioned 1,800-scfm flare was calculated based on the AP-42 emission factor of 40 pounds of NO_X per million dry standard cubic feet (dscf) of methane burned (AP-42, Section 2.4, MSW Landfills, Table 2.4-5), consistent with currently permitted emission rates for this open flare. The actual emission rate was calculated based on the most recent 2-year average gas methane content and flow rate (880 scfm) to the existing flare (see Appendix E).

For the 3,500-scfm, 1,000-scfm, and 2,000-scfm open flares, the emission rates for CO and NO_X are based on vendor emissions estimates, which, in turn, are from emission rates in AP-42's Industrial Flares Section, Section 13.5, Table 13.5-1. The NO_X emission rate is 0.068 pounds per MMBtu (lb/MMBtu) of heat input to the flare. The calculations are shown in Appendix E. The resulting maximum potential annual NO_X emission rates for the flares are shown below:

- 3,500-scfm flare: 35.9 tpy
- 1,000-scfm flare: 10.3 tpy
- 2,000-scfm flare: 20.5 tpy
- Decommissioned 1,800-scfm flare: -5.4 tpy, based on existing 2-year actual average flow of 1,034 scfm. Since this flare is being replaced, its emissions are being subtracted from those above.

The total net increase in NO_X emissions from the flares would be 61.3 tpy. If the BPF was drawing 2,800 scfm of gas, however, this total would be 32.6 tpy.

4.3.3 Carbon Monoxide

Another secondary emission from the combustion of landfill gas is CO. Similar to the approach for NO_X emissions, the CO emission rate for the decommissioned 1,800-scfm flare, the 3,500-scfm, 1,000-scfm, and 2,000-scfm open flares is 0.37 lb/MMBtu of heat input to the flare (AP-42, Section 13.5, Industrial Flares, Table 13.5-1). The calculations are shown in Appendix E. The resulting maximum potential annual CO emission rates for the flares are shown below:

- 3,500-scfm flare: 195.3 tpy
- 1,000-scfm flare: 55.8 tpy
- 2,000-scfm flare: 111.6 tpy
- Existing 1,800-scfm flare: -101.6 tpy, based on existing 2-year actual average flow of 1,034 scfm. Since this flare is being replaced, its emissions are being subtracted from those above.

The total net increase in CO emissions from the flares would be 261.1 tpy. If the BPF was drawing 2,800 scfm of gas, however, this total would be 104.9 tpy.

4.3.4 Sulfur Dioxide

Emissions of SO_2 from a flare are directly related to the amount of sulfur found in the landfill gas. As discussed for the BPF, above, SO_2 emission rates for the decommissioned 1,800-scfm flare, the existing 3,500 scfm flare, and the proposed three new flares were based on equations in Section 2.4 of AP-42 and an assumed landfill gas sulfur content of 190 ppmv. SO_2 calculations for all flares are presented in Appendix E. The resulting maximum potential annual SO_2 emission rates for the flares are shown below:

- 3,500-scfm flare: 29.1 tpy
- 1,000-scfm flare: 8.3 tpy
- 2,000-scfm flare: 16.6 tpy
- Existing 1,800-scfm flare: -8.6 tpy, based on existing 2-year actual average flow of 1,034 scfm. Since this flare is being replaced, its emissions are being subtracted from those above.

The total net increase in SO_2 emissions from the flares would be 45.4 tpy. If the BPF was drawing 2,800 scfm of gas, however, this total would be 22.1 tpy.

4.3.5 Particulate Matter and PM_{10}

PM and PM_{10} emissions from landfill gas combustion were estimated for the existing and proposed flares using AP-42, Section 2.4, emission factors. It was assumed that all PM is PM_{10}. The calculations are shown in Appendix E. The resulting maximum potential annual PM_{10} emission rates for the flares are shown below:

- 3,500-scfm flare: 8.6 tpy
- 1,000-scfm flare: 2.5 tpy
- 2,000-scfm flare: 4.9 tpy
- Existing 1,800-scfm flare: -2.3 tpy, based on existing 2-year actual average flow of 1,034 scfm. Since this flare is being replaced, its emissions are being subtracted from those above.

The total net increase in PM_{10} emissions from the flares would be 13.7 tpy. If the BPF was drawing 2,800 scfm of gas, however, this total would be 6.8 tpy.

4.3.6 Hazardous Air Pollutants

As discussed for the BPF, combustion of landfill gas will result in emissions of trace amounts of hazardous VOCs and mercury. Typical concentrations of these compounds in landfill gas were taken from AP-42, Section 2.4, Table 2.4-1, and are shown in Appendix E. In calculating emission rates for these compounds, it was assumed that the flares will meet the required destruction efficiency of 98 percent for NMOC (see VOC discussion, above), and that this will also be the expected overall destruction efficiency for individual VOC HAPs. It was assumed that all of the mercury in the landfill gas (about a 1/2 pound per year in all three proposed flares together), would pass through the flares.

Appendix E shows the existing and proposed Class I flares' resulting maximum potential total annual emission rate of all HAPs combined, without netting out the decommissioned flare, would be less than a ton per year (0.85 ton/year).

4.4 Operation Scenarios

It is necessary to determine the worst-case operating scenario for purposes of comparison with PSD emission rate thresholds and for the dispersion modeling analyses. For the proposed facility there are two possible worst-case scenarios:

- BPF operating at full capacity: all landfill gas being used by the proposed BPF at its design heat input capacity (84 MMBtu/hr, for a demand of 2,800 scfm of landfill gas) with the excess gas (3,700 scfm) going to the Class I Landfill flares;
- All gas (6,500 scfm) being combusted by the Class I Landfill flares: the BPF is not operating.

Emissions for the various sources under each scenario were calculated. For each pollutant, the scenario resulting in the highest total project emission rate at full build-out of the Class I Landfill was used for analyses:

- PM_{10}: BPF operating with 3,700 scfm of gas going to the flares;
- SO_2: BPF operating with 3,700 scfm of gas going to the flares;
- NO_X: BPF operating with 3,700 scfm of gas going to the flares;
- CO: All gas being combusted by the flares with the BPF shut down;
- Lead: BPF operating with 3,700 scfm of gas going to the flares;
- VOC: BPF operating with 3,700 scfm of gas going to the flares; and
- Total HAPs: BPF operating with 3,700 scfm of gas going to the flares.

Emissions for all sources/scenarios are shown in Table 3-1, in Section 3. Detailed emission rate calculations, including the calculation of emissions for the various scenarios, are presented in Appendix E.

Section 5
Best Available Control Technology Review

5.1 Description of Best Available Control Technology Review

This section contains a Best Available Control Technology (BACT) analysis of nitrogen oxides (NO_X) and particulate matter (PM) control technologies for the 135 dry tons per day (dtpd) (675 wet tons per day (wtpd)) Biosolids Pelletization Facility (BPF). The BPF contains two trains (i.e. two biosolids dryers and associated air pollution control equipment). The total maximum potential NO_X emission rate from the two BPF trains will be approximately 49 tons per year, which is greater than the Prevention of Significant Deterioration (PSD) significant net emissions increase level for a Major Modification (i.e. 40 tons per year). In addition, the total maximum potential PM emission rate will be approximately 21 tons per year. This exceeds the PSD significant net emissions increase level (15 tons per year of PM_{10}) (Rule 62-212.400(2)(e)2., Florida Administrative Code (FAC)). Therefore, since the project's NO_X and PM emissions constitute PSD significant net increases for these two pollutants, the new facilities are classified as a Major Modification and a BACT analysis is required for the two pollutants that exceed the PSD significance level. As shown in Section 4, all other maximum potential air pollutant emission rates for the BPF will be below the PSD significant net emissions increase levels.

A BACT analysis is an evaluation of the "best available" air pollution control technology for a particular emission source and for particular pollutants (in this case PM and NO_X). The evaluation must consider the environmental, economic, and energy impacts of each control technology. Furthermore, the analysis must be "top-down," that is, it must start with the most stringent control alternative and work down to the least effective control alternative. The most effective control technology which is determined to be technically and economically feasible is BACT.

Specifically, a BACT analysis consists of the following steps:

- Review BACT determinations of recent, similar type facilities;
- Identify all possible control technologies;
- Evaluate technical feasibility of alternative technologies;
- Develop capital and operations and maintenance (O&M) costs for the technically feasible alternatives;
- Evaluate environmental, economic and energy impacts; and
- Make final a BACT determination.

The evaluations for each pollutant are presented below.

5.2 Basis of Best Available Control Technology Analysis

NO_x will be generated by the BPF by the following mechanisms:

- Thermal NO_x from the dryer burner,
- Volatilization of ammonia in the dryer, recirculation of the dryer exhaust to the dryer furnace, and subsequent oxidation of the recycled ammonia to NO_x in the dryer furnace,
- Thermal NO_x from the regenerative thermal oxidizer (RTO) burner, and
- Volatilization of ammonia in the dryer and subsequent oxidation of the non-recycled portion of the dryer exhaust to NO_x in the RTO.

A brief explanation of these mechanisms follows. Thermal NO_x is the primary source of NO_x from the dryer and RTO burners. These burners will be burning either landfill gas or natural gas which both have very low levels of nitrogen and therefore fuel NO_x from these burners will be negligible. Uncontrolled emissions of thermal NO_x for the BPF are based on the uncontrolled emission factor for a natural gas fired boiler (0.10 pounds NOx per million British thermal unit (Btu)) taken from AP-42, Compilation of Air Pollution Emission Factors, (United States Environmental Protection Agency (EPA), Office of Air Quality Planning and Standards (OAQPS), 1998).

The second mechanism of NO_x generation can best be explained by referring to Figure 2-4, Process Flow Diagram. Most of the sludge received and processed at the BPF will be digested sludge. Digested sludge contains significant levels of ammonia as a result of anaerobic sludge digestion which is performed at the municipal wastewater treatment plants from which the sludge originates. Digested sludge typically contains approximately 700 milligrams per liter (mg/l) of ammonia dissolved in the water in the wet sludge cake. A portion of this ammonia is volatilized in the dryer and released in the dryer exhaust. The dryer exhaust is then sent to a condenser/scrubber and subsequently recirculated back to the dryer furnace. By using just cold water in the condenser, a large portion of the ammonia will be removed. The remaining ammonia in the exhaust stream would be returned to the dryer furnace where it is converted to NO_x. At some present-day sludge dryer plants, acid is added to the condenser water which improves the removal of ammonia. In a similar manner, the non-recirculated portion of the dryer exhaust (which also contains some volatilized ammonia) is sent to the RTO where the ammonia will be oxidized to NOx.

It should be noted that the condenser is an integral part of the dryer system since it enables recirculation of the dryer exhaust and thereby improves the thermal efficiency of the process and also enables the dryer to operate with a low (less than 8 percent) oxygen gas stream. The low oxygen concentration will not support combustion and is an important safety feature of the sludge drying system. Since essentially all municipal sludge dryer plants are now designed with dryer exhaust recirculation and a condenser/scrubber, this process configuration will be considered as the base case design. The NO_X emission rate for the base case is estimated to be 11.2 pounds of NO_X per hour per dryer train, equivalent to 98.2 tons of NO_X per year. The detailed calculations and assumptions used to generate this emission rate are presented in **Table 5-1**.

Table 5-1 NO_X Emission Rate for Baseline Case: Conventional Burner, Condenser with No Acid Addition

		Units
Dryer Burner Thermal NO_X		
Firing rate, @ max burner rating	40	MMBtu[1] per hour
Emission factor, thermal NO_X	0.10	pounds per MMBtu
Emission rate as NO	4.00	lb/hr [2]
Dryer NO_X from NH_3 in Recirculated Exhaust, 100% Digested Sludge		
Max wet sludge feed rate	337.5	tons per day
Percent solids of wet sludge feed	20	%
Max evaporation rate	22,500	lb/hr water
Ammonia in wet sludge cake	720	mg/l
Ammonia volatilization rate	80	%
Exhaust recirculation rate	75	%
Ammonia scrubbing efficiency using just water	80	%
Ammonia flow to the dryer furnace	1.944	lb/hr
Conversion of ammonia to NO_X	100	%
Emission rate of NO_X	5.26	lb/hr
RTO Burner Thermal NO_X		
Firing rate, @ max burner rating	2	MMBtu per hour
Emission factor, thermal NO_X	0.10	pounds per MMBtu
Emission rate as NO_X	0.20	lb/hr
RTO NO_X from Ammonia in Exhaust		
Max evaporation rate	22,500	pounds water per hour
Ammonia in wet sludge cake	720	mg/l
Ammonia volatilization rate	80	%
Exhaust recirculation rate	75	%
Exhaust flow to RTO	25	%
Ammonia scrubbing efficiency using just water	80	%
Ammonia flow to RTO	0.648	lb/hr
Conversion of ammonia to NO_X	100	%
Emission rate of NOx	1.75	lb/hr
Total Dryer and RTO NO_X Emission Rate	11.21	lb/hr per train
Total Dryer and RTO NO_X Emission Rate for Two Trains	98.2	tons per year

1. Million British thermal unit
2. Pounds per hour

Since the baseline case includes the condenser, the vendor prescribed control efficiency for the condenser is used as the baseline case. The uncontrolled PM emissions are based on vendor provided data, as shown in **Table 5-2**.

Table 5-2 Vendor Data

	Baseline Emission Factor	Emissions in lb/hr per Train	Emissions in tons per year per Train
NOx	See Table 5-1	11.2	49.1
PM (dryer exhaust only)	Based on vendor data includes Condenser	2.42	10.6

The above uncontrolled NO_X and PM emissions will be considered the baseline case against which all control technologies will be evaluated.

Technical and economic data on the various NO_X control technologies was obtained mainly from contacting numerous suppliers of NO_X and PM control systems. Capital and O&M costs were based on data supplied from control system suppliers. In addition, OAQPS Cost Control Manual (EPA OAQPS, 1996) was used to provide installation cost factors and O&M cost data. It should be noted that the fuel to be used in the BPF is landfill gas. Thus, the baseline case assumed the use of landfill gas for fuel.

5.3 Best Available Control Technology Reviews

The EPA's RACT/BACT/LAER Clearinghouse (RBLC) database was searched for BACT determinations on municipal biosolids drying plants throughout the United States. However, there were no sewage biosolids dryers in the RBLC database. Therefore, the BACT review was based upon recently permitted biosolids dryer facilities. In general, the rotary drum biosolids drying process has been modified and improved over the last 10 years to increase thermal efficiency, reduce pollutant emissions, and to provide assured control of odors. These improvements include:

- Cooling and condensing of the dryer exhaust gas
- Recirculation of 60 percent to 90 percent of the cooled dryer exhaust to the dryer furnace
- Wet scrubbing of the non-recirculated portion of the dryer exhaust for control of particulate matter and acid gases
- Regenerative thermal oxidation of the non-recirculated portion (of the dryer exhaust) to control volatile organic compounds (VOCs) and odors

The condenser/scrubber is approximately 97 percent effective in removing PM. Recirculation of the dryer exhaust is both beneficial and detrimental to controlling NO_X emissions. Specifically, recirculation of the exhaust is essentially flue gas recirculation which reduces thermal NO_X at the burner. However, this recirculation allows the ammonia volatilized in the dryer to be oxidized to NO_X in the dryer furnace. Fortunately, the condenser/scrubber is effective in removing ammonia and even greater removal efficiency can be obtained by adding acid to the condenser. The BPF will have a condenser/scrubber as well as all of the above process features.

It is noted that some of the recently permitted biosolids drying facilities (namely, Massachusetts Water Resource Authority in Boston, Massachusetts and the Greater Lawrence Sanitary District in North Andover, Massachusetts) have low NO_X burners on the dryer and RTO and acid addition to the condenser/scrubber. The following section evaluates the use of the following NO_X control technologies: selective catalytic reduction, low temperature ozone oxidation, and multi-chemical wet scrubbing. According to the major suppliers of biosolids drying systems, no biosolids drying facility has any of these NO_X control technologies.

5.4 NO_X Control Technologies

The following NO_X control technologies are evaluated for the BPF:

1. Low Temperature Selective Catalytic Reduction (SCR)
2. Low Temperature Ozone Oxidation
3. Multi-Chemical Wet Scrubbing System
4. Low NO_X Burner and Acid Addition

A brief description of each of the proposed technologies follows.

Low Temperature SCR

In the SCR process, ammonia is injected into the flue gas stream which is then sent through an SCR catalyst. The ammonia reacts with the NO_X in the flue gas on the surface of the catalyst to produce nitrogen gas (N_2) and water. The size of the catalyst bed is determined by the flue gas flow rate and the amount of NO_X control required. Low temperature SCR utilizes a platinum/palladium oxide catalyst which is effective over the temperature range of 300°F to 550°F. Most SCR systems are carried out at a higher temperature (600°F to 750°F) and use a vanadium/titanium oxide catalyst.

In the last 10 years, high temperature SCR systems have been applied to a wide range of gas-fired and coal-fired boilers and industrial furnaces and have achieved 90 percent to 94 percent control of NO_X in recent applications (Texas Institute, 2000). Neither high temperature nor low temperature SCR has ever been applied to a biosolids dryer. For application to the BPF, a NO_X control efficiency of 90 percent was assumed.

Low Temperature Ozone Oxidation

Low temperature ozone oxidation is a patented process by BOC Group, Ltd., gases for removal of NO_X from gas streams. In this system, ozone is injected into the flue gas stream at a temperature below 225°F. The ozone oxidizes the NO_X to a water soluble form such as N_2O_5. The gas stream is then passed through a wet scrubber where the N_2O_5 is absorbed into the scrubber water. The process requires an ozone generator as well as a supply of liquid oxygen which is converted to ozone in the ozone generator. A drawback of the process is that it generates considerable quantities of acidic wastewater that would have to be neutralized prior to discharge to a sewer system. The wastewater from the BPF will be treated at a nearby municipal wastewater treatment plant (WWTP). Thus, neutralization of the acidic wastewater would be required prior to discharge to the WWTP. The process can achieve high levels of NO_X removal, over 95 percent. However, there are only a handful of industrial applications of this process. For application to the BPF, a NO_X control efficiency of 90 percent was assumed.

Multi-Chemical Wet Scrubbing System
Multi-chemical wet scrubbing is a chemical oxidation process offered by Tri-Mer Corporation. For a dryer application, this system would consist of three scrubber towers in which the following chemicals are added: sodium sulfide, sodium chlorite, sodium hydroxide, and sulfuric acid. The chemistry is proprietary but appears to be based on oxidation of the NO and NO_2 to water soluble forms followed by reduction/absorption reactions. NO_X removals as high as 99 percent have been reported. The process can handle extremely high levels of NO_X (i.e. hundreds of lb/hr), but chemical usage costs can become quite high. Chemical storage tanks and feed systems are required for each of the chemicals. Capital cost for the system is high; but, other than keeping the chemical feed systems and scrubber water recirculation pumps running, O&M requirements are relatively straightforward. The system does produce a neutralized wastewater stream containing soluble salts which could be discharged to the on-site sanitary sewer. Tri-Mer reports over 100 installations mostly in the chemical and metal-finishing industry. Most of Tri-Mer's installations have a capacity of 20 to 12,000 standard cubic feet per minute which would be suitable for the BPF. For this technology a NO_X control efficiency of 90 percent was assumed.

Low NO_X Burner and Acid Addition
In a low NO_X burner the air and fuel addition are staged or distributed over several different zones at the flame front of the burner to create fuel rich and fuel lean zones and thereby control oxygen concentrations and localized temperatures. For instance, in the primary zone, a portion of the fuel would be burned with a slight amount of excess air to maintain a stable flame. (Flame stability is an important consideration when staging air and fuel flow to a burner.) In the second zone, excess fuel would be added to maintain a fuel-rich zone to limit oxygen concentration and to reduce any NO_X to molecular nitrogen and water. In the third zone, a slight amount of air would be added to complete the combustion while maintaining low excess air conditions, thereby limiting the temperature and oxygen concentration. There are many variations of low NO_X burners. The most advanced designs have been developed for large gas-fired utility and industrial boilers. The NO_X emission factor for this alternative is based the low NO_X burner emission factor for a natural gas fired boiler taken from AP-42 (i.e. 0.050 pounds of NO_X per MMBtu. This emission factor is essentially equal to the guaranteed NO_X emission rate offered by the low NO_X burner supplier (0.049 pounds per MMBtu).

The addition of acid to the condenser/scrubber will also reduce NO_X emissions by absorbing more ammonia in the condenser and thereby preventing its conversion to NO_X in the dryer furnace and RTO. With acid addition an ammonia removal efficiency of 90 percent was conservatively assumed. The use of both low NO_X burners and acid addition will result in a NO_X emission rate of 5.6 pounds of NOx per hour per dryer train which corresponds to 50 percent NO_X control from the base line case ((11.2 -5.6)/11.2).

5.4.1 Evaluation of NOx Control Technologies

The following control technologies were technically and economically evaluated for the BPF:

1. Low Temperature SCR
2. Low Temperature Ozone Oxidation
3. Multi-Chemical Wet Scrubbing System
4. Low NO_X Burner and Acid Addition

5.4.2 Low Temperature Selective Catalytic Reduction

Technical and Economic Evaluation

Low temperature SCR could be applied to the BPF; but, there are some technical uncertainties involved. SCR suppliers were reluctant to propose an SCR system for this application due to the fact that landfill gas would be used. The SCR suppliers stated that landfill gas can contain siloxanes, alkali metals, and other impurities which can deactivate or foul an SCR catalyst. Therefore, for this alternative it was assumed that an activated carbon system would be used to clean the landfill gas prior to its use in the BFP. The cost of the activated carbon system was included in the economic analysis. The SCR system would be located downstream of the RTO. The exhaust gas temperature at the outlet of the RTO is typically 210°F which is too low for the SCR catalyst since it requires a minimum temperature of 400°F. Therefore a thermal oxidizer with a lower thermal efficiency (of approximately 79 percent) would be used in lieu of an RTO which has a thermal efficiency of 95 percent. The estimated capital and O&M costs were developed for both dryer trains and are presented in **Table 5-3**. The total annual cost is $1,565,000. Since the base case NO_X emissions rate for both dryers is 98.2 tons per year and the NO_X control efficiency for this alternative is 90 percent, the tons of NO_X removed is 88.4 tons per year. Thus, the cost per ton of NO_X removed is $17,700. Typically, unit pollutant removal costs of greater than $10,000 are viewed as being economically infeasible. Thus, the $17,700 cost per ton of NO_X removed would dictate that this alternative is economically infeasible.

Energy, Environmental, and Social Impact Evaluation

The energy impact for low temperature SCR would be approximately 98 kilowatts of additional electrical power usage. The beneficial environmental impact would be the

Table 5-3 Low Temperature SCR System for BPF Capital and O&M Costs

CAPITAL COSTS		
Direct Costs		
Purchased Equipment Costs	$1,489,000	
SCR reactor, urea injection system, catalyst, urea storage and feed system, interconnecting ductwork, pumps and piping, instrumentation and controls, NOx analyzer, activated carbon system to remove impurities from landfill gas		
Sales Tax and Freight	$119,000	
1. Purchased Equipment Cost = A	**$1,608,000**	
Direct Installation Costs		
Foundations and Supports 0.12xA	$193,000	
Steel Supports, Ladders and Platforms 0.12xA	$193,000	
Handling and Erection 0.40xA	$643,000	
Electrical 0.10xA	$161,000	
Piping 0.30xA	$482,000	
Painting 0.02xA	$32,000	
2. Total Direct Installation Cost	**$1,704,000**	
Indirect Costs		
Engineering 0.10xA	$161,000	
Construction and Field Expenses 0.20xA	$322,000	
Contractor Fees 0.10xA	$161,000	
Start-Up, Performance Tes, and Contingencies 0.05*A	$80,000	
3. Total Indirect Cost	**$724,000**	
TOTAL CAPITAL INVESTMENT (1+2+3)	**$4,036,000**	
TOTAL ANNUALIZED CAPITAL COST (i =10%, 10 yrs, crf = 0.16275)		**$657,000**
ANNUAL O&M COSTS		
Operating Labor		
(8 hr/day x 365day/yr x $17/hr x 1.35 for fringe benefits)	$67,000	
Supervisory Labor		
(15% of operating labor)	$10,000	
Maintenance Labor		
(12 hr/day x 365 days/yr x $18/hr x 1.35 f.b.)	$106,000	
Maintenance Materials		
(100% of maintenance labor)	$106,000	
Catalyst Replacement - once every 3 years		
Annualized cost	$72,000	
Power - Additional ID Fan Power cost		
(0.000157 x 15000 acfm x 6 inches wc x 1/0.65 = 22 hp/fan)		
(22 hp/fan x 0.75 kw/hp x 8760 hr/yr x $0.07/kwhr x 2 fans)	$20,000	
Power - for urea feed and injection system		
(65 kw x 8760 hr/yr x $0.07/kwhr)	$40,000	
Filter Media Replacement - polymorphous graphite pellets		
(8,621 lb media/cannister x 3 cannisters x $3.00/lb x once/yr)	$78,000	
Chemicals - Urea		
(20.2lb NOx/hr x 1.0 gphr/1.0 lb NOx/hr x 8760 hr/yr x $1.40/gal)	$248,000	
Property Taxes, Administration & Insurance		
(0.04 x Total Capital Investment)	$161,000	
TOTAL ANNUAL O&M COST		**$908,000**
TOTAL ANNUAL COST		**$1,565,000**
Tons of NOx Removed per Year		**88.4**
TOTAL COST PER TON OF NOx REMOVED		**$17,700**

removal of 88.4 tons per year of NO_X from the atmosphere. The adverse environmental impacts are that approximately 800 cubic feet of spent catalyst would have to be disposed of once every 3 years and 13 tons of spent activated carbon would have to be disposed of per year. The social impact of this alternative is that it would provide jobs for one additional plant operator and 1.5 additional maintenance mechanics.

Overall Evaluation
The social impacts of this alternative would be minimal. The overall environmental impact would be beneficial, since 88.4 tons per year of NO_X would be removed from the atmosphere. Due to the high cost per ton of NO_X removed ($17,700), this alternative is judged to be economically infeasible. Overall evaluation of this alternative is that it has a severe economic impact and thus should not be considered BACT.

5.4.3 Low Temperature Ozone Oxidation

Technical and Economic Evaluation
Low temperature ozone oxidation could also be applied to the BPF and therefore is technically feasible for this application. The oxidation system would be located on both dryer trains downstream of the venturi scrubber prior to the RTO. The estimated capital and O&M costs are presented in **Table 5-4**. This alternative has a very high capital cost and a high operating cost due to the need for liquid oxygen to generate ozone and the high power usage by the ozone generators. The total annual cost is $2,641,000 and the total cost per ton of NO_X removed is $29,900. The amount of NO_X being removed (88.4 tons per year) is relatively small in comparison to the total annual cost and thus the cost per ton of NO_X removed is a large number. This alternative is also economically infeasible.

Energy, Environmental, and Social Impact Evaluation
The energy impact for low temperature ozone oxidation would be approximately 283 kilowatts of additional electrical power usage. The environmental impact would be the removal of 88.4 tons per year of NO_X from the atmosphere, but 21 million gallons per year of wastewater would be generated. The wastewater would contain nitrates and dilute nitric acid. This wastewater stream would have to be neutralized and then discharged to the sanitary sewer system. The social impact of this alternative is that it would provide jobs for one additional plant operator and 1.5 additional maintenance mechanics.

Overall Evaluation
The energy and social impacts of this alternative would be minimal. The overall environmental impact would be beneficial, since 88.4 tons per year of NO_X would be removed from the atmosphere. There would also be a significant wastewater stream generated which would have to be disposed of by discharge to the sanitary sewer. Due to the high cost per ton of NO_X removed ($29,900), this alternative is judged to be

Table 5-4 Low Temperature Ozone Oxidation System for BPF Capital and O&M Costs

CAPITAL COSTS		
Direct Costs		
Purchased Equipment Costs	$3,410,000	
Oxidation reactor, flue gas heat exchanger, wet scrubber, ozone generator, interconnecting ductwork, pumps and piping, instrumentation & controls, NOx analyzer		
Sales Tax and Freight	$273,000	
1. Purchased Equipment Cost = A	**$3,683,000**	
Direct Installation Costs		
Foundations and Supports 0.12xA	$442,000	
Steel Supports, Ladders and Platforms 0.12xA	$442,000	
Handling and Erection 0.40xA	$1,473,000	
Electrical 0.10xA	$368,000	
Piping 0.30xA	$1,105,000	
Painting 0.02xA	$74,000	
2. Total Direct Installation Cost	**$3,904,000**	
Indirect Costs		
Engineering 0.10xA	$368,000	
Construction and Field Expenses 0.20xA	$737,000	
Contractor Fees 0.10xA	$368,000	
Start-Up, Performance Test & Contingencies 0.05*A	$184,000	
3. Total Indirect Cost	**$1,657,000**	
TOTAL CAPITAL INVESTMENT (1+2+3)	**$9,244,000**	
TOTAL ANNUALIZED CAPITAL COST (i =10%, 10 yrs, crf = 0.16275)		**$1,504,000**
ANNUAL O&M COSTS		
Operating Labor		
(8 hr/day x 365day/yr x $17/hr x 1.35 for fringe benefits)	$67,000	
Supervisory Labor		
(15% of operating labor)	$10,000	
Maintenance Labor		
(12 hr/day x 365 days/yr x $18/hr x 1.35 f.b.)	$106,000	
Maintenance Materials		
(100% of maintenance labor)	$106,000	
Liquid Oxygen for Ozone Generation		
(20.2 lb NOx/hr x 2.25 ccf O2 /lb NOx x 8760 hr/yr x $0.35/ccf O2)	$139,000	
Power - Additional ID Fan Power cost		
(0.000157 x 13000 acfm x 10 inches wc x 1/0.65 = 31hp/fan)		
(31 hp/fan x 0.75 kw/hp x 8760 hr/yr x $0.07/kwhr x 2 fans)	$29,000	
Power - for ozone generator and pumps		
(236 kw/train x 2 trains x 8760 hr/yr x $0.07/kwhr)	$289,000	
Wastewater Disposal		
(40 gal/min x 60 min/hr x 8760 hr/yr x $1.00/1000 gal)	$21,000	
Property Taxes, Administration & Insurance		
(0.04 x Total Capital Investment)	$370,000	
TOTAL ANNUAL O&M COST		**$1,137,000**
TOTAL ANNUAL COST		**$2,641,000**
Tons of NOx Removed per Year		**88.4**
TOTAL COST PER TON OF NOx REMOVED		**$29,900**

economically infeasible. Overall evaluation of this alternative is that it has a severe economic impact and thus should not be considered BACT.

5.4.4 Multi-Chemical Wet Scrubbing System

Technical and Economic Evaluation

This technology could also be applied to the BPF. The scrubbing system would be located downstream of the venturi scrubber prior to the RTO. The estimated capital and O&M costs for both dryer trains are presented in **Table 5-5**. This alternative has a relatively moderate capital cost; however, the annual cost for chemicals is quite high at $502,000 per year. The total annual cost is $1,785,000 and the total cost per ton of NO_X removed is $20,200. Similar to the two previous alternatives, this technology is not economically feasible for the BPF.

Energy, Environmental, and Social Impact Evaluation

The energy impact for multi-chemical wet scrubbing would be approximately 163 kilowatts of additional electrical power usage. The environmental impact would be the removal of 88.4 tons per year of NO_X from the atmosphere. The process would generate 90 gallons per minute (gpm) or 47 million gallons per year of wastewater containing nitrates and soluble salts. This wastewater stream would have to be discharged to the sanitary sewer system. The social impact of this alternative is that it would provide jobs for one additional plant operator and 1.5 additional maintenance mechanics.

Overall Evaluation

The energy and social impacts of this alternative would be minimal. The environmental impact would be beneficial, since 88.4 tons per year of NO_X would be removed from the atmosphere. There would also be a significant wastewater stream generated which would have to be disposed of. Due to the high cost per ton of NO_X removed ($20,200), this alternative is judged to be economically infeasible. Overall evaluation of this alternative is that it has a severe economic impact and thus should not be considered BACT.

5.4.5 Low NO_X Burner and Acid Addition

Technical and Economic Evaluation

Low NO_X burners could certainly be used in place of conventional burners on the furnace of the dryer and the RTO. Based on the NO_X emission factors from AP-42, low NO_X burners can achieve a 50 percent reduction in NO_X emissions. The NO_X emission rate from the burners would be 0.050 pounds per MMBtu versus 0.10 pounds per MMBtu with conventional burners. Also, the addition of acid to the condenser will enhance capture of ammonia and prevent its conversion to NO_X. The combined effect of low NO_X burners and acid addition will result in a NO_X emission rate of 5.6 pounds of NOx per hour per train and result in an annual NO_X emission rate of 49.1 tons per year. Thus, the NO_X reduction for this alternative from the baseline case would be 49.1 tons per year (98.2 - 49.1). In preparing the economic evaluation for this alternative, only the additional incremental cost of installing low NO_X burners versus

Table 5-5 Multi-Chemical Wet Scrubbing System for BPF Capital and O&M Costs

CAPITAL COSTS		
Direct Costs		
Purchased Equipment Costs	$1,426,000	
Three scrubber towers with packing, chemical storage tanks and feed systems, interconnecting ductwork, pumps and piping, structural steel frame, instrumentation & controls, NOx analyzer		
Sales Tax and Freight	$114,000	
1. Purchased Equipment Cost = A	**$1,540,000**	
Direct Installation Costs		
Foundations and Supports 0.12xA	$185,000	
Steel Supports, Ladders and Platforms 0.12xA	$185,000	
Handling and Erection 0.40xA	$616,000	
Electrical 0.15xA	$231,000	
Piping 0.30xA	$462,000	
Painting 0.02xA	$31,000	
2. Total Direct Installation Cost	**$1,710,000**	
Indirect Costs		
Engineering 0.10xA	$154,000	
Construction and Field Expenses 0.20xA	$308,000	
Contractor Fees 0.10xA	$154,000	
Start-Up, Performance Test & Contingencies 0.05*A	$77,000	
3. Total Indirect Cost	**$693,000**	
TOTAL CAPITAL INVESTMENT (1+2+3)	**$3,943,000**	
TOTAL ANNUALIZED CAPITAL COST (i =10%, 10 yrs, crf = 0.16275)		**$642,000**
ANNUAL O&M COSTS		
Operating Labor (8 hr/day x 365day/yr x $17/hr x 1.35 for fringe benefits)	$67,000	
Supervisory Labor (15% of operating labor)	$10,000	
Maintenance Labor (12 hr/day x 365 days/yr x $18/hr x 1.35 f.b.)	$106,000	
Maintenance Materials (100% of maintenance labor)	$106,000	
Chemicals - NaClO2, H2SO4, Na2S & NaOH ($2.45/lb of NOx removed x 20.2 lb NOx removed/hr x 8760 hr/yr)	$502,000	
Power - Additional ID Fan Power cost (0.000157 x 13000 acfm x 12 inches wc x 1/0.65 = 38 hp/fan) (38 hp/fan x 0.75 kw/hp x 8760 hr/yr x $0.07/kwhr x 2 fans)	$35,000	
Power - for chemical feed and recirculation pumps (106 kw x 8760 hr/yr x $0.07/kwhr)	$65,000	
Water (90 gal/min x 60 min/hr x 8760 hr/yr x $1.00/1000 gal)	$47,000	
Wastewater Disposal (90 gal/min x 60 min/hr x 8760 hr/yr x $1.00/1000 gal)	$47,000	
Property Taxes, Administration & Insurance (0.04 x Total Capital Investment)	$158,000	
TOTAL ANNUAL O&M COST		**$1,143,000**
TOTAL ANNUAL COST		**$1,785,000**
Tons of NOx Removed per Year		**88.4**
TOTAL COST PER TON OF NOx REMOVED		**$20,200**

conventional burners was used. The additional capital cost for low NO_X burners versus convention burners is $146,000 for the equipment only.

The estimated capital and O&M costs are presented in **Table 5-6**. The total annual cost is $140,000 and the total cost per ton of NO_X removed is $2,900. This cost per ton of NO_X removed is low and meets the criteria for economic feasibility.

Energy, Environmental, and Social Impact Evaluation

The energy impact for low NO_X burner and acid addition would be approximately 36 kilowatts of additional electrical power usage. The environmental impact would be favorable, since 49.1 tons per year of NO_X would be removed from the atmosphere. There are no other adverse environmental impacts. The social impact of this alternative is negligible, since it would provide 208 hour per year of additional labor for a maintenance mechanic.

Overall Evaluation

The overall evaluation of this alternative is that: the energy and social impacts would be insignificant, the environmental impact is beneficial, and the economic impact is acceptable. Therefore, this alternative is ranked highly as a candidate BACT technology.

5.4.6 Determination of Best Available Control Technology for NOx

For the BPF the overall evaluation of the NO_X control technologies is summarized as follows:

1. Low Temperature SCR
   - Beneficial environmental impact - removal of 88.4 tons NO_X per year
   - Economically infeasible - $17,700 per ton NO_X removed
2. Low Temperature Ozone Oxidation
   - Beneficial environmental impact - removal of 88.4 tons NO_X per year
   - Economically infeasible - $29,900 per ton NO_X removed
3. Multi-Chemical Wet Scrubbing System
   - Beneficial environmental impact - removal of 88.4 tons NO_X per year
   - Economically infeasible - $20,200 per ton NO_X removed

Table 5-6 Low NOx Burner and Acid Addition for BPF Capital and O&M Costs

CAPITAL COSTS		
Direct Costs		
Purchased Equipment Costs[1]	$146,000	
Low NOx burner		
Sales Tax and Freight	$12,000	
1. Purchased Equipment Cost = A	**$158,000**	
Direct Installation Costs[1]		
Handling and Installation 0.20xA	$32,000	
Electrical 0.10xA	$16,000	
Piping	$0	
Painting	$0	
2. Total Direct Installation Cost	**$48,000**	
Indirect Costs[1]		
Engineering 0.1xA	$16,000	
Construction and Field Expenses 0.2xA	$32,000	
Contractor Fees 0.1xA	$16,000	
Start-Up, Performance Test & Contingencies 0.05xA	$8,000	
3. Total Indirect Cost	**$72,000**	
TOTAL CAPITAL INVESTMENT (1+2+3)	**$278,000**	
TOTAL ANNUALIZED CAPITAL COST (i =10%, 10 yrs, crf = 0.16275)		**$45,000**
ANNUAL O&M COSTS		
Operating Labor		
(No additional operating labor required.)	$0	
Supervisory Labor		
(No additional supervisory labor required.)	$0	
Maintenance Labor		
(4 hr/week x 52 weeks/yr x $18/hr x 1.35 f.b.)	$5,000	
Maintenance Materials		
(100% of maintenance labor)	$5,000	
Power		
(48 hp x 0.75 kw/hp x 8760 hr/yr x $0.07/kwhr)	$22,000	
Acid Addition to Condenser/Scrubber		
(1.5 gal/hr-dryer x 2 dryers x 8760 hr/yr x $2.30/gal)	$60,000	
Insurance		
(0.01 x Total Capital Investment)	$3,000	
TOTAL ANNUAL O&M COST		**$95,000**
TOTAL ANNUAL COST		**$140,000**
Tons of NOx Removed per Year		**49.1**
TOTAL COST PER TON OF NOx REMOVED		**$2,900**

1. All capital costs are the incremental costs for a Low NOx burner versus a conventional burner.

4. Low NO_X Burner and Acid Addition

- Beneficial environmental impact - removal of 49.1 tons NO_X per year
- Economically feasible - $2,900 per ton NO_X removed

For the BPF, the only technology which was determined to be both technically and economically feasible is the Low NO_X Burner and Acid Addition. Therefore, the Low NO_X Burner and Acid Addition is BACT for the BPF and it will control NO_X emissions to 24.55 tons per year for each train, a total of 49.1 tons per year for both trains.

5.5 PM Control Technologies

As previously pointed out, the condenser/scrubber and exhaust gas recirculation are considered integral parts of the dryer system. For this project, the dryer system supplier proposes to use a three tray impingement scrubber for a condenser which will achieve 97 percent control of particulate matter. In addition to condensing, the three tray impingement scrubber will provide a high degree of particulate control without such common operational problems as fouling of packing, inconsistent and unreliable performance, and high maintenance.

A three-stage impingement tray scrubber/condenser has been successfully applied for PM control at recently constructed biosolids drying facilities (Greater Lawrence Sanitary District, North Andover, Massachusetts; Blue Lake WWTP, Minneapolis, Minnesota). The tray scrubber by itself would achieve a minimum 97 percent removal of PM, based on a Sly® Emtrol® guarantee for the BPF. The tray scrubber/condenser would treat all of the exhaust leaving the dryer. Beyond the tray scrubber/condenser, the exhaust stream would be split, with approximately 75 percent being recycled back to the dryer furnace, and the remaining 25 percent going to the RTO before being vented to the stack. Between the tray scrubber and the RTO, the 25 percent exhaust stream would be treated by a venturi scrubber, which would remove additional PM as a polishing step, to prevent PM from clogging the heat exchange media in the RTO. Although additional PM would be removed by the venturi scrubber, no additional PM removal credit is being taken for the venturi scrubber. The overall PM removal from the condenser/scrubber is 97 percent. Since the uncontrolled PM emission from the dryer exhaust is 80.7 pounds of PM per hour per dryer, the base case PM emission factor is 2.42 pounds of PM per hour per dryer (0.03 x 80.7). This emission rate equates to 10.6 tons of PM per year per dryer.

The following PM control technologies are evaluated for the BPF 25 percent exhaust stream:

1. Fabric Filter
2. Dry Electrostatic Precipitator (ESP)

3. Wet ESP

There will be three minor PM sources, in addition to the dryer exhaust, for each of the two dryer trains: the pellet recycle bins, the pellet storage silo, and the single-cell cooling tower. Approximately 800 actual cubic feet per minute of exhaust air from the recycle bin will be ventilated through a fugitive dust control baghouse with a guaranteed outlet loading of 0.01 grains per dry standard cubic foot (gr/dscf). The dust collector will discharge into the process building room and be treated by the building odor control scrubber, which will remove PM before being emitted to the atmosphere. The emissions from this source, therefore, are considered negligible and will not be evaluated further in this BACT analysis. Dusty air from the pneumatic conveying of pellets to the storage silo and from the filling of the storage silo will be ducted back to the recycle bins and recycle bin baghouses. This source, therefore, is also considered negligible and will not be evaluated further. The cooling tower cell will be a source of PM as the airborne mist produced by the cooling tower evaporates and leaves the airborne dissolved salts. Although this source will not be negligible (0.27 tons per year PM for each cooling tower cell), the mist eliminators that will be included in the cooling tower design are the best and only control technology available for this source and will be considered BACT.

A brief description of each of the proposed technologies for the BPF dryer exhaust follows.

Fabric Filters

Fabric filters, or baghouses, are often considered to provide the top level of control for fine PM. However, electrostatic precipitators can achieve the same level of control in many applications depending on particle size distribution, flue gas PM concentrations, and other parameters.

Fabric filters remove dust from the gas stream by passing the stream through a porous fabric. Dust particles form a less porous cake on the surface of the fabric; it is typically this cake that does the filtration. The fabric is arranged in cylindrical "bags," with the exhaust stream entering the bottom open end of each bag, and exiting through the closed sides and top. Cleaning of the bags is an important factor in the performance of the fabric filter. If the dust cake is not adequately removed, the pressure drop will increase to unacceptably high levels (clogged fabric); if the dust cake is removed too well, excessive leakage will occur until the filtering cake is built back up again. The two most common types of cleaning systems are reverse-air and pulse-jet.

In the last 10 years, fabric filters have been applied to a wide range of waste-to-energy facilities and other solid-fuel-fired boilers. They have been found to reduce PM emissions to less than 0.010 gr/dscf, and in a number of cases, to as low as 0.001 to 0.005 gr/dscf. A fabric filter has never been applied to a biosolids dryer.

Dry ESPs

An ESP uses electrical forces to move particles out of the flowing exhaust gas stream and onto charged collector plates. The exhaust stream particles are given an electrical charge by passing them through a corona of gaseous ions. They then move into an electrical field that forces the now charged particles to the walls, or collection plates. Once the particles are on the plates, they must be removed without re-entraining them into the exhaust stream. This is typically done with a rapper that knocks the particles loose from the plates, allowing them to slide down the plate to a hopper. (With a Wet ESP, discussed below, the collected particles are removed from the collection plates or tubes with intermittent or continuous wash water.)

Re-entrainment of particles is a phenomenon which hinders ESP performance. Re-entrainment occurs when collected particles are rapped from the collection plates but instead of falling into the collection hopper are swept up into the exhaust stream. It is roughly estimated that rapping releases about 12 percent of the collected particles back into the gas stream. The re-entrained particles are then captured by downstream ESP sections, but the particles re-entrained in the last ESP section cannot be recaptured and are released to the atmosphere.

Another problem with ESPs is "back corona." Collected particles form a continuous layer on the plates, creating greater resistivity between the plates and the gas stream and creating an electric field in the layer. The electric field can get large enough to cause a local electrical breakdown, cause ions of the wrong polarity to form, and cause sparking. This sparking is called "back corona."

ESPs have been applied to waste-to-energy facilities, coal-fired boilers, iron/steel plants, incinerators, coke plants, and copper furnaces. ESPs can achieve a 90 to 99 percent removal efficiency for particles 10 microns or larger in size and will do less well for smaller particles. An ESP has never been applied to a biosolids dryer.

Wet ESPs

Wet ESPs function the same way as dry ESPs and can have a similar configuration as a dry ESP. Some Wet ESPs are cylindrical in shape and have vertical tubes for collection surfaces and vertical rods (in the tubes) as electrodes. Wet ESPs have the added feature of using water, either intermittently or continuously, to wash the collected particles off the plates or tubes into a sump for disposal. Wet ESPs can achieve removal efficiencies comparable to dry ESPs. Wet ESPs are typically used on wet saturated, low-temperature gas streams. Wet ESPs are not hindered by re-entrainment problems but can lose removal efficiency if the surfaces of the collection plates or tubes are not kept wet. Also sparking can occur in a wet ESP if there are water droplets of appreciable size in the inlet gas stream. Ideally the inlet gas stream should be a very fine mist or fog which would wet the collection surfaces but not create sparking.

5.5.1 Evaluation of PM Control Technologies

The following PM control technologies were technically and economically evaluated:

1. Fabric filter
2. Dry ESP
3. Wet ESP

All of the above PM control technologies can achieve a high degree of PM control. For the following technical evaluations, it was assumed that each of the above PM control devices would control PM emissions to an outlet grain loading of 0.005 gr/dscf. The base case dryer system with condenser/scrubber will control PM to 2.42 lb/hr per train which equates to an outlet grain loading of 0.026 gr/dscf. Thus, each of the above technologies was assigned a PM control efficiency of 81 percent ((0.026 - 0.005)/0.026). As previously discussed, the condenser control defines the baseline case and equates to a total PM emission rate of 21.2 tons of PM per year. Thus, application of any of the above PM control technologies would result in the removal of 17.2 tons of PM per year (0.81 x 21.2) and a total PM emission rate of 4.0 tons of PM per year (21.2 - 17.2).

5.5.2 Fabric Filter

Technical and Economic Evaluation

The fabric filter would be located following the RTO. However, it would be technically risky to apply a fabric filter to the BPF. This is due to the fact that the gas stream entering the fabric filter must be at least 50°F above its dew point in order to avoid having water vapor condense and cause the collected particles to stick, agglomerate, and "blind" the fabric. This would cause unacceptably high pressure drop. It is estimated that the exhaust gas exiting the RTO would be at 210°F and it would have a dew point of 140°F. This indicates that the above criterion would be met; but, it is unknown whether it could be met during all operating conditions particularly during start-ups and shut-downs. A secondary concern is that the particles from the dryers are combustible and explosive. If they were to form a dry filter cake on the surface of the bags, there would be substantial risk of spontaneous combustion or an explosion.

Capital and O&M costs were developed for the fabric filter alternative and are presented in **Table 5-7**. In general, fabric filters typically have low capital costs but high operating and maintenance costs. The total annual cost for the fabric filter alternative is $460,000 and the cost per ton of PM removed is $26,700. This is a high unit removal cost which is judged to be economically infeasible.

Energy, Environmental, and Social Impact Evaluation

The energy impact for fabric filter would be approximately 68 kilowatts of additional electrical power usage. The environmental impact would be the removal of 17.2 tons

Table 5-7 Fabric Filter for BPF Capital and O&M Costs

CAPITAL COSTS		
Direct Costs		
Purchased Equipment Costs		
Fabric Filter with Nomex bags, SS bags, ductwork, rotary airlocks, screw conveyors, instrumentation & controls	$404,000	
Sales Tax and Freight	$32,000	
1. Purchased Equipment Cost = A	**$436,000**	
Direct Installation Costs		
Foundations and Supports 0.12xA	$52,000	
Steel Supports, Ladders and Platforms 0.12xA	$52,000	
Handling and Erection 0.40xA	$174,000	
Electrical 0.10xA	$44,000	
Piping 0.08xA	$35,000	
Painting & Insulation 0.10xA	$44,000	
2. Total Direct Installation Cost	**$401,000**	
Indirect Costs		
Engineering 0.10xA	$44,000	
Construction and Field Expenses 0.20xA	$87,000	
Contractor Fees 0.10xA	$44,000	
Start-Up, Performance Test & Contingencies 0.05*A	$22,000	
3. Total Indirect Cost	**$197,000**	
TOTAL CAPITAL INVESTMENT (1+2+3)	**$1,034,000**	
TOTAL ANNUALIZED CAPITAL COST (i =10%, 10 yrs, crf = 0.16275)		**$168,000**
ANNUAL O&M COSTS		
Operating Labor		
(4 hr/day x 365day/yr x $17/hr x 1.35 for fringe benefits)	$34,000	
Supervisory Labor		
(15% of operating labor)	$5,000	
Maintenance Labor		
(8 hr/day x 365 days/yr x $18/hr x 1.35 f.b.)	$71,000	
Maintenance Materials		
(100% of maintenance labor)	$71,000	
Bag Replacement	$20,000	
Power - Additional ID Fan Power cost		
(0.000157 x 15000 acfm x 10 inches wc x 1/0.65 = 36 hp/fan)		
(36 hp/fan x 0.75 kw/hp x 8760 hr/yr x $0.07/kwhr x 2 fans)	$33,000	
Power- for Compressed Air for Bag Cleaning		
(18 hp x 0.75 kw/hr x 8760 hr/yr x $0.07/kwhr)	$17,000	
Property Taxes, Administration & Insurance		
(0.04 x Total Capital Investment)	$41,000	
TOTAL ANNUAL O&M COST		**$292,000**
TOTAL ANNUAL COST		**$460,000**
Tons of PM Removed per Year		**17.2**
TOTAL COST PER TON OF PM REMOVED		**$26,700**

Table 5-9 Wet Electrostatic Precipitator for BPF Capital and O&M Costs

CAPITAL COSTS		
Direct Costs		
Purchased Equipment Costs		
WESP, interconnecting ductwork, pumps and piping, instrumentation and controls	$680,000	
Sales Tax and Freight	$54,000	
1. Purchased Equipment Cost = A	**$734,000**	
Direct Installation Costs		
Foundations and Supports 0.12xA	$88,000	
Steel Supports, Ladders and Platforms 0.12xA	$88,000	
Handling and Erection 0.40xA	$294,000	
Electrical 0.10xA	$73,000	
Piping 0.30xA	$220,000	
Painting 0.02xA	$15,000	
2. Total Direct Installation Cost	**$778,000**	
Indirect Costs		
Engineering 0.10xA	$73,000	
Construction and Field Expenses 0.20xA	$147,000	
Contractor Fees 0.10xA	$73,000	
Start-Up, Performance Test & Contingencies 0.05*A	$37,000	
3. Total Indirect Cost	**$330,000**	
TOTAL CAPITAL INVESTMENT (1+2+3)	**$1,842,000**	
TOTAL ANNUALIZED CAPITAL COST (i =10%, 10 yrs, crf = 0.16275)		**$300,000**
ANNUAL O&M COSTS		
Operating Labor		
(4 hr/day x 365day/yr x $17/hr x 1.35 for fringe benefits)	$34,000	
Supervisory Labor		
(15% of operating labor)	$5,000	
Maintenance Labor		
(4 hr/day x 365 days/yr x $18/hr x 1.35 f.b.)	$35,000	
Maintenance Materials		
(100% of maintenance labor)	$35,000	
Power - Additional ID Fan Power cost		
(0.000157 x 15000 acfm x 4 inches wc x 1/0.65 = 15 hp/fan)		
(15 hp/fan x 0.75 kw/hp x 8760 hr/yr x $0.07/kwhr x 2 fans)	$14,000	
Power - to energize WESP electrodes		
(10 kw x 8760 hr/yr x $0.07/kwhr)	$6,000	
Wastewater Disposal		
(160 gal/min x 10 min x 4 times/day x 365 days/yr x $1.00/1000 gal)	$2,000	
Property Taxes, Administration & Insurance		
(0.04 x Total Capital Investment)	$74,000	
TOTAL ANNUAL O&M COST		**$205,000**
TOTAL ANNUAL COST		**$505,000**
Tons of PM Removed per Year		**17.2**
TOTAL COST PER TON OF PM REMOVED		**$29,400**

5.5.4 Wet ESP

Technical and Economic Evaluation

A wet ESP is technically feasible and could be used as a polishing step in lieu of the venturi scrubber and prior to the RTO. Achieving good performance with a wet ESP is contingent upon: getting a unit with precisely designed and manufactured tolerances particularly between electrodes and the collection surfaces, installing an appropriate demister and fogging nozzles upstream of the wet ESP to properly condition the inlet gas stream, and using corrosion resistant materials for fabrication. Typically, all of the wetted parts in a wet ESP are constructed of 316 stainless steel which can significantly add to the cost of the system.

The capital and O&M costs for the wet ESP alternative are presented in **Table 5-9**. The total annual cost for wet ESP is $505,000 and the unit cost per ton of PM removed is $29,400. Note that the capital cost for the wet ESP is quite high while the O&M cost is relatively moderate.

Energy, Environmental, and Social Impact Evaluation

The energy impact for a wet ESP would be approximately 33 kilowatts of additional electrical power usage. The environmental impact would be the removal of 17.2 tons per year of PM from the atmosphere. There would be a relatively small wastewater stream (approximately 2.3 million gallons per year) that would have to be disposed of. The social impact of this alternative is that it would provide jobs for 0.5 additional plant operators and 0.5 additional maintenance mechanics.

Overall Evaluation

The energy and social impacts of this alternative would be minimal. The environmental impact would be beneficial, since 17.2 tons per year of PM would be removed from the atmosphere. Due to the high cost per ton of PM removed ($29,400), this alternative is judged to be economically infeasible. Overall evaluation of this alternative is that it has a severe economic impact and thus should not be considered BACT.

5.5.5 Determination of Best Available Control Technology for PM

For the BPF the overall evaluation of the PM control technologies is summarized as follows:

1. Fabric Filter

   - Technical feasibility – substantial risk
   - Beneficial environmental impact – removal of 17.2 tons of PM per year
   - Economically infeasible - $26,700 per ton of PM removed

Table 5-8 Dry Electrostatic Precipitator for BPF Capital and O&M Costs

CAPITAL COSTS		
Direct Costs		
Purchased Equipment Costs	$740,000	
Three cell ESP, structural steel supports, trough hoppers & heaters, roof assemblies, 3 rectifier/transformers, inlet & outlet nozzles, insulation and lagging, instrumentation & controls		
Sales Tax and Freight	$59,000	
1. Purchased Equipment Cost = A	**$799,000**	
Direct Installation Costs		
Foundations and Supports 0.12xA	$96,000	
Steel Supports, Ladders and Platforms 0.12xA	$96,000	
Handling and Erection 0.40xA	$320,000	
Electrical 0.10xA	$80,000	
Piping 0.05xA	$40,000	
Painting & Insulation 0.10xA	$80,000	
2. Total Direct Installation Cost	**$712,000**	
Indirect Costs		
Engineering 0.10xA	$80,000	
Construction and Field Expenses 0.20xA	$160,000	
Contractor Fees 0.10xA	$80,000	
Start-Up, Performance Test & Contingencies 0.05*A	$40,000	
3. Total Indirect Cost	**$360,000**	
TOTAL CAPITAL INVESTMENT (1+2+3)	**$1,871,000**	
TOTAL ANNUALIZED CAPITAL COST (i =10%, 10 yrs, crf = 0.16275)		**$305,000**
ANNUAL O&M COSTS		
Operating Labor		
(4 hr/day x 365day/yr x $17/hr x 1.35 for fringe benefits)	$34,000	
Supervisory Labor		
(15% of operating labor)	$5,000	
Maintenance Labor		
(4 hr/day x 365 days/yr x $18/hr x 1.35 f.b.)	$35,000	
Maintenance Materials		
(100% of maintenance labor)	$35,000	
Power - Additional ID Fan Power cost		
(0.000157 x 15000 acfm x 4 inches wc x 1/0.65 = 15 hp/fan)		
(15 hp/fan x 0.75 kw/hp x 8760 hr/yr x $0.07/kwhr x 2 fans)	$14,000	
Power- for ESP and Hopper Heaters		
(0.00194 x 8800 sq ft + 2 x 8) x 8760 hr/yr x $0.07/kwhr)	$41,000	
Property Taxes, Administration & Insurance		
(0.04 x Total Capital Investment)	$75,000	
TOTAL ANNUAL O&M COST		**$239,000**
TOTAL ANNUAL COST		**$544,000**
Tons of PM Removed per Year		**17.2**
TOTAL COST PER TON OF PM REMOVED		**$31,600**

per year of PM from the atmosphere. The social impact of this alternative is that it would provide jobs for 0.5 additional plant operators and one additional maintenance mechanic.

Overall Evaluation
The energy and social impacts of this alternative would be minimal. The overall environmental impact would be beneficial, since 17.2 tons per year of PM would be removed from the atmosphere. Due to the high cost per ton of PM removed ($26,700), this alternative is judged to be economically infeasible. Overall evaluation of this alternative is that it has a severe economic impact and thus should not be considered BACT.

5.5.3 Dry ESP

Technical and Economic Evaluation
A dry ESP could be applied to the BPF. Conceivably the dry ESP could be located following the RTO. However, use of an ESP would be a technically risky endeavor. This is due to the relatively low temperature and high moisture content of the RTO exhaust and the likelihood of condensation occurring in the ESP. The insulation and lagging on the ESP would have to be well maintained so that cold sections do not develop. Also the varying moisture content of the sludge received at the BPF and hence varying moisture content of the exhaust gas could affect the resistivity of the particulate matter and the performance of the dry ESP.

The capital and O&M costs for this alternative are presented in **Table 5-8**. The total annual cost for dry ESP is $544,000 and the unit cost per ton of PM removed is $31,600. Note that the capital costs for the dry ESP are quite high while the O&M cost is moderate.

Energy, Environmental, and Social Impact Evaluation
The energy impact for dry ESP would be approximately 56 kilowatts of additional electrical power usage. The beneficial environmental impact would be the removal of 17.2 tons per year of PM from the atmosphere. The social impact of this alternative is that it would provide jobs for 0.5 addition plant operators and 0.5 additional maintenance mechanics.

Overall Evaluation
The social and energy impacts of this alternative would be minimal. The overall environmental impact would be beneficial, since 17.2 tons per year of PM would be removed from the atmosphere. Due to the high cost per ton of PM removed ($31,600), this alternative is judged to be economically infeasible. Overall evaluation of this alternative is that it has a severe economic impact and thus should not be considered BACT.

2. Dry ESP
   - Technical feasibility - substantial risk
   - Beneficial environmental impact - removal of 17.2 tons of PM per year
   - Economically infeasible - $31,600 per ton of PM removed
3. Wet ESP
   - Technically feasible
   - Beneficial environmental impact - removal of 17.2 tons PM per year
   - Economically infeasible - $29,400 per ton PM removed

Since none of the alternative PM control technologies are economically feasible, BACT for PM control is the baseline case which consists of the three-tray impingement scrubber which serves both as a condenser and particulate scrubber. Thus for the BPF, the baseline case is BACT and it will control PM emissions to 10.6 tons per year for each train, a total of 21.2 tons of PM per year for both trains.

Section 6 Existing Ambient Air Quality and Meteorology

According to Federal and Florida Prevention of Significant Deterioration (PSD) regulations (40 Code of Federal Regulations (CFR) 51.166 and 62-212.400 Florida Administrative Code (FAC)), an applicant for a PSD permit is required to conduct an air quality analysis to demonstrate that the emissions from the new project will not cause or contribute to a violation of any applicable ambient air quality standard or PSD increment. An assessment of existing air quality and a dispersion modeling analysis are used to determine compliance with the New Source Review regulations. Because this project exceeds the PSD significant net emissions increase threshold for nitrogen oxides (NO_X) and particulate matter (PM), an air quality assessment is required for these pollutants. However, a full analysis of all criteria pollutants is provided here for informational purposes.

6.1 Ambient Air Quality Status

The United States Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS) for certain "criteria" pollutants as mandated by the Clear Air Act Amendments of 1970. These standards have been set at two levels. Primary NAAQS are designed to protect public health with an adequate margin of safety. Secondary NAAQS are designed to protect the public welfare including property, materials, and plant and animal life. The State of Florida has adopted State Ambient Air Quality Standards (FAAQS) that are at least as stringent as the NAAQS and incorporate both the Federal Primary and Secondary standards (62-204.240, FAC). The sulfur dioxide FAAQS for annual and 24-hour averaging periods are more stringent (lower) than the NAAQS. These National and Florida ambient air quality standards are shown in **Table 6-1**. The six criteria pollutants with National and Florida ambient air quality standards are sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), fine PM less than 10 micrometers in diameter (PM_{10}), lead (Pb), and ozone (O_3). The ambient air quality standards for PM_{10} replaced the standards for total suspended particulates (TSP) in 1987 at the Federal level and in March 1996 at the State level.

The EPA promulgated new NAAQS in July 1997 for PM less than 2.5 microns in diameter ($PM_{2.5}$) and a more stringent 8-hour-average ozone standard of 0.08 parts per million (ppm) to replace the current 1-hour-average standard of 0.12 ppm. These standards were challenged in court and their implementation was delayed until recently. The EPA designated attainment areas for the 8-hour ozone NAAQS and issued a Phase 1 implementation rule on June 15, 2004. (A proposed rule on January 27, 2005 reconsiders some of this implementation, however.) The 1-hour ozone standard is being phased out, and will be replaced by the 8-hour standard on June 15, 2005. The EPA designated attainment areas for the $PM_{2.5}$ standard on December 17, 2004 but has not yet issued implementation rules for this standard. The EPA will retain both PM_{10} and $PM_{2.5}$ as NAAQS.

Table 6-1 National and Florida Ambient Air Quality Standards

Pollutant	Avg. Time	Florida Standard	National Primary Standard	National Secondary Standard	Significant Impact Level	PSD Increments Class II	Class I
NO_2 (μg/m³)	Annual	100	100	100	1	25	2.5
SO_2 (μg/m³)	3-Hr	1300	-	1300	25	512	25
	24-Hr	260	365	-	5	91	5
	Annual	60	80	-	1	20	2
CO (μg/m³)	1-Hr	40000	40000	-	2000	-	-
	8-Hr	10000	10000	-	500	-	-
Pb (μg/m³)	Qtr	1.5	1.5	1.5	-	-	-
O_3 (ppm)	1-Hr	0.12	0.12	0.12	-	-	-
PM_{10} (μg/m³)	24-Hr	150	150	150	5	30	8
	Annual	50	50	50	1	17	4

All short-term (1-hour, 3-hour, and 24-hour) standards except ozone are not to be exceeded more than once per 12 month period.
Annual standards are 12-month arithmetic means, never to be exceeded. Quarterly standards are also never to be exceeded.
The 1-hour ozone standard should not be exceeded more than an average of one day per year over three years.
Note that the National NO2 standard is promulgated at 0.053 ppm.
1 ppm NO2 = 1887 μg/m³ NO2
1 ppm CO = 1140 μg/m³ CO
1 ppm O3 = 1961 μg/m³ O3

Because procedures for implementing both the new 8-hour and $PM_{2.5}$ ozone NAAQS are still being developed by the EPA, this permit modification application does not contain a compliance demonstration for these two standards.

Under Section 110 of the Clean Air Act, each state is required to develop a State Implementation Plan (SIP), which specifies how all areas within the state will achieve and maintain compliance with the NAAQS. For regulatory purposes under the SIP, all areas in the United States are designated as either attainment, non-attainment, or unclassifiable with the NAAQS for each criteria pollutant. Attainment areas are areas that comply with the NAAQS and continued compliance is expected under the current SIP requirements. Non-attainment areas are areas either which currently do not comply with the NAAQS or which significantly contribute to nearby areas that do not comply with the NAAQS. "Maintenance" areas are attainment areas that have recently attained the NAAQS. Although in attainment, these areas are still subject to some of the same stringent requirements to which nonattainment areas are subject. Unclassifiable areas are areas where insufficient data exists to classify the area as either attainment or non-attainment and are generally presumed to be in attainment with the NAAQS.

Palm Beach County is part of the Southeast Florida Intrastate Air Quality Control Region (AQCR), which also includes Broward, Dade, Indian River, Martin, Monroe, Okeechobee, and St. Lucie Counties (40 CFR 81.49). The attainment status of the North County Resource Recovery Facility (NCRRF) and of Palm Beach County for each criteria pollutant is shown in **Table 6-2**. Palm Beach County, as well as all of Florida, is currently either Unclassifiable or in Attainment for all NAAQS.

6.2 Preconstruction Ambient Monitoring

40 CFR 51.166(i)(8) and 62-212.400(5)(f), FAC require that ambient monitoring data for air quality in the area of the facility shall be provided to the Florida Department of Environmental Protection (FDEP). For any pollutant (other than nonmethane hydrocarbons) for which national or state ambient air quality standards have been established, continuous air quality monitoring data sufficient to determine whether emissions of that pollutant would cause or contribute to a violation of any ambient air quality standard or any applicable maximum allowable increase must be provided.

The proposed facility would qualify for an exemption from the pre-construction monitoring requirements if:

- The emissions of the pollutant would not have an impact on any area equal or greater to that listed in **Table 6-3**, known as "significant monitoring concentrations" or "de minimis ambient impacts;"
- The ambient concentration in the area of the facility is less than the concentration listed in Table 6-3; or
- The pollutant is not listed in Table 212.400-3 under 62-212.400, FAC, or outlined in 40 CFR 51.166(i)(8)(i).

Modeling, in conjunction with FDEP ambient air quality data, was used to determine if there would be any facility impact greater than the "de minimis" impacts.

Information on the preconstruction modeling analysis can be found in Section 7.3.2, Screening Modeling Analysis. Table 7-4 located in that section demonstrates the proposed Solid Waste Authority of Palm Beach County (SWA) modifications would meet the criteria for an exemption from preconstruction monitoring. SWA requests, therefore, that the FDEP concur with the determination that preconstruction monitoring is not required for this project.

6.3 Available Ambient Monitoring Data

This application uses available monitoring data from the EPA's AIRSData website (http://www.epa.gov/airsdata) for 2002 to 2004 to develop background concentrations of PSD criteria pollutants in the vicinity of SWA. This period represents the most recent 3-year period for which complete ambient monitoring data was available as of January 2005.

Table 6-2 Attainment Status [1] for Areas Including the Solid Waste Authority of Palm Beach County

Pollutant	State Designation [2]	Federal Designation [3]
Total Suspended Particulate Matter (TSP)	Attainment (62-204.340(4)(b)1 FAC)	Attainment (40 CFR 81.310)
Particulate Matter with Diameter Less Than 10 Microns (PM_{10})	Unclassifiable (entire state 62-204.340(3)(a) FAC)	Cannot be classified
Sulfur Dioxide (SO_2)	Unclassifiable (62-204.340(3)(b)3 FAC)	Attainment (40 CFR 81.310)
Nitrogen Dioxide (NO_2)	Attainment (entire state 62-204.340(1)(e) FAC)	Cannot be classified or attainment (40 CFR 81.310)
Carbon Monoxide (CO)	Attainment (entire state 62-204.340(1)(d) FAC)	Unclassifiable or Attainment (40 CFR 81.310)
Ozone (O_3)	Maintenance Area (62-204.340(4)(a)3 FAC)	Unclassifiable or Attainment (40 CFR 81.310)
Lead (Pb)	Unclassifiable (entire state 62-204.340(3)(c) FAC)	Not Designated (40 CFR 81.310)

(1) Florida Administrative Code (FAC) Chapter 62-204 and Code of Federal Regulations (CFR) Title 40, Part 81.310. EPA defines Palm Beach County as part of the Southeast Florida Intrastate Air Quality Control Region (40 CFR 81.49).

(2) As of March 13, 1996

(3) As of July 20, 2000.

Table 6-3 De Minimis Ambient Impact Levels

Pollutant	Concentration ($\mu g/m^3$)	Averaging Period	Jurisdiction	
Beryllium	0.001	24-hour		Federal
Carbon Monoxide	575	8-hour	Florida	Federal
Fluorides	0.25	24-hour	Florida	
Hydrogen Sulfide	0.2	1-hour	Florida	Federal
Hydrogen Sulfide	0.04	1-hour		Federal
Lead	0.1	Quarterly	Florida	Federal
Mercury	0.25	24-hour	Florida	Federal
Nitrogen Dioxide	14	Annual	Florida	Federal
Ozone	(1)	-	Florida	Federal
PM_{10}	10	24-hour	Florida	Federal
Reduced Sulfur Compounds	10	1-hour		Federal
Sulfur Dioxide	13	24-hour	Florida	Federal
Total Reduced Sulfur	10	1-hour		Federal
Vinyl Chloride	15	24-hour		Federal

(1) No de minimis air quality level is provided for ozone. However, any net increase of 100 tons per year or more of volatile organic compounds subject to PSD would be required to perform and ambient impact analysis, including the gathering of ambient air quality data.

Because there were no monitoring stations located within Palm Beach County reporting Pb, data was considered from:

- Monitoring reports for 1997 to 1999, the most recent 3-year period for which complete ambient Pb monitoring data is available in Palm Beach County;
- Monitors outside of the county, reports for 2002 to 2004.

Monitoring sites are typically selected to determine:

- the highest concentrations expected in a given area;
- representative concentrations in areas of high population densities;
- ambient pollutant impacts of significant sources; and
- general background concentration levels.

For these reasons, most available monitoring sites in southeastern Florida are located in areas of heavy urban or industrial growth. Therefore, many sites in the Florida monitoring network will be overly conservative when used to estimate background levels at the SWA site, which is more rural. **Table 6-4** lists the Palm Beach County monitoring stations along with what data is available from each. **Figure 6-1** presents a map showing the locations of each monitoring station used for this analysis.

Table 6-4 Monitoring Stations in Palm Beach County, Closest to NCRRF Site

Site ID	City	Site Address	Distance from SWA	Location Type	Years	Pollutants Monitored					
						CO	NO_2	SO_2	PM_{10}	Pb	O_3
120990008	Belle Glade	38745 State Rd 80, Belle Glade		Rural	1996 - 2004				x		
120990018		Jog Road & Beeline Highway Pump Station	1 mile	Rural	1996 - 1999					x	
120991004	Palm Beach	3700 Belevedere Road	8.75 miles	Suburban	1996 - 2004	x	x				
120991006	West Palm Beach	50 South Military Trail		Urban / Center City	1997 - 2004	x					
120992003	Delray Beach	345 S. Congress Ave, Delray Beach	26 miles	Urban / Center City	1996 - 2004				x		
120992004	Delray Beach	210 Nw 1st Avenue	25 miles	Suburban	1996 - 2004						x
120993004	Riviera Beach	1050 15th Street W	6.5 miles	Suburban	1996 - 2004			x			

Source: US EPA - AIRData Monitor Address Report, Florida Air Quality Monitors (All Years)

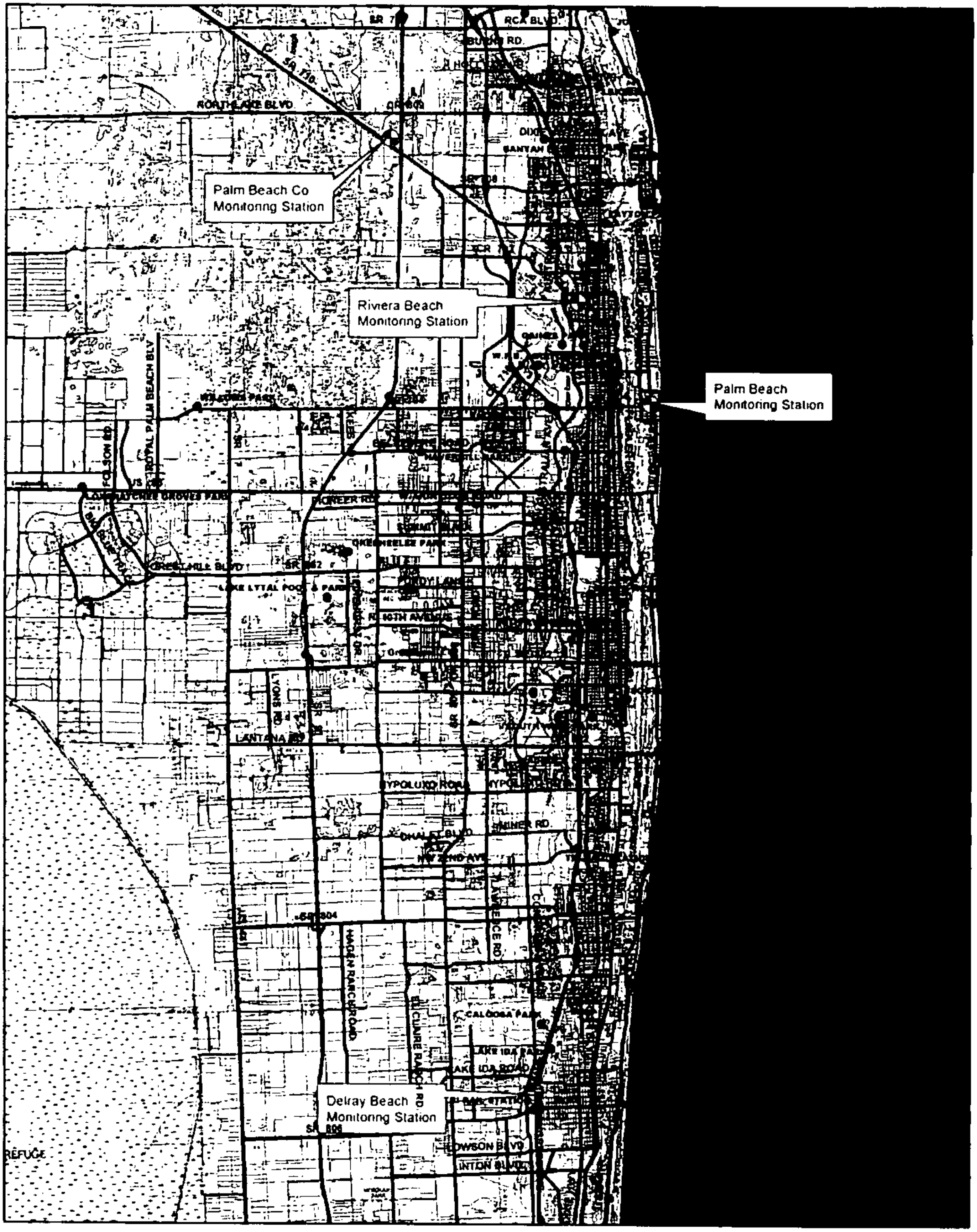


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Figure 6-1
Monitoring Locations

6.4 Selection of Background Pollutant Concentrations

As discussed above, Pb was no longer monitored in Palm Beach County after 1999. In the last 3 years of available Pb monitoring data (1997 to 1999), Pb levels were negligible, most likely leading to the end of Pb monitoring in the area. For purposes of this analysis, these Pb monitoring data (1997-1999) will be used.

Background concentrations available for use in this analysis are presented in **Table 6-5**. The available monitoring station/data closest in proximity to SWA's NCRRF was used for each pollutant that was modeled:

- Palm Beach Monitor: CO, NO_2, and Pb
- Riviera Beach Monitor: SO_2
- Delray Beach (Congress Ave): PM_{10}

The criteria pollutant background concentrations used in the refined modeling analysis for the Biosolids Pelletization Facility (BPF) are summarized in Table 6-5. The methodology employed to calculate representative pollutant background concentrations is described below.

For each pollutant, the annual average background concentration has been set equal to the highest annual average concentration observed during the last 3 years. For each pollutant and each short-term averaging period, the background concentration has been set equal to the highest of the second-highest concentrations observed during the last 3 years, pursuant to EPA guidance.

The CO monitor closest to the NCRRF is the Palm Beach monitor (Site ID 120991004) located less than 9 miles away to the east. While this monitor is significantly closer to the ocean, it is located along a major highway, therefore, making it a conservative choice for the NCRRF, which is located in a rural area. The maximum, second-highest concentrations as shown in Table 6-5 are:

- 3.8 ppm for the 1-hour averaging period (10.8 percent of the NAAQS/FAAQS); and
- 2.3 ppm for the 8-hour averaging period (26 percent of the NAAQS/FAAQS).

The Palm Beach monitoring site is also the closest available NO_2 monitor. The maximum annual NO_2 concentration for the last 3 years was 0.017 ppm, 32 percent of the annual NAAQS and FAAQS.

Table 6-5 Ambient Air Quality Summary Monitoring Stations Located Nearest to SWA

Pollutant	Averaging Time	National Ambient Air Quality Standards	Florida Ambient Air Quality Standards	Monitoring Station	Approximate Distance from SWA (miles)	Maximum Concentration [1]			Second Highest Concentration [2]			Three year summary	
						2002	2003	2004	2002	2003	2004	High	2nd High
Carbon Monoxide	1-hour	35 ppm	35 ppm	Palm Beach 3700 Belevedere Road	8.75	3.9	3.0	3.2	3.8	2.7	3.0	3.9	3.8
	8-hour	9 ppm	9 ppm			3.3	1.8	2.5	2.3	1.6	1.8	3.3	2.3
Nitrogen Dioxide	Annual Mean	0.053 ppm	0.053 ppm	Palm Beach 3700 Belevedere Road	8.75	0.017	0.014	0.010	NA	NA	NA	0.017	NA
Sulfur Dioxide [3]	3-hour	1300 µg/m³	1300 µg/m³	Riviera Beach 1050 15th Street W	6.5	33.8	10.40	5.202	28.6	7.80	5.202	33.8	28.6
	24-hour	365 µg/m³	260 µg/m³			13.0	5.20	2.60	13.0	5.20	2.60	13.0	13.0
	Annual Mean	80 µg/m³	60 µg/m³			2.60	2.60	2.60	NA	NA	NA	2.6	NA
Particulate Matter (PM_{10})	24-hour	150 µg/m³	150 µg/m³	Delray Beach 345 S. Congress Ave	26	47	120	82	46	53	62	120.0	62.0
	Annual Mean	50 µg/m³	50 µg/m³			22	30	33	NA	NA	NA	33.0	NA
Lead	Calendar Quarter	1.5 µg/m³	1.5 µg/m³	Palm Beach Co. Jog Road & Beeline Highway	1	0.001			0.001			0.001	
Ozone	1-hour	0.12 ppm	0.12 ppm	Delray Beach 210 NW 1st Avenue	25	0.091	0.087	0.076	0.084	0.081	0.075	0.091	0.084

Source: The EPA AIRSData website (http://www.epa.gov/airsdata). No stations in Palm Beach County had Pb data past 1999.

[1] Concentration units for a given pollutant are the same as those shown for the corresponding federal standard.
[2] Concentration units for a given pollutant are the same as those shown for the corresponding federal standard. "NA" means not applicable; there is only one average annual concentration
[3] Reported in ppm. Converted to µg/m³ using 1 ppm SO_2 = 2601 µg/m³ SO_2.

For SO_2 data, the closest monitor is in Riviera Beach (Site ID 120993004) located less than 7 miles away to the northeast. This monitor is located along a street in a suburban area. The maximum, second-highest concentrations as shown in Table 6-5 are:

- 28.6 $\mu g/m^3$ for the 3-hour averaging period (2.2 percent of the NAAQS/FAAQS);
- 13 $\mu g/m^3$ for the 24-hour averaging period (9 percent of the NAAQS, 5 percent of the FAAQS);
- 2.6 $\mu g/m^3$ for the annual averaging period (3.6 percent of the NAAQS, 4 percent of the FAAQS).

The PM_{10} data are from a Delray Beach monitor (Site ID 120992003) located approximately 26 miles to the southeast. This monitor is located in a commercial section of a suburban area. The maximum, second-highest concentrations as shown in Table 6-5 are:

- 62 $\mu g/m^3$ for the 1-hour averaging period (41 percent of the NAAQS/FAAQS); and
- 33 $\mu g/m^3$ for the annual averaging period (66 percent of the NAAQS/FAAQS).

Ozone is not directly emitted into the atmosphere but results from a series of complex photochemical reactions. O_3 measurements are available from a Delray Beach monitor (Site ID 120992004). The high, second-high 1-hour concentration, shown in Table 6-5 is 0.084 ppm (165 $\mu g/m^3$). This concentration is 70 percent of the 1 hour O_3 standard of 0.12 ppm (235 $\mu g/m^3$).

6.5 Available Meteorological Data

Screening meteorological data includes 54 unidirectional combinations of wind speed, stability, and mixing heights determined by EPA to produce the worst-case impacts. These data are included as default in the SCREEN3 model. These data can also be reproduced for all 36 directions from 0 to 350 degrees (10-degree increments) and used in the Industrial Source Complex, Short-Term, Version 3 (ISCST3) model to account for spatial orientation of multiple sources.

Five years of meteorological data have been provided by FDEP. This set of 5 years of meteorological data, from 1987 to 1991, was used for all refined and cumulative source modeling performed with ISCST3 as described in Section 7. Surface observations along with mixing height observation, are from the National Weather Service observing station (WBAN number 12844) at West Palm Beach Airport (Morrison Field). The first 2 days of meteorological data are shown in **Appendix J**.

The CALPUFF Model, run in a screening mode, can accept ISC preprocessed meteorological data. However, for deposition and visibility modeling, additional data not normally included in the basic ISC meteorological data file are needed. The most recent consecutive 5 years of surface data available with the additional information are 1986 to 1990. These 5 years of surface data were combined with the corresponding mixing height data, using the PCRAMMET preprocessor, to create an "enhanced" ISC meteorological data file. The additional analysis required at the Class I and sensitive areas located at a distance of greater than 50 km from the source used these enhance meteorological data files. As with the basic meteorological data files provided by FDEP, both surface and mixing height observations were obtained from the NWS observation station at West Palm Beach Airport.

The location coordinates of the NWS observation station at West Palm Beach Airport are 26.683° North Latitude, 80.117° West Longitude. The anemometer height is 33 feet (10 meters), and GMT time zone difference is +5. The West Palm Beach Airport is approximately 7 miles to the southeast of the project parcel.

A windrose depicting the 5 years of West Palm Beach Airport meteorological data (wind direction and velocity) shown in **Figure 6-2** and **Figure 6-3**.

Section 7
Air Quality Analysis

The purpose of this section is to present the predicted air quality impacts for the Biosolids Pelletization Facility (BPF) and the three proposed Class I Landfill flares in accordance with the protocol submitted to the Florida Department of Environmental Protection (FDEP) on May 13, 2002. These pollutant concentrations were estimated using United States Environmental Protection Agency (EPA) guideline dispersion models and techniques discussed with and approved by the FDEP prior to starting the analyses.

7.1 Model Selection

7.1.1 Industrial Source Complex, Short Term, Version 3

Appendix W to 40 Code of Federal Regulations (CFR) Part 51 (Guideline on Air Quality Models, "Guideline") lists preferred EPA dispersion models for use in air quality analyses. The guideline lists the Industrial Source Complex (ISC3) dispersion model as a preferred model to assess pollutant concentrations from a wide variety of sources. ISC3 is a steady-state Gaussian plume model which can account for settling and dry deposition of particles; downwash; area, line, and volume sources; plume rise as a function of downwind distance; separation of sources; and limited terrain adjustment.

The ISC model is appropriate for the following applications:

- Industrial source complexes;
- Rural or urban areas;
- Flat or rolling (including complex) terrain;
- Transport distances less than 50 kilometers;
- 1-hour to annual averaging times; and
- Continuous air emissions

Since there are multiple sources involved in the analysis and short-term concentrations are desired, the most recent version (Version 02035) of the Industrial Source Complex, Short Term, Version 3 (ISCST3) dispersion model was used for the refined and the cumulative impact analyses.

The ISCST3 model requires source emission rates and physical information (including stack height, gas temperature, and flow rate), hourly meteorological data (including wind speed and direction, temperature, Pasquill-Gifford stability class, and mixing heights), and receptor data (coordinates and elevations).

7.1.2 SCREEN3

A "cavity area" is the area on the downwind side of a building, and is characterized by strong turbulence and mixing. However, dispersion in this area is reduced due to building-induced recirculation of the pollutants and the lack of entrainment of cleaner air. Therefore, this area is a potential location of excessive pollutant impacts.

The SCREEN3 dispersion model was used to evaluate cavity impacts from the BPF facility. The guideline identifies the latest version of SCREEN as the recommended screening dispersion model. SCREEN3, version 96043, was selected for the following reasons:

- It calculates impacts within the cavity region of nearby structures;
- It is EPA's preferred screening level model for point sources subject to building induced downwash;
- It uses a built-in set of meteorological conditions and automatically screens for the worst-case combination of wind speed and stability class; and
- It uses an automated receptor distance array, which finds the point of maximum impact to within 1 meter. This feature is helpful when selecting receptor grid distances for the refined analysis.

The SCREEN3 model requires the source emission rate and pertinent physical information (including stack height, gas temperature, and flow rate). It is assumed that the dominant building for downwash purposes has already been determined. It uses a standard set of worst-case meteorological data, and an automated set of receptors. Terrain data is not incorporated into the SCREEN3 model.

Since there are multiple facility sources involved in the analysis, the ISCST3 model was used in most phases of the analysis. However, the SCREEN3 model was used to assess cavity impacts as described below.

7.1.3 CALPUFF

CALPUFF is a multi-layer, multi-species non-steady-state Lagrangian Gaussian puff dispersion model which can simulate the effects of time-and space-varying meteorological conditions on pollutant transport, transformation, and removal. CALPUFF can use the three-dimensional meteorological fields developed by the CALMET model, or simple, single station winds in a format consistent with the meteorological files used to drive the ISCST3 steady-state Gaussian Model.

CALPUFF contains algorithms for near-source effects such as building downwash, transitional plume rise, partial plume penetration, subgrid scale terrain interactions as well as longer range effects such as pollutant removal (wet scavenging and dry deposition), chemical transformation, vertical wind shear, over water transport, and coastal interaction effects. It can accommodate arbitrarily varying point source and gridded area source emissions.

The most recent version of CALPUFF (Version 5.7) was used. CALPUFF was selected for the following reasons:

- It is a non-steady state puff dispersion model suitable for long-range (> 50 km) transport;
- Its ability to model varying source types (point, area, volume);
- Its ability to mimic the iscst3 model in steady-state conditions; and,
- Its ability to use simple meteorological data already processed for use in the iscst3 model.

Since air quality impacts need to be evaluated at the Everglades National Park, located 128 km away from the proposed sources, and at the Big Cypress National Preserve, located 112 km from the proposed sources, a long-range transport model is appropriate. At FDEP's request, the CALPUFF model was used to analyze pollutant impacts at these Class I areas and any other areas indicated by FDEP and the National Park Service.

7.2 Modeling Parameters and Options

7.2.1 Sources

The dispersion modeling was initially performed only for the proposed new and modified sources at the North County Resource Recovery Facility (NCRRF). The existing sources at the NCRRF would be included in the cumulative source modeling if the Significant Impact Levels shown in **Table 7-1** could be exceeded by the new and modified sources. Temporary emissions were excluded from all analyses. In addition, non-continuous emitting sources, such as storage silos, were also excluded from the analyses since their particulate matter emissions were considered negligible, less than one ton per year (tpy) (see Section 4.2).

Facility sources included in the analysis and their stack parameters are presented in **Table 7-2.**

7.2.2 Model Options

The ISCST3 model was set to calculate concentrations only. Averaging periods were selected based on the corresponding pollutant significance level. Pollutant decay was not used.

Table 7-1 Significance Levels for Air Quality Impacts

Pollutant	Averaging Time	EPA SILs (μg/m³)	NPS Class I SILs [1] (μg/m³)
SO_2	3-hour	25	0.48
	24-hour	5	0.07
	Annual	1	0.03
NO_2	Annual	1	0.03
CO	1-hour	2000	n/a
	8-hour	500	n/a
PM_{10}	24-hour	5	0.27
	Annual	1	0.08
Pb	Quarter	0.1	n/a

1. Significant Impact Levels currently recommended by the National Park Service (NPS). NPS SILs are more stringent, or lower than (about 1/2 to 1/3 of) those proposed by the U.S. EPA as part of New Source Review Reform (61 FR 38292, July 23, 1996).

The ISCST3 model was run using regulatory default options. These options, as identified in Section A.5 of Appendix A to Appendix W to 40 CFR Part 51 and Section 3.2.2 of Volume I of the User's Guide to ISCST3 include the following:

- Use of stack-tip downwash;
- Use of buoyancy induced dispersion;
- Use of final plume rise;
- Use of calms processing routines;
- Use of upper-bound concentration estimates for sources influenced by downwash from super-squat buildings;
- Use of default wind speed profile exponents; and
- Use of default vertical potential temperature gradients.

A screening analysis using CALPUFF was run according to the methodology recommended by the Interagency Workshop on Air Quality Modeling (IWAQM). This methodology states that CALPUFF will be run using the following options:

- Five years of ISCST3 meteorological data were used (hourly values of relative humidity and other meteorological values were added for the deposition and visibility impacts analyses);
- The ISCST3 input files were converted to CALPUFF input files using the ISC2PUF utility; and
- The use of MESOPUFF II chemistry

Table 7-2 Source Parameters

Model Source ID	Emission Source	NAD 27, meters State Plane Coordinates: Easting	Northing	Stack Height: Actual (m)	GEP (m)	Modeled (m)	Diameter (m)	Source Height (ft)	Exit Temp (deg. K)	Exit Velocity (m/s)	Air Flow (acfm)	Flow (m^3/s)	Pollutant Emissions (g/s): CO[1]	Pb	PM	PM_{10}	SO_x	NO_x	H2S
Biosolids Pelletizing Facility 1																			
BPFS1	337.5 wtpd Sludge Dryer - West RTO	238030.28	268999.28	42.0	42.0	42.0	0.762		363	15.52	11200	7.08		9.20E-06	0.0983	0.305	0.561	0.71	0.0033
COOL1	North Cooling Tower	238059.55	269018.71	6.04	0.0	0.0	3.353		ambient	10.28		90.80			0.0142	7.87E-03			
Biosolids Pelletizing Facility 2																			
BPFS2	337.5wtpd Sludge Dryer - East RTO	238049.91	268998.89	42.0	42.0	42.0	0.762		363	15.52	11200	7.08		9.20E-06	0.0983	0.305	0.561	0.71	0.0033
COOL2	South Cooling Tower	238059.55	269010.57	6.04	0.0	0.0	3.353		ambient	10.28		90.80			0.0142	7.87E-03			
Class I Landfill Flare Modification																			
FLARE1K	LFG Collection System Flare	237883.2	269761.92				0.99		1273	20.0	11487.0	0.47	1.61			7.06E-02	0.24	0.29	
FLARE2K[2]	LFG Collection System Flare (Netted with 1800 scfm flare)	237882.6	269785.64				0.43		1273	20.0	11487.0	0.09	0.29			7.56E-02	0.23	0.43	
FLAR3500	LFG Collection System Flare (Less BPF 2800 scfm gas need)	237883.2	269808.18				1.85		1273	20.0	11487.0	1.65	5.62						

[1] CO Emission Rate is for 3,500-scfm Flare running at full capacity.
[2] The 2,000-scfm Flare air flow rate is based on 200 scfm to account for netting the existing 1,800-scfm Flare being decommissioned.

7.2.3 Building Downwash and Good Engineering Practice Stack Height

Downwash occurs when structures influence the plume from a nearby stack. The Good Engineering Practice (GEP) stack height is defined as the minimum stack height that ensures that the emissions from the stack do not result in excessive concentrations in the cavity and wake regions near large structures. The EPA has promulgated stack height regulations under 40 CFR Part 51 which help to determine the GEP stack height for any stationary source.

GEP stack height means the greater of:

- 65 meters, measured from the ground-level elevation at the base of the stack.
- (i) For stacks in existence on January 12, 1979, and for which the owner or operator had obtained all applicable permits or approvals required under 40 CFR Parts 51 and 52:

  $H(g) = 2.5H$

  Provided the owner or operator produces evidence that this equation was actually relied on in establishing an emission limitation:

  (ii) For all other stacks:

  $H(g) = H + 1.5L$

  Where:

  $H(g)$ = good engineering practice stack height, measured from the ground-level elevation at the base of the stack.

  H = height of nearby structure(s) measured from the ground-level elevation at the base of the stack.

  L = lesser dimension, height or projected width, of nearby structure(s) provided that the EPA, State or local control agency may require the use of a field study or fluid model to verify GEP stack height for the source; or

- The height demonstrated by a fluid model or a field study approved by the EPA, State, or local control agency, which ensures that the emissions from a stack do not result in excessive concentrations of any air pollutant as a result of atmospheric downwash, wakes, or eddy effects created by the source itself, nearby structures or nearby terrain features.

The BPF RTO stacks have been designed to be at GEP stack height. Although at 42 meters, the BPF RTO stacks will be lower than the minimum default height of 65 meters, they will be at least as high as the calculated GEP height according to the formula GEP = H + 1.5 L, where H and L are defined as above. This height will be sufficient to avoid plume downwash effects as calculated by the dispersion model. The cooling towers are not designed to be at GEP stack height.

The most recent version (Version 04112) of the EPA's Building Profile Input Program (BPIP) was used to calculate GEP stack heights, in addition to direction-specific building heights and widths for input into the downwash assessment algorithm of the ISCST3 dispersion model. The maximum height and maximum projected width of the dominant building were used in the SCREEN3 model to determine if any cavity or wake regions would exist near the BPF stacks. The modeling confirmed that these GEP stacks would cause no cavity or wake regions. Cavity regions do occur with the cooling towers. However, the cavity region and excessive particulate matter emissions from each tower does not extend beyond the property boundary. Therefore, downwash effects for the cooling towers were modeled in the refined modeling analysis to determine its impact on off-site maximum concentrations as described below.

A site layout showing nearby buildings and stack locations is provided in **Figure 7-1**.

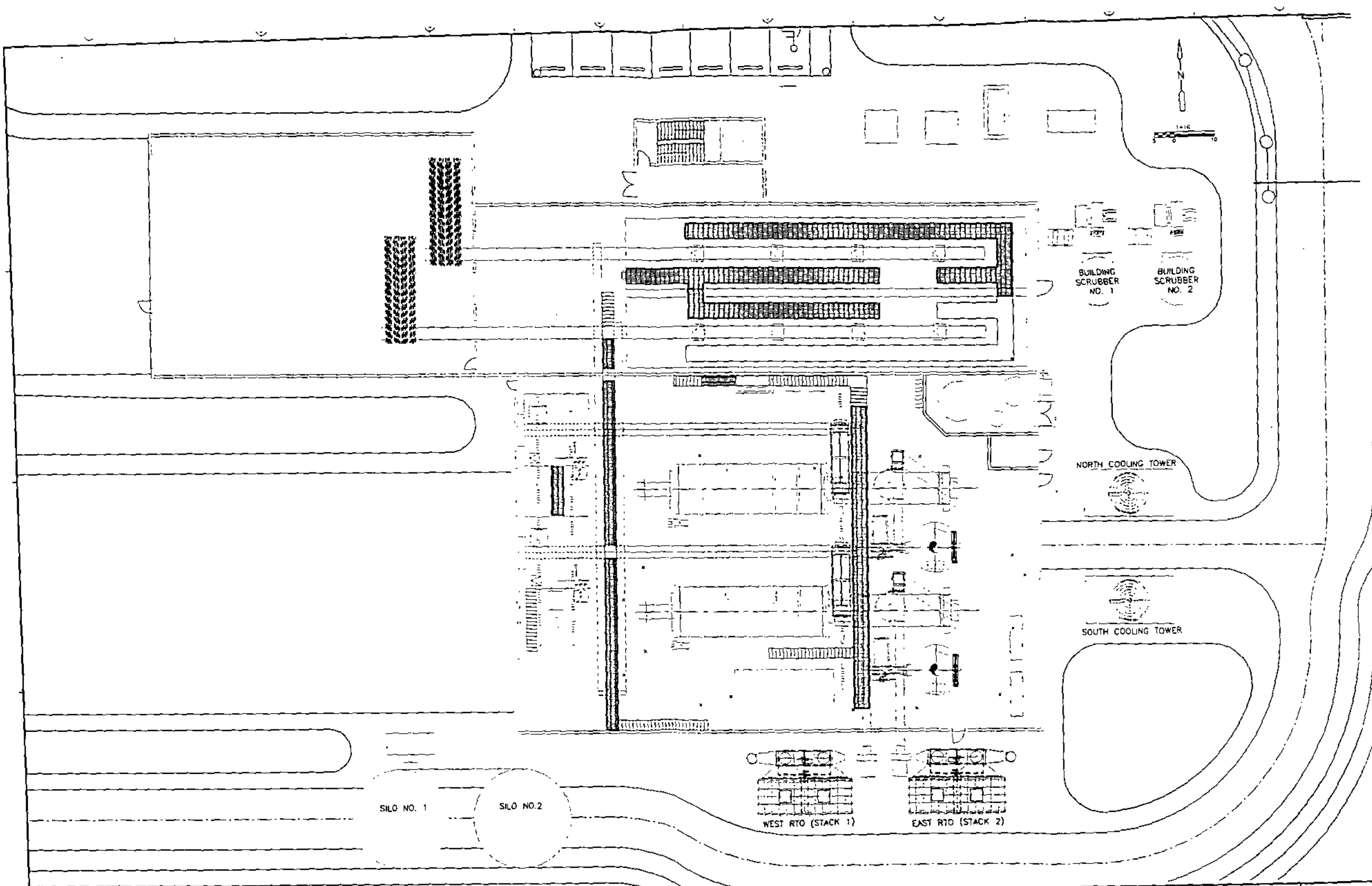
7.2.4 Urban/Rural Analysis

The selection of either rural or urban dispersion coefficients in a specific modeling exercise should follow one of the procedures described in Section 8.2.8 of Appendix W to 40 CFR Part 51. These include a land use classification procedure or a population based procedure to determine whether the character of an area is primarily urban or rural. Both procedures are described below.

- Land Use Procedure - Classify the land use within the total area circumscribed by a 3-kilometer radius circle about the source using the meteorological land use classification scheme (Auer, 1978). If land use types I1, I2, C1, R2, and R3 account for 50 percent or more of this area, urban dispersion coefficients must be used. Otherwise, rural dispersion coefficients must be used. Descriptions of the land use type classifications are shown in **Table 7-3**.

- Population Density Procedure - Compute the average population density per square kilometer in an area as defined above. If the population density is greater than 750 people per square kilometer, urban dispersion coefficients must be used. Otherwise, rural dispersion coefficients must be used.

Of the two methods, the land use procedure is considered more definitive. Population density should be used with caution and should not be applied to highly industrialized areas where the population density may be low and thus a rural classification would be indicated, but the area is sufficiently developed so that the urban land use criteria would be satisfied. In this case, the classification should already be "urban" and urban dispersion parameters should be used. Sources located in an area defined as urban should be modeled using urban dispersion parameters. Sources located in areas defined as rural should be modeled using the rural



REV NO	DATE	DRWN	CHKD	REMARKS

DESIGNED BY M. LEMS
DRAWN BY J. HOFFMAN
SHEET CHK'D BY W. SPRIGGS
CROSS CHK'D BY M. LEMS
APPROVED BY
DATE DECEMBER 2004

CDM Camp Dresser & McKee Inc.

SOLID WASTE AUTHORITY
PALM BEACH COUNTY, FLORIDA

BIOSOLIDS PELLETIZATION FACILITY
PPSA PERMIT APPLICATION, MAY 2005

PROPOSED SITE PLAN

FIGURE 7-1

dispersion parameters. For analyses of entire urban complexes, the entire area should be modeled as an urban region if most of the sources are located in areas classified as urban.

Table 7-3 Auer Land Use Classification Scheme

Type	Description	
	Use and Structures	**Vegetation**
I1	Heavy Industrial Major chemical, steel, and fabrication industries; generally 3-5 story buildings, flat roofs	Grass and tree growth extremely rare; < 5% vegetation
I2	Light-Moderate Industrial Rail yards, truck depots, warehouses, industrial parks, minor fabrications; generally 1-3 story buildings, flat roofs	Very limited grass, trees almost total absent; <5% vegetation
C1	Commercial Office and apartment buildings, hotels; >10 story heights, flat roofs	Limited grass and trees; <15% vegetation
R1	Common Residential Single family dwelling with normal easements; generally one story, pitched roof structures; frequent driveways	Abundant grass lawns and light-moderately wooded; >70% vegetation
R2	Compact Residential Single, some multiple, family dwelling with close spacing; generally < 2 story, pitched roof structures; garages via alley, no driveways	Limited lawn sizes and shade trees; <30% vegetation
R3	Compact Residential Old multi-family dwellings with close (<2 m) lateral separation; generally 2 story, flat roof structures; garages (via alley) and ashpits, no driveways	Limited lawn sizes, old established shade trees; <35% vegetation
R4	Estate Residential Expansive family dwelling on multi-acre tracts	Abundant grass lawns and lightly wooded; >80% vegetation
A1	Metropolitan Natural Major municipal, state, or federal parks, golf courses, cemeteries, campuses; occasional single story structures	Nearly total grass and lightly wooded; >95% vegetation
A2	Agricultural Rural	Local crops (e.g. corn, soybean); >95% vegetation
A3	Undeveloped Uncultivated; wasteland	Mostly wild grasses and weeds, lightly wooded; >90% vegetation
A4	Undeveloped Rural	Heavily wooded; >95% vegetation
A5	Water Surfaces Rivers, lakes	

The land use procedure was used to determine whether urban or rural dispersion coefficients should be used. **Figure 7-2** presents the area defined by the circumscribed circle of 3-kilometer radius. Urban land use types I1, I2, C1, R2, and R3 are denoted by hatched areas on the map. These urban land use areas comprise approximately 22

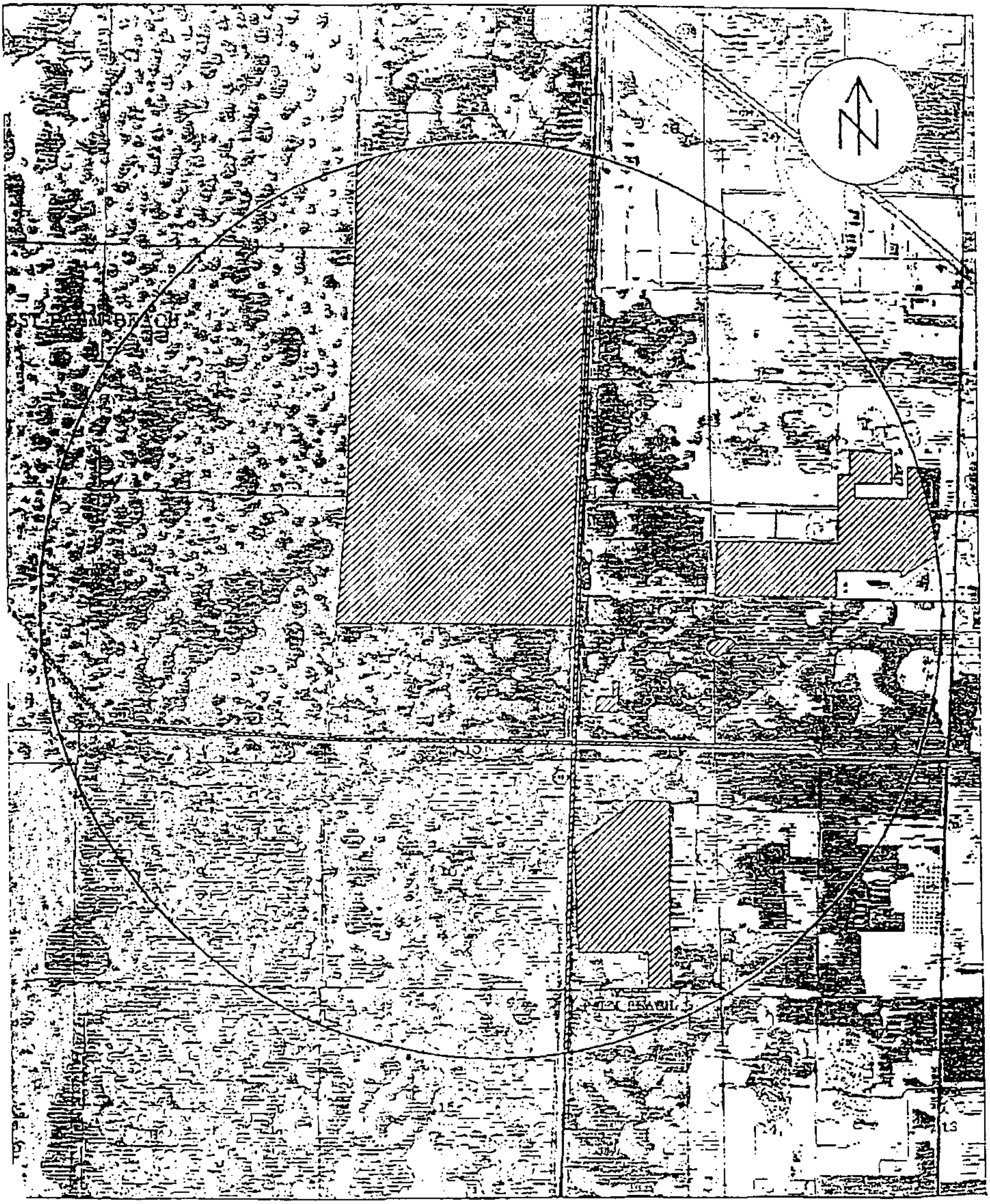


Figure 7-2
Auer Land Classification Analysis - 3 km radius
NCRRF Site Modification

CDM

percent of the area. Since these areas comprise less than 50 percent of the total area, rural dispersion coefficients were used in all modeling analyses.

7.2.5 Receptors

Receptors in the refined grid source modeling analyses consisted of a large Cartesian grid centered on the Solid Waste Authority complex. State planar coordinates (NAD 27) were used for all models. The extent of this grid was based on results obtained in the screening modeling analysis conducted for the NCRRF Site Second Revision to PPSA Request for Amendment, October 2003, and extended a maximum of 10 kilometers from the center of the complex. The grid consisted of receptors spaced 100 meters apart.

Receptors were also placed at regular intervals along SWA's property boundary. The spacing of these boundary receptors was no greater than 100 meters. To further identify the maximum predicted concentrations, a second round of refined modeling was performed using more refined receptor spacing. Secondary Cartesian grids (fine grids) were placed at the locations of the maximum concentrations found in the initial refined modeling. Since the property has a definitive fence line limiting public access, fine grid receptors that fall on SWA property were not included in the analyses. These fine grids consisted of 100 receptors in a ten-by-ten array, spaced 20 meters apart, and helped to refine the location of the maximum predicted off-site concentrations.

For a proposed new or modified emissions unit located within 100 kilometers of any Federal Class I area or whose emissions may affect any Federal Class I area (62-210.350(2)(h), Florida Administrative Code (FAC) and EPA, 1990), an air quality analysis of impacts to these areas must be performed. Florida regulations (62-204.360(4)(b), FAC) list four state areas designated as Prevention of Significant Deterioration (PSD) Class I Impact Areas. Of the four, none are within 100 kilometers of SWA's facility. However, FDEP requested (FDEP meeting, Feb. 14, 2002) that impacts at Everglades National Park, which is 128 km (80 miles) south-southwest of SWA's facility, be assessed. Class I areas have the smallest PSD increments, allowing only a small degree of air quality deterioration.

In addition, the National Park Service requested that receptors be placed at Big Cypress National Preserve, located approximately 112 km (70 miles) southwest of SWA's facility. Although this area is technically a Class II area, and **not** a Class I area according to Federal and Florida PSD regulations, concentrations predicted at receptors located at the Big Cypress National Preserve will be compared to Class I impact thresholds. FDEP has provided coordinates for a set of 127 receptors along the nearest edge of the Everglades Park for this analysis. (Cleve Holladay, FDEP, telephone conversation, April, 2002) An additional receptor has been placed at the nearest corner of the Big Cypress Preserve.

All receptors were assumed to lie at ground level. Flagpole receptors were not used.

7.3 Refined Modeling Analysis

The refined modeling analysis was conducted to determine the BPF, and three flares' area of significant impact for each applicable pollutant. The refined modeling analysis is only required for those pollutants that exceed PSD emission thresholds (NO_X) and exceed screening impact levels. However, the modeling has been performed for all criteria pollutants, except ozone, for informational purposes.

The impact area includes all locations where the significant increase in the potential emissions of a criteria pollutant from a new source, or significant net emission increase from a modification, will cause a significant ambient impact. The highest modeled pollutant concentration for each averaging time is used to determine whether the source will have a significant impact for that pollutant. The significant impact levels (SILs) for each pollutant/averaging time are shown in Table 7-1.

The EPA SILs in Table 7-1 apply to Class II areas, such as the project area. If a proposed source is located within 100 kilometers of a Class I, or "pristine", area, an impact for any regulated pollutant of 1 $\mu g/m^3$ on a 24-hour basis is significant. However, the National Park Service recommends SILs that are more stringent than EPA SILs for Class I areas. These NPS SILs are also presented in Table 7-1.
Should a significant impact be predicted for a particular pollutant, the impact area is defined as the circular area with a radius extending from the source to either the most distant point where approved dispersion modeling predicts a significant impact level to occur, or a distance of 50 kilometers, whichever is less. The impact area is determined for each pollutant of review and every applicable averaging time. The impact area is the largest of the areas determined for that pollutant, regardless of averaging time.

The impact area is then used a) to define the area of the cumulative impact analysis; b) to guide the identification of other sources to be included in the cumulative impact analysis; and c) to set boundaries for ambient monitoring, if necessary.

7.3.1 Compliance with Ambient Air Quality Standards and Prevention of Significant Deterioration Increments

As described in Section 2.4, Ambient Air Quality Standards (AAQS) and PSD increment compliance demonstrations are only required for NO_X emissions from the proposed projects. However, the modeling has been performed for all criteria pollutants for informational purposes. Should no significant impacts be predicted for a particular pollutant, no further National Ambient Air Quality Standards (NAAQS) or PSD analysis is required for that pollutant. However, background concentrations have been added to the modeled results and compared with the Federal and Florida AAQS and PSD increments, as described below. Although not required this has also been done for informational purposes.

7.3.1.1 Compliance with Ambient Air Quality Standards

For NAAQS and Florida Ambient Air Quality Standards (FAAQS) compliance, applicable (pollutant and averaging-time specific) background ambient concentrations (as presented in Table 6-5) have been added to the predicted concentrations to produce total concentrations. The highest predicted concentrations have been used for annual averaging times. The highest of the second-highest concentrations have been used for all short-term (1-hour to 24-hour) averaging times. To determine compliance with State and National AAQS, these total concentrations have been compared with the AAQS.

7.3.1.2 Prevention of Significant Deterioration Increment Compliance

For PSD compliance, the highest predicted concentrations have been used for annual averaging times. The highest of the second-highest concentrations have been used for all short-term (1-hour to 24-hour) averaging times. To determine compliance with Prevention of Significant Deterioration increment values (presented in Table 6-1), the predicted net concentrations were compared with the PSD increments.

7.3.2 Refined Modeling Results - Industrial Source Complex, Short Term, Version 3 Modeling

Results from the refined modeling analysis are shown in **Table 7-4**. **Appendix K** contains sample printouts the output (*.lst) files from select model runs. All of the model runs for each year of meteorological data and pollutant have been submitted to FDEP separately on the CDs. All the pollutants modeled have a maximum predicted impact for the proposed emissions increases below the ambient air quality significance impact levels for all locations and averaging times. Therefore, a cumulative impact analysis including other sources in the project area is not required. Table 7-4 also shows that modeled concentrations are below the de minimis ambient concentration thresholds for requiring preconstruction monitoring (see Section 6.2 and Table 6-3. SWA requests, therefore, that the FDEP concur with the determination that preconstruction monitoring is not required for this project.

Although cumulative impact analysis is not required for this project, total predicted project impacts were added to the background concentrations listed in Table 6-5 and compared with AAQS for informational purposes. As **Table 7-5** shows, all pollutant concentrations were predicted to be well below the air quality standards, demonstrating compliance with the FAAQS, NAAQS, and PSD increment. The highest predicted NO_X impacts are 33 percent of the AAQS, and less than four percent of the Class II PSD increment.

7.3.3 Refined Modeling Results - CALPUFF Modeling

The results of the refined modeling analysis using the CALPUFF model to determine impacts at the Everglades National Park and Big Cypress National Preserve were compared to the National Park Service (NPS) SILs and PSD increments, as shown in **Table 7-6**. No pollutants were found to be in exceedance and, therefore, no additional analysis was required.

Table 7-4 Comparison of BPF Predicted Air Pollutant Concentrations with Class II Area Significant Impact Levels and De Minimis Monitoring Levels

Pollutant	Avg. Time	EPA SILs (µg/m³)	Class II PSD Increments (µg/m³)	De Minimis Monitoring Levels (µg/m³)	Modeling Results	
					Highest (µg/m³)	High-Second Highest (µg/m³)
Sulfur Dioxide	3-hour	25	512	---	12.00	9.45
	24-hour	5	91	13	3.16	2.74
	Annual	1	20	---	0.63	
Nitrogen Dioxide	Annual	1	25	14	0.93	
Carbon Monoxide	1-hour	2000	---	---	16.86	16.39
	8-hour	500	---	575	12.50	10.47
PM_{10}*	24-hour	5	30	10	3.72	2.48
	Annual	1	17	---	0.29	
Lead	Quarter	0.1	---	0.1	4.00E-05	
Beryllium	24-hour	---	---	0.001		
Fluorides	24-hour	---	---	0.25		
Hydrogen Sulfide	1-hour	---	---	0.2		
Mercury	24-hour	---	---	0.25	4.36E-04	
Total Reduced Sulfur	1-hour	---	---	10 (0.2)		
Reduced Sulfur Compounds	1-hour	---	---	10 (0.2)		
Vinyl Chloride	24-hour	---	---	15		

Modeled highest short-term and annual impacts were compared to SILs and De Minimis Impact Levels, and highest annual and high-second-high short-term impacts were compared to PSD increments.
De Minimis Impact Levels in parentheses are the more stringent Florida De Minimis Levels.

Table 7-5 Comparison of BPF and Three Flares Predicted Air Pollutant Concentrations with AAQS and PSD Increments

Pollutant	Avg. Time	Florida Standard	National Primary Standard	National Secondary Standard	Model Results (μg/m³)
NO_2 (μg/m³)	Annual	100	100	100	33.0
SO_2 (μg/m³)	3-Hr	1300	-	1300	38.1
	24-Hr	260	365	-	15.7
	Annual	60	80	-	3.2
CO (μg/m³)	1-Hr	40000	40000	-	4348
	8-Hr	10000	10000	-	2632
Pb (μg/m³)	Qtr	1.5	1.5	1.5	1.04 E-03
O_3 (ppm)	1-Hr	0.12	0.12	0.12	[illegible]
PM_{10} (μg/m³)	24-Hr	150	150	150	64.5
	Annual	50	50	50	33.3

Background concentrations have been added to the modeled highest annual impacts and high-second high short term impacts.
All short-term (1-hour, 3-hour, and 24-hour) standards except ozone are not to be exceeded more than once per 12 month period.
Annual standards are 12-month arithmetic means, never to be exceeded. Quarterly standards are also never to be exceeded.
The 1-hour ozone standard should not be exceeded more than an average of 1 day per year over 3 years.
Note that the National NO_2 standard is promulgated at 0.053 ppm.
1 ppm NO_2 = 1887 μg/m³ NO_2
1 ppm CO = 1140 μg/m³ CO
1 ppm O_3 = 1961 μg/m³ O_3

Table 7-6 Comparison of BPF and Three Flares Predicted Air Pollutant Concentrations with Class I Significant Impact Levels (SILs) for Sensitive Areas

Pollutant	Averaging Time	NPS Class I SILs (μg/m³)	Class I PSD Increments (μg/m³)	Modeling Results: Everglades (μg/m³)	Modeling Results: Big Cypress (μg/m³)
SO_2	3-hour	0.48	25	0.04	0.05
	24-hour	0.07	5	8.69E-03	0.02
	Annual	0.03	2	3.90 E-04	1.13 E-03
NO_2	Annual	0.03	2.5	4.21E-04	5.39E-04
PM_{10}	24-hour	0.27	8	7.39E-03	9.63E-03
	Annual	0.08	4	1.84E-04	5.46E-04

As **Table 7-7** shows, all pollutants are below thresholds, demonstrating compliance with the FAAQS, NAAQS, and PSD increment.

Table 7-7 Comparison of BPF and Three Flares Predicted Air Pollutant Concentrations National and Florida Ambient Air Quality Standards, Sensitive Areas

Pollutant	Avg. Time	Florida Standard	National Primary Standard	National Secondary Standard	Modeling Results Everglades	Modeling Results Big Cypress
		($\mu g/m^3$)			($\mu g/m^3$)	
NO_2 ($\mu g/m^3$)	Annual	100	100	100	32.08	32.08
SO_2 ($\mu g/m^3$)	3-Hr	1300	-	1300	28.64	28.65
	24-Hr	260	365	-	13.01	13.02
	Annual	60	80	-	2.6	2.6
CO ($\mu g/m^3$)	1-Hr	40000	40000	-	4332	4332
	8-Hr	10000	10000	-	2622	2622
Pb ($\mu g/m^3$)	Qtr	1.5	1.5	1.5	1.00 E-03	1.00 E-03
O_3 (ppm)	1-Hr	0.12	0.12	0.12	[illegible]	[illegible]
PM_{10} ($\mu g/m^3$)	24-Hr	150	150	150	62.01	62.01
	Annual	50	50	50	33.00	33.00

Background concentrations have been added to the modeled impacts.
All short-term (1-hour, 3-hour, and 24-hour) standards except ozone are not to be exceeded more than once per 12 month period.
Annual standards are 12-month arithmetic means, never to be exceeded. Quarterly standards are also never to be exceeded.
The 1-hour ozone standard should not be exceeded more than an average of 1 day per year over 3 years.
Note that the National NO_2 standard is promulgated at 0.053 ppm.
1 ppm NO_2 = 1887 $\mu g/m^3$ NO_2
1 ppm CO = 1140 $\mu g/m^3$ CO
1 ppm O_3 = 1961 $\mu g/m^3$ O_3

7.4 Cumulative Impact Analysis

Because all pollutant concentrations modeled were predicted to be below significant impact levels, no cumulative impact analysis is required, and none was performed.

Section 8
Additional Impact Analysis

This section describes the analysis performed to assess the impact of the Solid Waste Authority of Palm Beach County (SWA) modification, addition of the Biosolids Pelletization Facility (BPF), and the three flares at the Class I Landfill on air quality related values as required under the Prevention of Significant Deterioration (PSD) regulations. The values assessed are:

- Visibility in Class I areas within 100 kilometers (km) of the SWA's site or as advised by the Florida Department of Environmental Protection (FDEP);
- Impacts from growth indirectly related to the BPF; and
- The potential for impacts to soil and vegetation.

Air quality impacts from criteria pollutants in the Big Cypress National Preserve are also presented. As the closest Class I Area, the Everglades National Park, is located over 100 km away, no additional Class I impact analysis was required. However, the additional Class I impact analyses were performed as requested by the FDEP. Other issues addressed in this section include an assessment of secondary sources from the SWA.

Because the sensitive areas are over 50 km from the source, the United States Environmental Protection Agency (EPA) guidance recommends the use of the CALPUFF model to analyze concentrations, visibility, and deposition impacts (40 Code of Federal Regulations (CFR) 51, Appendix W, Guideline on Air Quality Models; Cleve Holladay, FDEP, email and phone conversations April 2002). Modeling parameters as listed in Section 7.2.2 were used for the analyses. The CALPUFF post-processor, CALPOST, was used to calculate haze/visibility parameters as well as convert deposition flux to kilogram/(hectare*year).

8.1 Visibility Impacts

Visibility impairment can be quantified by determining the spectral light intensity at a given location in the atmosphere with known aerosol and pollutant concentrations. Visibility impairment includes such things as the reduction of visual range, the perceptibility of plume shapes and haze layers, atmospheric discoloration, and plume-modified visual contrast of distant objects. These effects are caused by changes in light intensity as a result of the scattering and absorption of light (radiation) by particles and/or atmospheric aerosols. When the physical and chemical properties of the plume are known, the impact on visibility can be estimated (Latimer and Ireason, 1980).

Calculation of impacts to visibility are only required at Class I areas. At the request of the National Park Service (NPS), the CALPUFF model was used to assess visibility impacts at the Everglades National Park and the Big Cypress National Preserve using methods outlined by IWAQM (EPA 1998). CALPUFF was used to produce concentrations of sulfates and nitrates. Resulting concentrations of $SO_4^=$, NO_3^-, and HNO_3 were used to calculate 24-hour averaged extinction coefficients and compute the percent change in extinction. The light extinction coefficient includes both scattering and absorption components, and is a measure of light attenuation over a unit distance.

CALPUFF was set to create concentration data files that were used as input files for the CALPOST post-processor. Parameters used in the CALPOST post-processor are listed below:

- Modeled Species: Sulfates, Nitrates
- Computation Method: (CALPOST, Method 6) Compute extinction from speciated PM measurements and user-specified Relative Humidity (RH) factors.
- Extinction Efficiency:
  - Ammonium Sulfate: 3 Mm^{-1} per $\mu g/m^3$
  - Ammonium Nitrate: 3 Mm^{-1} per $\mu g/m^3$
- Monthly RH Factors:
  - Winter (Jan, Feb, Dec): 3.6
  - Spring (Mar, Apr, May): 3.7
  - Summer (Jun, Jul, Aug): 3.8
  - Fall (Sep, Oct, Nov): 4.0
- Background concentration for computing background extinction coefficients
  - Ammonium Sulfate: 0.3 µg/m3
  - Ammonium Nitrate: 0.3 µg/m3
  - Soil: 8.5 µg/m3
- Extinction due to Rayleigh Scattering: 10 Mm^{-1}
- Averaging time: 24-hour
- Visibility units: Mm^{-1}

Natural background estimates for the visibility reference level at the Everglades National Park were obtained from information in the Federal Land Managers' Air Quality Related Values Workgroup (FLAG), guidance, December 2000. These data are assumed representative of the Big Cypress National Preserve as well.

In accordance with guidance, as the change in light extinction was predicted to be 5 percent or less when compared to natural conditions, no further visibility analysis is required. Results are shown in **Table 8-1** for each year of meteorological data. A sample of the modeling output can be found in Appendix D.

Table 8-1 Visibility Modeling Results

Class 1 - Everglades Nation Park, 24-hour Average						
	1986	**1987**	**1988**	**1989**	**1990**	**Threshold**
Largest Change in Extinction, Db_{ext}	0.06%	0.08%	0.06%	0.08%	0.07%	5%
Largest Delta-Deciview, DDV	0.006	0.008	0.006	0.008	0.007	
Maximum Extinction, (Mm^{-1})	25.715	25.720	25.716	25.720	25.719	
Big Cypress National Preserve, NE Corner, 24-hour Average						
	1986	**1987**	**1988**	**1989**	**1990**	**Threshold**
Largest Change in Extinction, Db_{ext}	0.07%	0.06%	0.04%	0.08%	0.13%	5%
Largest Delta-Deciview, DDV	0.007	0.006	0.004	0.008	0.013	
Maximum Extinction, (Mm^{-1})	25.718	25.712	25.710	25.720	25.733	

CALPOST was used to calculate visibility parameters using S and N concentrations calculated using the CALPUFF dispersion model.

8.2 Growth Analysis

The BPF, once operational, will employ approximately 13 people. The proposed flares can be managed by the SWA's current staff. It is anticipated that the majority of these personnel requirements will be filled from within the local labor force. Significant in-migration to the area is therefore not anticipated. As a result, no increase in population in the area attributable to the SWA's modifications is expected to occur.

The projects do not require the destruction, relocation, or alteration of any residential property in the area. In addition, since no net migration to the area is anticipated, there will be no change in demand for housing units in the area.

The construction and operation of the BPF and flares will have a minor positive net effect on industrial and commercial development. It is not anticipated that this effect will be significant when considered on a regional basis.

The growth analysis indicates that no net significant change in employment, populations, housing, or commercial/industrial development will be associated with the project. As a result, there will not be any significant increases in pollutant emissions indirectly associated with the BPF or flares.

8.3 Soils and Vegetation

Federal and Florida regulations require that an assessment be undertaken of the potential impacts of emissions from a proposed facility on soils and vegetation of commercial or recreational value (40 CFR 51.166(o)(1) and 62-212.400(5)(e)1.a Florida Administrative Code [FAC]). Pollutant emissions from the BPF and flares were used to compute potential impacts on soils and vegetation. Vegetative impacts from airborne pollutants may result from deposition on leaf surfaces as particulate matter (dry deposition), from solutions in rainfall (wet deposition), or by gaseous exchange. Airborne components may also enter vegetation through roots following deposition to soils. Accumulation of airborne pollutants in soil can also lead to changes in soil characteristics.

At NPS's request, total nitrogen and total sulfur deposition modeling was done using the CALPUFF model, to assess any potential impacts at the Everglades National Park and Big Cypress National Preserve. The parameters for running CALPUFF in screening mode, as listed in Section 7.2.2, were used for the analysis. (Cleve Holladay, FDEP, phone conversation, April 2002.)

Deposition estimates, in units of g/(m2*s), needed to be adjusted to compare modeling results with the limit of 0.1 kg/(ha*yr) of elemental sulfur (S) and nitrogen (N), as requested by NPS. The CALPUFF results for each pollutant were individually converted to kg/ha using the CALPOST post-processor. Molecular weight differences between S or N and a specific pollutant were corrected using the multipliers presented in **Table 8-2** and **Table 8-3**.

8.3.1 Total Sulfur Deposition

Sulfuric acid (H_2SO_4) is formed when gaseous SO_3 produced by a source reacts with water droplets. The acidified water vapor can result in acidic precipitation (acid rain). Plant sensitivity to sulfur dioxide (SO_2) appears to vary not only with the climate of an area but also with the duration of exposure.

Wet and dry deposition fluxes of SO_2 and $SO_4^=$ were calculated for the proposed modifications to the SWA. Deposition results were converted to kg/(ha*yr) and normalized for S deposition using the multipliers listed in Table 8-2. The maximum annual average from all receptors modeled was used for the comparison. As Table 8-2 shows, total S deposition resulting from the SWA's modifications do not exceed the NPS's 0.1 kg/(ha*yr) threshold.

8.3.2 Total Nitrogen Deposition

Nitrogen dioxide (NO_2) can be beneficial to vegetation in small amounts. Uptake of NO_2 varies with a number of factors such as nutrient supply in the soil, fertilization, and rainfall. NO_2 can also be converted to nitric acid (HNO_3) and contribute to acid precipitation.

The dry deposition fluxes of nitrogen oxides (NO_X), HNO_3, and NO_3^-, as well as the wet deposition flux of HNO_3 were calculated for the proposed BPF and flares. Deposition results were converted to kg/(ha*yr) and normalized for N deposition using the multipliers listed in Table 8-3. The maximum annual average from all receptors modeled was used for the comparison. As Table 8-3 shows, total N deposition resulting from the SWA's modifications do not exceed the NPS's 0.1 kg/(ha*yr) threshold.

Table 8-2 Total Sulfur Deposition Results

Class I - Everglades Nation Park, Annual Average S Deposition (kg/ha*yr)

	Multiplier*	1986	1987	1988	1989	1990
SO_2, Dry Deposition	157680000	1.23E-04	1.27E-04	1.25E-04	9.43E-05	1.25E-04
SO_2, Wet Deposition	157680000	1.41E-04	1.79E-04	1.30E-04	5.02E-05	1.55E-04
SO_4^{2-}, Dry Deposition	105118949	5.69E-07	5.46E-07	6.16E-07	3.81E-07	5.48E-07
SO_4^{2-}, Wet Deposition	105118949	1.88E-05	8.06E-06	8.26E-06	6.63E-06	1.21E-05
Total S Deposition:		2.84E-04	3.15E-04	2.64E-04	1.52E-04	2.93E-04

Big Cypress National Preserve, NE Corner, Annual Average S Deposition (kg/ha*yr)

	Multiplier*	1986	1987	1988	1989	1990
SO_2, Dry Deposition	157680000	3.94E-04	3.18E-04	4.65E-04	3.17E-04	4.84E-04
SO_2, Wet Deposition	157680000	1.41E-04	1.79E-04	1.30E-04	5.02E-05	1.55E-04
SO_4^{2-}, Dry Deposition	105118949	1.00E-06	8.14E-07	1.16E-06	7.85E-07	1.11E-06
SO_4^{2-}, Wet Deposition	105118949	2.79E-05	1.58E-05	1.47E-05	7.70E-06	2.00E-05
Total S Deposition:		5.64E-04	5.14E-04	6.10E-04	3.76E-04	6.61E-04

* Multiplier is applied using CALPOST to convert from the pollutant specific (g/m^2*s) values in the wet and dry deposition CALPUFF output files, to sulfur deposition values (in kg/ha*yr) for comparison with the NPS limit of 0.1 (kg/ha*yr)

Deposition of	Ratio of MW of	g to kg	m2 to ha	sec to hr	hr to year	Multiplier
S from SO2	0.5	0.001	10000	3600	8760	157680000
S from SO4	0.33333	0.001	10000	3600	8760	105118949

pg. 40 of IWAQM Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts, EPA-454/R-98-019, December, 1998.

Table 8-3 Class I - Everglades National Park, Annual Average N Deposition (kg/ha*yr)

	Multiplier*	1986	1987	1988	1989	1990
NO_X, Dry Deposition	95979816	2.05E-05	3.05E-05	2.13E-05	1.45E-05	1.76E-05
HNO_3, Dry Deposition	70079299	3.20E-05	3.05E-05	3.21E-05	2.19E-05	3.19E-05
HNO_3, Wet Deposition	70079299	1.31E-05	4.65E-06	5.41E-06	4.45E-06	8.80E-06
NO_3^{1-}, Dry Deposition	71211442	5.01E-07	5.23E-07	5.12E-07	3.92E-07	4.75E-07
NO_3^{1-}, Wet Deposition	71211442	3.83E-05	1.28E-05	1.32E-05	1.01E-05	1.87E-05
Total N Deposition:		1.04E-04	7.90E-05	7.25E-05	5.13E-05	7.76E-05

Big Cypress National Preserve, NE Corner, Annual Average N Deposition (kg/ha*yr)

	Multiplier*	1986	1987	1988	1989	1990
NO_X, Dry Deposition	95979816	1.03E-04	9.96E-05	1.23E-04	8.33E-05	1.34E-04
HNO_3, Dry Deposition	70079299	8.76E-05	6.34E-05	9.76E-05	6.95E-05	9.96E-05
HNO_3, Wet Deposition	70079299	2.58E-05	1.19E-05	1.40E-05	6.03E-06	2.34E-05
NO_3^{1-}, Dry Deposition	71211442	9.01E-07	9.93E-07	1.32E-06	7.20E-07	1.32E-06
NO_3^{1-}, Wet Deposition	71211442	2.66E-05	3.54E-05	2.30E-05	1.30E-05	3.34E-05
Total N Deposition:		2.44E-04	2.11E-04	2.59E-04	1.73E-04	2.92E-04

* Multiplier is applied using CALPOST to convert from the pollutant specific (g/m^2*s) values in the wet and dry deposition CALPUFF output files, to nitrogen deposition values (in kg/ha*yr) for comparison with the NPS limit of 0.1 (kg/ha*yr)

Deposition of	Ratio of MW of	g to kg	m2 to ha	sec to hr	hr to year	Multiplier
N from NO_X	0.30435	0.001	10000	3600	8760	95979816
N from HNO_3	0.22222	0.001	10000	3600	8760	70079299
N from NO_3^-	0.22581	0.001	10000	3600	8760	71211442

pg. 40 of IWAQM Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts, EPA-454/R-98-019, December, 1998.

Section 8
Additional Impact Analysis

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Calculation of impacts to visibility are only required at Class I areas. At the request of the National Park Service (NPS), the CALPUFF model was used to assess visibility impacts at the Everglades National Park and the Big Cypress National Preserve using methods outlined by IWAQM (EPA 1998). CALPUFF was used to produce concentrations of sulfates and nitrates. Resulting concentrations of $SO_4^{=}$, NO_3^{-}, and HNO_3 were used to calculate 24-hour averaged extinction coefficients and compute the percent change in extinction. The light extinction coefficient includes both scattering and absorption components, and is a measure of light attenuation over a unit distance.

CALPUFF was set to create concentration data files that were used as input files for the CALPOST post-processor. Parameters used in the CALPOST post-processor are listed below:

- Modeled Species: Sulfates, Nitrates
- Computation Method: (CALPOST, Method 6) Compute extinction from speciated PM measurements and user-specified Relative Humidity (RH) factors.
- Extinction Efficiency:
  - Ammonium Sulfate: 3 Mm^{-1} per $\mu g/m^3$
  - Ammonium Nitrate: 3 Mm^{-1} per $\mu g/m^3$
- Monthly RH Factors:
  - Winter (Jan, Feb, Dec): 3.6
  - Spring (Mar, Apr, May): 3.7
  - Summer (Jun, Jul, Aug): 3.8
  - Fall (Sep, Oct, Nov): 4.0
- Background concentration for computing background extinction coefficients
  - Ammonium Sulfate: 0.3 μg/m3
  - Ammonium Nitrate: 0.3 μg/m3
  - Soil: 8.5 μg/m3
- Extinction due to Rayleigh Scattering: 10 Mm^{-1}
- Averaging time: 24-hour
- Visibility units: Mm^{-1}

Natural background estimates for the visibility reference level at the Everglades National Park were obtained from information in the Federal Land Managers' Air Quality Related Values Workgroup (FLAG), guidance, December 2000. These data are assumed representative of the Big Cypress National Preserve as well.

In accordance with guidance, as the change in light extinction was predicted to be 5 percent or less when compared to natural conditions, no further visibility analysis is required. Results are shown in **Table 8-1** for each year of meteorological data. A sample of the modeling output can be found in Appendix D.

Table 8-1 Visibility Modeling Results

Class 1 - Everglades Nation Park, 24-hour Average						
	1986	**1987**	**1988**	**1989**	**1990**	**Threshold**
Largest Change in Extinction, Db_{ext}	0.06%	0.08%	0.06%	0.08%	0.07%	5%
Largest Delta-Deciview, DDV	0.006	0.008	0.006	0.008	0.007	
Maximum Extinction, (Mm^{-1})	25.715	25.720	25.716	25.720	25.719	
Big Cypress National Preserve, NE Corner, 24-hour Average						
	1986	**1987**	**1988**	**1989**	**1990**	**Threshold**
Largest Change in Extinction, Db_{ext}	0.07%	0.06%	0.04%	0.08%	0.13%	5%
Largest Delta-Deciview, DDV	0.007	0.006	0.004	0.008	0.013	
Maximum Extinction, (Mm^{-1})	25.718	25.712	25.710	25.720	25.733	

CALPOST was used to calculate visibility parameters using S and N concentrations calculated using the CALPUFF dispersion model.

8.2 Growth Analysis

The BPF, once operational, will employ approximately 13 people. The proposed flares can be managed by the SWA's current staff. It is anticipated that the majority of these personnel requirements will be filled from within the local labor force. Significant in-migration to the area is therefore not anticipated. As a result, no increase in population in the area attributable to the SWA's modifications is expected to occur.

The projects do not require the destruction, relocation, or alteration of any residential property in the area. In addition, since no net migration to the area is anticipated, there will be no change in demand for housing units in the area.

The construction and operation of the BPF and flares will have a minor positive net effect on industrial and commercial development. It is not anticipated that this effect will be significant when considered on a regional basis.

The growth analysis indicates that no net significant change in employment, populations, housing, or commercial/industrial development will be associated with the project. As a result, there will not be any significant increases in pollutant emissions indirectly associated with the BPF or flares.

8.3 Soils and Vegetation

Federal and Florida regulations require that an assessment be undertaken of the potential impacts of emissions from a proposed facility on soils and vegetation of commercial or recreational value (40 CFR 51.166(o)(1) and 62-212.400(5)(e)1.a Florida Administrative Code [FAC]). Pollutant emissions from the BPF and flares were used to compute potential impacts on soils and vegetation. Vegetative impacts from airborne pollutants may result from deposition on leaf surfaces as particulate matter (dry deposition), from solutions in rainfall (wet deposition), or by gaseous exchange. Airborne components may also enter vegetation through roots following deposition to soils. Accumulation of airborne pollutants in soil can also lead to changes in soil characteristics.

At NPS's request, total nitrogen and total sulfur deposition modeling was done using the CALPUFF model, to assess any potential impacts at the Everglades National Park and Big Cypress National Preserve. The parameters for running CALPUFF in screening mode, as listed in Section 7.2.2, were used for the analysis. (Cleve Holladay, FDEP, phone conversation, April 2002.)

Deposition estimates, in units of g/(m2*s), needed to be adjusted to compare modeling results with the limit of 0.1 kg/(ha*yr) of elemental sulfur (S) and nitrogen (N), as requested by NPS. The CALPUFF results for each pollutant were individually converted to kg/ha using the CALPOST post-processor. Molecular weight differences between S or N and a specific pollutant were corrected using the multipliers presented in **Table 8-2** and **Table 8-3**.

8.3.1 Total Sulfur Deposition

Sulfuric acid (H_2SO_4) is formed when gaseous SO_3 produced by a source reacts with water droplets. The acidified water vapor can result in acidic precipitation (acid rain). Plant sensitivity to sulfur dioxide (SO_2) appears to vary not only with the climate of an area but also with the duration of exposure.

Wet and dry deposition fluxes of SO_2 and $SO_4^{=}$ were calculated for the proposed modifications to the SWA. Deposition results were converted to kg/(ha*yr) and normalized for S deposition using the multipliers listed in Table 8-2. The maximum annual average from all receptors modeled was used for the comparison. As Table 8-2 shows, total S deposition resulting from the SWA's modifications do not exceed the NPS's 0.1 kg/(ha*yr) threshold.

8.3.2 Total Nitrogen Deposition

Nitrogen dioxide (NO_2) can be beneficial to vegetation in small amounts. Uptake of NO_2 varies with a number of factors such as nutrient supply in the soil, fertilization, and rainfall. NO_2 can also be converted to nitric acid (HNO_3) and contribute to acid precipitation.

The dry deposition fluxes of nitrogen oxides (NO_X), HNO_3, and NO_3^-, as well as the wet deposition flux of HNO_3 were calculated for the proposed BPF and flares. Deposition results were converted to kg/(ha*yr) and normalized for N deposition using the multipliers listed in Table 8-3. The maximum annual average from all receptors modeled was used for the comparison. As Table 8-3 shows, total N deposition resulting from the SWA's modifications do not exceed the NPS's 0.1 kg/(ha*yr) threshold.

Table 8-2 Total Sulfur Deposition Results

Class I - Everglades Nation Park, Annual Average S Deposition (kg/ha*yr)						
	Multiplier*	1986	1987	1988	1989	1990
SO_2, Dry Deposition	157680000	1.23E-04	1.27E-04	1.25E-04	9.43E-05	1.25E-04
SO_2, Wet Deposition	157680000	1.41E-04	1.79E-04	1.30E-04	5.02E-05	1.55E-04
SO_4^{2-}, Dry Deposition	105118949	5.69E-07	5.46E-07	6.16E-07	3.81E-07	5.48E-07
SO_4^{2-}, Wet Deposition	105118949	1.88E-05	8.06E-06	8.26E-06	6.63E-06	1.21E-05
Total S Deposition:		2.84E-04	3.15E-04	2.64E-04	1.52E-04	2.93E-04

Big Cypress National Preserve, NE Corner, Annual Average S Deposition (kg/ha*yr)						
	Multiplier*	1986	1987	1988	1989	1990
SO_2, Dry Deposition	157680000	3.94E-04	3.18E-04	4.65E-04	3.17E-04	4.84E-04
SO_2, Wet Deposition	157680000	1.41E-04	1.79E-04	1.30E-04	5.02E-05	1.55E-04
SO_4^{2-}, Dry Deposition	105118949	1.00E-06	8.14E-07	1.16E-06	7.85E-07	1.11E-06
SO_4^{2-}, Wet Deposition	105118949	2.79E-05	1.58E-05	1.47E-05	7.70E-06	2.00E-05
Total S Deposition:		5.64E-04	5.14E-04	6.10E-04	3.76E-04	6.61E-04

* Multiplier is applied using CALPOST to convert from the pollutant specific (g/m^2*s) values in the wet and dry deposition CALPUFF output files, to sulfur deposition values (in kg/ha*yr) for comparison with the NPS limit of 0.1 (kg/ha*yr)

Deposition of	Ratio of MW of	g to kg	m2 to ha	sec to hr	hr to year	Multiplier
S from SO2	0.5	0.001	10000	3600	8760	157680000
S from SO4	0.33333	0.001	10000	3600	8760	105118949

pg. 40 of IWAQM Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts, EPA-454/R-98-019, December, 1998.

Table 8-3 Class I - Everglades National Park, Annual Average N Deposition (kg/ha*yr)

	Multiplier*	1986	1987	1988	1989	1990
NO_X, Dry Deposition	95979816	2.05E-05	3.05E-05	2.13E-05	1.45E-05	1.76E-05
HNO_3, Dry Deposition	70079299	3.20E-05	3.05E-05	3.21E-05	2.19E-05	3.19E-05
HNO_3, Wet Deposition	70079299	1.31E-05	4.65E-06	5.41E-06	4.45E-06	8.80E-06
NO_3^{1-}, Dry Deposition	71211442	5.01E-07	5.23E-07	5.12E-07	3.92E-07	4.75E-07
NO_3^{1-}, Wet Deposition	71211442	3.83E-05	1.28E-05	1.32E-05	1.01E-05	1.87E-05
Total N Deposition:		1.04E-04	7.90E-05	7.25E-05	5.13E-05	7.76E-05

Big Cypress National Preserve, NE Corner, Annual Average N Deposition (kg/ha*yr)

	Multiplier*	1986	1987	1988	1989	1990
NO_X, Dry Deposition	95979816	1.03E-04	9.96E-05	1.23E-04	8.33E-05	1.34E-04
HNO_3, Dry Deposition	70079299	8.76E-05	6.34E-05	9.76E-05	6.95E-05	9.96E-05
HNO_3, Wet Deposition	70079299	2.58E-05	1.19E-05	1.40E-05	6.03E-06	2.34E-05
NO_3^{1-}, Dry Deposition	71211442	9.01E-07	9.93E-07	1.32E-06	7.20E-07	1.32E-06
NO_3^{1-}, Wet Deposition	71211442	2.66E-05	3.54E-05	2.30E-05	1.30E-05	3.34E-05
Total N Deposition:		2.44E-04	2.11E-04	2.59E-04	1.73E-04	2.92E-04

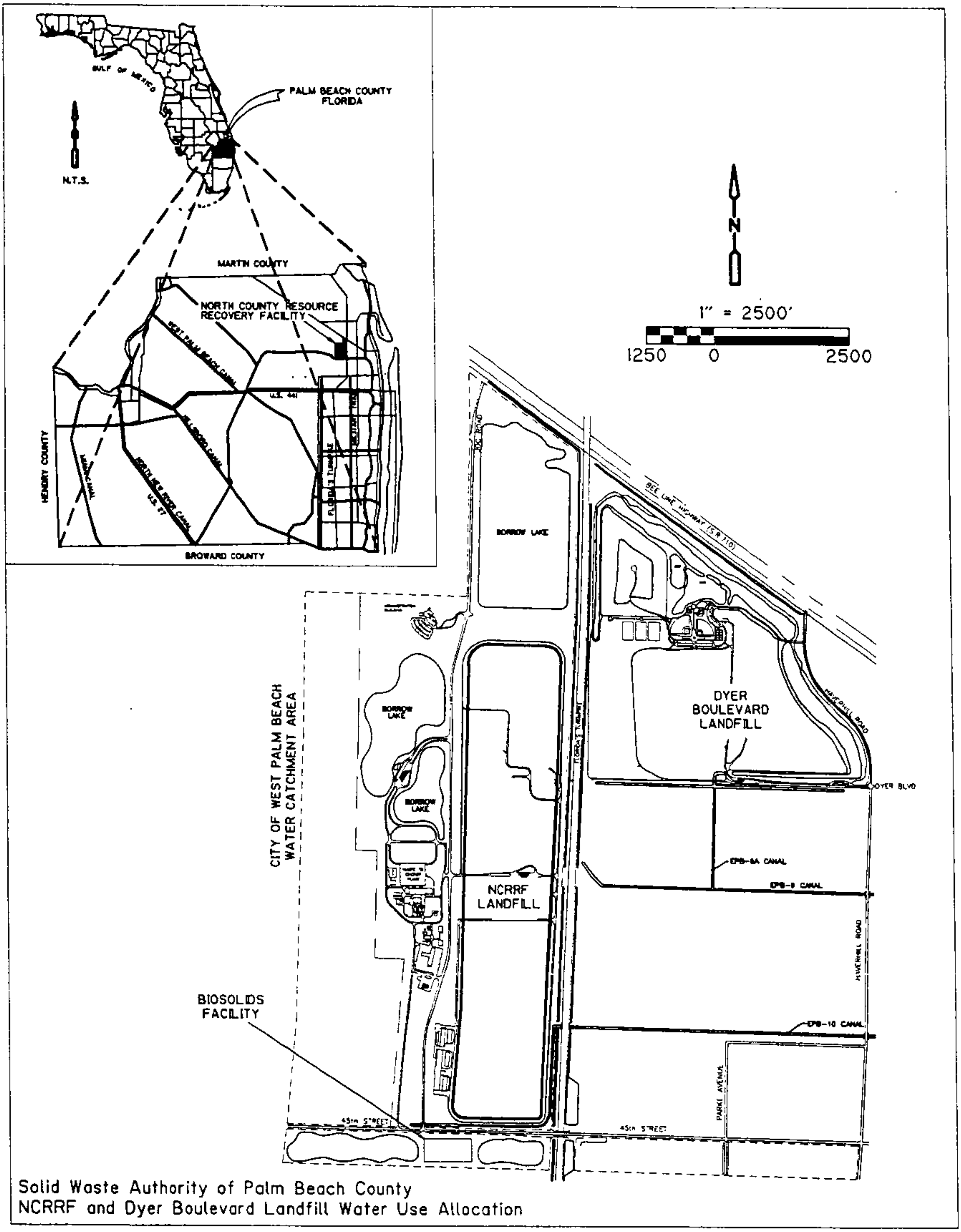
* Multiplier is applied using CALPOST to convert from the pollutant specific (g/m^2*s) values in the wet and dry deposition CALPUFF output files, to nitrogen deposition values (in kg/ha*yr) for comparison with the NPS limit of 0.1 (kg/ha*yr)

Deposition of	Ratio of MW of	g to kg	m2 to ha	sec to hr	hr to year	Multiplier
N from NO_X	0.30435	0.001	10000	3600	8760	95979816
N from HNO_3	0.22222	0.001	10000	3600	8760	70079299
N from NO_3^-	0.22581	0.001	10000	3600	8760	71211442

pg. 40 of IWAQM Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts, EPA-454/R-98-019, December, 1998.

Appendix A

Area Map

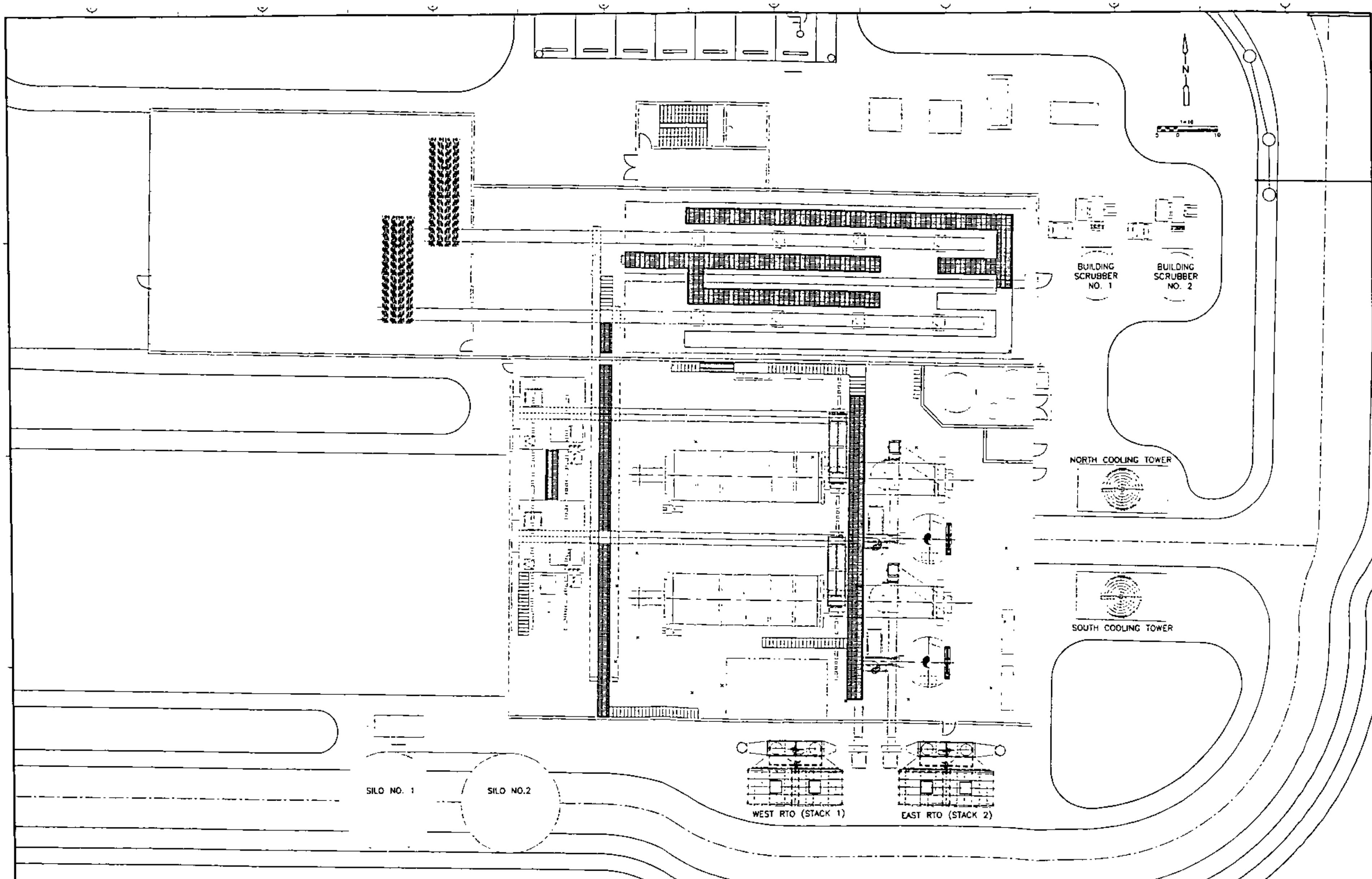


CDM

Figure A-1
Area Map

Appendix B

Facility Plot Plan



DESIGNED BY: H. LEWIS
DRAWN BY: F. HOFFMAN
CROSS CHK'D BY: H. LEWIS
APPROVED BY:
DATE: DECEMBER 2004

REV NO | DATE | DRWN | CHK'D | REMARKS

CDM Camp Dresser & McKee Inc.

SOLID WASTE AUTHORITY
PALM BEACH COUNTY, FLORIDA

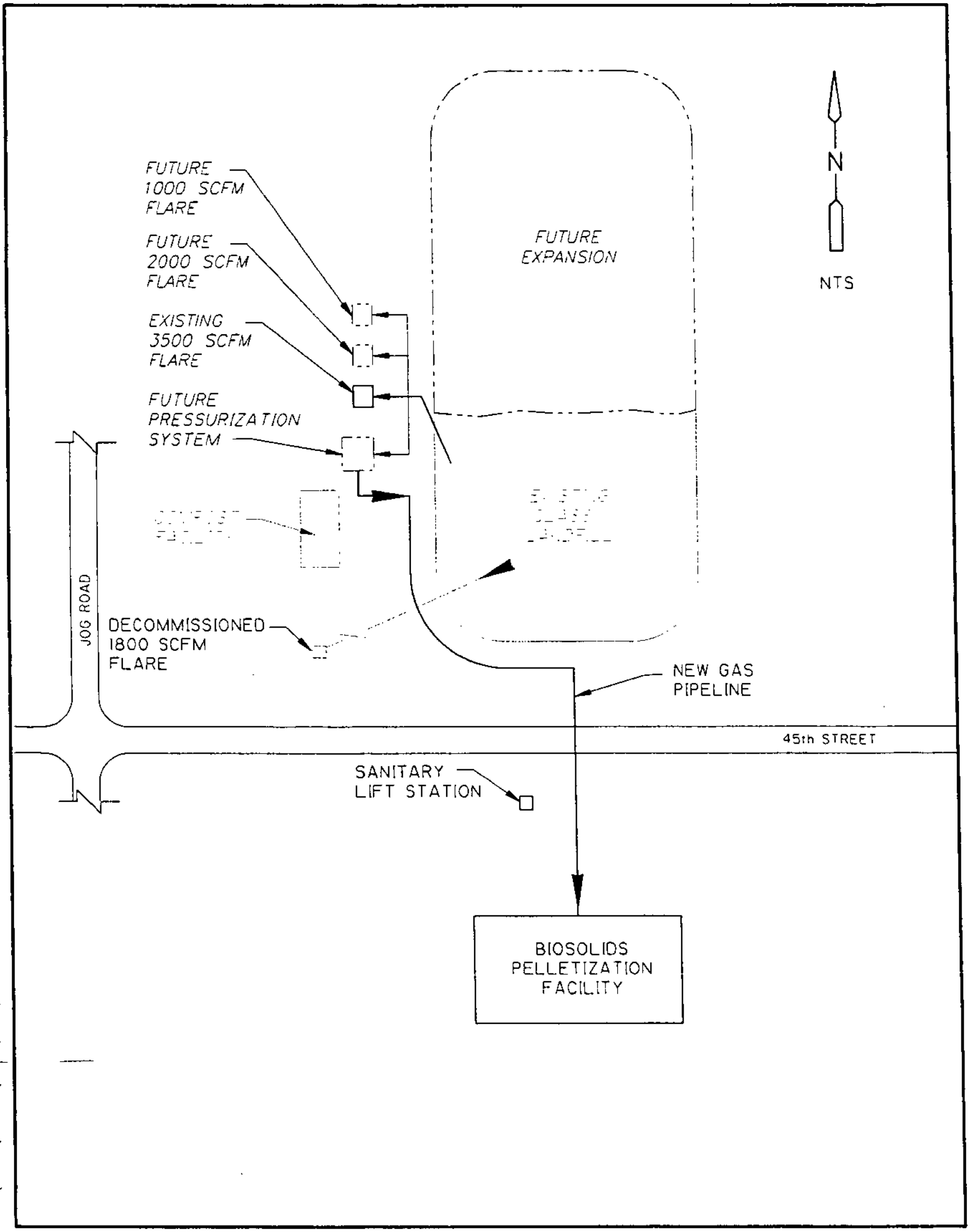
BIOSOLIDS PELLETIZATION FACILITY

PPSA PERMIT APPLICATION, MAY 2005

PROPOSED SITE PLAN

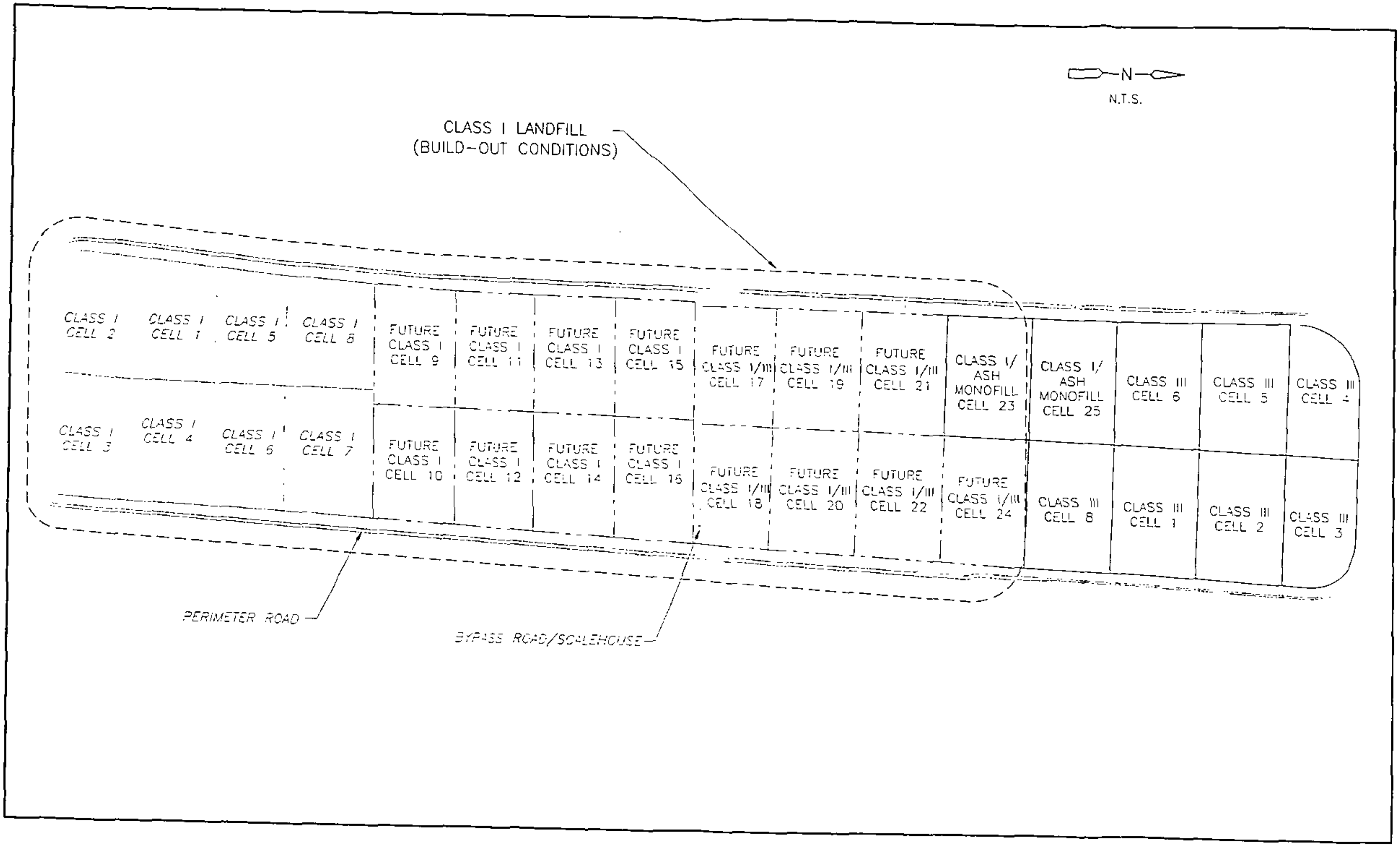
SHEET NO

FIGURE B-1



CDM

Figure No. B-2
Tie-in of Landfill
Gas Collection to the
BPF

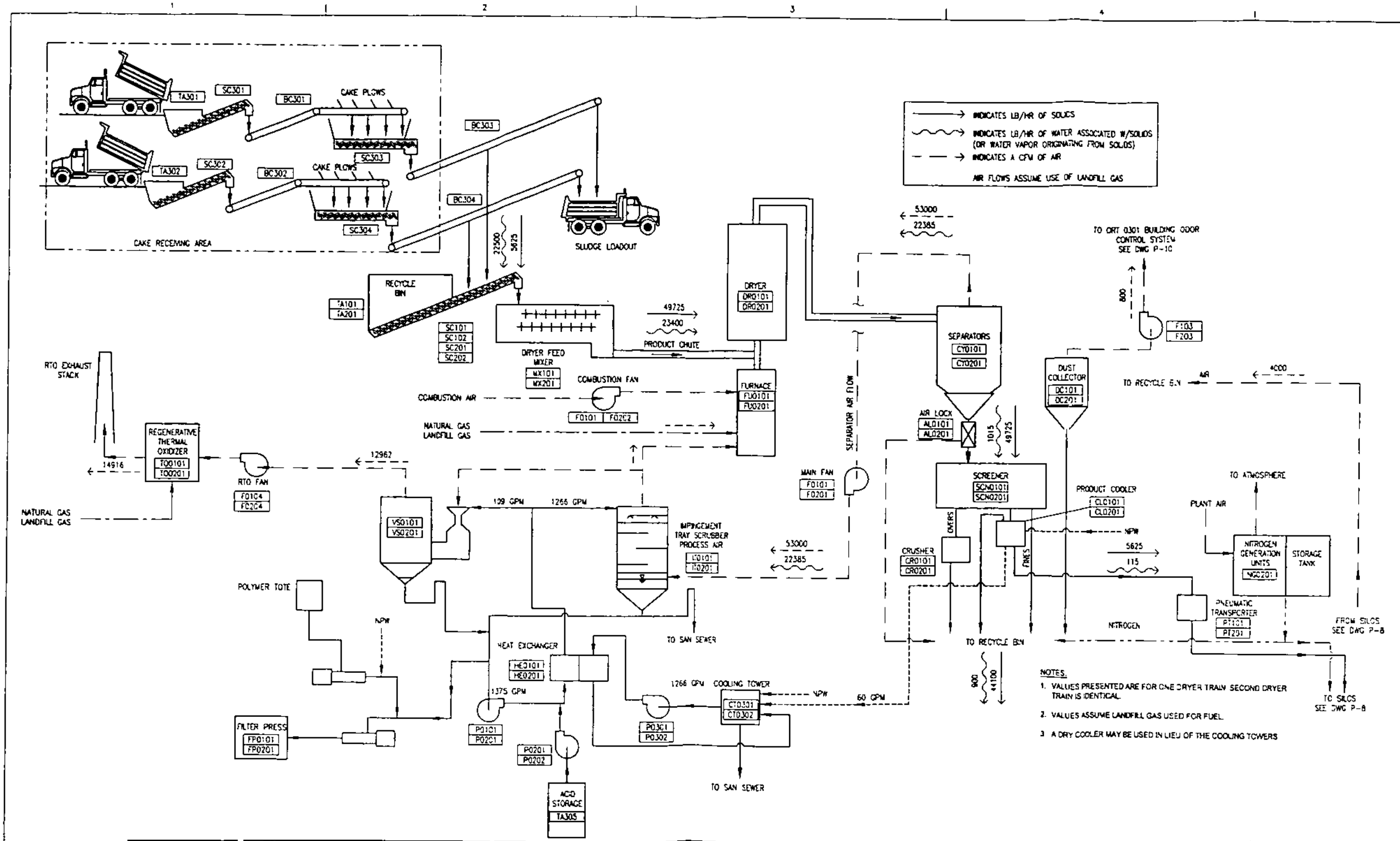


CDM

Figure No. B-3
Class I Landfill Build-Out Conditions

Appendix C

Process Flow Diagram



HDR
HDR Engineering, Inc.

ISSUE	DATE	DESCRIPTION
B	12/8/04	REV 2
A	5/25/04	REV 1

PROJECT MANAGER	E. DeLaFOREST
CIVIL	R. TRAVIS
STRUCTURAL	W. KAHON
ARCHITECT	S. BIRCH
MECHANICAL	B. SPOTT
ELECTRICAL	J. HARRISON
I&C	D. PENNER
PROCESS	E. ANDREWS
PROJECT NUMBER	000000000010162

BIOSOLIDS PROCESSING FACILITY

SWA Solid Waste Authority of Palm Beach County

Figure C-1
Process Flow Diagram

FILENAME
SCALE NONE
SHEET

C:\WINDM\PALM BEACH\WATFLOWDIAG.dwg, M-1, 12/07/2004 01:14:58 PM, mhenkel

Appendix D

Precautions to Prevent Unconfined Particulate Matter

Appendix D
Precautions to Prevent Emissions of Unconfined Particulate Matter

In accordance with the guidance contained in 62-296.320(4)(b)4.a., Florida Administrative Code, Control of Unconfined Particulate Matter, the following dust control measures are practiced at the Solid Waste Authority of Palm Beach County's North County Resource Recovery Facility Site:

- All parking lots and permanent drives are paved.
- Paved areas are subject to regular street sweeping.
- A water truck sprays water as a dust suppressant to unpaved roads and active unpaved areas.
- Landfill areas that are closed are promptly re-vegetated.
- Ash is quenched with water prior to landfilling.

Appendix E

Supplemental Information
Emissions Calculations

APPENDIX E
SWA Biosolids Pelletization Facility
Emission Calculation Tables

The tables in this Appendix include the emission inventory for the SWA Biosolids Pelletizing Facility PSD permit modification, along with calculation and information support documentation for the inventory.

Table Number	Table Name	Description
E-1	Estimated Maximum Potential Emission Rates	Summary of emission factors and emission rates for PSD pollutants emitted from the BPF and flares
E-2	Estimated PM Emission Rates for Baghouses on Pellet Recycle Bins	Calculation of PM/PM_{10} emissions from the proposed baghouses, based on vendor information
E-3	Cooling Tower Air Emissions - PM	Calculation of PM emissions from the cooling tower based on known design parameters and AP-42 estimates.
E-4	NEFCO Guaranteed Emissions Rates	Emissions Rates for CO, NO_X, SO_2, PM and VOC from Vendor
E-5	Methane Emission Rates	Calculation of Methane and NMOC emission rates for the biosolids pelletizing dryer.
E-6	HAP Emission Rates	Calculation of HAP emission rates for the biosolids pelletizing dryer, based on default HAP concentrations in landfill gas as listed in AP-42
E-7	Emergency Standby Generator Maximum Potential Emmissions Rates	Calculation of CO, NO_X, PM, SO_2 and VOC from generator
	Decommissioned 1800 SCFM Flare Emission Calculations	
E-8	Methane Emission Rates	Calculation of Methane and NMOC emission rates for the existing flare.
E-9	HAP Emission Rates	Calculation of HAP emission rates for the existing flare, based on default HAP concentrations in landfill gas as listed in AP-42
E-10	Estimated Emissions for the Decommissioned Flare	Calculation of CO, NO_X, PM, SO_2, and HCl based on AP-42 emission factors.
	Proposed 1000 SCFM Flare Emission Calculations	
E-11	Exit Gas Flow Rate Calculations	Calculation of exit flow and velocity from the flare
E-12	Methane Emission Rates	Calculation of Methane and NMOC emission rates for the proposed flare.
E-13	HAP Emission Rates	Calculation of HAP emission rates for the proposed flare, based on default HAP concentrations in landfill gas as listed in AP-42
E-14	Secondary Pollutant Emission Rates from Flare	Calculation of CO and NO_X emissions based on vendor information. Calculation of SO_2 and HCl based on AP-42 calculations and flare data.

Proposed 2000 SCFM Flare Emission Calculations		
E-15	Exit Gas Flow Rate Calculations	Calculation of exit flow and velocity from the flare
E-16	Methane Emission Rates	Calculation of Methane and NMOC emission rates for the proposed flare.
E-17	HAP Emission Rates	Calculation of HAP emission rates for the proposed flare, based on default HAP concentrations in landfill gas as listed in AP-42
E-18	Secondary Pollutant Emission Rates from Flare	Calculation of CO and NO_X emissions based on vendor information. Calculation of SO_2 and HCl based on AP-42 calculations and flare data.
Proposed 3500 SCFM Flare Emission Calculations (operating at capacity)		
E-19	Exit Gas Flow Rate Calculations	Calculation of exit flow and velocity from the flare
E-20	Methane Emission Rates	Calculation of Methane and NMOC emission rates for the proposed flare.
E-21	HAP Emission Rates	Calculation of HAP emission rates for the proposed flare, based on default HAP concentrations in landfill gas as listed in AP-42
E-22	Secondary Pollutant Emission Rates from Flare	Calculation of CO and NO_X emissions based on vendor information. Calculation of SO_2 and HCl based on AP-42 calculations and flare data.
Proposed 3500 SCFM Flare Emission Calculations (operating 700 SCFM to account for BPF demand of 2800 SCFM)		
E-23	Exit Gas Flow Rate Calculations	Calculation of exit flow and velocity from the flare
E-24	Methane Emission Rates	Calculation of Methane and NMOC emission rates for the proposed flare.
E-25	HAP Emission Rates	Calculation of HAP emission rates for the proposed flare, based on default HAP concentrations in landfill gas as listed in AP-42
E-26	Secondary Pollutant Emission Rates from Flare	Calculation of CO and NO_X emissions based on vendor information. Calculation of SO_2 and HCl based on AP-42 calculations and flare data.

Table E-1
SWA Biosolids Pelletization Facility
Estimated Maximum Potential Emission Rates

Emissions, by Air Pollutant

Source	Particulate Matter Emission Factor	Particulate Matter Units	Particulate Matter lb/hr	Particulate Matter ton/year	Sulfur Dioxide Emission Factor	Sulfur Dioxide Units	Sulfur Dioxide lb/hr	Sulfur Dioxide ton/year
Biosolids Pelletizing Facility								
337.5-wtpd Train (NEFCO) Odor Control Unit	2.42	lb/hour [1,2]	2.42	10.6	4.45	lb/hour [2,3]	4.45	19.5
Cooling Tower	3333	ppm TDS in drift	6.25E-02	2.74E-01	---	---	---	---
Recycle Bin w/ Baghouse	0.010	gr/dscf actual [2]	6.86E-02	0.30	---	---	---	---
337.5-wtpd Train (NEFCO) Odor Control Unit	2.42	lb/hour [1,2]	2.42	10.6	4.45	lb/hour [2,3]	4.45	19.5
Cooling Tower	3333	ppm TDS in drift	6.25E-02	2.74E-01	---	---	---	---
Recycle Bin w/ Baghouse	0.010	gr/dscf actual [2]	6.86E-02	0.30	---	---	---	---
Emergency Generator Engine	0.697	g/bhp-hr [2]	7.89E-01	0.20	1.83E-01	g/bhp-hr [2,3]	0.36	0.09
Facility Subtotal	---	---	---	22.6	---	---	---	39.1
1800 SCFM Flare								
Decommissioned Flare [4]	17	lbs/10^6 dscf CH_4	0.53	2.3	190	ppmv [3]	1.96	8.6
1000 SCFM Flare								
Proposed Flare [5]	17	lbs/10^6 dscf CH_4	0.56	2.5	190	ppmv [3]	1.90	8.3
2000 SCFM Flare Netted with Existing 1800 SCFM Flare								
Proposed Flare [5]	17	lbs/10^6 dscf CH_4	0.60	2.6	190	ppmv [3]	1.83	8.0
3500 SCFM Flare - Operating at Capacity								
New Flare (Case 1) [5]	17	lbs/10^6 dscf CH_4	1.96	8.6	190	ppmv [3]	6.64	29.1
3500 SCFM Flare - Operating at 700 SCFM [6]								
New Flare (Case 2) [5]	17	lbs/10^6 dscf CH_4	0.39	1.7	190	ppmv [3]	1.33	5.8
Totals								
Total (No Flares)	---	---	---	22.6	---	---	---	39.1
Total (Flares included)	---	---	---	29.4	---	---	---	61.2
Emission Thresholds								
PSD Significant Increase (Major Modification)				25 (15 PM_{10})				40

Source	Nitrogen Oxides Emission Factor	Nitrogen Oxides Units	Nitrogen Oxides lb/hr	Nitrogen Oxides ton/year	Carbon Monoxide Emission Factor	Carbon Monoxide Units	Carbon Monoxide lb/hr	Carbon Monoxide ton/year
Biosolids Pelletizing Facility								
337.5-wtpd Train (NEFCO) Odor Control Unit	5.60	lb/hour [2]	5.597	24.5	3.37	lb/hour [2]	3.369	14.8
Cooling Tower	---	---	---	---	---	---	---	---
Recycle Bin w/ Baghouse	---	---	---	---	---	---	---	---
337.5-wtpd Train (NEFCO) Odor Control Unit	5.60	lb/hour [2]	5.597	24.5	3.37	lb/hour [2]	3.369	14.8
Cooling Tower	---	---	---	---	---	---	---	---
Recycle Bin w/ Baghouse	---	---	---	---	---	---	---	---
Emergency Generator Engine	6.9 [1]	g/bhp-hr [2]	13.61	3.40	8.5	g/bhp-hr [2]	16.77	4.19
Facility Subtotal	---	---	---	52.4	---	---	[illegible]	33.7
1800 SCFM Flare								
Decommissioned Flare [4]	40	lbs/10^6 dscf CH_4	1.24	5.4	750	lbs/10^6 dscf CH_4	23.19	101.6
1000 SCFM Flare								
Proposed Flare [5]	0.068	lb/MMBtu	2.34	10.3	0.37	lb/MMBtu	12.74	55.8
2000 SCFM Flare Netted with Existing 1800 SCFM Flare								
Proposed Flare [5]	0.068	lb/MMBtu	3.44	15.09	0.37	lb/MMBtu	2.28	9.99
3500 SCFM Flare - Operating at Capacity								
New Flare (Case 1) [5]	0.068	lb/MMBtu	8.19	35.9	0.37	lb/MMBtu	44.58	195.3
3500 SCFM Flare - Operating at 700 SCFM [6]								
New Flare (Case 2) [5]	0.068	lb/MMBtu	1.64	7.2	0.37	lb/MMBtu	8.916	39.1
Totals								
Total (No Flares)	---	---	---	52.4	---	---	---	33.7
Total (Flares included)	---	---	---	85.0	---	---	---	261.0
Emission Thresholds								
PSD Significant Increase (Major Modification)				40				100

Source	Lead Emission Factor	Lead Units	Lead lb/hr	Lead ton/year	Volatile Organic Compounds Emission Factor	Volatile Organic Compounds Units	Volatile Organic Compounds lb/hr	Volatile Organic Compounds ton/year	Total HAP lb/hr	Total HAP ton/year
Biosolids Pelletizing Facility										
337.5-wtpd Train (NEFCO) Odor Control Unit	7.3E-04	lb/hour [2]	7.3E-04	3.2E-03	1.00	lb/hour [2]	1.002	4.4	0.0586	0.26
Cooling Tower	---	---	---	---	---	---	---	---	---	---
Recycle Bin w/ Baghouse	---	---	---	---	---	---	---	---	---	---
337.5-wtpd Train (NEFCO) Odor Control Unit	7.3E-04	lb/hour [2]	7.3E-04	3.2E-03	1.00	lb/hour [2]	1.002	4.4	0.0586	0.26
Cooling Tower	---	---	---	---	---	---	---	---	---	---
Recycle Bin w/ Baghouse	---	---	---	---	---	---	---	---	---	---
Emergency Generator Engine	---	---	---	---	0.97	g/bhp-hr [2]	1.91	0.48	---	---
Facility Subtotal	---	---	---	6.4E-03	---	---	---	9.3	0.12	0.51
1800 SCFM Flare										
Decommissioned Flare [4]	---	---	---	---	---	---	0.15	0.7	0.03	0.14
1000 SCFM Flare										
Proposed Flare [5]	---	---	---	---	---	---	0.15	0.6	0.03	0.13
2000 SCFM Flare Netted with Existing 1800 SCFM Flare										
Proposed Flare [5]	---	---	---	---	---	---	0.14	0.6	0.03	0.13
3500 SCFM Flare - Operating at Capacity										
New Flare (Case 1) [5]	---	---	---	---	---	---	0.51	2.3	0.11	0.46
3500 SCFM Flare - Operating at 700 SCFM [6]										
New Flare (Case 2) [5]	---	---	---	---	---	---	0.10	0.5	0.02	0.09
Totals										
Total (No Flares)	---	---	---	6.4E-03	---	---	---	9.3	---	0.5
Total (Flares included)	---	---	---	6.4E-03	---	---	---	11.0	---	0.9
Emission Thresholds										
PSD Significant Increase (Major Modification)				0.6				40		25

Bold Text denotes an exceedence of the PSD threshold

Notes:

A single 300-wtpd sludge dryer combusts about 1400 scfm of landfill gas

[1] Emissions are from the dryer stack only. Particulate matter emissions from screens, recycle bin, and storage silos not included

[2] Emissions based on Vendor guarantees for flue gas concentrations at the dryer RTO exit or recycle bin exhaust (New England Fertilizer Company), or engine generator exhaust (Detroit Diesel or Caterpillar)

[3] Based on an assumed 190 ppmv sulfur concentration in the landfill gas, which is a conservative estimate for the Class I landfill

[4] Emission factors for the Existing Flare are from U.S. EPA AP-42 Section 2.4 consistent with AOR reporting

[5] NO_x and CO emission factors are based on vendor guarantees and U.S. EPA AP-42 Section 13.5 (See Table A-16)

[6] 2800 SCFM is subtracted from flare capacity to account for the demand of the Biosolids Pellitization Facility

Table E-2
SWA Biosolids Pelletization Facility
Estimated PM Emission Rates for Baghouses on Pellet Recycle Bins

Biosolids Pellet Recycle Bin Baghouse (Note: includes airflow from pellet storage silo)

baghouse airflow	800 dscfm
PM Concentration	0.010 gr/dscf of PM

Calculate PM emission rate per unit:

$$\frac{0.010 \text{ grains}}{1 \text{ dscf}} * \frac{800 \text{ dscf}}{1 \text{ min}} * \frac{1 \text{ g}}{15.43 \text{ grain}} * \frac{1 \text{ min}}{60 \text{ second}} = \frac{0.01 \text{ g}}{\text{second}}$$

Calculate PM emission rate for one train

$$\frac{0.01 \text{ g}}{\text{sec/unit}} \quad 1 \text{ units} = \frac{0.01 \text{ g}}{\text{sec}}$$

$$\frac{0.01 \text{ g}}{\text{second}} * \frac{1 \text{ ton}}{907200 \text{ g}} * \frac{60 \text{ sec}}{1 \text{ min}} * \frac{60 \text{ min}}{1 \text{ hour}} * \frac{24 \text{ hour}}{1 \text{ day}} * \frac{365 \text{ days}}{1 \text{ year}} = \frac{0.30 \text{ ton}}{\text{year}}$$

Table E-3
SWA Biosolids Pelletization Facility
Cooling Tower Air Emissions - Particulate Matter

A. Flow Rate Across Cooling Tower Cell	1500	gal/min	
B. Total Dissolved Solids	3,333	ppm	(666 mg/l for makeup water; 5-fold concentration; AP-42 Section 13.4)
C. Drift as a Percentage of Recirculating Rate	0.005%	Vendor information	
D. Density of Water	8.330	lb/gal	
E. Total PM Emissions within Drift (A*B*C/10^6*D*60)	1.25E-01	lbs/hour	
F. PM_{10} Fraction of Total PM Emissions	50%	Reisman, J. and Frisbie, G., "Calculating Realistic PM10 Emissions from Cooling Towers," Proceedings from AWMA National Conference, June 2000	
G. Total PM_{10} Emissions (E*F)	6.25E-02	lbs/hour	
H. Hours of Operations	8760		
I. Annual PM_{10} Emissions for tower (G*H/2000)	**2.74E-01**	**tons/year**	
J. Modeling Emission Rate (g/s)	**7.87E-03**	**g/s**	

Notes: Each dryer train is served by one cooling tower cell.
Each cell has an air flow rate of 191,000 acfm.

Table E-4
SWA Biosolids Pelletization Facility
New England Fertilizer Company (NEFCO) Guaranteed Emission Rates

Dryer RTO Exhaust Emission Rates

Pollutant	Estimated Emission Rate[a]			Guaranteed Emission Rate	
	Vendor Estimates	Scaled from GLSD Permit	Scaled from GLSD Test Data		
	lb/hr	lb/hr	lb/hr	lb/hr[a]	TPY[b]
Carbon Monoxide (CO)	1.86	3.37	0.87	3.37	29.51
Nitrogen Oxides (NO_x)	5.60	4.54	1.18	5.60	49.03
Sulfur Dioxide (SO_2)	3.01	4.92	1.14	4.45[c]	39[c]
Particulate Matter (PM)	1.87	2.42	1.77	2.42	21.22
Volatile Organics (VOC)	0.93	0.83	1.00	1.00	8.78

Notes:

[a] Per Dryer/RTO unit. Each dryer is 337.5 wet tons per day. NEFCO Dryer Model No. 125-42.

[b] Total for two units at full-time operation (8,760 hours per year).

c Given uncertainty in WPB sludge quality with respect to volatile sulfur compounds, the requested permit emission rate is 4.45 lb/hr per dryer/RTO, 8.9 lb/hr total, or 39 tons/yr total SO_2. The only other project SO_2 emissions are from the emergency diesel generator, at 0.09 tons/yr.

"GLSD" is Greater Lawrence Sanitary District, North Andover, MA. GLSD is a NEFCO facility with similar dryers and air pollution control equipment. GLSD's capacity is 38 dry tons/day biosolids vs. SWA's planned 135 dry tons/day capacity.

Source: Memorandum dated December 29, 2004, from Mr. Edward DeLaforest, HDR, to Mr. Craig Dolan, NEFCO.

Table E-5
SWA Biosolids Pelletization Facility
Methane Emission Rates - Landfill Gas to Biosolids Pelletizing Facility

BPF Gas Demand Design Capacity:	2800	scfm	41673341.81 m^3/year
Methane Content of Landfill Gas:	58.5%	(percent by volume)	
Total Methane Flow to Flare:	1639.3	scfm	24398835.69 m^3/year
MW of Methane	16		

Methane Emission Rate

Pollutant	Methane Flow Rate to BPF (m^3/year)	Methane Flow Rate to BPF (m^3/minute)	Methane (Mg/yr)*
Class I Landfill Methane	24398836	46.4	16,228

*41.57 Conversion from std. m^3/yr to g/yr.

0.773682004

NMOC Emission Rate

Pollutant	Concentration of NMOC (ppmv)	MW of NMOC (g/mol)	Concentration of NMOC (μg/m³)	NMOC, Uncontrolled (Mg/yr)	NMOC, Uncontrolled (tpy)	NMOC, Controlled* (tpy)	NMOC, Controlled* (lbs/hr)
Class I Landfill NMOC	595	86.2	2,131,589	89	90	2	0.411

* 98% Control of NMOC assumed for calculation

Table E-6
SWA Biosolids Pelletization Facility
Biosolids Pelletizing Dryer HAP Emissions

Input Information:

NMOC concentration in landfill gas:	595	ppmdv expressed as hexane with MW of:		86.17
Equivalent mass/volume conc. is:	2131341.71	ug/m3	[ug/m3 = (ppm)41.57(MW)]	
LANDFILL 1995 NMOC em. rate:	89	Mg/yr	2.81679474 g/s	

HAP	Molecular Weight	Default Conc. (ppmv)	Mass Conc. (ug/m3)	Emissions (Mg/yr)	Emissions (tons/yr)
1,1,1-Trichlorethane (methyl chloroform)	133.42	0.480	2617.38	1.09E-01	1.11E-01
1,1,2,2-Tetrachloroethane	167.85	1.11	7614.63	3.17E-01	3.22E-01
1,1,2-Trichloroethane	133.42	0.100	545.29	2.27E-02	2.30E-02
1,1-Dichloroethane (ethylidene dichloride)	98.95	2.35	9503.60	3.96E-01	4.01E-01
1,1-Dichloroethene (vinylidene chloride)	96.94	0.201	796.35	3.32E-02	3.36E-02
1,2-Dichloroethane (ethylene dichloride)	98.96	0.407	1646.11	6.86E-02	6.95E-02
1,2-Dichloropropane (propylene dichloride)	112.98	0.18	831.15	3.46E-02	3.51E-02
Acrylonitrile	53.06	6.33	13727.00	5.72E-01	5.80E-01
Benzene	78.11	1.91	6097.40	2.54E-01	2.57E-01
Carbon disulfide	76.13	0.583	1813.97	7.56E-02	7.66E-02
Carbon tetrachloride	153.84	0.004	25.15	1.05E-03	1.06E-03
Carbonyl sulfide	60.07	0.490	1202.98	5.01E-02	5.08E-02
Chlorbenzene	112.56	0.254	1168.48	4.87E-02	4.93E-02
Chloroethane	64.52	1.25	3296.17	1.37E-01	1.39E-01
Chlorform	119.39	0.03	146.38	6.10E-03	6.18E-03
Chloromethane (methyl chloride)	50.49	1.21	2496.87	1.04E-01	1.05E-01
Dichlorbenzene	147.00	0.213	1279.68	5.33E-02	5.40E-02
Dichlormethane (methylene chloride)	84.94	14.3	49642.42	2.07E+00	2.10E+00
Ethylbenzene	106.16	4.61	20001.68	8.34E-01	8.45E-01
Hexane	86.17	6.57	23138.02	9.64E-01	9.77E-01
Mercury	200.61	0.000292	2.39	9.98E-05	1.01E-04
Methyl ethyl ketone (2-butanone)	72.10	7.09	20892.29	8.71E-01	8.82E-01
Methyl isobutyl ketone (hexone)	100.16	1.87	7654.92	3.19E-01	3.23E-01
Perchloroethylene (tetrachloroethylene)	165.83	3.73	25279.97	1.05E+00	1.07E+00
Toluene	92.13	39.3	147978.38	6.17E+00	6.25E+00
Trichloroethylene	131.40	2.82	15144.30	6.31E-01	6.40E-01
Vinyl chloride	62.50	7.34	18749.11	7.81E-01	7.92E-01
Xylenes	106.16	12.1	52498.99	2.19E+00	2.22E+00
Total Uncontrolled VOC HAPs (before burner)					1.84E+01
Mercury					1.01E-04
Total Controlled VOC HAPs					3.68E-01

Table E-6 (cont.)
SWA Biosolids Pelletization Facility
Biosolids Pelletizing Dryer HAP Emissions

METALS, based on PM emissions and conc.	Florida Class AA Sludge Conc. (mg/kg)	Max. Emission Rate/Unit (lb/hr)	Max. Emission Rate - Two Units (1) (tons/yr)
Particulate Matter		2.42	
Arsenic (As)	41	0.00010	0.0009
Cadmium (Cd)	39	0.00009	0.0008
Chromium (Cr) "Part 503"	1200	0.00290	0.0254
Copper (Cu)	1500	0.00363	0.0318
Lead (Pb)	300	0.00073	0.0064
Mercury (Hg) (2)	17	0.00091	0.0080
Molybdenum (Mo)	75	0.00018	0.0016
Nickel (Ni)	420	0.00102	0.0089
Selenium (Se)	100	0.00024	0.0021
Zinc (Zn)	2800	0.00678	0.0594

Note 1: Two dryers operating 24/365
Note 2: Mercury emission rate based on scaling GLSD mercury emission rate of 0.000091 lb/hr up for airflow (15,000 acfm for SWA v. 3545 acfm for GLSD) and mercury in sludge (17 mg/kg FL v. 1.5 mg/kg GLSD)

Mercury Total:	9.23E-04	8.08E-03
GRAND TOTAL ALL HAPS:		5.13E-01

Table E-7
SWA Biosolids Pelletization Facility
Emergency Standby Generator Maximum Potential Emission Rates

Source Description	No. of Units	Fuel	Capacity (horsepower)	Heat Rate (Btu/HP-hr)	Heat Input (MMBtu/hr)	Annual Hours
Emergency Generator	1	Diesel Fuel	895.0	7,000	6.27	500
Pollutant	CAS No.	Emission Factor (g/bhp-hr)		Emission Rate (lb/hr)	Emission Rate (lb/yr)	Emission Rate (ton/yr)
Carbon Monoxide (CO)[a]	630-08-0	8.5		16.77	8,386	4.19
Nitrogen Oxides (NOx)[a]	10102-43-9	6.9		13.61	6,807	3.40
Sulfur Dioxide (SO_2)[b]	7446-09-5	1.83E-01		0.36	181	0.09
Particulate Matter (PM)[a]	-	0.40		0.79	395	0.20
Volatile Organics (VOC)[a]	-	0.97		1.91	957	0.48

[a] US EPA Year 2000 Non-road Mobile Emission Requirements.

[b] Emission factor in g/bhp-hr was converted from the lb/hp-hr factor found in AP42 Chapter 3.4, Large Stationary Diesel and All Stationary Dual-Fuel Engines (10/96), Table 3.4-1, and based on fuel sulfur of 0.05% by weight.

Source: Memorandum dated December 29, 2004, from Mr. Edward DeLaforest, HDR, to Mr. Craig Dolan, NEFCO.

Table E-8
SWA Biosolids Pelletization Facility
Methane Emission Rates - Decommissioned Flare

Flare Actual Flow Rate:	1033.7	scfm	15384840.09 m^3/year
Methane Content of Landfill Gas:	58.5%	(percent by volume)	
Total Methane Flow to Flare:	605.2	scfm	9007489.42 m^3/year
MW of Methane	16		

Methane Emission Rate

Pollutant	Methane Flow Rate to Flare (m^3/year)	Methane Flow Rate to Flare (m^3/minute)	Methane (Mg/yr)*
Class I Landfill Methane	9007489	17.1	5,991

*41.57 Conversion from std. m^3/yr to g/yr.

0.285625616

NMOC Emission Rate

Pollutant	Concentration of NMOC (ppmv)	MW of NMOC (g/mol)	Concentration of NMOC (μg/m³)	NMOC, Uncontrolled (Mg/yr)	NMOC, Uncontrolled (tpy)	NMOC, Controlled* (tpy)	NMOC, Controlled* (lbs/hr)
Class I Landfill NMOC	595	86.2	2,131,589	33	33	0.7	0.152

* 98% Control of NMOC assumed for calculation

Table E-9
SWA Biosolids Pelletization Facility
Decommissioned Flare HAP Emissions

Input Information:

NMOC concentration in landfill gas:	595	ppmdv expressed as hexane with MW of:		86.17
Equivalent mass/volume conc. is:	2131341.71	ug/m3	[ug/m3 = (ppm)41.57(MW)]	
Uncontrolled NMOC Emission Rate	33	Mg/yr	1.03989588 g/s	

HAP	Molecular Weight	Default Conc. (ppmv)	Mass Conc. (ug/m3)	Emissions (Mg/yr)	Emissions (tons/yr)
1,1,1-Trichlorethane (methyl chloroform)	133.42	0.480	2617.38	4.03E-02	4.08E-02
1,1,2,2-Tetrachloroethane	167.85	1.11	7614.63	1.17E-01	1.19E-01
1,1,2-Trichloroethane	133.42	0.100	545.29	8.39E-03	8.50E-03
1,1-Dichloroethane (ethylidene dichloride)	98.95	2.35	9503.60	1.46E-01	1.48E-01
1,1-Dichloroethene (vinylidene chloride)	96.94	0.201	796.35	1.23E-02	1.24E-02
1,2-Dichloroethane (ethylene dichloride)	98.96	0.407	1646.11	2.53E-02	2.57E-02
1,2-Dichloropropane (propylene dichloride)	112.98	0.18	831.15	1.28E-02	1.30E-02
Acrylonitrile	53.06	6.33	13727.00	2.11E-01	2.14E-01
Benzene	78.11	1.91	6097.40	9.38E-02	9.51E-02
Carbon disulfide	76.13	0.583	1813.97	2.79E-02	2.83E-02
Carbon tetrachloride	153.84	0.004	25.15	3.87E-04	3.92E-04
Carbonyl sulfide	60.07	0.490	1202.98	1.85E-02	1.88E-02
Chlorbenzene	112.56	0.254	1168.48	1.80E-02	1.82E-02
Chloroethane	64.52	1.25	3296.17	5.07E-02	5.14E-02
Chlorform	119.39	0.03	146.38	2.25E-03	2.28E-03
Chloromethane (methyl chloride)	50.49	1.21	2496.87	3.84E-02	3.89E-02
Dichlorbenzene	147.00	0.213	1279.68	1.97E-02	1.99E-02
Dichlormethane (methylene chloride)	84.94	14.3	49642.42	7.64E-01	7.74E-01
Ethylbenzene	106.16	4.61	20001.68	3.08E-01	3.12E-01
Hexane	86.17	6.57	23138.02	3.56E-01	3.61E-01
Mercury	200.61	0.000292	2.39	3.68E-05	3.73E-05
Methyl ethyl ketone (2-butanone)	72.10	7.09	20892.29	3.21E-01	3.26E-01
Methyl isobutyl ketone (hexone)	100.16	1.87	7654.92	1.18E-01	1.19E-01
Perchloroethylene (tetrachloroethylene)	165.83	3.73	25279.97	3.89E-01	3.94E-01
Toluene	92.13	39.3	147978.38	2.28E+00	2.31E+00
Trichloroethylene	131.40	2.82	15144.30	2.33E-01	2.36E-01
Vinyl chloride	62.50	7.34	18749.11	2.88E-01	2.92E-01
Xylenes	106.16	12.1	52498.99	8.08E-01	8.18E-01
Total Uncontrolled VOC HAPs (before flare)					6.79E+00
Total Mercury					3.73E-05
Total Controlled VOC HAPs					1.36E-01
Total HAPs					**0.14**

Table E-10
SWA Biosolids Pelletization Facility
Estimated Emission Rates for the 1800-SCFM Decommissioned Flare

AP-42 Emission Factors

NO_X	40	$lbs/10^6$ dscf Methane
CO	750	$lbs/10^6$ dscf Methane
PM	17	$lbs/10^6$ dscf Methane

Class 1

Flare Flow Rate (current)	880	dscfm
% Methane	58.5%	

* Flow Rate is the two-year average taken from the SWA Flare Log Sheets for 2000 and 2001. Unclear whether cfm is acfm, scfm, or dscfm. Methane is also the two year average from SWA Flare Log Sheets for 2000 and 2001. Sulfur data taken from November 2000 Flare Inlet gas testing

PM Emissions

Calculate Total Methane emissions from the flares (current)

Class 1 Flare
$$\frac{880 \text{ dscf}}{\text{min}} * 58.5\% \text{ methane} = \frac{515.4 \text{ dscf}}{\text{min}} \text{ methane}$$

Calculate Total PM_{10} emissions from the flares

Class 1
$$\frac{515.43 \text{ dscf}}{\text{min}} * \frac{17 \text{ lbs}}{1 \; 10^6 \text{ dscf}} * \frac{1 \; 10^6 \text{ dscf}}{1E+06 \text{ dscf}} * \frac{60 \text{ min}}{1 \text{ hour}} * \frac{8760 \text{ hour}}{1 \text{ year}} * \frac{1 \text{ ton}}{2000 \text{ lbs}} = \frac{2.30 \text{ ton}}{\text{year}}$$

CO Emissions

Calculate Total Methane emissions from the flares (current)

Class 1 Flare
$$\frac{880 \text{ dscf}}{\text{min}} * 58.5\% \text{ methane} = \frac{515.4 \text{ dscf}}{\text{min}} \text{ methane}$$

Calculate Total CO emissions from the flares

Class 1
$$\frac{515.43 \text{ dscf}}{\text{min}} * \frac{750 \text{ lbs}}{1 \; 10^6 \text{ dscf}} * \frac{1 \; 10^6 \text{ dscf}}{1E+06 \text{ dscf}} * \frac{60 \text{ min}}{1 \text{ hour}} * \frac{8760 \text{ hour}}{1 \text{ year}} * \frac{1 \text{ ton}}{2000 \text{ lbs}} = \frac{101.59 \text{ ton}}{\text{year}}$$

NOX Emissions

Calculate Total Methane emissions from the flares (current)

Class 1 Flare
$$\frac{880 \text{ dscf}}{\text{min}} * 58.5\% \text{ methane} = \frac{515.4 \text{ dscf}}{\text{min}} \text{ methane}$$

Calculate Total NO_X emissions from the flares

Class 1
$$\frac{515.43 \text{ dscf}}{\text{min}} * \frac{40 \text{ lbs}}{1 \; 10^6 \text{ dscf}} * \frac{1 \; 10^6 \text{ dscf}}{1E+06 \text{ dscf}} * \frac{60 \text{ min}}{1 \text{ hour}} * \frac{8760 \text{ hour}}{1 \text{ year}} * \frac{1 \text{ ton}}{2000 \text{ lbs}} = \frac{5.42 \text{ ton}}{\text{year}}$$

Table E-10 (Cont.)
SWA Biosolids Pelletization Facility
Estimated Emission Rates for the 1800-SCFM Decommissioned Flare

	Current			
Class 1 flow rate	15384840.09 m^3/year			
Energy content of methane:	980	Btu/cf	34603.8	Btu/m3

SO_2 and HCl Emission Rates Based on Mass Balance

Pollutant	Total Landfill Gas Flow Rate to Flare (Std. m^3/yr)	Concentration of S or Cl in Landfill Gas (ppmV)	Emission rate of S or Cl (m^3/yr)	Molecular Weight of S or Cl (g/gmol)	Temperature at Standard Conditions (°C)	Uncontrolled Mass Emissions of S or Cl (kg/yr)	Control Efficiency (%)	Ratio of Molecular Weights SO_2/S or HCl/Cl	Controlled Mass Emissions of Pollutant (kg/yr)	Controlled Mass Emissions of Pollutant (lb/hr)	Controlled Mass Emissions of Pollutant (ton/yr)
				Current							
Class I Landfill Sulfur - Sulfur Dioxide	15384840	190	2923.12	32.06	20	3896.23	0	2.00	7785.41	1.960	8.58E+00
Class I Landfill Chlorine - Hydrogen Chloride	15384840	42	646.16	35.45	20	952.22	91	1.03	88.3	0.02	9.73E-02

The calculation of SO_2 and HCl is from: U.S. EPA, *Compilation of Air Pollutant Emission Factors*, Report No. AP-42, Fifth Edition, Supplement C, Section 2.4, updated November, 1997.

Table E-11
SWA Biosolids Pelletization Facility
Exit Gas Flow Rate Calculations - Proposed 1000 SCFM Flare

Maximum Potential Gas Flow Rate

Flare Gas Flow Design Capacity:	1000	scfm
cf of air needed to combust 1 cf of LFG:	15.7	(ratio)
Exit Gas Flow Rate:	15700	scfm

	Actual	Standard
Moisture Content of Gas (%):	6.0%	0%
Temperature of Gas (°F):	1400	68

Conversion from scfm to dscfm:

$$\frac{15700 \text{ ft}^3}{\text{minute}} * (1 - 0.06) = \frac{14{,}758 \text{ dscf}}{\text{minute}}$$

Converstion from scfm to acfm:

$$\frac{15700 \text{ ft}^3}{\text{minute}} * \frac{(459.67°R + 1400°F)}{(459.67°R + 68°F)} = \frac{55{,}332 \text{ acf}}{\text{minute}}$$

Table E-12
SWA Biosolids Pelletization Facility
Methane Emission Rates - Proposed 1000 SCFM Flare

Flare Gas Flow Design Capacity:	1000	scfm	14883336.36 m^3/year
Methane Content of Landfill Gas:	58.5%	(percent by volume)	
Total Methane Flow to Flare:	585.5	scfm	8713869.89 m^3/year
MW of Methane	16		

Methane Emission Rate

Pollutant	Methane Flow Rate to Flare (m^3/year)	Methane Flow Rate to Flare (m^3/minute)	Methane (Mg/yr)*
Class I Landfill			
Methane	8713870	16.6	5,796

*41.57 Conversion from std. m^3/yr to g/yr.

Table E-13
SWA Biosolids Pelletization Facility
Proposed 1000 SCFM Flare HAP Emissions

Input Information:

NMOC concentration in landfill gas:	595 ppmdv expressed as hexane with MW of:		86.17
Equivalent mass/volume conc. is:	2131341.71 ug/m3	[ug/m3 = (ppm)41.57(MW)]	
NMOC Emission Rate	32 Mg/yr	1.00599812 g/s	

HAP	Molecular Weight	Default Conc. (ppmv)	Mass Conc. (ug/m3)	Emissions (Mg/yr)	Emissions (tons/yr)
1,1,1-Trichlorethane (methyl chloroform)	133.42	0.480	2617.38	3.90E-02	3.95E-02
1,1,2,2-Tetrachloroethane	167.85	1.11	7614.63	1.13E-01	1.15E-01
1,1,2-Trichloroethane	133.42	0.100	545.29	8.12E-03	8.22E-03
1,1-Dichloroethane (ethylidene dichloride)	98.95	2.35	9503.60	1.41E-01	1.43E-01
1,1-Dichloroethene (vinylidene chloride)	96.94	0.201	796.35	1.19E-02	1.20E-02
1,2-Dichloroethane (ethylene dichloride)	98.96	0.407	1646.11	2.45E-02	2.48E-02
1,2-Dichloropropane (propylene dichloride)	112.98	0.18	831.15	1.24E-02	1.25E-02
Acrylonitrile	53.06	6.33	13727.00	2.04E-01	2.07E-01
Benzene	78.11	1.91	6097.40	9.08E-02	9.20E-02
Carbon disulfide	76.13	0.583	1813.97	2.70E-02	2.74E-02
Carbon tetrachloride	153.84	0.004	25.15	3.74E-04	3.79E-04
Carbonyl sulfide	60.07	0.490	1202.98	1.79E-02	1.81E-02
Chlorbenzene	112.56	0.254	1168.48	1.74E-02	1.76E-02
Chloroethane	64.52	1.25	3296.17	4.91E-02	4.97E-02
Chlorform	119.39	0.03	146.38	2.18E-03	2.21E-03
Chloromethane (methyl chloride)	50.49	1.21	2496.87	3.72E-02	3.77E-02
Dichlorbenzene	147.00	0.213	1279.68	1.90E-02	1.93E-02
Dichlormethane (methylene chloride)	84.94	14.3	49642.42	7.39E-01	7.49E-01
Ethylbenzene	106.16	4.61	20001.68	2.98E-01	3.02E-01
Hexane	86.17	6.57	23138.02	3.44E-01	3.49E-01
Mercury	200.61	0.000292	2.39	3.56E-05	3.61E-05
Methyl ethyl ketone (2-butanone)	72.10	7.09	20892.29	3.11E-01	3.15E-01
Methyl isobutyl ketone (hexone)	100.16	1.87	7654.92	1.14E-01	1.15E-01
Perchloroethylene (tetrachloroethylene)	165.83	3.73	25279.97	3.76E-01	3.81E-01
Toluene	92.13	39.3	147978.38	2.20E+00	2.23E+00
Trichloroethylene	131.40	2.82	15144.30	2.25E-01	2.28E-01
Vinyl chloride	62.50	7.34	18749.11	2.79E-01	2.83E-01
Xylenes	106.16	12.1	52498.99	7.81E-01	7.92E-01
Total Uncontrolled VOC HAPs (before flare)					6.57E+00
Total Mercury					3.61E-05
Total Controlled VOC HAPs					1.31E-01
Total HAPs					**0.13**

Table E-14
SWA Biosolids Pelletization Facility
Secondary Pollutant Emission Rates - Proposed 1000 SCFM Flare

Flare Gas Flow Design Capacity:	1000	scfm	14883336.36 m^3/year	0.4719475
Methane Content of Landfill Gas:	58.5%	(percent by volume)		
Total Methane Flow to Flare:	585.5			
Energy content of methane:	980	Btu/ft^3	34603.8 Btu/m^3	

CO and NO_x Emission Rates Based on Vendor Emission Factors

Pollutant	Methane Flow Rate to Flare (scfm)	Energy input to flare (MMBtu/yr)	Emission Factor (lb/MMBtu)	Emissions from Flare (lb/yr)	Emissions from Flare (ton/yr)
Class I Landfill					
Carbon Monoxide	585	301572.8	0.37	111581.9	55.79
Nitrogen Oxides	585	301572.8	0.068	20507.0	10.25

SO_2 and HCl Emission Rates Based on Mass Balance

Pollutant	Total Landfill Gas Flow Rate to Flare (Std. m^3/yr)	Concentration of S or Cl in Landfill Gas (ppmV)	Emission rate of S or Cl (m^3/yr)	Molecular Weight of S or Cl (g/gmol)	Temperature at Standard Conditions (°C)	Uncontrolled Mass Emissions of S or Cl (kg/yr)	Control Efficiency (%)	Ratio of Molecular Weights SO_2/S or HCl/Cl	Controlled Mass Emissions of Pollutant (kg/yr)	Controlled Mass Emissions of Pollutant (lb/hr)	Controlled Mass Emissions of Pollutant (ton/yr)
Class I Landfill											
Sulfur - Sulfur Dioxide	14883336	190	2827.83	32.06	20	3769.22	0	2.00	7531.62	1.9E+00	8.3
Chlorine - Hydrogen Chloride	14883336	42.0	625.10	35.45	20	921.18	91	1.03	85.29	2.1E-02	0.09

The emission rates for CO and NO_X are from U.S. EPA, *Compilation of Air Pollutant Emision Factors*, Report No. AP-42, Section 13.5, Industrial Flares, September 1991. The calculation of SO_2 and HCl is from: U.S. EPA, *Compilation of Air Pollutant Emission Factors*, Report No. AP-42, Section 2.4, updated November, 1997.

Table E-14 (cont.)
SWA Biosolids Pelletization Facility
Estimated Emissions for the Proposed 1000 SCFM Flare

AP-42 Emission Factors

PM		17 lbs/10^6 dscf Methane
Class 1		
	Flare Flow Rate (current)	940 dscfm
	% Methane	58.5%

Calculate Total Methane emissions from the flare:

$$\frac{940 \text{ dscf}}{\text{min}} * 58.5\% \text{ methane} = \frac{550.3 \text{ dscf}}{\text{min}} \text{ methane}$$

PM Emissions:

$$\frac{550.35 \text{ dscf}}{\text{min}} * \frac{17}{1}\frac{\text{lbs}}{10^6 \text{ dscf}} * \frac{1}{1000000}\frac{10^6 \text{ dscf}}{\text{dscf}} * \frac{60}{1}\frac{\text{min}}{\text{hour}} * \frac{8760}{1}\frac{\text{hour}}{\text{year}} * \frac{1}{2000}\frac{\text{ton}}{\text{lbs}} = \frac{2.46 \text{ ton}}{\text{year}}$$

Table E-15
SWA Biosolids Pelletization Facility
Exit Gas Flow Rate Calculations - Proposed 2000 SCFM Flare

Maximum Potential Gas Flow Rate

Flare Gas Flow Design Capacity:	2000	scfm
cf of air needed to combust 1 cf of LFG:	15.7	(ratio)
Exit Gas Flow Rate:	31400	scfm

	Actual	Standard
Moisture Content of Gas (%):	6.0%	0%
Temperature of Gas (°F):	1400	68

Conversion from scfm to dscfm:

$$\frac{31400 \ \text{ft}^3}{\text{minute}} * (1 - 0.06) = \frac{29{,}516 \ \text{dscf}}{\text{minute}}$$

Converstion from scfm to acfm:

$$\frac{31400 \ \text{ft}^3}{\text{minute}} * \frac{(459.67°R + 1400°F)}{(459.67°R + 68°F)} = \frac{110{,}663 \ \text{acf}}{\text{minute}}$$

Table E-16
SWA Biosolids Pelletization Facility
Methane Emission Rates - Proposed 2000 SCFM Flare

Flare Gas Flow Design Capacity:	2000	scfm	29766672.72 m^3/year
Methane Content of Landfill Gas:	58.5%	(percent by volume)	
Total Methane Flow to Flare:	1171.0	scfm	17427739.78 m^3/year
MW of Methane	16		

Methane Emission Rate

Pollutant	Methane Flow Rate to Flare (m^3/year)	Methane Flow Rate to Flare (m^3/minute)	Methane (Mg/yr)*
Class I Landfill			
Methane	17427740	33.2	11,592

*41.57 Conversion from std. m^3/yr to g/yr.

Table E-17
SWA Biosolids Pelletization Facility
Proposed 2000 SCFM Flare HAPs Emissions

Input Information:

NMOC concentration in landfill gas:	595	ppmdv expressed as hexane with MW of:		86.17
Equivalent mass/volume conc. is:	2131341.71	ug/m3	[ug/m3 = (ppm)41.57(MW)]	
NMOC Emission Rate	63	Mg/yr	2.01199624 g/s	

HAP	Molecular Weight	Default Conc. (ppmv)	Mass Conc. (ug/m3)	Emissions (Mg/yr)	Emissions (tons/yr)
1,1,1-Trichlorethane (methyl chloroform)	133.42	0.480	2617.38	7.79E-02	7.89E-02
1,1,2,2-Tetrachloroethane	167.85	1.11	7614.63	2.27E-01	2.30E-01
1,1,2-Trichloroethane	133.42	0.100	545.29	1.62E-02	1.64E-02
1,1-Dichloroethane (ethylidene dichloride)	98.95	2.35	9503.60	2.83E-01	2.87E-01
1,1-Dichloroethene (vinylidene chloride)	96.94	0.201	796.35	2.37E-02	2.40E-02
1,2-Dichloroethane (ethylene dichloride)	98.96	0.407	1646.11	4.90E-02	4.97E-02
1,2-Dichloropropane (propylene dichloride)	112.98	0.18	831.15	2.47E-02	2.51E-02
Acrylonitrile	53.06	6.33	13727.00	4.09E-01	4.14E-01
Benzene	78.11	1.91	6097.40	1.82E-01	1.84E-01
Carbon disulfide	76.13	0.583	1813.97	5.40E-02	5.47E-02
Carbon tetrachloride	153.84	0.004	25.15	7.49E-04	7.59E-04
Carbonyl sulfide	60.07	0.490	1202.98	3.58E-02	3.63E-02
Chlorbenzene	112.56	0.254	1168.48	3.48E-02	3.52E-02
Chloroethane	64.52	1.25	3296.17	9.81E-02	9.94E-02
Chlorform	119.39	0.03	146.38	4.36E-03	4.42E-03
Chloromethane (methyl chloride)	50.49	1.21	2496.87	7.43E-02	7.53E-02
Dichlorbenzene	147.00	0.213	1279.68	3.81E-02	3.86E-02
Dichlormethane (methylene chloride)	84.94	14.3	49642.42	1.48E+00	1.50E+00
Ethylbenzene	106.16	4.61	20001.68	5.95E-01	6.03E-01
Hexane	86.17	6.57	23138.02	6.89E-01	6.98E-01
Mercury	200.61	0.000292	2.39	7.13E-05	7.22E-05
Methyl ethyl ketone (2-butanone)	72.10	7.09	20892.29	6.22E-01	6.30E-01
Methyl isobutyl ketone (hexone)	100.16	1.87	7654.92	2.28E-01	2.31E-01
Perchloroethylene (tetrachloroethylene)	165.83	3.73	25279.97	7.53E-01	7.63E-01
Toluene	92.13	39.3	147978.38	4.41E+00	4.46E+00
Trichloroethylene	131.40	2.82	15144.30	4.51E-01	4.57E-01
Vinyl chloride	62.50	7.34	18749.11	5.58E-01	5.66E-01
Xylenes	106.16	12.1	52498.99	1.56E+00	1.58E+00
Total Uncontrolled VOC HAPs (before flare)					1.31E+01
Total Mercury					7.22E-05
Total Controlled VOC HAPs					2.63E-01
Total HAPs					**0.26**

Table E-18
SWA Biosolids Pelletization Facility
Secondary Pollutant Emission Rates - Proposed 2000 SCFM Flare

Flare Gas Flow Design Capacity:	2000	scfm	29766672.72	m^3/year	0.943895
Methane Content of Landfill Gas:	58.5%	(percent by volume)			
Total Methane Flow to Flare:	1171.0				
Energy content of methane:	*980*	*Btu/ft³*	*34603.8*	*Btu/m³*	

CO and NO_X Emission Rates Based on Vendor Emission Factors

Pollutant	Methane Flow Rate to Flare (scfm)	Energy input to flare (MMBtu/yr)	Emission Factor (lb/MMBtu)	Emissions from Flare (lb/yr)	Emissions from Flare (ton/yr)
Class I Landfill					
Carbon Monoxide	1171	603145.7	0.37	223163.9	111.58
Nitrogen Oxides	1171	603145.7	0.068	41013.9	20.51

SO_2 and HCl Emission Rates Based on Mass Balance

Pollutant	Total Landfill Gas Flow Rate to Flare (Std. m^3/yr)	Concentration of S or Cl in Landfill Gas (ppmV)	Emission rate of S or Cl (m^3/yr)	Molecular Weight of S or Cl (g/gmol)	Temperature at Standard Conditions (°C)	Uncontrolled Mass Emissions of S or Cl (kg/yr)	Control Efficiency (%)	Ratio of Molecular Weights SO_2/S or HCl/Cl	Controlled Mass Emissions of Pollutant (kg/yr)	Controlled Mass Emissions of Pollutant (lb/hr)	Controlled Mass Emissions of Pollutant (ton/yr)
Class I Landfill											
Sulfur - Sulfur Dioxide	29766673	190	5655.67	32.06	20	7538.44	0	2.00	15063.25	3.8E+00	16.6
Chlorine - Hydrogen Chloride	29766673	42.0	1250.20	35.45	20	1842.37	91	1.03	170.58	4.3E-02	0.19

The emission rates for CO and NOX are from U.S. EPA, *Compilation of Air Pollutant Emision Factors*, Report No. AP-42, Section 13.5, Industrial Flares, September 1991. The calculation of SO_2 and HCl is from: U.S. EPA, *Compilation of Air Pollutant Emission Factors*, Report No. AP-42, Section 2.4, updated November, 1997.

Table E-18 (cont.)
SWA Biosolids Pelletization Facility
Estimated Emissions for the Proposed 2000 SCFM Flare

AP-42 Emission Factors

PM 17 lbs/10^6 dscf Methane

Class 1

Flare Flow Rate (current) 1880 dscfm

% Methane 58.5%

Calculate Total Methane emissions from the flare:

$$\frac{1880 \text{ dscf}}{\text{min}} * 58.5\% \text{ methane} = \frac{1100.7 \text{ dscf}}{\text{min}} \text{ methane}$$

PM Emissions:

$$\frac{1100.70 \text{ dscf}}{\text{min}} * \frac{17 \text{ lbs}}{1 \ 10^6 \text{ dscf}} * \frac{1 \ 10^6 \text{ dscf}}{1000000 \text{ dscf}} * \frac{60 \text{ min}}{1 \text{ hour}} * \frac{8760 \text{ hour}}{1 \text{ year}} * \frac{1 \text{ ton}}{2000 \text{ lbs}} = \frac{4.92 \text{ ton}}{\text{year}}$$

Table E-19
SWA Biosolids Pelletization Facility
Exit Gas Flow Rate Calculations - Proposed 3500 SCFM Flare

Maximum Potential Gas Flow Rate

Flare Gas Flow Design Capacity:	3500	scfm
cf of air needed to combust 1 cf of LFG:	15.7	(ratio)
Exit Gas Flow Rate:	54950	scfm

	Actual	Standard
Moisture Content of Gas (%):	6.0%	0%
Temperature of Gas (°F):	1400	68

Conversion from scfm to dscfm:

$$\frac{54950 \ \text{ft}^3}{\text{minute}} * (1 - 0.06) = \frac{51{,}653 \ \text{dscf}}{\text{minute}}$$

Converstion from scfm to acfm:

$$\frac{54950 \ \text{ft}^3}{\text{minute}} * \frac{(459.67°R + 1400°F)}{(459.67°R + 68°F)} = \frac{193{,}661 \ \text{acf}}{\text{minute}}$$

Table E-20
SWA Biosolids Pelletization Facility
Methane Emission Rates - Proposed 3500 SCFM Flare

Flare Gas Flow Design Capacity:	3500	scfm	52091677.26 m^3/year
Methane Content of Landfill Gas:	58.5%	(percent by volume)	
Total Methane Flow to Flare:	2049.2	scfm	30498544.61 m^3/year
MW of Methane	16		

Methane Emission Rate

Pollutant	Methane Flow Rate to Flare (m^3/year)	Methane Flow Rate to Flare (m^3/minute)	Methane (Mg/yr)*
Class I Landfill			
Methane	30498545	58.0	20,285

*41.57 Conversion from std. m^3/yr to g/yr.

Table E-21
SWA Biosolids Pelletization Facility
Proposed 3500 SCFM Flare HAP Emissions

Input Information:

NMOC concentration in landfill gas:	595	ppmdv expressed as hexane with MW of:		86.17
Equivalent mass/volume conc. is:	2131341.71	ug/m3	[ug/m3 = (ppm)41.57(MW)]	
NMOC Emission Rate	111	Mg/yr	3.52099343 g/s	

HAP	Molecular Weight	Default Conc. (ppmv)	Mass Conc. (ug/m3)	Emissions (Mg/yr)	Emissions (tons/yr)
1,1,1-Trichlorethane (methyl chloroform)	133.42	0.480	2617.38	1.36E-01	1.38E-01
1,1,2,2-Tetrachloroethane	167.85	1.11	7614.63	3.97E-01	4.02E-01
1,1,2-Trichloroethane	133.42	0.100	545.29	2.84E-02	2.88E-02
1,1-Dichloroethane (ethylidene dichloride)	98.95	2.35	9503.60	4.95E-01	5.02E-01
1,1-Dichloroethene (vinylidene chloride)	96.94	0.201	796.35	4.15E-02	4.20E-02
1,2-Dichloroethane (ethylene dichloride)	98.96	0.407	1646.11	8.58E-02	8.69E-02
1,2-Dichloropropane (propylene dichloride)	112.98	0.18	831.15	4.33E-02	4.39E-02
Acrylonitrile	53.06	6.33	13727.00	7.15E-01	7.25E-01
Benzene	78.11	1.91	6097.40	3.18E-01	3.22E-01
Carbon disulfide	76.13	0.583	1813.97	9.45E-02	9.58E-02
Carbon tetrachloride	153.84	0.004	25.15	1.31E-03	1.33E-03
Carbonyl sulfide	60.07	0.490	1202.98	6.27E-02	6.35E-02
Chlorbenzene	112.56	0.254	1168.48	6.09E-02	6.17E-02
Chloroethane	64.52	1.25	3296.17	1.72E-01	1.74E-01
Chlorform	119.39	0.03	146.38	7.63E-03	7.73E-03
Chloromethane (methyl chloride)	50.49	1.21	2496.87	1.30E-01	1.32E-01
Dichlorbenzene	147.00	0.213	1279.68	6.67E-02	6.75E-02
Dichlormethane (methylene chloride)	84.94	14.3	49642.42	2.59E+00	2.62E+00
Ethylbenzene	106.16	4.61	20001.68	1.04E+00	1.06E+00
Hexane	86.17	6.57	23138.02	1.21E+00	1.22E+00
Mercury	200.61	0.000292	2.39	1.25E-04	1.26E-04
Methyl ethyl ketone (2-butanone)	72.10	7.09	20892.29	1.09E+00	1.10E+00
Methyl isobutyl ketone (hexone)	100.16	1.87	7654.92	3.99E-01	4.04E-01
Perchloroethylene (tetrachloroethylene)	165.83	3.73	25279.97	1.32E+00	1.33E+00
Toluene	92.13	39.3	147978.38	7.71E+00	7.81E+00
Trichloroethylene	131.40	2.82	15144.30	7.89E-01	7.99E-01
Vinyl chloride	62.50	7.34	18749.11	9.77E-01	9.90E-01
Xylenes	106.16	12.1	52498.99	2.74E+00	2.77E+00
Total Uncontrolled VOC HAPs (before flare)					2.30E+01
Total Mercury					1.26E-04
Total Controlled VOC HAPs					4.60E-01
Total HAPs					**0.46**

Table E-22
SWA Biosolids Pelletization Facility
Secondary Pollutant Emission Rates - Proposed 3500 SCFM Flare

Flare Gas Flow Design Capacity:	3500	scfm	52091677.26 m^3/year	1.65181625
Methane Content of Landfill Gas:	58.5%	(percent by volume)		
Total Methane Flow to Flare:	2049.2			
Energy content of methane:	980	Btu/ft^3	34603.8 Btu/m^3	

CO and NO_x Emission Rates Based on Vendor Emission Factors

Pollutant	Methane Flow Rate to Flare (scfm)	Energy input to flare (MMBtu/yr)	Emission Factor (lb/MMBtu)	Emissions from Flare (lb/yr)	Emissions from Flare (ton/yr)
Class I Landfill					
Carbon Monoxide	2049	1055504.9	0.37	390536.8	195.27
Nitrogen Oxides	2049	1055504.9	0.068	71774.3	35.89

SO_2 and HCl Emission Rates Based on Mass Balance

Pollutant	Total Landfill Gas Flow Rate to Flare (Std. m^3/yr)	Concentration of S or Cl in Landfill Gas (ppmV)	Emission rate of S or Cl (m^3/yr)	Molecular Weight of S or Cl (g/gmol)	Temperature at Standard Conditions (°C)	Uncontrolled Mass Emissions of S or Cl (kg/yr)	Control Efficiency (%)	Ratio of Molecular Weights SO_2/S or HCl/Cl	Controlled Mass Emissions of Pollutant (kg/yr)	Controlled Mass Emissions of Pollutant (lb/hr)	Controlled Mass Emissions of Pollutant (ton/yr)
Class I Landfill											
Sulfur - Sulfur Dioxide	52091677	190	9897.42	32.06	20	13192.27	0	2.00	26360.68	6.6E+00	29.1
Chlorine - Hydrogen Chloride	52091677	42.0	2187.85	35.45	20	3224.14	91	1.03	298.52	7.5E-02	0.33

The emission rates for CO and NO_x are from U.S. EPA, *Compilation of Air Pollutant Emision Factors*, Report No. AP-42, Section 13.5, Industrial Flares, September 1991. The calculation of SO_2 and HCl is from: U.S. EPA, *Compilation of Air Pollutant Emission Factors*, Report No. AP-42, Section 2.4, updated November, 1997.

Table E-22 (cont.)
SWA Biosolids Pelletization Facility
Estimated Emissions for the Proposed 3500 SCFM Flare

AP-42 Emission Factors

PM	17 lbs/10^6 dscf Methane
Class 1	
Flare Flow Rate (current)	3290 dscfm
% Methane	58.5%

Calculate Total Methane emissions from the flare:

$$\frac{3290 \text{ dscf}}{\text{min}} * 58.5\% \text{ methane} = \frac{1926.2 \text{ dscf}}{\text{min}} \text{ methane}$$

PM Emissions:

$$\frac{1926.22 \text{ dscf}}{\text{min}} * \frac{17 \text{ lbs}}{1 \; 10^6 \text{ dscf}} * \frac{1 \; 10^6 \text{ dscf}}{1000000 \text{ dscf}} * \frac{60 \text{ min}}{1 \text{ hour}} * \frac{8760 \text{ hour}}{1 \text{ year}} * \frac{1 \text{ ton}}{2000 \text{ lbs}} = \frac{8.61 \text{ ton}}{\text{year}}$$

Table E-23
SWA Biosolids Pelletization Facility
Exit Gas Flow Rate Calculations - Proposed 3500 SCFM Flare
(Operating at 700 SCFM to account for BPF demand of 2800 SCFM)

Maximum Potential Gas Flow Rate

Flare Gas Flow Design Capacity:	700	scfm
cf of air needed to combust 1 cf of LFG:	15.7	(ratio)
Exit Gas Flow Rate:	10990	scfm

	Actual	Standard
Moisture Content of Gas (%):	6.0%	0%
Temperature of Gas (°F):	1400	68

Conversion from scfm to dscfm:

$$\frac{10990 \text{ ft}^3}{\text{minute}} * (1 - 0.06) = \frac{10{,}331 \text{ dscf}}{\text{minute}}$$

Converstion from scfm to acfm:

$$\frac{10990 \text{ ft}^3}{\text{minute}} * \frac{(459.67°R + 1400°F)}{(459.67°R + 68°F)} = \frac{38{,}732 \text{ acf}}{\text{minute}}$$

Table E-24
SWA Biosolids Pelletization Facility
Methane Emission Rates - Proposed 3500 SCFM Flare
(Operating at 700 SCFM to account for BPF demand of 2800 SCFM)

Flare Gas Flow Design Capacity:	700	scfm	10418335.45 m^3/year
Methane Content of Landfill Gas:	58.5%	(percent by volume)	
Total Methane Flow to Flare:	409.8	scfm	6099708.92 m^3/year
MW of Methane	16		

Methane Emission Rate

Pollutant	Methane Flow Rate to Flare (m^3/year)	Methane Flow Rate to Flare (m^3/minute)	Methane (Mg/yr)*
Class I Landfill			
Methane	6099709	11.6	4,057

*41.57 Conversion from std. m^3/yr to g/yr.

Table E-25
SWA Biosolids Pelletization Facility
Proposed 3500 SCFM Flare HAP Emissions
(Operating at 700 SCFM to account for BPF demand of 2800 SCFM)

Input Information:

NMOC concentration in landfill gas:	595 ppmdv	expressed as hexane with MW of:		86.17
Equivalent mass/volume conc. is:	2131341.71 ug/m3	[ug/m3 = (ppm)41.57(MW)]		
NMOC Emission Rate	22 Mg/yr	0.70419869	g/s	

HAP	Molecular Weight	Default Conc. (ppmv)	Mass Conc. (ug/m3)	Emissions (Mg/yr)	Emissions (tons/yr)
1,1,1-Trichlorethane (methyl chloroform)	133.42	0.480	2617.38	2.73E-02	2.76E-02
1,1,2,2-Tetrachloroethane	167.85	1.11	7614.63	7.93E-02	8.04E-02
1,1,2-Trichloroethane	133.42	0.100	545.29	5.68E-03	5.76E-03
1,1-Dichloroethane (ethylidene dichloride)	98.95	2.35	9503.60	9.90E-02	1.00E-01
1,1-Dichloroethene (vinylidene chloride)	96.94	0.201	796.35	8.30E-03	8.41E-03
1,2-Dichloroethane (ethylene dichloride)	98.96	0.407	1646.11	1.72E-02	1.74E-02
1,2-Dichloropropane (propylene dichloride)	112.98	0.18	831.15	8.66E-03	8.77E-03
Acrylonitrile	53.06	6.33	13727.00	1.43E-01	1.45E-01
Benzene	78.11	1.91	6097.40	6.35E-02	6.44E-02
Carbon disulfide	76.13	0.583	1813.97	1.89E-02	1.92E-02
Carbon tetrachloride	153.84	0.004	25.15	2.62E-04	2.66E-04
Carbonyl sulfide	60.07	0.490	1202.98	1.25E-02	1.27E-02
Chlorbenzene	112.56	0.254	1168.48	1.22E-02	1.23E-02
Chloroethane	64.52	1.25	3296.17	3.43E-02	3.48E-02
Chlorform	119.39	0.03	146.38	1.53E-03	1.55E-03
Chloromethane (methyl chloride)	50.49	1.21	2496.87	2.60E-02	2.64E-02
Dichlorbenzene	147.00	0.213	1279.68	1.33E-02	1.35E-02
Dichlormethane (methylene chloride)	84.94	14.3	49642.42	5.17E-01	5.24E-01
Ethylbenzene	106.16	4.61	20001.68	2.08E-01	2.11E-01
Hexane	86.17	6.57	23138.02	2.41E-01	2.44E-01
Mercury	200.61	0.000292	2.39	2.49E-05	2.53E-05
Methyl ethyl ketone (2-butanone)	72.10	7.09	20892.29	2.18E-01	2.21E-01
Methyl isobutyl ketone (hexone)	100.16	1.87	7654.92	7.98E-02	8.08E-02
Perchloroethylene (tetrachloroethylene)	165.83	3.73	25279.97	2.63E-01	2.67E-01
Toluene	92.13	39.3	147978.38	1.54E+00	1.56E+00
Trichloroethylene	131.40	2.82	15144.30	1.58E-01	1.60E-01
Vinyl chloride	62.50	7.34	18749.11	1.95E-01	1.98E-01
Xylenes	106.16	12.1	52498.99	5.47E-01	5.54E-01
Total Uncontrolled VOC HAPs (before flare)					4.60E+00
Total Mercury					2.53E-05
Total Controlled VOC HAPs					9.20E-02
Total HAPs					**0.09**

Table E-26
SWA Biosolids Pelletization Facility
Secondary Pollutant Emission Rates - Proposed 3500 SCFM Flare
(Operating at 700 SCFM to account for BPF demand of 2800 SCFM)

Flare Gas Flow Design Capacity:	700	scfm	10418335.45 m^3/year	0.33036325
Methane Content of Landfill Gas:	58.5%	(percent by volume)		
Total Methane Flow to Flare:	409.8			
Energy content of methane:	980	Btu/ft^3	34603.8 Btu/m^3	

CO and NO_x Emission Rates Based on Vendor Emission Factors

Pollutant	Methane Flow Rate to Flare (scfm)	Energy input to flare (MMBtu/yr)	Emission Factor (lb/MMBtu)	Emissions from Flare (lb/yr)	Emissions from Flare (ton/yr)
Class I Landfill					
Carbon Monoxide	410	211101.0	0.37	78107.4	39.05
Nitrogen Oxides	410	211101.0	0.068	14354.9	7.18

SO_2 and HCl Emission Rates Based on Mass Balance

Pollutant	Total Landfill Gas Flow Rate to Flare (Std. m^3/yr)	Concentration of S or Cl in Landfill Gas (ppmV)	Emission rate of S or Cl (m^3/yr)	Molecular Weight of S or Cl (g/gmol)	Temperature at Standard Conditions (°C)	Uncontrolled Mass Emissions of S or Cl (kg/yr)	Control Efficiency (%)	Ratio of Molecular Weights SO_2/S or HCl/Cl	Controlled Mass Emissions of Pollutant (kg/yr)	Controlled Mass Emissions of Pollutant (lb/hr)	Controlled Mass Emissions of Pollutant (ton/yr)
Class I Landfill											
Sulfur - Sulfur Dioxide	10418335	190	1979.48	32.06	20	2638.45	0	2.00	5272.14	1.3E+00	5.8
Chlorine - Hydrogen Chloride	10418335	42.0	437.57	35.45	20	644.83	91	1.03	59.70	1.5E-02	0.07

The emission rates for CO and NO_x are from U.S. EPA, *Compilation of Air Pollutant Emision Factors*, Report No. AP-42, Section 13.5, Industrial Flares, September 1991. The calculation of SO_2 and HCl is from: U.S. EPA, *Compilation of Air Pollutant Emssion Factors*, Report No. AP-42, Section 2.4, updated November, 1997.

Table E-26 (cont.)
SWA Biosolids Pelletization Facility
Estimated Emissions for the Proposed 3500 SCFM Flare
(Operating at 700 SCFM to account for BPF demand of 2800 SCFM)

AP-42 Emission Factors

PM	17 lbs/10^6 dscf Methane
Class 1	
Flare Flow Rate (current)	658 dscfm
% Methane	58.5%

Calculate Total Methane emissions from the flare:

$$\frac{658 \text{ dscf}}{\text{min}} * 58.5\% \text{ methane} = \frac{385.2 \text{ dscf}}{\text{min}} \text{ methane}$$

PM Emissions:

$$\frac{385.24 \text{ dscf}}{\text{min}} * \frac{17 \text{ lbs}}{1 \; 10^6 \text{ dscf}} * \frac{1 \; 10^6 \text{ dscf}}{1000000 \text{ dscf}} * \frac{60 \text{ min}}{1 \text{ hour}} * \frac{8760 \text{ hour}}{1 \text{ year}} * \frac{1 \text{ ton}}{2000 \text{ lbs}} = \frac{1.72 \text{ ton}}{\text{year}}$$

Appendix F

List of Proposed Exempt Activities

Appendix F
List of Proposed Exempt/Insignificant Activities

Source	Quantity	Description	Reason for Exemption
Recycling Bins[1] Biosolids Pellet Storage Silo[1]	2 2	common baghouse exhaust	Criteria emissions < 5 ton/yr (See Appendix E)
Cooling Tower (1 cell)	2	1500 gpm for each tower	Criteria emissions < 5 ton/yr (See Appendix E)
Emergency Motor	1	diesel-powered motor One unit at part-time operation (500 hrs/yr of emergency use)	Rule 62-210.300 3.(a)20, F.A.C.

1 Each of two recycle bins will be ventilated through a fugitive dust control bag house and then to a building odor scrubber. Dusty air resulting from silo filling operations will be ducted to the recycle bin baghouses.

Appendix G

Description of Stack Sampling Facilities

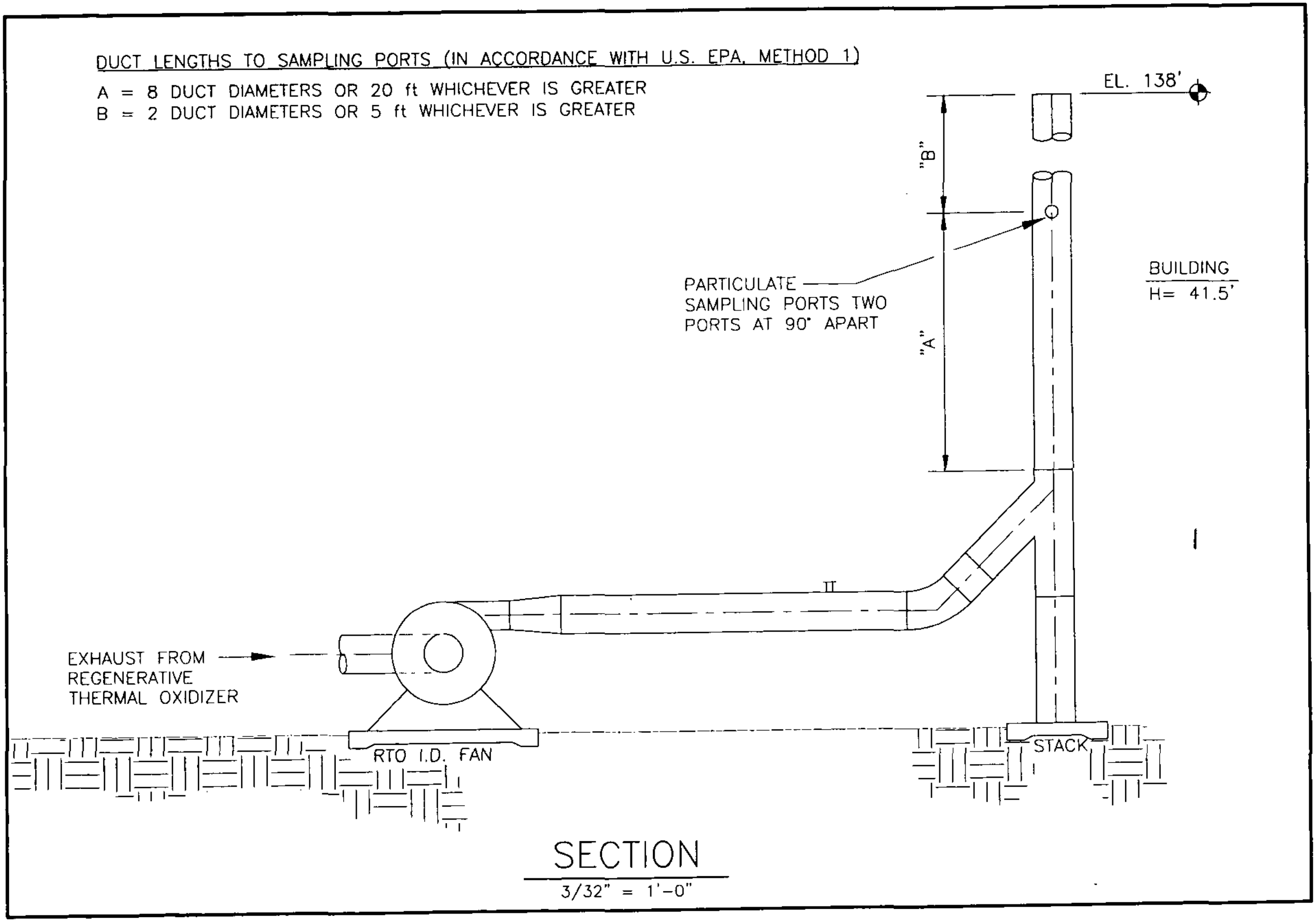


Figure No. G-1
Stack Sampling Location
Ports on Biosolids Pelletization Facility

CDM

Appendix H

Descriptions of Control Equipment

Detailed Description of RTO

Crawford Industrial Group LLC   Submittal Data

Order Name: H.E. Sargent

Customer Project Number: 8902
Crawford Order Number: 0131 A/B
Date:04/16/02
Engineering Manager: Rex McClure
Project Engineer: Robert Willoughby

RICK REIMLINGER — TECHNICAL INFO NOT SERVICE
908-233 8178
908-233-8447

E		Revision to Submittal Dated 2/1/02		4/16/2002
Revisio	Page	Description	By	Date

Crawford Industrial Group LLC

Unit Performance
General Information

0131 A/B

General	Unit Tag	RTO-1A/RTO-1B
	Unit Type	Regenerative Thermal Oxidizer
	Process Flow	4724 ACFM
	Fuel Type	Dual Fueled: Natural Gas/Digester Gas
	Heat Recovery	95% Thermal Efficiency
Destruction Efficiency	Voc Destruction	98% or down to 25ppm Methane
	Carbon Monoxide	98% of Carbon Monoxide or down to 50ppm
Material of Construction	Combustion Chamber	304 Stainless Steel
	Thermal Chambers	304 Stainless Steel
	Poppet Valves	304 Stainless Steel
	Inlet/Outlet Manifold	304 Stainless Steel
Operating Temperature	Inlet Temperature	120 F
	Average Outlet Temperature	194F
	Operating Temperature	1600 F Normal Operating Temperature
	Ramp Rate At Startup	500 Degrees F Per Hour
	Oxidizer Skin Temperature	To Follow Under Separate Cover
Media	Rauschert	25 Cell Ceramic Monolith 150mm X 150mm X 300mm
Refractory	Z Block	Thermal Ceramics Cerablanket with 7 folds
	Rated 2400 F	6" thick mounted with Stainless Steel Hardware
	Pyro Block	For Use in Regen Chambers
Poppet Valve	Material of Construction	304 Stainless Steel
	Tag Numbers	FCV 520A/B/C/D
	Size	18" to direct process flow to heat xfer beds
Bypass Poppet Valve	Material of Construction	304 Stainless Steel
	Tag Numbers	FCV 520I/J
	Size	12" to isolate RTO from discharge for purge
Burner	Maxon	Kinemax Burner 3" Series G W/ peepsight.
Gas Train	See BOM	Suitable for Digester and Natural Gas
RTO Fan	Tag Number	F-3A/F-3B
	Type	Robinson Fan Company
	Inlet Static Pressure (in w.c.)	-17
	Total Static Pressure (in w.c.)	36
	Fan Speed	3600 RPM
	Motor Horsepower	50
	Airflow	5100 ACFM
	Noise level 3ft	85 dBA @ 3ft from any surface
	Construction	1/4" 304 Stainless Steel Housing
Combustion Air Blower	Tag Numbers	F-4A/F-4B
	Type	American Fan #3N-04-20N Turboblower
	Motor	Baldor Catalog #M3559T
	Fan Speed	3600 rpm
	Motor Horsepower	3 HP
	Airflow	250 cfm at 12 osig
	Noise level 3ft	85 dBA
	Arrangement	Arrangement 4 Direct Drive Close Coupled

Crawford Industrial Group LLC
9101 Parkers Landing, Orlando, Fl 32824
Phone (407) 851-0993   Fax: (407) 859-7684

SUBMITTAL
Addendum A

To: Dan Brassard
HE Sargent
Construction Field Office
240 A Charles Street
North Andover, MA 01845

Order Name: HE Sargent
Crawford Order# 0131 A/B
Project # 8902

Submittal Date: 4/16/2002

SUBMITTAL STATUS

_____ SUBMIT FOR APPROVAL *
XXX RE-SUBMIT FOR APPROVAL *
_____ SUBMIT FOR RECORD

* If for approval no material will be ordered nor manufacturing begin until one approval submittal is returned to Crawford Industrial Group LLC

Please find the following documents included:

Copies Enclosed 8

RTO FAN Data	F-3A/F-3B RTO Fan Sound Data RTO Fan Information Sheet		

Prepared By: ____________________

Copies To:

Approved By: ____________________

Crawford Industrial Group LLC uses the submittal to clarify our interpretation of the plans and specifications. Please review and approve the submittal.
Crawford Industrial Group LLC will manufacture the equipment as ordered per the approved submittal.

Approved By: ____________________

Crawford Industrial Group LLC

Unit Construction

Specific Information

Specific Information Regarding Construction of RTO-1A/RTO-1B

Tag Numbers RTO-1A / RTO-1B

Combustion Chamber Specifications:

Construction:	Fabricated from 3/16" type 304 Stainless Steel.
Welding:	Continuously welded with airtight construction conforming to AWS code
External Structural Steel:	Stiffeners and structural steel not in contact with process gases material of Construction is ASTM A36
Access:	Access is provided with two (2) refractory lined davit doors.
Clearance:	6 ft 1/4 inches clearance from top of monolith block to refractory lining.
Refractory lining:	6" of 8.0 lf/ft3 rated for temperatures up to 2400 F/ Z-Block Construction
Dimensions:	Reference Drawing No. 0131B-140
Retention time:	Combustion Chamber sized for a one (1) second retention time.
Location:	Gasketed and bolted to the two (2) Thermal Energy Recovery Chambers.
Operation Temperature:	Designed to have a 1600 F continous operation temperature
Quantity:	One (1) per unit

Thermal Energy Recovery Chambers:

Construction:	Fabricated from 3/16" type 304 Stainless Steel.
Configuration:	Square chambers 5-1/2 ft X 5-1/2 ft X 8 ft High.
Welding:	Continuously welded with airtight construction conforming to AWS code.
External Structural Steel:	Stiffeners and structural steel not in contact with process gases material of Construction is ASTM A36.
Refractory Lining:	6" of 8.0 lf/ft3 / Pyro-Block by Thermal Ceramics
Clearance:	Clearance from the top of the monolith ceramic block to refractory is 6ft 1/4in.
Media Support Grid:	304 Stainless able to support weight of ceramic heat transfer media.
Location:	Bolted to structural steel base grid.
Operational Temperature:	Up to 1600F on hot end, 197F on inlet / outlet when RTO operating.
Quantity:	Two (2) per unit

Thermal Energy Recovery Media:

Construction:	25 X 25 Cell
Material:	Cordierite Dense Ceramic Honeycomb Monolith
Operational Temperature:	2100 F
Location:	Within Thermal Energy Recovery Chambers, atop Cold Face Support
Size:	150mm X 150mm X 300 mm
Quantity:	Of sufficient quantity to have a 6 ft height of material within each Thermal Energy Recovery Chambers.
Manufacturer Cut Sheet:	Attached to previous submittal

Crawford Industrial Group LLC

Unit Construction

Specific Information

Burner:

Tag Number:	None
Manufacturer:	Maxon
Model:	3" nozzle series "G" Kinematic burner
Location:	Centerline of each combustion chamber
Access:	From platform attached to each individual RTO unit
Temperature:	Will provide ramp up rate of 500 F per hour, will provide 500,000 BTUH for design temperature in Oxidizer
Fuel:	Will burn both natural gas and digester gas
Pilot:	Capability for a continous burn pilot
Sightglass:	Sightglass for visual flame verification
UV Scanner:	UV Scanner for flame supervision
Manufacturer Cut Sheet:	Attached in Submittal Appendix

Refractory:

Application:	RTO-1A/RTO-1B Combustion Chamber	Energy Recovery Chambers
Style:	Zblock	Pyro-Block
Thickness:	6-inch	
Base Material:	Thermal Ceramics Cerablanket	Thermal Ceramics Fiber Blocks
Number of Pleats:	7	None
Density:	8 lbs	8
Maximum temp. rating F:	2150	2400
Melting point F:	3200	3200
Continous use limit F:	2400	2200
Hardware:	Stainless Steel	Stainless Steel
Manufacturer Cut Sheet	In Submittal Appendix	In Submittal Appendix

Poppet Valves:

Tag Numbers:	FCV 520A / FCV 520B / FCV 520C / FCV 520 D
Application:	RTO-1A / RTO-1B
Size:	18" Diameter
Material of Construction:	304 Stainless Steel
Use:	Assemblies used to divert process gas to Thermal Energy Recovery Chambers, and to isolate RTO-1A / RTO-1B during Dryer Purge Evolution.
Acillary Components:	Proximity switches for signals ZSO 520A / ZSO 520B / ZSO 520C / ZSO 520D Proximity switches for signals ZSC 520A / ZSC 520B / ZSC 520C / ZSC 520D Model will be an Omicron E2E2 Series Incorporated into the unit during construction.
Manufacturer Cut Sheet:	Attached in Submittal Appendix
Manufacturers Drawing:	Attached in Submittal Appendix Drawing No. RC-1279-100
Spare parts list:	Attached in Submittal Appendix

Crawford Industrial Group LLC

Unit Construction

Specific Information

Bypass Poppet Valves:

Tag Numbers:	FCV 520I / FCV 520J
Application:	RTO-1A / RTO-1B
Size:	12" Diameter
Material of Construction:	304 Stainless Steel
Application:	Used to allow dryer purge gasses to escape thru stack
Acillary Components:	Proximity Switch incorporated into unit during fabrication. Proximity Switch an Omicron model E2E2 Series Proximity Switches will provide signals ZSC 520E/F and signal ZSC 520 E/F
Manufacturer Cut Sheet:	Attached in Submittal Appendix
Manufacturers Drawing:	Attached in Submittal Appendix Drawing No.RC-1279-200A
Spare parts list:	Attached in Submittal Appendix

RTO Blower:

Tag Numbers:	F-3A / F-3B
Manufacturer:	Robinson Fan Corporation
Design:	RB1216
Size:	24" X 3.3125"
Arrangement:	#8
Rotation:	F-3A Clockwise Rotation Bottom Discharge/ F-3B CCW Bottom Discharge
RPM:	3600
Brake Horsepower:	38.2
Housing Gauges:	1/4" 304L Stainless Steel
Wheel/Blades:	304L Stainless Steel
Application:	Deliver process gas to RTO-1A / RTO-1B
Flowrate:	5100 ACFM
Temperature at inlet:	120F
Pressure at inlet:	-17 inch w.c. on inlet
Total Static Pressure:	36 inch w.c.
Manufacturers Cutsheet:	Attached in Submittal Appendix
Performance Curve:	Attached in Submittal Appendix
Vibration Detector:	Vitec #438
Noise:	Below 85 dBA level @ 3 ft from any surface

RTO Blower Motor:

Motor Tag Number	
Motor Size:	50 HP
Manufacturer:	Reliance
Service Factor:	1.15
Catalogue Number:	
Manufacturers Cutsheet:	

Service: Inverter Duty

Combustion Blower:

Tag Numbers:	F-4A / F4-B
Manufacturer:	American Fan Corp
Design:	Turboblower
Model / Size:	3N-04-20N
Arrangement:	4
Rotation:	F-4A clockwise, Upblast / F-4B Counterclockwise, Upblast Discharge
RPM:	3450
Application:	Ambient Air
Flowrate:	250 CFM maximum, 100 CFM normal operation
Temperature at inlet:	Ambient
Static Pressure:	25-inch w.c.
Manufacturers Cutsheet:	Attached in Appendix
Performance Curve:	Attached in Appendix
Noise Performance:	85 DBA
Manufacturers Cutsheet:	Attached in Appendix
Performance Curve:	Attached in Appendix

Combustion Blower Motor:

Motor Tag Number	M520A / M520B
Motor Size:	3 HP
Manufacturer:	Baldor
Service Factor:	1.15
Catalogue Number:	M3559T
Manufacturers Cutsheet:	Attached in Submittal Appendix

Gas Train Components:	Listed in Bill of Materials by Tag Numbers.
Control Components:	Listed in Electrical Bill of Materials.
Piping:	316L Stainless Steel Piping where contact with digester gas is possible.

CRAWFORD
industrial group, LLC

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9101 Parkers Landing
Orlando, Florida 32824-8093
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July 24, 2003

Mr. Armand Asselin
500 Victory Rd
Quincy, MA 02171

Phone: (617) 773-3131
Fax: (617) 773-3122
(1) page

Reference: HE Sargent Material Contract dated July 20, 2001, Project No. 8902, 4 pages. CEE Project Number 0131.

Dear Armand:

This letter will serve as notification that the thermal oxidizers provided under the contract referenced above comply with our understanding of NFPA 86A and IRI requirements as delivered to the Greater Lawrence Sewer District in North Andover, MA.

Please feel free to contact either Rob Hablewitz (407.851.0993, x-220) or me (908.233.8178) should you have any questions, or require additional information.

Yours Truly,

Rick Reimlinger
Crawford Industrial Group, LLC

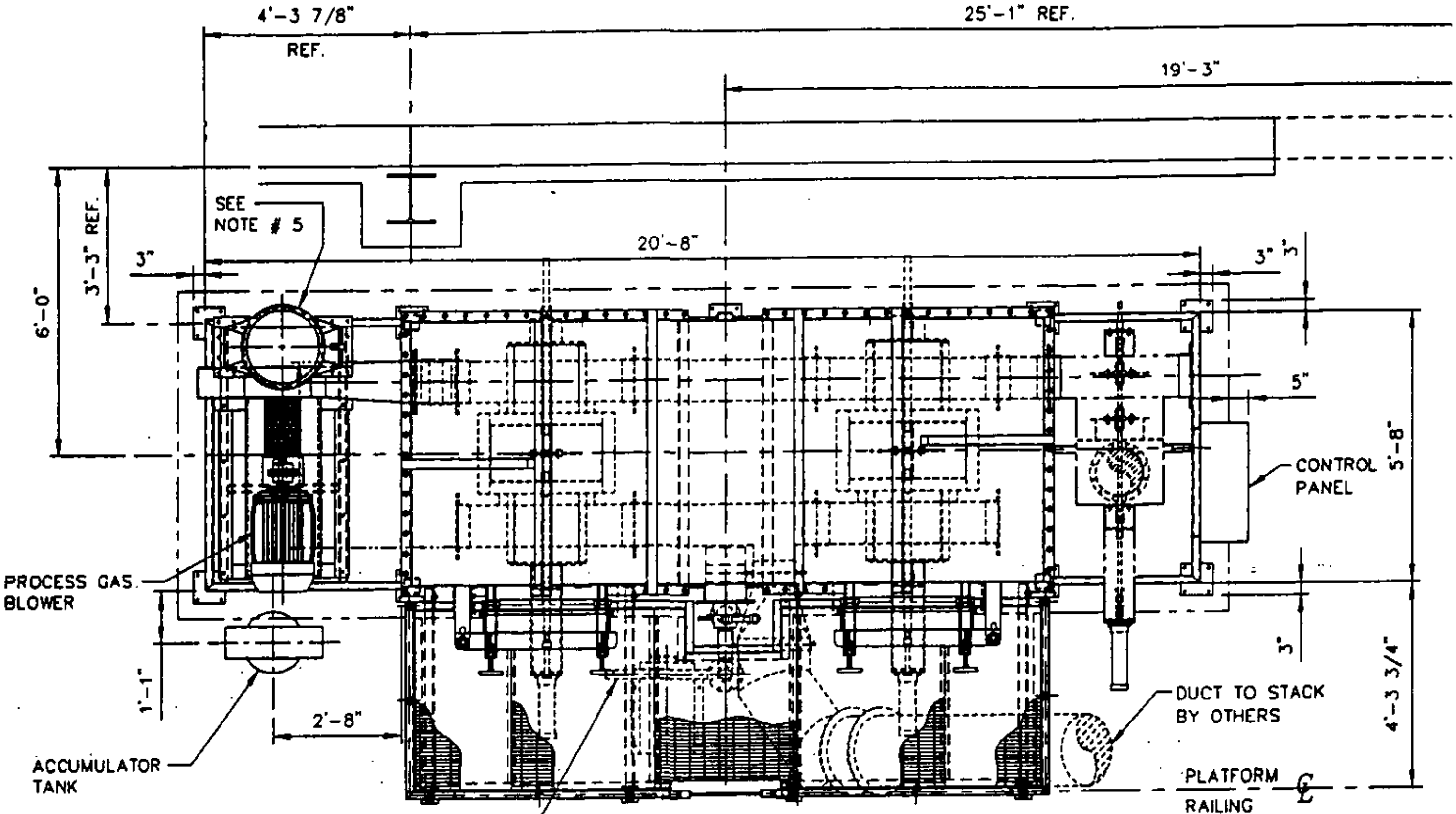
cc: Mr. Rex McClure - CIG - Orlando, FL
Mr. Robert Hablewitz - CIG - Orlando, FL

Tag #			Manufacturer	Description	MOC	No. per Unit	Model Number	Cut Sheet	Size
DPI	521	A/B	Dwyer	Magnahelic Differential Pressure Gauge 0-20"wc	Carbon Steel	1	2020	Y	4-inch face
EXP	3	A/B	Rose Controls	Inlet Expansion Joint	Stainless Steel	1		N	N/A
EXP	3	C/D	Rose Controls	Outlet Expansion Joint	Stainless Steel	1		N	N/A
F	3	A/B	Robinson	Robinson type RB1216 Arr 8 Class 4 304L SS construction	Stainless Steel	1		Y	N/A
F	4	A/B	American Fan	Model 3N-04-20N Turboblower, 3600 RPM, direct drive, arrangement 4 to provide up to 250 CFM at 12 OSIG	Carbon Steel	1	3N-04-20N	Y	N/A
FCV	520	A/B	Rose Controls	18" Dia. Poppet Valve Chamber #1	304 Stainless	1	RC-1279-100	Y	18-inch
FCV	520	C/D	Rose Controls	18" Dia. Poppet Valve Chamber #2	304 Stainless	1	RC-1279-100	Y	18-inch
FCV	520	E/F	Rose Controls	12" Dia. Poppet Valve Purge Bypass	304 Stainless	1	RC-1279-200A	Y	12-inch
FCV	530	A/B	Hauck	Combustion Air Modulating Flow Control Valve	Carbon Steel	1	BVA440	N	4-inch
FCV	530	C/D	Hauck	Manual Butterfly Valve - Combustion Air	Carbon Steel	1	BVA140	N	4-inch
FCV	531	A/B	Maxon	NFPA Motorized Shut Off Valve #1	Stainless Steel	1	5000-CP	Y	1-inch
FCV	531	C/D	Maxon	NFPA Motorized Shut Off Valve #2	Stainless Steel	1	5000-CP	Y	1-inch
FCV	531	E/F	Maxon	NFPA Motorized Shut Off Valve - Gas Injection	Stainless Steel	1	5000-CP	Y	1-inch
FCV	531	G/H	Kromshroder	Ratio Gas Regulator	Stainless Steel	1	GI20N02	Y	3/4-inch
FCV	531	I/J	Apollo	Manual 3 way valve w/proof of position switches	Stainless Steel	1	76-605-01	Y	1-inch

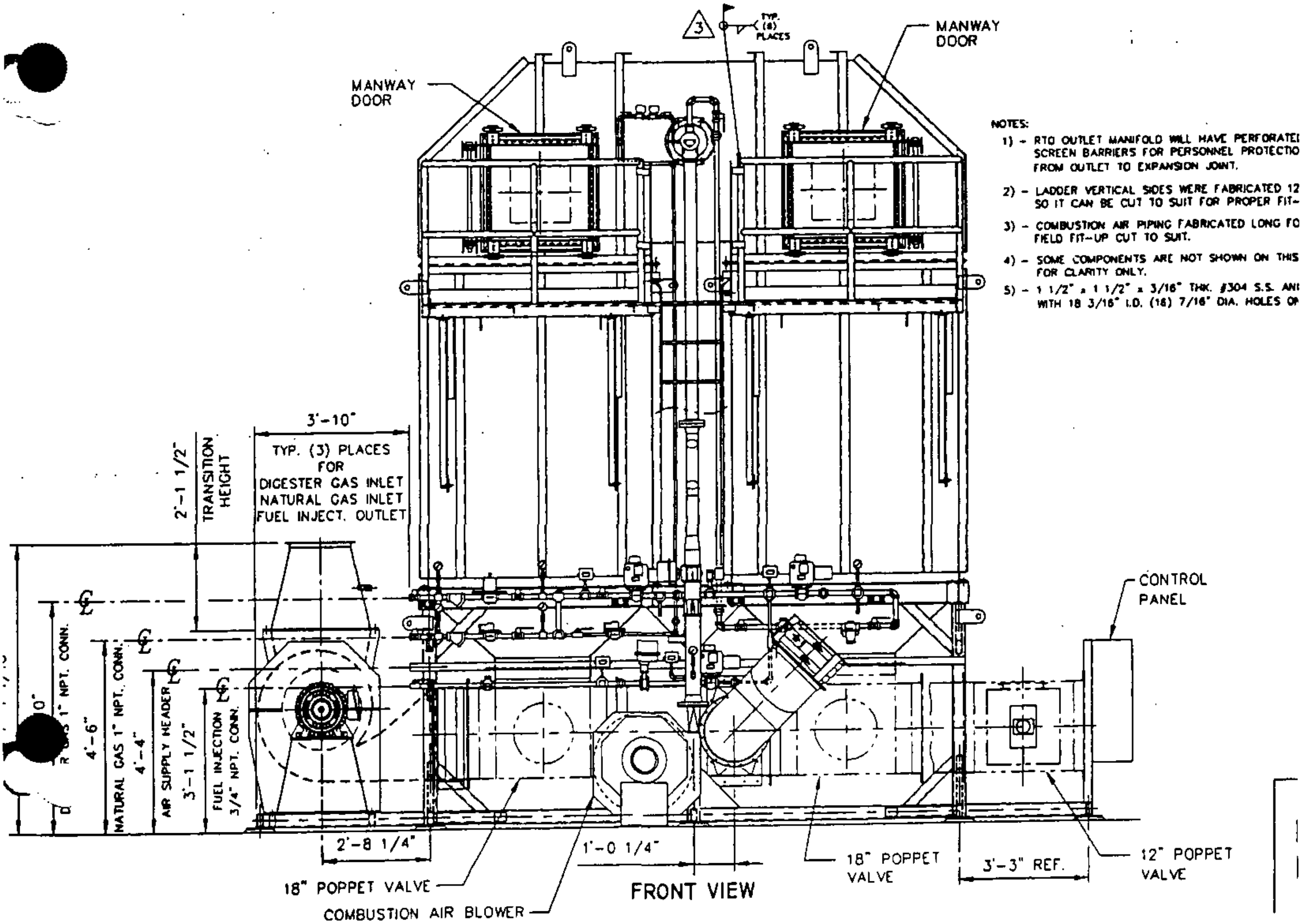
FCV	531	K/L	Bray	Gas Injection Modulating Flow Control Valve	Stainless Steel	1	Series 20	Y	1-inch
ACV	520	A/B		Regulator for pnuematic air	Carbon Steel	1			Conform to line size
HV	520	A/B	Apollo	Ball valves for pneumatic air	Carbon Steel	3	00705042	N	1/2-inch
HV	520	C/D	Apollo	Ball Valve, Air Isolation	Carbon Steel	1	70-100-06	N	1-inch
HV	531	A/B	Durco	Cock manual	Stainless Steel	7		N	1-inch
HV	531	C/D	Apollo	Leak Test Cocks	Stainless Steel	2	76-100-01	N	1/4-inch
HV	531	E/F	Hauck	Metering Orifice	Stainless Steel	2	OMG110	N	1-inch
HV	531	G/H	Durco	Cock manual	Carbon Steel	2		N	1/2-inch
HV	531	I/J	Durco	Cock manual	Carbon Steel	2		N	1-inch
M	520	A/B	Baldor	5 HP TEFC Electric Motor, 3600 RPM, 460/3/60	---	1	M3559T	Y	N/A
M	521	A/B	Baldor	50 HP TEFC Electric Motor, 3600 RPM, 460/3/60, Inverter Duty		1	IDM4115T	Y	N/A
M	530	A/B	Indelac	120/1/60 Actuator on FCV530A	---	1	SD-4	Y	N/A
M	531	K/L	Indelac	120/1/60 Actuator on FCV531K	---	1	SD-4	Y	N/A
PCV	531	A/B	Fisher	S402 Regulator - Natural Gas	Carbon Steel	1	S402	Y	1-inch
PCV	531	C/D	Fisher	95L Regulator - Digestor Gas	Stainless Steel	1	95L	Y	1-inch
PCV	531	E/F	Fisher	S402 Regulator Pilot	Carbon Steel	1	S402	Y	1/2-inch
PI	520	A/B	Dwyer	Pressure Gage 0-30wc - Process Air	Carbon Steel	1	61030	Y	2-1/2 inch
PI	520	C/D	Dwyer	Pressure Gage 0-100 PSI - Pneumatic Air	Carbon Steel	2	62100	Y	2-1/2 inch
PI	530	A/B	Dwyer	Pressure Gage 0-60wc - Combustion Air	Carbon Steel	1	61060	Y	2-1/2 inch

PI	531	A/B	Dwyer	Pressure Gage 0-15 PSI Liquid Filled	Carbon Steel	1	63015	Y	2-1/2 inch
PI	531	C/D	Dwyer	Pressure Gage 0-5 PSI	Carbon Steel	1	P354	Y	2-1/2 inch
PI	531	E/F	Dwyer	Pressure Gage 0-15 PSI	Stainless Steel	1	P5081	Y	2-1/2 inch
PI	531	G/H	Dwyer	Pressure Gage 0-15 PSI, Liquid Filled	Stainless Steel	1	63015	Y	2-1/2 inch
PI	531	I/J	Dwyer	Pressure Gage 0-55wc - Gas	Stainless Steel	1	P355	Y	2-1/2 inch
PSH	531	A/B	Mercoid	Snap Action Switch - High Gas Pressure	Stainless Steel Wetted Parts	1	Series DA	N	N/A
PSH	531	C/D	Mercoid	Snap Action Switch - High Gas Flow	Stainless Steel Wetted Parts	1	Series DA	N	N/A
PSL	520	A/B	Mercoid	Snap Action Switch - Low Pneumatic Air Pressure	Carbon Steel	1	DAW-7033-153-6	N	N/A
PSL	530	A/B	Honeywell	Snap action Switch - Low Pressure	Carbon Steel	1		N	N/A
PSL	531	A/B	Mercoid	Snap Action Switch - Low Gas Pressure	Stainless Steel Wetted Parts	1	Series DA	N	N/A
RE	520	A/B	Maxon	Kinematix burner	Stainless Steel Wetted Parts	1	Series "G" with 3-inch nozzle	Y	N/A
SV	520	A/B	ASCO	Soleniod Valve For FCV520A/B	Carbon Steel	1	10600163	Y	N/A
SV	520	C/D	ASCO	Soleniod Valve For FCV520C/D	Carbon Steel	1	10600163	Y	N/A
SV	520	E/F	ASCO	Soleniod Valve For FCV520E	Carbon Steel	1	10600163	Y	N/A
SV	531	G/H	ASCO	Solenoid Vent Valve, Main Gas,NO	Stainless Steel	1	8044B1 AC	Y	1/2-inch
SV	531	I/J K/L	ASCO	Pilot Safety Shut-Off Valve #1, 1/2" NPT	Carbon Steel	2	8040G22 AC	Y	1/2-inch
VIS	521	A/B	Vitec	Vibration Switch	Carbon Steel	1	Model 438	N	N/A
XX	520	A/B	Rauschert	Ceramic Heat Exchange Media	Cordierite	As Req	25Cell X 25Cell	Y	150mm x 150mm x 300mm
XX	531	A/B	Keckley	y strainer, 1"	Carbon Steel	1	SBY	Y	1-inch
XX	531	C/D	Keckley	y strainer, 1"	Stainless Steel	1	SSBY	Y	1-inch

ZSC	520	A/B/C D/E/F	Omicron	Proximity Switch	---	3	Model 2A187	Y	18-mm
ZSC	530	A/B	Hauck	Proof of Closure Switch on FCV530A	---	1	Factory Mounted	N	N/A
ZSC	531	A/B	Maxon	Proof of Closure Switch on FCV531A	---	1	Factory Mounted	N	N/A
ZSC	531	C/D	Maxon	Proof of Closure Switch on FCV531C	---	1	Factory Mounted	N	N/A
ZSC	531	E/F	Maxon	Proof of Closure Switch on FCV531E	---	1	Factory Mounted	N	N/A
ZSC	531	G/H		Proof of Closure Switch on FCV531G	---	1	Factory Mounted	N	N/A
ZSC	531	I/J		Proof of Closure Switch on FCV531I	---	1	Factory Mounted	N	N/A
ZSC	531	K/L		Proof of Closure Switch on FCV531K	---	1		N	N/A
ZSO	520	A/B/C D/E/F	Omicron	Proximity Switch	---	3	Model 2A187	Y	N/A
ZSO	530	A/B	Hauck	Proof of Open Switch on FCV530A	---	1	Factory Mounted	N	N/A
FS	531	A/B	Dwyer	Sail Switch	SS Vane	1	530	Y	N/A



PLATFORM PLAN VIEW
(SHOWN AS INSTALLED IN FIELD FOR CLARITY ONLY)



FRONT VIEW

NOTES:

1) - RTO OUTLET MANIFOLD WILL HAVE PERFORATE[D]
SCREEN BARRIERS FOR PERSONNEL PROTECTIO[N]
FROM OUTLET TO EXPANSION JOINT.

2) - LADDER VERTICAL SIDES WERE FABRICATED 12
SO IT CAN BE CUT TO SUIT FOR PROPER FIT-

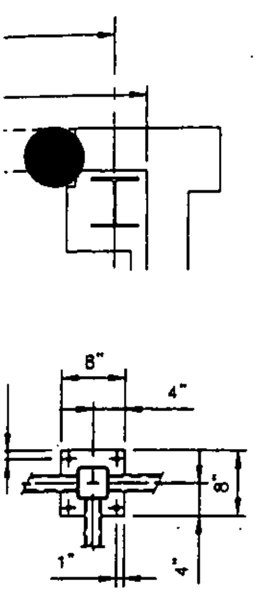
3) - COMBUSTION AIR PIPING FABRICATED LONG FO
FIELD FIT-UP CUT TO SUIT.

4) - SOME COMPONENTS ARE NOT SHOWN ON THIS
FOR CLARITY ONLY.

5) - 1 1/2" x 1 1/2" x 3/16" THK. #304 S.S. AN
WITH 18 3/16" I.D. (16) 7/16" DIA. HOLES O

FOUNDATION LOADING	
DEAD LOAD AT COLUMN "A-1" = 1,500 LBS.	DEAD LOAD AT COLUMN "A-2" = 1,500 LBS.
DEAD LOAD AT COLUMN "B-1" = 5,600 LBS.	DEAD LOAD AT COLUMN "B-2" = 5,600 LBS.
DEAD LOAD AT COLUMN "C-1" = 7,900 LBS.	DEAD LOAD AT COLUMN "C-2" = 7,900 LBS.
DEAD LOAD AT COLUMN "D-1" = 5,600 LBS.	DEAD LOAD AT COLUMN "D-2" = 5,600 LBS.
DEAD LOAD AT COLUMN "E-1" = 1,500 LBS.	DEAD LOAD AT COLUMN "E-2" = 1,500 LBS.
22,100 LBS.	22,100 LBS.

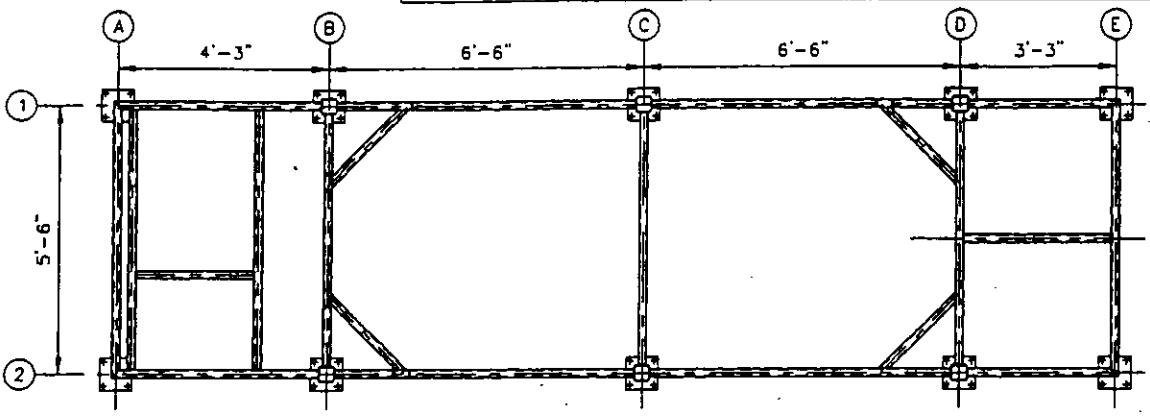
TOTAL OXIDIZER WEIGHT = 44,200 LBS.



YPICAL BASE PLATE DETAIL

(10) REQUIRED

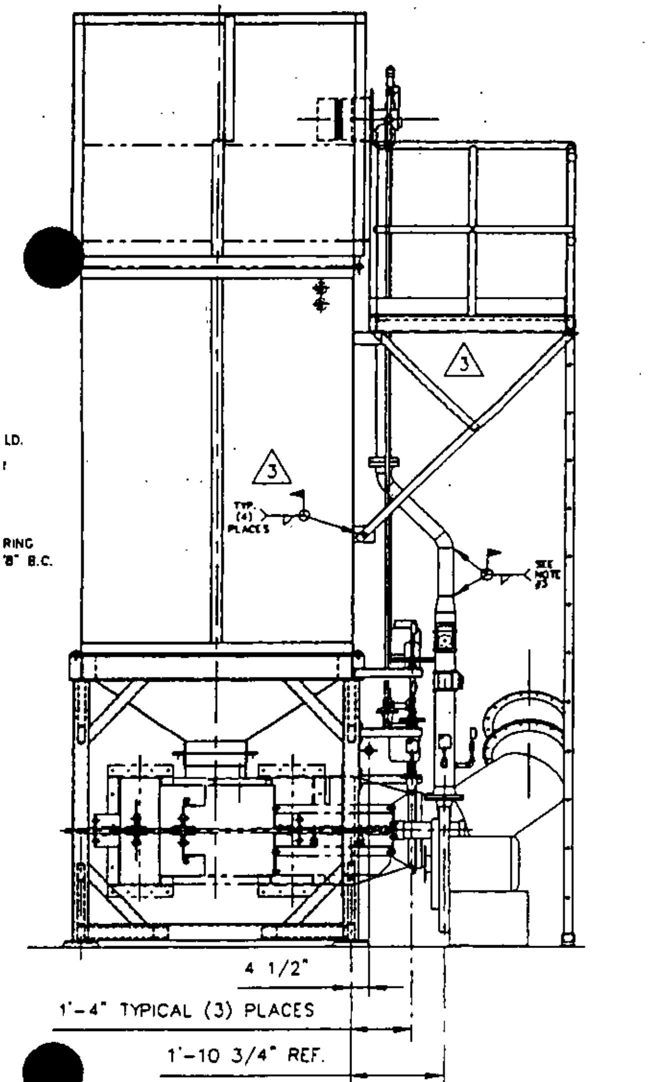
SCALE: 1:2



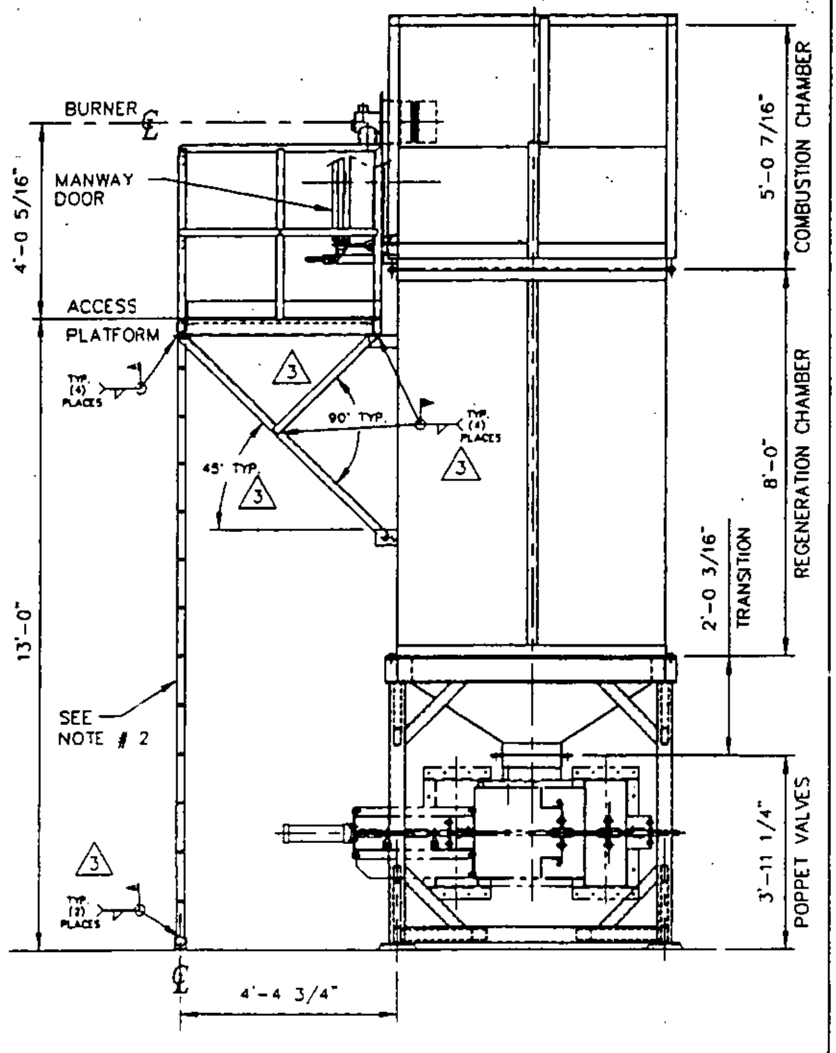
BASE FRAME ANCHOR BOLT LOCATION PLAN

(AS SEEN FROM FRONT VIEW)

SCALE: 1:1



LEFT SIDE ELEVATION



RIGHT SIDE ELEVATION

SARGENT

TH ANDOVER, MA

NO.	DATE	DESCRIPTION	BY
3	5/30/02	ADDED FIELD WELDS AND ADDITIONAL PLATFORM SUPPORTS	DR
2	5/21/02	ADDED NEW FAN, FAN SUPPORTS, FAN INLET TRANSITION ACCUMULATOR TANK AND UPDATED DIMENSION	DR
1	5/16/02	ADDED MANWAY DOORS & PIPING TERMINATION POINTS	DR
0	2/20/02	RELEASE FOR FABRICATION AS PER CLIENT COMMENTS	DR
C	02/01/02	REISSUED FOR CLIENT APPROVAL	DR
B	09/26/01	REISSUE FOR COMMENT	BB
A	09/07/01	ISSUE FOR COMMENT	BB

INDUSTRIAL GROUP CRAWFORD

DRAWN: DR DATE: 02/01/02

CHECKED: X DATE: X

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CRAWFORD INDUSTRIAL GROUP, LLC

9101 PARKERS LANDING, ORLANDO, FL. 32824 (407) 851-0993

TITLE: APPROVAL GENERAL ARRANGEMENT (UNIT "B")

JOB NO.: 0121B

Symbol	Description
ZSC	POSITION SWITCH, CLOSED
ZSO	POSITION SWITCH, OPEN
SV	SOLENOID VALVE
XV	CONTROL VALVE
PI	PRESSURE INDICATOR
PSL	PRESSURE SWITCH, LOW
PSH	PRESSURE SWITCH, HIGH
XFMR	TRANSFORMER
SI	SPARK IGNITOR
BC	BURNER CONTROL UNIT
UV	ULTRAVIOLET SCANNER
PIT	PRESSURE INDICATOR TRANSMITTER
TE	THERMOCOUPLE
TISH	TEMPERATURE INDICATING SWITCH, HIG
DPIT	DIFFERENTIAL INDICATOR PRESSURE TRANSMITTER
AE	ANALOG ELEMENT (LEL MONITOR)
M	ELECTRIC MOTOR
PCV	PRESSURE CONTROL VALVE

Symbol	Description	Line	Description
DO	DIGITAL OUTPUT	————————	PROCESS LINE
DI	DIGITAL INPUT	----------------	ELECTRICAL LINE
AO	ANALOG OUTPUT	-//-//-//-//-//-//-//-//-	PNEUMATIC LINE
AI	ANALOG INPUT		
/\/\/\/\	EXPANSION JOINT		

HE SARGENT
NORTH ANDOVER, MA

REV.	DATE	DESCRIPTION	BY
A	11/18/01	ISSUE FOR REVIEW	DR

CRAWFORD EQUIPMENT ENGINEERING

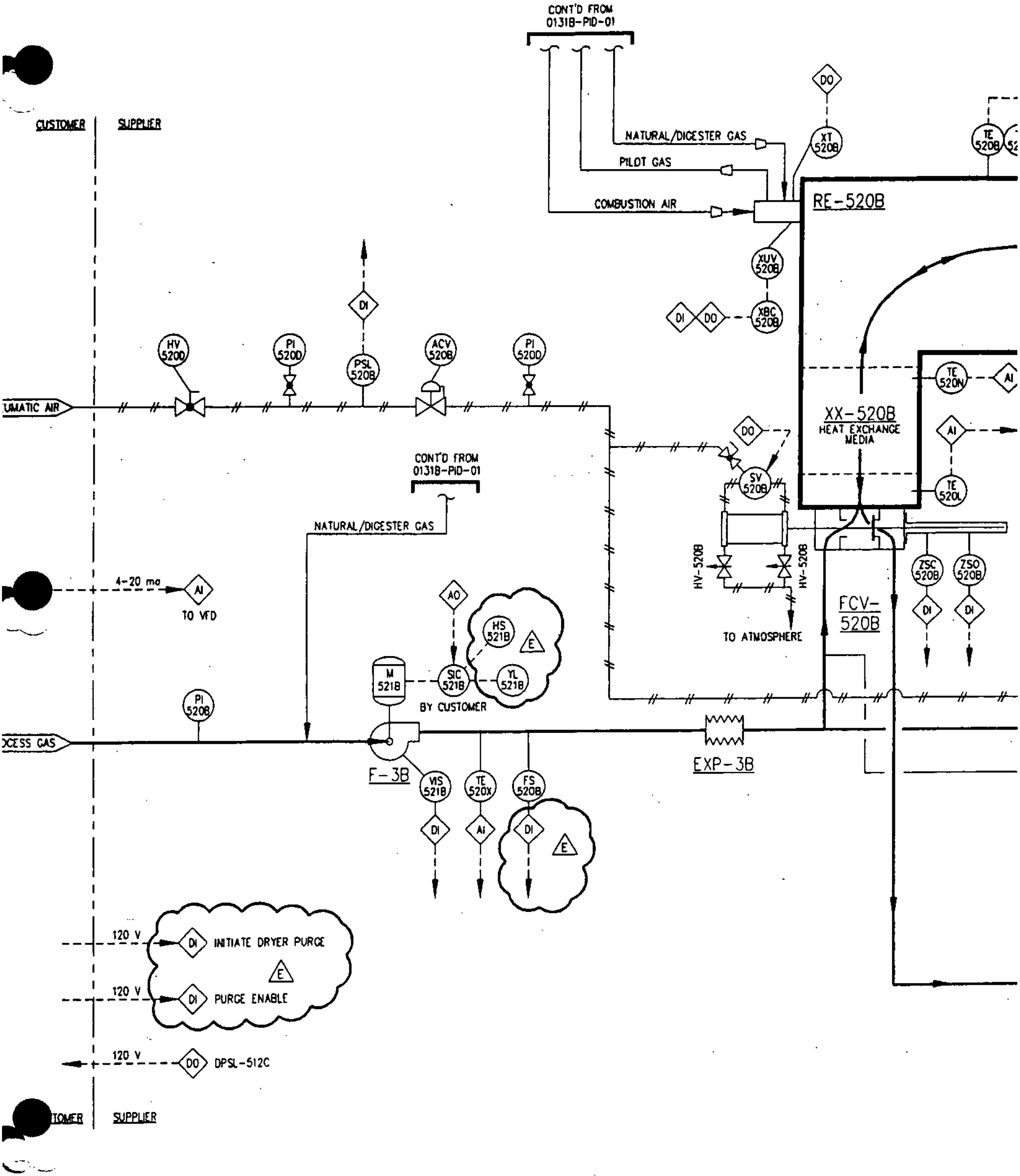
DRAWN: DR	DATE: 11/16/01
CHECKED:	DATE:

CRAWFORD
EQUIPMENT & ENGINEERING CO.
9101 PARKERS LANDING, ORLANDO, FL. 32824 (407) 851-0993

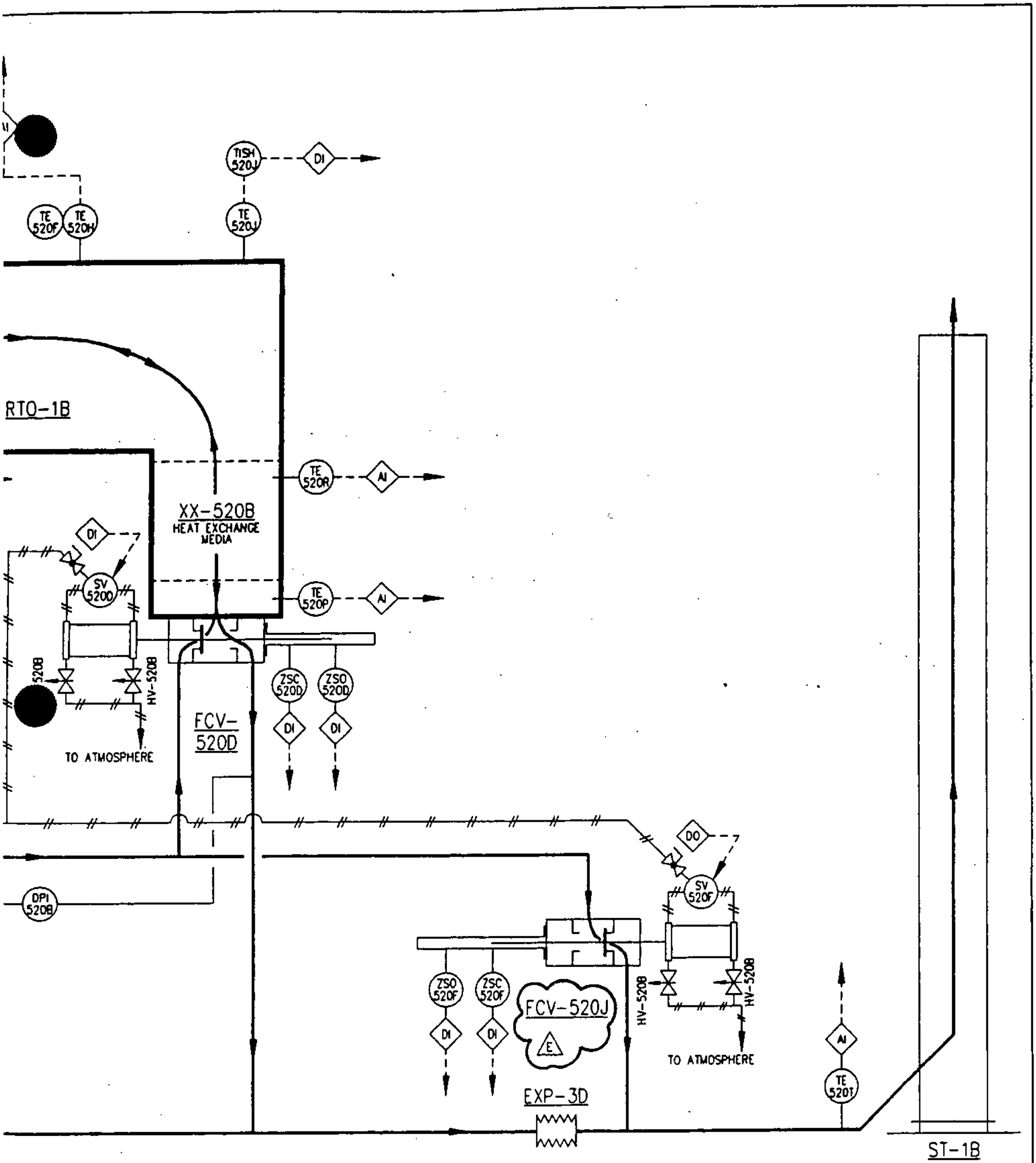
TITLE:

P&ID LEGEND

JOB NO.: 0121B | DWG. NO.: 0121B-PID-00 | DRAWING SCALE: 12"=1'-0" | REV.: A



HE SARGENT
NORTH ANDOVI



MA

DRAWING APPROVAL

- ☐ APPROVED AS SHOWN.
- ☐ APPROVED AS NOTED.
- ☐ NOT APPROVED.
- ☐ CHANGE REISSUE PER NOTES.

SIGNED: ______

DATE: ______

NO.	DATE	DESCRIPTION	BY:
E	2/13/02	REVISED PER CLIENT COMMENTS, AS NOTED	DR
D	2/1/02	REISSUED FOR APPROVAL	BB
C	1/10/02	REVISED AS NOTED	DR
B	11/15/01	REISSUED FOR APPROVAL	DR
A	9/5/01	ISSUE FOR REVIEW	BR

INDUSTRIAL GROUP CIG CRAWFORD

DRAWN: BR DATE: 9/5/01
CHECKED: X DATE: X

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CRAWFORD INDUSTRIAL GROUP, LLC
8101 PARKERS LANDING, ORLANDO, FL. 32824 (407) 851-0993

TITLE: THERMAL OXIDIZER P&ID RTO-1B

JOB NO: 0131B | SIZE: D | DWG. NO.: 0131B-PID-02 | PLOT SCALE: 1:1 | DRAWING SCALE: NONE | REV: E

		CONTROL	H E Sargent	SKID A
		Bill of Materials		
TAG #	**DEVICE**	**PART NUMBER**	**VENDOR**	**QTY**
	PLC	1747-L551	Allen Bradley	1
	Modular chassis	1746-A13	Allen Bradley	1
	I/O Module AC Input	1746-IA16	Allen Bradley	4
	I/O Module AC Output	1746-OA16	Allen Bradley	2
	I/O Module TC	1746 NT8	Allen Bradley	1
	I/O Module AnaIn	1746 NI4	Allen Bradley	1
	I/O Module AnaOut	1746 NO4I	Allen Bradley	1
	I/O Module Scnr	1747-SN	Allen Bradley	1
	I/O Module Filler	1747-N2	Allen Bradley	2
	PanelView MMI	2711-T5A1L1	Allen Bradley	1
	Power Supply Chss	1747-P4	Allen Bradley	1
	24vdc DC Power Supply			1
	Temp Controller	MIC 1160-3110	Partlow	2
XBC 520	Burner Control	RM 7838B	HoneyWell	1
XBC 520	Burner Wiring Base	Q7800A1005	HoneyWell	1
XBC 520	Amplifier Card	R7849A1023	HoneyWell	1
XBC 520	KyBd Display Module	S7800A	HoneyWell	1
XBC 521	Purge Timing card	ST7800A1039	HoneyWell	1
XUV 520	UV Scanner	C7076	HoneyWell	1
TE520A,TE520C	Thermocouple(s)	K8R16W618	Precision Equipment	8
TE520E,TE520G				
TE520M,TE520K				
TE520Q,TE520S				
	Pilot Light Green	52PX4E3	Siemens	3
	Pilot Light Blue		Siemens	1
	Pilot Light Red	52PX4E2	Siemens	1
	PushButton	52PXG2A	Siemens	1
	PushButton Green	52PX8A3	Siemens	2
	PushButton Red	52PX8A2	Siemens	1
	Selector Switch	2 position	Siemens	1
	Selector Switch	3 position	Siemens	3
	KeySwitch			1

	Modem	1747 CH0RAD1	Allen Bradley	1

		CONTROL	H E Sargent	SKID B
		Bill of Materials		
TAG #	DEVICE	PART NUMBER	VENDOR	QTY
	PLC	1747-L551	Allen Bradley	1
	Modular chassis	1746-A13	Allen Bradley	1
	I/O Module AC Input	1746-IA16	Allen Bradley	4
	I/O Module AC Output	1746-OA16	Allen Bradley	2
	I/O Module TC	1746 NT8	Allen Bradley	1
	I/O Module AnaIn	1746 NI4	Allen Bradley	1
	I/O Module AnaOut	1746 NO4I	Allen Bradley	1
	I/O Module Scnr	1747-SN	Allen Bradley	1
	I/O Module Filler	1747-N2	Allen Bradley	2
	PanelView MMI	2711-T5A1L1	Allen Bradley	1
	Power Supply Chss	1747-P4	Allen Bradley	1
	24vdc DC Power Supply			1
	Temp Controller	MIC 1160-3110	Partlow	2
XBC 520	Burner Control	RM 7838B	HoneyWell	1
XBC 520	Burner Wiring Base	Q7800A1005	HoneyWell	1
XBC 520	Amplifier Card	R7849A1023	HoneyWell	1
XBC 520	KyBd Display Module	S7800A	HoneyWell	1
XBC 521	Purge Timing card	ST7800A1039	HoneyWell	1
XUV 520	UV Scanner	C7076	HoneyWell	1
TE520A,TE520C	Thermocouple(s)	K8R16W618	Precision Equipment	8
TE520E,TE520G				
TE520M,TE520K				
TE520Q,TE520S				
	Pilot Light Green	52PX4E3	Siemens	3
	Pilot Light Blue		Siemens	1
	Pilot Light Red	52PX4E2	Siemens	1
	PushButton	52PXG2A	Siemens	1
	PushButton Green	52PX8A3	Siemens	2
	PushButton Red	52PX8A2	Siemens	1
	Selector Switch	2 position	Siemens	1
	Selector Switch	3 position	Siemens	3
	KeySwitch			1

	Modem	1747 CH0RAD1	Allen Bradley	1

I:2/0	Digestor Gas	Selected 531G	
I:2/1	Natural Gas Selected	FCV 531I	
I:2/2			
I:2/3			
I:2/4	RTO in Remote		
I:2/5	RTO in Local		
I:2/6	Combustion Blower	Auto mode	
I:2/7	Combustion Blower	manual mode	
I:2/8	Process Blower	Auto mode	
I:2/9	Process Blower	Manual mode	
I:2/10	Gas / Fuel Injection	SSW	
I:2/11	Stop PB		
I:2/12	Start PB		
I:2/13			
I:2/14			
I:2/15			
I:3/0	Combustion Blower	Pressure Switch	Proof of Closure
I:3/1	Combustion Blower	Damper POC	
I:3/2	Process Blower	Running	
I:3/3	Combustion Blower	Running	
I:3/4	Flame On Signal	from Burner Module	
I:3/5	Fault Alarm	from Burner Module	
I:3/6			
I:3/7	Poppet 1 LS Open		
I:3/8	Poppet 1 LS Closed		
I:3/9	Poppet 2 LS Open		
I:3/10	Poppet 2 LS Closed		
I:3/11			
I:3/12			
I:3/13	Gas Injection Mode	ZSC531K POC	
I:3/15	Fan Excess	Vibration	
I:4.0			
I:4/0	Alarm Silence		
I:4/1	Burner Start /	Flame Reset	PB
I:4/2	Combustion Chamber	OverTemp from PartLo	
I:4/3	Stack Overtemp	from PartLow	
I:4/4	VFD SIC521A	is running	
I:4/5			
I:4/6	Fuel Line	Blocking Valve 531A	POC ZSC531A
I:4/7	Fuel Line	Blocking Valve 531C	POC ZSC531C
I:4/8			
I:4/9	Dryer Bypass Open	ZSC 520E	
I:4/10	Dryer Bypass	ZSC 520E Closed	
I:4/11	Dryer Online	to Purge	(DCS)
I:4/12	Dryer Purge compete	(DCS)	
I:4/13			
I:4/14			
I:4/15			
I:5/0	KeySwitch for	Lockout enable	
I:5/1	Gas Line Pressure	Low PS 531A	
I:5/2	Gas Line Pressure	High PS 531A	

I:5/3	Pilot Request	from	Burner Module
I:5/4			
I:5/5			
I:5/6			
I:5/7	Process Gas Line	Fuel Injection	PSH 531C
I:5/8	Process Blower	Pressure Flow	FSL521A
I:5/9	System AirFlow	Pressure Switch	PSL520A
I:5/10	ComBustion Air	Normal PSL530A	
I:5/11	ComBustion	Actuator at	Low Fire position
I:5/12			
I:5/13			
I:5/14			
I:8.0	COMBUSTION CHAMBER 1		
I:8.1	LOWER BED MEDIA A		
I:8.2	UPPER BED MEDIA A		
I:8.3	LOWER BED MEDIA B		
I:8.4	UPPER BED MEDIA B		
I:8.5	Inlet Temperature		
I:8.6	COMBUSTION CHAMBER	TEMPERATURE	
I:8.7	STACK TEMPERATURE		
I:9.0	RTO FAN ANALOG	4-20ma	
I:9.1	DRYER FURNANCE	4-20ma	
I:9.2			
I:9.3			
O:3/0	Combustion Blower	Motor Start Relay	
O:3/1	Burner On		
O:3/2	Preheat Indicator	On	
O:3/3	RTO Ready Indicator	SetPoint Temperature	is satisfied
O:3/4	CoolDown Indicator	System in CoolDown	
O:3/5	BakeOut Indicator	Bakeout in progress	
O:3/6	Alarm Indicator		
O:3/7	Open Process	Isolation Solenoid	
O:3/8	Poppets cycle	command	
O:3/9	VFD Start	Command	Run at Preset Speed
O:3/10	Auto Temp Ramp	Signal to Partlow	
O:3/11	VFD Modulation Mode		
O:3/12	BakeOut Complete	Indicator	
O:3/13	With VFD faulted	online...this turns	on Process Blower
O:3/14	VFD Fault Contactor	ON for normal ops	OFF for fault ops
O:6/0	ComBustion Blower	Motor Start	
O:6/1	VFD Run	Process Blower Start	Run at Freq 1
O:6/2			
O:6/3			
O:6/4	VFD modulate	Read 4-20 input	
O:6/5	With vfd faulted....	this turns on proces	Blower for cooling
O:6/6	VFD Fault contactor	ON for normal	OFF for fault ops
O:6/7	Activate Burner		
O:6/8	RTO Purge	Complete	
O:6/9			
O:6/10			
O:6/11	Poppet 2	Cycle close	

O:6/12	Poppet 1	Cycle close	
O:6/13	Open Digestor Gas	Injection solenoid	FCV 531E
O:6/14			
O:6/15	Open Dryer(Bypass)	solenoid FCV520E	
O:7/0	Fuel Line Block	solenoid A FCV531A	
O:7/1	Fuel Line Block	solenoid B FCV531C	
O:7/2			
O:7/3	Safe Run Interlock	to Burner Module	
O:7/4			
O:7/5	RTO Ready	Indicator	
O:7/6	Purge complete	Indicator	
O:7/7	Manual Burner Start	to Module	
O:7/8			
O:7/9	CoolDown	Indicator	
O:7/10	Alarm	Indicator	
O:7/11	Alarm Horn	Indicator	
O:7/12	Burner Ready	Indicator	(Ready for operator
O:7/13			
O:7/14	Signal for Main	Valve Interlock	on Burner Module.
O:7/15			
O:10.0	PROCESS BLOWER	VFD 4-20MA	
O:10.1	GAS INJECTION	4-20ma modulation	
O:10.2	COMBUSTION ACTUATOR	4-20ma modulation	

I:2/0	Digestor Gas	Selected 531H	
I:2/1	Natural Gas Selected	FCV 531J	
I:2/2			
I:2/3			
I:2/4	RTO in Remote		
I:2/5	RTO in Local mode		
I:2/6	Combustion Blower	Auto mode	
I:2/7	Combustion Blower	Manual mode	
I:2/8	Process Blower	Auto mode	
I:2/9	Process Blower	Manual mode	
I:2/10	Gas / Fuel Injection	SSW	
I:2/11	Stop PB		
I:2/12	Start PB		
I:2/13	BakeOut PB		
I:2/14			
I:2/15			
I:3/0	Pressure Switch	PSL530B	Proof of Closure
I:3/1	Combustion Blower	Damper POC	ZSC530B
I:3/2	Process Blower F-3B	Running	
I:3/3	Combustion Blower	F-4B	Running
I:3/4	Flame On from	Burner Module	
I:3/5	Flame Failure	from Burner Module	
I:3/6			
I:3/7	Poppet 1 LS Open	ZSO520B	
I:3/8	Poppet 1 LS Closed	ZSC520B	
I:3/9	Poppet 2 LS Open	ZSO520D	
I:3/10	Poppet 2 LS Closed	ZSC520D	
I:3/11			
I:3/12			
I:3/13			
I:3/14	Burner Mode	FCV 531F POC	
I:3/15	Fan Excess	Vibration VIS521B	
I:4.0			
I:4/0	Alarm Silence		
I:4/1	Burner Start /	Flame Reset	PB
I:4/2	Combustion Chamber	OverTemp from PartLo	
I:4/3	Stack Overtemp	from PartLow	
I:4/4	VFD SIC521B	is running	
I:4/5			
I:4/6	Fuel Line Valve	531B POC	
I:4/7	Fuel Line Valve	531D POC	
I:4/8			
I:4/9	Dryer Bypass Open	ZSC 520F	
I:4/10	Dryer Bypass	ZSC 520F Closed	
I:4/11	Dryer Online	to Purge	(DCS)
I:4/12	Dryer Purge compete	(DCS)	
I:4/13			
I:4/14			
I:4/15			
I:5/0	KeySwitch for	Lockout enable	
I:5/1	Gas Line Pressure	Low PS 531B	

I:5/2	Gas Line Pressure	High PS 531B	
I:5/3	Pilot Request from	Burner Module	
I:5/4			
I:5/5			
I:5/6			
I:5/7	Fuel Injection Line	PSH 531D	
I:5/8	Process Blower	Pressure Flow	FSL521B
I:5/9	System AirFlow	Pressure Switch	PSL520B
I:5/10			
I:5/11	ComBustion	Actuator at	Low Fire position
I:5/12			
I:5/13			
I:5/14			
I:8.0	COMBUSTION CHAMBER 1		
I:8.1	LOWER BED MEDIA A		
I:8.2	UPPER BED MEDIA A		
I:8.3	LOWER BED MEDIA B		
I:8.4	UPPER BED MEDIA B		
I:8.5	Inlet Temperature		
I:8.6	COMBUSTION	CHAMBER 2	
I:8.7	STACK TEMPERATURE		
I:9.0	RTO FAN ANALOG	4-20ma	
I:9.1	DRYER FURNANCE	4-20ma	
I:9.2			
I:9.3			
O:3/0	Combustion Blower	Motor Start Relay	
O:3/1	Burner On		
O:3/2	Preheat Indicator	On	
O:3/3	RTO Ready Indicator	SetPoint Temperature	is satisfied
O:3/4	CoolDown Indicator	System in CoolDown	
O:3/5	BakeOut Indicator	Bakeout in progress	
O:3/6	Alarm Indicator		
O:3/7	Open Process	Isolation Solenoid	
O:3/8	Poppets cycle	command	
O:3/9	VFD Start	Command	Run at Preset Speed
O:3/10	Auto Temp Ramp	Signal to Partlow	
O:3/11	VFD Modulation Mode		
O:3/12	BakeOut Complete	Indicator	
O:6/0	ComBustion Blower	F4B	Motor Start
O:6/1	VFD Run SIC521B	Process Blower Start	Run at Freq 1
O:6/2			
O:6/3			
O:6/4	VFD modulate	Read 4-20 input	
O:6/5	With vfd faulted....	this turns on proces	Blower for cooling
O:6/6	VFD Fault contactor	ON for normal	OFF for fault ops
O:6/7	Activate Burner		
O:6/8	RTO Purge	Complete	
O:6/9			
O:6/10	Poppet 1	Cycle close	
O:6/11	Poppet 2	Cycle close	
O:6/12	Open Inlet	Isolation (DCS)	

O:6/13	Open Digestor Gas	Injection solenoid	FCV 531F
O:6/14			
O:6/15	Open Dryer(Bypass)	solenoid FCV520F	
O:7/0	Fuel Line Block	solenoid A FCV531B	
O:7/1	Fuel Line Block	solenoid B FCV531D	
O:7/2			
O:7/3	Safe Run Interlock	to Burner Module	
O:7/4			
O:7/5	RTO Ready	Indicator	
O:7/6	Purge complete	Indicator	
O:7/7	Manual Burner	Start to Module	
O:7/8			
O:7/9	CoolDown	Indicator	
O:7/10	Alarm	Indicator	
O:7/11	Alarm Horn	Indicator	
O:7/12	Burner Ready Ind.	(Ready for Manual	Start)
O:7/13			
O:7/14	Signal for	main Valve Intlk	on Burner Module
O:7/15			
O:10.0	PROCESS BLOWER	VFD 4-20MA	
O:10.1	GAS INJECTION	4-20ma modulation	
O:10.2	COMBUSTION ACTUATOR	4-20ma modulation	

Detailed Description of Sly Scrubber

"A"

FILE WITH ORDER

SLY INC

FINAL FACE OF ORDER

SLY ORDER NO. RJM-0637

CUSTOMER P.O. NO. 8902

DATE: August 10, 2001
Edited: 01/21/02
SALESMAN: BOS
(REP/SLY) G. Arthur/ B Kurz

INVOICE TO:

H E SARGENT INC
40 WINTER ST
ROCHESTER NH 03867

SHIP TO:
H.E.Sargent Inc.
GREATER LAWRENCE SAN. DIST.
240A CHARLES STREET
NORTH ANDOVER MA 01845-0649

REQUIRED DELIVERY: 8 WKS ARDA

APPROVAL DRAWINGS:
4 WKS ARO
REQUIRED

SHIPPING METHOD:
Best Way F.O. B. Jobsite

COMPLEXITY: 2

PURCHASING CONTACT:

David Jacques

PHONE: 603-332-5071
FAX: 603-332-5341
E-MAIL:

ENGINEERING CONTACT:

David Jacques

PHONE: 603-332-5071
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APPROVAL DRAWINGS TO: Above

METHODS FOR APPROVALS: * MAIL

SPECIAL INSTRUCTIONS:

(8) Copies of drawings required

ORDERS/PRELIMPG1

SECTION 1

NOTE: THE STANDARD WILL BE NOTED BY AN ASTERISK.

Application Data:

Inlet Air Flow Rate	-	13,100 ACFM
Inlet Temperature	-	180°F
Inlet Humidity	-	8,853 # H_2O/hr
Saturation Air	-	12,700 ACFM 156°F (calculated)
Contaminant	-	Sludge particulate - 49.8 #/hr
		Ammonia 9.25 lb/hr
Particle Size Distribution by weight		0.62% < 1 micron
	-	2.72% 0.1 - 0.2 microns
	-	1.07% 0.2 - 0.3 microns
	-	0.33% 0.3 - 0.4 microns
	-	0.30% 0.4 - 0.5 microns
		0.36% 0.5 - 0.6 microns
		0.28% 0.6 - 0.7 microns
		0.25% 0.7 - 0.8 microns
		0.31% 0.8 - 0.9 microns
		0.41% 0.9 - 1.0 microns
		2.12% 1.0 - 1.5 microns
		2.38% 1.5 - 2.0 microns
		7.8% 2.0 - 3.0 microns
		10.74% 3.0 - 5.0 microns
		19.75% 5.0 - 8.0 microns
		50.56% > 8.0 microns
Scrubbing Solution	-	450 GPM of water,
		70 F maintained at a pH of 5.
Removal Efficiency	-	98% of ammonia, 94% of particulate
Outlet Gas Temp	-	120°F
Outlet Water Temp	-	140 – 160°F

Materials of Construction:

Shell Material	*Thickness*
304 Stainless Steel	11 ga.
Gaskets	*Neoprene Color: Black

Paint:	**Structural:**	Surface Prep	* SPCC-SP6
		Primer	*
		Finish	* (2) coats Devoe 224 HS
		Color	* To follow

Welding Requirements: * Double Pass

External Finish Requirements *(If Not Painted):*

- Stainless Steel Finish: * 2B
- Remove Discoloration: Sandblast SP-6
- Grind welds: * None
- External welds: * None

Internal Finish Requirement:

- Stainless Finish: * 2B
- Grind Welds: * Smooth
- Internal Weld Finish Clean Air: * None
- Internal Weld Finish Product Contact: * None

Special Requirements:

Section 2

RJM-0637-A
Equipment No. SC-1A

1 - No. 360 Impinjet Gas Scrubber
6'0" diameter, 15'2" straight side, 18'7" overall height with
400 gallon reservoir in base.
(1) Gas inlet, 36-9/16" x 24-3/8" with 3/16" thick flange.
(1) Gas outlet, 26" with 3/16" thick flange.

1 Access door, sprays, bolted. 24'x 24'	Dwg. 91-4047
3 Access doors, plates, bolted. 16'x 48'	Dwg. 91-3030
1 Access door, above mist eliminator, bolted. 16'x 48'	Dwg. 91-3030
1 Inlet baffle plate	Dwg. 91-2482
Cone bottom	
Water Box	Dwg. 91-3198

NOTE: All door openings must be equivalent in size to 20" dia.
Bolts: 18-8 stainless steel

Support Lugs	Dwg. 91-2439*04

Plate water inlet –5'150# ANSI Drilled Flange
Plate water flow rate 450 GPM

Spray water inlet custom. Spray header with gasketed connection pulls out for service
Spray water flow rate 50 GPM @ 10 PSIG.

Pump suction:	None
Drain:	6" 150# ANSI Drilled Flange
Level Switches:	(2) Yes 2" Size
PH probe:	No
Level gage:	No
Pressure taps:	Yes 1/2" Size with mounting bracket on scrubber shell and stainless steel tubing on condensation trap
Make up water:	None
Temperature:	2"

Note: All nozzles have flanges, 150# ANSI drilling with 4" projection
Leak test method: * Air (soap test)

G.A.Dwg. 19-2568 Rev.C

RJM-0637-B

1 - Mist eliminator: Designed for 12,700 ACFM,
Chevron blade 304 SS with 4-bend profile and 1.375" spacing

RJM-0637-C

3 - 6'0" diameter diaphragm assemblies for stages 1 thru 3, of 304 SS construction. custom design with impingement baffle plates of 304 SS material

Dwg. 21-2406

Standard plate design, 304 stainless steel

Spray nozzle BETE TF48-150 316 SS I'NPT 150 deg. wide angle full cone.

RJM-0637-D

Scrubber support:
cone bottom with lugs/legs, to allow 2' clearance below drain,
carbon steel material of construction Dwg. 91-111(4)

RJM-0637-E

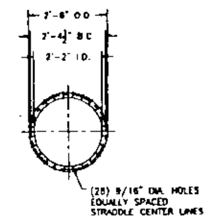
1 - Pull out spray header system with gasketed connection installed below chevron mist eliminator.
Spray Water Flow Rate: 50 GPM @ 10 PSIG.
Spray Nozzle–BETE TF48-150 316SS I'NPT 150 deg. Wide angle full cone.

RJM-0637-F (SHIP TO MS) **By Attachment**

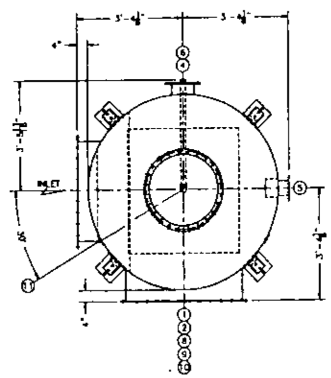
1–High Level Sensor (Tag: LE-501-A)
1–Low Level Sensor (Tag: LE-501-A)
1–Inlet Temperature Transmitter and RTD Probe (Tag: TE-501-C)
1–Outlet Temperature Transmitter and RTD Probe (Tag: TE-501-A)
All Instruments to be **TAGGED**

J.KURZ
Engr.Dept.

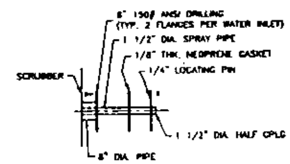
"B"



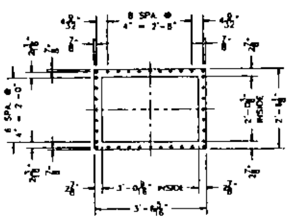
OUTLET FLANGE DETAIL



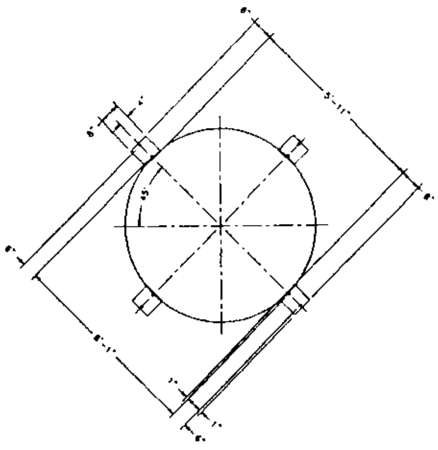
PLAN VIEW



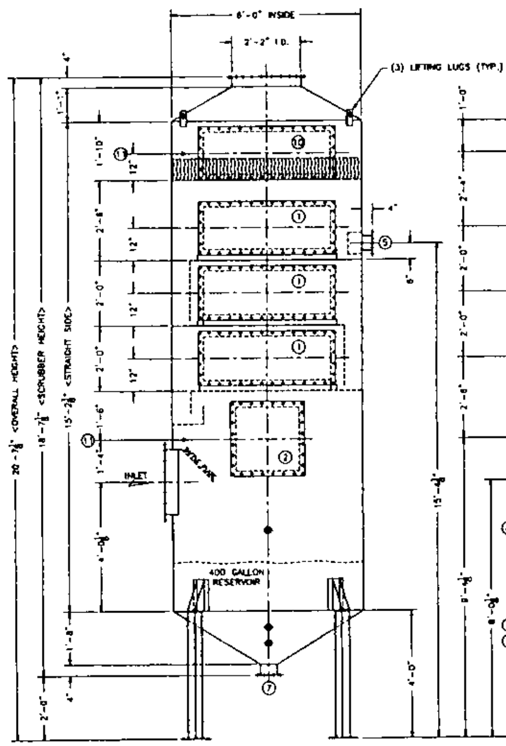
FL-1 ~ SPRAY WATER INLET DETAIL
(2) ASSEMBLIES REQUIRED
(REMOVABLE SPRAY PIPING & NOZZLE)
(NOT TO SCALE)



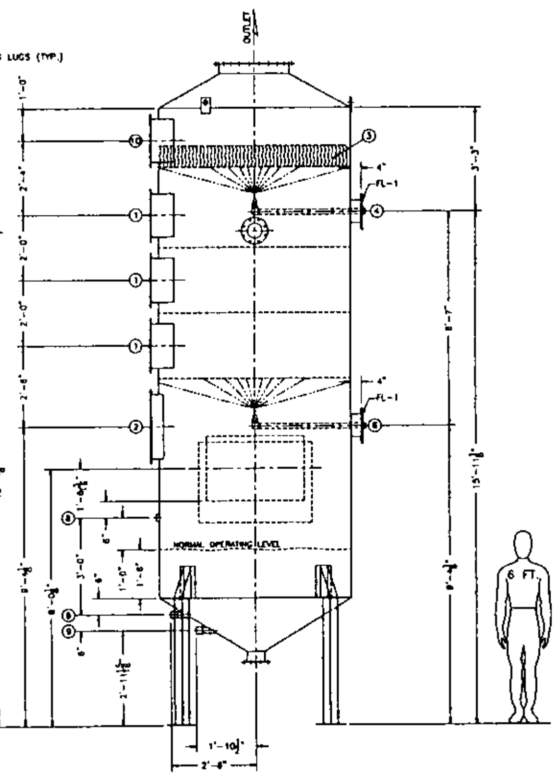
INLET FLANGE DETAIL
(40) 3/4" DIA. HOLES



FOUNDATION PLAN
ALL HOLES 3/4" DIA.
ALL DIMENSIONS TYPICAL



FRONT ELEVATION



RIGHT ELEVATION

DESIGN CONDITIONS

GAS FLOW RATE	- 13,100 ACFM
INLET TEMPERATURE	- 180°F
INLET HUMIDITY	- 8,853# H_2O/HR
SATURATED AIR	- 12,700 ACFM 134°F (CALCULATED)
CONTAMINANTS	- SLUDGE PARTICULATE - 49.8 #/HR - AMMONIA - 0.25 LB/HR
PARTICLE SIZE	- 0.62% < .1 MICRON - 2.72% 0.1-0.2 MICRONS - 1.07% 0.2-0.3 MICRONS - 0.33% 0.3-0.4 MICRONS - 0.30% 0.4-0.5 MICRONS - 0.34% 0.5-0.6 MICRONS - 0.28% 0.6-0.7 MICRONS - 0.25% 0.7-0.8 MICRONS - 0.31% 0.8-0.9 MICRONS - 0.41% 0.9-1.0 MICRONS - 2.12% 1.0-1.5 MICRONS - 2.38% 1.5-2.0 MICRONS - 7.8% 2.0-3.0 MICRONS - 10.74% 3.0-5.0 MICRONS - 19.75% 5.0-8.0 MICRONS - 50.56% > 8.0 MICRONS
SCRUBBING SOLUTION	- 450 GPM OF WATER 70°F MAINTAINED AT A pH OF 5
REMOVAL EFFICIENCY	- 99% OF AMMONIA, 94% OF PARTICULATE
OUTLET GAS TEMP.	- 120°F
OUTLET WATER TEMP.	- 140-160°F

SCRUBBER CONSTRUCTION

SCRUBBER SHELL	- 11 GA. 304 STAINLESS STEEL
FLANGES	- 3/16" THK. 304 STAINLESS STEEL
IMPINGEMENT PLATES	- 304 STAINLESS STEEL
DOOR GASKETS	- NEOPRENE FOAM, 3/8" THK. (BLACK)
SPRAY PIPING	- 1 1/2" SCH. 40, 304 S.S.
SPRAY NOZZLES	- 316 S.S.
SUPPORT LEGS	- CARBON STEEL

SCRUBBER:

1. (3) 18" x 48" BOLTED ACCESS DOOR W/ 1/2" NPS HALF CPLG. & PIPE PLUG FOR PRESSURE DROP READING ~ 304 S.S.
2. 24" x 24" BOLTED ACCESS DOOR - 304SS
3. CHEVRON FIXED BLADE MIST ELIMINATOR - 304 S.S.
4. SPRAY WATER INLET - 1 1/2" NPS HALF COUPLING ~ 304 S.S. @ 50 GPM AT 10 PSIG - FRESH WATER
5. PLATE WATER INLET - 5" 150# ANSI DRILLED FLANGE ~ 304 S.S. @ 450 GPM (MAX) AT FREE FLOW - RECIRCULATED WATER
6. SPRAY WATER INLET - 1 1/2" NPS HALF COUPLING ~ 304 S.S. @ 50 GPM AT 10 PSIG ~ RECIRCULATED WATER
7. DRAIN - 6" 150# ANSI DRILLED FLANGE ~ 304 S.S.
8. (2) LEVEL SENSOR - 2" NPS HALF COUPLING ~ 304 S.S.
9. TEMPERATURE SENSOR - 2" NPS HALF COUPLING ~ 304 S.S.
10. 18" x 48" BOLTED ACCESS DOOR - 304SS
11. (2) 1/2" NPS HALF CPLG & PIPE PLUG FOR PRESSURE DROP READING ~ 304 S.S.

APPROXIMATE WEIGHT: EMPTY - 3,000 LBS.
OPERATING - 9,200 LBS.

EQUIP. TAG NO. SC-1A
CUST. ORDER NO. 8902

SLY Incorporated

NOTICE TO PURCHASER

SLY INC.

DRAWN BY MAC DATE 8-31-01
SCALE 1/2"=1' RJM-0637

#360 SLY IMPINJET
GAS SCRUBBER w/
400 GAL. RECIRCULATION
RESERVOIR
FOR
H. E. SARGENT INC.

19-2568 Rev.C

CERTIFIED FINAL FOR CONSTRUCTION

C	1/17/03	REMOVED MAGNEHELIC GAGE	JK	
B	10/31/01	CHANGED LOCATION OF INLET, LEVEL SENSOR & TEMP SENSOR - CHANGED		
		No 4 SPRAY WATER INLET FROM 28 GPM TO 50 GPM	JK	
A	9-14-01	REVISED PLATE WATER FLOW RATE (180-450) & FLANGE SIZE (4"-5")	MAC	

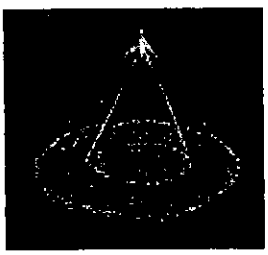
TF

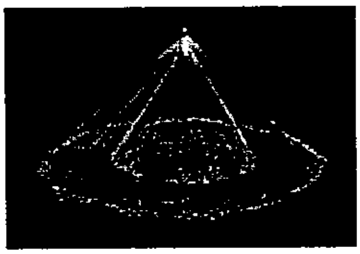
Wide Range of Flows and Angles

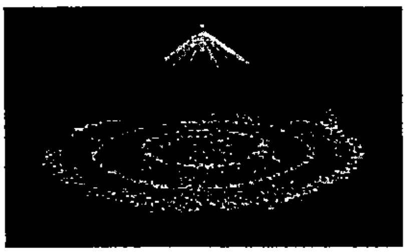
DESIGN FEATURES
- The original spiral nozzle
- High energy efficiency
- One piece/no internal parts
- Clog-resistant performance
- High discharge velocity
- Male connection standard; female connection available by special order

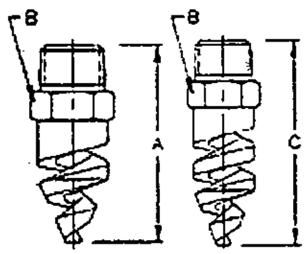
SPRAY CHARACTERISTICS
- Wide range of flow rates and spray angles
- Fine atomization

Spray patterns: Full and Hollow Cone
Spray angles: 50° to 180°
Flow rates: 0.5 to 3320 gpm
(Higher flow rates available)


Full Cone 60 ° (NN)


Full Cone 90° (FCN)


Full Cone 150°/170°



60°, 90°, 120° 150°, 170°

For a printable version of this table, click here. (Requires the free Adobe® Acrobat® Reader.)

TF Full Cone Flow Rates and Dimensions
Full Cone, 60° (NN), 90° (FCN or FFCN), 120° (FC or FFC), 150° and 170° Spray Angles, 1/8" to 4" Pipe Sizes

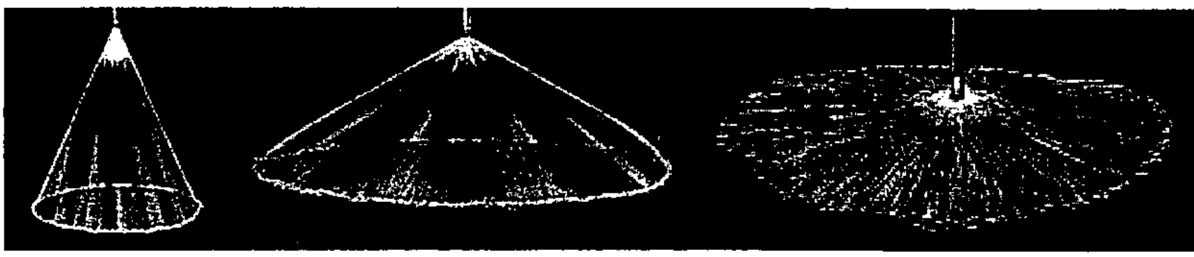
Male Pipe Size	Nozzle Number	Available Spray Angles 60° 90° 120° 150° 170°	K Factor	5 PSI	10 PSI	20 PSI	30 PSI	40 PSI	50 PSI	60 PSI (Operation above 60 PSI not recom. for PTFE)	80 PSI	100 PSI	200 PSI (High PSI operation recom. for Metal Only)	400 PSI	Approx. (in.) Orif. Dia.	Free Pass. Dia.	Dim. Male A
1/8	TF6	60° 90° 120° 150° 170°	0.221	0.495	0.70	0.99	1.21	1.40	1.57	1.71	1.98	2.21	[illegible]	[illegible]	0.09	0.09	1.69
	TF8	60° 90° 120° 150° 170°	0.411	0.919	1.30	1.84	2.25	2.60	2.91	3.18	3.68	4.11	[illegible]	[illegible]	0.13	0.13	
1/4	TF6	60° 90° 120° 150° 170°	0.221	0.495	0.70	0.99	1.21	1.40	1.57	1.71	1.98	2.21	3.13	[illegible]	0.09	0.09	1.88
	TF8	60° 90° 120° 150° 170°	0.411	0.919	1.30	1.84	2.25	2.60	2.91	3.18	3.68	4.11	5.81	8.22	0.13	0.13	
	TF10	60° 90° 120° 150° 170°	0.632	1.41	2.00	2.83	3.46	4.00	4.47	4.90	5.66	6.32	8.94	12.6	0.16	0.13	
3/8	TF6	60° [illegible]	0.221	0.495	0.70	0.99	1.21	1.40	1.57	1.71	1.98	2.21	[illegible]	[illegible]	[illegible]	[illegible]	1.88
	TF8	60° [illegible]	0.411	0.919	1.30	1.84	2.25	2.60	2.91	3.18	3.68	4.11	[illegible]	[illegible]	0.13	0.13	
	TF10	60° [illegible]	0.632	1.41	2.00	2.83	3.46	4.00	4.47	4.90	5.66	6.32	[illegible]	[illegible]	0.16	0.13	
	TF12	60° 90° 120° 150° 170°	0.949	2.12	3.00	4.24	5.20	6.00	6.71	7.35	8.49	9.49	[illegible]	[illegible]	0.19	0.13	
	TF14	60° 90° 120° 150° 170°	1.29	2.88	4.08	5.77	7.07	8.16	9.13	10.0	11.5	12.9	[illegible]	[illegible]	0.24	0.13	
	TF16	60° 90° 120° 150° 170°	1.68	3.76	5.30	7.50	9.19	10.6	11.9	13.0	15.0	16.8	[illegible]	[illegible]	0.28	0.13	

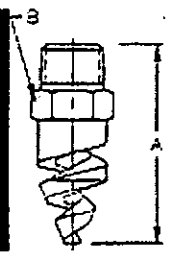
Male Pipe Size	Nozzle Number	Available Spray Angles	K Factor	5 PSI	10 PSI	20 PSI	30 PSI	40 PSI	50 PSI	60 PSI	80 PSI	100 PSI	200 PSI	400 PSI	Ord. Dia	Free Pass. Dia.	Dim. A
[illegible]	TF20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/2	TP24	60° 90° 120° 150° 170°	3.81	8.52	12.1	17.0	20.9	24.1	26.9	29.5	34.1	38.1	[illegible]	[illegible]	0.43	0.19	2.50
	TF28	60° 90° 120° 150° 170°	5.22	11.7	16.5	23.3	28.6	33.0	36.9	40.4	46.7	52.2	[illegible]	[illegible]	0.53	0.19	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	TF40	60° 90° 120° 150° 170°	10.6	23.7	33.5	47.4	58.0	67.0	74.9	82.1	[illegible]	[illegible]	[illegible]	[illegible]	0.77	0.25	3.63
	TF48	60° 90° 120° 150° 170°	15.0	33.6	47.5	67.2	82.3	95.0	106	116	[illegible]	[illegible]	[illegible]	[illegible]	0.93	0.25	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	TF88	60° 90° 120° 150° 170°	44.3	99.0	140	198	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.04	0.44	5.63
	TF96 *	60° 90° 120° 150° 170°	55.9	125	177	250	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.54	0.44	6.38
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	TF160 [1]	60° 90° 120°	166	371	525	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.15	0.63	10.1

Flow Rate (GPM) $= K\sqrt{PSI}$ *Dimensions are for bar stock, cast sizes may vary. [1] Three turn nozzles

Standard Materials: Brass, 316 Stainless Steel, PVC, Polypropylene and PTFE (Poly. not available for TF6 &TF8. See chart on page 17 for comple

150°,170° Metal 180° Metal 50° Metal





Hollow Cone 50° (N) Hollow Cone 120° (W) Hollow Cone 180° (XW) 50°, 120° (W)

For a printable version of this table, click here. (Requires the free Adobe® Acrobat® Reader.)

TF Hollow Cone Flow Rates and Dimensions

Hollow Cone 50° (N), 60° (V), 90° (M), 120° (W), and 180° (XW) Spray Angles, 1/4" to 4" Pipe Sizes

Male Pipe Size	Nozzle Number	Available Spray Angles 50° 60° 90° 120° 180°	K Factor	5 PSI	10 PSI	20 PSI	30 PSI	40 PSI	50 PSI	60 PSI	80 PSI (Operation above 60 PSI not recom. for PTFE)	100 PSI	200 PSI (High PSI operation recom. for Metal Only)	400 PSI	Approx. (in.) Ord. Dia	Free Pass. Dia.	Dim Me A
[illegible]	TF6	50° 60° 90° 120°	0.221	0.495	0.70	0.99	1.21	1.40	1.57	1.71	1.98	2.21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1/4	TF8	50° 60° 90° 120° 180°	0.411	0.919	1.30	1.84	2.25	2.60	2.91	3.18	3.68	4.11	[illegible]	[illegible]	0.13	0.13	[illegible]
[illegible]	TF10	50° 60° 90° 120° 180°	0.632	1.41	2.00	2.83	3.46	4.00	4.47	4.90	5.66	6.32	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

3/8	TF12	50° 60° 90° 120° 180°	0.949	2.12	3.00	4.24	5.20	6.00	6.71	7.35	8.49	9.49	[illegible]	[illegible]	0.19	0.13	1.88
	TF14	50° 60° 90° 120° 180°	1.28	2.86	4.05	5.73	7.01	8.10	9.06	9.92	11.5	12.8	[illegible]	[illegible]	0.24	0.13	
	TF16	50° 60° 90° 120° 180°	1.68	3.75	5.30	7.50	9.18	10.6	11.9	13.0	15.0	16.8	[illegible]	[illegible]	0.28	0.13	
	TF20	50° 60° 90° 120° 180°	2.61	5.83	8.25	11.7	14.3	16.5	18.4	20.2	23.3	26.1	[illegible]	[illegible]	0.36	0.13	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
3/4	TF32	50° 60° 90° 120° 180°	6.64	14.8	21.0	29.7	36.4	42.0	47.0	51.4	59.4	66.4	[illegible]	[illegible]	0.80	0.19	2.75
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
1 1/2	TF56	60° 90° 120° 180°	20.4	45.6	64.5	91.2	112	129	144	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.00	0.31	
	TF64	60° 90° 120° 180°	26.7	59.7	84.5	120	146	169	189	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.29	0.31	
	TF72	60° 90° 120° 180°	30.4	67.9	96.0	136	166	192	215	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.32	0.31	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	TF112	60° 90° 120°	81.0	181	256	362	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.00	0.58	8.63
	TF128	60° 90° 120°	107	239	339	480	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.30	0.58	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Flow Rate $(GPM) = K\sqrt{PSI}$ *Dimensions are for bar stock, cast sizes may vary.   [1] 1.00 for 180°   [2] 1.63 for 180°

Standard Materials: Brass, 316 Stainless Steel, PVC, Polypropylene and PTFE (Poly. not available for TF6, TF8 or TF10).

Back to Products

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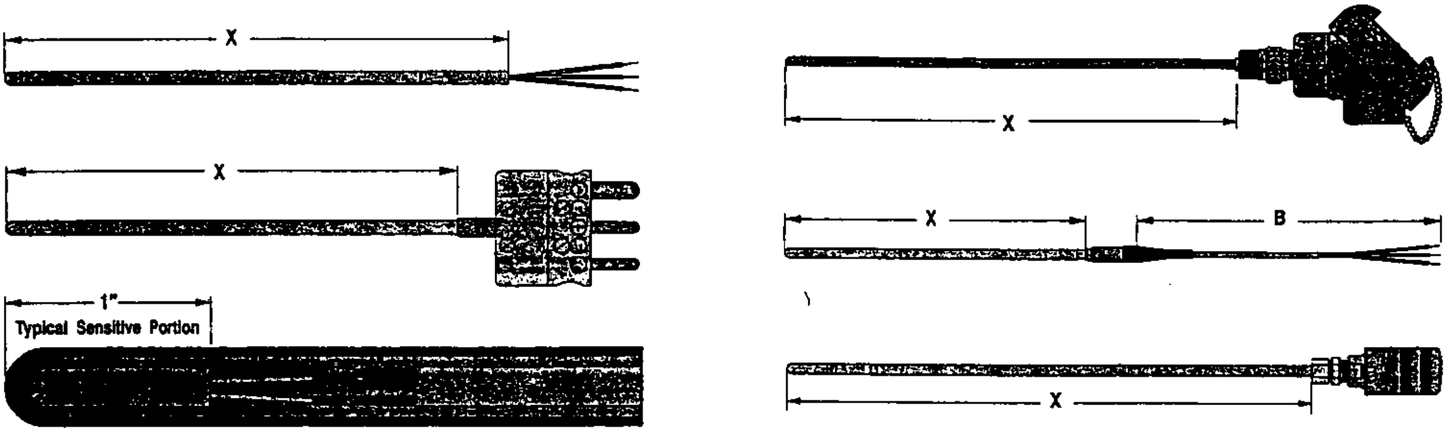
The single element RTDs illustrated and described on this and the following pages are designed to measure temperature in a variety of process and laboratory applications. These RTDs are specifically designed for use in two different process temperature ranges and they will provide accurate and repeatable temperature measurement through a broad range of -328° to 1112°F (-200° to 600°C). Low range wirewound RTDs -328° to 400°F (-200° to 204°C) and low range thin film RTDs -40° to 400°F (-40° to 204°C) are constructed using silver plated copper internal leads, teflon, and other suitable wire insulations with potting compounds to resist moisture penetration. High range RTDs -328° to 1112°F (-200° to 600°C) are constructed with nickel internal leads inside swaged MgO insulated cable to allow higher temperature measurements at the RTD element and to provide higher temperature lead protection along the sheath. The following tables allow customer selection of standard element materials, initial accuracies, sheath materials and diameters, mounting fittings and terminations. Custom built assemblies with non-standard specifications are available upon request.



Example Order Number: R5T185L 48 3 - 006 (1-1, 1-2, 1-3, 1-4)

1-1 SINGLE PLATINUM RTD ELEMENTS / 1-2 316 SS SHEATH

ELEMENT ACCURACY @ 0° C				SPECS		DIAMETERS			
±.1%	±.03%	±.01%	±.12%	VALUE IN OHMS	TEMP. COEF.	1/8" OD	3/16" OD	1/4" OD	3/8" OD
ORDER CODE	ORDER CODE	ORDER CODE	ORDER CODE			ORDER CODE	ORDER CODE	ORDER CODE	ORDER CODE
Low Range -328 to 400°F (-200 to 204°C)									
R1T185L	R3T185L	R5T185L	RBF185L	100	.00385	28	38	48	68
R1T192L	R3T192L			100	.00392	28	38	48	68
R1T125L				200	.00385	28	38	48	68
			RBF155L	500	.00385	28	38	48	68
			RBF195L	1000	.00385	28	38	48	68
High Range -328 to 1112°F (-200 to 600°C)									
R1T185H				100	.00385	28	38	48	68
R1T192H				100	.00392	28	38	48	68
			RBF155H	500	.00385		38	48	68
			RBF195H	1000	.00385		38	48	68

1-4 LENGTH

ORDER CODE
3 DIGIT 'X' LENGTH

SINGLE COPPER, NICKEL, NICKEL-IRON RTD ELEMENTS / 316 SS SHEATH

ACCURACY @ 0° C		ELEMENT MATERIAL	SPECS		DIAMETERS			
±.2%	±.5%		VALUE IN OHMS	TEMP. COEF.	1/8" OD	3/16" OD	1/4" OD	3/8" OD
ORDER CODE	ORDER CODE				ORDER CODE	ORDER CODE	ORDER CODE	ORDER CODE
Low Range -328 to 400°F (-200 to 204°C)								
RCT110L		Copper	10	.00427	28	38	48	68
	RDT112L	Nickel	120	.00672	28	38	48	68
	RDT164L	Nickel - Iron	604	.00518		38	48	68

Note: R1T191 has been changed to R1T192 to reflect a change to ITS-90 temperature scale

1-3 ELEMENT WIRE

ORDER CODE	DESCRIPTION
2	2 wire per element
3	3 wire per element
4	4 wire per element

1-2A

ORDER CODE	Nominal Sheath Dia.	Tip Dia.	Tip Length	Material
88R48	1/2" OD	1/4" OD	1 1/4"	316 SS
68R48	3/8" OD	1/4" OD	1 1/4"	316 SS
68R38	3/8" OD	3/16" OD	1 1/4"	316 SS
68R28	3/8" OD	1/8" OD	1 1/4"	316 SS
48R38	1/4" OD	3/16" OD	1 1/4"	316 SS
48R28	1/4" OD	1/8" OD	1 1/4"	316 SS

REDUCED TIP RTD's

Table 1-2A lists RTD elements with reduced tip sheaths. To order, use order code numbers from Tbl. 1-2A in place of straight sheath order code numbers from Tbl. 1-2. Other reduced tips are available upon request. Example: R1T185L68R483-006

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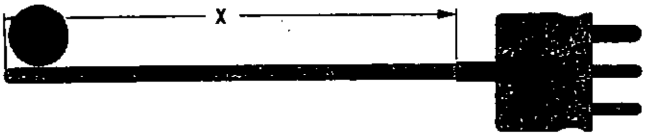

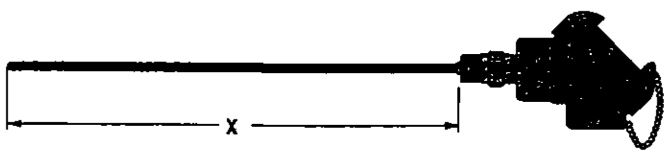

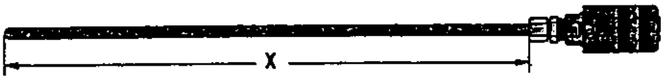

EXAMPLE ORDER NUMBERS: R5T185L483 - 006 - 00 - 6HN 31 (3-1: 6HN, 3-2: 31) **OR** R5T185L483 - 006 - 01A,304 - 16 (3-1: 16)

3-1 [illegible]

ORDER CODE	DESCRIPTION
6HN	1/2" x 1/2" NPT steel hex nipple
8HN	1/2" x 1/2" NPT stainless steel hex nipple
[illegible]	1/2" NPT stainless steel bushing (no process threads)
8RNDC	3/4" process x 1/2" NPT stainless steel hex nipple
22CF	Brass compression fitting (not available with head termination order codes 52, 71, or 81)

HEAD MOUNTING FITTINGS FOR MINIATURE HEADS

ORDER CODE	DESCRIPTION
9HNB	1/4" x 1/4" NPT stainless steel hex nipple
9HPB	1/4" NPT stainless steel bushing (no process threads)
22CFB	Brass compression fitting

3-2 STANDARD HEAD TERMINATIONS

ORDER CODE	DESCRIPTION
22	No head (3" individual leads) *(3" leads are standard; for different leadwire style or length, pages RTD-5 and RTD-6 must be completed)*
31	Cast aluminum screw cover head
34	Cast iron screw cover head
49	Flip top aluminum head
52	Class B explosion proof head
53	Delrin screw cover head
63	Polypropylene screw cover head
71	Cast iron/aluminum explosion proof head
81	316L stainless steel explosion proof head
91	316L stainless steel head
OPTIONS	
CT	Ceramic terminal block
GS	Ground screw (standard with opt. 52, 71, 81)
I	Stainless steel tag (supply tag information)
SB	1/2"NPT conuit reducer bushing
T	Transmitter
W	White epoxy coating

MINIATURE HEAD TERMINATIONS

ORDER CODE	DESCRIPTION
14	Ceramic Wafer head (not available in high temp construction)
17	Miniature plastic head
25	Miniature nickel plated head

3-1 LEADWIRE TRANSITIONS (Requires [illegible] and 5 selections)

ORDER CODE	DESCRIPTION
15	Extension leadwire transition with relief spring (400°F)
16	Extension leadwire transition with heat shrink tubing (220°F)
13	Same size transition with heat shrink tubing (220°F) Note 1
18	Same size transition without heat shrink tubing (400°F) Note 1
19	Extension leadwire transition without spring or heat shrink (400°F)

The temperature rating for the transition is for the epoxy. Individual lead selection might alter maximum rating.

OPTIONS	
HT Note 2	High temperature potting (1000°F) not available with option 13 or option 16

PLUG AND JACK TERMINATIONS

ORDER CODE	DESCRIPTION
4	Standard male plug (350°F)
5	Standard female jack (350°F)
6	Miniature male plug (350°F)
7	Miniature female jack (350°F)
OPTIONS	
MC	Mating connector
CC	Cable clamp
CL	Compression L bracket to hold plug to sheath

Note 1: 1/8" sheath diameter limited to wire code T3J, T3 or K3

Note 2: Not available with teflon or PVC insulated leadwire

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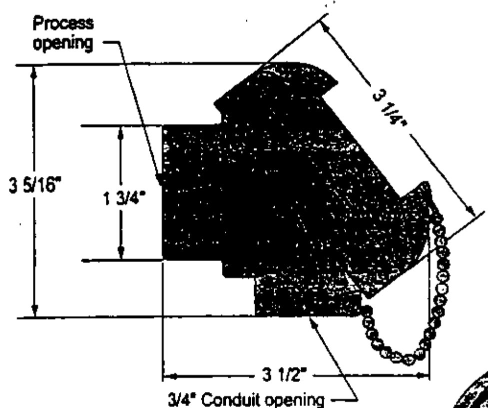
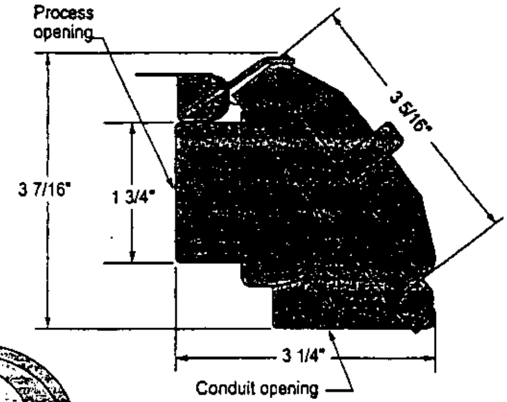
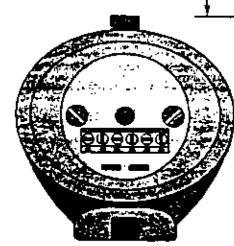
The thermocouple and RTD connection heads listed below meet the NEMA 4 requirements for indoor or outdoor non-hazardous use to provide protection against dust, rain, splashing and hose directed water. The 300 series heads include a compressed graphite material gasket that provides high chemical stability, good creep resistance, excellent wet/steam sealing characteristics and have an 825°F maximum temperature rating. The 500 series flip top aluminum head utilizes an EPDM O-ring seal with a maximum temperature rating of 400°F. These heads accept the Pyromation 340 series terminal blocks, Pyromation transmitters and DIN standard blocks and transmitters.







Now accepts DIN blocks and transmitters

DIE CAST ALUMINUM SCREW COVER

PROCESS OPENING SIZE	ORDER CODE HEAD & CAP WITHOUT BLOCK	SINGLE	DUPLEX	TRIPLEX 2-Term	TRIPLEX 3-Term	TRIPLEX 4-Term	TRIPLEX 6-Term
		Order Code for Complete Head and Block Assemblies					
1/8" NPT	301	311	321	331-2	331-3	331-4	331-6
1/4" NPT	302	312	322	332-2	332-3	332-4	332-6
3/8" NPT	303	313	323	333-2	333-3	333-4	333-6
1/2" NPT	304	314	324	334-2	334-3	334-4	334-6
3/4" NPT	305	315	325	335-2	335-3	335-4	335-6
1" NPT	306*	316	326	336-2	336-3	336-4	336-6

*Not available with DIN mounting holes

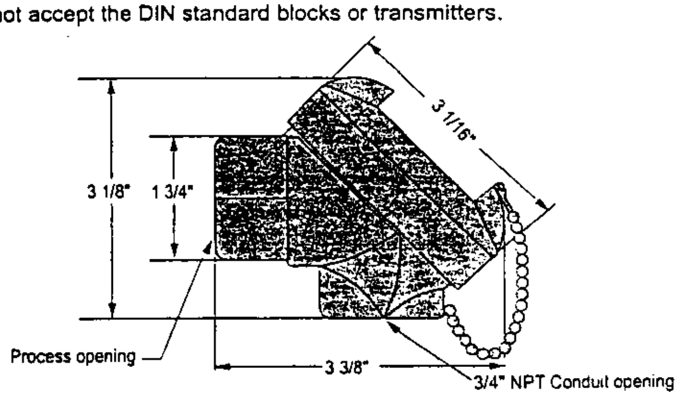
DIE CAST ALUMINUM FLIP TOP

PROCESS OPENING SIZE	ORDER CODE HEAD & CAP WITHOUT BLOCK	SINGLE	DUPLEX	TRIPLEX 2-Term	TRIPLEX 3-Term	TRIPLEX 4-Term	TRIPLEX 6-Term
		Order Code for Complete Head and Block Assemblies					
1/2" NPT	504	514	524	534-2	534-3	534-4	534-6
3/4" NPT	505	515	525	535-2	535-3	535-4	535-6

Other process openings available with minimum purchase

CAST IRON and STAINLESS STEEL CONNECTION HEADS

The thermocouple and RTD connection heads listed below also meet the NEMA 4 requirements discussed at the top of the page. The electroless nickel plated cast iron head offers some degree of corrosion resistance. The 316L stainless steel head offers excellent corrosion resistance and chemical resistance. These heads will accept any of the Pyromation 340 series terminal blocks and Pyromation transmitters. These heads will not accept the DIN standard blocks or transmitters.



316L STAINLESS STEEL

PROCESS OPENING SIZE	ORDER CODE HEAD & CAP WITHOUT BLOCK	SINGLE	DUPLEX	TRIPLEX 2-Term	TRIPLEX 3-Term	TRIPLEX 4-Term	TRIPLEX 6-Term
		Order Code for Complete Head and Block Assemblies					
1/2" NPT	904	914	924	934-2	934-3	934-4	934-6
3/4" NPT	905	915	925	935-2	935-3	935-4	935-6

CAST IRON

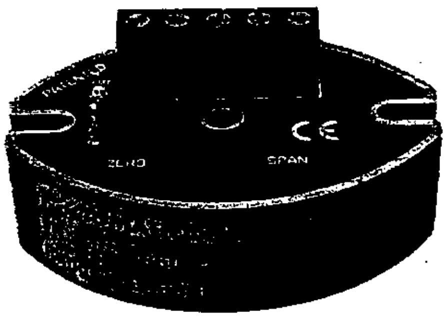
PROCESS OPENING SIZE	ORDER CODE HEAD & CAP WITHOUT BLOCK	SINGLE	DUPLEX	TRIPLEX 2-Term	TRIPLEX 3-Term	TRIPLEX 4-Term	TRIPLEX 6-Term
		Order Code for Complete Head and Block Assemblies					
1/2" NPT	307	317	327	337-2	337-3	337-4	337-6
3/4" NPT	308	318	328	338-2	338-3	338-4	338-6
1" NPT	309	319	329	339-2	339-3	339-4	339-6

HEAD OPTIONS

ORDER CODE	DESCRIPTION
B	Head with internal ground screw
W **	Protective epoxy coating (2 mil. thickness - white only) ** Not available in flip top aluminum or stainless steel
R	Ethylene propylene rubber gasket with adhesive

Add Suffix Above to Part Number. Example: #334 - 4B

The patented Pyromation RTD temperature transmitters are designed to produce a linearized (4 to 20) mA dc output current signal, which is directly proportional to the temperature of the RTD temperature sensing element. A variety of models are available for RTD sensor inputs of different element values and temperature coefficients. The model described is designed for use with RTDs that have platinum measuring elements with temperature coefficients of 0.00385 and 0.00392.

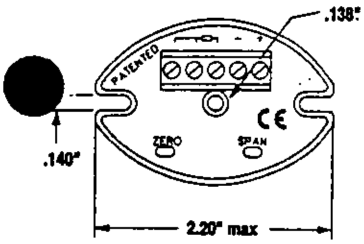


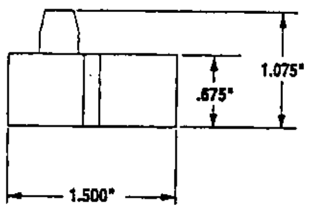
FEATURES

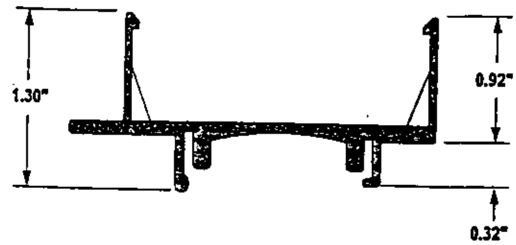
- Small size allows universal mounting in all Pyromation screw cover heads, thermostat housings, electrical handiboxes, and surface mounting on panel subplates
- Linearized (4 to 20) mA dc outputs
- Degree Fahrenheit or Celsius ranges
- Loop Powered (24 V dc nominal)
- Accepts 2 or 3 wire RTDs
- Zero and Span adjustments
- 48 hour burn-in prior to calibration and shipment
- Reverse polarity protection
- RFI/EMI Protected, CE marked

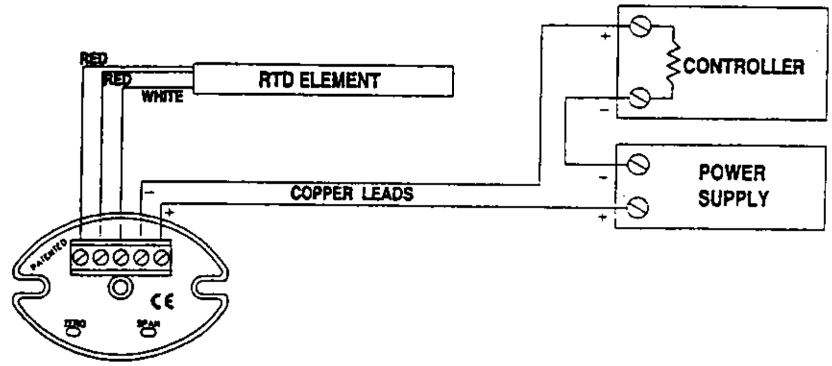
STANDARD MODEL SPECIFICATIONS

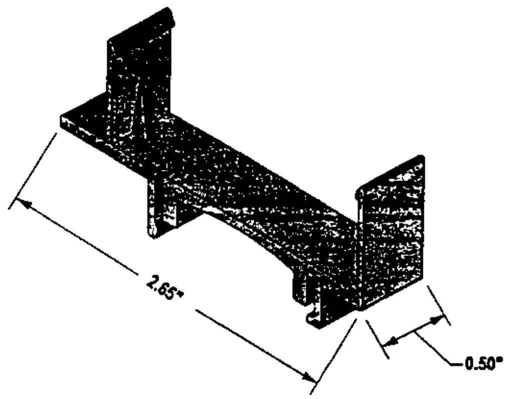
Sensor Input	2 and 3 wire platinum RTDs 0.00385 (Pt-100, Pt-200, Pt-500[1], Pt-1000[1]) 0.00392 (Pt-100, Pt-200) Note[1] = available in limited ranges	**Linearity** **% of span**	0.1% (0 to 660) °C [(32 to1220) °F] 0.2% (-200 to 660) °C [(-328 to1220) °F]
Output	(4 to 20) mA dc	**Calibration**	± 16 µA
Supply Voltage	(9 to 36) V dc at no load	**Repeatability**	0.001 mA
Open Circuit Detection	Upscale and Downscale	**Operating Temperature**	(-30 to 65) °C [(-22 to 149) °F]
Minimum Span	38 °C [69 °F]	**Temperature Influence**	0.02%/°C
Maximum Span	860 °C [1548 °F]	**Supply Voltage Effect**	.001%/V dc
Minimum Current	≈ 2.6 mA dc	**Zero Adjustment**	± 5 Ω typical
Maximum Current	≈ 30 mA dc	**Span Adjustment**	± 10 Ω typical
Minimum Voltage	$V_{Min} = 20_{mA} \times R_{Load} + 9$ V dc	**RFI Influence**	< 1.3% effect of span at (80 to 1000) MHz at a field strength of 10 V/m
Maximum Load	$R_{Maxload} = (V_{Supply} - 9 \text{ V dc}) / 20$ mA		











EXAMPLE ORDER NUMBER: **401L - 85U - 1825F**

INPUT SENSOR

ORDER CODE	RTD
85	100 Ohm Platinum α = 0.003 85
25	200 Ohm Platinum α = 0.003 85
55	500 Ohm Platinum α = 0.003 85
95	1000 Ohm Platinum α = 0.003 85
92	100 Ohm Platinum α = 0.003 92
22	200 Ohm Platinum α = 0.003 92

BURNOUT

ORDER CODE	DESCRIPTION
U	Upscale Burnout ≈ 30 mA
D	Downscale Burnout ≈ 2.6 mA

ACCESSORIES

ORDER CODE	DESCRIPTION
400-DIN35	35mm DIN rail mounting clip

RANGE CODES

RANGE CODE	TEMPERATURE RANGE	RANGE CODE	TEMPERATURE RANGE
1050	-200 to 0 F or C	3065	20 to 120 F or C
1080	-200 to 100 F or C	3080	25 to 100 F or C
1109	-100 to 0 F or C	3085	25 to 200 F or C
1110	-100 to 100 F or C	3105	30 to 130 F or C
1380	-50 to 50 F or C	3110	30 to 180 F or C
1725	0 to 50 C	3115	30 to 230 F or C
1750	0 to 100 F or C	3158	40 to 140 F or C
1775	0 to 150 F or C	3162	40 to 240 F or C
1800	0 to 200 F or C	3200	50 to 100 C
1825	0 to 250 F or C	3208	50 to 150 F or C
1850	0 to 300 F or C	3213	50 to 200 F or C
1875	0 to 350 F or C	3218	50 to 250 F or C
1900	0 to 400 F or C	3224	50 to 300 F or C
1925	0 to 450 F or C	3226	50 to 350 F or C
1950	0 to 500 F or C	3250	50 to 500 F or C
1975	0 to 550 F or C	3255	50 to 650 F or C
2000	0 to 600 F or C	3505	100 to 200 F or C
2025	0 to 650 F or C	3515	100 to 300 F or C
2050	0 to 700 F	3520	100 to 400 F or C
2075	0 to 750 F	3525	100 to 500 F or C
2100	0 to 800 F	3530	100 to 600 F or C
2125	0 to 850 F	3568	150 to 250 F or C
2150	0 to 900 F	3573	150 to 300 F or C
2175	0 to 950 F	3600	200 to 250 C
2200	0 to 1000 F	3605	200 to 300 F or C
2250	0 to 1100 F	3610	200 to 400 F or C
2300	0 to 1200 F	3615	200 to 500 F or C
		3655	300 to 400 F or C

Consult factory for temperature ranges not listed

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The information contained in the following pages is intended as a guideline for general RTD sensor useage. Specific applications and environmental conditions may require that other sensor element types, element materials, or construction styles be used to provide optimum temperature measurement results. The dimensions, temperature ratings, accuracies, and other specifications may vary to satisfy a particular application requirement. For further information and recommendations on specific applications, please consult with the factory.

RTD ELEMENTS

Elements of several different materials, base resistances, temperature coefficients, accuracies, and construction styles are available for installation into final RTD temperature sensor assemblies to meet customer specifications. The most commonly used element throughout the USA and Europe is a wire-wound or thin film platinum with a base resistance of 100 ohms at 0°C and with a .00385 ohms/ohm/°C temperature coefficient.

A few USA companies, and most Japanese companies, use a similar 100 ohm platinum element, but with a .00392 ohms/ohm/°C temperature coefficient.

Pyromation's standard element for either of these specified assemblies is a wire-wound type, in which the platinum winding is supported inside a ceramic body, although other process considerations may sometimes require the use of a thin film or "glassed-in" type of element. Elements of materials other than platinum are typically wire-wound on a core and covered with an insulating material such as Kapton.

The platinum elements used in Pyromation RTD assemblies are in accordance with the specifications set forth in the following standards:

STANDARDS for .00385 TEMPERATURE COEFFICIENT ELEMENTS

1.	German Standard:	DIN 43760 - 1980
2.	British Standard:	BS 1904 - 1984
3.	International Electrotechnical Commission Standard:	IEC 751 - 1983

STANDARDS for .00392 TEMPERATURE COEFFICIENT ELEMENTS

1.	American Scientific Apparatus Manuf. Association:	SAMA RC21 - 4 - 1966
2.	Japanese Standard:	JIS C1604 - 1989

RTD ELEMENT TERMINOLOGY and SPECIFICATIONS

Temperature Coefficient: Known as the "Alpha" value, and it is the average fractional change of element resistance per a 1°C change in the element temperature over the range of 0 to 100°C. The temperature coefficient of resistance is expressed as ohms/ohm/°C.

Accuracy: A statement of the initial element accuracy when its base resistance value is measured at **one point only**, usually 0°C.

Repeatability-Stability: The ability of an element to reproduce the same resistance or temperature reading each time it is at equilibrium at a given repeated temperature. Expressed as a ± resistance or temperature value over a given temperature range. May also be expressed as the stability of its resistance. Typically platinum elements will not change more than .04% at 0°C after receiving ten consecutive shocks from -200 to + 600°C.

Self-Heating: RTD elements are not self-powered and require a small current be passed through the device to provide a voltage that can be measured. Self-heating is the rise of temperature within the element itself, caused by the current flowing through the element. This self-heating appears as a measurement error and is affected by the thermal conductivity and velocity of the process being measured; it is negligible for most applications. Typical platinum resistance elements would require 60mV of power dissipation to cause a 1.8°F(1°C) temperature measurement error when tested in water flowing at 3 ft./sec.

Time Constant: The time required to sense 63% of a step temperature change from 25 to 80°C in water flowing at 3 ft./sec. See typical response times on page RTD Specs-III.

Interchangeability: The amount of allowable difference in readings between two RTD's when placed side by side in a process at the same temperature. Determined by the allowable RTD tolerance at that particular temperature.

Tolerance: The amount of resistance error tolerated when the elements are measured at various temperature points. Pyromation 100 and 200 ohm platinum elements are offered in three base resistance tolerance bands as follows:

Band 1:	± .1% @ 0°C	(Actual Elements Used Exceed DIN Class B Tolerances)
Band 3:	± .03% @ 0°C	(Actual Elements Used Exceed DIN Class A Tolerances)
Band 5:	± .01% @ 0°C	(Actual Elements Used Exceed DIN Class A Tolerances)

Elements of other values and of other materials are offered in the following base resistance tolerance bands:

DIN Class A	± .06% @ 0°C
DIN Class B	± .12% @ 0°C
Class C	± .2% @ 0°C
Class D	± .5% @ 0°C

Vibration: Pyromation's fully assembled sheathed RTD sensors are designed to withstand an average vibration level of 30 G's using random vibrating frequencies from 20 to 2,000 HZ at ambient temperature. Supporting test results indicate that initial RTD tolerances remain as specified when tested at these vibration levels.

Humidity Limits: Sheaths, transition fittings, and lead seals capable of withstanding 100% humidity at normal atmospheric pressure, and at normal ambient temperatures.

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PYROMATION'S STANDARD RTD ELEMENT SPECIFICATIONS

ELEMENT MATERIAL (NOTE 1)	RESISTANCE @ 0° C	TEMPERATURE COEFFICIENT	OPERATING RANGE (NOTE 2)	AVAILABLE ACCURACIES @ 0° C	CATALOG ORDER CODES
Platinum	100 Ohm	.00385	-328 to 1112°F (-200 to 600°C)	± .1% ± .03% ± .01%	R1T R3T R5T
Platinum	100 Ohm	.00392	-328 to 1112°F (-200 to 600°C)	± .1% ± .03%	R1T R3T
Platinum	200 Ohm	.00385	-328 to 1112°F (-200 to 600°C)	± .1% ± .03% ± .01%	R1T R3T R5T
Platinum	200 Ohm	.00392	-328 to 1112°F (-200 to 600°C)	± .1% ± .03%	R1T R3T
Platinum	500 Ohm	.00385	-94 to 932°F (-70 to 500°C)	± .12%	RBF
Platinum	1000 Ohm	.00385	-94 to 932°F (-70 to 500°C)	± .12%	RBF
Copper	10 Ohm	.00427	-328 to 400°F (-200 to 204°C)	± .2%	RCT
Nickel	120 Ohm	.00672	-328 to 400°F (-200 to 204°C)	± .5%	RDT
Nickel-Iron	604 Ohm	.00518	-328 to 400°F (-200 to 204°C)	± .5%	RDT

NOTE 1: Sensing elements of other materials, base values, and temperature coefficients are available upon request.

NOTE 2: Stated operating ranges are typical values and are dependant upon the sensing element, element substrate, and the construction style of the total sensor assembly. Sensor assemblies to exceed the stated limits may be available upon request.

TYPICAL 100 OHM PLATINUM ELEMENT TOLERANCES

TEMPERATURE		CLASS B (.12%) TOLERANCE DIN B [0.3 + 0.005 |t|] 0.12%		BAND 1 (.10%) TOLERANCE BAND 1 [0.26 + 0.0042 |t|] 0.1%		BAND 5 (.01%) TOLERANCE BAND 5 [0.03 + 0.0017 |t|] 0.01%	
F°	C°	F	C	F	C	F	C
-328	-200	1.30	2.34	1.10	1.98	0.37	0.67
-148	-100	0.80	1.44	0.68	1.22	0.20	0.36
32	0	0.30	0.54	0.26	0.47	0.03	0.05
212	100	0.80	1.44	0.68	1.22	0.20	0.36
392	200	1.30	2.34	1.10	1.98	0.37	0.67
572	300	1.80	3.24	1.52	2.74	0.54	0.97
752	400	2.30	4.14	1.94	3.49	0.71	1.28
932	500	2.80	5.04	2.36	4.25	0.88	1.58
1112	600	3.30	5.94	2.78	5.00	1.05	1.89

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[illegible]

Low Range - Thin Film Construction (L) **-40°F to 400°F (-40°C to 204°C)**

The element is welded to teflon insulated silver plated copper leads, and then placed inside a specially cleaned stainless steel sheath. The space surrounding the element and leads is filled and loosely packed with alumina oxide powder to provide good heat transfer times and to provide a damping cushion against vibration and mechanical shock. The filled sheath is then sealed with low temperature epoxies to prevent moisture penetration.

Standard Low Range (L) **-328°F to 400°F (-200°C to 204°C)**

The element is welded to teflon insulated silver plated copper leads, and then placed inside a specially cleaned stainless steel sheath. The space surrounding the element and leads is filled and loosely packed with alumina oxide powder to provide good heat transfer times and to provide a damping cushion against vibration and mechanical shock. The filled sheath is then sealed with low temperature epoxies to prevent moisture penetration.

Standard High Range (H) **-328°F to 1112°F (-200°C to 600°C)**

The element is welded to nickel leads that are insulated with compacted magnesium oxide (MgO) powder inside the stainless steel sheath. The void surrounding the element is packed with MgO powder and the sheath tip is welded closed with a stainless steel cap. The leads and sheath are sealed with low temperature epoxies to prevent moisture penetration.

MECHANICAL SPECIFICATIONS

The following specifications are those found on standard construction RTD sensor assemblies.

[illegible]

MATERIAL	CODE	APPLICATION DATA	NOTES
316 SS	8	Superior Corrosion Resistance	Used as standard sheath material on all but 1/16" OD sheaths
Inconel 600	3	Excellent Corrosion and Oxidation Resistance at High Temperatures	

[illegible]

ORDER CODE	STYLE	SHEATH OD	NPT SIZE	LENGTH
01A	One-Time SS Adj.	1/8, 3/16, 1/4	1/8"	1 5/16"
01B	One-Time SS Adj.	1/8, 3/16, 1/4, 3/8	1/4"	1 7/8"
01C	One-Time SS Adj.	1/8, 1/4, 3/8	1/2"	1 13/16"
10A	SS Re-Adjustable	1/8, 3/16	1/8"	1 1/4"
10B	SS Re-Adjustable	1/4, 3/8	1/4"	2 7/16"
11A	Brass Re-Adjustable	1/8, 3/16, 1/4	1/8"	1 19/64"
11B	Brass Re-Adjustable	1/8, 3/16, 1/4, 3/8	1/4"	1 9/16"
11C	Brass Re-Adjustable	1/4, 3/8	1/2"	1 13/16"
13	Fixed Bayonet Fitting	1/8, 3/16	None	1 5/8"
14	Adjustable Flange	1/8, 3/16, 1/4, 3/8	None	1 1/2"
15A	Brass One-Time Adj.	1/8, 3/16, 1/4	1/8"	1 1/4"
15B	Brass One-Time Adj.	1/8, 3/16, 1/4, 3/8	1/4"	1 3/8"
15C	Brass One-Time Adj.	1/4, 3/8	1/2"	1 1/2"
16	Adj. Bayonet Comp. Ftg.	1/8	None	1 5/8"
19	S-L SS Well Ftg.	3/16, 1/4	1/2"	2 1/4"
8A	Fixed Brazed Bushing	1/8, 3/16, 1/4	1/8"	5/8"
8B	Fixed Brazed Bushing	1/8, 3/16, 1/4, 3/8	1/4"	11/16"
8C	Fixed Brazed Bushing	1/8, 3/16, 1/4, 3/8	1/2"	15/16"
8D	Fixed Brazed Bushing	1/8, 3/16, 1/4, 3/8	3/4"	1"
6HN	Steel Hex Fitting	1/8, 3/16, 1/4, 3/8	1/2"	2"
8HN	316 SS Hex Fitting	1/8, 3/16, 1/4, 3/8	1/2"	2"
9HNA	303 SS Hex Fitting	1/8, 3/16, 1/4	1/8"	1 3/8"
9HNB	303 SS Hex Fitting	1/8, 3/16, 1/4, 3/8	1/4"	1 3/16"

[illegible]

ORDER CODE	SHEATH DIAMETER	FITTING OD	FITTING LENGTH WITH SPRING	FITTING LENGTH W/O SPRING
15, 16	1/8"	1/4"	2 1/4"	1 1/4"
15, 16	*1/8"	3/8"	2 1/2"	1 1/4"
15, 16	3/16"	3/8"	2 1/2"	1 1/4"
15, 16	1/4"	3/8"	2 1/2"	1 1/4"
15, 16	3/8"	7/16"	2 1/4"	1 1/2"

* Used with flexible armor tubing and duplex RTD's

[illegible]

DESCRIPTION	DIMENSIONS	Max. Temp. Rating
304 SS Flexible Armored Tubing	.188 ID x .275 OD	1600°F
PVC Covered 304 SS Flexible Armored Tubing	.188 ID x .343 OD	212°F
Teflon Covered 304 SS Flexible Armored Tubing	.188 ID x .313 OD	400°F

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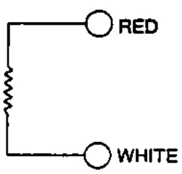
[illegible]

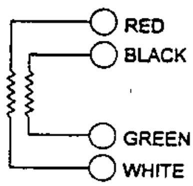
RTD sensor assemblies are available with two, three, and four wire leads. Two wire connected elements do not provide lead resistance compensation for the measuring device. Three and four wire connected elements provide a means for compensating for lead resistance between the sensor and the measuring device.

Two-Wire: Provides one connection to each end of the element. This construction is suitable where the resistance of the lead wire may be considered as an additive constant in the circuit, and particularly where the changes in lead resistance due to ambient temperature changes may be ignored.

2 WIRE SINGLE

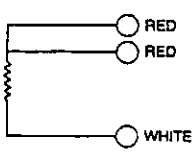


2 WIRE DUPLEX

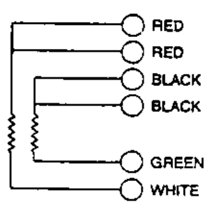


Three-Wire: Provides one connection to one end of the element and two to the other end of the element. Connected to an instrument designed to accept three wire input, sufficient compensation is usually achieved for leadwire resistance and temperature change in leadwire resistance. This is the most commonly used configuration.

3 WIRE SINGLE

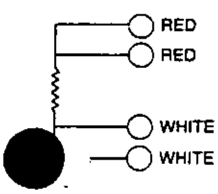


3 WIRE DUPLEX

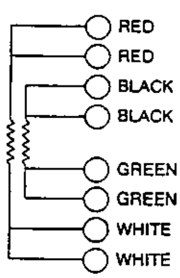


Four-Wire: Provides two connections to each end of the element to completely compensate for leadwire resistance and temperature change in leadwire resistance. This configuration is used where highly accurate temperature measurement is vital.

4 WIRE SINGLE



4 WIRE DUPLEX



LEADWIRE RESISTANCE

Lead resistance has a large effect on RTD temperature measurement accuracy. A two wire circuit provides no compensation and can provide large measurement errors. The following table shows the effects of leadwire resistance on temperature measurements using low temperature RTD assemblies with copper leadwire.

LEADWIRE RESISTANCE			
		UNCOMPENSATED 2-WIRE CIRCUITS	
LEADWIRE WIRE GAUGE	RESISTANCE OHMS PER FOOT	MAX. LENGTH FOR 1°F ERROR	ERROR IN °F PER DOUBLE FT.
30	.133	.81 Ft.	1.24°F
24	.0333	3.2 Ft.	.31°F
22	.0213	5.1 Ft.	.198°F
20	.0148	7.27 Ft.	.14°F
18	.0083	13.0 Ft.	.077°F
16	.0052	20.7 Ft.	.048°F

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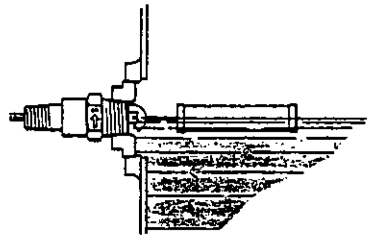
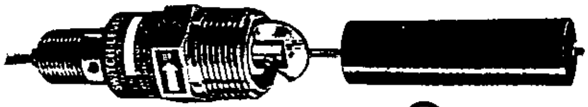
"E"

unted . . . Level Switches . . .
ɡht at the point of actuation . . .



ɔlve the problem of point level sensing in tanks with inaccessible tops or bottoms, diate locations in larger tanks. Installation is through the tank side...from the ıt at the detection point. Operation is positive and dependable. The float pivots g liquid level, displacing a shuttle which magnetically actuates a hermetically within the unit.

S-2050 Series Rugged brass or all-SS units operate iably in pressure to 900 PSIG. Brass/Buna N units for use ɔils, water...all-SS units for use in oils, water, chemicals, rrosive liquids.

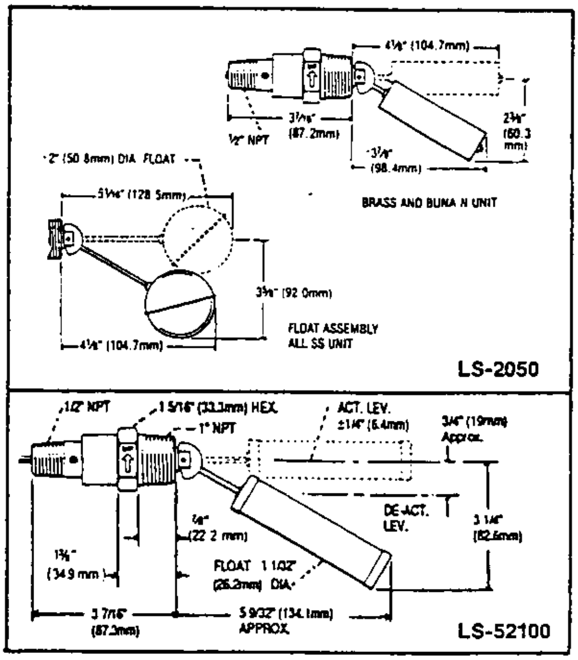


S-52100 Series Rugged, all-SS, with 1" dia. cylincal float. For use in water, oils, chemicals...at temperatures +300° F.

ions . . .

	LS-2050		LS-52100
[illegible]	Brass	316SS	316SS
[illegible]	Buna N	316SS	304SS
mp. [illegible]	32 to 180 Water / 0 to 250 Oil	-40 to 300	
70°F	150	900	200
[illegible]	NPT [illegible]		
Elec. [illegible] P-2	SPST 20/100 VA or SPDT 20 VA		
al [illegible]	½ min.		Approx. [illegible]
vity [illegible]	.8 min.	.9 min.	.85 min.
[illegible]	#18 AWG, 24"		

Dimensional Data . . .



⁄lodels . . .

Housing Mat.	Float Mat.	Switch	P/N
Brass	Buna N	SPDT 20 VA	30288
		SPDT 20 VA	30290
	316SS	SPST 100 VA N.C.	48068
		SPST 100 VA N.C.	48069
		SPDT 20 VA	52100
316SS	304SS	SPST 100 VA N.O.	116971
		SPST 100 VA N.C.	116972

Note:

GEMS LS-2050 Series Level Switches are available FM-approved, explosion-proof for Class I, Division 1, Group D hazardous areas.. Consult Gems Sensors Division for ordering P/N.

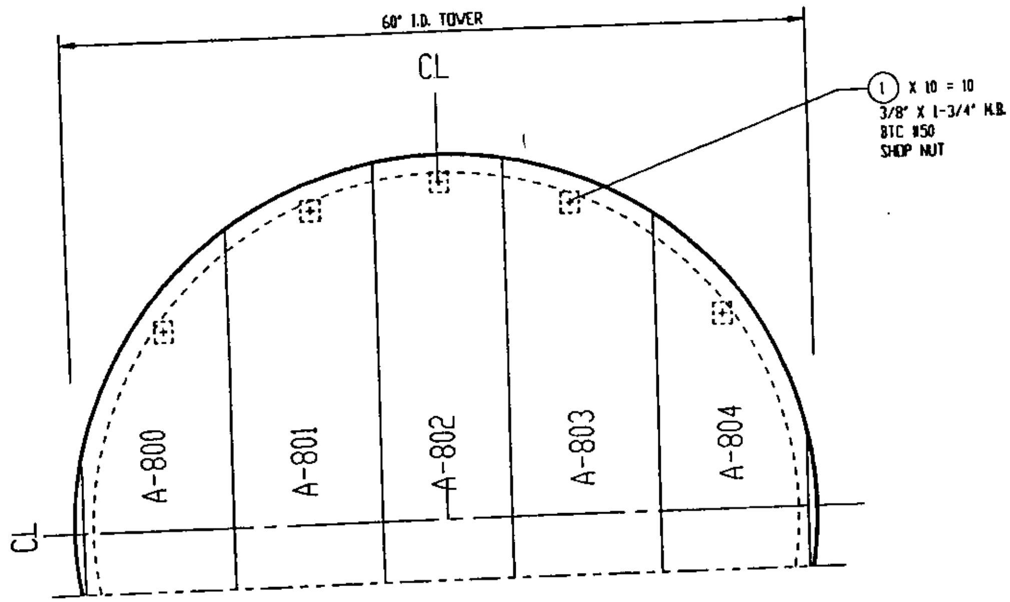
GEMS LS-2050 Series Level Switches are **UL-Recognized – File No. E45168** and are **CSA listed.**

*Other Wetted mat.: Brass/Buna N units – SS, 316SS, beryl, copper, Teflon, ceramic.
316SS units – SS, Teflon, ceramic.

**Other wetted materials: 430SS, Teflon, ceramic.

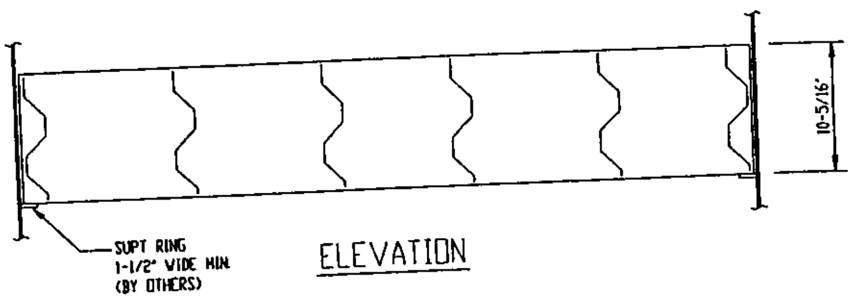
***Level switch units with 50 VA and/or 100 VA switches are not UL-recognized.

"F"

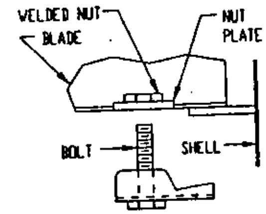


HALF PLAN

2 REQ'D MK'D 'A'



ELEVATION



HOLD-DOWN DETAIL

NOTES :

1. ALL PARTS DESIGNED TO PASS THRU 18" I.D. MANWAY.
2. ALL FLEXICHEVRON® PARTS BY KOCH.
3. ALL TOWER ATTACHMENTS BY OTHERS.
4. INSTALL FLEXICHEVRON® AND PUSH OUT AGAINST THE SHELL.
5. FLOW DIRECTIONAL DECALS TO BE APPLIED TO EACH MODULE.

MATERIAL:

FLEXICHEVRON® ------------ 304L
FLEXICHEVRON® HARDWARE -------- 304L

EQUIPMENT DESCRIPTION

QUAN	ITEM	DESCRIPTION	REMARKS
-	V	ASSEMBLY OF FLEXICHEVRON®	

NO.	DESCRIPTION OF REVISION	CHG BY/DATE	APPV'D.

CUSTOMER'S IDENTIFICATION

PURCHASED BY: SLY INC. @ CLEVELAND, OH.	
P.O. NO: 66253	
USER:	PLANT SITE:
SPEC. NO:	REFERENCE:
TOWER SERVICE:	PLANT SECTION:

KOCH-OTTO YORK®
SEPARATIONS TECHNOLOGY
WORLD LEADER IN MIST ELIMINATION TECHNOLOGY

A division of Koch-Glitsch, Inc.
Wichita, KS 67220
316/828-5110

MODEL: STYLE VIII-3-LS

DRAWN BY: BP	DATE: 1-23-02
CHECK BY: BLC	DATE: 1-23-02
PROCESS:	

SALES ORDER NO. : 936758
PART NO. : 90475405
WORK ORDER NO. : 073642

DRAWING ISSUE

APPROVED FOR FABRICATION	CERTIFIED FINAL AS FABRICATED
BY: BP	BY:
DATE: 2-1-02	DATE:

TOWER DIA.	VESSEL NO.
5'-0" I.D.	

DWG. NO: 936758-B-01

SHT. 1 OF 1 REV. ◇

INSTALLATION DRAWING

Appendix I

Operations and Maintenance Plans

Operations and Maintenance Manual for RTO

H E SARGENT INC
SEQUENCE of OPERATIONS
RTO 1A

SEQUENCE START

Normal Start Up is via automatic start from the Local Control Panel at the machine (RTO-A), Panel View Operator Interface, or remote designated location (SCADA system). The Local Panel will house the PLC, Temperature controls, burner safeguard unit, the Panel View Operator Interface, alarm horn, start/stop, auto/manual controls, and indicator lights for basic oxidizer functions.

1. Push the START pushbutton on the RTO-A or from the main process SCADA (via MCP-1A). If started from the SCADA system, MCP-1A sends a PRE-PURGE Command to RTO-A. If the following conditions are satisfied:
   - Combustion Gas valve Proof of Closure (ZSC 531C &531A)
   - Mode is Natural Gas (FCV ZSC 531I)
   - Injection Valve closed (FCV ZSC 531E)
   - Combustion Blower in Auto (F4A)
   - Process Blower in Auto (F3A)
   - Lock Out key switch in OFF.
   - Dryer Bypass Valve closed (FCV ZSC 520E)
   - No system cooldown

   The system continues to the next step. If the conditions are not satisfied an alarm is activated at RTO-A.

   NOTE The RTO System Selector switch must be in **REMOTE** position to allow interfacing with Dryer and SCADA network. If the switch is in the **LOCAL** position,only action possible is the running of the Fans, with no Burner Ignition possible. *****

2. The system will then cycle the Poppet valves (FCV520A &C) one complete cycle. If the Poppet limit switches are not made the system will activate an alarm. If the limits are made close poppet valves FCV-520A/C at the chamber and open valve FCV 520I to isolate the RTO from the rest of the process. RTO-A will send a PRE-PURGE CONFIRMED message to the MCP-1A.

3. Upon receipt of the INITIATE DRYER PURGE signal from MCP1-A, the RTO Fan F-3A will turn on. Fan F-3A shall operate at a constant speed until completion of the purge cycles. After completion of the dryer purge, MCP1-A will send a RTO PURGE ENABLE signal, at which time RTO-A will close the Dryer Bypass damper and return the Poppets to their regular cycle times

4. A start signal will be sent to the Combustion blower.

   Once these requirements are met:
   - Combustion Blower F-4A energized and Combustion Air Pressure switch closed (PSL 530A)
   - RTO fan F-3A energized and Process Air Pressure switch closed.(FSL-520A)

   A Safe run enable status is then achieved.

5. Once Safe Run enable is met, a RTO Purge signal will begin to purge the Combustion Chamber...upon completion of the RTO purge, RTO-A sends a PURGE COMPLETE signal to MCP-1A.

6. After the dryer and RTO purge cycles and operator action completed we enable the PREHEAT mode. Upon receiving the PreHeat signal, the Honeywell Burner Control Module and the PLC will cycle a gas line purge by sending first a 30 second open (high-fire) signal, followed by a 30 second close (low fire) signal to the combustion actuator. Burner lightoff will be intiated by having the Operator press the "FLAME START/RESET" pushbutton at RTO-A or at the SCADA system whereupon an IGNITE RTO signal will be sent from MCP-1A to RTO-A The Burner module will then perform a pilot ignition (there are also 2 burner restart buttons for maintenance and startups, one located behind the Panelview and one located on RTO-A)

7. Pilot Ignition is allotted 5 seconds, after 5 sec. There should be a flame detected by the UV scanner. At this point the Main blocking valves will open.The module will go through internal safety checks before igniting the burner.

8. Once the burner is lit the combustion ramp rate and temperature set point will be controlled by the Allen Bradley PLC in RTO-A. It will gain temperature at a rate of 500deg F per hour until the set point of 1600deg F is reached. Modulation of the Combustion actuator is controlled by the PLC.

9. Once the Up-to-Temperature signal is received from the PLC, a soak timer is activated and upon completion RTO-A generates a RTO READY signal to MCP1-A. We also need to be up to temp to switch over from Natural to Digestor gas. This is a manually operated hand valve. (FCV531I)

10. The Dryer Furnace pressure transmitter will send a 4-20ma signal to the RTO-A PLC. It will take this signal and modulate the VFD (thru set points and tuning parameters entered in the Panel View). Also after Up-to-Temp, and Gas Injection mode, the Fuel line solenoid will close (FCV 531C) and the Fuel Injection isolation valve (FCV 531E)

will open and the PLC will also control the modulating valve (FCV 531K) thru set points and parameters in the RTO-A PLC and PanelView.

11. There is a pushbutton on both the PanelView interface panel AND the RTO-A for reset of the Burner module (for Burner faults) There are also selector switches for running both the Combustion and Process fans independent of system control (manual mode)

12. STOP or COOLDOWN stage, the system will:
    a. Shut down the Burner safeguard
    b. Fuel Injection solenoid valve closes
    c. Fuel line solenoid closes
    d. VFD to preset speed
    e. RTO Fan F-3A will stay on (for cooling)
    f. Combustion Blower F-4A/B shuts down
    g. Poppets continue to cycle.

    Once the chamber reaches a temperature of xxxdeg F, the RTO Fan F-3A and poppet valves shut down.

ALARMS

The alarm conditions are two types: Minor and Major. Minor alarms will turn on the alarm light but will NOT put the process in cool down. Major alarms WILL put the system in cool down in addition to lighting the alarm light.

Minor faults are:
- Proof of closures not met at start-up
- Wrong selector switch positions
- Safe run loop not met at start-up

Major faults are:
- Loss of associated pressures switches after run
- Combustion Chamber Over temp
- Stack Over temp
- Low Natural /Digestor gas pressure
- High Natural /Digestor gas pressure Lower Bed 1 Over temp
- Lower Bed (s) Over temp
- Low RTO discharge Flowrate
- Low Combustion air blower static pressure
- Low Compressed air pressure
- RTO Fan fault
- Combustion Air Fan fault
- Chamber Low Temp
- Flame detection fault

- Poppet valves not in proper position
- VFD online failure

System Presets (used at startup and for reference)

Description	**Value**		
SetPoint	1600		
Ramp Rate	500deg/hr		
Hi-Limit Alm	1700		
VFD Preset 1	20hz		
DPT Range	.3-5 "wc		

Poppet Cycle	30 secs		
Stack Overtemp	700deg F		

Lower Bed Alm	900 deg F		
Poppet Shutdown	195 deg F		

SYSTEM "HANDSHAKING" SIGNALS

The system interface with the client MCP-1A in addition to all Alarm signals will also include:

- RTO Ready
- Remote Start
- Initate Dryer purge
- Pre Purge Complete
- Pre Purge Command
- Purge Enable (Dryer purge complete)
- General Fault
- RTO purge complete
- All Process Set points
- Reset Burner Fault

H E SARGENT PANELVIEW INTERFACE

THE H E SARGENT PANELVIEW INTERFACE CONSISTS OF 10 SCREENS:

1- MAIN SCREEN (DEFAULT)
2- SYSTEM STATUS SCREEN
3- POPPET VALVES SCREEN
4- BURNER CONTROL SCREEN
5- BURNER PID LOOP SCREEN
6- RTO FAN PID LOOP SCREEN
7- FUEL INJECTION PID LOOP SCREEN
8- RTO OVERVIEW
9- SYSTEM SETPOINTS
10- ALARM BANNER

SCREENS FUNCTIONAL DESCRIPTIONS

1) MAIN SCREEN

THE MAIN SCREEN WILL ALWAYS COME UP ON POWERUP AND SHOULD BE CONSIDERED THE DEFAULT SCREEN.
THE MAIN FEATURE OF THIS SCREEN IS THE SCREEN SELECTOR LIST. THIS IS A LIST OR MENU OF SCREENS FROM WHICH THE OPERATOR CAN MAKE VIEWING SELECTIONS. TO THE SIDE OF THE LIST ARE UP AND DOWN ARROW KEYS TO MOVE THE CURSOR IN THE LIST AND THE ENTER KEY TO SELECT THE ENTRY. ALL OTHER SCREENS WILL RETURN TO THIS SCREEN SO THE OPERATOR

CAN MAKE OTHER SCREEN SELECTIONS. THERE ARE ALSO 2 MOMENTARY SCREEN PUSHBUTTONS FOR START AND STOP RTO FUNCTIONS.

2) STATUS SCREEN

THIS SCREEN CONTAINS THE VARIOUS SYSTEM TEMPERATURES , RTO OPERATING STATE AND OTHER VARIOUS SYSTEM LEVEL STATUS INDICATORS.
THE INDICATORS WILL DISPLAY SYSTEM OPERATING CONDITIONS:

- BURNER ON/BURNER OFF
- LOCAL/REMOTE MODE
- COMBUSTION BLOWER RUNNING/OFF
- PROCESS BLOWER RUNNING/OFF
- RTO OPERATIONAL STATUS (OFF, STARTUP, DRYER PURGE, RTO PURGE, BURNER ON, RTO READY,COOLDOWN)

SYSTEM TEMPERATURES DISPLAYED ARE:
CHAMBER, INLET, STACK , LOWER AND UPPERBED A & B

IN ADDITIONAL THERE IS A "MAIN" PUSHBUTTON , THAT IS LOCATED IN THE UPPER RIGHT HAND OF ALL SCREENS WHICH RETURNS THE OPERATOR TO THE MAIN CONTROL SCREEN SELECTOR.

3) POPPET VALVES STATUS SCREEN

THIS SCREEN IS FOR CHANGING THE CYCLE TIME OF THE POPPET VALVES. THE NUMERIC DISPLAY BUTTON WHEN PRESSED, OPENS THE SCRATCHPAD AND ENABLES THE TERMINAL KEYPAD FOR DATA ENTRY AND SEND DATA TO THE CONTROLLER. THE VALUE IS ENTERED AND THEN PUSHING THE APPROPRIATE ACCEPT PUSHBUTTON ACCEPTS IT INTO THE PROGRAM. THIS SCREEN ALSO ALLOWS FOR MANUAL CYCLING OF THE POPPETS FOR MAINTENANCE PURPOSES. THE POPPETS CANNOT BE CYCLED MANUALLY (1 FULL OPEN/CLOSE CYCLE) UNLESS THE SYSTEM IS IN LOCAL MODE.

4) BURNER STATUS SCREEN

THIS SCREEN IS FOR BURNER CONTROL INFORMATION. THERE IS AN ANALOG GAUGE FOR COMBUSTION TEMPERATURE DISPLAY AND 3 INDICATORS FOR FLAMESAFEGUARD STATUS AND 3 PUSHBUTTONS FOR START/RESET/FUEL INJECTION OFF/ON

5) BURNER PID TUNING

ON THIS SCREEN IS THE BURNER PID DISPLAY INDICATORS AND THE ASSOCIATED PID PARAMETERS. THE TWO BAR GAUGES WILL DISPLAY PV (PROCESS VARIABLE , ACTUAL TEMPERATURE) AND CV (CONTROL VARIABLE, CONTROL SIGNAL BY % OF OUTPUT). THE AUTO /MANUAL PUSHBUTTON DETERMINES WHAT IS CONTROLLING THE OUTPUT. AUTO INDICATES THAT THE PID INSTRUCTION IN THE CONTROLLER IS CONTROLLING THE OUTPUT. MANUAL INDICATES THAT THE USER IS SETTING THE OUTPUT VALUE.

THERE ARE NUMERIC KEYPAD BUTTONS FOR:

SETPOINT (THE VALUE WE DESIRE THE PROCESS TO MAINTAIN)

PROPORTIONAL (KNOWN ALSO AS RATIO CONTROL FOR IMPROVING RISE TIME)

INTEGRAL (TO IMPROVE THE OVERSHOOT)

DERIVATIVE (TO ELIMINATE THE STEADY-STATE ERROR, THE FASTER THE CHANGE FROM THE SETPOINT, THE LARGER THE CORRECTIVE ACTION)

WHEN IN MANUAL MODE, THE CV "LOCKS IN AT THE LAST CV TO THE OUTPUT AND THEN ALLOWS THE OPERATOR TO MANUALLY ENTER A CV% VALUE (0-100) INTO THE CONTROLLER AFTER PUSHING THE "ENTER CV" PUSHBUTTON TO ACCEPT THE DATA.

6) RTO FAN PID TUNING

ON THIS SCREEN IS THE RTO FAN PID DISPLAY INDICATORS AND THE ASSOCIATED PID PARAMETERS. THE TWO BAR GAUGES WILL DISPLAY PV (PROCESS VARIABLE , ACTUAL "W C) AND CV (CONTROL VARIABLE, CONTROL SIGNAL BY % OF OUTPUT). ALL THE REST OF THE SETPOINT AND TUNING PARAMETERS FUNCTION THE SAME AS THE BURNER PID SCREEN.

7) FUEL INJECTION PID TUNING

ON THIS SCREEN IS THE FUEL INJECTION PID DISPLAY INDICATORS AND THE ASSOCIATED PID PARAMETERS. THE TWO BAR GAUGES WILL DISPLAY PV (PROCESS VARIABLE , ACTUAL TEMPERATURE) AND CV (CONTROL VARIABLE, CONTROL SIGNAL BY % OF OUTPUT). ALL THE REST OF THE SETPOINT AND TUNING PARAMETERS FUNCTION THE SAME AS THE BURNER PID SCREEN.

8) RTO OVERVIEW

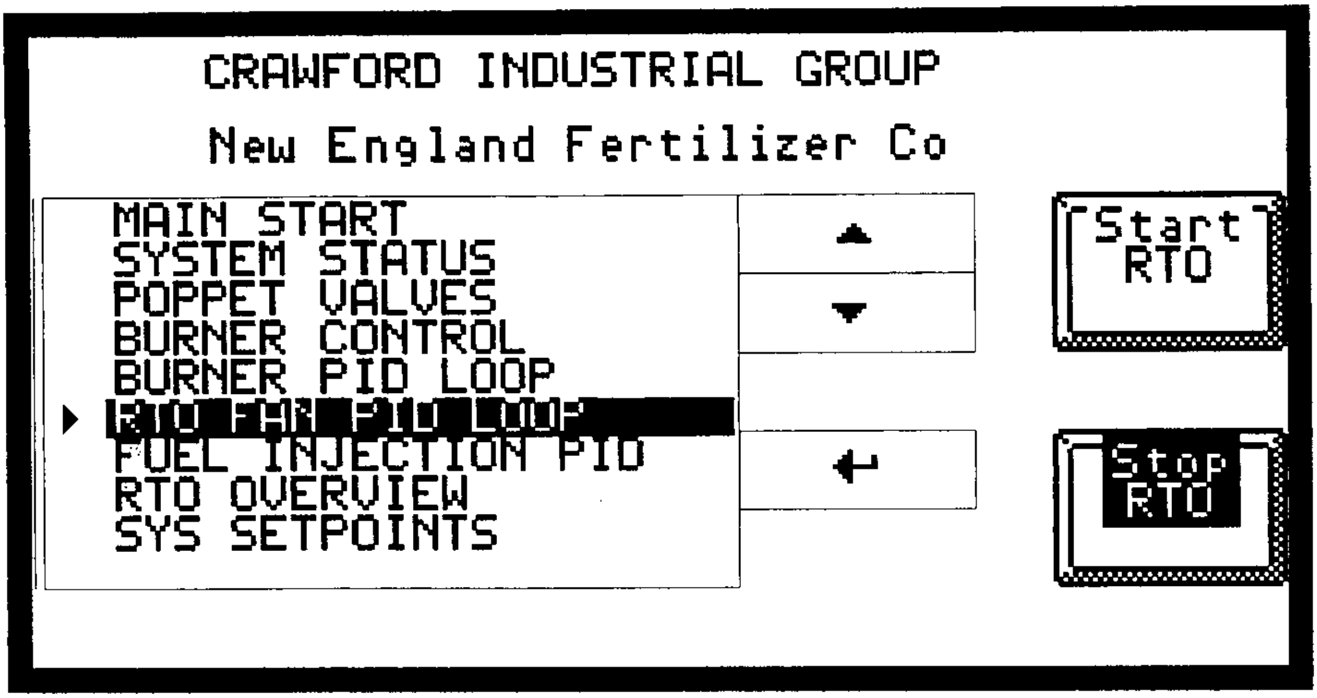
THIS SCREEN IS A GRAPHICAL REPRESENTATION OF DISPLAY DATA ONLY OF VARIOUS SYSTEM PARAMETERS SUCH AS :
BURNER STATUS, FAN/BLOWER STATUS, POPPET VALVES,SWITCH SETTINGS AND TEMPERATURES.

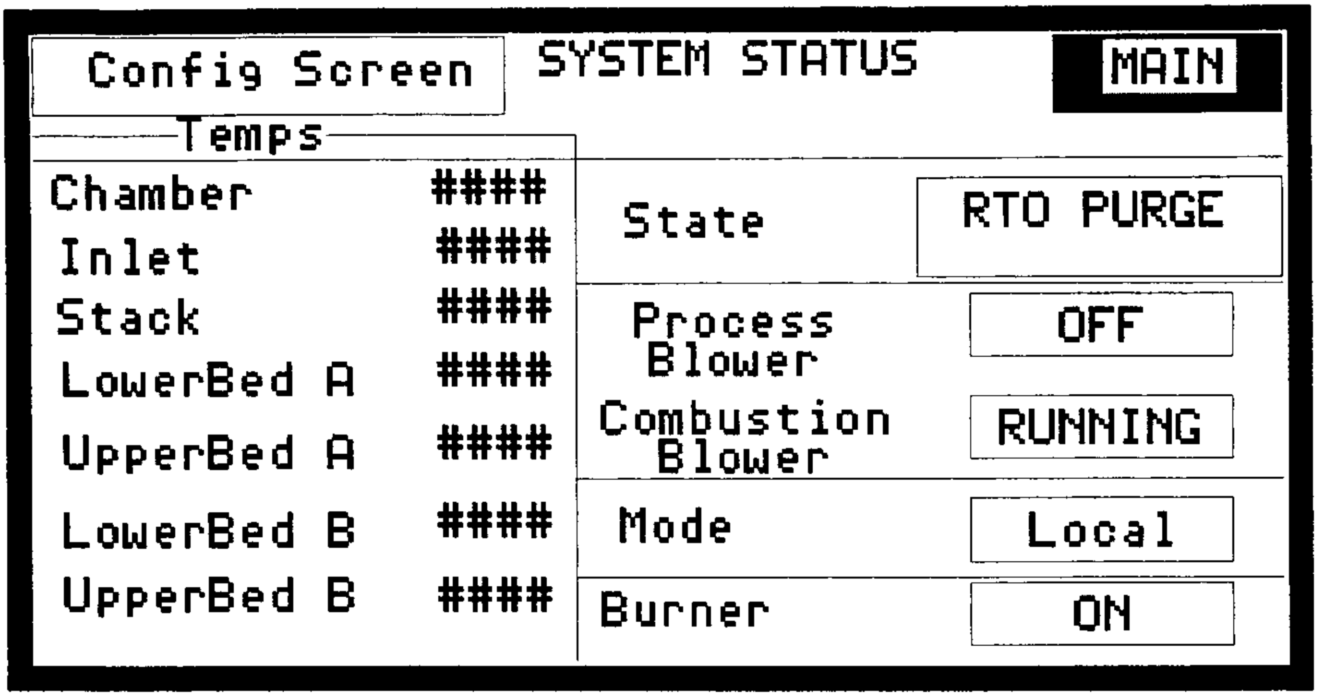
9) <u>SYSTEM SETPOINTS</u>

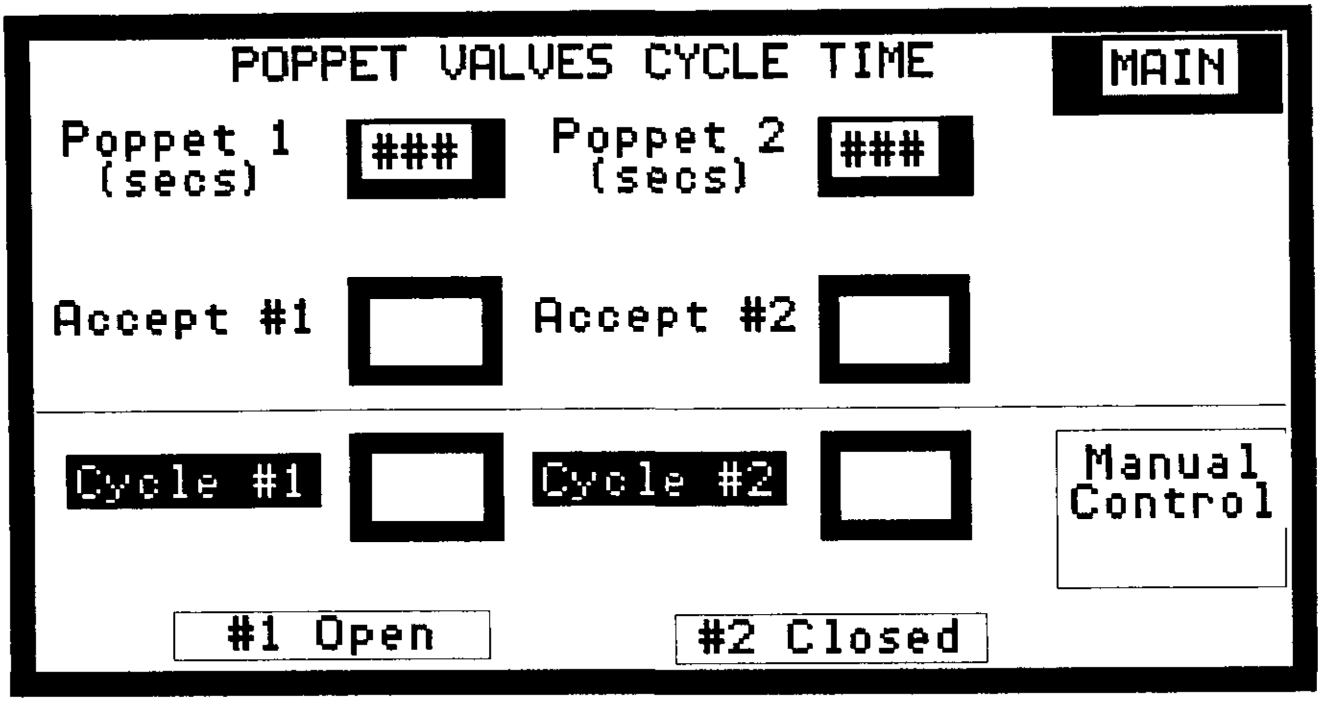
THIS SCREEN IS FOR THE OPERATOR TO ENTER/MODIFY CERTAIN ALARM LIMITS AND ALSO PURGE TIME,RAMP RATE AND POPPET SHUTDOWN PARAMETERS.

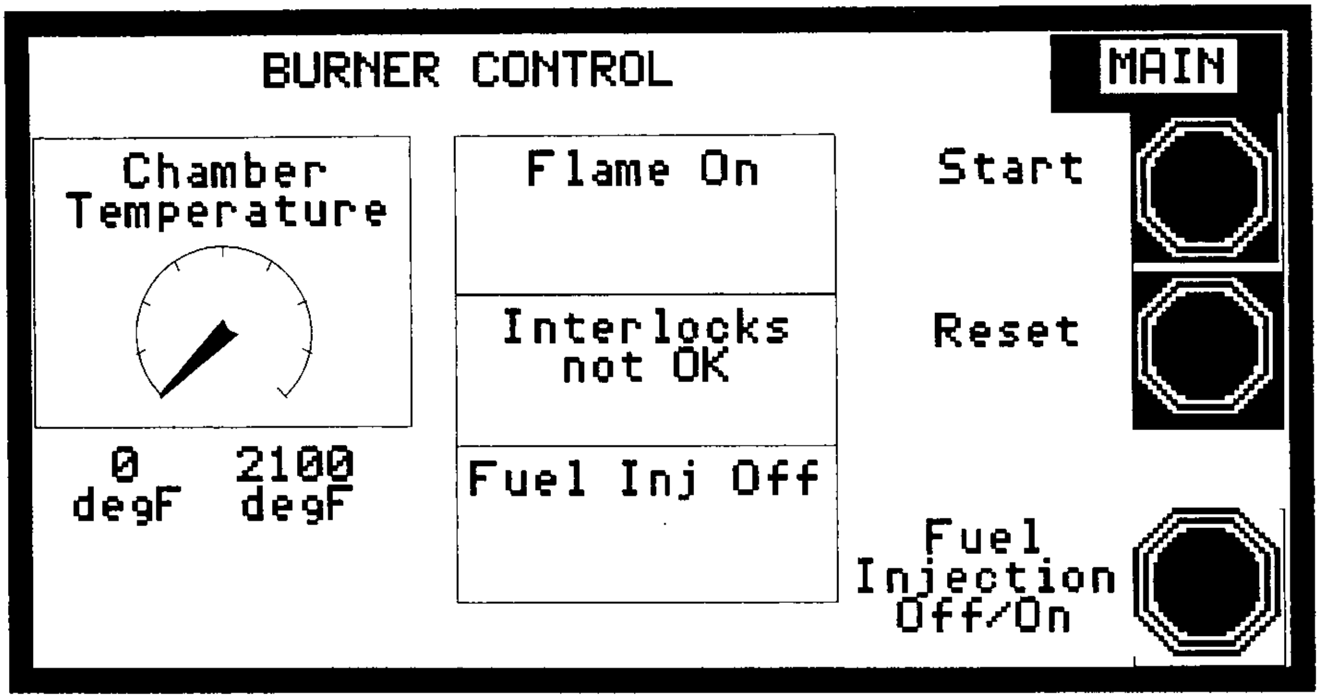
10) <u>ALARM BANNER</u>

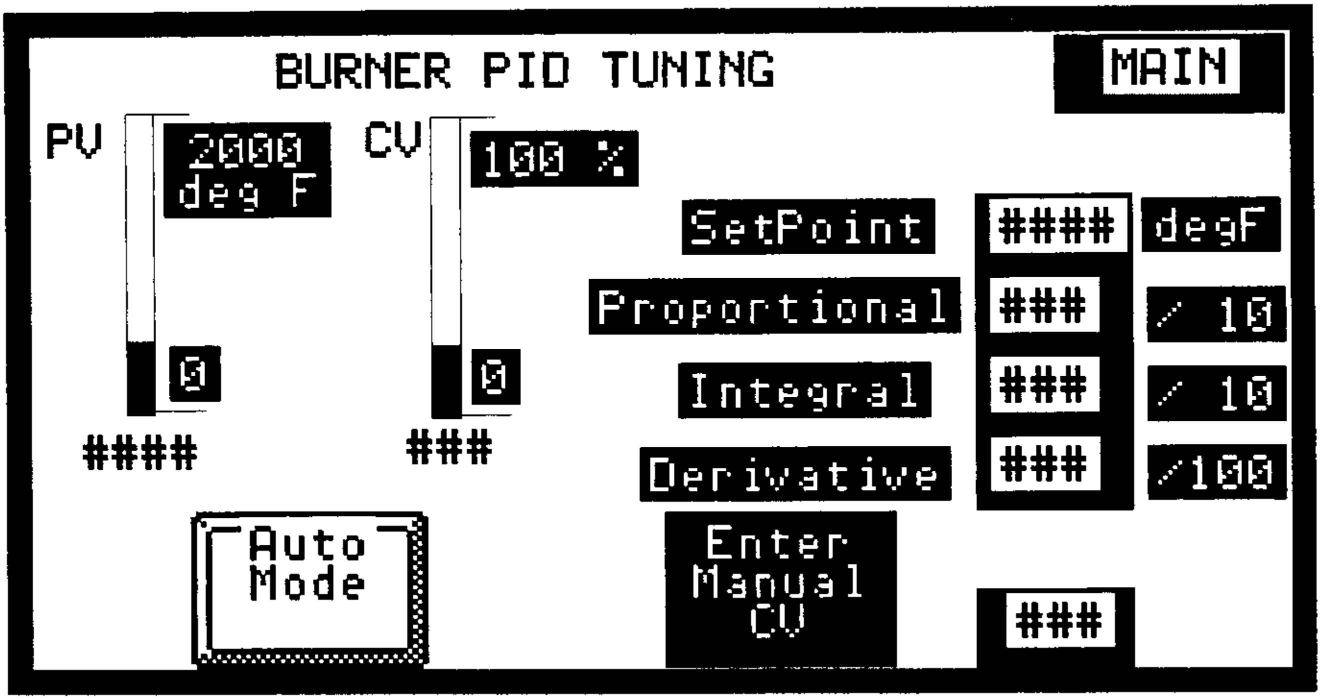
THIS IS A DISPLAY THAT POPS UP OVER THE CURRENT SCREEN WHEN AN ALARM IS TRIGGERED. THE BANNER CONTAINS A MESSAGE DESCRIBING THE ALARM CONDITION. WHEN THE ALARM IS ACKNOWLEDGED, IT CLEARS OR THE NEXT ACTIVE ALARM IS DISPLAYED. THIS BANNER WILL ALWAYS APPEAR ON THE BOTTOM OF THE SCREEN.

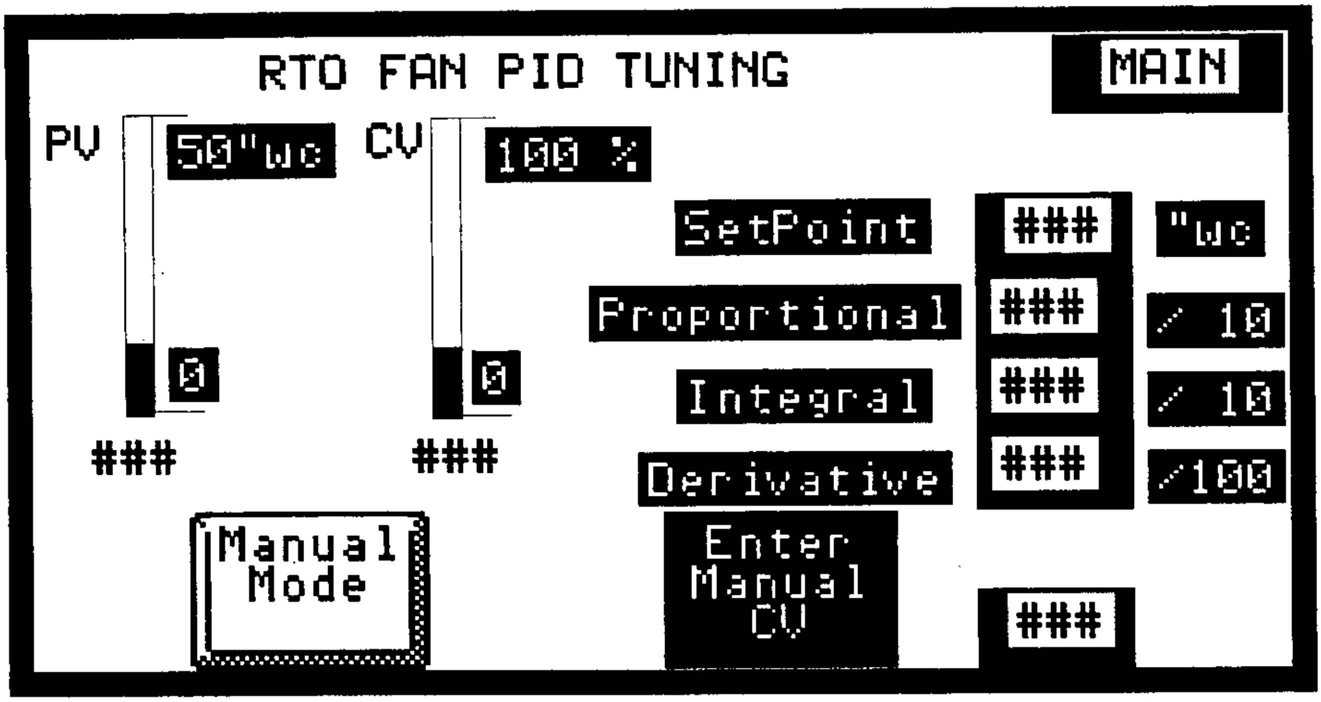

CRAWFORD INDUSTRIAL GROUP
New England Fertilizer Co
MAIN START
SYSTEM STATUS
POPPET VALVES
BURNER CONTROL
BURNER PID LOOP
RTO FAN PID LOOP
FUEL INJECTION PID
RTO OVERVIEW
SYS SETPOINTS
Start RTO
Stop RTO

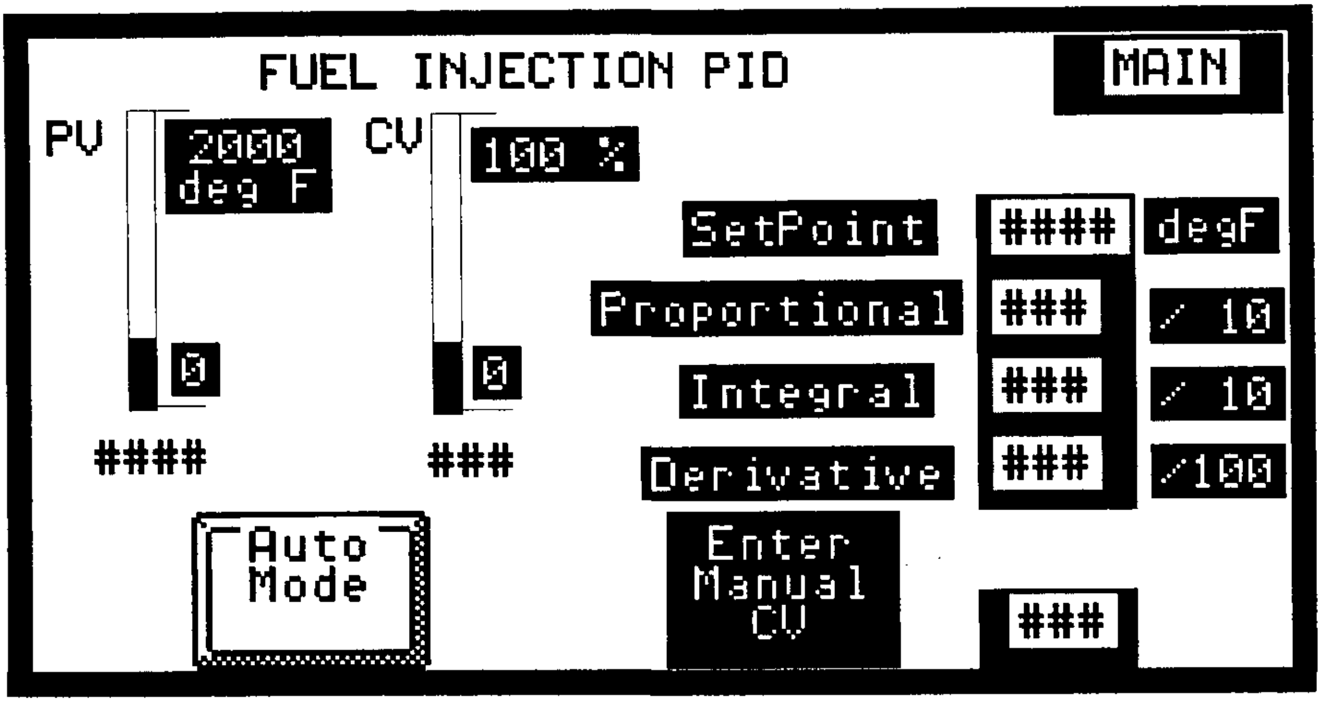

Config Screen
SYSTEM STATUS
MAIN
Temps
Chamber ####
Inlet ####
Stack ####
LowerBed A ####
UpperBed A ####
LowerBed B ####
UpperBed B ####
State
RTO PURGE
Process Blower
OFF
Combustion Blower
RUNNING
Mode
Local
Burner
ON

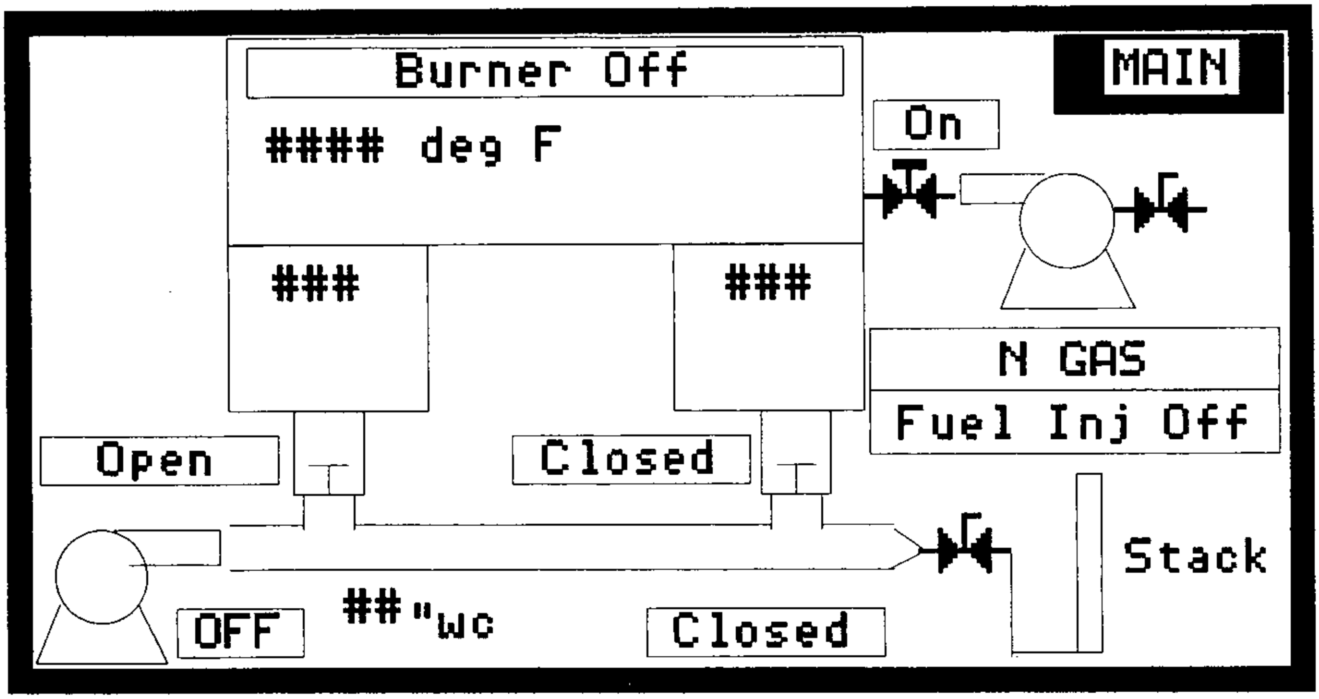

POPPET VALVES CYCLE TIME
MAIN
Poppet 1 (secs)
###
Poppet 2 (secs)
###
Accept #1
Accept #2
Cycle #1
Cycle #2
Manual Control
#1 Open
#2 Closed

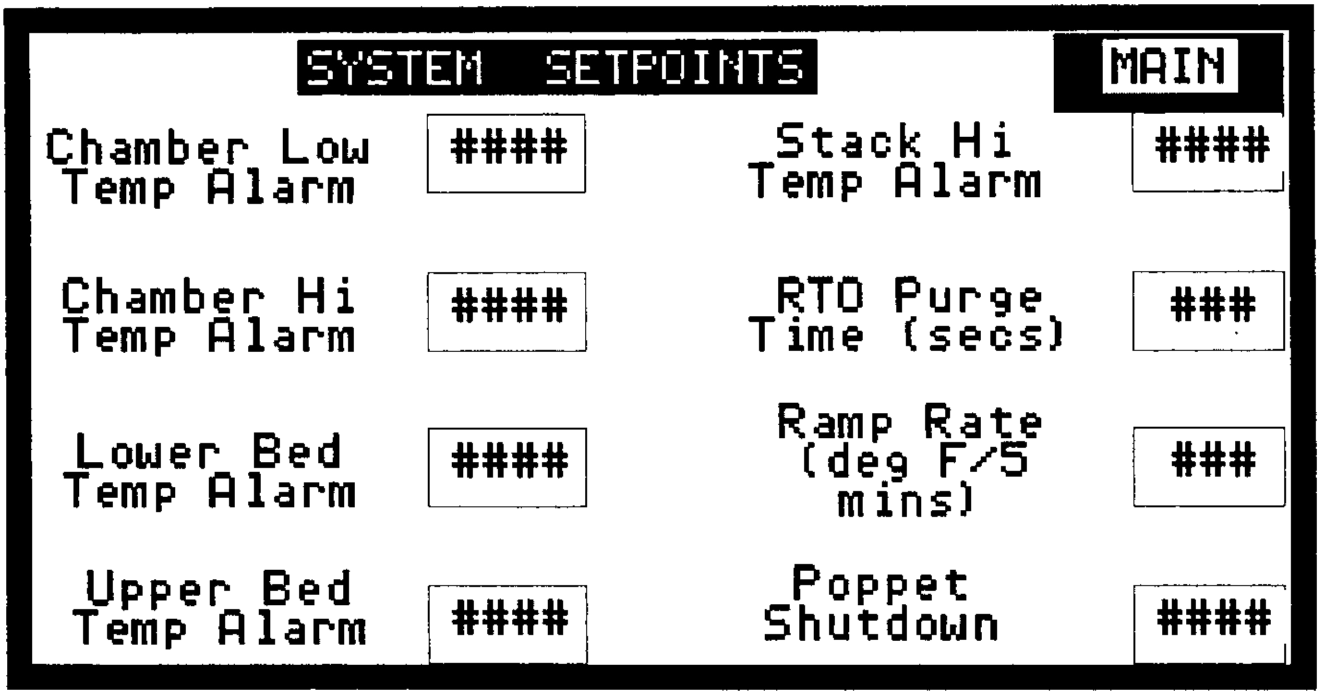

BURNER CONTROL
MAIN
Chamber Temperature
0 degF
2100 degF
Flame On
Interlocks not OK
Fuel Inj Off
Start
Reset
Fuel Injection Off/On


BURNER PID TUNING
MAIN
PV
2000
deg F
0
####
CV
100 %
0
###
SetPoint
####
degF
Proportional
###
/ 10
Integral
###
/ 10
Derivative
###
/100
Auto
Mode
Enter
Manual
CV
###


RTO FAN PID TUNING
MAIN
PV
50"wc
0
###
CV
100 %
0
###
SetPoint
###
"wc
Proportional
###
/ 10
Integral
###
/ 10
Derivative
###
/100
Manual Mode
Enter Manual CV
###


FUEL INJECTION PID
MAIN
PV
2000 deg F
0
####
CV
100 %
0
###
SetPoint
####
degF
Proportional
###
/ 10
Integral
###
/ 10
Derivative
###
/100
Auto Mode
Enter Manual CV
###


Burner Off
deg F
MAIN
On
###
###
N GAS
Fuel Inj Off
Open
Closed
Stack
OFF
"wc
Closed


SYSTEM SETPOINTS
MAIN
Chamber Low Temp Alarm
####
Stack Hi Temp Alarm
####
Chamber Hi Temp Alarm
####
RTO Purge Time (secs)
###
Lower Bed Temp Alarm
####
Ramp Rate (deg F/5 mins)
###
Upper Bed Temp Alarm
####
Poppet Shutdown
####

HE SARGENT RTO1A ALARM and STATUS MESSAGE LIST

Poppet Valves Alarm
Remote/Local SSW incorrect
NGas/DGas SSW incorrect
Blk Valve FCV531A Open
Blk Valve FCV531C Open
Fuel Inj FCV531E Open
Fuel Inj Damper FCV531K Open
Dryer Sol FCV520E Open
Lockout Keyswitch
Blower F4A in manual
Fan F3A in manual
Low Compressed Air PSL520A
Combustion Fan Fault
Process Fan F3A Fault
FSL 521A
Dryer ZSC520E open
Gas Line Pressure Sw PSL531A
Gas Line Pressure Sw PSH531A
Low Combustion Air Pressure
BV FCV531A IGN failure
BV FCV531C IGN failure
Burner Ignition Failure
Burner Flame out
VFD Failure

RTO Not Up to Temp
RTO Purge Not Complete
Chamber Low Temp
Chamber Over Temp
Lower Bed OverTemp
Upper Bed OverTemp
Stack OverTemp
Fan F3A Vibration
Burner Module Pilot Error
Blk Valve 531A Fault
Blk Valve 531C fault
Valve 531C Inj Flt

Crawford INDUSTRIAL GROUP LLC	VOC SYSTEMS GROUP
P.O. Box 592097 • Orlando, FL 32859 • (407) 851-0993 • (407) 851-2406 FAX	MAINTENANCE
	May 2, 2002

Type Equipment: Regenerative Thermal Oxidizer	Model Number: CVOC-4.0-RTO-95

General: CRAWFORD INDUSTRIAL GROUP's (CIG) Regenerative Thermal Oxidizers (RTOs) are designed to provide reliable operations with minimal requirements for maintenance. To ensure that the CIG equipment continues meet performance requirements, we recommend the following maintenance procedures and frequency be performed. These can be performed by the client, or through a service contract provided by CIG.

The control system will monitor the operation of the oxidizer, however some components don't lend themselves to be inspected by the PLC. The following is a list of maintenance/inspection items that should be undertaken to ensure continued performance.

Critical Components:

Burner and Burner Train:

Description	Comments	Frequency
UV Detector	Clean	Monthly - Quarterly
Spark Plug	Clean and Gap (1/8" to 3/16")	Monthly - Quarterly
FlameLength	Manually check through access door – should not reach far wall	Semi-Annual
Burner	Tune (Recalibrate Air/Gas Mixture if necessary)	Annually
Thermocouples	While access door open check thermocouples for broken ceramic – replace as needed	Annually

Mechanical Devices:

Description	Comments	Frequency
Fan Bearings	Grease with two shots be bearing – DO NOT OVER GREASE	Annually
Fans	Listen for worn bearing or fan wheels out of balance – replace if necessary	On Going
Fan Inlets	Examine inlet to combustion blower for any foreign matter, remove and clean any filters	On Going
Poppet Valves	Visually check valves through access panels to ensure they seat properly	Annually
Popper Valve Gaskets	Examine tadpole gaskets for unusual wear. Recommend changing annually	Annually
Poppet Valve Cylinders	Listen for unusual noises caused by wear. Change if necessary	On going
Other Valves	Visually check linkages, motors or cylinders	Annually

General:

Description	Comments	Frequency
Outer Skin	Visually check for hot spots or use portable IR scanner	Annually
Flanged Connections	Check all flanged connections (Housing expansion joints, and duct) for leakage. Replace gaskets, joints, and check for tightness of bolts	Annually
Gas Pressure	As natural gas demands change during the year monitor inlet gas pressure to ensure within specified range	Quarterly
Compressed Air	Check to ensure pressure and dryness of compressed air for cylinders, especially prior to Winter. Replace dessicant as necessary. Recommend dew point of -40°. Make sure lines are free of condensation	Annually
Refractory Lining	Check refractory lining in combustion chamber to ensure no gaps in the ceramic blanket material, especially if external hot spot is found. Add insulation as necessary.	Annually
Heat Recovery Media	Check media for excessive damage. Please note: media will crack due to the thermal stresses, but will not effect its performance	Annually
Pressure Drop	Monitor amperage draw on main process blower for unusually high amperage draw. May indicate high pressure loss across system. Manually check static pressure on each side of oxidizer and fan.	On going/Annual

Any questions on the operation of the unit, please direct to CIG Service Department at 407-851-0993 during normal business hours or at 407-???-???? after normal business hours.

Thank you for choosing CRAWFORD INDUSTRIAL GROUP, LLC for your VOC abatement requirements. We look forward to continued service.

Operations and Maintenance Manual for Sly Scrubber

Instructions
For
Installation – Operation – Maintenance
Of Your

Venturi Scrubber
And
Cyclonic Separator

GREATER LAWRENCE SANITARY DISTRICT

RVM-0638

This book contains instructions for installation, operation, and maintenance of this equipment. It is essential that it reaches the people who *Install* and *Use* the equipment.

SLY Incorporated

P.O. Box 5939
Cleveland, Ohio 44101

Tel: (440) 891-3200
Fax: (440) 891-3210

Table of Contents

SLY INC
TECHNOLOGY FOR A CLEAN ENVIRONMENT

WARRANTY AND BACKCHARGES POLICY

Our Warranty is defined clearly on our standard Terms and Conditions sheet which is a part of every quotation and order unless specifically modified and agreed to by the Cleveland Home Office.

We recognize that for reasons of practicality or expediency, field correction or repairs may occasionally be required. Backcharges for correction or repair of equipment during erection\installation will not be accepted unless authorized by Sly prior to work commencing. Sly will require a firm price for any and all work and a specific scope of the work. If a firm price cannot be established, a "not to exceed" figure will be required. When verbal agreement has been reached, it must be confirmed in writing by Purchaser within 24 hours. Under no circumstances will Sly be responsible for costs, penalties, consequential damages, etc., due to delays in completion. Under no circumstances may Purchaser withhold unauthorized backcharges from payment of monies due per Terms of Payment. This authority cannot be delegated to Representatives, Agents, Field Sales or Field Service Personnel.

Sly Incorporated has a reputation for fairness and service to customers. We intend to maintain this reputation.

P.O. Box 5939, Cleveland, Ohio 44101 • 8300 Dow Circle, Strongsville, Ohio 44136 AREA CODE CHANGED TO 440
(216) 891-3200 • Fax (216) 891-3210 • 1-800-334-2957

INSTALLATION

LEVELING

Installation of the Sly VENTURI Scrubber and Cyclonic Separator is comparatively simple. Since the equipment is dependent on reasonable uniform water flow and distribution at the venturi inlet, the scrubber should be leveled on its supports or foundation.

Caution: The Sly VENTURI Scrubber is not designed to support any weight or absorb any movement from the duct above it or any other external loadings.

GASKETING

Be sure to use both a suitable gasket and caulking compound when mating the inlet and outlet flanges at the VENTURI Scrubber and Cyclonic Separator. These flanges must be water tight!

PIPING

Piping for scrubber liquid distribution and all drain connections should be properly sealed and checked for secure mating.

To insure adequate seal, the minimum height between the skimmer and separator drain outlet and the seal pot should be equal to the pressure drop in inches w.g. at which the scrubber will be operating. The proper seal will prevent the draining scrubber fluid from backing up and re-entraining into the outlet exhaust gas stream.

Normal water consumption for scrubber liquid is approximately eight (8) GPM per 1,000 CFM at 70° F. (SEE General Arrangement drawing for specific requirements).

A flowmeter and pressure gauge should be installed in the scrubbing liquid supply line for the operating personnel's observance. Flow and pressure should be adjusted to design values.

Two flanged removable scrubbing liquid pipes are supplied on either side of the venturi inlet. These pipes are right hand and left hand and should be positioned to spray downward. (SEE General Arrangement drawing for flanged detail). No nozzles are present to wear or plug.

VENTURI AND SEPARATOR ADJUSTMENTS

Manual Venturi Throat -

The easily adjustable throat can be adjusted while scrubber is operating, permitting pressure drop to be fine-tuned to application.

Simple loosen lock nut(s) and bolt(s) located on either side of venturi throat section and adjust until desired pressure drop is achieved. Then re-tighten lock nut(s) to secure throat position.

Venturi throat damper blades are readily replaceable through bolted access covers on the side of the venturi throat.

On scrubbers with automatic positioning, separate instructions will be provided.

Separator Spin Damper -

An adjustable spin damper in the Separator maintains the proper inlet velocity for collection of fine droplets. To adjust this damper, remove the access door from the inlet then unbolt and rebolt the damper in one of the alternate positions provided.

START-UP AND OPERATION

It is essential that the proper sequence be used each time the scrubber is put into operation.

Before starting the system, make sure all manholes are secure and all erection debris has been flushed out of ducts, water lines and vessels.

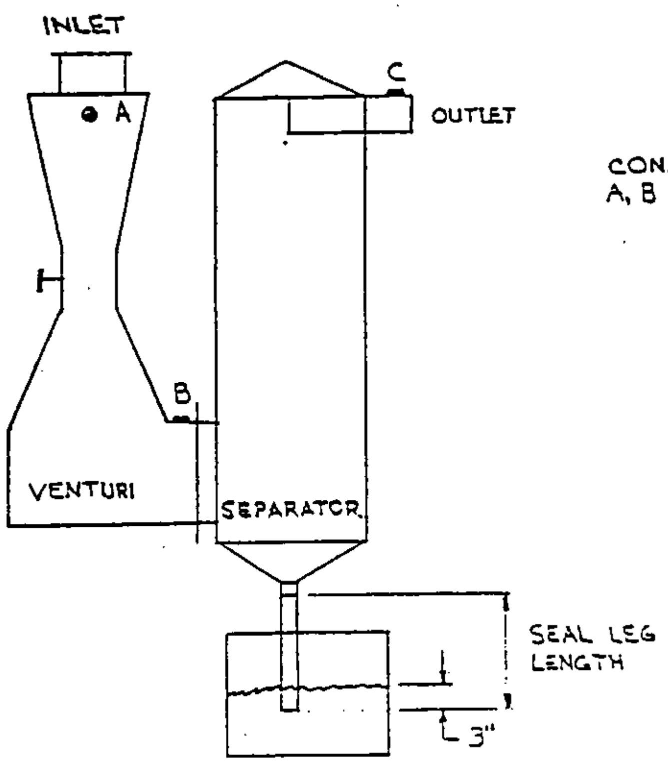
The scrubber fluid should be turned on first to allow all internal surfaces to be fully wetted and to allow wetted elbow to be filled. When properly adjusted the convergent approach surfaces above the venturi throat will be thoroughly wetted. No large dry areas are permitted below the edge of the inlet collar. (Air flow at the venturi inlet will assist in scrubbing fluid distribution).

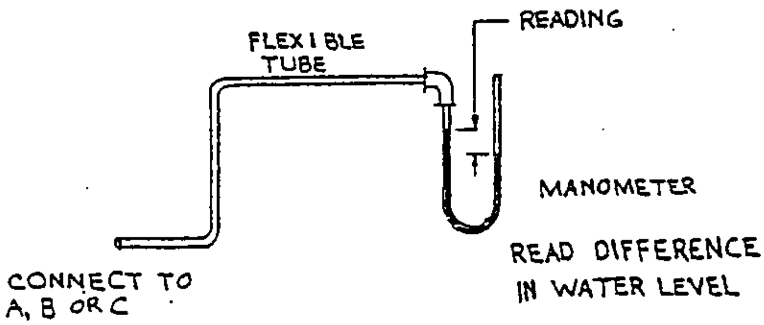
Turn on the air flow. The air flow should be measured to insure proper design volume is introduced to the unit. Then fine tune for proper efficiency required, by using venturi throat adjustment.

Increasing the pressure drop beyond design conditions at the venturi throat and/or separator damper will result in reduced volume unless the original design was for the maximum pressure drop (ΔP). If frequent variation on the air flow to the scrubber is possible, a damper at the exhaust fans would be beneficial to compensate for varying conditions. Once efficient pressure drop has been achieved, set separator damper for proper mist elimination.

When shutting down the unit, first shut off the air flow, then the scrubbing fluid. In cold weather make sure the water supply, drain lines, and equipment are emptied to prevent damage from freezing.

METHOD OF MEASURING PRESSURE DROP





Required: "U" tube Manometer or pressure gage. 1/4" plastic or rubber tubing to reach from test point to Manometer or gage.

At points A-B-C, find 1/2" couplings with plugs. Pressure drop readings are determined from these points.

To obtain static pressure readings at these points, connect one leg of Manometer or pressure gage to flexible tubing and insert other end of tube at points A, then point B, and point C. Record readings.

1. Pressure drop across Venturi throat is:

   Reading at B minus reading at A.

2. Pressure drop across separator is:

   Reading at C minus reading at B.

3. Pressure drop across system is:

   Reading at C minus reading at A.

INSPECTION

Periodic inspection of the equipment should be made to keep it at peak operating efficiency.

Pressure gauges and flowmeters should be observed daily for proper operating conditions.

Venturi and separator damper blades should be checked for excessive wear or material build-up.

"A"

SLY INC

FILE WITH ORDER

FINAL FACE OF ORDER

SLY ORDER NO. RVM-0638

CUSTOMER P.O. NO. 8902

DATE: August 10, 2001
Edited: 01/30/02
SALESMAN: BOS
(REP/SLY) G. Arthur/ B Kurz

INVOICE TO:
H E SARGENT INC
40 WINTER ST
ROCHESTER NH 03867

SHIP TO:
GREATER LAWRENCE SAN. DIST.
240 CHARLES STREET
NORTH ANDOVER MA 01845-0649

REQUIRED DELIVERY: 8 WKS ARDA

APPROVAL DRAWINGS:
4 WKS ARO
REQUIRED

SHIPPING METHOD:
Best Way F.O. B. Jobsite

COMPLEXITY: 2

PURCHASING CONTACT:

David Jacques

PHONE: 603-332-5071
FAX: 603-332-5341
E-MAIL:

ENGINEERING CONTACT:

David Jacques

PHONE: 603-332-5071
FAX: 603-332-5341
E-MAIL:

APPROVAL DRAWINGS TO: Above

METHODS FOR APPROVALS: * MAIL

SPECIAL INSTRUCTIONS:

(8) Copies of drawings required

Application Data:

Inlet Gas Flow Rate	-	1,500 to 4,600 ACFM
Inlet Temperature	-	120°F
Inlet Humidity	-	Saturated
Contaminant	-	Sludge particulate
Loading	-	0.834 lb/hr
Particle Size Distribution by weight		9.5% < 0.1 micron
	-	41.2% 0.1 to 0.2 microns
	-	15.8% 0.2 to 0.3 microns
	-	3.9% 0.3 to 0.4 microns
	-	2.6% 0.4 to 0.5 microns
		2.3% 0.5 to 0.6 microns
		1.3% 0.6 to 0.7 microns
		1% 0.7 to 0.8 microns
		1% 0.8 to 0.9 microns
		0.9% 0.9 to 1 microns
		5.5% 1 to 1.5 microns
		3.3% 1.5 to 2 microns
		6.9% 2 to 3 microns
		3.6% 3 to 5 microns
		1% 5 to 8 microns
		0.1% > 8 microns

Materials of Construction:

	GA or Thickness		Material
Venturi	11 ga.		304 stainless steel
Separator	11 ga		304 stainless steel
Gaskets			*Neoprene Color: Black
Paint:	**Internal**	Surface Prep	* SPCC-SP3
		Primer	* Mobile Silicone Alkyd (1-2 mils thk)
		Finish	* NONE
		Color	* Gray
	External	Surface Prep	* SPCC-SP3
		Primer	* Mobile Silicone Alkyd (1-2 mils thk)
		Finish	* Mobile Acrylic Enamel (1-2 mils thk)
		Color	* OSHA Blue
Supports, handrails, ladders:			
		Surface Prep	* SPCC-SP6
		Primer	*
		Finish	* (2) Devoe 224 HS
		Color	* Support: To follow

Welding Requirements: * Double Pass

External Finish Requirements *(If Not Painted)*:

- Stainless Steel Finish: * 2B / OTHER
- Remove Discoloration: * Sandblast
- Grind welds: * None
- External welds: * None

Internal Finish Requirement:

- Stainless Finish: * 2B
- Grind Welds: * Smooth
- Interior Weld Finish: * None

Special Requirements:

VENTURI
Equipment No. VSC-1B

RVM-0638--A

1 - No. 2 Sly VENTURI Scrubber

Variable throat damper for manual operation.
35 GPM recirculated water at 3 PSIG required.
18" dia. Inlet gas flange custom
Outlet gas flange std
DP pressure taps std/custom
Damper access door custom, 5" x 17"
Bottom access door custom, 8" dia.
(2) 2" dia. water inlets
Set Of Lifting Lugs
Note: All nozzle flanges w/150# ANSI drilling and 4" projection

RVM-0638-B

1 - No. 2 Sly cyclonic separator
Shell to be reinforced as necessary for 20" w.g.
Stiffeners required (# and location)
Inlet gas flange std
18" dia Outlet gas flange custom
Variable spin damper std
6" dia Drain custom
Set of Lifting Lugs
Note: All nozzle flanges w/150# ANSI drilling and 4" projection

DP connections (Y)
Leak test method: Soap & bubble

- Cover plate bolts, 18-8 stainless steel w/Neoprene Gaskets

G.A. DWG. 19-2570(Rev.B)

RVM-0638-C

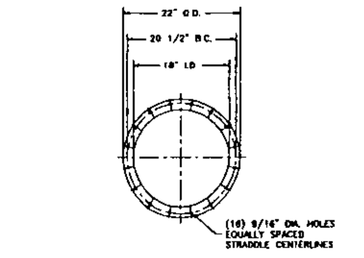
1 - Set of support legs to allow 4 ft below separate drain. Carbon steel painted

RVM-0638-D

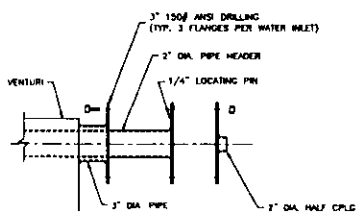
2 - Magnehelic pressure gauges w/mounting brackets and 304SS tubing.
Tag Nos. DPI-511A & DPI-511C

J.KURZ
Engr.Dept.

"B"

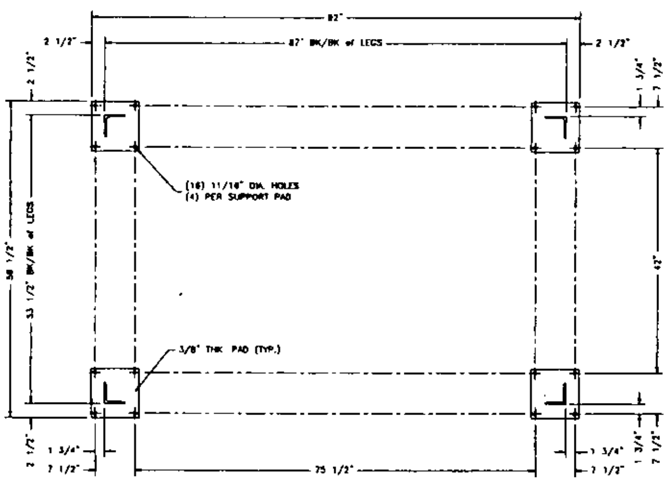


INLET/OUTLET FLANGE DETAIL

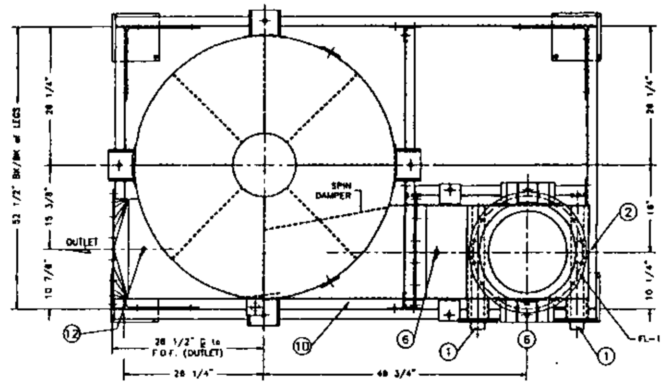


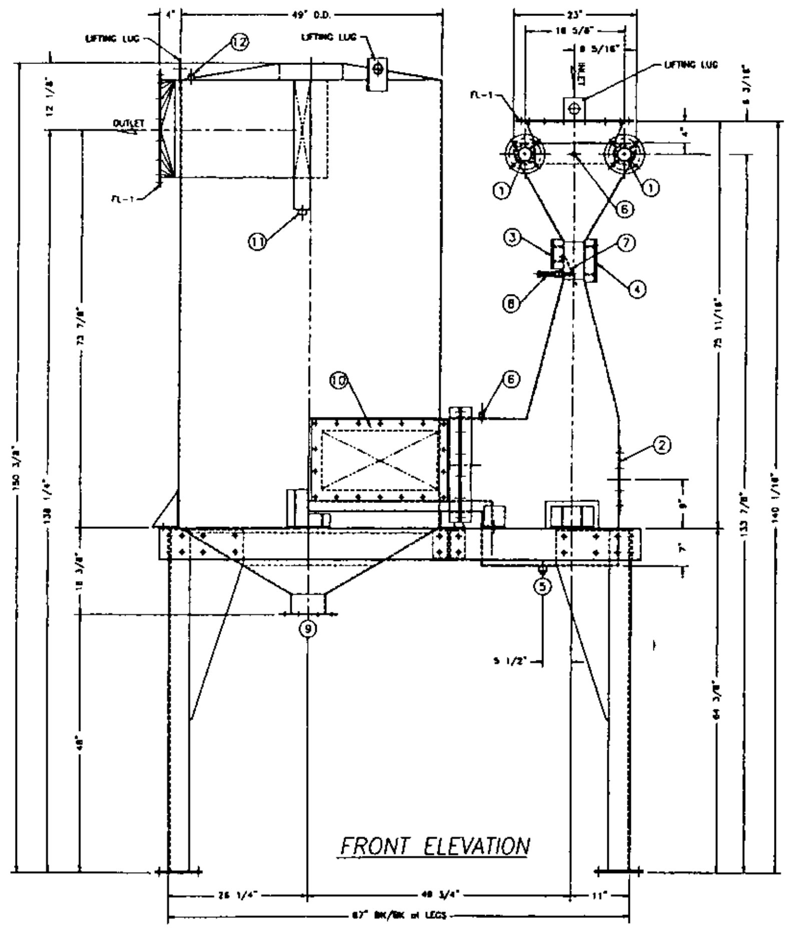
FL-1 ~ VENTURI WATER INLET DETAIL

(2) ASSEMBLIES REQUIRED
(REMOVABLE HEADER)



FOUNDATION





FRONT ELEVATION

DESIGN CONDITIONS

GAS FLOW RATE	– 1,500 TO 4,600 ACFM
INLET TEMPERATURE	– 120°F
INLET HUMIDITY	– SATURATED
CONTAMINANT	– SLUDGE PARTICULATE
LOADING	– 0.834 LB/HR
PARTICLE SIZE	– 9.5% < 0.1 MICRONS
	– 41.2% 0.1 TO 0.2 MICRONS
	– 15.6% 0.2 TO 0.3 MICRONS
	– 3.9% 0.3 TO 0.4 MICRONS
	– 2.6% 0.4 TO 0.5 MICRONS
	– 2.3% 0.5 TO 0.6 MICRONS
	– 1.3% 0.6 TO 0.7 MICRONS
	– 1.0% 0.7 TO 0.8 MICRONS
	– 1.0% 0.8 TO 0.9 MICRONS
	– 0.9% 0.9 TO 1 MICRONS
	– 5.6% 1 TO 1.5 MICRONS
	– 3.3% 1.5 TO 2 MICRONS
	– 6.9% 2 TO 3 MICRONS
	– 3.6% 3 TO 5 MICRONS
	– 1.0% 5 TO 8 MICRONS
	– 0.1% > 8 MICRONS

CONSTRUCTION MATERIAL

VENTURI SHELL	– 11 GA. 304 S.S.
SEPARATOR SHELL	– 11 GA. 304 S.S.
FLANGES	– 3/16 THK. 304 S.S.
GASKETS	– NEOPRENE FOAM, 3/8" THK (BLACK)
BOLTS	– 18-8 S.S.
REINFORCED	– ±20" w.c.

SLY #2 VENTURI:

1. (2) WATER INLET ~ 2" NPT HALF COUPLING ~ 304 S.S. 35 GPM @ 3 psig (17.5 GPM EA.)
2. 8" DIA. BOLTED ACCESS DOOR ~ 304 S.S.
3. 17" x 2 1/2" BOLTED VENTURI BLADE ACCESS DOOR
4. 17" x 5" BOLTED VENTURI BLADE ACCESS DOOR
5. DRAIN ~ 1" NPT HALF COUPLING W/ PLUG ~ 304 S.S.
6. (2) PRESSURE TAP FITTINGS ~ 1/2" NPT HALF COUPLING W/ PLUG ~ 304 S.S.
7. INTERNAL VENTURI THROAT BLADES ~ 304 S.S.
8. EXTERNAL MANUAL END BLADES ADJUSTMENT SCREWS

SLY #2 CYCLONIC SEPARATOR:

9. DRAIN ~ 6"-150# ANSI DRILLED FLANGE ~ 304 S.S.
10. 25 1/2" x 14 7/8" BOLTED ACCESS DOOR ~ 304 S.S.
11. SKIMMER DRAIN ~ 1" NPT HALF COUPLING ~ 304 S.S.
12. PRESSURE TAP FITTINGS ~ 1/2" NPT HALF COUPLING W/ PLUG ~ 304 S.S.

APPROXIMATE WEIGHTS	
VENTURI	DRY – 208#
	OPERATING – 325#
CYCLONIC SEPARATOR	DRY – 873#
	OPERATING – 925#
SUPPORT	– 850#

CERTIFIED FINAL FOR CONSTRUCTION

EQUIP. TAG NO. VSC-1A

CUST. ORDER NO 8902

THIS DRAWING IS THE PROPERTY OF SLY Incorporated

SLY INC.

DRAWN BY MAC | DATE 8-6-01

SCALE 1" = 12" | RVM-0838

#2 VENTURI SCRUBBER & #2 CYCLONE SEPARATOR

FOR

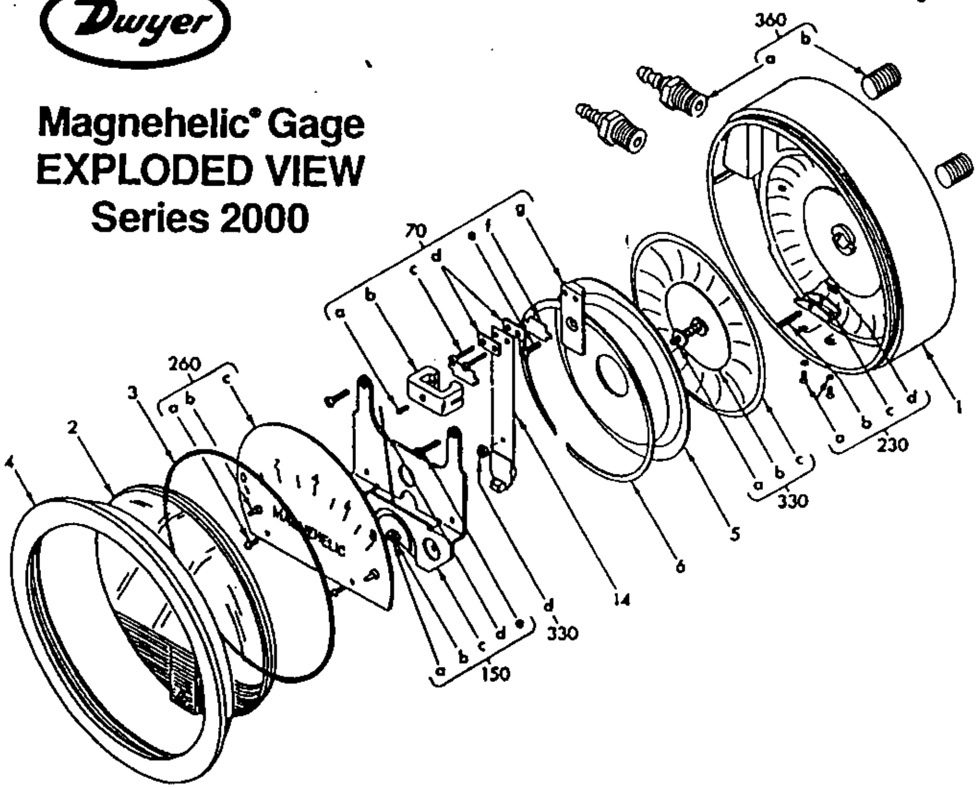
H. E. SARGENT

19-2570 REV B

B	1/28/02	ROTATED SEPARATOR OUTLET 90°. CORRECTED ORIENTATION.	JK	
A	11/1/01	CHANGED 7 1/2 GPM EA. TO 17.5 GPM EA., 5.5% TO 5.6% &		
		No 11 TO DRAIN. ROTATED OUTLET 90°. ADDED LIFTING LUGS.	JK	

Dwyer

Magnehelic® Gage EXPLODED VIEW Series 2000



1. Case
2. Cover with zero adjust assy.
3. "O" ring seal
4. Bezel
5. Diaphragm sealing plate
6. Retaining ring
70. Range Spring assembly
    a. Clamp set screw
    b. Clamp
    c. Mounting screws (2 req'd)
    d. Clamping shoe (2 req'd)
    e. Clamp plate screw
    f. Spacer (2 req'd)
    g. Clamp plate
14. Range Spring with magnet
150. Wishbone Assembly – consists of:
    a. Front jewel
    b. Locking nut
    c. Wishbone
    d. Pointer
    e. Mounting screws (2 req'd)
    f. Helix assembly (not shown)
    g. Pivots (2 req'd) (not shown)
    h. Rear jewel (not shown)
230. Zero adjust assembly – consists of:
    a. Foot screws with washers (2 req'd)
    b. Adjust screw
    c. Foot
    d. Finger
260. Scale Assembly – consists of:
    a. Mounting screws (2 req'd)
    b. Bumper pointer stop (2 req'd)
    c. Scale
330. Diaphragm Assembly – consists of: (Arbor press needed to install)
    a. Linkage assy., complete
    b. Front plate
    c. Diaphragm
    d. Rear plate (not shown)
    e. Plate washer (not shown)
360. Mounting Hardware Kit
    a. Adapter – pipe plug 1/8" NPT to rubber tubing – (2 req'd)
    b. Pipe plug 1/8" NPT – (2 req'd)
    c. Mounting lug (3 req'd)
    d. Long screw (3 req'd)
    e. Short screw (3 req'd)

MT – 8

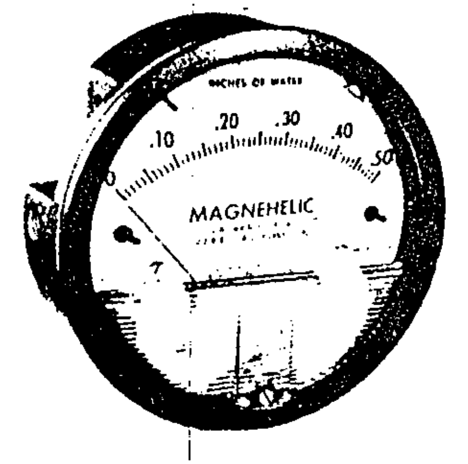
Ordering Instructions:

When corresponding with the factory regarding Magnehelic® gage problems, refer to the call-out numbers in this view. Be sure to include model number, pressure range, and any special options. Field repair is not recommended; contact the factory for repair service infor...on.

OPERATING INSTRUCTIONS and PARTS LIST

Magnehelic® Differential Pressure Gage

Dwyer



SPECIFICATIONS

Dimensions: 4-3/4" dia. X 2-3/16" deep.

Weight: 1 lb. 2 oz.

Finish: Baked dark gray enamel.

Connections: 1/8 N.P.T. high and low pressure taps, duplicated, one pair side and one pair back.

Accuracy: Plus or minus 2% of full scale, at 70°F. (Model 2000-0, 3%; 2000-00, 4%).

Pressure Rating: 15 PSI.

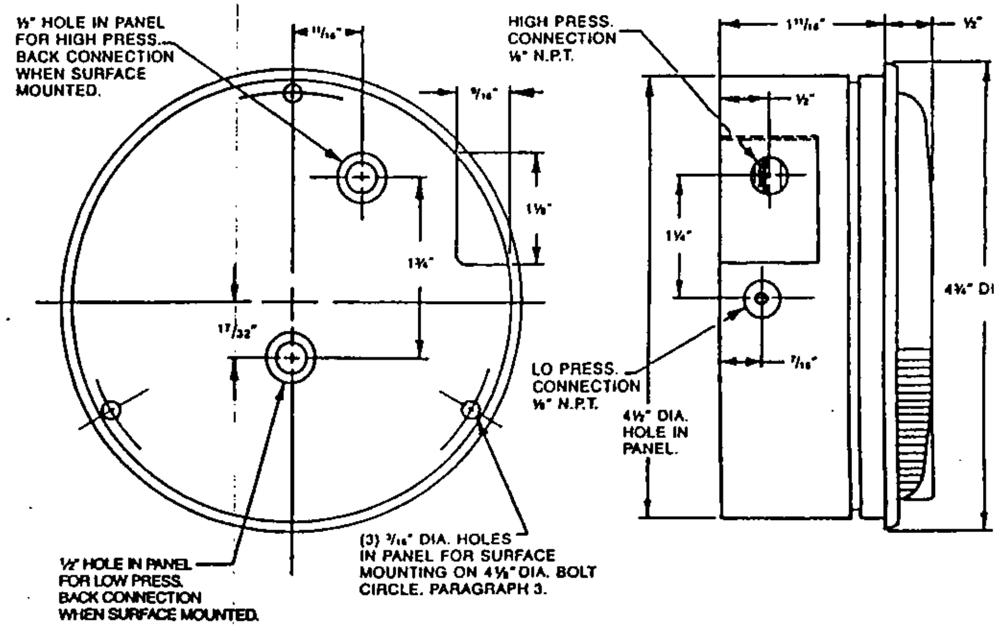
Ambient Temperature Range: 20° to 140°F.

Standard gage accessories include two 1/8" N.P.T. plugs for duplicate pressure taps, two 1/8" pipe thread to rubber tubing adapters, and three flush mounting adapters with screws.

Caution: For use with air or compatible gases only.

For repeated over-ranging or high cycle rates, contact factory.

Hydrogen Gas Precautionary Note: The rectangular rare earth magnet used in the standard gage may not be suitable for use with hydrogen gas since a toxic and explosive gas may form. For hydrogen service, consult the factory for an alternate gage construction.

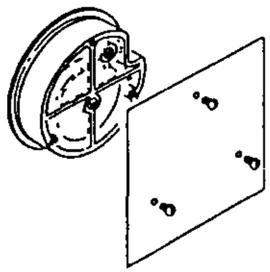


MAGNEHELIC' INSTALLATION

I. Select a location free from excessive /ibration and where the ambient temperature vill not exceed 140°F. Also, avoid direct .unlight which accelerates discoloration of he clear plastic cover. Sensing lines may be un any necessary distance. Long tubing engths will not affect accuracy but will ncrease response time slightly. Do not restrict ines. If pulsating pressures or vibration cause xcessive pointer oscillation, consult the fac- ory for ways to provide additional damping.

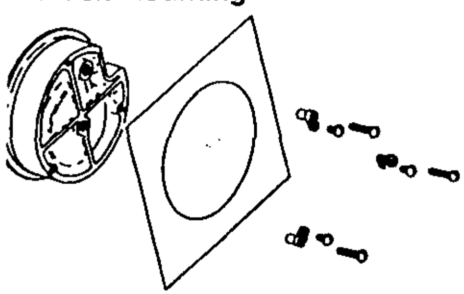
2. All standard Magnehelic gages are cali- rated with the diaphragm vertical and hould be used in that position for maximum ccuracy. If gages are to be used in other than ertical position, this should be specified on ıe order. Many higher range gages will per- orm within tolerance in other positions with nly rezeroing. Low range Model 2000-00 nd metric equivalents must be used in the ertical position only.

3. Surface Mounting



Locate mounting holes, 120° apart on a 4-1/8" lia. circle. Use No. 6-32 machine screws of appropriate length.

4. Flush Mounting



Provide a 4½" dia. opening in panel. Insert gage and secure in place with No. 6-32 nachine screws of appropriate length, with adaptors, Part No. 3··· , firmly secured in place. To mount ga··· 1¼"-2" pipe, order optional A-610 pip··· nting kit.

5. To zero the gage after installation

Set the indicating pointer exactly on the zero mark, using the external zero adjust screw on the cover at the bottom. Note that the zero check or adjustment can only be made with the high and low pressure taps both open to atmosphere.

Operation

Positive Pressure: Connect tubing from source of pressure to either of the two high pressure ports. Plug the port not used. Vent one or both low pressure ports to atmosphere.

Negative Pressure: Connect tubing from source of vacuum or negative pressure to either of the two low pressure ports. Plug the port not used. Vent one or both high pressure ports to atmosphere.

Differential Pressure: Connect tubing from the greater of two pressure sources to either high pressure port and the lower to either low pressure port. Plug both unused ports.

When one side of gage is vented in a dirty, dusty atmosphere, we suggest an A-331 Filter Vent Plug be installed in the open port to keep inside of gage clean.

a. For portable use or temporary installation, use 1/8" pipe thread to rubber tubing adapter and connect to source of pressure with rubber or Tygon tubing.

b. For permanent installation, 1/4" O.D., or larger, copper or aluminum tubing is recommended. See accessory bulletin S-101 for fittings.

MAINTENANCE

Maintenance: No lubrication or periodic servicing is required. Keep case exterior and cover clean. Occasionally disconnect pressure lines to vent both sides of gage to atmosphere and re-zero. Optional vent valves, (bulletin S-101), should be used in permanent installations.

Calibration Check: Select a second gage or manometer of known accuracy and in an appropriate range. Using short lengths of rubber or vinyl tubing, connect the high pressure side of the Magnehelic gage and the test gage to two legs of a tee. Very slowly apply pressure through the third leg. Allow a few seconds for pressure to equalize, fluid to drain, etc., and compare readings. If accuracy unacceptable, gage may be returned to factory for recalibration. To calibrate in the field, use the following procedure.

Calibration:

1. With gage case, P/N 1, held firmly, loosen bezel, P/N 4 by turning counterclockwise. To avoid damage, a canvas strap wrench or similar tool should be used.
2. Lift out plastic cover and "O" ring.
3. Remove scale screws and scale assembly. Be careful not to damage pointer.
4. The calibration is changed by moving the clamp, P/N. 70-b. Loosen the clamp screw(s) and move slightly toward the helix if gage is reading high, and away if reading low. Tighten clamp screw and install scale assembly.
5. Place cover and 0-ring in position. Make sure the hex shaft on inside of cover is properly engaged in zero adjust screw, P/N 230-b.
6. Secure cover in place by screwing bezel down snug. Note that the area under the cover is pressurized in operation and therefore gage will leak if not properly tightened.
7. Zero gage and compare to test instrument. Make further adjustments as necessary.

Caution: If bezel binds when installing, lubricate threads sparingly with light oil or molybdenum disulphide compound.

Warning: Attempted field repair may void your warranty. Recalibration or repair by the user is not recommended. For best results, return gage to the factory. Ship prepaid to:

Dwyer Instruments, Inc.
Attn. Repair Dept.
55 Ward St.
Wakarusa, IN 46573

Trouble Shooting Tips:

• *Gage won't indicate or is sluggish.*

1. Duplicate pressure port not plugged.
2. Diaphragm ruptured due to overpressure.
3. Fittings or sensing lines blocked, pinched, or leaking.
4. Cover loose or "O" ring damaged, missing.
5. Pressure sensors, (static tips, Pitot tube, etc.) improperly located.
6. Ambient temperature too low. For operation below 20°F, order gage with low temperature, (LT) option.

• *Pointer stuck-gage can't be zeroed.*

1. Scale touching pointer.
2. Spring/magnet assembly shifted and touching helix.
3. Metallic particles clinging to magnet and interfering with helix movement.
4. Cover zero adjust shaft broken or not properly engaged in P/N 230-b adjusting screw.

We generally recommend that gages needing repair be returned to the factory. Parts used in various sub-assemblies vary from one range of gage to another, and use of incorrect components may cause improper operation or failure. Gages repaired at the factory are carefully calibrated and tested to assure "like-new" operation. After receipt and inspection, we will be happy to quote repair costs before proceeding.

Consult factory for assistance on unusual applications or conditions.

Use with air or compatible gases only.

Instruction Book No. 62
Revision 2

Instructions
For
Installation – Operation – Maintenance
Of Your

ImpinJet® Scrubber

GREATER LAWRENCE SANITARY DISTRICT

RJM-0637

This book contains instructions for installation, operation, and maintenance of this equipment. It is essential that it reaches the people who *Install* and *Use* the equipment.

SLY Incorporated

P.O. Box 5939
Cleveland, Ohio 44101

Tel: (440) 891-3200
Fax: (440) 891-3210

Table of Contents

Warranty

Our Warranty is defined clearly on our standard Terms and Conditions sheet that is a part of every quotation and order unless specifically modified and agreed to by the Cleveland Home Office.

Backcharges Policy

We recognize that for reasons of practicality or expediency, field correction or repairs may occasionally be required. Backcharges for correction or repair of equipment during erection or installation will not be accepted unless authorized by Sly prior to work commencing. Sly will require a firm price for any and all work and a specific scope of the work. If a firm price cannot be established, a "not to exceed" figure will be required. When a verbal agreement has been reached, the Purchaser must confirm it in writing within 24 hours. Under no circumstances will Sly be responsible for costs, penalties, consequential damages, etc., due to delays in completion. Under no circumstances may the Purchaser withhold unauthorized backcharges from payment of monies due per Terms of Payment. This authority cannot be delegated to Representatives, Agents, Field Sales or Field Service Personnel.

Sly Incorporated has a reputation of fairness and service to customers. We intend to maintain this reputation.

Receiving Your ImpinJet®

When your unit arrives, it should be carefully inspected to make sure that the unit is in good condition and that all of the components listed on the packing list are received. Small components, bags or fasteners, etc., are often placed inside the collector or in the hoppers. If you are missing any of your items, make sure that you check these areas.

Sly loads its equipment on heavy shipping skids or in boxes, however it is still possible for units to be damages or lost in transit. All shortages or damages should be noted on the Bill of Lading at delivery. The Purchaser should take immediate steps to file reports and claims for damage or loss with the trucking firm. Since the manufacturer ships F.O.B., shipping point, when the trucker loads and accepts the shipment, ownership passes to the Purchaser. Any damage or loss occurring during transit is the responsibility of the Common Carrier. Any claims for damage or losses must be brought against the carrier by the Purchaser!

ImpinJet® Theory

The ImpinJet® Scrubber is basically a combination of two individual scrubbers; namely the spray section and the impingement plate section.

The purpose of the spray section is to take out large particles from the incoming stream; to cool and humidify the incoming stream and to wash the bottom of the impingement plate stage so there is no possibility of any build-up in this area.

Operating Principles

The gas passes up through the openings in the perforated plates (trays) which hold a bed of liquid. The secret is in the scrubber's design that uses an impingement baffle above each individual hole.

The tiny droplets, created by the wetted baffles, are the heart of the collection process.

Gas velocities of 60-75 feet/second through the holes result in thousands of jets that atomize the liquid into droplets on the order of 100 microns in diameter to clean the contaminated gas. This entraps the particles fluid and results in a wetted target surface on the baffle which is located just above the point of maximum velocity (vena contracts).

In operation, the scrubber is highly pluggage-resistant. The continuous violent agitation of the blanket of scrubbing fluid prevents settling of particles and flushes them away.

Intimate gas/liquid contact results in the maximum collection efficiency for particles and droplets as well as absorption (mass transfer) of gases, odors and vapors. When used for absorption, low outlet emissions can be achieved by virtue of the scrubber's countercurrent operation. The Sly ImpinJet® Gas Scrubber is able to reduce gaseous pollutants to any desired concentration if a sufficient number of plate stages is used.

When used as a dust collector, the water level height on the plate need not be more than 1" high. In this distance the interaction of the droplets and the dust particles has taken place. Increasing the water level will cause the formation of larger gaseous bubbles and relatively little contact between dust and fluid will be attained.

Installation and Adjustment

Leveling

Installation and adjustment of the ImpinJet® is comparatively simple and the services of a factory engineer are not necessarily required.

Since the equipment is dependent on reasonable uniform water flow and distribution, the scrubber should be leveled on its support or foundation.

After this is done a final check and further shimming should be made for levelness of the impingement plate. The impingement plate should be level ± 1/8".

Gasketing

If the equipment is broken into more than section, apply gasketing between all mating joints and flanges.

Spray Nozzles and Piping

Spray nozzles and piping should be checked to see all connections are secure.

Normal water consumption for the sprays is approximately one GPM @ 20 PSI per 1000 CFM @ 70°F. See general arrangement drawing for specific requirements. Be sure the water supply and pressure are adequate before starting equipment.

A pressure gauge should be installed in the spray water supply for operating personnel's observance.

Whenever there are solids in the spray water supply or when it is recirculated a strainer should be installed to avoid clogging the sprays. We have found that a dual basket-type strainer with an approximate 16x16 mesh is suitable. The dual basket-type requires no downtime and very little maintenance.

Water Flow Adjustments

Check to see that impingement plates are installed so that the water flow is parallel to the baffle strips.

Turn on plate water and adjust the water box weirs, if supplied, so that water overflows in a uniform rate along the entire width of the plate. Set the flow rate by means of flowmeters or by measuring the discharge into a container for given period of time.

The fixed-blade mist eliminator, if supplied, is equipped with one or more drainpipes. In knocked-down jobs, be sure these are securely connected.

The water discharge at the bottom of the scrubber must be trapped or sealed to allow water flow to flow against the differential in pressures between the inside and outside of the scrubber. In some cases, loop-type seals are furnished with the scrubber. (Refer to order and/or General Arrangement drawing.)

ImpinJet® Start-Up and Operation

It is essential that the proper sequence be used <u>each</u> time the scrubber is put into operation.

The plate water should be turned on first to allow water boxes to fill before the air is started through the unit.

It is important that the spray water be turned on before putting air through the scrubber. If it is not, plugging of the impingement plate may occur from "flashing" – "flashing" is the sudden evaporation of dust-laden air on the impingement plate.

Turn on the air or gas flow to the scrubber. For maximum efficiency, the airflow should be measured and the design volume introduced to the unit. Air volume can vary ±10% of design volume and not greatly affect over-all efficiency.

An approximate measurement of air volume can be made using the ImpinJet® itself. The pressure drop across one stage of impingement baffle plates will be 1¾" water gauge when handling the design volume of dry air at 60°F. Since the air will be neither dry nor at 60°F, the pressure drop must be corrected for density.

When shutting down the unit, the reverse sequence should be used. First, shut off the airflow, then the spray and plate water.

Inspection

Periodic inspection of the equipment should be made to keep it at peak operating efficiency.

Pressure gauges should be observed daily for proper operating pressure.

Spray nozzles should be checked for clogging or wear.

Line strainers should be checked for clogging or wear.

Impingement baffle plates should be checked to see they are secure.

Plate and mist eliminator seals should be checked for clogging or the accumulation of material.

Spare Parts

Our recommendations for stocking of spare parts for the ImpinJet® is generally limited to a complete set of spray nozzles. If the atmosphere or recirculated liquid is particularly corrosive, a spare set impingement plates will be desirable.

Troubleshooting and Servicing

There are relatively few types of operational problems with the ImpinJet® scrubber. Most of these involve the lack of proper distribution of water.

Many of the problems lead to or show up in the form of impingement plate plugging. Plugging of impingement baffle plates is always the result of one or more of the conditions listed. After an impingement plate has plugged, it can lead to other problems, as described.

The following pages have detailed charts of the types of problems that can be encountered with the ImpinJet® scrubber and how to determine and correct these problems.

Troubleshooting Charts

Type of Trouble	Check for Cause	Probable Cures
A. Plugging – When it occurs in a single stage unit or the first stage of a multiple stage unit. See method of measurement below.	1. Lack of spray water.	Check water pressure (20 psig normal). Check for clogged spray nozzles. Check strainer.
	2. Low plate water level.	Increase water flow rate. Raise outlet weir heights.
	3. Improper water distribution.	Adjust unit so impingement plate is level.
	4. Improperly installed plates.	Impingement plates must be installed so water flow is parallel with baffle strips.
	5. Fibrous material or paper, etc., adhering to underside of plate.	Increase spray water pressure. Use a pre-cleaner, such as a cyclone, to prevent this material from reaching the scrubber.
	6. Flashing – Sudden evaporation of dust laden air on impingement plate	Increase spray water flow. Increase plate water flow. Pre-cool air stream prior to entry to scrubber. If recirculating water, increase the amount of bleed-off to drain, thereby cooling recirculated water with make-up water.
	7. Chemical – Such as formation of salts in neutralization of acids.	Change chemical composition or solubility by additives. If recirculating water, increase amount of bleed-off to drain to reduce concentration.

Type of Trouble	Check for Cause	Probable Cures
B. Plugging – When it occurs in a additional stages of a multiple stage unit. See Method of Measurement below.	1. Recirculation of solids in water system.	Limit the percent of solids in the plate water to 10% weight. Check for clogged spray nozzles – set-up periodic maintenance program. Use open cone spray nozzles. Increase bleed-off water to drain – add fresh make-up water to lower concentration of solids. Increase retention time in water recirculation tank, providing more settling time.
	2. Low plate water level.	See A-2
	3. Improper water distribution.	See A-3
	4. Improperly installed plates.	See A-4

Type of Trouble	Check for Cause	Probable Cures
C. Low Air Volume – Dusting at hoods, loss of suction, etc.	1. Check items under "Plugging."	See – NOTE
	2. Check pressure drop across scrubber stages.	See – Measurement Instructions.
	3. Check fan performance against design data.	Adjust as required.
	4. Check duct design systems.	Remove unnecessary system resistance or adjust fan performance as required.

Type of Trouble	Check for Cause	Probable Cures
D. Low Efficiency – Excessive dust emission from scrubber discharge.	1. Gaps between plates and diaphragms.	Replace missing nuts and tighten others.
	2. Check items A-1, A-2, A-3 and A-4 under plugging.	See above.
	3. High air velocity blows water off plates.	Check fan performance and adjust to design volume.
	4. Low air velocity.	Check fan performance and adjust to design volume. Add blank-off plates at impingement plates to attain design velocity (900 FPM) per square foot area of impingement plate.
	5. High dust loading.	Do not exceed 10% solids (by weight) in plate water. Increase water to plates. Add cyclone or pre-cleaner.
	6. Check for corroded parts affecting air or water.	Repair as required – determine cause – See "Corrosion."
	7. Flow or distribution high percent of solids in recirculated water.	Bleed-off dirty water to drain, add fresh water. Lengthen settling time in recirculation tank. Filter recirculated water.

Type of Trouble	Check for Cause	Probable Cures
E. Water carryover.	1. Check mist eliminator drains for clogging. Check plate diaphragm drains for clogging. Clogging prevents normal drain of water, allowing carryover and re-entrainment in air stream.	Clean out drains for normal flow. This condition more prevalent in systems where water is recirculated. Set up periodic maintenance program.
	2. Excessive air volume.	Check against design data. Normal air velocity through scrubber cross-section diameter is 420-500 feet per minute.

Type of Trouble	Check for Cause	Probable Cures
F. Surging – Pulsating air flow, loss of suction.	1. Water flow too high across plates – more than drain can accommodate.	Low water flow.
	2. Frozen or plugged plate seals.	Provide weep holes or drain to prevent freezing.
	3. Blowing plate seals.	Clean out seals of accumulated sludge, etc. Prevalent where recirculated water is used. Set up periodic maintenance program.

Type of Trouble	Check for Cause	Probable Cures
G. Scrubber drain connections.	1. Blowing drain seal.	Drain should be sealed or trapped against differential between scrubber pressure or suction and atmosphere.
	2. Water build-up in bottom cone.	Check for clogging or restricting drain connection.

Type of Trouble	Check for Cause	Probable Cures
H. Equipment wear, corrosion and abrasion.	1. Where process handles material of corrosive nature, inspect for chemical attack.	Set up periodic maintenance, inspection program. If possible change chemical composition by additives or neutralizing.
	2. Where addition of water with process air creates corrosive solution, check for chemical attack.	See A-7
	3. Where recirculation water with solids in solution, check for abrasive wear.	See B-1

Type of Trouble	Check for Cause	Probable Cures
I. High pressure drop across impingement plates.	1. Water flow to high across plates.	Adjust water flow.
	2. Plugging.	See Section A & B above.
	3. Excessive Air Volume.	Measure and adjust.
High pressure drop across mist eliminator.	4. Check for material build-up.	Clean as required.
High pressure drop across inlet or outlet.	5. Check size of ducts.	Modify as required.
	6. Check for restrictions, improper turning vanes, etc.	Modify as required.
	7. Be sure readings are not false or improperly taken.	See section on Air Measurement.

NOTE: In most cases of plugging the underside of the impingement plate should be scraped with a flat wide-edged tool, and then hosed with water.

Methods of Measurement to Determine Plugging of ImpinJet®

The extent of plugging of an impingement plate cannot always be determined by observation alone. The following procedure can be used as an accurate means of determining the degree of pluggage.

Required

- U-Tube Manometer, with flexible rubber connections.
- Pitot Tube – 18" Size Minimum

Points of Measurement

1. Drill holes at inlet to scrubber, below the first (bottom) stage, between each succeeding stage and/or the mist eliminator, and above the mist eliminator (in straight section of duct if possible). Pressure taps are sometimes supplied at these locations, it the are not being used, they can be used.
2. Holes should be large enough to allow inserting of the pitot tube (normally 3/8" Dia.)
3. Obtain static pressure readings by connecting manometer to pitot tube by means of **one** rubber tube.
4. Insert pitot tube so as to obtain typical or average readings. Avoid false readings, such as result from cyclonic airflow immediately out of mist eliminator.
5. In suction systems, subtract static pressure reading below plate from reading above to obtain plate pressure drop. Pressure drop with normal air flow and water flow is approximately 1 ¾" w.g.

Notes

Appendix J

Meteorological Data

Table J-1 First Two Days of Meteorological Data (ISC, Extended format, 1986)

yr	mo	day	hr	Random Flow Vector	Wind Speed (m/s)	Ambient Temperature (K)	Stability Category	Rural Mixing Height (m)	Urban Mixing Height (m)	Friction Velocity at the Application Site (m/s)	Moninobukhov Length at the Application Site (m)	Roughness Length at the Application Site (m)	Precipitation Amount (mm)	Precipitation Rate (mm/hr)	Global Horizontal Radiation (W/m2)	Relative Humidity (%)
86	1	1	1	181	0	288.2	7	1057.8	40	0	0	0.01	0	0	0	93
86	1	1	2	28	2.0578	287.6	6	1058.6	40	0.1984	29.7	0.01	0	0	0	97
86	1	1	3	4	2.0578	289.3	6	1059.4	40	0.1985	29.9	0.01	0	0	0	90
86	1	1	4	33	1.5433	289.8	7	1060.2	40	0.1482	25	0.01	0	0	0	90
86	1	1	5	53	1.5433	289.8	6	1061	40	0.1474	25	0.01	0	0	0	90
86	1	1	6	52	0	290.4	5	1061.7	40	0	0	0.01	0	0	0	90
86	1	1	7	15	2.0578	290.9	5	1062.5	40	0.199	33	0.01	0	0	0	93
86	1	1	8	33	2.5722	291.5	4	122.8	158.2	0.2569	-224.7	0.01	0	0	49	93
86	1	1	9	17	4.1155	294.3	4	280.3	309.8	0.4105	-401.2	0.01	0	0	107	87
86	1	1	10	181	3.0866	292.6	4	437.8	461.4	0.3106	-70.4	0.01	0	0	224	87
86	1	1	11	194	2.5722	294.3	4	595.4	613.1	0.2639	-22.8	0.01	0	0	297	79
86	1	1	12	186	0	296.5	3	752.9	764.7	0	0	0.01	0	0	587	71
86	1	1	13	13	2.5722	298.7	2	910.5	916.4	0.2648	-20	0.01	0	0	629	67
86	1	1	14	59	1.5433	298.2	2	1068	1068	0.1673	-6.4	0.01	0	0	455	69
86	1	1	15	292	3.0866	295.9	3	1068	1068	0.3103	-76.9	0.01	0	0	155	82
86	1	1	16	344	3.0866	296.5	4	1068	1068	0.3085	-185.1	0.01	0	0	172	79
86	1	1	17	1	2.5722	295.9	4	1068	1068	0.2518	57	0.01	0	0	90	84
86	1	1	18	357	2.5722	294.3	5	1074.3	1015	0.2518	56.7	0.01	0	0	24	87
86	1	1	19	24	3.0866	294.3	5	1088.9	891	0.304	89.5	0.01	0	0	0	90
86	1	1	20	7	3.6011	293.2	5	1103.5	767	0.3548	93.5	0.01	0	0	0	97
86	1	1	21	20	3.0866	292.6	6	1118.2	643	0.3029	67.1	0.01	0	0	0	93
86	1	1	22	22	2.5722	292	6	1132.8	519	0.2508	46.1	0.01	0	0	0	97
86	1	1	23	20	2.5722	291.5	6	1147.4	395	0.2508	46	0.01	0	0	0	100
86	1	1	24	30	2.0578	290.4	6	1162.1	271	0.1982	28.6	0.01	0	0	0	100
86	1	2	1	76	2.5722	289.8	6	1176.6	271	0.2508	45.5	0.01	0	0	0	100
86	1	2	2	12	2.0578	290.4	6	1191.3	271	0.1982	28.6	0.01	0	0	0	100
86	1	2	3	102	1.5433	289.3	7	1205.9	271	0.1498	25	0.01	0	0	0	100
86	1	2	4	90	2.0578	289.3	6	1220.6	271	0.2015	58.5	0.01	0	0	0	100
86	1	2	5	116	2.522	290.9	5	1235.2	271	0.2534	92.8	0.01	0	0	0	100
86	1	2	6	47	1.5433	290.4	4	1249.8	1249.8	0.1492	32.4	0.01	0	0	0	100
86	1	2	7	89	2.0578	289.3	5	1264.5	271	0.1994	35.1	0.01	0	0	38	100
86	1	2	8	86	0	289.3	4	156.4	396.4	0	0	0.01	0	0	207	100
86	1	2	9	350	1.5433	292	3	358.1	558.1	0.1621	-11.5	0.01	0	0	383	82
86	1	2	10	341	2.0578	295.9	3	559.9	719.9	0.2143	-14.2	0.01	0	0	539	69
86	1	2	11	335	2.5722	298.2	2	761.7	881.7	0.2644	-21	0.01	0	0	595	64
86	1	2	12	41	3.0866	298.7	2	963.5	1043.5	0.3141	-32.2	0.01	0	0	688	62
86	1	2	13	359	2.5722	299.3	2	1165.2	1205.2	0.265	-19.5	0.01	0	0		

Table J-1 First Two Days of Meteorological Data (ISC, Extended format, 1986)

yr	mo	day	hr	Random Flow Vector	Wind Speed (m/s)	Ambient Temperature (K)	*Stability* Category	Rural Mixing *Height* (m)	Urban Mixing *Height* (m)	Friction Velocity at the Application Site (m/s)	Moninobukhov Length at the Application Site (m)	Roughness Length at the Application Site (m)	Precipitation Amount (mm)	Precipitation Rate (mm/hr)	Global Horizontal Radiation (W/m2)	Relative Humidity (%)
86	1	2	14	77	3.6011	300.4	2	1367	1367	0.3629	-61.3	0.01	0	0	583	56
86	1	2	15	360	4.1155	300.4	3	1367	1367	0.4116	-166.9	0.01	0	0	486	54
86	1	2	16	54	4.63	299.8	3	1367	1367	0.4613	-861.5	0.01	0	0	329	58
86	1	2	17	338	3.0866	298.2	4	1367	1367	0.303	68.4	0.01	0	0	156	69
86	1	2	18	351	3.0866	295.9	5	1362.1	1290.5	0.303	67.9	0.01	0	0	33	79
86	1	2	19	2	3.0866	295.4	6	1350.3	1107.3	0.303	67.8	0.01	0	0	0	84
86	1	2	20	5	2.5722	294.3	6	1338.6	924	0.2509	46.4	0.01	0	0	0	93
86	1	2	21	14	2.5722	294.3	6	1326.8	740.8	0.2509	46.4	0.01	0	0	0	93
86	1	2	22	25	2.5722	293.7	6	1315.1	557.5	0.2508	46.3	0.01	0	0	0	97
86	1	2	23	37	2.5722	293.7	6	1303.3	374.3	0.2508	46.1	0.01	0	0	0	97
86	1	2	24	158	3.0866	292.6	6	1291.6	191	0.3029	66.8	0.01	0	0	0	97

Appendix K

Dispersion Modeling Files

Sample K1: ISCST output file. First and last few pages of COOFF87.out (CO Fine Analysis 1987)

```
**
*****************************************
**
** ISCST3 INPUT PRODUCED BY:
** ISC-AERMOD VIEW VER. 4.8.5
** LAKES ENVIRONMENTAL SOFTWARE INC.
** DATE: 2/11/05
** FILE: C:\DOCUMENTS AND SETTINGS\WALLACEMC\MY DOCUMENTS\MY DOCUMENTS\WB SWA\BPF OFFSITE\COOFF87.INP
**
*****************************************
**
**
*****************************************
** ISCST3 CONTROL PATHWAY
*****************************************
**
** SOLID WASTE AUTHORITY OF PALM BEACH COUNTY, PPSA/PSD/TITLEV
** MODIFICATION.
** THIS MODEL REPRESENTS EMISSIONS FROM THE PROPOSED BIOSOLIDS
** PELLETIZING FACILITY AT THE SWA'S NCRRF SITE IN WEST PALM BEACH,
** FLORIDA.
**
CO STARTING
   TITLEONE BIOSOLIDS PELLETIZING FACILITY
   TITLETWO PSD PERMIT APPLICATION - CO OFFSITE FINE RUN 1987
   MODELOPT DFAULT CONC  RURAL
   AVERTIME 1 8
   POLLUTID CO
   TERRHGTS FLAT
   RUNORNOT RUN
** ERROR FILE PATH: C:\DOCUMENTS AND SETTINGS\WALLACEMC\MY DOCUMENTS\MY DOCUMENTS\WB SWA\BPF OFFSITE\
   ERRORFIL COOFF87.ERR
CO FINISHED
**
*****************************************
** ISCST3 SOURCE PATHWAY
*****************************************
**
** 6/29/03 - FLARES HAVE BEEN ADDED ASSUMING 1,000, 2,000 AND 3500 CFM
** FLOW AND PARAMETERS DETERMINED USING THE METHODS SPECIFED IN SCREEN3
** DISPERSION MODELING GUIDANCE.
```

**MODELOPTs:
CONC RURAL FLAT DFAULT

*** THE SUMMARY OF HIGHEST 1-HR RESULTS ***

** CONC OF CO IN MICROGRAMS/M**3 **

GROUP ID		AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR (XR, YR, ZELEV, ZFLAG)				OF TYPE	NETWORK GRID-ID
ALL	HIGH 1ST HIGH VALUE IS	16.86143	ON 87040411: AT (	238484.94,	269331.88,	0.00,	0.00)	DC	NA
	HIGH 2ND HIGH VALUE IS	16.38979	ON 87042614: AT (	237676.41,	268926.19,	0.00,	0.00)	DC	NA

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY

**MODELOPTs:
CONC RURAL FLAT DFAULT

*** THE SUMMARY OF HIGHEST 8-HR RESULTS ***

** CONC OF CO IN MICROGRAMS/M**3 **

GROUP ID		AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR (XR, YR, ZELEV, ZFLAG)				OF TYPE	NETWORK GRID-ID
ALL	HIGH 1ST HIGH VALUE IS	11.39236	ON 87062716: AT (	238538.84,	270286.78,	0.00,	0.00)	DC	NA
	HIGH 2ND HIGH VALUE IS	9.54896	ON 87052408: AT (	236896.41,	269786.19,	0.00,	0.00)	DC	NA

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY

Sample K2: CALPUFF control/input file. Input groups 0 and 1 for 87PUF.inp

```
BPF - 1987 CALPUFF RUN
CONC, DDEP, WDEP, VISIB

---------------- Run title (3 lines) ------------------------------------------

                    CALPUFF MODEL CONTROL FILE
                    --------------------------

-------------------------------------------------------------------------------


INPUT GROUP: 0 -- Input and Output File Names


--------------
Default Name  Type          File Name
------------  ----          ---------
CALMET.DAT    input     * METDAT =                  *
    or
ISCMET.DAT    input     ! ISCDAT =C:\SWACAL~1\1987CA~1\METDAT~1\WPBEX87.MET   !
    or
PLMMET.DAT    input     * PLMDAT =                  *
    or
PROFILE.DAT   input     * PRFDAT =                  *
SURFACE.DAT   input     * SFCDAT =                  *
RESTARTB.DAT  input     * RSTARTB=                  *
--------------------------------------------------------------------------------
CALPUFF.LST   output    ! PUFLST =87APUF.LST  !
CONC.DAT      output    ! CONDAT =87CONC.DAT     !
DFLX.DAT      output    ! DFDAT  =87DFLX.DAT     !
WFLX.DAT      output    ! WFDAT  =87WFLX.DAT     !

VISB.DAT      output    ! VISDAT =87VISB.DAT     !
RESTARTE.DAT  output    * RSTARTE=                  *
--------------------------------------------------------------------------------
Emission Files
--------------
PTEMARB.DAT   input     * PTDAT  =                  *
VOLEMARB.DAT  input     * VOLDAT =                  *
BAEMARB.DAT   input     * ARDAT  =                  *
LNEMARB.DAT   input     * LNDAT  =                  *
--------------------------------------------------------------------------------
```

```
Other Files
-----------
OZONE.DAT      input     * OZDAT   =              *
VD.DAT         input     * VDDAT   =              *
CHEM.DAT       input     * CHEMDAT=               *
H2O2.DAT       input     * H2O2DAT=               *
HILL.DAT       input     * HILDAT=               *
HILLRCT.DAT    input     * RCTDAT=               *
COASTLN.DAT    input     * CSTDAT=               *
FLUXBDY.DAT    input     * BDYDAT=               *
BCON.DAT       input     * BCNDAT=               *
DEBUG.DAT      output    * DEBUG =               *
MASSFLX.DAT    output    * FLXDAT=               *
MASSBAL.DAT    output    * BALDAT=               *
FOG.DAT        output    * FOGDAT=               *
-------------------------------------------------------------------------------
All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
         T = lower case       ! LCFILES = F !
         F = UPPER CASE
NOTE: (1) file/path names can be up to 70 characters in length


Provision for multiple input files
----------------------------------

     Number of CALMET.DAT files for run (NMETDAT)
                                    Default: 1       ! NMETDAT =   0   !

     Number of PTEMARB.DAT files for run (NPTDAT)
                                    Default: 0       ! NPTDAT =  0  !

     Number of BAEMARB.DAT files for run (NARDAT)
                                    Default: 0       ! NARDAT =  0  !

     Number of VOLEMARB.DAT files for run (NVOLDAT)
                                    Default: 0       ! NVOLDAT =  0  !

!END!

-------------
Subgroup (0a)
-------------
```

```
The following CALMET.DAT filenames are processed in sequence if NMETDAT>1

Default Name  Type          File Name
------------  ----          ---------
 none         input    * METDAT=      *    *END*


-------------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------

    Option to run all periods found
    in the met. file     (METRUN)   Default: 0       ! METRUN =   1  !

         METRUN = 0 - Run period explicitly defined below
         METRUN = 1 - Run all periods in met. file

     Starting date:   Year (IBYR) -- No default       ! IBYR =  1987  !
     (used only if   Month (IBMO) -- No default       ! IBMO =  0  !
      METRUN = 0)      Day (IBDY) -- No default       ! IBDY =  0  !
                      Hour (IBHR) -- No default       ! IBHR =  0  !

     Base time zone         (XBTZ) -- No default       ! XBTZ = 5.0  !
        PST = 8., MST = 7.
        CST = 6., EST = 5.

     Length of run (hours) (IRLG) -- No default       ! IRLG =  0  !

     Number of chemical species (NSPEC)
                                    Default: 5       ! NSPEC =  8   !

     Number of chemical species
     to be emitted  (NSE)           Default: 3       ! NSE =  5   !

     Flag to stop run after
     SETUP phase (ITEST)            Default: 2       ! ITEST =  2   !
     (Used to allow checking of the model inputs, files, etc.)
           ITEST = 1 - STOPS program after SETUP phase
           ITEST = 2 - Continues with execution of program after SETUP
```

```
Restart Configuration:

   Control flag (MRESTART)      Default: 0       ! MRESTART =  0   !

      0 = Do not read or write a restart file
      1 = Read a restart file at the beginning of
          the run
      2 = Write a restart file during run
      3 = Read a restart file at beginning of run
          and write a restart file during run

   Number of periods in Restart
   output cycle (NRESPD)        Default: 0       ! NRESPD =  0   !

      0 = File written only at last period
     >0 = File updated every NRESPD periods

Meteorological Data Format (METFM)
                                Default: 1       ! METFM =  2   !

      METFM = 1 - CALMET binary file (CALMET.MET)
      METFM = 2 - ISC ASCII file (ISCMET.MET)
      METFM = 3 - AUSPLUME ASCII file (PLMMET.MET)
      METFM = 4 - CTDM plus tower file (PROFILE.DAT) and
                  surface parameters file (SURFACE.DAT)

PG sigma-y is adjusted by the factor (AVET/PGTIME)**0.2
Averaging Time (minutes) (AVET)
                                Default: 60.0    ! AVET = 60. !
PG Averaging Time (minutes) (PGTIME)
                                Default: 60.0    ! PGTIME = 60. !


!END!
```

Sample K3: CALPOST Visibility *.lst output. First and last pages of 87VISB.lst (Visibility calculations for 1987)

```
*****************************************************************************************************************************
                                             CALPOST  Version 5.4          Level 030402
*****************************************************************************************************************************


 Run Title:
    BPF - 1987 VISIBILITY


 --------------------------------------------------------------------------------

 INPUT GROUP: 1 -- General run control parameters
 --------------

      Option to run all periods found
      in the met. file(s)  (METRUN)        Default: 0    ! METRUN =   1  !

          METRUN = 0 - Run period explicitly defined below
          METRUN = 1 - Run all periods in CALPUFF data file(s)

      Starting date:    Year  (ISYR) --    No default    ! ISYR  =  1987   !
      (used only if     Month (ISMO) --    No default    ! ISMO  =  0    !
       METRUN = 0)      Day   (ISDY) --    No default    ! ISDY  =  0    !
                        Hour  (ISHR) --    No default    ! ISHR  =  0    !

      Number of hours to process (NHRS) -- No default    ! NHRS  =  0  !

      Process every hour of data?(NREP) -- Default: 1   ! NREP  =  1  !
       (1 = every hour processed,
        2 = every 2nd hour processed,
        5 = every 5th hour processed, etc.)

 Species & Concentration/Deposition Information
 ----------------------------------------------

       Species to process (ASPEC)       -- No default    ! ASPEC = VISIB  !
       (ASPEC = VISIB for visibility processing)

       Layer/deposition code (ILAYER)   -- Default: 1    ! ILAYER =  1  !
         '1'  for CALPUFF concentrations,
         '-1' for dry deposition fluxes,
         '-2' for wet deposition fluxes,
         '-3' for wet+dry deposition fluxes.

       Scaling factors of the form:     -- Defaults:    ! A =  0.0    !
```

****

CALPOST Version 5.4 Level 030402

****

Run-Length VISIBILITY

VISIB B _SN__

(deciview)

RECEPTOR	COORDINATES (km)	TYPE	DV(Total)	DV(BKG)	DELTA DV	F(RH)

--- Number of recs with Delta-Deciview > 0.10: 0
--- Largest Delta-Deciview = 0.000

****

CALPOST Version 5.4 Level 030402

****

SUMMARY SECTION

VISIB B _SN__

(1/Mega-m)

RECEPTOR	COORDINATES (km)		TYPE	PEAK (YEAR,DAY,ENDING TIME)	FOR RANK	FOR AVERAGE PERIOD
22	202.916	152.906	DISCRETE	2.5720E+01 (1987,295,0000)	RANK 1	24 HOUR
127	162.495	223.553	DISCRETE	2.5712E+01 (1987,294,0000)	RANK 2	24 HOUR
127	162.495	223.553	DISCRETE	2.5711E+01 (1987,332,0000)	RANK 3	24 HOUR
127	162.495	223.553	DISCRETE	2.5708E+01 (1987,318,0000)	RANK 4	24 HOUR

Sample K4: CALPOST Deposition *.lst output. First and last few pages of 87SO2D.lst (Dry Deposition of SO2 in 1987)

```
************************************************************************************************************************
                                                    CALPOST  Version 5.4          Level 030402
************************************************************************************************************************


 Run Title:
    BPF - 1987 SO2 DRY DEPOSITION


 --------------------------------------------------------------------------------

 INPUT GROUP: 1 -- General run control parameters
 --------------

      Option to run all periods found
      in the met. file(s)  (METRUN)        Default: 0    ! METRUN =   1  !

          METRUN = 0 - Run period explicitly defined below
          METRUN = 1 - Run all periods in CALPUFF data file(s)

      Starting date:    Year  (ISYR) --    No default    ! ISYR  =  1987   !
      (used only if     Month (ISMO) --    No default    ! ISMO  =  0    !
       METRUN = 0)      Day   (ISDY) --    No default    ! ISDY  =  0    !
                        Hour  (ISHR) --    No default    ! ISHR  =  0    !

      Number of hours to process (NHRS) -- No default    ! NHRS  =  0  !

      Process every hour of data?(NREP) -- Default: 1    ! NREP  =  1  !
       (1 = every hour processed,
        2 = every 2nd hour processed,
        5 = every 5th hour processed, etc.)

 Species & Concentration/Deposition Information
 ----------------------------------------------

       Species to process (ASPEC)       -- No default    ! ASPEC = SO2  !
       (ASPEC = VISIB for visibility processing)

       Layer/deposition code (ILAYER)   -- Default: 1    ! ILAYER = -1  !
         '1'  for CALPUFF concentrations,
         '-1' for dry deposition fluxes,
         '-2' for wet deposition fluxes,
         '-3' for wet+dry deposition fluxes.
```

****
CALPOST Version 5.4 Level 030402
****

SO2 DF

TOP-50 8760 HOUR AVERAGE DRY DEPOSITION VALUES (g/m**2/s)

YEAR	DAY	TIME(HHMM)	RECEPTOR	TYPE	DRY DEPOSITION	COORDINATES (km)	
1988	1	0000	(0, 127)	D	3.1764E-04	162.495	223.553
1988	1	0000	(0, 107)	D	1.2745E-04	124.416	168.906
1988	1	0000	(0, 108)	D	1.2743E-04	123.416	168.906
1988	1	0000	(0, 109)	D	1.2738E-04	122.416	168.906
1988	1	0000	(0, 110)	D	1.2710E-04	121.416	168.906
1988	1	0000	(0, 106)	D	1.2699E-04	125.416	168.906
1988	1	0000	(0, 111)	D	1.2639E-04	120.416	168.906
1988	1	0000	(0, 112)	D	1.2571E-04	119.416	168.906
1988	1	0000	(0, 113)	D	1.2505E-04	118.416	168.906
1988	1	0000	(0, 114)	D	1.2434E-04	117.416	168.906
1988	1	0000	(0, 115)	D	1.2382E-04	116.416	168.906
1988	1	0000	(0, 116)	D	1.2305E-04	115.416	168.906
1988	1	0000	(0, 117)	D	1.2241E-04	114.416	168.906
1988	1	0000	(0, 120)	D	1.2176E-04	111.916	172.106
1988	1	0000	(0, 118)	D	1.2125E-04	113.416	168.906
1988	1	0000	(0, 121)	D	1.2112E-04	111.416	172.106
1988	1	0000	(0, 119)	D	1.2016E-04	112.416	168.906
1988	1	0000	(0, 105)	D	1.1997E-04	125.916	165.906
1988	1	0000	(0, 122)	D	1.1993E-04	110.416	172.106
1988	1	0000	(0, 123)	D	1.1873E-04	109.416	172.106
1988	1	0000	(0, 124)	D	1.1731E-04	108.416	172.106
1988	1	0000	(0, 125)	D	1.1611E-04	107.416	172.106
1988	1	0000	(0, 126)	D	1.1479E-04	106.416	172.106
1988	1	0000	(0, 104)	D	1.1350E-04	127.416	162.906
1988	1	0000	(0, 103)	D	1.1260E-04	132.416	161.406
1988	1	0000	(0, 101)	D	1.1226E-04	140.916	154.406
1988	1	0000	(0, 102)	D	1.1212E-04	135.416	157.406
1988	1	0000	(0, 61)	D	1.1057E-04	166.916	157.506
1988	1	0000	(0, 60)	D	1.1030E-04	167.416	157.506
1988	1	0000	(0, 59)	D	1.0998E-04	168.416	157.506
1988	1	0000	(0, 57)	D	1.0987E-04	170.416	157.506
1988	1	0000	(0, 58)	D	1.0980E-04	169.416	157.506
1988	1	0000	(0, 56)	D	1.0974E-04	171.416	157.506
1988	1	0000	(0, 55)	D	1.0954E-04	172.416	157.506
1988	1	0000	(0, 54)	D	1.0934E-04	173.416	157.506
1988	1	0000	(0, 62)	D	1.0922E-04	166.916	156.906
1988	1	0000	(0, 53)	D	1.0912E-04	174.416	157.506
1988	1	0000	(0, 52)	D	1.0881E-04	175.416	157.506
1988	1	0000	(0, 51)	D	1.0844E-04	176.416	157.506
1988	1	0000	(0, 63)	D	1.0835E-04	166.916	156.506

1988	1	0000	(0, 50)	D	1.0818E-04	177.416	157.506
1988	1	0000	(0, 49)	D	1.0791E-04	178.416	157.506
1988	1	0000	(0, 48)	D	1.0703E-04	179.416	157.506
1988	1	0000	(0, 47)	D	1.0634E-04	180.416	157.506
1988	1	0000	(0, 64)	D	1.0628E-04	166.916	155.506
1988	1	0000	(0, 25)	D	1.0621E-04	202.716	157.506
1988	1	0000	(0, 46)	D	1.0587E-04	181.416	157.506
1988	1	0000	(0, 26)	D	1.0560E-04	201.416	157.506
1988	1	0000	(0, 100)	D	1.0535E-04	143.916	149.906
1988	1	0000	(0, 45)	D	1.0530E-04	182.416	157.506

Sample K5: CALPOST Concentration *.lst output. First and last pages of 87PBCON.lst output (Lead concentrations in 1986)

```
**************************************************************************************************************************************
                                              CALPOST  Version 5.4          Level 030402
**************************************************************************************************************************************



 Run Title:
    BPF - 1987 PB CONCENTRATION



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 INPUT GROUP: 1 -- General run control parameters
 --------------

      Option to run all periods found
      in the met. file(s)  (METRUN)       Default: 0   ! METRUN =   1  !

          METRUN = 0 - Run period explicitly defined below
          METRUN = 1 - Run all periods in CALPUFF data file(s)

      Starting date:     Year  (ISYR) --    No default   ! ISYR  =  1987   !
      (used only if      Month (ISMO) --    No default   ! ISMO  =  0    !
       METRUN = 0)       Day   (ISDY) --    No default   ! ISDY  =  0    !
                         Hour  (ISHR) --    No default   ! ISHR  =  0    !

      Number of hours to process (NHRS) -- No default   ! NHRS  =  0  !

      Process every hour of data?(NREP) -- Default: 1   ! NREP  =  1  !
       (1 = every hour processed,
        2 = every 2nd hour processed,
        5 = every 5th hour processed, etc.)

 Species & Concentration/Deposition Information
 ----------------------------------------------

       Species to process (ASPEC)       -- No default   ! ASPEC = PB  !
       (ASPEC = VISIB for visibility processing)

       Layer/deposition code (ILAYER)   -- Default: 1   ! ILAYER =  1  !
         '1'  for CALPUFF concentrations,
         '-1' for dry deposition fluxes,
         '-2' for wet deposition fluxes,
         '-3' for wet+dry deposition fluxes.
```

****
CALPOST Version 5.4 Level 030402
****

SUMMARY SECTION

PB 1

(ug/m**3)

RECEPTOR	COORDINATES (km)		TYPE	PEAK (YEAR,DAY,ENDING TIME)	FOR RANK	FOR AVERAGE PERIOD
28	199.416	157.506	DISCRETE	1.7120E-07 (1987,064,0000)	RANK 1	24 HOUR
127	162.495	223.553	DISCRETE	9.4984E-08 (1987,306,0000)	RANK 2	24 HOUR
127	162.495	223.553	DISCRETE	9.4533E-08 (1987,127,0000)	RANK 3	24 HOUR
127	162.495	223.553	DISCRETE	9.3714E-08 (1987,205,0000)	RANK 4	24 HOUR