Florida Department of Environmental Regulation

Twin Towers Office Bldg. ● 2600 Blair Stone Road ● Tallahassee, Florida 32399-2400

Lawton Chiles, Governor
Carol M. Browner, Secretary

July 24, 1992

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

Mr. Macauley Whiting, Jr., President
Decker Energy - Ridge, Inc.
P.O. Box 2397
Winter Park, Florida 32790

Dear Mr. Whiting:

Attached is one copy of the Revised Technical Evaluation and Preliminary Determination and proposed permit for Ridge Generating Station to construct a wood/tire burning power generation facility near Auburndale, Polk County, Florida.

Please submit any written comments you wish to have considered concerning the Department's proposed action to Mr. Preston Lewis of the Bureau of Air Regulation.

Sincerely,

CHFancy

C. H. Fancy, P.E.
Chief
Bureau of Air Regulation

CHF/JR/plm

Attachments

c: W. Thomas, SWD
R. Anders, Polk County
J. Harper, EPA
C. Shaver, NPS
T. Fitzpatrick, P.E.
M. Killeen, WESI
J. Little, D&M
R. Stone, RGS

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

CERTIFIED MAIL

In the Matter of an
Application for Permit by:

Decker Energy - Ridge, Inc.
P.O. Box 2397
Winter Park, Florida 32790
______________________________/

DER File No. AC 53-206244
PSD-FL-183
Polk County

INTENT TO ISSUE

The Department of Environmental Regulation gives notice of its intent to issue a permit (copy attached) for the proposed project as detailed in the application specified above, for the reasons stated in the attached Technical Evaluation and Preliminary Determination.

The applicant, Ridge Generating Station, L.P., applied on April 6, 1992, to the Department of Environmental Regulation for a permit to construct a wood/tire burning power generation facility near Auburndale in Polk County, Florida.

The Department has permitting jurisdiction under the provisions of Chapter 403, Florida Statutes and Florida Administrative Code (F.A.C.) Chapters 17-2 and 17-4. The project is not exempt from permitting procedures. The Department has determined that a construction permit is required for the proposed work.

Pursuant to Section 403.815, Florida Statutes and Rule 17-103.150, F.A.C., you (the applicant) are required to publish at your own expense the enclosed Notice of Intent to Issue Permit. The notice shall be published one time only within 30 days in the legal ad section of a newspaper of general circulation in the area affected. For the purpose of this rule, "publication in a newspaper of general circulation in the area affected" means publication in a newspaper meeting the requirements of Sections 50.011 and 50.031, F.S., in the county where the activity is to take place. The applicant shall provide proof of publication to the Department's Bureau of Air Regulation, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400, within seven days of publication. Failure to publish the notice and provide proof of publication within the allotted time may result in the denial of the permit.

The Department will issue the permit with the attached conditions unless a petition for an administrative proceeding (hearing) is filed pursuant to the provisions of Section 120.57, F.S.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) in accordance with Section 120.57, Florida Statutes. The petition must contain the information set forth below and must be filed (received) in the Office of General Counsel of the Department at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400. Petitions filed by the permit applicant and the parties listed below must be filed within 14 days of receipt of this intent. Petitions filed by other persons must be filed within 14 days of publication of the public notice or within 14 days of their receipt of this intent, whichever first occurs. Petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. Failure to file a petition within this time period shall constitute a waiver of any right such person may have to request an administrative determination (hearing) under Section 120.57, Florida Statutes.

The Petition shall contain the following information;

(a) The name, address, and telephone number of each petitioner, the applicant's name and address, the Department Permit File Number and the county in which the project is proposed;
(b) A statement of how and when each petitioner received notice of the Department's action or proposed action;
(c) A statement of how each petitioner's substantial interests are affected by the Department's action or proposed action;
(d) A statement of the material facts disputed by Petitioner, if any;
(e) A statement of facts which petitioner contends warrant reversal or modification of the Department's action or proposed action;
(f) A statement of which rules or statutes petitioner contends require reversal or modification of the Department's action or proposed action; and
(g) A statement of the relief sought by petitioner, stating precisely the action petitioner wants the Department to take with respect to the Department's action or proposed action.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this intent. Persons whose substantial interests will be affected by any decision of the Department with regard to the application have the right to petition to become a party to the proceeding. The petition must conform to the requirements specified above and be filed (received) within 14 days of receipt of this intent in the Office of General Counsel at the above address of the Department. Failure to petition within the allowed time frame constitutes a waiver of any right such person has to request a hearing under Section 120.57, F.S., and to participate as a party to this proceeding. Any subsequent intervention will only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-5.207, F.A.C.

Executed in Tallahassee, Florida.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL REGULATION

C. H. Fancy, P.E., Chief
Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, Florida 32399
904-488-1344

CERTIFICATE OF SERVICE

The undersigned duly designated deputy clerk hereby certifies that this INTENT TO ISSUE and all copies were mailed by certified mail before the close of business on 7-27-92 to the listed persons.

Clerk Stamp

FILING AND ACKNOWLEDGMENT
FILED, on this date, pursuant to §120.52(11), Florida Statutes, with the designated Department Clerk, receipt of which is hereby acknowledged.

Clerk 7-27-92
Date

Copies furnished to:

- W. Thomas, SWD
- R. Anders, Polk County
- J. Harper, EPA
- C. Shaver, NPS
- T. Fitzpatrick, P.E.
- M. Killeen, WESI
- J. Little, D&M
- R. Stone, RGS

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION
NOTICE OF INTENT TO ISSUE PERMIT

The Department of Environmental Regulation gives notice of its intent to issue a permit to Ridge Generating Station, P.O. Box 2397, Winter Park, Florida 32790, to construct a wood/tire burning power generation facility at State Road 542 and Taylor Road near Auburndale, Polk County, Florida. A determination of Best Available Control Technology (BACT) was required. The proposed project is subject to Prevention of Significant Deterioration (PSD) regulations. Modeling results show that increases in ground-level concentrations are less than PSD significant impact levels for the applicable pollutants. The Department is issuing this Intent to Issue for the reasons stated in the Technical Evaluation and Preliminary Determination.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) in accordance with Section 120.57, Florida Statutes. The petition must contain the information set forth below and must be filed (received) in the Office of General Counsel of the Department at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400, within 14 days of publication of this notice. Petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. Failure to file a petition within this time period shall constitute a waiver of any right such person may have to request an administrative determination (hearing) under Section 120.57, Florida Statutes.

The Petition shall contain the following information; (a) The name, address, and telephone number of each petitioner, the applicant's name and address, the Department Permit File Number and the county in which the project is proposed; (b) A statement of how and when each petitioner received notice of the Department's action or proposed action; (c) A statement of how each petitioner's substantial interests are affected by the Department's action or proposed action; (d) A statement of the material facts disputed by Petitioner, if any; (e) A statement of facts which petitioner contends warrant reversal or modification of the Department's action or proposed action; (f) A statement of which rules or statutes petitioner contends require reversal or modification of the Department's action or proposed action; and (g) A statement of the relief sought by petitioner, stating precisely the action petitioner wants the Department to take with respect to the Department's action or proposed action.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this Notice. Persons whose substantial interests will be affected by any decision of the Department with regard to the application have the right to petition to become a party to the proceeding. The petition must conform to the requirements specified above and be filed (received) within 14 days of publication of this notice in the Office of General Counsel at the above address of the Department. Failure to petition within the allowed time frame constitutes a waiver of any right such person has to request a hearing under Section 120.57, F.S., and to participate as a party to this proceeding. Any subsequent intervention will only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-5.207, F.A.C.

The application is available for public inspection during normal business hours, 8:00 a.m. to 5:00 p.m., Monday through Friday, except legal holidays, at:

Department of Environmental Regulation
Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Department of Environmental Regulation
Southwest District
4520 Oak Fair Blvd.
Tampa, Florida 33610-7347

Any person may send written comments on the proposed action to Mr. Preston Lewis at the Department's Tallahassee address. All comments received within 30 days of the publication of this notice will be considered in the Department's final determination. Further, a public hearing can be requested by any person. Such requests must be submitted within 30 days of this notice.

Revised
Technical Evaluation
and
Preliminary Determination

Ridge Generating Station
Polk County, Florida

PSD-FL-183
AC 53-206244

Department of Environmental Regulation
Division of Air Resources Management
Bureau of Air Regulation

July 24, 1992

I. Application Information

A. Applicant

Ridge Generating Station, L.P.
P.O. Box 2397
Winter Park, FL 32790

B. Request

The Department received a complete application on April 6, 1992, for a permit to construct a 50 megawatt (MW) independent power generation facility known as the Ridge Generating Station (RGS) near Auburndale, Polk County, Florida. On June 22, 1992, the Department notified the applicant of the proposed permit conditions. On July 1, 1992, the applicant met with Department staff to request reconsideration of the applicant's proposed emission limits. The Department agreed to consider the permit limits originally proposed for SO2, NO_x and CO as target limits for the initial startup and operation pending the outcome of an emissions testing program. It was also agreed that the applicant's emission calculation for mercury will not be rounded off to make the RGS facility initially subject to PSD requirements for that pollutant. Other revisions include clarification of the municipal waste exclusion, correction of the maximum tire firing rate (9,000 lbs/hr), and modification of compliance test method requirements.

C. Classification/Location

The subject facility (SIC Code 4911) will be located at State Road 542 and Taylor Road near Auburndale, Florida. The UTM coordinates of the site are 416.7 km E and 3100.4 km N.

II. Project Description/Emissions

The applicant proposes to construct a 50 MW power generation facility consisting of a solid-fuel boiler, steam turbine, generator, and associated equipment. The RGS boiler will fire a mixture of waste wood, scrap tires, and landfill gas. Propane will be used for boiler startup and combustion stabilization. Fuel mix possibilities include wood, wood and tires, or a combination of wood, tires, and landfill gas from the adjacent Polk County North Central Landfill. No other fuels will be used. The RGS facility will not be permitted to burn any hazardous waste or municipal type solid waste as defined in applicable federal and state regulations, except tires and waste wood.

State-of-the-art emission control equipment will include a spray dryer-absorber/fabric filter for control of particulates and acid gases as well as most toxics and metals. The spray dryer-absorber employs an atomized lime-water solution to react with sulfur dioxide in the boiler flue gases. The dried compounds of calcium thus formed will be removed by the fabric filter. Nitrogen oxides will be controlled by selective noncatalytic reduction (SNCR) which reduces NO$_x$ to elemental nitrogen by injecting ammonia into the boiler furnace.

Since the hours of operation under each of the three scenarios are unknown, and since other fuel mix percentages will also occur, projections of maximum proposed annual emissions would have to be based on the maximums for these anticipated fuel mix cases. The applicant's estimated actual emissions for three anticipated fuel mix scenarios (based on heat input percentages using the applicant's proposed emission limits) are tabulated below.

	100% Wood		80% Wood 20% Tires		75% Wood/15% Tires 10% Landfill Gas		PSD Level
	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	tons/yr
PM/PM$_{10}$	12.6	55.2	12.6	55.2	12.6	55.2	25/10
SO$_2$	69.4	304.0	109.4	479.2	92.5	405.2	40
NO$_x$	94.5	413.9	94.5	413.9	94.5	413.9	40
CO	315.0	1,379.7	315.0	1,379.7	315.0	1,379.7	100
VOC	22.1	96.8	22.1	96.8	22.1	96.8	40
NH3	17.8	78.0	17.8	78.0	17.8	78.0	-
C6H6	5.0	21.9	5.0	21.9	5.0	21.9	-
HCHO	1.7	7.5	1.7	7.5	1.7	7.5	-
HCL	5.0	22.1	5.0	22.1	5.0	22.1	-
Pb	0.25	1.1	0.25	1.1	0.25	1.1	0.6
Zn	0.63	2.8	0.63	2.8	0.63	2.8	-
Hg	0.02	0.097	0.02	0.097	0.02	0.097	0.1
Be	.0063	0.03	.0063	0.03	.0063	0.03	.0004

III. Rule Applicability

The construction permit application is subject to review under Chapter 403, Florida Statutes, and Florida Administrative Code (F.A.C.) Chapters 17-2 and 17-4. The proposed facility is subject to the provisions of F.A.C. Rule 17-2.500, Prevention of Significant Deterioration (PSD). The facility is located in an area classified as attainment for all regulated air pollutants. Proposed emissions of PM/PM$_{10}$, SO$_2$, NO$_x$, CO, VOC, Pb, and Be equal or exceed the significant levels set forth in Table 500-2 of F.A.C. Rule 17-2.500. Preconstruction review must include a determination of Best Available Control Technology (BACT), good-engineering practice stack height, ambient impact analysis, impact on soils, vegetation and visibility. Applicable emission limit rules are F.A.C. Rules 17-2.660, Table 660-1, Section 60.40b, Subpart Db, 60.43b (c)(1), (f) and (g), 60.44b (d), Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units. For the ash handling system and lime silo, applicable rules are F.A.C. Rules 17-2.610(2) and (3). The above rules would dictate limits except that BACT limits are more stringent and therefore apply.

IV. Air Quality Analysis

a. Introduction

The operation of the proposed facility will result in emissions increases which are projected to be greater than the PSD significant emission rates for the following pollutants: NO_x, SO_2, PM, PM_{10}, Be, CO, VOC, and Pb. Therefore, the project is subject to the PSD NSR requirements contained in F.A.C. Rule 17-2.500(5) for these pollutants. Part of these requirements is an air quality impact analysis for these pollutants, which includes:

- An analysis of existing air quality;
- A PSD increment analysis (for SO_2, PM, PM_{10}, and NO_x);
- An ambient Air Quality Standards analysis (AAQS);
- An analysis of impacts on soils, vegetation, visibility and growth-related air quality impacts; and,
- A Good Engineering Practice (GEP) stack height determination.

The analysis of existing air quality generally relies on preconstruction monitoring data collected in accordance with EPA-approved methods. The PSD increment and AAQS analyses are based on air quality dispersion modeling completed in accordance with EPA guidelines.

Based on these required analyses, the Department has reasonable assurance that the proposed project, as described in this report and subject to the conditions of approval proposed herein, will not cause or contribute to a violation of any PSD increment or ambient air quality standard. A brief description of the modeling methods used and results of the required analyses follow. A more complete description is contained in the permit application on file.

b. Analysis of the Existing Air Quality

Preconstruction ambient air quality monitoring may be required for pollutants subject to PSD review. However, an exemption to the monitoring requirement can be obtained if the maximum air quality impact resulting from the projected emissions increase, as determined through air quality modeling, is less than a pollutant-specific de minimus concentration. The predicted maximum concentration increase for each pollutant subject to PSD (NSR) is given below:

	SO_2	TSP & PM10	NO_x	CO	Be	Pb
PSD de minimus Concentra. (ug/m^3)	13	10	14	575	0.001	0.1
Averaging Time	24-hr	24-hr	Annual	8-hr	24-hr	3 mo.
Maximum Predicted Impact (ug/m^3)	4.4	0.5	0.4	35	.0003	<.01

There are no monitoring de minumus concentrations for VOC emissions. As shown above, the predicted impacts are all less than the corresponding de minimus concentrations; therefore, no preconstruction monitoring is required for these pollutants.

c. Modeling Method

The EPA-approved Industrial Source Complex Short-Term (ISCST) dispersion model was used by the applicant to predict the impact of the proposed project on the surrounding ambient air. All recommended EPA default options were used. No downwash effects were considered because the stack will be equal to the good engineering practice (GEP) stack height. Five years of sequential hourly surface and mixing depth data from the Tampa Florida National Weather Service (NWS) station collected during 1982 through 1986 were used in the model. Since five years of data were used, the highest-second-high (HSH) short-term predicted concentrations are compared with the appropriate ambient air quality standards or PSD increments. For the annual averages, the highest predicted yearly average was compared with the standards.

d. Modeling Results

The applicant first evaluated the potential increase in ambient ground-level concentrations associated with the project to determine if these predicted ambient concentration increases would be greater than specified PSD significant impact levels for criteria pollutants SO_2, CO, NO_2, PM and PM_{10}. This evaluation was based on the proposed boiler operating at load conditions of 100, 75, and 50 percent. The modeling was performed using the highest emissions coupled with the lowest exit gas flow rates to maximize predicted impacts. Maximum modeled emissions were based on the use of the wood/tire combination for fuel. The maximum predicted concentrations occur for either the 100% or the 75% operating load. Dispersion modeling was performed with receptors placed along the 36 standard radial directions (10 degrees apart) surrounding the proposed unit beginning at 250m and going out at intervals of 250m to a distance of 3000m from the proposed boiler. The results of this modeling presented below show that the increases in ambient ground-level concentrations for all averaging times are less than the PSD significant impact levels for SO_2, CO, NO_2, PM and PM_{10}.

	SO_2			NO2	CO		PM and PM_{10}	
Avg. Time	Annual	3-hr	24-hr	Annual	1-hr	8-hr	Ann.	24-hr
PSD Signifi. Level (ug/m^3)	1.0	25.0	5.0	1.0	2000	500	1.0	5.0
Ambient Concen. Increase (ug/m^3)	0.4	18.7	4.4	0.4	126	35	0.05	0.5

Therefore, further dispersion modeling for comparison with AAQS and PSD Class II increment consumption were not required for these pollutants. There is currently no acceptable method to model VOC for ozone formation. Pb has no significant impact level; however, maximum predicted Pb concentrations were less than the 1.5 ug/m^3 quarterly ambient air quality standard.

Be and Hg are noncriteria pollutants, which means that neither national AAQS nor PSD Significant Impacts have been defined for these pollutants. However, the Department does have a draft Air Toxics Permitting Strategy, which defines no threat levels for these pollutants. The Department and the applicant have used the same modeling procedure described above to evaluate the maximum increase in ground level concentration of these pollutants for comparison with the no-threat levels. The results of this analysis are shown below:

Avg. Time	Be Annual	Hg Annual
No Threat-Level (ug/m^3)	0.00042	0.3
Max. Concen. Increase	0.00002	0.00008

All of these values are less than their respective no-threat levels.

The nearest PSD Class I area is the Chassahowitzka National Wilderness Area located 100 km northwest of the facility. The predicted impact of the proposed project on this area was evaluated by first using the ISCST model to predict maximum increment consumptions by the source alone and by comparing these predicted values to the appropriate recommended significance levels to determine whether further modeling was necessary. The significance levels used by the Department were the more stringent National Park Service (NPS) recommended levels. The predicted maximum PM/PM$_{10}$ and NO$_2$ increment consumptions for all applicable averaging times were less than these significance levels. Therefore, no further modeling for PM/PM$_{10}$ and NO$_2$ was required. In addition, the predicted maximum SO$_2$ annual average increment consumption by the source alone was also below the NPS significance level. However, the predicted maximum SO$_2$ 24-hour and 3-hour concentrations were predicted to be greater than the NPS levels. The Department and the NPS directed the applicant to further evaluate the SO$_2$ short term impacts on the Class I area by using the long range transport model, Mesopuff. This model is more applicable for distances greater than 100km. Mesopuff model results show that the maximum predicted SO$_2$ 3-hour average increment consumption for the project alone is predicted to be below the NPS significance level of 0.48 ug/m^3. Therefore, no further modeling was necessary for the SO$_2$ 3-hour averaging time. For the SO$_2$ 24-hour averaging case, Mesopuff results show that when the project alone is predicted to have impacts greater than the NPS significance level of 0.07 ug/m^3 (maximum predicted impact of 0.09 ug/m^3) cumulative impacts from all modeled sources in the area are less than the PSD Class I increment of 5.0 ug/m^3.

e. Additional Impacts Analysis

A Level-1 screening analysis using the EPA model, VISCREEN was used to determine any potential adverse visibility impacts on the Class I Chassahowitzka National Wilderness Area located about 100km away. Based on this analysis, the maximum predicted visual impacts due to the proposed project are less than the screening criteria both inside and outside the Class I area. A comprehensive air quality related values (AQRV) analysis for this Class I area was performed by the applicant. No significant impacts on the Class I area are expected.

In addition, the maximum predicted concentrations from NOx, CO, SO_2, PM and PM_{10} are predicted to be less than the AAQS, including the national secondary standards designed to protect public welfare-related values. As such, no harmful effects on soil and vegetation are expected in the area of the project. Also, the proposed modification will not significantly change employment, population, housing or commercial/industrial development in the area to the extent that a significant air quality impact will result.

V. Air Toxics Evaluation

Based on extensive test data for other facilities that burn tires, only negligible quantities of toxic pollutants will escape the emission control equipment and therefore are of no environmental concern.

VI. Conclusion

Based on the information provided by Ridge Generating Station, the Department has reasonable assurance that the proposed installation, as described in this evaluation, and subject to the conditions proposed herein, will not cause or contribute to a violation of any air quality standard, PSD increment, or any other technical provision of Chapter 17-2 of the Florida Administrative Code.

#41755

PRESTON L. LEWIS
No. 41755

Florida Department of Environmental Regulation

Twin Towers Office Bldg. ● 2600 Blair Stone Road ● Tallahassee, Florida 32399-2400

Lawton Chiles, Governor

Carol M. Browner, Secretary

PERMITTEE:
Ridge Generating Station, L.P.
P. O. Box 2397
Winter Park, Florida 32790

Permit Number: AC 53-206244
PSD-FL-183
Expiration Date: December 31, 1995
County: Polk
Project: Wood/Tire Burning Power Generation Facility

This permit is issued under the provisions of Chapter 403, Florida Statutes, and Florida Administrative Code Chapters 17-2 and 17-4. The above named permittee is hereby authorized to perform the work or operate the facility shown on the application and approved drawings, plans, and other documents attached hereto or on file with the Department and made a part hereof and specifically described as follows:

For the construction of a 50 Megawatt power generation facility to be located at State Road 542 and Taylor Road near Auburndale, Polk County, Florida. The UTM coordinates are 416.7 km East and 3,100.4 km North.

The source shall be constructed in accordance with the permit application, plans, documents, amendments and drawings, except as otherwise noted in the General and Specific Conditions.

Attachments are listed below:

1. DER incompleteness letter dated 1-17-92.
2. RGS letter dated 3-19-92.
3. RGS letter dated 3-27-92.
4. RGS submittal received 4-6-92.

GENERAL CONDITIONS:

1. The terms, conditions, requirements, limitations, and restrictions set forth in this permit are "Permit Conditions" and are binding and enforceable pursuant to Sections 403.161, 403.727, or 403.859 through 403.861, Florida Statutes. The permittee is placed on notice that the Department will review this permit periodically and may initiate enforcement action for any violation of these conditions.

2. This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviation from the approved drawings, exhibits, specifications, or conditions of this permit may constitute grounds for revocation and enforcement action by the Department.

3. As provided in Subsections 403.087(6) and 403.722(5), Florida Statutes, the issuance of this permit does not convey any vested rights or any exclusive privileges. Neither does it authorize any injury to public or private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations. This permit is not a waiver of or approval of any other Department permit that may be required for other aspects of the total project which are not addressed in the permit.

4. This permit conveys no title to land or water, does not constitute State recognition or acknowledgement of title, and does not constitute authority for the use of submerged lands unless herein provided and the necessary title or leasehold interests have been obtained from the State. Only the Trustees of the Internal Improvement Trust Fund may express State opinion as to title.

5. This permit does not relieve the permittee from liability for harm or injury to human health or welfare, animal, or plant life, or property caused by the construction or operation of this permitted source, or from penalties therefore; nor does it allow the permittee to cause pollution in contravention of Florida Statutes and Department rules, unless specifically authorized by an order from the Department.

6. The permittee shall properly operate and maintain the facility and systems of treatment and control (and related appurtenances) that are installed or used by the permittee to achieve compliance with the conditions of this permit, as required by Department rules. This provision includes the operation of backup or

GENERAL CONDITIONS:

auxiliary facilities or similar systems when necessary to achieve compliance with the conditions of the permit and when required by Department rules.

7. The permittee, by accepting this permit, specifically agrees to allow authorized Department personnel, upon presentation of credentials or other documents as may be required by law and at a reasonable time, access to the premises, where the permitted activity is located or conducted to:

a. Have access to and copy any records that must be kept under the conditions of the permit;

b. Inspect the facility, equipment, practices, or operations regulated or required under this permit; and

c. Sample or monitor any substances or parameters at any location reasonably necessary to assure compliance with this permit or Department rules.

Reasonable time may depend on the nature of the concern being investigated.

8. If, for any reason, the permittee does not comply with or will be unable to comply with any condition or limitation specified in this permit, the permittee shall immediately provide the Department with the following information:

a. a description of and cause of non-compliance; and

b. the period of noncompliance, including dates and times; or, if not corrected, the anticipated time the non-compliance is expected to continue, and steps being taken to reduce, eliminate, and prevent recurrence of the non-compliance.

The permittee shall be responsible for any and all damages which may result and may be subject to enforcement action by the Department for penalties or for revocation of this permit.

9. In accepting this permit, the permittee understands and agrees that all records, notes, monitoring data and other information relating to the construction or operation of this permitted source which are submitted to the Department may be used by the Department as evidence in any enforcement case involving the permitted source arising under the Florida Statutes or Department rules, except

GENERAL CONDITIONS:

where such use is prescribed by Sections 403.73 and 403.111, Florida Statutes. Such evidence shall only be used to the extent it is consistent with the Florida Rules of Civil Procedure and appropriate evidentiary rules.

10. The permittee agrees to comply with changes in Department rules and Florida Statutes after a reasonable time for compliance, provided, however, the permittee does not waive any other rights granted by Florida Statutes or Department rules.

11. This permit is transferable only upon Department approval in accordance with Florida Administrative Code Rules 17-4.120 and 17-30.300, F.A.C., as applicable. The permittee shall be liable for any non-compliance of the permitted activity until the transfer is approved by the Department.

12. This permit or a copy thereof shall be kept at the work site of the permitted activity.

13. This permit also constitutes:

    (x) Determination of Best Available Control Technology (BACT)
    (x) Determination of Prevention of Significant Deterioration (PSD)
    (x) Compliance with New Source Performance Standards (NSPS)

14. The permittee shall comply with the following:

    a. Upon request, the permittee shall furnish all records and plans required under Department rules. During enforcement actions, the retention period for all records will be extended automatically unless otherwise stipulated by the Department.

    b. The permittee shall hold at the facility or other location designated by this permit records of all monitoring information (including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation) required by the permit, copies of all reports required by this permit, and records of all data used to complete the application for this permit. These materials shall be retained at least

GENERAL CONDITIONS:

three years from the date of the sample, measurement, report, or application unless otherwise specified by Department rule.

c. Records of monitoring information shall include:

- the date, exact place, and time of sampling or measurements;
- the person responsible for performing the sampling or measurements;
- the dates analyses were performed;
- the person responsible for performing the analyses;
- the analytical techniques or methods used; and
- the results of such analyses.

15. When requested by the Department, the permittee shall within a reasonable time furnish any information required by law which is needed to determine compliance with the permit. If the permittee becomes aware that relevant facts were not submitted or were incorrect in the permit application or in any report to the Department, such facts or information shall be corrected promptly.

SPECIFIC CONDITIONS:

1. Unless otherwise indicated, the construction and operation of the Ridge Generating Station (RGS) facility shall be in accordance with the capacities and specifications stated in the revised application.

2. The RGS facility shall be allowed to operate at a maximum capacity of 50 Megawatts (approximately equivalent to 630 MMBtu/hr) for 8,760 hours per year.

3. Fuel for firing the RGS boiler shall consist only of wood, landfill gas, and up to 9.0 percent tires (percent by weight equivalent to 20 percent tires based on heat content). The 9.0 percent tire weight limitation is equivalent to a tire firing rate of 9,000 pounds of tires per hour. Propane may be used as a startup, shutdown, and combustion stabilization fuel.

4. No municipal type solid waste, as defined in 40 CFR 60, Subpart Ea (except tires and waste wood), or hazardous waste, as defined in 40 CFR 261 and F.A.C. Rule 17-730.020, shall be burned at any time at the RGS facility.

SPECIFIC CONDITIONS:

5. Initially, the RGS boiler exhaust gases shall not exceed the limits shown below. Following completion of the emission testing program required in Specific Condition No. 8, these limits may be revised.

Pollutant	Basis(lb/MMBTU)	Lbs/hr*	Tons/yr
PM/PM_{10}	0.02	12.6	55.2
SO2	0.17	109.4	479.2
NOx	0.15	94.5	413.9
CO	0.50	315.0	1,379.7
VOC	0.035	22.1	96.8
HCL	0.008	5.0	22.1
Hg	0.000035	0.022	0.097
Pb	0.0004	0.25	1.1
Be	0.00001	0.0063	0.03

*Based on 24 hour average. The feasibility of establishing startup/shutdown limits, hourly limits, or rolling average limits in addition to or in lieu of the above limits will be determined after analysis of test data.

6. SNCR chemical injection into the boiler exhaust gases shall be provided by an automated control system as described in the application. Ammonia emissions shall be continuously monitored at a prevailing downwind location on the RGS property line by commercially available ambient monitoring equipment. The monitoring data shall be collected and reported for the entire operating period from the initial startup to the time that the emissions test program is completed. Thereafter, the monitoring data shall be collected and stored and made available to the Department upon request.

7. Visible emissions from the RGS boiler stack, the fly ash silo vent filter, and the lime silo vent filter shall not exceed 10 percent opacity.

8. In lieu of the usual compliance test requirement, the RGS facility shall, at least six months prior to initial startup of the RGS facility, propose for Department approval a comprehensive emissions testing program representative of the full range of facility operation as stated in the application. It will include continuous emission monitoring (CEM) stack data for SO_2, NO_x and

SPECIFIC CONDITIONS:

CO, and stack emission tests for each limited pollutant at 50 percent, 75 percent, and 100 percent of permitted capacity for wood and tires. The emissions testing program shall be completed and results submitted as required in Specific Condition No. 16 within fifteen months after the initial startup. The following EPA test methods or other methods approved by the Department shall be followed:

Pollutant	Test Method
VE	9
PM/PM_{10}	5 (front half only)
SO_2	6C
NO_x	7E
CO	10
VOC	25A
HCl	26
Hg	101A
Pb	12
Be	104

9. As part of the required emissions testing program, the permittee shall sample the RGS boiler stack for the following pollutants after proposing acceptable test methods to the Department's Bureau of Air Regulation in Tallahassee. The results of these additional tests shall be reported in lbs/hr and ug/m3 along with the initial compliance test results: Ammonia, Arsenic, Cadmium, Chromium (total), Chromium VI, Zinc Oxide, Benzene, Sulfuric Acid, Polychlorinated Biphenyls (PCBs), Dioxins/Furans.

10. Continuous monitoring equipment shall be installed and operated to measure and record generator output, furnace temperature, stack opacity, and SO_2, NO_x and CO emissions. The tire feed rate in pounds per hour shall be monitored continuously by a commercially available weight detecting system with recording capability, or another method approved by the Department. The tire feed rate data shall be maintained and provided to the Department upon request.

11. Fugitive emissions from the RGS material receiving, processing, storage and transfer operations shall be determined according to EPA Method 22 over a 3-day period that is representative of typical operation. Results of the fugitive emissions survey shall be reported along with the results of the emissions testing program.

12. All reasonable precautions set forth in F.A.C. Rule 17-2.610(3), as well as all measures proposed by the permittee in

SPECIFIC CONDITIONS:

the application, shall be taken by the permittee to prevent fugitive emissions.

13. In the event of any malfunction resulting in failure of emission control equipment or any malfunction of process equipment resulting in emissions exceeding limits set forth in Specific Condition No. 5, the operator shall immediately stop the feeding of tires into the boiler and shall use propane firing, if necessary, to maintain a minimum of 1800 degrees F in the combustion zone until all tires in the system have been combusted. No tires may be refed into the boiler following the malfunction until the emission control equipment has been put into proper working order.

14. Whenever the baghouse bypass is activated during an on-line operating situation for any reason, the permittee shall, within 24 hours, provide the Department's Southwest District Office with a complete report of the circumstances and reasons for the occurrence, indicating the amounts of pollutants estimated to have been discharged during the bypass period.

15. No pollutants shall be discharged from the RGS facility which cause or contribute to an objectionable odor (F.A.C. Rule 17-2.620(2)).

16. Results of the emissions testing program and other required submittals shall be submitted to the Department's Southwest District office and the Department's Bureau of Air Regulation office in Tallahassee within fifteen months after initial startup of the RGS facility. Sampling facilities, methods, and reporting shall be in accordance with F.A.C. Rule 17-2.700 and 40 CFR 60, Appendix A. The Department's Southwest District office shall be notified at least 30 days prior to each emission test conducted in the testing program. Along with the submittal to the Department's Bureau of Air Regulation office, the permittee shall include a revised BACT application.

17. Within 90 days of receipt of the revised BACT application and other required submittals, the Department's Bureau of Air Regulation in Tallahassee shall revise the BACT determination and permit limits and conditions as appropriate with the goal of allowing the RGS facility to be operated in an environmentally responsible manner. Revisions may include additional emission limits for other air pollutants as well as separate limits for specific operating conditions. Except for mercury abatement, the BACT control technology would not be revised in the Department's final BACT determination.

SPECIFIC CONDITIONS:

18. The permittee, for good cause, may request that this construction permit be extended. Such a request shall be submitted to the Department's Bureau of Air Regulation in Tallahassee prior to 60 days before the expiration of the permit (F.A.C. Rule 17-4.090)

19. An application for an operation permit including an operation and maintenance plan must be submitted to the Department's Southwest District office at least 90 days prior to the expiration date of the revised construction permit. To properly apply for an operation permit, the applicant shall submit the appropriate application form, fee, certification that construction was completed noting any deviations from the conditions in the construction permit, and compliance test reports as required by this permit (F.A.C. Rule 17-4.220).

Issued this ______ day
of _______________, 1992

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL REGULATION

____
Carol M. Browner, Secretary
Department of Environmental
Regulation

Best Available Control Technology (BACT) Determination
Ridge Generating Station
Polk County

The applicant proposes to construct a 50 MW power generation facility to be named the Ridge Generating Station and located near Auburndale in Polk County, Florida. The facility will consist of a solid fuel boiler, steam turbine, generator and associated equipment. Fuel for the facility will consist of a mixture of waste wood, scrap tires, and landfill gas.

A BACT determination is required for all regulated air pollutants emitted in amounts equal to or greater than the significant emission rates listed in Table 500-2 of Florida Administrative Code (F.A.C.) Rule 17-2.500. Maximum annual emissions proposed by the applicant are tabulated below and in the Technical Evaluation and Preliminary Determination. Maximum allowable emissions as determined from the BACT determination are listed below in tons per year (based on burning 80% wood/20% tires):

	Maximum Allowable Emissions (tons per year)		
Pollutant	Proposed by RGS	Proposed by DER	PSD Level
PM/PM_{10}	55.2	55.2	25/10
SO_2	479.2	275.9*	40
NO_x	413.9	303.5*	40
CO	1,379.7	579.5*	100
VOC	96.6	96.6	40
HCL	22.1	22.1	-
Hg	0.1	0.1	0.1
Pb	1.1	1.1	0.6
Be	0.03	0.03	0.0004

*Limits not to be enforced until final determination based on emission testing program.

Date of Receipt of a Complete Application

April 6, 1992

BACT Determination Requested by Applicant

Control Technology: Spray Dryer-Absorber/Fabric Filter
Selective Noncatalytic Reduction (SNCR)
Combustion Efficiency

Emission Limits:	PM/PM_{10}	0.02 lb/MMBTU
	SO_2	0.17 lb/MMBTU

NO_x	0.15 lb/MMBTU
CO	0.50 lb/MMBTU
VOC	0.035 lb/MMBTU
Pb	0.0004 lb/MMBTU
Be	0.00001 lb/MMBTU

BACT Determined by the Department

Control Technology: Spray Dryer-Absorber/Fabric Filter
Selective Noncatalytic Reduction (SNCR)
Combustion Efficiency

Emission Limits: lb/MMBtu

	Initial Maximum Limits*	Estimated Acheivable Limit
PM/PM_{10}	0.02	-
SO_2	0.17	0.10
NO_x	0.15	0.11
CO	0.50	0.21
VOC	0.035	-
Pb	0.0004	-
Be	0.00001	-

*Initial limits to be revised as necessary following emission testing program.

BACT Determination Procedure

In accordance with F.A.C. Chapter 17-2, this BACT determination is based on the maximum degree of reduction of each pollutant emitted which the Department, on a case by case basis, taking into account energy, environmental and economic impacts, and other costs, determines is achievable through application of production processes and available control methods, systems and techniques. In addition, the regulations require that in making the BACT determination the Department shall give consideration to:

(a) Any Environmental Protection Agency determination of Best Available Control Technology pursuant to Section 169, and any emission limitation contained in 40 CFR Part 60 (Standards of Performance for New Stationary Sources) or 40 CFR Part 61 (National Emission Standards for Hazardous Air Pollutants).

(b) All scientific, engineering and technical material and other information available to the Department.

(c) The emission limiting standards or BACT determinations of any other State.

(d) The social and economic impact of the application of such technology.

The EPA currently stresses that BACT should be determined using the "top-down" approach. The first step in this approach is to determine for the emission source in question the most stringent control available for a similar or identical source or source category. If it is shown that this level of control is technically or economically infeasible for the source in question, then the next most stringent level of control is determined and similarly evaluated. This process continues until the BACT level under consideration cannot be eliminated by any substantial or unique technical, environmental, or economic objections.

BACT Determination Rationale

Irrespective of control technology economics, the Department believes that the applicant has selected the best control technology available based on a review of the literature and permit requirements for similar facilities. However, the applicant's final BACT proposal should include a detailed analysis of the economic justification for the control systems selected, since all of the economic data will be available by that time.

A review of EPA's BACT/LAER Clearinghouse indicates that there are no existing sources using the fuel mix proposed for the RGS facility. Since there are significant differences between existing wood/tire burning units and the proposed RGS facility, and since this facility is the first of its kind, the only reasonable approach would involve a two-step procedure for the BACT determination and permit; a preliminary followed by a final determination based on the results of the required emissions testing program. This two-step procedure will require that the applicant propose final enforceable BACT limits and permit conditions and that the Department issue a final BACT determination with permit revisions as indicated by the emissions testing results. Therefore, the Department has proposed enforceable initial emission limits and target emission limits for SO_2, NO_X and CO that are to be adjusted as necessary and made enforceable following completion of an emissions testing program. The target limits are based on the more stringent permit limits listed in the BACT/LAER Clearinghouse data.

Details of the Analysis May be Obtained by Contacting:

Preston Lewis, P.E., BACT Coordinator
Department of Environmental Regulation
Bureau of Air Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Recommended by:

C. H. Fancy, P.E., Chief
Bureau of Air Regulation

________________________1992
Date

Approved by:

Carol M. Browner, Secretary
Dept. of Environmental Regulation

________________________1992
Date

SENDER:
- Complete items 1 and/or 2 for additional services.
- Complete items 3, and 4a & b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "Return Receipt Requested" on the mailpiece below the article number.
- The Return Receipt Fee will provide you the signature of the person delivered to and the date of delivery.

I also wish to receive the following services (for an extra fee):

1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:

Mr Macauley Whiting, Jr.
Decker Energy-Ridge, Inc
P O Box 2397
Winter Park, Fl
32790

4a. Article Number
P 710 058 523

4b. Service Type
☐ Registered ☐ Insured
☒ Certified ☐ COD
☐ Express Mail ☐ Return Receipt for Merchandise

7. Date of Delivery
7-30-92

5. Signature (Addressee)

6. Signature (Agent)

8. Addressee's Address (Only if requested and fee is paid)

PS Form **3811**, November 1990 ★U.S. GPO: 1991—287-066 **DOMESTIC RETURN RECEIPT**

P 710 058 523

Certified Mail Receipt
No Insurance Coverage Provided
Do not use for International Mail
(See Reverse)

UNITED STATES POSTAL SERVICE

Sent to
Macauley Whiting

Street & No.
Decker-Energy Ridge

P.O., State & ZIP Code
Winter Park, Fl

Postage	$
Certified Fee	
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to Whom & Date Delivered	
Return Receipt Showing to Whom, Date, & Address of Delivery	
TOTAL Postage & Fees	$

Postmark or Date
AC 53-206244
PSD-FL-183
7-27-92

PS Form **3800**, June 1990

Is your RETURN ADDRESS completed on the reverse side?

SENDER:

- Complete items 1 and/or 2 for additional services.
- Complete items 3, and 4a & b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "Return Receipt Requested" on the mailpiece below the article number.
- The Return Receipt will show to whom the article was delivered and the date delivered.

I also wish to receive the following services (for an extra fee):

1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3\. Article Addressed to:

Mr. Matthew P. Killeen
Manager, Environmental Permits
Ridge Generating Station, L.P.
400 N. New York Avenue, Suite 101
Winter Park, Florida 32789

4a. Article Number
P 872 562 505

4b. Service Type
☐ Registered ☐ Insured
☒ Certified ☐ COD
☐ Express Mail ☐ Return Receipt for Merchandise

7\. Date of Delivery
12-8-93

5\. Signature (Addressee)

6\. Signature (Agent)

8\. Addressee's Address (Only if requested and fee is paid)

PS Form **3811**, December 1991 ☆U.S. GPO: 1992—323-402 **DOMESTIC RETURN RECEIPT**

Thank you for using Return Receipt Service.

P 872 562 505

UNITED STATES POSTAL SERVICE ™

Receipt for Certified Mail

No Insurance Coverage Provided
Do not use for International Mail
(See Reverse)

Sent to Mr. Matthew P. Killeen	
Street and No. 400 N. New York Avenue	
P.O., State and ZIP Code Winter Park, FL 32789	
Postage	$
Certified Fee	
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to Whom & Date Delivered	
Return Receipt Showing to Whom, Date, and Addressee's Address	
TOTAL Postage & Fees	$

Postmark or Date

AC53-206244/PSD-FL-183
Mailed: 12/06/93

PS Form **3800**, JUNE 1991

SENDER:
- Complete items 1 and/or 2 for additional services.
- Complete items 3, and 4a & b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "Return Receipt Requested" on the mailpiece below the article number.
- The Return Receipt Fee will provide you the signature of the person delivered to and the date of delivery.

I also wish to receive the following services (for an extra fee):

1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:

Mr. Macauley Whiting, Jr.
Decker Energy-Ridge, Inc.
P. O. Box 2397
Winter Park, FL 32790

4a. Article Number
P 062 922 004

4b. Service Type
☐ Registered ☐ Insured
☒ Certified ☐ COD
☐ Express Mail ☐ Return Receipt for Merchandise

7. Date of Delivery
10-2-92

5. Signature (Addressee)

6. Signature (Agent)

8. Addressee's Address (Only if requested and fee is paid)

PS Form 3811, November 1990 ☆U.S. GPO: 1991—287-066 **DOMESTIC RETURN RECEIPT**

P 062 922 004

UNITED STATES POSTAL SERVICE

Receipt for Certified Mail

No Insurance Coverage Provided
Do not use for International Mail
(See Reverse)

Sent to
Mr. Macauley Whiting, Decker Energy

Street and No.
P.O. Box 2397

P.O., State and ZIP Code
Winter Park, FL 32790

Postage	$
Certified Fee	
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to Whom & Date Delivered	
Return Receipt Showing to Whom, Date, and Addressee's Address	
TOTAL Postage & Fees	$

Postmark or Date
Mailed: 9-29-92
Permit: AC 53-206244

PS Form 3800, June 1991

Is your RETURN ADDRESS completed on the reverse side?

SENDER:
- Complete items 1 and/or 2 for additional services.
- Complete items 3, and 4a & b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "Return Receipt Requested" on the mailpiece below the article number.
- The Return Receipt will show to whom the article was delivered and the date delivered.

I also wish to receive the following services (for an extra fee):

1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:

Rodney Williams, Plant Mgr.
Wheelabrator Ridge Energy
3131 K-Ville avenue
Auburndale, FL
33823

4a. Article Number
Z 392 979 018

4b. Service Type
☐ Registered ☐ Insured
☒ Certified ☐ COD
☐ Express Mail ☐ Return Receipt for Merchandise

7. Date of Delivery 8/16/95

5. Signature (Addressee)

8. Addressee's Address (Only if requested and fee is paid)

6. Signature (Agent) Linda Colon

PS Form **3811**, December 1991 ☆U.S. GPO: 1993—352-714 **DOMESTIC RETURN RECEIPT**

Thank you for using Return Receipt Service.

Z 392 979 018

UNITED STATES POSTAL SERVICE

Receipt for Certified Mail

No Insurance Coverage Provided
Do not use for International Mail
(See Reverse)

PS Form 3800, March 1993

Sent to Rodney Williams, Plt. Mgr.	
Street and No. 3131 K-Ville avenue	
P.O., State and ZIP Code Auburndale, FL 33823	
Postage	$
Certified Fee	
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to Whom & Date Delivered	
Return Receipt Showing to Whom, Date, and Addressee's Address	
TOTAL Postage & Fees	$
Postmark or Date Sent 8/18/95 AC53-206244 PSD FL-183(A) Final Amendment	

270 844

Is your RETURN ADDRESS completed on the reverse side?

SENDER:
- Complete items 1 and/or 2 for additional services.
- Complete items 3, and 4a & b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "Return Receipt Requested" on the mailpiece below the article number.
- The Return Receipt will show to whom the article was delivered and the date delivered.

I also wish to receive the following services (for an extra fee):

1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:

Rodney Williams, Plant Mg.
Wheelabrator Ridge Energy
3131 K-Ville Ave
Auburndale, Fl

4a. Article Number
Z 392 979 061

4b. Service Type
☐ Registered ☐ Insured
☑ Certified ☐ COD
☐ Express Mail ☐ Return Receipt for Merchandise

7. Date of Delivery

AUBURNDALE FL 33823
JUL 25 1995
USPS

5. Signature (Addressee)

8. Addressee's Address (Only if requested and fee is paid)

6. Signature (Agent)
Linda Colon

PS Form **3811**, December 1991 ☆U.S. GPO: 1993—352-714 **DOMESTIC RETURN RECEIPT**

Thank you for using Return Receipt Service.

Z 392 979 061

Receipt for Certified Mail

No Insurance Coverage Provided
Do not use for International Mail
(See Reverse)

UNITED STATES POSTAL SERVICE

PS Form 3800, March 1993

Sent to Rodney Williams	
Street and No. Wheelabrator Ridge	
P.O., State and ZIP Code Auburndale, GA	
Postage	$
Certified Fee	
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to Whom & Date Delivered	
Return Receipt Showing to Whom, Date, and Addressee's Address	
TOTAL Postage & Fees	$
Postmark or Date 7-18-95 AC 53-206244 PSD-Fl-183(A)	

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
NOTICE OF INTENT TO ISSUE PERMIT AMENDMENT
PSD-FL-183(A)
AC53-206244

The Department of Environmental Protection (Department) gives notice of its intent to issue a permit amendment to Wheelabrator Ridge Energy, Inc., 3131 K-Ville Avenue, Auburndale, Florida 33823. This recently constructed and permitted facility consists of a stoke boiler which combusts waste wood, landfill gas, and up to 9 percent tires (by weight) while generating up to 50 megawatts of electric power. The amendment will allow the facility to burn up to 16.9 percent tires (40 percent of heat input). Emissions of acid gasses, metals, and particulate matter are controlled by a lime spray dryer/fabric filter and a selective non-catalytic reduction unit. Recent testing showed that emissions when burning 16.9 percent tires will be within the present permit limits. Additionally the applicant has agreed to reduce its interim sulfur dioxide emission limit from 109.4 pounds per hour to 72 pounds per hour.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) in accordance with Section 120.57, Florida Statutes (F.S.). The petition must contain the information set forth below and must be filed (received) in *the Office of General Counsel of the* Department at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400, within 14 days of publication of this notice. Petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. Failure to file a petition within this time period shall constitute a waiver of any right such person may have to request an administrative determination (hearing) under Section 120.57, F.S.

The Petition shall contain the following information; (a) The name, address, and telephone number of each petitioner, the applicant's name and address, the Department Permit File Number and the county in which the project is proposed; (b) A statement of how and when each petitioner received notice of the Department's action or proposed action; (c) A statement of how each petitioner's substantial interests are affected by the Department's action or proposed action; (d) A statement of the material facts disputed by Petitioner, if any; (e) A statement of facts which petitioner contends warrants reversal or modification of the Department's action or proposed action; (f) A statement of which rules or statutes petitioner contends *require reversal* or *modification of the* Department's action or proposed action; and (g) A statement of the relief sought by petitioner, stating precisely the action petitioner wants the Department to take with respect to the Department's action or proposed action.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any decision of the Department with regard to the application/request have the right to petition to become a party to the proceeding. The petition must conform to the requirements specified above and be filed (received) within 14 days of publication of this notice, in the Office of General Counsel at the above address of the Department. Failure to petition within the allowed time frame constitutes a waiver of any right such person has to request a hearing under Section 120.57, F.S., and to participate as a party to this proceeding. Any subsequent intervention will only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-5.207, Florida *Administrative Code*.

The application/request is available for public inspection during normal business hours, 8:00 a.m. to 5:00 p.m., Monday through Friday, except legal holidays, at

Department of Environmental Protection
Bureau of Air Regulation
111 S. Magnolia Drive, Suite 4
Tallahassee, Florida 32301

Department of Environmental Protection
Central District
Suits 200B
7825 Baymeadows Way
Jacksonville, Florida 32256-7577

Any person may send written comments on the proposed action to Administrator, New Source Review Section at the Department of Environmental Protection, Bureau of Air Regulations, Mail Station 5505, 3600 Blair Stone Road, Tallahassee, Florida 32399-2400. All comments received within 14 days of the publication of this notice will be considered in the Department's final determination.

F93-7-22; 1995

COPY

Wheelabrator Ridge Energy Inc.

3131 K-Ville Avenue
Auburndale, FL 33823
Tel. 813-665-2255
Fax. 813-665-0400

April 4, 1994

Department of Environmental Protection
Southwest District
3804 Coconut Palm Drive
Tampa, Florida 33619

RECEIVED
APR 11 1994
Bureau of
Air Regulation

Attn: Mr. W. Thomas

Subject: **Ridge Generating Station**
Air Permit #AC53-206244: Notifications

Dear Sir:

In accordance with 40 CFR 60.7 and the subject permit, this letter serves as notification of initial start-up of this facility.

Solid fuel firing at Ridge Generating Station commenced on March 30, 1994.

To update my letter of February 17, 1994, our present schedule calls for emissions testing as follows:

Opacity Conditioning Period:	April 17-23, 1994
CEMS 7-Day Drift Test:	May 1-8, 1994
Initial Stack Test Program:	May 9-15, 1994
CEMS Certification (RATA):	May 9-15, 1994

If there are any questions or concerns regarding the above, please call Mr. Gary Aguinaga, Director of Environmental Health and Safety, at (813) 665-2255.

Sincerely,

Rodney William

Rodney Williams
Plant Manager

GA/lc

cc: C. Wilson
G. Aguinaga
J. Rogers
M. Killeen
D. Raymond
J. Reynolds
M. Harley
B. Thomas, SW Dist

J. Goodwin
DEP-Chief Bureau of Air Regulation
EPA IV
Cert. #389 398 502

Wheelabrator Ridge Energy Inc.

CERTIFIED
P 389 398 503
MAIL

State of Florida
Department of Environmental Protection
Chief Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, FL 32399-2400

FEDERAL EXPRESS

QUESTIONS? CALL 800-238-5355 TOLL FREE.

AIRBILL
PACKAGE
TRACKING NUMBER

3436688990

2043N 3436688990

RECIPIENT'S COPY

1 Date 8/25/92

From (Your Name) Please Print: MATT KILLEEN
Your Phone Number (Very Important): (603)929-3000
Company: ELAGRATOR TECHNOLOGIES INC
Department/Floor No.:
Street Address: ERTY LANE
City: PTON
State: NH
ZIP Required: 0 3 8 4 2

2 To (Recipient's Name) Please Print: MR. PRESTON LEWIS, P.E.
Recipient's Phone Number (Very Important): (904) 487-493
Company: Florida Dept. of Env. Regulations
Division of Air Resources Management
Department/Floor No.:
Exact Street Address (We Cannot Deliver to P.O. Boxes or P.O. Zip Codes.): Twin Towers Office Building
2600 Blair Stone Road
City: Tallahassee,
State: FL
ZIP Required: 23299-2400

YOUR INTERNAL BILLING REFERENCE INFORMATION (First 24 characters will appear on invoice.)

H IF HOLD FOR PICK-UP, Print FEDEX Address Here
Street Address: 32399
City
State
ZIP Required

3 PAYMENT 1 ☒ Bill Sender 2 ☐ Bill Recipient's FedEx Acct. No. 3 ☐ Bill 3rd Party FedEx Acct. No. 4 ☐ Bill Credit Card 5 ☐ Cash/Check

4 SERVICES (Check only one box)

Priority Overnight (Delivery by next business morning†)
- 11 ☐ YOUR PACKAGING
- 16 ☐ FEDEX LETTER *
- 12 ☐ FEDEX PAK *
- 13 ☐ FEDEX BOX
- 14 ☐ FEDEX TUBE

Standard Overnight (Delivery by next business afternoon†)
- 51 ☐ YOUR PACKAGING
- 56 ☐ FEDEX LETTER *
- 52 ☐ FEDEX PAK *
- 53 ☐ FEDEX BOX
- 54 ☐ FEDEX TUBE

Economy Two-Day (Delivery by second business day†)
- 30 ☐ ECONOMY

Government Overnight (Restricted for authorized users only)
- 46 ☐ GOV'T LETTER
- 41 ☐ GOV'T PACKAGE

Freight Service (for Extra Large or any package over 150 lbs.)
- 70 ☐ OVERNIGHT FREIGHT ** (Confirmed reservation required)
- 80 ☐ TWO-DAY FREIGHT **

† Delivery commitment may be later in some areas.
* Declared Value Limit $100.
** Call for delivery schedule.

5 DELIVERY AND SPECIAL HANDLING (Check services required)
- 1 ☐ HOLD FOR PICK-UP (Fill in Box H)
- 2 ☒ DELIVER WEEKDAY
- 3 ☐ DELIVER SATURDAY (Extra charge) (Not available to all locations)
- 4 ☐ DANGEROUS GOODS (Extra charge)
- 5 ☐
- 6 ☐ DRY ICE ________ Lbs
- 7 ☐ OTHER SPECIAL SERVICE ________
- 8 ☐
- 9 ☐ SATURDAY PICK-UP (Extra charge)
- 10 ☐
- 11 ☐ DESCRIPTION
- 12 ☐ HOLIDAY DELIVERY (If offered) (Extra charge)

6
PACKAGES	WEIGHT In Pounds Only
1	1
Total 1	Total 1

DIM SHIPMENT (Chargeable Weight)
☐ ________ lbs.
___ x ___ x ___ = ___

Received At
1 ☒ Regular Stop 3 ☐ Drop Box
4 ☐ B.S.C.
2 ☐ On-Call Stop 5 ☐ Station

Emp. No. Date
☐ Cash Received
☐ Return Shipment
☐ Third Party ☐ Chg. To Del. ☐ Chg. To Hold
Street Address
City State Zip
Received By:
X
Date/Time Received FedEx Employee Number

7 Release Signature: ________
FedEx Emp. No. Date/Time

Federal Express Use
Base Charges
Declared Value Charge
Other 1
Other 2
Total Charges

REVISION DATE 4/91
PART #137204 NCREC 8/91
FORMAT #082

082

RIDGE GENERATING STATION, L. P.

General Partners

DECKER ENERGY-RIDGE, INC. **WHEELABRATOR POLK INC.**

400 North New York Avenue, Suite 101
Winter Park, Florida 32789
Tel. 407-628-8900
Fax. 407-628-8535

RECEIVED
AUG 26 1992
Bureau of
Air Regulation

August 24, 1992

Florida Department of Environmental Regulation
Division of Air Resources Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Attention: Mr. Preston Lewis, P.E.
Bureau of Air Regulation

Re: Ridge Generating Station, Polk County
DER File No. AC 53-206244, PSD-FL-183

Dear Mr. Lewis:

On July 29, 1992, Ridge Generating Station Limited Partnership (RGSLP) received the Revised Technical Evaluation and Preliminary Determination and the proposed permit for the Ridge Generating Station. This letter summarizes our comments on these documents. We have arranged our comments in the order in which they appear in the document. In addition, we have also attached a marked-up version of the documents which clearly illustrates the revisions that we are requesting. The basis for the requested revisions is provided below.

1. <u>Revised Technical Evaluation and Preliminary Determination, Page 3, Paragraph 1</u>

   <u>Requested Revisions</u>
   The words "urea or" should be inserted between the words "injecting" and "ammonia" in the last line.

   <u>Basis</u>
   As discussed in the Application, either urea or ammonia will be used as a reagent in the SNCR system, depending upon which vendor is selected. Since a final decision on the SNCR vendor has not been made, it would be more accurate to list both options in the Technical Evaluation.

2. <u>Proposed Permit, Page 6 of 9, Specific Condition 5</u>

   a. <u>Comment</u>
   Based upon discussions between Steve Smallwood and John Reynolds, it is our understanding that the numbers in the column titled "Basis (lb/MMBTU)" are not permit limits that are to be used for determining compliance. The permit limits are those numbers that are found in

RECEIVED
8-19-92

AFFIDAVIT OF PUBLICATION

THE LEDGER
Lakeland, Polk County, Florida

Case No ....

STATE OF FLORIDA)
COUNTY OF POLK)

Before the undersigned authority personally appeared Tharon Honeycutt, who on oath says that he is Controller of The Ledger, a daily newspaper published at Lakeland in Polk County, Florida; that the attached copy of advertisement, being a

Intent to issue Permit ....

in the matter of ....

Wood, tire ....

in the ....

Court, was published in said newspaper in the issues of ....

July 29;

1992

Affiant further says that said The Ledger is a newspaper published at Lakeland, in said Polk County, Florida, and that the said newspaper has heretofore been continuously published in said Polk County, Florida, daily, and has been entered as second class matter at the post office in Lakeland, in said Polk County, Florida, for a period of one year next preceding the first publication of the attached copy of advertisement; and affiant further says that he has neither paid nor promised any person, firm or corporation any discount, rebate, commission or refund for the purpose of securing this advertisement for publication in the said newspaper.

Signed ....
Controller

Sworn to and subscribed before me this 29th

day of July A.D. 19 1992

BILLIE MORLAN
MY COMMISSION # CC 191354
EXPIRES: April 6, 1996
Bonded Thru Notary Public Underwriters

(Seal)

Billie Morlan
Notary Public
Billie Morlan

My Commission Expires ....

Decker Energy
Acct #19040

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION
NOTICE OF INTENT TO ISSUE PERMIT

The Department of Environmental Regulation gives notice of its intent to issue a permit to Ridge Generating Station, P.O. Box 2397, Winter Park, Florida 32790, to construct a wood/tire burning power generation facility at State Road 542 and Taylor Road near Auburndale, Polk County, Florida. A determination of Best Available Control Technology (BACT) was required. The proposed project is subject to Prevention of Significant Deterioration (PSD) regulations. Modeling results show that increases in ground-level concentrations are less than PSD significant impact levels for the applicable pollutants. The Department is issuing this intent to issue for the reasons stated in the Technical Evaluation and Preliminary Determination.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) in accordance with Section 120.57, Florida Statutes. The petition must contain the information set forth below and must be filed (received) in the Office of General Counsel of the Department at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400, within 14 days of publication of this notice. Petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. Failure to file a petition within this time period shall constitute a waiver of any right such person may have to request an administrative determination (hearing) under Section 120.57, Florida Statutes.

The Petition shall contain the following information; (a) The name, address, and telephone number of each petitioner, the applicant's name and address, the Department Permit File Number and the county in which the project is proposed; (b) A statement of how and when each petitioner received notice of the Department's action or proposed action; (c) A statement of how each petitioner's substantial interests are affected by the Department's action or proposed action; (d) A statement of the material facts disputed by Petitioner, if any; (e) A statement af facts which petitioner contends warrant reversal or modification of the Department's action or proposed action; (f) A statement of which rules or statutes petitioner contends require reversal or modification of the Department's action or proposed action; and (g) A statement of the relief sought by petitioner, stating precisely the action petitioner wants the Department to take with respect to the Department's action or proposed action.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this Notice. Persons whose substantial interests will be affected by any decision of the Department with regard to the application have the right to petition to become a party to the proceeding. The petition must conform to the requirements specified above and be filed (received) within 14 days of publication of this notice in the Office of General Counsel at the above address of the Department. Failure to petition within the allowed time frame constitutes a waiver of any right such person has to request a hearing under Section 120.57, F.S., and to participate as a party to this proceeding. Any subsequent intervention will only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-5.207, F.A.C.

The application is available for public inspection during normal business hours, 8:00 a.m. to 5:00 p.m., Monday through Friday, except legal holidays, at:

Department of Environmental Regulation
Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Department of Environmental Regulation
Southwest District
452 Oak Fair Blvd.
Tampa, Florida 33610-7347

Any person may send written comments on the proposed action to Mr. Preston Lewis at the Department's Tallahassee address. All comments received within 30 days of the publication of this notice will be considered in the Department's final determination. Further, a public hearing can be requested by any person. Such requests must be submitted within 30 days of this notice.

M-659 — 7-29; 1992

M 659

SENDER:

- Complete items 1 and/or 2 for additional services.
- Complete items 3, and 4a & b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "Return Receipt Requested" on the mailpiece below the article number.
- The Return Receipt Fee will provide you the signature of the person delivered to and the date of delivery.

I also wish to receive the following services (for an extra fee):

1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:

Mr. Macauley Whiting, Jr.
Decker Energy-Ridge, Inc
PO Box 2597
Winter Park, Fl
32790

4a. Article Number
P 710 058 523

4b. Service Type
☐ Registered ☐ Insured
☒ Certified ☐ COD
☐ Express Mail ☐ Return Receipt for Merchandise

7. Date of Delivery
7-30-92

5. Signature (Addressee)

6. Signature (Agent)

8. Addressee's Address (Only if requested and fee is paid)

PS Form **3811**, November 1990 ☆U.S. GPO: 1991—287-066 **DOMESTIC RETURN RECEIPT**

P 710 058 523

Certified Mail Receipt

No Insurance Coverage Provided
Do not use for International Mail
(See Reverse)

UNITED STATES POSTAL SERVICE

Sent to Macauley Whiting	
Street & No. Decker-Energy Ridge	
P.O., State & ZIP Code Winter Park, Fl	
Postage	$
Certified Fee	
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to Whom & Date Delivered	
Return Receipt Showing to Whom, Date, & Address of Delivery	
TOTAL Postage & Fees	$
Postmark or Date AC 53-206244 PSD-FL-183 7-27-92	

PS Form **3800**, June 1990

AFFIDAVIT OF PUBLICATION

THE LEDGER

Lakeland, Polk County, Florida

Case No........................

STATE OF FLORIDA)
COUNTY OF POLK)

Before the undersigned authority personally appeared Tharon Honeycutt, who on oath says that he is Controller of The Ledger, a daily newspaper published at Lakeland in Polk County, Florida; that the attached copy of advertisement, being a

Notice of Appl.

in the matter of

Wood, tire

in the ....

Court, was published in said newspaper in the issues of

July 13;

1992

Affiant further says that said The Ledger is a newspaper published at Lakeland, in said Polk County, Florida, and that the said newspaper has heretofore been continuously published in said Polk County, Florida, daily, and has been entered as second class matter at the post office in Lakeland, in said Polk County, Florida, for a period of one year next preceding the first publication of the attached copy of advertisement; and affiant further says that he has neither paid nor promised any person, firm or corporation any discount, rebate, commission or refund for the purpose of securing this advertisement for publication in the said newspaper.

Signed..
Controller

Sworn to and subscribed before me this 13th

day of July A.D. 19 1992

BILLIE MORLAN
MY COMMISSION # CC 191354
EXPIRES: April 6, 1996
Bonded Thru Notary Public Underwriters

(Seal)

Billie Morlan
Notary Public
Billie Morlan

My Commission Expires ....

Ridge Generating Station
Acct #19040

NOTICE OF APPLICATION

The Department of Environmental Regulation announces receipt of an application for permit from Ridge Generation Station, L.P. to construct a wood/tire burning power generation facility. This proposed project will be located at State Road 542 and Taylor Road near Auburndale, Polk County, Florida. This application is being processed and is available for public inspection during normal business hours, 8:00am to 5:00pm, Monday through Friday, except legal holidays at:

Department of Environmental Regulation
Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, Florida 32399-2400
Department of Environmental Regulation
Southwest District
4520 Oak Fair Boulevard
Tampa, Florida 33610-7347

M-605 — 7-13; 1992

M 605

SENDER:
- Complete items 1 and/or 2 for additional services.
- Complete items 3, and 4a & b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "Return Receipt Requested" on the mailpiece below the article number.
- The Return Receipt Fee will provide you the signature of the person delivered to and the date of delivery.

I also wish to receive the following services (for an extra fee):

1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:

Mr. MaCauley Whiting, Pres.
Decker Energy-Ridge Inc
P O BOX 2397
Winter Park, Fl 32790

4a. Article Number P 710 058 491

4b. Service Type
☐ Registered ☐ Insured
☒ Certified ☐ COD
☐ Express Mail ☐ Return Receipt for Merchandise

7. Date of Delivery 6 28 92

5. Signature (Addressee)

8. Addressee's Address (Only if requested and fee is paid)

6. Signature (Agent)

PS Form **3811**, November 1990 ☆U.S. GPO: 1991—287-066 **DOMESTIC RETURN RECEIPT**

P 710 058 491

UNITED STATES POSTAL SERVICE

Certified Mail Receipt
No Insurance Coverage Provided
Do not use for International Mail
(See Reverse)

Sent to MaCauley Whiting
Street & No. Decker Energy - Ridge
P.O., State & ZIP Code Winter PK, Fl

Postage	$
Certified Fee	
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to Whom & Date Delivered	
Return Receipt Showing to Whom, Date, & Address of Delivery	
TOTAL Postage & Fees	$

Postmark or Date
6-24-92
PSD-Fl-183
AC 53-206244

PS Form **3800**, June 1990

File Copy

RECEIVED
APR 06 1992
Bureau of
Air Regulation

ADDITIONAL ASSESSMENT OF IMPACTS ON THE CHASSAHOWITZKA PSD CLASS I AREA FOR THE RIDGE GENERATING STATION PROJECT

APRIL 1992

DAMES & MOORE

ATLANTA, GEORGIA
Job No. 22250-004-049

FEDERAL EXPRESS

[redacted]

QUESTIONS? CALL 800-238-5355 TOLL FREE.

AIRBILL
PACKAGE
TRACKING NUMBER
2182 [illegible]

[illegible] 2182831884

RECIPIENT'S COPY

1 [redacted] Date 4-4-92

From (Your Name) Please Print: Jim Little
Your Phone Number (Very Important): (404)-262-2919
Company: DAMES & MOORE
Department/Floor No.:
Street Address: 3525 PIEDMONT RD #500 BLDG 6
City: ATLANTA State: GA ZIP Required: 30305

2 To (Recipient's Name) Please Print: Clair Fancy
Recipient's Phone Number (Very Important): ( )
Company: Florida Dept. of Enviromental Regulation
Department/Floor No.:
Exact Street Address (We Cannot Deliver to P.O. Boxes or P.O. Zip Codes.): 2600 Blair Stone Rd.
City: Tallahassee State: FLA. ZIP Required: 32399-2400

YOUR INTERNAL BILLING REFERENCE INFORMATION (optional) (First 24 characters will appear on invoice.)
22250-004-5108-049

H IF HOLD FOR PICK-UP, Print FEDEX Address Here
Street Address
City State ZIP Required

3 PAYMENT 1 ☒ Bill Sender 2 ☐ Bill Recipient's FedEx Acct. No. 3 ☐ Bill 3rd Party FedEx Acct. No. 4 ☐ Bill Credit Card
5 ☐ Cash/Check [redacted]

4 SERVICES (Check only one box)

Priority Overnight (Delivery by next business morning†)
11 ☐ YOUR PACKAGING
16 ☐ FEDEX LETTER *
12 ☒ FEDEX PAK *
13 ☐ FEDEX BOX
14 ☐ FEDEX TUBE

Standard Overnight (Delivery by next business afternoon†)
51 ☐ YOUR PACKAGING
56 ☐ FEDEX LETTER *
52 ☐ FEDEX PAK *
53 ☐ FEDEX BOX
54 ☐ FEDEX TUBE

Economy Two-Day (Delivery by second business day†)
30 ☐ ECONOMY

Government Overnight (Restricted to authorized users only)
46 ☐ GOVT LETTER
41 ☐ GOVT PACKAGE

Freight Service (for Extra Large or any package over 150 lbs.)
70 ☐ OVERNIGHT FREIGHT** (Confirmed reservation required)
80 ☐ TWO-DAY FREIGHT **

† Delivery commitment may be later in some areas.
* Declared Value Limit $100.
** Call for delivery schedule.

5 DELIVERY AND SPECIAL HANDLING (Check services required)
1 ☐ HOLD FOR PICK-UP (Fill in Box H)
2 ☐ DELIVER WEEKDAY
3 DELIVER SATURDAY (Extra charge) ☐ (Not available to all locations)
4 ☐ DANGEROUS GOODS (Extra charge)
5 ☐
6 ☐ DRY ICE ______ Lbs.
7 ☐ OTHER SPECIAL SERVICE ______
8 ☐
9 ☐ SATURDAY PICK-UP (Extra charge)
10 ☐
11 ☐ DESCRIPTION
12 ☐ HOLIDAY DELIVERY (If offered) (Extra charge)

6 PACKAGES | WEIGHT In Pounds Only | YOUR DECLARED VALUE
Total | Total | Total

RECEIVED
APR 0 1992
14
Division of Air Resources Management

SHIPMENT (Chargeable Weight) ☐ ______ lbs.
L x W x H = ______

Received At
1 ☐ Regular Stop 3 ☐ Drop Box
4 ☐ B.S.C.
2 ☐ On-Call Stop 5 ☒ Station

Emp. No. Date
☐ Cash Received
☐ Return Shipment
☐ Third Party ☐ Chg. To Del. ☐ Chg. To Hold
Street Address
City State Zip
Received By:
X
Date/Time Received FedEx Employee Number

7 Release Signature:
FedEx Emp. No. Date/Time

Federal Express Use
Base Charges
Declared Value Charge
Other 1
Other 2
Total Charges

REVISION DATE 6/91
PART #137204 FXEM 2/92
FORMAT #099
099

RIDGE GENERATING STATION, L. P.

General Partners
DECKER ENERGY-RIDGE, INC. ***WHEELABRATOR POLK INC.***

400 North New York Avenue, Suite 101
Winter Park, Florida 32789
Tel. 407-628-8900
Fax. 407-628-8535

RECEIVED
MAR 30 1992
Division of Air
Resources Management

March 27, 1992

Florida Department of Environmental Regulation
Division of Air Resources Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Attention: C. H. Fancy, P.E.
Chief, Bureau of Air Regulation

Re: Permit Application AC 53-206244, PSD-FL-183
Ridge Generating Station

Dear Mr. Fancy:

The letter from your office dated January 17, 1992, raised six questions regarding the air emissions permit application for the Ridge Generating Station project. Our letter to you dated March 19, 1992, provided responses to the first five of these questions. A summary response to the sixth question is provided below (along with a repetition of the question for your convenience). We have scheduled a meeting on April 1, 1992, with Tom Rogers and Cleve Holladay of the Air Modeling and Assessment Section to discuss our response in detail. A written detailed response will also be provided.

6. **The predicted maximum SO_2 24-hour and 3-hour concentrations in the Chassahowitzka PSD Class I area due to the Ridge Generating Station boiler emissions are greater than the National Park Service proposed 24-hour and 3-hour significant impact levels of 0.07 and 0.48 $\mu g/m^3$, respectively. Please perform a cumulative 24-hour and 3-hour SO_2 Class I increment analysis as required by the National Park Service. An air quality related values (AQRVs) analysis should also be done since there are presently no significant impact levels that exempt a proposed PSD project from performing this analysis. The AQRVs analysis includes impacts to soils, vegetation, and wildlife.**

ADDITIONAL AIR QUALITY MODELING ANALYSIS

An additional analysis of SO_2 impacts at the Chassahowitzka PSD Class I area has been developed. This additional impact analysis is based on the use of the standard ISCST model and a long-range transport model, the MESOPUFF II model. The following

RIDGE GENERATING STATION, L. P.

HAMPTON
MAR 27 '92
NH

P.B. METER
671[illegible]881

U.S. POSTAGE
0.29

Florida Dept. of Environmental Regulation
Division of Air Resources Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400

RIDGE GENERATING STATION, L. P.

General Partners

DECKER ENERGY-RIDGE, INC. ***WHEELABRATOR POLK INC.***

400 North New York Avenue, Suite 101
Winter Park, Florida 32789
Tel. 407-628-8900
Fax. 407-628-8535

March 19, 1992

RECEIVED
MAR 20 1992
Bureau of
Air Regulation

Florida Department of Environmental Regulation
Division of Air Resources Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Attention: C. H. Fancy, P.E.
Chief, Bureau of Air Regulation

Re: Permit Application AC 53-206244, PSD-FL-183
Ridge Generating Station

Dear Mr. Fancy:

This letter provides responses to the questions you raised in your letter dated January 17, 1992. For your convenience, we have repeated the questions and provided our response immediately below the question.

1. **The flow diagram shows no bypass around the dry scrubber/ baghouse. There may be times when the boiler flue gas temperature exceeds the baghouse design temperature. Are there plans to install a bypass, and if so, under what conditions would the bypass be open?**

RESPONSE:

As discussed in the application, the Ridge Generating Station (RGS) will be equipped with a spray dryer absorber (SDA) and fabric filter. Under normal circumstances, the SDA and fabric filter will both be in operation when the boiler is on-line. A bypass of the fabric filter will, however, be installed to protect the bags and structural integrity of the baghouse during infrequent upset or emergency conditions.

The RGS boiler will be a conventional stoker fired unit, in which the solid fuel will be burned both in suspension and on the grate. If a system failure occurred which resulted in the SDA going off-line, the fuel feed to the boiler would automatically stop and the suspension burning would cease. However, fuel already on the grate would continue to burn, sending combustion products to the SDA/fabric filter. To

BEST AVAILABLE COPY

FEDERAL EXPRESS

[redacted]

QUESTIONS? CALL 800-238-5355 TOLL FREE.

AIRBILL
PACKAGE
TRACKING NUMBER

3594194446

1363N 3594194446

RECIPIENT'S COPY

1 [redacted]

Date 3/19/92

From (Your Name) Please Print: ...t Killeen
Your Phone Number (Very Important): 603-929-3000
Company: ...ELABRATOR TECHNOLOGIES INC.
Department/Floor No.
Street Address: ...BERTY LANE
City: ...MPTON
State: NH
ZIP Required: 03842

2 To (Recipient's Name) Please Print: C. H. Fancy
Recipient's Phone Number (Very Important): (904) 488-4805
Company: Florida Dept. of Env. Regulations
Div. of Air Resources Mgmt.
Department/Floor No.
Exact Street Address (We Cannot Deliver to P.O. Boxes or P.O. Zip Codes.): Twin Towers Office Bldg.
2600 Blair Stone Road
City: Tallahassee,
State: FL
ZIP Required: 32399-240(

YOUR INTERNAL BILLING REFERENCE INFORMATION (optional) (First 24 characters will appear on invoice.)

H IF HOLD FOR PICK-UP, Print FEDEX Address Here
Street Address
City
State
ZIP Required

3 PAYMENT 1 ☒ Bill Sender 2 ☐ Bill Recipient's FedEx Acct. No. 3 ☐ Bill 3rd Party FedEx Acct. No. 4 ☐ Bill Credit Card
5 ☐ Cash/Check

[redacted]

4 SERVICES
(Check only one box)

Priority Overnight
(Delivery by next business morning†)
- 11 ☐ YOUR PACKAGING
- 16 ☐ FEDEX LETTER *
- 12 ☒ FEDEX PAK *
- 13 ☐ FEDEX BOX
- 14 ☐ FEDEX TUBE

Standard Overnight
(Delivery by next business afternoon†)
- 51 ☐ YOUR PACKAGING
- 56 ☐ FEDEX LETTER *
- 52 ☐ FEDEX PAK *
- 53 ☐ FEDEX BOX
- 54 ☐ FEDEX TUBE

Economy Two-Day
(Delivery by second business day†)
- 30 ☐ ECONOMY

Government Overnight
(Restricted for authorized users only)
- 46 ☐ GOV'T LETTER
- 41 ☐ GOV'T PACKAGE

Freight Service
(for Extra Large or any package over 150 lbs.)
- 70 ☐ OVERNIGHT FREIGHT **
- 80 ☐ TWO-DAY FREIGHT **

(Confirmed reservation required)
† Delivery commitment may be later in some areas.
*Declared Value Limit $100.
**Call for delivery schedule.

5 DELIVERY AND SPECIAL HANDLING
(Check services required)
- 1 ☐ HOLD FOR PICK-UP (Fill in Box H)
- 2 ☒ DELIVER WEEKDAY
- 3 ☐ DELIVER SATURDAY (Extra charge) (Not available to all locations)
- 4 ☐ DANGEROUS GOODS (Extra charge)
- 5 ☐
- 6 ☐ DRY ICE ______ Lbs
- 7 ☐ OTHER SPECIAL SERVICE ______
- 8 ☐
- 9 ☐ SATURDAY PICK-UP (Extra charge)
- 10 ☐
- 11 ☐ DESCRIPTION
- 12 ☐ HOLIDAY DELIVERY (If offered) (Extra charge)

6 PACKAGES	WEIGHT In Pounds Only	YOUR DECLARED VALUE
1	2	
Total 1	Total 2	Total

DIM SHIPMENT (Chargeable Weight)
☐ ______ lbs.
L x W x H = ______

Received At
1 ☒ Regular Stop 3 ☐ Drop Box
4 ☐ B.S.C.
2 ☐ On-Call Stop 5 ☐ Station

Emp. No. Date
☐ Cash Received
☐ Return Shipment
☐ Third Party ☐ Chg. To Del. ☐ Chg. To Hold
Street Address
City State Zip
Received By:
X
Date/Time Received FedEx Employee Number

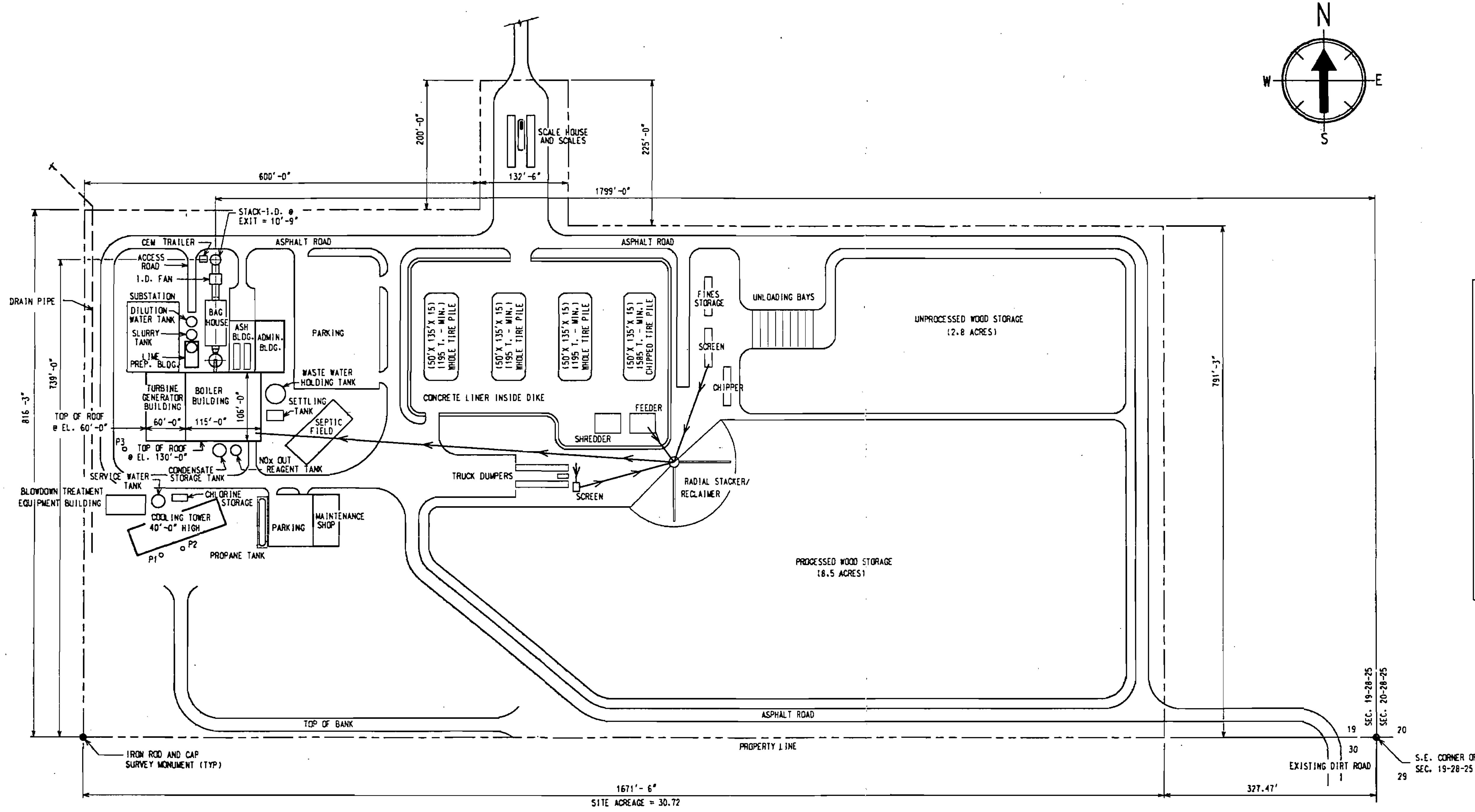
7 Release Signature: ______

FedEx Emp. No. Date/Time

Federal Express Use
Base Charges
Declared Value Charge
Other 1
Other 2
Total Charges

REVISION DATE 6/91
PART #137204 NCREC 10/91
FORMAT #099

099



LEGEND

WELL (P1) - MAIN FLORIDAN AQUIFER PUMP
WELL (P2) - AUXILLARY PUMP
WELL (P3) - POTABLE INTERMEDIATE AQUIFER PUMP
COOLING TOWER - 42' WIDE X 144' LONG X 40' HIGH
LIME SILO - 16'DIA. X 30' HIGH
CONDENSATE STORAGE TANK - TO BE DETERMINED
NOx OUT REAGENT TANK - 16' DIA. X 16' HIGH
WASTE WATER HOLDING TANK - TO BE DETERMINED
SERVICE WATER STORAGE TANK - TO BE DETERMINED
CHLORINE STORAGE - (4) ONE TON TANKS WITH PUMP HOUSE

SITE PLAN

PRELIMINARY
PRINT DATE 02/06/92
REVIEWED BY

REVISION
1 02-06-92
2 02-06-92

NOTICE: This drawing and all information contained thereon is confidential and proprietary to SFT, Inc. It cannot be copied or reproduced without the express written permission of SFT, Inc.

SIGNATURE	DATE
DRAWN: J.E.FISCHER	02-06-92
CH'KD:	- -
CH'KD:	- -
APP'D:	- -

SFT, Inc. Consulting Engineers SFT

RIDGE GENERATING STATION

TITLE:
SITE PLAN
FOR AIR PERMIT APPLICATION

SCALE:	PROJ./CONTRACT NO.	DRAWING NO.	REV.
NONE	9110-00-00	911000-PPR-008	2

D:\911000\PS11
BASE SCALE: " = '-0"

SENDER:

- Complete items 1 and/or 2 for additional services.
- Complete items 3, and 4a & b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "Return Receipt Requested" on the mailpiece next to the article number.

I also wish to receive the following services (for an extra fee):

1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:

Mr. Macauley Whiting, Jr.
President
Decker Energy - Ridge, Inc.
P. O. Box 2397
Winter Park, FL 32790

4a. Article Number
P 832 538 766

4b. Service Type

☐ Registered ☐ Insured
☒ Certified ☐ COD
☐ Express Mail ☐ Return Receipt for Merchandise

5. Signature (Addressee)

6. Signature (Agent)

7. Date of Delivery 1/22/92

8. Addressee's Address (Only if requested and fee is paid)

PS Form **3811**, October 1990 ☆U.S. GPO: 1990—273-861 **DOMESTIC RETURN RECEIPT**

P 832 538 766

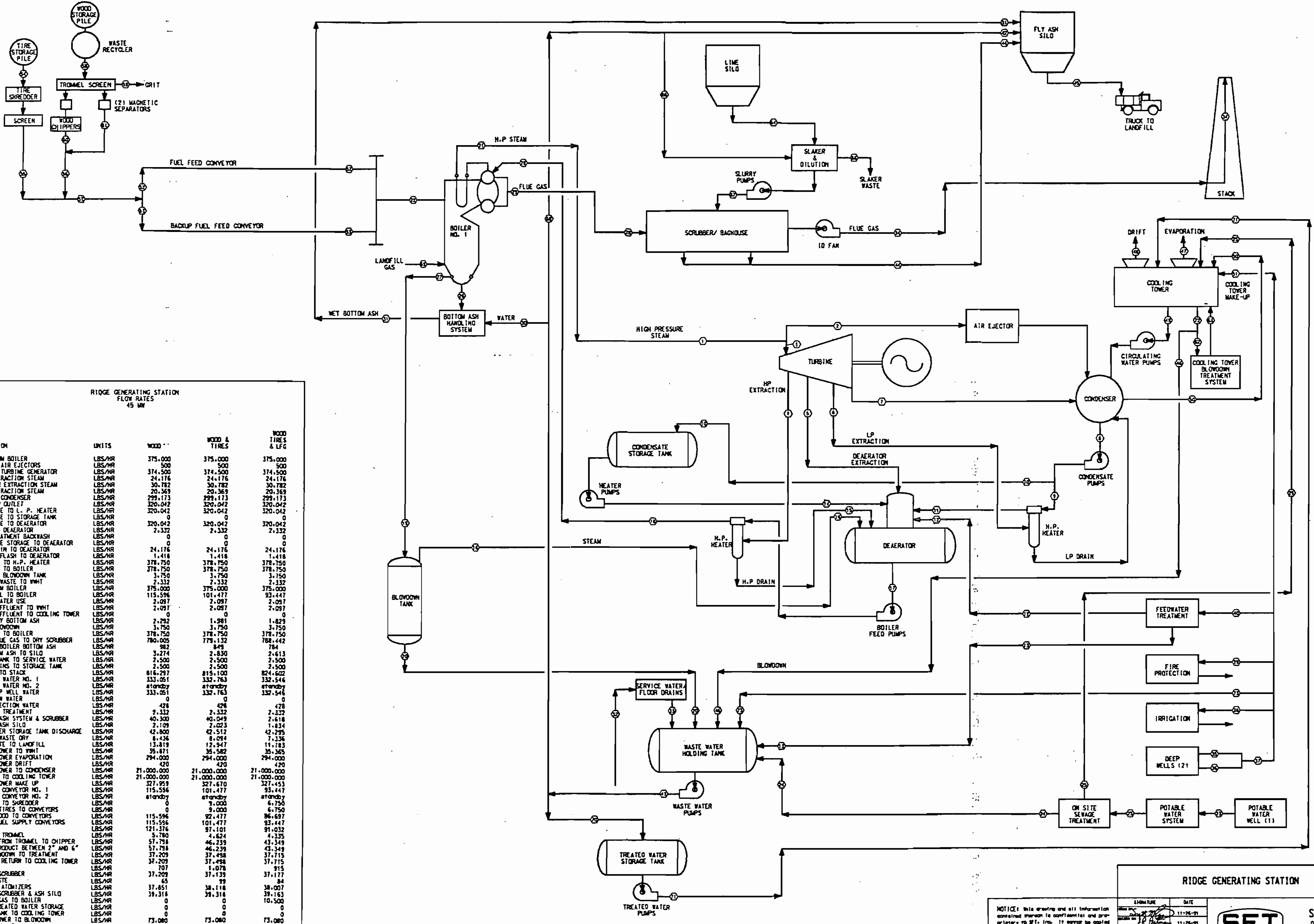
Certified Mail Receipt

No Insurance Coverage Provided
Do not use for International Mail
(See Reverse)

UNITED STATES POSTAL SERVICE

Sent to Mr. Macauley Whiting	
Street & No. Ridge, Inc. P. O. Box 2397	
P.O., State & ZIP Code Winter Park, FL 32790	
Postage	$
Certified Fee	
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to Whom & Date Delivered	
Return Receipt Showing to Whom, Date, & Address of Delivery	
TOTAL Postage & Fees	$
Postmark or Date Mailed: 1-17-92 Permit: AC 53-206244 PSD-FL-183	

PS Form **3800**, June 1990



RIDGE GENERATING STATION
FLOW RATES
45 MW

NO.	DESCRIPTION	UNITS	WOOD	WOOD & TIRES	WOOD TIRES & LFG
1	STEAM FROM BOILER	LBS/HR	375.000	375.000	375.000
2	STEAM TO AIR EJECTORS	LBS/HR	500	500	500
3	STEAM TO TURBINE GENERATOR	LBS/HR	374.500	374.500	374.500
4	H. P. EXTRACTION STEAM	LBS/HR	24.176	24.176	24.176
5	DEAERATOR EXTRACTION STEAM	LBS/HR	30.782	30.782	30.782
6	L. P. EXTRACTION STEAM	LBS/HR	20.369	20.369	20.369
7	STEAM TO CONDENSER	LBS/HR	299.173	299.173	299.173
8	CONDENSER OUTLET	LBS/HR	320.042	320.042	320.042
9	CONDENSATE TO L. P. HEATER	LBS/HR	320.042	320.042	320.042
10	CONDENSATE TO STORAGE TANK	LBS/HR	0	0	0
11	CONDENSATE TO DEAERATOR	LBS/HR	320.042	320.042	320.042
12	MAKEUP TO DEAERATOR	LBS/HR	2.332	2.332	2.332
13	WATER TREATMENT BACKWASH	LBS/HR	0	0	0
14	CONDENSATE STORAGE TO DEAERATOR	LBS/HR	0	0	0
15	H. P. DRAIN TO DEAERATOR	LBS/HR	24.176	24.176	24.176
16	BLOWDOWN FLASH TO DEAERATOR	LBS/HR	1.418	1.418	1.418
17	FEEDWATER TO H.P. HEATER	LBS/HR	378.750	378.750	378.750
18	FEEDWATER TO BOILER	LBS/HR	378.750	378.750	378.750
19	BOILER TO BLOWDOWN TANK	LBS/HR	3.750	3.750	3.750
20	BLOWDOWN WASTE TO WWHT	LBS/HR	2.332	2.332	2.332
21	STEAM FROM BOILER	LBS/HR	375.000	375.000	375.000
22	SOLID FUEL TO BOILER	LBS/HR	115.596	101.477	93.447
23	POTABLE WATER USE	LBS/HR	2.097	2.097	2.097
24	POTABLE EFFLUENT TO WWHT	LBS/HR	2.097	2.097	2.097
25	POTABLE EFFLUENT TO COOLING TOWER	LBS/HR	0	0	0
26	BOILER DRY BOTTOM ASH	LBS/HR	2.292	1.981	1.829
27	BOILER BLOWDOWN	LBS/HR	3.750	3.750	3.750
28	FEEDWATER TO BOILER	LBS/HR	378.750	378.750	378.750
29	BOILER FLUE GAS TO DRY SCRUBBER	LBS/HR	780.005	779.132	788.442
30	WATER TO BOILER BOTTOM ASH	LBS/HR	982	849	784
31	WET BOTTOM ASH TO SILO	LBS/HR	3.274	2.830	2.613
32	STORAGE TANK TO SERVICE WATER	LBS/HR	2.500	2.500	2.500
33	FLOOR DRAINS TO STORAGE TANK	LBS/HR	2.500	2.500	2.500
34	FLUE GAS TO STACK	LBS/HR	816.297	815.100	824.602
35	DEEP WELL WATER NO. 1	LBS/HR	333.051	332.763	332.546
36	DEEP WELL WATER NO. 2	LBS/HR	standby	standby	standby
37	TOTAL DEEP WELL WATER	LBS/HR	333.051	332.763	332.546
38	IRRIGATION WATER	LBS/HR	0	0	0
39	FIRE PROTECTION WATER	LBS/HR	428	428	428
40	FEEDWATER TREATMENT	LBS/HR	2.332	2.332	2.332
41	WATER TO ASH SYSTEM & SCRUBBER	LBS/HR	40.300	40.049	2.618
42	WATER TO ASH SILO	LBS/HR	2.109	2.023	1.834
43	WASTE WATER STORAGE TANK DISCHARGE	LBS/HR	42.800	42.512	42.295
44	SCRUBBER WASTE DRY	LBS/HR	8.436	8.094	7.336
45	SOLID WASTE TO LANDFILL	LBS/HR	13.819	12.947	11.783
46	COOLING TOWER TO WWHT	LBS/HR	35.871	35.582	35.365
47	COOLING TOWER EVAPORATION	LBS/HR	294.000	294.000	294.000
48	COOLING TOWER DRIFT	LBS/HR	420	420	420
49	COOLING TOWER TO CONDENSER	LBS/HR	21.000.000	21.000.000	21.000.000
50	CONDENSER TO COOLING TOWER	LBS/HR	21.000.000	21.000.000	21.000.000
51	COOLING TOWER MAKE UP	LBS/HR	327.959	327.670	327.453
52	FUEL FEED CONVEYOR NO. 1	LBS/HR	115.556	101.477	93.447
53	FUEL FEED CONVEYOR NO. 2	LBS/HR	standby	standby	standby
54	RAW TIRES TO SHREDDER	LBS/HR	0	9.000	6.750
55	SHREDDED TIRES TO CONVEYORS	LBS/HR	0	9.000	6.750
56	CHIPPED WOOD TO CONVEYORS	LBS/HR	115.596	92.477	86.697
57	FUEL TO FUEL SUPPLY CONVEYORS	LBS/HR	115.596	101.477	93.447
58	RAW WOOD	LBS/HR	121.376	97.101	91.032
59	GRIT FROM TROMMEL	LBS/HR	5.780	4.624	4.335
60	OVERSIZE FROM TROMMEL TO CHIPPER	LBS/HR	57.798	46.239	43.349
61	TROMMEL PRODUCT BETWEEN 2" AND 6"	LBS/HR	57.798	46.239	43.349
62	TOWER BLOWDOWN TO TREATMENT	LBS/HR	37.209	37.498	37.715
63	TREATMENT RETURN TO COOLING TOWER	LBS/HR	37.209	37.498	37.715
64	LIME USE	LBS/HR	707	1.078	915
65	WATER TO SCRUBBER	LBS/HR	37.209	37.139	37.177
66	SLAKER WASTE	LBS/HR	65	99	84
67	SLURRY TO ATOMIZERS	LBS/HR	37.851	38.118	38.007
68	WATER TO SCRUBBER & ASH SILO	LBS/HR	39.318	39.318	39.163
69	LANDFILL GAS TO BOILER	LBS/HR	0	0	10.500
70	WWHT TO TREATED WATER STORAGE	LBS/HR	0	0	0
71	STORAGE TANK TO COOLING TOWER	LBS/HR	0	0	0
72	COOLING TOWER TO BLOWDOWN	LBS/HR	73.080	73.080	73.080
73	MAKEUP TO WWHT	LBS/HR	0	0	0

WWHT = WASTE WATER HOLDING TANK

LETTER	ZONE	DESCRIPTION	DATE	BY APP'D	LETTER	ZONE	DESCRIPTION	DATE	BY APP'D	LETTER	ZONE	DESCRIPTION	DATE	BY APP'D
			- -					- -					- -	
			- -					- -					- -	
			- -					- -		A		ISSUED WITH PERMIT APPLICATION	11-26-91	

R E V I S I O N S

NOTICE: This drawing and all information contained thereon is confidential and proprietary to SFT, Inc. It cannot be copied or reproduced without the express written permission of SFT, Inc.

RIDGE GENERATING STATION

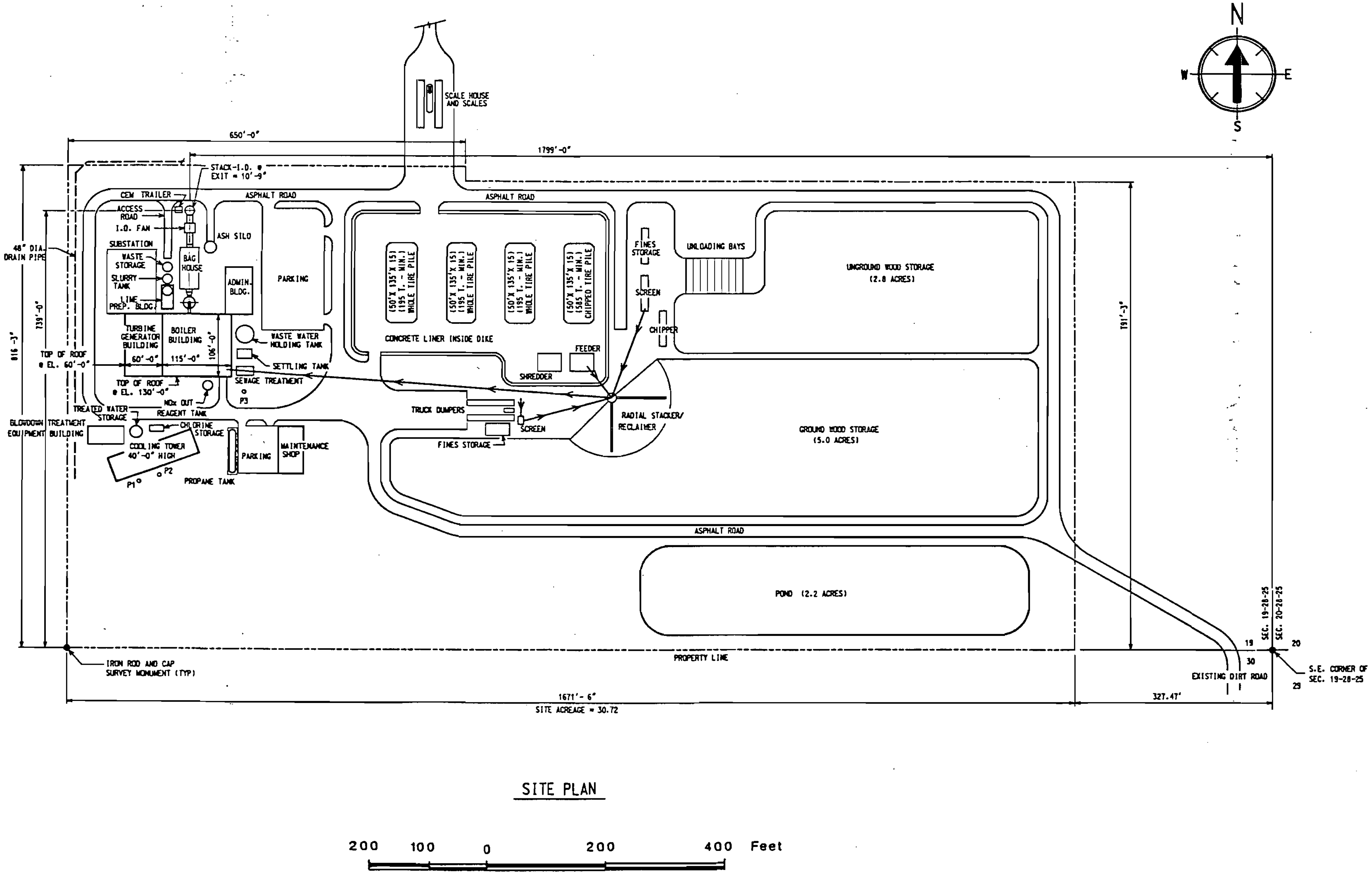
SIGNATURE	DATE
DRAWN BY	11-26-91
DESIGN BY JP Hahn	11-26-91
CHECKED BY TJG	11-26-91
APPROVED BY TJG	11-26-91

SFT
SFT, Inc.
Consulting
Engineers

TITLE:
Figure 3-1 FLOW DIAGRAM

SCALE:	PROJECT/CONTRACT NO.	DRAWING NO.	REV.
NONE	9110 - 00 - 00	911000 - MPI - 010	A

DN:911000.MPI010
BASE SCALE: " = ' -0"



LEGEND

WELL (P1) - MAIN FLORIDAN AQUIFER PUMP
WELL (P2) - AUXILLARY PUMP
WELL (P1) - POTABLE INTERMEDIATE AQUIFER PUMP
COOLING TOWER - 42' WIDE X 144' LONG X 40' HIGH
LIME SILO - 16'DIA. X 30' HIGH
ASH SILO - 20' DIA. X 104 HIGH
NOx OUT REAGENT TANK - 16' DIA. X 16' HIGH
WASTE WATER HOLDING TANK - 30' DIA. X 23' HIGH
TREATED WATER STORAGE TANK - 20' DIA. X 18' HIGH
CHLORINE STORAGE - (4) ONE TON TANKS WITH PUMP HOUSE

Figure 3-2
RIDGE GENERATING STATION
SITE PLAN

PRELIMINARY
PRINT DATE 12/ 09 /91 REVIEWED BY DJG

NOTICE: This drawing and all information contained thereon is confidential and proprietary to SFT, Inc. It cannot be copied or reproduced without the express written permission of SFT, Inc.

RIDGE GENERATING STATION

SIGNATURE	DATE
J.E. FISCHER	09-25-91
	- -
	- -
	- -

SFT
SFT, Inc.
Consulting Engineers

TITLE:
SITE PLAN
FOR AIR PERMIT APPLICATION

LETTER	ZONE	DESCRIPTION	DATE	BY
			- -	
			- -	
1		ISSUED FOR AIR PERMIT APPLICATION	- -	JEF

SCALE:	PROJECT/CONTRACT NO.	DRAWING NO.	REV.
	9110 - 00 - 00	911000 - PPR - 008	1

R E V I S I O N S

G:\911000\PSIT
BASE SCALE:

Wheelabrator Ridge Energy Inc.

A Wheelabrator Technologies Company
3131 K-Ville Avenue
Auburndale, FL 33823

Phone 941.665.2255
Fax 941.665.0400

Certification # Z 170-199-744

January 15, 1998

State of Florida
Department of Environmental Protection
Chief Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Re: Ridge Generating Station
Air Permit #AC53-206244, PSD-FL-183
AIRS Number 1050216
Emissions Unit Identification Number 001

Dear Sir:

In accordance with 40 CFR 60.50a(d), 60.59a(b)(14), and 60.59a(m), enclosed please find data summarizing the daily weight of MSW and other fuels fired during the Fourth Quarter of 1997. Our percentage of MSW combusted continues to be under 30%, so we remain subject only to the record-keeping and reporting requirements for co-fired combustors under the MWC-NSPS, 40 CFR Part 60, Subpart Ea.

If you have any questions regarding this submittal, please contact John Neil at (941) 665-2255 (Ext. 250).

Sincerely,

George D Woodward

George D. Woodward
Plant Manager

RECEIVED
JAN 20 1998
BUREAU OF
AIR REGULATION

cc: EPA Region IV
B. Proses, DEP SW District
Ridge File 6.2.1.3

WHEELABRATOR RIDGE ENERGY
FUEL STATISTICS
October 1997
QUANTITIES IN TONS

DATE	TIRES	YARDWASTE	WOOD	PROPANE	LANDFILL GAS	
01-Oct-97	102.07	121.93	752.61	0.00	27.81	
02-Oct-97	106.32	125.47	782.73	0.00	28.22	
03-Oct-97	68.88	77.21	489.71	0.00	19.04	
04-Oct-97	0.00	0.00	0.00	0.00	0.00	
05-Oct-97	0.00	0.00	0.00	0.00	0.00	
06-Oct-97	0.00	0.00	0.00	0.00	0.00	
07-Oct-97	0.00	0.00	0.00	0.00	0.00	
08-Oct-97	0.00	0.00	0.00	0.00	0.00	
09-Oct-97	0.00	0.00	0.00	0.00	0.00	
10-Oct-97	0.00	0.00	0.00	0.00	0.00	
11-Oct-97	68.15	73.22	494.18	30.38	14.34	
12-Oct-97	101.88	121.17	832.22	0.00	29.75	
13-Oct-97	81.48	96.17	680.94	0.00	27.63	
14-Oct-97	65.56	90.45	665.97	0.00	20.42	
15-Oct-97	89.36	100.83	750.93	0.00	26.51	
16-Oct-97	123.80	111.72	841.92	0.00	30.51	
17-Oct-97	130.28	110.82	844.30	0.00	30.00	
18-Oct-97	144.07	100.93	778.84	0.00	30.93	
19-Oct-97	96.70	80.64	621.87	0.00	25.62	
20-Oct-97	86.46	73.57	571.65	0.00	22.77	
21-Oct-97	77.51	75.49	611.30	0.00	27.02	
22-Oct-97	82.30	80.03	639.05	0.00	28.88	
23-Oct-97	82.09	83.36	663.83	0.00	30.09	
24-Oct-97	93.43	90.51	728.14	0.00	27.71	
25-Oct-97	134.38	85.35	691.20	0.00	28.92	
26-Oct-97	103.75	71.32	579.08	0.00	26.04	
27-Oct-97	112.30	74.31	611.51	0.00	22.50	
28-Oct-97	124.87	68.98	589.56	0.00	26.10	
29-Oct-97	113.76	70.26	586.69	0.00	19.37	
30-Oct-97	116.42	74.75	625.82	0.63	30.24	
31-Oct-97	84.71	49.73	416.50	0.00	11.43	
TOTAL	2390.53	2108.22	15850.55	31.02	611.81	20992.12
PERCENT	11.39	10.04	75.51	0.15	2.91	100.00
PERCENT MSW		21.43				

WHEELABRATOR RIDGE ENERGY
FUEL STATISTICS
November 1997
QUANTITIES IN TONS

DATE	TIRES	YARDWASTE	WOOD	PROPANE	LANDFILL GAS	
01-Nov-97	21.99	20.28	171.07	12.03	5.61	
02-Nov-97	132.28	116.04	973.60	0.00	27.20	
03-Nov-97	156.89	124.46	1046.12	0.00	20.19	
04-Nov-97	112.55	109.95	965.24	0.00	21.26	
05-Nov-97	103.49	110.56	959.00	0.00	28.65	
06-Nov-97	124.69	115.13	998.76	0.00	19.14	
07-Nov-97	105.71	112.63	981.30	0.00	19.19	
08-Nov-97	71.45	97.60	857.39	0.00	23.82	
09-Nov-97	97.14	116.35	1010.11	0.00	14.04	
10-Nov-97	115.79	118.10	1025.01	0.00	16.62	
11-Nov-97	114.62	89.72	808.06	0.00	26.76	
12-Nov-97	125.21	98.39	875.78	0.00	24.18	
13-Nov-97	121.45	71.85	643.15	0.00	12.51	
14-Nov-97	141.44	89.35	804.63	0.00	22.74	
15-Nov-97	144.09	94.07	853.37	0.00	25.04	
16-Nov-97	157.73	100.52	905.13	0.00	24.93	
17-Nov-97	162.63	87.56	791.60	0.63	20.28	
18-Nov-97	102.16	91.52	860.33	0.00	12.29	
19-Nov-97	134.46	108.95	1011.91	0.00	17.58	
20-Nov-97	104.58	93.07	869.86	0.00	10.13	
21-Nov-97	90.40	66.93	630.63	0.00	14.91	
22-Nov-97	109.87	92.75	879.76	0.00	20.51	
23-Nov-97	83.15	85.95	810.66	0.00	20.39	
24-Nov-97	132.27	90.38	857.43	0.00	22.41	
25-Nov-97	117.70	78.33	783.89	0.00	20.87	
26-Nov-97	9.98	39.77	389.53	0.00	17.07	
27-Nov-97	139.19	89.12	867.66	0.00	22.11	
28-Nov-97	89.55	46.44	457.99	0.00	12.06	
29-Nov-97	96.08	78.35	775.84	0.00	28.17	
30-Nov-97	110.96	98.23	972.76	0.00	25.31	
TOTAL	3329.50	2732.36	24837.56	12.66	595.92	31508.00
PERCENT	10.57	8.67	78.83	0.04	1.89	100.00
PERCENT MSW		19.24				

WHEELABRATOR RIDGE ENERGY
FUEL STATISTICS
December 1997
QUANTITIES IN TONS

DATE	TIRES	YARDWASTE	WOOD	PROPANE	LANDFILL GAS	
01-Dec-97	102.23	103.08	1027.31	0.00	27.24	
02-Dec-97	112.64	72.22	725.06	0.00	24.77	
03-Dec-97	107.17	52.39	518.46	0.00	14.73	
04-Dec-97	102.05	67.25	673.43	0.00	21.21	
05-Dec-97	147.77	81.55	828.51	0.00	22.82	
06-Dec-97	125.43	72.17	738.29	0.00	22.17	
07-Dec-97	135.28	72.55	738.77	0.00	18.59	
08-Dec-97	145.18	80.34	814.37	0.00	21.48	
09-Dec-97	106.27	62.87	654.26	0.00	22.56	
10-Dec-97	125.42	62.36	623.95	0.00	25.16	
11-Dec-97	102.69	61.01	617.20	0.00	20.76	
12-Dec-97	97.20	55.87	565.93	0.00	15.71	
13-Dec-97	112.88	70.63	715.44	0.00	27.21	
14-Dec-97	147.27	75.54	761.50	0.00	21.24	
15-Dec-97	125.23	73.35	739.05	0.00	21.63	
16-Dec-97	76.34	54.92	569.46	0.00	17.99	
17-Dec-97	123.50	70.48	729.45	0.00	25.02	
18-Dec-97	4.34	40.93	422.37	0.63	18.65	
19-Dec-97	12.32	20.64	212.65	0.00	10.19	
20-Dec-97	127.54	69.59	721.00	0.00	25.37	
21-Dec-97	137.27	83.00	851.38	0.00	28.41	
22-Dec-97	137.26	67.85	694.47	0.00	24.38	
23-Dec-97	160.35	74.19	775.95	0.00	18.17	
24-Dec-97	10.49	9.18	93.72	0.00	7.43	
25-Dec-97	141.66	69.83	705.83	0.00	21.63	
26-Dec-97	159.29	78.01	793.23	0.00	25.64	
27-Dec-97	164.25	84.40	858.25	0.00	26.21	
28-Dec-97	138.19	90.97	912.96	0.00	29.91	
29-Dec-97	132.85	71.09	709.61	0.00	29.24	
30-Dec-97	164.18	88.86	928.57	0.00	30.69	
31-Dec-97	127.23	64.74	650.33	0.00	28.38	
TOTAL	3484.54	2037.11	20720.44	0.63	666.14	26908.86
PERCENT	12.95	7.57	77.00	0.00	2.48	100.00
PERCENT MSW		20.52				

WHEELABRATOR RIDGE ENERGY
QUARTERLY FUEL STATISTICS

QUANTITIES IN TONS

MONTH	TIRES	YARDWASTE	WOOD	PROPANE	LANDFILL GAS	TOTAL
October	2390.53	2108.22	15850.55	31.02	611.81	20992.12
November	3329.50	2732.36	24837.56	12.66	595.92	31508.00
December	3484.54	2037.11	20720.44	0.63	666.14	26908.86
TOTAL	9204.57	6877.69	61408.55	44.31	1873.86	79408.98
PERCENT	11.59	8.66	77.33	0.06	2.36	100.00
PERCENT MSW		20.25				

Wheelabrator Ridge Energy Inc.

A Wheelabrator Technologies Company
3131 K-Ville Avenue
Auburndale, FL 33823

Phone 941.665.2255
Fax 941.665.0400

April 28, 1997

RECEIVED
MAY 01 1997
BUREAU OF
AIR REGULATION

Department of Environmental Protection
Southwest District
3804 Coconut Palm Drive
Tampa, FL 33619-8318

Attn: Mr. Bill Proses

Subject: Ridge Generating Station
Air Permit #AC53-206244
AIRS #1050216
Emissions Unit ID 001
Excess Emissions and Monitoring Systems Performance Report

Dear Sir:

Pursuant to 40CFR60, Subpart Db, and 40CFR60.7, please find enclosed Ridge Generating Station's First Quarter 1997 Excess Emissions and Monitoring Systems Performance Report for Opacity. This covers the period from January 1, 1997 through March 31, 1997.

Also enclosed is a Cylinder Gas Audit (CGA) report for the CGA conducted during the first quarter of 1997. The report indicates that all of the accuracy results were within the 15 percent specifications.

Please feel free to contact Chuck Davis at (941) 665-2255 (Ext. 250) should you have any questions or concerns regarding this submittal.

Sincerely,

George D. Woodward

George D. Woodward
Plant Manager

cc: Bureau of Air Regulation (w/o attachment)
EPA Region IV (w/o attachment)
T. Porter
F. Ferraro (w/o attachment)
Ridge File 6.2.1.4

Certification # P 432 887 081

SUMMARY REPORT - GASEOUS AND OPACITY EXCESS EMISSION AND MONITORING SYSTEM PERFORMANCE

Pollutant (Circle One -- SO_2 / NO_x / TRS / H_2S / CO / [✓ Opacity])

Reporting Period Dates: From 01/01/97 to 03/31/97

Company: Ridge Generating Station

Address: 3131 K-Ville Ave.
Auburndale, FL 33823

Emission Limitation: 10%

Monitor Manufacturer and Model Number: Thermal Environmental Instruments, Inc. - Model 400B

Date of Latest CMS Certification or Audit: 03/04/97

Process Unit(s) Description:
Wood and Tire Fired Boiler - Unit 1

Total Source Operating Time in Reporting Period: 119,694[1]

Emission Data Summary		**CMS Performance Summary**	
1. Duration of excess emissions in reporting period due to:		1. CMS downtime in reporting period due to:	
a. Startup/shutdown	0	a. Monitor equipment malfunctions	0
b. Control equipment problems	0	b. Non-Monitor equipment malfunctions	0
c. Process problems	0	c. Quality assurance calibration	612
d. Other known causes	0	d. Other known causes	0
e. Unknown causes	30	e. Unknown causes	0
2. Total duration of excess emission	30	2. Total CMS Downtime	612
3. Total duration of excess emissions x (100) / (Total source operating time)	0.02%[2]	3. **[Total CMS Downtime] x (100)** / (Total source operating time)	0.51%[2]

On a separate page, describe any changes since last quarter in CMS, process, or controls.
I certify that the information contained in this report is true, accurate, and complete.

George D. Woodward	George D. Woodward	Plant Manager	04/28/97
Name	Signature	Title	Date

---

[1] For opacity, record all times in minutes. For gases, record all times in hours.

[2] For the reporting period: If the total duration of excess emissions is 1 percent or greater of the total operating time or the total CMS downtime is 5 percent or greater of the total operating time, both the summary report form and the excess emission report described in 560.7(c) shall be submitted.

\EMIS_REP.1st

Wheelabrator Ridge Energy Inc.

A Wheelabrator Technologies Company
3131 K-Ville Avenue
Auburndale, FL 33823

Phone 941.665.2255
Fax 941.665.0400

RECEIVED
APR 25 1996
BUREAU OF
AIR REGULATION

April 19, 1996

State of Florida
Department of Environmental Protection
Chief Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, FL 32399-2400

File

Re: Ridge Generating Station
Air Permit #AC53-206244, PSD-FL-183
AIRS Number 1050216
Emissions Unit Identification Number 001

Dear Sir:

In accordance with 40 C.F.R. 60.50a(d), 60.59a(b)(14), and 60.59a(m), enclosed please find data summarizing the daily weight of MSW and other fuels fired during the First Quarter 1996. Our percentage of MSW combusted continues to be under 30%, so we remain subject only to the record keeping and reporting requirements for co-fired combustors under the MWC NSPS, 40 C.F.R. Part 60, Subpart Ea.

If you have any questions regarding this submittal, please contact Chuck Davis at (941) 665-2255.

Sincerely,

Rodney Williams

Rodney Williams
Plant Manager

CC: EPA Region IV
B. Proses, DEP S.W. District
Ridge File 6.2.1.3

Certification # P 597 437 502

CC: John Reynolds

WHEELABRATOR RIDGE ENERGY

JANUARY 1996 STATS

ALL QUANTITIES IN TONS

	MSW PROCESSED		TOTAL	OTHER FUELS PROCESSED		
			MSW			TOTAL
DAY	YARDWASTE	TIRES	PROCESSED	WOOD	PROPANE	PROCESSED
1	42.37	70.31	112.68	344.19	0.00	456.87
2	43.63	30.78	74.41	351.51	0.00	425.92
3	92.75	105.30	198.05	751.24	0.00	949.29
4	88.67	122.26	210.93	715.64	0.00	926.57
5	84.81	158.00	242.81	677.07	0.00	919.88
6	76.19	155.70	231.89	607.13	0.00	839.02
7	87.44	191.28	278.72	701.83	0.00	980.55
8	85.06	152.05	237.11	688.95	6.33	932.39
9	91.33	196.42	287.75	771.32	0.00	1059.07
10	81.02	175.31	256.33	688.94	5.70	950.97
11	78.32	152.01	230.33	665.16	8.86	904.35
12	90.66	183.42	274.08	770.84	0.40	1045.32
13	79.99	107.67	187.66	683.23	0.00	870.89
14	92.19	192.10	284.29	793.33	0.00	1077.62
15	78.62	166.72	245.34	708.44	0.00	953.78
16	72.72	156.07	228.79	660.43	0.00	889.22
17	88.72	178.88	267.60	826.27	0.00	1093.87
18	78.84	147.08	225.92	733.84	0.00	959.76
19	88.81	182.48	271.29	823.96	0.00	1095.25
20	83.73	157.23	240.96	776.29	0.00	1017.25
21	74.61	138.85	213.46	694.01	0.00	907.47
22	36.55	35.53	72.08	337.73	0.00	409.81
23	42.63	53.44	96.07	392.44	12.03	500.54
24	54.68	70.22	124.90	579.40	0.00	704.30
25	87.00	134.63	221.63	872.68	0.06	1094.25
26	63.61	144.62	208.23	633.94	6.96	849.13
27	39.13	61.97	101.10	389.69	8.23	499.02
28	34.56	88.91	123.47	343.70	12.66	479.83
29	71.10	78.78	149.88	731.41	0.43	881.72
30	69.04	140.76	209.80	715.68	0.00	925.48
31	69.40	165.20	234.60	727.41	0.00	962.01
TOTAL	2248.16	4093.98	6342.14	20157.72	61.66	26561.40
PERCENT			23.88%	75.89%	0.23%	100.00%

WHEELABRATOR RIDGE ENERGY

FEBRUARY 1996 STATS

ALL QUANTITIES IN TONS

	MSW PROCESSED		TOTAL	OTHER FUELS PROCESSED		
			MSW			TOTAL
DAY	YARDWASTE	TIRES	PROCESSED	WOOD	PROPANE	PROCESSED
1	71.85	159.22	231.07	711.15	0.00	942.22
2	46.27	90.38	136.65	449.68	0.00	586.33
3	75.63	143.36	218.99	722.96	0.00	941.95
4	37.53	94.14	131.67	358.75	0.00	490.42
5	101.93	189.07	291.00	964.10	0.00	1255.10
6	79.05	169.56	248.61	746.36	0.00	994.97
7	63.96	171.48	235.44	610.32	0.00	845.76
8	48.48	127.64	176.12	475.91	0.00	652.03
9	69.06	161.93	230.99	663.83	0.00	894.82
10	56.82	124.81	181.63	542.33	0.00	723.96
11	62.84	110.02	172.86	600.04	0.00	772.90
12	74.93	144.08	219.01	706.65	0.00	925.66
13	61.44	120.10	181.54	607.75	0.63	789.92
14	96.30	119.55	215.85	928.09	0.00	1143.94
15	63.63	105.39	169.02	590.64	0.00	759.66
16	73.13	120.00	193.13	647.55	0.00	840.68
17	110.55	153.22	263.77	976.34	0.00	1240.11
18	109.24	121.74	230.98	959.80	0.00	1190.78
19	86.04	142.06	228.10	746.48	0.00	974.58
20	79.43	162.12	241.55	694.99	0.00	936.54
21	87.67	91.04	178.71	757.62	0.00	936.33
22	82.97	143.20	226.17	696.68	0.00	922.85
23	64.73	94.15	158.88	531.13	0.00	690.01
24	48.34	87.80	136.14	396.76	6.33	539.23
25	82.36	122.97	205.33	674.29	0.00	879.62
26	69.55	133.91	203.46	564.20	0.00	767.66
27	78.23	121.68	199.91	631.79	0.00	831.70
28	67.77	104.52	172.29	552.22	1.40	723.11
29	14.25	22.15	36.40	112.54	0.00	148.94
30	0.00	0.00	0.00	0.00	0.00	0.00
31						
TOTAL	2063.97	3651.29	5715.26	18620.96	8.37	24341.78
PERCENT			23.48%	76.50%	0.03%	100.01%

PERCENT TOTAL MAY NOT EQUAL 100.00% DUE TO ROUNDING.

WHEELABRATOR RIDGE ENERGY

MARCH 1996 STATS

ALL QUANTITIES IN TONS

	MSW PROCESSED		TOTAL	OTHER FUELS PROCESSED		
			MSW			TOTAL
DAY	YARDWASTE	TIRES	PROCESSED	WOOD	PROPANE	PROCESSED
1	0.00	0.00	0.00	0.00	0.00	0.00
2	7.34	4.50	11.84	55.15	13.29	80.28
3	113.72	103.05	216.77	848.63	0.00	1065.40
4	121.35	114.70	236.05	892.10	0.00	1128.15
5	90.51	156.18	246.69	655.92	0.00	902.61
6	85.73	144.84	230.57	619.20	0.00	849.77
7	104.71	149.97	254.68	719.75	0.00	974.43
8	144.97	158.69	303.66	977.01	0.00	1280.67
9	189.06	135.87	324.93	1270.55	0.63	1596.11
10	137.08	163.05	300.13	919.42	0.00	1219.55
11	132.09	197.52	329.61	882.79	0.00	1212.40
12	83.30	199.76	283.06	669.87	0.00	952.94
13	114.31	182.83	297.14	760.52	0.00	1057.66
14	72.83	73.06	145.89	481.44	0.00	627.33
15	96.45	83.33	179.78	640.27	0.00	820.05
16	132.29	109.51	241.80	873.42	0.00	1115.21
17	118.39	116.33	234.72	782.59	0.00	1017.31
18	84.66	149.16	233.82	557.71	0.00	791.54
19	98.86	163.41	262.27	654.39	0.00	916.66
20	81.03	142.75	223.78	545.61	0.00	769.39
21	20.76	20.95	41.71	136.35	16.46	194.52
22	139.33	127.70	267.03	912.09	0.30	1179.42
23	99.99	134.62	234.61	657.80	0.00	892.41
24	99.67	122.71	222.38	655.67	0.00	878.05
25	95.19	157.01	252.20	626.18	0.00	878.38
26	105.14	118.50	223.64	684.74	0.00	908.38
27	99.82	134.27	234.09	647.05	0.00	881.14
28	73.99	118.88	192.87	456.30	0.00	649.17
29	111.86	156.35	268.21	665.01	0.00	933.22
30	140.88	144.51	285.39	831.29	0.00	1116.68
31	131.82	145.54	277.36	757.24	0.00	1034.60
TOTAL	3127.13	3929.55	7056.68	20836.05	30.69	27923.42
PERCENT			25.27%	74.62%	0.11%	100.00%

Wheelabrator Ridge Energy Inc.

3131 K-Ville Avenue
Auburndale, FL 33823
Tel. 813-665-2255
Fax. 813-665-0400

RECEIVED
OCT 10 '95
Bureau of
Air Regulation

October 4, 1995

State of Florida
Department of Environmental Protection
Chief Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Re: Ridge Generating Station
Air Permit #AC53-206244, PSD-FL-183
AIRS Number 1050216
Emissions Unit Identification Number 001

Dear Sir:

In accordance with 40 C.F.R. 60.50a(d), 60.59a(b)(14), and 60.59a(m), enclosed please find data summarizing the daily weight of MSW and other fuels fired during the Third Quarter 1995. Our percentage of MSW combusted continues to be under 30%, so we remain subject only to the record keeping and reporting requirements for co-fired combustors under the MWC NSPS, 40 C.F.R. Part 60, Subpart Ea.

If you have any questions regarding this submittal, please contact Chuck Davis at (941) 665-2255.

Sincerely,

Rodney Williams

Rodney Williams
Plant Manager

cc: EPA Region IV
B. Proses, DEP S.W. District

Certification # P 013 080 075

A WHEELABRATOR TECHNOLOGIES COMPANY

Date:	October 4, 1995
Subject:	Department of Environmental Protection Ridge Generation Station Air Permit #AC53-206244, PSD-FL-183 AIRS Number 1050216 Emissions Unit Identification Number 001

bcc:
F. Ferraro
M. Killeen
B. Ferguson
J. Rogers
G. Lynch
Ridge File 6.2.1

WHEELABRATOR RIDGE ENERGY

JULY '95 STATS

03-Oct

		MSW PROCESSED			OTHER FUELS PROCESSED		
		YARDWASTE TONS	TIRES TONS	TOTAL MSW PROCESSED TONS	WOOD TONS	PROPANE TONS	TOTAL PROCESSED TONS
2nd Qtr		16822.47	13764.20	30586.67	147586.46	615.88	178789.01
SUN							
MON							
TUE							
WED							
THU							
FRI							
SAT	1	89.18	59.04	148.22	817.09	0.00	965.31
SUN	2	141.77	56.34	198.11	726.89	0.00	925.00
MON	3	170.02	80.24	250.26	871.75	1.27	1123.28
TUE	4	162.23	64.55	226.78	831.81	0.00	1058.59
WED	5	169.19	71.57	240.76	867.52	0.00	1108.28
THU	6	168.81	67.32	236.13	865.59	0.00	1101.72
FRI	7	160.14	91.74	251.88	821.09	0.00	1072.97
SAT	8	143.93	107.56	251.49	738.00	0.63	990.12
SUN	9	113.66	107.79	221.45	680.05	0.00	901.50
MON	10	89.92	66.84	156.76	538.00	8.86	703.62
TUE	11	88.82	80.98	169.80	531.44	0.00	701.24
WED	12	121.23	103.86	225.09	725.36	1.27	951.72
THU	13	149.06	98.49	247.55	891.92	1.27	1140.74
FRI	14	130.56	92.32	222.88	781.23	0.00	1004.11
SAT	15	139.21	107.22	246.43	832.92	0.00	1079.35
SUN	16	85.02	98.94	183.96	953.51	0.00	1137.47
MON	17	65.20	104.69	169.89	731.26	0.00	901.15
TUE	18	74.70	95.92	170.62	837.82	0.00	1008.44
WED	19	63.58	52.46	116.04	713.09	0.00	829.13
THU	20	103.70	99.61	203.31	1163.05	0.00	1366.36
FRI	21	101.12	95.04	196.16	1134.13	0.00	1330.29
SAT	22	93.35	99.32	192.67	1046.94	0.00	1239.61
SUN	23	206.22	107.46	313.68	951.20	0.00	1264.88
MON	24	217.08	101.94	319.02	1001.31	0.00	1320.33
TUE	25	216.65	107.25	323.90	999.30	0.00	1323.20
WED	26	221.38	95.42	316.80	1021.14	0.00	1337.94
THU	27	161.40	87.80	249.20	744.45	0.00	993.65
FRI	28	206.58	104.85	311.43	952.85	0.00	1264.28
SAT	29	207.78	101.03	308.81	958.39	0.00	1267.20
SUN	30	30.63	7.68	38.31	134.21	0.00	172.52
MON	31	144.22	79.77	223.99	631.99	20.26	876.24
MTD	MTD	4236.33	2695.04	6931.37	25495.31	33.55	32460.23
	%FUELS			21.35%	78.54%	0.10%	100.00%

					OTHER FUELS		
		YARDWASTE TONS	TIRES TONS	TOTAL MSW PROCESSED TONS	WOOD TONS	PROPANE TONS	TOTAL PROCESSED TONS
WK	1	89.18	59.04	148.22	817.09	0.00	965.31
WK	2	1116.08	539.32	1655.40	5722.66	1.90	7379.96
WK	3	832.45	657.50	1489.95	4980.93	11.39	6482.27
WK	4	586.69	645.98	1232.67	6579.78	0.00	7812.45
WK	5	1437.08	705.75	2142.83	6628.65	0.00	8771.48
WK	6	174.85	87.45	262.30	766.20	20.26	1048.76
MTD		4236.33	2695.04	6931.37	25495.31	33.55	32460.23
	%FUELS			17.76%	81.93%	0.31%	100.00%
YTD	YTD	21058.80	16459.24	37518.04	173081.77	649.43	211249.24

WHEELABRATOR RIDGE ENERGY
AUGUST '95 STATS

03-Oct

		MSW		TOTAL	OTHER FUELS		
		YARDWASTE PROCESSED TONS	TIRES PROCESSED TONS	MSW PROCESSED TONS	WOOD PROCESSED TONS	PROPANE PROCESSED TONS	TOTAL PROCESSED TONS
SUN							
MON							
TUE	1	192.72	102.72	295.44	844.54	0.00	1139.98
WED	2	219.78	106.10	325.88	963.11	0.00	1288.99
THU	3	194.24	87.73	281.97	851.19	5.70	1138.86
FRI	4	239.67	87.90	327.57	1050.23	4.43	1382.23
SAT	5	176.32	71.25	247.57	772.66	0.00	1020.23
SUN	6	227.68	105.49	333.17	979.27	0.00	1312.44
MON	7	212.03	105.95	317.98	911.96	0.00	1229.94
TUE	8	194.50	99.45	293.95	836.57	0.00	1130.52
WED	9	68.15	19.33	87.48	293.12	13.22	393.82
THU	10	152.83	124.46	277.29	657.36	7.03	941.68
FRI	11	180.41	97.43	277.84	775.99	6.96	1060.79
SAT	12	195.04	127.14	322.18	838.88	0.00	1161.06
SUN	13	275.94	107.37	383.31	653.23	3.80	1040.34
MON	14	155.77	61.03	216.80	368.73	4.43	589.96
TUE	15	0.00	0.00	0.00	0.00	6.96	6.96
WED	16	296.47	104.37	400.84	701.80	6.33	1108.97
THU	17	295.68	105.04	400.72	699.95	0.00	1100.67
FRI	18	340.27	107.53	447.80	805.51	0.00	1253.31
SAT	19	285.87	147.99	433.86	676.72	0.00	1110.58
SUN	20	198.14	154.33	352.47	693.09	0.00	1045.56
MON	21	199.67	132.15	331.82	698.46	0.00	1030.28
TUE	22	224.83	138.87	363.70	786.47	0.00	1150.17
WED	23	228.27	151.82	380.09	798.48	0.00	1178.57
THU	24	229.67	165.29	394.96	803.39	0.00	1198.35
FRI	25	216.57	155.62	372.19	757.58	0.00	1129.77
SAT	26	214.13	123.32	337.45	749.01	0.00	1086.46
SUN	27	115.66	79.79	195.45	773.70	2.53	971.68
MON	28	121.48	103.44	224.92	812.64	0.00	1037.56
TUE	29	112.05	83.83	195.88	749.54	0.00	945.42
WED	30	122.68	95.65	218.33	820.62	1.90	1040.85
THU	31	116.00	105.47	221.47	775.96	0.00	997.43
FRI	1						
SAT	2						
MTD	MTD	6002.54	3257.86	9260.40	22899.74	63.30	32223.44
	%FUELS			28.74%	71.07%	0.20%	100.00%

				TOTAL	OTHER FUELS		
		YARDWASTE PROCESSED TONS	TIRES PROCESSED TONS	MSW PROCESSED TONS	WOOD PROCESSED TONS	PROPANE PROCESSED TONS	TOTAL PROCESSED TONS
WK	1	1022.74	455.70	1478.44	4481.72	10.13	5970.29
WK	2	1230.64	679.25	1909.89	5293.15	27.22	7230.26
WK	3	1650.00	633.33	2283.33	3905.94	21.52	6210.79
WK	4	1511.29	1021.40	2532.69	5286.47	0.00	7819.16
WK	5	587.88	468.18	1056.06	3932.45	4.43	4992.94
MTD		6002.54	3257.86	9260.40	22899.74	63.30	32223.44
	%FUELS			19.21%	80.49%	0.29%	100.00%
YTD	YTD	27061.34	19717.10	46778.44	195981.51	712.73	243472.68

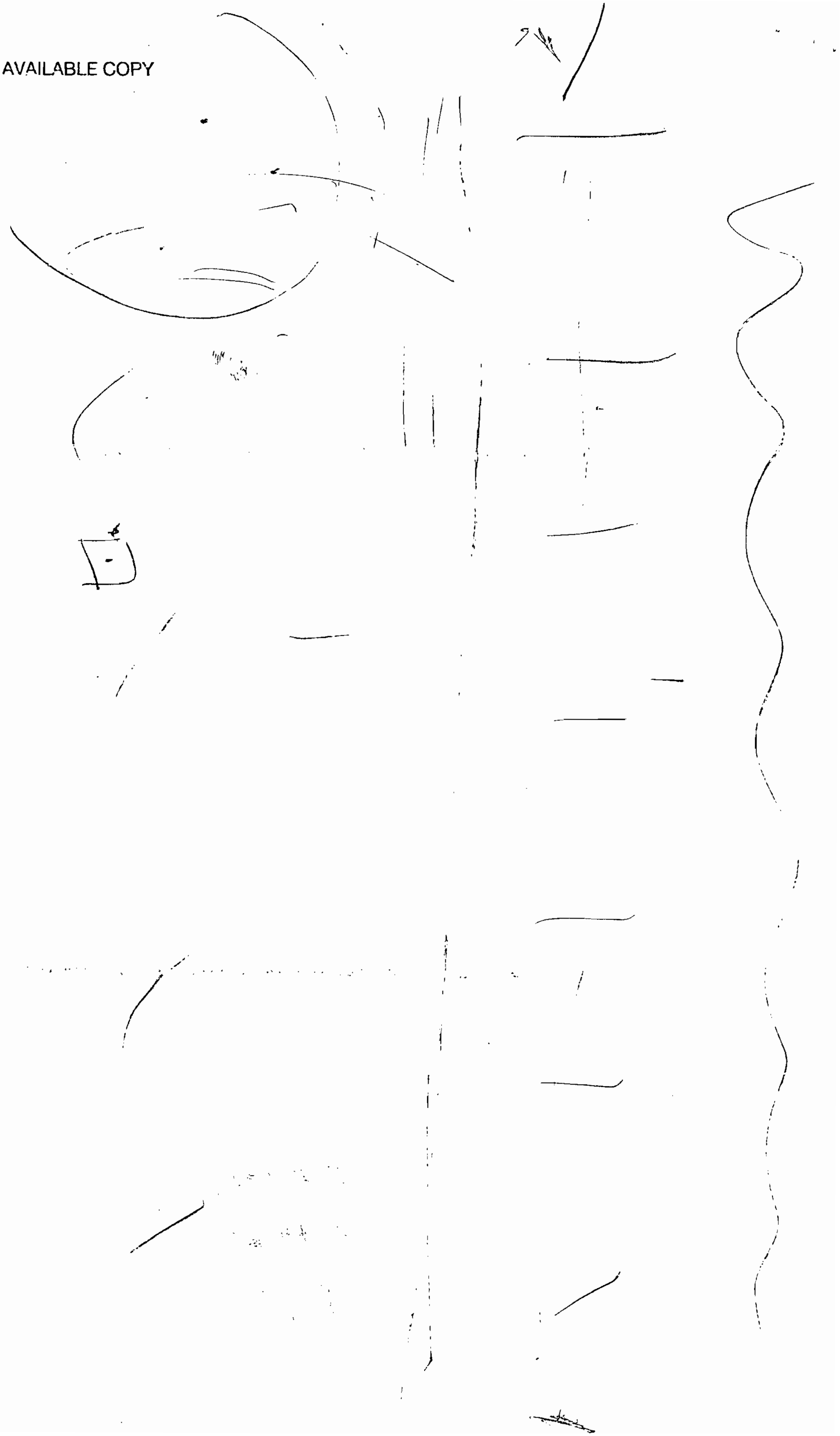
WHEELABRATOR RIDGE ENERGY
SEPTEMBER'95 STATS

03-Oct

		MSW			OTHER FUELS		
		YARDWASTE PROCESSED TONS	TIRES PROCESSED TONS	TOTAL MSW PROCESSED TONS	WOOD PROCESSED TONS	PROPANE PROCESSED TONS	TOTAL PROCESSED TONS
SUN							
MON							
TUE							
WED							
THU							
FRI	1	0.00	0.00	0.00	0.00	8.23	8.23
SAT	2	116.38	113.64	230.02	778.46	0.00	1008.48
SUN	3	106.74	106.49	213.23	493.94	18.99	726.16
MON	4	188.19	104.04	292.23	870.82	0.00	1163.05
TUE	5	86.77	48.44	135.21	401.50	0.00	536.71
WED	6	11.66	8.07	19.73	53.94	11.06	84.73
THU	7	148.94	112.86	261.80	689.24	0.00	951.04
FRI	8	201.06	131.57	332.63	930.37	0.00	1263.00
SAT	9	127.65	111.09	238.74	590.72	6.33	835.79
SUN	10	168.69	145.50	314.19	601.30	0.00	915.49
MON	11	191.30	151.19	342.49	681.87	0.00	1024.36
TUE	12	171.28	139.65	310.93	610.52	0.00	921.45
WED	13	177.26	63.37	240.63	631.84	0.00	872.47
THU	14	239.54	77.73	317.27	853.83	0.00	1171.10
FRI	15	224.66	73.65	298.31	800.78	0.00	1099.09
SAT	16	228.81	90.81	319.62	815.61	0.00	1135.23
SUN	17	145.60	106.59	252.19	743.62	0.00	995.81
MON	18	143.04	124.70	267.74	730.54	0.00	998.28
TUE	19	143.29	133.02	276.31	731.84	5.70	1013.85
WED	20	15.21	18.32	33.53	77.71	0.00	111.24
THU	21	131.96	144.37	276.33	673.95	13.93	964.21
FRI	22	88.77	85.85	174.62	453.40	0.00	628.02
SAT	23	108.26	99.03	207.29	552.91	0.00	760.20
SUN	24	172.59	142.87	315.46	760.85	0.00	1076.31
MON	25	146.64	155.15	301.79	646.46	0.00	948.25
TUE	26	130.94	134.64	265.58	577.21	0.00	842.79
WED	27	128.93	73.52	202.45	568.39	7.60	778.44
THU	28	112.49	78.12	190.61	495.92	0.00	686.53
FRI	29	147.86	93.55	241.41	651.80	7.86	901.07
SAT	30	174.42	119.61	294.03	768.92	0.00	1062.95
MTD	MTD	4178.90	2987.44	7166.34	18238.29	79.69	25484.32
	%FUELS			28.12%	71.57%	0.31%	100.00%

		MSW			OTHER FUELS		
		YARDWASTE PROCESSED TONS	TIRES PROCESSED TONS	TOTAL MSW PROCESSED TONS	WOOD PROCESSED TONS	PROPANE PROCESSED TONS	TOTAL PROCESSED TONS
WK	1	116.38	113.64	230.02	778.46	8.23	1016.71
WK	2	871.00	622.56	1493.56	4030.54	36.38	5560.48
WK	3	1401.53	741.90	2143.43	4995.76	0.00	7139.19
WK	4	776.12	711.88	1488.00	3963.98	19.62	5471.60
WK	5	1013.87	797.46	1811.33	4469.55	15.45	6296.33
MTD		4178.90	2987.44	7166.34	18238.29	79.69	25484.32
	%FUELS			20.06%	79.65%	0.29%	100.00%
YTD	YTD	31240.24	22704.54	53944.78	214219.80	792.42	268957.00

BEST AVAILABLE COPY



Wheelabrator Ridge Energy Inc.

Kanani /al- FYI

3131 K-Ville Avenue
Auburndale, FL 33823
Tel. 813-665-2255
Fax 813-665-0400

RECEIVED
AUG 9 95
Bureau of
Air Regulation

August 4, 1995

Florida Department of Environmental Protection
Southwest District
3804 Coconut Palm Drive
Tampa, FL 33619

Attn: Mr. Bill Proses

Subject: Ridge Generating Station
Air Permit #AC53-206244
AIRS Number 1050216
Emissions Unit Identification Number 001

Dear Sir:

The Department is notified that Ridge Generating Station has scheduled its annual Relative Accuracy Test Audit (RATA) to be performed on September 7, 1995.

If there are any questions or concerns, please call Chuck Davis at (941) 665-2255.

Sincerely,

Rodney Williams

Rodney Williams
Plant Manager

/lc

cc: Chief Bureau of Air Regulation
EPA Region IV
F. Ferraro
J. Goodwin
J. Rogers
C. Davis
Ridge File 6.2.1

Fed Ex #4288780613

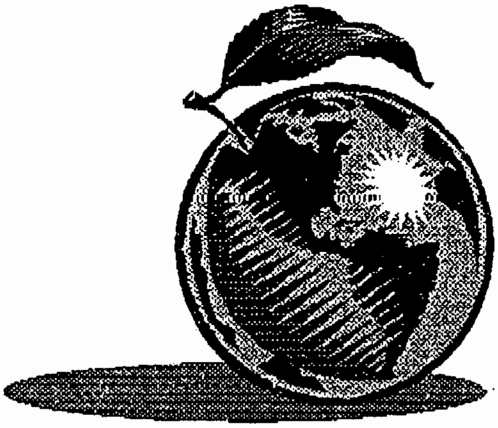
Wheelabrator Environmental Systems Inc.

Environmental Engineering Dept.
Liberty Lane
Hampton, NH 03833

904-922-6979

FAX TRANSMISSION

It takes years to build a reputation, but only seconds to lose one.



DATE: 8/3/95

No. of Pages: 4
(including cover sheet)

TO: ~~A. LINERO, P.E.~~ KANANI

FROM: MATT KILLEEN

****

MESSAGE: AS A FOLLOW-UP TO OUR EARLIER DISCUSSION TODAY, I HAVE NOTED A COUPLE OF ADDITIONAL TYPOS ON THE DRAFT AMENDMENT TO CONSTRUCTION PERMIT NO. AC 53-206244, PSD-FL-183(A).

THANK YOU FOR YOUR ASSISTANCE ON THIS MATTER.

****

PLEASE DELIVER TO RECIPIENT AS SOON AS POSSIBLE!!

TELEPHONE NO.: (603) 929-3000
FAX NO.: (603) 929-3315

Wheelabrator Ridge Energy Inc

3131 K-Ville Avenue
Auburndale, FL 33823
Tel. 813-665-2255
Fax. 813-665-0400

FAX

Date 7/17/95

Number of Pages 2

TO: MR. A. LINERO
(904) 922-6979

FROM: GARY AGUINAGA
DIRECTOR, ENVIRONMENTAL, HEALTH,
SAFETY COMPLIANCE

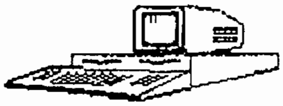
REMARKS:

ENCLOSED PLEASE FIND A FAXED COPY OF THE LETTER YOU AND MR. MATT KILLEEN OF WHEELABRATOR DISCUSSED EARLIER TODAY.

MR. KILLEEN INDICATED THAT YOU WOULD MOST LIKELY BE ABLE TO ISSUE A PERMIT AMENDMENT TODAY. IF SO, I WOULD VERY MUCH APPRECIATE IT IF YOU WOULD FAX A COPY TO THE FACILITY, SO I CAN MAKE ARRANGEMENTS FOR PUBLIC NOTICE.

THANK YOU,

GARY AGUINAGA



Wheelabrator Ridge Energy Inc.

3131 K-Ville Avenue
Auburndale, FL 33823
Tel. 813-665-2255
Fax. 813-665-0400

July 17, 1995

State of Florida
Department of Environmental Protection
Chief Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Re: Ridge Generating Station--Request for Permit Amendment to Increase Tire Burning
Air Permit #AC53-206244, PSD-FL-183

Attn: Mr. A. Linero

Dear Mr. Linero:

Pursuant to Facility correspondence dated April 17, 1995 and June 29, 1995, Department correspondence of July 3, 1995, and subsequent verbal communication with the Department, the Facility is willing to accept a revised SO_2 permit limit on an interim basis. It is our understanding that the Department will amend the subject permit to allow the combustion of 40% tires by heat input (approximately 16.9% by weight) with an interim SO_2 emission limit of 72 lb/hr, based on a 30-day rolling average.

It is also our understanding that if the CEMS data generated during this interim period demonstrates that higher SO_2 permit limits are justified, then the Department will consider this data prior to establishing a final permit limit for SO_2.

We look forward to your early favorable reply. Upon receipt, we will publish the required 14-day public notice.

If you have any questions concerning this submittal, please do not hesitate to contact Gary Aguinaga at (941) 665-2255, or Matt Killeen at (603) 929-3420.

Sincerely,

Rodney Williams
Plant Manager

cc: F. Ferraro
G. Aguinaga
J. Rogers
M. Killeen
C. Davis
J. Goodwin

A WHEELABRATOR TECHNOLOGIES COMPANY

375

0102869

Wheelabrator Ridge Energy Inc.

3131 K-Ville Avenue
Auburndale, FL 33823
Tel. 813-665-2255
Fax. 813-665-0400

April 27, 1995

May 5th, '95

Mr. Clair Fancy, P.E.
Chief, Bureau of Air Regulation
Florida Department of Environmental Protection
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Re: Ridge Generating Station
Permit Number AC53-206244 PSD-FL-183
Request for Permit Amendment

Dear Mr. Fancy:

Ridge Generating Station L.P. requests that Specific Condition #3 of the subject permit be amended to increase Ridge Generating Station's permitted tire firing capacity from 20 percent to 40 percent by heat input. Enclosed is the $250.00 fee required to process this request.

Department approval to conduct special testing at 40% tires was received on February 9, 1995. Testing was conducted at the 40% heat input level during the first week of March, 1995. Test results clearly indicate that the facility emission limits can be met at the increased tire firing rate. Enclosed is data summarizing stack test results at 40% tires/60% wood and at 20% tires/80% wood.

Since increasing the percentage of tires combusted from 20% to 40% (heat input basis) does not result in any of the regulated air pollutants exceeding their maximum allowable BACT emission limits in the permit, it is appropriate to process this request as a permit amendment. Pursuant to Rule 62-212.200 (Definitions) (2) ("Actual Emissions"), (b) "The Department may presume that source specific allowable emissions for a source are equivalent to the actual emissions of the source provided that, for any air pollutant that is regulated by the EPA under the Clean Air Act, such source specific allowable emissions limits are federally enforceable." Rule 62-212.200 (Definitions), (2) ("Actual Emissions"), (c) states that "for a source which has not completed start-up and testing on a particular date, actual emissions shall equal the potential emissions at the source on that date."

The Facility has not completed start-up and testing, since the comprehensive emissions test program required by Specific Condition #8 of the subject permit has not yet been completed. The emission limits in the permit are federally enforceable. The potential emissions are the federally enforceable limits in the permit. The test data demonstrates that all of the federally enforceable BACT emission limits in the permit would be met. There are both operational and environmental benefits to burning a higher percentage of tires. Therefore, the facility's allowable emissions are its current "actual emissions."

Since the facility is not requesting an increase in any of the allowable emission limits, the requested change does not result in a "net emissions increase." If there is not a "net emissions increase," the proposed change in the method of operations is not a "modification." Therefore, the Department can process the requested change as an amendment to the permit.

Based on the above, it is requested that Specific Condition #3 of the subject permit be amended to read as follows:

> **Fuel for firing the RGS boiler shall consist only of wood, landfill gas, and up to 16.1 percent tires by weight (equivalent to 40 percent tires based on heat content). The 16.1 percent tire weight limitation is equivalent to 18,505 pounds of tires per hour. Propane may be used as a startup, shutdown, and combustion stabilization fuel.**

Thank you for your early response to this request. This change is important to the Facility now because it will improve current operational flexibility and efficiency. It will also help to more rapidly alleviate the tire disposal problem in Florida. Facility representatives would be very happy to meet with you if you have questions related to this submittal or if you require additional information. Please do not hesitate to contact Gary Aguinaga at (813) 665-2255.

Sincerely,

Rodney William

Rodney Williams
Plant Manager

Certification # P 013 080 037

cc: B. Proses (DEP, SW District)
W. Ferguson
F. Ferraro
M. Killeen
G. Aguinaga
S. Smallwood

Wheelabrator Ridge Energy, Inc. - Summary of Results

Condition I - 80% Wood/20% Tires at 100% Load
February/March 1995

POLLUTANT	UNITS	TEST RESULT				PERMIT LIMIT	COMMENT
		Rep. 1	Rep. 2	Rep. 3	Average*		
Particulate/PM10	lb/hr	2.2	2.0	1.1	1.8	12.6	
Sulfur Dioxide	lb/hr	68.9	40.6	33.2	47.6	109.4	
Nitrogen Oxides	lb/hr	82.4	86.6	84.3	84.4	94.5	
Carbon Monoxide	lb/hr	58.0	72.8	46.8	59.2	315.0	
Non-Methane Hydrocarbon	lb/hr	3.2	2.7	1.3	2.4	22.1	
Hydrogen Chloride	lb/hr	0.1	0.5	0.1	0.2	5	Rep. 1 & 3 were Non-Detect
Mercury	lb/hr	8.0E-04	8.7E-04	8.7E-04	8.5E-04	0.022	Rep. 1,2 & 3 were Non-Detect
Lead	lb/hr	1.8E-03	8.8E-03	5.6E-04	3.7E-03	0.25	
Beryllium	lb/hr	1.9E-05	1.9E-05	1.8E-05	1.9E-05	0.0063	Rep. 1,2 & 3 were Non-Detect

* - Non Detect values used in averages for worst case.

Condition III - 60% Wood/40% Tires at 100% Load
February/March 1995

POLLUTANT	UNITS	TEST RESULT				PERMIT LIMIT	COMMENT	
		Rep. 1	Rep. 2	Rep. 3	Average*			
Particulate/PM10	lb/hr	0.43	2.0	1.82	1.4	12.6	down	
Sulfur Dioxide	lb/hr	74.2	87.3	56.9	72.8	109.4	up	
Nitrogen Oxides	lb/hr	78.1	77.0	82.2	79.1	94.5	down	
Carbon Monoxide	lb/hr	56.6	64.3	63.7	61.5	315.0	down	
Non-Methane Hydrocarbon	lb/hr	1.5	0.9	1.3	1.2	22.1	up	
Hydrogen Chloride	lb/hr	0.1	0.2	0.2	0.2	5	—	
Mercury	lb/hr	9.1E-04	9.0E-04	8.0E-04	8.7E-04	0.022	~~down~~ Rep. 1,2 & 3 were Non-Detect	down
Lead	lb/hr	4.0E-03	6.1E-04	2.2E-04	1.6E-03	0.25	~~up~~ ~~up~~ up	up
Beryllium	lb/hr	1.8E-05	1.8E-05	1.8E-05	1.8E-05	0.0063	Rep. 1,2 & 3 were Non-Detect	up

* - Non Detect values used in averages for worst case.

COPY

Wheelabrator Ridge Energy Inc.

3131 K-Ville Avenue
Auburndale, FL 33823
Tel. 813-665-2255
Fax. 813-665-0400

March 20, 1995

RECEIVED
MAR 23 1995
Bureau of
Air Regulation

Florida Department of Environmental Protection
Southwest District
3804 Coconut Palm Drive
Tampa, FL 33619

Attn: Mr. Bill Proses

Subject: Ridge Generating Station
Air Permit #AC53-206244

Dear Sir:

The Department is notified that Ridge Generating Station has scheduled its annual Relative Accuracy Test Audit (RATA) to be performed on April 21, 1995. The RATA will be performed by Entropy, Inc. at the conclusion of the scheduled quarterly stack test event.

If there are any questions or concerns, please call Gary Aguinaga at (813) 665-2255.

Sincerely,

Rodney Williams

Rodney Williams
Plant Manager

/lc

cc: Chief Bureau of Air Regulation
EPA Region IV
F. Ferraro
J. Goodwin
J. Rogers
G. Aguinaga
Ridge File 6.2.1

Fed Ex #4288782492

Wheelabrator Ridge Energy Inc.

3131 K-Ville Avenue
Auburndale, FL 33823
Tel. 813-665-2255
Fax. 813-665-0400

RECEIVED
DEC 5 1994
Bureau of
Air Regulation

November 28, 1994

Department of Environmental Protection
Chief Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, FL 32399

Attn: Mr. Claire Fancy

Subject: Ridge Generating Station
Air Construction Permit #AC53-206244/PSD-FL-813

Dear Sir:

This letter is written at the request of Bruce Mitchell of your office as a result of telephone discussions held between Mr. Mitchell and Bob Soich of the Department's S. W. District, and between Mr. Soich and Gary Aguinaga of this facility. It concerns the ambient ammonia monitor required by Specific Condition #6 of the subject permit. The permit requires ambient ammonia to be continuously measured and data collected at the property fenceline during the first year of facility operation. The Comprehensive Emissions Test report, due within 15 months of initial start-up of the facility, was to include a discussion of the data collected and a recommendation to the Department on whether or not ambient ammonia monitoring should be continued.

Despite continued efforts, the facility has been unable to measure ambient ammonia successfully. The system installed has repeatedly failed and provided inaccurate data due to high humidity in the ambient air sample.

The ambient ammonia monitoring system installed is a TECO Model 17 chemiluminescence ammonia analyzer with converting data logger and chart recorder. The system was set up to measure ambient ammonia in the 0-10 ppb and 0-5000 ppb ranges. The system also consists of a Model 145 permeation calibrator to generate known quantities of NH_3 for calibration of the instrument. The principle of measurement is to measure NO, NO_2, and NH_3 in the sample, using catalytic reduction with selective absorption/conversion procedure [$(NO_x + NH_3) - NO_x = NH_3$]. A pump supplies sample to the system. Particulate is removed by a 1 micron filter located at the sample inlet. The entire system is housed in a climate-controlled shelter to maintain 68°F-72°F, which is necessary for instrument measurement stability.

The system was assembled and tested at the factory prior to shipment. This testing, however, could not include high humidity ambient air due to the vender factory location. Once the system had operated in the field, it became apparent that the high humidity ambient air in Florida was creating problems due to the condensation of water vapor in the system. Since any condensed moisture will scrub ammonia prior to measurement during both calibration and measurement periods, if ambient ammonia was present in the air, it would not be measured by the system accurately. In addition, the moisture was continually damaging the internals of the analyzer.

Altech, the ammonia monitor supplier, worked extensively on site to resolve the problems using numerous approaches. A water condenser system was installed to remove water vapor without scrubbing ammonia. The sample line was heated to prevent condensation. Finally, on the advice of the instrument manufacturer, TECO, the entire analyzer was sent back to TECO for overhaul and re-calibration. None of these measures were successful. Discussions with TECO and with other manufacturers of similar instruments have indicated that measurement of ambient ammonia using best available technology in a humid environment at such low concentrations is very difficult. Currently, we know of no ambient ammonia systems successfully operating in this area and conclude that we will not be able to measure ambient ammonia at the facility until current technology is refined or new technology is developed.

It should be noted that we have been complying with ammonia monitoring requirements by taking daily measurements for ambient ammonia using a Sensidyne hand pump system. This system is capable of detecting ammonia at concentrations as low as .5 ppm. No ammonia has been detected using this method.

As alternatives to continuously monitoring for ambient ammonia during the initial year of facility operation, the facility recommends that surrogate methods be used to evaluate the need for future monitoring. The first method is to use the ammonia slip data collected during each of the quarterly stack emission tests and PSD monitoring results to predict ambient ammonia. The second surrogate method is already in place. The facility's selective non-catalytic reduction (SNCR) system to control boiler NO_x emissions is fully automated and closely controls the amount of urea injected into the furnace to prevent excessive over-feeding, which minimizes ammonia slip. In addition, the system was carefully optimized during facility start-up operations so that urea is injected from ideal furnace injection points and at ideal flow combinations to maximize system effectiveness and to achieve efficient reagent mixing without over-feeding. The plant's distributed control system monitors, controls, and records urea injection rates, furnace temperatures, NO_x emissions and other process parameters required to ensure proper system operation.

screen modeling

Based on the above, Ridge Generating Station requests your approval of using the surrogate methods described herein to evaluate the need for ambient ammonia monitoring beyond the initial year of facility operation, in lieu of recording data with the non-functional monitor presently located at the facility. If approved, the Comprehensive Emissions Test report to be submitted in June, 1995 will contain a discussion that contains conclusions drawn from analyzing all available data, as well as a recommendation to the Department on whether the need still exists for continued ambient ammonia monitoring at the facility.

Please do not hesitate to call Gary Aguinaga at (813) 665-2255 if you have any questions regarding this submittal. We would be happy to meet with the Department to discuss this matter further.

Sincerely,

Rodney Williams

Rodney Williams
Plant Manager

cc: G. Aguinaga
B. Soich (DEP, Tampa)
F. Ferraro
T. Porter
J. Goodwin
M. Killeen
J. Rogers

Certification #P 389 398 540

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

In the matter of:	)	Permit No.	AC 53-206244 PSD-FL-183
Wheelabrator Environmental Systems Inc.,	)		
	)	ASP No.	94-I-01
Petitioner.	)		

ORDER ON REQUEST FOR ALTERNATE PROCEDURES AND REQUIREMENTS

Pursuant to Rule 62-297.620, Florida Administrative Code (F.A.C.), Wheelabrator Environmental Systems Inc., petitioned for approval to use: (1) EPA Method 26A in lieu of EPA Method 5 for determining particulate; (2) EPA Method 26A in lieu of EPA Method 26 for measuring hydrogen chloride (HCl); (3) EPA Method 26A for measuring ammonia (NH_3); (4) EPA Method 23 for measuring polychlorinated biphenyls (PCBs); (5) the EPA Method described in 40 CFR 266, Appendix IX, Section 3.1 in lieu of EPA Method 108 for measuring arsenic (As); (6) the EPA Method described in 40 CFR 266, Appendix IX, Section 3.1 in lieu of EPA Method 104 for measuring beryllium (Be); and, (7) the EPA Method described in 40 CFR 266, Appendix IX, Section 3.1 in lieu of EPA Method 12 for measuring lead (Pb) emissions from Petitioner's wood/tire/landfill gas fired boiler (AC 53-206244, PSD-FL-183) which is equipped with a spray dryer absorber and a fabric filter at Ridge Generating Station, located in Polk County.

Having considered Petitioner's written request and all supporting documentation, the following Findings of Fact, Conclusions of Law, and Order are entered:

FINDINGS OF FACT

1. On July 29, 1994, Petitioner specifically requested approval to use EPA Method 26A as the compliance verification procedure for simultaneously determining particulate, hydrogen chloride (HCl), and ammonia (NH_3) emissions from the affected emission unit at Ridge Generating Station (AC 05-206894 and PSD-FL-183) using a single sampling train. [Exhibit 1]

2. As justification for the use of EPA Method 26A for the measurement of particulate, hydrogen chloride (HCl), and ammonia (NH_3), Petitioner stated, "...basis for this request is to set forth an approved FDEP procedure for ammonia sampling. The approval of this request would allow WESI/WRE to combine three separate sampling

trains without a loss in accuracy or precision of the individual methods for particulate, hydrogen chloride and ammonia." [Exhibit 2]

3. Section 1.1 of EPA Method 26A: "Determination of hydrogen halide and halogen emissions from stationary sources - isokinetic method", describes the applicability of the method as, "...This method collects the emission sample isokinetically and is therefore particularly suited for sampling sources such as those controlled by wet scrubbers, emitting acid particulate matter..."

4. Currently, there is no method available which is approved by EPA for the measurement of ammonia (NH_3) emissions from stationary sources.

5. The proposed method for ammonia has been field validated pursuant to EPA Method 301 on a municipal waste boiler which was equipped with a spray dryer absorber and a multi-module fabric filter. [Exhibit 1]

6. On July 29, 1994, Petitioner specifically requested approval to use EPA Method 23 as the compliance verification procedure for simultaneously determining emissions of polychlorinated dibenzo-p-dioxins (PCDD), polychlorinated dibenzofurans (PCDF) and polychlorinated biphenyls (PCBs) from the affected emission unit at Ridge Generating Station (AC 05-206894 and PSD-FL-183) using a single sampling train. [Exhibit 1]

7. As justification for the use of EPA Method 23, Petitioner stated, "...The Method 23 sampling and analysis for PCDD's/PCDF's would not be compromised in any way as the sample is fully extracted in accordance with the method and then split to accomplish the PCDD/PCDF and PCB analyses on the respective split sample." [Exhibit 1]

8. Petitioner further stated, "The basis for this request is to utilize an approved EPA test methodology which has been extensively developed and validated at similar sources (ie., boilers and industrial furnaces) in order to provide lower detection limits, increased accuracy and improved precision for use in submitting the most accurate data to the FDEP. A second basis for this request is to set forth an approved FDEP procedure for PCB sampling. The approval of this request would allow WESI/WRE to combine two separate sampling trains without loss in accuracy or precision of the individual methods for PCDD/PCDF and PCB." [Exhibit 2]

9. Currently, there is no method available which is approved by EPA for the measurement of polychlorinated biphenyl (PCB) emissions from stationary sources.

10. On July 29, 1994, Petitioner specifically requested approval to use the EPA Method, "Methodology for the determination of metals emissions in exhaust gases from hazardous waste

incineration and similar combustion processes" described in Section 3.1 of 40 CFR 266, Appendix IX as the compliance verification procedure for simulataneously determining emissions of arsenic (As), beryllium (Be), lead (Pb), cadmium (Cd), total chromium (Cr), and zinc (Zn) from the affected emission unit at Ridge Generating Station (AC 05-206894 and PSD-FL-183) using a single sampling train. [Exhibit 1]

11. As justification for the use of the EPA Method described in Section 3.1 of 40 CFR 266, Appendix IX, Petitioner stated, "The approval of this request would allow WESI/WRE to combine four separate sampling trains with an increase in the accuracy and precision of the individual methods for arsenic, beryllium and lead. The use of this sampling train would provide detection limits of nanogram/milliliter versus detection limits of microgram/milliliter utilizing the EPA Method 12, 104 and 108 sampling trains."

12. The applicability section of the method described in section 3.1.1.1 in 40 CFR 266, Appendix IX states, "This method is being developed for the determination of total chromium (Cr), cadmium (Cd), arsenic (As), nickel (Ni), manganese (Mn), beryllium (Be), copper (Cu), Zinc (Zn), lead (Pb), selenium (Se), phosphorous (P), thallium (Tl), silver (Ag), antimony (Sb), barium (Ba), and mercury (Hg) stack emissions from hazardous waste incinerators and similar combustion processes."

CONCLUSIONS OF LAW

1. The Department has jurisdiction to consider Petitioner's request pursuant to Section 403.061, Florida Statutes (F.S.), and Rule 62-297.620, F.A.C.

2. Pursuant to Rule 62-297.340(2), F.A.C., the Department may require Petitioner to conduct compliance tests that identify the nature and quantity of pollutant emission, if, after investigation, it is believed that any applicable emission standard or condition of a permit is being violated.

3. Petitioner has provided reasonable justification that the use of EPA Method 26A will be adequate to verify compliance with the particulate and hydrogen chloride (HCl) emission limiting standards and to measure ammonia (NH_3) emissions from the affected emission unit.

4. Petitioner has provided reasonable justification that EPA Method 23 will be an adequate compliance verification procedure for the measurement of polychlorinated biphenyl (PCB) emissions from the affected emission unit.

5. Petitioner has provided reasonable justification that the EPA Method described in Section 3.1 of 40 CFR 266, Appendix IX will be adequate to verify compliance with the beryllium (Be), and lead

(Pb) emission limiting standards and for the measurement of arsenic (As) emissions from the affected emission unit.

ORDER

Having considered Petitioner's written request and supporting documentation, it is hereby ordered that:

1. Petitioner's request to use EPA Method 26A in lieu of EPA Method 5 for the measurement of particulate is granted;

2. Petitioner's request to use EPA Method 26A in lieu of EPA Method 26 for the measurement of hydrogen chloride (HCl) is granted;

3. Petitioner's proposed procedure for the sampling and analysis of ammonia (NH_3) based on EPA Method 26A is granted;

4. Petitioner's request to use EPA Method 26A sampling train for the simultaneous collection of samples to quantify particulate, hydrogen chloride (HCl), and ammonia (NH_3) emissions is granted;

5. Petitioner's proposed procedure for the sampling and analysis of polychlorinated biphenyls (PCBs) based on EPA Method 23 is granted;

6. Petitioner's request to use EPA Method 23 sampling train for the simultaneous collection of samples to quantify emissions of polychlorinated dibenzo-p-dioxins (PCDD), polychlorinated dibenzofurans (PCDF) and polychlorinated biphenyl (PCB) is granted;

7. Petitioner's request to use the EPA method described in Section 3.1 of 40 CFR 266, Appendix IX in lieu of EPA Method 108 is granted;

8. Petitioner's request to use the EPA method described in Section 3.1 of 40 CFR 266, Appendix IX in lieu of EPA Method 104 is granted;

9. Petitioner's request to use the EPA method described in Section 3.1 of 40 CFR 266, Appendix IX in lieu of EPA Method 12 is granted;

10. Petitioner's request to use a single sampling train described in Section 3.1 of 40 CFR 266, Appendix IX for the simultaneous collection of arsenic (As), beryllium (Be), lead (Pb), cadmium (Cd), total chromium (Cr), and zinc (Zn) emissions is granted; and,

11. The Department retains the right to require Petitioner to conduct EPA Method 5, EPA Method 26, EPA Method 108, EPA Method 104, and EPA Method 12 if, after investigation, it is believed that the use of any of these methods is necessary to more accurately measure

particulate, hydrogen chloride (HCl), arsenic (As), beryllium (Be), and lead (Pb) emissions respectively and to assess the compliance status of the emission unit.

PETITION FOR ADMINISTRATIVE REVIEW

1. A person whose substantial interests are affected by the Department's decision may petition for an administrative proceeding (hearing) in accordance with Section 120.57, F.S. The petition must contain the information set forth below and must be filed (received) in the Office of General Counsel of the Department at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400, within 21 days of receipt of this Order. The petitioner shall mail a copy of the petition to the applicant at the time of filing. Failure to file a petition within this time period shall constitute a waiver of any right such person may have to request an administrative determination (hearing) under Section 120.57, F.S.

2. The petition shall contain the following information:

(a) The name, address, and telephone number of each petitioner, the applicant's name and address, and the Department File Number;

(b) A statement of how and when each petitioner received notice of the Department's action or proposed action;

(c) A statement of how each petitioner's substantial interests are affected by the Department's action or proposed action;

(d) A statement of the material facts disputed by each petitioner, if any;

(e) A statement of facts which each petitioner contends warrant reversal or modification of the Department's action or proposed action;

(f) A statement of which rules or statutes each petitioner contends require reversal or modification of the Department's action or proposed action; and,

(g) A statement of the relief sought by each petitioner, stating precisely the action each petitioner wants the Department to take with respect to the Department's action or proposed action.

3. If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this Order. Persons whose substantial interests will be affected by any decision of the Department with regard to the application have the right to petition to become a party to the proceeding. The petition must conform with the requirements specified above and be filed (received) within 21 days of receipt of this notice in the Office of General Counsel at 2600 Blair Stone

Road, Tallahassee, Florida 32399-2400. Failure to petition within the allowed time frame constitutes a waiver of any right such person has to request a hearing under Section 120.57, F.S., and to participate as a party to this proceeding. Any subsequent intervention will only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-5.207, F.A.C.

4. This Order constitutes final agency action unless a petition is filed in accordance with the above paragraphs or unless a request for extension of time in which to file a petition is filed within the time specified for filing a petition and conforms to Rule 62-103.070, F.A.C. Upon timely filing of a petition or a request for an extension of time, this Order will not be effective until further Order of the Department.

RIGHT TO APPEAL

Any party to this Order has the right to seek judicial review of the Order pursuant to Section 120.68, F.S., by the filing of a Notice of Appeal pursuant to Rule 9.110, Florida Rules of Appellate Procedure, with the Clerk of the Department in the Office of General Counsel, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400; and, by filing a copy of the Notice of Appeal accompanied by the applicable filing fees with the appropriate District Court of Appeal. The Notice of Appeal must be filed within 30 days from the date the Notice of Agency Action is filed with the Clerk of the Department.

DONE AND ORDERED this 17 day of February, 1995 in Tallahassee, Florida.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

Howard L Rhodes
HOWARD L. RHODES
Director
Division of Air Resources Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

(904) 488-0114

Wheelabrator Environmental Systems Inc.

Liberty Lane
Hampton, NH 03842
Tel. 603-929-3000

July 29, 1994

RECEIVED
AUG 1 1994
Emissions Monitoring

RECEIVED
Bureau of
Air Regulation

Mr. Michael Harley, P.E., DEE
Florida Department of Environmental Protection
Emissions Monitoring Section
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Re: **Alternate Sampling Procedure Request for Compliance Emissions Tests at Ridge Generating Station - AC 53-206244**

Dear Mr. Harley,

In accordance with Rule 17-297.620 F.A.C., Wheelabrator Ridge Energy, Inc. (WRE) is requesting approval of alternate sampling procedures for use during compliance emissions testing at Ridge Generating Station - AC 53-206244. The approval is requested in order to utilize methodologies which will result in lower detection limits for metals emissions as well as set forth procedures for performing PCB and NH_3 sampling for which there are no FDEP approved methods. The approval of the following methodologies will allow for a combination of sampling trains which will not affect the Quality Assurance/Quality Control requirements of any one method.

The following alternate sampling procedure approvals are requested for use during the Comprehensive Compliance Emissions Test Program to be performed at Ridge Generating Station, Auburndale, Polk County, Florida.

1. WRE requests approval to perform EPA Method 26A for particulate and hydrogen chloride sampling. Additionally, WRE requests a modification to the method to allow for the analysis of an aliquot of the .1 N H_2SO_4 impinger reagent for ammonia by ion specific electrode.

   A detailed description of the sampling and analytical procedures for the EPA Method 26A sampling train as it would be utilized at WRE is attached. Also enclosed is the EPA Method 301 ammonia validation report prepared by ENTROPY, Inc. which verifies that the ion specific electrode analyses of the .1 N H_2SO_4 reagent of the Method 26A sampling train provides valid results. There is no alteration of the Method 26A sampling train for obtaining ammonia, only an additional analysis of an aliquot of the .1 N H_2SO_4.

2. WRE requests approval to perform EPA Method 23 for PCDD/PCDF and PCB sampling. The only modification to this method would be to include the impinger reagent/catch/rinse in the analyses of the PCBs.

Exhibit 1

A detailed description of the sampling and analytical procedures for the EPA Method 23 sampling train as it would be utilized at WRE is attached. The Method 23 sampling and analysis for PCDD's/PCDF's would not be compromised in any way as the sample is fully extracted in accordance with the method and then split to accomplish the PCDD/PCDF and PCB analyses on the respective split sample. The PCB standards are added to the appropriate extract for analysis in accordance with EPA Method 680. Detection limits of .02 - .04 nanograms for PCDDs/PCDFs and .06 nanograms for PCBs are expected from this sampling train.

3. WRE requests approval to perform the method in 40 CFR 266, Appendix IX, Section 3.1 for arsenic, beryllium and lead sampling. There is no modification to this method. The sampling and analysis for arsenic, beryllium and lead would be performed along with cadmium, total chromium and zinc (as zinc oxide) in a single sampling train.

   A detailed description of the sampling and analytical procedures for the 40 CFR 266, Appendix IX, Section 3.1 method sampling train as it would be utilized at WRE is attached. The use of this sampling train would provide detection limits of nanogram/milliliter versus detection limits of microgram/milliliter utilizing the EPA Method 12, 104 and 108 sampling trains.

As stated in your July 11, 1994 letter, you are requesting guidance from the EPA concerning the PCB and ammonia sampling and analytical procedures. If I can be of any assistance in supplying further documentation, or if you would like to meet to discuss the requests outlined in this letter, please do not hesitate to call me at 800-682-0026.

WRE appreciates the effort from the FDEP in finalizing the sampling and analytical procedures for the compliance testing at Ridge Generating Station.

Sincerely,

John P. Goodwin
Environmental Engineer

Attachments

cc: G. Aguinaga
T. Porter
D. Raymond
B. Rudd
R. Williams

JPG060

EPA Method 26A
Particulate, Hydrogen Chloride, and Ammonia

Sample Collection. Samples will be withdrawn isokinetically from the source using an EPA Method 26A combined sampling train. The sampling train will consist of a glass nozzle, a heated glass probe with a type S pitot tube attached, a filter, five chilled impingers, and a metering console. The particulate sample will be collected on a Pallflex 2500QAT-UP quartz filter maintained at a temperature of 248°F ± 25°F. The first and second impingers will each contain 100 ml of 0.1 N H_2SO_4, the third and fourth will each contain 100 mL of 0.1 N sodium hydroxide (NaOH), and the fifth will contain preweighed silica gel.

Sample Recovery. The filter will be removed from the filter holder and placed in a 250 mL glass jar. The H_2SO_4 and NaOH reagents will be returned to the original 1,000 mL and 500 mL glass jars, weighed, the weight recorded on the labels , and the liquid levels marked. The silica gel will be returned to the original tared container, weighed, and the weight recorded on the label. The volume of water vapor condensed in the impingers and the volume of water vapor collected in the silica gel will be summed and entered into moisture content calculations.

The nozzle, probe, and front half of the filter holder will be rinsed with acetone into a 500 mL glass jar. The back half of the filter holder and the first and second impingers along with the connecting glassware will be rinsed with DI water into the glass jar containing the H_2SO_4 reagent. The third and fourth impingers along with the connecting glassware will be rinsed with DI water into the glass jar containing the NaOH reagent.

Sample Analysis. EPA Method 5 analytical procedures will be used to analyze the filter and front half acetone rinse for particulate. An aliquot of the H_2SO_4 reagent and associated DI water rinse will be analyzed for hydrogen chloride using ion chromatography as outlined in the method. An aliquot of the H_2SO_4 reagent and associated DI water rinse will be analyzed for ammonia using ion-specific electrode.

STATIONARY SOURCE SAMPLING REPORT

REFERENCE NO. 12283

For

at the

EPA METHOD 301 AMMONIA METHOD VALIDATION TESTING

UNIT NO. 1 STACK

SEPTEMBER 9 THROUGH 11, 1993

TABLE OF CONTENTS

(continued next page)

TABLE OF CONTENTS (continued)

PAGE

QUALITY ASSURANCE/QUALITY CONTROL

APPENDICES

LIST OF TABLES AND FIGURES

INTRODUCTION

1.1 Outline of Test Program. EPA Method 301 ammonia method validation testing was performed for at their Recovery Facility in on September 9 through 11, 1993. Testing was performed at the unit No. 1 stack to validate sampling and analytical methods for ammonia. The test program was designed according to the criteria of EPA Method 301, "Protocol for the Field Validation of Emission Concentrations from Stationary Sources." This method includes procedures for determining the bias and precision of the measured concentrations.

Six repetitions of quadruplicately located concurrent EPA Method 5 trains modified to capture ammonia were used. Four EPA Method 5 probe and impinger assemblies were built into a single unit that allowed for simultaneous sampling through a single port at a single point. Ammonia was quantified by Ion Specific Electrode (ISE) analytical techniques.

The sampling train consisted of a heated glass probe, a filter, four chilled impingers, and a metering console. The first three impingers each contained 100 mL of 0.1N sulfiric acid (H_2SO_4) and the fourth contained preweighed silica gel. The results of the testing show the train is suitable for measuring ammonia emissions and that the amount of ammonia captured in the probe and on the filter is insignificant.

Table 1-1 is a test log which presents the test dates and run numbers.

TABLE 1-1
UNIT NO. 1 STACK TEST LOG

Test Date	Run Numbers Concurrent Train 1	2	3	4
9/09	1-MNH3-1A*	1-MNH3-1B	1-MNH3-1C*	1-MNH3-1D
9/09	1-MNH3-2A*	1-MNH3-2B	1-MNH3-2C*	1-MNH3-2D
9/09	1-MNH3-3A*	1-MNH3-3B	1-MNH3-3C*	1-MNH3-3D
9/10	1-MNH3-4A*	1-MNH3-4B	1-MNH3-4C*	1-MNH3-4D
9/10	1-MNH3-5A*	1-MNH3-5B	1-MNH3-5C*	1-MNH3-5D
9/10	1-MNH3-6A*	1-MNH3-6B	1-MNH3-6C*	1-MNH3-6D
9/10	1-MNH3-7A*	1-MNH3-7B	1-MNH3-7C*	1-MNH3-7D
9/10	1-MNH3-8A*	1-MNH3-8B	1-MNH3-8C*	1-MNH3-8D
9/11	1-MNH3-9A*	1-MNH3-9B	1-MNH3-9C*	1-MNH3-9D

* Spiked trains

1.2 Test Participants. Table 1-2 lists the personnel involved in the test program.

TABLE 1-2
TEST PARTICIPANTS

Entropy, Inc.	Herb Dixon Project Manager
	David Brintle Project Supervisor
	Joe Winslow Sampling Team Leader
	Danny Speer Sampling Team Leader
	Jeff Coppedge Laboratory Technician

SUMMARY OF RESULTS

2.1 Presentation. Table 2-1 presents the pertinent bias and precision calculations. The ammonia results were calculated using only the impinger fractions since previous experience has shown no detectable ammonia in the fronthalf rinse or on the filter. Detailed test results for ammonia concentrations and the matrix spike recovery efficiencies are presented in Appendix A. Field and analytical data are given in Appendix B.

2.2.1 Aborted Runs. Run 1-MNH3-7 was aborted due to a failed posttest leak check on the "D" sample train. Runs 1-MNH3-1 and 1-MNH3-6 were aborted due to various sampling problems.

2.2.2 Precision. The relative standard deviation is 7% for both the spiked and unspiked samples for the impingers analyses. The acceptable range is ±50%. Therefore, the precision for the impingers analyses is acceptable.

2.2.3 Bias. The calculated bias for the analyses of the impingers is 0.174. The bias is not statistically significant. Based on the t-test criteria, a correction factor is not necessary because the bias is not statistically significant. The calculated correction factor would be 1.05. The acceptable range for the correction factor is 0.7 to 1.3.

2.2.4 Breakthrough. Breakthrough is defined as the percentage of the total impingers catch that is found in the third impinger. The highest ammonia breakthrough to the third impinger was 0.7% on sample 1-MNH3-1C, indicating that the sampling train efficiently captured ammonia. Additionally, the highest ammonia breakthrough to the second impinger was 1.1% on sample 1-MNH3-9B, indicating that the sampling train efficiently captured ammonia if only two impingers are used.

TABLE 2-1

BIAS AND PRECISION CALCULATIONS

ANALYTE SPIKING: QUAD TRAINS

ENTER VALUE OF SPIKED LEVEL (CS)= 3.650

	SPIKED SAMPLES		UNSPIKED SAMPLES					
RUN #	A	C	B	D	A-C	(A-C)^2	B-D	(B-D)^2
2	8.03	7.65	3.62	3.80	0.38	0.14	-0.18	0.03
3	11.97	10.38	7.32	6.66	1.59	2.53	0.66	0.44
4	9.90	10.28	6.34	6.03	-0.38	0.14	0.31	0.10
5	6.05	7.47	3.61	3.51	-1.42	2.02	0.10	0.01
8	11.01	11.30	6.93	6.93	-0.29	0.08	0.00	0.00
9	7.84	7.21	4.73	3.72	0.63	0.40	1.01	1.02
						2.05		✓

AVERAGE: Sm= ✓ 9.09 Mm= 5.27

STANDARD DEVIATION:

SPIKED SDs= 0.67 ✓

UNSPIKED SDu= 0.36 ✓

RELATIVE STD RSDs= 7% (acceptable) ✓

RELATIVE STD RSDu= 7% (acceptable) ✓

BIAS:

B= 0.174166 ✓

STD OF MEAN SDm= 0.759 ✓

t-VALUE= 0.230 /

CRITICAL t-VALUE= 2.201
(n=12, alpha=95%)

Bias not statistically significant, CF not needed.

CORRECTION FACTOR=1.047716 (Acceptable)

TABLE 2-1

BIAS AND PRECISION CALCULATIONS

```
ANALYTE SPIKING: QUAD TRAINS

ENTER VALUE OF SPIKED LEVEL (CS)=      3.650


             SPIKED SAMPLES    UNSPIKED SAMPLES
  RUN #        A        C        B        D        A-C   (A-C)^2     B-D   (B-D)^2
      2      8.03     7.65     3.62     3.80     0.38     0.14    -0.18     0.03
      3     11.97    10.38     7.32     6.66     1.59     2.53     0.66     0.44
      4      9.90    10.28     6.34     6.03    -0.38     0.14     0.31     0.10
      5      6.05     7.47     3.61     3.51    -1.42     2.02     0.10     0.01
      8     11.01    11.30     6.93     6.93    -0.29     0.08     0.00     0.00
      9      7.84     7.21     4.73     3.72     0.63     0.40     1.01     1.02

AVERAGE:       Sm=      9.09      Mm=      5.27

STANDARD DEVIATION:

        SPIKED SDs=            0.67

        UNSPIKED SDu=          0.36

        RELATIVE STD RSDs=        7% (acceptable)

        RELATIVE STD RSDu=        7% (acceptable)

BIAS:

              B=       0.174166

        STD OF MEAN SDm=      0.759

              t-VALUE=    0.230

        CRITICAL t-VALUE=    2.201
        (n=12, alpha=95%)

        Bias not statistically significant, CF not needed.

        CORRECTION FACTOR=1.047716 (Acceptable)
```

PROCESS DESCRIPTION AND OPERATION

3.1 General

The is owned and operated by The facility contains three independent Martin GmbH reverse reciprocating stoker type boilers. Each boiler has a design rated capacity of 400 TPD for a total plant capacity of 1200 TPD. The facility is designed to generate 35.7 MegaWatts of power. Municipal waste is dumped on the tipping floor and then transferred to the refuse holding pit where one of two refuse cranes feed three chutes leading to each waterwall furnace. A ram-type feeder pushes the refuse on to the grate of the reciprocating stoker, where refuse is burned.

A furnace lime injection system is available to reduce acid gas emissions. Flue gases exiting the economizer are directed to a spray dryer absorber (SDA). Lime slurry is added to the effluent to reduce acid gas emissions. Upon exiting the SDA, flue gases flow through a multi-module fabric filter (FF) for particulate emission control. The flue gases exiting the fabric filter flow through the stack to the atmosphere.

3.2 Source Air Flow

Figure 3-1 is an air flow schematic which shows the passage of flue gases exhausted from the boilers.

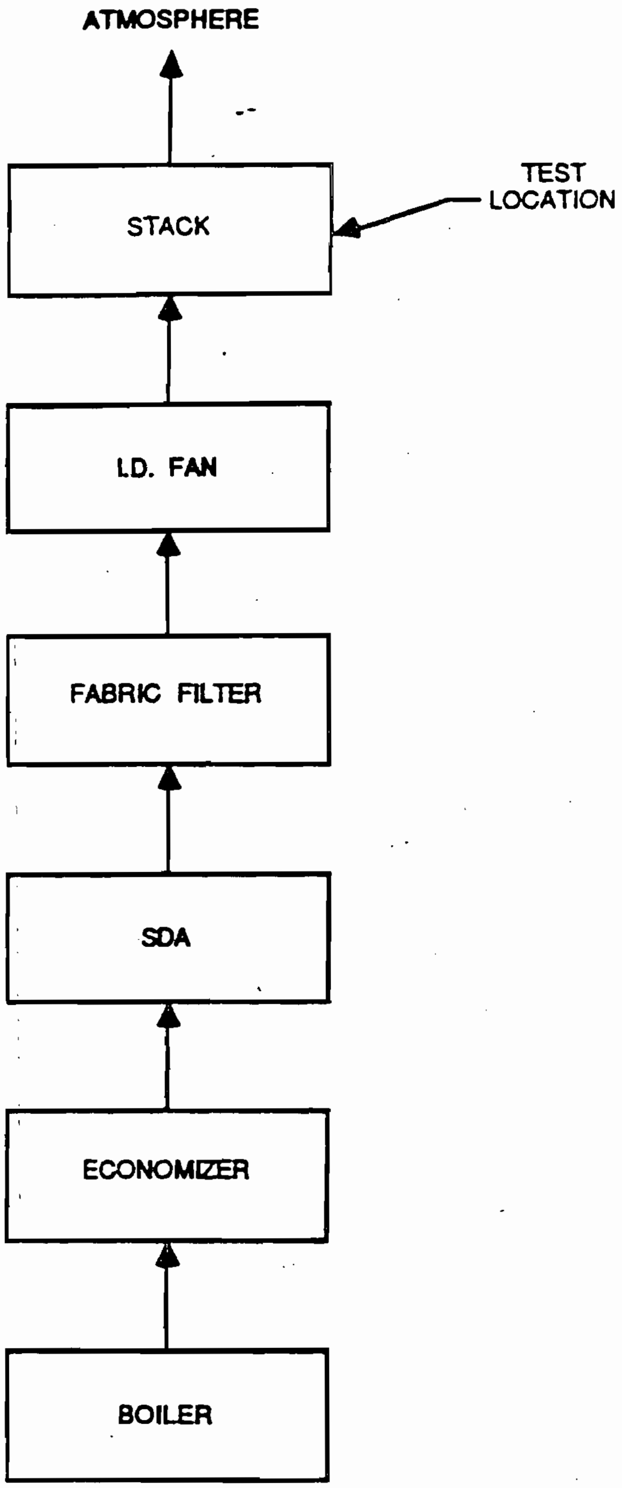


FIGURE 3-1. UNIT NOS. 1, 2, AND 3 AIR FLOW SCHEMATIC.

SAMPLING AND ANALYTICAL PROCEDURES

4.1 General. All sampling procedures were those recommended by the United States Environmental Protection Agency and the

This section provides brief descriptions of the sampling and analytical procedures. Detailed descriptions of the procedures are provided in Appendix E.

4.2 Emissions Determinations. Ammonia concentrations were determined by using a modified EPA Method 5 type train. Four EPA Method 5 probe and impinger assemblies were built into a single unit that allowed for simultaneous sampling through a single port.

Sample Collection. Each sampling train consisted of a heated glass probe, a filter, four chilled impingers, and a metering console. The first three impingers each contained 100 mL of 0.1N H_2SO_4, and the fourth contained preweighed silica gel.

Two of the four simultaneous trains (the first impinger of trains A and C) were spiked with ammonia for each run. Proper spiking levels were determined by previous experience.

Single point sampling was conducted at a single point within the stack for 60 minutes.

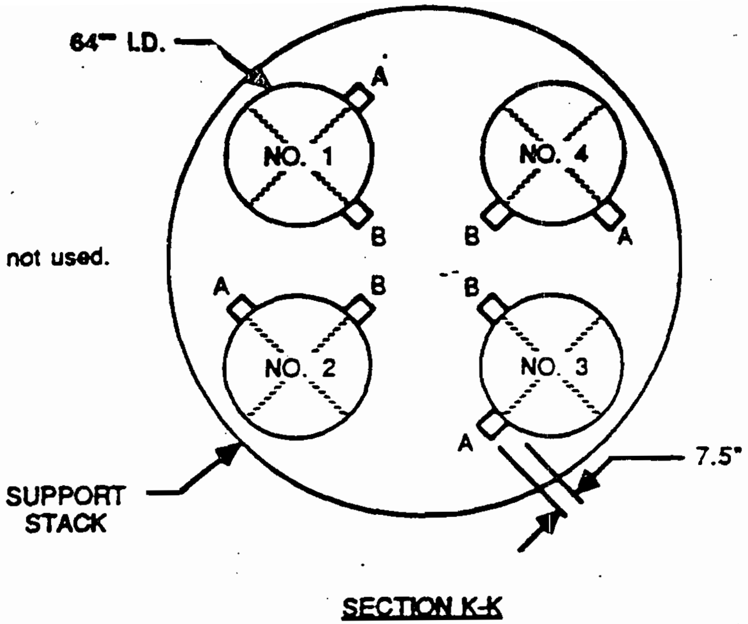
Sample Recovery. The filter was removed from the filter holder and placed in a 250 mL glass jar. The 0.1N H_2SO_4 reagents were returned to their original 1000 mL glass jars, weighed, the weight recorded on the labels, and the liquid levels marked. The silica gel was returned to the original tared container, weighed, and the weight recorded on the label.

The probe and fronthalf of the filter holder were rinsed with 0.1N H_2SO_4 into a 500 mL glass jar. The backhalf of the filter holder and first impinger were rinsed with DI water into the glass jar containing the reagent from the first impinger. The second impinger was rinsed with DI water into the glass jar containing the second impinger reagent. The third impinger was rinsed with DI water into the glass jar containing the third impinger reagent.

Sample Analysis. Each impinger was analyzed separately by ISE for

(continued on page 4-3)

Note: Stack No. 4 not used.



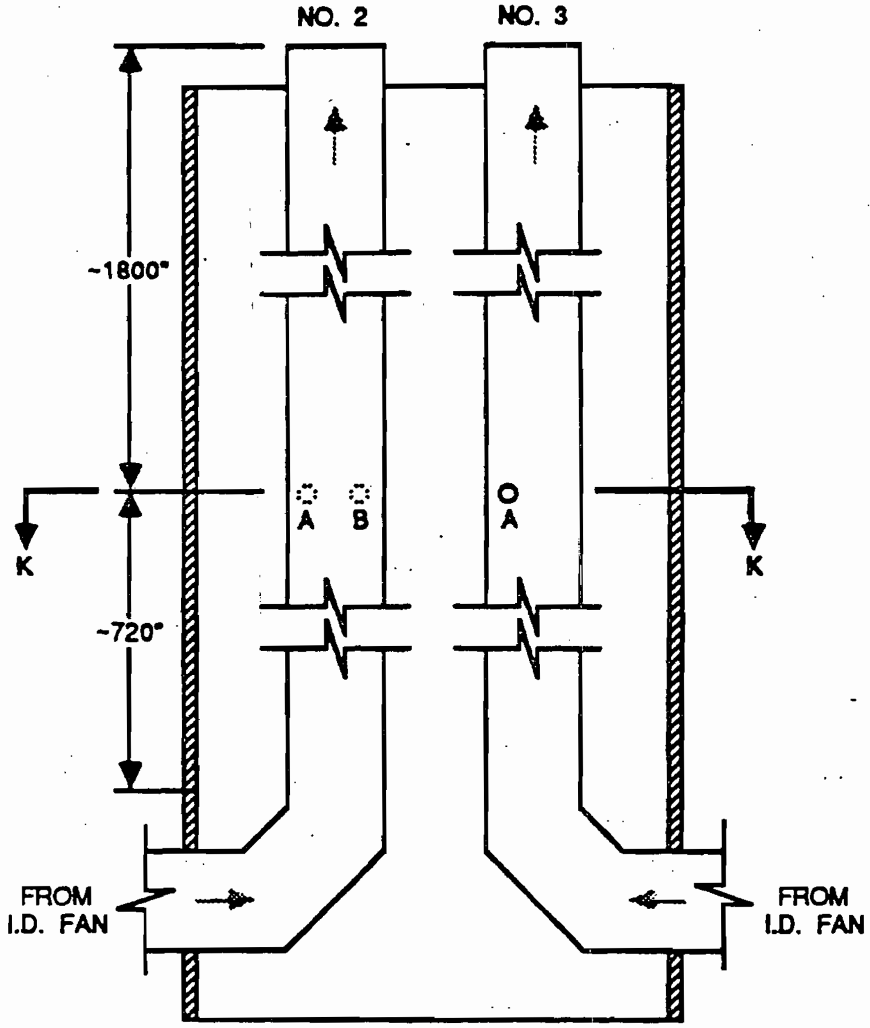


FIGURE 4-2. UNIT NOS. 1, 2, AND 3 STACK TEST LOCATION.

ammonia. The filter was resuspended in the fronthalf 0.1N H_2SO_4 rinse and analyzed for ammonia.

Field samples were analyzed onsite. A calibration curve was generated prior to the analyses. Any sample with a concentration below that of the lowest standard on the curve was reported as less than the lowest standard.

4.3 Equipment Calibration. Pertinent calibration data are provided in Appendix C.

QUALITY ASSURANCE/QUALITY CONTROL

5.1 General. Entropy Environmentalists Inc. (EEI) is committed to the continued implementation of a Quality Assurance Program to assure the quality of sampling and analytical procedures of environmental measurement data. The Quality Assurance measures taken during this test project equals or exceeds the minimum QA/QC recommendations as set forth by the U.S. Environmental Protection Agency (EPA) for a particular method.

The following sections outline the QA program implemented by EEI to justify the validity of test procedures. As applicable, the QA system for the various test programs addresses the following areas:

- ▲ Preventive Maintenance & Equipment Calibration
- ▲ QA Sample Processing
- ▲ Analytical Instrument Calibration
- ▲ Blanks and Spiked Samples
- ▲ Internal/External System Checks
- ▲ Data Reduction & Validation
- ▲ QA/QC Summary

5.2 Preventive Maintenance and Equipment Calibration. An effective preventive maintenance program decreases downtime and thus increases data completeness and quality. Pretest and posttest equipment calibrations are conducted in a manner and at a frequency which meets or exceeds U.S. EPA specifications.

Each item transported to the field is inspected to detect equipment problems which may originate during periods of storage. All equipment returning from the field is cleaned, repaired, reconditioned, and recalibrated as necessary. Routine maintenance on equipment (dry gas meters, pumps, Magnehelics, manometers, pitot tubes, and nozzles) is carried out periodically for leaks, corrosion, dents, or any other damage. Table 5-1 shows the activities for equipment calibration.

TABLE 5-1

IN-HOUSE EQUIPMENT CALIBRATION

Apparatus	Calibration Method And Frequency	Specifications	Corrective Action
Type S Pitot Tubes	Standards contained in EPA Method 2. Visual inspection prior to shipment to test site and again prior to each day of testing.	Coefficient of 0.84 ± 0.02	Refurbish or recalibrate.

(continued next page)

TABLE 5-1 (continued)

IN-HOUSE EQUIPMENT CALIBRATION

Apparatus	Calibration Method And Frequency	Specifications	Corrective Action
Manometers	Leak checked before and after each field use.		Adjust or replace.
Magnehelic Gauges	Initially calibrated over full range.	0-10" water column	
	After each field use, checked against inclined manometer at average settings encountered during testing.	Within ± 5%	Repair and Recalibrate.
Thermometers -Impinger -Dry Gas Meter -Filter Box	After purchase and prior to each field use, using ASTM mercury-in-glass thermometer.	Imp = ± 2°F DGM = ± 5.4°F FB = ± 5.4°F	Adjust, determine correction factor, or reject.
Thermocouple/ Potentiometer	After purchase. 3-point (ice bath, boiling water, and hot oil) using ASTM mercury-in-glass thermometer.	± 1.5% of absolute temperature.	Adjust, determine correction factor, or reject.
	Before and after each field use, compared to ASTM mercury-in-glass thermometer at ambient conditions.		
Dry Gas Meter and Orifice	Full calibration (every 6 months) over wide range of orifice settings to obtain calibration factor (isokinetic meterbox).	DGM = ± 0.02 from avg.coeff. for each run. Orifice = ± 0.20 from average ΔH@ for each run.	Adjust or replace.
	10-minute quick calibration before sending to test site and again prior to each day of field use (isokinetic).	± 3% of full. ± 5% of full.	Use if no backup. Do not use.
	Posttest (at average delta H and highest vacuum encoun-)tered during testing) to determine if meter gamma has changed (isokinetic).	± 5% of full calibration. Gamma (initial or recalibration) that yields the lowest sample volume for the testing is used for calculations.	Recalibrate or replace.
	Full calibration w/spirometer before/after each field use (nonisokinetic meterbox).	± 5% of pretest, .02 from average coeff. from each run	Recalibrate.
Dry Gas Meter Transfer Standard	Annual calibrations conducted in triplicate using EPA wet test meter. Calibrations conducted at 7 flow rates from 0.25 to 1.40 cfm.	± 2% of average factor for each calibration run.	Adjust and recalibrate.
Barometer	Before and after each field use against an aneroid barometer.	± 0.1" mercury.	Adjust to agree.
	Reference barometer adjusted for elevation differences.		
Probe Nozzle	Average of 5 I.D. measurements using a micrometer. Visual inspection before and after each field use.	Difference between high and low measurement ≤ 0.004"	Repair and recalibrate.

5.3 Sample Processing. Entropy employs systems which ensure the integrity of an environmental sample from the time of acquisition, through analysis, and ultimately to proper disposal. These systems are necessary to allow valid conclusions to be drawn from analytical results separated in time and space from the sampling operation. In addition, these systems recognize that samples are occasionally of value even after analytical results have been reported.

Samples are collected, transported, and stored in clean containers which are constructed of materials inert to the analytical matrix. Containers are used which allow air tight seals. When necessary, containers are employed which prevent photochemical reactions. All sample containers are labeled with the following information:

- ▲ Unique source identifier
- ▲ Sample run identifier
- ▲ Analyte identifier
- ▲ Sample matrix identifier
- ▲ Sample analyst identifier

Additional information relating to the sample is recorded on the data sheet for the sampling run that afforded the subject sample. Accordingly, the sampling data sheet contains all the information listed above, plus the date and time the sample was acquired and supplemental information such as observations pertinent to the quality of the sample. For condensed samples, e.g., samples in liquid media, the sample levels are marked on the outside of the container; this mark is used to indicate sample loss, and as such, may serve as a reference in adjusting results accordingly.

For transport from the field to the laboratory, samples are stored in sealed containers and secured in a fashion which minimizes movement and thus prevents breakage of containers. Containers used for transporting glass are packed with foam. Samples which require chilling are kept cold until analyzed.

Samples remain in the custody of the sampler, from acquisition until conveyance to the sample custodian. All custody transfers are signed for and documented on a record of custody form, which remains with the sample until turned over to the custodian.

Analytical data are identified in a manner identical to that of the sampling data. Accordingly, all data generated from the analysis of samples are documented with the following information:

- ▲ Source identifier
- ▲ Sample run identifier
- ▲ Analyte identifier
- ▲ Sample matrix identifier
- ▲ Analyst identifier
- ▲ Analysis date

Portions of samples remaining after analysis are returned to their original sample containers. These samples are stored in designated storage areas until their destruction is authorized.

5.4 Instrument Calibration. Instrument calibration is one of the most important functions in generating precise and accurate quality data. A listing of major in-house instrumentation and the corresponding Quality Assurance program is given in Table 5-2.

All of the contract laboratories involved in the analytical testing for the test program maintained rigorous QA programs for instrument calibration.

TABLE 5-2

IN-HOUSE INSTRUMENT CALIBRATION

Apparatus	Calibration Method And Frequency	Corrective Specifications	Action
Analytical & Top Loading Balance	Daily and monthly checks with a series of class S weights. Balance serviced annually by a qualified service representative and checked with a series of NBS weights.	± 1 mg of class S weights.	Adjust or repair.
Gas Chromatograph	3-point calibration curve at the expected range. Duplicate injection of the sample until ± 5% variation is achieved. Calibration repeated at the end of each test series.		
HPLC/Ion Chromatograph	Calibrations conducted at the beginning, after the first injection, and after the second injection.		
Fisher Accument 925 pH/Selective Ion Meter	5- point calibration prior to analyzing the samples for the specific ions.		

5.5 Blanks and Spikes. Field blanks, method blanks, trip blanks, lab-proof blanks and filter blanks are obtained, digested and analyzed when applicable. The blanks reflect the background contamination obtained from the various sources during the sampling and analysis. Thus, data adjustment or correction can be made accordingly.

In most cases, it is not necessary to digest and analyze the method blanks, reagent blanks or the lab-proof blanks unless the field blank shows a high level of contamination. If a high level of contamination is present, it is imperative to individually analyze the above blanks to help determine the cause of contamination.

Spiked samples are used to check on the performance of a routine analysis or the recovery efficiency of a method. During spiking, a known amount of stock solutions of the substance of interest is added to the sample prior to sample extraction, digestion, and analysis.

5.6 Internal/External System Audit Checks. System and performance audits are routine elements of all Entropy QA/QC programs.

Internal Systems Audit: The following sampling equipment checks were conducted prior to sample collection.

- ▲ All sampling equipment was thoroughly checked to ensure clean and operable components.
- ▲ Equipment was inspected for possible damage from shipment.
- ▲ The oil manometers or Magnehelic gauges were leveled and zeroed.
- ▲ The temperature measurement systems were checked for damage and operability by measuring the ambient temperature.

Performance Audits: Performance audits of the laboratory are conducted prior to the processing of any compliance samples for analysis. Audit materials typically include samples available from the EPA prior to new source testing. Also, samples of known concentration are specially prepared in-house or obtained from the EPA for Internal QA checks.

External Systems Audits: Entropy is subject to a system audit each time a test is conducted for any Air Pollution Control agency. This procedure entails an EPA observer on-site to do qualitative evaluation of performance to demonstrate compliance with the applicable regulations.

5.7 Data Reduction and Validation. The test team leader is responsible for reviewing and validating data as they are acquired. Each team leader has extensive knowledge of sampling methodology and the characteristics of the process being measured and is capable of evaluating the accuracy, representativeness, and completeness of raw data on-site, where action to replace inadequate data can be taken immediately.

Data obtained during calibrations and test runs are recorded on standardized forms which are checked twice for completeness and accuracy by the QA Director or his designated representative. Data reduction and consistency are achieved by using the standardized forms and using Entropy's in-house computer facilities.

5.8 QA/QC Summary. All chemicals used were American Chemical Society (ACS), High Performance Liquid Chromatography (HPLC), or pesticide grade. The deionized, distilled water utilized met or exceeded the American Society for Testing and Materials (ASTM) specifications for Type-I reagent water. Pretest and posttest leak checks were conducted on each sampling train.

Ammonia

Calibration Curve: Three standards containing known amounts of ammonia were prepared and analyzed. Linear regression was performed on the standards to produce a curve. No standard deviated more than 7.1% from the curve.

Blanks and Spikes: Reagent blanks of 0.1N H_2SO_4 were injected with each set of samples. Each "A" and "C" sample of the quad train was spiked with a known amount of ammonia. Percent recovery was determined to be 100% (+/- 20%) for each spike.

EPA Method 23: PCDD/PCDF and PCB

Sample Collection. Samples for polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans (PCDD/PCDF) and polychlorinated biphenyls (PCB) will be withdrawn isokinetically from the source using an EPA Method 23 sampling train. The sampling train will consist of a nickel-plated stainless steel nozzle, a heated borosilicate glass probe, a Whatman EPM2000 glass filter maintained at a temperature of 248°F ± 25°F, a water-cooled condenser, a sorbent trap containing XAD-2 resin, five chilled impingers and a metering console.

The water-cooled condenser and sorbent trap are arranged in a manner that allows the condensate to drain vertically through the trap. Gas entering the trap will be maintained at or below 68°F. The first impinger (optional knockout) will remain empty, the second and third impingers will each contain 100 mL of DI water, the fourth will remain empty, and the fifth will contain preweighed silica gel. Sealing greases will not be used on any portion of the sample train.

Sample Train Component Preparation.

Glassware. All glass parts of the sample train including the sorbent trap, will be precleaned before sampling according to the following procedures.

1. Soak in hot soapy water (Alconox) at 50°C or higher
2. Rinse three times with tap water
3. Rinse three times with DI water
4. Rinse three times with pesticide grade acetone
5. Rinse three times with pesticide grade methanol/methylene chloride
6. Bake at 450°F for 2 hours
7. Cap with Teflon tape or methylene chloride rinsed aluminum foil

The glassware will be capped with precleaned foil or Teflon tape until sample train assembly. Following sample recovery, the glassware will be reused at the same sampling location.

XAD-2 Resin. The XAD-2 resin is purchased precleaned from Supelco Chromatography Products. The sorbent trap will be charged with 20 to 30 grams of the precleaned resin. Care will be taken to ensure the resin is kept at temperatures below 120°F before and after sample collection to prevent resin decomposition. The period between charging the trap and use in the field will be as brief as possible and will not be allowed to exceed 14 days.

Sample Recovery. Recovery of the samples and assembly of the sample trains for reuse will be conducted in the dust-free environment of the sample recovery and field laboratory. The DI water reagent will be returned to the original 1,000 mL amber glass jar, weighed, the weight recorded on the label, and the liquid level marked. The volume of water vapor condensed in the impingers and the volume of water vapor collected in the XAD-2 resin and silica gel will be summed and entered into moisture content calculations.

The sample-exposed components of the sampling train up to the XAD-2 cartridge will be rinsed with acetone, methylene chloride, toluene, and finally with acetone (which will be discarded). The impingers will be rinsed with acetone and methylene chloride into a 500 mL amber glass jar. All samples will be stored at 40°F until analyzed. Sample containers from a typical run will include:

Container 1	Filter(s)
Container 2	Rinses of nozzle, probe, and front half of filter holder
Container 3	XAD-2 cartridge and resin
Container 4	Impinger contents
Container 5	Rinses of back half of filter holder, transfer line, and condenser
Container 6	Silica gel

Blanks of each solvent lot used at the test site will also be saved for potential analysis. Depending on the particulate loading and/or the flue gas moisture content, the actual number of containers from each sample run may vary.

One field blank will be recovered for the test location during the testing program. A field blank is a complete sampling train assembled in the same manner as those that collect samples, except that flue gas is not pulled through the train. The field blank train will be leak-checked the same number of times as a sampling train used during a run. The train will be placed at the sampling location for the duration of one run. The train is then returned to the laboratory and disassembled for recovery using the same procedure used to recover actual samples. The field blank will use a train that has previously been used to collect at least one actual sample from the test site.

Sample Analysis. The filter(s), XAD-2 resin, and acetone, methylene chloride, and toluene rinses up to the XAD-2 will be analyzed for PCDD/PCDF, according to EPA Method 23X. The filter(s), XAD-2 resin, acetone methylene chlorine, DI reagent, and impinger rinses with acetone and methylene chloride will be analyzed for PCB according to EPA Method 680 with high resolution. All extracts from one run will be combined and volume reduced to 1 mL resulting in one extract per run from which an aliquot will be taken for analysis.

40 CFR 266, Appendix IX, Section 3.1
Determination of Metals Emissions

Sample Collection. Samples will be withdrawn isokinetically from the source using a sampling train set-up as outlined in Section 3.1.3.1 of the method. The sampling train will consist of a glass nozzle, a heated glass probe with a type S pitot tube attached, a filter, six chilled impingers, and a metering console. The particulate sample will be collected on a Pallflex 2500QAT-UP quartz filter maintained at a temperature of 248°F ± 25°F. The first and second impingers will each contain 100 mL of 5 percent HNO_3/10 percent H_2O_2, the third will remain empty, the fourth and fifth impingers will each contain 100 mL of 4 percent potassium permanganate ($KMnO_4$)/10 percent sulfuric acid (H_2SO_4), and the sixth will contain preweighed silica gel. Each run will be a minimum of 2 hours in duration and will sample a minimum of 60 dry standard cubic feet.

Sample Recovery. A Teflon spatula and Teflon coated tweezers will be used to remove the filter from the filter holder and place it in a 250 mL glass jar. The reagents will be returned to the original bottles, weighed, the weights recorded on the labels, and the liquid levels marked. The silica gel will be returned to the original container, weighed, and the weight recorded on the label. The volume of water vapor condensed in the impingers and the volume of water vapor collected in the silica gel will be summed and entered into moisture content calculations.

The nozzle, probe, and front half of the filter holder will be rinsed with 100 mL of 0.1N HNO_3 into a 500 mL glass jar. A Teflon probe brush will be used to clean the probe.

The back half of the filter holder and the first and second impingers will be rinse with 100 mL of 0.1N HNO_3 into the 1,000 mL jar containing the HNO_3/H_2O_2 reagent. The third impinger will be rinsed with 100 mL of 0.1 HNO_3 into a 500 mL glass jar. The fourth and fifth impingers will be rinsed with 100 mL of acidified $KMnO_4$ into the 500 mL bottle containing the $KMnO_4/H_2SO_4$ reagent. If necessary, to remove any residual brown deposits, the fourth and fifth impingers will be rinsed with 25 mL of 8N HCl into a 500 mL glass jar containing 200 mL of water.

Sample Analyses. The front half HNO_3 rinses will be evaporated to near dryness in a Teflon beaker. The filter, loose particulate, 3 mL of concentrated HNO_3, and 5 mL of concentrated HF will be added to the beaker. The sample will be digested on a hot plate until brown fumes are evident, indicating the destruction of organic matter. After the addition of concentrated HNO_3, the reagent and impinger rinses will be evaporated to near dryness in a Teflon beaker on a hot plate. After cooling, 3 mL of concentrated HNO_3 and 5 mL of concentrated HF will be added to the beaker and the sample will be fumed on a hot plate to destroy organic residue. The prepared filter and HNO_3/H_2O_2 reagent samples will be combined, brought to a final volume of 100 mL with 10 percent HNO_3, and analyzed for metals with a Perkin Elmer 3030 atomic absorption analyzer using the appropriate SW-846 methods. Metals analysis will include arsenic (As), beryllium (Be), cadmium (Cd), total chromium (Cr), lead (Pb), and zinc (Zn). All metals will be analyzed for the lowest detectable limits. A field blank and reagent blanks will also be analyzed.

Wheelabrator Environmental Systems Inc.

A Wheelabrator Technologies Company
Liberty Lane
Hampton, NH 03842

Phone 603.929.3000

January 6, 1995

Mr. Michael Harley, P.E., DEE
Florida Department of Environmental Protection
Emissions Monitoring Section
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Re: **Alternate Procedure Request for Compliance Emissions Tests at Ridge Generating Station - AC 53-206244**

Dear Mr. Harley,

This letter serves as a follow up to our January 5 phone conversation during which you expressed the importance of explaining the basis of each individual request for approval of an alternate sampling procedure. This correspondence, in addition to the letters of June 23, July 29 and September 14, 1994 should provide you with the information requested in F.A.C. 17-297.620.

WESI/WRE requests approval of the following alternate procedures for use during Compliance Emissions Tests at Ridge Generating Station, FDEP Permit No. AC 53-206244, Auburndale, Polk County, Florida.

1. WESI/WRE requests approval to perform EPA Method 26A for particulate and hydrogen chloride sampling. The FDEP does not have an approved ammonia test method. Therefore, WESI/WRE requests a modification to EPA Method 26A to allow for the analysis of ammonia in the same sampling train. A detailed description of the sample collection, recovery and analysis, as well as an EPA Method 301 validation test for the ammonia, was enclosed with the July 29, 1994 correspondence.

   The basis for this request is to utilize an approved EPA test methodology which has been extensively developed and validated at similar sources (i.e. Boilers & Industrial Furnaces) for use in submitting the most accurate data to the FDEP. A second basis for this request is to set forth an approved FDEP procedure for ammonia sampling. The approval of this request would allow WESI/WRE to combine three separate sampling trains without a loss in accuracy or precision of the individual methods for particulate, hydrogen chloride and ammonia.

2. The FDEP does not currently have an approved PCB test method. Therefore, WESI/WRE requests approval to perform a modification of EPA Method 23 for PCDD/PCDF to include PCB sampling. The modification would not interfere with the standard EPA Method 23 procedures in that the modification consists of analyzing a separate aliquot of the reagent/catch/rinse for PCB's. A detailed description of the sample collection, recovery and analysis of the EPA Method 23 test, as it would be utilized at WRE, was enclosed with the July 29, 1994 correspondence.

Exhibit 2

The basis for this request is to utilize an approved EPA test methodology which has been extensively developed and validated at similar sources (i.e. Boilers & Industrial Furnaces) in order to provide lower detection limits, increased accuracy and improved precision for use in submitting the most accurate data to the FDEP. A second basis for this request is to set forth an approved FDEP procedure for PCB sampling. The approval of this request would allow WESI/WRE to combine two separate sampling trains without a loss in accuracy or precision of the individual methods for PCDD/PCDF and PCB.

3. WESI/WRE requests approval to perform the EPA Method outlined in 40 CFR 266, Appendix IX, Section 3.1 for arsenic, beryllium and lead sampling in place of EPA Methods 108, 104 and 12 respectively. A detailed description of the sample collection, recovery and analysis of the EPA Method outlined in 40 CFR 266, Appendix IX, Section 3.1 was enclosed with the July 29, 1994 correspondence. The sampling and analysis for arsenic, beryllium and lead would be performed along with cadmium, total chromium and zinc (as zinc oxide) in a single sampling train.

The basis for this request is to utilize an approved EPA test methodology which has been extensively developed and validated at similar sources (i.e. Boilers & Industrial Furnaces) in order to provide lower detection limits, increased accuracy and improved precision for use in submitting the most accurate data to the FDEP. The approval of this request would allow WESI/WRE to combine four separate sampling trains with an increase in the accuracy and precision of the individual methods for arsenic, beryllium and lead. The use of this sampling train would provide lower detection limits of nanogram/milliliter versus detection limits of microgram/milliliter utilizing the EPA Method 108, 104 and 12 sampling trains.

As you are aware, Ridge Generating Station is equipped with a state of the art air pollution control system consisting of good combustion practices, selective non-catalytic reduction, spray dryer adsorber and a fabric filter baghouse which will result in low emissions of the subject pollutants. It is important, therefore, that the test methods to be utilized at the facility offer the most reliable qualitative and quantitative data possible.

If I can be of any assistance in supplying further documentation, or if you would like to meet to discuss the requests outlined in this letter, please do not hesitate to call me at 800-682-0026.

Sincerely,

John P. Goodwin
Environmental Engineer

cc: G. Aguinaga
T. Porter
D. Raymond
B. Rudd
R. Williams

JPG086

Wheelabrator Ridge Energy Inc.

3131 K-Ville Avenue
Auburndale, FL 33823
Tel. 813-665-2255
Fax 813-665-0400

January 30, 1995

State of Florida
Department of Environmental Protection
Chief Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, FL 32399-2400

RECEIVED
FEB 2 1995
Bureau of Air Regulation

Attn: Mr. Martin Costello

Subject: Ridge Generating Station
Air Construction Permit #AC53-206244/PSD-FL-813
Ammonia Ambient Impact Calculations

Dear Sir:

Attached is a summary of ammonia ambient impacts calculated from the PSD permit application ambient modelling results and actual compliance test ammonia emission rates. This information was requested by you during a December 20, 1994 telephone conversation between yourself, and Gary Aguinaga and Tim Porter of Wheelabrator.

The analyses show that the maximum ammonia ambient impacts are two to three orders of magnitude below the Florida DEP Air Toxic Threat Level. Additionally, the maximum ambient impacts equate to a concentration of 2.2 ppb, an order of magnitude below any levels detectable with current ambient monitoring equipment. Using the currently installed equipment to monitor for ambient ammonia at higher concentrations (i.e. 0-25 ppm) does not appear logical based on the results of the enclosed data. In addition, it is unclear whether the currently installed equipment would be technically capable of accurate measurements, even at higher concentrations, due to the high humidity ambient air being sampled.

In light of this information, the Facility requests that the requirement for ambient ammonia monitoring, as specified in Specific Condition #6 of the subject permit, be waived.

Thank you for your attention in this matter. Should you have any questions or concerns regarding this submittal, please do not hesitate to call Gary Aguinaga at (813) 665-2255.

Sincerely,

Rodney Williams

Rodney Williams
Plant Manager

— Max measured Ambient: ND
— downtime ~50% of time

cc: Gary Aguinaga
B. Soich, DEP-Tampa
T. Porter
M. Killeen
J. Rogers

RIDGE GENERATING STATION

AMBIENT AMMONIA IMPACT ANALYSES

Ambient ammonia impacts have been calculated using the PSD permit application ambient modelling results and actual ammonia emission rates from the stack compliance tests. The PSD permit modelling analysis ambient impacts originally are based on a normalized emission rate of 1 gram per second (g/s). A scaling analysis is then performed where pollutant specific ambient impacts are calculated directly by scaling of the ambient impact calculated on 1 g/s normalized emission rate by the actual emission rate of the specific pollutant. The pollutant specific ambient impact calculated by scaling can then be compared directly to the ambient air quality standards or Florida DER Air Toxics No Threat Levels. The scaling analysis is considered a valid approach specifically if the values for stack exit velocity and gas temperature used in the PSD ambient modeling are equivalent or lower than the actual values determined during compliance tests. The lower stack exit velocity and gas temperature used in the PSD modelling results in higher predicted ambient impacts and are considered conservative since ambient impacts would be lower if the compliance test stack parameters were used.

Tables 1-4 summarize the PSD permit application ambient modelling and compliance stack test data including stack parameters and predicted ambient ammonia concentrations. The intent is to demonstrate that actual ammonia ambient impacts from the Ridge Generating Station, using the compliance test results, are lower than impacts predicted in the PSD permit application modelling analysis and consequently significantly below the Air Toxics No Threat Level.

Table 1 shows that the PSD modelling stack exit velocity and temperature are lower than actual values obtained during the compliance test at both full load (100% MCR) and reduced load (75% MCR) conditions. Table 2 summarizes the ammonia emission rates. During compliance testing, the maximum single test run result was 13.8 lbs/hr with a three-test average of 8.13 lbs/hr with boiler at full load or 100% MCR. Comparatively, the maximum ammonia emission rate used in the PSD modelling analysis was 17.8 lbs/hr.

Table 3 summarizes PSD modelling results showing the maximum predicted normalized ambient concentrations using the normalized emission rate of 1 g/s. Ambient impacts were calculated from these normalized concentrations by scaling using the actual maximum single run and average ammonia emission rates from the compliance tests. These scaling results are summarized in Table 4 and compared to the PSD modelling concentrations and Florida DER Air Toxics No Threat Levels. The ambient concentrations for all averaging times calculated from the compliance test results are 2-3 orders of magnitude below the Florida DER No Threat Levels. Since the calculated ambient impacts from the scaling analysis are significantly below the No Threat Levels, it does not appear that an ambient ammonia monitor is necessary to evaluate actual ambient impacts. Further, the predicted maximum ambient ammonia impacts of 1.54 $\mu g/m^3$ associated with the 8-hour averaging period converts to an alternative concentration of 2.2 ppb. This extremely low concentration cannot be measured with any commercially available ambient monitoring equipment.

TABLE 1

RIDGE GENERATING STATION

STACK PARAMETERS

PARAMETER	PSD MODELLING		COMPLIANCE TEST	
	MCR**	75% LOAD	MCR	75% LOAD
Normalized Emission Rate g/s*	1.0	1.0	N/A	N/A
Stack Height, m	99.06	99.06	99.06	99.06
Stack Diameter, m	3.05	3.05	3.05	3.05
Exit Temperature, K	349.8	349.8	386.0	387.0
Exit Velocity, m/s	14.54	10.91	16.04	14.46

* Normalized Emission Rate used for model input. Modelled results are scaled using potential emission rates in the PSD permit application and actual emission rates from Compliance Testing.

** MCR = Maximum Continuous Rating at 100% Load

TABLE 2

NH_3 EMISSION RATES USED FOR CONVERSION TO AMBIENT CONCENTRATIONS

	MCR		75% LOAD	
	#/Hr	g/sec	#/Hr	g/sec
Compliance Test				
Maximum Run	13.8*	1.74	4.24	0.534
Average	8.13*	1.02	4.02	0.506
PSD Permit				
Maximum	17.8	2.24	17.8	2.24

* Denotes values used in scaling analyses.

TABLE 3

PSD MODELLING RESULTS*

PREDICTED MAXIMUM NORMALIZED CONCENTRATIONS

NORMALIZED EMISSION RATE = 1.0 g/s

		NORMALIZED CONCENTRATION - $\mu g/m^3$	
AVERAGE	RECEPTOR RESOLUTION	MCR	75% LOAD
8-Hour	250 m 100 m	0.765 0.884**	1.008
24-Hour	250 m 100 m	0.301 0.319**	0.378
Annual	250 m 100 m	0.030 0.030**	0.036

* Summarized directly from PSD modelling report contained in permit application.

** Denotes values used in final PSD modelling impacts and for compliance test results scaling analyses.

TABLE 4

SCALING RESULTS USING ACTUAL EMISSION RATES

	NH_3 AMBIENT CONCENTRATIONS - $\mu g/m^3$			
	PSD PERMIT APPLICATION	COMPLIANCE TEST*		FL DER NO THREAT LEVEL
AVERAGING TIME		Highest	Average	
8 Hour	2.0	1.54	0.89	180
24 Hour	0.7	0.55	0.32	43.2
Annual	0.07	0.05	0.029	1.0

* Conservatively calculated using highest single test run and average result from 100% MCR test condition.

FLORIDA

Department of Environmental Protection

Lawton Chiles
Governor

Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Virginia B. Wetherell
Secretary

July 11, 1994

Certified Mail - Return Receipt Requested

Mr. John P. Goodwin
Wheelabrator Environmental Systems, Inc.
Liberty Lane
Hampton, New Hampshire 03842

RE: Initial Compliance Test-Ridge Generating Station-AC 53-206244

Dear Mr. Goodwin:

We received your June 23 letter about the proposed procedures for conducting compliance tests at the above referenced source. The use of a different test method to measure a pollutant for which there is an adopted method in Chapter 17-297, F.A.C., requires approval pursuant to Rule 17-297.620, F.A.C. The modification of an adopted procedure also requires approval pursuant to Rule 17-297.620, F.A.C. Alternate standards and procedures are approved on an individual source-by-source basis. Therefore, the issuance of an Order approving the use of an alternate sampling procedure at one facility (i.e., South Broward) does not automatically sanction its use at another facility (i.e., Ridge Energy).

The proposal still includes test methods which are different from those required by the permit and which have not been adopted in Chapter 17-297, F.A.C. The Department has adopted EPA Methods 5 and 17 for particulate, EPA Method 12 for lead (Pb), EPA Method 104 for beryllium (Be), EPA Method 108 for arsenic (As), and EPA Method 26 for hydrochloric acid (HCl) in Rule 17-297, F.A.C. The use of EPA Method 0050 for particulate and hydrochloric acid; and the method in 40 CFR 266, Appendix IX Section 3.1 for arsenic (As), beryllium (Be), and lead (Pb) will require approval as alternate sampling procedures. EPA Method 23 is for the measurement of polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans (PCDFs/PCDDs) and the incorporation of any deviations for the measurement of polychlorinated biphenyls (PCBs) will also require prior approval as an alternate sampling procedure.

The Department will consider approval of the proposed methods if the information required by Rule 17-297.620, F.A.C., is provided. The additional information should include detailed descriptions of

"Protect, Conserve and Manage Florida's Environment and Natural Resources"

the sampling and analytical procedures for polychlorinated biphenyls (PCBs) and ammonia (NH_3). Please furnish a copy of the results of the EPA Method 301 validation procedure for ammonia (NH_3). A letter requesting guidance concerning the most appropriate sampling and analytical procedures for polychlorinated biphenyls (PCBs) and ammonia (NH_3) is being sent to EPA. EPA has recently adopted Method 26A for the measurement of halogens. Since EPA Method 26A has not yet been adopted by the Department, its use for the measurement of halogens and particulate would require approval as an alternate sampling procedure. The Department is more likely to consider approval of EPA Method 26A than EPA Method 0050.

If you have any questions, please call Ramesh Menon at (904) 488-1344 or write to me.

Sincerely,

Michael D. Harley

Michael D. Harley, P.E., DEE
P.E. Administrator
Emissions Monitoring Section

Enclosure

cc: C. Fancy
J. Brown
J. Pennington
W. Thomas, S.W. District
D. M^{c}Neal, EPA Region IV

Florida Department of
Environmental Protection

Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Lawton Chiles
Governor

Virginia B. Wetherell
Secretary

① ~~JOHN REYNOLDS~~
② PATTY ADAMS

June 14, 1994

PL INFO
File w/permit JO

Certified Mail - Return Receipt Requested

Mr. Gary S. Aguinaga
Wheelabrator Ridge Energy Inc.
3131 K-Ville Avenue
Auburndale, Florida 33823

RE: Initial Compliance Test-Ridge Generating Station-AC 53-206244

Dear Mr. Aguinaga:

We received the proposed test schedule for the above referenced source on June 13, 1994, and have reviewed it. The proposed schedule includes test methods which are different from those required by the permit and which have not been adopted in Chapter 17-297, F.A.C. Those specific test methods include 1) EPA Method 0050 for particulate (PM/PM_{10}), ammonia (NH_3), arsenic (As), and hydrochloric acid (HCl); 2) EPA Method 29 for mercury (Hg), beryllium (Be), and lead (Pb); and, 3) EPA Method 13B for hexavalent chromium (Cr^{+6}). The use of these proposed methods would require advance approval as alternate sampling procedures pursuant to Rule 17-297.620, F.A.C. A copy of the rule is attached for your information.

Since EPA Method 29 is still a conditional test method which has not been adopted by EPA, it is unlikely that its use will be approved for the measurement of metals. However, the Department may consider approving the use of the RCRA multi-metals method in 40 CFR 266 Appendix IX for the metals cadmium (Cd), chromium (Cr), and zinc (Zn). Please note that EPA Method 13B is for fluoride (F^-) and not for hexavalent chromium (Cr^{+6}). EPA Method 23 is for polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans and not for polychlorinated biphenyls (PCBs). A description of the proposed test procedures for ammonia (NH_3), hexavalent chromium (Cr^{+6}), and polychlorinated biphenyls (PCBs) will be required.

The proposed schedule also includes several deviations from the adopted procedures in Chapter 17-297, F.A.C., and 40 CFR 60. The deviations include the proposal to conduct tests for polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans that consist of only 1-2 runs, the proposal not to conduct the required EPA Method 9 evaluations concurrent with the particulate testing, and the proposal to conduct 15-minute observations using EPA Method 22. These deviations also require approval pursuant to Rule 17-297.620, F.A.C.

The purpose of the six EPA Method 2, 3, and 4 runs is not clear. If these measurements are for the purpose of determining mass emissions, the testing needs to be concurrent with testing for each of the specific pollutants for which a mass emission rate is required. An acceptable compliance test generally consists of three runs. If this testing is for the purpose of certifying continuous emission monitors, then a minimum of 9 runs is required.

Requests for approval of alternate standards and procedures are processed by the Division of Air Resources Management in Tallahassee (specifically the Emissions Monitoring Section). In order to satisfy the demonstration requirements of Rule 17-297.620(2)(d), F.A.C., the Department routinely requires the petitioner to test the source simultaneously using both the adopted procedure and the proposed procedure. The processing of a request for approval of an alternate standard or procedure generally requires a minimum of about 90 days from the date that all of the required information is received.

If you have any questions, please call Ramesh Menon at (904) 488-1344 or write to me.

Sincerely,

Michael D. Harley

Michael D. Harley, P.E., DEE
P.E. Administrator
Emissions Monitoring Section

Enclosure

cc: C. Fancy
J. Brown
J. Pennington
W. Thomas
D. McNeal

Wheelabrator Ridge Energy Inc.

CERTIFIED
P 389 398 503
MAIL

State of Florida
Department of Environmental Protection
Chief Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, FL 32399-2400

BEST AVAILABLE COPY

COPY

Wheelabrator Ridge Energy Inc.

3131 K-Ville Avenue
Auburndale, FL 33823
Tel. 813-665-2255
Fax. 813-665-0400

April 4, 1994

Department of Environmental Protection
Southwest District
3804 Coconut Palm Drive
Tampa, Florida 33619

RECEIVED

APR 11 1994

Bureau of
Air Regulation

Attn: Mr. W. Thomas

Subject: **Ridge Generating Station**
Air Permit #AC53-206244: Notifications

Dear Sir:

In accordance with 40 CFR 60.7 and the subject permit, this letter serves as notification of initial start-up of this facility.

Solid fuel firing at Ridge Generating Station commenced on March 30, 1994.

To update my letter of February 17, 1994, our present schedule calls for emissions testing as follows:

Opacity Conditioning Period:	April 17-23, 1994
CEMS 7-Day Drift Test:	May 1-8, 1994
Initial Stack Test Program:	May 9-15, 1994
CEMS Certification (RATA):	May 9-15, 1994

If there are any questions or concerns regarding the above, please call Mr. Gary Aguinaga, Director of Environmental Health and Safety, at (813) 665-2255.

Sincerely,

Rodney Williams

Rodney Williams
Plant Manager

GA/lc

cc: C. Wilson
G. Aguinaga
J. Rogers
M. Killeen
D. Raymond
J. Reynolds
M. Harley
B. Thomas, SW Dist

J. Goodwin
DEP-Chief Bureau of Air Regulation
EPA IV
Cert. #389 398 502

A WHEELABRATOR TECHNOLOGIES COMPANY

PRINTED ON RECYCLED PAPER

Wheelabrator Ridge Energy Inc.

3131 K-Ville Avenue
Auburndale, FL 33823
Tel. 813-665-2255
Fax. 813-665-0400

~~Preston~~
~~① Regina~~
② Patty-file

COPY

April 15, 1994

RECEIVED

APR 21 1994

Bureau of
Air Regulation

Department of Environmental Protection
Southwest District
3804 Coconut Palm Drive
Tampa, FL 33619

Attn: Mr. W. Thomas

Subject: **Ridge Generating Station**
Air Permit #AC53-206244: Notifications

Dear Sir:

In accordance with 40 CFR60.49b (Subpart Db), the following information is provided as an addendum to my notification letter dated April 4, 1994 of initial start-up of this facility.

1. The design heat input capacity of the facility is 630 MMBtu/hour.
2. Fuels to be combusted at Ridge Generating Station include wood, tires, and landfill gas. Propane will be used for start-up, shutdown, and combustion stabilization.
3. The anticipated annual capacity factor at the facility for propane is estimated at 2% or less.

If there are any questions regarding the above, please call Mr. Gary Aguinaga, Director of Environmental Health and Safety at (813) 665-2255.

Sincerely,

Rodney William

Rodney Williams
Plant Manager

GA/lc

cc: C. Wilson
G. Aguinaga
J. Rogers
M. Killeen
Certification #P 389 398 508
D. Raymond
J. Goodwin
DEP - Chief Bureau of Air Regulation
EPA Region IV

Wheelabrator Ridge Energy Inc.

3131 K-Ville Avenue
Auburndale, FL 33823
Tel. 813-665-2255
Fax. 813-665-0400

RECEIVED
FEB 22 1994
Bureau of
Air Regulation

February 17, 1994

State of Florida
Department of Environmental Protection
Chief Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Attn: Mr. C. H. Fancy, P.E.

SUBJECT: Ridge Generating Station
Air Permit #AC53-206244; Notifications

Dear Sir:

In compliance with conditions of the subject permit, this letter serves as notification of preliminary operations activities for this facility.

The following are anticipated dates of activities requiring notification in accordance with 40 CFR 60.7:

Facility Start-up

• Initial Solid Fuel Firing --	March 23, 1994

Continuous Emissions Monitoring System Testing

• Preliminary CEMS Testing -- (Preliminary Demo, RATA, Opacity Conditioning)	April 10, 1994
• 7-Day Drift Test --	May 1, 1994
• CEMS Performance Demo. & Certification --	May 1, 1994

If there are any questions or concerns regarding the above, please call Mr. Gary Aguinaga, Director of Environmental, Health and Safety, at (813) 665-2255.

Sincerely,

Rodney Williams

Rodney Williams
Plant Manager

RW/lc

cc: C. Wilson
G. Aguinaga
J.Rogers
M. Killeen
D. Raymond
EPA IV
Florida DEP - S. W. District
J. Reynolds
M. Harley

Florida Department of
Environmental Protection

Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Lawton Chiles
Governor

Virginia B. Wetherell
Secretary

November 23, 1993

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. Matthew P. Killeen
Manager, Environmental Permits
Ridge Generating Station, L.P.
400 N. New York Avenue, Suite 101
Winter Park, Florida 32789

Dear Mr. Killeen:

RE: Ridge Generating Station/Polk County
Permit No. AC53-206244/PSD-FL-183

The Department reviewed the proposed protocol for the test program required by Specific Condition No. 8 of the subject permit. It appears that the proposed protocol sufficiently covers all testing requirements. Therefore, Ridge Generating Station is authorized to proceed with implementation of the test program. However, if it is later determined that the protocol will result in any deviation from the permit conditions, the permit shall dictate requirements unless the Department agrees that the deviation is justified.

Sincerely,

C. H. Fancy, P.E.
Chief
Bureau of Air Regulation

CHF/JR/bb
c: B. Thomas, SWD
R. Anders, Polk County
J. Harper, EPA
C. Shaver, NPS

Is your RETURN ADDRESS completed on the reverse side?

SENDER:
- Complete items 1 and/or 2 for additional services.
- Complete items 3, and 4a & b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "Return Receipt Requested" on the mailpiece below the article number.
- The Return Receipt will show to whom the article was delivered and the date delivered.

I also wish to receive the following services (for an extra fee):

1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:

Mr. Matthew P. Killeen
Manager, Environmental Permits
Ridge Generating Station, L.P.
400 N. New York Avenue, Suite 101
Winter Park, Florida 32789

4a. Article Number
P 872 562 505

4b. Service Type
☐ Registered ☐ Insured
☒ Certified ☐ COD
☐ Express Mail ☐ Return Receipt for Merchandise

7. Date of Delivery
12-8-93

5. Signature (Addressee)

6. Signature (Agent)

8. Addressee's Address (Only if requested and fee is paid)

PS Form 3811, December 1991 ★U.S. GPO: 1992—323-402 **DOMESTIC RETURN RECEIPT**

Thank you for using Return Receipt Service.

P 872 562 505

Receipt for Certified Mail

UNITED STATES POSTAL SERVICE

No Insurance Coverage Provided
Do not use for International Mail
(See Reverse)

Sent to Mr. Matthew P. Killeen	
Street and No. 400 N. New York Avenue	
P.O., State and ZIP Code Winter Park, FL 32789	
Postage	$
Certified Fee	
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to Whom & Date Delivered	
Return Receipt Showing to Whom, Date, and Addressee's Address	
TOTAL Postage & Fees	$

Postmark or Date
AC53-206244/PSD-FL-183
Mailed: 12/06/93

PS Form 3800, JUNE 1991

RIDGE GENERATING STATION, L. P.

General Partners

DECKER ENERGY-RIDGE, INC. ***WHEELABRATOR POLK INC.***

400 North New York Avenue, Suite 101
Winter Park, Florida 32789
Tel. 407-628-8900
Fax. 407-628-8535

October 29, 1993

Mr. John Reynolds, P.E.
Florida Department of Environmental Protection
Division of Air Resource Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Re: Ridge Generating Station, Polk County
DER File No. AC 53-206244, PSD-FL-183

Dear Mr. Reynolds:

Pursuant to our telephone conversation on October 26, 1993 and Specific Condition 8 of the subject permit, a proposed protocol for the Comprehensive Emissions Testing Program is enclosed for your review and approval. The contractor is currently ahead of schedule and it is anticipated that the initial startup could occur early in March, 1994. We believe that the protocol includes all of the information required in the permit and that the approach for establishing the proposed emissions limits is reasonable. We would, however, be happy to meet with you to discuss the proposed protocol, if you feel that such a meeting would facilitate your review and approval.

Based on our telephone conversation, we have included the vent filter for the fuel transfer building in the proposed testing protocol and we will submit the additional details associated with this vent in the application for the operating permit. The addition of the fuel transfer building is beneficial because it will reduce the noise levels at the facility and the vent filter will reduce fugitive emissions.

Please call me at 1-800-682-0026 if you have questions or need any additional information. I will call you in a couple of weeks to determine if a meeting would be beneficial. Thank you for your assistance on this matter.

Very truly yours,

MPKilleen

Matthew P. Killeen
Manager, Environmental Permits

MPK220/ga

Att. - Two copies of Protocol

cc: Preston Lewis, P.E. (FLDEP) w/att.
D. Raymond
File Ridge 6.1

COMPREHENSIVE EMISSIONS TESTING PROGRAM PROTOCOL

for

RIDGE GENERATING STATION

3131 K-VILLE AVENUE

AUBURNDALE, POLK COUNTY, FL 33823

WHEELABRATOR ENVIRONMENTAL SYSTEMS, INC.

COMPREHENSIVE EMISSIONS TESTING PROGRAM PROTOCOL

for

RIDGE GENERATING STATION

3131 K-VILLE AVENUE

AUBURNDALE, POLK COUNTY, FL 33823

PSD-FL-183
FDEP AC 53-206244

Submitted by

WHEELABRATOR ENVIRONMENTAL SYSTEMS, INC.

LIBERTY LANE

HAMPTON, NH 03842

for

RIDGE GENERATING STATION LIMITED PARTNERSHIP

TABLE OF CONTENTS

APPENDICES

1.0 General Emissions Test Program Description

In lieu of the usual compliance test requirement, a Comprehensive Emissions Testing Program will be performed at the Ridge Generating Station. The Emissions Test Program will be representative of the full range of operation of the facility. The Comprehensive Emissions Test Program will include an initial stack test and three additional quarterly stack tests. The initial test and one additional quarterly test program will consist of stack emissions testing for each limited and additional pollutant at 100 percent capacity while operating at both 80 percent wood/20 percent tire feed and 100% wood feed. One of the additional quarterly programs will consist of testing for each limited pollutant at 75 and 100 percent capacity, as well as testing for the additional pollutants at 100 percent capacity while operating on 80 percent wood and 20 percent tire feed. The remaining additional quarterly program will consist of testing for each limited and additional pollutant at 100 percent capacity while operating at 80 percent wood and 20 percent tire feed.

2.0 Facility Description

The Ridge Generating Station located off State Road 542 and Taylor Road near Auburndale, Polk County, Florida is an electric power generation facility with a permitted capacity of 50 megawatts or 630 million Btu per hour. The boiler is a conventional wood-fired boiler with waterwall construction which will burn a mixture of wood, tires and landfill gas.

Wood loading to the boiler will be at a rate of 75-100 percent of the heat input. Tire loading to the boiler will be limited to 20 percent of the heat input. Landfill gas, when available, will represent 5-10 percent of the heat input. Propane is utilized for start-up, shutdown and combustion stabilization fuel.

Wood fuel is obtained from independent contractors, and includes the following materials: construction and demolition material, forest residuals/land clearing material, industrial wood wastes and wood derived from residential yard waste. The wood is processed (chipped) both onsite and offsite, stockpiled then reclaimed and delivered to the boiler in a minus 2-inch processed form. Tires are received both whole and chipped and are free from dirt, metal rims and other foreign materials. Tires are processed to 3-inch nominal material. Two covered conveyors separately transport the processed fuels to feed bins located at the boiler front. Landfill gas will be obtained from Polk County's North Central Landfill.

A combination of combustion controls and selective noncatalytic reduction (SNCR) is utilized to control NO_X emissions from the boiler. The air pollution control system for this facility consists of a spray dryer absorber (SDA) and fabric filter (FF) to control acid gases, metals and particulate matter. The SDA system is equipped with redundant slakers and multiple atomizers for the addition of the lime slurry for acid gas control.

The FF is designed for collection of flyash at all boiler loads. A pulse jet type bag cleaning system will clean the bags and direct the flyash to the ash removal system.

An Altech Continuous Emissions Monitoring System (CEMS) is located at the FF outlet to continuously monitor sulfur dioxide (SO_2), nitrogen oxides (NO & NO_2), Carbon Monoxide (CO), and on a wet basis, Oxygen (O_2), Moisture, opacity and flue gas volumetric flowrate for compliance purposes. The Altech system also includes a multipoint mass flow meter to determine stack gas volumetric flowrate. SO_2, NO_X and CO concentrations will be measured in parts per million and converted to lbs/hr utilizing the values obtained for flue gas volumetric flow and molecular weight. O_2, CO_2, and moisture concentrations will be measured in percent by volume.

3.0 Sampling Location Descriptions

3.1 Fabric Filter Outlet (Stack)

Exhaust gases from the Ridge Generating Station (RGS) boiler flow through ductwork to the spray dry absorber and subsequently to the fabric filter. The emissions test program will be performed at the outlet to the fabric filter upstream of the induced draft fan. The stack sampling location is a rectangular duct which is 107.5 inches wide by 84 inches deep which corresponds to an equivalent diameter of 94.3 inches. The stack test ports are located 211.7 inches or 2.3 diameters from the nearest upstream disturbance and 69 inches or 0.7 diameters from the nearest downstream disturbance. This location has sufficient straight run to meet EPA Method 1 sampling location requirements. Five test ports are situated equidistantly across the duct. The CEMS are also located at the FF outlet duct (see Appendix A for drawings).

3.2 Fugitive

During the initial emissions test program, fugitive emissions will be determined from the material receiving, processing, storage and transfer operations. In accordance with EPA Method 22, locations of potential fugitive emissions will be confirmed in the field prior to the start of an observation period.

3.3 Ambient

Based on Tampa, Florida wind measurements made at a height of 22 feet above ground level, the most common near-surface wind direction in the vicinity of the RGS facility is a direction from east to west. Wind rose data for the years 1982 through 1986 were used for this determination. This same wind rose data was used in the PSD modeling evaluation. As a result of this information, Ammonia emissions will be continuously monitored at a location west of the stack near the fenceline of the RGS property (see Appendix A for location).

4.0 Detailed Emissions Test Program

A Comprehensive Emissions Test Program will be conducted at the Ridge Generating Station facility located off State Road 542 and Taylor Road near Auburndale, Polk County, Florida. The test program will commence after the facility has had a shakedown period and is considered to be in normal operation. The emissions test program will consist of the following three efforts.

4.1 Stack Emissions Tests

4.1.1 Objective

The objective of the stack emission tests is to collect data to evaluate compliance with the current emission limits as well as to establish proposed emission limits for the current limited pollutants and assess limits for any additional pollutants. In addition to the limited pollutants listed in Table 4-1, emission rates of the additional pollutants listed in Table 4-2 will also be determined. The initial test program will include certification of the CEMS and the quarterly test programs will include cylinder gas audits of the CEMS. Visible and fugitive emissions at the RGS facility will be determined at the locations and in accordance with the EPA Methods found in Table 4-3. The visible and fugitive emissions testing will only be performed during the initial test program.

4.1.2 Process Operating Conditions

The Comprehensive Emissions Test Program will include an initial stack test and three additional quarterly stack tests. The initial test and one additional quarterly test program will consist of stack emissions testing for each limited and additional pollutant at 100 percent capacity while operating at both 80 percent wood/20 percent tire feed and 100% wood feed. One of the additional quarterly programs will consist of testing for each limited pollutant at 75 and 100 percent capacity, as well as testing for the additional pollutants at 100 percent capacity while operating on 80 percent wood and 20 percent tire feed. The remaining additional quarterly program will consist of testing for each limited and additional pollutant at 100 percent capacity while operating at 80 percent wood and 20 percent tire feed. Table 4-4 details the boiler conditions during the stack emissions tests.

Process information will be collected by the Bailey distributed control system throughout the emissions test program. Process measurements will be provided in hourly averages during each test period.

TABLE 4-1
LIMITED POLLUTANTS

Pollutant	EPA Test Method	# Runs	Run Duration	Location	Initial BACT Limitation*
PM/PM10	201A (front ½ only)	3	120 Min	Stack	12.6 lb/hr
SO_2	6C	3	60 Min	Stack	109.4 lb/hr
NOx	7E	3	60 Min	Stack	94.5 lb/hr
CO	10	3	60 Min	Stack	315.0 lb/hr
VOC	25A	3	60 Min	Stack	22.1 lb/hr
HCl	26	3	60 Min	Stack	5.0 lb/hr
Hg	29	3	120 Min	Stack	0.022 lb/hr
Pb	29	3	120 Min	Stack	0.25 lb/hr
Be	29	3	120 Min	Stack	0.0063 lb/hr

* Based on 24 hour average

TABLE 4-2
ADDITIONAL POLLUTANTS

Pollutant	EPA Test Method	# Runs	Run Duration	Location
Ammonia (NH_3)	26 - 0050	3	60 Min	Stack
Arsenic (As)	29	3	60 Min	Stack
Cadmium (Cd)	29	3	120 Min	Stack
Total Chromium (Cr)	29	3	120 Min	Stack
Chromium VI (Cr^{+6})	13B	3	120 Min	Stack
Zinc Oxide	29	3	120 Min	Stack
Benzene	18	3	60 Min	Stack
Sulfuric Acid (H_2SO_4)	8	3	120 Min	Stack
PCB's Total mono-deca Congeners	23	3	180 Min	Stack
Dioxins/Furans	23	3	180 Min	Stack

TABLE 4-3

VISIBLE/FUGITIVE EMISSIONS

PROCESS/LOCATION	EPA TEST METHOD	TEST DURATION	FDEP LIMITATION
Boiler Stack	9	60 Mins.	10%
Ash Handling Vent Filter	9	60 Mins.	10%
Lime Silo Vent Filter	9	60 Mins.	10%
Fuel Transfer Bldg. Vent Filter	9	60 Mins.	10%*
Receiving	22	3 Days	N/A
Processing	22	3 Days	N/A
Transfer	22	3 Days	N/A
Storage	22	3 Days	N/A

* This limitation will be confirmed prior to the test

TABLE 4-4

STACK EMISSIONS TESTING BOILER CONDITIONS*

	75% LOAD	100% LOAD	100% LOAD
Generator Output (MW)	37.5	50	50
Total Heat Input (MMBtu/hr)	473	630	630
Steam Flow (Klb/hr)**	259	345	345
Fuel Feed (Heat Input)			
• Wood (%)	80	80	100
• Tires (%)	20	20	-
Fuel Feed (weight)			
• Wood (lb/hr)	69,358	92,477	115,596
• Tires (lb/hr)	6,750	9,000	-
Stack Emissions Testing			
• Initial Compliance***	- -	Table 4-1 Table 4-2	Table 4-1 Table 4-2
• Additional Quarterly Tests			
- 1 Quarter	- -	Table 4-1 Table 4-2	Table 4-1 Table 4-2
- 1 Quarter	Table 4-1 -	Table 4-1 Table 4-2	- -
- 1 Quarter	- -	Table 4-1 Table 4-2	- -

* During the stack emissions testing, actual boiler conditions will be maintained within 10% of the values listed in this table.

** Actual determination of percent load will be based on steam flow.

*** Initial compliance will not included the 75% load condition due to the 30-day 100% capacity performance test.

The process data that will be collected will consist of the following:

1. Boiler Measurements
    a. Wood feed, lb/hr
    b. Tire feed, lb/hr
    c. Landfill gas, KPPH
    d. Propane, KPPH
    e. Generator Output, MW
    f. Steam production, klb/hr
    g. Furnace temperature, °F
    h. Furnace draft, inches H_2O
    i. Superheater outlet steam temperature, °F
    j. Superheater outlet steam pressure, psig
    k. Feed water flow, klb/hr
    l. Economizer water outlet temperature, °F
    m. Primary air heater gas outlet temperature, °F

2. Spray Dryer Absorber Measurements
    a. SDA inlet flue gas temperature, °F
    b. SDA outlet flue gas temperature, °F
    c. Lime slurry concentrations, %
    d. Dilution water flow, gpm
    e. SDA atomizer air flow, scfm
    f. SDA total slurry flow, gpm

3. Fabric Filter Measurements
    a. FF outlet flue gas temperature, °F
    b. FF pressure differential, inches H_2O

4. Hourly Plant CEM Data
    a. FF outlet - SO_2, NO_X, CO, opacity, stack gas volumetric flow
    b. Ambient - NH_3 (local recorder)

All test runs will be performed under normal, non-upset feed and operating conditions in order to obtain quality data. The wood and tire feed will represent the normal range of conditions for the facility. The following upset or atypical process conditions will be considered valid reasons for delaying or interrupting the testing:

1. Feed stoppage
2. Fan outage
3. Ash conveyor system shutdown
4. Turbine trip

5. Steam flow variation more than ±10% of setpoint
6. SDA malfunction
7. FF malfunction
8. SNCR Malfunction

4.1.3 Sampling and Analytical Procedures

The stack emissions tests will be performed in accordance with EPA reference methods as outlined in 40 CFR 60 Appendix A and SW 846. The specific methods to be performed are outlined in Tables 4-1 and 4-2 for each pollutant. EPA draft method 29 "Determination of metals emissions from stationary sources" will be performed for all metals listed in Tables 4-1 and 4-2. EPA reference methods 1 through 4 will be performed in support of each isokinetic test. Copies of the individual test methods can be found in Appendix B.

Visible emissions from the RGS boiler stack, ash handling area vent filter, lime silo vent filter and fuel transfer building vent filter will be determined in accordance with EPA method 9. Fugitive emissions from the material receiving, processing, and storage operations will be determined in accordance with EPA method 22 over a three day period during normal operation.

4.2 Long Term CEMS Data Collection for BACT Determination

4.2.1 Objective

The objective of the long term CEMS data collection is to establish final SO_2, NO_x and CO emission limits and averaging times. In addition, the feasibility of establishing emission limits specific to startup and shutdown periods will be evaluated. The CEMS consists of an Altech Model MCS 100 analyzer to continuously measure SO_2, NO_X, CO, O_2, CO_2 and moisture. Opacity will be determined continuously by a TECO Model 400 monitor. Stack gas volumetric flow will be determined by a Kurz Model 4500 flow monitor.

4.2.2 Process Operating Conditions

During the long term CEMS data collection, three operational periods will be identified. These three periods will be normal operation, startup and shutdown. Normal operation will be considered operation between 70 and 100 percent capacity with all equipment outlined in section 4.1.2 operating correctly. During normal operation the fuel ratios will range from 80-100 percent wood to 0-20 percent tires. Startup periods will be defined as the period of time before which solid fuel feed has been started and steady state conditions exist. Shutdown periods will be defined as the period of time after which solid fuel feed has been stopped and the boiler steam flow is less than 10% capacity. A shutdown may be the result of a malfunction or scheduled maintenance. During the long term CEMS data collection period, accurate records will be kept of normal operation, startup and shutdown periods.

4.2.3 Data Validation Procedures

A quality assurance/quality control (QA/QC) program will be followed in order to assure valid data is recorded during the long term CEMS data collection period. This program will include an initial CEMS certification (RATA), daily calibrations and subsequent cylinder gas audits (CGA) to include stack gas volumetric flow monitor calibrations. This QA/QC program will be performed in accordance with 40 CFR 60 Appendix B Performance Specifications 1, 2, 4 and 6 and 40 CFR 60 Appendix F Procedure 1.

4.3 Ambient Ammonia Monitoring

Ambient ammonia concentrations will be monitored at the Northwest corner fenceline of the RGS facility which has been determined to be the prevailing downwind location (see Appendix A). The ammonia monitor will be a TECO Model 17 chemiluminescence ammonia analyzer with converter, data logger and chart recorder. The equipment will be housed in a climate controlled shelter. The data will be collected from the initial startup through to the completion of the emissions test program. A meteorological station capable of measuring and recording wind speed and wind direction will be part of the ambient ammonia monitoring program. The Comprehensive Emissions Test Program report will include a discussion of this data and a recommendation related to the continuation of the ambient ammonia monitoring program.

5.0 Comprehensive Emissions Test Program Reporting

A Comprehensive Emissions Test Report will be submitted to the Florida Department of Environmental Protection - Southwest District Office within 15 months of initial startup of the facility. This report will include results of the stack emissions testing, long term CEMS data collection, ambient ammonia monitoring and the proposed emission limit determinations with revised BACT analyses.

Due to the amount of data which will be contained in the Comprehensive Emissions Test Report, a number of volumes will be needed. A sample would be to have Volume 1 contain a discussion of the overall test program, summary tables of the results of all efforts to include stack emissions tests, long term CEM data and ambient ammonia results as well as a discussion of the proposed BACT limitations. Volumes 2-5 would contain the stack emission test reports for the initial and quarterly testing. Volumes 6 and 7 would contain the long term CEM data.

The stack emissions test report will include at a minimum a list of relevant personnel present during testing, a summary of results, description of the test procedures used, description of the source and it's operation during testing, test location description, example calculations, raw field data, laboratory analyses with chain of custody documentation, copies of the EPA test methods and equipment calibrations.

The summary tables will contain average test results in units of standard, the corresponding permit limitations, as well as the process data recorded during each test run. Individual test run averages will be in the following units where applicable: lbs/hr, gr/dscf @ 12% CO_2 and 7% O_2, ng/m^3 @ 12% CO_2 and 7% O_2 and ppm @ 12% CO_2 and 7% O_2.

A sample stack emissions test report will be submitted for review to the FDEP-Southwest District Office prior to the field testing, once a contractor has been chosen to perform the emissions test program.

6.0 Proposed Emission Limit Determinations and BACT Analyses

6.1 General Approach

In accordance with PSD Permit Conditions 5, 16 and 17, the results of the comprehensive emission testing program will be used to establish compliance with the initial permit limits and to evaluate the feasibility of proposing revised emission limits and/or averaging times for the operating permit. Specifically, the manual stack testing results from the initial compliance and subsequent quarterly stack testing will be used to evaluate revised limits for VOC, HCl, Hg, Pb and Be.

Long term SO_2, NOx and CO data from the plant CEMS will be analyzed to propose final CEM emission limits and averaging times. In addition, the feasibility of establishing emission limits specific to startup and shutdown periods will be evaluated. The long term CEM data analyses results, in conjunction with the air pollution control equipment annualized costs, will be incorporated in the revised BACT application proposing final SO_2, NOx and CO emission limits. Generally, both the manual stack test results and long term CEM data will be evaluated using several statistical analyses techniques. These techniques will include:

- routine summary statistics (mean, standard deviation),

- time series plots to examine trends in emissions over time and to identify data anomalies,

- normality testing and frequency distribution plots to evaluate distribution of data, and

- determining maximum estimated emissions based on appropriate statistical mean standard deviation and confidence level.

It should be noted that analyses of the long term CEM data will appropriately account for emission variations that are directly related to variations in fuel composition. For long term normal boiler operations the fuel ratios will range from 75-100% wood to 0-20% tires, and the final emission limits proposed as a result of the emission test program will account for these variations.

6.2 Determination of Manual Stack Test Emission Limits

Results from the initial compliance and subsequent quarterly manual stack testing will be analyzed to propose final limits for the following permit limited pollutants: total volatile organics (VOC), Hydrogen Chloride (HCl), Mercury (Hg), Lead (Pb) and Beryllium (Be). Manual stack test results from the non-limited pollutants will be analyzed using the same procedure in the event that limits for these pollutants might be included in the operating permit.

The following procedure will be followed to develop proposed emission limits from the manual stack test results:

- When results are below the method detection limit, the detection limit will be used in the statistical analyses.

- The sample ($\bar{x}$) mean and standard deviation (s) will be calculated from all data.

- The single tail 99% upper confidence limit will be determined using the Student t Test.

- The proposed emission limit will set at the 99% single tailed upper confidence limit.

The Student t Test 99% upper confidence limit has been established as the basis for the proposed or new emission limits due to the very low number of test results that will be used in the analyses, the heterogeneity of the fuel, sampling analytical method precision and bias limits. The 99% upper confidence limit will provide the assurance that the final emission limits will not be exceeded for the term of the operating permit if periodic manual stack testing is required.

The Student t Test confidence limit determination is the standard confidence limit determination calculation used for small sample populations.

The Student t 99% upper confidence limit equation is:

CL_{99} = $\bar{x} + t_{99} \times s$, where:

CL_{99} = Student t upper 99% confidence limit

$\bar{x}$ = Mean of test results

s = Standard deviation of test results

t_{99} = Standard Student t value for 99% confidence interval for n-1 degree of freedom (no of results - 1)

6.3 Long Term CEM Emission Limit Determinations

The long term data for SO_2, NOx and CO will be reduced to hourly averages in both lbs/hour and ppm @ 7% O_2. Hourly averages will be segregated into startup/shutdown and normal operating periods. These boiler operating conditions will be evaluated separately to determine appropriate revised emission limits. The CEM hourly data will be analyzed as follows:

1. Time series plots will be developed to visually examine trends in SO_2, NOx and CO emissions over time and to identify data gaps or anomalies.

2. Data anomalies identified in time series plots will be compared to actual wood/tire fuel ratios for the concurrent time periods. If frequent or extensive anomalies are found that directly correlate to specific wood/tire firing ratios, then the affected hourly averages will be separated and the data set evaluated independently in accordance with steps 3-7 below.

3. Hourly data will be tested for normality using the Shapiro-Wilke Normality Test statistic. Since environmental data tends to be high tailed where there are many data values grouped together and a few larger values, using the natural logarithm (ln) of the data will provide a more normal distribution. Therefore, raw hourly data and logarithms of the hourly data will be tested for normality. It is important to establish the normality of the data because probability statistics such as the confidence limit depend on the underlying sample data to be normally distributed.

4. To evaluate the effect of averaging times on data variability and maximum emission rates, both the raw and ln transformed hourly data will be reduced as follows:

   - SO_2 Data - 24 hour block and rolling averages
   - NOx Data - 24 hour block and rolling averages
   - CO Data - 24 and 8 hour block and rolling averages

   Raw hourly CEM data collected during startup and shutdown periods will be evaluated in 3 and 8 hour rolling and block averages.

5. Routine statistics will be performed in the raw and ln hourly data, and averaging times. Data means and standard deviations will be calculated. For ln data, the geometric mean and standard deviation will be calculated.

6. Distribution of the various normal and ln averaging times will be tested for normality using the Shapiro-Wilke Normality Test statistic. The raw or ln averaging time that is more normally distributed will be selected as the averaging time for the proposed emission limit.

7. The 99% upper confidence limit using the Student t distribution will be calculated using the final averaging time data sets selected for each emission using the following equation:

   $CI_{99} = \bar{x} + t_{99} \times s$, where:

   CI_{99} = 99% one tailed upper confidence limit

   $\bar{x}$ = Mean of the averaging time data set

   s = Standard deviation of the data set

   t_{99} = Student t value from Student t table

   The 99% upper confidence limit will be proposed as the final CEM emission limits.

   The statistical and averaging times evaluated for boiler startup/shutdown periods will be used to calculate the 99% upper confidence limit for these data. As necessary, specific startup/shutdown emission limits will be proposed for the operating permit.

6.4 Revised BACT Analyses

In accordance with Specific Condition 16 and the initial BACT determination, a revised BACT application will be submitted with the emissions test program report. The revised BACT application will include proposed final enforceable BACT limits for SO_2, NOx and CO and detailed cost analyses of the installed air pollution control systems. As determined in the initial BACT determination, the revised BACT application will be limited to SO_2, NOx and CO emissions where BACT/LAER clearinghouse data was used as the basis for the target emission limits for these emissions.

6.4.1 Final BACT Emission Limit

The final emission limits for SO_2, NOx and CO determined in CEM data analyses will not be used for the revised BACT determination cost analyses since there is a distinct difference between an enforceable "not to exceed" permit emission limit and the hourly average emission used to calculate annual emission reductions. These final proposed (upper 99% confidence limit) enforceable limits will represent the lowest level of emissions continuously achievable for the operating life of the facility which reflect the top control technologies selected in the initial BACT determination. Selection of the final emission limits at the 99% upper confidence limit will ensure that any reported excess emission will not be the result of natural fuel variations given that the boiler and air pollution control systems are being operated in a normal manner at the design control efficiencies. A conservative approach is warranted since this is the first facility of this type that will be combusting wood and tires simultaneously, and long term emission variations are unknown. The average 24 hour block average emissions rates for SO_2 and NOx will be used in conjunction with the design control efficiencies specified in the initial BACT application to calculate uncontrolled emissions for use as necessary in the BACT cost analyses.

6.4.2 BACT Cost Analyses

The BACT cost analyses will be specific for SO_2, and NOx emissions since operating costs for the respective best control technologies can be specifically defined. A cost analyses based on the final CO BACT emission limit will not be meaningful because operating costs for the good combustion practice best control technology cannot be accurately defined.

The capital and operating costs associated with the NOx and SO_2 best available control technologies will be based on the actual construction cost and from operating costs over the first year of facility operation.

Construction costs will include all costs associated with turnkey operation such as design, equipment purchase, and installation. Operating costs will include reagent usage, energy costs and routine repair and maintenance.

Cost effectiveness will be calculated using the annualized costs (annualized capital and operating) and total annual tons of SO_2 and NOx removed for the respective best control technology. Annual tons of pollutant removal will be calculated based on 100% annual boiler availability (8,760 hours/year). The average of the 24-block average and SO_2 and NOx CEM data from the emission test period will be used to calculate the annual uncontrolled pollutant emissions in accordance with the following equation:

$$E_a = \frac{8760 \text{ x } (\bar{x}_{24} \div (1 - RE/100))}{2000}, \text{ where:}$$

E_a = Total annual uncontrolled emission (tons/year)

$\bar{x}_{24}$ = Average of 24-hour block averages (lbs/hr)

RE = Air pollution control technology removal Efficiency (Thermal DeNOx = 40% and SDA/FF = 80%)

The total annual tons of pollutant removed will be calculated as follows:

$$T_R = \frac{E_a - (8760 \text{ hours x } \bar{x}_{24})}{2000}, \text{ where:}$$

T_R = Total annual emissions removed (tons/year)

E_a = Total annual uncontrolled emissions (tons/year)

$\bar{x}_{24}$ = Average of the 24-hour block averages (lbs/hr)

The cost effectiveness is then calculated by the following equation:

$CE = C_a/T_R$

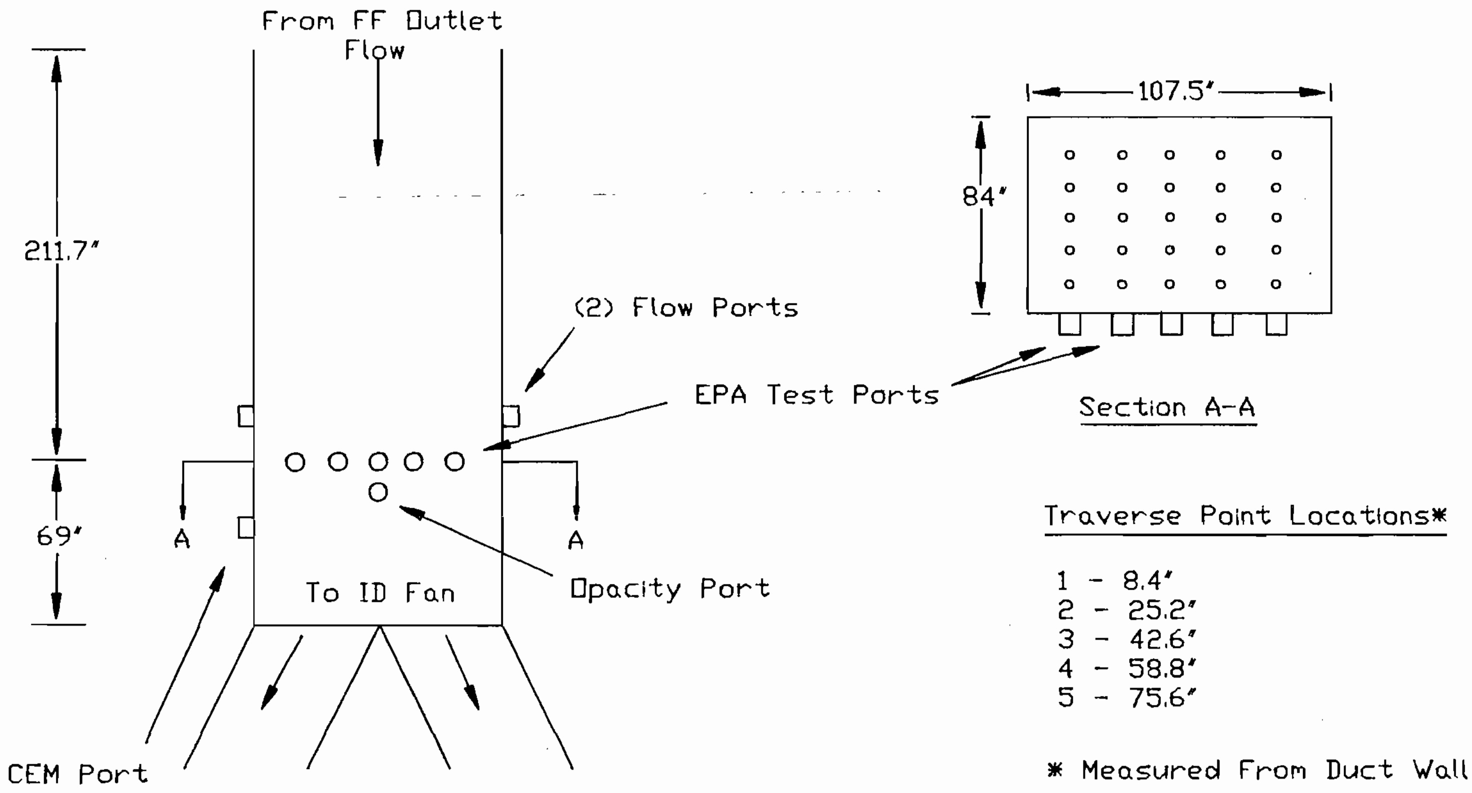
CE = Cost Effectiveness - \$/ton removed

T_R = Total annual emissions removed

C_a = Total Annualized Costs

APPENDIX A

Sample Location Drawings



Traverse Point Locations*

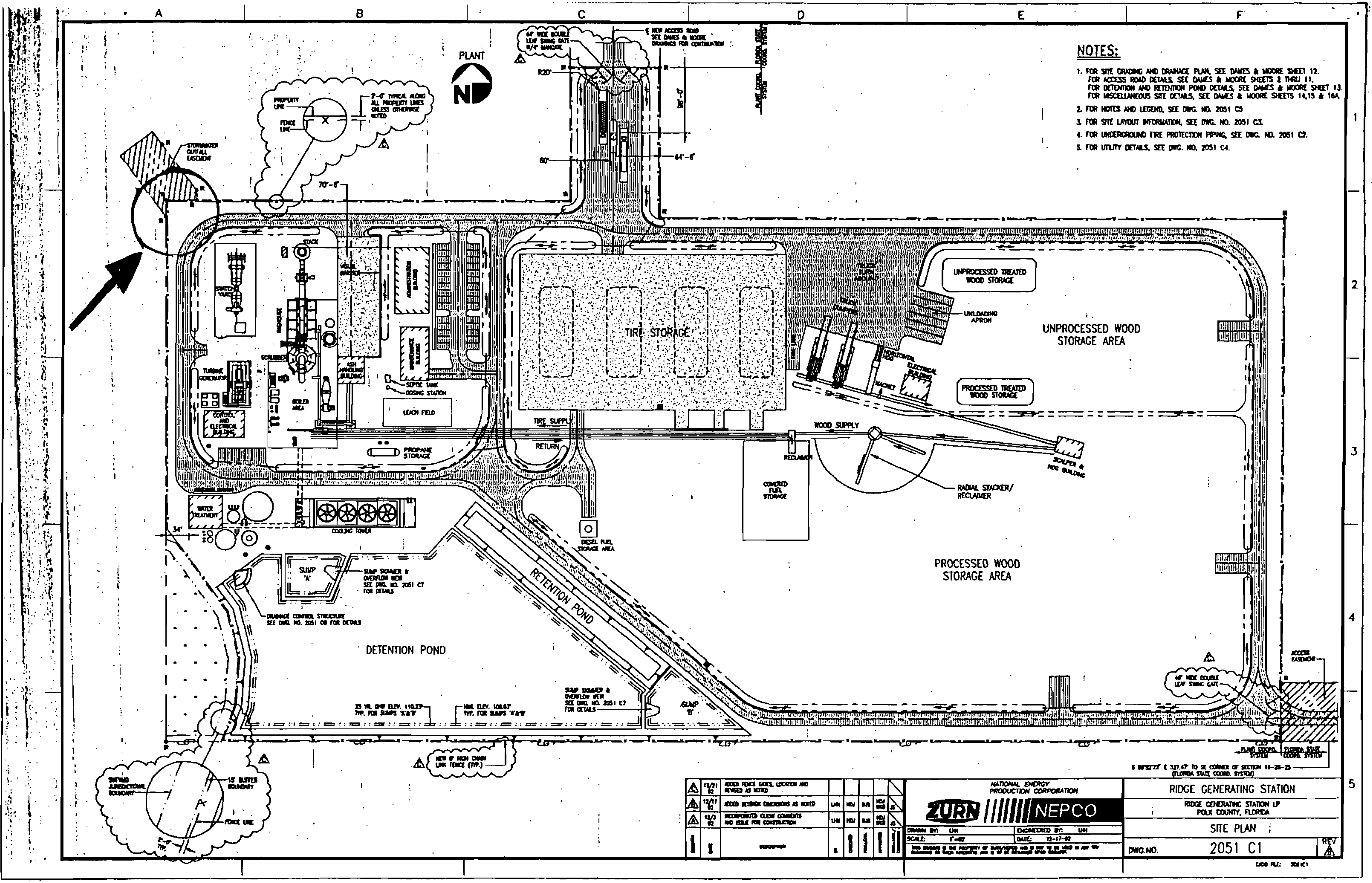
1 - 8.4″
2 - 25.2″
3 - 42.6″
4 - 58.8″
5 - 75.6″

* Measured From Duct Wall

Not Drawn to Scale

Stack Location Schematic

AMBIENT AMMONIA MONITOR LOCATION



APPENDIX B

EPA Sampling Methodologies

Method 1—Sample and Velocity Traverses for Stationary Sources

1. Principle and Applicability

1.1 Principle. To aid in the representative measurement of pollutant emissions and/or total volumetric flow rate from a stationary source, a measurement site where the effluent stream is flowing in a known direction is selected, and the cross-section of the stack is divided into a number of equal areas. A traverse point is then located within each of these equal areas.

1.2 Applicability. This method is applicable to flowing gas streams in ducts, stacks, and flues. The method cannot be used when: (1) flow is cyclonic or swirling (see Section 2.4), (2) a stack is smaller than about 0.30 meter (12 in.) in diameter, or 0.071 m² (113 in.2) cross-sectional area, or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

The requirements of this method must be considered before construction of a new facility from which emissions will be measured; failure to do so may require subsequent alterations to the stack or deviation from the standard procedure. Cases involving variants are subject to approval by the Administrator, U.S. Environmental Protection Agency.

[illegible] Procedure

2.1 Selection of Measurement Site. Sampling or velocity measurement is performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and a half diameter upstream from any flow disturbance. For a rectangular cross section, an equivalent diameter (De) shall be calculated from the following equation, to determine the upstream and downstream distances:

$$De = \frac{2LW}{(L+W)}$$

Where L = length and W = width.

An alternative procedure is available for determining the acceptability of a measurement location not meeting the criteria above. This precedure, [illegible]termination of gas flow angles at the [illegible]mpling points and comparing the results with acceptability criteria, is described in Section 2.5.

2.2 Determining the Number of Traverse Points.

2.2.1 Particulate Traverses. When the eight— and two-diameter criterion can be met, the minimum number of traverse points shall be: (1) twelve, for circular or rectangular stacks with diameters (or equivalent diameters) greater than 0.61 meter (24 in.); (2) eight, for circular stacks with diameters between 0.30 and 0.61 meter (12-24 in.); (3) nine, for rectangular stacks with equivalent diameters between 0.30 and 0.61 meter (12-24 in.).

When the eight— and two-diameter criterion cannot be met, the minimum number of traverse points is determined from Figure 1-1. Before referring to the figure, however, determine the distances from the chosen measurement site to the nearest upstream and downstream disturbances, and divide each distance by the stack diameter or equivalent diameter, to determine the distance in terms of the number of duct diameters. Then, determine from Figure 1-1 the minimum number of traverse points that corresponds: (1) to the number of duct diameters upstream; and (2) to the number of diameters downstream. Select the higher of the two minimum numbers of traverse points, or a greater value, so that for circular stacks the number is a multiple of 4, and for rectangular stacks, the number is one of those shown in Table 1-1.

Table 1-1. Cross-Section Layout for Rectangular Stacks

Number of traverse points	Matrix layout
9	3x3
12	4x3
16	4x4
20	5x4
25	5x5
30	6x5
36	6x6
42	7x6
49	7x7

2.2.2 Velocity (Non-Particulate) Traverses. When velocity or volumetric flow rate is to be determined (but not particulate matter), the same procedure as that for particulate traverses (Section 2.2.1) is followed, except that Figure 1-2 may be used instead of Figure 1-1.

2.3 Cross-sectional Layout and Location of Traverse Points.

2.3.1 Circular Stacks. Locate the traverse points on two perpendicular diameters according to Table 1-2 and the example shown in Figure 1-3. Any equation (for examples, see Citations 2 and 3 in the Bibliography) that gives the same values as those in Table 1-2 may be used in lieu of Table 1-2.

For particulate traverses, one of the diameters must be in a plane containing the greatest expected concentration variation, e.g., after bends, one diameter shall be in the plane of the bend. This requirement

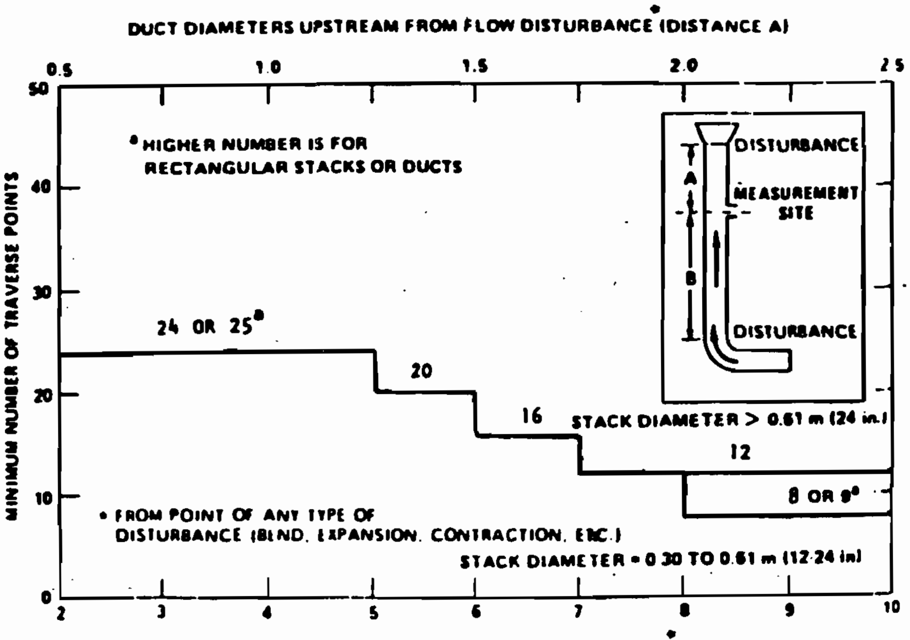


Figure 1-1. Minimum number of traverse points for particulate traverses.

becomes less critical as the distance from the disturbance increases; therefore, other diameter locations may be used, subject to approval of the Administrator.

In addition for stacks having diameters greater than 0.61 m (24 in.) no traverse points shall be located within 2.5 centimeters (1.00 in.) of the stack walls; and for stack diameters equal to or less than 0.61 m (24 in.), no traverse points shall be located within 1.3 cm (0.50 in.) of the stack walls. To meet these criteria, observe the procedures given below.

2.3.1.1 Stacks With Diameters Greater Than 0.61 m (24 in.). When any of the traverse points as located in Section 2.3.1 fall within 2.5 cm (1.00 in.) of the stack walls, relocate them away from the stack walls to: (1) a distance of 2.5 cm (1.00 in.); or (2) a distance equal to the nozzle inside diameter, whichever is larger. These relocated traverse points (on each end of a diameter) shall be the "adjusted" traverse points.

Whenever two successive traverse points are combined to form a single adjusted traverse point, treat the adjusted point as two separate traverse points, both in the sampling (or velocity measurement) procedure, and in recording the data.

2.3.1.2 Stacks With Diameters Equal to or Less Than 0.61 m (24 in.). Follow the procedure in Section 2.3.1.1, noting only that any "adjusted" points should be relocated away from the stack walls to: (1) a distance of 1.3 cm (0.50 in.); or (2) a distance equal to the nozzle inside diameter, whichever is larger.

2.3.2 Rectangular Stacks. Determine the number of traverse points as explained in Sections 2.1 and 2.2 of this method. From Table 1-1, determine the grid configuration. Divide the stack cross-section into as many equal rectangular elemental areas as traverse points, and then locate a traverse point at the centroid of each equal area according to the example in Figure 1-4.

If the tester desires to use more than the minimum number of traverse points, expand the "minimum number of traverse points" matrix (see Table 1-1) by adding the extra traverse points along one or the other or both legs of the matrix; the final matrix need not be balanced. For example, if a 4x3 "minimum number of points" matrix were expanded to 36 points, the final matrix could be 9x4 or 12x3, and would not necessarily have to be 6x6. After constructing the final matrix, divide the stack cross-section into as many equal rectangular, elemental areas as traverse points, and locate a traverse point at the centroid of each equal area.

The situation of traverse points being too close to the stack walls is not expected to arise with rectangular stacks. If this problem should ever arise, the Administrator must be contacted for resolution of the matter.

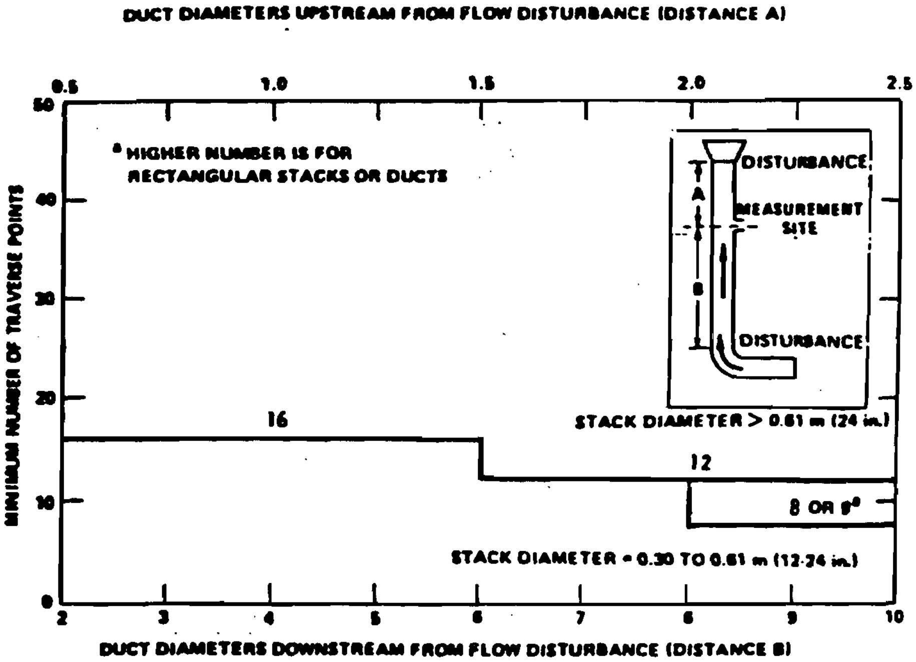


Figure 1-2. Minimum number of traverse points for velocity (nonparticulate) traverses.

TRAVERSE POINT	DISTANCE. % of diameter
1	4.4
2	14.7
3	29.5
4	70.5
5	85.3
6	95.6

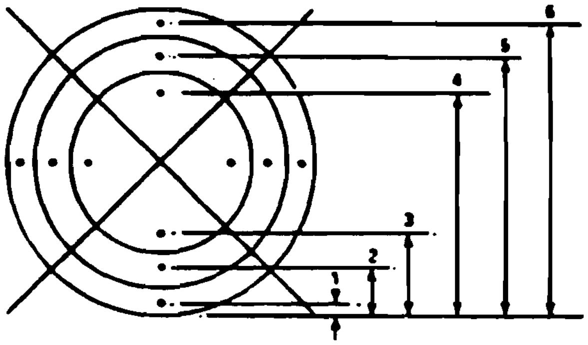


Figure 1-3. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points indicated.

TABLE 1-2. LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

[Percent of stack diameter from inside wall to traverse point]

Traverse point number on a diameter	Number of traverse points on a diameter—											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.4	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6	80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	18.1
8				96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.2	23.0
10					97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.8	67.7
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										96.1	91.3	86.8
20										98.7	94.0	89.5

TABLE 1-2. LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS—Continued

[Percent of stack diameter from inside wall to traverse point]

Traverse point number on a diameter	Number of traverse points on a diameter—											
	2	4	6	8	10	12	14	16	18	20	22	24
21											96.5	92.1
22											98.9	94.5
23												96.8
24												98.9

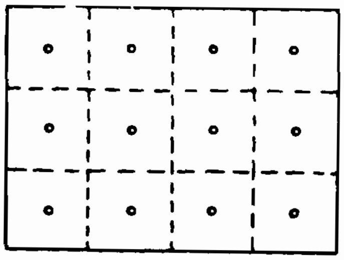


Figure 1-4. Example showing rectangular stack cross section divided into 12 equal areas, with a traverse point at centroid of each area.

2.4 Verification of Absence of Cyclonic Flow. In most stationary sources, the direction of stack gas flow is essentially parallel to the stack walls. However, cyclonic flow may exist (1) after such devices as cyclones and inertial demisters following venturi scrubbers, or (2) in stacks having tangential inlets or other duct configurations which tend to induce swirling; in these instances, the presence or absence of cyclonic flow at the sampling location must be determined. The following techniques are acceptable for this determination.

Level and zero the manometer. Connect a Type S pitot tube to the manometer. Position the Type S pitot tube at each traverse point, in succession, so that the planes of the face openings of the pitot tube are perpendicular to the stack cross-sectional plane; when the Type S pitot tube is in this position, it is at "0°reference." Note the differential pressure (delta p) reading at each traverse point. If a null (zero) pitot reading is obtained at 0°reference at a given traverse point, an acceptable flow condition exists at that point. If the pitot reading is not zero at 0°reference, rotate the pitot tube (up to ± 90°yaw angle), until a null reading is obtained. Carefully determine and record the value of the rotation angle (α) to the nearest degree. After the null technique has been applied at each traverse point, calculate the average of the absolute values of α; assign α values of 0°to those points for which no rotation was required, and include these in the overall average. If the average value of α is greater than 20°, the overall flow condition in the stack is unacceptable and alternative methodology, subject to the approval of the Administrator, must be used to perform accurate sample and velocity traverses.

The alternative procedure described in Section 2.5 may be used to determine the rotation angles in lieu of the procedure described above.

2.5 Alternative Measurement Site Selection Procedure. This alternative applies to sources where measurement locations are less than 2 equivalent stack or duct diameters downstream or less than ½ duct diameter upstream from a flow disturbance. The alternative should be limited to ducts larger than 24 in. in diameter where blockage and wall effects are minimal. A directional flow-sensing probe is used to measure pitch and yaw angles of the gas flow at 40 or more traverse points; the resultant angle is calculated and compared with acceptable criteria for mean and standard deviation.

Note: Both the pitch and yaw angles are measured from a line passing through the traverse point and parallel to the stack axis. The pitch angle is the angle of the gas flow component in the plane that INCLUDES the traverse line and is parallel to the stack axis. The yaw angle is the angle of the gas flow component in the plane PERPENDICULAR to the traverse line at the traverse point and is measured from the line passing through the traverse point and parallel to the stack axis.

2.5.1 Apparatus.

2.5.1.1 Directional Probe. Any directional probe, such as United Sensor Type DA Three-Dimensional Directional Probe, capable of measuring both the pitch and yaw angles of gas flows is acceptable. (Note: Mention of trade name or specific products does not constitute endorsement by the U.S. Environmental Protection Agency.) Assign an identification number to the directional probe, and permanently mark or engrave the number on the body of the probe. The pressure holes of directional probes are susceptible to plugging when used in particulate-laden gas streams. Therefore, a system for cleaning the pressure holes by "back-purging" with pressurized air is required.

2.5.1.2 Differential Pressure Gauges. Inclined manometers, U-tube manometers, or other differential pressure gauges (e.g., magnehelic gauges) that meet the specifications described in Method 2, section 2.2.

Note: If the differential pressure gauge produces both negative and positive readings, then both negative and positive pressure readings shall be calibrated at a minimum of three points as specified in Method 2, section 2.2.

2.5.2 Traverse Points. Use a minimum of 40 traverse points for circular ducts and 42 points for rectangular ducts for the gas flow angle determinations. Follow section 2.3 and Table 1-1 or 1-2 for the location and layout of the traverse points. If the measurement location is determined to be acceptable according to the criteria in this alternative procedure, use the same traverse point number and locations for sampling and velocity measurements.

2.5.3 Measurement Procedure.

2.5.3.1 Prepare the directional probe and differential pressure gauges as recommended by the manufacturer. Capillary tubing or surge tanks may be used to dampen pressure fluctuations. It is recommended, but not required, that a pretest leak check be conducted. To perform a leak check, pressurize or use suction on the impact opening until a reading of at least 7.6 cm (3 in.) H_2O registers on the differential pressure gauge, then plug the impact opening. The pressure of a leak-free system will remain stable for at least 15 seconds.

2.5.3.2 Level and zero the manometers. Since the manometer level and zero may drift because of vibrations and temperature changes, periodically check the level and zero during the traverse.

2.5.3.3 Position the probe at the appropriate locations in the gas stream, and rotate until zero deflection is indicated for the yaw angle pressure gauge. Determine and record the yaw angle. Record the pressure gauge readings for the pitch angle, and determine the pitch angle from the calibration curve. Repeat this procedure for each traverse point. Complete a "back-purge" of the pressure lines and the impact openings prior to measurements of each traverse point.

A post-test check as described in section 2.5.3.1 is required. If the criteria for a leak-free system are not met, repair the equipment, and repeat the flow angle measurements.

2.5.4 Calculate the resultant angle at each traverse point, the average resultant angle, and the standard deviation using the following equations. Complete the calculations retaining at least one extra significant figure beyond that of the acquired data. Round the values after the final calculations.

2.5.4.1 Calculate the resultant angle at each traverse point:

$$R_i = \text{arc cosine}\,[(\text{cosine } Y_i)(\text{cosine } P_i)] \qquad \text{Eq. 1-2}$$

Where:
R_i = Resultant angle at traverse point i, degree.
Y_i = Yaw angle at traverse point i, degree.
P_i = Pitch angle at traverse point i, degree.

2.5.4.2 Calculate the average resultant for the measurements:

$$\bar{R} = \frac{\Sigma R_i}{n} \qquad \text{Eq. 1-3}$$

Where:
R *bar* = Average resultant angle, degree.
n = Total number of traverse points.

2.5.4.3 Calculate the standard deviations:

$$S_d = \sqrt{\frac{\sum_{i=1}^{n} (R_i - \bar{R})^2}{(n-1)}} \qquad \text{Eq. 1-4}$$

Where:

Sd = Standard deviation, degree.

2.5.5 The measurement location is acceptable if R *bar* ≤ 20° and Sd ≤ 10°.

2.5.6 Calibration. Use a flow system as described in Sections 4.1.2.1 and 4.1.2.2 of Method 2. In addition, the flow system shall have the capacity to generate two test-section velocities: one between 365 and 730 m/min (1200 and 2400 ft/min) and one between 730 and 1100 m/min (2400 and 3600 ft/min).

2.5.6.1 Cut two entry ports in the test section. The axes through the entry ports shall be perpendicular to each other and intersect in the centroid of the test section. The ports should be elongated slots parallel to the axis of the test section and of sufficient length to allow measurement of pitch angles while maintaining the pitot head position at the test-section centroid. To facilitate alignment of the directional probe during calibration, the test section should be constructed of plexiglass or some other transparent material. All calibration measurements should be made at the same point in the test section, preferably at the centroid of the test-section.

2.5.6.2 To ensure that the gas flow is parallel to the central axis of the test section, follow the procedure in Section 2.4 for cyclonic flow determination to measure the gas flow angles at the centroid of the test section from two test ports located 90° apart. The gas flow angle measured in each port must be ± 2° of 0°. Straightening vanes should be installed, if necessary, to meet this criterion.

2.5.6.3 Pitch Angle Calibration. Perform a calibration traverse according to the manufacturer's recommended protocol in 5° increments for angles from -60° to +60° at one velocity in each of the two ranges specified above. Average the pressure ratio values obtained for each angle in the two flow ranges, and plot a calibration curve with the average values of the pressure ratio (or other suitable measurement factor as recommended by the manufacturer) versus the pitch angle. Draw a smooth line through the data points. Plot also the data values for each traverse point. Determine the differences between the measured data values and the angle from the calibration curve at the same pressure ratio. The difference at each comparison must be within 2° for angles between 0° and 40° and within 3° for angles between 40° and 60°.

2.5.6.4 Yaw Angle Calibration. Mark the three-dimensional probe to allow the determination of the yaw position of the probe. This is usually a line extending the length of the probe and aligned with the impact opening. To determine the accuracy of measurements of the yaw angle, only the zero or null position need be calilbrated as follows. Place the directional probe in the test section, and rotate the probe until the zero position is found. With a protractor or other angle measuring device, measure the angle indicated by the yaw angle indicator on the three-dimensional probe. This should be within 2° of 0°. Repeat this measurement for any other points along the length of the pitot where yaw angle measurements could be read in order to account for variations in the pitot markinga used to indicate pitot head positions.

3. Bibliography

1. Determining Dust Concentration in a Gas Stream, ASME. Performance Test Code No. 27. New York, 1957.

2. Devorkin, Howard, et al. Air Pollution Source Testing Manual. Air Pollution Control District. Los Angeles, CA November 1963.

3. Methods for Determination of Velocity, Volume, Dust and Mist Content of Gases. Western Precipitation Division of Joy Manufacturing Co. Los Angeles, CA. Bulletin WP-50. 1968.

4. Standard Method for Sampling Stacks for Particulate Matter. In: 1971 Book of ASTM Standards, Part 23. ASTM Designation D-2928-71. Philadelphia, PA 1971.

5. Hanson, H. A., et al. Particulate Sampling Strategies for Large Power Plants Including Nonuniform Flow. USEPA, ORD, ESRL, Research Triangle Park, NC. EPA-600/2-76-170, June 1976.

6. Entropy Environmentalists, Inc. Determination of the Optimum Number of Sampling Points: An Analysis of Method 1 Criteria. Environmental Protection Agency, Research Triangle Park, NC. EPA Contract No. 68-01-3172, Task 7.

7. Hanson, H.A., R.J. Davini, J.K. Morgan, and A.A. Iversen. Particulate Sampling Strategies for Large Power Plants Including Nonuniform Flow. U.S. Environmental Protection Agency. Research Triangle Park, NC. Publication No. EPA-600/2-76-170. June 1976. 350 p.

8. Brooks, E.F., and R.L. Williams. Flow and Gas Sampling Manual. U.S. Environmental Protection Agency. Research Triangle Park, NC. Publication No. EPA-600/2-76-203. July 1976. 93 p.

9. Entropy Environmentalists, Inc. Traverse Point Study. EPA Contract No. 68-02-3172. June 1977. 19 p.

10. Brown, J. and K. Yu. Test Report: Particulate Sampling Strategy in Circular Ducts. Emission Measurement Branch, Emission Standards and Engineering Division. U.S. Environmental Protection Agency, Research Triangle Park, NC. 27711. July 31, 1980. 12 p.

11. Hawksley, P.G.W., S. Badzioch, and J.H. Blackett. Measurement of Solids in Flue Gases. Leatherhead, England, The British Coal Utilisation Research Association, 1961. p. 129-133.

12. Knapp, K.T. The Number of Sampling Points Needed for Representative Source Sampling. In: Proceedings of the Fourth National Conference on Energy and the Environment, Theodore, L., et al. (ed.). Dayton, Dayton Section of the American Institute of Chemical Engineers. October 3-7, 1976. p. 563-568.

13. Smith, W.S. and D.J. Grove. A Proposed Extension of EPA Method 1 Criteria. "Pollution Engineering." XV (8):36-37. August 1983.

14. Gerhart, P.M. and M.J. Dorsey. Investigation of Field Test Procedures for Large Fans. University of Akron. Akron, OH. (EPRI Contract CS-1651). Final Report (RP-1649-5) December 1980.

15. Smith, W.S. and D.J. Grove. A New Look at Isokinetic Sampling——Theory and Applications. "Source Evaluation Society Newsletter." VIII (3):19-24. August 1983.

Method 2—Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)

1. Principle and Applicability

1.1 Principle. The average gas velocity in a stack is determined from the gas density and from measurement of the average velocity head with a Type S (Stausscheibe or reverse type) pitot tube.

1.2 Applicability. This method is applicable for measurement of the average velocity of a gas stream and for quantifying gas flow.

This procedure is not applicable at measurement sites which fail to meet the criteria of Method 1, Section 2.1. Also, the method cannot be used for direct measurement in cyclonic or swirling gas streams; Section 2.4 of Method 1 shows how to determine cyclonic or swirling flow conditions. When unacceptable conditions exist, alternative procedures, subject to the approval of the Administrator, U.S. Environmental Protection Agency, must be employed to make accurate flow rate determinations; examples of such alternative procedures are: (1) to install straightening vanes; (2) to calculate the total volumetric flow rate stoichiometrically, or (3) to move to another measurement site at which the flow is acceptable.

2. Apparatus

Specifications for the apparatus are given below. Any other apparatus that has been demonstrated (subject to approval of the Administrator) to be capable of meeting the specifications will be considered acceptable.

2.1 Type S Pitot Tube. The Type S pitot tube (Figure 2-1) shall be made of metal tubing (e.g., stainless steel). It is recommended that the external tubing diameter (dimension Dt Figure 2-2b) be between 0.48 and 0.95 centimeter (3/16 and 3/8 inch). There shall be an equal distance from the base of each leg of the pitot tube to its face-opening plane (dimensions PA and PB Figure 2-2b); it is recommended that this distance be between 1.05 and 1.50 times the external tubing diameter. The face openings of the pitot tube shall, preferably, be aligned as shown in Figure 2-2; however, slight misalignments of the openings are permissible (see Figure 2-3).

The Type S pitot tube shall have a known coefficient, determined as outlined in Section 4. An identification number shall be assigned to the pitot tube; this number shall be permanently marked or engraved on the body of the tube.

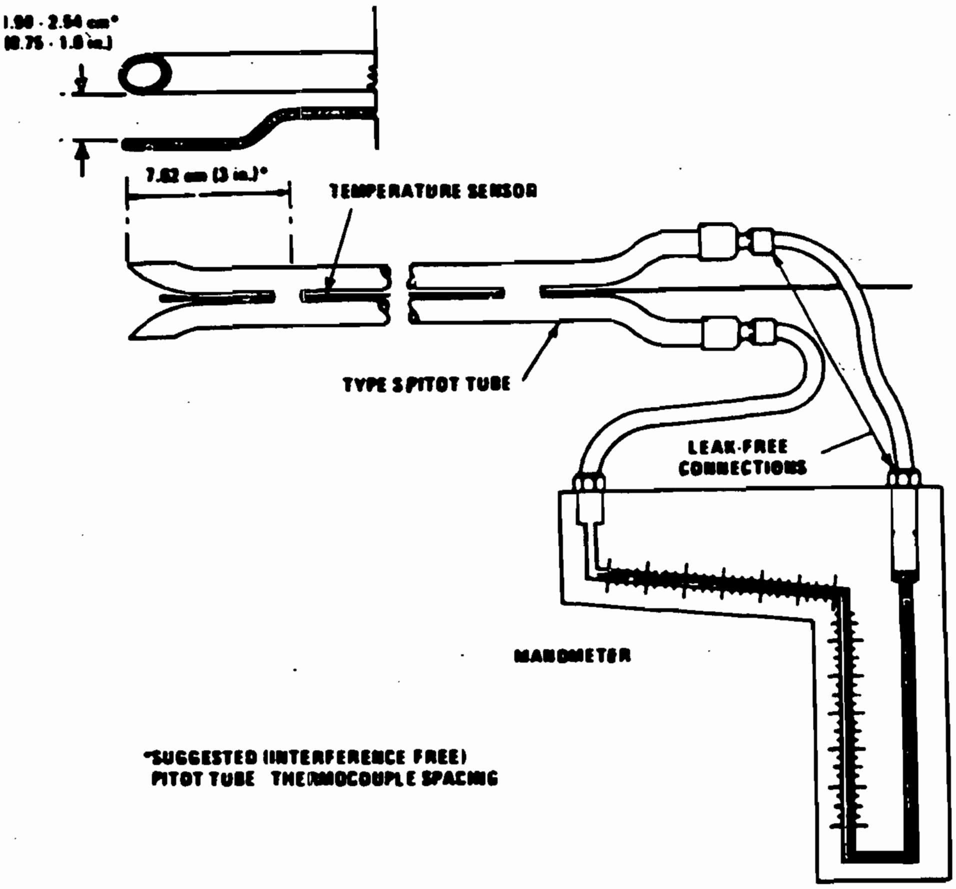


Figure 2-1. Type S pitot tube manometer assembly.

Figure 2-2. Properly constructed Type S pitot tube, shown in: (a) end view; face opening planes perpendicular to transverse axis; (b) top view; face opening planes parallel to longitudinal axis; (c) side view; both legs of equal length and centerlines coincident, when viewed from both sides. Baseline coefficient values of 0.84 may be assigned to pitot tubes constructed this way.

Figure 2-3. Types of face-opening misalignment that can result from field use or improper construction of Type S pitot tubes. These will not affect the baseline value of Cp(s) so long as α_1 and $\alpha_2 \leq 10°$, β_1 and $\beta_2 \leq 5°$, $z \leq 0.32$ cm (1/8 in.) and $w \leq 0.08$ cm (1/32 in.) (citation 11 in Bibliography).

A standard pitot tube may be used instead of a Type S, provided that it meets the specifications of Sections 2.7 and 4.2; note, however, that the static and impact pressure holes of standard pitot tubes are susceptible to plugging in particulate-laden gas streams. Therefore, whenever a standard pitot tube is used to perform a traverse, adequate proof must be furnished that the openings of the pitot tube have not plugged up during the traverse period; this can be done by taking a velocity head (delta p) reading at the final traverse point, cleaning out the impact and static holes of the standard pitot tube by "back-purging" with pressurized air, and then taking another delta p reading. If the delta p readings made before and after the air purge are the same (± 5 percent), the traverse is acceptable. Otherwise, reject the run. Note that if delta p at the final traverse point is unsuitably low, another point may be selected. If "back-purging" at regular intervals is part of the procedure, then comparative delta p readings shall be taken, as above, for the last two back purges at which suitably high delta p readings are observed.

2.2 Differential Pressure Gauge. An inclined manometer or equivalent device is used. Most sampling trains are equipped with a 10—in. (water column) inclined-vertical manometer, having 0.01—in. H_2O divisions on the 0-to 1—in. inclined scale, and 0.1—in. H_2O divisions on the 1— to 10—in. vertical scale. This type of manometer (or other gauge of equivalent sensitivity) is satisfactory for the measurement of delta p values as low as 1.3 mm (0.05 in.) H2O. However, a differential pressure gauge of greater sensitivity shall be used (subject to the approval of the Administrator), if any of the following is found to be true: (1) the arithmetic average of all delta p readings at the traverse points in the stack is less than 1.3 mm (0.05 in.) H2O; (2) for traverses of 12 or more points, more than 10 percent of the individual delta p readings are below 1.3 mm (0.05 in.) H2O; (3) for traverses of fewer than 12 points, more than one delta p reading is below 1.3 mm (0.05 in.) H2O. Citation 18 in Bibliography describes commercially available instrumentation for the measurement of low-range gas velocities.

As an alternative to criteria (1) through (3) above, the following calculation may be performed to determine the necessity of using a more sensitive differential pressure gauge:

$$T=\frac{\sum_{i=1}^{n}\sqrt{\Delta p_i+K}}{\sum_{i=1}^{n}\sqrt{\Delta p_i}}$$

Where:

delta pi = Individual velocity head reading at a traverse point, mm H2O (in. H2O).

n = Total number of traverse points.

K = 0.13 mm H2O when metric units are used and 0.005 in. H2O when English units are used.

If T is greater than 1.05, the velocity head data are unacceptable and a more sensitive differential pressure gauge must be used.

Note: If differential pressure gauges other than inclined manometers are used (e.g., magnehelic gauges), their calibration must be checked after each test series. To check the calibration of a differential pressure gauge, compare delta p readings of the gauge with those of a gauge-oil manometer at a minimum of three points, approximately representing the range of delta p values in the stack. If, at each point, the values of delta p as read by the differential pressure gauge and gauge-oil manometer agree to within 5 percent, the differential pressure gauge shall be considered to be in proper calibration. Otherwise, the test series shall either be voided, or procedures to adjust the measured delta p values and final results shall be used subject to the approval of the Administrator.

2.3 Temperature Gauge. A thermocouple, liquid-filled bulb thermometer, bimetallic thermometer, mercury—in—glass thermometer, or other gauge, capable of measuring temperature to within 1.5 percent of the minimum absolute stack temperature shall be used. The temperature gauge shall be attached to the pitot tube such that the sensor tip does not touch any metal; the gauge shall be in an interference-free arrangement with respect to the pitot tube face openings (see Figure 2-1 and also Figure 2-7 in Section 4). Alternative positions may be used if the pitot tube-temperature gauge system is calibrated according to the procedure of Section 4. Provided that a difference of not more than 1 percent in the average velocity measurement is introduced, the temperature gauge need not be attached to the pitot tube; this alternative is subject to the approval of the Administrator.

2.4 Pressure Probe and Gauge. A piezometer tube and mercury— or water-filled U-tube manometer capable of measuring stack pressure to within 2.5 mm (0.1 in.) Hg is used. The static tap of a standard type pitot tube or one leg of a Type S pitot tube with the face opening planes positioned parallel to the gas flow may also be used as the pressure probe.

2.5 Barometer. A mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg) may be used. In many cases, the barometric reading may be obtained from a nearby National Weather Service station, in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and the sampling point shall be applied at a rate of minus 2.5 mm (0.1 in.) Hg per 30—meter (100 foot) elevation increase or vice-versa for elevation decrease.

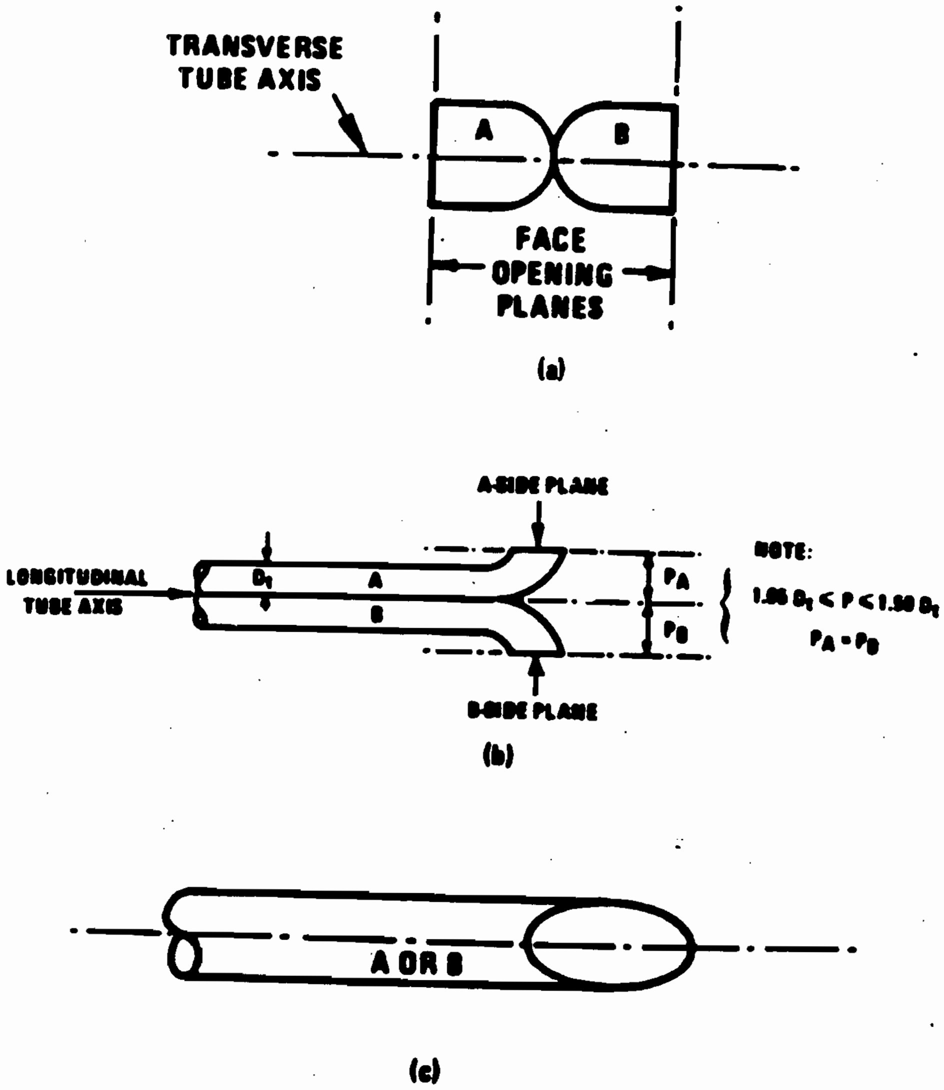


Figure 2-2. Properly constructed Type S pitot tube, shown in: (a) end view; face opening planes perpendicular to transverse axis; (b) top view; face opening planes parallel to longitudinal axis; (c) side view; both legs of equal length and centerlines coincident, when viewed from both sides. Baseline coefficient values of 0.84 may be assigned to pitot tubes constructed this way.

2.6 Gas Density Determination Equipment. Method 3 equipment, if needed (see Section 3.6), to determine the stack gas dry molecular weight, and Reference Method 4 or Method 5 equipment for moisture content determination; other methods may be used subject to approval of the Administrator.

2.7 Calibration Pitot Tube. When calibration of the Type S pitot tube is necessary (see Section 4), a standard pitot tube is used as a reference. The standard pitot tube shall, preferably, have a known coefficient, obtained either (1) directly from the National Bureau of Standards, Route 270, Quince Orchard Road, Gaithersburg, Maryland, or (2) by calibration against another standard pitot tube with an NBS-traceable coefficient. Alternatively, a standard pitot tube designed according to the criteria given in 2.7.1 through 2.7.5 below and illustrated in Figure 2-4 (see also Citations 7, 8, and 17 in Bibliography) may be used. Pitot tubes designed according to these specifications will have baseline coefficients of about 0.99 ± 0.01.

2.7.1 Hemispherical (shown in Figure 2-4), ellipsoidal, or conical tip.

2.7.2 A minimum of six diameters straight run (based upon D, the external diameter of the tube) between the tip and the static pressure holes.

2.7.3 A minimum of eight diameters straight run between the static pressure holes and the centerline of the external tube, following the 90 degree bend.

2.7.4 Static pressure holes of equal size (approximately 0.1 D), equally spaced in a piezometer ring configuration.

2.7.5 Ninety degree bend, with curved or mitered junction.

2.8 Differential Pressure Gauge for Type S Pitot Tube Calibration. An inclined manometer or equivalent is used. If the single-velocity calibration technique is employed (see Section 4.1.2.3), the calibration differential pressure gauge shall be readable to the nearest 0.13 mm H2O (0.005 in. H2O). For multivelocity calibrations, the gauge shall be readable to the nearest 0.13 mm H2O (0.005 in. H2O) for delta p values between 1.3 and 25 mm H2O (0.05 and 1.0 in. H2O), and to the nearest 1.3 mm H2O (0.05 in. H2O) for delta p values above 25 mm H2O (1.0 in. H2O). A special, more sensitive gauge will be required to read delta p values below 1.3 mm H2O [0.05 in. H2O] (see Citation 18 in Bibliography).

3. Procedure

3.1 Set up the apparatus as shown in Figure 2-1. Capillary tubing or surge tanks installed between the manometer and pitot tube may be used to dampen delta p fluctuations. It is recommended, but not required, that a pretest leak-check be conducted, as follows: (1) blow through the pitot impact opening until at least 7.6 cm (3 in.) H2O velocity pressure registers on the manometer; then, close off the impact opening. The pressure shall remain stable for at least 15 seconds; (2) do the same for the static pressure side, except using suction to obtain the minimum of 7.6 cm (3 in.) H2O. Other leak-check procedures, subject to the approval of the Administrator, may be used.

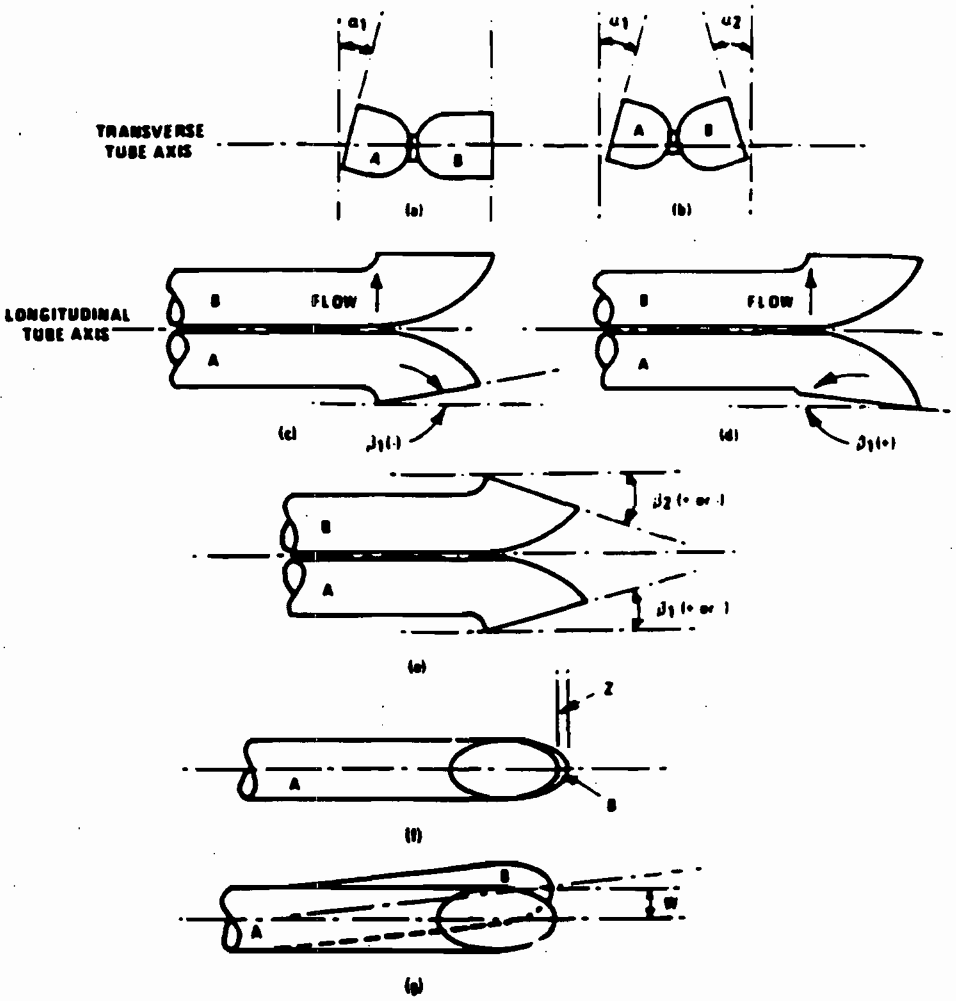


Figure 2-3. Types of face-opening misalignment that can result from field use or improper construction of Type S pitot tubes. These will not affect the baseline value of Cp(s) so long as α^1 and $\alpha^2 \leq 10°$, β^1 and $\beta^2 \leq 5°$, $z \leq 0.32$ cm (1/8 in.) and $w \leq 0.08$ cm (1/32 in.) (citation 11 in Bibliography).

3.2 Level and zero the manometer. Because the manometer level and zero may drift due to vibrations and temperature changes, make periodic checks during the traverse. Record all necessary data as shown in the example data sheet (Figure 2-5).

3.3 Measure the velocity head and temperature at the traverse points specified by Method 1. Ensure that the proper differential pressure gauge is being used for the range of delta p values encountered (see Section 2.2). If it is necessary to change to a more sensitive gauge, do so, and remeasure the delta p and temperature readings at each traverse point. Conduct a post-test leak-check (mandatory), as described in Section 3.1 above, to validate the traverse run.

3.4 Measure the static pressure in the stack. One reading is usually adequate.

3.5 Determine the atmospheric pressure.

3.6 Determine the stack gas dry molecular weight. For combustion processes or processes that emit essentially CO2, O2, CO, and N2, use Method 3. For processes emitting ing essentially air, an analysis need not be conducted; use a dry molecular weight of 29.0. For other processes, other methods, subject to the approval of the Administrator, must be used.

3.7 Obtain the moisture content from Reference Method 4 (or equivalent) or from Method 5.

3.8 Determine the cross-sectional area of the stack or duct at the sampling location. Whenever possible, physically measure the stack dimensions rather than using blueprints.

4. Calibration

4.1 Type S Pitot Tube. Before its initial use, carefully examine the Type S pitot tube in top, side, and end views to verify that the face openings of the tube are aligned within the specifications illustrated in Figure 2-2 or 2-3. The pitot tube shall not be used if it fails to meet these alignment specifications.

After verifying the face opening alignment, measure and record the following dimensions of the pitot tube: (a) the external tubing diameter (dimension Dt, Figure 2-2b); and (b) the base—to—opening plane distances (dimensions PA and PB, Figure 2-2b). If Dt is between 0.48 and 0.95 cm (3/16 and 3/8 in.) and if PA and PB are equal and between 1.05 and 1.50 Dt, there are two possible options: (1) the pitot tube may be calibrated according to the procedure outlined in Sections 4.1.2 through 4.1.5 below, or (2) a baseline (isolated tube) coefficient value of 0.84 may be assigned to the pitot tube. Note, however, that if the pitot tube is part of an assembly, calibration may still be required, despite knowledge of the baseline coefficient value (see Section 4.1.1).

If Dt, PA, and PB are outside the specified limits, the pitot tube must be calibrated as outlined in 4.1.2 through 4.1.5 below.

4.1.1 Type S Pitot Tube Assemblies. During sample and velocity traverses, the isolated Type S pitot tube is not always used; in many instances, the pitot tube is used in combination with other source-sampling components (thermocouple, sampling probe, nozzle) as part of an "assembly." The presence of other sampling components can sometimes affect the baseline value of the Type S pitot tube coefficient (Citation 9 in Bibliography); therefore an assigned (or otherwise known) baseline coefficient value may or may not be valid for a given assembly. The baseline and assembly coefficient values will be identical only when the relative placement of the components in the assembly is such that aerodynamic interference effects are eliminated. Figures 2-6 through 2-8 illustrate interference-free component arrangements for Type S pitot tubes having external tubing diameters between 0.48 and 0.95 cm (3/16 and 3/8 in.). Type S pitot tube assemblies that fail to meet any or all of the specifications of Figures 2-6 through 2-8 shall be calibrated according to the procedure outlined in Sections 4.1.2 through 4.1.5 below, and prior to calibration, the values of the intercomponent spacings (pitot-nozzle, pitot-thermocouple, pitot-probe sheath) shall be measured and recorded.

Note: Do not use any Type S pitot tube assembly which is constructed such that the impact pressure opening plane of the pitot tube is below the entry plane of the nozzle (see Figure 2-6b).

4.1.2 Calibration Setup. If the Type S pitot tube is to be calibrated, one leg of the tube shall be permanently marked A, and the other, B. Calibration shall be done in a flow system having the following essential design features:

Figure 2-6. Proper pitot tube-sampling nozzle configuration to prevent aerodynamic interference; buttonhook-type nozzle; centers of nozzle and pitot opening aligned; Dt between 0.48 and 0.95 cm (3/16 and 3/8 in.).

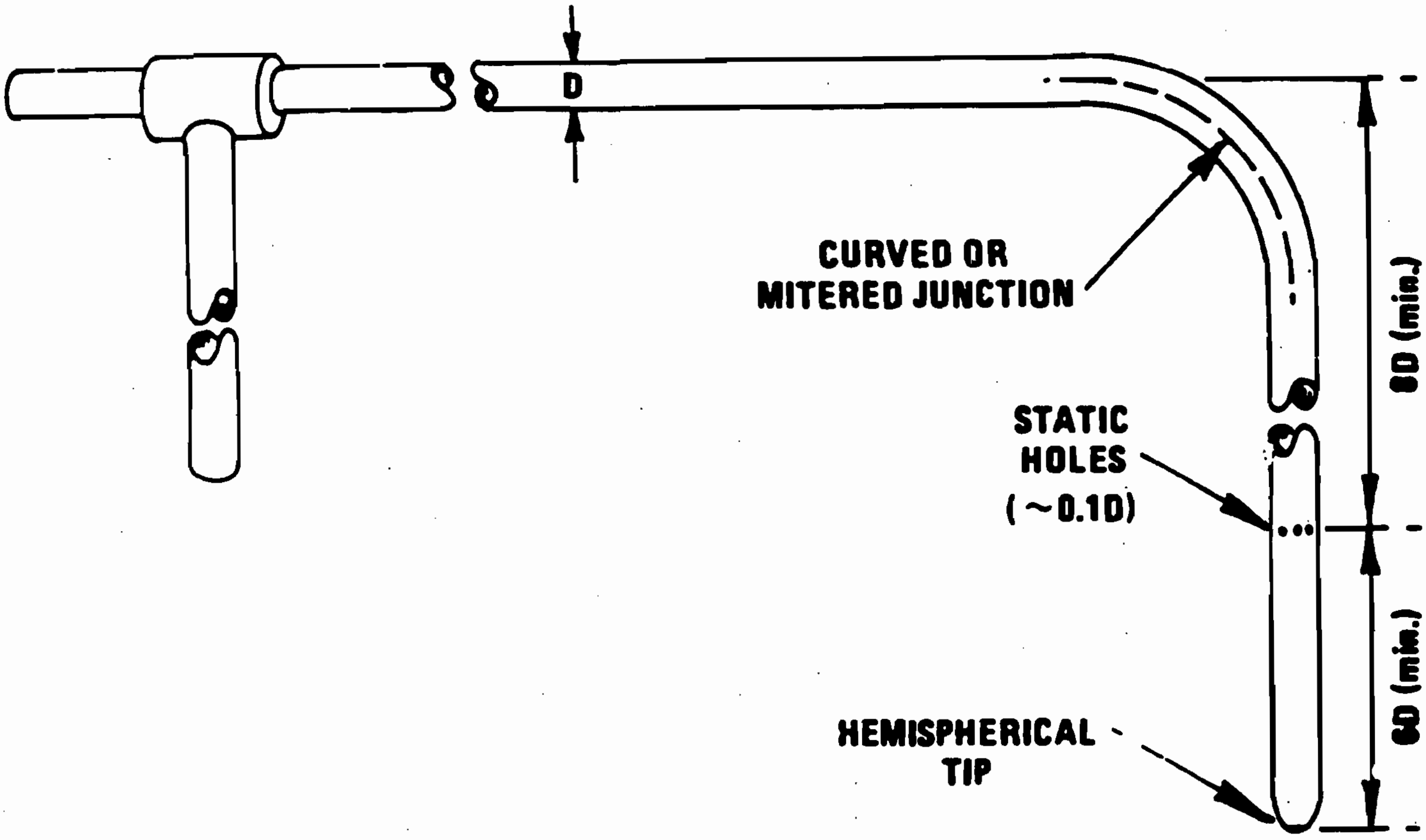


Figure 2-4. Standard pitot tube design specifications.

PLANT ____

DATE ______________________ RUN NO. __________________

STACK DIAMETER OR DIMENSIONS, m(in.) ______________

BAROMETRIC PRESSURE, mm Hg (in. Hg) ______________

CROSS SECTIONAL AREA, $m^2(ft^2)$ ____________________

OPERATORS ____

PITOT TUBE I.D. NO. __________________________________

AVG. COEFFICIENT, C_p = ____________________________

LAST DATE CALIBRATED ____________________________

SCHEMATIC OF STACK CROSS SECTION

Traverse Pt. No.	Vel. Hd., Δp mm (in.) H_2O	Stack Temperature t_s, °C (°F)	T_s, °K (°R)	P_g mm Hg (in.Hg)	$\sqrt{\Delta p}$
		Average			

Figure 2-5. Velocity traverse data.

4.1.2.1 The flowing gas stream must be confined to a duct of definite cross-sectional area, either circular or rectangular. For circular cross-sections, the minimum duct diameter shall be 30.5 cm (12 in.); for rectangular cross-sections, the width (shorter side) shall be at least 25.4 cm (10 in.).

4.1.2.2 The cross-sectional area of the calibration duct must be constant over a distance of 10 or more duct diameters. For a rectangular cross-section, use an equivalent diameter, calculated from the following equation, to determine the number of duct diameters:

$$De = \frac{2LW}{(L+W)} \qquad \text{Eq. 2-1}$$

Where:

De = Equivalent diameter

L = Length

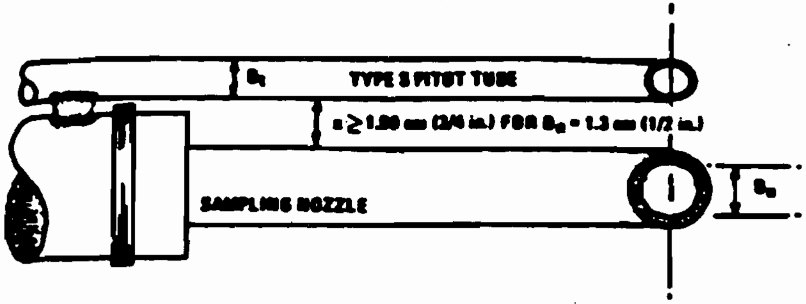
W = Width

To ensure the presence of stable, fully developed flow patterns at the calibration site, or "test section," the site must be located at least eight diameters downstream and two diameters upstream from the nearest disturbances.

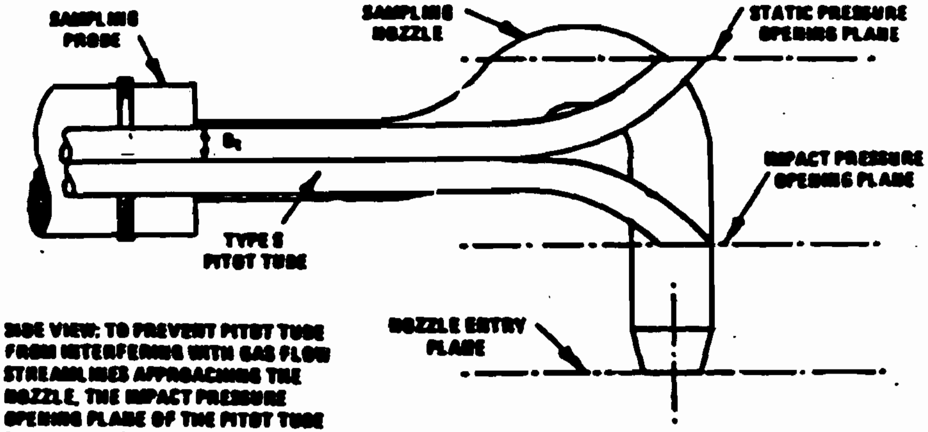
Note: The eight— and two-diameter criteria are not absolute; other test section locations may be used (subject to approval of the Administrator), provided that the flow at the test site is stable and demonstrably parallel to the duct axis.

4.1.2.3 The flow system shall have the capacity to generate a test-section velocity around 915 m/min (3,000 ft/min). This velocity must be constant with time to guarantee steady flow during calibration. Note that Type S pitot tube coefficients obtained by single-velocity calibration at 915 m/min (3,000 ft/min) will generally be valid to within ± 3 percent for the measurement of velocities above 305 m/min (1,000 ft/min) and to within ± 5 to 6 percent for the measurement of velocities between 180 and 305 m/min (600 and 1,000 ft/min). If a more precise correlation between Cp and velocity is desired, the flow system shall have the capacity to generate at least four distinct, time—invariant test-section velocities covering the velocity range from 180 to 1,525 m/min (600 to 5,000 ft/min), and calibration data shall be taken at regular velocity intervals over this range (see Citations 9 and 14 in Bibliography for details).

4.1.2.4 Two entry ports, one each for the standard and Type S pitot tubes, shall be cut in the test section; the standard pitot entry port shall be located slightly downstream of the Type S port, so that the standard and Type S impact openings will lie in the same cross-sectional plane during



A. BOTTOM VIEW; SHOWING MINIMUM PITOT-NOZZLE SEPARATION.



B. SIDE VIEW; TO PREVENT PITOT TUBE FROM INTERFERING WITH GAS FLOW STREAMLINES APPROACHING THE NOZZLE, THE IMPACT PRESSURE OPENING PLANE OF THE PITOT TUBE SHALL BE EVEN WITH OR ABOVE THE NOZZLE ENTRY PLANE.

Figure 2-6. Proper pitot tube-sampling nozzle configuration to prevent aerodynamic interference; buttonhook-type nozzle; centers of nozzle and pitot opening aligned; D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.).

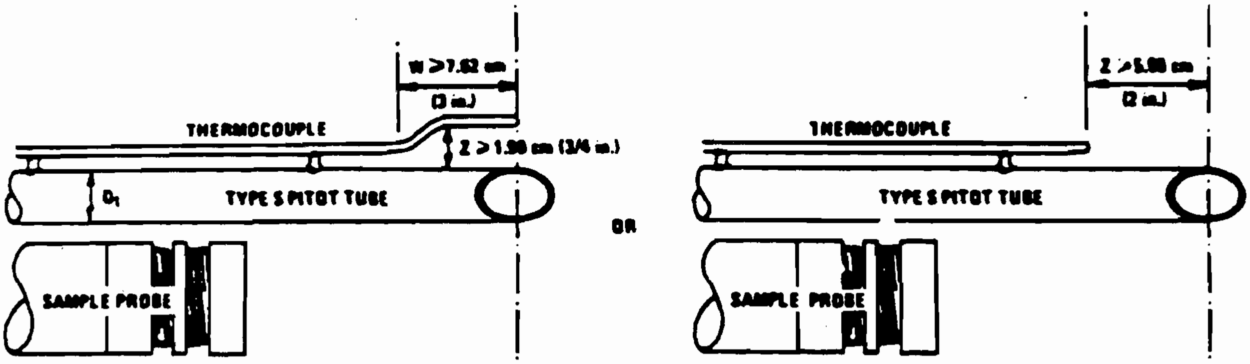


Figure 2-7. Proper thermocouple placement to prevent interference; D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.).

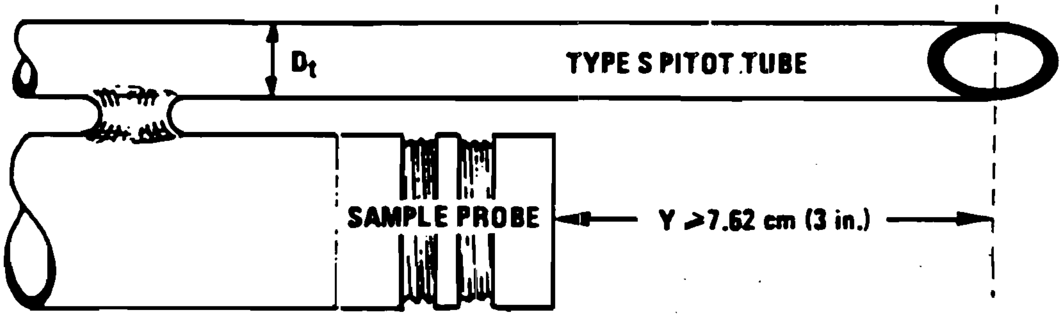


Figure 2-8. Minimum pitot-sample probe separation needed to prevent interference; D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.).

calibration. To facilitate alignment of the pitot tubes during calibration, it is advisable that the test section be constructed of plexiglas or some other transparent material.

4.1.3 Calibration Procedure. Note that this procedure is a general one and must not be used without first referring to the special considerations presented in Section 4.1.5. Note also that this procedure applies only to single-velocity calibration. To obtain calibration data for the A and B sides of the Type S pitot tube, proceed as follows:

4.1.3.1 Make sure that the manometer is properly filled and that the oil is free from contamination and is of the proper density. Inspect and leak-check all pitot lines; repair or replace if necessary.

4.1.3.2 Level and zero the manometer. Turn on the fan and allow the flow to stabilize. Seal the Type S entry port.

4.1.3.3 Ensure that the manometer is level and zeroed. Position the standard pitot tube at the calibration point (determined as outlined in Section 4.1.5.1), and align the tube so that its tip is pointed directly into the flow. Particular care should be taken in aligning the tube to avoid yaw and pitch angles. Make sure that the entry port surrounding the tube is properly sealed.

4.1.3.4 Read delta pstd and record its value in a data table similar to the one shown in Figure 2-9. Remove the standard pitot tube from the duct and disconnect it from the manometer. Seal the standard entry port.

4.1.3.5 Connect the Type S pitot tube to the manometer. Open the Type S entry port. Check the manometer level and zero. Insert and align the Type S pitot tube so that its A side impact opening is at the same point as was the standard pitot tube and is pointed directly into the flow. Make sure that the entry port surrounding the tube is properly sealed.

PITOT TUBE IDENTIFICATION NUMBER: ______________ DATE: ________

CALIBRATED BY: ______________________________

	"A" SIDE CALIBRATION			
RUN NO.	Δp_{std} cm H_2O (in. H_2O)	$\Delta p_{(s)}$ cm H_2O (in. H_2O)	$C_{p(s)}$	DEVIATION $C_{p(s)} - \bar{C}_p(A)$
1				
2				
3				
		$\bar{C}_p$ (SIDE A)		

	"B" SIDE CALIBRATION			
RUN NO.	Δp_{std} cm H_2O (in. H_2O)	$\Delta p_{(s)}$ cm H_2O (in. H_2O)	$C_{p(s)}$	DEVIATION $C_{p(s)} - \bar{C}_p(B)$
1				
2				
3				
		$\bar{C}_p$ (SIDE B)		

$$\text{AVERAGE DEVIATION} = \sigma(\text{A OR B}) = \frac{\sum_{1}^{3} \left| C_p(s) - \bar{C}_p(\text{A OR B}) \right|}{3} \longleftarrow \text{MUST BE} < 0.01$$

$$\left| \bar{C}_p(\text{SIDE A}) - \bar{C}_p(\text{SIDE B}) \right| \longleftarrow \text{MUST BE} < 0.01$$

Figure 2-9. Pitot tube calibration data.

4.1.3.6 Read delta p8 and enter its value in the data table. Remove the Type S pitot tube from the duct and disconnect it from the manometer.

4.1.3.7 Repeat steps 4.1.3.3 through 4.1.3.6 above until three pairs of delta p readings have been obtained.

4.1.3.8 Repeat steps 4.1.3.3 through 4.1.3.7 above for the B side of the Type S pitot tube.

4.1.3.9 Perform calculations, as described in Section 4.1.4 below.

4.1.4 Calculations.

4.1.4.1 For each of the six pairs of delta p readings (i.e., three from side A and three from side B) obtained in Section 4.1.3 above, calculate the value of the Type S pitot tube coefficient as follows:

$$C_{p(s)} = C_{p(std)} \sqrt{\frac{\Delta p_{std}}{\Delta p_s}}$$

Equation 2-2

Where:

Cp(s) = Type S pitot tube coefficient

Cp(std) = Standard pitot tube coefficient; use 0.99 if the coefficient is unknown and the tube is designed according to the criteria of Sections 2.7.1 to 2.7.5 of this method.

DELTA pstd = Velocity head measured by the standard pitot tube, cm H2O (in. H2O)

DELTA ps = Velocity head measured by the Type S pitot tube, cm H2O (in. H2O)

4.1.4.2 Calculate C *bar* p (side A), the mean A-side coefficient, and C *bar* p (side B), the mean B-side coefficient: calculate the difference between these two average values.

4.1.4.3 Calculate the deviation of each of the three A-side values of Cp(s) from C *bar* p (side A), and the deviation of each B-side value of Cp(s) from C *bar* p (side B). Use the following equation:

$$\text{Deviation} = C_{p(s)} - \bar{C}_p \ (A \text{ or } B)$$

Equation 2-3

4.1.4.4 Calculate σ, the average deviation from the mean, for both the A and B sides of the pitot tube. Use the following equation:

$$\sigma \ (\text{side A or B}) = \frac{\sum_{1}^{3} |C_{p(s)} - \bar{C}_p(A \text{ or } B)|}{3}$$

Equation 2-4

4.1.4.5 Use the Type S pitot tube only if the values of σ (side A) and σ (side B) are less than or equal to 0.01 and if the absolute value of the difference between C *bar* p (A) and C *bar* p (B) is 0.01 or less.

4.1.5 Special considerations.

4.1.5.1 Selection of calibration point.

4.1.5.1.1 When an isolated Type S pitot tube is calibrated, select a calibration point at or near the center of the duct, and follow the procedures outlined in Sections 4.1.3 and 4.1.4 above. The Type S pitot coefficients so obtained, i.e., C *bar* p (side A) and C *bar* p (side B), will be valid, so long as either: (1) the isolated pitot tube is used; or (2) the pitot tube is used with other components (nozzle, thermocouple, sample probe) in an arrangement that is free from aerodynamic interference effects (see Figures 2-6 through 2-8).

4.1.5.1.2 For Type S pitot tube-thermocouple combinations (without sample probe), select a calibration point at or near the center of the duct, and follow the procedures outlined in Sections 4.1.3 and 4.1.4 above. The coefficients so obtained will be valid so long as the pitot tube-thermocouple combination is used by itself or with other components in an interference-free arrangement (Figures 2-6 and 2-8).

4.1.5.1.3 For assemblies with sample probes, the calibration point should be located at or near the center of the duct; however, insertion of a probe sheath into a small duct may cause significant cross-sectional area blockage and yield incorrect coefficient values (Citation 9 in Bibliography). Therefore, to minimize the blockage effect, the calibration point may be a few inches off-center if necessary. The actual blockage effect will be negligible when the theoretical blockage, as determined by a projected-area model of the probe sheath, is 2 percent or less of the duct cross-sectional area for assemblies without external sheaths (Figure 2-10a), and 3 percent or less for assemblies with external sheaths (Figure 2-10b).

4.1.5.2 For those probe assemblies in which pitot tube-nozzle interference is a factor (i.e., those in which the pitot-nozzle separation distance fails to meet the specification illustrated in Figure 2-6a), the value of Cp(s) depends upon the amount of free-space between the tube and nozzle, and therefore is a function of nozzle size. In these instances, separate calibrations shall be performed with each of the commonly used nozzle sizes in place. Note that the single-velocity calibration technique is acceptable for this purpose, even though the larger nozzle sizes (> 0.635 cm or ¼ in.) are not ordinarily used for isokinetic sampling at velocities around 915 m/min (3,000 ft/min), which is the calibration velocity; note also that it is not necessary to draw an isokinetic sample during calibration (see Citation 19 in Section 6).

4.1.5.3 For a probe assembly constructed such that its pitot tube is always used in the same orientation, only one side of the pitot tube need be calibrated (the side which will face the flow). The pitot tube must still meet the alignment specifications of Figure 2-2 or 2-3, however, and must have an average deviation (σ) value of 0.01 or less (see Section 4.1.4.4).

4.1.6 Field Use and Recalibration.

4.1.6.1 Field Use.

4.1.6.1.1 When a Type S pitot tube (isolated tube or assembly) is used in the field, the appropriate coefficient value (whether assigned or obtained by calibration) shall be used to perform velocity calculations. For calibrated Type S pitot tubes, the A side coefficient shall be used when the A side of the tube faces the flow, and the B side coefficient shall be used when the B side faces the flow; alternatively, the arithmetic average of the A and B side coefficient values may be used, irrespective of which side faces the flow.

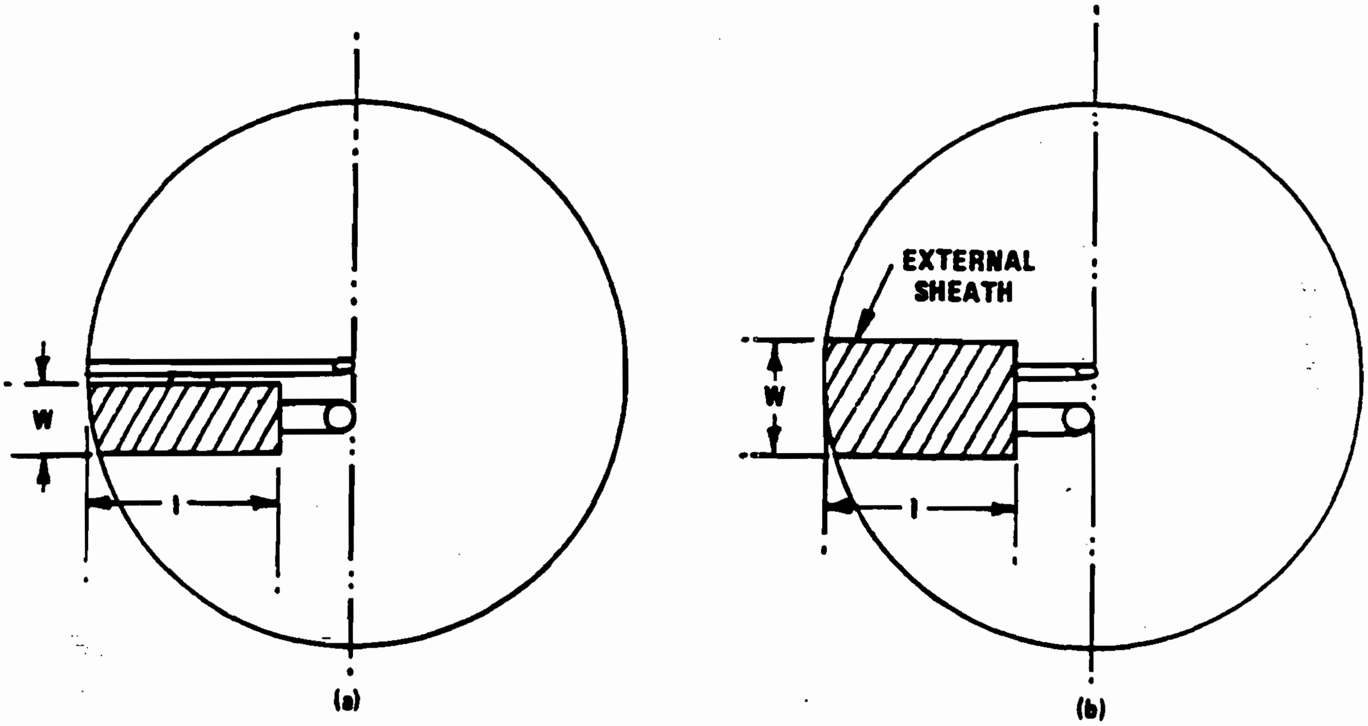
4.1.6.1.2 When a probe assembly is used to sample a small duct (12 to 36 in. in diameter), the probe sheath sometimes blocks a significant part of the duct cross-section, causing a reduction in the effective value of Cp(s). Consult Citation 9 in Bibliography for details. Conventional pitot-sampling probe assemblies are not recommended for use in ducts having inside diameters smaller than 12 inches (Citation 16 in Bibliography).

4.1.6.2 Recalibration.

4.1.6.2.1 Isolated Pitot Tubes. After each field use, the pitot tube shall be carefully reexamined in top, side, and end views. If the pitot face openings are still aligned within the specifications illustrated in Figure 2-2 or 2-3, it can be assumed that the baseline coefficient of the pitot tube has not changed. If, however, the tube has been damaged to the extent that it no longer meets the specifications of Figure 2-2 or 2-3, the damage shall either be repaired to restore proper alignment of the face openings or the tube shall be discarded.

4.1.6.2.2 Pitot Tube Assemblies. After each field use, check the face opening alignment of the pitot tube, as in Section 4.1.6.2.1; also, remeasure the intercomponent spacings of the assembly. If the intercomponent spacings have not changed and the face opening alignment is acceptable, it can be assumed that the coefficient of the assembly has not changed. If the face opening alignment is no longer within the specifications of Figures 2-2 or 2-3, either repair the damage or replace the pitot tube (calibrating the new assembly, if necessary). If the intercomponent spacings have changed, restore the original spacings or recalibrate the assembly.

4.2 Standard pitot tube (if applicable). If a standard pitot tube is used for the



$$\text{ESTIMATED SHEATH BLOCKAGE (\%)} = \left[\frac{l \times W}{\text{DUCT AREA}}\right] \times 100$$

Figure 2-10. Projected-area models for typical pitot tube assemblies.

velocity traverse, the tube shall be constructed according to the criteria of Section 2.7 and shall be assigned a baseline coefficient value of 0.99. If the standard pitot tube is used as part of an assembly, the tube shall be in an interference-free arrangement (subject to the approval of the Administrator).

4.3 Temperature Gauges. After each field use, calibrate dial thermometers, liquid-filled bulb thermometers, thermocouple-potentiometer systems, and other gauges at a temperature within 10 percent of the average absolute stack temperature. For temperatures up to 405°C (761°F), use an ASTM mercury—in—glass reference thermometer, or equivalent, as a reference; alternatively, either a reference thermocouple and potentiometer (calibrated by NBS) or thermometric fixed points, e.g., ice bath and boiling water (corrected for barometric pressure) may be used. For temperatures above 405°C (761°F), use an NBS-calibrated reference thermocouple-potentiometer system or an alternate reference, subject to the approval of the Administrator.

If, during calibration, the absolute temperatures measured with the gauge being calibrated and the reference gauge agree within 1.5 percent, the temperature data taken in the field shall be considered valid. Otherwise, the pollutant emission test shall either be considered invalid or adjustments (if appropriate) of the test results shall be made, subject to the approval of the Administrator.

4.4 Barometer. Calibrate the barometer used against a mercury barometer.

5. Calculations

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

5.1 Nomenclature.

A = Cross-sectional area of stack, m^2 (ft^2).

Bws = Water vapor in the gas stream (from Method 5 or Reference Method 4), proportion by volume.

Cp = Pitot tube coefficient, dimensionless.

Kp = Pitot tube constant,

$$34.97\ \frac{m}{sec}\left[\frac{(g/g\text{—}mole)(mm\ Hg)}{(°K)(mmH2O)}\right]^{1/2}$$

for the metric system and

$$85.49\ \frac{ft}{sec}\left[\frac{(lb/lb\text{—}mole)(in\ Hg)}{(°R)(in\ H2O)}\right]^{1/2}$$

for the English system.

Md = Molecular weight of stack gas, dry basis (see Section 3.6) g/g—mole (lb/lb—mole).

Ms = Molecular weight of stack gas, wet basis, g/g—mole (lb/lb—mole).

= Md (1-Bws) + 18.0 Bws Eq. 2-5

Pbar = Barometric pressure at measurement site, mm Hg (in. Hg).

Pg = Stack static pressure, mm Hg (in. Hg).

Ps = Absolute stack gas pressure, mm Hg (in. Hg).

= Pbar+Pg Eq. 2-6

Pstd = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

Qsd = Dry volumetric stack gas flow rate corrected to standard conditions, dscm/hr (dscf/hr).

ts = Stack temperature, °C (°F).

Ts = Absolute stack temperature, °K, (°R).

= 273+ts for metric. Eq. 2-7

= 460+ts for English. Eq. 2-8

Tstd = Standard absolute temperature, 293 °K (528°R).

vs = Average stack gas velocity, m/sec (ft/sec).

delta p = Velocity head of stack gas, mm H2O (in. H2O).

3,600 = Conversion factor, sec/hr.

18.0 = Molecular weight of water, g/g—mole (lb/lb—mole).

5.2 Average Stack Gas Velocity.

$$v_s = K_p C_p (\sqrt{\Delta p})_{avg} \sqrt{\frac{T_{s(avg)}}{P_s M_s}}$$

Equation 2-9

5.3 Average Stack Gas Dry Volumetric Flow Rate.

$$Q_{sd} = 3{,}600(1-B_{ws})v_sA \frac{T_{std}}{T_{s\,(avg)}} \frac{P_s}{P_{std}}$$

Eq. 2-10

To convert Qsd from dscm/hr (dscf/hr) to dscm/min (dscf/min), divide Qsd by 60.

6. Bibliography

1. Mark, L. S. Mechanical Engineers' Handbook. New York, McGraw-Hill Book Co., Inc. 1951.
2. Perry, J. H. Chemical Engineers' Handbook. New York. McGraw-Hill Book Co., Inc. 1960.
3. Shigehara, R. T., W. F. Todd, and W. S. Smith. Significance of Errors in Stack Sampling Measurements. U.S. Environmental Protection Agency, Research Triangle Park, NC (Presented at the Annual Meeting of the Air Pollution Control Association, St. Louis, MO, June 14-19, 1970.)
4. Standard Method for Sampling Stacks for Particulate Matter. In: 1971 Book of ASTM Standards, Part 23. Philadelphia, PA 1971. ASTM Designation D-2928-71.
5. Vennard, J. K. Elementary Fluid Mechanics. New York. John Wiley and Sons, Inc. 1947.
6. Fluid Meters——Their Theory and Application. American Society of Mechanical Engineers, New York, NY 1959.
7. ASHRAE Handbook of Fundamentals. 1972. p. 208.
8. Annual Book of ASTM Standards, Part 26. 1974. p. 648.
9. Vollaro, R. F. Guidelines for Type S Pitot Tube Calibration. U.S. Environmental Protection Agency. Research Triangle Park. NC (Presented at 1st Annual Meeting, Source Evaluation Society, Dayton, OH, September 18, 1975.)
10. Vollaro, R. F. A Type S Pitot Tube Calibration Study. U.S. Environmental Protection Agency, Emission Measurement Branch, Research Triangle Park, NC July 1974.
11. Vollaro, R. F. The Effects of Impact Opening Misalignment on the Value of the Type S Pitot Tube Coefficient. U.S. Environmental Protection Agency, Emission Measurement Branch, Research Triangle Park, NC. October 1976.
12. Vollaro, R. F. Establishment of a Basline Coefficient Value for Properly Constructed Type S Pitot Tubes. U.S. Environmental Protection Agency, Emission Measurement Branch, Research Triangle Park, NC. November 1976.
13. Vollaro, R. F. An Evaluation of Single-Velocity Calibration Technique as a Means of Determining Type S Pitot Tubes Coefficient. U.S. Environmental Protection Agency, Emission Measurement Branch, Research Triangle Park, NC. August 1975.
14. Vollaro, R. F. The Use of Type S Pitot Tubes for the Measurement of Low Velocities. U.S. Environmental Protection Agency, Emission Measurement Branch, Research Triangle Park, NC. November 1976.
15. Smith, Marvin L. Velocity Calibration of EPA Type Source Sampling Probe. United Technologies Corporation, Pratt and Whitney Aircraft Division, East Hartford, CN. 1975.
16. Vollaro, R. F. Recommended Procedure for Sample Traverses in Ducts Smaller than 12 Inches in Diameter. U.S. Environmental Protection Agency, Emission Measurement Branch, Research Triangle Park, NC. November 1976.
17. Ower, E. and R. C. Pankhurst. The Measurement of Air Flow, 4th Ed., London, Pergamon Press. 1966.
18. Vollaro, R. F. A Survey of Commercially Available Instrumentation for the Measurement of Low-Range Gas Velocities. U.S. Environmental Protection Agency, Emission Measurement Branch, Research Triangle Park, NC. November 1976. (Unpublished Paper)
19. Gnyp, A. W., C. C. St. Pierre, D. S. Smith, D. Mozzon, and J. Steiner. An Experimental Investigation of the Effect of Pitot Tube-Sampling Probe Configurations on the Magnitude of the S Type Pitot Tube Coefficient for Commercially Available Source Sampling Probes. Prepared by the University of Windsor for the Ministry of the Environment, Toronto, Canada. February 1975.

Method 3—Gas Analysis for the Determination of Dry Molecular Weight

1. Applicability and Principle

1.1 Applicability.

1.1.1 This method is applicable for determining carbon dioxide (CO2) and oxygen (O2) concentrations and dry molecular weight of a sample from a gas stream of a fossil-fuel combustion process. The method may also be applicable to other processes where it has been determined that compounds other than CO2, O2, carbon monoxide (CO), and nitrogen (N2) are not present in concentrations sufficient to affect the results.

1.1.2 Other methods, as well as modifications to the procedure described herein, are also applicable for some or all of the above determinations. Examples of specific methods and modifications include: (1) A multi-point sampling method using an Orsat analyzer to analyze individual grab samples obtained at each point; (2) a method using CO2 or O2 and stoichiometric calculations to determine dry molecular weight; and (3) assigning a value of 30.0 for dry molecular weight, in lieu of actual measurements, for processes burning natural gas, coal, or oil. These methods and modifications may be used, but are subject to the approval of the Administrator, U.S. Environmental Protection Agency (EPA).

1.1.3 Note. Mention of trade names or specific products does not constitute endorsements by EPA.

1.2 Principle. A gas sample is extracted from a stack by one of the following methods: (1) Single-point, grab sampling; (2) single-point, integrated sampling; or (3) multi-point, integrated sampling. The gas sample is analyzed for pecent CO2, percent O2, and if necessary, for percent CO. For dry molecular weight determination, either an Orsat or a Fyrite analyzer may be used for the analysis.

2. Apparatus

As an alternative to the sampling apparatus and systems described herein, other sampling systems (e.g., liquid displacement) may be used, provided such systems are capable of obtaining a representative sample and maintaining a constant sampling rate, and are, otherwise, capable of yielding acceptable results. Use of such systems is subject to the approval of the Administrator.

2.1 Grab Sampling (Figure 3-1).

2.1.1 Probe. Stainless steel or borosilicate glass tubing equipped with an in-stack or out-stack filter to remove particulate matter (a plug of glass wool is satisfactory for this purpose). Any other materials, inert to O2, CO2, CO, and N2 and resistant to temperature at sampling conditions, may be used for the probe. Examples of such materials are aluminum, copper, quartz glass, and Teflon.

2.1.2 Pump. A one—way squeeze bulb, or equivalent, to transport the gas sample to the analyzer.

2.2 Integrated Sampling (Figure 3-2).

2.2.1 Probe. Same as in Section 2.1.1.

2.2.2 Condenser. An air-cooled or water-cooled condenser, or other condenser no greater than 250 ml that will not remove O2, CO2, CO, and N2, to remove excess moisture which would interfere with the operation of the pump and flowmeter.

2.2.3 Valve. A needle valve, to adjust sample gas flow rate.

2.2.4 Pump. A leaf-free, diaphragm-type pump, or equivalent, to transport sample gas to the flexible bag. Install a small surge tank between the pump and rate meter to eliminate the pulsation effect of the diaphragm pump on the rotameter.

2.2.5 Rate Meter. A rotameter, or equivalent rate meter, capable of measuring flow rate to within 2 percent of the selected flow rate. A flow rate range of 500 to 1000 cc/min is suggested.

2.2.6 Flexible Bag. Any leak-free plastic (e.g., Tedlar, Mylar, Teflon) or plastic-coated aluminum (e.g., aluminized Mylar) bag, or equivalent, having a capacity consistent with the selected flow rate and time length of the test run. A capacity in the range of 55 to 90 liters is suggested. To leak check the bag, connect

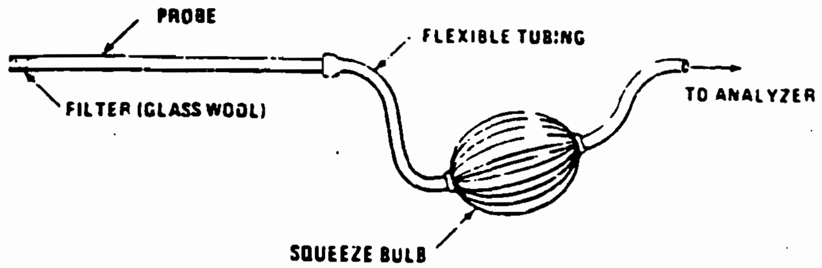


Figure 3-1. Grab sampling train.

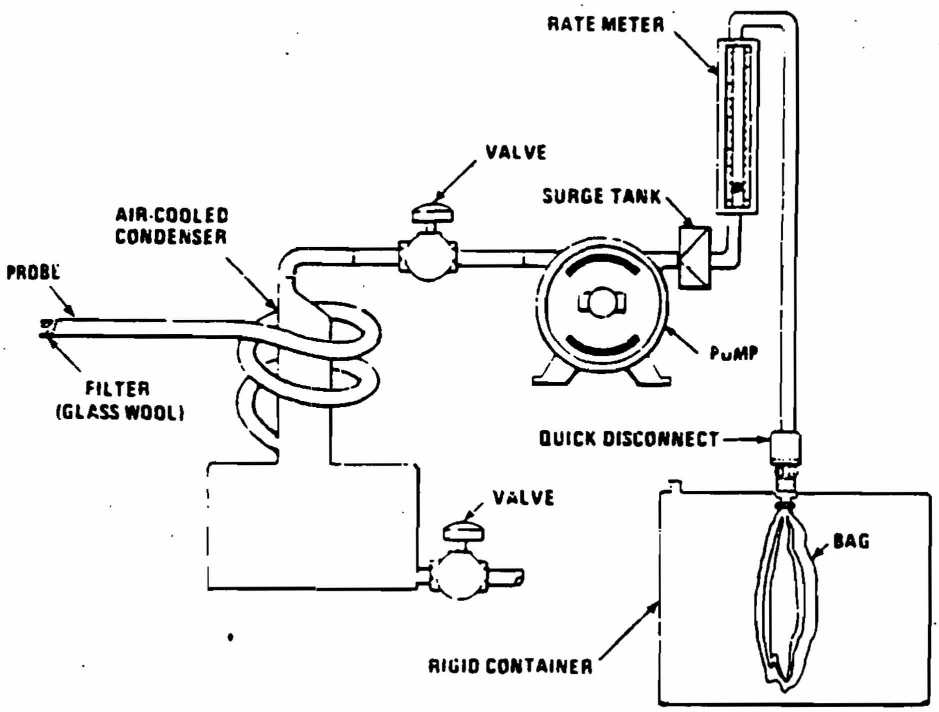


Figure 3-2. Integrated gas-sampling train.

it to a water manometer, and pressurize the bag to 5 to 10 cm H2O (2 to 4 in. H2O). Allow to stand for 10 minutes. Any displacement in the water manometer indicates a leak. An alternative leak-check method is to pressurize the bag to 5 to 10 cm (2 to 4 in.) H2O and allow to stand overnight. A deflated bag indicates a leak.

2.2.7 Pressure Gauge. A water-filled U-tube manometer, or equivalent, of about 30 cm (12 in.), for the flexible bag leak check.

2.2.8 Vacuum Gauge. A mercury manometer, or equivalent, of at least 760 mm (30 in.) Hg, for the sampling train leak check.

2.3 Analysis. An Orsat or Fyrite type combustion gas analyzer. For Orsat and Fyrite analyzer maintenance and operation procedures, follow the instructions recommended by the manufacturer, unless otherwise specified herein.

3. Single-Point, Grab Sampling and Analytical Procedure

3.1 The sampling point in the duct shall either be at the centroid of the cross section or at a point no closer to the walls than 1.00 m (3.3 ft), unless otherwise specified by the Administrator.

3.2 Set up the equipment as shown in Figure 3-1, making sure all connections ahead of the analyzer are tight. If an Orsat analyzer is used, it is recommended that the analyzer be leak checked by following the procedure in Section 6; however, the leak check is optional.

3.3 Place the probe in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line long enough to allow at least five exchanges. Draw a sample into the analyzer, and immediately analyze it for percent CO2 and percent O2. Determine the percentage of the gas that is N2 and CO by subtracting the sum of the percent CO2 and percent O2O from 100 percent. Calculate the dry molecular weight as indicated in Section 7.2.

3.4 Repeat the sampling, analysis, and calculation procedures until the dry molecular weights of any three grab samples differ from their mean by no more than 0.3 g/g—mole (0.3 lb/lb—mole). Average these three molecular weights, and report the results to the nearest 0.1 g/g—mole (0.1 lb/lb—mole).

4. Single-Point, Integrated Sampling and Analytical Procedure

4.1 The sampling point in the duct shall be located as specified in Section 3.1.

4.2 Leak check (optional) the flexible bag as in Section 2.2.6. Set up the equipment as shown in Figure 3-2. Just before sampling, leak check (optional) the train by placing a vacuum gauge at the condenser inlet, pulling a vacuum of at least 250 mm Hg (10 in. Hg), plugging the outlet at the quick disconnect, and then turning off the pump. The vacuum should remain stable for at least 0.5 minute. Evacuate the flexible bag. Connect the probe, and place it in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line. Next, connect the bag, and make sure that all connections are tight.

4.3 Sample at a constant rate. The sampling run should be simultaneous with, and for the same total length of time as, the pollutant emission rate determination. Collection of at least 30 liters (1.00 ft^3) of sample gas is recommended; however, smaller volumes may be collected, if desired.

4.4 Obtain one integrated flue gas sample during each pollutant emission rate determination. Within 8 hours after the sample is taken, analyze it for percent CO2 and percent O2 using either an Orsat analyzer or a Fyrite type combustion gas analyzer. If an Orsat analyzer is used, it is recommended that Orsat leak check described in Section 6, be performed before this determination; however, the check is optional. Determine the percentage of the gas that is N2 and CO by subtracting the sum of the percent CO2 and percent 0 from 100 percent. Calculate the dry molecular weight as indicated in Section 7.2.

4.5 Repeat the analysis and calculation procedures until the individual dry molecular weights for any three analyses differ from their mean by no more than 0.3 g/g—mole (0.3 lb/lb—mole). Average these three molecular weights, and report the results to the nearest 0.1 g/g—mole (0.1 lb/lb—mole).

5. Multi-Point, Integrated Sampling and Analytical Procedure

5.1 Unless otherwise specified by the Administrator, a minimum of eight traverse points shall be used for circular stacks having diameters less than 0.61 m (24 in.), a minimum of nine shall be used for rectangular stacks having equivalent diameters less than 0.61 m (24 in.), and a minimum of 12 traverse points shall be used for all other cases. The traverse points shall be located according to Method 1. The use of fewer points is subject to approval of the Administrator.

5.2 Follow the procedures outlined in Sections 4.2 through 4.5, except for the following: Traverse all sampling points, and sample at each point for an equal length of time. Record sampling data as shown in Figure 3-3.

Time	Traverse pt	Q, liter/min	% dev ᵃ
Average			

a % dev. = ($\bar{Q}$—Qavg)/Qavg X 100 (Must be | ± 10%)

Figure 3-3. Sampling rate data.

6. Leak-Check Procedure for Orsat Analyzer

Moving an Orsat analyzer frequently causes it to leak. Therefore, an Orsat analyzer should be thoroughly leak checked on site before the flue gas sample is introduced into it. The procedure for leak checking an Orsat analyzer is as follows:

6.1 Bring the liquid level in each pipette up to the reference mark on the capillary tubing, and then close the pipette stopcock.

6.2 Raise the leveling bulb sufficiently to bring the confining liquid meniscus onto the graduated portion of the burette, and then close the manifold stopcock.

6.3 Record the meniscus position.

6.4 Observe the menisus in the burette and the liquid level in the pipette for movement over the next 4 minutes.

6.5 For the Orsat analyzer to pass the leak check, two conditions must be met:

6.5.1 The liquid level in each pipette must not fall below the botton of the capillary tubing during this 4—minute interval.

6.5.2 The menisus in the burette must not change by more than 0.2 ml during this 4—minute interval.

6.6 If the anlyzer fails the leak-check procedure, check all ck all rubber connections and stopcocks to determine whether they might be the cause of the leak. Disassemble, clean, and regrease leaking stopcocks. Replace leaking rubber connections. After the analyzer is reassembled, repeat the lead-check procedure.

7. Calculations

7.1 Nomenclature

Md = Dry molecular weight, g/g—mole (1b/1b—mole).

%CO2 = Percent CO2 by volume, dry basis.

%O2 = Percent O2 by volume, dry basis.

%CO = Percent CO by volume, dry basis.

%N2 = Percent N2 by volume, dry basis.

0.280 = Molecular weight of N_2 or CO, divided by 100.

0.320 = Molecular wight of O_2 divided by 100.

0.440 = Molecular weight of CO_2 divided by 100.

7.2 Dry Molecular Weight. Use Equation 3-1 to calculate the dry molecular weight of the stack gas.

$$M_d = 0.440(\%CO_2) + 0.320\,(\%O_2) + 0.280(\%N_2 + \%CO) \quad \text{Eq. 3-1}$$

Note. The above equation does not consider argon in air (about 0.9 percent, molecular weight of 39.9). A negative error of about 0.4 percent is introduced. The tester may choose to include argon in the analysis using procedures subject to approval of the Administrator.

8. Bibliography

1. Altshuller, A.P. Storage of Gases and Vapors in Plastic Bags. International Journal of Air and Water Pollution. 6:75-81. 1963.

2. Conner, William D. and J.S. Nader. Air Sampling with Plastic Bags. Journal of the American Industrial Hygiene Association. 25:292-297. 1964.

3. Burrell Manual for Gas Analysts, Seventh edition. Burrell Corporation, 2223 Fifth Avenue, Pittsburgh, PA. 15219. 1951.

4. Mitchell, W.J. and M.R. Midgett, Field Reliability of the Orsat Analyzer. Journal of Air Pollution Control Association. 26:491-495. May 1976.

5. Shigehara, R.T., R. M. Neulicht, and W.S. Smith. Validating Orsat Analysis Data from Fossil Fuel-Fired Units. Stack Sampling News. 4(2):21-26. August 1976.

Method 3A—Determination of Oxygen and Carbon Dioxide Concentrations in Emissions From Stationary Sources (Instrumental Analyzer Procedure)

1. Applicability and Principle

1.1 Applicability. This method is applicable to the determination of oxygen (O2) and carbon dioxide (CO2) concentrations in emissions from stationary sources only when specified within the regulations.

1.2 Principle. A sample is continuously extracted from the effluent stream: a portion of the sample stream is conveyed to an instrumental analyzer(s) for determination of O2 and CO2 concentration(s). Performance specifications and test procedures are provided to ensure reliable data.

2. Range and Sensitivity

Same as Method 6C, Sections 2.1 and 2.2, except that the span of the monitoring system shall be selected such that the average O2 or CO2 concentration is not less than 20 percent of the span.

3. Definitions

3.1 Measurement System. The total equipment required for the determination of the O2 or CO2 concentration. The measurement system consists of the same major subsystems as defined in Method 6C, Sections 3.1.1, 3.1.2, and 3.1.3.

3.2 Span, Calibration Gas, Analyzer Calibration Error, Sampling System Bias, Zero Drift, Calibration Drift, Response Time, and Calibration Curve. Same as Method 6C, Sections 3.2 through 3.8, and 3.10.

3.3 Interference Response. The output response of the measurement system to a component in the sample gas, other than the gas component being measured.

4. Measurement System Performance Specifications

Same as Method 6C, Sections 4.1 through 4.4.

5. Apparatus and Reagents

5.1 Measurement System. Any measurement system for O2 or CO2 that meets the specifications of this method. A schematic of an acceptable measurement system is shown in Figure 6C-1 of Method 6C. The essential components of the measurement system are described below:

5.1.1 Sample Probe. A leak-free probe, of sufficient length to traverse the sample points.

5.1.2 Sample Line. Tubing, to transport the sample gas from the probe to the moisture removal system. A heated sample line is not required for systems that measure the O2 or CO2 concentration on a dry basis, or transport dry gases.

5.1.3 Sample Transport Line, Calibration Value Assembly, Moisture Removal System, Particulate Filter, Sample Pump, Sample Flow Rate Control, Sample Gas Manifold, and Data Recorder. Same as Method 6C, Sections 5.1.3 through 5.1.9, and 5.1.11, except that the requirements to use stainless steel, Teflon, and nonreactive glass filters do not apply.

5.1.4 Gas Analyzer. An analyzer to determine continuously the O2 or CO2 concentration in the sample gas stream. The analyzer shall meet the applicable performance specifications of Section 4. A means of controlling the analyzer flow rate and a device for determining proper sample flow rate (e.g., precision rotameter, pressure gauge downstream of all flow controls, etc.) shall be provided at the analyzer. The requirements for measuring and controlling the analyzer flow rate are not applicable if data are presented that demonstrate the analyzer is insensitive to flow variations over the range encountered during the test.

5.2 Calibration Gases. The calibration gases for CO2 analyzers shall be CO2 in N2 or CO2 in air. Alternatively, CO2/SO2, O2/SO2 , or O2/CO2/SO2 gas mixtures in N2 may be used. Three calibration gases, as specified Section 5.3.1 through 5.3.3 of Method 6C, shall be used. For O2 monitors that cannot analyze zero gas, a calibration gas concentration equivalent to less than 10 percent of the span may be used in place of zero gas.

6. Measurement System Performance Test Procedures

Perform the following procedures before measurement of emissions (Section 7).

6.1 Calibration Concentration Verification. Follow Section 6.1 of Method 6C, except if calibration gas analysis is required, use Method 3 and change the acceptance criteria for agreement among Method 3 results to 5 percent (or 0.2 percent by volume, whichever is greater).

6.2 Interference Response. Conduct an interference response test of the analyzer prior to its initial use in the field. Thereafter, recheck the measurement system if changes are made in the instrumentation that could alter the interference response (e.g., changes in the type of gas detector). Conduct the interference response in accordance with Section 5.4 of Method 20.

6.3 Measurement System Preparation, Analyzer Calibration Error, and Sampling System Bias Check. Follow Sections 6.2 through 6.4 of Method 6C.

7. Emission Test Procedure

7.1 Selection of Sampling Site and Sampling Points. Select a measurement site and sampling points using the same criteria that are applicable to tests performed using Method 3.

7.2 Sample Collection. Position the sampling probe at the first measurement point, and begin sampling at the same rate as used during the sampling system bias check. Maintain constant rate sampling (i.e., ± 10 percent) during the entire run. The sampling time per run shall be the same as for tests conducted using Method 3 plus twice the system response time. For each run, use only those measurements obtained after twice the response time of the measurement system has elapsed to determine the average effluent concentration.

7.3 Zero and Calibration Drift Test. Follow Section 7.4 of Method 6C.

8. Quality Control Procedures

The following quality control procedures are recommended when the results of this method are used for an emission rate correction factor, or excess air determination. The tester should select one of the following options for validating measurement results:

8.1 If both O2 and CO2 are measured using Method 3A, the procedures described in Section 4.4 of Method 3 should be followed to validate the O2 and CO2 measurement results.

8.2 If only O2 is measured using Method 3A, measurements of the sample stream CO2 concentration should be obtained at the sample by-pass vent discharge using an Orsat or Fyrite analyzer, or equivalent. Duplicate samples should be obtained concurrent with at least one run. Average the duplicate Orsat or Fyrite analysis results for each run. Use the average CO2 values for comparison with the O2 measurements in accordance with the procedures described in Section 4.4 of Method 3.

8.3 If only CO2 is measured using Method 3A, concurrent measurements of the sample stream CO2 concentration should be obtained using an Orsat or Fyrite analyzer as described in Section 8.2. For each run, differences greater than 0.5 percent between the Method 3A results and the average of the duplicate Fyrite analysis should be investigated.

9. Emission Calculation

For all CO2 analyzers, and for O2 analyzers that can be calibrated with zero gas, follow Section 8 of Method 6C, except express all concentrations as percent, rather than ppm.

For O2 analyzers that use a low-level calibration gas in place of a zero gas, calculate the effluent gas concentration using Equation 3A-1.

$$C_{gas} = \frac{C_{ma} - C_{oa}}{C_{m} - C_{o}} (\bar{C} - C_{m}) + C_{ma}$$

Where: Eq. 3A-1

Cgas = Effluent gas concentration, dry basis, percent.

Cma = Actual concentration of the upscale calibration gas, percent.

Coa = Actual concentration of the low-level calibration gas, percent.

Cm = Average of initial and final system calibration bias check responses for the upscale calibration gas, percent.

Co = Average of initial and final system calibration bias check responses for the low-level gas, percent.

C *bar* = Average gas concentration indicated by the gas analyzer, dry basis, percent.

10. Bibliography

1. Traceability Protocol for Establishing True Concentrations of Gases Used for Calibrations and Audits of Continuous Source Emission Monitors: Protocol Number 1. U.S. Environmental Protection Agency, Quality Assurance Division. Research Triangle Park, NC. June 1978.

2. Westlin, Peter R. and J. W. Brown. Methods for Collecting and Analyzing Gas Cylinder Samples. Source Evaluation Society Newsletter. 3(3):5-15. September 1978.

Method 4—Determination of Moisture Content in Stack Gases

1. Principle and Applicability

1.1 Principle. A gas sample is extracted at a constant rate from the source; moisture is removed from the sample stream and determined either volumetrically or gravimetrically.

1.2 Applicability. This method is applicable for determining the moisture content of stack gas.

Two procedures are given. The first is a reference method, for accurate determinations of moisture content (such as are needed to calculate emission data). The second is an approximation method, which provides estimates of percent moisture to aid in setting isokinetic sampling rates prior to a pollutant emission measurement run. The approximation method described herein is only a suggested approach; alternative means for approximating the moisture content, e.g., drying tubes, wet bulb-dry bulb techniques, condensation techniques, stoichiometric calculations, previous experience, etc., are also acceptable.

The reference method is often conducted simultaneously with a pollutant emission measurement run; when it is, calculation of percent isokinetic, pollutant emission rate, etc., for the run shall be based upon the results of the reference method or its equivalent; these calculations shall not be based upon the results of the approximation method, unless the approximation method is shown, to the satisfaction of the Administrator, U.S. Environmental Protection Agency, to be capable of yielding results within 1 percent H_2O of the reference method.

Note: The reference method may yield questionable results when applied to saturated gas streams or to streams that contain water droplets. Therefore, when these conditions exist or are suspected, a second determination of the moisture content shall be made simultaneously with the reference method, as follows: Assume that the gas stream is saturated. Attach a temperature sensor [capable of measuring to ± 1°C (2°F)] to the reference method probe. Measure the stack gas temperature at each traverse point (see Section 2.2.1) during the reference method traverse; calculate the average stack gas temperature. Next, determine the moisture percentage, either by: (1) using a psychrometric chart and making appropriate corrections if stack pressure is different from that of the chart, or (2) using saturation vapor pressure tables. In cases where the pyschrometric chart or the saturation vapor pressure tables are not applicable (based on evaluation of the process), alternative methods, subject to the approval of the Administrator, shall be used.

2. Reference Method

The procedure described in Method 5 for determining moisture content is acceptable as a reference method.

2.1 Apparatus. A schematic of the sampling train used in this reference method is shown in Figure 4-1. All components shall be maintained and calibrated according to the procedure outlined in Method 5.

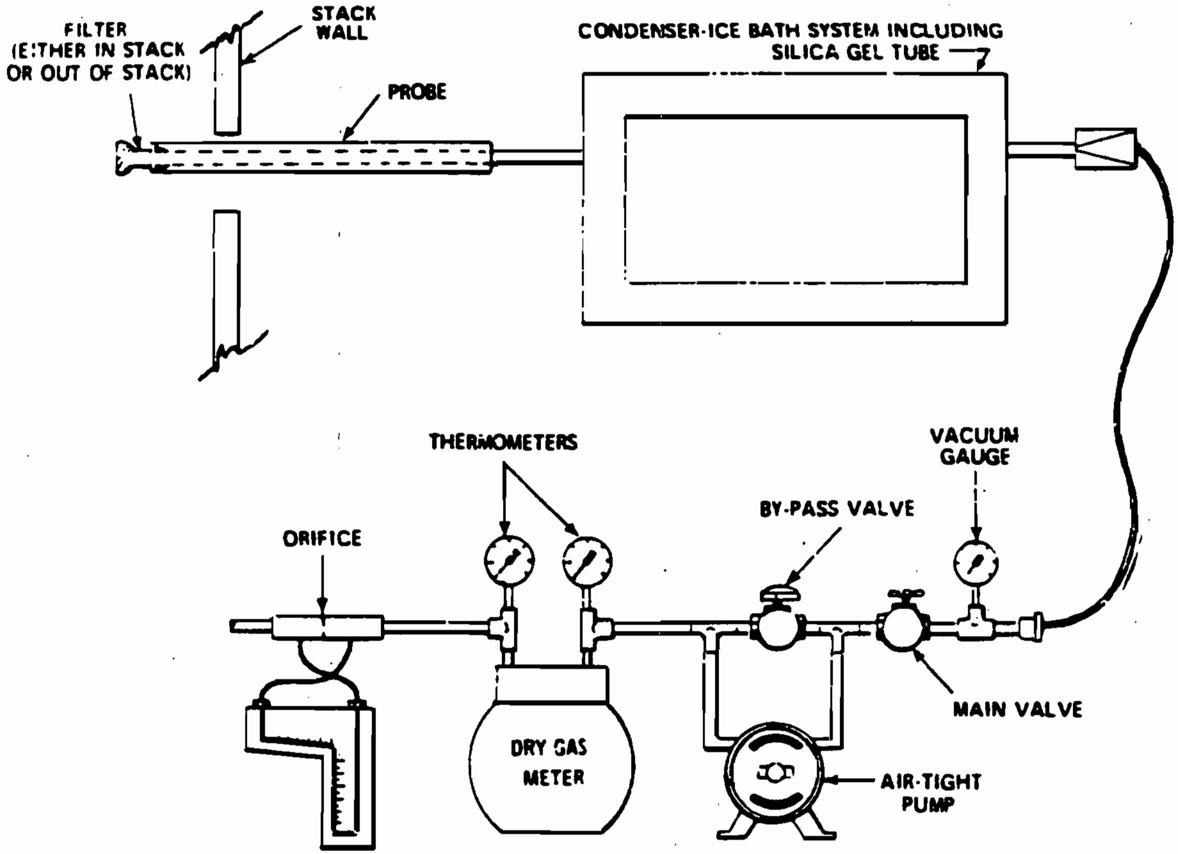


Figure 4-1. Moisture sampling train-reference method.

2.1.1 Probe. The probe is constructed of stainless steel or glass tubing, sufficiently heated to prevent water condensation, and is equipped with a filter, either in-stack (e.g., a plug of glass wool inserted into the end of the probe) or heated out-stack (e.g., as described in Method 5), to remove particular matter.

When stack conditions permit, other metals or plastic tubing may be used for the probe, subject to the approval of the Administrator.

2.1.2 Condenser. The condenser consists of four impingers connected in series with ground glass, leak-free fittings or any similarly leak-free non-contaminating fittings. The first, third, and fourth impingers shall be of the Greenburg-Smith design, modified by replacing the tip with a 1.3 centimeter (½ inch) ID glass tube extending to about 1.3 cm (½ in.) from the bottom of the flask. The second impinger shall be of the Greenburg-Smith design with the standard tip. Modifications (e.g., using flexible connections between the impingers, using materials other than glass, or using flexible vacuum lines to connect the filter holder to the condenser) may be used, subject to the approval of the Administrator.

The first two impingers shall contain known volumes of water, the third shall be empty, and the fourth shall contain a known weight of 6— to 16—mesh indicating type silica gel, or equivalent desiccant. If the silica gel has been previously used, dry at 175°C (350°F) for 2 hours. New silica gel may be used as received. A thermometer, capable of measuring temperature to within 1°C (2°F), shall be placed at the outlet of the fourth impinger, for monitoring purposes.

Alternatively, any system may be used (subject to the approval of the Administrator) that cools the sample gas stream and allows measurement of both the water that has been condensed and the moisture leaving the condenser, each to within 1 ml or 1 g. Acceptable means are to measure the condensed water, either gravimetrically or volumetrically, and to measure the moisture leaving the condenser by: (1) monitoring the temperature and pressure at the exit of the condenser and using Dalton's law of partial pressures, or (2) passing the sample gas stream through a tared silica gel (or equivalent desiccant) trap, with exit gases kept below 20°C (68°F), and determining the weight gain.

If means other than silica gel are used to determine the amount of moisture leaving the condenser, it is recommended that silica gel (or equivalent) still be used between the condenser system and pump, to prevent moisture condensation in the pump and metering devices and to avoid the need to make corrections for moisture in the metered volume.

2.1.3 Cooling System. An ice bath container and crushed ice (or equivalent) are used to aid in condensing moisture.

2.1.4 Metering System. This system includes a vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 3°C (5.4°F), dry gas meter capable of measuring volume to within 2 percent, and related equipment as shown in Figure 4-1. Other metering systems, capable of maintaining a constant sampling rate and determining sample gas volume, may be used, subject to the approval of the Administrator.

2.1.5 Barometer. Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg) may be used. In many cases, the barometric reading may be obtained from a nearby National Weather Service station, in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and the sampling point shall be applied at a rate of minus 2.5 mm Hg (0.1 in. Hg) per 30 m (100 ft) elevation increase or vice versa for elevation decrease.

2.1.6 Graduated Cylinder and/or Balance. These items are used to measure condensed water and moisture caught in the silica gel to within 1 ml or 0.5 g. Graduated cylinders shall have subdivisions no greater than 2 ml. Most laboratory balances are capable of weighing to the nearest 0.5 g or less. These balances are suitable for use here.

2.2 Procedure. The following procedure is written for a condenser system (such as the impinger system described in Section 2.1.2) incorporating volumetric analysis to measure the condensed moisture, and silica gel and gravimetric analysis to measure the moisture leaving the condenser.

2.2.1 Unless otherwise specified by the Administrator, a minimum of eight traverse points shall be used for circular stacks having diameters less than 0.61 m (24 in.), a minimum of nine points shall be used for rectangular stacks having equivalent diameters less than 0.61 m (24 in.), and a minimum of twelve traverse points shall be used in all other cases. The traverse points shall be located according to Method 1. The use of fewer points is subject to the approval of the Administrator. Select a suitable probe and probe length such that all traverse points can be sampled. Consider sampling from opposite sides of the stack (four total sampling ports) for large stacks, to permit use of shorter probe lengths. Mark the probe with heat resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point. Place known volumes of water in the first two impingers. Weigh and record the weight of the silica gel to the nearest 0.5 g, and transfer the silica gel to the fourth impinger; alternatively, the silica gel may first be transferred to the impinger, and the weight of the silica gel plus impinger recorded.

2.2.2 Select a total sampling time such that a minimum total gas volume of 0.60 scm (21 scf) will be collected, at a rate no greater than 0.021 m^3/min (0.75 cfm). When both moisture content and pollutant emission rate are to be determined, the moisture determination shall be simultaneous with, and for the same total length of time as, the pollutant emission rate run, unless otherwise specified in an applicable subpart of the standards.

2.2.3 Set up the sampling train as shown in Figure 4-1. Turn on the probe heater and (if applicable) the filter heating system to temperatures of about 120°C (248°F), to prevent water condensation ahead of the condenser; allow time for the temperatures to stabilize. Place crushed ice in the ice bath container. It is recommended, but not required, that a leak check be done, as follows: Disconnect the probe from the first impinger or (if applicable) from the filter holder. Plug the inlet to the first impinger (or filter holder) and pull a 380 mm (15 in.) Hg vacuum; a lower vacuum may be used, provided that it is not exceeded during the test. A leakage rate in excess of 4 percent of the average sampling rate or 0.00057 m^3/min (0.02 cfm), whichever is less, is unacceptable. Following the leak check, reconnect the probe to the sampling train.

2.2.4 During the sampling run, maintain a sampling rate within 10 percent of constant rate, or as specified by the Administrator. For each run, record the data required on the example data sheet shown in Figure 4-2. Be sure to record the dry gas meter reading at the beginning and end of each sampling time increment and whenever sampling is halted. Take other appropriate readings at each sample point, at least once during each time increment.

2.2.5 To begin sampling, position the probe tip at the first traverse point. Immediately start the pump and adjust the flow to the desired rate. Traverse the cross section, sampling at each traverse point for an equal length of time. Add more ice and, if necessary, salt to maintain a temperature of less 20°C (68°F) at the silica gel outlet.

2.2.6 After collecting the sample, disconnect the probe from the filter holder (or from the first impinger) and conduct a leak check (mandatory) as described in Section 2.2.3. Record the leak rate. If the leakage rate exceeds the allowable rate, the tester shall either reject the test results or shall correct the sample volume as in Section 6.3 of Method 5. Next, measure the volume of the moisture condensed to the nearest ml. Determine the increase in weight of the silica gel (or silica gel plus impinger) to the nearest 0.5 g. Record this

FIGURE 4-2—FIELD MOISTURE DETERMINATION REFERENCE METHOD

Plant ....
Location ....
Operator ....
Date ....
Run No. ....
Ambient temperature ....
Barometric pressure ....
Probe length m (ft) ....

SCHEMATIC OF STACK CROSS SECTION

Traverse point number	Sampling time	Stack temperature	Pressure differential across orifice meter ΔH	Meter reading gas sample volume	ΔV_m	Gas Sample temperature at dry gas meter		Temperaturem of gas leaving condenser or last impinger
						Inlet	Outlet	
	(θ), min.	°C (°F)	mm (in.) H_2O	m^3 (ft^3)	m^3 (ft^3)	(Tm_{in}), °C (°F)	(Tm_{out}), °C (°F)	°C (°F)
Total								
Average					Avg.	Avg.	Avg.	

information (see example data sheet, Figure 4-3) and calculate the moisture percentage, as described in 2.3 below.

2.2.7 A quality control check of the volume metering system at the field site is suggested before collecting the sample following the procedure in Method 5, Section 4.4

2.3 Calculations. Carry out the following calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

Figure 4-3—Analytical Data—Reference Method

	Impinger volume, ml	Silica gel weight, g
Final		
Initial		
Difference		

2.3.1 Nomenclature.

B ws = Proportion of water vapor, by volume, in the gas stream.

M w = Molecular weight of water, 18.0 g/g—mole (18.0 lb/lb—mole).

P m = Absolute pressure (for this method, same as barometric pressure) at the dry gas meter, mm Hg (in. Hg).

P std = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

R = Ideal gas constant, 0.06236 (mm Hg) (m^3)/(g—mole) (°K) for metric units and 21.85 (in. Hg) (ft^3)/(lb—mole) (°R) for English units.

T m = Absolute temperature at meter, °K (°R).

T std = Standard absolute temperature, 293°K (528°R).

V m = Dry gas volume measured by dry gas meter, dcm (dcf).

delta V m = Incremental dry gas volume measured by dry gas meter at each traverse point, dcm (dcf).

V m(std) = Dry gas volume measured by the dry gas meter, corrected to standard conditions, dscm (dscf).

V wc(std) = Volume of water vapor condensed corrected to standard conditions, scm (scf).

V wsg(std) = Volume of water vapor collected in silica gel corrected to standard conditions, scm (scf).

V f = Final volume of condenser water, ml.

V i = Initial volume, if any, of condenser water, ml.

W f = Final weight of silica gel or silica gel plus impinger, g.

W i = Initial weight of silica gel or silica gel plus impinger, g.

Y = Dry gas meter calibration factor.

ß w = Density of water, 0.9982 g/ml (0.002201 lb/ml).

2.3.2 Volume of Water Vapor Condensed.

$$V_{wc(std)} = \frac{(V_f - V_i)\rho_w R T_{std}}{P_{std} M_w}$$

$$= K_1 (V_f - V_i)$$

Eq. 4-1

Where:

K1 = 0.001333 m^3/ml for metric units
= 0.04707 ft^3/ml for English units

2.3.3 Volume of Water Vapor Collected in Silica Gel.

$$V_{wsg(std)} = \frac{(W_f - W_i) R T_{std}}{P_{std} M_w}$$

$$= K_2 (W_f - W_i)$$

Eq. 4-2

Where:

K 2 = 0.001335 m^3/g for metric units.
= 0.04715 ft^3/g for English units

2.3.4 Sample Gas Volume.

$$V_{m(std)} = V_m Y \frac{(P_m)(T_{std})}{(P_{std})(T_m)}$$

$$= K_3 Y \frac{V_m P_m}{T_m}$$

Eq. 4-3

Where:
K 3 = 0.3858 °K/mm Hg for metric units
= 17.64 °R/in. Hg for English units

Note: If the post-test leak rate (Section 2.2.6) exceeds the allowable rate, correct the value of V m in Equation 4-3, as described in Section 6.3 of Method 5.

2.3.5 Moisture Content.

$$B_{ws} = \frac{V_{wc(std)} + V_{wsg(std)}}{V_{wc(std)} + V_{wsg(std)} + V_{m(std)}}$$

Eq. 4-4

Note: In saturated or moisture droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one using a value based upon the saturated conditions (see Section 1.2), and another based upon the results of the impinger analysis. The lower of these two values of B ws shall be considered correct.

2.3.6 Verification of Constant Sampling Rate. For each time increment, determine the delta V m. Calculate the average. If the value for any time increment differs from the average by more than 10 percent, reject the results and repeat the run.

3. Approximation Method

The approximation method described below is presented only as a suggested method (see Section 1.2).

3.1 Apparatus.

3.1.1 Probe. Stainless steel glass tubing, sufficiently heated to prevent water condensation and equipped with a filter (either in-stack or heated out-stack) to remove particulate matter. A plug of glass wool, inserted into the end of the probe, is a satisfactory filter.

3.1.2 Impingers. Two midget impingers, each with 30 ml capacity, or equivalent.

3.1.3 Ice Bath. Container and ice, to aid in condensing moisture in impingers.

3.1.4 Drying Tube. Tube packed with new or regenerated 6— to 16—mesh indicating-type silica gel (or equivalent desiccant), to dry the sample gas and to protect the meter and pump.

3.1.5 Valve. Needle valve, to regulate the sample gas flow rate.

3.1.6 Pump. Leak-free, diaphragm type, or equivalent, to pull the gas sample through the train.

3.1.7 Volume Meter. Dry gas meter, sufficiently accurate to measure the sample volume within 2%, and calibrated over the range of flow rates and conditions actually encountered during sampling.

3.1.8 Rate Meter. Rotameter, to measure the flow range from 0 to 3 lpm (0 to 0.11 cfm).

3.1.9 Graduated Cylinder. 25 ml.

3.1.10 Barometer. Mercury, aneroid, or other barometer, as described in Section 2.1.5 above.

3.1.11 Vacuum Gauge. At least 760 mm Hg (30 in. Hg) gauge, to be used for the sampling leak check.

3.2 Procedure.

3.2.1 Place exactly 5 ml distilled water in each impinger.

Leak check the sampling train as follows: Temporarily insert a vacuum gauge at or near the probe inlet; then, plug the probe inlet and pull a vacuum of at least 250 mm Hg (10 in. Hg). Note the time rate of change of the dry gas meter dial; alternatively, a rotameter (0-40 cc/min) may be temporarily attached to the dry gas meter outlet to determine the leakage rate. A leak rate not in excess of 2 percent of the average sampling rate is acceptable.

Note: Carefully release the probe inlet plug before turning off the pump.

FIGURE 4-5—FIELD MOISTURE DETERMINATION—APPROXIMATION METHOD

Location.................................... Comments:
Test..
Date ....
Operator ....
Barometric pressure ....

Clock time	Gas volume through meter, (V_m), m³ (ft³)	Rate meter setting m³/min (ft³/min)	Meter temperature, °C (° F)

3.2.2 Connect the probe, insert it into the stack, and sample at a constant rate of 2 lpm (0.071 cfm). Continue sampling until the dry gas meter registers about 30 liters (1.1 ft^3) or until visible liquid droplets are carried over from the first impinger to the second. Record temperature, pressure,

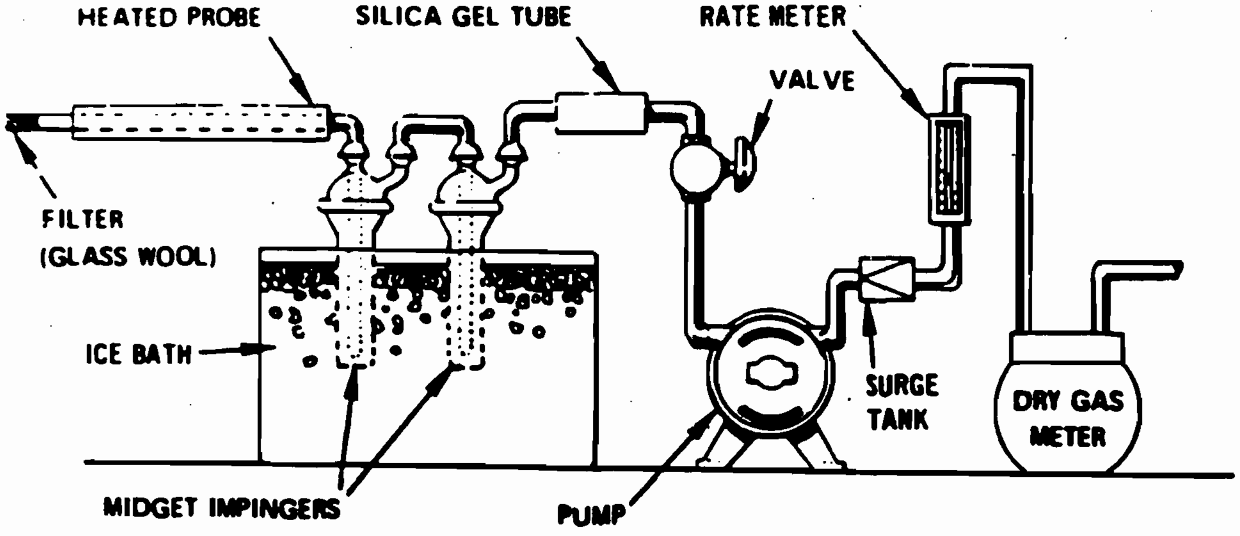


Figure 4-4. Moisture-sampling train - approximation method.

and dry gas meter readings as required by Figure 4-5.

3.2.3 After collecting the sample, combine the contents of the two impingers and measure the volume to the nearest 0.5 ml.

3.3 Calculations. The calculation method presented is designed to estimate the moisture in the stack gas; therefore, other data, which are only necessary for accurate moisture determinations, are not collected. The following equations adequately estimate the moisture content, for the purpose of determining isokinetic sampling rate settings.

3.3.1 Nomenclature.

Bwm = Approximate proportion, by volume, of water vapor in the gas stream leaving the second impinger, 0.025.

Bws = Water vapor in the gas stream, proportion by volume.

Mw = Molecular weight of water, 18.0 g/g—mole (18.0 lb/lb—mole).

Pm = Absolute pressure (for this method, same as barometric pressure) at the dry gas meter.

Pstd = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

R = Ideal gas constant, 0.06236 (mm Hg) (m^3)/(g—mole) (°K) for metric units and 21.85 (in. Hg) (ft^3)/lb—mole) (°R) for English units.

Tm = Absolute temperature at meter, °K (°R).

Tstd = Standard absolute temperature, 293°K (528°R).

Vf = Final volume of impinger contents, ml.

Vi = Initial volume of impinger contents, ml.

m = Dry gas volume measured by dry gas meter, dcm (dcf).

Vm(std) = Dry gas volume measured by dry gas meter, corrected to standard conditions, dscm (dscf).

Vwc(std) = Volume of water vapor condensed, corrected to standard conditions, scm (scf).

ß w = Density of water, 0.9982 g/ml (0.002201 lb/ml).

Y = Dry gas meter calibration factor.

3.3.2 Volume of Water Vapor Collected.

$$V_{wc} = \frac{(V_f - V_i)\rho_w R T_{std}}{P_{std} M_w}$$

$$= K_1 (V_f - V_i)$$

Eq. 4-5

Where:

K1 = 0.001333 m^3/ml for metric units

= 0.04707 ft^3/ml for English units.

3.3.3 Gas Volume.

$$V_{m(std)} = V_m \left(\frac{P_m}{P_{std}}\right)\left(\frac{T_{std}}{T_m}\right)$$

$$= K_2 \frac{V_m P_m}{T_m}$$

Equation 4-6

Where:

K2 = 0.3858 °K/mm Hg for metric units

= 17.64 °R/in. Hg for English units

3.3.4 Approximate Moisture Content.

$$B_{ws} = \frac{V_{wc}}{V_{wc} + V_{m(std)}} + B_{wm}$$

$$= \frac{V_{wc}}{V_{wc} + V_{m(std)}} + (0.025)$$

Equation 4-7

4. Calibration

4.1 For the reference method, calibrate equipment as specified in the following sections of Method 5: Section 5.3 (metering system); Section 5.5 (temperature gauges); and Section 5.7 (barometer). The recommended leak check of the metering system (Section 5.6 of Method 5) also applies to the reference method. For the approximation method, use the procedures outlined in Section 5.1.1 of Method 6 to calibrate the metering system, and the procedure of Method 5, Section 5.7 to calibrate the barometer.

5. Bibliography

1. Air Pollution Engineering Manual (Second Edition). Danielson, J. A. (ed.). U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, NC. Publication No. AP-40. 1973.

2. Devorkin, Howard. et al. Air Pollution Source Testing Manual. Air Pollution Control District, Los Angeles, CA. November, 1963.

3. Methods for Determination of Velocity, Volume, Dust and Mist Content of Gases. Western Precipitation Division of Joy Manufacturing Co., Los Angeles, CA. Bulletin WP-50. 1968.

Method 6C—Determination of Sulfur Dioxide Emissions From Stationary Sources (Instrumental Analyzer Procedure)

1. Applicability and Principle

1.1 Applicability. This method is applicable to the determination of sulfur dioxide (SO2) concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations.

1.2 Principle. A gas sample is continuously extracted from a stack, and a portion of the sample is conveyed to an instrumental analyzer for determination of SO2 gas concentration using an ultraviolet (UV), nondispersive infrared (NDIR), or fluorescence analyzer. Performance specifications and test procedures are provided to ensure reliable data.

2. Range and Sensitivity

2.1 Analytical Range. The analytical range is determined by the instrumental design. For this method, a portion of the analytical range is selected by choosing the span of the monitoring system. The span of the monitoring system shall be selected such that the pollutant gas concentration equivalent to the emission standard is not less than 30 percent of the span. If at any time during a run the measured gas concentration exceeds the span, the run shall be considered invalid.

2.2 Sensitivity. The minimum detectable limit depends on the analytical range, span, and signal—to—noise ratio of the measurement system. For a well designed system, the minimum detectable limit should be less than 2 percent of the span.

3. Definitions

3.1 Measurement System. The total equipment required for the determination of gas concentration. The measurement system consists of the following major subsystems:

3.1.1 Sample Interface. That portion of a system used for one or more of the following: sample acquisition, sample transport, sample conditioning, or protection of the analyzers from the effects of the stack effluent.

3.1.2 Gas Analyzer. That portion of the system that senses the gas to be measured and generates an output proportional to its concentration.

3.1.3 Data Recorder. A strip chart recorder, analog computer, or digital recorder for recording measurement data from the analyzer output.

3.2 Span. The upper limit of the gas concentration measurement range displayed on the data recorder.

3.3 Calibration Gas. A known concentration of a gas in an appropriate diluent gas.

3.4 Analyzer Calibration Error. The difference between the gas concentration exhibited by the gas analyzer and the known concentration of the calibration gas when the calibration gas is introduced directly to the analyzer.

3.5 Sampling System Bias. The difference between the gas concentrations exhibited by the measurement system when a known concentration gas is introduced at the outlet of the sampling probe and when the same gas is introduced directly to the analyzer.

3.6 Zero Drift. The difference in the measurement system output reading from the initial calibration response at the zero concentration level after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

3.7 Calibration Drift. The difference in the measurement system output reading from the initial calibration response at a mid-range calibration value after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

3.8 Response Time. The amount of time required for the measurement system to display 95 percent of a step change in gas concentration on the data recorder.

3.9 Interference Check. A method for detecting analytical interferences and excessive biases through direct comparison of gas concentrations provided by the measurement system and by a modified Method 6 procedure. For this check, the modified Method 6 samples are acquired at the sample by-pass discharge vent.

3.10 Calibration Curve. A graph or other systematic method of establishing the relationship between the analyzer response and the actual gas concentration introduced to the analyzer.

4. Measurement System Performance Specifications

4.1 Analyzer Calibration Error. Less than ± 2 percent of the span for the zero, mid-range, and high-range calibration gases.

4.2 Sampling System Bias. Less than ± 5 percent of the span for the zero, and mid— or high-range calibration gases.

4.3 Zero Drift. Less than ± 3 percent of the span over the period of each run.

4.4 Calibration Drift. Less than ± 3 percent of the span over the period of each run.

4.5 Interference Check. Less than ± 7 percent of the modified Method 6 result for each run.

5. Apparatus and Reagents

5.1 Measurement System. Any measurement system for SO2 that meets the specifications of this method. A schematic of an acceptable measurement system is shown in Figure ~~6~~C-1. The essential components of the measurement system are described below:

5.1.1 Sample Probe. Glass, stainless steel, or equivalent, of sufficient length to traverse the sample points. The sampling probe shall be heated to prevent condensation.

5.1.2 Sample Line. Heated (sufficient to prevent condensation) stainless steel or Teflon tubing, to transport the sample gas to the moisture removal system.

5.1.3 Sample Transport Lines. Stainless steel or Teflon tubing, to transport the sample from the moisture removal system to the sample pump, sample flow rate control, and sample gas manifold.

5.1.4 Calibration Valve Assembly. A three—way valve assembly, or equivalent, for blocking the sample gas flow and introducing calibration gases to the measurement system at the outlet of the sampling probe when in the calibration mode.

5.1.5 Moisture Removal System. A refrigerator-type condenser or similar device (e.g., permeation dryer), to remove condensate continuously from the sample gas while maintaining minimal contact between the condensate and the sample gas. The moisture removal system is not necessary for analyzers that can measure gas concentrations on a wet basis; for these analyzers, (1) heat the sample line and all interface components up to the inlet of the analyzer sufficiently to prevent condensation, and (2) determine the moisture content and correct the measured gas concentrations to a dry basis using appropriate methods, subject to the approval of the Administrator. The determination of sample moisture content is not necessary for pollutant analyzers that measure concentrations on a wet basis when (1) a wet basis CO2 analyzer operated according to Method 3A is used to obtain simultaneous measurements, and (2) the pollutant/CO2 measurements are used to determine emissions in units of the standard.

5.1.6 Particulate Filter. An in-stack or heated (sufficient to prevent water condensation) out—of—stack filter. The filter shall be borosilicate or quartz glass wool, or glass fiber mat. Additional filters at the inlet or outlet of the moisture removal system and inlet of the analyzer may be used to prevent accumulation of particulate material in the measurement system and extend the useful life of the

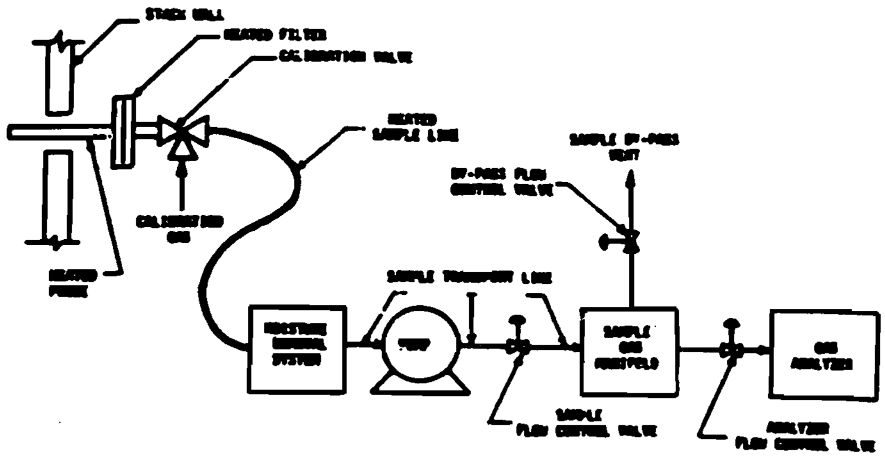


Figure 6C-1. Measurement system schematic.

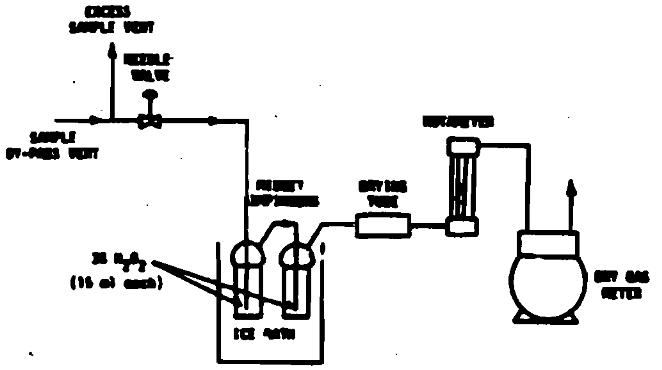


Figure 6C-2. Interference check sampling train.

components. All filters shall be fabricated of materials that are nonreactive to the gas being sampled

5.1.7 Sample Pump. A leak-free pump. to pull the sample gas through the system at a flow rate sufficient to minimize the response time of the measurement system. The pump may be constructed of any material that is nonreactive to the gas being sampled

5.1.8 Sample Flow Rate Control. A sample flow rate control valve and rotameter, or equivalent, to maintain a constant sampling rate within 10 percent.

|_(Note: The tester may elect to install a back-pressure regulator to maintain the sample gas manifold at a constant pressure in order to protect the analyzer(s) from overpressurization, and to minimize the need for flow rate adjustments.)

5.1.9 Sample Gas Manifold. A sample gas manifold, to divert a portion of the sample gas stream to the analyzer, and the remainder to the by-pass discharge vent. The sample gas manifold should also include provisions for introducing calibration gases directly to the analyzer. The manifold may be constructed of any material that is nonreactive to the gas being sampled.

5.1.10 Gas Analyzer. A UV or NDIR absorption or fluorescence analyzer, to determine continuously the SO2 concentration in the sample gas stream. The analyzer shall meet the applicable performance specifications of Section 4. A means of controlling the analyzer flow rate and a device for determining proper sample flow rate (e.g., precision rotameter, pressure gauge downstream of all flow controls, etc.) shall be provided at the analyzer.

|_(Note: Housing the analyzer(s) in a clean, thermally-stable, vibration-free environment will minimize drift in the analyzer calibration.)

5.1.11 Data Recorder. A strip chart recorder, analog computer, or digital recorder, for recording measurement data. The data recorder resolution (i.e., readability) shall be 0.5 percent of span. Alternatively, a digital or analog meter having a resolution of 0.5 percent of span may be used to obtain the analyzer responses and the readings may be recorded manually. If this alternative is used, the readings shall be obtained at equally spaced intervals over the duration of the sampling run. For sampling run durations of less than 1 hour, measurements at 1—minute intervals or a minimum of 30 measurements, whichever is less restrictive, shall be obtained. For sampling run durations greater than 1 hour, measurements at 2—minute intervals or a minimum of 96 measurements, whichever is less restrictive, shall be obtained.

5.2 Method 6 Apparatus and Reagents. The apparatus and reagents described in Method 6, and shown by the schematic of the sampling train in Figure 6C-2, to conduct the interference check.

5.3 SO2 Calibration Gases. The calibration gases for the gas analyzer shall be SO2 in N2 or SO2 in air. Alternatively, SO2/CO2, SO2/O2, or SO2/CO2/O2 gas mixtures in N2 may be used. For fluorescence-based analyzers, the O2 and CO2 concentrations of the calibration gases as introduced to the analyzer shall be within 1 percent (absolute) O2 and 1 percent (absolute) CO2 of the O2 and Co2 concentrations of the effluent samples as introduced to the analyzer. Alternatively, for fluorescence-based analyzers, use calibration blends of SO2 in air and the nomographs provided by the vendor to determine the quenching correction factor (the effluent O2 and CO2 concentrations must be known). Use three calibration gases as specified below:

5.3.1 High-Range Gas. Concentration equivalent to 80 to 100 percent of the span.

5.3.2 Mid-Range Gas. Concentration equivalent to 40 to 60 percent of the span.

5.3.3 Zero Gas. Concentration of less than 0.25 percent of the span. Purified ambient air may be used for the zero gas by passing air through a charcoal filter, or through one or more impingers containing a solution of 3 percent H2O2.

6. Measurement System Performance Test Procedures

Perform the following procedures before measurement of emissions (Section 7).

6.1 Calibration Gas Concentration Verification. There are two alternatives for establishing the concentrations of calibration gases. Alternative Number 1 is preferred.

6.1.1 Alternative Number 1—Use of calibration gases that are analyzed following the Environmental Protection Agency Traceability Protocol Number 1 (see Citation 1 in the Bibliography). Obtain a certification from the gas manufacturer that Protocol Number 1 was followed.

6.1.2 Alternative Number 2—Use of calibration gases not prepared according to Protocol Number 1. If this alternative is chosen, obtain gas mixtures with a manufacturer's tolerance not to exceed ± 2 percent of the tag value. Within 6 months before the emission test, analyze each of the calibration gases in triplicate using Method 6. Citation 2 in the Bibliography describes procedures and techniques that may be used for this analysis. Record the results on a data sheet (example is shown in Figure 6C-3). Each of the individual SO2 analytical results for each calibration gas shall be within 5 percent (or 5 ppm, whichever is greater) of the triplicate set average; otherwise, discard the entire set, and repeat the triplicate analyses. If the average of the triplicate analyses is within 5 percent of the calibration gas manufacturer's cylinder tag value, use the tag value; otherwise, conduct at least three additional analyses until the results of six consecutive runs agree with 5 percent (or 5 ppm, whichever is greater) of their average. Then use this average for the cylinder value.

6.2 Measurement System Preparation. Assemble the measurement system by following the manufacturer's written instructions for preparing and preconditioning the gas analyzer and, as applicable, the other system components. Introduce the calibration gases in any sequence, and make all necessary adjustments to calibrate the analyzer and the data recorder. Adjust system components to achieve correct sampling rates.

6.3 Analyzer Calibration Error. Conduct the analyzer calibration error check by introducing calibration gases to the measurement system at any point upstream of the gas analyzer as follows:

6.3.1 After the measurement system has been prepared for use, introduce the zero, mid-range, and high-range gases to the analyzer. During this check, make no adjustments to the system except those necessary to achieve the correct calibration gas flow rate at the analyzer. Record the analyzer responses to each calibration gas on a form similar to Figure 6C-4.

Note: A calibration curve established prior to the analyzer calibration error check may be used to convert the analyzer response to the equivalent gas concentration introduced to the analyzer. However, the same correction procedure shall be used for all effluent and calibration measurements obtained during the test.

FIGURE 6C-3—ANALYSIS OF CALIBRATION GASES

Date ____________________ Analytic method used ____________________

	Gas concentration (indicate units)		
	Zero [a]	Mid-range [b]	High-range [c]
Sample run:			
1			
2			
3			
Average			
Maximum percent deviation			

[a] Average must be less than 0.25 percent of span.
[b] Average must be 50 to 60 percent of span.
[c] Average must be 80 to 90 percent of span.

FIGURE 6C-4—ANALYZER CALIBRATION DATA

Source identification: ____________________
Test personnel: ____________________
Date: ____________________
Analyzer calibration data for sampling runs: ____________________
Span: ____________________

	Cylinder value (indicate units)	Analyzer calibration response (indicate units)	Absolute difference (indicate units)	Difference (percent of span)
Zero gas				
Mid-range gas				
High-range gas				

FIGURE 6C-5—SYSTEM CALIBRATION BIAS AND DRIFT DATA

Source identification: ____________________
Test personnel: ____________________
Date: ____________________
Run number: ____________________
Span: ____________________

	Analyzer calibration response	Initial values		Final values		Drift (percent of span)
		System calibration response	System cal. bias (percent of span)	System calibration response	System cal. bias (percent of span)	
Zero gas						
Upscale gas						

$$\text{System Calibration Bias} = \frac{\text{System Cal. Response-Analyzer Cal. Response}}{\text{Span}} \times 100$$

6.3.2 The analyzer calibration error check shall be considered invalid if the gas concentration displayed by the analyzer exceeds ± 2 percent of the span for any of the calibration gases. If an invalid calibration is exhibited, take corrective action, and repeat the analyzer calibration error check until acceptable performance is achieved.

6.4 Sampling System Bias Check. Perform the sampling system bias check by introducing calibration gases at the calibration valve installed at the outlet of the sampling probe. A zero gas and either the mid-range or high-range gas, whichever most closely approximates the effluent concentrations, shall be used for this check as follows:

6.4.1 Introduce the upscale calibration gas, and record the gas concentration displayed by the analyzer on a form similar to Figure 6C-5. Then introduce zero gas, and record the gas concentration displayed by the analyzer. During the sampling system bias check, operate the system at the normal sampling rate, and make no adjustments to the measurement system other than those necessary to achieve proper calibration gas flow rates at the analyzer. Alternately introduce the zero and upscale gases until a stable response is achieved. The tester shall determine the measurement system response time by observing the times required to achieve a stable response for both the zero and upscale gases. Note the longer of the two times as the response time.

6.4.2 The sampling system bias check shall be considered invalid if the difference between the gas concentrations displayed by the measurement system for the analyzer calibration error check and for the sampling system bias check exceeds ± 5 percent of the span for either the zero or upscale calibration gas. If an invalid calibration is exhibited, take corrective action, and repeat the sampling system bias check until acceptable performance is achieved. If adjustment to the analyzer is required, first repeat the analyzer calibration error check, then repeat the sampling system bias check.

7. Emission Test Procedure

7.1 Selection of Sampling Site and Sampling Points. Select a measurement site and sampling points using the same criteria that are applicable to Method 6.

7.2 Interference Check Preparation. For each individual analyzer, conduct an interference check for at least three runs during the initial field test on a particular source category. Retain the results, and report them with each test performed on that source category.

If an interference check is being performed, assemble the modified Method 6 train (flow control valve, two midget impingers containing 3 percent H_2O_2, and dry gas meter) as shown in Figure 6C-2. Install the sampling train to obtain a sample at the measurement system sample by-pass discharge vent. Record the initial dry gas meter reading.

7.3 Sample Collection. Position the sampling probe at the first measurement point, and begin sampling at the same rate as used during the sampling system bias check. Maintain constant rate sampling (i.e., ± 10 percent) during the entire run. The sampling time per run shall be the same as for Method 6 plus twice the system response time. For each run, use only those measurements obtained after twice response time of the measurement system has elapsed, to determine the average effluent concentration. If an interference check is being performed, open the flow control valve on the modified Method 6 train concurrent with the initiation of the sampling period, and adjust the flow to 1 liter per minute (± 10 percent).

|_(Note: If a pump is not used in the modified Method 6 train, caution should be exercised in adjusting the flow rate since overpressurization of the impingers may cause leakage in the impinger train, resulting in positively biased results).

7.4 Zero and Calibration Drift Tests. Immediately preceding and following each run, or if adjustments are necessary for the measurement system during the run, repeat the sampling system bias check procedure described in Section 6.4 (Make no adjustments to the measurement system until after the drift checks are completed.) Record and analyzer's responses on a form similar to Figure 6C-5.

7.4.1 If either the zero or upscale calibration value exceeds the sampling system bias specification, then the run is considered invalid. Repeat both the analyzer calibration error check procedure (Section 6.3) and the sampling system bias check procedure (Section 6.4) before repeating the run.

7.4.2 If both the zero and upscale calibration values are within the sampling system bias specification, then use the average of the initial and final bias check values to calculate the gas concentration for the run. If the zero or upscale calibration drift value exceeds the drift limits, based on the difference between the sampling system bias check responses immediately before and after the run, repeat both the analyzer calibration error check procedure (Section 6.3) and the sampling system bias check procedure (Section 6.4) before conducting additional runs.

7.5 Interference Check (if performed). After completing the run, record the final dry gas meter reading, meter temperature, and barometric pressure. Recover and analyze the contents of the midget impingers, and determine the SO_2 gas concentration using the procedures of Method 6. (It is not necessary to analyze EPA performance audit samples for Method 6.) Determine the average gas concentration exhibited by the analyzer for the run. If the gas concentrations provided by the analyzer and the modified Method 6 differ by more than 7 percent of the modified Method 6 result, the run is invalidated.

8. Emission Calculation

The average gas effluent concentration is determined from the average gas concentration displayed by the gas analyzer, and is adjusted for the zero and upscale sampling system bias checks, as determined in accordance with Section 7.4. The average gas concentration displayed by the analyzer may be determined by integration of the area under the curve for chart recorders, or by averaging all of the effluent measurements. Alternatively, the average may be calculated from measurements recorded at equally spaced intervals over the entire duration of the run. For sampling run durations of less than 1 hour, measurements at 1—minute intervals or a minimum of 30 measurements, whichever is less restrictive, shall be used. For sampling run durations greater than 1 hour, measurements at 2—minute intervals or a minimum of 96 measurements, whichever is less restrictive, shall be used. Calculate the effluent gas concentration using Equation 6C-1.

$$C_{gas} = (\bar{C} - C_o)\,\frac{C_{ma}}{C_m - C_o} \qquad \text{Eq. 6C-1}$$

Where:

Cgas = Effluent gas concentration, dry basis, ppm.

$\bar{C}$ = Average gas concentration indicated by gas analyzer, dry basis, ppm.

Co = Average of initial and final system calibration bias check responses for the zero gas, ppm.

Cm = Average of initial and final system calibration bias check responses for the upscale calibration gas, ppm.

Cma = Actual concentration of the upscale calibration gas, ppm.

9. Bibliography

1. Traceability Protocol for Establishing True Concentrations of Gases Used for Calibrations and Audits of Continuous Source Emission Monitors: Protocol Number 1. U.S. Environmental Protection Agency, Quality Assurance Division. Research Triangle Park, NC. June 1978.

2. Westlin, Peter R. and J. W. Brown. Methods for Collecting and Analyzing Gas Cylinder Samples. Source Evaluation Society Newsletter. 3(3):5-15. September 1978.

Method 7E—Determination of Nitrogen Oxides Emissions From Stationary Sources (Instrumental Analyzer Procedure)

1. Applicability and Principle

1.1 Applicability. This method is applicable to the determination of nitrogen oxides (NOx) concentrations in emissions from stationary sources only when specified within the regulations.

1.2 Principle. A gas simple is continuously extracted from a stack, and a portion of the sample is conveyed to an instrumental chemiluminescent analyzer for determination of NOx concentration. Performance specifications and test procedures are provided to ensure reliable data.

2. Range and Sensitivity

Same as Method 6C, Sections 2.1 and 2.2.

3. Definitions

3.1 Measurement System. The total equipment required for the determination of NOx concentration. The measurement system consists of the following major subsystems:

3.1.1 Sample Interface, Gas Analyzer, and Data Recorder. Same as Method 6C, Sections 3.1.1, 3.1.2, and 3.1.3.

3.1.2 NO2 to NO Converter. A device that converts the nitrogen dioxide (NO2) in the sample gas to nitrogen oxide (NO).

3.2 Span, Calibration Gas, Analyzer Calibration Error, Sampling System Bias, Zero Drift, Calibration Drift, and Response Time. Same as Method 6C, Sections 3.2 through 3.8.

3.3 Interference Response. The output response of the measurement system to a component in the sample gas, other than the gas component being measured.

4. Measurement System Performance Specifications

Same as Method 6C, Sections 4.1 through 4.4.

5. Apparatus and Reagents

5.1 Measurement System. Any measurement system for NOx that meets the specifications of this method. A schematic of an acceptable measurement system is shown in Figure 6C-1 of Method 6C. The essential components of the measurement system are described below:

5.1.1 Sample Probe, Sample Line, Calibration Valve Assembly, Moisture Removal System, Particulate Filter, Sample Pump, Sample Flow Rate Control, Sample Gas Manifold, and Data Recorder. Same as Method 6C, Sections 5.1.1 through 5.1.9, and 5.1.11.

5.1.2 NO2 to NO Converter. That portion of the system that converts the nitrogen dioxide (NO2) in the sample gas to nitrogen oxide (NO). An NO2 to NO converter is not necessary if data are presented to demonstrate that the NO2 portion of the exhaust gas is less than 5 percent of the total NOx concentration.

5.1.3 NOx Analyzer. An analyzer based on the principles of chemiluminescence, to determine continuously the NOx concentration in the sample gas stream. The analyzer shall meet the applicable performance specifications of Section 4. A means of controlling the analyzer flow rate and a device for determining proper sample flow rate (e.g., precision rotameter, pressure gauge downstream of all flow controls, etc.) shall be provided at the analyzer.

5.2 NOx Calibration Gases. The calibration gases for the NOx analyzer shall be NO in N2. Three calibration gases, as specified in Sections 5.3.1 through 5.3.3. of Method 6C, shall be used. Ambient air may be used for the zero gas.

6. Measurement System Performance Test Procedures

Perform the following procedures before measurement of emissions (Section 7).

6.1 Calibration Gas Concentration Verification. Follow Section 6.1 of Method 6C, except if calibration gas analysis is required, use Method 7, and change all 5 percent performance values to 10 percent (or 10 ppm, whichever is greater).

6.2 Interference Response. Conduct an interference response test of the analyzer prior to its initial use in the field. Thereafter, recheck the measurement system if changes are made in the instrumentation that could alter the interference response (e.g., changes in the gas detector). Conduct the interference response in accordance with Section 5.4 of Method 20.

6.3 Measurement System Preparation, Analyzer Calibration Error, and Sample System Bias Check. Follow Sections 6.2 through 6.4 of Method 6C.

6.4 NO2 to NO Conversion Efficiency. Unless data are presented to demonstrate that the NO2 concentration within the sample stream is not greater than 5 percent of the NOx concentration, conduct an NO2 to NO conversion efficiency test in accordance with Section 5.6 of Method 20.

7. Emission Test Procedure

7.1 Selection of Sampling Site and Sampling Points. Select a measurement site and sampling points using the same criteria that are applicable to tests performed using Method 7.

7.2 Sample Collection. Position the sampling probe at the first measurement point, and begin sampling at the same rate as used during the system calibration drift test. Maintain constant rate sampling (i.e., ± 10 percent) during the entire run. The sampling time per run shall be the same as the total time required to perform a run using Method 7, plus twice the system response time. For each run, use only those measurements obtained after twice the response time of the measurement system has elapsed, to determine the average effluent concentration.

7.3 Zero and Calibration Drift Test. Follow Section 7.4 of Method 6C.

8. Emission Calculation

Follow Section 8 of Method 6C.

9. Bibliography

Same as bibliography of Method 6C.

Method 8—Determination of Sulfuric Acid Mist and Sulfur Dioxide Emissions From Stationary Sources

1. Principle and Applicability

1.1 Principle. A gas sample is extracted isokinetically from the stack. The sulfuric acid mist (including sulfur trioxide) and the sulfur dioxide are separated, and both fractions are measured separately by the barium-thorin titration method.

1.2 Applicability. This method is applicable for the determination of sulfuric acid mist (including sulfur trioxide, and in the absence of other particulate matter) and sulfur dioxide emissions from stationary sources. Collaborative tests have shown that the minimum detectable limits of the method are 0.05 milligrams/cubic meter (0.03 > 10-7 pounds/cubic foot) for sulfur trioxide and 1.2 mg/m^3 (0.74 10-7 lb/ft^3) for sulfur dioxide. No upper limits have been established. Based on theoretical calculations for 200 milliters of 3 percent hydrogen peroxide solution, the upper concentration limit for sulfur dioxide in a 1.0 m^3 (35.3 ft^3) gas sample is about 12,500 mg/m^3 (7.7 x 10-4 lb/ft^3). The upper limit can be extended by increasing the quantity of peroxide solution in the impingers.

Possible interfering agents of this method are fluorides, free ammonia, and dimethyl aniline. If any of these interfering agents are present (this can be determined by knowledge of the process), alternative methods, subject to the approval of the Administrator, U. S. E. P.A., are required.

Filterable particulate matter may be determined along with SO3 and SO2 (subject to the approval of the Administrator) by inserting a heated glass fiber filter between the probe and isopropanol impinger (see Section 2.1 of Method 6.) If this option is chosen, particulate analysis is gravimetric only; H2SO4 acid mist is not determined separately.

2. Apparatus

2.1 Sampling. A schematic of the sampling train used in this method is shown in Figure 8-1; it is similiar to the Method 5 train except that the filter position is different and the filter holder does not have to be heated. Commercial models of this train are available. For those who desire to build their own, however, complete construction details are described in APTD-0581. Changes from the APTD-0581 document and allowable modifications to Figure 8-1 are discussed in the following subsections.

The operating and maintenance procedures for the sampling train are described in APTD-0576. Since correct usage is important in obtaining valid results, all users should read the APTD-0576 document and adopt the operating and maintenance procedures outlined in it, unless otherwise specified herein. Further details and guidelines on operation and maintenance are given in Method 5 and should be read and followed whenever they are applicable.

2.1.1 Probe Nozzle. Same as Method 5, Section 2.1.1.

2.1.2 Probe Liner. Borosilicate or quartz glass, with a heating system to prevent visible condensation during sampling. Do not use metal probe liners.

2.1.3 Pitot Tube. Same as Method 5, Section 2.1.3.

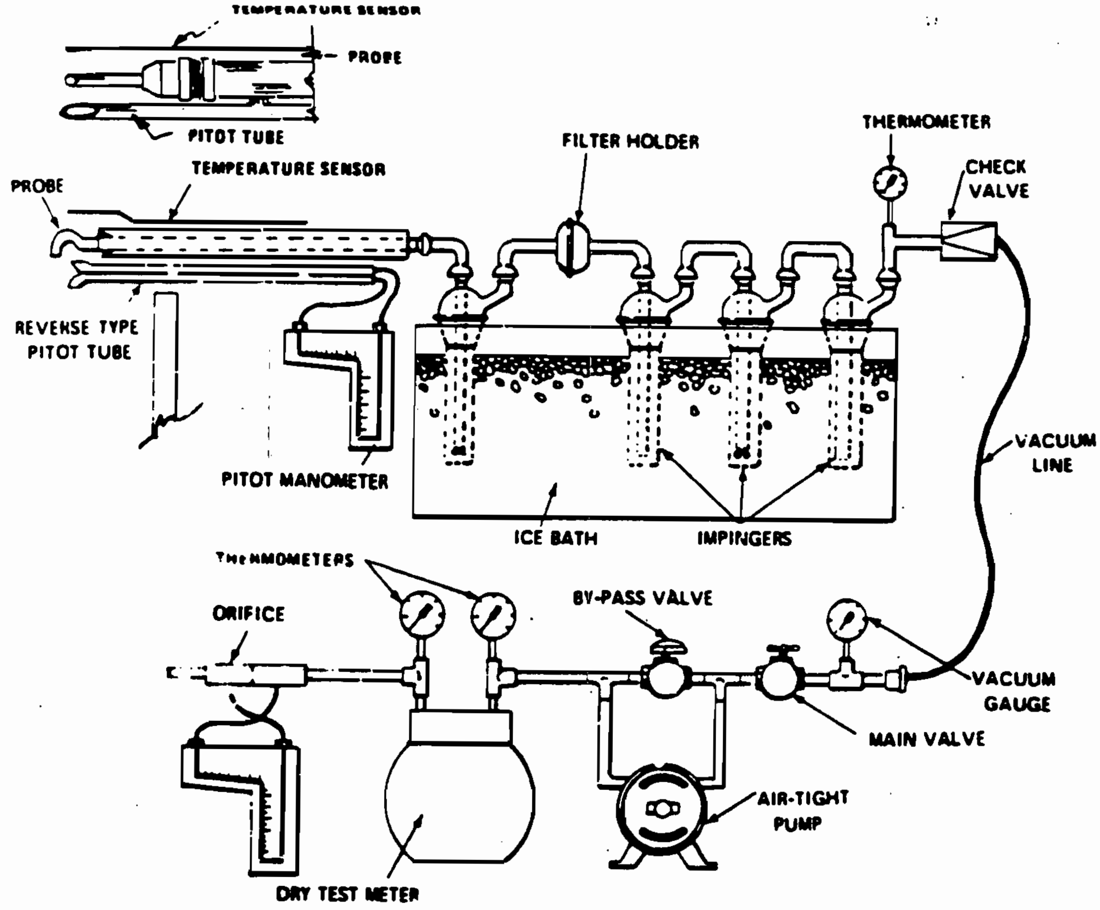


Figure 8-1. Sulfuric acid mist sampling train.

2.1.4 Differential Pressure Gauge. Same as Method 5, Section 2.1.4.

2.1.5 Filter Holder. Borosilicate glass, with a glass frit filter support and a silicone rubber gasket. Other gasket materials, e.g., Teflon or Viton, may be used subject to the approval of the Administrator. The holder design shall provide a positive seal against leakage from the outside or around the filter. The filter holder shall be placed between the first and second impingers. Note: Do not heat the filter holder.

2.1.6 Impingers. Four, as shown in Figure 8-1. The first and third shall be of the Greenburg-Smith design with standard tips. The second and fourth shall be of the Greenburg-Smith design, modified by replacing the insert with an approximately 13 millimeter (0.5 in.) ID glass tube, having an unconstricted tip located 13 mm (0.5 in.) from the bottom of the flask. Similar collection systems, which have been approved by the Administrator, may be used.

2.1.7 Metering System. Same as Method 5, Section 2.1.8.

2.1.8 Barometer. Same as Method 5, Section 2.1.9.

2.1.9 Gas Density Determination Equipment. Same as Method 5, Section 2.1.10.

2.1.10 Temperature Gauge. Thermometer, or equivalent, to measure the temperature of the gas leaving the impinger train to within 1°C (2°F).

2.2 Sample Recovery.

2.2.1 Wash Bottles. Polyethylene or glass, 500 ml. (two).

2.2.2 Graduated Cylinders. 250 ml, 1 liter. (Volumetric flasks may also be used.

2.2.3 Storage Bottles. Leak-free polyethlene bottles, 1000 ml size (two for each sampling run).

2.2.4 Trip Balance. 500-gram capacity, to measure to ± 0.5 g (necessary only if a moisture content analysis is to be done).

2.3 Analysis.

2.3.1 Pipettes. Volumetric 25 ml, 100 ml.

2.3.2 Burette. 50 ml.

2.3.3 Erlenmeyer Flask. 250 ml. (one for each sample, blank, and standard).

2.3.4 Graduated Cylinder. 100 ml.

2.3.5 Trip Balance. 500 g capacity, to measure to ± 0.5 g.

2.3.6 Dropping Bottle. To add indicator solution, 125—ml size.

3. Reagents

Unless otherwise indicated, all reagents are to conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Otherwise, use the best available grade.

3.1 Sampling.

3.1.1 Filters. Same as Method 5, Section 3.1.1.

3.1.2 Silica Gel. Same as Method 5, Section 3.1.2.

3.1.3 Water. Deionized, distilled to conform to ASTM Specification D1193-77, Type 3 (incorporated by reference——see § 60.17). At the option of the analyst, the KMnO4 test for oxidizable organic matter may be omitted when high concentrations of organic matter are not expected to be present.

3.1.4 Isopropanol. 80 Percent. Mix 800 ml of isopropanol with 200 ml of deionized, distilled water.

Note: Experience has shown that only A.C.S. grade isopropanol is satisfactory. Tests have shown that isopropanol obtained from commercial sources occasionally has peroxide impurities that will cause erroneously high sulfuric acid mist measurement. Use the following test for detecting peroxides in each lot of isopropanol: Shake 10 ml of the isopropanol with 10 ml of freshly prepared 10 percent potassium iodide solution. Prepare a blank by similarly treating 10 ml of distilled water. After 1 minute, read the absorbance on a spectrophotometer at 352 nanometers. If the absorbance exceeds 0.1, the isopropanol shall not be used. Peroxides may be removed from isopropanol by redistilling, or by passage through a column of activated alumina. However, reagent grade isopropanol with suitably low peroxide levels is readily available from commercial sources; therefore, rejection of contaminated lots may be more efficient than following the peroxide removal procedure.

3.1.5 Hydrogen Peroxide, 3 Percent. Dilute 100 ml of 30 percent hydrogen peroxide to 1 liter with deionized, distilled water. Prepare fresh daily.

3.1.6 Crushed Ice.

3.2 Sample Recovery.

3.2.1 Water. Same as 3.1.3.

3.2.2 Isopropanol, 80 Percent. Same as 3.1.4.

3.3 Analysis.

3.3.1 Water. Same as 3.1.3.

3.3.2 Isopropanol, 100 Percent.

3.3.3 Thorin Indicator. 1-(o-arsonophenylazo) 2-naphthol-3, 6-disulfonic acid, disodium salt, or equivalent. Dissolve 0.20 g in 100 ml of deionized, distilled water.

3.3.4 Barium Perchlorate (0.0100 Normal). Dissolve 1.95 g of barium perchlorate trihydrate (Ba(C104)2 + 3H2O) in 200 ml deionized, distilled water, and dilute to 1 liter with isopropanol; 1.22 g of barium chloride dihydrate (BaC12 + 2H2O) may be used instead of the barium perchlorate. Standardize with sulfuric acid as in Section 5.2. This solution must be protected against evaporation at all times.

3.3.5 Sulfuric Acid Standard (0.0100 N). Purchase or standardize to ± 0.0002 N against 0.0100 N NaOH that has previously been standardized against primary standard potassium acid phthalate.

3.3.6 Quality Assurance Audit Samples. Same as in Method 6, Section 3.3.6.

4. Procedure

4.1 Sampling.

4.1.1 Pretest Preparation. Follow the procedure outlined in Method 5, Section 4.1.1; filters should be inspected, but need not be desiccated, weighed, or identified. If the effluent gas can be considered dry, i.e., moisture free, the silica gel need not be weighed.

4.1.2 Preliminary Determinations. Follow the procedure outlined in Method 5, Section 4.1.2.

4.1.3 Preparation of Collection Train. Follow the procedure outlined in Method 5, Section 4.1.3 (except for the second paragraph and other obviously inapplicable parts) and use Figure 8-1 instead of Figure 5-1. Replace the second paragraph with: Place 100 ml of 80 percent isopropanol in the first impinger, 100 ml of 3 percent hydrogen peroxide in both the second and third impingers; retain a portion of each reagent for use as a blank solution. Place about 200 g of silica gel in the fourth impinger.

Note: If moisture content is to be determined by impinger analysis, weigh each of the first three impingers (plus absorbing solution) to the nearest 0.5 g and record these weights. The weight of the silica gel (or silica gel plus container) must also be determined to the nearest 0.5 g and recorded.

4.1.4 Pretest Leak-Check Procedure. Follow the basic procedure outlined in Method 5, Section 4.1.4.1, noting that the probe heater shall be adjusted to the minimum temperature required to prevent condensation, and also that verbage such as, ". . . plugging the inlet to the filter holder . . .," shall be replaced by, ". . . plugging the inlet to the first impinger . . ." The pretest leak-check is optional.

4.1.5 Train Operation. Follow the basic procedures outlined in Method 5, Section 4.1.5, in conjunction with the following special instructions. Data shall be recorded on a sheet similar to the one in Figure 8-2. The sampling rate shall not exceed 0.030 m^3/min (1.0 cfm) during the run.

Periodically during the test, observe the connecting line between the probe and first impinger for signs of condensation. If it does occur, adjust the probe heater setting upward to the minimum temperature required to prevent condensation. If component changes become necessary during a run, a leak-check shall be done immediately before each change, according to the procedure outlined in Section 4.1.4.2 of Method 5 (with appropriate modifications, as mentioned in Section 4.1.4 of this method); record all leak rates. If the leakage rate(s) exceed the specified rate, the tester shall either void the run or shall plan to correct the sample volume as outlined in Section 6.3 of Method 5. Immediately after component changes, leak-checks are optional. If these leak-checks are done, the procedure outlined in Section 4.1.4.1 of Method 5 (with appropriate modifications) shall be used.

After turning off the pump and recording the final readings at the conclusion of each run, remove the probe from the stack. Conduct a post-test (mandatory) leak-check as in Section 4.1.4.3 of Method 5 (with appropriate modification) and record the leak rate. If the post-test leakage rate exceeds the specified acceptable rate, the tester shall either correct the sample volume, as outlined in Section 6.3 of Method 5, or shall void the run.

Drain the ice bath and, with the probe disconnected, purge the remaining part of the train, by drawing clean ambient air through the system for 15 minutes at the average flow rate used for sampling.

Note: Clean ambient air can be provided by passing air through a charcoal filter. At the option of the tester, ambient air (without cleaning) may be used.

4.1.6 Calculation of Percent Isokinetic. Follow the procedure outlined in Method 5, Section 4.1.6.

4.2 Sample Recovery.

4.2.1 Container No. 1. If a moisture content analysis is to be done, weigh the first impinger plus contents to the nearest 0.5 g and record this weight.

Transfer the contents of the first impinger to a 250—ml graduated cylinder. Rinse the probe, first impinger, all connecting glassware before the filter, and the front half of the filter holder with 80 percent isopropanol. Add the rinse solution to the cylinder. Dilute to 250 ml with 80 percent 80 percent isopropanol. Add the filter to the solution, mix, and transfer to the storage container. Protect the solution against evaporation. Mark the level of liquid on the container and identify the sample container.

4.2.2 Container No. 2. If a moisture content analysis is to be done, weigh the second and third impingers (plus contents) to the nearest 0.5 g and record these weights. Also, weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g.

Transfer the solutions from the second and third impingers to a 1000—ml graduated cylinder. Rinse all connecting glassware (including back half of filter holder) between the filter and silica gel impinger with deionized, distilled water, and add this rinse water to the cylinder. Dilute to a volume of 1000 ml with deionized, distilled water. Transfer the solution to a storage container. Mark the level of liquid on the container. Seal and identify the sample container.

4.3 Analysis.

Note the level of liquid in Containers 1 and 2, and confirm whether or not any sample was lost during shipment; note this on the analytical data sheet. If a noticeable amount of leakage has occured, either void the sample or use methods, subject to the approval of the Administrator, to correct the final results.

4.3.1 Container No. 1. Shake the container holding the isopropanol solution and the filter. If the filter breaks up, allow the fragments to settle for a few minutes before removing a sample. Pipette a 100—ml aliquot of this solution into a 250—ml Erlenmeyer flask, add 2 to 4 drops of thorin indicator, and titrate to a pink endpoint using 0.0100 N barium perchlorate. Repeat the titration with a second aliquot of sample and average the titration values. Replicate titrations must

FIGURE 8-2—FIELD DATA

Plant ....
Location ....
Operator ....
Date ....
Run No. ....
Sample box No. ....
Meter box No. ....
Meter ΔH@ ....
C factor ....
Pitot tube coefficient Cp ....

SCHEMATIC OF STACK CROSS SECTION

Static pressure, mm Hg (in. Hg) ....
Ambient temperature ....
Barometer pressure ....
Assumed moisture, % ....
Probe length, m (ft) ....
Nozzle identification No. ....
Average calibrated nozzle diameter, cm (in.) ....
Probed heater setting ....
Leak rate, m³/min, (cfm) ....
Probe liner material ....
Filter No. ....

Traverse point number	Sampling time	Vacuum	Stack temperature (T_s)	Velocity head (ΔP)	Pressure differential-across orifice meter	Gas sample volume	Gas sample temperature at dry gas meter		Temperature of gas leaving condenser or last impinger
							Inlet	Outlet	
	(θ), min.	mm Hg (in. Hg)	°C (°F)	mm H_2O (in H_2O)	mm H_2O (in H_2O)	m^3 (ft^3)	°C (°F)	°C (°F)	°C (°F)
Total Average							Avg Avg	Avg	

agree within 1 percent or 0.2 ml, whichever is greater.

4.3.2 Container No. 2. Thoroughly mix the solution in the container holding the contents of the second and third impingers. Pipette a 10—ml aliquot of sample into a 250—ml Erlenmeyer flask. Add 40 ml of isopropanol, 2 to 4 drops of thorin indicator, and titrate to a pink endpoint using 0.0100 N barium perchlorate. Repeat the titration with a second aliquot of sample and average the titration values. Replicate titrations must agree within 1 percent or 0.2 ml, whichever is greater.

4.3.3 Blanks. Prepare blanks by adding 2 to 4 drops of thorin indicator to 100 ml of 80 percent isopropanol. Titrate the blanks in the same manner as the samples.

4.4 Quality Control Procedures. Same as in Method 5, Section 4.4.

4.5 Audit Sample Analysis. Same as in Method 6, Section 4.4.

5. Calibration

5.1 Calibrate equipment using the procedures specified in the following sections of Method 5: Section 5.3 (metering system); Section 5.5 (temperature gauges); Section 5.7 (barometer). Note that the recommended leak-check of the metering system, described in Section 5.6 of Method 5, also applies to this method.

5.2 Standardize the barium perchlorate solution with 25 ml of standard sulfuric acid, to which 100 ml of 100 percent isopropanol has been added.

6. Calculations

Note: Carry out calculations retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

6.1 Nomenclature.

An = Cross-sectional area of nozzle, m^2 (ft^2).

Bws = Water vapor in the gas stream, proportion by volume.

CH2SO4 = Sulfuric acid (including SO3) concentration, g/dscm (lb/dscf).

CSO2 = Sulfur dioxide concentration, g/dscm (lb/dscf).

I = Percent of isokinetic sampling.

N = Normality of barium perchlorate titrant, meq/ml.

Pbar = Barometric pressure at the sampling site, mm Hg (in. Hg).

Ps = Absolute stack gas pressure, mm Hg (in. Hg).

Pstd = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

Tm = Average absolute dry gas meter temperature (see Figure 8-2), °K (°R).

Ts = Average absolute stack gas temperature (see Figure 8-2), °K (°R).

Tstd = Standard absolute temperature, 293°K (528°R).

Va = Volume of sample aliquot titrated, 100 ml for H2SO4 and 10 ml for SO2.

Vlc = Total volume of liquid collected in impingers and silica gel, ml.

Vm = Volume of gas sample as measured by dry gas meter, dcm (dcf).

Vm(std) = Volume of gas sample measured by the dry gas meter corrected to standard conditions, dscm (dscf).

vs = Average stack gas velocity, calculated by Method 2, Equation 2-9, using data obtained from Method 8, m/sec (ft/sec).

Vsoln = Total volume of solution in which the sulfuric acid or sulfur dioxide sample is contained, 250 ml or 1,000 ml, respectively.

Vt = Volume of barium perchlorate titrant used for the sample, ml.

Vtb = Volume of barium perchlorate titrant used for the blank, ml.

Y = Dry gas meter calibration factor.

DELTA H = Average pressure drop across orifice meter, mm (in.) H2O.

Θ = Total sampling time, min.

13.6 = Specific gravity of mercury.

60 = sec/min.

100 = Conversion to percent.

6.2 Average Dry Gas Meter Temperature and Average Orifice Pressure Drop. See data sheet (Figure 8-2).

6.3 Dry Gas Volume. Correct the sample volume measured by the dry gas meter to standard conditions (20°C and 760 mm Hg or 68°F and 29.92 in. Hg) by using Equation 8-1.

$$V_{m(std)} = V_m Y \left(\frac{T_{std}}{T_m}\right) \frac{P_{bar} + \left(\frac{\Delta H}{13.6}\right)}{P_{std}}$$

$$= K_1 V_m Y \frac{P_{bar} + (\Delta H/13.6)}{T_m}$$

Equation 8-1

Where:

K1 = 0.3858 °K/mm Hg for metric units.

= 17.64 °R/in., Hg for English units.

Note: If the leak rate observed during any mandatory leak-checks exceeds the specified acceptable rate, the tester shall either correct the value of Vm in Equation 8-1 (as described in Section 6.3 of Method 5), or shall invalidate the test run.

6.4 Volume of Water Vapor and Moisture Content. Calculate the volume of water vapor using Equation 5-2 of Method 5; the weight of water collected in the impingers and silica gel can be directly converted to milliliters (the specific gravity of water is 1 g/ml). Calculate the moisture content of the stack gas, using Equation 5-3 of Method 5. The "Note" in Section 6.5 of Method 5 also applies to this method. Note that if the effluent gas stream can be considered dry, the volume of water vapor and moisture content need not be calculated.

6.5 Sulfuric Acid Mist (including SO3) Concentration.

$$C_{H_2SO_4} = K_2 \frac{N(V_t - V_{tb})\left(\frac{V_{soln}}{V_a}\right)}{V_{m(std)}}$$

Equation 8-2

Where:

K2 = 0.04904 g/milliequivalent for metric units.

= 1.081 x 10-4 lb/meq for English units.

6.6 Sulfur Dioxide Concentration.

$$C_{SO_2} = K_3 \frac{N(V_t - V_{tb})\left(\frac{V_{soln}}{V_a}\right)}{V_{m(std)}}$$

Equation 8-3

Where:

K3 = 0.03203 g/meq for metric units.

= 7.061 x 10-5 lb/meq for English units.

6.7 Isokinetic Variation.

6.7.1 Calculation from Raw Data.

$$I = \frac{100 T_s [K_4 V_{lc} + (V_m Y/T_m)/(P_{bar} + \Delta H/13.6)]}{60 \theta v_s P_s A_n}$$

Eq. 8-4

Where:

K4 = 0.003464 mm Hg—m^3/ml-°K for metric units.

= 0.002676 in. Hg-ft^3/ml-°R for English units.

6.7.2 Calculation from Intermediate Values.

$$I = \frac{T_s V_{m(std)} P_{std} 100}{T_{std} v_s \theta A_n P_s 60 (1 - B_{ws})}$$

$$= K_5 \frac{T_s V_{m(std)}}{P_s v_s A_n \theta (1 - B_{ws})}$$

Equation 8-5

Where:

K5 = 4.320 for metric units.

= 0.09450 for English units

6.8 Acceptable Results. If 90 percent < I < 110 percent, the results are acceptable. If the results are low in comparison to the standards and I is beyond the acceptable range, the Administrator may opt to accept the results. Use Citation 4 in the Bibliography of Method 5 to make judgments. Otherwise, reject the results and repeat the test.

6.9 Stack Gas Velocity and Volumetric Flow Rate. Calculate the average stack gas velocity and volumetric flow rate, if needed, using data obtained in this method and equations in Sections 5.2 and 5.3 of Method 2.

6.10 Relative Error (RE) for QA Audit Samples. Same as in Method 6, Section 6.4.

7. Bibliography

1. Atmospheric Emissions from Sulfuric Acid Manufacturing Processes. U.S. DHEW, PHS, Division of Air Pollution. Public Health Service Publication No. 999-AP-13. Cincinnati, OH. 1965.

2. Corbett, P. F. The Determination of SO2 and SO3 in Flue Gases. Journal of the Institute of Fuel. 24:237-243. 1961.

3. Martin, Robert M. Construction Details of Isokinetic Source Sampling Equipment. Environmental Protection Agency. Research Triangle Park, NC. Air Pollution Control Office Publication No. APTD-0581. April, 1971.

4. Patton, W. F. and J. A. Brink, Jr. New Equipment and Techniques for Sampling Chemical Process Gases. Journal of Air Pollution Control Association. 13:162. 1963.

5. Rom, J. J. Maintenance, Calibration, and Operation of Isokinetic Source-Sampling Equipment. Office of Air Programs, Environmental Protection Agency. Research Triangle Park, NC. APTD-0576. March, 1972.

6. Hamil, H. F. and D. E. Camann. Collaborative Study of Method for Determination of Sulfur Dioxide Emissions from Stationary Sources (Fossil Fuel-Fired Steam Generators). Environmental Protection Agency. Research Triangle Park, NC. EPA-650/4-74-024. December, 1973.

7. Annual Book of ASTM Standards. Part 31; Water, Atmospheric Analysis. pp. 40-42. American Society for Testing and Materials. Philadelphia, Pa. 1974.

Method 9—Visual Determination of the Opacity of Emissions From Stationary Sources

Many stationary sources discharge visible emissions into the atmosphere; these emissions are usually in the shape of a plume. This method involves the determination of plume opacity by qualified observers. The method includes procedures for the training and certification of observers, and procedures to be used in the field for determination of plume opacity. The appearance of a plume as viewed by an observer depends upon a number of variables, some of which may be controllable and some of which may not be controllable in the field. Variables which can be controlled to an extent to which they no longer exert a significant influence upon plume appearance include: Angle of the observer with respect to the plume; angle of the observer with respect to the sun; point of observation of attached and detached steam plume; and angle of the observer with respect to a plume emitted from a rectangular stack with a large length to width ratio. The method includes specific criteria applicable to these variables.

Other variables which may not be controllable in the field are luminescence and color contrast between the plume and the background against which the plume is viewed. These variables exert an influence upon the appearance of a plume as viewed by an observer, and can affect the ability of the observer to accurately assign opacity values to the observed plume. Studies of the theory of plume opacity and field studies have demonstrated that a plume is most visible and presents the greatest apparent opacity when viewed against a contrasting background. It follows from this, and is confirmed by field trials, that the opacity of a plume, viewed under conditions where a contrasting background is present can be assigned with the greatest degree of accuracy. However, the potential for a positive error is also the greatest when a plume is viewed under such contrasting conditions. Under conditions presenting a less contrasting background, the apparent opacity of a plume is less and approaches zero as the color and luminescence contrast decrease toward zero. As a result, significant negative bias and negative errors can be made when a plume is viewed under less contrasting conditions. A negative bias decreases rather than increases the possibility that a plant operator will be cited for a violation of opacity standards due to observer error.

Studies have been undertaken to determine the magnitude of positive errors which can be made by qualified observers while reading plumes under contrasting conditions and using the procedures set forth in this method. The results of these studies (field trials) which involve a total of 769 sets of 25 readings each are as follows:

|_(1) For black plumes (133 sets at a smoke generator), 100 percent of the sets were read with a positive error|_\1\ of less than 7.5 percent opacity; 99 percent were read with a positive error of less than 5 percent opacity.

|_{Footnote}\1\ For a set, positive error = average opacity determined by observers' 25 observations——average opacity determined from transmissometer's 25 recordings.

|_(2) For white plumes (170 sets at a smoke generator, 168 sets at a coal-fired power plant, 298 sets at a sulfuric acid plant), 99 percent of the sets were read with a positive error of less than 7.5 percent opacity; 95 percent were read with a positive error of less than 5 percent opacity.

The positive observational error associated with an average of twenty-five readings is therefore established. The accuracy of the method must be taken into account when determining possible violations of applicable opacity standards.

1. Principle and Applicability

1.1 Principle. The opacity of emissions from stationary sources is determined visually by a qualified observer.

1.2 Applicability. This method is applicable for the determination of the opacity of emissions from stationary sources pursuant to § 60.11(b) and for qualifying observers for visually determining opacity of emissions.

2. Procedures

The observer qualified in accordance with section 3 of this method shall use the following procedures for visually determining the opacity of emissions:

2.1 Position. The qualified observer shall stand at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140° sector to his back. Consistent with maintaining the above requirement, the observer shall, as much as possible, make his observations from a position such that his line of vision is approximately perpendicular to the plume direction, and when observing opacity of emissions from rectangular outlets (e.g., roof monitors, open baghouses, noncircular stacks), approximately perpendicular to the longer axis of the outlet. The observer's line of sight should not include more than one plume at a time when multiple stacks are involved, and in any case the observer should make his observations with his line of sight perpendicular to the longer axis of such a set of multiple stacks (e.g., stub stacks on baghouses).

2.2 Field Records. The observer shall record the name of the plant, emission location, type facility, observer's name and affiliation, a sketch of the observer's position relative to the source, and the date on a field data sheet (Figure 9-1). The time, estimated distance to the emission location, approximate wind direction, estimated wind speed, description of the sky condition (presence and color of clouds), and plume background are recorded on a field data sheet at the time opacity readings are initiated and completed.

2.3 Observations. Opacity observations shall be made at the point of greatest opacity in that portion of the plume where condensed water vapor is not present. The observer shall not look continuously at the plume, but instead shall observe the plume momentarily at 15-second intervals.

2.3.1 Attached Steam Plumes. When condensed water vapor is present within the plume as it emerges from the emission outlet, opacity observations shall be made beyond the point in the plume at which condensed water vapor is no longer visible. The observer shall record the approximate distance from the emission outlet to the point in the plume at which the observations are made.

2.3.2 Detached Steam Plume. When water vapor in the plume condenses and becomes visible at a distinct distance from the emission outlet, the opacity of emissions should be evaluated at the emission outlet prior to the condensation of water vapor and the formation of the steam plume.

2.4 Recording Observations. Opacity observations shall be recorded to the nearest 5 percent at 15-second intervals on an observational record sheet. (See Figure 9-2 for an example.) A minimum of 24 observations shall be recorded. Each momentary observation recorded shall be deemed to represent the average opacity of emissions for a 15-second period.

2.5 Data Reduction. Opacity shall be determined as an average of 24 consecutive observations recorded at 15-second intervals. Divide the observations recorded on the record sheet into sets of 24 consecutive observations. A set is composed of any 24 consecutive observations. Sets need not be consecutive in time and in no case shall two sets overlap. For each set of 24 observations, calculate the average by summing the opacity of the 24 observations and dividing this sum by 24. If an applicable standard specifies an averaging time requiring more than 24 observations, calculate the average for all observations made during the specified time period. Record the average opacity on a record sheet. (See Figure 9-1 for an example.)

3. Qualifications and Testing

3.1 Certification Requirements. To receive certification as a qualified observer, a candidate must be tested and demonstrate the ability to assign opacity readings in 5 percent increments to 25 different black plumes and 25 different white plumes, with an error not to exceed 15 percent opacity on any one reading and an average error not to exceed 7.5 percent opacity in each category. Candidates shall be tested according to the procedures described in section 3.2. Smoke generators used pursuant to section 3.2 shall be equipped with a smoke meter which meets the requirements of section 3.3.

The certification shall be valid for a period of 6 months, at which time the qualification procedure must be repeated by any observer in order to retain certification.

3.2 Certification Procedure. The certification test consists of showing the candidate a complete run of 50 plumes——25 black plumes and 25 white plumes——generated by a smoke generator. Plumes within each set of 25 black and 25 white runs shall be presented in random order. The candidate assigns an opacity value to each plume and records his observation on a suitable form. At the completion of each run of 50 readings, the score of the candidate is determined. If a candidate fails to qualify, the complete run of 50 readings must be repeated in any retest. The smoke test may be administered as part of a smoke school or training program, and may be preceded by training or familiarization runs of the smoke generator during which candidates are shown black and white plumes of known opacity.

3.3 Smoke Generator Specifications. Any smoke generator used for the purposes of section 3.2 shall be equipped with a smoke meter installed to measure opacity across the diameter of the smoke generator stack. The smoke meter output shall display instack opacity based upon a pathlength equal to the stack exit diameter, on a full 0 to 100 percent chart recorder scale. The smoke meter optical design and performance shall meet the specifications shown in Table 9-1. The smoke meter shall be calibrated as prescribed in section 3.3.1 prior to the conduct of each smoke reading test. At the completion of each test, the zero and span drift shall be checked and if the drift exceeds ± 1 percent opacity, the condition shall be corrected prior to conducting any subsequent test runs. The smoke meter shall be demonstrated, at the time of installation, to meet the specifications listed in Table 9-1. This demonstration shall be repeated following any subsequent repair or replacement of the photocell or associated electronic circuitry including the chart recorder or output meter, or every 6 months, whichever occurs first.

3.3.1 Calibration. The smoke meter is calibrated after allowing a minimum of 30 minutes warmup by alternately producing simulated opacity of 0 percent and 100 percent. When stable response at 0 percent or 100 percent is noted, the smoke meter is adjusted to produce an output of 0 percent or 100 percent, as appropriate. This calibration shall be repeated until

FIGURE 9-1
RECORD OF VISUAL DETERMINATION OF OPACITY

PAGE___of___

COMPANY________________
LOCATION________________
TEST NUMBER________________
DATE________________
TYPE FACILITY________________
CONTROL DEVICE________________

HOURS OF OBSERVATION________________
OBSERVER________________
OBSERVER CERTIFICATION DATE________________
OBSERVER AFFILIATION________________
POINT OF EMISSIONS________________
HEIGHT OF DISCHARGE POINT________________

CLOCK TIME	Initial			Final
OBSERVER LOCATION Distance to Discharge				
Direction from Discharge				
Height of Observation Point				
BACKGROUND DESCRIPTION				
WEATHER CONDITIONS Wind Direction				
Wind Speed				
Ambient Temperature				
SKY CONDITIONS (clear, overcast, % clouds, etc.)				
PLUME DESCRIPTION Color				
Distance Visible				
OTHER INFORMATION				

SUMMARY OF AVERAGE OPACITY

Set Number	Time	Opacity	
	Start--End	Sum	Average

Readings ranged from ____ to ____ % opacity

The source was/was not in compliance with ____ at the time evaluation was made.

stable 0 percent and 100 percent readings are produced without adjustment. Simulated 0 percent and 100 percent opacity values may be produced by alternately switching the power to the light source on and off while the smoke generator is not producing smoke.

3.3.2 Smoke Meter Evaluation. The smoke meter design and performance are to be evaluated as follows:

3.3.2.1 Light Source. Verify from manufacturer's data and from voltage measurements made at the lamp, as installed, that the lamp is operated within ± 5 percent of the nominal rated voltage.

3.3.2.2 Spectral Response of Photocell. Verify from manufacturer's data that the photocell has a photopic response; i.e., the spectral sensitivity of the cell shall closely approximate the standard spectral-luminosity curve for photopic vision which is referenced in (b) of Table 9-1.

TABLE 9-1—SMOKE METER DESIGN AND PERFORMANCE SPECIFICATIONS

Parameter	Specification
a. Light source	Incandescent lamp operated at nominal rated voltage.
b. Spectral response of photocell.	Photopic (daylight spectral response of the human eye—Citation 3).
c. Angle of view	15° maximum total angle.
d. Angle of projection	15° maximum total angle.
e. Calibration error	±3% opacity, maximum.
f. Zero and span drift	±1% opacity, 30 minutes
g. Response time	5 seconds.

3.3.2.3 Angle of View. Check construction geometry to ensure that the total angle of view of the smoke plume, as seen by the photocell, does not exceed 15°. The total angle of view may be calculated from: $\Theta = 2 \tan^{-1} d/2L$, where Θ = total angle of view; d = the sum of the photocell diameter + the diameter of the limiting aperture; and L = the distance from the photocell to the limiting aperture. The limiting aperture is the point in the path between the photocell and the smoke plume where the angle of view is most restricted. In smoke generator smoke meters this is normally an orifice plate.

3.3.2.4 Angle of Projection. Check construction geometry to ensure that the total angle of projection of the lamp on the smoke plume does not exceed 15°. The total angle of projection may be calculated from: $\Theta = 2 \tan^{-1} d/2L$, where Θ = total angle of projection; d = the sum of the length of the lamp filament + the diameter of the limiting aperture; and L = the distance from the lamp to the limiting aperture.

3.3.2.5 Calibration Error. Using neutral-density filters of known opacity, check the error between the actual response and the theoretical linear response of the smoke meter. This check is accomplished by first calibrating the smoke meter according to 3.3.1 and then inserting a series of three neutral-density filters of nominal opacity of 20, 50, and 75 percent in the smoke meter pathlength. Filters calibrated within ± 2 percent shall be used. Care should be taken when inserting the filters to prevent stray light from affecting the meter. Make a total of five nonconsecutive readings for each filter. The maximum error on any one reading shall be 3 percent opacity.

3.3.2.6 Zero and Span Drift. Determine the zero and span drift by calibrating and operating the smoke generator in a normal manner over a 1—hour period. The drift is measured by checking the zero and span at the end of this period.

3.3.2.7 Response Time. Determine the response time by producing the series of five simulated 0 percent and 100 percent opacity values and observing the time required to reach stable response. Opacity values of 0 percent and 100 percent may be simulated by alternately switching the power to the light source off and on while the smoke generator is not operating.

FIGURE 9-2—OBSERVATION RECORD

Page —— of ——

Company ....
Location ....
Test Number ....
Date ....

Observer ....
Type facility ....
Point of emissions ....

Hr.	Min.	Seconds				Steam plume (check if applicable)		Comments
		0	15	30	45	Attached	Detached	
	0							
	1							
	2							
	3							
	4							
	5							
	6							
	7							
	8							
	9							
	10							
	11							
	12							
	13							
	14							
	15							
	16							
	17							
	18							
	19							
	20							
	21							
	22							
	23							
	24							
	25							
	26							
	27							
	28							
	29							

4. Bibliography.

1. Air Pollution Control District Rules

and Regulations, Los Angeles County Air Pollution Control District, Regulation IV, Prohibitions, Rule 50.

2. Weisburd, Melvin I., Field Operations and Enforcement Manual for Air, U.S. Environmental Protection Agency, Research Triangle Park, NC. APTD-1100, August 1972, pp. 4.1-4.36.

3. Condon, E.U., and Odishaw, H., Handbook of Physics, McGraw-Hill Co., New York, NY, 1958, Table 3.1, p. 6-52.

§60, App. A, Alt. Meth.

Alternate Method 1—Determination of the Opacity of Emissions From Stationary Sources Remotely by Lidar

This alternate method provides the quantitative determination of the opacity of an emissions plume remotely by a mobile lidar system (laser radar; Light Detection and Ranging). The method includes procedures for the calibration of the lidar and procedures to be used in the field for the lidar determination of plume opacity. The lidar is used to measure plume opacity during either day or nighttime hours because it contains its own pulsed light source or transmitter. The operation of the lidar is not dependent upon ambient lighting conditions (light, dark, sunny or cloudy).

The lidar mechanism or technique is applicable to measuring plume opacity at numerous wavelengths of laser radiation. However, the performance evaluation and calibration test results given in support of this method apply only to a lidar that employs a ruby (red light) laser [Reference 5.1].

1. Principle and Applicability

1.1 Principle. The opacity of visible emissions from stationary sources (stacks, roof vents, etc.) is measured remotely by a mobile lidar (laser radar).

1.2 Applicability. This method is applicable for the remote measurement of the opacity of visible emissions from stationary sources during both nighttime and daylight conditions, pursuant to 40 CFR § 60.11(b). It is also applicable for the calibration and performance verification of the mobile lidar for the measurement of the opacity of emissions. A performance/design specification for a basic lidar system is also incorporated into this method.

1.3 Definitions.

Azimuth angle: The angle in the horizontal plane that designates where the laser beam is pointed. It is measured from an arbitrary fixed reference line in that plane.

Backscatter: The scattering of laser light in a direction opposite to that of the incident laser beam due to reflection from particulates along the beam's atmospheric path which may include a smoke plume.

Backscatter signal: The general term for the lidar return signal which results from laser light being backscattered by atmospheric and smoke plume particulates.

Convergence distance: The distance from the lidar to the point of overlap of the lidar receiver's field—of—view and the laser beam.

Elevation angle: The angle of inclination of the laser beam referenced to the horizontal plane.

Far region: The region of the atmosphere's path along the lidar line—of—sight beyond or behind the plume being measured.

Lidar: Acronym for Light Detection and Ranging.

Lidar range: The range or distance from the lidar to a point of interest along the lidar line—of—sight.

Near region: The region of the atmospheric path along the lidar line—of—sight between the lidar's convergence distance and the plume being measured.

Opacity: One minus the optical transmittance of a smoke plume, screen target, etc.

Pick interval: The time or range intervals in the lidar backscatter signal whose minimum average amplitude is used to calculate opacity. Two pick intervals are required, one in the near region and one in the far region.

Plume: The plume being measured by lidar.

Plume signal: The backscatter signal resulting from the laser light pulse passing through a plume.

1/R2 correction: The correction made for the systematic decrease in lidar backscatter signal amplitude with range.

Reference signal: The backscatter signal resulting from the laser light pulse passing through ambient air.

Sample interval: The time period between successive samples for a digital signal or between successive measurements for an analog signal.

Signal spike: An abrupt, momentary increase and decrease in signal amplitude.

Source: The source being tested by lidar.

Time reference: The time (to) when the laser pulse emerges from the laser, used as the reference in all lidar time or range measurements.

2. Procedures

The mobile lidar calibrated in accordance with Paragraph 3 of this method shall use the following procedures for remotely measuring the opacity of stationary source emissions:

2.1 Lidar Position. The lidar shall be positioned at a distance from the plume sufficient to provide an unobstructed view of the source emissions. The plume must be at a range of at least 50 meters or three consecutive pick intervals (whichever is greater) from the lidar's transmitter/receiver convergence distance along the line—of—sight. The maximum effective opacity measurement distance of the lidar is a function of local atmospheric conditions, laser beam diameter, and plume diameter. The test position of the lidar shall be selected so that the diameter of the laser beam at the measurement point within the plume shall be no larger than three-fourths the plume diameter. The beam diameter is calculated by Equation (AM1-1):

$$D(\text{lidar}) = A+R\phi \leq 0.75\,D(\text{Plume}) \quad (\text{AM1-1})$$

Where:

D(Plume) = diameter of the plume (cm),
ϕ = laser beam divergence measured in radians
R = range from the lidar to the source (cm)
D(Lidar) = diameter of the laser beam at range R (cm),
A = diameter of the laser beam or pulse where it leaves the laser.

The lidar range, R, is obtained by aiming and firing the laser at the emissions source structure immediately below the outlet. The range value is then determined from the backscatter signal which consists of a signal spike (return from source structure) and the atmospheric backscatter signal [Reference 5.1]. This backscatter signal should be recorded.

When there is more than one source of emissions in the immediate vicinity of the plume, the lidar shall be positioned so that the laser beam passes through only a single plume, free from any interference of the other plumes for a minimum of 50 meters or three consecutive pick intervals (whichever is greater) in each region before and beyond the plume along the line—of—sight (determined from the backscatter signals). The lidar shall initially be positioned so that its line—of—sight is approximately perpendicular to the plume.

When measuring the opacity of emissions from rectangular outlets (e.g., roof monitors, open baghouses, noncircular stacks, etc.), the lidar shall be placed in a position so that its line—of—sight is approximately perpendicular to the longer (major) axis of the outlet.

2.2 Lidar Operational Restrictions. The lidar receiver shall not be aimed within an

Method 10—Determination of Carbon Monoxide Emissions From Stationary Sources

1. Principle and Applicability

1.1 Principle. An integrated or continuous gas sample is extracted from a sampling point and analyzed for carbon monoxide (CO) content using a Luft-type nondispersive infrared analyzer (NDIR) or equivalent.

1.2 Applicability. This method is applicable for the determination of carbon monoxide emissions from stationary sources only when specified by the test procedures for determining compliance with new source performance standards. continuous or an integrated sample is to be used.

2. Range and Sensitivity

2.1 Range. 0 to 1,000 ppm.

2.2 Sensitivity. Minimum detectable concentration is 20 ppm for a 0 to 1,000 ppm span.

3. Interferences

Any substance having a strong absorption of infrared energy will interfere to some extent. For example, discrimination ratios for water (H2O) and carbon dioxide (CO2) are 3.5 percent H2O per 7 ppm CO and 10 percent CO2 per 10 ppm CO, respectively, for devices measuring in the 1,500 to 3,000 ppm range. For devices measuring in the 0 to 100 ppm range, interference ratios can be as high as 3.5 percent H2O per 25 ppm CO and 10 percent CO2 per 50 ppm CO. The use of silica gel and ascarite traps will alleviate the major interference problems. The measured gas volume must be corrected if these traps are used.

4. Precision and Accuracy

4.1 Precision. The precision of most NDIR analyzers is approximately ± 2 percent of span.

4.2 Accuracy. The accuracy of most NDIR analyzers is approximately ± 5 percent of span after calibration.

5. Apparatus

5.1 Continuous Sample (Figure 10-1).

5.1.1 Probe. Stainless steel or sheathed Pyrex\1\ glass, equipped with a filter to remove particulate matter.

5.1.2 Air-Cooled Condenser or Equivalent. To remove any excess moisture.

5.2 Integrated Sample (Figure 10-2).

5.2.1 Probe. Stainless steel or sheathed Pyrex glass, equipped with a filter to remove particulate matter.

5.2.2 Air-Cooled Condenser or Equivalent. To remove any excess moisture.

5.2.3 Valve. Needle valve, or equivalent, to to adjust flow rate.

5.2.4 Pump. Leak-free diaphragm type, or equivalent, to transport gas.

5.2.5 Rate Meter. Rotameter, or equivalent, to measure a flow range from 0 to 1.0 liter per min (0.035 cfm).

5.2.6 Flexible Bag. Tedlar, or equivalent, with a capacity of 60 to 90 liters (2 to 3 ft^3). Leak-test the bag in the laboratory before using by evacuating bag with a pump followed by a dry gas meter. When evacuation is complete, there should be no flow through the meter.

5.2.7 Pitot Tube. Type S, or equivalent, attached to the probe so that the sampling rate can be regulated proportional to the stack gas velocity when velocity is varying with the time or a sample traverse is conducted.

5.3 Analysis (Figure 10-3).

5.3.1 Carbon Monoxide Analyzer. Nondispersive infrared spectrometer, or equivalent. This instrument should be demonstrated, preferably by the manufacturer, to meet or exceed manufacturer's specifications and those described in this method.

5.3.2 Drying Tube. To contain approximately 200 g of silica gel.

5.3.3 Calibration Gas. Refer to section 6.1.

5.3.4 Filter. As recommended by NDIR manufacturer.

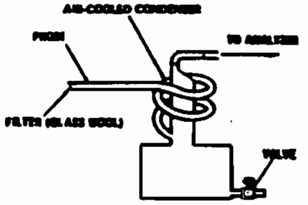


Figure 10-1. Continuous sampling train.

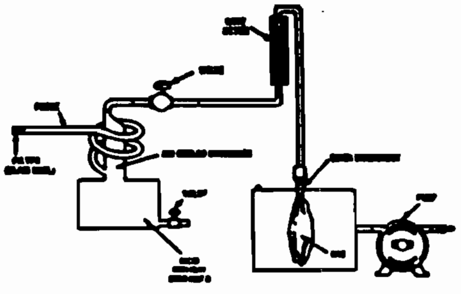


Figure 10-2. Integrated gas sampling train.

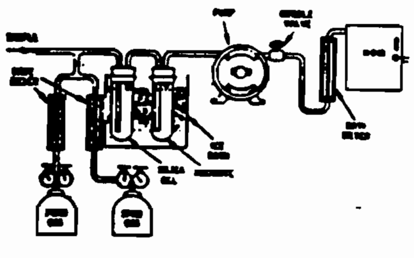


Figure 10-3. Analytical equipment.

5.3.5 CO2 Removal Tube. To contain approximately 500 g of ascarite.

5.3.6 Ice Water Bath. For ascarite and silica gel tubes.

5.3.7 Valve. Needle valve, or equivalent, to adjust flow rate

5.3.8 Rate Meter. Rotameter or equivalent to measure gas flow rate of 0 to 1.0 liter per min (0.035 cfm) through NDIR.

5.3.9 Recorder (optional). To provide permanent record of NDIR readings.

6. Reagents

6.1 Calibration Gases. Known concentration of CO in nitrogen (N2) for instrument span, prepurified grade of N2 for zero, and two additional concentrations corresponding approximately to 60 percent and 30 percent span. The span concentration shall not exceed 1.5 times the applicable source performance standard. The calibration gases shall be certified by the manufacturer to be within ± 2 percent of the specified concentration.

6.2 Silica Gel. Indicating type, 6 to 16 mesh, dried at 175°C (347°F) for 2 hours.

6.3 Ascarite. Commercially available.

7. Procedure

7.1 Sampling.

7.1.1 Continuous Sampling. Set up the equipment as shown in Figure 10-1 making sure all connections are leak free. Place the probe in the stack at a sampling point and purge the sampling line. Connect the analyzer and begin drawing sample into the analyzer. Allow 5 minutes for the system to stabilize, then record the analyzer reading as required by the test procedure. (See section 7.2 and 8). CO2 content of the gas may be determined by using the Method 3 integrated sample procedure, or by weighing the ascarite CO2 removal tube and computing CO2 concentration from the gas volume sampled and the weight gain of the tube.

7.1.2 Integrated Sampling. Evacuate the flexible bag. Set up the equipment as shown in Figure 10-2 with the bag disconnected. Place the probe in the stack and purge the sampling line. Connect the

---

|_{Footnote}\1\ Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.

bag, making sure that all connections are leak free. Sample at a rate proportional to the stack velocity. CO2 content of the gas may be determined by using the Method 3 integrated sample procedures, or by weighing the ascarite CO2 removal tube and computing CO2 concentration from the gas volume sampled and the weight gain of the tube.

7.2 CO Analysis. Assemble the apparatus as shown in Figure 10-3, calibrate the instrument, and perform other required operations as described in section 8. Purge analyzer with N2 prior to introduction of each sample. Direct the sample stream through the instrument for the test period, recording the readings. Check the zero and span again after the test to assure that any drift or malfunction is detected. Record the sample data on Table 10-1.

8. Calibration

Assemble the apparatus according to Figure 10-3. Generally an instrument requires a warm-up period before stability is obtained. Follow the manufacturer's instructions for specific procedure. Allow a minimum time of 1 hour for warm-up. During this time check the sample conditioning apparatus, i.e., filter, condenser, drying tube, and CO2 removal tube, to ensure that each component is in good operating condition. Zero and calibrate the instrument according to the manufacturer's procedures using, respectively, nitrogen and the calibration gases.

TABLE 10-1—FIELD DATA

	Comments
Location Test Date Operator	
Clock time	Rotameter setting, liters per minute (cubic feet per minute)

9. Calculation

Calculate the concentration of carbon monoxide in the stack using Equation 10-1.

$$C_{CO\ stack} = C_{CO\ NDIR}(1 - F_{CO_2})$$

Eq. 10-1

Where:

CCO stack = Concentration of CO in stack, ppm by volume (dry basis).

CCO NDIR = Concentration of CO measured by NDIR analyzer, ppm by volume (dry basis).

FCO 2 = Volume fraction of CO2 in sample, i.e., percent CO2 from Orsat analysis divided by 100.

10. Alternative Procedures

10.1 Interference Trap. The sample conditioning system described in Method 10A, sections 2.1.2 and 4.2, may be used as an alternative to the silica gel and ascarite traps.

11. Bibliography

1. McElroy, Frank, The Intertech NDIR-CO Analyzer, Presented at 11th Methods Conference on Air Pollution, University of California, Berkeley, CA. April 1, 1970.

2. Jacobs, M. B., et al., Continuous Determination of Carbon Monoxide and Hydrocarbons in Air by a Modified Infrared Analyzer, J. Air Pollution Control Association, 9(2): 110-114. August 1959.

3. MSA LIRA Infrared Gas and Liquid Analyzer Instruction Book, Mine Safety Appliances Co., Technical Products Division, Pittsburgh, PA.

4. Models 215A, 315A, and 415A Infrared Analyzers, Beckman Instruments, Inc., Beckman Instructions 1635-B, Fullerton, CA. October 1967.

5. Continuous CO Monitoring System, Model A5611, Intertech Corp., Princeton, NJ.

6. UNOR Infrared Gas Analyzers, Bendix Corp., Ronceverte, WV

ADDENDA

A. PERFORMANCE SPECIFICATIONS FOR NDIR CARBON MONOXIDE ANALYZERS

Range (minimum)	0–1000 ppm.
Output (minimum)	0–10mV.
Minimum detectable sensitivity.	20 ppm.
Rise time, 90 percent (maximum).	30 seconds.
Fall time, 90 percent (maximum).	30 seconds.
Zero drift (maximum)	10% in 8 hours.
Span drift (maximum)	10% in 8 hours.
Precision (minimum)	±2% of full scale.
Noise (maximum)	±1% of full scale.
Linearity (maximum deviation)	2% of full scale.
Interference rejection ratio	CO_2—1000 to 1, H_2O—50 to 1.

B. Definitions of Performance Specifications.

Range——The minimum and maximum measurement limits.

Output——Electrical signal which is proportional to the measurement; intended for connection to readout or data processing devices. Usually expressed as millivolts or milliamps full scale at a given impedance.

Full scale——The maximum measuring limit for a given range.

Minimum detectable sensitivity——The smallest amount of input concentration that can be detected as the concentration approaches zero.

Accuracy——The degree of agreement between a measured value and the true value; usually expressed as ± percent of full scale.

Time to 90 percent response——The time interval from a step change in the input concentration at the instrument inlet to a reading of 90 percent of the ultimate recorded concentration.

Rise Time (90 percent)——The interval between initial response time and time to 90 percent response after a step increase in the inlet concentration.

Fall Time (90 percent)——The interval between initial response time and time to 90 percent response after a step decrease in the inlet concentration.

Zero Drift——The change in instrument output over a stated time period, usually 24 hours, of unadjusted continuous operation when the input concentration is zero; usually expressed as percent full scale.

Span Drift——The change in instrument output over a stated time period, usually 24 hours, of unadjusted continuous operation when the input concentration is a stated upscale value; usually expressed as percent full scale.

Precision——The degree of agreement between repeated measurements of the same concentration, expressed as the average deviation of the single results from the mean.

Noise——Spontaneous deviations from a mean output not caused by input concentration changes.

Linearity——The maximum deviation between an actual instrument reading and the reading predicted by a straight line drawn between upper and lower calibration points.

Method 13B—Determination of Total Fluoride Emissions From Stationary Sources——Specific Ion Electrode Method

1. Principle and Applicability

1.1 Applicability. This method applies to the determination of fluoride (F) emissions from stationary sources as specified in the regulations. It does not measure fluorocarbons, such as freons.

1.2 Principle. Gaseous and particulate F are withdrawn isokinetically from the source and collected in water and on a filter. The total F is then determined by the specific ion electrode method.

2. Range and Sensitivity

The range of this method is 0.02 to 2,000 μg F/ml; however, measurements of less than 0.1 μg F/ml require extra care. Sensitivity has not been determined.

3. Interferences

Grease on sample-exposed surfaces may cause low F results because of adsorption.

4. Precision and Accuracy

4.1 Precision. The following estimates are based on a collaborative test done at a primary aluminum smelter. In the test, six laboratories each sampled the stack simultaneously using two sampling trains for a total of 12 samples per sampling run. Fluoride concentrations encountered during the test ranged from 0.1 to 1.4 mg F/m^3. The within-laboratory and between-laboratory standard deviations, which include sampling and analysis errors, are 0.037 mg F/m^3 with 60 degrees of freedom and 0.056 mg F/m^3 with five degrees of freedom, respectively.

4.2 Accuracy. The collaborative test did not find any bias in the analytical method.

5. Apparatus

5.1 Sampling Train and Sample Recovery. Same as Method 13A, Sections 5.1 and 5.2, respectively.

5.2 Analysis. The following items are needed:

5.2.1 Distillation Apparatus, Bunsen Burner, Electric Muffle Furnace, Crucibles, Beakers, Volumetric Flasks, Erlenmeyer Flasks or Plastic Bottles, Constant Temperature Bath, and Balance. Same as Method 13A, Sections 5.3.1 to 5.3.9, respectively, except include also 100—ml polyethylene beakers.

5.2.2 Fluoride Ion Activity Sensing Electrode.

5.2.3 Reference Electrode. Single junction, sleeve type.

5.2.4 Electrometer. A pH meter with millivolt-scale capable of ± 0.1—mv resolution, or a specific ion meter made specifically for specific ion use.

5.2.5 Magnetic Stirrer and TFE 2 Fluorocarbon-Coated Stirring Bars.

|_{Footnote} 2 Mention of any trade name or specific product does not constitute endorsement by the U.S. Environmental Protection Agency.

6. Reagents

6.1 Sampling and Sample Recovery. Same as Method 13A, Sections 6.1 and 6.2, respectively.

6.2 Analysis. Use ACS reagent grade chemicals (or equivalent), unless otherwise specified. The reagents needed for analysis are as follows:

6.2.1 Calcium Oxide (CaO). Certified grade containing 0.005 percent F or less.

6.2.2 Phenolphthalein Indicator. Dissolve 0.1 g of phenolphthalein in a mixture of 50 ml of 90 percent ethanol and 50 ml deionized distilled water.

6.2.3 Sodium Hydroxide (NaOH). Pellets.

6.2.4 Sulfuric Acid (H2SO4), Concentrated.

6.2.5 Filters. Whatman No. 541, or equivalent.

6.2.6 Water. From same container as 6.1.2 of Method 13A.

6.2.7 Sodium Hydroxide, 5 M. Dissolve 20 g of NaOH in 100 ml of deionized distilled water.

6.2.8 Sulfuric Acid, 25 percent (V/V). Mix 1 part of concentrated H2SO4 with 3 parts of deionized distilled water.

6.2.9 Total Ionic Strength Adjustment Buffer (TISAB). Place approximately 500 ml of deionized distilled water in a 1-liter beaker. Add 57 ml of glacial acetic acid, 58 g of sodium chloride, and 4 g of cyclohexylene dinitrilo tetraacetic acid. Stir to dissolve. Place the beaker in a water bath to cool it. Slowly add 5 M NaOH to the solution, measuring the pH continuously with a calibrated pH/reference electrode pair, until the pH is 5.3. Cool to room temperature. Pour into a 1-liter volumetric flask, and dilute to volume with deionized distilled water. Commercially prepared TISAB may be substituted for the above.

6.2.10 Fluoride Standard Solution, 0.1 M. Oven dry some sodium fluoride (NaF) for a minimum of 2 hours at 110°C, and store in a desiccator. Then add 4.2 g of NaF to a 1-liter volumetric flask, and add enough deionized distilled water to dissolve. Dilute to volume with deionized distilled water.

7. Procedure

7.1 Sampling, Sample Recovery, and Sample Preparation and Distillation. Same as Method 13A, Sections 7.1, 7.2, and 7.3, respectively, except the notes concerning chloride and sulfate interferences are not applicable.

7.2 Analysis.

7.2.1 Containers No. 1 and No. 2. Distill suitable aliquots from Containers No. 1 and No. 2. Dilute the distillate in the volumetric flasks to exactly 250 ml with deionized distilled water and mix thoroughly. Pipet a 25—ml aliquot from each of the distillate and separate beakers. Add an equal volume of TISAB, and mix. The sample should be at the same temperature as the calibration standards when measurements are made. If ambient laboratory temperature fluctuates more than ± 2°C from the temperature at which the calibration standards were measured, condition samples and standards in a constant-temperature bath before measurement. Stir the sample with a magnetic stirrer during measurement to minimize electrode response time. If the stirrer generates enough heat to change solution temperature, place a piece of temperature insulating material such as cork, between the stirrer and the beaker. Hold dilute samples (below 10-4 M fluoride ion content) in polyethylene beakers during measurement.

Insert the fluoride and reference electrodes into the solution. When a steady millivolt reading is obtained, record it. This may take several minutes. Determine concentration from the calibration curve. Between electrode measurements, rinse the electrode with deionized distilled water.

7.2.2 Container No. 3 (Silica Gel). Same as Method 13A, Section 7.4.2.

8. Calibration

Maintain a laboratory log of all calibrations.

8.1 Sampling Train. Same as Method 13A.

8.2 Fluoride Electrode. Prepare fluoride standardizing solutions by serial dilution of the 0.1 M fluoride standard solution. Pipet 10 ml of 0.1 M fluoride standard solution into a 100—ml volumetric flask, and make up to the mark with deionized distilled water for a 10-2 M standard solution. Use 10 ml of 10-2 M solution to make a 10-3 M solution in the same manner. Repeat the dilution procedure and make 10-4 and 10-5 solutions.

Pipet 50 ml of each standard into a

separate beaker. Add 50 ml of TISAB to each beaker. Place the electrode in the most dilute standard solution. When a steady millivolt reading is obtained, plot the value on the linear axis of semilog graph paper versus concentration on the log axis. Plot the nominal value for concentration of the standard on the log axis, e.g., when 50 ml of 10-2 M standard is diluted with 50 ml of TISAB, the concentration is still designated "10-2 M."

Between measurements soak the fluoride sensing electrode in deionized distilled water for 30 seconds, and then remove and blot dry. Analyze the standards going from dilute to concentrated standards. A straight-line calibration curve will be obtained, with nominal concentrations of 10-4, 10-3, 10-2, and 10-1 fluoride molarity on the log axis plotted versus electrode potential (in mv) on the linear scale. Some electrodes may be slightly nonlinear between 10-5 and 10-4 M. If this occurs, use additional standards between these two concentrations.

Calibrate the fluoride electrode daily, and check it hourly. Prepare fresh fluoride standardizing solutions daily (10-2 M or less). Store fluoride standardizing solutions in polyethylene or polypropylene containers.

Note: Certain specific ion meters have been designed specifically for fluoride electrode use and give a direct readout of fluoride ion concentration. These meters may be used in lieu of calibration curves for fluoride measurements over narrow concentration ranges. Calibrate the meter according to the manufacturer's instructions.)

9. Calculations

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

9.1 Nomenclature. Same as Method 13A, Section 9.1. In addition:

M = F concentration from calibration curve, molarity

9.2 Average Dry Gas Meter Temperature and Average Orifice Pressure Drop, Dry Gas Volume, Volume of Water Vapor and Moisture Content, Fluoride Concentration in Stack Gas, and Isokinetic Variation and Acceptable Results. Same as Method 13A, Sections 9.2 to 9.4, 9.5.2, and 9.6, respectively.

9.3 Fluoride in Sample. Calculate the amount of F in the sample using the following:

$$F_t = K \frac{V_t}{A_t} V_a \; M \qquad \text{Eq. 13B-1}$$

Where:

K = 19 mg/millimole.

10. Bibliography

1. Same as Method 13A, Citations 1 and 2 of Bibliography.

2. MacLeod, Kathryn E. and Howard L. Crist. Comparison of the SPADNS—Zirconium Lake and Specific Ion Electrode Methods of Fluoride Determination in Stack Emission Samples. Analytical Chemistry. 45:1272-1273. 1973.

Method 18—Measurement of Gaseous Organic Compound Emissions by Gas Chromatography

Introduction

This method should not be attempted by persons unfamiliar with the performance characteristics of gas chromatography, nor by those persons who are unfamiliar with source sampling. Particular care should be exercised in the area of safety concerning choice of equipment and operation in potentially explosive atmospheres.

1. Applicability and Principle

1.1 Applicability. This method applies to the analysis of approximately 90 percent of the total gaseous organics emitted from an industrial source. It does not include techniques to identify and measure trace amounts of organic compounds, such as those found in building air and fugitive emission sources.

This method will not determine compounds that (1) are polymeric (high molecular weight), (2) can polymerize before analysis, or (3) have very low vapor pressures at stack or instrument conditions.

1.2 Principle.

The major organic components of a gas mixture are separated by gas chromatography (GC) and individually quantified by flame ionization, photoionization, electron capture, or other appropriate detection principles.

The retention times of each separated component are compared with those of known compounds under identical conditions. Therefore, the analyst confirms the identity and approximate concentrations of the organic emission components beforehand. With this information, the analyst then prepares or purchases commercially available standard mixtures to calibrate the GC under conditions identical to those of the samples. The analyst also determines the need for sample dilution to avoid detector saturation, gas stream filtration to eliminate particulate matter, and prevention of moisture condensation.

2. Range and Sensitivity

2.1 Range. The range of this method is from about 1 part per million (ppm) to the upper limit governed by GC detector saturation or column overloading. The upper limit can be extended by diluting the stack gases with an inert gas or by using smaller gas sampling loops.

2.2 Sensitivity. The sensitivity limit for a compound is defined as the minimum detectable concentration of that compound, or the concentration that produces a signal—to—noise ratio of three to one. The minimum detectable concentration is determined during the presurvey calibration for each compound.

3. Precision and Accuracy

Gas chromatographic techniques typically provide a precision of 5 to 10 percent relative standard deviation (RSD), but an experienced GC operator with a reliable instrument can readily achieve 5 percent RSD. For this method, the following combined GC/operator values are required.

|_(a) Precision. Duplicate analyses are within 5 percent of their mean value.

|_(b) Accuracy. Analysis results of prepared audit samples are within 10 percent of preparation values.

4. Interferences

Resolution interferences that may occur can be eliminated by appropriate GC column and detector choice or by shifting the retention times through changes in the column flow rate and the use of temperature programming.

The analytical system is demonstrated to be essentially free from contaminants by periodically analyzing blanks that consist of hydrocarbon-free air or nitrogen.

Sample cross-contamination that occurs when high-level and low-level samples or standards are analyzed alternately, is best dealt with by thorough purging of the GC sample loop between samples.

To assure consistent detector response, calibration gases are contained in dry air. To adjust gaseous organic concentrations when water vapor is present in the sample, water vapor concentrations are determined for those samples, and a correction factor is applied.

5. Presurvey and Presurvey Sampling.

Perform a presurvey for each source to be tested. Refer to Figure 18-1. Some of the information can be collected from literature surveys and source personnel. Collect gas samples that can be analyzed to confirm the identities and approximate concentrations of the organic emissions.

5.1 Apparatus. This apparatus list also applies to Sections 6 and 7.

5.1.1 Teflon Tubing. (Mention of trade names or specific products does not constitute endorsement by the U.S. Environmental Protection Agency.) Diameter and length determined by connection requirements of cylinder regulators and the GC. Additional tubing is necessary to connect the GC sample loop to the sample.

5.1.2 Gas Chromatograph. GC with suitable detector, columns, temperature-controlled sample loop and valve assembly, and temperature programable oven, if necessary. The GC shall achieve sensitivity requirements for the compounds under study.

5.1.3 Pump. Capable of pumping 100 ml/min. For flushing sample loop.

5.1.4 Flowmeters. To measure flow rates.

5.1.5 Regulators. Used on gas cylinders for GC and for cylinder standards.

5.1.6 Recorder. Recorder with linear strip chart is minimum acceptable. Integrator (optional) is recommended.

5.1.7 Syringes. 0.5—ml, 1.0— and 10—microliter sizes, calibrated, maximum accuracy (gas tight), for preparing calibration standards. Other appropriate sizes can be used.

5.1.8 Tubing Fittings. To plumb GC and gas cylinders.

5.1.9 Septums. For syringe injections.

5.1.10 Glass Jars. If necessary, clean-colored glass jars with Teflon-lined lids for condensate sample collection. Size depends on volume of condensate.

5.1.11 Soap Film Flow Meter. To determine flow rates.

5.1.12 Tedlar Bags. 10— and 50-liter capacity, for preparation of standards.

5.1.13 Dry Gas Meter with Temperature and Pressure Gauges. Accurate to ± 2 percent, for perparation of gas standards.

5.1.14 Midget Impinger/Hot Plate Assembly. For preparation of gas standards.

5.1.15 Sample Flasks. For presurvey samples, must have gas-tight seals.

5.1.16 Adsorption Tubes. If necessary, blank tubes filled with necessary adsorbent (charcoal, Tenax, XAD-2, etc.) for presurvey samples.

5.1.17 Personnel Sampling Pump. Calibrated, for collecting adsorbent tube presurvey samples.

5.1.18 Dilution System. Calibrated, the dilution system is to be constructed following the specifications of an acceptable method.

5.1.19 Sample Probes. Pyrex or stainless steel, of sufficient length to reach centroid of stack, or a point no closer to the walls than 1 m.

5.1.20 Barometer. To measure barometric pressure.

5.2 Reagents.

5.2.1 Deionized Distilled Water.

5.2.2 Methylene Dichloride.

5.2.3 Calibration Gases. A series of standards prepared for every compound of interest.

5.2.4 Organic Compound Solutions. Pure

(99.9 percent), or as pure as can reasonably be obtained, liquid samples of all the organic compounds needed to prepare calibration standards.

5.2.5 Extraction Solvents. For extraction of adsorbent tube samples in preparation for analysis.

5.2.6 Fuel. As recommended by the manufacturer for operation of the GC.

5.2.7 Carrier Gas. Hydrocarbon free, as recommended by the manufacturer for operation of the detector and compatability with the column.

5.2.8 Zero Gas. Hydrocarbon free air or nitrogen, to be used for dilutions, blank preparation, and standard preparation.

5.3 Sampling.

5.3.1 Collection of Samples with Glass Sampling Flasks. Presurvey samples can be collected in precleaned 250—ml double-ended glass sampling flasks. Teflon stopcocks, without grease, are preferred. Flasks should be cleaned as follows: Remove the stopcocks from both ends of the flasks, and wipe the parts to remove any grease. Clean the stopcocks, barrels, and receivers with methylene dichloride. Clean all glass ports with a soap solution, then rinse with tap and deionized distilled water. Place the flask in a cool glass annealing furnace and apply heat up to 500°C. Maintain at this temperature for 1 hour. After this time period, shut off and open the furnace to allow the flask to cool. Grease the stopcocks with stopcock grease and return them to the flask receivers. Purge the assembly with high-purity nitrogen for 2 to 5 minutes. Close off the stopcocks after purging to maintain a slight positive nitrogen pressure. Secure the stopcocks with tape.

Presurvey samples can be obtained either by drawing the gases into the previously evacuated flask or by drawing the gases into and purging the flask with a rubber suction bulb.

5.3.1.1 Evacuated Flask Procedure. Use a high-vacuum pump to evacuate the flask to the capacity of the pump; then close off the stopcock leading to the pump. Attach a 6—mm outside diameter (OD) glass tee to the flask inlet with a short piece of Teflon tubing. Select a 6—mm OD borosilicate sampling probe, enlarged at one end to a 12—mm OD and of sufficient length to reach the centroid of the duct to be sampled. Insert a glass wool plug in the enlarged end of the probe to remove particulate matter. Attach the other end of the probe to the tee with a short piece of Teflon tubing. Connect a rubber suction bulb to the third leg of the tee. Place the filter end of the probe at the centroid of the duct, or at a point no closer to the walls than 1 m, and purge the probe with the rubber suction bulb. After the probe is completely purged and filled with duct gases, open the stopcock to the grab flask until the pressure in the flask reaches duct pressure. Close off the stopcock, and remove the probe from the duct. Remove the tee from the flask and tape the stopcocks to prevent leaks during shipment. Measure and record the duct temperature and pressure.

5.3.1.2 Purged Flask Procedure. Attach one end of the sampling flask to a rubber suction bulb. Attach the other end to a 6—mm OD glass probe as described in Section 5.3.1.1. Place the filter end of the probe at the centroid of the duct, or at a point no closer to the walls than 1 m, and apply suction with the bulb to completely purge the probe and flask. After the flask has been purged, close off the stopcock near the suction bulb, and then close the stopcock near the probe. Remove the probe from the duct, and disconnect both the probe and suction bulb. Tape the stopcocks to prevent leakage during shipment. Measure and record the duct temperature and pressure.

5.3.2 Flexible Bag Procedure. Tedlar or aluminized Mylar bags can also be used to obtain the presurvey sample. Use new bags, and leak check them before field use. In addition, check the bag before use for contamination by filling it with nitrogen or air, and analyzing the gas by GC at high sensitivity. Experience indicates that it is desirable to allow the inert gas to remain in the bag about 24 hours or longer to check for desorption of organics from the bag. Follow the leak check and sample collection procedures given in Section 7.1.

5.3.3 Determination of Moisture Content. For combustion or water-controlled processes, obtain the moisture content from plant personnel or by measurement during the presurvey. If the source is below 59°C, measure the wet bulb and dry bulb temperatures, and calculate the moisture content using a psychrometric chart. At higher temperatures, use Method 4 to determine the moisture content.

5.4 Determination of Static Pressure. Obtain the static pressure from the plant personnel or measurement. If a type S pitot tube and an inclined manometer are used, take care to align the pitot tube 90° from the direction of the flow. Disconnect one of the tubes to the manometer, and read the static pressure; note whether the reading is positive or negative.

5.5 Collection of Presurvey Samples with Adsorption Tube. Follow Section 7.4 for presurvey sampling.

6. Analysis Development

6.1 Selection of GC Parameters.

6.1.1 Column Choice. Based on the initial contact with plant personnel concerning the plant process and the anticipated emissions, choose a column that provides good resolution and rapid analysis time. The choice of an appropriate column can be aided by a literature search, contact with manufacturers of GC columns, and discussion with personnel at the emission source.

Most column manufacturers keep excellent records of their products. Their technical service departments may be able to recommend appropriate columns and detector type for separating the anticipated compounds, and they may be able to provide information on interferences, optimum operating conditions, and column limitations.

Plants with analytical laboratories may also be able to provide information on appropriate analytical procedures.

6.1.2 Preliminary GC Adjustment. Using the standards and column obtained in Section 6.1.1, perform initial tests to determine appropriate GC conditions that provide good resolution and minimum analysis time for the compounds of interest.

6.1.3 Preparation of Presurvey Samples. If the samples were collected on an adsorbent, extract the sample as recommended by the manufacturer for removal of the compounds with a solvent suitable to the type of GC analysis. Prepare other samples in an appropriate manner.

6.1.4 Presurvey Sample Analysis. Before analysis, heat the presurvey sample to the duct temperature to vaporize any condensed material. Analyze the samples by the GC procedure, and compare the retention times against those of the calibration samples that contain the components expected to be in the stream. If any compounds cannot be identified with certainty by this procedure, identify them by other means such as GC/mass spectroscopy (GC/MS) or GC/infrared techniques. A GC/MS system is recommended.

Use the GC conditions determined by the procedures of Section 6.1.2 for the first injection. Vary the GC parameters during subsequent injections to determine the optimum settings. Once the optimum settings have been determined, perform repeat injections of the sample to determine the retention time of each compound. To inject a sample, draw sample through the loop at a constant rate (100 ml/min for 30 seconds). Be careful not to pressurize the gas in the loop. Turn off the pump and allow the gas in the sample loop to come to ambient pressure. Activate the sample valve, and record injection time, loop temperature, column temperature, carrier flow rate, chart speed, and attenuator setting. Calculate the retention time of each peak using the distance from injection to the peak maximum divided by the chart speed. Retention times should be repeatable within 0.5 seconds.

If the concentrations are too high for appropriate detector response, a smaller sample loop or dilutions may be used for gas samples, and, for liquid samples, dilution with solvent is appropriate. Use the standard curves (Section 6.3) to obtain an estimate of the concentrations.

Identify all peaks by comparing the known retention times of compounds expected to be in the retention times of peaks in the sample. Identify any remaining unidentified peaks which have areas larger than 5 percent of the total using a GC/MS, or estimation of possible compounds by their retention times compared to known compounds, with confirmation by further GC analysis.

6.2 Calibration Standards. Prepare or obtain enough calibration standards so that there are three different concentrations of each organic compound expected to be measured in the source sample. For each organic compound, select those concentrations that bracket the concentrations expected in the source samples. A calibration standard may contain more than one organic compound. If available, commercial cylinder gases may be used if their concentrations have been certified by direct analysis.

If samples are collected in adsorbent tubes (charcoal, XAD-2, Tenax, etc.), prepare or obtain standards in the same solvent used for the sample extraction procedure. Refer to Section 7.4.3.

Verify the stability of all standards for the time periods they are used. If gas standards are prepared in the laboratory, use one or more of the following procedures.

6.2.1 Preparation of Standards from High Concentration Cylinder Standards. Obtain enough high concentration cylinder standards to represent all the organic compounds expected in the source samples.

Use these high concentration standards to prepare lower concentration standards by dilution, as shown by Figures 18-5 and 18-6.

To prepare the diluted calibration samples, calibrated rotameters are normally used to meter both the high concentration calibration gas and the diluent gas. Other types of flowmeters and commercially available dilution systems can also be used.

Calibrate each flowmeter before use by placing it between the diluent gas supply and suitably sized bubble meter, spirometer, or wet test meter. Record all data shown on Figure 18-4. While it is desirable to calibrate the cylinder gas flowmeter with cylinder gas, the available quantity and cost may preclude it. The error introduced by using the diluent gas for calibration is insignificant for gas mixtures of up to 1,000 to 2,000 ppm of each organic component.

Once the flowmeters are calibrated, connect the flowmeters to the calibration and diluent gas supplies using 6—mm Teflon tubing. Connect the outlet side of the flowmeters through a connector to a leak-free Tedlar bag as shown in Figure 18-5. (See Section 7.1 for bag leak-check procedures.) Adjust the gas flow to provide the desired dilution, and fill the bag with sufficient gas for GC calibration. Be careful not to overfill and cause the bag to apply additional pressure on the dilution system. Record the flow rates of both flowmeters, and the laboratory temperature and atmospheric pressure. Calculate the concentration Cs in ppm of each organic in the diluted gas as follows:

$$C_s = \frac{10^6 (\bar{X} q_c)}{q_c + q_d} \qquad \text{Eq. 18-1}$$

Where:

10\6\ = Conversion to ppm.
X = Mole or volume fraction of the organic in the calibration gas to be diluted.
qc = Flow rate of the calibration gas to be diluted.
qd = Diluent gas flow rate.

Single-stage dilutions should be used to prepare calibration mixtures up to about 1:20 dilution factor.

For greater dilutions, a double dilution system is recommended, as shown in Figure 18-6. Fill the Tedlar bag with the dilute gas from the second stage. Record the laboratory temperature, barometric pressure, and static pressure readings. Correct the flow reading for temperature and pressure. Calculate the concentration Cs in ppm of the organic in the final gas mixture as follows:

$$C_s = 10^6 \bar{X} \left(\frac{q_{c1}}{q_{c1} + q_{d1}}\right) \left(\frac{q_{c2}}{q_{c2} + q_{d2}}\right) \qquad \text{Eq. 18-2}$$

Where:

10\6\ = Conversion to ppm.
X = Mole or volume fraction of the organic in the calibration gas to be diluted.
qc1 = Flow rate of the calibration gas to be diluted in stage 1.
qc2 = Flow rate of the calibration gas to be diluted in stage 2.
qd1 = Flow rate of diluent gas in stage 1.
qd2 = Flow rate of diluent gas in stage 2.

Further details of the calibration methods for flowmeters and the dilution system can be found in Citation 21 in the Bibliography.

6.2.2 Preparation of Standards from Volatile Materials. Record all data shown on Figure 18-3.

6.2.2.1 Gas Injection Technique. This procedure is applicable to organic compounds that exist entirely as a gas at ambient conditions. Evacuate a 10-liter Tedlar bag that has passed a leak-check (see Section 7.1), and meter in 5.0 liters of air or nitrogen through a dry gas meter that has been calibrated in a manner consistent with the procedure described in Section 5.1.1 of Method 5. While the bag is filling use a 0.5—ml syringe to inject a known quantity of "pure" gas of the organic compound through the wall of the bag, or through a septum-capped tee at the bag inlet. Withdraw the syringe needle, and immediately cover the resulting hole with a piece of masking tape. In a like manner, prepare dilutions having other concentrations. Prepare a minimum of three concentrations. Place each bag on a smooth surface, and alternately depress opposite sides of the bag 50 times to mix the gases Record the average meter temperature and pressure, the gas volume and the barometric pressure. Record the syringe temperature and pressure before injection.

Calculate each organic standard concentration Cs in ppm as follows:

$$C_s = \frac{G_v \times 10^6 \frac{293}{T_s} \frac{P_s}{760}}{V_m Y \frac{293}{T_m} \frac{P_m}{760} 1000} = \frac{G_v \times 10^3 \frac{P_s}{T_s} \frac{T_m}{P_m}}{V_m Y} \qquad \text{Eq. 18-3}$$

Where:

Gv = Gas volume or organic compound njected, ml.

10^6 = Conversion to ppm.

Ps = Absolute pressure of syringe before injection, mm Hg.

Ts = Absolute temperature of syringe before injection, °K.

Vm = Gas volume indicated by dry gas meter, liters.

Y = Dry gas meter calibration factor, dimensionless.

Pm = Absolute pressure of dry gas meter, mm Hg.

Tm = Absolute temperature of dry gas meter, °K.

1000 = Conversion factor, ml/liter.

6.2.2.2 Liquid Injection Technique. Use the equipment shown in Figure 18-8. Calibrate the dry gas meter as described in Section 6.2.2.1 with a wet test meter or a spirometer. Use a water manometer for the pressure gauge and glass, Teflon, brass, or stainless steel for all connections. Connect a valve to the inlet of the 50-liter Tedlar bag.

To prepare the standards, assemble the equipment as shown in Figure 18-8, and leak-check the system. Completely evacuate the bag. Fill the bag with hydrocarbon-free air, and evacuate the bag again. Close the inlet valve.

Turn on the hot plate, and allow the water to reach boiling. Connect the bag to the impinger outlet. Record the initial meter reading, open the bag inlet valve, and open the cylinder. Adjust the rate so that the bag will be completely filled in approximately 15 minutes. Record meter pressure and temperature, and local barometric pressure.

Allow the liquid organic to equilibrate to room temperature. Fill the 1.0— or 10—microliter syringe to the desired liquid volume with the organic. Place the syringe needle into the impinger inlet using the septum provided, and inject the liquid into the flowing air stream. Use a needle of sufficient length to permit injection of the liquid below the air inlet branch of the tee. Remove the syringe.

When the bag is filled, stop the pump, and close the bag inlet valve. Record the final meter reading, temperature, and pressure.

Disconnect the bag from the impinger outlet, and either set it aside for at least 1 hour, or massage the bag to insure complete mixing.

Measure the solvent liquid density at room temperature by accurately weighing a known volume of the material on an analytical balance to the nearest 1.0 milligram. A ground-glass stoppered 25—mil volumetric flask or a glass-stoppered specific gravity bottle is suitable for weighing. Calculate the result in terms of g/ml. As an alternative, literature values of the density of the liquid at 20 °C may be used.

Calculate each organic standard concentration Cs in ppm as follows:

$$C_s = \frac{\frac{L_v \rho}{M}\,(24.055 \times 10^6)}{V_m\, Y\, \frac{293}{T_m}\, \frac{P_m}{760}\, 1000}$$

$$= 6.24 \times 10^4 \, \frac{L_v \rho\, T_m}{M\, V_m\, Y\, P_m}$$

Eq. 18-4

Where:

Lv = Liquid volume of organic injected, ul.

ul = Liquid organic density as determined, g/ml.

M = Molecular weight of organic, g/g—mole.

24.055 = Ideal gas molar volume at 293 °K and 760 mm Hg, liters/g—mole.

10^6 = Conversion to ppm.

1000 = Conversion factor, ul/ml.

6.3 Preparation of Calibration Curves. Establish proper GC conditions, then flush the sampling loop for 30 seconds at a rate of 100 ml/min. Allow the sample loop pressure to equilibrate to atmospheric pressure, and activate the injection valve. Record the standard concentration, attenuator factor, injection time, chart speed, retention time, peak area, sample loop temperature, column temperature, and carrier gas flow rate. Repeat the standard injection until two consecutive injections give area counts within 5 percent of their average. The average value multipled by the attenuator factor is then the calibration area value for the concentration.

Repeat this procedure for each standard. Prepare a graphical plot of concentration (Cs) versus the calibration area values. Perform a regression analysis, and draw the least squares line.

6.4 Relative Response Factors. The calibration curve generated from the standards for a single organic can usually be related to each of the individual GC response curves that are developed in the laboratory for all the compounds in the source. In the field, standards for that single organic can then be used to "calibrate" the GC for all the organics present. This procedure should first be confirmed in the laboratory by preparing and analyzing calibration standards containing multiple organic compounds.

6.5 Quality Assurance for Laboratory Procedures. Immediately after the preparation of the calibration curves and prior to the presurvey sample analysis, the analysis audit described in 40 CFR Part 61, Appendix C, Procedure 2: "Procedure for Field Auditing GC Analysis," should be performed. The information required to document the analysis of the audit samples has been included on the example data sheets shown in Figures 18-3 and 18-7. The audit analyses should agree with the audit concentrations within 10 percent. When available, the tester may obtain audit cylinders by contacting: U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Quality Assurance Division (MD-77), Research Triangle Park, North Carolina 27711. Audit cylinders obtained from a commercial gas manufacturer may be used provided that (a) the gas manufacturer certifies the audit cylinder in a manner similar to the procedure described in 40 CFR Part 61, Appendix B, Method 106, Section 5.2.3.1, and (b) the gas manufacturer obtains an independent analysis of the audit cylinders to verify this analysis. Independent analysis is defined as an analysis performed by an individual other than the individual who performs the gas manufacturer's analysis, while using calibration standards and analysis equipment different from those used for the gas manufacturer's analysis. Verification is complete and acceptable when the independent analysis concentration is within 5 percent of the gas manufacturer's concentration.

7. Final Sampling and Analysis Procedure

Considering safety (flame hazards) and the source conditions, select an appropriate sampling and analysis procedure (Section 7.1, 7.2, 7.3, or 7.4). In situations where a hydrogen flame is a hazard and no intrinsically safe GC is suitable, use the flexible bag collection technique or an adsorption technique. If the source temperature is below 100°C, and the organic concentrations are suitable for the detector to be used, use the direct interface method. If the source gases require dilution, use a dilution interface and either the bag sample or adsorption tubes. The choice between these two techniques will depend on the physical layout of the site, the source temperature, and the storage stability of the compounds if collected in the bag. Sample polar compounds by direct interfacing or dilution interfacing to prevent sample loss by adsorption on the bag.

7.1 Integrated Bag Sampling and Analysis.

7.1.1 Evacuated Container Sampling Procedure. In this procedure, the bags are filled by evacuating the rigid air-tight containers that hold the bags. Use a field sample data sheet as shown in Figure 18-10. Collect triplicate sample from each sample location.

7.1.1.1 Apparatus.

7.1.1.1.1 Probe. Stainless steel, Pyrex glass, or Teflon tubing probe, according to the duct temperature, with 6.4—mm OD Teflon tubing of sufficient length to connect to the sample bag. Use stainless steel or Teflon unions to connect probe and sample line.

7.1.1.1.2 Quick Connects. Male (2) and female (2) of stainless steel construction.

7.1.1.1.3 Needle Valve. To control gas flow.

7.1.1.1.4 Pump. Leakless Teflon-coated diaphragm-type pump or equivalent. To deliver at least 1 liter/min.

7.1.1.1.5 Charcoal Adsorption Tube. Tube filled with activated charcoal, with glass wool plugs at each end, to adsorb organic vapors.

7.1.1.1.6 Flowmeter. 0 to 500—ml flow range; with manufacturer's calibration curve.

7.1.1.2 Sampling Procedure. To obtain a sample, assemble the sample train as shown in Figure 18-9. Leak check both the bag and the container. Connect the vacuum line from the needle valve to the Teflon sample line from the probe. Place the end of the probe at the centroid of the stack, or at a point no closer to the walls than 1 m, and start the pump with the needle valve adjusted to yield a flow of 0.5 liter/minute. After allowing sufficient time to purge the line several times, connect the vacuum line to the bag, and evacuate until the rotameter indicates no flow. Then position the sample and vacuum lines for sampling, and begin the actual sampling, keeping the rate proportional to the stack velocity. As a precaution, direct the gas exiting the rotameter away from sampling personnel. At the end of the sample period, shut off the pump, disconnect the sample line from the bag, and disconnect the vacuum line from the bag container. Record the source temperature, barometric pressure, ambient temperature, sampling flow rate, and initial and final sampling time on the data sheet shown in Figure 18-10. Protect the Tedlar bag and its container from sunlight. When possible, perform the analysis within 2 hours of sample collection.

7.1.2 Direct Pump Sampling Procedure. Follow 7.1.1, except place the pump and needle valve between the probe and the bag. Use a pump and needle valve constructed of stainless steel or some other material not affected by the stack gas. Leak check the system, and then purge with stack gas before the connecting to the previously evacuated bag.

7.1.3 Explosion Risk Area Bag Sampling Procedure. Follow 7.1.1 except replace the pump with another evacuated can (see Figure 18-9a). Use this method whenever there is a possibility of an explosion due to pumps, heated probes, or other flame producing equipment.

7.1.4 Other Modified Bag Sampling Procedures. In the event that condensation is observed in the bag while collecting the sample and a direct interface system cannot be used, heat the bag during collection, and maintain it at a suitably elevated temperature during all subsequent operations. (Note: Take care to leak check the system prior to the dilutions so as not to create a potentially explosive atmosphere.) As an alternative, collect the sample gas, and simultaneously dilute it in the Tedlar bag.

In the first procedure, heat the box containing the sample bag to the source temperature, provided the components of the bag and the surrounding box can withstand this temperature. Then transport the bag as rapidly as possible to the analytical area while maintaining the heating, or cover the box with an insulating blanket. In the analytical area, keep the box heated to source temperature until analysis. Be sure that the method of heating the box and the control for the heating circuit are compatible with the safety restrictions required in each area.

To use the second procedure, prefill the Tedlar bag with a known quantity of inert gas. Meter the inert gas into the bag according to the procedure for the preparation of gas concentration standards of volatile liquid materials (Section 6.2.2.2), but eliminate the midget impinger section. Take the partly filled bag to the source, and meter the source gas into the bag through heated sampling lines and a heated flowmeter, or Teflon positive displacement pump. Verify the dilution factors periodically through dilution and analysis of gases of known concentration.

7.1.5 Analysis of Bag Samples.

7.1.5.1 Apparatus. Same as Section 5. A minimum of three gas standards are required.

7.1.5.2 Procedure. Establish proper GC operating conditions as described in Section 6.3, and record all data listed in Figure 18-7. Prepare the GC so that gas can be drawn through the sample valve. Flush the sample loop with gas from one of the three calibration mixtures, and activate the valve. Obtain at least two chromatograms for the mixture. The results are acceptable when the peak areas from two consecutive injections agree to within 5 percent of their average. If they do not, run additional analyses or correct the analytical techniques until this requirement is met. Then analyze the other two calibration mixtures in the same manner. Prepare a calibration curve as described in the same manner. Prepare a calibration curve as described in Section 6.3.

Analyze the source gas samples by connecting each bag to the sampling valve with a piece of Teflon tubing identified for that bag. Follow the specifications on replicate analyses specified for the calibration gases. Record the data listed in Figure 18-11. If certain items do not apply, use the notation "N.A." After all samples have been analyzed, repeat the analyses of the calibration gas mixtures, and generate a second calibration curve. Use an average of the two curves to determine the sample gas concentrations. If the two calibration curves differ by more than 5 percent from their mean value, then report the final results by comparison to both calibration curves.

7.1.6 Determination of Bag Water Vapor Content. Measure and record the ambient temperature and barometric pressure near the bag. From a water saturation vapor pressure table, determine and record the water vapor content as a decimal figure. (Assume the relative humidity to be 100 percent unless a lesser value is known.) If the bag has been maintained at an elevated temperature as described in Section 7.1.4, determine the stack gas water content by Method 4.

7.1.7 Quality Assurance. Immediately prior to the analysis of the stack gas samples, perform audit analyses as described in Section 6.5. The audit analyses must agree with the audit concentrations within 10 percent. If the results are acceptable, proceed with the analyses of the source samples. If they do not agree within 10 percent, then determine the reason for the discrepancy, and take corrective action before proceeding.

7.1.8 Emission Calculations. From the average calibration curve described in Section 7.1.5., select the value of Cs that corresponds to the peak area. Calculate the concentration Cc in ppm, dry basis, of each organic in the sample as follows:

$$C_c = \frac{C_s P_r T_i F_r}{P_i T_r (1-B_{ws})} \qquad \text{Eq. 18-5}$$

Where:

Cs = Concentration of the organic from the calibration curve, ppm.

Pr = Reference pressure, the barometric pressure or absolute sample loop pressure recorded during calibration, mm Hg.

Ti = Sample loop temperature at the time of sample analysis, °K.

Fr = Relative response factor (if applicable, see Section 6.4).

Pi = Barometric or absolute sample loop pressure at time of sample analysis, mm Hg.

Tr = Reference temperature, the temperature of the sample loop recorded during calibration, °K.

Bws = Water vapor content of the bag sample or stack gas, proportion by volume.

7.2 Direct Interface Sampling and Analysis Procedure. The direct interface procedure can be used provided that the moisture content of the gas does not interfere with the analysis procedure, the physical requirements of the equipment can be met at the site, and the source gas concentration is low enough that detector saturation is not a problem. Adhere to all safety requirements with this method.

7.2.1 Apparatus.

7.2.1.1 Probe. Constructed of stainless steel, Pyrex glass, or Teflon tubing as required by duct temperature, 6.4—mm OD, enlarged at duct end to contain glass wool plug. If necessary, heat the probe with heating tape or a special heating unit capable of maintaining duct temperature.

7.2.1.2 Sample Lines. 6.4—mm OD Teflon lines, heat-traced to prevent condensation of material.

7.2.1.3 Quick Connects. To connect sample line to gas sampling valve on GC instrument and to pump unit used to withdraw source gas. Use a quick connect or equivalent on the cylinder or bag containing calibration gas to allow connection of the calibration gas to the gas sampling valve.

7.2.1.4 Thermocouple Readout Device. Potentiometer or digital thermometer, to measure source temperature and probe temperature.

7.2.1.5 Heated Gas Sampling Valve. Of two-position, six-port design, to allow sample loop to be purged with source gas or to direct source gas into the GC instrument.

7.2.1.6 Needle Valve. To control gas sampling rate from the source.

7.2.1.7 Pump. Leakless Teflon-coated diaphragm-type pump or equivalent, capable of at least 1 liter/minute sampling rate.

7.2.1.8 Flowmeter. Of suitable range to measure sampling rate.

7.2.1.9 Charcoal Adsorber. To adsorb organic vapor collected from the source to prevent exposure of personnel to source gas.

7.2.1.10 Gas Cylinders. Carrier gas (helium or nitrogen), and oxygen and hydrogen for a flame ionization detector (FID) if one is used.

7.2.1.11 Gas Chromatograph. Capable of being moved into the field, with detector, heated gas sampling valve, column required to complete separation of desired components, and option for temperature programming.

7.2.1.12 Recorder/Integrator. To record results.

7.2.2 Procedure. To obtain a sample, assemble the sampling system as shown in Figure 18-12. Make sure all connections are tight. Turn on the probe and sample line heaters. As the temperature of the probe and heated line approaches the source temperature as indicated on the thermocouple readout device, control the heating to maintain a temperature of 0 to 3°C above the source temperature. While the probe and heated line are being heated, disconnect the sample line from the gas sampling valve, and attach the line from the calibration gas mixture. Flush the sample loop with calibration gas and analyze a portion of that gas. Record the results. After the calibration gas sample has been flushed into the GC instrument, turn the gas sampling valve to flush position, then reconnect the probe sample line to the valve. Place the inlet of the probe at the centroid of the duct, or at a point no closer to the walls than 1 m, and draw source gas into the probe, heated line, and sample loop. After thorough flushing, analyze the sample using the same conditions as for the calibration gas mixture. Repeat the analysis on an additional sample. Measure the peak areas for the two samples, and if they do not agree to within 5 percent of their mean value, analyze additional samples until two consecutive analyses meet this criteria. Record the data. After consistent results are obtained, remove the probe from the source and analyze a second calibration gas mixture. Record this calibration data and the other required data on the data sheet shown in Figure 18-11, deleting the dilution gas information.

|_(Note: Take care to draw all samples, calibration mixtures, and audits through the sample loop at the same pressure.)

7.2.3 Determination of Stack Gas Moisture Content. Use Method 4 to measure the stack gas moisture content.

7.2.4 Quality Assurance. Same as Section 7.1.7. Introduce the audit gases in the sample line immediately following the probe.

7.2.5 Emission Calculations. Same as Section 7.1.8.

7.3 Dilution Interface Sampling and Analysis Procedure. Source samples that contain a high concentration of organic materials may require dilution prior to analysis to prevent saturating the GC detector. The apparatus required for this direct interface procedure is basically the same as that described in the Section 7.2, except a dilution system is added between the heated sample line and the gas sampling valve. The apparatus is arranged so that either a 10:1 or 100:1 dilution of the source gas can be directed to the chromatograph. A pump of larger capacity is also required, and this pump must be heated and placed in the system between the sample line and the dilution apparatus.

7.3.1 Apparatus. The equipment required in addition to that specified for the direct interface system is as follows:

7.3.1.1 Sample Pump. Leakless Teflon-coated diaphragm-type that can withstand being heated to 120°C and deliver 1.5 liters/minute.

7.3.1.2 Dilution Pumps. Two Model A-150 Komhyr Teflon positive displacement type delivering 150 cc/minute, or equivalent. As an option, calibrated flowmeters can be used in conjunction with Teflon-coated diaphragm pumps.

7.3.1.3 Valves. Two Teflon three—way valves, suitable for connecting to 6.4—mm OD Teflon tubing.

7.3.1.4 Flowmeters. Two, for measurement of diluent gas, expected delivery flow rate to be 1,350 cc/min.

7.3.1.5 Diluent Gas with Cylinders and Regulators. Gas can be nitrogen or clean dry air, depending on the nature of the source gases.

7.3.1.6 Heated Box. Suitable for being heated to 120°C, to contain the three pumps, three—way valves, and associated connections. The box should be equipped with quick connect fittings to facilitate connection of: (1) The heated sample line from the probe, (2) the gas sampling valve, (3) the calibration gas mixtures, and (4) diluent gas lines. A schematic diagram of the components and connections is shown in Figure 18-13.

|_(Note: Care must be taken to leak check the system prior to the dilutions so as not to create a potentially explosive atmosphere.)

The heated box shown in Figure 18-13 is designed to receive a heated line from the probe. An optional design is to build a probe unit that attaches directly to the heated box. In this way, the heated box contains the controls for the probe heaters, or, if the box is placed against the duct being sampled, it may be possible to eliminate the probe heaters. In either case, a heated Teflon line is used to connect the heated box to the gas sampling valve on

7.3.2 Procedure. Assemble the apparatus by connecting the heated box, shown in Figure 18-13, between the heated sample line from the probe and the gas sampling valve on the chromatograph. Vent the source gas from the gas sampling valve directly to the charcoal filter, eliminating the pump and rotameter. Heat the sample probe, sample line, and heated box. Insert the probe and source thermocouple to the centroid of the duct, or to a point no closer to the walls than 1 m. Measure the source temperature, and adjust all heating units to a temperature 0 to 3°C above this temperature. If this temperature is above the safe operating temperature of the Teflon components, adjust the heating to maintain a temperature high enough to prevent condensation of water and organic compounds. Verify the operation of the dilution system by analyzing a high concentration gas of known composition through either the 10:1 or 100:1 dilution stages, as appropriate. (If necessary, vary the flow of the diluent gas to obtain other dilution ratios.) Determine the concentration of the diluted calibration gas using the dilution factor and the calibration curves prepared in the laboratory. Record the pertinent data on the data sheet shown in Figure 18-11. If the data on the diluted calibration gas are not within 10 percent of the expected values, determine whether the chromatograph or the dilution system is in error, and correct it. Verify the GC operation using a low concentration standard by diverting the gas into the sample loop, bypassing the dilution system. If these analyses are not within acceptable limits, correct the dilution system to provide the desired dilution factors. Make this correction by diluting a high-concentration standard gas mixture to adjust the dilution ratio as required.

Once the dilution system and GC operations are satisfactory, proceed with the analysis of source gas, maintaining the same dilution settings as used for the standards. Repeat the analyses until two consecutive values do not vary by more than 5 percent from their mean value are obtained.

Repeat the analysis of the calibration gas mixtures to verify equipment operation. Analyze the two field audit samples using either the dilution system, or directly connect to the gas sampling valve as required. Record all data and report the results to the audit supervisor.

7.3.3 Determination of Stack Gas Moisture Content. Same as Section 7.2.3.

7.3.4 Quality Assurance. Same as Section 7.2.4.

7.3.5 Emission Calculations. Same as Section 7.2.5, with the dilution factor applied.

7.4 Adsorption Tube Procedure (Alternative Procedure). It is suggested that the tester refer to the National Institute of Occupational Safety and Health (NIOSH) method for the particular organics to be sampled. The principal interferent will be water vapor. If water vapor is present at concentrations above 3 percent, silica gel should be used in front of the charcoal. Where more than one compound is present in the emissions, then develop relative adsorptive capacity information.

7.4.1 Additional Apparatus. In addition to the equipment listed in the NIOSH method for the particular organic(s) to be sampled, the following items (or equivalent) are suggested.

7.4.1.1 Probe (Optional). Borosilicate glass or stainless steel, approximately 6—mm ID, with a heating system if water condensation is a problem, and a filter (either in-stack or out-stack heated to stack temperature) to remove particulate matter. In most instances, a plug of glass wool is a satisfactory filter.

7.4.1.2 Flexible Tubing. To connect probe to adsorption tubes. Use a material that exhibits minimal sample adsorption.

7.4.1.3 Leakless Sample Pump. Flow controlled, constant rate pump, with a set of limiting (sonic) orifices to provide pumping rates from approximately 10 to 100 cc/min.

7.4.1.4 Bubble-Tube Flowmeter. Volume accuracy within ± 1 percent, to calibrate pump.

7.4.1.5 Stopwatch. To time sampling and pump rate calibration.

7.4.1.6 Adsorption Tubes. Similar to ones specified by NIOSH, except the amounts of adsorbent per primary/backup sections are 800/200 mg for charcoal tubes and 1040/260 mg for silica gel tubes. As an alternative, the tubes may contain a porous polymer adsorbent such as Tenax GC or XAD-2.

7.4.1.7 Barometer. Accurate to 5 mm Hg, to measure atmospheric pressure during sampling and pump calibration.

7.4.1.8 Rotameter. 0 to 100 cc/min, to detect changes in flow rate during sampling.

7.4.2 Sampling and Analysis. It is suggested that the tester follow the sampling and analysis portion of the respective NIOSH method section entitled "Procedure." Calibrate the pump and limiting orifice flow rate through adsorption tubes with the bubble tube flowmeter before sampling. The sample system can be operated as a "recirculating loop" for this operation. Record the ambient temperature and barometric pressure. Then, during sampling, use the rotameter to verify that the pump and orifice sampling rate remains constant.

Use a sample probe, if required, to obtain the sample at the centroid of the duct, or at a point no closer to the walls than 1 m. Minimize the length of flexible tubing between the probe and adsorption tubes. Several adsorption tubes can be connected in series, if the extra adsorptive capacity is needed. Provide the gas sample to the sample system at a pressure sufficient for the limiting orifice to function as a sonic orifice. Record the total time and sample flow rate (or the number of pump strokes), the barometric pressure, and ambient temperature. Obtain a total sample volume commensurate with the expected concentration(s) of the volatile organic(s) present, and recommended sample loading factors (weight sample per weight adsorption media). Laboratory tests prior to actual sampling may be necessary to predetermine this volume. When more than one organic is present in the emissions, then develop relative adsorptive capacity information. If water vapor is present in the sample at concentrations above 2 to 3 percent, the adsorptive capacity may be severely reduced. Operate the gas chromatograph according to the manufacture's instructions. After establishing optimum conditions, verify and document these conditions during all operations. Analyze the audit samples (see Section 7.4.4.3), then the emission samples. Repeat the analysis of each sample until the relative deviation of two consecutive injections does not exceed 5 percent.

7.4.3 Standards and Calibration. The standards can be prepared according to the respective NIOSH method. Use a minimum of three different standards; select the concentrations to bracket the expected average sample concentration. Perform the calibration before and after each day's sample analyses. Prepare the calibration curve by using the least squares method.

7.4.4 Quality Assurance.

7.4.4.1 Determination of Desorption Efficiency. During the testing program, determine the desorption efficiency in the expected sample concentration range for each batch of adsorption media to be used. Use an internal standard. A minimum desorption efficiency of 50 percent shall be obtained. Repeat the desorption determination until the relative deviation of two consecutive determinations does not exceed 5 percent. Use the average desorption efficiency of these two consecutive determinations for the correction specified in Section 7.4.4.5. If the desorption efficiency of the compound(s) of interest is questionable under actual sampling conditions, use of the Method of Standard Additions may be helpful to determine this value.

7.4.4.2 Determination of Sample Collection Efficiency. For the source samples, analyze the primary and backup portions of the adsorption tubes separately. If the backup portion exceeds 10 percent of the total amount (primary and backup), repeat the sampling with a larger sampling portion.

7.4.4.3 Analysis Audit. Immediately before the sample analyses, analyze the two audits in accordance with Section 7.4.2. The analysis audit shall agree with the audit concentration within 10 percent.

7.4.4.4 Pump Leak Checks and Volume Flow Rate Checks. Perform both of these checks immediately after sampling with all sampling train components in place. Perform all leak checks according to the manufacturer's instructions, and record the results. Use the bubble-tube flowmeter to measure the pump volume flow rate with the orifice used in the test sampling, and the result. If it has changed by more than 5 but less than 20 percent, calculate an average flow rate for the test. If the flow rate has changed by more than 20 percent, recalibrate the pump and repeat the sampling.

7.4.4.5 Calculations. All calculations can be performed according to the respective NIOSH method. Correct all sample volumes to standard conditions. If a sample dilution system has been used, multiply the results by the appropriate dilution ratio. Correct all results by dividing by the desorption efficiency (decimal value). Report results as ppm by volume, dry basis.

7.5 Reporting of Results. At the completion of the field analysis portion of the study, ensure that the data sheets shown in Figure 18-11 have been completed. Summarize this data on the data sheets shown in Figure 18-15.

8. Bibliography

1. American Society for Testing and Materials. C1 Through C5 Hydrocarbons in the Atmosphere by Gas Chromatography. ASTM D 2820-72, Part 23. Philadelphia, Pa. 23:950-958. 1973.

2. Corazon, V. V. Methodology for Collecting and Analyzing Organic Air Pollutants. U.S. Environmental Protection Agency. Publication No. EPA-600/2-79-042. February 1979.

3. Dravnieks, A., B. K. Krotoszynski, J. Whitfield, A. O'Donnell, and T. Burgwald. Environmental Science and Technology. 5(12):1200-1222. 1971.

4. Eggertsen, F. T., and F. M. Nelsen. Gas Chromatographic Analysis of Engine Exhaust and Atmosphere. Analytical Chemistry. 30(6): 1040-1043. 1958.

5. Feairheller, W. R., P. J. Marn, D. H. Harris, and D. L. Harris. Technical Manual for Process Sampling Strategies for Organic Materials. U.S. Environmental Protection Agency. Research Triangle Park, NC. Publication No. EPA 600/2-76-122. April 1976. 172 p.

6. FR, 39 FR 9319-9323. 1974.

7. FR, 39 FR 32857-32860. 1974.

8. FR, 41 FR 23069-23072 and 23076-23090. 1976.

9. FR, 41 FR 46569-46571. 1976.

10. FR, 42 FR 41771-41776. 1977.

11. Fishbein, L. Chromatography of Environmental Hazards, Volume II. Elsevier Scientific Publishing Company. NY, NY. 1973.

12. Hamersma, J. W., S. L. Reynolds, and R. F. Maddalone. EPA/IERL-RTP Procedures Manual: Level 1 Environmental Assessment. U.S. Environmental Protection Agency. Research Triangle Park, NC. Publication No. EPA 600/276-160a. June 1976. 130 p.

13. Harris, J. C., M. J. Hayes, P. L. Levins, and D. B. Lindsay. EPA/IERL-RTP Procedures for Level 2 Sampling and Analysis of Organic Materials. U.S. Environmental Protection Agency. Research Triangle Park, NC. Publication No. EPA 600/7-79-033. February 1979. 154 p.

14. Harris, W. E., H. W. Habgood. Programmed Temperature Gas Chromatography. John Wiley & Sons, Inc. New York. 1966.

15. Intersociety Committee. Methods of Air Sampling and Analysis. American Health Association. Washington, DC. 1972.

16. Jones, P. W., R. D. Grammar, P. E. Strup, and T. B. Stanford. Environmental Science and Technology. 10:806-810. 1976.

17. McNair Han Bunelli, E. J. Basic Gas Chromatography. Consolidated Printers. Berkeley. 1969.

18. Nelson, G. O. Controlled Test Atmospheres, Principles and Techniques. Ann Arbor. Ann Arbor Science Publishers. 1971. 247 p.

19. NIOSH Manual of Analytical Methods, Volumes 1, 2, 3, 4, 5, 6, 7. U.S. Department of Health and Human Services National Institute for Occupational Safety and Health. Center for Disease Control. 4676 Columbia Parkway, Cincinnati, Ohio 45226. April 1977-August 1981. May be available from the Superintendent of Documents, Government Printing Office, Washington, DC 20402. Stock Number/Price: Volume 1—017-033-00267-3/$13, Volume 2—017-033-00260-6/$11, Volume 3—017-033-00261-4/$14, Volume 4—017-033-00317-3/$7.25, Volume 5—017-033-00349-1/$10, Volume 6—017-033-00369-6/$9, and Volume 7—017-033-00396-5/$7. Prices subject to change. Foreign orders add 25 percent.

20. Schuetzle, D., T. J. Prater, and S. R. Ruddell. Sampling and Analysis of Emissions from Stationary Sources; I. Odor and Total Hydrocarbons. Journal of the Air Pollution Control Association. 25(9):925-932. 1975.

21. Snyder, A. D., F. N. Hodgson, M. A. Kemmer and J. R. McKendree. Utility of Solid Sorbents for Sampling Organic Emissions from Stationary Sources. U.S. Environmental Protection Agency. Research Triangle Park, NC Publication No. EPA 600/2-76-201. July 1976. 71 p.

22. Tentative Method for Continuous Analysis of Total Hydrocarbons in the Atmosphere. Intersociety Committee, American Public Health Association. Washington, DC 1972. p. 184-186.

23. Zwerg, G., CRC Handbook of Chromatography, Volumes I and II. Sherma, Joseph (ed.). CRC Press. Cleveland. 1972.

I. Name of company ____________ Date ______
Address ____________
____
Contacts ____________ Phone ______
____________ ______
Process to be sampled ____________
____
____
Duct or vent to be sampled ____________
____

II. Process description ____________
____
____
____
____
Raw material ____________
____
____
Products ____________
____
____
Operating cycle
Check: Batch ______ Continuous ______ Cyclic ______
Timing of batch or cycle ____________
Best time to test ____________

Figure 18-1. Preliminary survey data sheet.

III. Sampling site
A. Description
Site description ____________
Duct shape and size ____________
Material ____________
Wall thickness ____________ inches
Upstream distance ______ inches ______ diameter
Downstream distance ______ inches ______ diameter
Size of port ____________
Size of access area ____________
Hazards ____________ Ambient temp. ______ °F

B. Properties of gas stream
Temperature _____ °C _____ °F, Data source ____________
Velocity ____________, Data source ____________
Static pressure ___ inches H_2O, Data source ____________
Moisture content ______ %, Data source ____________
Particulate content ______, Data source ____________
Gaseous components
N_2 ______ % Hydrocarbons ______ ppm
O_2 ______ % ______ ______
CO ______ % ______ ______
CO_2 ______ % ______ ______
SO_2 ______ % ______ ______
Hydrocarbon components
______ ______ ppm
______ ______ ppm
______ ______ ppm
______ ______ ppm
______ ______ ppm
______ ______ ppm

Figure 18-1 (continued). Preliminary survey data sheet.

C. Sampling considerations
Location to set up GC ____________
____
Special hazards to be considered ____________
____
Power available at duct ____________
Power available for GC ____________
Plant safety requirements ____________
____
Vehicle traffic rules ____________
____
Plant entry requirements ____________
____
Security agreements ____________
____
Potential problems ____________
____

D. Site diagrams. (Attach additional sheets if required).

Figure 18-1 (continued). Preliminary survey data sheet.

Components to be analyzed	Expected concentration

Suggested chromatographic column ____________
____
Column flow rate ____ ml/min Head pressure ____ mm Hg
Column temperature:
Isothermal ______ °C
Programmed from ____ °C to ____ °C at ____ °C/min
Injection port/sample loop temperature ______ °C
Detector temperature ______ °C
Detector flow rates: Hydrogen ____ ml/min.
head pressure ____ mm Hg
Air/Oxygen ____ ml/min,
head pressure ____ mm Hg
Chart speed ______ inches/minute
Compound data:

Compound	Retention time	Attenuation

Figure 18-2. Chromatographic conditions data sheet.

Preparation of Standards in Tedlar Bags
and Calibration Curve

	Mixture #1	Standards Mixture #2	Mixture #3
Standards Preparation Data:			
Organic: ______			
Bag number or identification	______	______	______
Dry gas meter calibration factor	______	______	______
Final meter reading (liters)	______	______	______
Initial meter reading (liters)	______	______	______
Metered volume (liters)	______	______	______
Average meter temperature (°K)	______	______	______
Average meter pressure, gauge (mm Hg)	______	______	______
Average atmospheric pressure (mm Hg)	______	______	______
Average meter pressure, absolute (mm Hg)	______	______	______
Syringe temperature (°K) (Section 6.2.2.1)	______	______	______
Syringe pressure, absolute (mm Hg) (Section 6.2.2.1)	______	______	______
Volume of gas in syringe (ml) (Section 6.2.2.1)	______	______	______
Density of liquid organic (g/ml) (Section 6.2.2.2)	______	______	______
Volume of liquid in syringe (μl) (Section 6.2.2.2)	______	______	______
GC Operating Conditions:			
Sample loop volume (ml)	______	______	______
Sample loop temperature (°C)	______	______	______
Carrier gas flow rate (ml/min)	______	______	______
Column temperature			
Initial (°C)	______	______	______
Rate change (°C/min)	______	______	______
Final (°C)	______	______	______
Organic Peak Identification and Calculated Concentrations:			
Injection time (24-hr clock)	______	______	______
Distance to peak (cm)	______	______	______
Chart speed (cm/min)	______	______	______
Organic retention time (min)	______	______	______
Attenuation factor	______	______	______
Peak height (mm)	______	______	______
Peak area (mm²)	______	______	______
Peak area x attenuation factor (mm²)	______	______	______
Calculated concentration (ppm) (Equation 18-3 or 18-4)	______	______	______

Plot peak area x attenuation factor against calculated concentration to obtain calibration curve.

Figure 18-3. Standards prepared in Tedlar bags and calibration curve.

Flowmeter Calibration

Flowmeter number or identification ______________________
Flowmeter type ______________________
Calibration device (x): Bubble meter ___ Spirometer ___ Wet test mete
Readings at laboratory conditions:
Laboratory temperature (T_{lab}) ______ °K
Laboratory barometric pressure (P_{lab}) ______ mm Hg
Flow data:

Flowmeter reading (as marked)	Flowmeter temp. (°K)	Flowmeter pressure (absolute)

Calibration device Time (min)	Calibration device gas volume[a]	Calibration device flow rate[b]

a = Volume of gas measured by calibration device, corrected to standard conditions (liters).

b = Calibration device gas volume/time.

Plot flowmeter reading against flow rate (standard conditions), and draw a smooth curve. If the flowmeter being calibrated is a rotameter or other flow device that is viscosity dependent, it may be necessary to generate a "family" of calibration curves that cover the operating pressure and temperature ranges of the flowmeter.

While the following technique should be verified before application, it may be possible to calculate flow rate readings for rotameters at standard conditions Q_{std} as follows:

$$Q_{std} = Q_{lab}\left(\frac{760 \times T_{lab}}{P_{lab} \times 293}\right)^{1/2}$$

Flow rate (laboratory conditions)	Flow rate (standard conditions)

Figure 18-4. Flowmeter calibration.

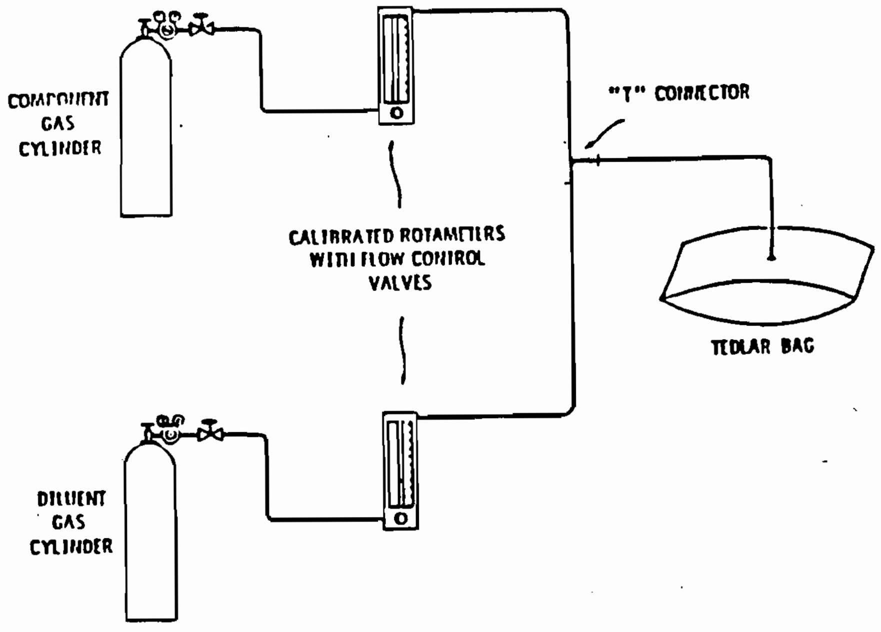


Figure 18-5. Single-stage calibration gas dilution system.

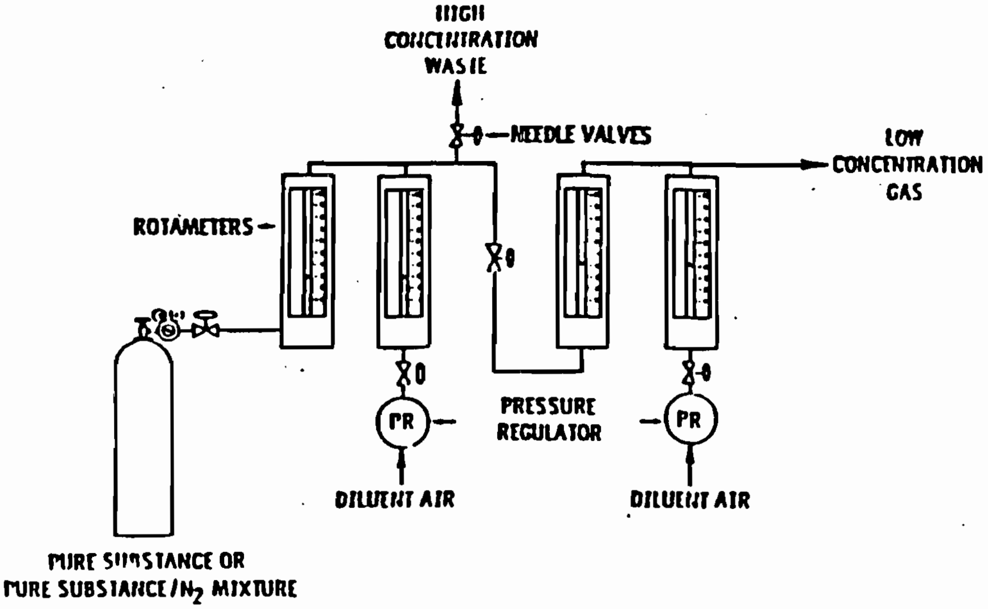


Figure 18-6. Two-stage dilution apparatus.

Preparation of Standards by Dilution of Cylinder Standard

Cylinder standard: Organic ________ Certified concentration ______ ppm

Standards Preparation Data: Date ____________

Stage 1	Mixture 1	Mixture 2	Mixture 3
Standard gas flowmeter reading			
Diluent gas flowmeter reading			
Laboratory temperature (°K)			
Barometric pressure (mm Hg)			
Flowmeter gage pressure (mm Hg)			
Flow rate cylinder gas at standard conditions (ml/min)			
Flow rate diluent gas at standard conditions (ml/min)			
Calculated concentration (ppm)			
Stage 2 (if used)			
Standard gas flowmeter reading			
Diluent gas flowmeter reading			
Flow rate stage 1 gas at standard conditions (ml/min)			
Flow rate diluent gas at standard conditions (ml/min)			
Calculated concentration (ppm)			
GC Operating Conditions:			
Sample loop volume (ml)			
Sample loop temperature (°C)			
Carrier gas flow rate (ml/min)			
Column temperature:			
Initial (°C)			
Program rate (°C/min)			
Final (°C)			
Organic Peak Identification and Calculated Concentrations:			
Injection time (24-hr clock)			
Distance to peak (cm)			
Chart speed (cm/min)			
Retention time (min)			
Attenuation factor			
Peak area (mm^2)			
Peak area x attenuation factor			

Plot peak area x attenuation factor against calculated concentration to obtain calibration curve.

Figure 18-7. Standards prepared by dilution of cylinder standard.

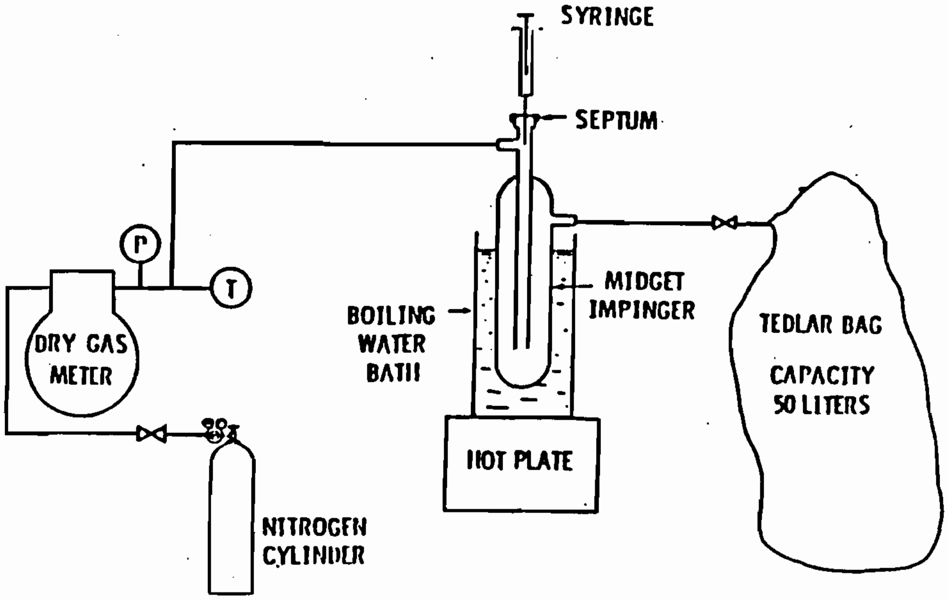


Figure 18-8. Apparatus for preparation of liquid materials.

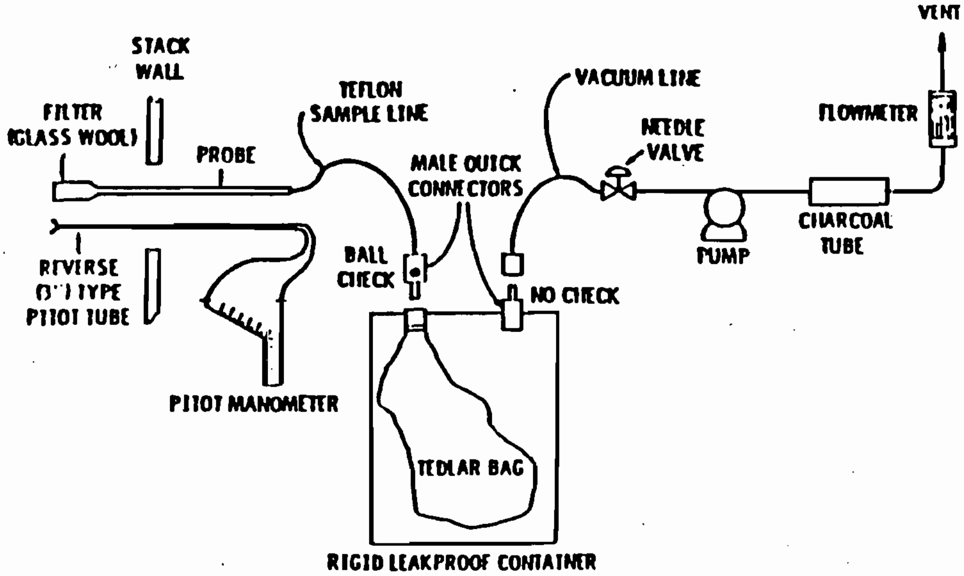


Figure 18-9. Integrated bag sampling train.

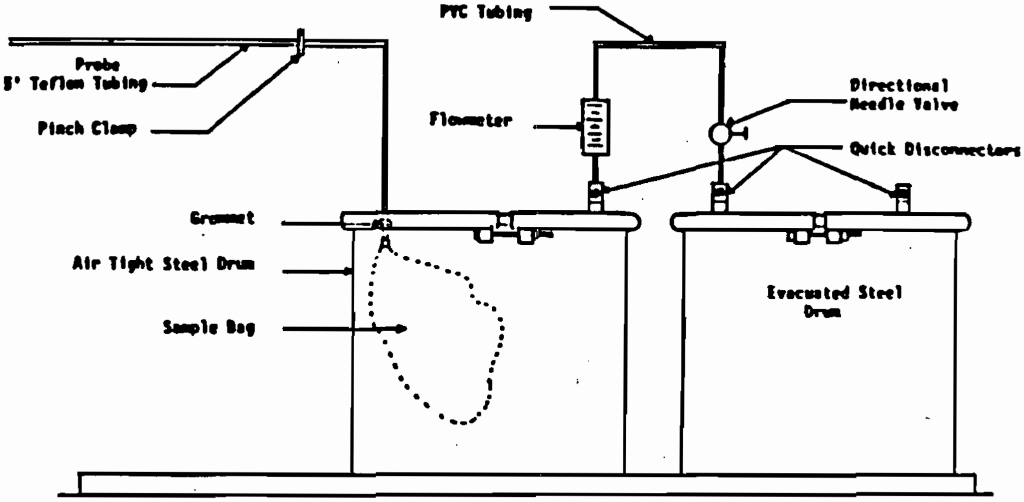


Figure 18-9a. Explosion risk gas sampling method.

Plant______________________ Date____________

Site____

	Sample 1	Sample 2	Sample 3
Source temperature (°C)			
Barometric pressure (mm Hg)			
Ambient temperature (°C)			
Sample flow rate (appr.)			
Bag number			
Start time			
Finish time			

Figure 18-10. Field sample data sheet - Tedlar bag collection method.

Plant______________________ Date____________

Location____________________________________

1. General information

Source temperature (°C) ________

Probe temperature (°C) ________

Ambient temperature (°C) ________

Atmospheric pressure (mm) ________

Source pressure ("Hg) ________

Absolute source pressure (mm) ________

Sampling rate (liter/min) ________

Sample loop volume (ml) ________

Sample loop temperature (°C) ________

Columnar temperature:

Initial (°C)/time (min) ________

Program rate (°C/min) ________

Final (°C)/ time (min) ________

Carrier gas flow rate (ml/min) ________

Detector temperature (°C) ________

Injection time (24-hour basis) ________

Chart speed (mm/min) ________

Dilution gas flow rate (ml/min) ________

Dilution Gas used (symbol) ________

Dilution ratio ________

Figure 18-11. Field analysis data sheets.

2. Field Analysis Data - Calibration Gas

Run No.__________ Time__________

Components	Area	Attenuation	A x A Factor	Conc. (ppm)

Run No.__________ Time__________

Components	Area	Attenuation	A x A Factor	Conc. (ppm)

Run No.__________ Time__________

Components	Area	Attenuation	A x A Factor	Conc. (ppm)

Figure 18-11 (continued). Field analysis data sheets.

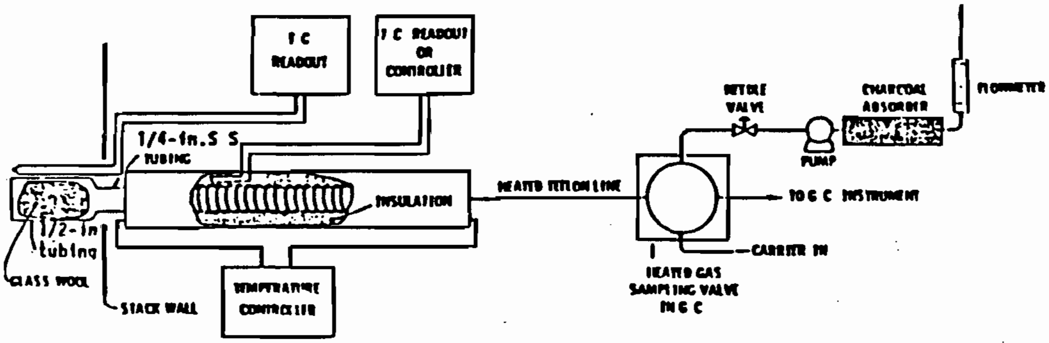


Figure 18-12. Direct interface sampling system.

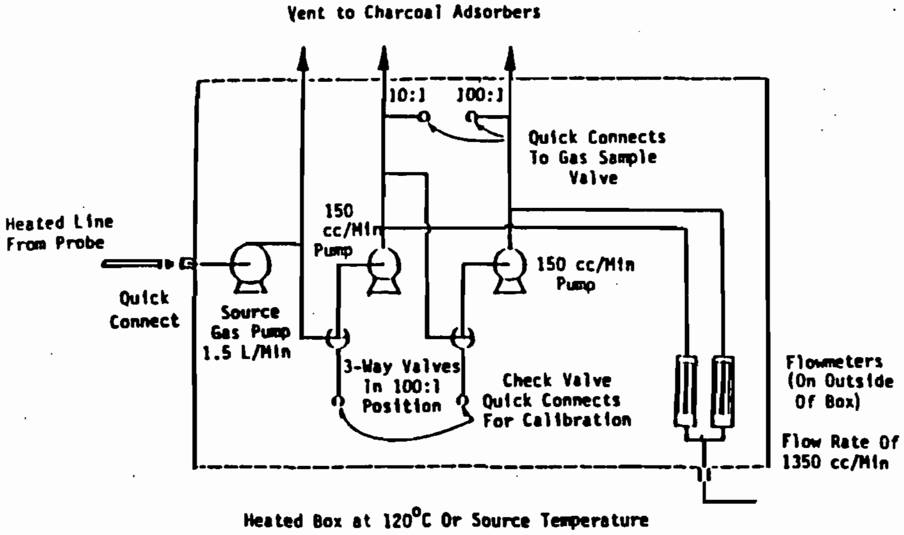


Figure 18-13. Schematic diagram of the heated box required for dilution of sample gas.

Gaseous Organic Sampling and Analysis Check List

(Respond with initials or number as appropriate)

		Date
1. Presurvey data:		
A. Grab sample collected	☐	
B. Grab sample analyzed for composition	☐	
Method GC	☐	☐
GC/MS	☐	☐
Other	☐	☐
C. GC-FID analysis performed	☐	
2. Laboratory calibration data:		
A. Calibration curves prepared	☐	
Number of components	☐	☐
Number of concentrations/component (3 required)	☐	☐
B. Audit samples (optional):		
Analysis completed	☐	
Verified for concentration	☐	
OK obtained for field work	☐	
3. Sampling procedures:		
A. Method:		
Bag sample	☐	☐
Direct interface	☐	☐
Dilution interface	☐	☐
B. Number of samples collected	☐	
4. Field analysis:		
A. Total hydrocarbon analysis performed	☐	
B. Calibration curve prepared	☐	
Number of components	☐	☐
Number of concentrations per component (3 required)	☐	☐

Figure 18-14. Sampling and analysis check.

Gaseous Organic Sampling and Analysis Data

Plant— ______________________

Date— ______________________

Location— ______________________

	Source sample 1	Source sample 2	Source sample 3
1. General information:			
Source temperature (°C)			
Probe temperature (°C)			
Ambient temperature (°C)			
Atmospheric pressure (mm Hg)			
Source pressure (mm Hg)			
Sampling rate (ml/min)			
Sample loop volume (ml)			
Sample loop temperature (°C)			
Sample collection time (24-hr basis)			
Column temperature:			
Initial (°C)			
Program rate (°C/min)			
Final (°C)			
Carrier gas flow rate (ml/min)			
Detector temperature (°C)			
Chart speed (cm/min)			
Dilution gas flow rate (ml/min)			
Diluent gas used (symbol)			
Dilution ratio			

Performed by (signature): ______________________

Date: ______________________

Figure 18-14. Sampling and analysis sheet.

Method 22—Visual Determination of Fugitive Emissions From Material Sources and Smoke Emissions from Flares

1. Introduction

This method involves the visual determination of fugitive emissions, i.e., emissions not emitted directly from a process stack or duct. Fugitive emissions include emissions that (1) escape capture by process equipment exhaust hoods; (2) are emitted during material transfer; (3) are emitted from buildings housing material processing or handling equipment; and (4) are emitted directly from process equipment. This method is used also to determine visible smoke emissions from flares used for combustion of waste process materials.

This method determines the amount of time that any visible emissions occur during the observation period, i.e., the accumulated emission time. This method does not require that the opacity of emissions be determined. Since this procedure requires only the determination of whether a visible emission occurs and does not require the determination of opacity levels, observer certification according to the procedures of Method 9 are not required. However, it is necessary that the observer is educated on the general procedures for determining the presence of visible emissions. As a minimum, the observer must be trained and knowledgeable regarding the effects on the visibility of emissions caused by background contrast, ambient lighting, observer position relative to lighting, wind, and the presence of uncombined water (condensing water vapor). This training is to be obtained from written materials found in Citations 1 and 2 of Bibliography or from the lecture portion of the Method 9 certification course.

2. Applicability and Principle

2.1 Applicability. This method applies to the determination of the frequency of fugitive emissions from stationary sources (located indoors or outdoors) when specified as the test method for determining compliance with new source performance standards.

This method also is applicable for the determination of the frequency of visible smoke emissions from flares.

2.2 Principle. Fugitive emissions produced during material processing, handling, and transfer operations or smoke emissions from flares are visually determined by an observer without the aid of instruments.

3. Definitions

3.1 Emission Frequency. Percentage of time that emissions are visible during the observation period.

3.2 Emission Time. Accumulated amount of time that emissions are visible during the observation period.

3.3 Fugitive Emissions. Pollutant generated by an affected facility which is not collected by a capture system and is released to the atmosphere.

3.4 Smoke Emissions. Pollutant generated by combustion in a flare and occurring immediately downstream of the flame. Smoke occurring within the flame, but not downstream of the flame, is not considered a smoke emission.

3.5 Observation Period. Accumulated time period during which observations are conducted, not to be less than the period specified in the applicable regulation.

4. Equipment

4.1 Stopwatches. Accumulative type with unit divisions of at least 0.5 seconds; two required.

4.2 Light Meter. Light meter capable of measuring illuminance in the 50— to 200-lux range; required for indoor observations only.

5. Procedure

5.1 Position. Survey the affected facility or building or structure housing the process to be observed and determine the locations of potential emissions. If the affected facility is located inside a building, determine an observation location that is consistent with the requirements of the applicable regulation (i.e., outside observation of emissions escaping the building/structure or inside observation of emissions directly emitted from the affected facility process unit). Then select a position that enables a clear view of the potential emission point(s) of the affected facility or of the building or structure housing the affected facility, as appropriate for the applicable subpart. A position at least 15 feet, but not more than 0.25 miles, from the emission source is recommended. For outdoor locations, select a position where the sun is not directly in the observer's eyes.

5.2 Field Records.

5.2.1 Outdoor Location. Record the following information on the field data sheet (Figure 22-1): company name, industry, process unit, observer's name, observer's affiliation, and date. Record also the estimated wind speed, wind direction, and sky condition. Sketch the process unit being observed and note the observer location relative to the source and the sun. Indicate the potential and actual emission points on the sketch.

5.2.2 Indoor Location. Record the following information on the field data sheet (Figure 22-2): company name, industry, process unit, observer's name, observer's affiliation, and date. Record as appropriate the type, location, and intensity of lighting on the data sheet. Sketch the process unit being observed and note observer location relative to the source. Indicate the potential and actual fugitive emission points on the sketch.

5.3 Indoor Lighting Requirements. For indoor locations, use a light meter to measure the level of illumination at a location as close to the emission source(s) as is feasible. An illumination of greater than 100 lux (10 foot candles) is considered necessary for proper application of this method.

5.4 Observations. Record the clock time when observations begin. Use one stopwatch to monitor the duration of the observation period; start this stopwatch when the observation period begins. If the observation period is divided into two or more segments by process shutdowns or observer rest breaks, stop the stopwatch when a break begins and restart it without resetting when the break ends. Stop the stopwatch at the end of the observation period. The accumulated time indicated by this stopwatch is the duration of the observation period. When the observation period is completed, record the clock time.

During the observation period, continously watch the emission source. Upon observing an emission (condensed water vapor is not considered an emission), start the second accumulative stopwatch; stop the watch when the emission stops. Continue this procedure for the entire observation period. The accumulated elapsed time on this stopwatch is the total time emissions were visible during the observation period, i.e., the emission time.

5.4.1 Observation Period. Choose an observation period of sufficient length to meet the requirements for determining compliance with the emission regulation in the applicable subpart. When the length of the observation period is specifically stated in the applicable subpart, it may not be necessary to observe the source for this entire period if the emission time required to indicate noncompliance (based on the specified observation period) is observed in a shorter time period. In other words, if the regulation prohibits emissions for more than 6 minutes in any hour, then observations may (optional) be stopped after an emission time of 6 minutes is exceeded. Similarly, when the regulation is expressed as an emission frequency and the regulation prohibits emissions for greater than 10 percent of the time in any hour, then observations may (optional) be terminated after 6 minutes of emissions are observed since 6 minutes is 10 percent of an hour. In any case, the observation period shall not be less than 6 minutes in duration. In some cases, the process operation may be intermittent or cyclic. In such cases, it may be convenient for the observation period to coincide with the length of the process cycle.

5.4.2 Observer Rest Breaks. Do not observe emissions continuously for a period of more than 15 to 20 minutes without taking a rest break. For sources requiring observation periods of greater than 20 minutes, the observer shall take a break of not less than 5 minutes and not more than 10 minutes after every 15 to 20 minutes of observation. If continuous observations are desired for extended time periods, two observers can alternate between making observations and taking breaks.

5.4.3 Visual Interference. Occasionally, fugitive emissions from sources other than the affected facility (e.g., road dust) may prevent a clear view of the affected facility. This may particularly be a problem during periods of high wind. If the view of the potential emission points is obscured to such a degree that the observer questions the validity of continuing observations, then the observations are terminated, and the observer clearly notes this fact on the data form.

5.5 Recording Observations. Record the accumulated time of the observation period on the data sheet as the observation period duration. Record the accumulated time emissions were observed on the data sheet as the emission time. Record the clock time the observation period began and ended, as well as the clock time any observer breaks began and ended.

6. Calculations

If the applicable subpart requires that the emission rate be expressed as an emission frequency (in percent), determine this value as follows: Divide the accumulated emission time (in seconds) by the duration of the observation period (in seconds) or by any minimum observation period required in the applicable subpart, if the acutal observation period is less than the required period and multiply this quotient by 100.

7. Bibliography

1. Missan, Robert and Arnold Stein. Guidelines for Evaluation of Visible Emissions Certification, Field Procedures, Legal Aspects, and Background Material. EPA Publication No. EPA-340/1-75-007. April 1975

2. Wohlschlegel, P. and D. E. Wagoner. Guideline for Development of a Quality Assurance Program: Volume IX—Visual Determination of Opacity Emissions From Stationary Sources. EPA Publication No. EPA-650/4-74-005-i. November 1975.

FUGITIVE OR SMOKE EMISSION INSPECTION
OUTDOOR LOCATION

Company ____________________
Location ____________________
Company representative ____________________

Observer ____________________
Affiliation ____________________
Date ____________________

Sky Conditions ____________________
Precipitation ____________________

Wind direction ____________________
Wind speed ____________________

Industry ____________________

Process unit ____________________

Sketch process unit; indicate observer position relative to source and sun; indicate potential emission points and/or actual emission points.

OBSERVATIONS

	Clock time	Observation period duration, min:sec	Accumulated emission time, min:sec
Begin Observation			
End observation			

Figure 22-1

Fugitive Emission Inspection Indoor Location Table

FUGITIVE EMISSION INSPECTION
INDOOR LOCATION

Company ____________________

Observer ____________________

Location ____________________

Affiliation ____________________

Company Representative ____________________

Date ____________________

Industry ____________________

Process unit ____________________

Light type (fluorescent, incandescent, natural ____________________

Light location (overhead, behind observer, etc.) ____________________

Illuminance (lux or footcandles) ____________________

Sketch process unit; indicate observer position relative to source; indicate potential emission points and/or actual emission points.

OBSERVATIONS

	Clock time	Observation period duration, min:sec	Accumulated emission, time, min:sec
Beginning observation	________		
	________	________	________
	________	________	________
	________	________	________
	________	________	________
End observation	________	________	________

Figure 22-2

Method 23—Determination of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans From Stationary Sources

1. Applicability and Principle

1.1 Applicability. This method is applicable to the determination of polychlorinated dibenzo-p-dioxins (PCDD's) and polychlorinated dibenzofurans (PCDF's) from stationary sources.

1.2 Principle. A sample is withdrawn from the gas stream isokinetically and collected in the sample probe, on a glass fiber filter, and on a packed column of adsorbent material. The sample cannot be separated into a particle vapor fraction. The PCDD's and PCDF's are extracted from the sample, separated by high resolution gas chromatography, and measured by high resolution mass spectrometry.

2. Apparatus

2.1 Sampling. A schematic of the sampling train used in this method is shown in Figure 23-1. Sealing greases may not be used in assembling the train. The train is identical to that described in section 2.1 of Method 5 of this appendix with the following additions:

2.1.1 Nozzle. The nozzle shall be made of nickel, nickel-plated stainless steel, quartz, or borosilicate glass.

2.1.2 Sample Transfer Lines. The sample transfer lines, if needed, shall be heat traced, heavy walled TFE (½ in. OD with 1/8 in. wall) with connecting fittings that are capable of forming leak-free, vacuum-tight connections without using sealing greases. The line shall be as short as possible and must be maintained at 120 °C.

2.1.1 Filter Support. Teflon or Teflon-coated wire.

2.1.2 Condenser. Glass, coil type with compatible fittings. A schematic diagram is shown in Figure 23-2.

2.1.3 Water Bath. Thermostatically controlled to maintain the gas temperature exiting the condenser at >20 °C (68 °F).

2.1.4 Adsorbent Module. Glass container to hold the solid adsorbent. A shematic diagram is shown in Figure 23-2. Other physical configurations of the resin trap/condenser assembly are acceptable. The connecting fittings shall form leak-free, vacuum tight seals. No sealant greases shall be used in the sampling train. A coarse glass frit is included to retain the adsorbent.

2.2 Sample Recovery.

2.2.1 Fitting Caps. Ground glass, Teflon tape, or aluminum foil (Section 2.2.6) to cap off the sample exposed sections of the train.

2.2.2 Wash Bottles. Teflon, 500—ml.

2.2.3 Probe-Liner Probe-Nozzle, and Filter-Holder Brushes. Inert bristle brushes with precleaned stainless steel or Teflon handles. The probe brush shall have extensions of stainless steel or Teflon, at least as long as the probe. The brushes shall be properly sized and shaped to brush

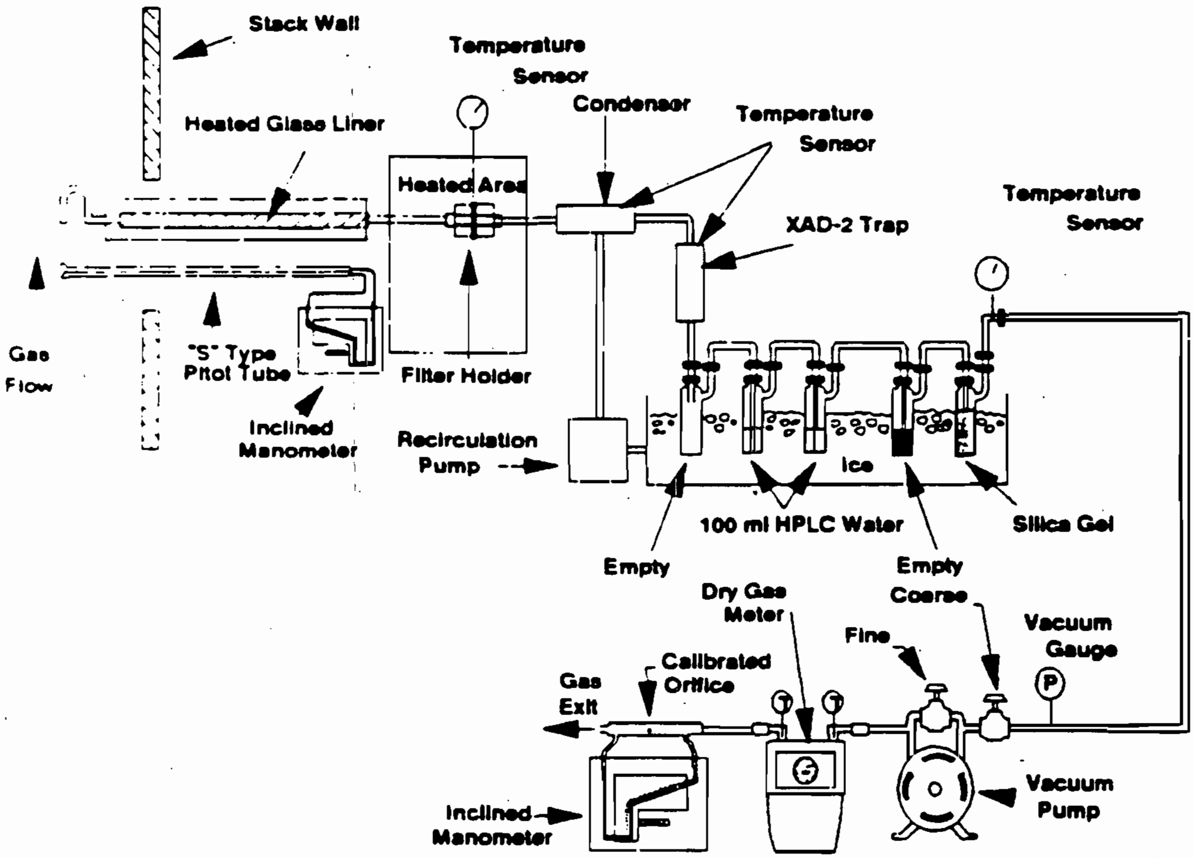


Figure 23.1 Sampling train

out the nozzle, probe liner, and transfer line, if used.

2.2.4 Filter Storage Container. Sealed filter holder, wide—mouth amber glass jar with Teflon-lined cap, or glass petri dish.

2.2.5 Balance. Triple beam.

2.2.6 Aluminum Foil. Heavy duty, hexane-rinsed.

2.2.7 Metal Storage Container. Air tight container to store silica gel.

2.2.8 Graduated Cylinder. Glass, 250—ml with 2—ml graduation.

2.2.9 Glass Sample Storage Container. Amber glass bottle for sample glassware washes, 500— or 1000—ml, with leak free Teflon-lined caps.

2.3 Analysis.

2.3.1 Sample Container. 125— and 250—ml flint glass bottles with Teflon-lined caps.

2.3.2 Test Tube. Glass.

2.3.3 Soxhlet Extraction Apparatus. Capable of holding 43 x 123 mm extraction thimbles.

2.3.4 Extraction Thimble. Glass, precleaned cellulosic, or glass fiber.

2.3.5 Pasteur Pipettes. For preparing liquid chromatographic columns.

2.3.6 Reacti-vials. Amber glass, 2—ml, silanized prior to use.

2.3.7 Rotary Evaporator. Buchi/Brinkman RF-121 or equivalent.

2.3.8 Nitrogen Evaporative Concentrator. N-Evap Analytical Evaporator Model III or equivalent.

2.3.9 Separatory Funnels. Glass, 2-liter.

2.3.10 Gas Chromatograph. Consisting of the following components:

2.3.10.1 Oven. Capable of maintaining the separation column at the proper operating temperature ± °C and performing programmed increases in temperature at rates of at least 40 °C/min.

2.3.10.2 Temperature Gauge. To monitor column oven, detector, and exhaust temperatures ± 1 °C.

2.3.10.3 Flow System. Gas metering system to measure sample, fuel, combustion gas, and carrier gas flows.

2.3.10.4 Capillary Columns. A fused silica column, 60 x 0.25 mm inside diameter (ID), coated with DB-5 and a fused silica column, 30 m x 0.25 mm ID coated with DB-225. Other column systems may be used provided that the user is able to demonstrate using calibration and performance checks that the column system is able to meet the specifications of section 6.1.2.2.

2.3.11 Mass Spectrometer. Capable of routine operation at a resolution of 1:10000 with a stability of ± 5 ppm.

2.3.12 Data System. Compatible with the mass spectrometer and capable of monitoring at least five groups of 25 ions.

2.3.13 Analytical Balance. To measure within 0.1 mg.

3. Reagents

3.1 Sampling.

3.1.1 Filters. Glass fiber filters, without organic binder, exhibiting at least 99.95 percent efficiency (<0.05 percent penetration) on 0.3—micron dioctyl phthalate smoke particles. The filter efficiency test shall be conducted in accordance with ASTM Standard Method D 2986-71 (Reapproved 1978) (incorporated by reference——see § 60.17).

3.1.1.1 Precleaning. All filters shall be cleaned before their initial use. Place a glass extraction thimble and 1 g of silica gel and a plug of glass wool into a Soxhlet apparatus, charge the apparatus with toluene, and reflux for a minimum of 3 hours. Remove the toluene and discard it, but retain the silica gel. Place no more than 50 filters in the thimble onto the silica gel bed and top with the cleaned glass wool. Charge the Soxhlet with toluene and reflux for 16 hours. After extraction, allow the Soxhlet to cool, remove the filters, and dry them under a clean N_2 stream. Store the filters in a glass petri dish sealed with Teflon tape.

3.1.2 Adsorbent Resin. Amberlite XAD-2 resin. Thoroughly cleaned before initial use.

3.1.2.1 Cleaning Procedure. This procedure may be carried out in a giant Soxhlet extractor. An all-glass filter thimble containing an extra-course frit is used for extraction of XAD-2. The frit is recessed 10-15 mm above a crenelated ring at the bottom of the thimble to facilitate drainage. The resin must be carefully retained in the extractor cup with a glass wool plug and a stainless steel ring because it floats on methylene chloride. This process involves sequential extraction in the following order.

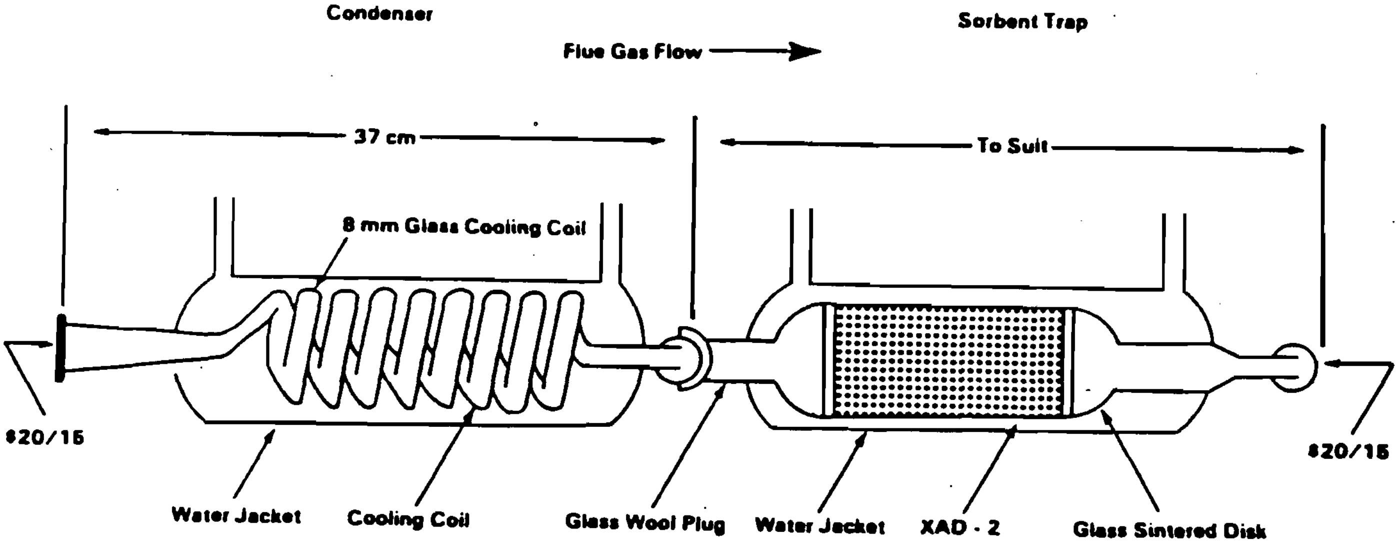


Figure 23.2. Condenser and adsorbent trap

Solvent	Procedure
Water	Initial rinse: Place resin in a beaker, rinse once with water, and discard. Fill with water a second time, let stand overnight, and discard.
Water	Extract with water for 8 hours.
Methanol	Extract for 22 hours.
Methylene Chloride	Extract for 22 hours.
Toluene	Extract for 22 hours.

3.1.2.2 Drying.

3.1.2.2.1 Drying Column. Pyrex pipe, 10.2 cm ID by 0.6 m long, with suitable retainers.

3.1.2.2.2 Procedure. The adsorbent must be dried with clean inert gas. Liquid nitrogen from a standard commercial liquid nitrogen cylinder has proven to be a reliable source of large volumes of gas free from organic contaminants. Connect the liquid nitrogen cylinder to the column by a length of cleaned copper tubing, 0.95 cm ID, coiled to pass through a heat source. A convenient heat source is a water-bath heated from a steam line. The final nitrogen temperature should only be warm to the touch and not over 40 °C. Continue flowing nitrogen through the adsorbent until all the residual solvent is removed. The flow rate should be sufficient to gently agitate the particles but not so excessive as the cause the particles to fracture.

3.1.2.3 Quality Control Check. The adsorbent must be checked for residual toluene.

3.1.2.3.1 Extraction. Weigh 1.0 g sample of dried resin into a small vial, add 3 ml of toluene, cap the vial, and shake it well.

3.1.2.3.2 Analysis. Inject a 2 ul sample of the extract into a gas chromatograph operated under the following conditions: Column: 6 ft x 1/8 in stainless steel containing 10 percent OV-101 on 100/120 Supelcoport. Carrier Gas: Helium at a rate of 30 ml/min. Detector: Flame ionization detector operated at a sensitivity of 4 x 10-11 A/mV. Injection Port Temperature: 250 °C. Detector Temperature: 305 °C. Oven Temperature. 30 °C for 4 min; programmed to rise at 40 °C/min until it reaches 250 °C; return to 30 °C after 17 minutes.

Compare the results of the analysis to the results from the reference solution. Prepare the reference solution by injection 2.5 ul of methylene chloride into 100 ml of toluene. This corresponds to 100 μg of methylene chloride per g of adsorbent. The maximum acceptable concentration is 1000 μg/g of adsorbent. If the adsorbent exceeds this level, drying must be continued until the excess methylene chloride is removed.

3.1.2.4 Storage. The adsorbent must be used within 4 weeks of cleaning. After cleaning, it may be stored in a wide mouth amber glass container with a Teflon-lined cap or placed in one of the glass adsorbent modules tightly sealed with glass stoppers. If precleaned adsorbent is purchased in sealed containers, it must be used within 4 weeks after the seal is broken.

3.1.3 Glass Wool. Cleaned by sequential immersion in three aliquots of methylene chloride, dried in a 110 °C oven, and stored in a methylene chloride—washed glass jar with a Teflon-lined screw cap.

3.1.4 Water. Deionized distilled and stored in a methylene chloride-rinsed glass container with a Teflon-lined screw cap.

3.1.5 Silica Gel. Indicating type, 6 to 16 mesh. If previously used, dry at 175 °C (350 °F) for two hours. New silica gel may be used as received. Alternately other types of desiccants (equivalent or better) may be used, subject to the approval of the Administrator.

3.1.6 Chromic Acid Cleaning Solution. Dissolve 20 g of sodium dichromate in 15 ml of water, and then carefully add 400 ml of concentrated sulfuric acid.

3.2 Sample Recovery.

3.2.2 Acetone. Pesticide quality.

3.2.2 Methylene Chloride. Pesticide qualtity.

3.2.3 Toluene. Pesticide quality.

3.3 Analysis.

3.3.1 Potassium Hydroxide. ACS grade, 2-percent (weight/volume) in water.

3.3.2 Sodium Sulfate. Granulated, reagent grade. Purify prior to use by rinsing with methylene chloride and oven drying. Store the cleaned material in a glass container with a Teflon-lined screw cap.

3.3.3 Sulfuric Acid. Reagent grade.

3.3.4 Sodium Hydroxide. 1.0 N. Weigh 40 g of sodium hydroxide into a 1-liter volumetric flask. Dilute to 1 liter with water.

3.3.5 Hexane. Pesticide grade.

3.3.6 Methylene Chloride. Pesticide grade.

3.3.7 Benzene. Pesticide Grade.

3.3.8 Ethyl Acetate.

3.3.9 Methanol. Pesticide Grade.

3.3.10 Toluene. Pesticide Grade.

3.3.11 Nonane. Pesticide Grade.

3.3.12 Cyclohexane. Pesticide Grade.

3.3.13 Basic Alumina. Activity grade 1, 100-200 mesh. Prior to use, activate the alumina by heating for 16 hours at 130 °C before use. Store in a desiccator. Pre-activated alumina may be purchased from a supplier and may be used as received.

3.3.14 Silica Gel. Bio-Sil A, 100-200 mesh. Prior to use, activate the silica gel by heating for at least 30 minutes at 180 °C. After cooling, rinse the silica gel sequentially with methanol and methylene chloride. Heat the rinsed silica gel at 50 °C for 10 minutes, then increase the temperature gradually to 180 °C over 25 minutes and maintain it at this temperature for 90 minutes. Cool at room temperature and store in a glass container with a Teflon-lined screw cap.

3.3.15 Silica Gel Impregnated with Sulfuric Acid. Combine 100 g of silica gel with 44 g of concentrated sulfuric acid in a screw capped glass bottle and agitate thoroughly. Disperse the solids with a stirring rod until a uniform mixture is obtained. Store the mixture in a glass container with a Teflon-lined screw cap.

3.3.16 Silica Gel Impregnated with Sodium Hydroxide. Combine 39 g of 1 N sodium hydroxide with 100 g of silica gel in a screw capped glass bottle and agitate thoroughly. Disperse solids with a stirring rod until a uniform mixture is obtained. Store the mixture in glass container with a Teflon-lined screw cap.

3.3.17 Carbon/Celite. Combine 10.7 g of AX-21 carbon with 124 g of Celite 545 in a 250—ml glass bottle with a Teflon-lined screw cap. Agitate the mixture thoroughly until a uniform mixture is obtained. Store in the glass container.

3.3.18 Nitrogen. Ultra high purity.

3.3.19 Hydrogen. Ultra high purity.

3.3.20 Internal Standard Solution. Prepare a stock standard solution containing the isotopically labelled PCDD's and PCDF's at the concentrations shown in Table 1 under the heading "Internal Standards" in 10 ml of nonane.

3.3.21 Surrogate Standard Solution. Prepare a stock standard solution containing the isotopically labelled PCDD's and PCDF's at the concentrations shown in Table 1 under the heading "Surrogate Standards" in 10 ml of nonane.

3.3.22 Recovery Standard Solution. Prepare a stock standard solution containing the isotopically labelled PCDD's and PCDF's at the concentrations shown in Table 1 under the heading "Recovery Standards" in 10 ml of nonane.

4. Procedure

4.1 Sampling. The complexity of this method is such that, in order to obtain reliable results, testers should be trained and experienced with the test procedures.

4.1.1 Pretest Preparation.

4.1.1.1 Cleaning Glassware. All glass components of the train upstream of and including the adsorbent module, shall be cleaned as described in section 3A of the "Manual of Analytical Methods for the Analysis of Pesticides in Human and Environmental Samples." Special care shall be devoted to the removal of residual silicone grease sealants on ground glass connections of used glassware. Any residue shall be removed by soaking the glassware for several hours in a chromic acid cleaning solution prior to cleaning as described above.

4.1.1.2 Adsorbent Trap. The traps must be loaded in a clean area to avoid contamination. They may not be loaded in the field. Fill a trap with 20 to 40 g of XAD-2. Follow the XAD-2 with glass wool and tightly cap both ends of the trap. Add 100 ul of the surrogate standard solution (section 3.3.21) to each trap.

4.1.1.3 Sample Train. It is suggested that all components be maintained according to the procedure described in APTD-0576.

4.1.1.4 Silica Gel. Weigh several 200 to 300 g portions of silica gel in an air tight container to the nearest 0.5 g. Record the total weight of the silica gel plus container, on each container. As an alternative, the silica gel may be weighed directly in its impinger or sampling holder just prior to sampling.

4.1.1.5 Filter. Check each filter against light for irregularities and flaws or pinhole leaks. Pack the filters flat in a clean glass container.

4.1.2 Preliminary Determinations. Same as section 4.1.2 of Method 5.

4.1.3 Preparation of Collection Train.

4.1.3.1 During preparation and assembly of the sampling train, keep all train openings where contamination can enter, sealed until just prior to assembly or until sampling is about to begin.

Note: Do not use sealant grease in assembling the train.

4.1.3.2 Place approximately 100 ml of water in the second and third impingers, leave the first and fourth impingers empty, and transfer approximately 200 to 300 g of preweighed silica gel from its container to the fifth impinger.

4.1.3.3 Place the silica gel container in a clean place for later use in the sample recovery. Alternatively, the weight of the silica gel plus impinger may be determined to the nearest 0.5 g and recorded.

4.1.3.4 Assemble the train as shown in Figure 23-1.

4.1.3.5 Turn on the adsorbent module and condenser coil recirculating pump and begin monitoring the adsorbent module gas entry temperature. Ensure proper sorbent temperature gas entry temperature before proceeding and before sampling is initiated. It is extremely important that the XAD-2 adsorbent resin temperature never exceed 50 °C because thermal decomposition will occur. During testing, the XAD-2 temperature must not exceed 20 °C for efficient capture of the PCDD's and PCDF's.

4.1.4 Leak-Check Procedure. Same as Method 5, section 4.1.4.

4.1.5 Sample Train Operation. Same as Method 5, section 4.1.5.

4.2 Sample Recovery. Proper cleanup procedure begins as soon as the probe is removed from the stack at the end of the sampling period. Seal the nozzle end of the sampling probe with Teflon tape or aluminum foil.

When the probe can be safely handled, wipe off all external particulate matter near the tip of the probe. Remove the probe from the train and close off both ends with aluminum foil. Seal off the inlet to the train with Teflon tape, a ground glass cap, or aluminum foil.

Transfer the probe and impinger assembly to the cleanup area. This area shall be clean and enclosed so that the chances of losing or contaminating the sample are minimized. Smoking, which could contaminate the sample, shall not be allowed in the cleanup area.

Inspect the train prior to and during disassembly and note any abnormal conditions, e.g., broken filters, colored impinger liquid, etc. Treat the samples as follows:

4.2.1 Container No. 1. Either seal the filter holder or carefully remove the filter from the filter holder and place it in its identified container. Use a pair of cleaned tweezers to handle the filter. If it is necessary to fold the filter, do so such that the particulate cake is inside the fold. Carefully transfer to the container any particulate matter and filter fibers which adhere to the filter holder gasket, by using a dry inert bristle brush and a sharp-edged blade. Seal the container.

4.2.2 Adsorbent Module. Remove the module from the train, tightly cap both ends, label it, cover with aluminum foil, and store it on ice for transport to the laboratory.

4.2.3 Container No. 2. Quantitatively recover material deposited in the nozzle, probe transfer lines, the front half of the filter holder, and the cyclone, if used, first, by brushing while rinsing three times each with acetone and then, by rinsing the probe three times with methylene chloride. Collect all the rinses in Container No. 2.

Rinse the back half of the filter holder three times with acetone. Rinse the connecting line between the filter and the condenser three times with acetone. Soak the connecting line with three separate portions of methylene chloride for 5 minutes each. If using a separate condenser and adsorbent trap, rinse the condenser in the same manner as the connecting line. Collect all the rinses in Container No. 2 and mark the level of the liquid on the container.

4.2.4 Container No. 3. Repeat the methylene chloride-rinsing described in Section 4.2.3 using toluene as the rinse solvent. Collect the rinses in Container No. 3 and mark the level of the liquid on the container.

4.2.5 Impinger Water. Measure the liquid in the first three impingers to within ± 1 ml by using a graduated cylinder or by weighing it to within ± 0.5 g by using a balance. Record the volume or weight of liquid present. This information is required to calculate the moisture content of the effluent gas.

Discard the liquid after measuring and recording the volume or weight.

4.2.7 Silica Gel. Note the color of the indicating silica gel to determine if it has been completely spent and make a mention of its condition. Transfer the silica gel from the fifth impinger to its original container and seal.

5. Analysis

All glassware shall be cleaned as described in section 3A of the "Manual of Analytical Methods for the Analysis of Pesticides in Human and Environmental Samples." All samples must be extracted within 30 days of collection and analyzed within 45 days of extraction.

5.1 Sample Extraction.

5.1.1 Extraction System. Place an extraction thimble (section 2.3.4), 1 g of silica gel, and a plug of glass wool into the Soxhlet apparatus, charge the apparatus with toluene, and reflux for a minimum of 3 hours. Remove the toluene and discard it, but retain the silica gel. Remove the extraction thimble from the extraction system and place it in a glass beaker to catch the solvent rinses.

5.1.2 Container No. 1 (Filter). Transfer the contents directly to the glass thimble of the extraction system and extract them simultaneously with the XAD-2 resin.

5.1.3 Adsorbent Cartridge. Suspend the adsorbent module directly over the extraction thimble in the beaker (See section 5.1.1). The glass frit of the module should be in the up position. Using a Teflon squeeze bottle containing toluene, flush the XAD-2 into the thimble onto the bed of cleaned silica gel. Thoroughly rinse the glass module catching the rinsings in the beaker containing the thimble. If the resin is wet, effective extraction can be accomplished by loosely packing the resin in the thimble. Add the XAD-2 glass wool plug into the thimble.

5.1.4 Container No. 2 (Acetone and

Methylene Chloride). Concentrate the sample to a volume of about 1-5 ml using the rotary evaporator apparatus, at a temperature of less than 37 °C. Rinse the sample container three times with small portions of methylene chloride and add these to the concentrated solution and concentrate further to near dryness. This residue contains particulate matter removed in the rinse of the train probe and nozzle. Add the concentrate to the filter and the XAD-2 resin in the Soxhlet apparatus described in section 5.1.1.

5.1.5 Extraction. Add 100 ul of the internal standard solution (Section 3.3.20) to the extraction thimble containing the contents of the adsorbent cartridge, the contents of Container No. 1, and the concentrate from section 5.1.4. Cover the contents of the extraction thimble with the cleaned glass wool plug to prevent the XAD-2 resin from floating into the solvent reservoir of the extractor. Place the thimble in the extractor, and add the toluene contained in the beaker to the solvent reservoir. Pour additional toluene to fill the reservoir approximately 2/3 full. Add Teflon boiling chips and assemble the apparatus. Adjust the heat source to cause the extractor to cycle three times per hour. Extract the sample for 16 hours. After extraction, allow the Soxhlet to cool. Transfer the toluene extract and three 10—ml rinses to the rotary evaporator. Concentrate the extract to approximately 10 ml. At this point the analyst may choose to split the sample in half. If so, split the sample, store one half for future use, and analyze the other according to the procedures in sections 5.2 and 5.3. In either case, use a nitrogen evaporative concentrator to reduce the volume of the sample being analyzed to near dryness. Dissolve the residue in 5 ml of hexane.

5.1.6 Container No. 3 (Toluene Rinse). Add 100 ul of the Internal Standard solution (section 3.3.2) to the contents of the container. Concentrate the sample to a volume of about 1-5 ml using the rotary evaporator apparatus at a temperature of less than 37 °C. Rinse the sample container apparatus at a temperature of less than 37 °C. Rinse the sample container three times with small portions of toluene and add these to the concentrated solution and concentrate further to near dryness. Analyze the extract separately according to the procedures in sections 5.2 and 5.3, but concentrate the solution in a rotary evaporator apparatus rather than a nitrogen evaporative concentrator.

5.2 Sample Cleanup and Fractionation.

5.2.1 Silica Gel Column. Pack one end of a glass column, 20 mm x 230 mm, with glass wool. Add in sequence, 1 g silica gel, 2 g of sodium hydroxide impregnated silica gel, 1 g silica gel, 4 g of acid—modified silica gel, and 1 g of silica gel. Wash the column with 30 ml of hexane and discard it. Add the sample extract, dissolved in 5 ml of hexane to the column with two additional 5—ml rinses. Elute the column with an additional 90 ml of hexane and retain the entire eluate. Concentrate this solution to a volume of about 1 ml using the nitrogen evaporative concentrator (section 2.3.7).

5.2.2 Basic Alumina Column. Shorten a 25—ml disposable Pasteur pipette to about 16 ml. Pack the lower section with glass wool and 12 g of basic alumina. Transfer the concentrated extract from the silica gel column to the top of the basic alumina column and elute the column sequentially with 120 ml of 0.5 percent methylene chloride in hexane followed by 120 ml of 35 percent methylene chloride in hexane. Discard the first 120 ml of eluate. Collect the second 120 ml of eluate and concentrate it to about 0.5 ml using the nitrogen evaporative concentrator.

5.2.3 AX-21 Carbon/Celite 545 Column. Remove the botton 0.5 in. from the tip of a 9—ml disposable Pasteur pipette. Insert a glass fiber filter disk in the top of the pipette 2.5 cm from the constriction. Add sufficient carbon/celite mixture to form a 2 cm column. Top with a glass wool plug. In some cases AX-21 carbon fines may wash through the glass wool plug and enter the sample. This may be prevented by adding a celite plug to the exit end of the column. Rinse the column in sequence with 2 ml of 50 percent benzene in ethyl acetate, 1 ml of 50 percent methylene chloride in cyclohexane, and 2 ml of hexane. Discard these rinses. Transfer the concentrate in 1 ml of hexane from the basic alumina column to the carbon/celite column along with 1 ml of hexane rinse. Elute the column sequentially with 2 ml of 50 percent methylene chloride in hexane and 2 ml of 50 percent benzene in ethyl acetate and discard these eluates. Invert the column and elute in the reverse direction with 13 ml of toluene. Collect this eluate. Concentrate the eluate in a rotary evaporator at 50 °C to about 1 ml. Transfer the concentrate to a Reacti-vial using a toluene rinse and concentrate to a volume of 200 ul using a stream of N_2. Store extracts at room temperature, shielded from light, until the analysis is performed.

5.3 Analysis. Analyze the sample with a gas chromatograph coupled to a mass spectrometer (GC/MS) using the instrumental parameters in sections 5.3.1 and 5.3.2. Immediately prior to analysis, add a 20 ul aliquot of the Recovery Standard solution from Table 1 to each sample. A 2 ul aliquot of the extract is injected into the GC. Sample extracts are first analyzed using the DB-5 capillary column to determine the concentration of each isomer of PCDD's and PCDF's (tetra-through octa-). If tetra-chlorinated dibenzofurans are detected in this analysis, then analyze another aliquot of the sample in a separate run, using the DB-225 column to measure the 2,3,7,8 tetra-chloro dibenzofuran isomer. Other column systems may be used, provided that the user is able to demonstrate using calibration and performance checks that the column system is able to meet the specifications of section 6.1.2.2.

5.3.1 Gas Chromatograph Operating Conditions.

5.3.1.1 Injector. Configured for capillary column, splitless, 250°C.

5.3.1.2 Carrier Gas. Helium, 1-2 ml/min.

5.3.1.3 Oven. Initially at 150°C. Raise by at least 40°C/min to 190°C and then at 3°C/min up to 300°C.

5.3.2 High Resolution Mass Spectrometer.

5.3.2.1 Resolution. 10000 m/e.

5.3.2.2 Ionization Mode. Electron impact.

5.3.2.3 Source Temperature 250°C.

5.3.2.4 Monitoring Mode. Selected ion monitoring. A list of the various ions to be monitored is summarized in Table 3.

5.3.2.5 Identification Criteria. The following identification criteria shall be used for the characterization of polychlorinated dibenzodioxins and dibenzofurans.

1. The integrated ion-abundance ratio (M/M+2 or M+2/M+4) shall be within 15 percent of the theoretical value. The acceptable ion-abundance ratio ranges for the identification of chlorine-containing compounds are given in Table 4.
2. The retention time for the analytes must be within 3 seconds of the corresponding \1\\3\ C-labeled internal standard, surrogate or alternate standard.
3. The monitored ions, shown in Table 3 for a given analyte, shall reach their maximum within 2 seconds of each other.
4. The identification of specific isomers that do not have corresponding \1\\3\ C-labeled standards is done by comparison of the relative retention time (RRT) of the analyte to the nearest internal standard retention time with reference (i.e., within 0.005 RRT units) to the comparable RRT's found in the continuing calibration.
5. The signal to noise ratio for all monitored ions must be greater than 2.5.
6. The confirmation of 2, 3, 7, 8-TCDD and 2, 3, 7, 8-TCDF shall satisfy all of the above identification criteria.
7. For the identification of PCDF's, no

signal may be found in the corresponding PCDPE channels.

5.3.2.6 Quantification. The peak areas for the two ions monitored for each analyte are summed to yield the total response for each analyte. Each internal standard is used to quantify the indigenous PCDD's or PCDF's in its homologous series. For example, the \1\\3\ C 12-2,3,7,8-tetra chlorinated dibenzodioxin is used to calculate the concentrations of all other tetra chlorinated isomers. Recoveries of the tetra— and penta— internal standards are calculated using the \1\\3\ C 12-1,2,3,4-TCDD. Recoveries of the hexa— through octa— internal standards are calculated using \1\\3\ C 12-1,2,3,7,8,9-HxCDD. Recoveries of the surrogate standards are calculated using the corresponding homolog from the internal standard.

6. Calibration

Same as Method 5 with the following additions.

6.1 GC/MS System.

6.1.1 Initial Calibration. Calibrate the GC/MS system using the set of five standards shown in Table 2. The relative standard deviation for the mean response factor from each of the unlabeled analytes (Table 2) and of the internal, surrogate, and alternate standards shall be less than or equal to the values in Table 5. The signal to noise ratio for the GC signal present in every selected ion current profile shall be greater than or equal to 2.5. The ion abundance ratios shall be within the control limits in Table 4.

6.1.2 Daily Performance Check.

6.1.2.1 Calibration Check. Inject on ul of solution Number 3 from Table 2. Calculate the relative response factor (RRF) for each compound and compare each RRF to the corresponding mean RRF obtained during the initial calibration. The analyzer performance is acceptable if the measured RRF's for the labeled and unlabeled compounds for the daily run are within the limits of the mean values shown in Table 5. In addition, the ion-abundance ratios shall be within the allowable control limits shown in Table 4.

6.1.2.2 Column Separation Check. Inject a solution of a mixture of PCDD's and PCDF's that documents resolution between 2,3,7,8-TCDD and other TCDD isomers. Resolution is defined as a valley between peaks that is less than 25 percent of the lower of the two peaks. Identify and record the retention time windows for each homologous series.

Perform a similar resolution check on the confirmation column to document the resolution between 2,3,7,8 TCDF and other TCDF isomers.

6.2 Lock Channels. Set mass spectrometer lock channels as specified in Table 3. Monitor the quality control check channels specified in Table 3 to verify instrument stability during the analysis.

7. Quality Control

7.1 Sampling Train Collection Efficiency Check. Add 100 ul of the surrogate standards in Table 1 to the absorbent cartridge of each train before collecting the field samples.

7.2 Internal Standard Percent Recoveries. A group of nine carbon labeled PCDD's and PCDF's representing, the tetra-through octachlorinated homologues, is added to every sample prior to extraction. The role of the internal standards is to quantify the native PCDD's and PCDF's present in the sample as well as to determine the overall method efficiency. Recoveries of the internal standards must be between 40 to 130 percent for the tetra-through hexachlorinated compounds while the range is 25 to 130 percent for the higher hepta— and octachlorinated homologues.

7.3 Surrogate Recoveries. The five surrogate compounds in Table 2 are added to the resin in the adsorbent sampling cartridge before the sample is collected. The surrogate recoveries are measured relative to the internal standards and are a measure of collection efficiency. They are not used to measure native PCDD's and PCDF's. All recoveries shall be between 70 and 130 percent. Poor recoveries for all the surrogates may be an indication of breakthrough in the sampling train. If the recovery of all standards is below 70 percent, the sampling runs must be repeated. As an alternative, the sampling runs do not have to be repeated if the final results are divided by the fraction of surrogate recovery. Poor recoveries of isolated surrogate compounds should not be grounds for rejecting an entire set of the samples.

7.4 Toluene QA Rinse. Report the results of the toluene QA rinse separately from the total sample catch. Do not add it to the total sample.

8. Quality Assurance

8.1 Applicability. When the method is used to analyze samples to demonstrate compliance with a source emission regulation, an audit sample must be analyzed, subject to availability.

8.2 Audit Procedure. Analyze an audit sample with each set of compliance samples. The audit sample contains tetra through octa isomers of PCDD and PCDF. Concurrently, analyze the audit sample and a set of compliance samples in the same manner to evaluate the technique of the analyst and the standards preparation. The same analyst, analytical reagents, and analytical system shall be used both for the compliance samples and the EPA audit sample.

8.3 Audit Sample Availability. Audit samples will be supplied only to enforcement agencies for compliance tests. The availability of audit samples may be obtained by writing: Source Test Audit Coordinator (MD-77B), Quality Assurance Division, Atmospheric Research and Exposure Assessment Laboratory, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711, or by calling the Source Test Audit Coordinator (STAC) at (919) 541-7834. The request for the audit sample must be made at least 30 days prior to the scheduled complisnce sample analysis.

8.4 Audit Results. Calculate the audit sample concentration according to the calculation procedure described in the audit instructions included with the audit sample. Fill in the audit sample concentration and the analyst's name on the audit response form included with the audit instructions. Send one copy to the EPA Regional Office or the appropriate enforcement agency and a second copy to the STAC. The EPA Regional office or the appropriate enforcement agency will report the results of the audit to the laboratory being audited. Include this response with the results of the compliance samples in relevant reports to the EPA Regional Office or the appropriate enforcement agency.

9. Calculations

Same as Method 5, section 6 with the following additions.

9.1 Nomenclature.

Aai = Integrated ion current of the noise at the retention time of the analyte. A*ci = Integrated ion current of the two ions characteristic of the internal standard i in the calibration standard. Acij = Integrated ion current of the two ions characteristic of compound i in the jth calibration standard. A*cij = Integrated ion current of the two ions characteristic of the internal standard i in the jth calibration standard. Acsi = Integrated ion current of the two ions characteristic of surrogate compound i in the calibration standard. Ai = Integrated ion current of the two ions characteristic of compound i in the sample. A*i = Integrated ion current of the two ions characteristic of internal standard i in the sample. Ars = Integrated ion current of the two ions characteristic of the recovery standard. Asi = Integrated ion current of the two ions characteristic of surrogate compound i in the sample. Ci = Concentration of PCDD or PCDF i in the sample, pg/M \3\. CT = Total concentration of PCDD's or PCDF's in the sample, pg/M \3\. mci = Mass of compound i in the calibration standard injected into the analyzer, pg. mrs = Mass of recovery standard in the calibration standard injected into the analyzer, pg. msi = Mass of surrogate compound i in the calibration standard, pg. RRFi = Relative response factor. RRFrs = Recovery standard response factor. RRFs = Surrogate compound response factor.

9.2 Average Relative Response Factor.

$$RRF_i = \frac{1}{n} \sum_{j=1}^{n} \frac{A_{ci}\, m^*_{ci}}{A^*_{ci}\, m_{ci}} \qquad \text{Eq. 23-1}$$

9.3 Concentration of the PCDD's and PCDF's.

$$C_i = \frac{m_i^*\, A_i}{A_i^*\, RRF_i\, V_{mstd}} \qquad \text{Eq. 23-2}$$

9.4 Recovery Standard Response Factor.

$$RRF_{rs} = \frac{A_{ci}^* m_{rs}}{A_{rs}\, m_{ci}^*} \qquad \text{Eq. 23-3}$$

9.5 Recovery of Internal Standards (R*).

$$R^* = \frac{A_i^*\, m_{rs}}{A_{rs}\, RF_{rs}\, m_i^*} \times 100\% \qquad \text{Eq. 23-4}$$

9.6 Surrogate Compound Response Factor.

$$RRF_s = \frac{A_{ci}^*\, m_s}{A_{cis}\, m_{ci}^*} \qquad \text{Eq. 23-5}$$

9.7 Recovery of Surrogate Compounds (Rs).

$$R_s = \frac{A_s\, m_i^*}{A_i^*\, RRF_s\, m_s} \times 100\% \qquad \text{Eq. 23-6}$$

9.8 Minimum Detectable Limit (MDL).

$$MDL = \frac{2.5\, A_{ai}\, m_i^*}{A_{ci}^*\, RRF_i} \qquad \text{Eq. 23-7}$$

9.9 Total Concentration of PCDD's and PCDF's in the Sample.

$$C_T = \sum_{i=1}^{n} C_i \qquad \text{Eq. 23-8}$$

Any PCDD's or PCDF's that are reported as nondetected (below the MDL) shall be counted as zero for the purpose of calculating the total concentration of PCDD's and PCDF's in the sample.

10. Bibliography

1. American Society of Mechanical Engineers. Sampling for the Determination of Chlorinated Organic Compounds in Stack Emissions. Prepared for U.S. Department of Energy and U.S. Environmental Protection Agency. Washington DC. December 1984. 25 p.

2. American Society of Mechanical Engineers. Analytical Procedures to Assay Stack Effluent Samples and Residual Combustion Products for Polychlorinated Dibenzo-p-Dioxins (PCDD) and Polychlorinated Dibenzofurans (PCDF). Prepared for the U.S. Department of Energy and U.S. Environmental Protection Agency. Washington, DC. December 1984. 23 p.

3. Thompson, J. R. (ed.). Analysis of Pesticide Residues in Human and Environmental Samples. U.S. Environmental Protection Agency. Research Triangle Park, NC. 1974.

4. Triangle Laboratories. Case Study: Analysis of Samples for the Presence of Tetra Through Octachloro-p-Dibenzodioxins and Dibenzofurans. Research Triangle Park, NC. 1988. 26 p.

5. U.S. Environmental Protection Agency. Method 8290—The Analysis of Polychlorinated Dibenzo-p-dioxin and Polychlorinated Dibenzofurans by High-Resolution Gas Chromotography/High-Resolution Mass Spectrometry. In: Test Methods for Evaluating Solid Waste. Washington, DC. SW-846.

TABLE 1—COMPOSITION OF THE SAMPLE FORTIFICATION AND RECOVERY STANDARDS SOLUTIONS

Analyte	Concentration (pg/µl)
Internal Standards:	
$^{13}C_{12}$-2,3,7,8-TCDD	100
$^{13}C_{12}$-1,2,3,7,8-PeCDD	100
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	100
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	100
$^{13}C_{12}$-OCDD	100
$^{13}C_{12}$-2,3,7,8-TCDF	100
$^{13}C_{12}$-1,2,3,7,8-PeCDF	100
$^{13}C_{12}$-1,2,3,6,7,. HxCDF	100
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	100
Surrogate Standards	
$^{37}Cl_4$-2,3,7,8-TCDD	100
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	100
$^{13}C_{12}$-2,3,4,7,8-PeCDF	100
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	100
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	100
Recovery Standards	
$^{13}C_{12}$-1,2,3,4-TCDD	500
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD	500

TABLE 2—COMPOSITION OF THE INITIAL CALIBRATION SOLUTIONS

Compound	Concentrations (pg/µL)				
	Solution No.				
	1	2	3	4	5
Alternate Standard:					
$^{13}C_{12}$-1,2,3,7,8,9-HxCDF	2.5	5	25	250	500
Recovery Standards:					
$^{13}C_{12}$-1,2,3,4-TCDD	100	100	100	100	100
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD	100	100	100	100	100

TABLE 3—ELEMENTAL COMPOSITIONS AND EXACT MASSES OF THE IONS MONITORED BY HIGH RESOLUTION MASS SPECTROMETRY FOR PCDD'S AND PCDF'S

Descriptor No.	Accurate mass	Ion type	Elemental composition	Analyte
2	292.9825	LOCK	C_7F_{11}	PFK
	303.9016	M	$C_{12}H_4{}^{35}Cl_4O$	TCDF
	305.8987	M+2	$C_{12}H_4{}^{35}Cl_3{}^{37}ClO$	TCDF
	315.9419	M	$^{13}C_{12}H_4{}^{35}Cl_4O$	TCDF (S)
	317.9389	M+2	$^{13}C_{12}H_4{}^{35}Cl_3{}^{37}ClO$	TCDF (S)
	319.8965	M	$C_{12}H_4{}^{35}Cl_4O_2$	TCDD
	321.8936	M+2	$C_{12}H_4{}^{35}Cl_3{}^{37}ClO_2$	TCDD
	327.8847	M	$C_{12}H_4{}^{37}Cl_4O_2$	TCDD (S)
	330.9792	OC	C_7F_{13}	PFK
	331.9368	M	$^{13}C_{12}H_4{}^{35}Cl_4O_2$	TCDD (S)
	333.9339	M+2	$^{13}C_{12}H_4{}^{35}Cl_3{}^{37}ClO_2$	TCDD (S)
	339.8597	M+2	$C_{12}H_3{}^{35}Cl_4{}^{37}ClO$	PECDF
	341.8567	M+4	$C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O$	PeCDF
	351.9000	M+2	$^{13}C_{12}H_3{}^{35}Cl_4{}^{37}ClO$	PeCDF (S)
	353.8970	M+4	$^{13}C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O$	PeCDF (S)
	355.8546	M+2	$C_{12}H_3{}^{35}Cl_4\,37ClO_2$	PeCDD
	357.8516	M+4	$C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O_2$	PeCDD
	367.8949	M+2	$^{13}C_{12}H_3{}^{35}Cl_4{}^{37}ClO_2$	PeCDD (S)
	369.8919	M+4	$^{13}C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O_2$	PeCDD (S)
	375.8364	M+2	$C_{12}H_4{}^{35}Cl_5{}^{37}ClO$	HxCDPE
	409.7974	M+2	$C_{12}H_3{}^{35}Cl_6{}^{37}ClO$	HpCPDE
3	373.8208	M+2	$C_{12}H_2\,35Cl_5{}^{37}ClO$	HxCDF
	375.8178	M+4	$C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O$	HxCDF
	383.8639	M	$^{13}C_{12}H_2{}^{35}Cl_6O$	HxCDF (S)
	385.8610	M+2	$^{13}C_{12}H_2{}^{35}Cl_5{}^{37}ClO$	HxCDF (S)
	389.8157	M+2	$C_{12}H_2{}^{35}Cl_5{}^{37}ClO_2$	HxCDD
	391.8127	M+4	$C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O_2$	HxCDD
	392.9760	LOCK	C_9F_{15}	PFK
	401.8559	M+2	$^{13}C_{12}H_2{}^{35}Cl_5{}^{37}ClO_2$	HxCDD (S)
	403.8529	M+4	$^{13}C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O$	HxCDD (S)
	445.7555	M+4	$C_{12}H_2{}^{35}Cl_6{}^{37}Cl_2O$	OCDPE
	430.9729	OC	C_9F_{17}	PFK
4	407.7818	M+2	$C_{12}H{}^{35}Cl_6{}^{37}ClO$	HpCDF
	409.7789	M+4	$C_{12}H{}^{35}Cl_5{}^{37}Cl_2O$	HpCDF
	417.8253	M	$^{13}C_{12}H{}^{35}Cl_7O$	HpCDF (S)
	419.8220	M+2	$^{13}C_{12}H{}^{35}Cl_6{}^{37}ClO$	HpCDF (S)
	423.7766	M+2	$C_{12}H{}^{35}Cl_6{}^{37}ClO_2$	HpCDD
	425.7737	M+4	$C_{12}H{}^{35}Cl_5{}^{37}Cl_2O_2$	HpCDD
	435.8169	M+2	$^{13}C_{12}H{}^{35}Cl_6{}^{37}ClO_2$	HpCDD (S)
	437.8140	M+4	$^{13}C_{12}H{}^{35}Cl_5{}^{37}Cl_2O_2$	HpCDD (S)
	479.7165	M+4	$C_{12}H{}^{35}Cl_7{}^{37}Cl_2O$	NCPDE
	430.9729	LOCK	C_9F_{17}	PFK
	441.7428	M+2	$C_{12}{}^{35}Cl_7{}^{37}ClO$	OCDF
	443.7399	M+4	$C_{12}{}^{35}Cl_6{}^{37}Cl_2O$	OCDF
	457.7377	M+2	$C_{12}{}^{35}Cl_7{}^{37}ClO_2$	OCDD
	459.7348	M+4	$C_{12}{}^{35}Cl_6{}^{37}Cl_2O_2$	OCDD
	469.7779	M+2	$^{13}C_{12}{}^{35}Cl_7{}^{37}ClO_2$	OCDD (S)
	471.7750	M+4	$^{13}C_{12}{}^{35}Cl_6{}^{37}Cl_2O_2$	OCDD (S)
	513.6775	M+4	$C_{12}{}^{35}Cl_8{}^{37}Cl_2O_2$	DCDPE
	442.9728	OC	$C_{10}F_{17}$	PFK

(a) The following nuclidic masses were used
H = 1.007825
C = 12.000000
^{13}C = 13.003355
F = 18.9984
O = 15.994915
^{35}Cl = 34.968853
^{37}Cl = 36.965903
S = Labeled Standard
OC = Ion selected for monitoring instrument stability during the GC/MS analysis.

TABLE 5—MINIMUM REQUIREMENTS FOR INITIAL AND DAILY CALIBRATION RESPONS FACTORS

Compound	Relative response factors	
	Initial calibration RSD	Daily calibration % difference
Unlabeled Analytes:		
2,3,7,8-TCDD	25	25
2,3,7,8-TCDF	25	25
1,2,3,7,8-PeCDD	25	25
1,2,3,7,8-PeCDF	25	25
2,3,4,7,8-PeCDF	25	25
1,2,4,5,7,8-HxCDD	25	25
1,2,3,6,7,8-HxCDD	25	25
1,2,3,7,8,9-HxCDD	25	25
1,2,3,4,7,8-HxCDF	25	25
1,2,3,6,7,8-HxCDF	25	25
1,2,3,7,8,9-HxCDF	25	25
2,3,4,6,7,8-HxCDF	25	25
1,2,3,4,6,7,8-HpCDD	25	25
1,2,3,4,6,7,8-HpCDF	25	25
OCDD	25	25
OCDF	30	30
Internal Standards		
$^{13}C_{12}$-2,3,7,8-TCDD	25	25
$^{13}C_{12}$-1,2,3,7,8-PeCDD	30	30
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	25	25
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	30	30
$^{13}C_{12}$-OCDD	30	30
$^{13}C_{12}$-2,3,7,8-TCDF	30	30
$^{13}C_{12}$-1,2,3,7,8-PeCDF	30	30
$^{13}C_{12}$-1,2,3,6,7,8 HxCDF	30	30
$^{13}C_{12}$-1,2,3,4,6,7,8 HpCDF	30	30
Surrogate Standards:		
$^{37}Cl_4$-2,3,7,8-TCDD	25	25
$^{13}C_{12}$-2,3,4,7,8-PeCDF	25	25
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	25	25
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	25	25
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	25	25
Alternate Standard		
$^{13}C_{12}$-1,2,3,7,8,9-HxCDF	25	25

TABLE 4—ACCEPTABLE RANGES FOR ION-ABUNDANCE RATIOS OF PCDD'S AND PCDF'S

No of chlorine atoms	Ion type	Theoretical ratio	Control limits	
			Lower	Upper
4	M/M+2	0.77	0.65	0.89
5	M+2/M+4	1.55	1.32	1.78
6	M+2/M+4	1.24	1.05	1.43
6[a]	M/M+2	0.51	0.43	0.59
7[b]	M/M+2	0.44	0.37	0.51
7	M+2/M+4	1.04	0.88	1.20
8	M+2/M+4	0.89	0.76	1.02

[a] Used only for ^{13}C-HxCDF.
[b] Used only for ^{13}C-HpCDF.

Method 25A—Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer

|s60xA_Meth_25A

1. Applicability and Principle

1.1 Applicability. This method applies to the measurement of total gaseous organic concentration of vapors consisting primarily of alkanes, alkenes, and/or arenes (aromatic hydrocarbons). The concentration is expressed in terms of propane (or other appropriate organic calibration gas) or in terms of carbon.

1.2 Principle. A gas sample is extracted from the source through a heated sample line, if necessary, and glass fiber filter to a flame ionization analyzer (FIA). Results are reported as volume concentration equivalents of the calibration gas or as carbon equivalents.

2. Definitions

2.1 Measurement System. The total equipment required for the determination of the gas concentration. The system consists of the following major subsystems:

2.1.1 Sample Interface. That portion of the system that is used for one or more of the following: sample acquisition, sample transportation, sample conditioning, or protection of the analyzer from the effects of the stack effluent.

2.1.2 Organic Analyzer. That portion of the system that senses organic concentration and generates an output proportional to the gas concentration.

2.2 Span Value. The upper limit of a gas concentration measurement range that is specified for affected source categories in the applicable part of the regulations. The span value is established in the applicable regulation and is usually 1.5 to 2.5 times the applicable emission limit. If no span value is provided, use a span value equivalent to 1.5 to 2.5 times the expected concentration. For convenience, the span value should correspond to 100 percent of the recorder scale.

2.3 Calibration Gas. A known concentration of a gas in an appropriate diluent gas.

2.4 Zero Drift. The difference in the measurement system response to a zero level calibration gas before and after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

2.5 Calibration Drift. The difference in the measurement system response to a mid-level calibration gas before and after a stated period of operation during which no unscheduled maintenance, repair or adjustment took place.

2.6 Response Time. The time interval from a step change in pollutant concentration at the inlet to the emission measurement system to the time at which 95 percent of the corresponding final value is reached as displayed on the recorder.

2.7 Calibration Error. The difference between the gas concentration indicated by the measurement system and the known concentration of the calibration gas.

3. Apparatus

A schematic of an acceptable measurement system is shown in Figure 25A-1. The essential components of the measurement system are described below:

3.1 Organic Concentration Analyzer. A flame ionization analyzer (FIA) capable of meeting or exceeding the specifications in this method.

3.2 Sample Probe. Stainless steel, or equivalent, three-hole rake type. Sample holes shall be 4 mm in diameter or smaller and located at 16.7, 50, and 83.3 percent of the equivalent stack diameter. Alternatively, a single opening probe may be used so that a gas sample is collected from the centrally located 10 percent area of the stack cross-section.

3.3 Sample Line. Stainless steel or Teflon* tubing to transport the sample gas to the analyzer. The sample line should be heated, if necessary, to prevent condensation in the line.

3.4 Calibration Valve Assembly. A three—way valve assembly to direct the zero and calibration gases to the analyzers is recommended. Other methods, such as quick-connect lines, to route calibration gas to the analyzers are applicable.

3.5 Particulate Filter. An in-stack or an out—of—stack glass fiber filter is recommended if exhaust gas particulate loading is significant. An out—of—stack filter should be heated to prevent any condensation.

3.6 Recorder. A strip-chart recorder, analog computer, or digital recorder for recording measurement data. The minimum data recording requirement is one measurement value per minute. Note: This method is often applied in highly explosive areas. Caution and care should be exercised in choice of equipment and installation.

4. Calibration and Other Gases

Gases used for calibrations, fuel, and combustion air (if required) are contained in compressed gas cylinders. Preparation of calibration gases shall be done according to the procedure in Protocol No. 1, listed in Citation 2 of Bibliography. Additionally, the manufacturer of the cylinder should provide a recommended shelf life for each calibration gas cylinder over which the concentration does not change more than ± 2 percent from the certified value. For calibration gas values not generally available (i.e., organics between 1 and 10 percent by volume), alternative methods for preparing calibration gas mixtures, such as dilution systems, may be used with prior approval of the Administrator.

Calibration gases usually consist of propane in air or nitrogen and are determined in terms of the span value. Organic compounds other than propane can be used following the above guidelines and making the appropriate corrections for

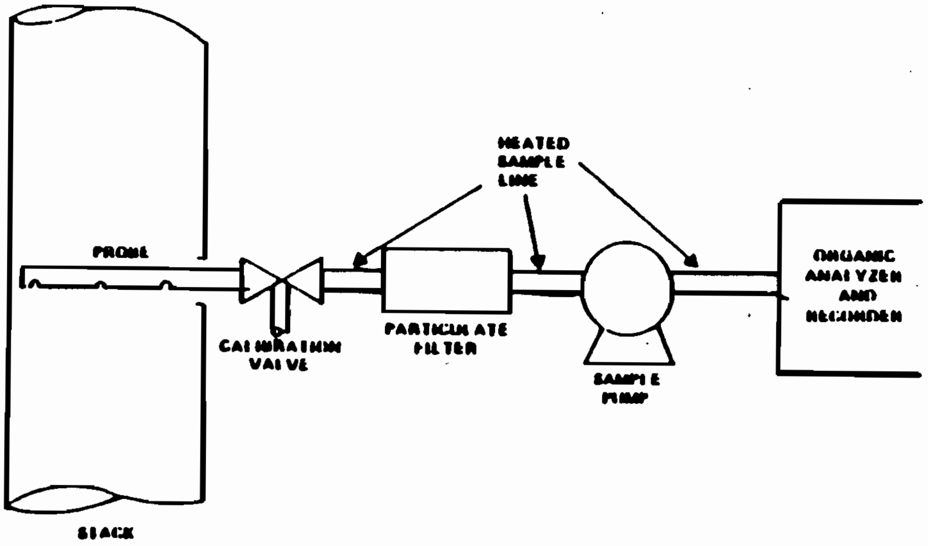


Figure 25A-1. Organic Concentration Measurement System.

|_{Footnote} * Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.

response factor.

4.1 Fuel. A 40 percent H2/60 percent He or 40 percent H2/60 percent N2 gas mixture is recommended to avoid an oxygen synergism effect that reportedly occurs when oxygen concentration varies significantly from a mean value.

4.2 Zero Gas. High purity air with less than 0.1 parts per million by volume (ppmv) of organic material (propane or carbon equivalent) or less than 0.1 percent of the span value, whichever is greater.

4.3 Low-level Calibration Gas. An organic calibration gas with a concentration equivalent to 25 to 35 percent of the applicable span value.

4.4 Mid-level Calibration Gas. An organic calibration gas with a concentration equivalent to 45 to 55 percent of the applicable span value.

4.5 High-level Calibration Gas. An organic calibration gas with a concentration equivalent to 80 to 90 percent of the applicable span value.

5. Measurement System Performance Specifications

5.1 Zero Drift. Less than ± 3 percent of the span value.

5.2 Calibration Drift. Less than ± 3 percent of span value.

5.3 Calibration Error. Less than ± 5 percent of the calibration gas value.

6. Pretest Preparations

6.1 Selection of Sampling Site. The location of the sampling site is generally specified by the applicable regulation or purpose of the test; i.e., exhaust stack, inlet line, etc. The sample port shall be located at least 1.5 meters or 2 equivalent diameters upstream of the gas discharge to the atmosphere.

6.2 Location of Sample Probe. Install the sample probe so that the probe is centrally located in the stack, pipe, or duct and is sealed tightly at the stack port connection.

6.3 Measurement System Preparation. Prior to the emission test, assemble the measurement system following the manufacturer's written instructions in preparing the sample interface and the organic analyzer. Make the system operable.

FIA equipment can be calibrated for almost any range of total organics concentrations. For high concentrations of organics (> 1.0 percent by volume as propane) modifications to most commonly available analyzers are necessary. One accepted method of equipment modification is to decrease the size of the sample to the analyzer through the use of a smaller diameter sample capillary. Direct and continuous measurement of organic concentration is a necessary consideration when determining any modification design.

6.4 Calibration Error Test. Immediately prior to the test series, (within 2 hours of the start of the test) introduce zero gas and high-level calibration gas at the calibration valve assembly. Adjust the analyzer output to the appropriate levels, if necessary. Calculate the predicted response for the low-level and mid-level gases based on a linear response line between the zero and high-level responses. Then introduce low-level and mid-level calibration gases successively to the measurement system. Record the analyzer responses for low-level and mid-level calibration gases and determine the differences between the measurement system responses and the predicted responses. These differences must be less than 5 percent of the respective calibration gas value. If not, the measurement system is not acceptable and must be replaced or repaired prior to testing. No adjustments to the measurement system shall be conducted after the calibration and before the drift check (Section 7.3). If adjustments are necessary before the completion of the test series, perform the drift checks prior to the required adjustments and repeat the calibration following the adjustments. If multiple electronic ranges are to be used, each additional range must be checked with a mid-level calibration gas to verify the multiplication factor.

6.5 Response Time Test. Introduce zero gas into the measurement system at the calibration valve assembly. When the system output has stabilized, switch quickly to the high-level calibration gas. Record the time from the concentration change to the measurement system response equivalent to 95 percent of the step change. Repeat the test three times and average the results.

7. Emission Measurement Test Procedure

7.1 Organic Measurement. Begin sampling at the start of the test period, recording time and any required process information as appropriate. In particular, note on the recording chart periods of process interruption or cyclic operation.

7.2 Drift Determination. Immediately following the completion of the test period and hourly during the test period, reintroduce the zero and mid-level calibration gases, one at a time, to the measurement system at the calibration valve assembly. (Make no adjustments to the measurement system until after both the zero and calibration drift checks are made.) Record the analyzer response. If the drift values exceed the specified limits, invalidate the test results preceding the check and repeat the test following corrections to the measurement system. Alternatively, recalibrate the test measurement system as in Section 6.4 and report the results using both sets of calibration data (i.e., data determined prior to the test period and data determined following the test period).

8. Organic Concentration Calculations

Determine the average organic concentration in terms of ppmv as propane or other calibration gas. The average shall be determined by the integration of the output recording over the period specified in the applicable regulation.

If results are required in terms of ppmv as carbon, adjust measured concentrations using Equation 25A-1.

$$C_c = K\, C_{meas} \qquad \text{Eq. 25A-1}$$

Where:

C_c = Organic concentration as carbon, ppmv.

C_{meas} = Organic concentration as measured, ppmv.

K = Carbon equivalent correction factor, K = 2 for ethane. K = 3 for propane. K = 4 for butane. K = Appropriate response factor for other organic calibration gases.

9. Bibliography

1. Measurement of Volatile Organic Compounds——Guideline Series. U.S. Environmental Protection Agency. Research Triangle Park, NC. Publication No. EPA-450/2-78-041. June 1978. p. 46-54.

2. Traceability Protocol for Establishing True Concentrations of Gases Used for Calibration and Audits of Continuous Source Emission Monitors (Protocol No. 1). U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory. Research Triangle Park, NC. June 1978.

3. Gasoline Vapor Emission Laboratory Evaluation——Part 2. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, NC. EMB Report No. 75-GAS-6. August 1975.

Method 26—Determination of Hydrogen Chloride Emissions From Stationary Sources

1. Applicability, Principle, Interferences, Precision, Bias, and Stability

1.1 Applicability. This method is applicable for determining hydrogen chloride (HCl) emissions from stationary sources.

1.2 Principle. An integrated sample is extracted from the stack and passed through dilute sulfuric acid. In the dilute acid, the HCl gas is dissolved and forms chloride (Cl-) ions. The Cl— is analyzed by ion chromatography (IC).

{**new-92-2 revised; Source: 57 FR 24551, June 10, 1992}

1.3 Interferences. Volatile materials which produce chloride ions upon dissolution during sampling are obvious interferences. Another likely interferent is diatomic chlorine (Cl2) gas which reacts to form HCl and hypochlorous acid (HOCl) upon dissolving in water. However, Cl2 gas exhibits a low solubility in water and the use of acidic, rather than neutral or basic collection solutions, greatly reduces the chance of dissolving any chlorine present.

{**new text ending}

1.4 Precision and Bias. The within-laboratory relative standard deviations are 6.2 and 3.2 percent at HCl concentrations of 3.9 and 15.3 ppm, respectively. The method does not exhibit a bias to Cl2 when sampling at concentrations less than 50 ppm.

1.5 Stability. The collected samples can be stored for up to 4 weeks before analysis.

1.6 Detection Limit. The analytical detection limit of the method is 0.1 µg/ml.

2. Apparatus

2.1 Sampling. The sampling train is shown in Figure 26-1, and component parts are discussed below.

{**new-92-2 revised; Source: 57 FR 24551, June 10, 1992}

2.1.1 Probe. Borsilicate glass, approximately 3/8—in. (9—mm) I.D. with a heating system to prevent moisture condensation. A Teflon-glass filter in a mat configuration shall be installed behind the probe to remove particulate matter from the gas stream (see section 2.1.5). A glass wool plug should not be used to remove particulate matter since a negative bias in the data could result.

2.1.2 Three-Way Stopcock. A borosilicate glass three—way stopcock with a heating system to prevent moisturecondensation. The heated stopcock should connect to the outlet of the heated filter and the inlet of the first impinger. The heating system shall be capable of preventing condensation up to the inlet of the first impinger. Silicone grease may be used, if necessary, to prevent leakage.

{**new text ending}

2.1.3 Impingers. Four 30—ml midget impingers with leak-free glass connectors. Silicone grease may be used, if necessary, to prevent leakage. For sampling at high

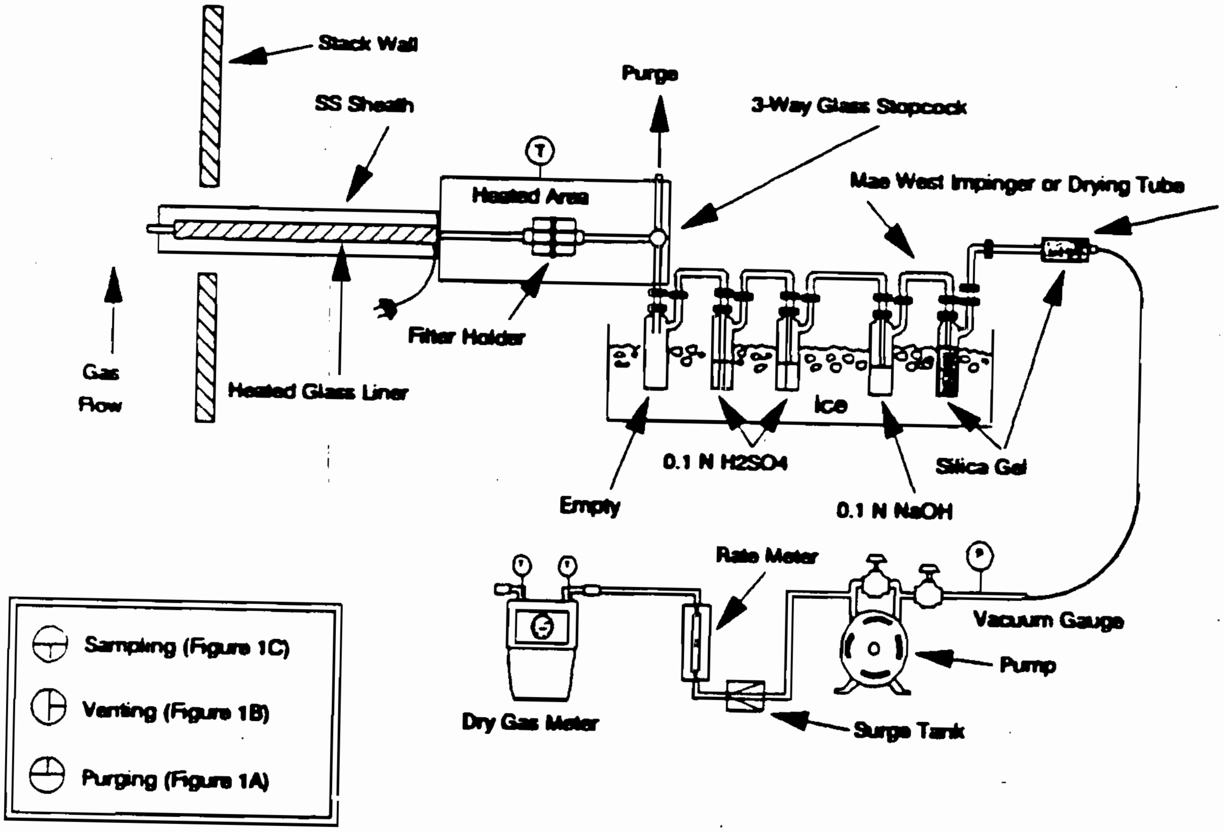


Figure 26-1. Sampling train.

moisture sources or for sampling times greater than 1 hour, a midget impinger with a shortened stem (such that the gas sample does not bubble through the collected condensate) should be used in front of the first impinger.

2.1.4 Drying Tube or Impinger. Tube or impinger, of Mae West design, filled with 6— to 16—mesh indicating type silica gel, or equivalent, to dry the gas sample and to protect the dry gas meter and pump. If the silica gel has been used previously, dry at 175 °C (350 °F) for 2 hours. New silica gel may be used as received. Alternatively, other types of desiccants (equivalent or better) may be used.

{**new-92-2 revised; Source: 57 FR 24551, June 10, 1992}

2.1.5 Filter. A 25—mm (or other size) Teflon-glass mat, Pallflex TX40HI75 (Pallflex Inc., 125 Kennedy Drive, Putnam, CT 06260). This filter is in a mat configuration to prevent fine particulate matter from entering the sampling train. Its composition is 75 percent Teflon/25 percent borosilicate glass. Other filters may be used, but they must be in a mat (as opposed to a laminate) configuration and contain at least 75 percent Teflon.

{**new text ending}

{**new-92-2 added: Source: 57 FR 24551, June 10, 1992}

2.1.6 Filter Holder and Support. The filter holder should be made of Teflon or quartz. The filter support shall be made of Teflon. All-Teflon filter holders and supports are available from Savillex Corp., 5325 Hwy 101, Minnetonka, MN 55345.

{**new text ending}

{**new-92-2 redesignated: Source: 57 FR 24551, June 10, 1992}

2.1.7 Sample Line. Leak-free, with compatible fittings to connect the last impinger to the needle valve.

2.1.8 Rate Meter. Rotameter, or equivalent, capable of measuring flow rate to within 2 percent of the selected flow rate of 2 liters/min

2.1.9 Purge Pump, Purge Line, Drying Tube, Needle Valve, and Rate Meter. Pump capable of purging the sampling probe at 2 liters/min, with drying tube, filled with silica gel or equivalent, to protect pump, and a rate meter capable of measuring 0 to 5 liters/min.

2.1.10 Stopcock Grease, Valve, Pump, Volume Meter, Barometer, and Vacuum Gauge. Same as in Method 6, Sections 2.1.4, 2.1.7, 2.1.8, 2.1.10, 2.1.11, and 2.1.12.

{**new text ending}

{**new-92-2 added: Source: 57 FR 24551, June 10, 1992}

2.1.11 Temperature Measuring Devices. Temperature measuring device to monitor the temperature of the probe and a thermometer or other temperature measuring device to monitor the temperature of the sampling system from the outlet of the probe to the inlet of the first impinger.

2.1.12 Ice Water Bath. To minimize loss of absorbing solution.

{**new text ending}

2.2 Sample Recovery.

2.2.1 Wash Bottles. Polyethylene or glass, 500—ml or larger, two.

{**new-92-2 revised; Source: 57 FR 24551, June 10, 1992}

2.2.2 Storage Bottles. 100—ml glass, with Teflon-lined lids, to store impinger samples (two per sampling run).

{**new text ending}

2.3 Sample Preparation and Analysis. The materials required for volumetric dilution and chromatographic analysis of samples are described below.

2.3.1 Volumetric Flasks. Class A, 100—ml size.

2.3.2 Volumetric Pipets. Class A, assortment. To dilute samples into the calibration range of the instrument.

{**new-92-2 revised; Source: 57 FR 24551, June 10, 1992}

2.3.3 Ion Chromatograph. Suppressed or nonsuppressed, with a conductivity detector and electronic integrator operating in the peak area mode. Other detectors, strip chart recorders, and peak height measurements may be used.

{**new text ending}

3. Reagents

Unless otherwise indicated, all reagents must conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society (ACS reagent grade). When such specifications are not available, the best available grade shall be used.

3.1. Sampling.

3.1.1 Water. Deionized, distilled water that conforms to ASTM Specification D 1193-77, Type 3.

3.1.2 Absorbing solution, 0.1 N Sulfuric Acid (H2SO4). To prepare 100 ml of the absorbing solution for the front impinger pair, slowly add 0.28 ml of concentrated H2SO4 to about 90 ml of water while stirring, and adjust the final volume to 100 ml using additional water. Shake well to mix the solution.

3.1.3. Chlorine Scrubber Solution, 0.1 N Sodium Hydroxide (NaOH). To prepare 100 ml of the scrubber solution for the back pair of impingers, dissolve 0.40 g of solid NaOH in about 90 ml of water, and adjust the final solution volume to 100 ml using additional water. Shake well to mix the solution.

3.2 Sample Preparation and Analysis.

3.2.1 Water. Same as in Section 3.1.1.

3.2.2 Blank Solution. A separate blank solution of the absorbing reagent should be prepared for analysis with the field samples. Dilute 30 ml of absorbing solution to 100 ml with water in a separate volumetric flask.

{**new-92-2 revised; Source: 57 FR 24551, June 10, 1992}

3.2.3 Sodium Chloride (NaCl) Stock Standard Solution. Solutions containing a nominal certified concentration of 1000 mg/l are commercially available as convenient stock solutions from which working standards can be made by appropriate volumetric dilution. Alternately, concentrated stock solutions may be produced from reagent grade NaCl. The NaCl should be dried at 110 °C for 2 or more hours and cooled to room temperature in a desiccator immediately before weighing. Accurately weigh 1.6 to 1.7 g of the dried NaCl to within 0.1 mg, dissolve in water, and dilute to 1 liter. The exact Cl concentration can be calculated using Eq. 26-1.

{**new text ending}

3.2.4 Chromatographic Eluent. Effective eluents for nonsuppressed IC using a resin— or silica-based weak ion exchange column are a 4 mM potassium hydrogen phthalate solution, adjusted to pH 4.0 using a saturated sodium borate solution, and a 4 mM 4-hydroxy benzoate solution, adjusted to pH 8.6 using 1 N NaOH. An effective eluent for suppressed ion chromatography is a solution containing 3 mM sodium bicarbonate and 2.4 mM sodium carbonate. Other dilute solutions buffered to a similar pH and containing no interfering ions may be used. When using suppressed ion chromatography, if the "water dip" resulting from sample injection interferes with the chloride peak, use a 2 mM NaOH/2.4 mM sodium bicarbonate eluent.

$$\mu g\ Cl^{-}/ml = g\ of\ NaCl \times 10^{3} \times 35.45/58.44$$

Eq. 26-1

Refrigerate the stock standard solution and store no longer than 1 month.

4. Procedure

4.1 Sampling.

4.1.1 Preparation of Collection Train. Prepare the sampling train as follows: Pour 15 ml of the aborbing solution into each of the first two impingers, and add 15 ml of scrubber solution to the third and fourth impingers. Connect the impingers in series with the knockout impinger first, followed by the two impingers containing absorbing solution and the two containing the scrubber solution. Place a fresh charge of silica gel, or equivalent, in the drying tube or Mae West impinger.

{**new-92-2 revised; Source: 57 FR 24551, June 10, 1992}

4.1.2 Adjust the probe temperature and the temperature of the filter and the stopcock, i.e., the heated area in Figure 26-1 to a temperature sufficient to prevent water condensation. This temperature should be at least 20° C above the source temperature, but not greater than 120° C. The temperature should be monitored throughout a sampling run to ensure that the desired temperature is maintained.

4.1.3 Leak-Check Procedure. A leak-check prior to the sampling run is optional; however, a leak-check after the sampling run is mandatory. The leak-check procedure is as follows: Temporarily attach a suitable (e.g., 0–40 cc/min) rotameter to the outlet of the dry gas meter and place a vacuum gauge at or near the probe inlet. Plug the probe inlet, pull a vacuum of at least 250 mm Hg (10 in. Hg), and note the flow rate as indicated by the rotameter. A leakage rate not in excess of 2 percent of the average sampling rate is acceptable. (NOTE: Carefully release the probe inlet plug before turning off the pump.) It is suggested (not mandatory) that the pump be leak-checked separately, either prior to or after the sampling run. If done prior to the sampling run, the pump leak-check shall precede the leak-check of the sampling train described immediately above; if done after the sampling run, the pump leak-check shall follow the train leak-check. To leak-check the pump, proceed as follows: Disconnect the drying tube from the probe-impinger assembly. Place a vacuum gauge at the inlet to either the drying tube or pump, pull a vacuum of 250 mm (10 in.) Hg, plug or pinch off the outlet of the flowmeter, and then turn off the pump. The vacuum should remain stable for at least 30 sec. Other leak-check procedures may be used, subject to the approval of the Administrator, U.S. Environmental Protection Agency.

{**new text ending}

4.1.4 Purge Procedure. Immediately before sampling, connect the purge line to the stopcock, and turn the stopcock to permit the purge pump to purge the probe (see Figure 1A of Figure 26-1). Turn on the purge pump, and adjust the purge rate to 2 liters/min. Purge for at least 5 minutes before sampling.

{**new-92-2 revised; Source: 57 FR 24551, June 10, 1992}

4.1.5 Sample Collection. Turn on the sampling pump, pull a slight vacuum of approximately 25 mm Hg (1 in. Hg) on the impinger train, and turn the stopcock to permit stack gas to be pulled through the impinger train (see Figure 1C of Figure 26-1). Adjust the sampling rate to 2 liters/min, as indicated by the rate meter, and maintain this rate to within 10 percent during the entire sampling run. Take readings of the dry gas meter volume and temperature, rate meter, and vacuum gauge at least once every 5 minutes during the run. A sampling time of 1 hour is recommended. Shorter sampling times may introduce a significant negative bias in the HCl concentration. At the conclusion of the sampling run, remove the train from the stack, cool, and perform a leak-check as described in section 4.1.2.

{**new text ending}

4.2 Sample Recovery. Disconnect the impingers after sampling. Quantitatively transfer the contents of the first three impingers (the knockout impinger and the two absorbing solution impingers) to a leak-free storage bottle. Add the water rinses of each of these impingers and connecting glassware to the storage bottle. The contents of the scrubber impingers and connecting glassware rinses may be discarded. The sample bottle should be sealed, shaken to mix, and labeled. The fluid level should be marked so that if any sample is lost during transport, a correction proportional to the lost volume can be applied.

4.3 Sample Preparation for Analysis. Check the liquid level in each sample, and determine if any sample was lost during shipment. If a noticeable amount of leakage has occurred, the volume lost can be determined from the difference between the initial and final solution levels, and this value can be used to correct the analytical results. Quantitatively transfer the sample solution to a 100—ml volumetric flask, and dilute the solution to 100 ml with water.

4.4 Sample Analysis.

{**new-92-2 revised; Source: 57 FR 24551, June 10, 1992}

{ 4.4.1 The IC conditions will depend upon analytical column type and whether suppressed or nonsuppressed IC is used. An example chromatogram from a nonsuppressed system using a 150—mm Hamilton PRP-X100 anion column, a 2 ml/min flow rate of 4 mM 4-hydroxy benzoate solution adjusted to a pH of 8.6 using 1 N NaOH, a 50-μl sample loop, and a conductivity detector set on 1.0 μS full scale is shown in Figure 26-2.

**new text ending}

4.4.2 Before sample analysis, establish a stable baseline. Next, inject a sample of water, and determine if any Cl^ appears in the chromatogram. If Cl^ is present, repeat the load/injection procedure until no Cl^ is present. At this point, the instrument is ready for use.

4.4.3 First, inject the calibration standards covering an appropriate concentration range, starting with the lowest concentration standard. Next, inject in duplicate, a QC sample followed by a water blank and the field samples. Finally, repeat the injection of calibration standards to allow compensation for any drift in the instrument during analysis of the field samples. Measure the Cl^ peak areas or heights of the samples. Use the average response from the duplicate injections to determine the field sample concentrations using a linear calibration curve generated from the standards.

4.5 Audit Analysis. An audit sample must be analyzed, subject to availability.

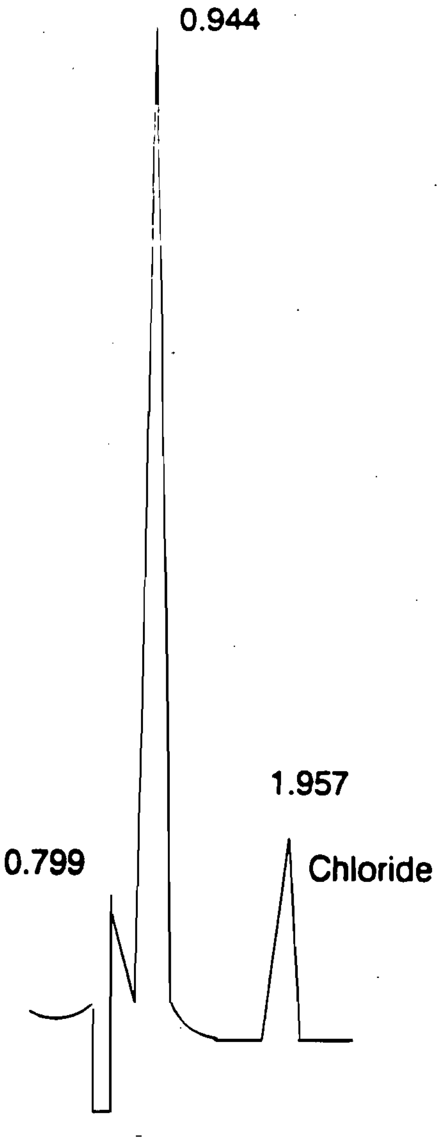


Figure 26-2. Example Chromatogram

5. Calibration

5.1 Dry Gas Metering System, Thermometers, Rate Meter, and Barometer. Same as in Method 6, sections 5.1, 5.2, 5.3, and 5.4.

5.2 Calibration Curve for Ion Chromatograph. To prepare calibration standards, dilute given volumes (1.0 ml or greater) of the stock standard solution, with 0.1 N H_2SO_4 (section 3.1.2) to convenient volumes. Prepare at least four standards that are within the linear range of the instrument and which cover the expected concentration range of the field samples. Analyze the standards as instructed in section 4.4.3, beginning with the lowest concentration standard. Determine the peak measurements, and plot individual values versus Cl^- concentration in µg/ml. Draw a smooth curve through the points. Use linear regression to calculate a formula describing the resulting linear curve.

6. Quality Assurance

6.1 Applicability. When the method is used to analyze samples to demonstrate compliance with a source emission regulation, a set of two audit samples must be analyzed.

6.2 Audit Procedure. The audit sample are chloride solutions. Concurrently analyze the two audit samples and a set of compliance samples in the same manner to evaluate the technique of the analyst and the standards preparation. The same analyst, analytical reagents, and analytical system shall be used both for compliance samples and the EPA audit samples. If this condition is met, auditing the subsequent compliance analyses for the same enforcement agency within 30 days is not required. An audit sample set may not be used to validate different sets of compliance samples under the jurisdiction of different enforcement agencies, unless prior arrangements are made with both enforcement agencies.

6.3 Audit Sample Availability. The audit samples may be obtained by writing or calling the EPA Regional Office or the appropriate enforcement agency. The request for the audit samples must be made at least 30 days prior to the scheduled compliance sample analyses.

{**new-92-2 revised; Source: 57 FR 24551, June 10, 1992}

6.4 Audit Results.

6.4.1 Calculate the concentrations in mg/dscm using the specified sample volume in the audit instructions.

Note: Indication of acceptable results may be obtained immediately by reporting the audit results in mg/dscm and compliance results in total µg HCl/sample to the responsible enforcement agency. Include the results of both audit samples, their identification numbers, and the analyst's name with the results of the compliance determination samples in appropriate reports to the EPA Regional Office or the appropriate enforcement agency. Include this information with subsequent analyses for the same enforcement agency during the 30—day period.

6.4.2 The concentrations of the audit samples obtained by the analyst shall agree within 10 percent of the actual concentrations. If the 10 percent specification is not met, reanalyze the compliance samples and audit samples, and include initial and reanalysis values in the test report.

6.4.3 Failure to meet the 10 percent specification may require retests until the audit problems are resolved. However, if the audit results do no affect the compliance or noncompliance status of the affected facility, the Administrator may waive the reanalysis requirement, further audits, or retests and accept the results of the compliance test. While steps are being taken to resolve audit analysis problems, the Administrator may also choose to use the data to determine the compliance or noncompliance status of the affected facility.

{**new text ending}

7. Calculations

Retain at least one extra decimal figure beyond those contained in the available data in intermediate calculations, and round off only the final answer appropriately.

7.1 Sample Volume, Dry Basis, Corrected to Standard Conditions. Calculate the sample volume using Eq. 6-1 of Method 6.

7.2 Total µg HCl Per Sample.

$$m = \frac{(S-B)(100)(36.46)}{(35.45)}$$

$$= (102.8)(S-B) \qquad \text{Eq. 26-2}$$

Where:

m = Mass of HCl in sample, µg.

S = Concentration of sample, µg Cl—/ml.

B = Concentration of blank, µg Cl—/ml.

100 = Volume of filtered and diluted sample, ml.

36.46 = Molecular weight of HCl, µg/µg—mole.

35.45 = Atomic weight of Cl, µg/µg—mole.

7.3 Concentration of HCl in the Flue Gas.

$$C = Km/V_{m(std)} \qquad \text{Eq. 26-3}$$

Where:

C = Concentration of HCl, dry basis, mg/dscm.

K = 10^-3 mg/ µg.

m = Mass of HCl in sample, µg.

Vm(std) = Dry gas volume measured by the dry gas meter, corrected to standard conditions, dscm.

8. Bibliography

{**new-92-2 revised; Source: 57 FR 24551, June 10, 1992}

1. Steinsberger, S.C. and J.H. Margeson, "Laboratory and Field Evaluation of a Methodology for Determination of Hydrogen Chloride Emissions form Municipal and Hazardous Waste Incinerators." U.S. Environmental Protection Agency, Office of Research and Develpment, Report No. 600/3-89/064, April 1989. Available from the National Technical Information Service, Springfield, VA 22161 as PB89220586/AS.

{**new text ending}

2. State of California, Air Resources Board. Method 421. "Determination of Hydrochloric Acid Emissions from Stationary Sources." March 18, 1987.

{**new-92-2 revised; Source: 57 FR 24551, June 10, 1992}

3. Cheney, J.L. and C.R. Fortune. Improvements in the Methodology for Measuring Hydrochloric Acid in Combustion Source Emissions. J. Environ. Sci. Health. A19(3): 337-350. 1984.

{**new text ending}

It is proposed that 40 CFR Parts 60 and 61 be amended as follows:

1. The authority citations for Parts 60 and 61 continue to read as follows:

42 U.S.C. 7401, 7411, 7412, 7414, 7416, and 7601.

2. In Part 60, by adding Method 29 to Appendix A as follows:

Appendix A - Test Methods

* * * * *

Method 29 - Determination of Metals Emissions from Stationary Sources

1. Applicability and Principle

1.1 Applicability. This method is applicable to the determination of total chromium (Cr), cadmium (Cd), arsenic (As), nickel (Ni), manganese (Mn), beryllium (Be), copper (Cu), zinc (Zn), lead (Pb), selenium (Se), phosphorus (P), thallium (Tl), silver (Ag), antimony (Sb), barium (Ba), and mercury (Hg) emissions from stationary sources This method may also be used for determining particulate emissions when the prescribed procedures and precautions are followed. Changes in the procedures to further facilitate particulate determination may affect the front-half mercury determination.

1.2 Principle. A stack sample is withdrawn isokinetically from the source, with particulate emissions collected in the probe and on a heated filter and gaseous emissions collected in solutions of acidic hydrogen peroxide and acidic potassium permanganate. The recovered samples are digested, and appropriate fractions are analyzed for mercury by cold vapor atomic absorption spectroscopy (CVAAS) and for Cr, Cd, Ni, Mn, Be, Cu, Zn, Pb, Se, P, Tl, Ag, Sb, Ba, and As by inductively coupled argon plasma emission spectroscopy (ICAP) or atomic absorption spectroscopy (AAS). Graphite furnace atomic absorption spectroscopy (GFAAS) is used for analysis of Sb, As, Dc, Pb, Se, and Tl if these elements require greater analytical sensitivity than can be obtained by ICAP. Additionally, if desired, the tester may use AAS for analysis of all metals if the resulting in-stack method detection limits meet the goal of the testing program.

2. Range, Sensitivity, Precision, and Interferences

2.1 Range. For the analysis described and for similar analyses, the ICAP response is linear over several orders of magnitude. Samples containing metal concentrations in the nanograms per ml (ng/ml) to micrograms per ml (μg/ml) range in the final analytical solution can be analyzed using this method. Samples containing greater than approximately 50 μg/ml Cr, Pb, or As should be diluted to that level or lower for final analysis. Samples containing greater than approximately 20 μg/ml of Cd should be diluted to that level before analysis.

2.2 Analytical Sensitivity. ICAP analytical detection limits for the sample solutions (based on <u>SW-846</u>, Method 6010) are approximately as follows: Sb (32 ng/ml), As (53 ng/ml), Ba (2 ng/ml), Be (0.3 ng/ml), Cd (4 ng/ml), Cr (7 ng/ml), Cu (6 ng/ml), Pb (42 ng/ml), Mn (2 ng/ml), Ni (15 ng/ml), P (75 ng/ml), Se (75 ng/ml), Ag (7 ng/ml), Tl (40 ng/ml), and Zn (2 ng/ml). The actual method detection limits are sample dependent and may vary as the sample matrix may affect the limits. The analytical detection limits for analysis by direct aspiration AAS (based on SW-846, Method 7000 series) are approximately as follows: Sb (200 ng/ml), As (2 ng/ml), Ba (100 ng/ml), Be (5 ng/ml), Cd (5 ng/ml), Cr (50 ng/ml), Cu (20 ng/ml), Pb (100 ng/ml), Mn (10 ng/ml), Ni (40 ng/ml), Se (2 ng/ml), Ag (10 ng/ml), Tl (100 ng/ml), and Zn (5 ng/ml). The detection limit for mercury by CVAAS is approximately 0.2 ng/ml. The use of GFAAS can give added sensitivity compared to direct aspiration AAS for the following metals: Sb (3 ng/ml), As (1 ng/ml), Be (0.2 ng/ml), Cd (0.1 ng/ml), Cr (1 ng/ml), Pb (1 ng/ml), Se (2 ng/ml), and Tl (1 ng/ml).

2.3 In-stack Detection Limit.

2.3.1 Using (1) the procedures described in this method, (2) the analytical detection limits described in the previous paragraph, (3) a volume of 300 ml (Fraction 1) for the front-half and 150 ml (Fraction 2A) for the back-half samples, and (4) a stack gas sample volume of 1.25 m^3, the corresponding in-stack method detection limits are presented in Table 29-1 and calculated using Eq. 29-1.

$$A \times B/C = D \qquad \text{Eq. 29-1}$$

where:

A = Analytical detection limit, $\mu g/ml$.

B = Volume of sample prior to aliquotting for analysis, ml.

C = Stack sample volume, dsm^3.

D = In-stack detection limit, $\mu g/m^3$.

Values in Table 29-1 are calculated for the front- and back-half and/or the total train.

2.3.2 To ensure optimum sensitivity in the measurements, the concentrations of target metals in the solutions are suggested to be at least ten times the analytical detection limits. Under certain conditions, and with greater care in the analytical procedure, this concentration can be as low as approximately three times the analytical detection limit. In all cases, on at least one sample (run) in the source test and for each metal analyzed, repetitive analyses, method of standard additions (MSA), serial dilution, or matrix spike addition, etc., shall be used to establish the quality of the data.

2.3.3 Actual in-stack method detection limits will be determined based on actual source sampling parameters and analytical results as described above. If required, the method in-stack detection limits can be made more sensitive than those shown in Table 29-1 for a specific test by using one or more of the following options:

2.3.4 A 1-hour sampling run may collect a stack gas sampling volume of about 1.25 m^3. If the sampling time is increased and 5 m^3 are collected, the in-stack method detection limits would be one fourth the values shown in Table 29-1 (with this change, the method is four times more sensitive than a 1-hour run. Larger sample volumes (longer runs) would make it even more sensitive.

2.3.5 The in-stack detection limits assume that all of the sample is digested (except the aliquot for mercury) and the final liquid volumes for analysis are 300 ml (Fraction 1) for the front-half and 150 ml (Fraction 2A) for the back-half sample. If the front-half volume is reduced from 300 to 30 ml, the front-half in-stack detection limits would be one tenth the values shown above (ten times more sensitive). If the back-half volume is reduced from 150 to 25 ml, the in-stack detection limits would be one sixth the above values. Matrix effect checks are necessary on sample analyses and typically are of greater significance for samples that have been concentrated to less than the normal original sample volume. Reduction to a volume of less than 25 ml may not allow redissolving of the residue and may increase interference by other compounds.

2.3.6 When both of the above modifications are used simultaneously on one sample, the resultant improvements are multiplicative. For example, where stack gas volume is increased by a factor of five and the total liquid sample digested volume of both the front- and back-halves is reduced by a factor of six, the in-stack method detection limit is reduced by a factor of thirty (the method is thirty times more sensitive). Conversely, reducing stack sample volume and increasing sample liquid volume will increase in-stack detection limits (the method would then be less sensitive). The front-half and back-half samples (Fractions 1A and 2A) can be combined proportionally (see Section 1.2) prior to analysis. The resultant liquid volume (excluding the mercury fractions, which must be analyzed separately) is recorded. Combining the sample in this manner does not allow the point of capture in the train to be determined. The in-stack method detection limit then becomes a single value for all metals except mercury (due to exclusion of the mercury fraction). This discussion assumes no blank correction. Blank corrections are discussed later in this method.

2.4 Precision. The precision (relative standard deviation) for each metal detected in a method development test at a sewage sludge incinerator are as follows: Sb (12.7 percent), As (13.5 percent), Ba (20.6 percent), Cd (11.5 percent), Cr (11.2 percent), Cu (11.5 percent), Pb (11.6 percent), P (14.6 percent), Se (15.3 percent), Tl (12.3 percent), and Zn (11.8 percent). The precision for Ni was 7.7 percent for another test conducted at a source simulator. Beryllium, Mn, and Ag were not detected in the tests; however, based on the analytical sensitivity of the ICAP for these metals, it is assumed that their precisions should be similar to those for the other metals when detected at similar levels.

2.5 Interferences. Iron can be a spectral interference during the analysis of As, Cr, and Cd by ICAP. Al can be a spectral interference during the analysis of As and Pb by ICAP. Generally, these interferences can be reduced by diluting the sample, but this increases the method detection limit (in-stack detection limit). Refer to Method 6010 of Citation 1 of the Bibliography or the other analytical methods used for details on potential interferences to this method. The analyst must eliminate or reduce interferences to acceptable levels. For all GFAAS analyses, matrix modifiers should be used to limit interferences, and standards should be matrix matched.

3. Apparatus

3.1 Sampling Train. A schematic of the sampling train is shown in Figure 29-1. It is similar to the Method 5 train and consists of the following components.

3.1.1 Probe Nozzle (Probe Tip) and Borosilicate or Quartz Glass Probe Liner. Same as Method 5, Sections 2.1.1 and 2.1.2, except that glass nozzles are required unless alternate tips are constructed of materials that are free from contamination and will not interfere with the sample. If a probe tip other than glass is used, no correction to the sample test results may be made to compensate for its effect on the sample. Probe fittings of plastic such as Teflon, polypropylene, etc. are recommended over metal fittings to prevent contamination; further, if desired, a single glass piece consisting of a combined probe tip and probe liner may be used, but such a single glass piece is <u>not</u> a requirement of this methodology)

3.1.2 Pitot Tube and Differential Pressure Gauge. Same as Method 2, Sections 2.1 and 2.2, respectively.

3.1.3 Filter Holder. Glass, same as Method 5, Section 2.1.5, except a Teflon filter support or other non-metallic, non-contaminating support must be used in place of the glass frit.

3.1.4 Filter Heating System. Same as Method 5, Section 2.1.6.

3.1.5 Condenser. The following system shall be used for condensing and collecting gaseous metals and determining the moisture content of the stack gas. The condensing system should consist of four to seven impingers connected in series with leak-free ground glass fittings or other leak-free, non-contaminating fittings. The first impinger is optional and is recommended as a moisture trap. The second impinger (or the first HNO_3/H_2O_2 impinger) shall be as described for the first impinger in Method 5. The third impinger (or second HNO_3/H_2O_2 impinger) shall be the Greenburg Smith impinger with the standard tip described as the second impinger in Method 5, Section 2.1.7. All other impingers are the same as the first HNO_3/H_2O_2 impinger previously described. A thermometer capable of measuring to within $1^{\circ}C$ ($2^{\circ}F$) shall be placed at the outlet of the last impinger. If mercury analysis is not to be performed, the potassium permanganate impingers and the empty impinger preceding them are removed.

3.1.6 Metering System, Barometer, and Gas Density Determination Equipment. Same as Method 5, Sections 2.1.8 through 2.1.10, respectively.

3.1.7 Teflon Tape. For capping openings and sealing connections, if necessary, on the sampling train.

3.2 Sample Recovery. Same as Method 5, Sections 2.2.1 through 2.2.8 (Probe-Liner and Probe-Nozzle Brushes or Swabs, Wash Bottles, Sample Storage Containers, Petri Dishes, Glass Graduated Cylinder, Plastic Storage Containers, Funnel and Rubber Policeman, and Glass Funnel), respectively, with the following exceptions and additions:

3.2.1 Non-metallic Probe-Liner and Probe-Nozzle Brushes or Swabs. For quantitative recovery of materials collected in the front-half of the sampling train. A description of acceptable all-Teflon component brushes or swabs are to be included in EPA's Emission Measurement Technical Information Center (EMTIC) files.

3.2.2 Sample Storage Containers. Glass bottles with Teflon-lined caps which are non-reactive to the oxidizing solutions, with capacities of 1000- and 500-ml shall be used for $KMnO_4$-containing samples and blanks. Polyethylene bottles may be used for other sample types.

3.2.3 Graduated Cylinder. Glass or equivalent.

3.2.4 Funnel. Glass or equivalent.

3.2.5 Labels. For identifying samples.

3.2.6 Polypropylene Tweezers and/or Plastic Gloves. For recovery of the filter from the sampling train filter holder.

3.3 Sample Preparation and Analysis. For the analysis, the following equipment is needed:

3.3.1 Volumetric Flasks, 100-ml, 250-ml, and 1000-ml. For preparation of standards and sample dilutions.

3.3.2 Graduated Cylinders. For preparation of reagents.

3.3.3 Parr^R Bombs or Microwave Pressure Relief Vessels with Capping Station (CEM Corporation model or equivalent).

3.3.4 Beakers and Watch Glasses. 250-ml beakers for sample digestion with watch glasses to cover the tops.

3.3.5 Ring Stands and Clamps. For securing equipment such as filtration apparatus.

3.3.6 Filter Funnels. For holding filter paper.

3.3.7 Disposable Pasteur Pipets and Bulbs.

3.3.8 Volumetric Pipets.

3.3.9 Analytical Balance. Accurate to within 0.1 mg.

3.3.10 Microwave or Conventional Oven. For heating samples at fixed power levels or temperatures.

3.3.11 Hot Plates.

3.3.12 Atomic Absorption Spectrometer (AAS). Equipped with a background corrector.

3.3.12.1 Graphite Furnace Attachment. With Sb, As, Cd, Pb, Se, and Tl hollow cathode lamps (HCLs) or electrodeless discharge lamps (EDLs). Same as Bibliography Citation 1 Methods 7041 (Sb), 7060 (As), 7131 (Cd), 7421 (Pb), 7740 (Se), and 7841 (Tl).

3.3.12.2 Cold Vapor Mercury Attachment. With a mercury HCL or EDL. The equipment needed for the cold vapor mercury attachment includes an air recirculation pump, a quartz cell, an aerator apparatus, and a heat lamp or desiccator tube. The heat lamp should be capable of raising the ambient temperature at the quartz cell by 10°C such that no condensation forms on the wall of the quartz cell. Same as Method 7470 in Citation 2 of the Bibliography.

3.3.13 Inductively Coupled Argon Plasma Spectrometer. With either a direct or sequential reader and an alumina torch. Same as EPA Method 6010 in Citation 1 of the Bibliography.

4. Reagents

4.1 Unless otherwise indicated, it is intended that all reagents conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available; otherwise, use the best available grade.

4.2 Sampling. The reagents used in sampling are as follows:

4.2.1 Filters. The filters shall contain less than 1.3 $\mu g/in.^2$ of each of the metals to be measured. Analytical results provided by filter manufacturers are acceptable. However, if no such results are available, filter blanks must be analyzed for each target metal prior to emission testing. Quartz or glass fiber filters without organic binders shall be used. The filters should exhibit at least 99.95 percent efficiency (<0.05 percent penetration) on 0.3-μ dioctyl phthalate smoke particles. The filter efficiency test shall be conducted in accordance with ASTM Standard Method D2986-71 (incorporated by reference). For particulate determination in sources containing sulfur dioxide (SO_2) or sulfur trioxide (SO_3), the filter material must be of a type that is unreactive to SO_2 or SO_3, as described in Method 5. Quartz fiber filters meeting these requirements are recommended.

4.2.2 Water. To conform to ASTM Specification D1193-77, Type II (incorporated by reference). If necessary, analyze the water for all target metals prior to field use. All target metals should be less than 1 ng/ml.

4.2.3 Nitric Acid. Concentrated. Baker Instra-analyzed or equivalent.

4.2.4 Hydrochloric Acid. Concentrated. Baker Instra-analyzed or equivalent.

4.2.5 Hydrogen Peroxide, 30 Percent (V/V).

4.2.6 Potassium Permanganate.

4.2.7 Sulfuric Acid. Concentrated.

4.2.8 Silica Gel and Crushed Ice. Same as Method 5, Sections 3.1.2 and 3.1.4, respectively.

4.3 Pretest Preparation of Sampling Reagents.

4.3.1 Nitric Acid (HNO_3)/Hydrogen Peroxide (H_2O_2) Absorbing Solution, 5 Percent HNO_3/10 Percent H_2O_2. Add carefully with stirring 50 ml of concentrated HNO_3 to a 1000-ml volumetric flask containing approximately 500 ml of water, and then add carefully with stirring 333 ml of 30 percent H_2O_2. Dilute to volume with water. Mix well. The reagent shall contain less than 2 ng/ml of each target metal.

4.3.2 Acidic Potassium Permanganate ($KMnO_4$) Absorbing Solution, 4 Percent $KMnO_4$ (W/V), 10 Percent H_2SO_4 (V/V). Prepare fresh daily. Mix carefully, with stirring, 100 ml of concentrated H_2SO_4 into approximately 800 ml of water, and add water with stirring to make a volume of 1 liter: this solution is 10 percent H_2SO_4 (V/V). Dissolve, with stirring, 40 g of $KMnO_4$ into 10 percent H_2SO_4 (V/V) and add 10 percent H_2SO_4 (V/V) with stirring to make a volume of 1 liter: this is the acidic potassium permanganate absorbing solution. Prepare and store in glass bottles to prevent degradation. The reagent shall contain less than 2 ng/ml of Hg.

Precaution: To prevent autocatalytic decomposition of the permanganate solution, filter the solution through Whatman 541 filter paper. Also, due to the potential reaction of the potassium permanganate with the acid, there may be pressure buildup in the sample storage bottle; these bottles shall not be fully filled and shall be vented to relieve excess pressure and prevent explosion potentials. Venting is required, but should not allow contamination of the sample; a No. 70-72 hole drilled in the container cap and Teflon liner has been used.

4.3.3 Nitric Acid, 0.1 N. Add with stirring 6.3 ml of concentrated HNO_3 (70 percent) to a flask containing approximately 900 ml of water. Dilute to 1000 ml with water.

Mix well. The reagent shall contain less than 2 ng/ml of each target metal.

4.3.4 Hydrochloric Acid (HCl), 8 N. Make the desired volume of 8N HCl in the following proportions. Carefully add with stirring 690 ml of concentrated HCl to a flask containing 250 ml of water. Dilute to 1000 ml with water. Mix well. The reagent shall contain less than 2 ng/ml of Hg.

4.4 Glassware Cleaning Reagents.

4.4.1 Nitric Acid, Concentrated. Fisher ACS grade or equivalent.

4.4.2 Water. To conform to ASTM Specifications D1193-77, Type II.

4.4.3 Nitric Acid, 10 Percent (V/V). Add with stirring 500 ml of concentrated HNO_3 to a flask containing approximately 4000 ml of water. Dilute to 5000 ml with water. Mix well. Reagent shall contain less than 2 ng/ml of each target metal.

4.5 Sample Digestion and Analysis Reagents.

4.5.1 Hydrochloric Acid, Concentrated.

4.5.2 Hydrofluoric Acid, Concentrated.

4.5.3 Nitric Acid, Concentrated. Baker Instra-analyzed or equivalent.

4.5.4 Nitric Acid, 50 Percent (V/V). Add with stirring 125 ml of concentrated HNO_3 to 100 ml of water. Dilute to 250 ml with water. Mix well. Reagent shall contain less than 2 ng/ml of each target metal.

4.5.5 Nitric Acid, 5 Percent (V/V). Add with stirring 50 ml of concentrated HNO_3 to 800 ml of water. Dilute to 1000 ml with water. Mix well. Reagent shall contain less than 2 ng/ml of each target metal.

4.5.6 Water. To conform to ASTM Specifications D1193-77, Type II.

4.5.7 Hydroxylamine Hydrochloride and Sodium Chloride Solution. See Citation 2 of the Bibliography for preparation.

4.5.8 Stannous Chloride. See Citation 2 of the Bibliography for preparation.

4.5.9 Potassium Permanganate, 5 Percent (W/V). See Citation 2 of the Bibliography for preparation.

4.5.10 Sulfuric Acid, Concentrated.

4.5.11 Nitric Acid, 50 Percent (V/V).

4.5.12 Potassium Persulfate, 5 Percent (W/V). See Citation 2 of the Bibliography for preparation.

4.5.13 Nickel Nitrate, $Ni(NO_3)_2 \cdot 6H_2O$.

4.5.14 Lanthanum Oxide, La_2O_3.

4.5.15 Hg Standard (AAS Grade), 1000 µg/ml.

4.5.16 Pb Standard (AAS Grade), 1000 µg/ml.

4.5.17 As Standard (AAS Grade), 1000 µg/ml.

4.5.18 Cd Standard (AAS Grade), 1000 µg/ml.

4.5.19 Cr Standard (AAS Grade), 1000 µg/ml.

4.5.20 Sb Standard (AAS Grade), 1000 µg/ml.

4.5.21 Ba Standard (AAS Grade), 1000 µg/ml.

4.5.22 Be Standard (AAS Grade), 1000 µg/ml.

4.5.23 Cu Standard (AAS Grade), 1000 μg/ml.

4.5.24 Mn Standard (AAS Grade), 1000 μg/ml.

4.5.25 Ni Standard (AAS Grade), 1000 μg/ml.

4.5.26 P Standard (AAS Grade), 1000 μg/ml.

4.5.27 Se Standard (AAS Grade), 1000 μg/ml.

4.5.28 Ag Standard (AAS Grade), 1000 μg/ml.

4.5.29 Tl Standard (AAS Grade), 1000 μg/ml.

4.5.30 Zn Standard (AAS Grade), 1000 μg/ml.

4.5.31 Al Standard (AAS Grade), 1000 μg/ml.

4.5.32 Fe Standard (AAS Grade), 1000 μg/ml.

4.5.33 The metals standards may also be made from solid chemicals as described in Citation 3 of the Bibliography. Citations 1, 2, or 4 of the Bibliography should be referred to for additional information on mercury standards.

4.5.34 Mercury Standards and Quality Control Samples. Prepare fresh weekly a 10 μg/ml intermediate mercury standard by adding 5 ml of 1000 μg/ml mercury stock solution to a 500-ml volumetric flask; dilute with stirring to 500 ml by first carefully adding 20 ml of 15 percent HNO_3 and then adding water to the 500-ml volume. Mix well. Prepare a 200 ng/ml working mercury standard solution fresh daily: add 5 ml of the 10 μg/ml intermediate standard to a 250-ml volumetric flask, and dilute to 250 ml with 5 ml of 4 percent $KMnO_4$, 5 ml of 15 percent HNO_3, and then water. Mix well. At least six separate aliquots of the working mercury standard solution should be used to prepare the standard curve. These aliquots should contain 0.0, 1.0, 2.0, 3.0, 4.0, and 5.0 ml of the working standard solution containing 0, 200, 400, 600, 800, and 1000 ng mercury, respectively. Quality control samples should be prepared by making a separate 10 µg/ml standard and diluting until in the range of the calibration.

4.5.35 ICAP Standards and Quality Control Samples. Calibration standards for ICAP analysis can be combined into four different mixed standard solutions as shown below.

MIXED STANDARD SOLUTIONS FOR ICAP ANALYSIS

Solution	Elements
I	As, Be, Cd, Mn, Pb, Se, Zn
II	Ba, Cu, Fe
III	Al, Cr, Ni
IV	Ag, P, Sb, Tl

Prepare these standards by combining and diluting the appropriate volumes of the 1000 µg/ml solutions with 5 percent HNO_3. A minimum of one standard and a blank can be used to form each calibration curve. However, a separate quality control sample spiked with known amounts of the target metals in quantities in the mid-range of the calibration curve should be prepared. Suggested standard levels are 25 µg/ml for AL, Cr and Pb, 15 µg/ml for Fe, and 10 µg/ml for the remaining elements. Prepare any standards containing less than 1 µg/ml of metal on a daily basis. Standards containing greater than 1 µg/ml of metal should be stable for a minimum of 1 to 2 weeks.

4.5.36 Graphite Furnace AAS Standards. Sb, As, Cd, Pb, Se, and Tl. Prepare a 10 µg/ml standard by adding 1 ml of 1000 µg/ml standard to a 100-ml volumetric flask. Dilute with stirring to

100 ml with 10 percent HNO_3. For graphite furnace AAS, the standards must be matrix matched. Prepare a 100 ng/ml standard by adding 1 ml of the 10 µg/ml standard to a 100-ml volumetric flask, and dilute to 100 ml with the appropriate matrix solution. Other standards should be prepared by diluting the 100 ng/ml standards. At least five standards should be used to make up the standard curve. Suggested levels are 0, 10, 50, 75, and 100 ng/ml. Quality control samples should be prepared by making a separate 10 µg/ml standard and diluting until it is in the range of the samples. Any standards containing less than 1 µg/ml of metal should be prepared on a daily basis. Standards containing greater than 1 µg/ml of metal should be stable for a minimum of 1 to 2 weeks.

4.5.37 Matrix Modifiers.

4.5.37.1 Nickel Nitrate, 1 Percent (V/V). Dissolve 4.956 g of $Ni(NO_3)_2 \cdot 6H_2O$ in approximately 50 ml of water in a 100-ml volumetric flask. Dilute to 100 ml with water.

4.5.37.2 Nickel Nitrate, 0.1 Percent (V/V). Dilute 10 ml of the 1 percent nickel nitrate solution from Section 4.5.37.1 above to 100 ml with water. Inject an equal amount of sample and this modifier into the graphite furnace during AAS analysis for As.

4.5.37.3 Lanthanum. Carefully dissolve 0.5864 g of La_2O_3 in 10 ml of concentrated HNO_3, and dilute the solution by adding it with stirring to approximately 50 ml of water. Dilute to 100 ml with water, and mix well. Inject an equal amount of sample and this modifier into the graphite furnace during AAS analysis for Pb.

4.5.38 Whatman 541 Filter Paper (or equivalent). For filtration of digested samples.

5. Procedure

5.1 Sampling. The complexity of this method is such that, to obtain reliable results, testers and analysts should be trained and experienced with the test procedures, including source sampling, reagent preparation and handling, sample handling, safety equipment, analytical calculations, reporting, and specific descriptions throughout this method.

5.1.1 Pretest Preparation. Follow the same general procedure given in Method 5, Section 4.1.1, except that, unless particulate emissions are to be determined, the filter need not be desiccated or weighed. All sampling train glassware should first be rinsed with hot tap water and then washed in hot soapy water. Next, glassware should be rinsed three times with tap water, followed by three additional rinses with water. All glassware should then be soaked in a 10 percent (V/V) nitric acid solution for a minimum of 4 hours, rinsed three times with water, rinsed a final time with acetone, and allowed to air dry. All glassware openings where contamination can occur should be covered until the sampling train is assembled for sampling.

5.1.2 Preliminary Determinations. Same as Method 5, Section 4.1.2.

5.1.3 Preparation of Sampling Train.

5.1.3.1 Follow the same general procedures given in Method 5, Section 4.1.3, except place 100 ml of the HNO_3/H_2O_2 solution (Section 4.2.1) in each of the two impingers as shown in Figure 29-1 (normally the second and third impingers). Place 100 ml of the acidic $KMnO_4$ absorbing solution (Section 4.2.2) in each of the two impingers as shown in Figure 29-1, and transfer approximately 200 to 300 g of preweighed silica gel from its container to the last impinger. Alternatively, the silica gel may be weighed directly in the impinger just prior to train assembly.

5.1.3.2 Several options are available to the tester based on the sampling requirements and conditions. The use of an empty first impinger can be eliminated if the moisture to be collected in the impingers will be less than approximately 100 ml. If necessary, use as applicable to this methodology the procedure described in Section 7.1.1 of Method 101A, 40 CFR Part 61, Appendix B, to maintain the desired color in the last permanganate impinger.

5.1.3.3 Retain for reagent blanks volumes of the HNO_3/H_2O_2 solution per Section 5.2.16 of this method and of the acidic $KMnO_4$ solution per Section 5.2.17. These reagent blanks should be labeled and analyzed as described in Section 7. Set up the sampling train as shown in Figure 29-1. If mercury analysis is not desired, delete the empty impinger and the two permanganate impingers following the HNO_3/H_2O_2 impingers. If necessary to ensure leak-free sampling train connections, Teflon tape or other non-contaminating material should be used instead of silicone grease to prevent contamination. <u>Precaution:</u> Extreme care should be taken to prevent contamination within the train. Prevent the mercury collection reagent (acidic $KMnO_4$) from contacting any glassware of the train which is washed and analyzed for Mn. Prevent H_2O_2 from mixing with the acidic $KMnO_4$.

5.1.3.4 Mercury emissions can be measured, alternatively, in a separate train using EPA Method 101A with the modifications for processing the permanganate containers as described in the precaution in Section 4.3.2 and the note in Section 5.2.11 of this method). This alternative method is applicable for measurement of mercury emissions, and it may be of special interest to sources which must measure both mercury and manganese emissions.

5.1.4 Leak-Check Procedures. Follow the leak-check procedures given in Method 5, Section 4.1.4.1 (Pretest Leak-Check), Section 4.1.4.2 (Leak-Checks During the Sample Run), and Section 4.1.4.3 (Post-Test Leak-Checks).

5.1.5 Sampling Train Operation. Follow the procedures given in Method 5, Section 4.1.5. For each run, record the data required on a data sheet such as the one shown in Figure 5-2 of Method 5.

5.1.6 Calculation of Percent Isokinetic. Same as Method 5, Section 4.1.6.

5.2 Sample Recovery.

5.2.1 Begin cleanup procedures as soon as the probe is removed from the stack at the end of a sampling period. The probe should be allowed to cool prior to sample recovery. When it can be safely handled, wipe off all external particulate matter near the tip of the probe nozzle and place a rinsed, non-contaminating cap over the probe nozzle to prevent losing or gaining particulate matter. Do not cap the probe tip tightly while the sampling train is cooling; a vacuum may form in the filter holder with the undesired result of drawing liquid from the impingers onto the filter.

5.2.2 Before moving the sampling train to the cleanup site, remove the probe from the sampling train and cap the open outlet. Be careful not to lose any condensate that might be present. Cap the filter inlet where the probe was fastened. Remove the umbilical cord from the last impinger and cap the impinger. Cap off the filter holder outlet and impinger inlet. Use non-contaminating caps, whether ground-glass stoppers, plastic caps, serum caps, or Teflon tape to close these openings.

5.2.3 Alternatively, the train can be disassembled before the probe and filter holder/oven are completely cooled if this procedure is followed: Initially disconnect the filter holder outlet/impinger inlet and loosely cap the open ends. Then disconnect the probe from the filter holder or cyclone inlet and loosely cap the open ends. Cap the probe tip and remove the umbilical cord as previously described.

5.2.4 Transfer the probe and filter-impinger assembly to a cleanup area that is clean and protected from the wind and other potential causes of contamination or loss of sample. Inspect the train before and during disassembly and note any abnormal conditions. The sample is recovered and treated as follows (see schematic in Figures 29-2a and 29-2b). Assure that all items necessary for recovery of the sample do not contaminate it.

5.2.5 Container No. 1 (Filter). Carefully remove the filter from the filter holder and place it in its identified petri dish container. Acid-washed polypropylene or Teflon coated tweezers or clean, disposable surgical gloves rinsed with water and dried should be used to handle the filters. If it is necessary to fold the filter, make certain the particulate cake is inside the fold. Carefully transfer the filter and any particulate matter or filter fibers that adhere to the filter holder gasket to the petri dish by using a dry (acid-cleaned) nylon bristle brush. Do not use any metal-containing materials when recovering this train. Seal the labeled petri dish.

5.2.6 Container No. 2 (Acetone Rinse). **NOTE**: Perform this section only if determination of particulate emissions are desired in addition to metals emissions. Ensuring that dust on the outside of the probe or other exterior surfaces does not get into the sample, quantitatively recover particulate matter and any condensate from the probe nozzle, probe fitting, probe liner, and front half of the filter holder by washing these components with 100 ml of acetone and placing the wash in a glass container.

NOTE: The use of exactly 100 ml is necessary for the subsequent blank correction procedures. Distilled water may be used instead of acetone when approved by the Administrator and shall be used when specified by the Administrator; in these cases, save a water blank and follow the Administrator's directions on analysis. Perform the acetone rinse as follows: Carefully remove the probe nozzle and clean the inside surface by rinsing with acetone from a wash bottle and brushing with a non-metallic brush. Brush until the acetone rinse shows no visible particles, after which make a final rinse of the inside surface with acetone.

5.2.7 Brush and rinse the sample exposed inside parts of the fitting with acetone in a similar way until no visible particles remain. Rinse the probe liner with acetone by tilting and rotating the probe while squirting acetone into its upper end so that all inside surfaces will be wetted with acetone. Allow the acetone to drain from the lower end into the sample container. A funnel may be used to aid in transferring liquid washings to the container. Follow the acetone rinse with a non-metallic probe brush. Hold the probe in an inclined position, squirt acetone into the upper end as the probe brush is being pushed with a twisting action through the probe. Hold a sample container underneath the lower end of the probe, and catch any acetone and particulate matter which is brushed through the probe three times or more until no visible particulate matter is carried out with the acetone or until none remains in the probe liner on visual inspection. Rinse the brush with acetone, and quantitatively collect these washings in the sample container. After the brushing, make a final acetone rinse of the probe as described above.

5.2.8 It is recommended that two people clean the probe to minimize sample losses. Between sampling runs, keep brushes clean and protected from contamination. Clean the inside of the front-half of the filter holder by rubbing the surfaces with a non-metallic nylon bristle brush and rinsing with acetone. Rinse each surface three times or more if needed to remove visible particulate. Make a final rinse of the brush and filter holder. After all acetone washings and particulate matter have been collected in the sample container, tighten the lid so that acetone will not leak out when shipped to the laboratory. Mark the height of the fluid level to determine whether or not leakage occurred during transport. Label the container clearly to identify its contents.

5.2.9 Container No. 3 (Probe Rinse). Keep the probe assembly clean and free from contamination during the probe rinse. Rinse the probe nozzle and fitting, probe liner, and front-half of the filter holder thoroughly with 100 ml of 0.1 N HNO_3, and place the wash into a sample storage container. **NOTE**: The use of exactly 100 ml is necessary for the subsequent blank correction procedures. Perform the rinses as applicable and generally as described in Method 12, Section 5.2.2. Record the volume of the combined rinse. Mark the height of the fluid level on the outside of the storage container and use this mark to determine if leakage occurs during transport. Seal the container, and clearly label the contents. Finally, rinse the nozzle, probe liner, and front-half of the filter holder with water followed by acetone, and discard these rinses.

5.2.10 Container No. 4 (Impingers 1 through 3, HNO_3/H_2O_2 Impingers and Moisture Knockout Impinger, when used, Contents and Rinses). Due to the potentially large quantity of liquid involved, the tester may place the impinger solutions from impingers 1 through 3 in more than one container. Measure the liquid in the first three impingers to within 0.5 ml using a graduated cylinder. Record the volume. This information is required to calculate the moisture content of the sampled flue gas. Clean each of the first three impingers, the filter support, the back half of the filter housing, and connecting glassware by thoroughly rinsing with 100 ml of 0.1 N HNO_3 using the procedure as applicable in Method 12, Section 5.2.4. **NOTE**: The use of exactly 100 ml of 0.1 N HNO_3 rinse is necessary for the subsequent blank correction procedures. Combine the rinses and impinger solutions, measure and record the volume. Mark the height of the fluid level, seal the container, and clearly label the contents.

5.2.11 Container Nos. 5A (0.1 N HNO_3), 5B ($KMnO_4/H_2SO_4$ absorbing solution), and 5C (8 N HCl rinse and dilution). Pour all the liquid, if any, from the impinger which was empty at the start of the run and which immediately precedes the two permanganate impingers (normally impinger No. 4) into a graduated cylinder and measure the volume to within 0.5 ml. This information is required to calculate the moisture content of the sampled flue gas. Place the liquid in Sample Container No. 5A. Rinse the impinger (No. 4) with 100 ml of 0.1 N HNO_3 and place this into Container No. 5A.

5.2.12 Pour all the liquid from the two permanganate impingers into a graduated cylinder and measure the volume to within 0.5 ml. This information is required to calculate the moisture content of the sampled flue gas. Place this $KMnO_4$ solution into Container No. 5B. Using 100 ml total of fresh acidified $KMnO_4$ solution, rinse the two permanganate impingers and connecting glass a minimum of three times. Pour the rinses into Container No. 5B, carefully assuring transfer of all loose precipitated materials from the two impingers. Using 100 ml total of water, rinse the permanganate impingers and connecting glass a minimum of three times, and pour the rinses into Container 5B, carefully assuring transfer of all loose precipitated material, if any. Mark the height of the fluid level, and clearly label the contents. Note the precaution in Section 4.3.2. **NOTE**: Due to the potential reaction of $KMnO_4$ with acid, there may be pressure buildup in the sample storage bottles. These bottles shall not be filled completely and shall be vented to relieve excess pressure. A No. 70-72 hole drilled in the container cap and Teflon liner has been used successfully.

5.2.13 If no visible deposits remain after the above described water rinse, no further rinse is necessary. However, if deposits do remain on the glassware, wash the impinger surfaces with 25 ml of 8 N HCl, and place the wash in a separate sample container labeled Container No. 5C containing 200 ml of water as follows. Place 200 ml of water in a sample container labeled Container No. 5C. Wash the impinger walls and stem with the HCl by turning the impinger on its side and rotating it so that the HCl contacts all inside surfaces. Use a total of only 25 ml of 8 N HCl for rinsing <u>both permanganate impingers combined</u>. Rinse the first impinger, then pour the actual rinse used for the first impinger into the second impinger for its rinse. Finally, pour the 25 ml of 8 N HCl rinse carefully into Container No. 5C. Mark the height of the fluid level on the outside of the bottle to determine if leakage occurs during transport.

5.2.14 Container No. 6 (Silica Gel). Note the color of the indicating silica gel to determine whether it has been completely spent and make a notation of its condition. Transfer the silica gel from its impinger to its original container and seal. The tester may use a funnel to pour the silica gel and a rubber policeman to remove the silica gel from the impinger. The small amount of particles that may adhere to the impinger wall need not be removed. Do not use water or other liquids to transfer the silica gel since weight gained in the silica gel impinger is used for moisture calculations. Alternatively, if a balance is available in the field, record the weight of the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g.

5.2.15 Container No. 7 (Acetone Blank). If particulate emissions are to be determined, at least once during each field test, place a 100-ml portion of the acetone used in the sample recovery process into a labeled container for use in the front-half field reagent blank. Seal the container.

5.2.16 Container No. 8A (0.1 N HNO_3 Blank). At least once during each field test, place 300 ml of the 0.1 N HNO_3 solution used in the sample recovery process into a labeled container for use in the front-half and back-half field reagent blanks. Seal the container.

5.2.17 Container No. 8B (water blank). At least once during each field test, place 100 ml of the water used in the sample recovery process into a labeled Container No. 8B. Seal the container.

5.2.18 Container No. 9 (5 Percent HNO_3/10 Percent H_2O_2 Blank). At least once during each field test, place 200 ml of the 5 Percent HNO_3/10 Percent H_2O_2 solution used as the nitric acid impinger reagent into a labeled container for use in the back-half field reagent blank. Seal the container.

5.2.19 Container No. 10 (Acidified $KMnO_4$ Blank). At least once during each field test, place 100 ml of the acidified $KMnO_4$ solution used as the impinger solution and in the sample recovery process into a labeled container for use in the back-half field reagent blank for mercury analysis. Prepare the container as described in Section 5.2.11. See the note in Section 5.2.12.

5.2.20 Container No. 11 (8 N HCl Blank). At least once during each field test, perform both of the following. Place 200 ml of water into a sample container. Pour 25 ml of 8 N HCl carefully with stirring into the container. Mix well and seal the container.

5.2.21 Container No. 12 (Filter Blank). Once during each field test, place three unused blank filters from the same lot as the sampling filters in a labeled petri dish. Seal the petri dish. These will be used in the front-half field reagent blank.

5.3 Sample Preparation. Note the level of the liquid in each of the containers and determine if any sample was lost during shipment. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Administrator, to correct the final results. A diagram illustrating sample preparation and analysis procedures for each of the sample train components is shown in Figure 29-3.

5.3.1 Container No. 1 (Filter). If particulate emissions are being determined, desiccate the filter and filter catch without added heat and weigh to a constant weight as described in Section 4.3 of Method 5. For analysis of metals, divide the filter with its filter catch into portions containing approximately 0.5 g each and place into the analyst's choice of either individual microwave pressure relief vessels or Parr^R Bombs. Add 6 ml of concentrated HNO_3 and 4 ml of concentrated HF to each vessel. For microwave heating, microwave the sample vessels for approximately 12-15 minutes in intervals of 1 to 2 minutes at 600 Watts. For conventional heating, heat the Parr^R Bombs at 140°C (285°F) for 6 hours. Then cool the samples to room temperature, and combine with the acid digested probe rinse as required in Section 5.3.3, below. **<u>NOTES</u>**:

5.3.1.1 Suggested microwave heating times are approximate and are dependent upon the number of samples being digested. Twelve to 15 minute heating times have been found to be acceptable for simultaneous digestion of up to 12 individual samples. Sufficient heating is evidenced by sorbent reflux within the vessel.

5.3.1.2 If the sampling train uses an optional cyclone, the cyclone catch should be prepared and digested using the same procedures described for the filters and combined with the digested filter samples.

5.3.2 Container No. 2 (Acetone Rinse). Note the level of liquid in the container and confirm on the analysis sheet whether or not leakage occurred during transport. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Administrator, to correct the final results. Measure the liquid in this container either volumetrically within 1 ml or gravimetrically within 0.5 g. Transfer the contents to an acid-cleaned, tared 250-ml beaker and evaporate to dryness at ambient temperature and pressure. If particulate emissions are being determined, desiccate for 24 hours without added heat, weigh to a constant weight according to the procedures described in Section 4.3 of Method 5, and report the results to the nearest 0.1 mg. Redissolve the residue with 10 ml of concentrated HNO_3. Quantitatively combine the resultant sample, including all liquid and any particulate matter, with Container No. 3 before beginning Section 5.3.3.

5.3.3 Container No. 3 (Probe Rinse). The pH of this sample shall be 2 or lower. If the pH is higher, the sample should be acidified by careful addition with stirring of concentrated HNO_3 to pH 2. The sample should be rinsed into a beaker with water, and the beaker should be covered with a ribbed watch glass. The sample volume should be reduced to approximately 20 ml by heating on a hot plate at a temperature just below boiling. Digest the sample in microwave vessels or Parr^R Bombs by quantitatively transferring the sample to the vessel or bomb, carefully adding the 6 ml of concentrated HNO_3, 4 ml of concentrated HF, and then continuing to follow the procedures described in Section 5.3.1. Then combine the resultant sample directly with the acid digested portions of the filter prepared previously in Section 5.3.1. The resultant combined sample is referred to as Fraction 1 precursor. Filter the combined solution of the acid digested filter and probe rinse samples using Whatman 541 filter paper. Dilute to 300 ml (or the appropriate volume for the expected metals concentration) with water. This dilution is Fraction 1. Measure and record the volume of the Fraction 1 solution to within 0.1 ml. Quantitatively remove a 50-ml aliquot and label as Fraction 1B. Label the remaining 250-ml portion as

Fraction 1A. Fraction 1A is used for ICAP or AAS analysis. Fraction 1B is used for the determination of front-half mercury.

5.3.4 Container No. 4 (Impingers 1-3). Measure and record the total volume of this sample (Fraction 2) to within 0.5 ml. Remove a 75- to 100-ml aliquot for mercury analysis and label as Fraction 2B. Label the remaining portion of Container No. 4 as aliquot Fraction 2A. Aliquot Fraction 2A defines the volume of 2A <u>prior</u> to digestion. All of aliquot Fraction 2A is digested to produce concentrated Fraction 2A. Concentrated Fraction 2A defines the volume of 2A <u>after</u> digestion and is normally 150 ml. Only concentrated Fraction 2A is analyzed for metals (except that it is not analyzed for mercury). The Fraction 2B aliquot should be prepared and analyzed for mercury as described in Section 5.4.3. Aliquot Fraction 2A shall have a pH of 2 or lower. If necessary, use concentrated HNO_3 by careful addition and stirring to lower aliquot Fraction 2A to pH 2. The sample should be rinsed into a beaker with water and the beaker covered with a ribbed watchglass. The sample volume should be reduced to approximately 20 ml by heating on a hot plate at a temperature just below boiling. Then follow either of the digestion procedures described in Sections 5.3.4.1 and 5.3.4.2, below.

5.3.4.1 Conventional Digestion Procedure. Add 30 ml of 50 percent HNO_3, and heat for 30 minutes on a hot plate to just below boiling. Add 10 ml of 3 percent H_2O_2 and heat for 10 more minutes. Add 50 ml of hot water, and heat the sample for an additional 20 minutes. Cool, filter the sample, and dilute to

150 ml (or the appropriate volume for the expected metals concentrations) with water. This dilution is concentrated Fraction 2A. Measure and record the volume of the Fraction 2A solution to within 0.1 ml.

5.3.4.2 Microwave Digestion Procedure. Add 10 ml of 50 percent HNO_3 and heat for 6 minutes in intervals of 1 to 2 minutes at 600 Watts. Allow the sample to cool. Add 10 ml of 3 percent H_2O_2 and heat for 2 more minutes. Add 50 ml of hot water, and heat for an additional 5 minutes. Cool, filter the sample, and dilute to 150 ml (or the appropriate volume for the expected metals concentrations) with water. This dilution is concentrated Fraction 2A. Measure and record the volume of the Fraction 2A solution to within 0.1 ml. **NOTE**: All microwave heating times given are approximate and are dependent upon the number of samples being digested at a time. Heating times as given above have been found acceptable for simultaneous digestion of up to 12 individual samples. Sufficient heating is evidenced by solvent reflux within the vessel.

5.3.5 Container Nos. 5A, 5B, and 5C (Impingers 4, 5, and 6). Keep these samples separate from each other and measure and record the volumes of 5A and 5B separately to within 0.5 ml. Dilute sample 5C to 500 ml with water. These samples 5A, 5B, and 5C are referred to respectively as Fractions 3A, 3B, and 3C. Follow the analysis procedures described in Section 5.4.3. Because the permanganate rinse and water rinse have the capability to recover a high percentage of the mercury from the permanganate impingers, the amount of mercury in the HCl rinse (Fraction 3C) may be very small, possibly even insignificantly small. However, as instructed in this method, add the total of any mercury measured in and calculated for the HCl rinse (Fraction 3C) to that for Fractions 1B, 2B, 3A, and 3B for calculation of the total sample mercury concentration.

5.3.6 Container No. 6 (Silica Gel). Weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g using a balance. (This step may be conducted in the field.)

5.4 Sample Analysis. For each sampling train, seven individual samples are generated for analysis. A schematic identifying each sample and the prescribed sample preparation and analysis scheme is shown in Figure 29-3. The first two samples, labeled Fractions 1A and 1B, consist of the digested samples from the front-half of the train. Fraction 1A is for ICAP or AAS analysis as described in Sections 5.4.1 and/or 5.4.2. Fraction 1B is for determination of front-half mercury as described in Section 5.4.3. The back-half of the train was used to prepare the third through seventh samples. The third and fourth samples, labeled Fractions 2A and 2B, contain the digested samples from the moisture knockout, if used, and HNO_3/H_2O_2 Impingers 1 through 3. Fraction 2A is for ICAP or AAS analysis. Fraction 2B will be analyzed for mercury. The fifth through seventh samples, labeled Fractions 3A, 3B, and 3C, consist of the impinger contents and rinses from the empty and permanganate impingers 4, 5, and 6. These samples are analyzed for mercury as described in Section 5.4.3. The total back-half mercury catch is determined from the sum of Fraction 2B and Fractions 3A, 3B, and 3C.

5.4.1 ICAP Analysis. Fraction 1A and Fraction 2A are analyzed by ICAP using Method 6010 or Method 200.7 (40 CFR 136, Appendix C). Calibrate the ICAP, and set up an analysis program as described in Method 6010 or Method 200.7. The quality control procedures described in Section 7.3.1 shall be followed. Recommended wavelengths for use in the analysis are listed below.

Element	Wavelength (nm)
Aluminum	308.215
Antimony	206.833
Arsenic	193.696
Barium	455.403
Beryllium	313.042
Cadmium	226.502
Chromium	267.716
Copper	324.754
Iron	259.940
Lead	220.353
Manganese	257.610
Nickel	231.604
Phosphorous	214.914
Selenium	196.026
Silver	328.068
Thallium	190.864
Zinc	213.856

The wavelengths listed are recommended because of their sensitivity and overall acceptance. Other wavelengths may be substituted if they can provide the needed sensitivity and are treated with the same corrective techniques for spectral interference. Initially, analyze all samples for the desired target metals (except mercury) plus iron and aluminum. If iron and aluminum are present, the sample may have to be diluted so that each of these elements is at a concentration of less than

50 ppm to reduce their spectral interferences on arsenic, cadmium, chromium, and lead. **NOTE**: When analyzing samples in a HF matrix, an alumina torch should be used; since all front-half samples will contain HF, use an alumina torch.

5.4.2 AAS by Direct Aspiration and/or Graphite Furnace. If analysis of metals in Fraction 1A and Fraction 2A using graphite furnace or direct aspiration AAS is desired, Table 29-2 should be used to determine which techniques and methods should be applied for each target metal. Table 29-2 should also be consulted to determine possible interferences and techniques to be followed for their minimization. Calibrate the instrument according to Section 6.3 and follow the quality control procedures specified in Section 7.3.2.

5.4.3 Cold Vapor AAS Mercury Analysis. Fractions 1B, 2B, 3A, 3B, and 3C should be analyzed separately for mercury using CVAAS following the method outlined in EPA SW-846 Method 7470 or in Standard Methods for Water and Wastewater Analysis, 15th Edition, Method 303F. Set up the calibration curve (zero to 1000 ng) as described in SW-846 Method 7470 or similar to Method 303F using 300-ml BOD bottles instead of Erlenmeyers. Dilute separately, as described below, an aliquot sized from 1 ml to 10 ml of each original sample to 100 ml with water. Record the amount of the aliquot used for dilution to 100 ml. If no prior knowledge exists of the expected amount of mercury in the sample, a 5-ml aliquot is suggested for the first dilution to 100 ml and analysis. In determining the emission value for mercury, the size of the sample aliquot used for dilution and analysis is dependent upon its mercury content. The total amount of mercury in the aliquot shall be less than 1 μg and within the range (zero to 1000 ng) of the calibration curve. Place each sample aliquot into a separate 300-ml BOD bottle, and add enough water to make a total volume of 100 ml. Then analyze the sample for mercury by adding to it sequentially the sample preparation solutions and performing the sample preparation and analysis as described in the procedures of SW-846 Method 7470 or Method 303F. If the reading maximums are off-scale (because mercury in the aliquot exceeded the calibration range), including the dilution of 1-ml aliquots of the original sample, then perform the following: dilute the original sample (or a portion of it) with 0.15 percent HNO_3 (1.5 ml concentrated HNO_3 per liter aqueous solution) so that when a 1- to 10-ml aliquot of the original sample is further diluted to 100 ml and analyzed by the procedures described above, it will yield an analysis within the range of the calibration curve.

6. Calibration

Maintain a laboratory log of all calibrations.

6.1 Sampling Train Calibration. Calibrate the sampling train components according to the indicated sections of Method 5: Probe Nozzle (Section 5.1); Pitot Tube (Section 5.2); Metering System (Section 5.3); Probe Heater (Section 5.4); Temperature Gauges (Section 5.5); Leak-Check of the Metering System (Section 5.6); and Barometer (Section 5.7).

6.2 Inductively Coupled Argon Plasma Spectrometer Calibration. Prepare standards as outlined in Section 4.5. Profile and calibrate the instrument according to the manufacturer's recommended procedures using the above standards. The calibration should be checked once per hour. If the instrument does not reproduce the standard concentrations within 10 percent, the complete calibration procedures should be performed.

6.3 Atomic Absorption Spectrometer - Direct Aspiration, Graphite Furnace and Cold Vapor Mercury Analyses. Prepare the standards as outlined in Section 4.5 and use to calibrate the spectrometer. Calibration procedures are also outlined in the EPA methods referred to in Table 29-2 and in SW-846 Method 7470 or Standard Methods for Water and Wastewater Method 303F (for mercury). Each standard curve should be run in duplicate and the mean values used to calculate the calibration line. The instrument should be recalibrated approximately once every 10 to 12 samples.

7. Quality Control

7.1 Sampling. Field Reagent Blanks. When analyzed, the blanks in Container Nos. 7 through 12 produced previously in Sections 5.2.14 through 5.2.19, respectively, shall be processed, digested, and analyzed as follows. Digest and process one of the filters from Container No. 12 per Section 5.3.1, 100 ml from Container No. 7 per Section 5.3.2, and 100 ml from Container No. 8A per Section 5.3.3. This produces Fraction Blanks 1A and

1B from Fraction Blank 1. [If desired, the other two filters may be digested separately according to Section 5.3.1, diluted separately to 300 ml each, and analyzed separately to produce a blank value for each of the two additional filters. If these analyses are performed, they will produce two additional values for each of Fraction Blanks 1A and 1B. The three Fraction Blank 1A values will be calculated as three values of M_{fhb} in Equation 3 of Section 8.4.3, then the three values shall be totalled and divided by 3 to become the value M_{fhb} to be used in computing M_t by Equation 3. Similarly, the three Fraction Blank 1B values will be calculated separately as three values, totalled, averaged, and used as the value for Hg_{fhb} in Equation 8 of Section 8.5.3. The analyses of the two extra filters are optional and are <u>not</u> a requirement of this method, but if the analyses are performed, the results must be considered as described above.] Combine 100 ml of Container No. 8A with 200 ml from Container No. 9, and digest and process the resultant volume per Section 5.3.4. This produces concentrated Fraction Blanks 2A and 2B from Fraction Blank 2. A 100-ml portion of Container No. 8A is Fraction Blank 3A. Combine 100 ml from Container No. 10 with 33 ml from Container No. 8B. This produces Fraction Blank 3B (use 400 ml as the volume of Fraction Blank 3B when calculating the blank value. Use the actual volumes when calculating all the other blank values). Dilute 225 ml from Container No. 11 to 500 ml with water. This produces Fraction Blank 3C. Analyze Fraction Blank 1A and Fraction Blank 2A per

Section 5.4.1 and/or 5.4.2. Analyze Fraction Blank 1B, Fraction Blank 2B, and Fraction Blanks 3A, 3B, and 3C per Section 5.4.3. The analysis of Fraction Blank 1A produces the front-half reagent blank correction values for the metals except for mercury; the analysis of Fraction Blank 1B produces the front-half reagent blank correction value for mercury. The analysis of concentrated Fraction Blank 2A produces the back-half reagent blank correction values for the metals except for mercury, while separate analyses of Fraction Blanks 2B, 3A, 3B, and 3C produce the back-half reagent blank correction value for mercury.

7.2 An attempt may be made to determine if the laboratory reagents used in Section 5.3 caused contamination. They should be analyzed by the procedures in Section 5.4. The Administrator will determine whether or not the laboratory blank reagent values can be used in the calculation of the test results.

7.3 Quality Control Samples. The following quality control samples should be analyzed.

7.3.1 ICAP Analysis. Follow the quality control shown in Section 8 of Method 6010. For the purposes of a three run test series, these requirements have been modified to include the following: two instrument check standard runs, two calibration blank runs, one interference check sample at the beginning of the analysis (must be within 25 percent or analyze by standard additions), one quality control sample to check the accuracy of the calibration standards (must be within 25 percent of calibration), and one duplicate analysis (must be within 10 percent of average or repeat all analyses).

7.3.2 Direct Aspiration and/or Graphite Furnace AAS Analysis for Sb, As, Ba, Be, Cd, Cu, Cr, Pb, Ni, Mn, Hg, P, Se, Ag, Tl, and Zn. All samples should be analyzed in duplicate. Perform a matrix spike on at least one front-half sample and one back-half sample or one combined sample. If recoveries of less than 75 percent or greater than 125 percent are obtained for the matrix spike, analyze each sample by the method of additions. A quality control sample should be analyzed to check the accuracy of the calibration standards. The results must be within 10 percent or the calibration repeated.

7.3.3 Cold Vapor AAS Analysis for Mercury. All samples should be analyzed in duplicate. A quality control sample should be analyzed to check the accuracy of the calibration standards (within 15 percent or repeat calibration). Perform a matrix spike on one sample from the HNO_3 impinger portion (must be within 25 percent or samples must be analyzed by the method of standard additions). Additional information on quality control can be obtained from EPA SW-846 Method 7470 or in Standard Methods for Water and Wastewater Method 303F.

8. Calculations

8.1 Dry Gas Volume. Using the data from this test, calculate $V_{m(std)}$, the dry gas sample volume at standard conditions as outlined in Section 6.3 of Method 5.

8.2 Volume of Water Vapor and Moisture Content. Using the data obtained from this test, calculate the volume of water vapor $V_{w(std)}$ and the moisture content B_{ws} of the stack gas. Use Equations 5-2 and 5-3 of Method 5.

8.3 Stack Gas Velocity. Using the data from this test and Equation 2-9 of Method 2, calculate the average stack gas velocity.

8.4 Metals (Except Mercury) in Source Sample.

8.4.1 Fraction 1A, Front-Half, Metals (except Hg). Calculate separately the amount of each metal collected in Fraction 1 of the sampling train using the following equation:

$$M_{fh} = C_{a1} F_d V_{soln,1} \qquad \text{Eq. 29-1}$$

where:

M_{fh} = Total mass of each metal (except Hg) collected in the front half of the sampling train (Fraction 1), μg.

C_{a1} = Concentration of metal in sample Fraction 1A as read from the standard curve, μg/ml.

F_d = Dilution factor (F_d = the inverse of the fractional portion of the concentrated sample in the solution actually used in the instrument to produce the reading C_{a1}. For example, when 2 ml of Fraction 1A are diluted to 10 ml, F_d = 5).

$V_{soln,1}$ = Total volume of digested sample solution (Fraction 1), ml.

NOTE: If Fractions 1A and 2A are combined, proportional aliquots must be used. Appropriate changes must be made in Equations 29-1 to 29-3 to reflect this approach.

8.4.2 Fraction 2A, Back-Half, Metals (except Hg). Calculate separately the amount of each metal collected in Fraction 2 of the sampling train using the following equation.

$$M_{bh} = C_{a2}\ F_a\ V_a \qquad \text{Eq. 29-2}$$

where:

M_{bh} = Total mass of each metal (except Hg) collected in the back-half of the sampling train (Fraction 2), µg.

C_{a2} = Concentration of metal in sample concentrated Fraction 2A as read from the standard curve, (µg/ml).

F_a = Aliquot factor, volume of Fraction 2 divided by volume of aliquot Fraction 2A (see Section 5.3.4).

V_a = Total volume of digested sample solution (concentrated Fraction 2A), ml (see Section 5.3.4.1 or 5.3.4.2, as applicable).

8.4.3 Total Train, Metals (except Hg). Calculate the total amount of each of the quantified metals collected in the sampling train as follows:

$$M_t = (M_{fh} - M_{fhb}) + (M_{bh} - M_{bhb}) \qquad \text{Eq. 29-3}$$

where:

M_t = Total mass of each metal (separately stated for each metal) collected in the sampling train, µg.

M_{fhb} = Blank correction value for mass of metal detected in front-half field reagent blank, µg.

M_{bhb} = Blank correction value for mass of metal detected in back-half field reagent blank, µg.

NOTE: If the measured blank value for the front half (m_{fhb}) is in the range 0.0 to A µg [where A µg equals the value determined by multiplying 1.4 µg/in.^{2} times the actual area in in.^{2} of the filter used in the emission sample], m_{fhb} may be used to correct the emission sample value (m_{fh}); if m_{fhb} exceeds A µg, the greater of the two following values may be used:

I. A µg, or

II. the lesser of (a) m_{fhb}, or (b) 5 percent of m_{fh}.

If the measured blank value for the back-half (m_{bhb}) is in the range 0.0 to 1 µg, m_{bhb} may be used to correct the emission sample value (m_{bh}); if m_{bhb} exceeds 1 µg, the greater of the two following values may be used: 1 µg or 5 percent of m_{bh}.

8.5 Mercury in Source Sample.

8.5.1 Fraction 1B, Front-Half, Mercury. Calculate the amount of mercury collected in the front-half, Fraction 1, of the sampling train using the following equation:

$$Hg_{fh} = \frac{Q_{fh}}{V_{f1B}} (V_{soln,1}) \qquad \text{Eq. 29-4}$$

where:

Hg_{fh} = Total mass of mercury collected in the front-half of the sampling train (Fraction 1), µg.

Q_{fh} = Quantity of mercury in analyzed sample, µg.

$V_{soln,1}$ = Total volume of digested sample solution (Fraction 1), ml.

V_{f1B} = Volume of Fraction 1B analyzed, ml. See the following Note.

Note: V_{f1B} is the actual amount of Fraction 1B analyzed. For example, if 1 ml of Fraction 1B were diluted to 100 ml to bring it into the proper analytical range, and 1 ml of the 100-ml dilution were analyzed, V_{f1B} would be 0.01.

8.5.2 Fractions 2B, 3A, 3B, and 3C, Back Half, Mercury. Calculate the amount of mercury collected in Fractions 2 using Equation 5 and in Fractions 3A, 3B, and 3C using Equation 6. Calculate the total amount of mercury collected in the back-half of the sampling train using Eq. 29-7.

$$Hg_{bh2} = \frac{Q_{bh2}}{V_{f2B}} (V_{soln,2}) \qquad \text{Eq. 29-5}$$

where:

Hg_{bh2} = Total mass of mercury collected in Fraction 2, µg.

Q_{bh2} = Quantity of mercury in analyzed sample, µg.

$V_{soln,2}$ = Total volume of Fraction 2, ml.

V_{f2B} = Volume of Fraction 2B analyzed, ml (see the following note).

<u>Note</u>: V_{f2B} is the actual amount of Fraction 2B analyzed. For example, if 1 ml of Fraction 2B were diluted to 10 ml to bring it into the proper analytical range, and 5 ml of the 10-ml dilution was analyzed, V_{f2B} would be 0.5. Use Equation 6 to calculate separately the back-half mercury for Fractions 3A, then 3B, then 3C.

$$Hg_{bh3(A,B,C)} = \frac{Q_{bh3(A,B,C)}}{V_{f3(A,B,C)}} (V_{soln,3(A,B,C,)} \qquad \text{Eq. 29-6}$$

where:

$Hg_{bh3(A,B,C)}$ = Total mass of mercury collected separately in Fraction 3A, 3B, or 3C, µg.

$Q_{bh3(A,B,C)}$ = Quantity of mercury in separately analyzed samples, µg.

$V_{f3(A,B,C)}$ = Volume of Fraction 3A, 3B, or 3C analyzed, ml (see note in Sections 8.5.1 and 8.5.2, and calculate similarly).

$V_{soln,3(A,B,C)}$ = Total volume of Fraction 3A, 3B, or 3C, ml.

$$Hg_{bh} = Hg_{bh2} + Hg_{bh3A} + Hg_{bh3B} + Hg_{bh3C} \qquad \text{Eq. 29-7}$$

where:

Hg_{bh} = Total mass of mercury collected in the back-half of the sampling train, µg.

8.5.3 Total Train Mercury Catch. Calculate the total amount of mercury collected in the sampling train using Eq 29-8.

$$Hg_t = (Hg_{fh} - Hg_{fhb}) + (Hg_{bh} - Hg_{bhb}) \qquad \text{Eq. 29-8}$$

where:

Hg_t = Total mass of mercury collected in the sampling train, ug.

Hg_{fhb} = Blank correction value for mass of mercury detected in front-half field reagent blank, μg.

Hg_{bhb} = Blank correction value for mass of mercury detected in back-half field reagent blanks, μg.

Note: If the total of the measured blank values ($Hg_{fhb} + Hg_{bhb}$) is in the range of 0 to 6 μg, then the total may be used to correct the sample value ($Hg_{fh} + Hg_{bh}$); if it exceeds 6 μg, the greater of the following two values may be used: 6 μg or 5 percent of the sample value ($Hg_{fh} + Hg_{bh}$).

8.6 Metal Concentration in Stack Gas. Calculate each metal separately for the Cd, total Cr, As, Ni, Mn, Be, Cu, Pb, P, Tl, Ag, Ba, Zn, Se, Sb, and Hg concentrations in the stack gas (dry basis, adjusted to standard conditions) as follows:

$$C_s = \frac{K_4 \, M_t}{V_{m(std)}} \qquad \text{Eq. 29-9}$$

where:

C_s = Concentration of each metal in the stack gas, mg/dscm.

K_4 = 10^{-3} mg/μg.

M_t = Total mass of each metal collected in the sampling train, μg; (substitute Hg_t for M_t for the mercury calculation).

$V_{m(std)}$ = Volume of gas sample as measured by the dry gas meter, corrected to dry standard conditions, dscm.

8.7 Isokinetic Variation and Acceptable Results. Same as Method 5, Sections 6.11 and 6.12, respectively.

9. Bibliography

1. Method 303F in _Standard Methods for the Examination of Water Wastewater_, 15th Edition, 1980. Available from the American Public Health Association, 1015 18th Street N.W., Washington, D.C. 20036.

2. EPA Methods 6010, 7000, 7041, 7060, 7131, 7421, 7470, 7740, and 7841, _Test Methods for Evaluating Solid Waste: Physical/Chemical Methods._ SW-846, Third Edition. September 1988. Office of Solid Waste and Emergency Response, U. S. Environmental Protection Agency, Washington, D.C. 20460.

3. EPA Method 200.7, _Code of Federal Regulations_, Title 40, Part 136, Appendix C. July 1, 1987.

4. EPA Methods 1 through 5, _Code of Federal Regulations_, Title 40, Part 60, Appendix A, July 1, 1991.

* * * * *

METHOD 201A - DETERMINATION OF PM_{10} EMISSIONS

(Constant Sampling Rate Procedure)

1. Applicability and Principle

1.1 Applicability. This method applies to the measurement of particulate matter (PM) emissions with an aerodynamic diameter equal to or less than nominally 10 μm (PM_{10}) from stationary sources. This method does not measure condensible emissions; it measures only PM_{10} as it occurs in the stack and at 120°C (248°F).

1.2 Principle. A gas sample is extracted at a constant flow rate through an in-stack sizing device, which separates PM greater than PM_{10}, and two glass fiber filters are used to collect the PM_{10}. Variations from isokinetic sampling conditions are maintained within well-defined limits. The particulate mass is determined gravimetrically after removal of uncombined water.

2. Apparatus

2.1 Sampling Train. A schematic of the Method 201A sampling train is shown in Figure 1. With the exception of the PM_{10} sizing device and in-stack filter, this train is the same as a standard Method 5 train. NOTE: Method 5 as cited in this method is part of 40 CFR Part 60, Appendix A.

2.1.1 Nozzle. Stainless steel (316 or equivalent) with a sharp tapered leading edge. Eleven nozzles that meet the design specifications in Figure 2 are recommended. A large number of nozzles with small nozzle increments increase the likelihood that a single nozzle can be used for the entire traverse. If the nozzles do not meet the design specifications in Figure 2, then the nozzles must meet the criteria in Section 5.2.

2.1.2 Sizing Device. Stainless steel (316 or equivalent), capable of determining the PM_{10} fraction. The sizing device shall be either a cyclone that meets the specifications in Section 5.2 or a cascade impactor that meets the specifications in Section 5.3.

2.1.3 Probe Liner. Same as in Method 5, Section 2.1.2.

2.1.4 Pitot Tube. Same as in Method 5, Section 2.1.3. The pitot lines shall be made of heat resistant tubing and attached to the probe with stainless steel fittings.

2.1.5 Differential Pressure Gauge, Filter Holders, Filter Heating System, Condenser, Metering System, Barometer, and Gas Density Determination Equipment. Same as in Method 5, Sections 2.1.4 through 2.1.10, respectively.

2.2 Sample Recovery.

2.2.1 Nozzle, Sizing Device, Probe, and Filter Holder Brushes. Nylon bristle brushes with stainless steel wire shafts and handles, properly sized and shaped for cleaning the nozzle, sizing device, probe or probe liner, and filter holders.

2.2.2 Wash Bottles, Glass Sample Storage Containers, Petri Dishes, Graduated Cylinder and Balance, Plastic Storage Containers, Funnel and Rubber Policeman, and Funnel. Same as in Method 5, Sections 2.2.2 through 2.2.8, respectively.

2.3 Analysis. Same as in Method 5, Section 2.3.

3. Reagents

The reagents for sampling, sample recovery, and analysis are the same as that specified in Method 5, Sections 3.1, 3.2, and 3.3, respectively.

4. Procedure

4.1 Sampling. The complexity of this method is such that, in order to obtain reliable results, testers should be trained and experienced with the test procedures.

4.1.1 Pretest Preparation. Same as in Method 5, Section 4.1.1.

4.1.2 Preliminary Determinations. Same as in Method 5, Section 4.1.2, except use the directions on nozzle size selection and sampling time in this section. Use of any nozzles greater than 0.16 in. in diameter require a minimum sampling port diameter of 6 inches. Also, the required maximum number of traverse points at any location shall be 12.

4.1.2.1 The sizing device must be in-stack or maintained at stack temperature during sampling. The blockage effect of the EGR sampling assembly will be minimal if the cross-sectional area of the sampling assembly is 3 percent or less of the cross-sectional area of the duct. If the cross-sectional area of the assembly is greater than 3 percent of the cross-sectional area of the duct, then use the procedures in Method 1A to determine the sampling site. flow measurements, and the number of traverse points.

4.1.2.2 The setup calculations can be performed by using the following procedures.

4.1.2.2.1 In order to maintain a cut size of 10 μm in the sizing device, the flow rate through the sizing device must be maintained at a constant, discrete value during the run. If the sizing device is a cyclone that meets the design specifications in Figure 3, use the equations in Figure 4 to calculate three orifice pressure heads (ΔH): one at the average stack temperature, and the other two at temperatures ±28°C (±50°F) of the average stack temperature. Use the ΔH calculated at the average stack temperature as the pressure head for the sample flow rate as long as the stack temperature during the run is within 28°C (50°F) of the average stack temperature. If the stack temperature varies by more than 28°C (50°F), then use the appropriate ΔH.

4.1.2.2.2 If the sizing device is a cyclone that does not meet the design specifications in Figure 3, use the equations in Figure 4, except use the equation for cyclone flow rate derived in Section 5.2.6.

4.1.2.2.3 To select a nozzle, use the equations in Figure 5 to calculate Δp_{min} and Δp_{max} for each nozzle at all three temperatures. If the sizing device is a cyclone that does not meet the design specifications in Figure 3, the example worksheets can be used except use the procedures in Section 5.2.6 to determine Q_s, the correct cyclone flow rate for a 10 μm cut size.

4.1.2.2.4 Correct the Method 2 pitot readings to Method 201A pitot readings by multiplying the Method 2 pitot readings by the square of a ratio of the Method 201A pitot coefficient to the Method 2 pitot coefficient. Select the nozzle for which Δp_{min} and Δp_{max} bracket all of the corrected Method 2 pitot readings. If more than one nozzle meets this requirement, select the nozzle giving the greatest symmetry. Note that if the expected pitot reading for one or more points is near a limit for a chosen nozzle, it may be outside the limits at the time of the run.

4.1.2.2.5 Vary the dwell time, or sampling time, at each traverse point proportionately with the point velocity. Use the equations in Figure 6 to calculate the dwell time at the first point and at each subsequent point. It is recommended that the number of minutes sampled at each point be rounded to the nearest 15 seconds.

4.1.3 Preparation of Collection Train. Same as in Method 5, Section 4.1.3, except omit directions about a glass cyclone.

4.1.4 Leak-Check Procedure.

4.1.4.1 Pretest Leak-Check. Same as in Method 5, Section 4.1.4.1.

4.1.4.2 Leak-Checks During Sample Run. Same as in Method 5, Section 4.1.4.1.

4.1.4.3 Post-Test Leak-Check. Same as in Method 5, Section 4.1.4.3.

4.1.5 Method 201A Train Operation. Same as in Method 5, Section 4.1.5, except use the procedures in this section for isokinetic sampling and flow rate adjustment. Maintain the flow rate calculated in Section 4.1.2 throughout the run provided the stack temperature is within 28°C (50°F) of the temperature used to calculate ΔH. If stack temperatures vary by more than 28°C (50°F), use the appropriate ΔH value calculated in Section 4.1.2. Calculate the dwell time at each traverse point as in Figure 6.

4.1.6 Calculation of Percent Isokinetic Rate and Aerodynamic Cut Size (D_{50}). Calculate percent isokinetic rate and D_{50} (see Calculations, Section 6) to determine whether the test was valid or another test run should be made. If there was difficulty in maintaining isokinetic sampling rates within the prescribed range, or if the D_{50} is not in its proper range because of source conditions, the Administrator may be consulted for possible variance.

4.2 Sample Recovery. If a cascade impactor is used, use the manufacturer's recommended procedures for sample recovery. If a cyclone is used, use the same sample recovery as that in Method 5, Section 4.2, except an increased number of sample recovery containers is required.

4.2.1 <u>Container No. 1</u> (In-Stack Filter). The recovery shall be the same as that for Container No. 1 in Method 5, Section 4.2.

4.2.2 <u>Container No. 2</u> (Out-of-Stack Filter). The recovery shall be the same as that for Container No. 1 in Method 5, Section 4.2.

4.2.3 <u>Container No. 3</u> (Cyclone or Large PM Catch). This step is optional. The anisokinetic error for the cyclone PM is theoretically larger than the error for the PM_{10} catch. Therefore, adding all the fractions to get a total PM catch is not as accurate as Method 5 or Method F2. Disassemble the cyclone and remove the nozzle to recover the large PM catch. Quantitatively recover the PM from the interior surfaces of the nozzle and cyclone, excluding the "turn around" cup and the interior surfaces of the exit tube. The recovery shall be the same as that for Container No. 2 in Method 5, Section 4.2.

4.2.4 <u>Container No. 4</u> (PM_{10}). Quantitatively recover the PM from all of the surfaces from the cyclone exit to the front half of the in-stack filter holder, including the "turn around" cup inside the cyclone and the interior surfaces of the exit tube. The recovery shall be the same as that for Container No. 2 in Method 5, Section 4.2.

4.2.5 <u>Container No. 5</u> (PM_{10}). Quantitatively recover PM between the back half of the in-stack filter holder and the front half of the out-of-stack filter. The recovery shall be the same as that for Container No. 2 in Method 5, Section 4.2.

4.2.6 Container No. 6 (Silica Gel). The recovery shall be the same as that for Container No. 3 in Method 5, Section 4.2.

4.2.7 Impinger Water. Same as Method 5, Section 4.2, under "Impinger Water."

4.3 Analysis. Same as in Method 5, Section 4.3, except handle Method 201A Containers No. 1 and No. 2 like Container No. 1, Method 201A Containers No. 3, No. 4, and No. 5 like Container No. 2, and Method 201A Container No. 6 like Container No. 3. Use Figure 7 to record the weights of PM collected. Use Figure 5-3 in Method 5, Section 4.3, to record the volume of water collected.

4.4 Quality Control Procedures. Same as in Method 5, Section 4.4.

5. Calibration

Maintain an accurate laboratory log of all calibrations.

5.1 Probe Nozzle, Pitot Tube, Metering System, Probe Heater Calibration, Temperature Gauges, Leak-check of Metering System, and Barometer. Same as in Method 5, Sections 5.1 through 5.7, respectively.

5.2 Probe Cyclone and Nozzle Combinations. The probe cyclone and nozzle combinations need not be calibrated if both meet design specifications in Figures 2 and 3. If the nozzles do not meet design specifications, then the cyclone and nozzle combinations shall be tested for conformity with performance specifications (PS's) in Table 1. If the cyclone does not meet design specifications, then the cyclone and nozzle combination shall conform to PS's and the cyclone shall be calibrated to determine the relationship between flow rate, gas viscosity, and gas density. Use the procedures in Section 5.2.4 to conduct PS tests and the procedures in Section 5.2.6 to calibrate the cyclone.

5.2.1 Conduct the PS tests in a wind tunnel described in Section 5.2.2 and particle generation system described in Section 5.2.3. Use five particle sizes and three wind velocities as listed in Table 2. A minimum of three replicate measurements of collection efficiency shall be performed for each of the 15 conditions listed, for a minimum of 45 measurements.

5.2.2 Wind Tunnel. The calibration and PS tests shall be performed in a wind tunnel (or equivalent test apparatus) capable of establishing and maintaining the required gas stream velocities within 10 percent.

5.2.3 Particle Generation System. The particle generation system shall be capable of producing solid monodispersed dye particles with the mass median aerodynamic diameters specified in Table 2. The particle size distribution verification should be performed on an integrated sample obtained during the sampling period of each test. An acceptable alternative is to verify the size distribution of samples obtained before and after each test, with both samples required to meet the diameter and monodispersity requirements for an acceptable test run.

5.2.4 Establish the size of the solid dye particles delivered to the test section of the wind tunnel by using the operating parameters of the particle generation system, and verify them during the tests by microscopic examination of samples of the particles collected on a membrane filter. The particle size, as established by the operating parameters of the generation system, shall be within the tolerance specified in Table 2.

The precision of the particle size verification technique shall be at least ±0.5 μm, and particle size determined by the verification technique shall not differ by more than 10 percent from that established by the operating parameters of the particle generation system.

5.2.5 The monodispersity of the particles shall be certified for each test either by microscopic inspection of collected particles on filters or by other suitable monitoring techniques such as an optical particle counter followed by a multichannel pulse height analyzer. If the proportion of multiplets and satellites in an aerosol exceeds 10 percent by mass, the particle generation system is unacceptable for purposes of this test. Multiplets are particles that are agglomerated, and satellites are particles that are smaller than the specified size range.

5.2.6 Schematic drawings of the wind tunnel and blower system and other information showing complete procedural details of the test atmosphere generation, verification, and delivery techniques shall be furnished with calibration data to the reviewing agency.

5.2.7 Flow Measurements. Measure the cyclone air flow rates with a dry gas meter and a stopwatch, or a calibrated orifice system capable of measuring flow rates to within 2 percent.

5.2.8 Performance Specification Procedure. Establish test particle generator operation and verify particle size microscopically. If monodispersity is to be verified by measurements at the beginning and the end of the run rather than by an integrated sample, these measurements may be made at this time.

5.2.9 The cut size, or D_{50}, of a cyclone is defined here as the particle size having a 50 percent probability of penetration. Determine the cyclone flow rate at which the D_{50} is 10 μm. A suggested procedure is to vary the cyclone flow rate while keeping a constant particle size of 10 μm. Measure the PM collected in the cyclone (m_c), the exit tube (m_t), and the filter (m_f). Calculate cyclone efficiency (E_c) for each flow rate as follows:

$$E_c = \frac{m_c}{(m_c + m_t + m_f)} \times 100$$

5.2.10 Do three replicates and calculate the average cyclone efficiency [$E_{c(avg)}$] as follows:

$$E_{c(avg)} = (E_1 + E_2 + E_3)/3$$

where E_1, E_2, and E_3 are replicate measurements of E_c.

5.2.11 Calculate the standard deviation (σ) for the replicate measurements of E_c as follows.

$$\sigma = \left[\frac{(E_1^2 + E_2^2 + E_3^2) - \dfrac{(E_1 + E_2 + E_3)^2}{3}}{2}\right]^{0.5}$$

If σ exceeds 0.10, or if $E_{c(avg)}$ is not 50 ± 0.5 percent, repeat the replicate runs.

5.2.12 Measure the overall efficiency of the cyclone and nozzle, E_o, at the particle sizes and nominal gas velocities in Table 2 using the following procedure.

5.2.13 Set the air velocity and particle size from one of the conditions in Table 2. Establish isokinetic sampling conditions and the correct flow rate in the cyclone (obtained by procedures in this section) such that the D_{50} is 10 μm. Sample long enough to obtain ±5 percent precision on total collected mass as determined by the precision and the sensitivity of measuring technique. Determine separately the nozzle catch (m_n), cyclone catch (m_c), cyclone exit tube (m_t), and collection filter catch (m_f) for each particle size and nominal gas velocity in Table 2. Calculate overall efficiency (E_o) as follows:

$$E_o = \frac{(m_n + m_c)}{(m_n + m_c + m_t + m_f)} \times 100$$

5.2.14 Do three replicates for each combination of gas velocity and particle size in Table 2. Use the equation below to calculate the average overall efficiency [$E_{o(avg)}$] for each combination following the procedures described in this section for determining efficiency.

$$E_{o(avg)} = (E_1 + E_2 + E_3)/3$$

where E_1, E_2, and E_3 are replicate measurements of E_o.

5.2.15 Use the appropriate formula in this section to calculate σ for the replicate measurements. If σ exceeds 0.10 or if the particle sizes and nominal gas velocities are not within the limits specified in Table 2, repeat the replicate runs.

5.2.16 Criteria for Acceptance. For each of the three gas stream velocities, plot the $E_{o(avg)}$ as function of particle size on Figure 8. Draw smooth curves through all particle sizes. $E_{o(avg)}$ shall be within the banded region for all sizes, and the $E_{c(avg)}$ shall be 50 ± 0.5 percent at 10 μm.

5.3 Cyclone Calibration Procedure. The purpose of this section is to develop the relationship between flow rate, gas viscosity, gas density, and D_{50}.

5.3.1 Determine flow rates and D_{50}'s for three different particle sizes between 5 µm and 15 µm, one of which shall be 10 µm. All sizes must be determined within 0.5 µm. For each size, use a different temperature within 60°C (108°F) of the temperature at which the cyclone is to be used and conduct triplicate runs. A suggested procedure is to keep the particle size constant and vary the flow rate.

5.3.2 On log-log graph paper, plot the Reynolds number (Re) on the abscissa, and the square root of the Stokes 50 number $[(Stk_{50})^{0.5}]$ on the ordinate for each temperature. Use the following equations to compute both values:

$$Re = \frac{4 \rho Q_{cyc}}{d_{cyc} \pi \mu_{cyc}}$$

$$(Stk_{50})^{0.5} = \left[\frac{4 Q_{cyc} (D_{50})^2}{9 \pi \mu_{cyc} (d_{cyc})^3}\right]^{0.5}$$

where:

Q_{cyc} = Cyclone flow rate, cm^3/sec.

ρ = Gas density, g/cm^3.

d_{cyc} = Diameter of cyclone inlet, cm.

μ_{cyc} = Viscosity of gas through the cyclone, micropoise.

D_{50} = Aerodynamic diameter of a particle having a 50 percent probability of penetration, cm.

5.3.3 Use a linear regression analysis to determine the slope (m) and the y-intercept (b). Use the following formula to determine Q, the cyclone flow rate required for a size cut of 10 μm.

$$Q = \frac{\pi\ \mu_{cyc}}{4} \left[(3000)(K_1)^b \right]^{-(0.5-m)} \left[\frac{T_s}{M_c\ P_s} \right]^{m/(m-0.5)} d^{(m-1.50)/(m-0.5)}$$

where:

m = Slope of the calibration line.

b = y-interept of the calibration line.

Q = Cyclone flow rate for a size cut of 10 μm, cm^3/sec.

d = Diameter of nozzle, cm.

T_s = Stack gas temperature, °R.

P_s = Absolute stack pressure, in. Hg.

M_c = Molecular weight of the stack gas, lb/lb-mole.

K_1 = 4.077 x 10^{-3}.

5.3.4 Refer to the Method 201A operators manual, entitled <u>Measurement of Size Selective Particulate Emissions from Stationary Sources by Constant Sampling Rate</u>, for directions in the use of this equation for Q in the setup calculations.

5.4 Cascade Impactor Calibration Procedure. The purpose of calibrating a cascade impactor is to determine the empirical constant (Stk_{50}), which is specific to the impactor and which permits the accurate determination of the cut sizes of the impactor stages at field conditions. It is not necessary to calibrate each individual impactor. Once an impactor has been calibrated, the calibration data can be applied to other impactors of identical design.

5.4.1 Wind Tunnel. Same as in Section 5.2.2.

5.4.2 Particle Generation System. Same as in Section 5.2.3.

5.4.4 Hardware Configuration for Calibrations. An impaction stage constrains an aerosol to form circular or rectangular jets, which are directed toward a suitable substrate where the larger aerosol particles are collected. For calibration purposes, three stages of the cascade impactor shall be discussed and designated calibration stages 1, 2, and 3. The first calibration stage consists of the collection substrate of an impaction stage and all upstream surfaces up to and including the nozzle. This may include other preceding impactor stages. The second and third calibration stages consist of each respective collection substrate and all upstream surfaces up to but excluding the collection substrate of the preceding calibration stage. This may include intervening impactor stages which are not designated as calibration stages. The cut size, or D_{50}, of the adjacent calibration stages shall differ by a factor of not less than 1.5 and not more than 2.0. For example, if the first calibration stage has a D_{50} of 12 µm, then the D_{50} of the downstream stage shall be between 6 and 8 µm.

5.4.5 It is expected, but not necessary, that the complete hardware assembly will be used in each of the sampling runs of the calibration and performance determinations. Only the first calibration stage must be tested under isokinetic sampling conditions. The second and third calibration stages must be calibrated with the collection substrate of the preceding calibration stage in place, so that gas flow patterns existing in field operation will be simulated.

5.4.6 Each of the PM_{10} stages should be calibrated with the type of collection substrate, viscid material (such as grease) or glass fiber, used in PM_{10} measurements. Note that most materials used as substrates at elevated temperatures are not viscid at normal laboratory conditions. The substrate material used for calibrations should minimize particle bounce yet be viscous enough to withstand erosion or deformation by the impactor jets and not interfere with the procedure for measuring the collected PM.

5.4.7 Calibration Procedure. Establish test particle generator operation and verify particle size microscopically. If monodispersity is to be verified by measurements at the beginning and the end of the run rather than by an integrated sample, these measurements shall be made at this time. Measure in triplicate the PM collected by the calibration stage (m) and the PM on all surfaces downstream of the respective calibration stage (m') for all of the flow rates and particle size combinations shown in Table 2. Techniques of mass measurement may include the use of a dye and spectrophotometer. Particles on the upstream side of a jet plate shall be included with the substrate downstream, except agglomerates of particles, which shall be included with the preceding or upstream substrate. Use the following formula to calculate the collection efficiency (E) for each stage.

$$E = \frac{m}{m + m'} \times 100$$

5.4.8 Use the appropriate formula in Section 5.2.4 to calculate the standard deviation (σ) for the replicate measurements. If σ exceeds 0.10, repeat the replicate runs.

5.4.9 Use the following formula to calculate the average collection efficiency (E_{avg}) for each set of replicate measurements.

$$E_{avg} = (E_1 + E_2 + E_3)/3$$

where E_1, E_2, and E_3 are replicate measurements of E.

5.4.10 Use the following formula to calculate Stk for each E_{avg}.

$$Stk = \frac{D^2Q}{9 \mu A d_j}$$

where:

D = Aerodynamic diameter of the test particle, cm $(g/cm^3)^{0.5}$.

Q = Gas flow rate through the calibration stage at inlet conditions, cm^3/sec.

μ = Gas viscosity, micropoise.

A = Total cross-sectional area of the jets of the calibration stage, cm^2.

d_j = Diameter of one jet of the calibration stage, cm.

5.4.11 Determine Stk_{50} for each calibration stage by plotting E_{avg} versus Stk on log-log paper. Stk_{50} is the Stk number at 50 percent efficiency. Note that particle bounce can cause efficiency to decrease at high values of Stk. Thus, 50 percent efficiency can occur at multiple values of Stk. The calibration data should clearly indicate the value of Stk_{50} for minimum particle bounce. Impactor efficiency versus Stk with minimal particle bounce is characterized by a monotonically increasing function with constant or increasing slope with increasing Stk.

5.4.12 The Stk_{50} of the first calibration stage can potentially decrease with decreasing nozzle size. Therefore, calibrations should be performed with enough nozzle sizes to provide a measured value within 25 percent of any nozzle size used in PM_{10} measurements.

5.4.13 Criteria For Acceptance. Plot E_{avg} for the first calibration stage versus the square root of the ratio of Stk to Stk_{50} on Figure 9. Draw a smooth curve through all of the points. The curve shall be within the banded region.

6. Calculations

6.1 Nomenclature.

B_{ws} = Moisture fraction of stack, by volume, dimensionless.

C_1 = Viscosity constant, 51.12 micropoise for °K (51.05 micropoise for °R).

C_2 = Viscosity constant, 0.372 micropoise/°K (0.207 micropoise/°R).

C_3 = Viscosity constant, 1.05×10^{-4} micropoise/$°K^2$ (3.24×10^{-5} micropoise/$°R^2$).

C_4 = Viscosity constant, 53.147 micropoise/fraction O_2.

C_5 = Viscosity constant, 74.143 micropoise/fraction H_2O.

D_{50} = Diameter of particles having a 50 percent probability of penetration, μm.

f_{O_2} = Stack gas fraction O_2, by volume, dry basis.

K_1 = 0.3858 °K/mm Hg (17.64 °R/in. Hg).

M_c = Wet molecular weight of mixed gas through the PM_{10} cyclone, g/g-mole (lb/lb-mole).

M_d = Dry molecular weight of stack gas, g/g-mole (lb/lb-mole).

P_{bar} = Barometric pressure at sampling site, mm Hg (in. Hg).

P_s = Absolute stack pressure, mm Hg (in. Hg).

Q_s = Total cyclone flow rate at wet cyclone conditions, m^3/min (ft^3/min).

$Q_{s(std)}$ = Total cyclone flow rate at standard conditions, dscm/min (dscf/min).

T_m = Average absolute temperature of dry meter, °K (°R).

T_s = Average absolute stack gas temperature, °K (°R).

$V_{w(std)}$ = Volume of water vapor in gas sample (standard conditions), scm (scf).

θ = Total sampling time, min.

μ_{cyc} = Viscosity of mixed cyclone gas, micropoise.

μ_{std} = Viscosity of standard air, 180.1 micropoise.

6.2 Analysis of Cascade Impactor Data. Use the manufacturer's recommended procedures to analyze data from cascade impactors.

6.3 Analysis of Cyclone Data. Use the following procedures to analyze data from a single stage cyclone.

6.3.1 PM_{10} Weight. Determine the PM catch in the PM_{10} range from the sum of the weights obtained from Containers Nos. 1, 2, 4, and 5 less the acetone blank.

6.3.2 Total PM Weight (optional). Determine the PM catch for greater than PM_{10} from the weight obtained from Container No. 3 less the acetone blank, and add it to the PM_{10} weight.

6.3.3 Aerodynamic Cut Size. Calculate the stack gas viscosity as follows:

$$\mu_{cyc} = C_1 + C_2\ T_s + C_3\ T_s^2 + C_4\ f_{O_2} - C_5\ B_{ws}$$

6.3.3.1 The PM_{10} flow rate, at actual cyclone conditions, is calculated as follows:

$$Q_s = \frac{T_s\ V_{m(std)}}{K_1\ P_s\ (1-B_{ws})\ \theta}\ .$$

6.3.3.2 Calculate the molecular weight on a wet basis of the stack gas as follows:

$$M_c = M_d(1 - B_{ws}) + 18.0(B_{ws})$$

6.3.3.3 Calculate the actual D_{50} of the cyclone for the given conditions as follows:

$$D_{50} = \beta_1 \left[\frac{T_s}{M_c\quad P_s}\right]^{0.2091} \left[\frac{\mu_{cyc}}{Q_s}\right]^{0.7091}$$

where β_1 = 0.027754 for metric units (0.15625 for English units).

6.3.4 Acceptable Results. The results are acceptable if two conditions are met. The first is that $9.0\ \mu m \leq D_{50} \leq 11.0\ \mu m$. The second is that no sampling points are outside Δp_{min} and Δp_{max}, or that 80 percent $\leq I \leq$ 120 percent and no more than one sampling point is outside Δp_{min} and Δp_{max}. If D_{50} is less than 9.0 μm, reject the results and repeat the test, unless the total particulate catch is less than the PM_{10}

standard. In this case, or if D_{50} is greater than 11 μm, the Administrator may accept the results.

7. Bibliography

1. Same as Bibliography in Method 5.

2. McCain, J.D., J.W. Ragland, and A.D. Williamson. Recommended Methodology for the Determination of Particle Size Distributions in Ducted Sources, Final Report. Prepared for the California Air Resources Board by Southern Research Institute. May 1986.

3. Farthing, W.E., S.S. Dawes, A.D. Williamson, J.D. McCain, R.S. Martin, and J.W. Ragland. Development of Sampling Methods for Stationary Source PM-10 Particulate Emissions. Southern Research Institute for the Environmental Protection Agency. 1986 (Unpublished).

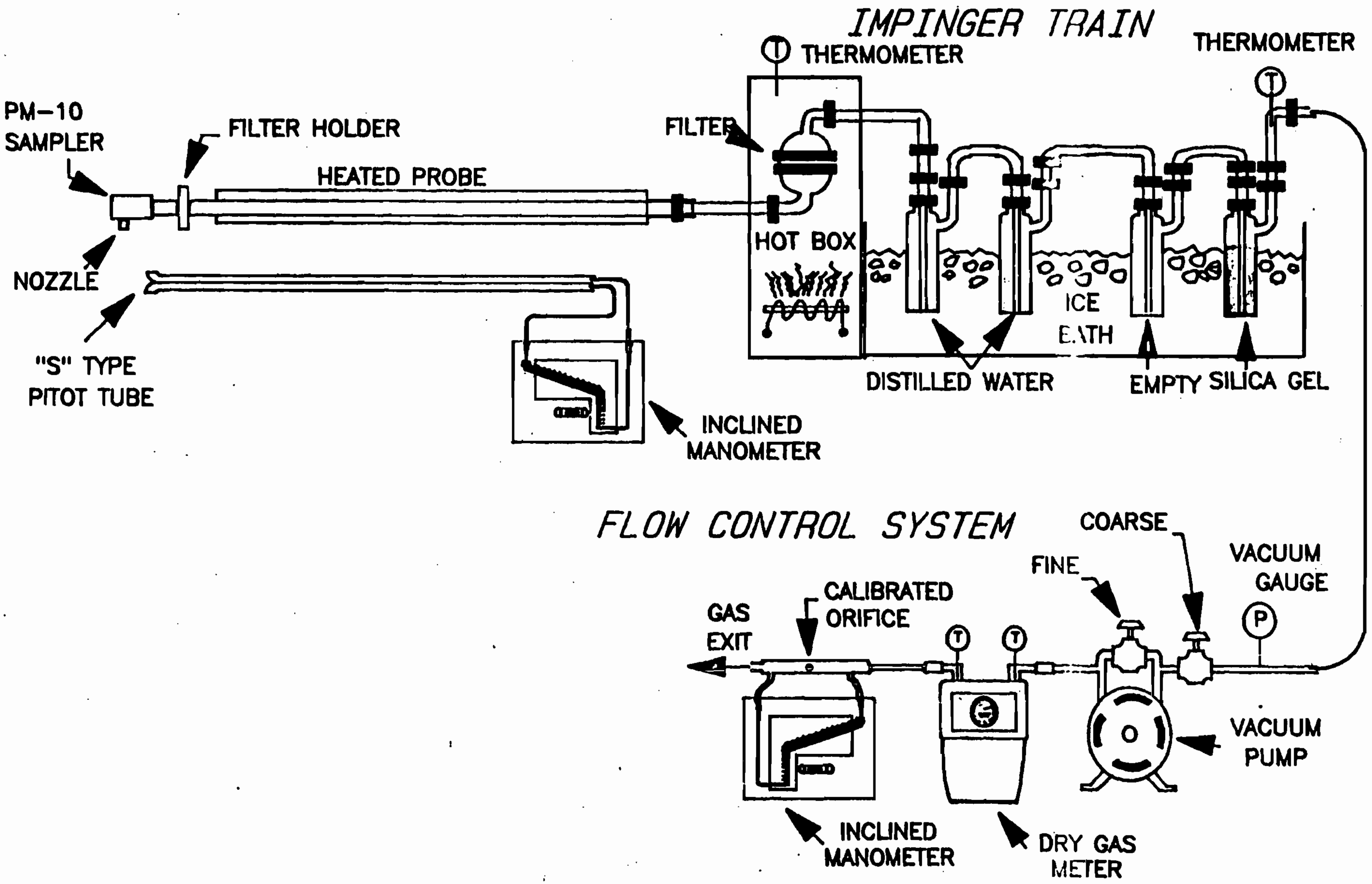
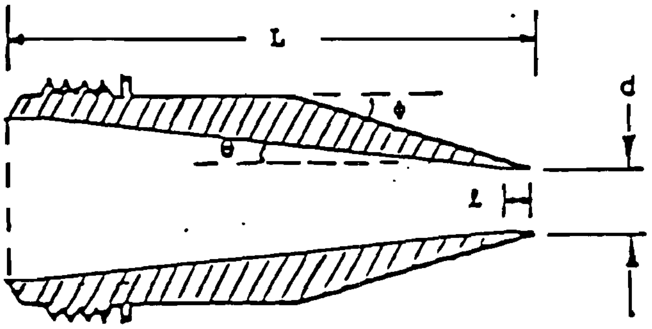


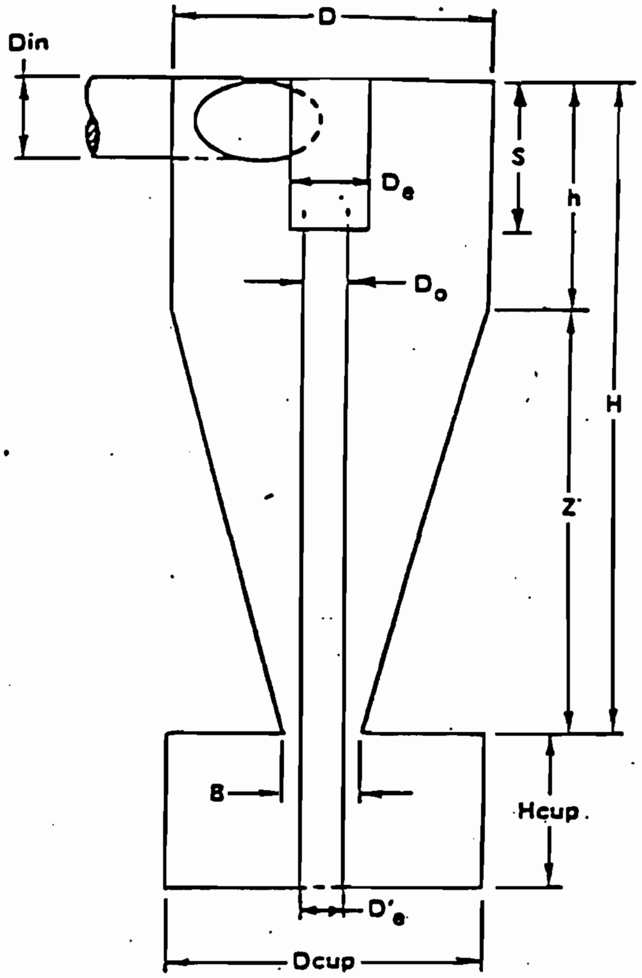
Figure 1. CSR Sampling Train



Nozzle Diameter (inches)	Cone Angle, θ (degrees)	Outside taper, φ (degrees)	Straight inlet length, ℓ (inches)	Total Length L (inches)
0.136	4	15	<0.05	2.653±0.05
0.150	4	15	<0.05	2.553±0.05
0.164	5	15	<0.05	1.970±0.05
0.180	6	15	<0.05	1.572±0.05
0.197	6	15	<0.05	1.491±0.05
0.215	6	15	<0.05	1.45 ±0.05
0.233	6	15	<0.05	1.45 ±0.05
0.264	5	15	<0.05	1.45 ±0.05
0.300	4	15	<0.05	1.48 ±0.05
0.342	4	15	<0.05	1.45 ±0.05
0.390	3	15	<0.05	1.45 ±0.05

Figure 2. Nozzle design specifications.

Cyclone Interior Dimensions



	Dimensions, ± 0.013 cm (± 0.005 in.)											
	Din	D	De	B	H	h	Z	S	Hcup	Dcup	D'_e	D_a
cm	1.27	4.47	1.50	1.88	6.95	2.24	4.71	1.57	2.25	4.45	1.02	1.24
inches	0.50	1.76	0.59	0.74	2.74	0.88	1.85	0.62	0.89	1.75	0.40	0.49

Figure 3. Cyclone design specifications.

Barometric pressure, P_{bar}, in. Hg = ______
Stack gauge pressure, P_g, in. H_2O = ______
Average stack temperature, t_s, °F = ______
Meter temperature, t_m, °F = ______
Orifice $\Delta H_@$, in. H_2O = ______

Gas analysis:

% CO_2 = ______
% O_2 = ______
% N_2 + % CO = ______
Fraction moisture content, B_{ws} = ______

Molecular weight of stack gas, dry basis:
$M_d = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO) =$ ______ lb/lb mole

Molecular weight of stack gas, wet basis:
$M_w = M_d\ (1-B_{ws}) + 18\ (B_{ws}) =$ ______ lb/lb mole

Absolute stack pressure:

$$P_s = P_{bar} + \frac{P_g}{13.6} = \underline{\qquad\qquad} \text{in. Hg}$$

Viscosity of stack gas:

$$\mu_s = 152.418 + 0.2552\ t_s + 3.2355\text{x}10^{-5}\ t_s{}^2 + 0.53147\ (\%\ O_2) - 74.143\ B_{ws} = \underline{\qquad\qquad} \text{ micropoise}$$

Cyclone flow rate:

$$Q_s = 0.002837\ \mu_s \left[\frac{(t_s + 460)}{M_w\ P_s}\right]^{0.2949} = \underline{\qquad\qquad} \text{ft}^3/\text{min}$$

Figure 4. Example worksheet 1 (Page 1 of 2), cyclone flow rate and ΔH.

Orifice pressure head (ΔH) needed for cyclone flow rate:

$$\Delta H = \left[\frac{Q_s\ (1-B_{ws})\ P_s}{t_s + 460}\right]^2 \quad \frac{t_m\ M_d\ 1.083\ \Delta H@}{P_{bar}} = \underline{\qquad\qquad\qquad} \text{in. } H_2O$$

Calculate ΔH for three temperatures:

t_s, °F			
ΔH, in. H_2O			

Figure 4. Example worksheet 1 (Page 2 of 2), cyclone flow rate and ΔH.

Stack viscosity, μ_s, micropoise = ______________

Absolute stack pressure, P_s, in. Hg = ______________

Average stack temperature, t_s, °F = ______________

Meter temperature, t_m, °F = ______________

Method 201A pitot coefficient, C_p = ______________

Cyclone flow rate, ft^3/min, Q_s = ______________

Method 2 pitot coefficient, C_p' = ______________

Molecular weight of stack gas, wet basis, M_w = ______________

Nozzle diameter, D_n, in. = ______________

Nozzle velocity

$$v_n = \frac{3.056\ Q_s}{D_n^{\ 2}} = \underline{\hspace{3cm}}\text{ft/sec}$$

Maximum and minimum velocities:

$$v_{min} = v_n \left[0.2457 + \left[0.3072 - \frac{0.2603\ Q_s^{\ 0.5}\ \mu_s}{v_n^{\ 1.5}} \right]^{0.5} \right] = \underline{\hspace{3cm}}\text{ft/sec}$$

$$v_{max} = v \left[0.4457 + \left[0.5690 + \frac{0.2603\ Q_s^{\ 0.5}\ \mu_s}{v_n^{\ 1.5}} \right]^{0.5} \right] = \underline{\hspace{3cm}}\text{ft/sec}$$

Figure 5. Example worksheet 2 (page 1 of 2), nozzle selection.

Maximum and minimum velocity head values:

$$\Delta p_{min} = 1.3686\times10^{-4} \frac{P_s\ M_w\ (v_{min})^2}{(t_s + 460)\ C_p^2} = \underline{\qquad\qquad} \text{ in. } H_2O$$

$$\Delta p_{max} = 1.3686\times10^{-4} \frac{P_s\ M_w\ (v_{max})^2}{(t_s + 460)\ C_p^2} = \underline{\qquad\qquad} \text{ in. } H_2O$$

Nozzle number				
D_n, in.				
v_n, ft/sec				
v_{min}, ft/sec				
v_{max}, ft/sec				
Δp_{min}, in. H_2O				
Δp_{max}, in. H_2O				

Velocity traverse data:

$$\Delta p(\text{Method 201A}) = \Delta p(\text{Method 2}) \left[\frac{C_p}{C_p'}\right]^2 = \underline{\qquad\qquad} \text{ in. } H_2O$$

Figure 5. Example worksheet 2 (page 2 of 2), nozzle selection.

Total run time, minutes = __________

No. traverse points = __________

$$t_1 = \left[\frac{\Delta p'_1}{\Delta p'_{avg}} \right]^{0.5} \frac{\text{(Total run time)}}{\text{(No. points)}}$$

where:

t_1 = dwell time at first traverse point, minutes.

$\Delta p'_1$ = the velocity head at the first traverse point (from a previous traverse), in. H_2O.

$\Delta p'_{avg}$ = the square of the average square root of the Δp's (from a previous velocity traverse), in. H_2O.

At subsequent traverse points, measure the velocity Δp and calculate the dwell time by using the following equation:

$$t_n = \frac{t_1}{(\Delta p_1)^{0.5}} \quad (\Delta p_n)^{0.5}, \; n = 2,3,\ldots \text{ total number of sampling points}$$

where:

t_n = dwell time at traverse point n, minutes.

Δp_n = measured velocity head at point n, in. H_2O.

Δp_1 = dwell time at first traverse point, minutes.

Figure 6. Example worksheet 3 (page 1 of 2), dwell time.

	Port____		Port____		Port____		Port____	
Point No.	Δp	t	Δp	t	Δp	t	Δp	t
1	____	____	____	____	____	____	____	____
2	____	____	____	____	____	____	____	____
3	____	____	____	____	____	____	____	____
4	____	____	____	____	____	____	____	____
5	____	____	____	____	____	____	____	____
6	____	____	____	____	____	____	____	____

Figure 6. Example worksheet 3 (page 2 of 2), dwell time.

Plant________________________
Date________________________
Run no.________________________
Filter no. (in-stack)____________________
Filter no. (out-of-stack)__________________
Amount of liquid lost during transport ____________
Acetone blank volume, ml__________________
Acetone wash volume, ml (4)____________(5)________
Acetone blank conc., mg/mg (Equation 5-4, Method 5)________
Acetone wash blank, mg (Equation 5-5, Method 5)________

Container number	Weight of PM_{10} mg		
	Final weight	Tare weight	Weight gain
1			
2			
4			
5			

Total........................	
Less acetone blank............	
Weight of PM_{10}................	

Figure 7. Method 201A analysis sheet

TABLE 1. PERFORMANCE SPECIFICATIONS FOR SOURCE PM_{10} CYCLONES AND NOZZLE COMBINATIONS

Parameter	Units	Specification
1. Collection efficiency	Percent	Such that collection efficiency falls within envelope specified by Section 5.2.5 and Figure 8.
2. Cyclone cut size (D_{50})	μm	10 ± 1 μm aerodynamic diameter.

TABLE 2. PARTICLE SIZES AND NOMINAL GAS VELOCITIES FOR EFFICIENCY

Particle size (μm)[a]	Target gas velocities (m/sec)		
	7 ± 1.0	15 ± 1.5	25 ± 2.5
5 ± 0.5			
7 ± 0.5			
10 ± 0.5			
14 ± 1.0			
20 ± 1.0			

(a) Mass median aerodynamic diameter.

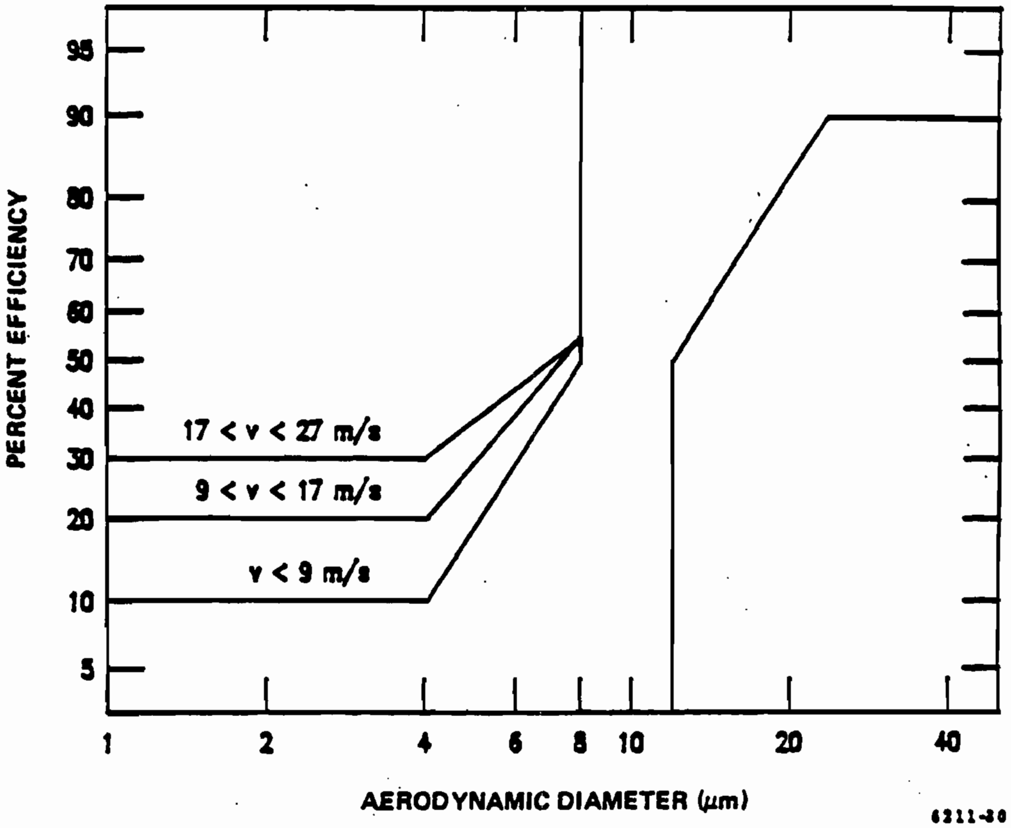


Figure 8. Efficiency envelope for the PM_{10} cyclone.

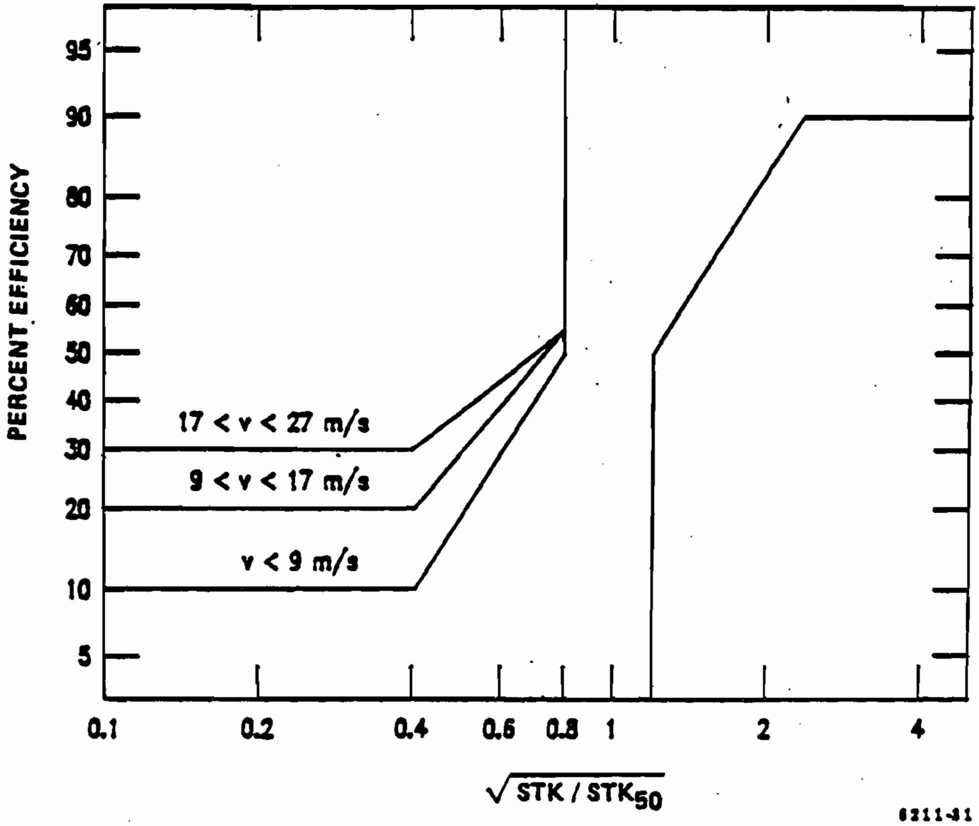


Figure 9. Efficiency envelope for first calibration stage.

Patty - for file
copy District

RIDGE GENERATING STATION, L. P.

General Partners

DECKER ENERGY-RIDGE, INC. ***WHEELABRATOR POLK INC.***

400 North New York Avenue, Suite 101
Winter Park, Florida 32789
Tel. 407-628-8900
Fax. 407-628-8535

March 17, 1993

RECEIVED

MAR 22 1993

Division of Air
Resources Management

State of Florida
Department of Environmental Regulation
Chief Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, FL 32399-2400
Attn: Mr. C.H. Fancy, P.E.

Re: Ridge Generating Station - Air Permit No. AC 53-206244

Dear Mr. Fancy,

In accordance with 40 CFR 60.7(a)(1), this letter provides notification that construction of the source that is regulated by the subject permit has started effective March 1, 1993. Specifically, the Ridge Generating System boiler foundations were poured and erection of the wood, tire and landfill gas fired boiler has commenced.

If you have any questions regarding this submittal, please call the writer at (603)929-3227.

Very truly yours,

David L. Raymond

David L. Raymond, P.E.
Senior Project Engineer

DLR265

cc: M. Killeen
W. Slack
T. White
M. Whiting
C. Wilson
File 6.1
B. Thomas, SW Dist.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

RECEIVED
SEP 3 1992
Division of
Resources

AUG 27 1992

4APT-AEB

Mr. Clair H. Fancy, P.E., Chief
Bureau of Air Regulation
Florida Department of Environmental
 Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

RE: Ridge Generating Station, L.P. (PSD-FL-183)

Dear Mr. Fancy:

This is to acknowledge receipt of your revised preliminary determination and draft Prevention of Significant Deterioration (PSD) permit for the above referenced facility, by your letter dated July 24, 1992. The applicant proposes to construct a stoker boiler to combust waste wood, scrap tires, and landfill gas, while generating approximately 50 megawatts of electrical power.

Your determination proposes the use of a spray dryer absorber/fabric filter to limit particulate, acid gas, and heavy metal emissions, selective noncatalytic reduction (SNCR) to limit NO_x emissions, and combustion efficiency to limit CO and VOC emissions.

We have reviewed the package as submitted and have no adverse comments. Thank you for the opportunity to review and comment on this package. If you have any questions or comments, please contact either Mr. Gregg Worley or Mr. Scott Davis of my staff at (404) 347-5014.

Sincerely yours,

Brian L. Beals, Chief
Source Evaluation Unit
Air, Pesticides, and Toxics
 Management Division

CHF/PL
John Reynolds
Cleve Holladay
Bill Thomas, SWD
Linda Novak, Polk Co

9-9-92 [illegible]

RIDGE GENERATING STATION, L. P.

General Partners

DECKER ENERGY-RIDGE, INC. ***WHEELABRATOR POLK INC.***

400 North New York Avenue, Suite 101
Winter Park, Florida 32789
Tel. 407-628-8900
Fax. 407-628-8535

RECEIVED
AUG 20 1992
Division of Air
Resources Management

BY FEDERAL EXPRESS

August 19, 1992

Mr. Preston Lewis
Bureau of Air Regulation
Florida Department of Environmental Regulation
Division of Air Resources Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

RE: Ridge Generating Station, Polk County
DER File No. AC 53-206244, PSD-FL-183

Dear Mr. Lewis:

Enclosed please find original affidavit of publication of Intent To Issue Permit for Ridge Generating Station. This was not received in our office until today. The Lakeland Ledger apparently had staffing problems which caused the delay.

Thank you for your patience and cooperation.

Sincerely,

Tina Stoia

Tina Stoia
Administrator

cc: J. Reynolds
C. Holladay
B. Thomas, SW Dist.
J. Harper, EPA
C. Shaver, NPS

8 17 92

AFFIDAVIT OF PUBLICATION

THE LEDGER
Lakeland, Polk County, Florida

Case No........................

STATE OF FLORIDA)
COUNTY OF POLK)

Before the undersigned authority personally appeared Tharon Honeycutt, who on oath says that he is Controller of The Ledger, a daily newspaper published at Lakeland in Polk County, Florida; that the attached copy of advertisement, being a

Intent to issue Permit

in the matter of

Wood, tire

in the

Court, was published in said newspaper in the issues of

July 29;

1992

Affiant further says that said The Ledger is a newspaper published at Lakeland, in said Polk County, Florida, and that the said newspaper has heretofore been continuously published in said Polk County, Florida, daily, and has been entered as second class matter at the post office in Lakeland, in said Polk County, Florida, for a period of one year next preceding the first publication of the attached copy of advertisement; and affiant further says that he has neither paid nor promised any person, firm or corporation any discount, rebate, commission or refund for the purpose of securing this advertisement for publication in the said newspaper.

Signed ....
Controller

Sworn to and subscribed before me this 29th

day of July A.D. 19 1992

BILLIE MORLAN
MY COMMISSION # CC 191354
EXPIRES: April 6, 1996
Bonded Thru Notary Public Underwriters

(Seal)

Billie Morlan
Notary Public
Billie Morlan

My Commission Expires ....

Decker Energy
Acct #19040

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION
NOTICE OF INTENT TO ISSUE PERMIT

The Department of Environmental Regulation gives notice of its intent to issue a permit to Ridge Generating Station, P.O. Box 2397, Winter Park, Florida 32790, to construct a wood/tire burning power generation facility at State Road 542 and Taylor Road near Auburndale, Polk County, Florida. A determination of Best Available Control Technology (BACT) was required. The proposed project is subject to Prevention of Significant Deterioration (PSD) regulations. Modeling results show that increases in ground-level concentrations are less than PSD significant impact levels for the applicable pollutants. The Department is issuing this intent to issue for the reasons stated in the Technical Evaluation and Preliminary Determination.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) in accordance with Section 120.57, Florida Statutes. The petition must contain the information set forth below and must be filed (received) in the Office of General Counsel of the Department at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400, within 14 days of publication of this notice. Petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. Failure to file a petition within this time period shall constitute a waiver of any right such person may have to request an administrative determination (hearing) under Section 120.57, Florida Statutes.

The Petition shall contain the following information; (a) The name, address, and telephone number of each petitioner, the applicant's name and address, the Department Permit File Number and the county in which the project is proposed; (b) A statement of how and when each petitioner received notice of the Department's action or proposed action; (c) A statement of how each petitioner's substantial interests are affected by the Department's action or proposed action; (d) A statement of the material facts disputed by Petitioner, if any; (e) A statement of facts which petitioner contends warrant reversal or modification of the Department's action or proposed action; (f) A statement of which rules or statutes petitioner contends require reversal or modification of the Department's action or proposed action; and (g) A statement of the relief sought by petitioner, stating precisely the action petitioner wants the Department to take with respect to the Department's action or proposed action.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this Notice. Persons whose substantial interests will be affected by any decision of the Department with regard to the application have the right to petition to become a party to the proceeding. The petition must conform to the requirements specified above and be filed (received) within 14 days of publication of this notice in the Office of General Counsel at the above address of the Department. Failure to petition within the allowed time frame constitutes a waiver of any right such person has to request a hearing under Section 120.57, F.S., and to participate as a party to this proceeding. Any subsequent intervention will only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-5.207, F.A.C.

The application is available for public inspection during normal business hours, 8:00 a.m. to 5:00 p.m., Monday through Friday, except legal holidays, at:

Department of Environmental Regulation
Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Department of Environmental Regulation
Southwest District
452 Oak Fair Blvd.
Tampa, Florida 33610-7347

Any person may send written comments on the proposed action to Mr. Preston Lewis at the Department's Tallahassee address. All comments received within 30 days of the publication of this notice will be considered in the Department's final determination. Further, a public hearing can be requested by any person. Such requests must be submitted within 30 days of this notice.

M-659 — 7-29; 1992

M 659

RIDGE GENERATING STATION, L. P.

General Partners

DECKER ENERGY-RIDGE, INC. ***WHEELABRATOR POLK INC.***

400 North New York Avenue, Suite 101
Winter Park, Florida 32789
Tel. 407-628-8900
Fax. 407-628-8535

RECEIVED
JUL 22 1992
Division of Air
Resources Management

July 20, 1992

Mr. Preston Lewis
Department of Environmental Regulation
Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Dear Mr. Lewis:

Attached please find the original affidavit of publication from the Lakeland Ledger for a notice of application for the Ridge Generating Station.

We are not certain that you are the proper person to send this affidavit to. If you are not, we would ask that you please forward it to the right individual.

Sincerely yours,

RIDGE GENERATING STATION LIMITED PARTNERSHIP

Macauley Whiting Jr.

Macauley Whiting, Jr., President
Decker Energy - Ridge, Inc.
General Partner

Attachment

cc: Richard C. Stone, Wheelabrator
Matthew P. Killeen, Wheelabrator
Kimberly Rautio, Dames & Moore
J. Reynolds
C. Holladay
B. Thomas, SW Dist.
J. Harper, EPA
C. Shaver, NPS
D. Martin, Polk Co.

AFFIDAVIT OF PUBLICATION

THE LEDGER
Lakeland, Polk County, Florida

Case No........................

STATE OF FLORIDA)
COUNTY OF POLK)

Before the undersigned authority personally appeared Tharon Honeycutt, who on oath says that he is Controller of The Ledger, a daily newspaper published at Lakeland in Polk County, Florida; that the attached copy of advertisement, being a

Notice of Appl.

in the matter of

Wood, tire

in the

Court, was published in said newspaper in the issues of

July 13,

1992

Affiant further says that said The Ledger is a newspaper published at Lakeland, in said Polk County, Florida, and that the said newspaper has heretofore been continuously published in said Polk County, Florida, daily, and has been entered as second class matter at the post office in Lakeland, in said Polk County, Florida, for a period of one year next preceding the first publication of the attached copy of advertisement; and affiant further says that he has neither paid nor promised any person, firm or corporation any discount, rebate, commission or refund for the purpose of securing this advertisement for publication in the said newspaper.

Signed ....
Controller

Sworn to and subscribed before me this 13th

day of July A.D. 19 1992

BILLIE MORLAN
MY COMMISSION # CC 191354
EXPIRES: April 6, 1996
Bonded Thru Notary Public Underwriters

Billie Morlan
Notary Public
Billie Morlan

My Commission Expires ....

Ridge Generating Station
Acct #19040

NOTICE OF APPLICATION

The Department of Environmental Regulation announces receipt of an application for permit from Ridge Generation Station, L.P. to construct a wood/tire burning power generation facility. This proposed project will be located at State Road 542 and Taylor Road near Auburndale, Polk County, Florida. This application is being processed and is available for public inspection during normal business hours, 8:00am to 5:00pm, Monday through Friday, except legal holidays at:

Department of Environmental Regulation
Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, Florida 32399-2400
Department of Environmental Regulation
Southwest District
4520 Oak Fair Boulevard
Tampa, Florida 33610-7347

M-605 — 7-13; 1992

M 605

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

4APT-AE

JUL 15 1992

RECEIVED

JUL 20 1992

Bureau of
Air Regulation

Mr. Clair H. Fancy, P.E., Chief
Bureau of Air Regulation
Florida Department of Environmental
 Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

RE: Ridge Generating Station, L. P. (PSD-FL-183)

Dear Mr. Fancy:

This is to acknowledge receipt of your preliminary determination and draft Prevention of Significant Deterioration (PSD) permit for the above referenced facility by letter dated June 22, 1992. The applicant proposes to construct a stoker boiler to combust wood waste, tires, and landfill gas while generating approximately 45 MW of electrical power. We have reviewed the package as requested and have the following comments.

Best available control technology (BACT), as determined by your agency for this source consists of a spray dryer absorber in conjunction with a fabric filter for the control of particulates, heavy metals, and acid gases. In addition, selective non-catalytic reduction (SNCR) will be utilized for the control of NO_x emissions while combustion controls will be utilized for CO and VOC emissions. We concur with your determination of BACT.

The modelling performed by the applicant included the use of MESOPUFF II to address long range impacts on the Chassahowitzka Wilderness Area. In addressing cumulative impacts on the Class I Area, sources greater than 20 km from the area were modelled using MESOPUFF II, while sources within 20 km of the area were modelled using ISC (a guideline model). EPA's current guidance, however, requires that a guideline model be used for sources within 50 km of the area. For future applications, please ensure that the use of MESOPUFF II is consistent with EPA guidance.

Thank you for the opportunity to review and comment on this package. If you have any questions concerning modelling, please contact Mr. Lew Nagler of my staff at (404) 347-5014. Any other questions may be directed to Mr. Gregg Worley of my staff, also at (404) 347-5014.

Sincerely yours,

Reginald S. Barnes/for

Jewell A. Harper, Chief
Air Enforcement Branch
Air, Pesticides, and Toxics
Management Division

cc: J. Reynolds
C. Holladay
B. Thomas, SW Dist,
C. Shaver, NPS
M. Whiting
CHF/PL

MARCH 3, 1849

United States Department of the Interior

TAKE PRIDE IN AMERICA

FISH AND WILDLIFE SERVICE
75 Spring Street, S.W.
Atlanta, Georgia
30303

RECEIVED
JUN 18 1992
Division of Air
Resources Management

June 12, 1992

Mr. C. H. Fancy
Chief, Bureau of Air Regulation
Florida Department of
Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Dear Mr. Fancy:

We have completed our review of the material that you sent us regarding Ridge Generating Station Limited Partnership's (RGSLP) proposal to construct and operate a 45-MW electric power generating station in Polk County. The Ridge Generating Station would be located near Lakeland, approximately 100 km southeast of the Chassahowitzka Wilderness Area (WA), a Class I air quality area administered by the Fish and Wildlife Service. The facility would consist of one boiler designed to burn a mixture of fuels including wood, tires, and landfill gas. This fuel mix would result in significant emissions of sulfur dioxide (SO_2), nitrogen oxides, volatile organic compounds, particulate matter, lead, and beryllium. Based on concerns we have expressed in previous letters to you regarding increment consumption at the Chassahowitzka WA, we are particularly concerned about SO_2 emissions from the proposed facility.

We were pleased to see that you required RGSLP to perform extensive SO_2 increment modeling analyses for the Chassahowitzka WA. Following consultations with us, RGSLP performed long range transport modeling using MESOPUFF II to evaluate their impact alone, plus their impact combined with other SO_2 increment-consuming sources, on the wilderness area. After reviewing the results of the modeling analyses, we are satisfied that the proposed Ridge Generating Station would not contribute significantly to an increment exceedance at the Chassahowitzka WA.

In addition, we agree that the proposed dry scrubber/baghouse and selective noncatalytic reduction systems represent best available control technology to minimize emissions from the boiler. Regarding the air quality related values analyses, RGSLP sufficiently addressed potential impacts to vegetation, soils and visibility in the wilderness area. However, RGSLP failed to address potential impacts to freshwater creeks and related wildlife in the wilderness area from acid deposition. Nevertheless, based on the distance from the Chassahowitzka WA and the modeling results, we do not anticipate that resources will be adversely affected by emissions from the proposed facility.

We appreciate your continued cooperation in requiring applicants to adequately assess the impacts of new emissions on the resources in our Class I areas. If you have any further questions regarding our comments on the Ridge Generating Station application, please contact Ms. Tonnie Maniero of our Air Quality Office in Denver at 303/969-2071.

Sincerely yours,

John R. Eadie

for James W. Pulliam, Jr.
Regional Director

cc:
Ms. Jewell Harper, Chief
Air Enforcement Branch
Air, Pesticides and Toxic Management Division
U.S. EPA, Region 4
345 Courtland Street, NE
Atlanta, Georgia 30365

J. Reynolds
C. Holladay
B. Thomas, SW Dist.

Florida Department of Environmental Regulation
Twin Towers Office Bldg. ● 2600 Blair Stone Road ● Tallahassee, Florida 32399-2400
Lawton Chiles, Governor
Carol M. Browner, Secretary

June 22, 1992

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

Mr. Macauley Whiting, Jr., President
Decker Energy - Ridge, Inc.
P.O. Box 2397
Winter Park, Florida 32790

Dear Mr. Whiting:

Attached is one copy of the Technical Evaluation and Preliminary Determination and proposed permit for Ridge Generating Station to construct a wood/tire burning power generation facility near Auburndale, Polk County, Florida.

Please submit any written comments you wish to have considered concerning the Department's proposed action to Mr. Preston Lewis of the Bureau of Air Regulation.

Sincerely,

for Janet K. Pennington
C. H. Fancy, P.E.
Chief
Bureau of Air Regulation

CHF/JR/plm

Attachments

c: W. Thomas, SWD
R. Anders, Polk County
J. Harper, EPA
C. Shaver, NPS
T. Fitzpatrick, P.E.
M. Killeen, WESI
J. Little, D&M
R. Stone, RGS

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

CERTIFIED MAIL

In the Matter of an
Application for Permit by:

Decker Energy - Ridge, Inc.
P.O. Box 2397
Winter Park, Florida 32790
_______________________________/

DER File No. AC 53-206244
PSD-FL-183
Polk County

INTENT TO ISSUE

The Department of Environmental Regulation gives notice of its intent to issue a permit (copy attached) for the proposed project as detailed in the application specified above, for the reasons stated in the attached Technical Evaluation and Preliminary Determination.

The applicant, Ridge Generating Station, L.P., applied on April 6, 1992, to the Department of Environmental Regulation for a permit to construct a wood/tire burning power generation facility near Auburndale in Polk County, Florida.

The Department has permitting jurisdiction under the provisions of Chapter 403, Florida Statutes and Florida Administrative Code (F.A.C.) Chapters 17-2 and 17-4. The project is not exempt from permitting procedures. The Department has determined that a construction permit is required for the proposed work.

Pursuant to Section 403.815, Florida Statutes and Rule 17-103.150, F.A.C., you (the applicant) are required to publish at your own expense the enclosed Notice of Intent to Issue Permit. The notice shall be published one time only within 30 days in the legal ad section of a newspaper of general circulation in the area affected. For the purpose of this rule, "publication in a newspaper of general circulation in the area affected" means publication in a newspaper meeting the requirements of Sections 50.011 and 50.031, F.S., in the county where the activity is to take place. The applicant shall provide proof of publication to the Department's Bureau of Air Regulation, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400, within seven days of publication. Failure to publish the notice and provide proof of publication within the allotted time may result in the denial of the permit.

The Department will issue the permit with the attached conditions unless a petition for an administrative proceeding (hearing) is filed pursuant to the provisions of Section 120.57, F.S.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) in accordance with Section 120.57, Florida Statutes. The petition must contain the information set forth below and must be filed (received) in the Office of General Counsel of the Department at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400. Petitions filed by the permit applicant and the parties listed below must be filed within 14 days of receipt of this intent. Petitions filed by other persons must be filed within 14 days of publication of the public notice or within 14 days of their receipt of this intent, whichever first occurs. Petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. Failure to file a petition within this time period shall constitute a waiver of any right such person may have to request an administrative determination (hearing) under Section 120.57, Florida Statutes.

The Petition shall contain the following information;

(a) The name, address, and telephone number of each petitioner, the applicant's name and address, the Department Permit File Number and the county in which the project is proposed;
(b) A statement of how and when each petitioner received notice of the Department's action or proposed action;
(c) A statement of how each petitioner's substantial interests are affected by the Department's action or proposed action;
(d) A statement of the material facts disputed by Petitioner, if any;
(e) A statement of facts which petitioner contends warrant reversal or modification of the Department's action or proposed action;
(f) A statement of which rules or statutes petitioner contends require reversal or modification of the Department's action or proposed action; and
(g) A statement of the relief sought by petitioner, stating precisely the action petitioner wants the Department to take with respect to the Department's action or proposed action.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this intent. Persons whose substantial interests will be affected by any decision of the Department with regard to the application have the right to petition to become a party to the proceeding. The petition must conform to the requirements specified above and be filed (received) within 14 days of receipt of this intent in the Office of General Counsel at the above address of the Department. Failure to petition within the allowed time frame constitutes a waiver of any right such person has to request a hearing under Section 120.57, F.S., and to participate as a party to this proceeding. Any subsequent intervention will only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-5.207, F.A.C.

Executed in Tallahassee, Florida.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL REGULATION

for C. H. Fancy, P.E., Chief
Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, Florida 32399
904-488-1344

CERTIFICATE OF SERVICE

The undersigned duly designated deputy clerk hereby certifies that this INTENT TO ISSUE and all copies were mailed by certified mail before the close of business on 6-24-92 to the listed persons.

Clerk Stamp

FILING AND ACKNOWLEDGMENT
FILED, on this date, pursuant to §120.52(11), Florida Statutes, with the designated Department Clerk, receipt of which is hereby acknowledged.

Clerk 6-24-92
Date

Copies furnished to:
- W. Thomas, SWD
- R. Anders, Polk County
- J. Harper, EPA
- C. Shaver, NPS
- T. Fitzpatrick, P.E.
- M. Killeen, WESI
- J. Little, D&M
- R. Stone, RGS

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION
NOTICE OF INTENT TO ISSUE PERMIT

The Department of Environmental Regulation gives notice of its intent to issue a permit to Ridge Generating Station, P.O. Box 2397, Winter Park, Florida 32790, to construct a wood/tire burning power generation facility at State Road 542 and Taylor Road near Auburndale, Polk County, Florida. A determination of Best Available Control Technology (BACT) was required. The proposed project is subject to Prevention of Significant Deterioration (PSD) regulations. Modeling results show that increases in ground-level concentrations are less than PSD significant impact levels for the applicable pollutants. The Department is issuing this Intent to Issue for the reasons stated in the Technical Evaluation and Preliminary Determination.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) in accordance with Section 120.57, Florida Statutes. The petition must contain the information set forth below and must be filed (received) in the Office of General Counsel of the Department at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400, within 14 days of publication of this notice. Petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. Failure to file a petition within this time period shall constitute a waiver of any right such person may have to request an administrative determination (hearing) under Section 120.57, Florida Statutes.

The Petition shall contain the following information; (a) The name, address, and telephone number of each petitioner, the applicant's name and address, the Department Permit File Number and the county in which the project is proposed; (b) A statement of how and when each petitioner received notice of the Department's action or proposed action; (c) A statement of how each petitioner's substantial interests are affected by the Department's action or proposed action; (d) A statement of the material facts disputed by Petitioner, if any; (e) A statement of facts which petitioner contends warrant reversal or modification of the Department's action or proposed action; (f) A statement of which rules or statutes petitioner contends require reversal or modification of the Department's action or proposed action; and (g) A statement of the relief sought by petitioner, stating precisely the action petitioner wants the Department to take with respect to the Department's action or proposed action.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this Notice. Persons whose substantial interests will be affected by any decision of the Department with regard to the application have the right to petition to become a party to the proceeding. The petition must conform to the requirements specified above and be filed (received) within 14 days of publication of this notice in the Office of General Counsel at the above address of the Department. Failure to petition within the allowed time frame constitutes a waiver of any right such person has to request a hearing under Section 120.57, F.S., and to participate as a party to this proceeding. Any subsequent intervention will only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-5.207, F.A.C.

The application is available for public inspection during normal business hours, 8:00 a.m. to 5:00 p.m., Monday through Friday, except legal holidays, at:

Department of Environmental Regulation
Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Department of Environmental Regulation
Southwest District
4520 Oak Fair Blvd.
Tampa, Florida 33610-7347

Any person may send written comments on the proposed action to Mr. Preston Lewis at the Department's Tallahassee address. All comments received within 30 days of the publication of this notice will be considered in the Department's final determination. Further, a public hearing can be requested by any person. Such requests must be submitted within 30 days of this notice.

Technical Evaluation
and
Preliminary Determination

Ridge Generating Station
Polk County, Florida

PSD-FL-183
AC 53-206244

Department of Environmental Regulation
Division of Air Resources Management
Bureau of Air Regulation

June 22, 1992

I. Application Information

A. Applicant

Ridge Generating Station, L.P.
P.O. Box 2397
Winter Park, FL 32790

B. Request

The Department received a complete application on April 6, 1992, for a permit to construct a 45 megawatt (MW) independent power generation facility known as the Ridge Generating Station (RGS) near Auburndale, Polk County, Florida.

C. Classification/Location

The subject facility (SIC Code 4911) will be located at State Road 542 and Taylor Road near Auburndale, Florida. The UTM coordinates of the site are 416.7 km E and 3100.4 km N.

II. Project Description/Emissions

The applicant proposes to construct a 45 MW power generation facility consisting of a solid-fuel boiler, steam turbine, generator, and associated equipment. The RGS boiler will fire a mixture of waste wood, scrap tires, and landfill gas. Propane will be used for boiler startup and combustion stabilization. Fuel mix possibilities include wood, wood and tires, or a combination of wood, tires, and landfill gas from the adjacent Polk County North Central Landfill. No other fuels will be required. The RGS facility will not be permitted to burn any municipal solid waste or hazardous waste as defined in applicable federal and state regulations.

State-of-the-art emission control equipment will include a spray dryer-absorber/fabric filter for control of particulates and acid gases as well as most toxics and metals. The spray dryer-absorber employs an atomized lime-water solution to react with sulfur dioxide in the boiler flue gases. The dried compounds of calcium thus formed will be removed by the fabric filter. Nitrogen oxides will be controlled by selective noncatalytic reduction (SNCR) which reduces NO_x to elemental nitrogen by injecting ammonia into the boiler furnace.

The applicant's estimated actual emissions for three anticipated fuel mix scenarios (based on heat input percentages using the applicant's proposed emission limits) are tabulated below. Since the hours of operation under each of the three scenarios are unknown, and since other fuel mix percentages will also occur, projections of maximum proposed annual emissions would be based on the maximums for these anticipated fuel mix cases.

	100% Wood		80% Wood 20% Tires		75% Wood/15% Tires 10% Landfill Gas		PSD Level
	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	tons/yr
PM/PM_{10}	12.6	55.2	12.6	55.2	12.6	55.2	25/10
SO_2	69.4	304.0	109.4	479.2	92.5	405.2	40
NO_x	94.5	413.9	94.5	413.9	94.5	413.9	40
CO	315.0	1,379.7	315.0	1,379.7	315.0	1,379.7	100
VOC	22.1	96.6	22.1	96.6	22.1	96.6	40
NH3	17.8	78.0	17.8	78.0	17.8	78.0	-
C6H6	5.0	21.9	5.0	31.9	5.0	21.9	-
HCHO	1.7	7.5	1.7	7.5	1.7	7.5	-
HCL	5.0	22.1	5.0	22.1	5.0	22.1	-
Pb	0.25	1.1	0.25	1.1	0.25	1.1	0.6
Zn	0.63	2.8	0.63	2.8	0.63	2.8	-
Hg	0.02	0.1	0.02	0.1	0.02	0.1	0.1
Be	.0063	0.03	.0063	0.03	.0063	0.03	.0004

III. Rule Applicability

The construction permit application is subject to review under Chapter 403, Florida Statutes, and Florida Administrative Code (F.A.C.) Chapters 17-2 and 17-4. The proposed facility is subject to the provisions of F.A.C. Rule 17-2.500, Prevention of Significant Deterioration (PSD). The facility is located in an area classified as attainment for all regulated air pollutants. Proposed emissions of PM/PM_{10}, SO_2, NO_x, CO, VOC, Pb, Hg, and Be equal or exceed the significant levels set forth in Table 500-2 of F.A.C. Rule 17-2.500. Preconstruction review must include a determination of Best Available Control Technology (BACT), good-engineering practice stack height, ambient impact analysis, impact on soils, vegetation and visibility. Applicable emission limit rules are F.A.C. Rules 17-2.660, Table 660-1, Section 60.40b, Subpart Db, 60.43b (c)(1), (f) and (g), 60.44b (d), Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units. For the ash handling system and lime silo, applicable rules are F.A.C. Rules 17-2.610(2) and (3). The above rules would dictate limits except that BACT limits are more stringent and therefore apply.

IV. Air Quality Analysis

a. Introduction

The operation of the proposed facility will result in emissions increases which are projected to be greater than the PSD significant emission rates for the following pollutants: NO_x, SO_2, PM, PM_{10}, Be, CO, VOC, Pb, and Hg. Therefore, the project is subject to the PSD NSR requirements contained in F.A.C. Rule 17-2.500(5) for these pollutants. Part of these requirements is an air quality impact analysis for these pollutants, which includes:

- An analysis of existing air quality;
- A PSD increment analysis (for SO_2, PM, PM_{10}, and NO_x);
- An ambient Air Quality Standards analysis (AAQS);
- An analysis of impacts on soils, vegetation, visibility and growth-related air quality impacts; and,
- A Good Engineering Practice (GEP) stack height determination

The analysis of existing air quality generally relies on preconstruction monitoring data collected in accordance with EPA-approved methods. The PSD increment and AAQS analyses are based on air quality dispersion modeling completed in accordance with EPA guidelines.

Based on these required analyses, the Department has reasonable assurance that the proposed project, as described in this report and subject to the conditions of approval proposed herein, will not cause or contribute to a violation of any PSD increment or ambient air quality standard. A brief description of the modeling methods used and results of the required analyses follow. A more complete description is contained in the permit application on file.

b. Analysis of the Existing Air Quality

Preconstruction ambient air quality monitoring may be required for pollutants subject to PSD review. However, an exemption to the monitoring requirement can be obtained if the maximum air quality impact resulting from the projected emissions increase, as determined through air quality modeling, is less than a pollutant-specific de minimus concentration. The predicted maximum concentration increase for each pollutant subject to PSD (NSR) is given below:

	SO_2	TSP & PM10	NO_x	CO	Be	Pb	Hg
PSD de minimus Concentra. (ug/m^3)	13	10	14	575	0.001	0.1	0.25
Averaging Time	24-hr	24-hr	Annual	8-hr	24-hr	3 mo.	24-hr
Maximum Predicted Impact (ug/m^3)	4.4	0.5	0.4	35	.0003	<.01	0.0009

There are no monitoring de minumus concentrations for VOC emissions. As shown above, the predicted impacts are all less than the corresponding de minimus concentrations; therefore, no preconstruction monitoring is required for these pollutants.

c. Modeling Method

The EPA-approved Industrial Source Complex Short-Term (ISCST) dispersion model was used by the applicant to predict the impact of the proposed project on the surrounding ambient air. All recommended EPA default options were used. No downwash effects were considered because the stacks will be equal to the good engineering practice (GEP) stack height. Five years of sequential hourly surface and mixing depth data from the Tampa Florida National Weather Service (NWS) station collected during 1982 through 1986 were used in the model. Since five years of data were used, the highest-second-high (HSH) short-term predicted concentrations are compared with the appropriate ambient air quality standards or PSD increments. For the annual averages, the highest predicted yearly average was compared with the standards.

d. Modeling Results

The applicant first evaluated the potential increase in ambient ground-level concentrations associated with the project to determine if these predicted ambient concentration increases would be greater than specified PSD significant impact levels for criteria pollutants SO_2, CO, NO_2, PM and PM_{10}. This evaluation was based on the proposed boiler operating at load conditions of 100, 75, and 50 percent. The modeling was performed using the highest emissions coupled with the lowest exit gas flow rates to maximize predicted impacts. Maximum modeled emissions were based on the use of the wood/tire combination for fuel. The maximum predicted concentrations occur for either the 100% or the 75% operating load. Dispersion modeling was performed with receptors placed along the 36 standard radial directions (10 degrees apart) surrounding the proposed unit beginning at 250m and going out at intervals of 250m to a distance of 3000m from the proposed boiler. The results of this modeling presented below show that the increases in ambient ground-level concentrations for all averaging times are less than the PSD significant impact levels for SO_2, CO, NO_2, PM and PM_{10}.

	SO_2			NO2	CO		PM and PM_{10}	
Avg. Time	Annual	3-hr	24-hr	Annual	1-hr	8-hr	Ann.	24-hr
PSD Signifi. Level (ug/m^3)	1.0	25.0	5.0	1.0	2000	800	1.0	5.0
Ambient Concen. Increase (ug/m^3)	0.4	18.7	4.4	0.4	126	35	0.05	0.5

Therefore, further dispersion modeling for comparison with AAQS and PSD Class II increment consumption were not required for these pollutants. There is currently no acceptable method to model VOC for ozone formation. Pb has no significant impact level; however, maximum predicted Pb concentrations were less than the 1.5 ug/m^3 quarterly ambient air quality standard.

Be and Hg are noncriteria pollutants, which means that neither national AAQS nor PSD Significant Impacts have been defined for these pollutants. However, the Department does have a draft

Air Toxics Permitting Strategy, which defines no threat levels for these pollutants. The Department and the applicant have used the same modeling procedure described above to evaluate the maximum increase in ground level concentration of these pollutants for comparison with the no-threat levels. The results of this analysis are shown below:

	Be	Hg
Avg. Time	Annual	24-hr
No Threat-Level (ug/m^3)	0.00042	0.3
Max. Concen. Increase	0.00002	0.00008

All of these values are less than their respective no-threat levels.

The nearest PSD Class I area is the Chassahowitzka National Wilderness Area located 100 km northwest of the facility. The predicted impact of the proposed project on this area was evaluated by first using the ISCST model to predict maximum increment consumptions by the source alone and by comparing these predicted values to the appropriate recommended significance levels to determine whether further modeling was necessary. The significance levels used by the Department were the more stringent National Park Service (NPS) recommended levels. The predicted maximum PM/PM_{10} and NO_2 increment consumptions for all applicable averaging times were less than these significance levels. Therefore, no further modeling for PM/PM_{10} and NO_2 was required. In addition, the predicted maximum SO_2 annual average increment consumption by the source alone was also below the NPS significance level. However, the predicted maximum SO_2 24-hour and 3-hour concentrations were predicted to be greater than the NPS levels. The Department and the NPS directed the applicant to further evaluate the SO_2 short term impacts on the Class I area by using the long range transport model, Mesopuff. This model is more applicable for distances greater than 100km. Mesopuff model results show that the maximum predicted SO_2 3-hour average increment consumption for the project alone is predicted to be below the NPS significance level of 0.48 ug/m^3. Therefore, no further modeling was necessary for the SO_2 3-hour averaging time. For the SO_2 24-hour averaging case, Mesopuff results show that when the project alone is predicted to have impacts greater than the NPS significance level of 0.07 ug/m^3 (maximum predicted impact of 0.09 ug/m^3) cumulative impacts from all modeled sources in the area are less than the PSD Class I increment of 5.0 ug/m^3.

e. Additional Impacts Analysis

A Level-1 screening analysis using the EPA model, VISCREEN was used to determine any potential adverse visibility impacts on the Class I Chassahowitzka National Wilderness Area located about 100km away. Based on this analysis, the maximum predicted visual impacts due to the proposed project are less than the screening criteria both inside and outside the Class I area. A comprehensive air quality related values (AQRV) analysis for this Class I area was performed by the applicant. No significant impacts on the Class I area are expected.

In addition, the maximum predicted concentrations from NOx, CO, SO_2, PM and PM_{10} are predicted to be less than the AAQS, including the national secondary standards designed to protect public welfare-related values. As such, no harmful effects on soil and vegetation are expected in the area of the project. Also, the proposed modification will not significantly change employment, population, housing or commercial/industrial development in the area to the extent that a significant air quality impact will result.

V. Air Toxics Evaluation

Based on extensive test data for other facilities that burn tires, only negligible quantities of toxic pollutants will escape the emission control equipment and therefore are of no environmental concern.

VI. Conclusion

Based on the information provided by Ridge Generating Station, the Department has reasonable assurance that the proposed installation, as described in this evaluation, and subject to the conditions proposed herein, will not cause or contribute to a violation of any air quality standard, PSD increment, or any other technical provision of Chapter 17-2 of the Florida Administrative Code.

Preston Lewis
PE # 41755

e. Additional Impacts Analysis

A Level-1 screening analysis using the EPA model, VISCREEN was used to determine any potential adverse visibility impacts on the Class I Chassahowitzka National Wilderness Area located about 100km away. Based on this analysis, the maximum predicted visual impacts due to the proposed project are less than the screening criteria both inside and outside the Class I area. A comprehensive air quality related values (AQRV) analysis for this Class I area was performed by the applicant. No significant impacts on the Class I area are expected.

In addition, the maximum predicted concentrations from NOx, CO, SO_2, PM and PM_{10} are predicted to be less than the AAQS, including the national secondary standards designed to protect public welfare-related values. As such, no harmful effects on soil and vegetation are expected in the area of the project. Also, the proposed modification will not significantly change employment, population, housing or commercial/industrial development in the area to the extent that a significant air quality impact will result.

V. Air Toxics Evaluation

Based on extensive test data for other facilities that burn tires, only negligible quantities of toxic pollutants will escape the emission control equipment and therefore are of no environmental concern.

VI. Conclusion

Based on the information provided by Ridge Generating Station, the Department has reasonable assurance that the proposed installation, as described in this evaluation, and subject to the conditions proposed herein, will not cause or contribute to a violation of any air quality standard, PSD increment, or any other technical provision of Chapter 17-2 of the Florida Administrative Code.

PE #41755

PRESTON LEWIS
No. 41755

Florida Department of Environmental Regulation
Twin Towers Office Bldg. ● 2600 Blair Stone Road ● Tallahassee, Florida 32399-2400
Lawton Chiles, Governor
Carol M. Browner, Secretary

PERMITTEE:
Ridge Generating Station, L.P.
P. O. Box 2397
Winter Park, Florida 32790

Permit Number: AC 53-206244
PSD-FL-183
Expiration Date: December 31, 1994
County: Polk
Latitude/Longitude: ° ' "N
° ' "W
Project: Wood/Tire Burning Power Generation Facility

This permit is issued under the provisions of Chapter 403, Florida Statutes, and Florida Administrative Code Chapters 17-2 and 17-4. The above named permittee is hereby authorized to perform the work or operate the facility shown on the application and approved drawings, plans, and other documents attached hereto or on file with the Department and made a part hereof and specifically described as follows:

For the construction of a 45 Megawatt power generation facility to be located at State Road 542 and Taylor Road near Auburndale, Polk County, Florida. The UTM coordinates are 416.7 km East and 3,100.4 km North.

The source shall be constructed in accordance with the permit application, plans, documents, amendments and drawings, except as otherwise noted in the General and Specific Conditions.

Attachments are listed below:

1. DER incompleteness letter dated 1-17-92.
2. RGS letter dated 3-19-92.
3. RGS letter dated 3-27-92.
4. RGS submittal received 4-6-92.

GENERAL CONDITIONS:

1. The terms, conditions, requirements, limitations, and restrictions set forth in this permit are "Permit Conditions" and are binding and enforceable pursuant to Sections 403.161, 403.727, or 403.859 through 403.861, Florida Statutes. The permittee is placed on notice that the Department will review this permit periodically and may initiate enforcement action for any violation of these conditions.

2. This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviation from the approved drawings, exhibits, specifications, or conditions of this permit may constitute grounds for revocation and enforcement action by the Department.

3. As provided in Subsections 403.087(6) and 403.722(5), Florida Statutes, the issuance of this permit does not convey any vested rights or any exclusive privileges. Neither does it authorize any injury to public or private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations. This permit is not a waiver of or approval of any other Department permit that may be required for other aspects of the total project which are not addressed in the permit.

4. This permit conveys no title to land or water, does not constitute State recognition or acknowledgement of title, and does not constitute authority for the use of submerged lands unless herein provided and the necessary title or leasehold interests have been obtained from the State. Only the Trustees of the Internal Improvement Trust Fund may express State opinion as to title.

5. This permit does not relieve the permittee from liability for harm or injury to human health or welfare, animal, or plant life, or property caused by the construction or operation of this permitted source, or from penalties therefore; nor does it allow the permittee to cause pollution in contravention of Florida Statutes and Department rules, unless specifically authorized by an order from the Department.

6. The permittee shall properly operate and maintain the facility and systems of treatment and control (and related appurtenances) that are installed or used by the permittee to achieve compliance with the conditions of this permit, as required by Department rules. This provision includes the operation of backup or

GENERAL CONDITIONS:

auxiliary facilities or similar systems when necessary to achieve compliance with the conditions of the permit and when required by Department rules.

7. The permittee, by accepting this permit, specifically agrees to allow authorized Department personnel, upon presentation of credentials or other documents as may be required by law and at a reasonable time, access to the premises, where the permitted activity is located or conducted to:

  a. Have access to and copy any records that must be kept under the conditions of the permit;

  b. Inspect the facility, equipment, practices, or operations regulated or required under this permit; and

  c. Sample or monitor any substances or parameters at any location reasonably necessary to assure compliance with this permit or Department rules.

Reasonable time may depend on the nature of the concern being investigated.

8. If, for any reason, the permittee does not comply with or will be unable to comply with any condition or limitation specified in this permit, the permittee shall immediately provide the Department with the following information:

  a. a description of and cause of non-compliance; and

  b. the period of noncompliance, including dates and times; or, if not corrected, the anticipated time the non-compliance is expected to continue, and steps being taken to reduce, eliminate, and prevent recurrence of the non-compliance.

The permittee shall be responsible for any and all damages which may result and may be subject to enforcement action by the Department for penalties or for revocation of this permit.

9. In accepting this permit, the permittee understands and agrees that all records, notes, monitoring data and other information relating to the construction or operation of this permitted source which are submitted to the Department may be used by the Department as evidence in any enforcement case involving the permitted source arising under the Florida Statutes or Department rules, except

GENERAL CONDITIONS:

where such use is prescribed by Sections 403.73 and 403.111, Florida Statutes. Such evidence shall only be used to the extent it is consistent with the Florida Rules of Civil Procedure and appropriate evidentiary rules.

10. The permittee agrees to comply with changes in Department rules and Florida Statutes after a reasonable time for compliance, provided, however, the permittee does not waive any other rights granted by Florida Statutes or Department rules.

11. This permit is transferable only upon Department approval in accordance with Florida Administrative Code Rules 17-4.120 and 17-30.300, F.A.C., as applicable. The permittee shall be liable for any non-compliance of the permitted activity until the transfer is approved by the Department.

12. This permit or a copy thereof shall be kept at the work site of the permitted activity.

13. This permit also constitutes:

    (x) Determination of Best Available Control Technology (BACT)
    (x) Determination of Prevention of Significant Deterioration (PSD)
    (x) Compliance with New Source Performance Standards (NSPS)

14. The permittee shall comply with the following:

    a. Upon request, the permittee shall furnish all records and plans required under Department rules. During enforcement actions, the retention period for all records will be extended automatically unless otherwise stipulated by the Department.

    b. The permittee shall hold at the facility or other location designated by this permit records of all monitoring information (including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation) required by the permit, copies of all reports required by this permit, and records of all data used to complete the application for this permit. These materials shall be retained at least

GENERAL CONDITIONS:

three years from the date of the sample, measurement, report, or application unless otherwise specified by Department rule.

c. Records of monitoring information shall include:

- the date, exact place, and time of sampling or measurements;
- the person responsible for performing the sampling or measurements;
- the dates analyses were performed;
- the person responsible for performing the analyses;
- the analytical techniques or methods used; and
- the results of such analyses.

15. When requested by the Department, the permittee shall within a reasonable time furnish any information required by law which is needed to determine compliance with the permit. If the permittee becomes aware that relevant facts were not submitted or were incorrect in the permit application or in any report to the Department, such facts or information shall be corrected promptly.

SPECIFIC CONDITIONS:

1. Unless otherwise indicated, the construction and operation of the Ridge Generating Station (RGS) facility shall be in accordance with the capacities and specifications stated in the revised application.

2. The RGS facility shall be allowed to operate at a maximum capacity of 45 Megawatts for 8,760 hours per year.

3. Fuel for firing the RGS boiler shall consist only of wood, landfill gas, and up to 9.0 percent tires (percent by weight equivalent to 20 percent tires based on heat content). The 9.0 percent tire weight limitation is equivalent to a tire firing rate of 4,500 pounds of tires per hour.

4. No municipal type solid waste, as defined in 40 CFR 60, Subpart E, and Florida Administrative Code (F.A.C.) Rule 17-2.100, or hazardous waste, as defined in 40 CFR 261 and F.A.C. Rule 17-730.020, shall be burned at any time at the RGS facility.

SPECIFIC CONDITIONS:

5. The RGS boiler exhaust gases shall not exceed the following limits:

Pollutant	Basis(lb/MMBTU)	Lbs/hr	Tons/yr
PM/PM_{10}	0.02	12.6	55.2
SO_2	0.10	63.0	275.9
NO_x	0.11	69.3	303.5
CO	0.21	132.3	579.5
VOC	0.035	22.1	96.6
HCL	0.008	5.0	22.1
Hg	0.000035	0.022	0.1
Pb	0.0004	0.25	1.1
Be	0.00001	0.0063	0.03

The feasibility of establishing rolling average limits in addition to or in lieu of the above limits will be determined after analysis of compliance test data.

6. SNCR chemical injection into the boiler exhaust gases shall be provided by an automated control system as described in the application. Ammonia emissions shall be continuously monitored at a prevailing downwind location on the RGS property line by commercially available ambient monitoring equipment. The monitoring data shall be reported for the entire operating period from startup to the time that the initial compliance test results are submitted. Thereafter, the monitoring data shall be stored and made available to the Department upon request.

7. Visible emissions from the RGS boiler stack, the ash handling system, and the lime silo shall not exceed 10 percent opacity.

8. Before this construction permit expires, the RGS facility shall be tested for compliance with the emission limits and other requirements specified herein. Annual compliance tests shall be carried out each year thereafter. The compliance tests shall be conducted at 100 percent of permitted capacity. The following EPA test methods shall be followed:

Pollutant	Test Method
PM/PM_{10}	5 (front half only)
SO_2	6C
NO_x	7E

SPECIFIC CONDITIONS:

8. Cont'd

Pollutant	Test Method
CO	10
VOC	25
HCL	26
Hg	101A
Pb	12
Be	104

9. As part of the initial compliance requirement, the permittee shall sample the RGS boiler stack for the following pollutants after proposing acceptable test methods to the Department's Bureau of Air Regulation in Tallahassee. The results of these additional tests shall be reported in lbs/hr and ug/m3 along with the initial compliance test results: Ammonia, Arsenic, Cadmium, Chromium (total), Chromium VI, Zinc Oxide, Benzene, Sulfuric Acid, Polychlorinated Biphenyls (PCBs), Dioxins/Furans.

10. Continuous monitoring equipment shall be installed and operated to measure and record generator output, furnace temperature, stack opacity, and SO_2, NO_x and CO emissions. The tire feed rate in pounds per hour shall be monitored continuously by a commercially available weight detecting system with recording capability. The tire feed rate data shall be maintained and provided to the Department upon request.

11. Fugitive emissions from the RGS material receiving, processing, storage and transfer operations shall be determined according to EPA Method 22 over a 3-day period that is representative of typical operation. Results of the fugitive emissions survey shall be reported along with the compliance test results.

12. All reasonable precautions set forth in F.A.C. Rule 17-2.610(3), as well as all measures proposed by the permittee in the application, shall be taken by the permittee to prevent fugitive emissions.

13. In the event of any malfunction resulting in failure of emission control equipment or emission-related process equipment to perform as required by this permit, the operator shall immediately stop the feeding of tires into the boiler and shall use propane firing to maintain a minimum of 1800 degrees F in the combustion zone until all tires in the system have been combusted. No tires

SPECIFIC CONDITIONS:

may be refed into the boiler following the malfunction until the emission control equipment has been put into proper working order.

14. Whenever the baghouse bypass is activated during an on-line operating situation for any reason, the permittee shall, within 24 hours, provide the Department's Southwest District Office with a complete report of the circumstances and reasons for the occurrence, indicating the amounts of pollutants estimated to have been discharged during the bypass period.

15. No pollutants shall be discharged from the RGS facility which cause or contribute to an objectionable odor (F.A.C. Rule 17-2.620(2)).

16. The Department's Southwest District office shall be notified at least 30 days prior to the compliance tests. Compliance test results and other required submittals shall be submitted to the Department's Southwest District office and the Department's Bureau of Air Regulation Office in Tallahassee within 45 days after completion of the tests. Sampling facilities, methods, and reporting shall be in accordance with F.A.C. Rule 17-2.700 and 40 CFR 60, Appendix A. Along with the submittal to the Department's Bureau of Air Regulation Office, the permittee shall include a revised BACT application.

17. Within 90 days of receipt of initial compliance test results and the permittee's revised BACT application, the Department's Bureau of Air Regulation in Tallahassee shall revise the BACT determination and permit limits and conditions as required with the goal of allowing the RGS facility to be operated in an environmentally responsible manner. Revisions may include additional emission limits for other air pollutants as well as separate limits for specific operating conditions.

18. The permittee, for good cause, may request that this construction permit be extended. Such a request shall be submitted to the Department's Bureau of Air Regulation in Tallahassee prior to 60 days before the expiration of the permit (F.A.C. Rule 17-4.090)

19. An application for an operation permit including an operation and maintenance plan must be submitted to the Department's Southwest District office at least 90 days prior to the expiration date of this construction permit or within 45 days after completion

SPECIFIC CONDITIONS:

of compliance testing, whichever occurs first. To properly apply for an operation permit, the applicant shall submit the appropriate application form, fee, certification that construction was completed noting any deviations from the conditions in the construction permit, and compliance test reports as required by this permit (F.A.C. Rule 17-4.220).

Issued this ______ day
of ______________, 1992

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL REGULATION

____
Carol M. Browner, Secretary
Department of Environmental
Regulation

Best Available Control Technology (BACT) Determination
Ridge Generating Station
Polk County

The applicant proposes to construct a 45 MW power generation facility to be named the Ridge Generating Station and located near Auburndale in Polk County, Florida. The facility will consist of a solid fuel boiler, steam turbine, generator and associated equipment. Fuel for the facility will consist of a mixture of waste wood, scrap tires, and landfill gas.

A BACT determination is required for all regulated air pollutants emitted in amounts equal to or greater than the significant emission rates listed in Table 500-2 of Florida Administrative Code (F.A.C.) Rule 17-2.500. Maximum annual emissions proposed by the applicant are tabulated below and in the Technical Evaluation and Preliminary Determination. Maximum allowable emissions as determined from the BACT determination are listed below in tons per year (based on burning 80% wood/20% tires):

	Maximum Allowable Emissions		
Pollutant	Proposed by RGS	Proposed by DER	PSD Level
PM/PM_{10}	55.2	55.2	25/10
SO_2	479.2	275.9	40
NO_x	413.9	303.5	40
CO	1,379.7	579.5	100
VOC	96.6	96.6	40
HCL	22.1	22.1	-
Hg	0.1	0.1	0.1
Pb	1.1	1.1	0.6
Be	0.03	0.03	0.0004

Date of Receipt of a Complete Application

April 6, 1992

BACT Determination Requested by Applicant

Control Technology:
Spray Dryer-Absorber/Fabric Filter
Selective Noncatalytic Reduction (SNCR)
Combustion Efficiency

Emission Limits:

PM/PM_{10}	0.02 lb/MMBTU
SO_2	0.17 lb/MMBTU
NO_x	0.15 lb/MMBTU
CO	0.50 lb/MMBTU
VOC	0.035 lb/MMBTU
Pb	0.0004 lb/MMBTU
Be	0.00001 lb/MMBTU

BACT Determined by the Department

Control Technology:
Spray Dryer-Absorber/Fabric Filter
Selective Noncatalytic Reduction (SNCR)
Combustion Efficiency

Emission Limits:	PM/PM_{10}	0.02 lb/MMBTU*
	SO_2	0.10 lb/MMBTU*
	NO_x	0.11 lb/MMBTU*
	CO	0.21 lb/MMBTU*
	VOC	0.035 lb/MMBTU*
	Hg	0.000035 lb/MMBTU**
	Pb	0.0004 lb/MMBTU*
	Be	0.00001 lb/MMBTU*

* Initial limits to be revised if necessary, following compliance tests.

** Hg considered as PSD significant due to rounding 0.096 to 0.1 TPY.

BACT Determination Procedure

In accordance with F.A.C. Chapter 17-2, this BACT determination is based on the maximum degree of reduction of each pollutant emitted which the Department, on a case by case basis, taking into account energy, environmental and economic impacts, and other costs, determines is achievable through application of production processes and available control methods, systems and techniques. In addition, the regulations require that in making the BACT determination the Department shall give consideration to:

(a) Any Environmental Protection Agency determination of Best Available Control Technology pursuant to Section 169, and any emission limitation contained in 40 CFR Part 60 (Standards of Performance for New Stationary Sources) or 40 CFR Part 61 (National Emission Standards for Hazardous Air Pollutants).

(b) All scientific, engineering and technical material and other information available to the Department.

(c) The emission limiting standards or BACT determinations of any other State.

(d) The social and economic impact of the application of such technology.

The EPA currently stresses that BACT should be determined using the "top-down" approach. The first step in this approach is to determine for the emission source in question the most stringent control available for a similar or identical source or source category. If it is shown that this level of control is technically or economically infeasible for the source in question, then the next most stringent level of control is determined and similarly evaluated. This process continues until the BACT level under consideration cannot be eliminated by any substantial or unique technical, environmental, or economic objections.

BACT Determination Rationale

A review of EPA's BACT/LAER Clearinghouse indicates that there are no existing sources using the fuel mix proposed for the RGS facility. Therefore, the Department has proposed initial emission limits and permit conditions that may be revised if necessary following the compliance tests. The preliminary limits are based on the more stringent permit limits listed in the BACT/LAER Clearinghouse data. Since there are significant differences between existing wood/tire burning units and the proposed RGS facility, and since this facility is the first of its kind, the only reasonable approach would involve a two-step BACT determination; a preliminary followed by a final determination based on compliance test results. This two-step procedure will allow the applicant to revise their current "preliminary" BACT application prior to the final BACT determination in regard to setting final limits and conditions.

The Department believes that the applicant has selected the best control technology available based on a review of the literature and permit requirements for similar facilities. To confirm this, the applicant's final BACT application should include a detailed analysis of the economic justification for the control systems selected, since all of the economic data will be available by that time.

Details of the Analysis May be Obtained by Contacting:

Preston Lewis, P.E., BACT Coordinator
Department of Environmental Regulation
Bureau of Air Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Recommended by:	Approved by:
C. H. Fancy, P.E., Chief Bureau of Air Regulation	Carol M. Browner, Secretary Dept. of Environmental Regulation
1992 Date	1992 Date

SENDER:
- Complete items 1 and/or 2 for additional services.
- Complete items 3, and 4a & b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "Return Receipt Requested" on the mailpiece below the article number.
- The Return Receipt Fee will provide you the signature of the person delivered to and the date of delivery.

I also wish to receive the following services (for an extra fee):

1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:

Mr. MaCauley Whiting, Pres.
Decker Energy-Ridge Inc
P.O. Box 2397
Winter Park, Fl 32790

4a. Article Number
P 710 058 491

4b. Service Type
☐ Registered ☐ Insured
☒ Certified ☐ COD
☐ Express Mail ☐ Return Receipt for Merchandise

7. Date of Delivery 6 28 2

5. Signature (Addressee)

6. Signature (Agent)

8. Addressee's Address (Only if requested and fee is paid)

PS Form **3811**, November 1990 ☆U.S. GPO: 1991—287-066 **DOMESTIC RETURN RECEIPT**

P 710 058 491

Certified Mail Receipt

No Insurance Coverage Provided
Do not use for International Mail
(See Reverse)

UNITED STATES POSTAL SERVICE

Sent to MaCauley Whiting	
Street & No. Decker Energy - Ridge	
P.O., State & ZIP Code Winter PK, Fl	
Postage	$
Certified Fee	
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to Whom & Date Delivered	
Return Receipt Showing to Whom, Date, & Address of Delivery	
TOTAL Postage & Fees	$
Postmark or Date 6-24-92 PSD-F1-183 AC 53-20624K	

PS Form **3800**, June 1990

EPA
Region IV
Atlanta

BEST AVAILABLE COPY

Department of Environmental Regulation

Routing and Transmittal Slip

To: (Name, Office, Location)

1. Ms. Jewell A. Harper
2. U.S. EPA, Region IV
3.
4.

Remarks:

PSD-FL-183
Ridge Generating Station

From: C. H. Fancy

Date: 4-7-92

Phone: 904-488-1344

ADDITIC
CHASS/
RID

DAMES & MOORE

DECKER ENERGY INTERNATIONAL

MACAULEY WHITING, JR.
PRESIDENT

400 N. New York Ave., Suite 101
Post Office Box 2397
Winter Park, Florida 32790
(407) 628-8900

James W. Little
Associate

DAMES & MOORE

SIX PIEDMONT CENTER, SUITE 500
3525 PIEDMONT ROAD
ATLANTA, GEORGIA 30305
(404) 262-2915 FAX (404) 233-2271
A PROFESSIONAL LIMITED PARTNERSHIP

SFT

Consulting Engineers

Thomas J. Fitzpatrick, P.E.
Assistant Manager
Mechanical Engineering

SFT, Inc.
6629 W. Central Avenue
Toledo, Ohio 43617
Phone (419) 843-8200
FAX (419) 843-8020

Matthew P. Killeen
Senior Environmental
Engineer

WHEELABRATOR ENVIRONMENTAL SYSTEMS INC.

Liberty Lane
Hampton, NH 03842
603-929-3420
800-682-0026

Printed on Recycled Paper

File Copy

RECEIVED

APR 06 1992

Bureau of
Air Regulation

ADDITIONAL ASSESSMENT OF IMPACTS ON THE CHASSAHOWITZKA PSD CLASS I AREA FOR THE RIDGE GENERATING STATION PROJECT

APRIL 1992

DAMES & MOORE

ATLANTA, GEORGIA
Job No. 22250-004-049

BEST AVAILABLE COPY

FEDERAL EXPRESS

[redacted]

QUESTIONS? CALL 800-238-5355 TOLL FREE.

AIRBILL
PACKAGE
TRACKING NUMBER

2182831284

2182831284

RECIPIENT'S COPY

1 [redacted]

Date 4-4-92

From (Your Name) Please Print: Jim Little
Your Phone Number (Very Important): (404)-2[illegible]
Company: [illegible]
Department/Floor No.
Street Address: [illegible]
City: [illegible]
State: [illegible]
ZIP Required: [illegible]

2 To (Recipient's Name) Please Print: Clair Fancy
Recipient's Phone Number (Very Important): ( )
Company: Florida Dept. of Enviromental Regulation
Department/Floor No.
Exact Street Address (We Cannot Deliver to P.O. Boxes or P.O. Zip Codes.): 2600 Blair Stone Rd.
City: Tallahassee,
State: FLA.
ZIP Required: 32399-2400

YOUR INTERNAL BILLING REFERENCE INFORMATION (optional) (First 24 characters will appear on invoice.)
22250-004-5108-049

H IF HOLD FOR PICK-UP, Print FEDEX Address Here
Street Address
City
State
ZIP Required

3 PAYMENT 1 ☒ Bill Sender 2 ☐ Bill Recipient's FedEx Acct. No 3 ☐ Bill 3rd Party FedEx Acct. No 4 ☐ Bill Credit Card
5 ☐ Cash/Check
[redacted]

4 SERVICES
(Check only one box)

Priority Overnight
(Delivery by next business morning†)
11 ☐ YOUR PACKAGING
16 ☐ FEDEX LETTER *
12 ☐ FEDEX PAK *
13 ☐ FEDEX BOX
14 ☐ FEDEX TUBE

Standard Overnight
(Delivery by next business afternoon†)
51 ☐ YOUR PACKAGING
56 ☐ FEDEX LETTER *
52 ☐ FEDEX PAK *
53 ☐ FEDEX BOX
54 ☐ FEDEX TUBE

Economy Two-Day
(Delivery by second business day†)
30 ☐ ECONOMY

Government Overnight
(Restricted for authorized users only)
46 ☐ GOVT LETTER
41 ☐ GOVT PACKAGE

Freight Service
(for Extra Large or any package over 150 lbs.)
70 ☐ OVERNIGHT FREIGHT **
80 ☐ TWO-DAY FREIGHT **
(Confirmed reservation required)
† Delivery commitment may be later in some areas
*Declared Value Limit $100
**Call for delivery schedule.

5 DELIVERY AND SPECIAL HANDLING
(Check services required)
1 ☐ HOLD FOR PICK-UP (Fill in Box H)
2 ☒ DELIVER WEEKDAY
3 ☐ DELIVER SATURDAY (Extra charge) (Not available to all locations)
4 ☐ DANGEROUS GOODS (Extra charge)
5 ☐
6 ☐ DRY ICE Lbs
7 ☐ OTHER SPECIAL SERVICE
8 ☐
9 ☐ SATURDAY PICK-UP (Extra charge)
10 ☐
11 ☐
12 ☐ HOLIDAY DELIVERY (If offered) (Extra charge)

6 PACKAGES | WEIGHT In Pounds Only | YOUR DECLARED VALUE
Total | Total | Total
1

RECEIVED
APR [illegible] 1992
Division of Air Resources Management

☐ DIM SHIPMENT (Chargeable Weight) lbs
____ X ____ X ____ = ____
Received At
1 ☐ Regular Stop 3 ☐ Drop Box
4 ☐ B.S.C.
2 ☐ On-Call Stop 5 ☒ Station

Emp. No. Date
☐ Cash Received
☐ Return Shipment
☐ Third Party ☐ Chg. To Del. ☐ Chg. To Hold
Street Address
City State Zip
Received By:
X
Date/Time Received FedEx Employee Number

7 Release Signature:
FedEx Emp. No. Date/Time

Federal Express Use
Base Charges
Declared Value Charge
Other 1
Other 2
Total Charges

REVISION DATE 6/91
PART #137204 FXEM 2/92
FORMAT #099
099
© 1990 91 FEDEX
PRINTED IN U.S.A.

DAMES & MOORE

SIX PIEDMONT CENTER, SUITE 500, 3525 PIEDMONT ROAD, ATLANTA, GEORGIA 30305
(404) 262-2915 FAX: (404) 233-2271

April 3, 1992

Florida Department of Environmental Regulation
Division of Air Resources Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Attention: C.H. Fancy, P.E.
Chief, Bureau of Air Regulation

Re: Permit Application AC 53-206244, PSD-FL-183
Ridge Generating Station

Dear Mr. Fancy:

Item 6 in your letter dated January 17, 1992, requested an additional evaluation of impacts on the Chassahowitzka PSD Class I area resulting from Ridge Generating Station emissions. A summary response to Item 6 was provided in a letter from the project partners dated March 27, 1992. A meeting was then held on April 1, 1992, with Tom Rogers and Cleve Holladay of the Air Modeling and Assessment Section to discuss requirements for a detailed response. The attached report constitutes the detailed response. At the suggestion of Mr. Rogers and Mr. Holladay, we are sending a copy of the report to Mr. John Notar at the Air Quality Division of the National Park Service.

Included in the attached report are the results of an additional modeling evaluation of PSD Class I area impacts. Printouts and computer files supporting these results are being sent under separate cover.

Please call me (404-262-2915) or Matt Killeen at Wheelabrator Environmental Systems (1-800-682-0026) if you have any questions.

Sincerely,

Dames & Moore, Inc.

James W. Little

James W. Little
Associate

Attachments
cc: J. Notar, National Park Service, Air Quality Division ✓
J. Reynolds, Florida Department of Environmental Regulation
C. Holladay, Florida Department of Environmental Regulation
M. Whiting, Decker Energy-Ridge, Inc.
R. Stone, Wheelabrator Polk Inc.
M. Killeen, Wheelabrator Environmental Systems Inc.
Cleve Holladay
Jewell A. Harper, EPA-Region IV } 4-7-92

OFFICES WORLDWIDE

DAMES & MOORE

SIX PIEDMONT CENTER, SUITE 500, 3525 PIEDMONT ROAD, ATLANTA, GEORGIA 30305
(404) 262-2915 FAX: (404) 233-2271

April 3, 1992

Mr. John Notar
National Park Service
Air Quality Division
12795 West Alameda Parkway
Lakewood, Colorado 80228

PSD Class I Impact Evaluation
Ridge Generating Station Project
Auburndale, Florida

Dear Mr. Notar:

Ridge Generating Station Limited Partnership is proposing to develop an independent power production facility near Auburndale, Florida. Known as the Ridge Generating Station (RGS) project, the proposed facility will be capable of combusting a mixture of wood, tires, and landfill gas to generate up to 45 MW of electricity.

An air emissions permit application for the project was submitted to the Florida Department of Environmental Regulation (DER) in December 1991. We understand that a copy of the application was forwarded by DER to the Air Quality Division of the National Park Service during DER's initial application completeness review. After reviewing the application, DER requested that an additional evaluation be performed on the impacts of RGS emissions at the Chassahowitzka PSD Class I area. That additional evaluation is the subject of the attached report. DER suggested that we send a copy of the report directly to your office.

The primary subject of the attached report is an additional modeling evaluation of sulfur dioxide impacts. In reviewing this section of the report, we request that you keep in mind the sulfur dioxide control system that will be installed at RGS as described in the original permit application. This system will consist of a spray dryer absorber (scrubber) and fabric filter, which will provide for very effective sulfur oxides control. Use of a flue gas desulfurization system on a boiler fueled predominantly by wood demonstrates the commitment of the project developers to minimize sulfur oxides emissions.

Please call if you have any questions.

Sincerely,

Dames & Moore, Inc.

James W. Little

James W. Little
Associate

Attachment

cc: C. Holladay, Florida DER
M. Whiting, Decker Energy-Ridge, Inc.
R. Stone, Wheelabrator Polk Inc.

ADDITIONAL ASSESSMENT OF IMPACTS ON THE CHASSAHOWITZKA PSD CLASS I AREA FOR THE RIDGE GENERATING STATION PROJECT

(Permit Application AC 53-206244, PSD-FL-183)

This additional assessment for the Ridge Generating Station is in response to the following item in the request for information from the Florida Department of Environmental Regulation dated January 17, 1992:

> 6. *The predicted maximum SO_2 24-hour and 3-hour concentrations in the Chassahowitzka PSD Class I area due to the Ridge Generating Station boiler emissions are greater than the National Park Service proposed 24-hour and 3-hour significant impact levels of 0.07 and 0.48 $\mu g/m^3$, respectively. Please perform a cumulative 24-hour and 3-hour SO_2 Class I increment analysis as required by the National Park Service. An air quality related values (AQRVs) analysis should also be done since there are presently no significant impact levels that exempt a proposed PSD project from performing this analysis. The AQRVs analysis includes impacts to soils, vegetation, and wildlife.*

RESPONSE

ADDITIONAL AIR QUALITY MODELING ANALYSIS

An additional analysis of SO_2 impacts at the Chassahowitzka PSD Class I area is provided in Attachment A. This additional impact analysis is based on use of the standard ISCST model and a long-range transport model, the MESOPUFF II model. The following conclusions result from this additional analysis: (1) Predicted maximum 3-hour SO_2 concentrations at the Chassahowitzka PSD Class I area due to Ridge Generating Station (RGS) emissions are less than the National Park Service significant impact level of 0.48 $\mu g/m^3$. (2) Predicted maximum 24-hour SO_2 concentrations due to RGS emissions exceed the National Park Service significant impact level of 0.07 $\mu g/m^3$, but only on an infrequent basis. Furthermore, during the meteorological conditions when RGS emissions result in concentrations above the significant impact level, the cumulative predicted maximum 24-hour concentrations due to all PSD sources identified by DER are less than the PSD Class I increment. Therefore, RGS emissions neither cause nor contribute to a violation of the PSD Class I increment at the Chassahowitzka PSD Class I area.

AIR QUALITY RELATED VALUES ANALYSIS

An air quality related values analysis is provided in Attachment B. The conclusions reached from this analysis are that the RGS project (1) will not diminish the national significance of the Chassahowitzka National Wilderness Area (which comprises the PSD Class I area), (2) will not impair the quality of the visitor experience at this area, and (3) will not impair the structure and functioning of the ecosystems within the area.

ATTACHMENT A

ADDITIONAL PSD CLASS I AREA AIR QUALITY MODELING ANALYSIS FOR RIDGE GENERATING STATION SULFUR DIOXIDE EMISSIONS

INTRODUCTION

The Chassahowitzka PSD Class I area impact analysis provided in the Ridge Generating Station (RGS) permit application involved use of the ISCST model. The ISCST model is a straight-line trajectory, steady-state Gaussian dispersion model that assumes meteorological conditions at the time of plume release will persist over the entire distance from the point of release to the receptors of interest. Over relatively short distances, the assumptions of the ISCST model are reasonably valid. The deficiencies of steady-state models for assessing impacts at more distant receptors are well recognized, however.

The RGS site is separated from the modeled receptors in the Chassahowitzka PSD Class I area by distances ranging from 100.5 to 119.0 km. The uncertainties in using the ISCST model at these great distances are such that the maximum PSD Class I SO_2 impacts presented in the application are expected to exceed actual impacts. To further assess PSD Class I impacts attributable to RGS SO_2 emissions, a modeling analysis has been performed using a combination of the ISCST model used previously and the MESOPUFF II model - a model specifically developed to estimate concentrations at distances of as much as 400 km from an emission source.

The MESOPUFF II portion of the additional modeling evaluation was conducted by Sigma Research Corporation under the direction of Mr. Joseph Scire. Mr. Scire was one of the original developers of the MESOPUFF II model and is experienced in its use. Attached is a technical report prepared by Sigma Research describing the method of applying MESOPUFF II and the results obtained from its use. Presented below is a discussion of the overall additional modeling evaluation using both ISCST and MESOPUFF II.

EVALUATION METHOD

General Approach

From the previous modeling evaluation based on the ISCST model, the determination was made that predicted maximum SO_2 concentrations due to RGS emissions are less than the PSD Class I area significant impact levels recommended by the U.S. Environmental Protection Agency (EPA). The National Park Service (NPS), however, has proposed lower significant impact levels for SO_2. The previous ISCST modeling evaluation demonstrated that maximum annual concentrations at the Chassahowitzka PSD Class I area due to RGS emissions are less than the proposed NPS annual average significant impact level but that predicted maximum 3-hour and 24-hour concentrations exceed the NPS proposed significant impact levels.

Accordingly, the first step in the additional modeling evaluation was to use the MESOPUFF II model to predict whether maximum 3-hour and 24-hour SO_2 concentrations due to RGS SO_2 emissions alone are still higher than the NPS levels. This step resulted in the finding that predicted maximum 3-hour concentrations are less than the National Park Service significant impact concentration of 0.48 $\mu g/m^3$ (see modeling results section below). Therefore, assessing the cumulative impact of other PSD sources on 3-hour concentrations is not necessary. Operation of the RGS project will not cause or contribute to a violation of the 3-hour SO_2 PSD Class I increment at the Chassahowitzka PSD Class I area.

The next step in the evaluation was to assess 24-hour impacts taking into account both RGS emissions and the emissions of other PSD sources in the general vicinity of the Chassahowitzka PSD Class I area. Based on an approach discussed with DER, this cumulative impact analysis pertains just to 24-hour periods in the modeled meteorological data set when a significant contribution (concentrations greater than or equal to 0.07 $\mu g/m^3$) due to RGS emissions is predicted using MESOPUFF II. Consideration of other periods is not necessary because RGS would not be a contributor under those meteorological conditions.

Emission Source Distance Consideration

In the 24-hour cumulative impact assessment, the ISCST model was used to estimate concentrations due to sources located less than 20 km from the Class I area, and the MESOPUFF II model was used to estimate concentrations from sources located 20 km or more from the Class I area. The results from the two models were then summed, as further discussed in the modeling results section below.

As mentioned in the introduction, results from the ISCST model become increasingly uncertain as the distance increases between the emission source and the points at which concentrations are calculated. The choice of 20 km as the distance at which to change from the ISCST model to another model is consistent with findings that show possible inaccuracies with the ISCST model at even closer distances. It is also consistent with the objective of assessing cumulative impacts when concentrations due to RGS emissions are "significant" as defined by the proposed NPS significant impact levels. Information obtained through DER indicates that the National Park Service accepts use of the MESOPUFF II model at distances of 20 km and greater.

Another important consideration in selecting a 20-km distance for application of the MESOPUFF II model relates to the location of the PSD sources in the inventory provided by DER. All but one of the 83 sources in this inventory (or 84 sources including RGS) are located at distances of 20 km or more from the Chassahowitzka PSD Class I area. Therefore, use of the MESOPUFF II model for sources starting at 20 km provides a much more consistent modeling approach than having to mix the results from the ISCST model for a large portion of the 84 sources with the results from the MESOPUFF II model for the remaining portion of the sources as would be the case if a greater distance criterion were used.

Modeling Options

In running the MESOPUFF II model, the dry deposition and chemical transformation options of the model were specified. The attached report from Sigma Research contains additional information on model options. The ISCST model was run in the standard regulatory default mode.

EMISSION SOURCE DATA

The initial emission source modeled was the RGS boiler. RGS emission source characteristics considered in the additional evaluation are the characteristics representing the maximum continuous rating (MCR) case. Previous evaluations had demonstrated that the MCR operating level produces higher PSD Class I impacts than either the 75 percent load level or the 50 percent load level. Specific RGS boiler emissions data evaluated with the MESOPUFF II model are as follows:

- SO_2 emission rate = 13.78 g/s (109.4 lb/hr)
- Stack height = 99.06 m (325 ft)
- Stack diameter = 3.05 m (10 ft)
- Exit temperature = 349.82 K (170 °F)
- Exit velocity = 14.54 m/s (48.1 ft/s)
- UTM coordinates = 416690 m E., 3100380 m N.

Data on PSD sources other than RGS were supplied by DER. These sources are listed in Table A-1, divided into two groups. One group consists of SO_2 sources (actually, only one source) located less than 20 km from the PSD Class I area and modeled with the ISCST model. The second group consists of those sources located 20 km or more from the PSD Class I area and modeled with the MESOPUFF II model. Note that the modeled emission source inventory consists of both increment-consuming sources and increment-expanding sources (baseline sources that have shut down or reduced emissions). Increment-expanding sources are denoted by a negative emission rate.

METEOROLOGICAL DATA

As discussed in the attached report, meteorological data from four surface stations (Tampa, Orlando, Gainesville, and Daytona Beach) and one upper air station (Tampa) were processed for use with MESOPUFF II. A detailed meteorological data base was modeled by considering an entire year of data for each of the surface stations and for the upper air station. The meteorological year selected for evaluation with MESOPUFF II is year 1986.

At the recommendation of DER, the meteorological data station selected for the ISCST portion of the modeling evaluation is Tampa (Tampa surface and Tampa upper air data). For consistency, 1986 data were used with the ISCST model as well.

RECEPTORS

The PSD Class I area receptors assessed in the additional modeling evaluation consist of 13 receptors specified by DER. The UTM coordinates of these receptors are shown in Table A-2.

MODELING RESULTS

Sulfur Dioxide 3-Hour Concentrations

The predicted maximum 3-hour concentration attributable to RGS emissions is 0.26 $\mu g/m^3$ as shown in Table A-3. This predicted maximum concentration is much less than the proposed NPS significant impact level of 0.48 $\mu g/m^3$. Therefore, no need exists to develop a cumulative SO_2 3-hour concentration impact analysis with other PSD sources considered.

Sulfur Dioxide 24-Hour Concentrations

Predicted highest 24-hour SO_2 concentrations attributable to RGS emissions exceed the proposed NPS significant impact level of 0.07 $\mu g/m^3$. However, 24-hour meteorological periods producing predicted "significant" concentrations are infrequent. Table A-4 shows that three days in the 1986 meteorological data set which produce significant concentrations. The predicted maximum 24-hour concentration due to RGS emissions alone is 0.09 $\mu g/m^3$.

A cumulative impact analysis was performed for the three meteorological periods when RGS emissions produce concentrations that equal or exceed the proposed NPS significant impact level. Modeling results for all 84 PSD sources (RGS plus 83 other sources) are presented in Tables A-5, A-6, and A-7 for each of these days. The "Total" concentration column in these tables is simply the sum of the MESOPUFF II concentration at a specific receptor plus the ISCST concentration at the same receptor.

The highest cumulative concentration at any receptor where RGS emissions produce a significant impact (as proposed by NPS) is 4.68 $\mu g/m^3$ which is less than the PSD Class I increment of 5 $\mu g/m^3$. Therefore, when RGS is a "contributor" to 24-hour SO_2 concentrations at the Chassahowitzka PSD Class I area, compliance with the PSD Class I increment is predicted.

CONCLUSION

Based on the additional modeling evaluation described in this attachment, SO_2 emissions from the proposed RGS boiler will neither cause nor contribute to a violation of PSD increments within the Chassahowitzka PSD Class I area.

TABLE A-1
EMISSION SOURCES CONSIDERED IN THE ADDITIONAL PSD CLASS I MODELING EVALUATION

I. Sources Less than 20 Kilometers from Chassahowitzka PSD Class I Area (modeled with ISCST model)

DER Source Number	SO_2 Emission Rate (g/s)	UTM East Coordinate (m)	UTM North Coordinate (m)	Stack Height (m)	Exit Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
22	1.45	356200	3169900	27.40	470.2	7.48	4.88

(continued on next page)

II. Sources Greater than or Equal to 20 Kilometers from Chassahowitzka PSD Class I Area (modeled with MESOPUFF II model)

DER Source Number	SO_2 Emission Rate (g/s)	UTM East Coordinate (m)	UTM North Coordinate (m)	Stack Height (m)	Exit Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
RGS[a]	13.78	416690	3100380	99.06	349.82	14.54	3.05
9900200	466.4	467500	3197200	15.24	819.8	56.21	4.21
9900500	310.9	446300	3126000	15.24	819.8	56.21	4.21
9900800	276.1	446300	3126000	15.24	880.8	32.07	7.04
1	98.4	360008	3162398	97.6	442.0	23.23	4.88
6	-50.4	388000	3116000	60.35	353.0	16.40	2.44
7	54.6	388000	3116000	60.35	353.0	17.77	2.44
9	-50.4	388000	3116000	60.35	353.0	16.40	2.44
10	54.6	388000	3116000	60.35	353.0	17.77	2.44
30	654.7	361900	3075000	149.4	342.2	19.81	7.32
31	-2436.0	361900	3075000	149.4	422.0	28.65	7.32
33	-1218.0	361900	3075000	149.4	418.0	14.33	7.32
40	14.1	347100	3139200	83.82	394.3	15.70	3.05
46	1008.8	334200	3204500	182.90	398.0	21.00	6.90
47	1008.0	334200	3204500	182.90	398.0	21.00	6.90
48	-314.0	334200	3204500	152.00	422.0	42.10	4.57
49	-1859.0	334200	3204500	153.00	422.0	42.10	4.88
50	105.4	483500	3150600	167.60	325.7	21.60	5.80
51	242.4	483500	3150600	167.60	324.2	23.50	5.80
52	32.1	460100	3129300	18.30	422.0	38.00	3.66

DER Source Number	SO_2 Emission Rate (g/s)	UTM East Coordinate (m)	UTM North Coordinate (m)	Stack Height (m)	Exit Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
53	277.6	404800	3057400	22.90	389.0	23.90	4.88
54	-52.07	325600	3116700	49.00	293.0	3.60	1.20
55	500.1	408500	3105800	76.20	350.0	19.70	4.88
56	21.4	368200	3092700	50.00	491.0	18.30	1.80
57	62.24	335300	3084400	49.10	522.0	27.72	2.74
61	0.2	383300	3135800	12.30	466.2	9.20	0.40
70	2.25	361400	3168400	8.50	357.4	10.95	1.08
71	2.25	359900	3162400	12.20	377.0	10.58	1.37
90	29.11	409185	3102754	30.48	783.2	28.22	5.79
91	-170.1	396600	3078900	61.00	350.0	14.28	2.60
92	182.85	396600	3078900	61.00	350.0	15.31	2.60
93	121.9	396600	3078900	60.70	350.0	15.31	2.60
94	5.54	396600	3078900	36.60	319.1	20.15	1.83
101	5.04	385600	3139000	30.48	384.3	17.13	3.35
102	5.04	434000	3198800	30.48	384.3	17.13	3.35
111	-110.6	408500	3083000	30.50	350	14.60	1.68
112	4.30	408500	3083000	9.10	450	22.50	0.70
113	52.90	408500	3083000	67.10	351	9.80	2.40
114	21.02	361800	3088300	30.00	375	20.00	0.61
115	-15.20	398400	3084200	30.50	308	18.90	1.80
116	42.00	398400	3084200	45.70	352	10.30	2.30
117	-54.56	409500	3079500	30.48	311	20.18	1.37

DER Source Number	SO_2 Emission Rate (g/s)	UTM East Coordinate (m)	UTM North Coordinate (m)	Stack Height (m)	Exit Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
118	67.16	409500	3079500	30.48	355	9.27	2.29
119	41.96	409500	3079500	45.72	355	9.65	2.44
120	18.40	389550	3067930	38.10	339	10.13	2.90
121	21.17	389550	3067930	38.10	346	18.40	2.44
128	63.00	396560	3078640	60.70	350	15.55	2.60
129	3.78	396750	3079350	52.40	322	13.00	2.40
130	5.36	396830	3079430	52.40	319	7.10	2.40
131	5.54	396450	3079150	36.60	319	20.80	1.80
132	63.00	396490	3078640	60.70	350	15.55	2.60
133	-34.27	396680	3078860	21.04	347	18.56	2.13
134	-146.00	396530	3078750	61.00	350	11.14	2.50
135	189.00	396530	3078750	61.00	350	16.71	2.50
136	-257.60	406700	3085200	51.00	356	9.90	2.13
137	35.70	406700	3085200	61.00	360	12.20	2.13
140	63.00	416120	3068620	53.40	355	15.91	2.59
141	63.00	416120	3068620	53.40	355	15.91	2.59
142	-78.80	416210	3068740	29.00	314	6.77	3.02
143	-216.00	409700	3086000	45.70	352	16.50	1.40
144	73.60	409700	3086000	61.00	346	7.30	2.80
145	72.00	409500	3086500	61.00	347	28.40	1.52
147	-196.30	363400	3082400	22.60	322	19.50	1.52
148	-50.71	363400	3082400	45.70	355	9.20	2.29

DER Source Number	SO_2 Emission Rate (g/s)	UTM East Coordinate (m)	UTM North Coordinate (m)	Stack Height (m)	Exit Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
149	36.75	363400	3082400	45.70	355	9.20	2.29
150	0.60	394800	3067720	8.20	505	7.57	0.41
151	16.35	394850	3069770	30.50	334	7.26	1.82
152	13.40	389500	3068000	38.10	339	15.20	2.44
153	30.64	414700	3080300	13.70	330	40.40	1.22
154	2.44	398290	3084290	25.90	339	15.20	2.29
250	2.99	382200	3166100	9.14	478	4.57	0.61
260	0.82	386700	3155800	10.67	327	8.99	1.83
270	2.09	359800	3164900	7.62	347	6.29	1.83
280	0.23	340600	3119200	12.2	339	6.47	3.05
290	3.67	355900	3143700	9.14	408	16.0	1.30
300	0.06	331200	3124500	10.98	544	3.88	0.31
310	0.03	331200	3124500	10.98	544	3.88	0.31
320	0.08	333400	3141000	10.98	533	4	0.31
330	0.08	333400	3141000	10.98	533	4	0.31
340	7.25	340700	3119500	9.14	436	22.3	1.40
350	3.54	390300	3129400	6.1	422	21	1.38
400	-75.6	407500	3071300	45.73	350	26.4	1.6
410	113.5	407500	3071300	45.73	350	39.06	1.6

[a] Ridge Generating Station

TABLE A-2

UTM COORDINATES OF CHASSAHOWITZKA PSD CLASS I AREA RECEPTORS

Receptor	East UTM Coordinate (m)	North UTM Coordinate (m)
1	340300	3165700
2	340300	3167700
3	340300	3169800
4	340700	3171900
5	342000	3174000
6	343000	3176200
7	343700	3178300
8	342400	3180600
9	341100	3183400
10	339000	3183400
11	336500	3183400
12	334000	3183400
13	331500	3183400

TABLE A-3

PREDICTED MAXIMUM 3-HOUR SULFUR DIOXIDE CONCENTRATION AT THE CHASSAHOWITZKA PSD CLASS I AREA ATTRIBUTABLE TO RIDGE GENERATING STATION (RGS) EMISSIONS

Predicted Maximum 3-Hour Concentration[a] ($\mu g/m^3$) and Associated Meteorological Period
0.26 (Day 343, Ending Hour 6)

[a] "Significant" concentration is 0.48 $\mu g/m^3$ as proposed by the National Park Service.

TABLE A-4

PREDICTED "SIGNIFICANT" 24-HOUR SULFUR DIOXIDE CONCENTRATIONS AT THE CHASSAHOWITZKA PSD CLASS I AREA ATTRIBUTABLE TO RIDGE GENERATING STATION EMISSIONS

Predicted Concentrations ($\mu g/m^3$) and Associated Meteorological Day
0.08 (Day 282)
0.09 (Day 332)
0.08 (Day 333)

NOTE: "Significant" concentration is 0.07 $\mu g/m^3$ as proposed by the National Park Service.

TABLE A-5

PREDICTED CUMULATIVE 24-HOUR SULFUR DIOXIDE CONCENTRATIONS ON DAYS WHEN RIDGE GENERATING STATION (RGS) EMISSIONS PRODUCE A "SIGNIFICANT" CONTRIBUTION

(concentrations in $\mu g/m^3$)

Meteorological Period: Day 282

Receptor	Contribution from Sources ≥20 km from PSD Class I Area[a] (Modeled with MESOPUFF II)	Contribution from Sources <20 km from PSD Class I Area (Modeled with ISCST)	Total	Contributions from RGS Emissions Alone
1	3.01	0.04	3.05	0.075
2	3.29	0.00	3.29	0.073
3	3.59	0.00	3.59	0.070
4	b	b	b	0.067
5	b	b	b	0.063
6	b	b	b	0.059
7	b	b	b	0.055
8	b	b	b	0.053
9	b	b	b	0.050
10	b	b	b	0.052
11	b	b	b	0.053
12	b	b	b	0.054
13	b	b	b	0.055

[a] Includes RGS emissions.

[b] RGS contribution is less than proposed National Park Service significant impact level at this receptor.

TABLE A-6

PREDICTED CUMULATIVE 24-HOUR SULFUR DIOXIDE CONCENTRATIONS ON DAYS WHEN RIDGE GENERATING STATION (RGS) EMISSIONS PRODUCE A "SIGNIFICANT" CONTRIBUTION

(concentrations in $\mu g/m^3$)

Meteorological Period: Day 332

Receptor	Contribution from Sources ≥20 km from PSD Class I Area[a] (Modeled with MESOPUFF II)	Contribution from Sources <20 km from PSD Class I Area (Modeled with ISCST)	Total	Contributions from RGS Emissions Alone
1	3.84	0.03	3.87	0.088
2	3.60	0.02	3.62	0.088
3	3.80	0.03	3.83	0.087
4	4.32	0.04	4.36	0.086
5	4.28	0.06	4.34	0.084
6	4.30	0.13	4.43	0.084
7	4.43	0.02	4.45	0.084
8	4.51	0.01	4.52	0.083
9	4.62	0.01	4.63	0.082
10	4.67	0.01	4.68	0.083
11	4.54	0.01	4.55	0.085
12	4.38	0.01	4.39	0.088
13	4.33	0.03	4.36	0.091

[a] Includes RGS emissions.

TABLE A-7

PREDICTED CUMULATIVE 24-HOUR SULFUR DIOXIDE CONCENTRATIONS ON DAYS WHEN RIDGE GENERATING STATION (RGS) EMISSIONS PRODUCE A "SIGNIFICANT" CONTRIBUTION

(concentrations in $\mu g/m^3$)

Meteorological Period: Day 333

Receptor	Contribution from Sources ≥20 km from PSD Class I Area[a] (Modeled with MESOPUFF II)	Contribution from Sources <20 km from PSD Class I Area (Modeled with ISCST)	Total	Contributions from RGS Emissions Alone
1	b	b	b	0.032
2	b	b	b	0.031
3	b	b	b	0.030
4	b	b	b	0.029
5	b	b	b	0.026
6	b	b	b	0.026
7	b	b	b	0.026
8	b	b	b	0.028
9	b	b	b	0.031
10	b	b	b	0.038
11	b	b	b	0.050
12	b	b	b	0.065
13	1.22	0.01	1.23	0.081

[a] Includes RGS emissions.

[b] RGS contribution is less than proposed National Park Service significant impact level at this receptor.

ATTACHMENT B

CHASSAHOWITZKA PSD CLASS I AREA AIR QUALITY RELATED VALUES ANALYSIS FOR RIDGE GENERATING STATION

INTRODUCTION

The proposed Ridge Generating Station (RGS) is located approximately 100 km from the closest point in the Chassahowitzka prevention of significant deterioration (PSD) Class I area. Based on estimated emissions from the RGS boiler at maximum continuous rating, the facility will be a "significant" emission source (as defined by PSD regulations) for sulfur dioxide, nitrogen oxides, carbon monoxide, volatile organic compounds, particulate matter, lead, and beryllium.

Although any additional increase in pollutant levels resulting from a specific emission source could theoretically have some effect on air quality related values (AQRV's), recognition of the magnitude of an expected increase is still an important consideration. The highest predicted sulfur dioxide concentration increases at the Chassahowitzka PSD Class I area due to RGS emissions are a 3-hour concentration of 0.26 $\mu g/m^3$ (0.000099 ppm), a 24-hour concentration of 0.09 $\mu g/m^3$ (0.000034 ppm), and an annual average concentration of 0.01 $\mu g/m^3$ (0.0000038 ppm). Predicted concentration increases for other pollutants emitted in significant amounts is similarly low. For example, the highest predicted annual average nitrogen dioxide concentration increase due to RGS emissions is 0.01 $\mu g/m^3$ (0.0000053 ppm). Simply on the face of these small predicted concentration increases, no adverse effect on AQRV's would be expected as result of Ridge Generating Station operation. This conclusion is supported by the following AQRV's evaluation which considers effects on vegetation, soils, wildlife, and visibility.

CHARACTERISTICS OF THE CHASSAHOWITZKA PSD CLASS I AREA

The Chassahowitzka PSD Class I area is defined by the boundaries of the Chassahowitzka National Wilderness Area (NWA). The Chassahowitzka NWA comprises most but not all of the Chassahowitzka National Wildlife Refuge. Pertinent air quality, vegetation, soils, and wildlife characteristics of the Chassahowitzka NWA are as follows:

> Existing and Projected Ambient Sulfur Dioxide Levels -- No ambient monitoring stations are located at the Chassahowitzka PSD Class I area. To obtain an approximation of SO_2 levels in this area, monitoring data summarized in DER's annual reports for 1989 and 1990 were reviewed. Second highest 3-hour and 24-hour concentrations were considered for evaluation of short-term concentration. For the entire state of Florida including metropolitan and industrialized areas, measured concentrations are typically well below ambient standards. At the two monitoring stations in Citrus County, which are the stations closest to the Chassahowitzka PSD Class I area, second highest 3-hour concentrations ranged from 85 to 248 $\mu g/m^3$ in 1989 and 1990, and second highest 24-hour concentrations ranged from 18 to 64 $\mu g/m^3$. Annual means ranged from 4 to 7 $\mu g/m^3$. By comparison, the national ambient air quality standards are a 3-hour standard of 1,300 $\mu g/m^3$ (0.5 ppm), a 24-hour standard of 365 $\mu g/m^3$ (0.14 ppm), and an annual average standard of 80 $\mu g/m^3$ (0.03 ppm).
>
> New emission sources can, of course, add to current levels. However, based on discussions with DER about recent permit application modeling results for projects in central Florida, potential SO_2 concentration increases at the Chassahowitzka PSD Class I area due to proposed new sources are at the PSD Class I increments level - that is, 3- hour concentrations less than 25 $\mu g/m^3$ and 24-hour concentrations less than 5 $\mu g/m^3$. Therefore, even with proposed new sources considered,

current short-term SO_2 concentrations at the Chassahowitzka PSD Class I area are expected to be on the order of 300 $\mu g/m^3$ (0.11 ppm) or less for 3-hour averages, and on the order of 70 $\mu g/m^3$ (0.03 ppm) or less for 24-hour averages. Annual mean concentrations are expected to be less than 10 $\mu g/m^3$ (0.004 ppm). These levels are far below national ambient standards.

Existing Ambient Levels of Other Pollutants -- Based on 1989 and 1990 Florida ambient monitoring data for nitrogen dioxide, carbon monoxide, particulate matter, and lead, concentrations of these pollutants at the Chassahowitzka PSD Class I area should be below ambient standards. However, monitoring data specific to Chassahowitzka are not available.

Vegetation -- Vascular species that are typical of central Florida Gulf coastal areas like the Chassahowitzka NWA include tree species such as slash pine, laurel oak, live oak, sweetgum, and red maple; shrubs such as sawtooth palm, gallberry, and yaupon holly; and other plants such as black and soft needle rush, maiden cane, and red mangrove. Non-vascular vegetation species would include mosses and lichens.

Soils -- The characteristic soils in the Chassahowitzka NWA can be generally classified as sulfihemist soils. Such soils are dominantly organic and contain sulfidic materials within 1 meter of the surface. Based on soil survey data for Citrus and Hernando Counties (U.S. Department of Agriculture, 1991a and 1991b), the sulfur content of this upper soil layer can range up to 4 percent.

Wildlife -- The terrestrial wildlife species expected to be present in the Chassahowitzka NWA are the species common to the central Florida Gulf Coast. These include mammals such as white-tailed deer and raccoons, amphibians such as southern toads and leopard frogs, reptiles such as rat snakes and box turtles, and a variety of birds.

VEGETATION EFFECTS

Sulfur Dioxide

As DER is aware, the literature on vegetation effects from SO_2 exposure is extensive. Rather than trying to select and summarize specific studies that may be most pertinent to vegetation species in the Chassahowitzka NWA, reference can be made to a U.S. Environmental Protection Agency (EPA) review of the 3-hour secondary SO_2 ambient air quality standard established to protect against adverse vegetation effects. This review (found in the 4/26/88 edition of the *Federal Register*, 53 FR 14926) was included in EPA's proposal to retain the current 3-hour standard of 1,300 $\mu g/m^3$ (0.5 ppm). The following is an excerpt from the summary (p. 14931). In this excerpt, CD stands for criteria document (U.S. Environmental Protection Agency, 1982a), SP stands for staff paper (U.S. Environmental Protection Agency, 1982b), and CASAC stands for Clean Air Scientific Advisory Committee.

> "The basis for the existing 3-hour secondary standard rests on studies documenting acute effects on sensitive plants (38 FR 25678; September 1973). The effects of concern include reduced growth and yield, and foliar injury. The staff assessment of the greatly expanded scientific data base as summarized in the criteria document (CD, Chapter 7) found even stronger support for the 3-hour standard (SP, pp. 108-112). As a result of this most recent review, both staff and CASAC recommended retaining a 3-hour standard at or slightly below the level of the current standard (0.5 ppm)(SP, p. 126). CASAC pointed out that evidence suggesting effects at lower levels is very uncertain (SP, Appendix E, p. 8)."

While recognizing that some studies have indicated adverse vegetation effects on sensitive species at concentrations below the current 3-hour ambient air quality standard, information as summarized in the EPA statement above suggests that concentrations on the order of the 3-hour standard are protective. (For example, a CASAC letter attached to the EPA staff paper recommends that the 3-hour standard be limited to the range 0.4 to 0.5 ppm if the standard were revised.) Since current short-term concentrations in the Chassahowitzka PSD Class I area are estimated to be far below the ambient standard, no reason exists to expect that vegetation species are under stress due to SO_2 exposures. Furthermore, the extremely small increase in SO_2 concentrations predicted to result from RGS emissions will not alter current conditions. Therefore, SO_2 emissions from the RGS project are not expected to create or contribute to adverse impacts on vegetation.

Nitrogen Oxides

With respect to short-term (acute) exposures, data from a variety of experiments on crops and native plants indicate that nitrogen dioxide exposures less than 1,880 $\mu g/m^3$ (1.0 ppm) for one hour have not caused adverse effects (Taylor and Eaton, 1966; Tingey and others, 1971; Taylor and others, 1975; U.S. Environmental Protection Agency, 1982c). Current NO_2 ambient levels at the Chassahowitzka PSD Class I area combined with the minor increase in concentrations due to RGS emissions are expected to be far below this level. Therefore, no acute adverse vegetation impacts are expected to result from RGS NO_x emissions.

Long-term (chronic) exposures to high levels of NO_2 can result in such adverse effects as inhibition of photosynthesis and reduced yield. Ashenden and Mansfield (1978) found that an NO_2 concentration of 207 $\mu g/m^3$ (0.11 ppm) for 103 hours per week over a period of 20 weeks reduced yields of several turf grasses. Other studies (Taylor and others, 1975; U.S. Environmental Protection Agency, 1982c) indicate that yield effects are unlikely to occur in most crops at levels below 470 $\mu g/m^3$ (0.25 ppm). Since these values are far above the national ambient air quality standards and even further above the Chassahowitzka PSD Class I area concentration levels likely to exist after RGS begins operating, no long-term adverse effects on vegetation are expected to result from RGS NO_x emissions.

Ozone

Nitrogen oxides and volatile organic compounds, which are ozone precursors, will be emitted from the RGS facility in significant amounts. However, compared to current ozone precursor emission levels in central Florida (including the metropolitan areas of Tampa-St. Petersburg, Orlando, and the Lakeland area) that could affect the Chassahowitzka PSD Class I area, RGS emissions will be minor. Accordingly, the effect of RGS emissions on Chassahowitzka PSD Class I area ozone concentrations and related vegetation impacts should be negligible.

Other Significant Pollutants

The other significant pollutants that will be emitted from the RGS facility are carbon monoxide, particulate matter, lead, and beryllium. The potential for phytotoxic effects from these emissions at the distance of the Chassahowitzka PSD Class I area is negligible.

SOILS EFFECTS

Sulfur Dioxide

As discussed above, the dominant soils of the Chassahowitzka PSD Class I area are naturally high in sulfur content. The additional sulfur deposition resulting from RGS emissions would be negligible by comparison. In addition, tidal effects and the flushing effect of storms and tributary inflow further reduce the chances of soil sulfur level increases resulting from RGS emissions. Therefore, Chassahowitzka NWA soil composition properties and soil organism makeup should be unaffected by the proposed project.

Other Significant Pollutants

Deposition of other significant pollutants emitted by RGS are not expected to affect the existing soil characteristics of the Chassahowitzka PSD Class I area. This is especially true for lead and beryllium since these metals will be emitted in such small amounts.

WILDLIFE EFFECTS

Sulfur Dioxide

Total levels of sulfur dioxide within the Chassahowitzka PSD Class I area are expected to be well below those levels producing direct adverse toxicological effects on animals. More to the point, as discussed for vegetation, is the incremental effect of RGS emissions. The extremely small increase in concentrations predicted to resulting from RGS SO_2 emissions is highly unlikely to produce an observable effect on wildlife. A similar conclusion can be reached regarding indirect effects on wildlife that might result from damage to vegetation habitat. That is, no adverse impact on wildlife habitat should result from RGS emissions and, consequently, no indirect adverse effect on wildlife.

Other Significant Pollutants

The conclusions for sulfur dioxide also apply to the other significant pollutants.

VISIBILITY EFFECTS

The potential effect of RGS boiler emissions on visibility conditions within the Chassahowitzka PSD Class I area is assessed in Section 7.0 of the permit application. Based on a conservative screening modeling approach, RGS emissions are highly unlikely to produce an adverse visibility impact.

CONCLUSION

Based on this evaluation of air quality related values consisting of effects on vegetation, soils, wildlife, and visibility, significant pollutant emissions from the proposed RGS boiler are not expected to produce adverse impacts within the

Chassahowitzka PSD Class I area. Restated in terms of the PSD Class I adverse impact guidelines developed by the Assistant Secretary for Fish and Wildlife and Parks (see, for example, 57 FR 4465, 2/5/92), the RGS project (1) will not diminish the national significance of the Chassahowitzka NWA, (2) will not impair the quality of the visitor experience, and (3) will not impair the structure and functioning of the ecosystems with the Chassahowitzka NWA.

REFERENCES

Ashenden, T.W., and T.A. Mansfield, 1978. Extreme pollution sensitivity of grasses when SO_2 and NO_2 are present in the atmosphere together. Nature, Vol. 273, p. 142-143.

Taylor, O.C. and F.N. Eaton, 1966. Suppression of plant growth by nitrogen dioxide. Plant Physiology, Vol. 41, p. 132-135.

Taylor, O.C., C.R. Thompson, D.T. Tingey, and R.A. Reinert, 1975. Oxides of nitrogen. In J.B. Mudd and T.T. Kozlowski (eds.), Responses of Plants to Air Pollution, Academic Press, Inc., p. 121- 139.

Tingey. D.T., R.A. Reinert, J.A. Dunning, and W.W. Heck, 1971. Vegetation injury form the interaction of nitrogen dioxide and sulfur dioxide. Phytopathology, Vol. 61, p. 1506-1511.

U.S. Department of Agriculture, 1991a. Survey of Citrus County, Florida. Soil Conservation Service in cooperation with University of Florida, Institute of Food and Agricultural Sciences, Agricultural Experiment Stations and Soil Science Department.

U.S. Department of Agriculture, 1991b. Survey of Hernando County, Florida. Soil Conservation Service in cooperation with University of Florida, Institute of Food and Agricultural Sciences, Agricultural Experiment Stations and Soil Science Department.

U.S. Environmental Protection Agency, 1982a. Air quality criteria for particulate matter and sulfur dioxides (three volumes). Office of Research and Development, EPA-600/8-82-029af-cf.

U.S. Environmental Protection Agency, 1982b. Review of the national ambient air quality standards for sulfur oxides: assessment of scientific and technical information; OAQPS staff paper. Office of Air Quality Planning and Standards, EPA-450/5-82-007.

U.S. Environmental Protection Agency, 1982c. Air quality criteria for oxides of nitrogen; final report. Environmental Criteria and Assessment Office.

CLASS I IMPACT ANALYSIS OF THE RIDGE GENERATING STATION AND BACKGROUND PSD SOURCES AT THE CHASSAHOWITZKA NATIONAL WILDERNESS AREA IN FLORIDA

by

Joseph Scire
Robert Mentzer
Gary Moore

Sigma Research Corporation
Westford, Massachusetts 01886

Final Report
Document A244-01
April 3, 1992

Prepared under subcontract to

Dames & Moore
Atlanta, Georgia

for

Ridge Generating Station Limited Partnership
Winter Park, Florida

1. INTRODUCTION

The proposed Ridge Generating Station (RGS) is located near the city of Lakeland, Florida between Orlando and Tampa. Initial modeling of the RGS conducted by Dames & Moore with the Industrial Source Complex Short Term (ISCST) model predicted maximum 24-hour and 3-hour average SO_2 concentrations at receptors in the Chassahowitzka National Wilderness Area PSD Class I area due to the RGS which were greater than the 24-hour and 3-hour SO_2 significance limits of 0.07 $\mu g/m^3$ and 0.48 $\mu g/m^3$, respectively, proposed by the National Park Service.

The Chassahowitzka Class I area is located a minimum of 100 km to the northwest of the RGS along the Gulf of Mexico coast of Florida. The limitations of straight-line trajectory models such as ISCST which assume steady-state meteorological conditions over the entire travel path of plume are well known. Over source-receptor distances of 10-50 km, the spatial and temporal variability in transport winds and other meteorological fields can have a significant effect in determining plume trajectories and dispersion rates. In addition, as distance increases, chemical transformation and pollutant removal mechanisms become increasingly important for reactive and soluble pollutants such as SO_2.

The MESOPUFF II model (Scire et al., 1984a) is a Lagrangian variable-trajectory puff superposition model suitable for transport distances beyond the range of conventional steady-state Gaussian plume models (i.e., beyond about 10 to 50 km). MESOPUFF II is listed in Appendix B and Supplement B (draft) of the *Guideline on Air Quality Models (Revised)* (EPA, 1986 and EPA, 1991) as a model which may be applied on a case-by-case basis for long-range transport problems. In the current study, MESOPUFF II was used to obtain more refined estimates of short-term average SO_2 concentrations at the Chassahowitzka Class I area due to emissions from the RGS and other background increment-consuming and increment-expanding PSD sources in the area.

2. OVERVIEW OF MESOPUFF II

As illustrated in Figure 1, the MESOPUFF II model is one element of a modeling package which includes components for processing meteorological data and postprocessing predicted concentration results. The various programs in the modeling system are:

READ56/READ62 reads and processes twice-daily upper air wind and temperature data. READ62 is a modified version of READ56 which accommodates the new TDF-6200 upper air data format used by the National Climatic Data Center (NCDC). READ62 was used in the current study.

MESOPAC II is the meteorological model which computes time-varying and space-varying fields of meteorological variables (e.g., transport winds, mixing heights). The fields produced by MESOPAC II include hourly, gridded winds at two levels: a lower layer representing flow within the atmospheric boundary layer and an upper layer representing flow above the boundary layer.

MESOPUFF II is the Gaussian dispersion modeling component of the modeling system. MESOPUFF II contains modules accounting for plume transport, diffusion, chemical transformation, wet removal, and dry deposition. In the current analysis, wet removal effects were not considered.

MESOFILE II is a postprocessing program which time averages the concentrations produced by MESOPUFF II. It was used to compute 3-hour and 24-hour averaged SO_2 concentrations at discrete receptors in the Chassahowitzka Class I area.

2.1 Program Modifications

Several modifications were made to the MESOPUFF II model in order to accommodate its use on a 486 PC computer with a large number of sources and

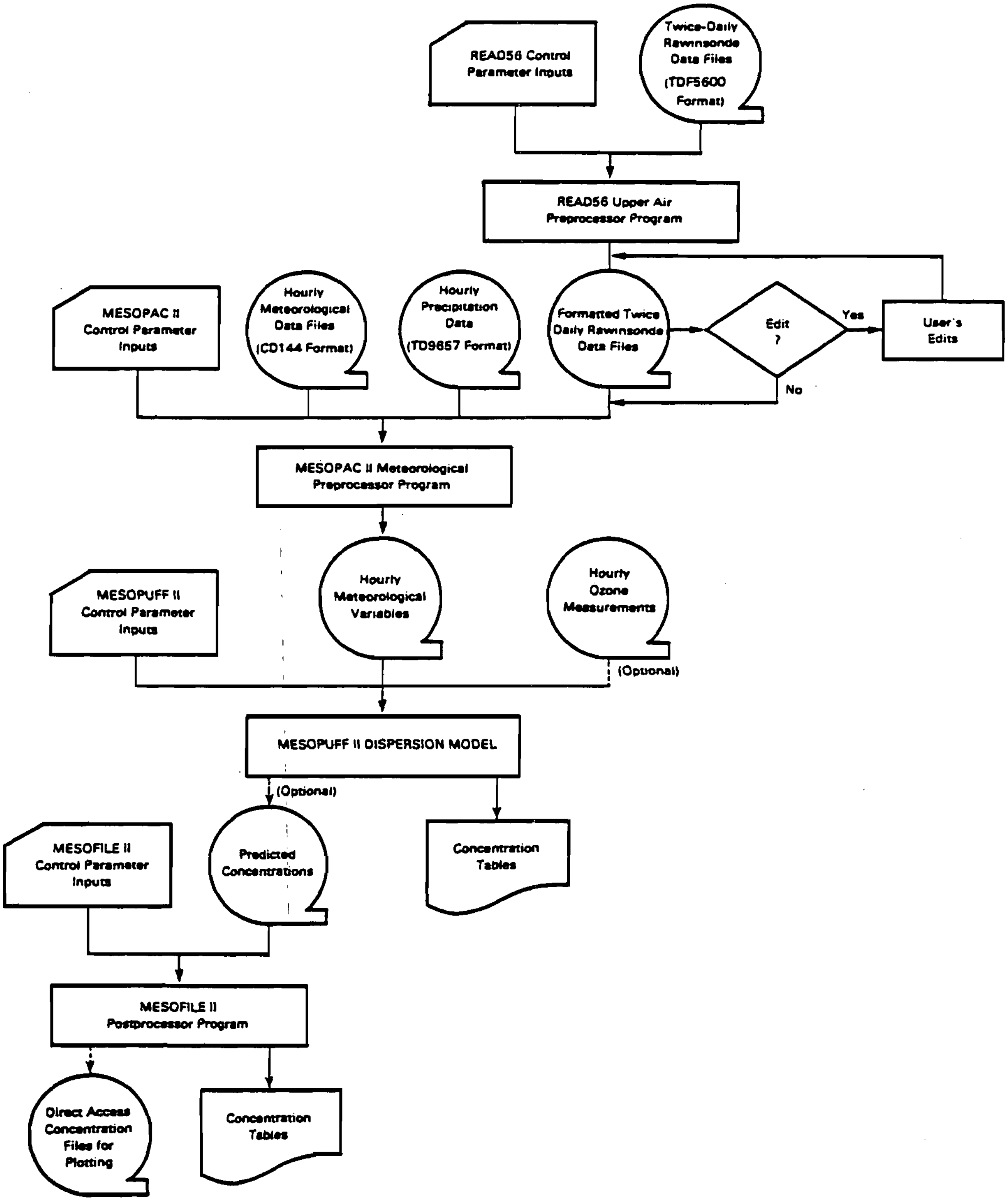


Figure 1. Major Components of the MESOPUFF II Modeling Package.

to avoid computational problems associated with divide by zero errors for variables with no minimum values.

- The dimensions of all arrays relating to the maximum number of puffs were increased from 500 to 8,000.

- Fortran subroutines to compute the error function (ERF) and the difference of two error functions (ERFDIF) were implemented into the MESOPUFF II sampling routine (SAMPLE).

- Small, minimum values were assigned to certain variables which were used in the denominator of equations and which otherwise were allowed to have zero values. These changes were made to avoid divide by zero runtime errors.
  -- SUBR. PRISE - replaced the variable "U" in the denominator of the unstable plume rise equation with the variable "UU", which has a minimum value assigned to it.
  -- SUBR. DEPVEL - set a minimum value of 1×10^{-30} for the surface friction velocity (u_*).
  -- MAIN program - set a minimum value of 1 meter for the absolute value of the Monin-Obukhov length (L).

- Several minor modifications were made to the output format to improve the readability of the output listing.

A call to the Lahey Fortran UNDER0 subroutine was added to all programs in order to properly treat very small numbers (i.e., $< \sim 10^{-38}$). In addition, the location in the code of the list file write statements in SUBR. ADD2 of the MESOFILE II postprocessor were moved from outside the time loop to within the time loop. This change corrected an error which prevented all except the last time period to be printed in the output list file.

The MESOPAC II program was modified to restrict mixing heights to a maximum height of 3000 m. This change is necessary because the model requires that the mixed-layer height not exceed the height of the 700-mb level when the default wind options are used.

3. TECHNICAL APPROACH

The purpose of the current study was to develop more refined estimates of the maximum 3-hour and 24-hour SO_2 concentrations due to emissions from the RGS at the Chassahowitzka National Wilderness Area and, during periods for which the RGS contributions were predicted to be above proposed NPS "significance limits", to assess the cumulative net impact of emissions from other PSD sources in the region. The study was designed to assess whether emissions from the RGS will cause or contribute to an exceedance of the PSD Class I increment at the Chassahowitzka Class I area.

The RGS and other background PSD sources were modeled with MESOPUFF II for the one year period, 1986. The year selected was based on previous modeling with ISCST for the five year period (1982-1986) conducted by Dames & Moore. The year 1986 was predicted by ISCST to have the highest 24-hour contributions from RGS at the Class I area. (The 24-hour averaging period is the limiting averaging period in this case.)

The approach used with MESOPUFF II was to first model emissions from the RGS alone in order to determine those time periods when the RGS contribution at any receptors within the Chassahowitzka Class I area were above the proposed NPS 3-hour and 24-hour SO_2 significance limits of 0.48 $\mu g/m^3$ and 0.07 $\mu g/m^3$, respectively. A total of 82 other background PSD sources were also modeled with MESOPUFF II for the one year period. During periods when the RGS contribution exceeded the significance limits at a particular receptor, the net predicted contribution of background PSD sources were added to the RGS concentration in order to determine the total cumulative impact for comparison to Class I PSD increment standards. The sources modeled with MESOPUFF II are located at distances of 20 km or more from the Class I area receptors. An additional source located closer to the Class I area was modeled with ISCST.

As indicated in Figure 1, several steps are involved in performing the modeling. In Section 3.1, the development of the meteorological grid and preparation of the meteorological data fields are described. Section 3.2 describes the technical options and model inputs used in the MESOPUFF II simulations.

3.1 Meteorological Data Processing

Meteorological Grid System

A meteorological grid of 25 x 30 grid cells with a 10 km grid size was developed for the MESOPUFF II modeling. The domain allows the RGS source, the Chassahowitzka Class I area, and all of the background sources to be included within the modeling region with a buffer zone of at least three grid cells (30 km) from any source or receptor to the nearest boundary. The meteorological grid is shown in Figure 2.

Meteorological Data

Meteorological data from all the Class I National Weather Surface (NWS) stations within the modeling domain were used in the MESOPAC II modeling. The four surface meteorological stations used were Tampa, Orlando, Gainesville, and Daytona Beach. These stations all include hourly surface observations. Twice-daily upper air data from Tampa were also used. Figure 2 shows the location of the meteorological stations (TAMP, ORLD, GAIN, and DAYT) along with the RGS and receptors within the Class I area (X). Meteorological station information is summarized in Table 1.

The 1986 surface data from the Tampa station was obtained in CD144 format. The data from the other surface stations were downloaded from the U.S. EPA modeling bulletin board. Because MESOPAC II requires two parameters (station pressure, relative humidity) which are in the CD144-type records but not in the compressed EPA bulletin board format, the values of station pressure and relative humidity from Tampa were used throughout the grid. This was accomplished by substituting the Tampa pressure and relative humidity values into the appropriate blank fields in the Orlando, Gainesville, and Daytona Beach data records. MESOPUFF II is only weakly sensitive to station pressure and relative humidity, so this approach is considered appropriate for the domain of interest in the current application.

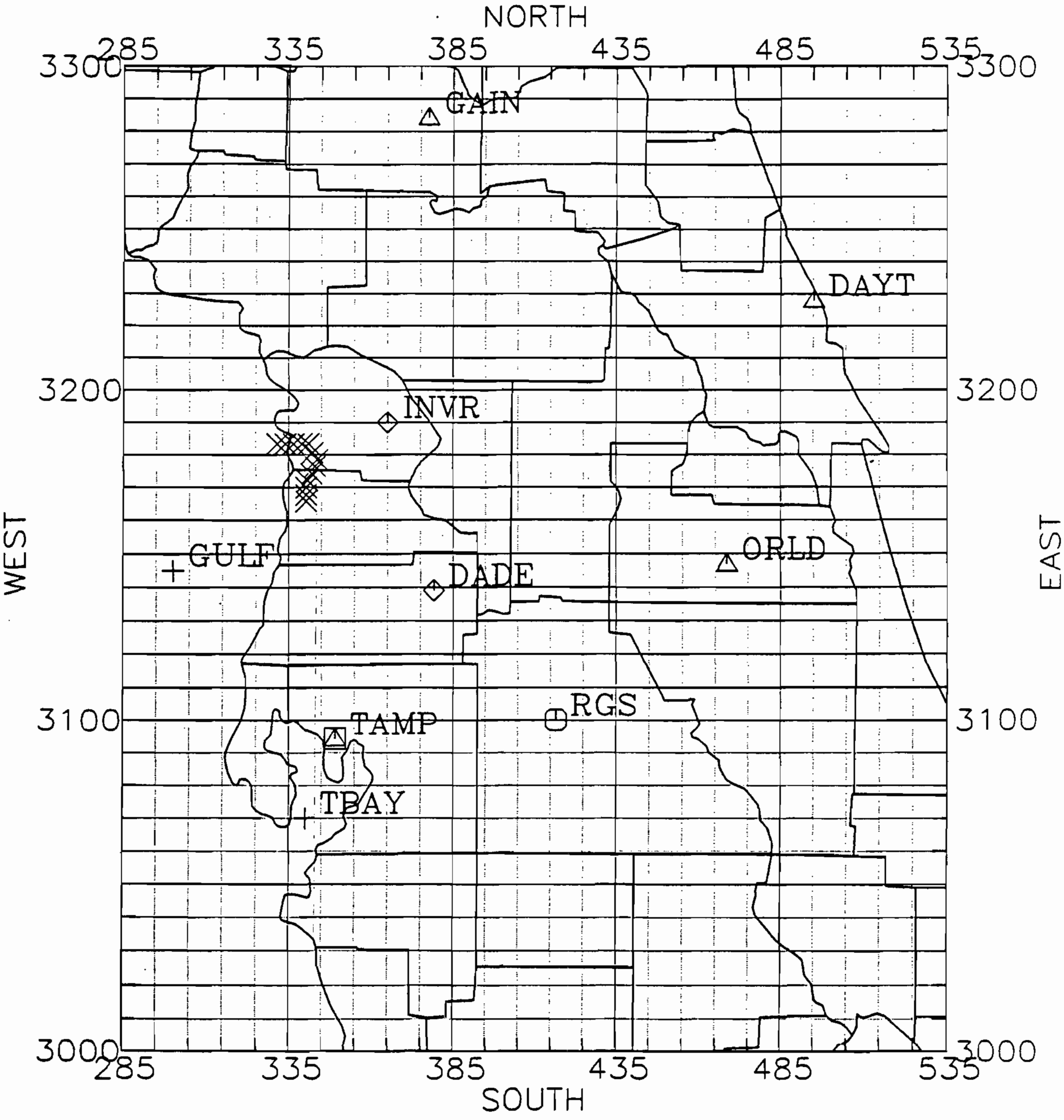


Figure 2. Meteorological Grid System (25 x 30) used in the MESOPUFF II modeling. Grid size is 10 km. (Meteorological stations: TAMP = Tampa, ORLD = Orlando, GAIN = Gainesville, DAYT = Daytona Beach; RGS = Ridge Generating Station; X = Chassohowitzka Class I area receptors).

Table 1

Meteorological Station Data

Station Name	Type	Station ID	Meteorological Grid Coordinate[*]		Latitude	Longitude
			X	Y	(deg.)	(deg.)
Tampa	surface	12842	7.40	10.50	27.97	82.53
Orlando	surface	12815	19.40	15.70	28.45	81.32
Gainesville	surface	12816	10.20	29.40	29.68	82.27
Daytona	surface	12834	22.00	23.80	29.18	81.05
Tampa	upper air	12842	7.40	10.50	27.97	82.53

---

[*] Meteorological grid coordinate (1,1) corresponds to UTM coordinate (x,y) = (285000, 3040000). One meteorological grid unit = 10 km.

The upper air data from Tampa were obtained from the NCDC in TDF-6200 data format. READ62 was executed using the following missing data control options: LHT = T, LTEMP = F, LWD = F, LWS = F. These options will eliminate a pressure level if the height field is missing, but retain the level if the temperature, wind speed, or wind direction is missing. Missing values of temperature or winds were interpolated from valid values in adjacent levels in order to provide a complete data set. The data from the surface to the 500 mb pressure level were extracted from the TDF-6200 data file by READ62.

READ62 identifies periods with missing or duplicate sounding data. Duplicate records were eliminated. Missing soundings were replaced by substituting the previous day's soundings at the same time of day (i.e., 00:00 GMT or 12:00 GMT).

Land Use Data

An estimation of the dominant land use type of each grid cell is one of the input fields required by the MESOPAC II model. The land use data for the grid shown in Figure 2 was based on the Geographic Information Systems (GIS) land cover data base provided as part of the ARM3 model (Morris et al., 1988). The GIS land use file has a resolution of roughly 35 km x 35 km. The land use data are specified in terms of a fractional coverage for each of ten land use categories.

The land use data are extracted from the archive using the ARM3 PRELND program. The user specifies the origin and size of the region. The grid origin used was UTM (x,y) = (285000, 3040000) meters, with a grid size of 10 km. MESOPAC II requires the specification of the dominant land use type in each grid cell, rather than fractional coverage of the cell for each land use category. Therefore, the land use category with the highest percentage of coverage in each cell was selected. The coastal areas and lakes were reset to water, if necessary, using map information so that the smaller scale features blurred by the lower resolution GIS data were not lost.

Because the GIS land use categories do not exactly correspond to those used in MESOPUFF II, the GIS categories were assigned to the most similar

MESOPUFF II categories based on the surface roughness characteristics. Table 2 illustrates the mapping of the GIS categories into the MESOPUFF II categories. For example, the GIS "agricultural/rangeland" category was mapped into the MESOPUFF II "cropland/grazing" category rather than the "irrigated crops" category because of a better match of the roughness length. Figure 3 contains the gridded MESOPUFF II land use categories used in the modeling.

MESOPAC II Model Options

The default model options were used for all of the technical options in MESOPAC II. These included the use of mixed-layer averaged winds for the lower-layer wind field, and mixing height to 700 mb averaged winds for the upper layer wind field. The model's mixing height constants, cloud-induced radiation reduction factors, and heat flux constants were set to the default values as described in the MESOPUFF II User's Guide.

The output file of gridded meteorological fields for a full year run of MESOPAC II for the 25x30 grid described above would require about 250 megabytes of disk storage. In order to reduce the size of this file and allow the modeling to be conducted simultaneously on multiple computers, the modeling was split into two six-month runs. The second run contained a four-day overlap period with the first in order to eliminate model initialization effects. Thus, the runs were for Julian days 1-181, and days 178-365, respectively. The MESOPUFF II results for Days 178-181 of the second run were discarded.

3.2 MESOPUFF II Dispersion Modeling

Technical Options

A number of important physical and chemical processes affect pollutants traveling over distance scales of tens of kilometers which are generally not important (and therefore not usually considered) in modeling applications for

Table 2

Mapping of ARM3 GIS Land Use Categories into MESOPUFF II Land Use Categories

GIS		MESOPUFF II		
Category	Roughness Length (m)	Category	Roughness Length (m)	Category Number
Urban	1.00	Urban	1.00	11
Agriculture	0.25	Crop/pasture	0.20	1
Rangeland	0.03	Grazing land	0.10	6
Forest - deci.	1.00	Grazed forest	0.90	4
Forest - coni.	1.00	Ungrazed forest	1.00	5
Swamp/forest	1.00	Ungrazed forest	1.00	5
Water	0.0002	Water	0.0001	12
Swamp	0.10	Swamp	0.20	9
Agric./rangeland	0.25	Cropland/grazing	0.30	2
Snow	0.005	-	-	-
-	-	Irrigated crops	0.05	3
-	-	Open woodland	0.20	7
-	-	Desert shrubland	0.30	8
-	-	Marshland	0.50	10

30	5	5	5	5	5	1	1	5	5	5	5	5	5	5	5	5	5	5	5	12	12	12	12	12	12
29	5	5	5	5	5	1	1	5	5	5	5	5	5	5	5	5	5	5	5	12	12	12	12	12	12
28	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	12	12	12	12	12	12
27	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	12	12	12	12	12	12
26	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	12	12	12	12	12
25	5	5	5	5	5	5	5	5	5	1	1	1	5	5	5	5	5	5	5	5	12	12	12	12	12
24	12	5	5	5	5	5	5	5	5	1	1	1	5	5	5	5	5	5	5	5	5	12	12	12	12
23	12	12	12	12	5	5	5	5	5	1	1	1	5	5	5	5	5	5	5	5	5	5	12	12	12
22	12	12	12	12	5	5	5	5	5	1	1	1	5	5	5	5	5	5	5	5	5	5	12	12	12
21	12	12	12	12	5	5	5	5	5	1	1	1	1	1	1	1	1	5	5	5	5	5	5	12	12
20	12	12	12	12	12	5	5	5	5	1	1	1	1	1	1	1	1	5	5	5	5	5	5	12	12
19	12	12	12	12	12	5	5	5	5	5	5	5	1	1	1	1	1	5	5	5	5	5	5	12	12
18	12	12	12	12	12	5	5	5	5	5	5	5	1	1	1	1	1	5	5	5	5	5	5	12	12
17	12	12	12	12	12	5	5	5	5	1	1	1	1	1	1	1	1	5	5	5	5	5	9	12	12
16	12	12	12	12	12	5	5	5	5	1	1	1	1	1	1	1	1	5	5	5	5	5	9	12	12
15	12	12	12	12	12	5	5	1	1	5	5	5	5	5	12	12	12	5	5	6	6	6	5	5	12
14	12	12	12	12	5	5	5	1	1	5	5	5	5	5	12	12	12	5	5	6	6	6	5	5	12
13	12	12	12	12	5	5	5	1	1	1	1	1	1	1	5	5	5	12	12	1	1	1	1	1	12
12	12	12	12	12	5	5	5	1	1	1	1	1	12	12	1	1	1	6	6	6	6	6	1	1	12
11	12	12	12	12	5	5	5	1	1	1	1	1	12	12	1	1	1	6	6	6	6	6	1	1	1
10	12	12	12	5	12	12	5	5	5	5	5	5	5	5	1	1	1	6	6	6	6	6	1	1	1
9	12	12	12	5	5	12	12	12	5	5	5	5	5	5	1	1	1	6	6	6	6	6	1	1	1
8	12	12	12	12	5	12	12	1	1	1	1	1	1	1	1	1	1	5	5	1	1	1	6	6	6
7	12	12	12	12	12	12	1	1	1	1	1	1	1	1	1	1	1	5	5	1	1	1	6	6	6
6	12	12	12	12	12	12	6	6	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	12	12	12	12	12	6	6	6	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	12	12	12	12	12	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	12	12	12	12	12	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	12	12	12	12	12	12	1	1	1	1	1	1	1	1	1	1	1	6	6	1	1	1	1	1	1
1	12	12	12	12	12	12	12	6	6	6	6	6	1	1	1	1	1	6	6	1	1	1	1	1	1
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

Figure 3. Gridded MESOPUFF II land use categories for the 25x30 meteorological grid (1 = crop, 5 = forest, 6 = grazing land, 9 = swamp, 12 = water).

small source-receptor distances (i.e., < 10 km). These include gas and aqueous phase transformation of SO_2 into sulfate, dry deposition, and wet scavenging processes. In addition, the spatial and temporal variability in the meteorological fields is usually an important factor affecting concentration estimates at mesoscale distances. MESOPUFF II was developed specifically for transport distances greater than 10 km, and therefore has specific modules to parameterize these effects.

In the current application, the RGS and background PSD sources of SO_2 were modeled for the 1986 annual period. The recommendations contained in the MESOPUFF II User's Guide were used in the modeling with three exceptions. First, wet removal processes were not considered. This assumption is conservative in the sense that during wet periods, significant removal of SO_2 actually occurs. By neglecting this process, the modeling results obtained during periods with precipitation will tend to be overestimated, other factors being equal, than if it were considered. The decision to not include wet removal was based on the preference of the NPS.

The second change was to use a cross-over distance of 10 km instead of 100 km for the use of the time-dependent dispersion equations of Heffter (1965). The 10 km cross-over distance has been recommended by the model authors for several years, and in fact was used in the model evaluation study of MESOPUFF II conducted by the Argonne National Laboratory (ANL). The use of the 10 km cross-over distance was noted by ANL as one of the main factors leading to the superior performance of MESOPUFF II over some of the other models tested in the ANL study. Included in Appendix A are additional comments regarding this issue which were submitted to EPA in response to the request for public comments on the proposed Supplement B revisions to the EPA modeling guidelines.

The third change was the use of two-layer mode for deposition instead of the three-layer mode. This change was the result of sensitivity tests with and without deposition, which produced inconsistent results when the three-layer model was used. It is believed that the vertical dilution term in the three-layer model should be modified to account for the 10-meter surface layer. The two-layer deposition mode produced reasonable and consistent results as compared to the sensitivity run without deposition, and therefore it was used for the current application.

Appendix B contains a listing of a portion of a MESOPUFF II list file which shows the model options selected and values for the various input variables. The listing shown is for a run with the RGS source for the January to June time period. Sources located between 20 and 50 km from the Class I area were modeled with a minimum sampling rate of 8 per hour. Sources greater than 50 km from the Class I area (including the RGS source) used a minimum sampling rate of 2 per hour. As discussed in the MESOPUFF II technical report (Scire et al., 1984b), more frequent sampling is required as the source-receptor distance decreases (see Table 3). These values of the sampling rate should provide a good representation of the plumes for all sources modeled, including those as close as 20 km from the Class I area.

Although wet removal processes were not considered in the modeling analysis, the dry deposition and chemical transformation mechanisms of the model were invoked. This is an especially reasonable procedure in this case since the great majority of sources modeled (including nearly all of the larger sources) are located more than 50 km from the Class I area.

Receptor Locations

Thirteen discrete receptors in the Class I area were used in the modeling analysis. The coordinates of each receptor are listed in Table 4. These receptors were specified by the Florida DER.

Source Data

The stack coordinates, emission parameters, and stack parameters for each of the sources included in the MESOPUFF II modeling are shown in Tables 5a and 5b. The RGS is Source 1 in Table 5a. The background PSD source inventory was specified by the Florida DER. It consists of 63 increment-consuming PSD sources (Table 5a) and 19 increment-expanding sources (Table 5b). The increment-expanding sources are baseline sources which have stopped operations or reduced emissions. Their contribution was subtracted from that of the increment-consuming sources on a receptor-by-receptor and

Table 3

Comparison of MESOPUFF II Concentrations with Straight-Line Gaussian Plume Results as a Function of Source-Receptor Distance and Puff Sampling Rate (N)

(from Scire et al., 1984b)

(Wind Speed = 5 m/s, D Stability, Mixing Height = 1000 m, Uniform Vertical Distribution)

Distance (km)	σ_y (m)	Straight-Line Gaussian Eqn.	MESOPUFF II Sampling Algorithm N=1	N=2	N=4	N=8	N=16
10	518	1.54	1.69	1.09	1.33	1.51	1.55
20	966	0.83	0.59	0.72	0.81	0.83	0.83
30	1,392	0.57	0.63	0.54	0.59	0.57	0.57
40	1,803	0.44	0.39	0.44	0.45	0.44	0.44
50	2,203	0.36	0.41	0.37	0.36	0.36	0.36

Table 4

Meteorological Grid Coordinates of Receptors in the Chassahowitzka National Wildlife Refuge Class I Area

Receptor	Meteorological Grid Coordinates*	
	X	Y
1	6.53	17.57
2	6.53	17.77
3	6.53	17.98
4	6.57	18.19
5	6.70	18.40
6	6.80	18.62
7	6.87	18.83
8	6.74	19.06
9	6.61	19.34
10	6.40	19.34
11	6.15	19.34
12	5.90	19.34
13	5.65	19.34

---

[*] Meteorological grid coordinate (1,1) corresponds to UTM coordinate (x,y) = (285000, 3040000). One meteorological grid unit = 10 km.

Table 5a

Increment-Consuming PSD Sources Modeled with MESOPUFF II

SOURCE	METEOROLOGICAL* GRID COORDINATES		STACK HT	DIAMETER	EXIT VEL.	TEMP.	SO2 EMISSION RATE
	X	Y	(m)	(m)	(m/s)	(deg K)	(g/s)
1	14.17	11.04	99.06	3.05	14.54	349.80	13.78
2	19.25	20.72	15.24	4.21	56.21	819.80	466.40
3	17.13	13.60	15.24	4.21	56.21	819.80	310.90
4	17.13	13.60	15.24	7.04	32.07	880.80	276.10
5	11.30	12.60	60.35	2.44	17.77	353.00	54.60
6	11.30	12.60	60.35	2.44	17.77	353.00	54.60
7	8.69	8.50	149.40	7.32	19.81	342.20	654.70
8	20.85	16.06	167.60	5.80	21.60	325.70	105.40
9	20.85	16.06	167.60	5.80	23.50	324.20	242.40
10	18.51	13.93	18.30	3.66	38.00	422.00	32.10
11	12.98	6.74	22.90	4.88	23.90	389.00	277.60
12	13.35	11.58	76.20	4.88	19.70	350.00	500.10
13	9.32	10.27	50.00	1.80	18.30	491.00	21.40
14	6.03	9.44	49.10	2.74	27.72	522.00	62.24
15	10.83	14.58	12.30	0.40	9.20	466.20	0.20
16	13.42	11.28	30.48	5.79	28.22	783.20	29.11
17	12.16	8.89	61.00	2.60	15.31	350.00	182.85
18	12.16	8.89	60.70	2.60	15.31	350.00	121.90
19	12.16	8.89	36.60	1.83	20.15	319.10	5.54
20	11.06	14.90	30.48	3.35	17.13	384.30	5.04
21	15.90	20.88	30.48	3.35	17.13	384.30	5.04
22	13.35	9.30	9.10	0.70	22.50	450.00	4.30
23	13.35	9.30	67.10	2.40	9.80	351.00	52.90
24	8.68	9.83	30.00	0.61	20.00	375.00	21.02
25	12.34	9.42	45.70	2.30	10.30	352.00	42.00
26	13.45	8.95	30.48	2.29	9.27	355.00	67.16
27	13.45	8.95	45.72	2.44	9.65	355.00	41.96
28	11.46	7.79	38.10	2.90	10.13	339.00	18.40
29	11.46	7.79	38.10	2.44	18.40	346.00	21.17
30	12.16	8.86	60.70	2.60	15.55	350.00	63.00

---

*Meteorological grid coordinate (1,1) corresponds to UTM coordinates (x,y) = (285000, 3040000). One meteorological grid unit = 10 km.

(Continued)

Table 5a

Increment Consuming PSD Sources Modeled with MESOPUFF II

(Concluded)

SOURCE	METEOROLOGICAL* GRID COORDINATES		STACK HT (m)	DIAMETER (m)	EXIT VEL. (m/s)	TEMP. (deg K)	SO2 EMISSION RATE (g/s)
	X	Y					
31	12.18	8.94	52.40	2.40	13.00	322.00	3.78
32	12.18	8.94	52.40	2.40	7.10	319.00	5.36
33	12.15	8.92	36.60	1.80	20.80	319.00	5.54
34	12.15	8.86	60.70	2.60	15.55	350.00	63.00
35	12.15	8.88	61.00	2.50	16.71	350.00	189.00
36	13.17	9.52	61.00	2.13	12.20	360.00	35.70
37	14.11	7.86	53.40	2.59	15.91	355.00	63.00
38	14.11	7.86	53.40	2.59	15.91	355.00	63.00
39	13.47	9.60	61.00	2.80	7.30	346.00	73.60
40	13.45	9.65	61.00	1.52	28.40	347.00	72.00
41	8.84	9.24	45.70	2.29	9.20	355.00	36.75
42	11.98	7.77	8.20	0.41	7.57	505.00	0.60
43	11.99	7.98	30.50	1.82	7.26	334.00	16.35
44	11.45	7.80	38.10	2.44	15.20	339.00	13.40
45	13.97	9.03	13.70	1.22	40.40	330.00	30.64
46	12.33	9.43	25.90	2.29	15.20	339.00	2.44
47	11.53	13.94	6.10	1.38	21.00	422.00	3.54
48	13.25	8.13	45.73	1.60	39.06	350.00	113.50
49	8.50	17.24	97.60	4.88	23.23	442.00	98.40
50	7.21	14.92	83.82	3.05	15.70	394.30	14.10
51	5.92	21.45	182.90	6.90	21.00	398.00	1008.80
52	5.92	21.45	182.90	6.90	21.00	398.00	1008.00
53	8.64	17.84	8.50	1.08	10.95	357.40	2.25
54	8.49	17.24	12.20	1.37	10.58	377.00	2.25
55	10.72	17.61	9.14	0.61	4.57	478.00	2.99
56	11.17	16.58	10.67	1.83	8.99	327.00	0.82
57	8.48	17.49	7.62	1.83	6.29	347.00	2.09
58	6.56	12.92	12.20	3.05	6.47	339.00	0.23
59	8.09	15.37	9.14	1.30	16.00	408.00	3.67
60	5.62	13.45	10.98	0.31	3.88	544.00	0.06
61	5.62	13.45	10.98	0.31	3.88	544.00	0.03
62	5.84	15.10	10.98	0.31	4.00	533.00	0.08
63	5.84	15.10	10.98	0.31	4.00	533.00	0.08
64	6.57	12.95	9.14	1.40	22.30	436.00	7.25

---

* Meteorological grid coordinate (1,1) corresponds to UTM coordinates (x,y) = (285000, 3040000). One meteorological grid unit = 10 km.

Table 5b

Increment-Expanding PSD Sources Modeled with MESOPUFF II

SOURCE	METEOROLOGICAL* GRID COORDINATES X	Y	STACK HT (m)	DIAMETER (m)	EXIT VEL. (m/s)	TEMP. (deg K)	SO2 EMISSION RATE (g/s)
1	11.30	12.60	60.35	2.44	16.40	353.00	50.40
2	11.30	12.60	60.35	2.44	16.40	353.00	50.40
3	8.69	8.50	149.40	7.32	28.65	422.00	2436.00
4	8.69	8.50	149.40	7.32	14.33	418.00	1218.00
5	5.06	12.67	49.00	1.20	3.60	293.00	52.07
6	12.16	8.89	61.00	2.60	14.28	350.00	170.10
7	13.35	9.30	30.50	1.68	14.60	350.00	110.60
8	12.34	9.42	30.50	1.80	18.90	308.00	15.20
9	13.45	8.95	30.48	1.37	20.18	311.00	54.56
10	12.17	8.89	21.04	2.13	18.56	347.00	34.27
11	12.15	8.88	61.00	2.50	11.14	350.00	146.00
12	13.17	9.52	51.00	2.13	9.90	356.00	257.60
13	14.12	7.87	29.00	3.02	6.77	314.00	78.80
14	13.47	9.60	45.70	1.40	16.50	352.00	216.00
15	8.84	7.24	22.60	1.52	19.50	322.00	196.30
16	8.84	9.24	45.70	2.29	9.20	355.00	50.71
17	13.25	8.13	45.73	1.60	26.40	350.00	75.60
18	5.92	21.45	152.00	4.57	42.10	422.00	314.00
19	5.92	21.45	153.00	4.88	42.10	422.00	1859.00

---

*Meteorological grid coordinate (1,1) corresponds to UTM coordinates (x,y) = (285000, 3040000). One meteorological grid unit = 10 km.

hour-by-hour basis in the MESOFILE II postprocessing step of the analysis. Thus, the total net concentration for a particular time period can be either positive or negative, depending on the relative contribution of the various sources.

4. MESOPUFF II MODELING RESULTS

3-Hour SO_2 Concentrations

The peak predicted 3-hour SO_2 concentration predicted by MESOPUFF II due to emissions from the RGS was 0.26 $\mu g/m^3$ on Day 343 for the hours 03:00-0:600 LST. Because this value is less than the proposed 3-hour SO_2 significance level of 0.48 $\mu g/m^3$, a cumulative impact analysis with background PSD sources was not necessary.

24-Hour SO_2 Concentrations

MESOPUFF II modeling for the RGS source produced three days with predicted 24-hour SO_2 concentrations at or above the proposed NPS 24-hour significance level of 0.07 $\mu g/m^3$ at one or more of the Class I area receptors. As shown in Table 6, concentrations on Days 282, 332, and 333 exceeded the significance level, with the peak concentration (0.09 $\mu g/m^3$) predicted on Day 332.

Tables 7, 8, and 9 show the concentrations due to RGS and the total net contribution from the 82 background PSD sources located at or beyond 20 km from the Class I area added to the RGS contribution. The highest predicted concentrations at a receptor for which the RGS contribution was significant (i.e., $\geq$ 0.07 $\mu g/m^3$) was 4.67 $\mu g/m^3$.

In order to reach conclusions relating to compliance with the 24-hour PSD Class I increment for SO_2, the contributions of the one source located less than 20 km from the Class I area must be added to the values in Tables 7 to 9. The modeling of the additional source with the ISCST model was conducted by Dames & Moore. The results of that analysis are described in a separate report.

Table 6

Predicted Peak 24-Hour Average SO_2 Concentrations Due to RGS Emissions At or Above the Proposed NPS 24-Hour Significance Threshold of 0.07 μg/m^3

Day	Receptor	Concentration (μg/m^3)
282	1	0.08
332	13	0.09
333	13	0.08

Table 7

Predicted 24-Hour Average SO_2 Concentrations on Days when RGS Contributions Exceeded the Proposed NPS Significance Level

Day: 282

Receptor	Contribution from RGS	Contribution from Sources ≥ 20 km from Class I Area (Including RGS)
1	0.075	3.01
2	0.073	3.29
3	0.070	3.59
4	0.067	*
5	0.063	*
6	0.059	*
7	0.055	*
8	0.053	*
9	0.050	*
10	0.052	*
11	0.053	*
12	0.054	*
13	0.055	*

---

* At this receptor, the RGS contribution is less than the proposed NPS 24-hour significance level of 0.07 $\mu g/m^3$.

Table 8

Predicted 24-Hour Average SO_2 Concentrations on Days when RGS Contributions Exceeded the Proposed NPS Significance Level

Day: 332

Receptor	Contribution from RGS	Contribution from Sources ≥ 20 km from Class I Area (Including RGS)
1	0.088	3.84
2	0.088	3.60
3	0.087	3.80
4	0.086	4.32
5	0.084	4.28
6	0.084	4.30
7	0.084	4.43
8	0.083	4.51
9	0.082	4.62
10	0.083	4.67
11	0.085	4.54
12	0.088	4.38
13	0.091	4.33

Table 9

Predicted 24-Hour Average SO_2 Concentrations on Days when RGS Contributions Exceeded the Proposed NPS Significance Level

Day: 333

Receptor	Contribution from RGS	Contribution from Sources ≥ 20 km from Class I Area (Including RGS)
1	.032	*
2	.031	*
3	.030	*
4	.029	*
5	.026	*
6	.026	*
7	.026	*
8	.028	*
9	.031	*
10	.038	*
11	.050	*
12	.065	*
13	.081	1.22

---

* At this receptor, the RGS contribution is less than the proposed NPS 24-hour significance level of 0.07 $\mu g/m^3$.

5. REFERENCES

EPA, 1986: Guidance on air quality models (revised). EPA-450/2-78-027R, U.S. Environmental Protection Agency, Research Triangle Park, NC.

EPA, 1991: Supplement B to the guideline on air quality models (revised). Draft. U.S. Environmental Protection Agency, Research Triangle Park, NC.

Heffter, J.L., 1965: The variations of horizontal diffusion parameters with time travel periods of one hour or longer. *J. Applied Meteorol.*, **4**, 153-156.

Policastro, A.J., M. Wastag, L. Coke, R.A. Carhart and W.E. Dunn, 1986: Evaluation of short-term long-range transport models (Draft final report). U.S. Environmental Protection Agency, Research Triangle Park, NC.

Scire, J.S., F.W. Lurmann, A. Bass and S.R. Hanna, 1984a: User's guide to the MESOPUFF II model and related processor programs. EPA-600/8-84-013, U.S. Environmental Protection Agency, REsearch Triangle Park, NC.

Scire, J.S., F.W. Lurmann, A. Bass and S.R. Hanna, 1984b: Development of the MESOPUFF II dispersion model. EPA-600/3-84-057. U.S. Environmental Protection Agency, Research Triangle Park, NC.

Appendix A

Comments on the use of MESOPUFF II

Sigma Research Corporation

Telephone: (508) 692-0330
Telefax: (508) 692-8547

234 Littleton Road, Suite 2E • Westford, Massachusetts 01886, U.S.A.

May 3, 1991

Air Docket (LE-131), Room M-1500
Waterside Mall
Attention: Docket A-88-04
U.S. Environmental Protection Agency
401 M Street SW
Washington, DC 20460

Dear Sir:

I am writing in response to the Federal Register Notice (AD-FRL-3908-3, Docket No. A-88-04, Monday February 25, 1991) requesting comments on the proposed revisions to the "Guideline on Air Quality Models (Revised)" and Supplement B to the Guideline. In particular, my comments relate to the EPA recommendations regarding the use of the MESOPUFF II dispersion model (Scire et al., 1984).

Supplement B notes that MESOPUFF II, listed in Appendix B of the Guidelines, may be applied on a case-by-case basis when long range transport estimates are needed. It is also noted that information on applying this model is contained in the EPA document "A Modeling Protocol for Applying MESOPUFF-II to Long-Range Problems" (Docket No. A-88-04, II-I-11).

The following changes are recommended to the EPA MESOPUFF II modeling protocol.

- MESOPUFF II contains a input parameter, TMDEP, which controls the distance at which the functions used to compute dispersion coefficients are switched from the distance-dependent equations of Turner to the time-dependent functions of Heffter (1965). The default value for this parameter is set at 100 km, indicating that the time-dependent functions are used at greater distances. However, in our review of the model evaluation protocol prepared by Argonne National Laboratory (ANL) in their evaluation of long-range transport models, we suggested that a value of 10 km be used for TMDEP. The model evaluation work done by ANL was based on a 10 km value for TMDEP. ANL concluded that "the use of 10 km as the transition distance between the use of the Turner curves and Heffter formula for lateral dispersion definitely improved concentration predictions" (page 6-7, Policastro et al., 1986). They also noted that a main cause of the under-prediction of lateral spreading by some of the other models evaluated was due to the use of the distance-dependent curves out to 50-100 km. They concluded that "the more correct distance is about 10 km" (page 6-3). Therefore, it is recommended that the EPA modeling protocol for MESOPUFF II be modified to recommend that a value of 10 km be used for TMDEP.

- The EPA modeling protocol recommends that MESOPUFF II be run for pollutants such as SO_2 with the chemical transformation and pollutant removal algorithms turned off. However, over source-receptor distances of 50 to 300 kilometers, these processes can have a very significant effect on the predicted concentrations. Wet deposition of SO_2 is a particularly efficient removal mechanism. For example, studies of observed scavenging ratios indicate typical removal rates of 10-20 *per hour* or higher for modest precipitation rates of only 1-2 mm/hr. (At an average transport speed of 5 m/s, over 16 hours is required to travel 300 km).

  Current EPA modeling guidelines allow consideration of SO_2 transformation in straight-line Gaussian models on even smaller spatial scales than those for which MESOPUFF II would be applied. For example, the modeling guidelines recommend a pollutant half life of 4 hours for SO_2 modeling in urban areas). Therefore, some allowance for chemical conversion and removal is consistent with current guidance and is justifiable on technical grounds. Although first-level screening analyses with removal and chemical conversion switched off is appropriate, it is suggested that more refined screening modeling with MESOPUFF II which accounts for SO_2 transformation and removal should be allowed.

- The modeling protocol recommends the use of MESOPUFF II at source-receptor distances greater than 50 km. It should be noted that the puff model can reproduce a straight-line Gaussian model results under steady-state conditions with the appropriate choice of puff release parameters at distances much less than 50 km (Table 9 in the MESOPUFF II report shows nearly identical results down to 10 km with N=16). Therefore, it is not so much an issue of when does the puff model become valid as when the straight-line, steady-state assumptions in conventional models become not appropriate. The straight-line Gaussian model is more efficient computationally over short distances, but because there are many flow situations when non-steady-state conditions occur over spatial scales less than 50 km, the use of the puff model may be justified.

The modeling protocol recommends application of MESOPUFF II for a full year period for small numbers of sources. Recent advances in the computational speed of advanced PCs and workstations have made large multi-source or multi-year simulations with the MESOPUFF II model practical. For example, the state agency in Massachusetts sponsored a study to simulate nearly 200 point and area sources of SO_2 for a full year with only modest computational resources. Similar studies have been performed in other states, including Minnesota and Maryland.

Thank you for the opportunity to comment on these issues.

Sincerely,

Joseph S. Scire

Joseph S. Scire
Chief Executive Officer

cc: J. Tikvart

References

Heffter, J.L., 1965: The variations of horizontal diffusion parameters with time travel periods of one hour or longer. *J. Applied Meteorol.*, 4, 153-156.

Policastro, A.J., M. Wastag, L. Coke, R.A. Carhart, and W.E. Dunn, 1986: Evaluation of short-term long-range transport models (Draft final report). U.S. Environmental Protection Agency, Research Triangle Park, NC.

Scire, J.S., F.W. Lurmann, A. Bass, S.R. Hanna, 1984: User's guide to the MESOPUFF II model and related processor programs. EPA-600/8-84-013. U.S. Environmental Protection Agency, Research Triangle Park, NC.

Scire J.S., F.W. Lurmann, A. Bass, S.R. Hanna, 1984: Development of the MESOPUFF II dispersion model. EPA-600/3-84-057. U.S. Environmental Protection Agency, Research Triangle Park, NC.

Appendix B

MESOPUFF II Output List File

(RGS Source, January - June, 1986)

```
                   MESOPUFF - VERSION 2.0 (DATED 85360)

                                         MESOPUFF   VERSION  2.0
*************************************************************************************************************************

MESOPUFF II - RGS - 1/1/86 - 6/30/86  w/dry dep and Chem

GENERAL RUN INFORMATION:
    YEAR OF RUN (NSYR) = 86
    JULIAN DAY OF START OF RUN (NSDAY) =   1
    HOUR OF START OF RUN (NSHR) =  0
    LENGTH OF RUN (NADVTS) = 4344 (HOURS)
    NUMBER OF POINT SOURCES (NPTS) =  1
    NUMBER OF AREA (URBAN) SOURCES (NAREAS) =  0
    NUMBER OF NONGRIDDED RECEPTORS (NREC) =  13
    NUMBER OF POLLUTANT SPECIES (NSPEC) =  1

COMPUTATIONAL VARIABLES:
    CONCENTRATION AVERAGING TIME (IAVG) =    1 (HOUR(S))
    PUFF RELEASE RATE (NPUF) =   4 (PUFFS/HOUR)
    MINIMUM SAMPLING RATE (NSAMAD) =  2 (SAMPLES/HOUR)
    SAMPLING RATE VARIED WITH WIND SPEED ? (LVSAMP) = T
    SAMPLING RATE WIND SPEED INTERVAL (WSAMP) =  2.00 (M/S)
    CONCENTRATIONS CALCULATED AT SAMPLING GRID POINTS ? (LSGRID) = F
    PUFFS YOUNGER THAN "AGEMIN" SECONDS ARE NOT SAMPLED (AGEMIN) =   900. (SECONDS)

GRID INFORMATION:
    BEGINNING OF COMPUTATIONAL GRID IN X-DIRECTION (IASTAR) =  1
    END OF COMPUTATIONAL GRID IN X-DIRECTION (IASTOP) = 25
    BEGINNING OF COMPUTATIONAL GRID IN Y-DIRECTION (JASTAR) =  1
    END OF COMPUTATIONAL GRID IN Y-DIRECTION (JASTOP) = 30
    BEGINNING OF SAMPLING GRID IN X-DIRECTION (ISASTR) =  1
    END OF SAMPLING GRID IN X-DIRECTION (ISASTP) = 25
    BEGINNING OF SAMPLING GRID IN Y-DIRECTION (JSASTR) =  1
    END OF SAMPLING GRID IN Y-DIRECTION (JSASTP) = 30
    SAMPLING GRID SPACING FACTOR (MESHDN) =  1

TECHNICAL OPTIONS:
    GAUSSIAN VERTICAL CONCENTRATION DISTRIBUTION ? (LGAUSS) = T
    CHEMICAL PROCESSES MODELED ? (LCHEM) = T
    DRY DEPOSITION MODELED ? (LDRY) = T
    WET REMOVAL MODELED ? (LWET) = F
    3 VERTICAL LAYERS ? (L3VL) = F

OUTPUT OPTIONS:
    CONCENTRATIONS STORED ON TAPE ? (LTAPE) = T
    CONCENTRATIONS PRINTED ? (LPRINT) = T
    PRINT INTERVAL (IPRINF) =   24
    PUFF PARAMETERS PRINTED EACH SAMPLING STEP ? (LDB) = F
    TIME STEPS FOR WHICH PUFF PARAMETERS PRINTED (NN1,NN2) =    0,   0
```

```
                                         MESOPUFF   VERSION  2.0
***************************************************************************************************************************

DEFAULT OVERRIDE OPTIONS (0=NO,1=YES)
    USER INPUT SIGY, SIGZ VARIABLES (IOPTS(1)) =                1
    USER INPUT VERTICAL DIFFUSIVITY CONSTANTS (IOPTS(2)) =      0
    USER INPUT DRY DEP. SO2 CANOPY RESISTANCES (IOPTS(3)) =     0
    USER INPUT OTHER DRY DEP. CONSTANTS (IOPTS(4)) =            0
    USER INPUT WET REMOVAL CONSTANTS (IOPTS(5)) =               0
    USER INPUT CHEMICAL TRANSFORMATION VARIABLES (IOPTS(6)) =   0

SIGY, SIGZ VARIABLES:
    AY =             0.36000   0.25000   0.19000   0.13000   0.09600   0.06300
    BY =             0.90000   0.90000   0.90000   0.90000   0.90000   0.90000
    AZ =             0.00023   0.05800   0.11000   0.57000   0.85000   0.77000
    BZ =             2.10000   1.09000   0.91000   0.58000   0.47000   0.42000
    AZT (IN M) =     5.00000   3.87300   2.73900   1.87100   1.22500   0.70700
    TMDEP =     10000. (M)
    STABILITY CLASS USED IN SIGY, SIGZ CALCULATIONS FOR PUFFS ABOVE BOUNDARY LAYER (JSUP) =  5
         (0 = BOUNDARY LAYER STABILITY CLASS, 5 = E STABILITY, 6 = F STABILITY)

VERTICAL DIFFUSIVITY CONSTANTS:
    CON1K =      0.010 (M**2/S)
    CON2K =      0.100 (M**2/S)

LAND USE CATEGORY   SO2 CANOPY RESISTANCE (S/M)
                      A,B,C       D         E         F
        1            100.00    300.00   1000.00      0.00
        2            100.00    300.00   1000.00      0.00
        3            100.00    300.00   1000.00      0.00
        4            100.00    300.00   1000.00      0.00
        5            100.00    300.00   1000.00      0.00
        6            100.00    300.00   1000.00      0.00
        7            100.00    300.00   1000.00      0.00
        8            200.00    500.00   1000.00   1000.00
        9             50.00     75.00    100.00      0.00
       10             75.00    300.00   1000.00      0.00
       11           1000.00   1000.00   1000.00      0.00
       12              0.00      0.00      0.00      0.00

DRY DEPOSITION CONSTANTS:
    CANOPY RESISTANCE FOR NOX IN S/M (RCNOX) =  130.00 (A,B,C)   500.00 (D)  1500.00 (E)  1500.00 (F)
    SURFACE RESISTANCE CONSTANT FOR GASES (RSGCON) =    2.60
    SURFACE RESISTANCE FOR PARTICLES (RSPART) = 1000.00 (S/M)
```

```
                                                   MESOPUFF   VERSION  2.0
*************************************************************************************************************************

CHEMICAL TRANSFORMATION VARIABLES:
    SOX TRANSFORMATION METHOD FLAG (MSOX) =  2
        0 - NO TRANSFORMATION
        1 - USER SPECIFIED
        2 - ERT THEORETICAL EQUATION
        3 - GILLANI EQUATION
        4 - HENRY EQUATION FOR ST. LOUIS
        5 - HENRY EQUATION FOR LOS ANGELES
    NOX TRANSFORMATION METHOD FLAG (MNOX) =  2
        0 - NO TRANSFORMATION
        1 - USER SPECIFIED
        2 - ERT THEORETICAL EQUATION
    OZONE INPUT METHOD FLAG (MO3) =  0
        0 - DEFAULT OZONE VALUE USED
        1 - HOURLY OZONE VALUES READ
    DEFAULT BACKGROUND OZONE (CO3B) =   80.0 (PPB)
    TOTAL AMMONIA CONCENTRATION (CTNH3) =   10.0 (PPB)
    NIGHTTIME TRANSFORMATION RATES:
        SO2 LOSS RATE (RNITE(1)) =   0.2 (%/HOUR)
        NOX LOSS RATE (RNITE(2)) =   2.0 (%/HOUR)
        TOTAL NO3 FORMATION RATE (RNITE(3)) =   2.0 (%/HOUR)
```

```
                                                  MESOPUFF   VERSION  2.0
************************************************************************************************************************************

POINT SOURCE DATA
SOURCE     GRID COORDINATES    STACK HT   DIAMETER   EXIT VEL.   TEMP.    ------------- EMISSION RATES (G/S) -------------
              X        Y         (M)        (M)        (M/S)    (DEG K)      SO2       SO4       NOX       HNO3       NO3

   1        14.17    11.04      99.06       3.05       14.54     349.80     13.78      0.00      0.00      0.00      0.00
```

```
                                                MESOPUFF   VERSION  2.0
******************************************************************************************************************************


     NONGRIDDED RECEPTOR LOCATIONS
RECEPTOR    X (GRID UNITS)    Y (GRID UNITS)


     1          6.530             17.570
     2          6.530             17.770
     3          6.530             17.980
     4          6.570             18.190
     5          6.700             18.400
     6          6.800             18.620
     7          6.870             18.830
     8          6.740             19.060
     9          6.610             19.340
    10          6.400             19.340
    11          6.150             19.340
    12          5.900             19.340
    13          5.650             19.340
```

```
                                              MESOPUFF   VERSION  2.0
*************************************************************************************************************************

INFORMATION READ FROM METEOROLOGICAL DATA FILE:
    YEAR OF METEOROLOGICAL DATA = 86
    METEOROLOGICAL DATA BEGINS ON JULIAN DAY   1
    NUMBER OF HOURS OF METEOROLOGICAL DATA = 4345
    METEOROLOGICAL GRID SIZE IN X (WEST-EAST) DIRECTION = 25
    METEOROLOGICAL GRID SIZE IN Y (SOUTH-NORTH) DIRECTION = 30
    METEOROLOGICAL GRID SPACING =    10000.0 (M)
    BASE TIME ZONE = 5 (E.S.T.)
    VON KARMAN CONSTANT = 0.40
    CODE FOR LOWER-LEVEL WIND FIELD (ILWF) =  2
    CODE FOR UPPER-LEVEL WIND FIELD (IUWF) =  4
    NUMBER OF STATIONS USED IN CONSTRUCTION OF METEOROLOGICAL DATA FIELDS
         SURFACE:     4
         RAWINSONDE:  1
    STATION         GRID COORDINATES
       TYPE           X            Y
                 (GRID UNITS)  (GRID UNITS)

    SURFACE        7.40         10.50
    SURFACE       19.40         15.70
    SURFACE       10.20         29.40
    SURFACE       22.00         23.80
    RAWINSONDE     7.40         10.50
```

RECEIVED

APR 06 1992

Bureau of
Air Regulation

ADDITIONAL ASSESSMENT OF IMPACTS ON THE CHASSAHOWITZKA PSD CLASS I AREA FOR THE RIDGE GENERATING STATION PROJECT

APRIL 1992

DAMES & MOORE

ATLANTA, GEORGIA
Job No. 22250-004-049

DAMES & MOORE

SIX PIEDMONT CENTER, SUITE 500, 3525 PIEDMONT ROAD, ATLANTA, GEORGIA 30305
(404) 262-2915 FAX: (404) 233-2271

April 3, 1992

Florida Department of Environmental Regulation
Division of Air Resources Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Attention: C.H. Fancy, P.E.
Chief, Bureau of Air Regulation

Re: Permit Application AC 53-206244, PSD-FL-183
Ridge Generating Station

Dear Mr. Fancy:

Item 6 in your letter dated January 17, 1992, requested an additional evaluation of impacts on the Chassahowitzka PSD Class I area resulting from Ridge Generating Station emissions. A summary response to Item 6 was provided in a letter from the project partners dated March 27, 1992. A meeting was then held on April 1, 1992, with Tom Rogers and Cleve Holladay of the Air Modeling and Assessment Section to discuss requirements for a detailed response. The attached report constitutes the detailed response. At the suggestion of Mr. Rogers and Mr. Holladay, we are sending a copy of the report to Mr. John Notar at the Air Quality Division of the National Park Service.

Included in the attached report are the results of an additional modeling evaluation of PSD Class I area impacts. Printouts and computer files supporting these results are being sent under separate cover.

Please call me (404-262-2915) or Matt Killeen at Wheelabrator Environmental Systems (1-800-682-0026) if you have any questions.

Sincerely,

Dames & Moore, Inc.

James W. Little

James W. Little
Associate

Attachments
cc: J. Notar, National Park Service, Air Quality Division
J. Reynolds, Florida Department of Environmental Regulation
C. Holladay, Florida Department of Environmental Regulation
M. Whiting, Decker Energy-Ridge, Inc.
R. Stone, Wheelabrator Polk Inc.
M. Killeen, Wheelabrator Environmental Systems Inc.

DAMES & MOORE

SIX PIEDMONT CENTER, SUITE 500, 3525 PIEDMONT ROAD, ATLANTA, GEORGIA 30305
(404) 262-2915 FAX: (404) 233-2271

April 3, 1992

Mr. John Notar
National Park Service
Air Quality Division
12795 West Alameda Parkway
Lakewood, Colorado 80228

PSD Class I Impact Evaluation
Ridge Generating Station Project
Auburndale, Florida

Dear Mr. Notar:

Ridge Generating Station Limited Partnership is proposing to develop an independent power production facility near Auburndale, Florida. Known as the Ridge Generating Station (RGS) project, the proposed facility will be capable of combusting a mixture of wood, tires, and landfill gas to generate up to 45 MW of electricity.

An air emissions permit application for the project was submitted to the Florida Department of Environmental Regulation (DER) in December 1991. We understand that a copy of the application was forwarded by DER to the Air Quality Division of the National Park Service during DER's initial application completeness review. After reviewing the application, DER requested that an additional evaluation be performed on the impacts of RGS emissions at the Chassahowitzka PSD Class I area. That additional evaluation is the subject of the attached report. DER suggested that we send a copy of the report directly to your office.

The primary subject of the attached report is an additional modeling evaluation of sulfur dioxide impacts. In reviewing this section of the report, we request that you keep in mind the sulfur dioxide control system that will be installed at RGS as described in the original permit application. This system will consist of a spray dryer absorber (scrubber) and fabric filter, which will provide for very effective sulfur oxides control. Use of a flue gas desulfurization system on a boiler fueled predominantly by wood demonstrates the commitment of the project developers to minimize sulfur oxides emissions.

Please call if you have any questions.

Sincerely,

Dames & Moore, Inc.

James W. Little

James W. Little
Associate

Attachment

cc: C. Holladay, Florida DER
M. Whiting, Decker Energy-Ridge, Inc.
R. Stone, Wheelabrator Polk Inc.

ADDITIONAL ASSESSMENT OF IMPACTS ON THE CHASSAHOWITZKA PSD CLASS I AREA FOR THE RIDGE GENERATING STATION PROJECT

(Permit Application AC 53-206244, PSD-FL-183)

This additional assessment for the Ridge Generating Station is in response to the following item in the request for information from the Florida Department of Environmental Regulation dated January 17, 1992:

> *6. The predicted maximum SO_2 24-hour and 3-hour concentrations in the Chassahowitzka PSD Class I area due to the Ridge Generating Station boiler emissions are greater than the National Park Service proposed 24-hour and 3-hour significant impact levels of 0.07 and 0.48 $\mu g/m^3$, respectively. Please perform a cumulative 24-hour and 3-hour SO_2 Class I increment analysis as required by the National Park Service. An air quality related values (AQRVs) analysis should also be done since there are presently no significant impact levels that exempt a proposed PSD project from performing this analysis. The AQRVs analysis includes impacts to soils, vegetation, and wildlife.*

RESPONSE

ADDITIONAL AIR QUALITY MODELING ANALYSIS

An additional analysis of SO_2 impacts at the Chassahowitzka PSD Class I area is provided in Attachment A. This additional impact analysis is based on use of the standard ISCST model and a long-range transport model, the MESOPUFF II model. The following conclusions result from this additional analysis: (1) Predicted maximum 3-hour SO_2 concentrations at the Chassahowitzka PSD Class I area due to Ridge Generating Station (RGS) emissions are less than the National Park Service significant impact level of 0.48 $\mu g/m^3$. (2) Predicted maximum 24-hour SO_2 concentrations due to RGS emissions exceed the National Park Service significant impact level of 0.07 $\mu g/m^3$, but only on an infrequent basis. Furthermore, during the meteorological conditions when RGS emissions result in concentrations above the significant impact level, the cumulative predicted maximum 24-hour concentrations due to all PSD sources identified by DER are less than the PSD Class I increment. Therefore, RGS emissions neither cause nor contribute to a violation of the PSD Class I increment at the Chassahowitzka PSD Class I area.

NEED EXPLANATION OF INFREQUENT BASIS

AIR QUALITY RELATED VALUES ANALYSIS

An air quality related values analysis is provided in Attachment B. The conclusions reached from this analysis are that the RGS project (1) will not diminish the national significance of the Chassahowitzka National Wilderness Area (which comprises the PSD Class I area), (2) will not impair the quality of the visitor experience at this area, and (3) will not impair the structure and functioning of the ecosystems within the area.

ATTACHMENT A

ADDITIONAL PSD CLASS I AREA AIR QUALITY MODELING ANALYSIS FOR RIDGE GENERATING STATION SULFUR DIOXIDE EMISSIONS

INTRODUCTION

The Chassahowitzka PSD Class I area impact analysis provided in the Ridge Generating Station (RGS) permit application involved use of the ISCST model. The ISCST model is a straight-line trajectory, steady-state Gaussian dispersion model that assumes meteorological conditions at the time of plume release will persist over the entire distance from the point of release to the receptors of interest. Over relatively short distances, the assumptions of the ISCST model are reasonably valid. The deficiencies of steady-state models for assessing impacts at more distant receptors are well recognized, however.

The RGS site is separated from the modeled receptors in the Chassahowitzka PSD Class I area by distances ranging from 100.5 to 119.0 km. The uncertainties in using the ISCST model at these great distances are such that the maximum PSD Class I SO_2 impacts presented in the application are expected to exceed actual impacts. To further assess PSD Class I impacts attributable to RGS SO_2 emissions, a modeling analysis has been performed using a combination of the ISCST model used previously and the MESOPUFF II model - a model specifically developed to estimate concentrations at distances of as much as 400 km from an emission source.

The MESOPUFF II portion of the additional modeling evaluation was conducted by Sigma Research Corporation under the direction of Mr. Joseph Scire. Mr. Scire was one of the original developers of the MESOPUFF II model and is experienced in its use. Attached is a technical report prepared by Sigma Research describing the method of applying MESOPUFF II and the results obtained from its use. Presented below is a discussion of the overall additional modeling evaluation using both ISCST and MESOPUFF II.

EVALUATION METHOD

General Approach

From the previous modeling evaluation based on the ISCST model, the determination was made that predicted maximum SO_2 concentrations due to RGS emissions are less than the PSD Class I area significant impact levels recommended by the U.S. Environmental Protection Agency (EPA). The National Park Service (NPS), however, has proposed lower significant impact levels for SO_2. The previous ISCST modeling evaluation demonstrated that maximum annual concentrations at the Chassahowitzka PSD Class I area due to RGS emissions are less than the proposed NPS annual average significant impact level but that predicted maximum 3-hour and 24-hour concentrations exceed the NPS proposed significant impact levels.

Accordingly, the first step in the additional modeling evaluation was to use the MESOPUFF II model to predict whether maximum 3-hour and 24-hour SO_2 concentrations due to RGS SO_2 emissions alone are still higher than the NPS levels. This step resulted in the finding that predicted maximum 3-hour concentrations are less than the National Park Service significant impact concentration of 0.48 $\mu g/m^3$ (see modeling results section below). Therefore, assessing the cumulative impact of other PSD sources on 3-hour concentrations is not necessary. Operation of the RGS project will not cause or contribute to a violation of the 3-hour SO_2 PSD Class I increment at the Chassahowitzka PSD Class I area.

The next step in the evaluation was to assess 24-hour impacts taking into account both RGS emissions and the emissions of other PSD sources in the general vicinity of the Chassahowitzka PSD Class I area. Based on an approach discussed with DER, this cumulative impact analysis pertains just to 24-hour periods in the modeled meteorological data set when a significant contribution (concentrations greater than or equal to 0.07 $\mu g/m^3$) due to RGS emissions is predicted using MESOPUFF II. Consideration of other periods is not necessary because RGS would not be a contributor under those meteorological conditions.

Emission Source Distance Consideration

In the 24-hour cumulative impact assessment, the ISCST model was used to estimate concentrations due to sources located less than 20 km from the Class I area, and the MESOPUFF II model was used to estimate concentrations from sources located 20 km or more from the Class I area. The results from the two models were then summed, as further discussed in the modeling results section below.

As mentioned in the introduction, results from the ISCST model become increasingly uncertain as the distance increases between the emission source and the points at which concentrations are calculated. The choice of 20 km as the distance at which to change from the ISCST model to another model is consistent with findings that show possible inaccuracies with the ISCST model at even closer distances. It is also consistent with the objective of assessing cumulative impacts when concentrations due to RGS emissions are "significant" as defined by the proposed NPS significant impact levels. Information obtained through DER indicates that the National Park Service accepts use of the MESOPUFF II model at distances of 20 km and greater.

Another important consideration in selecting a 20-km distance for application of the MESOPUFF II model relates to the location of the PSD sources in the inventory provided by DER. All but one of the 83 sources in this inventory (or 84 sources including RGS) are located at distances of 20 km or more from the Chassahowitzka PSD Class I area. Therefore, use of the MESOPUFF II model for sources starting at 20 km provides a much more consistent modeling approach than having to mix the results from the ISCST model for a large portion of the 84 sources with the results from the MESOPUFF II model for the remaining portion of the sources as would be the case if a greater distance criterion were used.

Modeling Options

In running the MESOPUFF II model, the dry deposition and chemical transformation options of the model were specified. The attached report from Sigma Research contains additional information on model options. The ISCST model was run in the standard regulatory default mode.

EMISSION SOURCE DATA

The initial emission source modeled was the RGS boiler. RGS emission source characteristics considered in the additional evaluation are the characteristics representing the maximum continuous rating (MCR) case. Previous evaluations had demonstrated that the MCR operating level produces higher PSD Class I impacts than either the 75 percent load level or the 50 percent load level. Specific RGS boiler emissions data evaluated with the MESOPUFF II model are as follows:

■ SO_2 emission rate =	13.78 g/s (109.4 lb/hr)
■ Stack height =	99.06 m (325 ft)
■ Stack diameter =	3.05 m (10 ft)
■ Exit temperature =	349.82 K (170 °F)
■ Exit velocity =	14.54 m/s (48.1 ft/s)
■ UTM coordinates =	416690 m E., 3100380 m N.

Data on PSD sources other than RGS were supplied by DER. These sources are listed in Table A-1, divided into two groups. One group consists of SO_2 sources (actually, only one source) located less than 20 km from the PSD Class I area and modeled with the ISCST model. The second group consists of those sources located 20 km or more from the PSD Class I area and modeled with the MESOPUFF II model. Note that the modeled emission source inventory consists of both increment-consuming sources and increment-expanding sources (baseline sources that have shut down or reduced emissions). Increment-expanding sources are denoted by a negative emission rate.

METEOROLOGICAL DATA

As discussed in the attached report, meteorological data from four surface stations (Tampa, Orlando, Gainesville, and Daytona Beach) and one upper air station (Tampa) were processed for use with MESOPUFF II. A detailed meteorological data base was modeled by considering an entire year of data for each of the surface stations and for the upper air station. The meteorological year selected for evaluation with MESOPUFF II is year 1986.

At the recommendation of DER, the meteorological data station selected for the ISCST portion of the modeling evaluation is Tampa (Tampa surface and Tampa upper air data). For consistency, 1986 data were used with the ISCST model as well.

RECEPTORS

The PSD Class I area receptors assessed in the additional modeling evaluation consist of 13 receptors specified by DER. The UTM coordinates of these receptors are shown in Table A-2.

MODELING RESULTS

Sulfur Dioxide 3-Hour Concentrations

The predicted maximum 3-hour concentration attributable to RGS emissions is 0.26 $\mu g/m^3$ as shown in Table A-3. This predicted maximum concentration is much less than the proposed NPS significant impact level of 0.48 $\mu g/m^3$. Therefore, no need exists to develop a cumulative SO_2 3-hour concentration impact analysis with other PSD sources considered.

Sulfur Dioxide 24-Hour Concentrations

Predicted highest 24-hour SO_2 concentrations attributable to RGS emissions exceed the proposed NPS significant impact level of 0.07 $\mu g/m^3$. However, 24-hour meteorological periods producing predicted "significant" concentrations are infrequent. Table A-4 shows that three days in the 1986 meteorological data set which produce significant concentrations. The predicted maximum 24-hour concentration due to RGS emissions alone is 0.09 $\mu g/m^3$.

A cumulative impact analysis was performed for the three meteorological periods when RGS emissions produce concentrations that equal or exceed the proposed NPS significant impact level. Modeling results for all 84 PSD sources (RGS plus 83 other sources) are presented in Tables A-5, A-6, and A-7 for each of these days. The "Total" concentration column in these tables is simply the sum of the MESOPUFF II concentration at a specific receptor plus the ISCST concentration at the same receptor.

The highest cumulative concentration at any receptor where RGS emissions produce a significant impact (as proposed by NPS) is 4.68 $\mu g/m^3$ which is less than the PSD Class I increment of 5 $\mu g/m^3$. Therefore, when RGS is a "contributor" to 24-hour SO_2 concentrations at the Chassahowitzka PSD Class I area, compliance with the PSD Class I increment is predicted.

CONCLUSION

Based on the additional modeling evaluation described in this attachment, SO_2 emissions from the proposed RGS boiler will neither cause nor contribute to a violation of PSD increments within the Chassahowitzka PSD Class I area.

TABLE A-1
EMISSION SOURCES CONSIDERED IN THE ADDITIONAL PSD CLASS I MODELING EVALUATION

I. Sources Less than 20 Kilometers from Chassahowitzka PSD Class I Area (modeled with ISCST model)

DER Source Number	SO_2 Emission Rate (g/s)	UTM East Coordinate (m)	UTM North Coordinate (m)	Stack Height (m)	Exit Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
22	1.45	356200	3169900	27.40	470.2	7.48	4.88

(continued on next page)

II. Sources Greater than or Equal to 20 Kilometers from Chassahowitzka PSD Class I Area (modeled with MESOPUFF II model)

DER Source Number	SO_2 Emission Rate (g/s)	UTM East Coordinate (m)	UTM North Coordinate (m)	Stack Height (m)	Exit Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
RGS[a]	13.78	416690	3100380	99.06	349.82	14.54	3.05
9900200	466.4	467500	3197200	15.24	819.8	56.21	4.21
9900500	310.9	446300	3126000	15.24	819.8	56.21	4.21
9900800	276.1	446300	3126000	15.24	880.8	32.07	7.04
1	98.4	360008	3162398	97.6	442.0	23.23	4.88
6	-50.4	388000	3116000	60.35	353.0	16.40	2.44
7	54.6	388000	3116000	60.35	353.0	17.77	2.44
9	-50.4	388000	3116000	60.35	353.0	16.40	2.44
10	54.6	388000	3116000	60.35	353.0	17.77	2.44
30	654.7	361900	3075000	149.4	342.2	19.81	7.32
31	-2436.0	361900	3075000	149.4	422.0	28.65	7.32
33	-1218.0	361900	3075000	149.4	418.0	14.33	7.32
40	14.1	347100	3139200	83.82	394.3	15.70	3.05
46	1008.8	334200	3204500	182.90	398.0	21.00	6.90
47	1008.0	334200	3204500	182.90	398.0	21.00	6.90
48	-314.0	334200	3204500	152.00	422.0	42.10	4.57
49	-1859.0	334200	3204500	153.00	422.0	42.10	4.88
50	105.4	483500	3150600	167.60	325.7	21.60	5.80
51	242.4	483500	3150600	167.60	324.2	23.50	5.80
52	32.1	460100	3129300	18.30	422.0	38.00	3.66

DER Source Number	SO_2 Emission Rate (g/s)	UTM East Coordinate (m)	UTM North Coordinate (m)	Stack Height (m)	Exit Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
53	277.6	404800	3057400	22.90	389.0	23.90	4.88
54	-52.07	325600	3116700	49.00	293.0	3.60	1.20
55	500.1	408500	3105800	76.20	350.0	19.70	4.88
56	21.4	368200	3092700	50.00	491.0	18.30	1.80
57	62.24	335300	3084400	49.10	522.0	27.72	2.74
61	0.2	383300	3135800	12.30	466.2	9.20	0.40
70	2.25	361400	3168400	8.50	357.4	10.95	1.08
71	2.25	359900	3162400	12.20	377.0	10.58	1.37
90	29.11	409185	3102754	30.48	783.2	28.22	5.79
91	-170.1	396600	3078900	61.00	350.0	14.28	2.60
92	182.85	396600	3078900	61.00	350.0	15.31	2.60
93	121.9	396600	3078900	60.70	350.0	15.31	2.60
94	5.54	396600	3078900	36.60	319.1	20.15	1.83
101	5.04	385600	3139000	30.48	384.3	17.13	3.35
102	5.04	434000	3198800	30.48	384.3	17.13	3.35
111	-110.6	408500	3083000	30.50	350	14.60	1.68
112	4.30	408500	3083000	9.10	450	22.50	0.70
113	52.90	408500	3083000	67.10	351	9.80	2.40
114	21.02	361800	3088300	30.00	375	20.00	0.61
115	-15.20	398400	3084200	30.50	308	18.90	1.80
116	42.00	398400	3084200	45.70	352	10.30	2.30
117	-54.56	409500	3079500	30.48	311	20.18	1.37

DER Source Number	SO_2 Emission Rate (g/s)	UTM East Coordinate (m)	UTM North Coordinate (m)	Stack Height (m)	Exit Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
118	67.16	409500	3079500	30.48	355	9.27	2.29
119	41.96	409500	3079500	45.72	355	9.65	2.44
120	18.40	389550	3067930	38.10	339	10.13	2.90
121	21.17	389550	3067930	38.10	346	18.40	2.44
128	63.00	396560	3078640	60.70	350	15.55	2.60
129	3.78	396750	3079350	52.40	322	13.00	2.40
130	5.36	396830	3079430	52.40	319	7.10	2.40
131	5.54	396450	3079150	36.60	319	20.80	1.80
132	63.00	396490	3078640	60.70	350	15.55	2.60
133	-34.27	396680	3078860	21.04	347	18.56	2.13
134	-146.00	396530	3078750	61.00	350	11.14	2.50
135	189.00	396530	3078750	61.00	350	16.71	2.50
136	-257.60	406700	3085200	51.00	356	9.90	2.13
137	35.70	406700	3085200	61.00	360	12.20	2.13
140	63.00	416120	3068620	53.40	355	15.91	2.59
141	63.00	416120	3068620	53.40	355	15.91	2.59
142	-78.80	416210	3068740	29.00	314	6.77	3.02
143	-216.00	409700	3086000	45.70	352	16.50	1.40
144	73.60	409700	3086000	61.00	346	7.30	2.80
145	72.00	409500	3086500	61.00	347	28.40	1.52
147	-196.30	363400	3082400	22.60	322	19.50	1.52
148	-50.71	363400	3082400	45.70	355	9.20	2.29

DER Source Number	SO_2 Emission Rate (g/s)	UTM East Coordinate (m)	UTM North Coordinate (m)	Stack Height (m)	Exit Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
149	36.75	363400	3082400	45.70	355	9.20	2.29
150	0.60	394800	3067720	8.20	505	7.57	0.41
151	16.35	394850	3069770	30.50	334	7.26	1.82
152	13.40	389500	3068000	38.10	339	15.20	2.44
153	30.64	414700	3080300	13.70	330	40.40	1.22
154	2.44	398290	3084290	25.90	339	15.20	2.29
250	2.99	382200	3166100	9.14	478	4.57	0.61
260	0.82	386700	3155800	10.67	327	8.99	1.83
270	2.09	359800	3164900	7.62	347	6.29	1.83
280	0.23	340600	3119200	12.2	339	6.47	3.05
290	3.67	355900	3143700	9.14	408	16.0	1.30
300	0.06	331200	3124500	10.98	544	3.88	0.31
310	0.03	331200	3124500	10.98	544	3.88	0.31
320	0.08	333400	3141000	10.98	533	4	0.31
330	0.08	333400	3141000	10.98	533	4	0.31
340	7.25	340700	3119500	9.14	436	22.3	1.40
350	3.54	390300	3129400	6.1	422	21	1.38
400	-75.6	407500	3071300	45.73	350	26.4	1.6
410	113.5	407500	3071300	45.73	350	39.06	1.6

[a] Ridge Generating Station

TABLE A-2

UTM COORDINATES OF CHASSAHOWITZKA PSD CLASS I AREA RECEPTORS

Receptor	East UTM Coordinate (m)	North UTM Coordinate (m)
1	340300	3165700
2	340300	3167700
3	340300	3169800
4	340700	3171900
5	342000	3174000
6	343000	3176200
7	343700	3178300
8	342400	3180600
9	341100	3183400
10	339000	3183400
11	336500	3183400
12	334000	3183400
13	331500	3183400

TABLE A-3

PREDICTED MAXIMUM 3-HOUR SULFUR DIOXIDE CONCENTRATION AT THE CHASSAHOWITZKA PSD CLASS I AREA ATTRIBUTABLE TO RIDGE GENERATING STATION (RGS) EMISSIONS

Predicted Maximum 3-Hour Concentration[a] (μg/m³) and Associated Meteorological Period
0.26 (Day 343, Ending Hour 6)

[a] "Significant" concentration is 0.48 μg/m³ as proposed by the National Park Service.

TABLE A-4

PREDICTED "SIGNIFICANT" 24-HOUR SULFUR DIOXIDE CONCENTRATIONS AT THE CHASSAHOWITZKA PSD CLASS I AREA ATTRIBUTABLE TO RIDGE GENERATING STATION EMISSIONS

Predicted Concentrations (μg/m^3) and Associated Meteorological Day
0.08 (Day 282) 0.09 (Day 332) 0.08 (Day 333)

NOTE: "Significant" concentration is 0.07 μg/m^3 as proposed by the National Park Service.

TABLE A-5

PREDICTED CUMULATIVE 24-HOUR SULFUR DIOXIDE CONCENTRATIONS ON DAYS WHEN RIDGE GENERATING STATION (RGS) EMISSIONS PRODUCE A "SIGNIFICANT" CONTRIBUTION

(concentrations in $\mu g/m^3$)

Meteorological Period: Day 282

Receptor	Contribution from Sources ≥20 km from PSD Class I Area[a] (Modeled with MESOPUFF II)	Contribution from Sources <20 km from PSD Class I Area (Modeled with ISCST)	Total	Contributions from RGS Emissions Alone
1	3.01	0.04	3.05	0.075
2	3.29	0.00	3.29	0.073
3	3.59	0.00	3.59	0.070
4	b	b	b	0.067
5	b	b	b	0.063
6	b	b	b	0.059
7	b	b	b	0.055
8	b	b	b	0.053
9	b	b	b	0.050
10	b	b	b	0.052
11	b	b	b	0.053
12	b	b	b	0.054
13	b	b	b	0.055

[a] Includes RGS emissions.

[b] RGS contribution is less than proposed National Park Service significant impact level at this receptor.

TABLE A-6

PREDICTED CUMULATIVE 24-HOUR SULFUR DIOXIDE CONCENTRATIONS ON DAYS WHEN RIDGE GENERATING STATION (RGS) EMISSIONS PRODUCE A "SIGNIFICANT" CONTRIBUTION

(concentrations in μg/m^3)

Meteorological Period: Day 332

Receptor	Contribution from Sources ≥20 km from PSD Class I Area[a] (Modeled with MESOPUFF II)	Contribution from Sources <20 km from PSD Class I Area (Modeled with ISCST)	Total	Contributions from RGS Emissions Alone
1	3.84	0.03	3.87	0.088
2	3.60	0.02	3.62	0.088
3	3.80	0.03	3.83	0.087
4	4.32	0.04	4.36	0.086
5	4.28	0.06	4.34	0.084
6	4.30	0.13	4.43	0.084
7	4.43	0.02	4.45	0.084
8	4.51	0.01	4.52	0.083
9	4.62	0.01	4.63	0.082
10	4.67	0.01	4.68	0.083
11	4.54	0.01	4.55	0.085
12	4.38	0.01	4.39	0.088
13	4.33	0.03	4.36	0.091

[a] Includes RGS emissions.

TABLE A-7

PREDICTED CUMULATIVE 24-HOUR SULFUR DIOXIDE CONCENTRATIONS ON DAYS WHEN RIDGE GENERATING STATION (RGS) EMISSIONS PRODUCE A "SIGNIFICANT" CONTRIBUTION
(concentrations in $\mu g/m^3$)

Meteorological Period: Day 333

Receptor	Contribution from Sources ≥20 km from PSD Class I Area[a] (Modeled with MESOPUFF II)	Contribution from Sources <20 km from PSD Class I Area (Modeled with ISCST)	Total	Contributions from RGS Emissions Alone
1	b	b	b	0.032
2	b	b	b	0.031
3	b	b	b	0.030
4	b	b	b	0.029
5	b	b	b	0.026
6	b	b	b	0.026
7	b	b	b	0.026
8	b	b	b	0.028
9	b	b	b	0.031
10	b	b	b	0.038
11	b	b	b	0.050
12	b	b	b	0.065
13	1.22	0.01	1.23	0.081

[a] Includes RGS emissions.

[b] RGS contribution is less than proposed National Park Service significant impact level at this receptor.

ATTACHMENT B

CHASSAHOWITZKA PSD CLASS I AREA AIR QUALITY RELATED VALUES ANALYSIS FOR RIDGE GENERATING STATION

INTRODUCTION

The proposed Ridge Generating Station (RGS) is located approximately 100 km from the closest point in the Chassahowitzka prevention of significant deterioration (PSD) Class I area. Based on estimated emissions from the RGS boiler at maximum continuous rating, the facility will be a "significant" emission source (as defined by PSD regulations) for sulfur dioxide, nitrogen oxides, carbon monoxide, volatile organic compounds, particulate matter, lead, and beryllium.

Although any additional increase in pollutant levels resulting from a specific emission source could theoretically have some effect on air quality related values (AQRV's), recognition of the magnitude of an expected increase is still an important consideration. The highest predicted sulfur dioxide concentration increases at the Chassahowitzka PSD Class I area due to RGS emissions are a 3-hour concentration of 0.26 $\mu g/m^3$ (0.000099 ppm), a 24-hour concentration of 0.09 $\mu g/m^3$ (0.000034 ppm), and an annual average concentration of 0.01 $\mu g/m^3$ (0.0000038 ppm). Predicted concentration increases for other pollutants emitted in significant amounts is similarly low. For example, the highest predicted annual average nitrogen dioxide concentration increase due to RGS emissions is 0.01 $\mu g/m^3$ (0.0000053 ppm). Simply on the face of these small predicted concentration increases, no adverse effect on AQRV's would be expected as result of Ridge Generating Station operation. This conclusion is supported by the following AQRV's evaluation which considers effects on vegetation, soils, wildlife, and visibility.

CHARACTERISTICS OF THE CHASSAHOWITZKA PSD CLASS I AREA

The Chassahowitzka PSD Class I area is defined by the boundaries of the Chassahowitzka National Wilderness Area (NWA). The Chassahowitzka NWA comprises most but not all of the Chassahowitzka National Wildlife Refuge. Pertinent air quality, vegetation, soils, and wildlife characteristics of the Chassahowitzka NWA are as follows:

> Existing and Projected Ambient Sulfur Dioxide Levels -- No ambient monitoring stations are located at the Chassahowitzka PSD Class I area. To obtain an approximation of SO_2 levels in this area, monitoring data summarized in DER's annual reports for 1989 and 1990 were reviewed. Second highest 3-hour and 24-hour concentrations were considered for evaluation of short-term concentration. For the entire state of Florida including metropolitan and industrialized areas, measured concentrations are typically well below ambient standards. At the two monitoring stations in Citrus County, which are the stations closest to the Chassahowitzka PSD Class I area, second highest 3-hour concentrations ranged from 85 to 248 $\mu g/m^3$ in 1989 and 1990, and second highest 24-hour concentrations ranged from 18 to 64 $\mu g/m^3$. Annual means ranged from 4 to 7 $\mu g/m^3$. By comparison, the national ambient air quality standards are a 3-hour standard of 1,300 $\mu g/m^3$ (0.5 ppm), a 24-hour standard of 365 $\mu g/m^3$ (0.14 ppm), and an annual average standard of 80 $\mu g/m^3$ (0.03 ppm).
>
> New emission sources can, of course, add to current levels. However, based on discussions with DER about recent permit application modeling results for projects in central Florida, potential SO_2 concentration increases at the Chassahowitzka PSD Class I area due to proposed new sources are at the PSD Class I increments level - that is, 3- hour concentrations less than 25 $\mu g/m^3$ and 24-hour concentrations less than 5 $\mu g/m^3$. Therefore, even with proposed new sources considered,

current short-term SO_2 concentrations at the Chassahowitzka PSD Class I area are expected to be on the order of 300 $\mu g/m^3$ (0.11 ppm) or less for 3-hour averages, and on the order of 70 $\mu g/m^3$ (0.03 ppm) or less for 24-hour averages. Annual mean concentrations are expected to be less than 10 $\mu g/m^3$ (0.004 ppm). These levels are far below national ambient standards.

Existing Ambient Levels of Other Pollutants -- Based on 1989 and 1990 Florida ambient monitoring data for nitrogen dioxide, carbon monoxide, particulate matter, and lead, concentrations of these pollutants at the Chassahowitzka PSD Class I area should be below ambient standards. However, monitoring data specific to Chassahowitzka are not available.

Vegetation -- Vascular species that are typical of central Florida Gulf coastal areas like the Chassahowitzka NWA include tree species such as slash pine, laurel oak, live oak, sweetgum, and red maple; shrubs such as sawtooth palm, gallberry, and yaupon holly; and other plants such as black and soft needle rush, maiden cane, and red mangrove. Non-vascular vegetation species would include mosses and lichens.

Soils -- The characteristic soils in the Chassahowitzka NWA can be generally classified as sulfihemist soils. Such soils are dominantly organic and contain sulfidic materials within 1 meter of the surface. Based on soil survey data for Citrus and Hernando Counties (U.S. Department of Agriculture, 1991a and 1991b), the sulfur content of this upper soil layer can range up to 4 percent.

Wildlife -- The terrestrial wildlife species expected to be present in the Chassahowitzka NWA are the species common to the central Florida Gulf Coast. These include mammals such as white-tailed deer and raccoons, amphibians such as southern toads and leopard frogs, reptiles such as rat snakes and box turtles, and a variety of birds.

VEGETATION EFFECTS

Sulfur Dioxide

As DER is aware, the literature on vegetation effects from SO_2 exposure is extensive. Rather than trying to select and summarize specific studies that may be most pertinent to vegetation species in the Chassahowitzka NWA, reference can be made to a U.S. Environmental Protection Agency (EPA) review of the 3-hour secondary SO_2 ambient air quality standard established to protect against adverse vegetation effects. This review (found in the 4/26/88 edition of the *Federal Register*, 53 FR 14926) was included in EPA's proposal to retain the current 3-hour standard of 1,300 $\mu g/m^3$ (0.5 ppm). The following is an excerpt from the summary (p. 14931). In this excerpt, CD stands for criteria document (U.S. Environmental Protection Agency, 1982a), SP stands for staff paper (U.S. Environmental Protection Agency, 1982b), and CASAC stands for Clean Air Scientific Advisory Committee.

> "The basis for the existing 3-hour secondary standard rests on studies documenting acute effects on sensitive plants (38 FR 25678; September 1973). The effects of concern include reduced growth and yield, and foliar injury. The staff assessment of the greatly expanded scientific data base as summarized in the criteria document (CD, Chapter 7) found even stronger support for the 3-hour standard (SP, pp. 108-112). As a result of this most recent review, both staff and CASAC recommended retaining a 3-hour standard at or slightly below the level of the current standard (0.5 ppm)(SP, p. 126). CASAC pointed out that evidence suggesting effects at lower levels is very uncertain (SP, Appendix E, p. 8)."

While recognizing that some studies have indicated adverse vegetation effects on sensitive species at concentrations below the current 3-hour ambient air quality standard, information as summarized in the EPA statement above suggests that concentrations on the order of the 3-hour standard are protective. (For example, a CASAC letter attached to the EPA staff paper recommends that the 3-hour standard be limited to the range 0.4 to 0.5 ppm if the standard were revised.) Since current short-term concentrations in the Chassahowitzka PSD Class I area are estimated to be far below the ambient standard, no reason exists to expect that vegetation species are under stress due to SO_2 exposures. Furthermore, the extremely small increase in SO_2 concentrations predicted to result from RGS emissions will not alter current conditions. Therefore, SO_2 emissions from the RGS project are not expected to create or contribute to adverse impacts on vegetation.

Nitrogen Oxides

With respect to short-term (acute) exposures, data from a variety of experiments on crops and native plants indicate that nitrogen dioxide exposures less than 1,880 $\mu g/m^3$ (1.0 ppm) for one hour have not caused adverse effects (Taylor and Eaton, 1966; Tingey and others, 1971; Taylor and others, 1975; U.S. Environmental Protection Agency, 1982c). Current NO_2 ambient levels at the Chassahowitzka PSD Class I area combined with the minor increase in concentrations due to RGS emissions are expected to be far below this level. Therefore, no acute adverse vegetation impacts are expected to result from RGS NO_x emissions.

Long-term (chronic) exposures to high levels of NO_2 can result in such adverse effects as inhibition of photosynthesis and reduced yield. Ashenden and Mansfield (1978) found that an NO_2 concentration of 207 $\mu g/m^3$ (0.11 ppm) for 103 hours per week over a period of 20 weeks reduced yields of several turf grasses. Other studies (Taylor and others, 1975; U.S. Environmental Protection Agency, 1982c) indicate that yield effects are unlikely to occur in most crops at levels below 470 $\mu g/m^3$ (0.25 ppm). Since these values are far above the national ambient air quality standards and even further above the Chassahowitzka PSD Class I area concentration levels likely to exist after RGS begins operating, no long-term adverse effects on vegetation are expected to result from RGS NO_x emissions.

Ozone

Nitrogen oxides and volatile organic compounds, which are ozone precursors, will be emitted from the RGS facility in significant amounts. However, compared to current ozone precursor emission levels in central Florida (including the metropolitan areas of Tampa-St. Petersburg, Orlando, and the Lakeland area) that could affect the Chassahowitzka PSD Class I area, RGS emissions will be minor. Accordingly, the effect of RGS emissions on Chassahowitzka PSD Class I area ozone concentrations and related vegetation impacts should be negligible.

Other Significant Pollutants

The other significant pollutants that will be emitted from the RGS facility are carbon monoxide, particulate matter, lead, and beryllium. The potential for phytotoxic effects from these emissions at the distance of the Chassahowitzka PSD Class I area is negligible.

SOILS EFFECTS

Sulfur Dioxide

As discussed above, the dominant soils of the Chassahowitzka PSD Class I area are naturally high in sulfur content. The additional sulfur deposition resulting from RGS emissions would be negligible by comparison. In addition, tidal effects and the flushing effect of storms and tributary inflow further reduce the chances of soil sulfur level increases resulting from RGS emissions. Therefore, Chassahowitzka NWA soil composition properties and soil organism makeup should be unaffected by the proposed project.

Other Significant Pollutants

Deposition of other significant pollutants emitted by RGS are not expected to affect the existing soil characteristics of the Chassahowitzka PSD Class I area. This is especially true for lead and beryllium since these metals will be emitted in such small amounts.

WILDLIFE EFFECTS

Sulfur Dioxide

Total levels of sulfur dioxide within the Chassahowitzka PSD Class I area are expected to be well below those levels producing direct adverse toxicological effects on animals. More to the point, as discussed for vegetation, is the incremental effect of RGS emissions. The extremely small increase in concentrations predicted to resulting from RGS SO_2 emissions is highly unlikely to produce an observable effect on wildlife. A similar conclusion can be reached regarding indirect effects on wildlife that might result from damage to vegetation habitat. That is, no adverse impact on wildlife habitat should result from RGS emissions and, consequently, no indirect adverse effect on wildlife.

Other Significant Pollutants

The conclusions for sulfur dioxide also apply to the other significant pollutants.

VISIBILITY EFFECTS

The potential effect of RGS boiler emissions on visibility conditions within the Chassahowitzka PSD Class I area is assessed in Section 7.0 of the permit application. Based on a conservative screening modeling approach, RGS emissions are highly unlikely to produce an adverse visibility impact.

CONCLUSION

Based on this evaluation of air quality related values consisting of effects on vegetation, soils, wildlife, and visibility, significant pollutant emissions from the proposed RGS boiler are not expected to produce adverse impacts within the

Chassahowitzka PSD Class I area. Restated in terms of the PSD Class I adverse impact guidelines developed by the Assistant Secretary for Fish and Wildlife and Parks (see, for example, 57 FR 4465, 2/5/92), the RGS project (1) will not diminish the national significance of the Chassahowitzka NWA, (2) will not impair the quality of the visitor experience, and (3) will not impair the structure and functioning of the ecosystems with the Chassahowitzka NWA.

REFERENCES

Ashenden, T.W., and T.A. Mansfield, 1978. Extreme pollution sensitivity of grasses when SO_2 and NO_2 are present in the atmosphere together. Nature, Vol. 273, p. 142-143.

Taylor, O.C. and F.N. Eaton, 1966. Suppression of plant growth by nitrogen dioxide. Plant Physiology, Vol. 41, p. 132-135.

Taylor, O.C., C.R. Thompson, D.T. Tingey, and R.A. Reinert, 1975. Oxides of nitrogen. In J.B. Mudd and T.T. Kozlowski (eds.), Responses of Plants to Air Pollution, Academic Press, Inc., p. 121- 139.

Tingey. D.T., R.A. Reinert, J.A. Dunning, and W.W. Heck, 1971. Vegetation injury form the interaction of nitrogen dioxide and sulfur dioxide. Phytopathology, Vol. 61, p. 1506-1511.

U.S. Department of Agriculture, 1991a. Survey of Citrus County, Florida. Soil Conservation Service in cooperation with University of Florida, Institute of Food and Agricultural Sciences, Agricultural Experiment Stations and Soil Science Department.

U.S. Department of Agriculture, 1991b. Survey of Hernando County, Florida. Soil Conservation Service in cooperation with University of Florida, Institute of Food and Agricultural Sciences, Agricultural Experiment Stations and Soil Science Department.

U.S. Environmental Protection Agency, 1982a. Air quality criteria for particulate matter and sulfur dioxides (three volumes). Office of Research and Development, EPA-600/8-82-029af-cf.

U.S. Environmental Protection Agency, 1982b. Review of the national ambient air quality standards for sulfur oxides: assessment of scientific and technical information; OAQPS staff paper. Office of Air Quality Planning and Standards, EPA-450/5-82-007.

U.S. Environmental Protection Agency, 1982c. Air quality criteria for oxides of nitrogen; final report. Environmental Criteria and Assessment Office.

CLASS I IMPACT ANALYSIS OF THE RIDGE GENERATING STATION AND BACKGROUND PSD SOURCES AT THE CHASSAHOWITZKA NATIONAL WILDERNESS AREA IN FLORIDA

by

Joseph Scire
Robert Mentzer
Gary Moore

Sigma Research Corporation
Westford, Massachusetts 01886

Final Report
Document A244-01
April 3, 1992

Prepared under subcontract to

Dames & Moore
Atlanta, Georgia

for

Ridge Generating Station Limited Partnership
Winter Park, Florida

1. INTRODUCTION

The proposed Ridge Generating Station (RGS) is located near the city of Lakeland, Florida between Orlando and Tampa. Initial modeling of the RGS conducted by Dames & Moore with the Industrial Source Complex Short Term (ISCST) model predicted maximum 24-hour and 3-hour average SO_2 concentrations at receptors in the Chassahowitzka National Wilderness Area PSD Class I area due to the RGS which were greater than the 24-hour and 3-hour SO_2 significance limits of 0.07 $\mu g/m^3$ and 0.48 $\mu g/m^3$, respectively, proposed by the National Park Service.

The Chassahowitzka Class I area is located a minimum of 100 km to the northwest of the RGS along the Gulf of Mexico coast of Florida. The limitations of straight-line trajectory models such as ISCST which assume steady-state meteorological conditions over the entire travel path of plume are well known. Over source-receptor distances of 10-50 km, the spatial and temporal variability in transport winds and other meteorological fields can have a significant effect in determining plume trajectories and dispersion rates. In addition, as distance increases, chemical transformation and pollutant removal mechanisms become increasingly important for reactive and soluble pollutants such as SO_2.

The MESOPUFF II model (Scire et al., 1984a) is a Lagrangian variable-trajectory puff superposition model suitable for transport distances beyond the range of conventional steady-state Gaussian plume models (i.e., beyond about 10 to 50 km). MESOPUFF II is listed in Appendix B and Supplement B (draft) of the *Guideline on Air Quality Models (Revised)* (EPA, 1986 and EPA, 1991) as a model which may be applied on a case-by-case basis for long-range transport problems. In the current study, MESOPUFF II was used to obtain more refined estimates of short-term average SO_2 concentrations at the Chassahowitzka Class I area due to emissions from the RGS and other background increment-consuming and increment-expanding PSD sources in the area.

2. OVERVIEW OF MESOPUFF II

As illustrated in Figure 1, the MESOPUFF II model is one element of a modeling package which includes components for processing meteorological data and postprocessing predicted concentration results. The various programs in the modeling system are:

> READ56/READ62 reads and processes twice-daily upper air wind and temperature data. READ62 is a modified version of READ56 which accommodates the new TDF-6200 upper air data format used by the National Climatic Data Center (NCDC). READ62 was used in the current study.
>
> MESOPAC II is the meteorological model which computes time-varying and space-varying fields of meteorological variables (e.g., transport winds, mixing heights). The fields produced by MESOPAC II include hourly, gridded winds at two levels: a lower layer representing flow within the atmospheric boundary layer and an upper layer representing flow above the boundary layer.
>
> MESOPUFF II is the Gaussian dispersion modeling component of the modeling system. MESOPUFF II contains modules accounting for plume transport, diffusion, chemical transformation, wet removal, and dry deposition. In the current analysis, wet removal effects were not considered.
>
> MESOFILE II is a postprocessing program which time averages the concentrations produced by MESOPUFF II. It was used to compute 3-hour and 24-hour averaged SO_2 concentrations at discrete receptors in the Chassahowitzka Class I area.

2.1 Program Modifications

Several modifications were made to the MESOPUFF II model in order to accommodate its use on a 486 PC computer with a large number of sources and

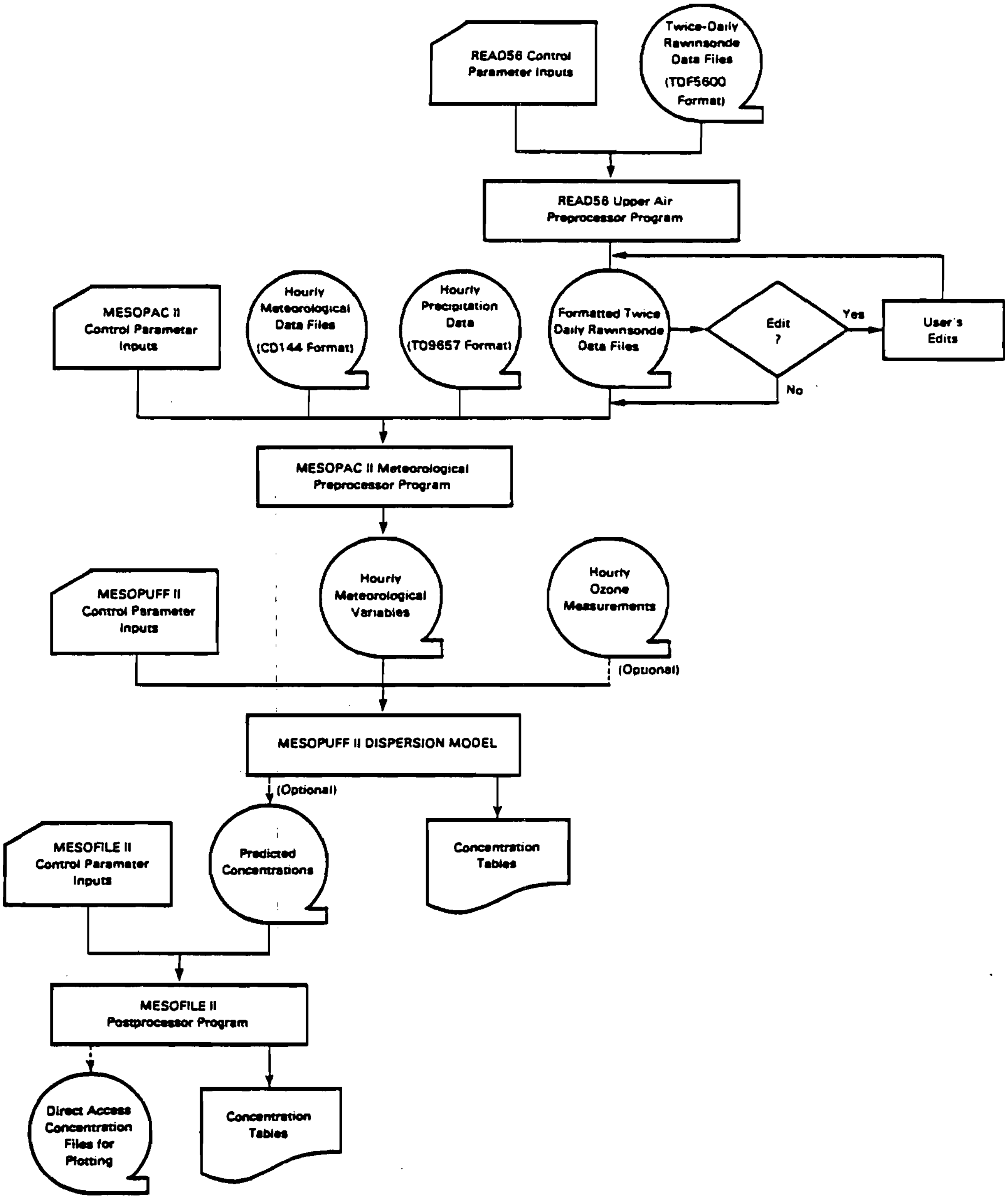


Figure 1. Major Components of the MESOPUFF II Modeling Package.

to avoid computational problems associated with divide by zero errors for variables with no minimum values.

- The dimensions of all arrays relating to the maximum number of puffs were increased from 500 to 8,000.

- Fortran subroutines to compute the error function (ERF) and the difference of two error functions (ERFDIF) were implemented into the MESOPUFF II sampling routine (SAMPLE).

- Small, minimum values were assigned to certain variables which were used in the denominator of equations and which otherwise were allowed to have zero values. These changes were made to avoid divide by zero runtime errors.
  - -- SUBR. PRISE - replaced the variable "U" in the denominator of the unstable plume rise equation with the variable "UU", which has a minimum value assigned to it.
  - -- SUBR. DEPVEL - set a minimum value of 1×10^{-30} for the surface friction velocity (u_*).
  - -- MAIN program - set a minimum value of 1 meter for the absolute value of the Monin-Obukhov length (L).

- Several minor modifications were made to the output format to improve the readability of the output listing.

A call to the Lahey Fortran UNDER0 subroutine was added to all programs in order to properly treat very small numbers (i.e., $< \sim 10^{-38}$). In addition, the location in the code of the list file write statements in SUBR. ADD2 of the MESOFILE II postprocessor were moved from outside the time loop to within the time loop. This change corrected an error which prevented all except the last time period to be printed in the output list file.

The MESOPAC II program was modified to restrict mixing heights to a maximum height of 3000 m. This change is necessary because the model requires that the mixed-layer height not exceed the height of the 700-mb level when the default wind options are used.

3. TECHNICAL APPROACH

The purpose of the current study was to develop more refined estimates of the maximum 3-hour and 24-hour SO_2 concentrations due to emissions from the RGS at the Chassahowitzka National Wilderness Area and, during periods for which the RGS contributions were predicted to be above proposed NPS "significance limits", to assess the cumulative net impact of emissions from other PSD sources in the region. The study was designed to assess whether emissions from the RGS will cause or contribute to an exceedance of the PSD Class I increment at the Chassahowitzka Class I area.

The RGS and other background PSD sources were modeled with MESOPUFF II for the one year period, 1986. The year selected was based on previous modeling with ISCST for the five year period (1982-1986) conducted by Dames & Moore. The year 1986 was predicted by ISCST to have the highest 24-hour contributions from RGS at the Class I area. (The 24-hour averaging period is the limiting averaging period in this case.)

The approach used with MESOPUFF II was to first model emissions from the RGS alone in order to determine those time periods when the RGS contribution at any receptors within the Chassahowitzka Class I area were above the proposed NPS 3-hour and 24-hour SO_2 significance limits of $0.48\ \mu g/m^3$ and $0.07\ \mu g/m^3$, respectively. A total of 82 other background PSD sources were also modeled with MESOPUFF II for the one year period. During periods when the RGS contribution exceeded the significance limits at a particular receptor, the net predicted contribution of background PSD sources were added to the RGS concentration in order to determine the total cumulative impact for comparison to Class I PSD increment standards. The sources modeled with MESOPUFF II are located at distances of 20 km or more from the Class I area receptors. An additional source located closer to the Class I area was modeled with ISCST.

As indicated in Figure 1, several steps are involved in performing the modeling. In Section 3.1, the development of the meteorological grid and preparation of the meteorological data fields are described. Section 3.2 describes the technical options and model inputs used in the MESOPUFF II simulations.

3.1 Meteorological Data Processing

Meteorological Grid System

A meteorological grid of 25 x 30 grid cells with a 10 km grid size was developed for the MESOPUFF II modeling. The domain allows the RGS source, the Chassahowitzka Class I area, and all of the background sources to be included within the modeling region with a buffer zone of at least three grid cells (30 km) from any source or receptor to the nearest boundary. The meteorological grid is shown in Figure 2.

Meteorological Data

Meteorological data from all the Class I National Weather Surface (NWS) stations within the modeling domain were used in the MESOPAC II modeling. The four surface meteorological stations used were Tampa, Orlando, Gainesville, and Daytona Beach. These stations all include hourly surface observations. Twice-daily upper air data from Tampa were also used. Figure 2 shows the location of the meteorological stations (TAMP, ORLD, GAIN, and DAYT) along with the RGS and receptors within the Class I area (X). Meteorological station information is summarized in Table 1.

The 1986 surface data from the Tampa station was obtained in CD144 format. The data from the other surface stations were downloaded from the U.S. EPA modeling bulletin board. Because MESOPAC II requires two parameters (station pressure, relative humidity) which are in the CD144-type records but not in the compressed EPA bulletin board format, the values of station pressure and relative humidity from Tampa were used throughout the grid. This was accomplished by substituting the Tampa pressure and relative humidity values into the appropriate blank fields in the Orlando, Gainesville, and Daytona Beach data records. MESOPUFF II is only weakly sensitive to station pressure and relative humidity, so this approach is considered appropriate for the domain of interest in the current application.

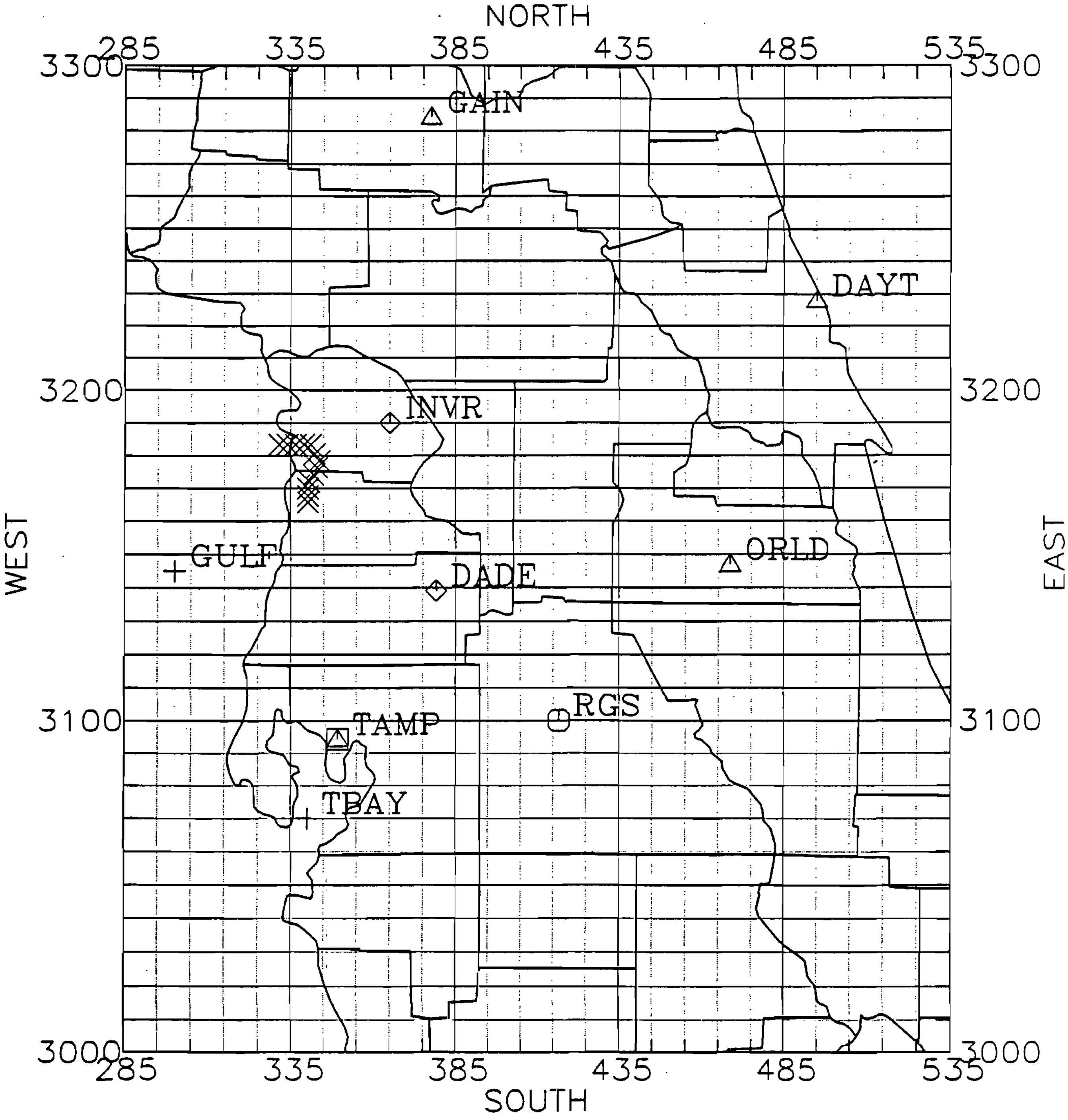


Figure 2. Meteorological Grid System (25 x 30) used in the MESOPUFF II modeling. Grid size is 10 km. (Meteorological stations: TAMP = Tampa, ORLD = Orlando, GAIN = Gainesville, DAYT = Daytona Beach; RGS = Ridge Generating Station; X = Chassohowitzka Class I area receptors).

Table 1
Meteorological Station Data

Station Name	Type	Station ID	Meteorological Grid Coordinate* X	Y	Latitude (deg.)	Longitude (deg.)
Tampa	surface	12842	7.40	10.50	27.97	82.53
Orlando	surface	12815	19.40	15.70	28.45	81.32
Gainesville	surface	12816	10.20	29.40	29.68	82.27
Daytona	surface	12834	22.00	23.80	29.18	81.05
Tampa	upper air	12842	7.40	10.50	27.97	82.53

---

* Meteorological grid coordinate (1,1) corresponds to UTM coordinate (x,y) = (285000, 3040000). One meteorological grid unit = 10 km.

The upper air data from Tampa were obtained from the NCDC in TDF-6200 data format. READ62 was executed using the following missing data control options: LHT = T, LTEMP = F, LWD = F, LWS = F. These options will eliminate a pressure level if the height field is missing, but retain the level if the temperature, wind speed, or wind direction is missing. Missing values of temperature or winds were interpolated from valid values in adjacent levels in order to provide a complete data set. The data from the surface to the 500 mb pressure level were extracted from the TDF-6200 data file by READ62.

READ62 identifies periods with missing or duplicate sounding data. Duplicate records were eliminated. Missing soundings were replaced by substituting the previous day's soundings at the same time of day (i.e., 00:00 GMT or 12:00 GMT).

Land Use Data

An estimation of the dominant land use type of each grid cell is one of the input fields required by the MESOPAC II model. The land use data for the grid shown in Figure 2 was based on the Geographic Information Systems (GIS) land cover data base provided as part of the ARM3 model (Morris et al., 1988). The GIS land use file has a resolution of roughly 35 km x 35 km. The land use data are specified in terms of a fractional coverage for each of ten land use categories.

The land use data are extracted from the archive using the ARM3 PRELND program. The user specifies the origin and size of the region. The grid origin used was UTM (x,y) = (285000, 3040000) meters, with a grid size of 10 km. MESOPAC II requires the specification of the dominant land use type in each grid cell, rather than fractional coverage of the cell for each land use category. Therefore, the land use category with the highest percentage of coverage in each cell was selected. The coastal areas and lakes were reset to water, if necessary, using map information so that the smaller scale features blurred by the lower resolution GIS data were not lost.

Because the GIS land use categories do not exactly correspond to those used in MESOPUFF II, the GIS categories were assigned to the most similar

MESOPUFF II categories based on the surface roughness characteristics. Table 2 illustrates the mapping of the GIS categories into the MESOPUFF II categories. For example, the GIS "agricultural/rangeland" category was mapped into the MESOPUFF II "cropland/grazing" category rather than the "irrigated crops" category because of a better match of the roughness length. Figure 3 contains the gridded MESOPUFF II land use categories used in the modeling.

MESOPAC II Model Options

The default model options were used for all of the technical options in MESOPAC II. These included the use of mixed-layer averaged winds for the lower-layer wind field, and mixing height to 700 mb averaged winds for the upper layer wind field. The model's mixing height constants, cloud-induced radiation reduction factors, and heat flux constants were set to the default values as described in the MESOPUFF II User's Guide.

The output file of gridded meteorological fields for a full year run of MESOPAC II for the 25x30 grid described above would require about 250 megabytes of disk storage. In order to reduce the size of this file and allow the modeling to be conducted simultaneously on multiple computers, the modeling was split into two six-month runs. The second run contained a four-day overlap period with the first in order to eliminate model initialization effects. Thus, the runs were for Julian days 1-181, and days 178-365, respectively. The MESOPUFF II results for Days 178-181 of the second run were discarded.

3.2 MESOPUFF II Dispersion Modeling

Technical Options

A number of important physical and chemical processes affect pollutants traveling over distance scales of tens of kilometers which are generally not important (and therefore not usually considered) in modeling applications for

Table 2
Mapping of ARM3 GIS Land Use Categories into MESOPUFF II Land Use Categories

GIS		MESOPUFF II		
Category	Roughness Length (m)	Category	Roughness Length (m)	Category Number
Urban	1.00	Urban	1.00	11
Agriculture	0.25	Crop/pasture	0.20	1
Rangeland	0.03	Grazing land	0.10	6
Forest - deci.	1.00	Grazed forest	0.90	4
Forest - coni.	1.00	Ungrazed forest	1.00	5
Swamp/forest	1.00	Ungrazed forest	1.00	5
Water	0.0002	Water	0.0001	12
Swamp	0.10	Swamp	0.20	9
Agric./rangeland	0.25	Cropland/grazing	0.30	2
Snow	0.005	-	-	-
-	-	Irrigated crops	0.05	3
-	-	Open woodland	0.20	7
-	-	Desert shrubland	0.30	8
-	-	Marshland	0.50	10

30	5	5	5	5	5	1	1	5	5	5	5	5	5	5	5	5	5	5	5	12	12	12	12	12	12
29	5	5	5	5	5	1	1	5	5	5	5	5	5	5	5	5	5	5	5	12	12	12	12	12	12
28	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	12	12	12	12	12	12
27	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	12	12	12	12	12	12
26	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	12	12	12	12	12
25	5	5	5	5	5	5	5	5	5	1	1	1	5	5	5	5	5	5	5	5	12	12	12	12	12
24	12	5	5	5	5	5	5	5	5	1	1	1	5	5	5	5	5	5	5	5	5	12	12	12	12
23	12	12	12	12	5	5	5	5	5	1	1	1	5	5	5	5	5	5	5	5	5	5	12	12	12
22	12	12	12	12	5	5	5	5	5	1	1	1	5	5	5	5	5	5	5	5	5	5	12	12	12
21	12	12	12	12	5	5	5	5	5	1	1	1	1	1	1	1	1	5	5	5	5	5	5	12	12
20	12	12	12	12	12	5	5	5	5	1	1	1	1	1	1	1	1	5	5	5	5	5	5	12	12
19	12	12	12	12	12	5	5	5	5	5	5	5	1	1	1	1	1	5	5	5	5	5	5	12	12
18	12	12	12	12	12	5	5	5	5	5	5	5	1	1	1	1	1	5	5	5	5	5	5	12	12
17	12	12	12	12	12	5	5	5	5	1	1	1	1	1	1	1	1	5	5	5	5	5	9	12	12
16	12	12	12	12	12	5	5	5	5	1	1	1	1	1	1	1	1	5	5	5	5	5	9	12	12
15	12	12	12	12	12	5	5	1	1	5	5	5	5	5	12	12	12	5	5	6	6	6	5	5	12
14	12	12	12	12	5	5	5	1	1	5	5	5	5	5	12	12	12	5	5	6	6	6	5	5	12
13	12	12	12	12	5	5	5	1	1	1	1	1	1	1	5	5	5	12	12	1	1	1	1	1	12
12	12	12	12	12	5	5	5	1	1	1	1	1	12	12	1	1	1	6	6	6	6	6	1	1	12
11	12	12	12	12	5	5	5	1	1	1	1	1	12	12	1	1	1	6	6	6	6	6	1	1	1
10	12	12	12	5	12	12	5	5	5	5	5	5	5	5	1	1	1	6	6	6	6	6	1	1	1
9	12	12	12	5	5	12	12	12	5	5	5	5	5	5	1	1	1	6	6	6	6	6	1	1	1
8	12	12	12	12	5	12	12	1	1	1	1	1	1	1	1	1	1	5	5	1	1	1	6	6	6
7	12	12	12	12	12	12	1	1	1	1	1	1	1	1	1	1	1	5	5	1	1	1	6	6	6
6	12	12	12	12	12	12	6	6	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	12	12	12	12	12	6	6	6	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	12	12	12	12	12	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	12	12	12	12	12	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	12	12	12	12	12	12	1	1	1	1	1	1	1	1	1	1	1	6	6	1	1	1	1	1	1
1	12	12	12	12	12	12	12	6	6	6	6	6	1	1	1	1	1	6	6	1	1	1	1	1	1
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

Figure 3. Gridded MESOPUFF II land use categories for the 25x30 meteorological grid (1 = crop, 5 = forest, 6 = grazing land, 9 = swamp, 12 = water).

small source-receptor distances (i.e., < 10 km). These include gas and aqueous phase transformation of SO_2 into sulfate, dry deposition, and wet scavenging processes. In addition, the spatial and temporal variability in the meteorological fields is usually an important factor affecting concentration estimates at mesoscale distances. MESOPUFF II was developed specifically for transport distances greater than 10 km, and therefore has specific modules to parameterize these effects.

In the current application, the RGS and background PSD sources of SO_2 were modeled for the 1986 annual period. The recommendations contained in the MESOPUFF II User's Guide were used in the modeling with three exceptions. First, wet removal processes were not considered. This assumption is conservative in the sense that during wet periods, significant removal of SO_2 actually occurs. By neglecting this process, the modeling results obtained during periods with precipitation will tend to be overestimated, other factors being equal, than if it were considered. The decision to not include wet removal was based on the preference of the NPS.

The second change was to use a cross-over distance of 10 km instead of 100 km for the use of the time-dependent dispersion equations of Heffter (1965). The 10 km cross-over distance has been recommended by the model authors for several years, and in fact was used in the model evaluation study of MESOPUFF II conducted by the Argonne National Laboratory (ANL). The use of the 10 km cross-over distance was noted by ANL as one of the main factors leading to the superior performance of MESOPUFF II over some of the other models tested in the ANL study. Included in Appendix A are additional comments regarding this issue which were submitted to EPA in response to the request for public comments on the proposed Supplement B revisions to the EPA modeling guidelines.

The third change was the use of two-layer mode for deposition instead of the three-layer mode. This change was the result of sensitivity tests with and without deposition, which produced inconsistent results when the three-layer model was used. It is believed that the vertical dilution term in the three-layer model should be modified to account for the 10-meter surface layer. The two-layer deposition mode produced reasonable and consistent results as compared to the sensitivity run without deposition, and therefore it was used for the current application.

Appendix B contains a listing of a portion of a MESOPUFF II list file which shows the model options selected and values for the various input variables. The listing shown is for a run with the RGS source for the January to June time period. Sources located between 20 and 50 km from the Class I area were modeled with a minimum sampling rate of 8 per hour. Sources greater than 50 km from the Class I area (including the RGS source) used a minimum sampling rate of 2 per hour. As discussed in the MESOPUFF II technical report (Scire et al., 1984b), more frequent sampling is required as the source-receptor distance decreases (see Table 3). These values of the sampling rate should provide a good representation of the plumes for all sources modeled, including those as close as 20 km from the Class I area.

Although wet removal processes were not considered in the modeling analysis, the dry deposition and chemical transformation mechanisms of the model were invoked. This is an especially reasonable procedure in this case since the great majority of sources modeled (including nearly all of the larger sources) are located more than 50 km from the Class I area.

Receptor Locations

Thirteen discrete receptors in the Class I area were used in the modeling analysis. The coordinates of each receptor are listed in Table 4. These receptors were specified by the Florida DER.

Source Data

The stack coordinates, emission parameters, and stack parameters for each of the sources included in the MESOPUFF II modeling are shown in Tables 5a and 5b. The RGS is Source 1 in Table 5a. The background PSD source inventory was specified by the Florida DER. It consists of 63 increment-consuming PSD sources (Table 5a) and 19 increment-expanding sources (Table 5b). The increment-expanding sources are baseline sources which have stopped operations or reduced emissions. Their contribution was subtracted from that of the increment-consuming sources on a receptor-by-receptor and

Table 3

Comparison of MESOPUFF II Concentrations with Straight-Line Gaussian Plume Results as a Function of Source-Receptor Distance and Puff Sampling Rate (N)

(from Scire et al., 1984b)

(Wind Speed = 5 m/s, D Stability, Mixing Height = 1000 m, Uniform Vertical Distribution)

Distance (km)	σ_y (m)	Straight-Line Gaussian Eqn.	MESOPUFF II Sampling Algorithm N=1	N=2	N=4	N=8	N=16
10	518	1.54	1.69	1.09	1.33	1.51	1.55
20	966	0.83	0.59	0.72	0.81	0.83	0.83
30	1,392	0.57	0.63	0.54	0.59	0.57	0.57
40	1,803	0.44	0.39	0.44	0.45	0.44	0.44
50	2,203	0.36	0.41	0.37	0.36	0.36	0.36

Table 4

Meteorological Grid Coordinates of Receptors in the Chassahowitzka National Wildlife Refuge Class I Area

Receptor	Meteorological Grid Coordinates* X	Y
1	6.53	17.57
2	6.53	17.77
3	6.53	17.98
4	6.57	18.19
5	6.70	18.40
6	6.80	18.62
7	6.87	18.83
8	6.74	19.06
9	6.61	19.34
10	6.40	19.34
11	6.15	19.34
12	5.90	19.34
13	5.65	19.34

---

* Meteorological grid coordinate (1,1) corresponds to UTM coordinate (x,y) = (285000, 3040000). One meteorological grid unit = 10 km.

Table 5a

Increment-Consuming PSD Sources Modeled with MESOPUFF II

SOURCE	METEOROLOGICAL* GRID COORDINATES		STACK HT (m)	DIAMETER (m)	EXIT VEL. (m/s)	TEMP. (deg K)	SO2 EMISSION RATE (g/s)
	X	Y					
1	14.17	11.04	99.06	3.05	14.54	349.80	13.78
2	19.25	20.72	15.24	4.21	56.21	819.80	466.40
3	17.13	13.60	15.24	4.21	56.21	819.80	310.90
4	17.13	13.60	15.24	7.04	32.07	880.80	276.10
5	11.30	12.60	60.35	2.44	17.77	353.00	54.60
6	11.30	12.60	60.35	2.44	17.77	353.00	54.60
7	8.69	8.50	149.40	7.32	19.81	342.20	654.70
8	20.85	16.06	167.60	5.80	21.60	325.70	105.40
9	20.85	16.06	167.60	5.80	23.50	324.20	242.40
10	18.51	13.93	18.30	3.66	38.00	422.00	32.10
11	12.98	6.74	22.90	4.88	23.90	389.00	277.60
12	13.35	11.58	76.20	4.88	19.70	350.00	500.10
13	9.32	10.27	50.00	1.80	18.30	491.00	21.40
14	6.03	9.44	49.10	2.74	27.72	522.00	62.24
15	10.83	14.58	12.30	0.40	9.20	466.20	0.20
16	13.42	11.28	30.48	5.79	28.22	783.20	29.11
17	12.16	8.89	61.00	2.60	15.31	350.00	182.85
18	12.16	8.89	60.70	2.60	15.31	350.00	121.90
19	12.16	8.89	36.60	1.83	20.15	319.10	5.54
20	11.06	14.90	30.48	3.35	17.13	384.30	5.04
21	15.90	20.88	30.48	3.35	17.13	384.30	5.04
22	13.35	9.30	9.10	0.70	22.50	450.00	4.30
23	13.35	9.30	67.10	2.40	9.80	351.00	52.90
24	8.68	9.83	30.00	0.61	20.00	375.00	21.02
25	12.34	9.42	45.70	2.30	10.30	352.00	42.00
26	13.45	8.95	30.48	2.29	9.27	355.00	67.16
27	13.45	8.95	45.72	2.44	9.65	355.00	41.96
28	11.46	7.79	38.10	2.90	10.13	339.00	18.40
29	11.46	7.79	38.10	2.44	18.40	346.00	21.17
30	12.16	8.86	60.70	2.60	15.55	350.00	63.00

---

*Meteorological grid coordinate (1,1) corresponds to UTM coordinates (x,y) = (285000, 3040000). One meteorological grid unit = 10 km.

(Continued)

Table 5a
Increment Consuming PSD Sources Modeled with MESOPUFF II
(Concluded)

SOURCE	METEOROLOGICAL* GRID COORDINATES		STACK HT	DIAMETER	EXIT VEL.	TEMP.	SO2 EMISSION RATE
	X	Y	(m)	(m)	(m/s)	(deg K)	(g/s)
31	12.18	8.94	52.40	2.40	13.00	322.00	3.78
32	12.18	8.94	52.40	2.40	7.10	319.00	5.36
33	12.15	8.92	36.60	1.80	20.80	319.00	5.54
34	12.15	8.86	60.70	2.60	15.55	350.00	63.00
35	12.15	8.88	61.00	2.50	16.71	350.00	189.00
36	13.17	9.52	61.00	2.13	12.20	360.00	35.70
37	14.11	7.86	53.40	2.59	15.91	355.00	63.00
38	14.11	7.86	53.40	2.59	15.91	355.00	63.00
39	13.47	9.60	61.00	2.80	7.30	346.00	73.60
40	13.45	9.65	61.00	1.52	28.40	347.00	72.00
41	8.84	9.24	45.70	2.29	9.20	355.00	36.75
42	11.98	7.77	8.20	0.41	7.57	505.00	0.60
43	11.99	7.98	30.50	1.82	7.26	334.00	16.35
44	11.45	7.80	38.10	2.44	15.20	339.00	13.40
45	13.97	9.03	13.70	1.22	40.40	330.00	30.64
46	12.33	9.43	25.90	2.29	15.20	339.00	2.44
47	11.53	13.94	6.10	1.38	21.00	422.00	3.54
48	13.25	8.13	45.73	1.60	39.06	350.00	113.50
49	8.50	17.24	97.60	4.88	23.23	442.00	98.40
50	7.21	14.92	83.82	3.05	15.70	394.30	14.10
51	5.92	21.45	182.90	6.90	21.00	398.00	1008.80
52	5.92	21.45	182.90	6.90	21.00	398.00	1008.00
53	8.64	17.84	8.50	1.08	10.95	357.40	2.25
54	8.49	17.24	12.20	1.37	10.58	377.00	2.25
55	10.72	17.61	9.14	0.61	4.57	478.00	2.99
56	11.17	16.58	10.67	1.83	8.99	327.00	0.82
57	8.48	17.49	7.62	1.83	6.29	347.00	2.09
58	6.56	12.92	12.20	3.05	6.47	339.00	0.23
59	8.09	15.37	9.14	1.30	16.00	408.00	3.67
60	5.62	13.45	10.98	0.31	3.88	544.00	0.06
61	5.62	13.45	10.98	0.31	3.88	544.00	0.03
62	5.84	15.10	10.98	0.31	4.00	533.00	0.08
63	5.84	15.10	10.98	0.31	4.00	533.00	0.08
64	6.57	12.95	9.14	1.40	22.30	436.00	7.25

---

* Meteorological grid coordinate (1,1) corresponds to UTM coordinates (x,y) = (285000, 3040000). One meteorological grid unit = 10 km.

Table 5b

Increment-Expanding PSD Sources Modeled with MESOPUFF II

SOURCE	METEOROLOGICAL* GRID COORDINATES X	Y	STACK HT (m)	DIAMETER (m)	EXIT VEL. (m/s)	TEMP. (deg K)	SO2 EMISSION RATE (g/s)
1	11.30	12.60	60.35	2.44	16.40	353.00	50.40
2	11.30	12.60	60.35	2.44	16.40	353.00	50.40
3	8.69	8.50	149.40	7.32	28.65	422.00	2436.00
4	8.69	8.50	149.40	7.32	14.33	418.00	1218.00
5	5.06	12.67	49.00	1.20	3.60	293.00	52.07
6	12.16	8.89	61.00	2.60	14.28	350.00	170.10
7	13.35	9.30	30.50	1.68	14.60	350.00	110.60
8	12.34	9.42	30.50	1.80	18.90	308.00	15.20
9	13.45	8.95	30.48	1.37	20.18	311.00	54.56
10	12.17	8.89	21.04	2.13	18.56	347.00	34.27
11	12.15	8.88	61.00	2.50	11.14	350.00	146.00
12	13.17	9.52	51.00	2.13	9.90	356.00	257.60
13	14.12	7.87	29.00	3.02	6.77	314.00	78.80
14	13.47	9.60	45.70	1.40	16.50	352.00	216.00
15	8.84	7.24	22.60	1.52	19.50	322.00	196.30
16	8.84	9.24	45.70	2.29	9.20	355.00	50.71
17	13.25	8.13	45.73	1.60	26.40	350.00	75.60
18	5.92	21.45	152.00	4.57	42.10	422.00	314.00
19	5.92	21.45	153.00	4.88	42.10	422.00	1859.00

---

*Meteorological grid coordinate (1,1) corresponds to UTM coordinates (x,y) = (285000, 3040000). One meteorological grid unit = 10 km.

hour-by-hour basis in the MESOFILE II postprocessing step of the analysis. Thus, the total net concentration for a particular time period can be either positive or negative, depending on the relative contribution of the various sources.

4. MESOPUFF II MODELING RESULTS

3-Hour SO_2 Concentrations

The peak predicted 3-hour SO_2 concentration predicted by MESOPUFF II due to emissions from the RGS was 0.26 μg/m^3 on Day 343 for the hours 03:00-0:600 LST. Because this value is less than the proposed 3-hour SO_2 significance level of 0.48 μg/m^3, a cumulative impact analysis with background PSD sources was not necessary.

24-Hour SO_2 Concentrations

MESOPUFF II modeling for the RGS source produced three days with predicted 24-hour SO_2 concentrations at or above the proposed NPS 24-hour significance level of 0.07 μg/m^3 at one or more of the Class I area receptors. As shown in Table 6, concentrations on Days 282, 332, and 333 exceeded the significance level, with the peak concentration (0.09 μg/m^3) predicted on Day 332.

Tables 7, 8, and 9 show the concentrations due to RGS and the total net contribution from the 82 background PSD sources located at or beyond 20 km from the Class I area added to the RGS contribution. The highest predicted concentrations at a receptor for which the RGS contribution was significant (i.e., $\geq$ 0.07 μg/m^3) was 4.67 μg/m^3.

In order to reach conclusions relating to compliance with the 24-hour PSD Class I increment for SO_2, the contributions of the one source located less than 20 km from the Class I area must be added to the values in Tables 7 to 9. The modeling of the additional source with the ISCST model was conducted by Dames & Moore. The results of that analysis are described in a separate report.

Table 6

Predicted Peak 24-Hour Average SO_2 Concentrations Due to RGS Emissions At or Above the Proposed NPS 24-Hour Significance Threshold of 0.07 $\mu g/m^3$

Day	Receptor	Concentration ($\mu g/m^3$)
282	1	0.08
332	13	0.09
333	13	0.08

Table 7

Predicted 24-Hour Average SO_2 Concentrations on Days when RGS Contributions Exceeded the Proposed NPS Significance Level

Day: 282

Receptor	Contribution from RGS	Contribution from Sources ≥ 20 km from Class I Area (Including RGS)
1	0.075	3.01
2	0.073	3.29
3	0.070	3.59
4	0.067	*
5	0.063	*
6	0.059	*
7	0.055	*
8	0.053	*
9	0.050	*
10	0.052	*
11	0.053	*
12	0.054	*
13	0.055	*

---

[*] At this receptor, the RGS contribution is less than the proposed NPS 24-hour significance level of 0.07 $\mu g/m^3$.

Table 8

Predicted 24-Hour Average SO_2 Concentrations on Days when RGS Contributions Exceeded the Proposed NPS Significance Level

Day: 332

Receptor	Contribution from RGS	Contribution from Sources ≥ 20 km from Class I Area (Including RGS)
1	0.088	3.84
2	0.088	3.60
3	0.087	3.80
4	0.086	4.32
5	0.084	4.28
6	0.084	4.30
7	0.084	4.43
8	0.083	4.51
9	0.082	4.62
10	0.083	4.67
11	0.085	4.54
12	0.088	4.38
13	0.091	4.33

Table 9

Predicted 24-Hour Average SO_2 Concentrations on Days when RGS Contributions Exceeded the Proposed NPS Significance Level

Day: 333

Receptor	Contribution from RGS	Contribution from Sources ≥ 20 km from Class I Area (Including RGS)
1	.032	*
2	.031	*
3	.030	*
4	.029	*
5	.026	*
6	.026	*
7	.026	*
8	.028	*
9	.031	*
10	.038	*
11	.050	*
12	.065	*
13	.081	1.22

---

* At this receptor, the RGS contribution is less than the proposed NPS 24-hour significance level of 0.07 $\mu g/m^3$.

5. REFERENCES

EPA, 1986: Guidance on air quality models (revised). EPA-450/2-78-027R, U.S. Environmental Protection Agency, Research Triangle Park, NC.

EPA, 1991: Supplement B to the guideline on air quality models (revised). Draft. U.S. Environmental Protection Agency, Research Triangle Park, NC.

Heffter, J.L., 1965: The variations of horizontal diffusion parameters with time travel periods of one hour or longer. *J. Applied Meteorol.*, **4**, 153-156.

Policastro, A.J., M. Wastag, L. Coke, R.A. Carhart and W.E. Dunn, 1986: Evaluation of short-term long-range transport models (Draft final report). U.S. Environmental Protection Agency, Research Triangle Park, NC.

Scire, J.S., F.W. Lurmann, A. Bass and S.R. Hanna, 1984a: User's guide to the MESOPUFF II model and related processor programs. EPA-600/8-84-013, U.S. Environmental Protection Agency, REsearch Triangle Park, NC.

Scire, J.S., F.W. Lurmann, A. Bass and S.R. Hanna, 1984b: Development of the MESOPUFF II dispersion model. EPA-600/3-84-057. U.S. Environmental Protection Agency, Research Triangle Park, NC.

Appendix A

Comments on the use of MESOPUFF II

Sigma Research Corporation

Telephone: (508) 692-0330
Telefax: (508) 692-8547

234 Littleton Road, Suite 2E • Westford, Massachusetts 01886, U.S.A.

May 3, 1991

Air Docket (LE-131), Room M-1500
Waterside Mall
Attention: Docket A-88-04
U.S. Environmental Protection Agency
401 M Street SW
Washington, DC 20460

Dear Sir:

I am writing in response to the Federal Register Notice (AD-FRL-3908-3, Docket No. A-88-04, Monday February 25, 1991) requesting comments on the proposed revisions to the "Guideline on Air Quality Models (Revised)" and Supplement B to the Guideline. In particular, my comments relate to the EPA recommendations regarding the use of the MESOPUFF II dispersion model (Scire et al., 1984).

Supplement B notes that MESOPUFF II, listed in Appendix B of the Guidelines, may be applied on a case-by-case basis when long range transport estimates are needed. It is also noted that information on applying this model is contained in the EPA document "A Modeling Protocol for Applying MESOPUFF-II to Long-Range Problems" (Docket No. A-88-04, II-I-11).

The following changes are recommended to the EPA MESOPUFF II modeling protocol.

- MESOPUFF II contains a input parameter, TMDEP, which controls the distance at which the functions used to compute dispersion coefficients are switched from the distance-dependent equations of Turner to the time-dependent functions of Heffter (1965). The default value for this parameter is set at 100 km, indicating that the time-dependent functions are used at greater distances. However, in our review of the model evaluation protocol prepared by Argonne National Laboratory (ANL) in their evaluation of long-range transport models, we suggested that a value of 10 km be used for TMDEP. The model evaluation work done by ANL was based on a 10 km value for TMDEP. ANL concluded that "the use of 10 km as the transition distance between the use of the Turner curves and Heffter formula for lateral dispersion definitely improved concentration predictions" (page 6-7, Policastro et al., 1986). They also noted that a main cause of the under-prediction of lateral spreading by some of the other models evaluated was due to the use of the distance-dependent curves out to 50-100 km. They concluded that "the more correct distance is about 10 km" (page 6-3). Therefore, it is recommended that the EPA modeling protocol for MESOPUFF II be modified to recommend that a value of 10 km be used for TMDEP.

- The EPA modeling protocol recommends that MESOPUFF II be run for pollutants such as SO_2 with the chemical transformation and pollutant removal algorithms turned off. However, over source-receptor distances of 50 to 300 kilometers, these processes can have a very significant effect on the predicted concentrations. Wet deposition of SO_2 is a particularly efficient removal mechanism. For example, studies of observed scavenging ratios indicate typical removal rates of 10-20 *per hour* or higher for modest precipitation rates of only 1-2 mm/hr. (At an average transport speed of 5 m/s, over 16 hours is required to travel 300 km).

  Current EPA modeling guidelines allow consideration of SO_2 transformation in straight-line Gaussian models on even smaller spatial scales than those for which MESOPUFF II would be applied. For example, the modeling guidelines recommend a pollutant half life of 4 hours for SO_2 modeling in urban areas). Therefore, some allowance for chemical conversion and removal is consistent with current guidance and is justifiable on technical grounds. Although first-level screening analyses with removal and chemical conversion switched off is appropriate, it is suggested that more refined screening modeling with MESOPUFF II which accounts for SO_2 transformation and removal should be allowed.

- The modeling protocol recommends the use of MESOPUFF II at source-receptor distances greater than 50 km. It should be noted that the puff model can reproduce a straight-line Gaussian model results under steady-state conditions with the appropriate choice of puff release parameters at distances much less than 50 km (Table 9 in the MESOPUFF II report shows nearly identical results down to 10 km with N=16). Therefore, it is not so much an issue of when does the puff model become valid as when the straight-line, steady-state assumptions in conventional models become not appropriate. The straight-line Gaussian model is more efficient computationally over short distances, but because there are many flow situations when non-steady-state conditions occur over spatial scales less than 50 km, the use of the puff model may be justified.

The modeling protocol recommends application of MESOPUFF II for a full year period for small numbers of sources. Recent advances in the computational speed of advanced PCs and workstations have made large multi-source or multi-year simulations with the MESOPUFF II model practical. For example, the state agency in Massachusetts sponsored a study to simulate nearly 200 point and area sources of SO_2 for a full year with only modest computational resources. Similar studies have been performed in other states, including Minnesota and Maryland.

Thank you for the opportunity to comment on these issues.

Sincerely,

Joseph S. Scire

Joseph S. Scire
Chief Executive Officer

cc: J. Tikvart

References

Heffter, J.L., 1965: The variations of horizontal diffusion parameters with time travel periods of one hour or longer. *J. Applied Meteorol.*, **4**, 153-156.

Policastro, A.J., M. Wastag, L. Coke, R.A. Carhart, and W.E. Dunn, 1986: Evaluation of short-term long-range transport models (Draft final report). U.S. Environmental Protection Agency, Research Triangle Park, NC.

Scire, J.S., F.W. Lurmann, A. Bass, S.R. Hanna, 1984: User's guide to the MESOPUFF II model and related processor programs. EPA-600/8-84-013. U.S. Environmental Protection Agency, Research Triangle Park, NC.

Scire J.S., F.W. Lurmann, A. Bass, S.R. Hanna, 1984: Development of the MESOPUFF II dispersion model. EPA-600/3-84-057. U.S. Environmental Protection Agency, Research Triangle Park, NC.

Appendix B

MESOPUFF II Output List File

(RGS Source, January - June, 1986)

```
                         MESOPUFF - VERSION 2.0 (DATED 85360)

                                                        MESOPUFF   VERSION  2.0
**************************************************************************************************************************

MESOPUFF II - RGS - 1/1/86 - 6/30/86 w/dry dep and Chem

GENERAL RUN INFORMATION:
    YEAR OF RUN (NSYR) = 86
    JULIAN DAY OF START OF RUN (NSDAY) =   1
    HOUR OF START OF RUN (NSHR) =  0
    LENGTH OF RUN (NADVTS) = 4344 (HOURS)
    NUMBER OF POINT SOURCES (NPTS) =  1
    NUMBER OF AREA (URBAN) SOURCES (NAREAS) =  0
    NUMBER OF NONGRIDDED RECEPTORS (NREC) =  13
    NUMBER OF POLLUTANT SPECIES (NSPEC) =  1

COMPUTATIONAL VARIABLES:
    CONCENTRATION AVERAGING TIME (IAVG) =    1 (HOUR(S))
    PUFF RELEASE RATE (NPUF) =   4 (PUFFS/HOUR)
    MINIMUM SAMPLING RATE (NSAMAD) =  2 (SAMPLES/HOUR)
    SAMPLING RATE VARIED WITH WIND SPEED ? (LVSAMP) = T
    SAMPLING RATE WIND SPEED INTERVAL (WSAMP) =  2.00 (M/S)
    CONCENTRATIONS CALCULATED AT SAMPLING GRID POINTS ? (LSGRID) = F
    PUFFS YOUNGER THAN "AGEMIN" SECONDS ARE NOT SAMPLED (AGEMIN) =   900. (SECONDS)

GRID INFORMATION:
    BEGINNING OF COMPUTATIONAL GRID IN X-DIRECTION (IASTAR) =  1
    END OF COMPUTATIONAL GRID IN X-DIRECTION (IASTOP) = 25
    BEGINNING OF COMPUTATIONAL GRID IN Y-DIRECTION (JASTAR) =  1
    END OF COMPUTATIONAL GRID IN Y-DIRECTION (JASTOP) = 30
    BEGINNING OF SAMPLING GRID IN X-DIRECTION (ISASTR) =  1
    END OF SAMPLING GRID IN X-DIRECTION (ISASTP) = 25
    BEGINNING OF SAMPLING GRID IN Y-DIRECTION (JSASTR) =  1
    END OF SAMPLING GRID IN Y-DIRECTION (JSASTP) = 30
    SAMPLING GRID SPACING FACTOR (MESHDN) =  1

TECHNICAL OPTIONS:
    GAUSSIAN VERTICAL CONCENTRATION DISTRIBUTION ? (LGAUSS) = T
    CHEMICAL PROCESSES MODELED ? (LCHEM) = T
    DRY DEPOSITION MODELED ? (LDRY) = T
    WET REMOVAL MODELED ? (LWET) = F
    3 VERTICAL LAYERS ? (L3VL) = F

OUTPUT OPTIONS:
    CONCENTRATIONS STORED ON TAPE ? (LTAPE) = T
    CONCENTRATIONS PRINTED ? (LPRINT) = T
    PRINT INTERVAL (IPRINF) =   24
    PUFF PARAMETERS PRINTED EACH SAMPLING STEP ? (LDB) = F
    TIME STEPS FOR WHICH PUFF PARAMETERS PRINTED (NN1,NN2) =    0,   0
```

```
                                                MESOPUFF   VERSION  2.0
****************************************************************************************************************************

DEFAULT OVERRIDE OPTIONS (0=NO,1=YES)
    USER INPUT SIGY, SIGZ VARIABLES (IOPTS(1)) =                 1
    USER INPUT VERTICAL DIFFUSIVITY CONSTANTS (IOPTS(2)) =       0
    USER INPUT DRY DEP. SO2 CANOPY RESISTANCES (IOPTS(3)) =      0
    USER INPUT OTHER DRY DEP. CONSTANTS (IOPTS(4)) =             0
    USER INPUT WET REMOVAL CONSTANTS (IOPTS(5)) =                0
    USER INPUT CHEMICAL TRANSFORMATION VARIABLES (IOPTS(6)) =    0

SIGY, SIGZ VARIABLES:
    AY =            0.36000   0.25000   0.19000   0.13000   0.09600   0.06300
    BY =            0.90000   0.90000   0.90000   0.90000   0.90000   0.90000
    AZ =            0.00023   0.05800   0.11000   0.57000   0.85000   0.77000
    BZ =            2.10000   1.09000   0.91000   0.58000   0.47000   0.42000
    AZT (IN M) =    5.00000   3.87300   2.73900   1.87100   1.22500   0.70700
    TMDEP =     10000. (M)
    STABILITY CLASS USED IN SIGY, SIGZ CALCULATIONS FOR PUFFS ABOVE BOUNDARY LAYER (JSUP) =  5
         (0 = BOUNDARY LAYER STABILITY CLASS, 5 = E STABILITY, 6 = F STABILITY)

VERTICAL DIFFUSIVITY CONSTANTS:
    CON1K =      0.010 (M**2/S)
    CON2K =      0.100 (M**2/S)

LAND USE CATEGORY   SO2 CANOPY RESISTANCE (S/M)
                      A,B,C       D         E         F
        1            100.00    300.00   1000.00      0.00
        2            100.00    300.00   1000.00      0.00
        3            100.00    300.00   1000.00      0.00
        4            100.00    300.00   1000.00      0.00
        5            100.00    300.00   1000.00      0.00
        6            100.00    300.00   1000.00      0.00
        7            100.00    300.00   1000.00      0.00
        8            200.00    500.00   1000.00   1000.00
        9             50.00     75.00    100.00      0.00
       10             75.00    300.00   1000.00      0.00
       11           1000.00   1000.00   1000.00      0.00
       12              0.00      0.00      0.00      0.00

DRY DEPOSITION CONSTANTS:
    CANOPY RESISTANCE FOR NOX IN S/M (RCNOX) =  130.00 (A,B,C)   500.00 (D)  1500.00 (E)  1500.00 (F)
    SURFACE RESISTANCE CONSTANT FOR GASES (RSGCON) =     2.60
    SURFACE RESISTANCE FOR PARTICLES (RSPART) = 1000.00 (S/M)
```

```
******************************************************************************************************************************

CHEMICAL TRANSFORMATION VARIABLES:
    SOX TRANSFORMATION METHOD FLAG (MSOX) =  2
        0 - NO TRANSFORMATION
        1 - USER SPECIFIED
        2 - ERT THEORETICAL EQUATION
        3 - GILLANI EQUATION
        4 - HENRY EQUATION FOR ST. LOUIS
        5 - HENRY EQUATION FOR LOS ANGELES
    NOX TRANSFORMATION METHOD FLAG (MNOX) =  2
        0 - NO TRANSFORMATION
        1 - USER SPECIFIED
        2 - ERT THEORETICAL EQUATION
    OZONE INPUT METHOD FLAG (MO3) =  0
        0 - DEFAULT OZONE VALUE USED
        1 - HOURLY OZONE VALUES READ
    DEFAULT BACKGROUND OZONE (CO3B) =   80.0 (PPB)
    TOTAL AMMONIA CONCENTRATION (CTNH3) =   10.0 (PPB)
    NIGHTTIME TRANSFORMATION RATES:
        SO2 LOSS RATE (RNITE(1)) =   0.2 (%/HOUR)
        NOX LOSS RATE (RNITE(2)) =   2.0 (%/HOUR)
        TOTAL NO3 FORMATION RATE (RNITE(3)) =   2.0 (%/HOUR)
```

```
                                                     MESOPUFF   VERSION  2.0
************************************************************************************************************************************

POINT SOURCE DATA
SOURCE     GRID COORDINATES    STACK HT   DIAMETER   EXIT VEL.   TEMP.    ------------- EMISSION RATES (G/S) -------------
              X        Y          (M)        (M)        (M/S)    (DEG K)      SO2        SO4        NOX        HNO3        NO3

   1      14.17    11.04        99.06       3.05       14.54     349.80      13.78       0.00       0.00       0.00        0.00
```

```
                                               MESOPUFF   VERSION  2.0
***************************************************************************************************************************

     NONGRIDDED RECEPTOR LOCATIONS
RECEPTOR    X (GRID UNITS)    Y (GRID UNITS)

     1            6.530            17.570
     2            6.530            17.770
     3            6.530            17.980
     4            6.570            18.190
     5            6.700            18.400
     6            6.800            18.620
     7            6.870            18.830
     8            6.740            19.060
     9            6.610            19.340
    10            6.400            19.340
    11            6.150            19.340
    12            5.900            19.340
    13            5.650            19.340
```

```
                                              MESOPUFF   VERSION  2.0
**************************************************************************************************************************

INFORMATION READ FROM METEOROLOGICAL DATA FILE:
    YEAR OF METEOROLOGICAL DATA = 86
    METEOROLOGICAL DATA BEGINS ON JULIAN DAY   1
    NUMBER OF HOURS OF METEOROLOGICAL DATA = 4345
    METEOROLOGICAL GRID SIZE IN X (WEST-EAST) DIRECTION = 25
    METEOROLOGICAL GRID SIZE IN Y (SOUTH-NORTH) DIRECTION = 30
    METEOROLOGICAL GRID SPACING =    10000.0 (M)
    BASE TIME ZONE = 5 (E.S.T.)
    VON KARMAN CONSTANT = 0.40
    CODE FOR LOWER-LEVEL WIND FIELD (ILWF) =  2
    CODE FOR UPPER-LEVEL WIND FIELD (IUWF) =  4
    NUMBER OF STATIONS USED IN CONSTRUCTION OF METEOROLOGICAL DATA FIELDS
         SURFACE:     4
         RAWINSONDE:  1
    STATION         GRID COORDINATES
       TYPE           X             Y
                (GRID UNITS)  (GRID UNITS)

    SURFACE        7.40          10.50
    SURFACE       19.40          15.70
    SURFACE       10.20          29.40
    SURFACE       22.00          23.80
    RAWINSONDE     7.40          10.50
```

RIDGE GENERATING STATION, L. P.

General Partners

DECKER ENERGY-RIDGE, INC. ***WHEELABRATOR POLK INC.***

400 North New York Avenue, Suite 101
Winter Park, Florida 32789
Tel. 407-628-8900
Fax. 407-628-8535

March 19, 1992

RECEIVED
MAR 20 1992
Bureau of
Air Regulation

Florida Department of Environmental Regulation
Division of Air Resources Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Attention: C. H. Fancy, P.E.
Chief, Bureau of Air Regulation

Re: Permit Application AC 53-206244, PSD-FL-183
Ridge Generating Station

Dear Mr. Fancy:

This letter provides responses to the questions you raised in your letter dated January 17, 1992. For your convenience, we have repeated the questions and provided our response immediately below the question.

1. **The flow diagram shows no bypass around the dry scrubber/ baghouse. There may be times when the boiler flue gas temperature exceeds the baghouse design temperature. Are there plans to install a bypass, and if so, under what conditions would the bypass be open?**

RESPONSE:

As discussed in the application, the Ridge Generating Station (RGS) will be equipped with a spray dryer absorber (SDA) and fabric filter. Under normal circumstances, the SDA and fabric filter will both be in operation when the boiler is on-line. A bypass of the fabric filter will, however, be installed to protect the bags and structural integrity of the baghouse during infrequent upset or emergency conditions.

The RGS boiler will be a conventional stoker fired unit, in which the solid fuel will be burned both in suspension and on the grate. If a system failure occurred which resulted in the SDA going off-line, the fuel feed to the boiler would automatically stop and the suspension burning would cease. However, fuel already on the grate would continue to burn, sending combustion products to the SDA/fabric filter. To

BEST AVAILABLE COPY

FEDERAL EXPRESS [redacted]

QUESTIONS? CALL 800-238-5355 TOLL FREE.

AIRBILL
PACKAGE
TRACKING NUMBER 3594194446

1543B 3594194446

RECIPIENT'S COPY

1 [redacted] Date 3/19/92

From (Your Name) Please Print
...t Killeen

Your Phone Number (Very Important) (603)929-3000

Company ..ELABRATOR TECHNOLOGIES INC
Department/Floor No.

Street Address ..ERTY LANE

City ..MPTON State NH ZIP Required 0 3 3 4 2

2 To (Recipient's Name) Please Print
C. H. Fancy
Recipient's Phone Number (Very Important) (904) 488-4805

Company
Florida Dept. of Env. Regulations
Div. of Air Resources Mgmt.
Department/Floor No.

Exact Street Address (We Cannot Deliver to P.O. Boxes or P.O. Zip Codes.)
Twin Towers Office Bldg.
2600 Blair Stone Road

City Tallahassee, State FL ZIP Required 32399-2400

YOUR INTERNAL BILLING REFERENCE INFORMATION (optional) (First 24 characters will appear on invoice.)

H IF HOLD FOR PICK-UP, Print FEDEX Address Here
Street Address
City State ZIP Required

3 PAYMENT 1 ☒ Bill Sender 2 ☐ Bill Recipient's FedEx Acct. No. 3 ☐ Bill 3rd Party FedEx Acct. No. 4 ☐ Bill Credit Card
5 ☐ Cash/Check [redacted]

4 SERVICES (Check only one box)

Priority Overnight (Delivery by next business morning†)	Standard Overnight (Delivery by next business afternoon†)
11 ☐ YOUR PACKAGING	51 ☐ YOUR PACKAGING
16 ☐ FEDEX LETTER *	56 ☐ FEDEX LETTER *
12 ☐ FEDEX PAK *	52 ☐ FEDEX PAK *
13 ☐ FEDEX BOX	53 ☐ FEDEX BOX
14 ☐ FEDEX TUBE	54 ☐ FEDEX TUBE
Economy Two-Day (Delivery by second business day†)	**Government Overnight** (Restricted for authorized users only)
30 ☐ ECONOMY	46 ☐ GOVT LETTER
	41 ☐ GOVT PACKAGE

Freight Service (for Extra Large or any package over 150 lbs.)
70 ☐ OVERNIGHT FREIGHT ** (Confirmed reservation required) 80 ☐ TWO-DAY FREIGHT **
† Delivery commitment may be later in some areas
*Declared Value Limit $100
**Call for delivery schedule.

5 DELIVERY AND SPECIAL HANDLING (Check services required)
1 ☐ HOLD FOR PICK-UP (Fill in Box H)
2 ☒ DELIVER WEEKDAY
3 ☐ DELIVER SATURDAY (Extra charge) (Not available to all locations)
4 ☐ DANGEROUS GOODS (Extra charge)
5 ☐
6 ☐ DRY ICE .... Lbs
7 ☐ OTHER SPECIAL SERVICE
8 ☐
9 ☐ SATURDAY PICK-UP (Extra charge)
10 ☐
11 ☐
12 ☐ HOLIDAY DELIVERY (If offered) (Extra charge)

6

PACKAGES	WEIGHT In Pounds Only	YOUR DECLARED VALUE
1	2	
Total 1	Total 2	Total

DIM SHIPMENT (Chargeable Weight)
☐ .... lbs.
L x W x H =

Received At
1 ☐ Regular Stop 3 ☐ Drop Box
4 ☐ B.S.C.
2 ☐ On-Call Stop 5 ☐ Station

Emp. No. Date
☐ Cash Received
☐ Return Shipment
☐ Third Party ☐ Chg. To Del. ☐ Chg. To Hold
Street Address
City State Zip
Received By:
X
Date/Time Received FedEx Employee Number

7 Release Signature:
FedEx Emp. No. Date/Time

Federal Express Use
Base Charges
Declared Value Charge
Other 1
Other 2
Total Charges

REVISION DATE 6/91
PART #137204 NCREC 10/91
FORMAT #099

099

© 1990-91 F.E.C.
PRINTED IN U.S.A.

prevent the possibility of having burning embers and higher than normal temperature flue gases causing a fire, the bypass would be temporarily opened to divert the gases directly to the fabric filter outlet. The duration of the bypass would be limited to the time required to burn the fuel remaining on the grate at the time of the malfunction or the time necessary to correct the SDA malfunction, whichever is shorter.

As indicated above, the bypass capability would only be used under upset or emergency situations to prevent fires or damage to the air pollution control equipment. Conditions that would result in a bypass include:

- o Loss of water flow to the SDA. Redundant water pumps will be installed to minimize the potential for this occurrence.
- o Extreme high fabric filter inlet temperatures (i.e., greater than 500°F). This situation would occur only under system upset conditions.
- o Extremely high fabric filter pressure differential (i.e., greater than approximately 30 inches of water). Again, this situation would occur only under system upset conditions.

The only other proposed bypass condition would occur during periods of boiler warm-up when only propane gas is being burned. This bypass is warranted to prevent excess moisture from "blinding" the bags.

2. **How many days supply of wood and tires will be stored on site? Will landfill gas be available in sufficient quantities to offset temporary shortages of wood or tires? Are there contingency plans for use of other alternate fuels and if so, what are they?**

RESPONSE:

The site will have separate piles for both processed and unprocessed wood. The piles will encompass an area of approximately 2.8 acres of unprocessed wood storage and 8.5 acres of processed wood storage. Based upon this arrangement, on-site wood storage will provide an inventory in excess of thirty (30) days.

The tire pile storage area encompasses approximately 2.3 acres. There will be four (4) tire piles, each separated by fifty (50) foot fire access lanes. It is currently anticipated that one (1) pile will contain chipped tires and the remaining piles will contain whole tires. Based upon this arrangement, the tire piles will provide a fourteen (14) day inventory. The size of the tire storage area and the required layout limits the inventory to a maximum of 28 days.

Current estimates of the quantity of landfill gas indicate that up to 10% of the total heat input of the facility could be landfill gas. This fuel will not be available in sufficient quantities to be a complete substitute for wood and tires.

In addition to wood, tires, and landfill gas, the RGS boiler will be equipped with a propane burner (or burners). The propane burner(s) will have a maximum heat input of 180 MMBtu/hour and will be used for start-up, shutdown and infrequent combustion stabilization purposes. No other alternate fuels are proposed for use at RGS.

RGSLP has conducted two market studies of the supply of wood. These studies indicate that there are between 1.2 million and 2.5 million tons of wood fuel available per year within the procurement area. The project will require approximately 350,000 tons of wood per year.

It is also estimated that greater than 5 million scrap tires per year are disposed of within the procurement area of the facility. In addition, there are illegal tire piles which need to be brought into compliance, including a large site in Polk County.

Based on our studies, we are confident that there are adequate supplies of wood, scrap tires, and landfill gas from Polk County's North Central Landfill to reliably fuel the plant. Therefore, there are no contingency plans for use of other alternate fuels.

3. **Unreacted ammonia from the SNCR system may pose a difficult control problem due to variability in the fuel mix. Given the public's and the Department's concern about ammonia discharges from phosphate plants in the area, some control system or practice must be in place to effectively prevent ammonia from being detected beyond the RGS property line. The application states that this problem will be minimized through careful attention to combustion control by the**

operator (i.e, manual adjustments). A properly designed facility should have some control loop or system such that the operator will not have to make very many manual adjustments. The application should address other methods that may prove necessary for controlling ammonia slip.

RESPONSE:

The RGS will have an automated control system which will minimize manual adjustments by the operator. As discussed in the application, the SNCR process incorporates a reagent storage and delivery system to feed a solution through injectors into the combustion gases of the boiler. The injectors atomize the solution as it enters the boiler and mixes with the boiler flue gas. The solution reacts with the NO_x in the flue gas to form N_2, and H_2O. Excess levels of solution can result in emissions of ammonia into the atmosphere (referred to as ammonia slip). Control of the SNCR system will be maintained through the use of a programmable logic controller and single loop controllers. This system will automatically maintain acceptable NO_x emissions and control reagent use, which will limit ammonia emissions. Operation and control of the SNCR system is described in the following paragraphs:

> A concentrated solution is typically metered to the boiler for NO_x reduction by a variable stroke chemical metering pump. The feed rate of the solution is automatically controlled through an auto/manual NO_x control station that uses a feed-forward boiler load signal and a feedback stack NO_x signal. The control station output signal is sent to the chemical metering pump electronic capacity control which automatically adjusts the stroke of the pump.
>
> Process water and the concentrated solution are typically mixed in the chemical mixing pump, located downstream of the chemical metering pump. In addition to providing intimate mixing when diluting the concentrated solution, the chemical mixing pump provides the required reagent pressure at the injectors. The degree of dilution is generally affected by the location of the injectors and the temperature and gas velocity profiles in the boiler. The net effect of the dilution is to assure more efficient contact between the NO_x and the solution in the boiler, thus increasing NO_x removal efficiency and minimizing ammonia slip.

Dilution water requirements will be optimized during start-up. A single loop controller will be used to provide for automatic control of the dilution water rate. The controller receives a signal from the pressure transmitter in the chemical mixing pump recirculation line and outputs a signal to the pressure regulating valve.

A control system will interface with the SNCR system, and will include a programmable logic controller for relay and timing functions, regulators, circuit breaker/fuses, selector switches, status lights and annunciator. The control system will include monitors and recorders for boiler load and NO_x emissions as well as chemical and carrier feed rates. Various status lights and annuniciators will provide operators with continuous indications of system operability and equipment conditions. The control system will require only infrequent adjustment or manual operation by plant personnel.

Wheelabrator has SNCR systems currently operating at two facilities, including a California facility with three wood fired boilers. The automatic control systems at these facilities have proven to be effective at controlling NO_x emissions and ammonia slip. Therefore, Ridge Generating Station Limited Partnership (RGSLP) is confident that a similar control system at the RGS facility will minimize potential concerns associated with ammonia slip.

4. **Table B-2 lists essentially the same emission factors for all three fuel types. Typically, one would expect some difference, although small. It would be helpful to include footnoted or numbered references in the discussion so that items such as "test data and other literature" could be properly identified. Also, an explanation of the rationale that went into derivation of the emission rates would be desirable.**

RESPONSE:

Emission rates may vary depending on the specific mix of fuels being burned. For the most part, however, these variations are expected to be small. Furthermore, the primary objective of the emission estimation process was to assess maximum emissions for impact assessment purposes and for emission compliance purposes. Therefore, rather than indicating separate emission rates for all pollutants and all fuel mixes, the approach followed for most pollutants was simply to indicate the maximum emission rate expected for operation of the Ridge Generating Station (RGS) at a given load level. These maximum rates were then in turn used in the impact analysis. Another consideration related to estimating variations in emissions is that available emissions data references are not specific to the types of fuels and types of emission controls to be used at RGS. With reference data of this type, making a precise distinction in emission factors among the RGS fuel mixes did not seem supportable.

The principal references used to derive the emission factors in Table B-2 are listed below. The complete citation for these references is provided as Attachment A. Also presented in the following list is a brief rationale for emission rate derivation.

Sulfur Oxides - Derived from the expected fuel sulfur content, the expected fuel mix and the anticipated scrubber control efficiency. Data on fuel sulfur content were obtained from wood analyses and published data, including Grasso and Atkins, 1990. See permit application for additional information on fuel analysis and control methods.

Particulate Matter - Based on design data and the BACT analysis. The emission rate of 0.02 lb/MMBtu assumes that the test method is U.S. EPA Method 5, front-half catch only. See permit application for additional information. Revised versions of Table 5-4 and Table B-2 are attached to clarify the test method for particulate matter.

Nitrogen Oxides - Based on design data and the BACT analysis. See permit application for additional information.

Carbon Monoxide - Based on design data and the BACT analysis. See application for additional information.

Volatile Organic Compounds - Based on design data and the BACT analysis. See permit application for additional information.

Lead - Based primarily on Genesse Generating Station, 1991 and an evaluation of urban wood ash compositional data (Grasso and Atkins, 1990). Also reviewed Malcolm Pirnie, 1991; Oxford Energy, 1988; and Oxford Energy, 1990.

Hydrogen Chloride - The emission rate presented in the application was based primarily on information presented in the permit applications for the Genesse Generating Station (1991) and the Westminster, Massachusetts facility (ERL 1989), which was adjusted based upon the anticipated control efficiency of the scrubber. Additional fuel chlorine content data have been obtained since the application was initially submitted. Attachment B summarizes the chlorine fuel data.

As a result of these data, RGSLP is proposing to increase the hydrogen chloride emission rate from 0.005 lb/MMBtu to 0.008 lb/MMBtu. This revised emission rate conservatively assumes a wood chlorine content of 0.12% (which represents the 95% upper confidence limit) and a scrubber removal efficiency of 95%.

Tables 4-5, 6-8, B-1 and B-2 have been revised to include this change. Table 6-8 shows that the predicted maximum ambient concentrations based on the increased emission rate is less than the Florida no-threat levels.

<u>Beryllium</u> - Based primarily on Genesse Generating Station, 1991 and emissions test data from Champion International in Bucksport, Maine (Malcolm Pirnie, 1991). Also reviewed Oxford Energy, 1990, and Dow Corning, 1989. Beryllium was not detected in Dow Corning test results.

<u>Mercury</u> - Based primarily on an evaluation of urban wood and ash compositional data (Grasso and Atkins, 1990, and personal communications with ERL, 1991 and 1992) with an assumed control efficiency of fifty percent, and tire emissions data (Oxford Energy, 1990). The Genesse Generating Station Permit Application (1991) and stack test data at Wheelabrator's Shasta wood-burning facility in California (Galson, 1991), were also considered.

<u>Ammonia</u> - Based on design data.

<u>Arsenic</u> - Based primarily on an evaluation of urban wood ash compositional data (Grasso and Atkins, 1990 and personal communications with ERL, 1991 and 1992) and the assumed particulate matter control efficiency. Also reviewed Oxford Energy (1988 and 1990) test results which show minimal arsenic emissions from tire burning.

<u>Cadmium</u> - Based primarily on wood and tire emission test data from the Port Townsend facility (Washington Department of Ecology, 1986).

Chromium - The emission rate initially proposed in the application was based upon total chromium emission test results (Dow Corning, 1989 and Washington Department of Ecology, 1986). Based upon a review of wood and ash composition data (Grasso and Atkins, 1990 and personal communications with ERL, 1991 and 1992) a revised emission rate is being proposed for chromium. RGSLP is proposing to increase the total chromium emission rate from 2.6E-05 lb/MMBtu to 1.15E-04 lb/MMBtu. The revised emission rate was derived using the chromium concentration in urban wood ash (95th percentile) when considering the proposed particulate matter control efficiency. Data on chromium concentrations in urban wood ash are provided in Attachment C.

Chromium VI - The proposed emission rate for hexavalent chromium is also being revised based upon the information obtained from ERL. ERL has indicated that a maximum of 5 to 10 percent of the total chromium could be in the form of hexavalent chromium. To be conservative, in terms of impact assessment, RGSLP has assumed that 20 percent of the total chromium could be in the form of Chromium VI. This results in a reduction of the Chromium VI emission rate from 2.6E-05 to 2.3E-05.

Tables 4-5, 6-8, B-1 and B-2 have been revised to account for the revisions to the emission rates for chromium and chromium VI. Table 6-8 shows that the predicted maximum ambient concentrations based on the revised emission rates are less than the Florida no-threat levels.

Nickel - Based primarily on wood and tire emission test data from the Port Townsend facility (Washington Department of Ecology, 1986).

Zinc - Based primarily on emissions test data from the Oxford Energy facility (1988), adjusted to account for the fact that Oxford Energy burns 100% tires, while RGS will burn mostly wood with a maximum of 20% tires. Tires will represent the primary source of zinc emissions. Wood emissions estimates are based upon urban wood compositional data (ERL, 1991 and 1992) and stack test data from the Champion International Facility in Bucksport, Maine (Malcolm Pirnie, 1991).

Benzene - Based primarily on emissions test data reported in Caron, et al., 1990.

Formaldehyde - Based primarily on stack test data from Wheelabrator's Shasta wood-burning facility in California (Galson, 1991) and personal communications with ERL related to their emissions databases.

Pursuant to your request, Table B-3 has been revised to identify the specific references that were used to establish the emission factors. This has been done by numbering the references and identifying the numbered reference for each emission factor.

5. **The flow diagram contains a table showing the process material balance. Review of the application would be facilitated if the diagram also showed process conditions, including flue gas temperatures ahead of and after the baghouse.**

RESPONSE:

A revised flow diagram is attached. It has been revised to provide the additional information that you requested. The information is provided to illustrate the expected conditions. It is based upon the best available information and it is expected to be representative. The actual conditions, however, may vary depending upon the final equipment suppliers that are selected for the facility.

It should be noted that a number of additional changes have also been made to the flow diagram. These additional changes deal with the facility water balance. There have been no changes in the amount of fuel used or flue gases generated.

6. **The predicted maximum SO_2 24-hour and 3-hour concentrations in the Chassohowitzka PSD Class I area due to the Ridge Generating Station boiler emissions are greater than the National Park Service proposed 24-hour and 3-hour significant impact levels of 0.07 and 0.48 ug/m^3, respectively. Please perform a cumulative 24-hour and 3-hour SO_2 Class I increment analysis as required by the National Park Service. An air quality related**

values (AQRVs) analysis should also be done since there are presently no significant impact levels that exempt a proposed PSD project from performing this analysis. The AQRVs analysis includes impacts to soils, vegetation, and wildlife.

RESPONSE:

A response to Item No. 6 is in preparation. This response will include the results of an additional modeling evaluation assessing in more detail the effect of Ridge Generating Station sulfur dioxide emissions and emissions of other sources within a wide region around the Chassahowitzka PSD Class I area. Effects on air quality related values (including soils, vegetation, and wildlife) will also be discussed in the response.

During the process of preparing a response to Item No. 6, several discussions with DER's air quality modeling staff have been held. Among the topics discussed was the inventory of other sulfur dioxide emission sources to be included in the impact evaluation. DER has been developing an updated inventory of PSD sources that might affect ambient sulfur dioxide concentrations within the Chassahowitzka PSD Class I area. The latest version of this inventory, consisting of 83 emission sources, was received from DER on March 6, 1992. This recently updated inventory is being used in the modeling analysis required for preparation of a response to Item No. 6. A response will be submitted as soon as it is available.

ADDITIONAL TOPICS

Revised Site Plan

An updated site plan is also enclosed. While the turbine generator building, boiler building and stack configuration have remained unchanged from the original submittal, there have been a number of minor changes to other portions of the site. The paragraph below, summarizes the changes that have been made since the initial submittal.

The processed wood storage area has been expanded. The 2.2 acre pond has been removed. The sewage treatment system has been replaced by a septic system with drainfield. Potable well P3 has been moved to a location southwest of the turbine-generator building. The ash silo has been replaced by an ash building containing "roll-on roll-off" containers.

The fines storage area located next to the truck dump has been removed. A condensate tank has been added and the name of the treated water tank has been changed to service water tank.

Table B-2

There is a typographical error in Table B-2 of the permit application. The emission factor shown in Table B-2 for Arsenic is 0.0003 lb/MMBtu, while the correct factor is 0.00003. The correct factor was used to calculate emissions in lb/hr so that the emission rates for Arsenic in Table B-1 and in Table 4-5 are correct. The correct emission rate was also used for the impact evaluation. A revision to Table B-2 containing the correct emission factor for Arsenic is attached.

We have attempted to provide comprehensive responses to Questions 1 through 5, to ensure that the application will now be complete with respect to those issues. As discussed above, a complete response to Question 6 will be forwarded as soon as it is completed. We currently expect to submit that response prior to March 27, 1992. The submittal of that response has been delayed by the revision of the emissions inventory and the large number of additional sources that were added to the inventory.

We would be happy to provide any additional assistance to facilitate the review of this application. Please contact Matt Killeen at 1-800-682-0026 if you have additional questions or comments. We appreciate the efforts of you and your staff on this important project.

Sincerely,

Richard C. Stone

Richard C. Stone
Project Manager

MPK112:ga

Attachments (See attached List)

cc: John Reynolds - FDER
Cleve Holladay - FDER
Matt Killeen - WESI
Macauley Whiting - Decker
B. Thomas, SW Dist
J. Harper, EPA
C. Shaver, NPS

List of Attachments

1. Attachment A - References
2. Attachment B - Ultimate Analysis, Percent Chlorine in Wood and Tires
3. Attachment C - Summary Data from Six Wood Processors, Chromium Analysis
4. Revised Table 4-5 - Ridge Generating Station, Estimated Maximum Toxic Air Pollutant Emissions at Maximum Continuous Rating, dated 3/12/92.
5. Revised Table 5-4 - Ridge Generating Station, Summary of Proposed BACT Approach, dated 3/12/92.
6. Revised Table 6-8 - Ridge Generating Station, Summary of Predicted Maximum Concentrations of Toxic Air Pollutants Attributable to Boiler Emissions, dated 3/12/92.
7. Revised Table B-1 - Ridge Generating Station Boiler Emission Rate Calculations for Maximum Continuous Rating, dated 3/12/92.
8. Revised Table B-2 - Ridge Generating Station Boiler Emission Rate Calculation Variables for Maximum Continuous Rating, dated 3/12/92.
9. Revised Table B-3 - Ridge Generating Station Boiler Derivation of Emission Rate Calculation Variables, dated 3/12/92.
10. Revised Figure 3-1 - Ridge Generating Station Flow Diagram, last revised 3/11/92.
11. Revised Figure 3-2 - Ridge Generating Station Site Plan, last revised 02/06/92.

Attachment A

References

Caron, A., Messmer, R. and Hoy, D., 1990. Project progress report: the emissions of selected air contaminants from wood-residue fired boilers, in Proceedings of 1990 National Council of the Paper industry for Air and Stream Improvement West Coast Regional Meeting.

Dow Corning Corp., 1989. Report of tire chip test burn performed March 9-29, 1989.

Environmental Risk Limited (ERL), 1989. An Application to the Massachusetts Department of Environmental Protection for a 16 MW Wood-Fired Electric Generating Facility in Westminster, Massachusetts.

ERL, 1991 and 1992. Personal communications with R. Atkins, M. Holzman and others; and information received from ERL databases.

Galson Technical Services, 1991. Source Test Report, Source Emission Testing of the Wood-Fired Boiler #1 Exhaust Stack at the Wheelabrator Shasta Energy Company, Anderson, California.

Genesse Generating Station, 1991. Air emission permit application for Genesse Generating Station, Michigan.

Grasso, D.T. and Atkins, R.S., Environmental Risk Limited, 1990. The composition of recycled wood fuel and its environmental permitting implications. Presented at the ACA/CIPCA Fourth Annual Meeting and Exposition, Hartford, CT, September 16-17, 1990.

Malcolm Pirnie, Inc., 1991. Air emissions associated with the combustion of scrap tires for energy recovery.

Oxford Energy Co., 1988. Final emission test report for Modesto Energy Company waste tire to energy facility, Westley, California.

Oxford Energy Co., 1990. Stack test report (for the Oxford Energy Company facility at Westley, California, October 9-10, 1990).

Washington Department of Ecology, 1986. Source test for Port Townsend Paper Company (February 25 and March 5, 1986).

Attachment B

Ultimate Analysis

Percent Chlorine in Wood and Tires (Dry Weight Basis)

	Number of Samples	Arithmetic mean	Standard Deviation	95% Upper Confidence Limit
C/D Wood[b]	21	0.05	0.03	0.12[a]
Tires[c]	7	0.10	0.05	0.15[d]

Source: Environmental Risk Limited (ERL) Databases.

Notes:
- a. Defined as mean plus two standard deviations.
- b. Construction/Demolition wood composition data collected and analyzed by ERL.
- c. Tire-derived fuel data summarized by ERL.
- d. The maximum chlorine content detected was 0.15%. The mean plus two standard deviations was higher than the maximum detected; therefore, the 95% upper confidence limit was set equal to the maximum detected.

Attachment C

Summary Data from Six Wood Processors

Chromium Analysis (ppm in Ash)

Number of Samples	Arithmetic mean	95th Percentile
41	992	5760.9

Source: Environmental Risk Limited (ERL) Databases

Revised 3/12/92

TABLE 4-5

RIDGE GENERATING STATION ESTIMATED TOXIC AIR POLLUTANT EMISSIONS AT MAXIMUM CONTINUOUS RATING

Pollutant	Highest Emissions (lb/hr) for Any Fuel Mix
• Metals	
arsenic	0.019
beryllium	0.0063
cadmium	0.033
chromium (total)	0.072
chromium VI	0.014
lead	0.25
mercury	0.022
nickel	0.063
zinc	0.63
• Non-Metal Inorganics	
ammonia	17.8
hydrogen chloride	5.04
• Organics	
benzene	5.0
formaldehyde	1.7

TABLE 5-4

RIDGE GENERATING STATION
SUMMARY OF PROPOSED BACT APPROACH

Pollutant	Proposed Best Available Control Technology	Proposed Emission Limit (lb/MMBtu)
PM	Fabric Filtration	0.02[a]
SO_2	Spray Dryer with Fabric Filtration	0.17[b]
NO_X	Combustor Design and Selective Noncatalytic Reduction System	0.15[b]
CO	Good Combustion Practices	0.5[b,c]
VOCs	Good Combustion Practices	0.035
Pb	Fabric Filtration	0.0004
Be	Fabric Filtration	0.00001

[a] Based on EPA Method 5 front-half catch only.

[b] On a 24-hour block average basis.

[c] Excluding periods of start-up and shut down.

TABLE 6-8

Revised 3/12/92

RIDGE GENERATING STATION
SUMMARY OF PREDICTED MAXIMUM CONCENTRATIONS OF TOXIC AIR POLLUTANTS ATTRIBUTABLE TO BOILER EMISSIONS

	Maximum Predicted Concentrations ($\mu g/m^3$)			Florida DER No-Threat Levels[b] ($\mu g/m^3$)		
Pollutant	8-Hour	24-Hour	Annual	8-Hour	24-Hour	Annual
Arsenic	0.002	0.0008	7.2×10^{-5}	2	0.48	2.3×10^{-4}
Beryllium	0.0007	0.0003	2.4×10^{-5}	0.02	0.005	4.2×10^{-4}
Cadmium	0.004	0.001	1.2×10^{-4}	0.5	0.12	5.6×10^{-4}
Chromium (total)	0.008	0.003	2.7×10^{-4}	5	1.2	2.0×10^{-3}
Chromium VI	0.002	0.0006	5.3×10^{-5}	0.5	0.12	8.3×10^{-5}
Lead	0.03	0.01	9.5×10^{-4}	1.5	0.36	9.0×10^{-2}
Mercury	0.002	0.0009	8.4×10^{-5}	0.5	0.12	0.3
Nickel	0.007	0.003	2.4×10^{-4}	0.5	0.12	4.2×10^{-3}
Zinc	0.07	0.03	-	50	12	-
Ammonia	2.0	0.7	0.07	180	43.2	1.0
Hydrogen chloride	0.6	0.2	0.02	70	16.8	7.0
Formaldehyde	0.2	0.07	6.4×10^{-3}	4.5	1.08	7.7×10^{-2}
Benzene	0.6	0.2	0.02	30	7.2	0.12

[a] Based on operating year-round at maximum continuous rating or 75 percent load firing an 80% wood/20% tires fuel mix.

[b] Including any relevant federal reference air concentrations, reference specific doses (divided by 10), or inhalation reference concentrations.

Revised 3/12/92

TABLE B-1

RIDGE GENERATING STATION BOILER EMISSION RATE CALCULATIONS FOR MAXIMUM CONTINUOUS RATING

	EMISSION RATES (LB/HR) BY FUEL TYPE (FUEL PERCENTAGES ON A HEAT INPUT BASIS)		
POLLUTANT	100% WOOD	80% WOOD 20% TIRES	75% WOOD 15% TIRES 10% LANDFILL GAS
sulfur oxides (as SO_2)	B x C x E x H = 69.4	B x C x E x H = 109.4	B x C x E x H = 92.5
particulate matter/PM_{10}	A x I = 12.6	A x I = 12.6	A x I = 12.6
nitrogen oxides (as NO_2)	A x J = 94.5	A x J = 94.5	A x J = 94.5
carbon monoxide	A x K = 315.0	A x K = 315.0	A x K = 315.0
volatile organic compounds	A x L = 22.1	A x L = 22.1	A x L = 22.1
lead[a]	A x M = 0.25	A x M = 0.25	A x M = 0.25
hydrogen chloride	B x D x F x G x AA = 5.04	B x D x F x G x AA = 4.70	B x D x F x G x AA = 4.44
beryllium[a]	A x N = 0.0063	A x N = 0.0063	A x N = 0.0063
mercury[a]	A x O = 0.022	A x O = 0.022	A x O = 0.022
ammonia[a]	P x Q x R = 17.8	P x Q x R = 17.8	P x Q x R = 17.8
arsenic[a]	A x S = 0.019	A x S = 0.019	A x S = 0.019
cadmium[a]	A x T = 0.033	A x T = 0.033	A x T = 0.033
chromium (total)[a]	A x U = 0.072	A x U = 0.072	A x U = 0.072
chromium VI[a]	A x U x Z = 0.014	A x U x Z = 0.014	A x U x Z = 0.014
nickel[a]	A x V = 0.063	A x V = 0.063	A x V = 0.063
zinc[a]	A x W = 0.63	A x W = 0.63	A x W = 0.63
benzene[a]	A x X = 5.0	A x X = 5.0	A x X = 5.0
formaldehyde[a]	A x Y = 1.7	A x Y = 1.7	A x Y =1.7

Note: Calculation variables are defined in Table B-2.

[a] Highest estimated emissions for any fuel mix shown in each column.

TABLE B-2

RIDGE GENERATING STATION BOILER EMISSION RATE CALCULATION VARIABLES FOR MAXIMUM CONTINUOUS RATING

	CALCULATION VALUES BY FUEL TYPE (FUEL PERCENTAGES ON A HEAT INPUT BASIS)		
VARIABLE	100% WOOD	80% WOOD 20% TIRES	75% WOOD 15% TIRES 10% LANDFILL GAS
A = heat input, MMBtu/hr	630	630	630
B = fuel consumption, lb/hr	115,596	101,477	103,947
C = SO_2 dry scrubber/ fabric filter efficiency factor (1 - 80%/100%)	0.2	0.2	0.2
D = fuel chlorine content fraction, dry basis	0.0012	0.00123	0.00110
E = fuel sulfur content fraction	0.0015	0.00269	0.00222
F = adjustment to dry fuel basis lb/MMBtu	0.708	0.733	0.756
G = ratio of HCl to Cl	1.028	1.028	1.028
H = ratio of SO_2 to S	2	2	2
I = PM emission factor[a], lb/MMBtu	0.02	0.02	0.02
J = NO_X emission factor, lb/MMBtu	0.15	0.15	0.15
K = CO emission factor, lb/MMBtu	0.50	0.50	0.50
L = VOC emission factor, lb/MMBtu	0.035	0.035	0.035
M = Pb emission factor[b], lb/MMBtu	0.0004	0.0004	0.0004
N = Be emission factor[b], lb/MMBtu	0.00001	0.00001	0.00001
O = Hg emission factor[b], lb/MMBtu	0.000035	0.000035	0.000035

TABLE B-2

RIDGE GENERATING STATION BOILER EMISSION RATE CALCULATION VARIABLES FOR MAXIMUM CONTINUOUS RATING (continued)

VARIABLE	CALCULATION VALUES BY FUEL TYPE (FUEL PERCENTAGES ON A HEAT INPUT BASIS)		
	100% WOOD	80% WOOD 20% TIRES	75% WOOD 15% TIRES 10% LANDFILL GAS
P = NH_3 volume (ppmv) divided by 10^6	$35.36/10^6$	$35.18/10^6$	$35.26/10^6$
Q = flue gas volume, ft^3/hr (@ 170°F)	13,593,360	13,481,580	13,653,180
R = factor to convert ft^3 of NH_3 @ 170°F flue gas exit temperature	0.037	0.037	0.037
S = arsenic emission factor[b], lb/MMBtu	0.00003	0.00003	0.00003
T = cadmium emission factor[b], lb/MMBtu	0.000052	0.000052	0.000052
U = chromium (total) emission factor[b], lb/MMBtu	0.000115	0.000115	0.000115
V = nickel emission factor[b], lb/MMBtu	0.0001	0.0001	0.0001
W = zinc emission factor[b], lb/MMBtu	0.001	0.001	0.001
X = benzene emission factor[b], lb/MMBtu	0.008	0.008	0.008
Y = formaldehyde emission factor[b], lb/MMBtu	0.0027	0.0027	0.0027
Z = chromium VI fraction of total chromium	0.2	0.2	0.2
AA = HCl dry scrubber/ fabric filter efficiency factor (1-95%/100%)	0.05	0.05	0.05

[a] Based on EPA Method 5 front-half catch only.

[b] Represents highest emission factor for any fuel combination.

TABLE B-3

RIDGE GENERATING STATION BOILER
DERIVATION OF EMISSION RATE CALCULATION VARIABLES

VARIABLE[a]	DERIVATION
A	design data
B	design data and expected fuel heating value
C	design data
D	reference 4
E	test data
F	test data
G	basic chemistry
H	basic chemistry
I	design data
J	design data
K	design data
L	design data
M	references 6, 7, 8, 9, 10
N	references 2, 6, 8, 10
O	references 4, 5, 6, 7, 10
P	design data
Q	design data
R	17 lb/lb mole x lb mole/358.8 ft^3 (@ 32 °F) x (460 + 32 °R)/(460 + 170 °R) = 0.037
S	references 4, 7, 9, 10
T	reference 11
U	references 3, 4
V	reference 11
W	references 4, 8, 9
X	reference 1
Y	references 4,5
Z	reference 4
AA	design data

[a] Variable defined in Table B-2.

TABLE B-3
(Continued)

1. Caron, A., Messmer, R. and Hoy, D., 1990. Project progress report: the emissions of selected air contaminants from wood-residue fired boilers. In Proceedings of 1990 National Council of the Paper industry for Air and Stream Improvement West Coast Regional Meeting.

2. Dow Corning Corp., 1989. Report of tire chip test burn performed March 9-29, 1989.

3. Environmental Risk Limited, 1989. An application to the Massachusetts Department of Environmental Protection for a 16-MW wood-fired electric generating facility in Westminster, Massachusetts.

4. Environmental Risk Limited, 1991 and 1992. Personal communications with R. Atkins, M. Holzman, and others; and information received from Environmental Risk Limited databases.

5. Galson Technical Services, 1991. Source test report, source emission testing of the wood-fired boiler #1 exhaust stack at the Wheelabrator Shasta Energy Company, Anderson, California.

6. Genesse Generating Station, 1991. Air emission permit application for Genesse Generating Station, Michigan.

7. Grasso, D.T. and Atkins, R.S., Environmental Risk Limited, 1990. The composition of recycled wood fuel and its environmental permitting implications. Presented at the ACA/CIPCA Fourth Annual Meeting and Exposition, Hartford, CT, September 16-17, 1990.

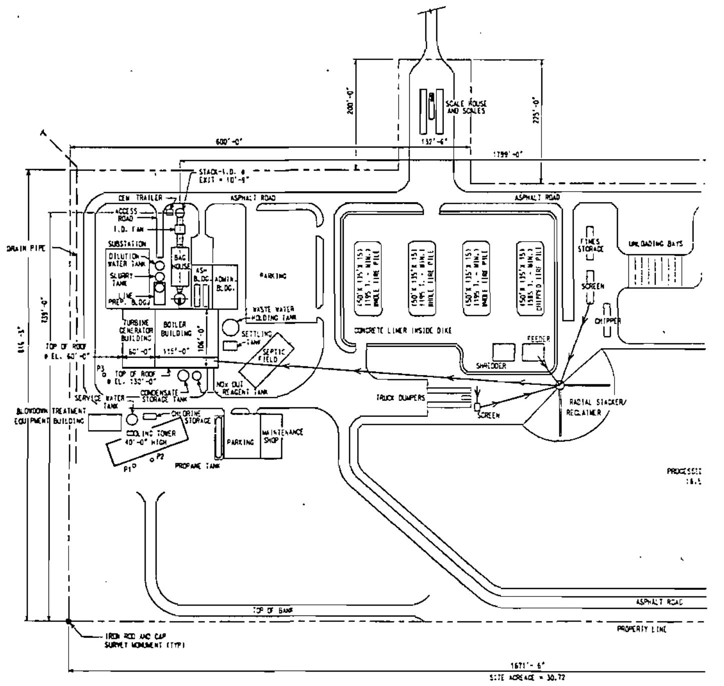
8. Malcolm Pirnie, Inc., 1991. Air emissions associated with the combustion of scrap tires for energy recovery.

9. Oxford Energy Co., 1988. Final emission test report for Modesto Energy Company waste tire to energy facility, Westley, California.

10. Oxford Energy Co., 1990. Stack test report (for the Oxford Energy Company facility at Westley, California, October 9-10, 1990).

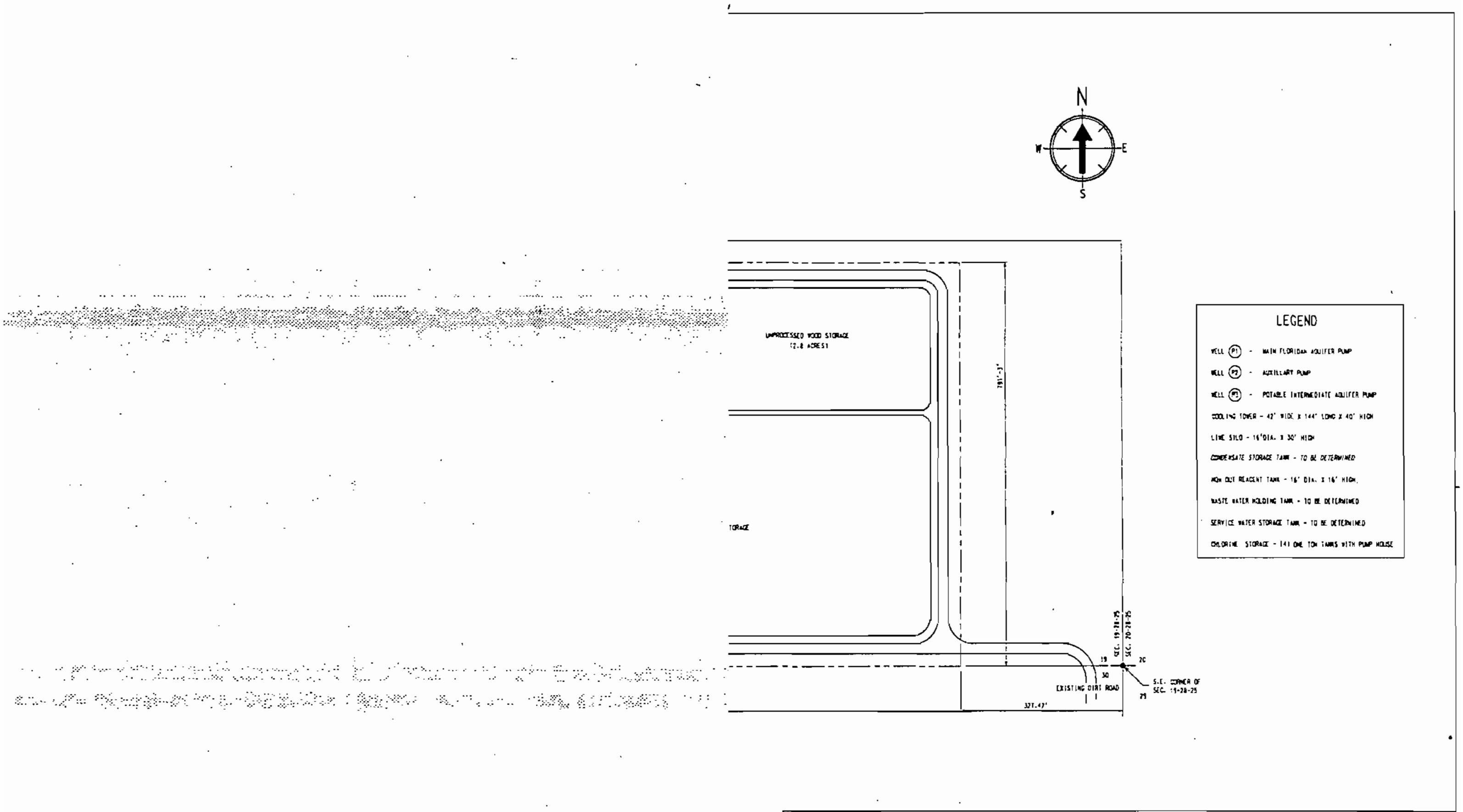
11. Washington Department of Ecology, 1986. Source test for Port Townsend Paper Company (February 25 and March 5, 1986).

Best Available Copy



SITE PLAN

PRELIM
PRINT
DATE 02/06/92



LEGEND

WELL (P1) - MAIN FLORIDAN AQUIFER PUMP

WELL (P2) - AUXILLARY PUMP

WELL (P3) - POTABLE INTERMEDIATE AQUIFER PUMP

COOLING TOWER - 42' WIDE X 144' LONG X 40' HIGH

LIME SILO - 16'DIA. X 30' HIGH

CONDENSATE STORAGE TANK - TO BE DETERMINED

NOx OUT REAGENT TANK - 16' DIA. X 16' HIGH.

WASTE WATER HOLDING TANK - TO BE DETERMINED

SERVICE WATER STORAGE TANK - TO BE DETERMINED

CHLORINE STORAGE - (4) ONE TON TANKS WITH PUMP HOUSE

REVISION					
1	02-06-92				
2	02-06-92				

RIDGE GENERATING STATION

NOTICE: This drawing and all information contained thereon is confidential and proprietary to SFT, Inc. It cannot be copied or reproduced without the express written permission of SFT, Inc.

	SIGNATURE	DATE
DRAWN:	s.e.nisaler	02-06-92
CHK'D:		- -
CHK'D:		- -
APP'D:		- -

TITLE:

SITE PLAN
FOR AIR PERMIT APPLICATION

IARY
VED

SFT, Inc. Consulting Engineers SFT

SCALE:	PROJ./CONTRACT NO.	DRAWING NO.	REV.
NONE	9110-00-00	911000-PPR-008	2

C:\911000\PS11
BASE SCALE: " = '-0"

RIDGE GENERATING STATION, L. P.

General Partners
DECKER ENERGY-RIDGE, INC. *WHEELABRATOR POLK INC.*

400 North New York Avenue, Suite 101
Winter Park, Florida 32789
Tel. 407-628-8900
Fax. 407-628-8535

RECEIVED
MAR 30 1992
Division of Air
Resources Management

March 27, 1992

Florida Department of Environmental Regulation
Division of Air Resources Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Attention: C. H. Fancy, P.E.
Chief, Bureau of Air Regulation

Re: Permit Application AC 53-206244, PSD-FL-183
Ridge Generating Station

Dear Mr. Fancy:

The letter from your office dated January 17, 1992, raised six questions regarding the air emissions permit application for the Ridge Generating Station project. Our letter to you dated March 19, 1992, provided responses to the first five of these questions. A summary response to the sixth question is provided below (along with a repetition of the question for your convenience). We have scheduled a meeting on April 1, 1992, with Tom Rogers and Cleve Holladay of the Air Modeling and Assessment Section to discuss our response in detail. A written detailed response will also be provided.

6. **The predicted maximum SO_2 24-hour and 3-hour concentrations in the Chassahowitzka PSD Class I area due to the Ridge Generating Station boiler emissions are greater than the National Park Service proposed 24-hour and 3-hour significant impact levels of 0.07 and 0.48 $\mu g/m^3$, respectively. Please perform a cumulative 24-hour and 3-hour SO_2 Class I increment analysis as required by the National Park Service. An air quality related values (AQRVs) analysis should also be done since there are presently no significant impact levels that exempt a proposed PSD project from performing this analysis. The AQRVs analysis includes impacts to soils, vegetation, and wildlife.**

ADDITIONAL AIR QUALITY MODELING ANALYSIS

An additional analysis of SO_2 impacts at the Chassahowitzka PSD Class I area has been developed. This additional impact analysis is based on the use of the standard ISCST model and a long-range transport model, the MESOPUFF II model. The following

RIDGE GENERATING STATION, L. P.

Florida Dept. of Environmental Regulation
Division of Air Resources Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400

conclusions result from this additional analysis: (1) Predicted maximum 3-hour SO_2 concentrations at the Chassahowitzka PSD Class I area due to Ridge Generating Station (RGS) emissions are less than the proposed National Park Service significant impact level of 0.48 $\mu g/m^3$. (2) Predicted maximum 24-hour SO_2 concentrations due to RGS emissions exceed the proposed National Park Service significant impact level of 0.07 $\mu g/m^3$, but only on a very infrequent basis. Furthermore, during the meteorological conditions when RGS emissions result in concentrations above the proposed significant impact level, the cumulative predicted maximum 24-hour concentrations due to all PSD sources identified by DER are less than the PSD Class I increment. Therefore, RGS emissions neither cause nor contribute to a violation of the PSD Class I increment at the Chassahowitzka PSD Class I area.

AIR QUALITY RELATED VALUES ANALYSIS

An air quality related values analysis has also been developed. The conclusions reached from this analysis are that the RGS project (1) will not diminish the national significance of the Chassahowitzka National Wilderness Area (which comprises the PSD Class I area), (2) will not impair the quality of the visitor experience at this area, and (3) will not impair the structure and functioning of the ecosystems within the area.

Please contact Matt Killeen at 1-800-682-0026 if you have any questions or comments.

Sincerely,

Richard C Stone

Richard C. Stone
Project Manager

MPK118:cjb

cc: John Reynolds - FDER
Cleve Holladay - FDER
Matt Killeen - WESI
Macauley Whiting - Decker
B. Thomas, SW Dist
J. Harper, EPA
C. Shaver, NPS

DECKER ENERGY INTERNATIONAL

RECEIVED
FEB 6 1992
Division of Air
Resources Management

February 4, 1992

Mr. Barry Andrews
Florida Department of Environmental Regulation
Division of Air Resources Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Re: Ridge Generating Station Air Permit Application

Dear Mr. Andrews:

Polk County has requested that we submit the attached letter to all applicable permitting agencies indicating an interest in participating in the permitting process for our project.

Please note that they would like you to acknowledge and return the second page of their letter.

Sincerely yours,

RIDGE GENERATING STATION LIMITED PARTNERSHIP

Macauley Whiting, Jr.

Macauley Whiting, Jr., President
Decker Energy - Ridge, Inc.
General Partner

MW/m

Attachment
cc: J. Reynolds

Imperial

Polk County

Board of County Commissioners

Planning Division

P.O. Box 1969
330 W. Church St.
Bartow, FL 33830
(813) 534-6084
SUNCOM 569-6084
FAX (813) 534-6055

Florida Department of Env. Reg.
Div. of Air Resources Mgmt.
4520 Oak Fair Blvd.
Tampa, Fl 33610

January 30, 1992

Dr. Richard Garrity:

This letter is to inform you that Polk County is an interested party in the permitting process for the following project:

Applicant: Decker Energy International
Project: Ridge Generation Station Power Plant
Location: Section 19, Township 28 Range 25

Please notify us of all meetings as we would like the opportunity to participate in the conditioning of the permit for the purposes of compliance with the Polk County Comprehensive Plan and site specific parameters. If this permit has already been granted or if an intent to issue has been noticed, please contact Celeste Deardorf of my staff immediately. Under provisions of Florida Statutes, we would like the opportunity to comment as it relates to local issues.

Thank you for your cooperation in this matter.

Sincerely,

Robert Anders, AICP
Planning Director

Donald Martin
Principal Planner
Planning Division
P.O. Box 1969
Bartow, Florida 33830

RE: Decker Energy/Ridge Generating Station

I have received the permit application pursuant to the above referenced project as well as Polk County's Notice of Interested Party and Notice of Participation. We will keep you informed of all proceedings and decisions in regards to this project.

AGENCY:
Florida Department of Env. Reg.
Div. of Air Resources Mgmt.

______________________________ ______________
(signature of permit reviewer) (date)

____
(print name)

____
____
(address)

____
(phone)

SENDER:
- Complete items 1 and/or 2 for additional services.
- Complete items 3, and 4a & b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "Return Receipt Requested" on the mailpiece next to the article number.

I also wish to receive the following services (for an extra fee):

1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:

Mr. Macauley Whiting, Jr.
President
Decker Energy - Ridge, Inc.
P. O. Box 2397
Winter Park, FL 32790

4a. Article Number
P 832 538 766

4b. Service Type
☐ Registered
☐ Insured
☒ Certified
☐ COD
☐ Express Mail
☐ Return Receipt for Merchandise

7. Date of Delivery 1/22/92

5. Signature (Addressee)

8. Addressee's Address (Only if requested and fee is paid)

6. Signature (Agent)

PS Form **3811**, October 1990 ☆U.S. GPO: 1990—273-861 **DOMESTIC RETURN RECEIPT**

P 832 538 766

Certified Mail Receipt

No Insurance Coverage Provided
Do not use for International Mail
(See Reverse)

UNITED STATES POSTAL SERVICE

Sent to
Mr. Macauley Whiting

Street & No.
Ridge, Inc.
P. O. Box 2397

P.O., State & ZIP Code
Winter Park, FL 32790

Postage	$
Certified Fee	
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to Whom & Date Delivered	
Return Receipt Showing to Whom, Date, & Address of Delivery	
TOTAL Postage & Fees	$

Postmark or Date
Mailed: 1-17-92
Permit: AC 53-206244
PSD-FL-183

PS Form **3800**, June 1990

Florida Department of Environmental Regulation
Twin Towers Office Bldg. ● 2600 Blair Stone Road ● Tallahassee, Florida 32399-2400
Lawton Chiles, Governor
Carol M. Browner, Secretary

January 17, 1992

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. Macauley Whiting, Jr., President
Decker Energy - Ridge, Inc.
P.O. Box 2397
Winter Park, Florida 32790

Re: Permit Application AC 53-206244, PSD-FL-183
Ridge Generating Station

Dear Mr. Whiting:

The Department received the subject application on December 20, 1991, and reviewed it for completeness. Your consultant did a commendable job. Only a few points need to be clarified or expanded. These items are listed below:

1. The flow diagram shows no bypass around the dry scrubber/baghouse. There may be times when the boiler flue gas temperature exceeds the baghouse design temperature. Are there plans to install a bypass and if so, under what conditions would the bypass be open?

2. How many days supply of wood and tires will be stored on site? Will landfill gas be available in sufficient quantities to offset temporary shortages of wood or tires? Are there contingency plans for use of other alternate fuels and if so, what are they?

3. Unreacted ammonia from the SNCR system may pose a difficult control problem due to variability in the fuel mix. Given the public's and the Department's concern about ammonia discharges from phosphate plants in the area, some control system or practice must be in place to effectively prevent ammonia from being detected beyond the RGS property line. The application states that this problem will be minimized through careful attention to combustion control by the operator (i.e. manual adjustments). A properly designed facility should have some control loop or system such that the operator will not have to make very many manual adjustments. The application should address other methods that may prove necessary for controlling ammonia slip.

4. Table B-2 lists essentially the same emission factors for all three fuel types. Typically, one would expect some difference, although small. It would be helpful to include footnoted or numbered references in the discussion so that items such as "test data and other literature" could be properly identified. Also, an explanation of the rationale that went into derivation of the emission rates would be desirable.

5. The flow diagram contains a table showing the process material balance. Review of the application would be facilitated if the diagram also showed process conditions, including flue gas temperatures ahead of and after the baghouse.

6. The predicted maximum SO_2 24-hour and 3-hour concentrations in the Chassohowitzka PSD Class I area due to the Ridge Generating Station boiler emissions are greater than the National Park Service proposed 24-hour and 3-hour significant impact levels of 0.07 and 0.48 ug/m^3, respectively. Please perform a cumulative 24-hour and 3-hour SO_2 Class I increment analysis as required by the National Park Service. An air quality related values (AQRVs) should also be done since there are presently no significant impact levels that exempt a proposed PSD project from performing this analysis. The AQRVs analysis includes impacts to soils, vegetation, and wildlife.

If further clarification is needed on any of the above, please contact the permit engineer, John Reynolds, or the permit meteorologist, Cleve Holladay, at 904-488-1344.

Sincerely,

C. H. Fancy

C. H. Fancy, P.E.
Chief
Bureau of Air Regulation

CHF/JR/plm

c: W. Thomas, SWD
T. Fitzpatrick, P.E.
J. Little, D & M
M. Killeen, WESI
J. Harper, EPA
C. Shaver, NPS

Florida Department of Environmental Regulation

Twin Towers Office Bldg. ● 2600 Blair Stone Road ● Tallahassee, Florida 32399-2400

Lawton Chiles, Governor
Carol M. Browner, Secretary

We received an application for a permit to construct (Ridge Generating Station) from Wheelabrator Environmental Systems Inc. and a check for $7,500.00 to cover PSD permitting fees on December 20, 1991.

Barry D. Andrews
Administrator
Permit and Standards Section.

Florida Department of Environmental Regulation

Twin Towers Office Bldg. ● 2600 Blair Stone Road ● Tallahassee, Florida 32399-2400

Lawton Chiles, Governor

Carol M. Browner, Secretary

December 23, 1991

Ms. Jewell A. Harper, Chief
Air Enforcement Branch
U.S. EPA, Region IV
345 Courtland Street, N.E.
Atlanta, Georgia 30308

Dear Mrs. Harper:

RE: Ridge Generating Station
Polk County, PSD-FL-183

Enclosed for you review and comment is the above referenced PSD permit application. If you have any comments or questions, please contact John Reynolds or Cleve Holladay at (904)488-1344.

Sincerely,

Patricia G. Adams

Patricia G. Adams
Planner
Bureau of Air Regulation

/pa

Enclosures

Florida Department of Environmental Regulation

Twin Towers Office Bldg. ● 2600 Blair Stone Road ● Tallahassee, Florida 32399-2400

Lawton Chiles, Governor

Carol M. Browner, Secretary

December 23, 1991

Mrs. Chris Shaver, Chief
Permit Review and Technical Support Branch
National Park Service-Air Quality Division
P. O. Box 25287
Denver, Colorado 80225

Dear Mrs. Shaver:

RE: Ridge Generating Station
Polk County, PSD-FL-183

Enclosed for you review and comment is the above referenced PSD permit application. If you have any comments or questions, please contact John Reynolds or Cleve Holladay at (904)488-1344.

Sincerely,

Patricia G. Adams

Patricia G. Adams
Planner
Bureau of Air Regulation

/pa

Enclosures

WHEELABRATOR ENVIRONMENTAL SYSTEMS INC.

Liberty Lane
Hampton, NH 03842
603-929-3000

RECEIVED

DEC 20 1991

Bureau of
Air Regulation

December 19, 1991

Florida Department of Environmental Regulation
Division of Air Resources Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Attention: Mr. Barry Andrews, Administrator
Permitting and Standards Section
Bureau of Air Regulation

Re: Ridge Generating Station
Air Emission Source Construction Permit Application

Dear Mr. Andrews:

Ridge Generating Station Limited Partnership (RGSLP) is proposing to develop an independent power production facility in Polk County, Florida. The General Partners of RGSLP are Decker Energy-Ridge, Inc., and Wheelabrator Polk Inc.

The proposed facility will be designated as the Ridge Generating Station (RGS). The facility will consist of a 45-MW multi-fuel, steam driven electric power plant, with one boiler providing the total steam production. It will generate up to 40 megawatts (net) of electric power by burning a mixture of wood, tires and landfill gas. The electric power will be sold under an existing contract to Florida Power Corporation.

Enclosed are an original and six copies of an air emission source construction permit application for the project. Also enclosed is one package of computer printouts in support of the application's ambient air quality impact analysis, and a check for the permit application fee in the amount of $7,500.00.

Please direct all written correspondence regarding this project to me with a copy also sent to Mr. Macauley Whiting, Jr. Both addresses are provided on Page 2-1 of the application. We will be pleased to assist as needed in helping you complete your review of the application. If you have questions or comments on the application materials, please contact Matt Killeen, of Wheelabrator Environmental Systems Inc., at 1-800-682-0026.

Sincerely,

Richard C Stone

Richard C. Stone
Project Manager
Wheelabrator Polk Inc.

MPK101/cjb

Enclosures

- Original and 6 copies of Construction Permit Application
- Package of modeling printouts
- Application fee ($7,500.00)

cc: Macauley Whiting, Jr. - Decker Energy - Ridge, Inc.
Matthew Killeen - Wheelabrator Environmental Systems Inc.

APPLICATION FOR PERMIT TO CONSTRUCT AIR EMISSION SOURCES

(INCLUDING PREVENTION OF SIGNIFICANT DETERIORATION EVALUATION)

RIDGE GENERATING STATION
POLK COUNTY, FLORIDA

OWNER:
RIDGE GENERATING STATION LIMITED PARTNERSHIP

GENERAL PARTNERS:
DECKER ENERGY - RIDGE, INC.
AND
WHEELABRATOR POLK INC.

SUBMITTED TO:
FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION

PREPARED WITH ASSISTANCE OF
DAMES & MOORE
AND
SFT, INC.

December 1991

TABLE OF CONTENTS

TABLES

FIGURES

ABBREVIATIONS AND ACRONYMS

SUBSTANCES

Be - beryllium
CO - carbon monoxide
HCl - hydrogen chloride (hydrochloric acid)
HF - hydrogen fluoride
Hg - mercury
H_2SO_4 - sulfuric acid
NH_3 - ammonia
NO_X - nitrogen oxides
NO_2 - nitrogen dioxide
O_2 - oxygen (molecular)
PM - particulate matter (total)
PM_{10} - particulate matter (equivalent aerodynamic diameter of 10μm or less)
SO_2 - sulfur dioxide

DIMENSIONAL AND QUANTITY UNITS

acfm - actual cubic foot per minute
Btu - British thermal unit
°F - degree fahrenheit
ft - foot
g - gram
gr - grain
hr - hour
K - kelvin
km - kilometer
lb - pound
m - meter
mg - milligram
min - minute
MMBtu - million British thermal units
MW - megawatt
ppm - parts per million
ppmv - parts per million by volume
s - second
ton - short ton (2,000 lb)
yr - year
μg - microgram

ABBREVIATIONS AND ACRONYMS (Continued)

PROJECT RELATED AND OTHER TERMS

BACT	-	best available control technology
C&D	-	construction and demolition
DER	-	Florida Department of Environmental Regulation
DSI	-	dry sorbent injection
EPA	-	U.S. Environmental Protection Agency
ESP	-	electrostatic precipitator
FAAQS	-	Florida ambient air quality standards
FF	-	fabric filter
GEP	-	good engineering practice
LAER	-	lowest achievable emission rate
MCR	-	maximum continuous rating
MSW	-	municipal-type solid waste
MWC	-	municipal waste combustor
NAAQS	-	national ambient air quality standards
NSPS	-	new source performance standards
NTL	-	no-threat level
PSD	-	prevention of significant deterioration
RDF	-	refuse-derived fuel
RGS	-	Ridge Generating Station
RGSLP	-	Ridge Generating Station Limited Partnership
SCR	-	selective catalytic reduction
SDA	-	spray dryer absorber
SNCR	-	selective noncatalytic reduction
UTM	-	Universal Transverse Mercator

1.0 INTRODUCTION

Ridge Generation Station Limited Partnership (RGSLP) proposes to construct and operate a 45-MW electric power generating station in central Polk County, Florida. The proposed facility will be designated as the Ridge Generating Station (RGS) and will sell power under an existing contract with Florida Power Corporation. Facility construction is planned to begin during July 1992, and the start of operation is planned for July of 1994.

The power block portion of the RGS will include one boiler. This boiler will be capable of burning wood, tires, and landfill gas. The various fuel mixes that can be accommodated consist of wood alone, a mixture of wood and tires with tires representing up to 20 percent of the heat input to the boiler, and a mixture of wood, tires, and landfill gas. Landfill gas will be extracted from the Polk County North Central Landfill located adjacent to the RGS site.

Estimated RGS emissions are of sufficient quantity that the project is subject to prevention of significant deterioration (PSD) air quality regulations. This permit application therefore addresses all PSD requirements including compliance with best available control technology (BACT) requirements. In addition, the impacts of toxic air pollutant emissions have been assessed to determine compliance with the Florida air toxics permitting strategy.

The project is being designed to meet stringent air pollution control objectives. The principal air pollution control features consist of (1) a spray dryer absorber and fabric filter for control of acid gases, particulate matter (including metals), and organic compounds, and (2) a selective noncatalytic reduction system for control of oxides of nitrogen. Through use of efficient air pollution control equipment and appropriate operating procedures, the RGS project will comply with all applicable air quality protection requirements.

2.0 APPLICANT AND SITE INFORMATION

2.1 APPLICANT INFORMATION

The proposed project will be developed by Ridge Generating Station Limited Partnership.

The Ridge Generating Station Limited Partnership is comprised solely of subsidiaries of Decker Energy International, Inc. and Wheelabrator Environmental Systems Inc. The two General Partners are Decker Energy-Ridge, Inc. and Wheelabrator Polk Inc. The contact persons, their addresses and telephone numbers are as follows:

Contact:
Macauley Whiting, Jr. President
Decker Energy-Ridge, Inc.
400 N. New York Avenue, Suite 101
P.O. Box 2397
Winter Park, Florida 32790
(407) 628-8900

Contact:
Richard C. Stone, Project Manager
Wheelabrator Polk Inc.
Liberty Lane
Hampton, New Hampshire 03842
(803) 929-3456

2.2 SITE INFORMATION

The location of the RGS site is in Polk County as shown in Figure 2-1 and Figure 2-2. The site is approximately five miles east of Lakeland in the southeast part of Section 19, Township 28 South, Range 25 East. The site is approximately 30 acres in size. It is located about three-quarters of a mile from the nearest residence and is bounded on the north by mined-out phosphate lands and on the south by the Polk County North Central Landfill.

2.3 APPLICATION FORM

Appendix A contains a signed copy of DER Form 17-1.202(1).

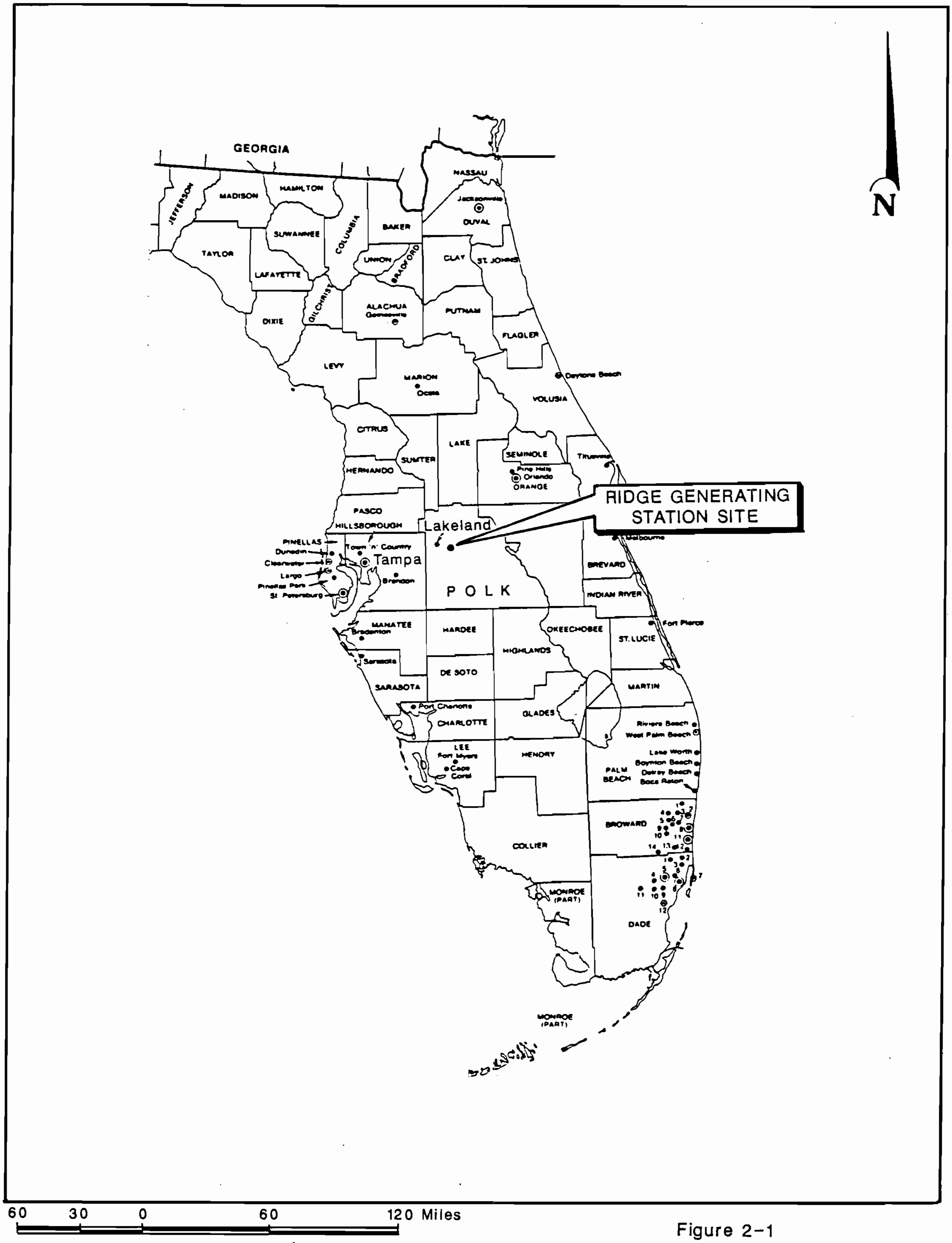
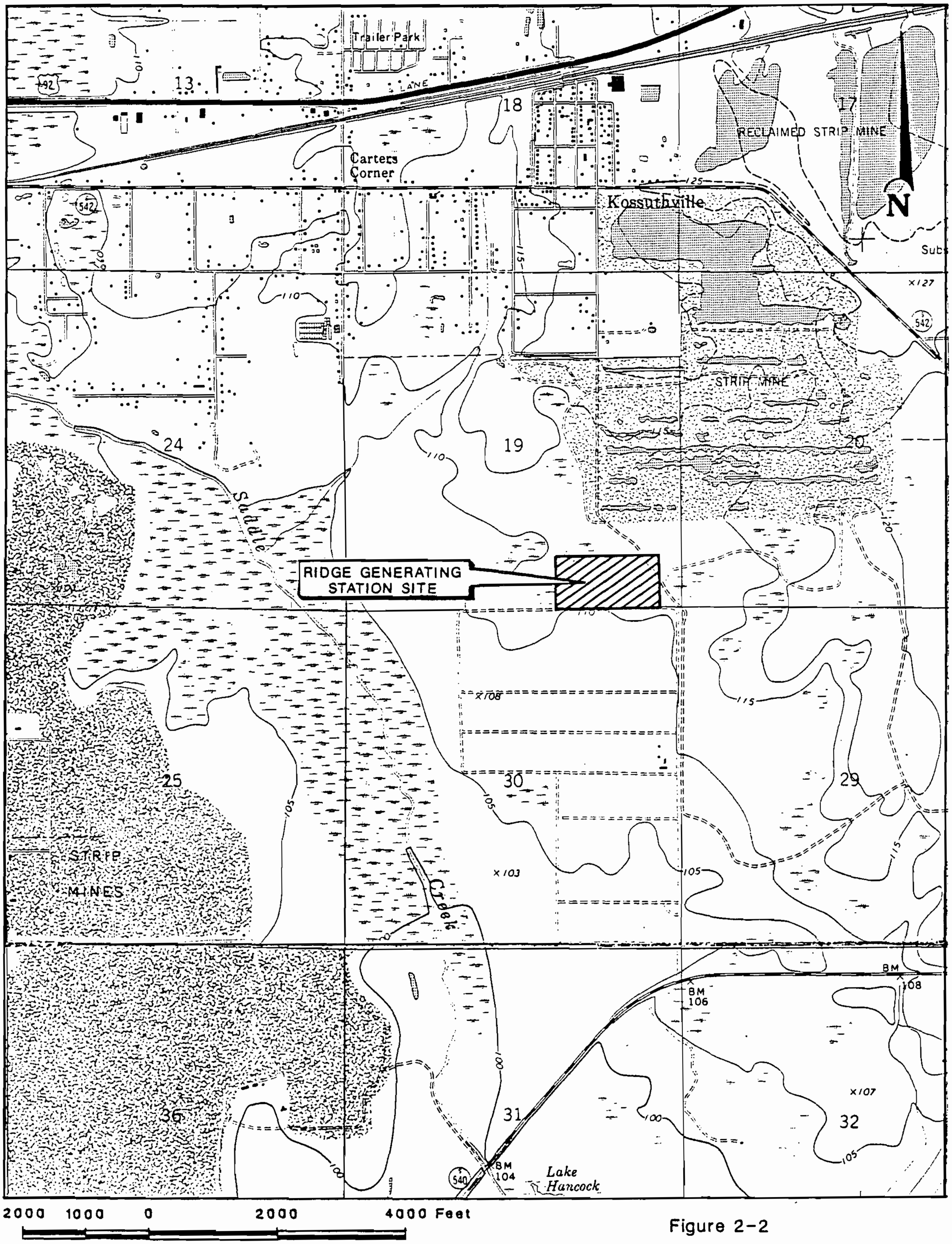


Figure 2-1

RIDGE GENERATING STATION SITE LOCATION



SOURCE: USGS 7.5' Auburndale, Fla. Quadrangle, Photorevised 1988

Figure 2-2

RIDGE GENERATING STATION SITE BOUNDARIES

3.0 PROJECT DESCRIPTION

3.1 TYPE OF PROJECT

The Ridge Generating Station consists of a 45-MW multi-fuel, steam-driven electric power plant, with one boiler providing the total steam production. The boiler will typically burn a mixture of wood, tires, and landfill gas. Figure 3-1 contains a flow diagram for station operations. A site plan is shown in Figure 3-2.

3.2 DESCRIPTION OF FUELS AND EXPECTED FUEL USE

Four different fuels will be used to fire the boiler: wood, tires, landfill gas, and propane. Wood, tires, and landfill gas will be the primary fuels used on a regular basis, whereas propane will be used for start-up, shutdown, and emergency purposes only. The wood and tires will be obtained from a variety of sources, while the landfill gas will be delivered by pipeline from the Polk County North Central Landfill located adjacent to the RGS site. Combustion of propane will not exceed a heat input of 180 MMBtu/hr.

The boiler will be designed to burn wood alone as well as a combination of wood, tires, and landfill gas. Table 3-1 provides the projected range of fuels by weight for each category. Tire usage will be limited to 20 percent of the total heat input (equivalent to approximately 10 percent on a weight basis). The average fuel combination will be a mix of approximately 75 percent wood, 15 percent tires, and 10 percent landfill gas on a heat input basis. Table 3-2 shows the typical expected fuel analysis for the individual fuel components. Each of the three fuels will exhibit a certain degree of variability in their makeup. Due to both the number of suppliers and local weather conditions, the wood components are expected to exhibit the greatest degree of variability. Therefore, although the Btu/lb value of wood is shown in Table 3-2 to be 5,450, the actual heating value may vary from 5,000 to 5,900 Btu/lb. The expected fuel analysis for the average condition fuel mix and the maximum tire use fuel mix is given in Table 3-3.

3.2.1 Wood Fuels

Wood accepted at RGS is anticipated to have a moisture content of less than 50 percent. The wood will be essentially free of dirt, concrete, steel, aluminum, and other metals. Wood fuel will be obtained from independent contractors, and will include the following materials: construction and demolition (C&D) material, forest residuals/land clearing material, industrial wood wastes, and wood chips derived from processing residential yard waste. C&D wood includes scrap wood from new construction, lumber from demolished buildings, and processed/separated wood from C&D processing facilities and transfer stations. Forest residuals/land clearing material includes commercial tree trimmings, electric/telephone transmission line clearing and maintenance material, and brush and land clearing residuals including trees, limbs, logging waste, orchard trimmings, etc. Industrial waste wood includes materials from pallet companies, sawmills, manufacturers of wood products, and may also include a small percentage of railroad ties and utility poles. Finally, wood derived from processing residential yard waste includes wood material, sized one inch and greater, separated from grass clippings, leaves, and other yard waste material that would otherwise be suitable for composting. While the plant will have wood processing equipment, it is planned that the bulk of the wood fuel will be delivered in a minus 2-inch processed form suitable as boiler-ready fuel.

Wood fuel will be obtained from sources as close to the RGS site as possible to minimize transportation costs. While most of the wood will be obtained from within a 50-mile radius of the site, it is expected that wood fuels will be delivered to the facility from an area approximately 75 miles in radius. The primary procurement area includes the following counties: Polk, Hardee, Hillsborough, Pasco, Lake, Orange, and Osceola. The secondary procurement area includes the following counties: Highlands, De Soto, Sarasota, Manatee, Pinellas, Hernando, Citrus, Sumter, Seminole, Brevard, and Volusia.

3.2.2 Scrap Tires

Scrap tires will be received at the plant from various sources. Tires accepted at the site will be essentially free of dirt, metal rims, and other foreign matter. Both whole tires and chipped tires will be accepted. The plant will have a whole tire shredder to process tires into minus 2-inch material prior to its being mixed with the processed wood fuel. RGS will co-fire tires at an expected rate of 15-20 percent of the heat input to the boiler.

3.2.3 Landfill Gas

Polk County's North Central Landfill will be required to install a landfill gas collection system by 1994 in order to comply with Florida landfill regulations. The gas is planned to be collected, dehydrated, and compressed at the County site for delivery to RGS. Based on current estimates, the landfill gas will represent 5-10 percent of the heat input to the boiler.

3.3 FUEL PROCESSING, HANDLING, AND STORAGE

Received tires will be stored in a designated tire storage area. This area will be constructed in accordance with Florida DER Chapter 17-711 Waste Tire Rule. The approximate size of the tire storage area is 2.4 acres. Tires will be processed as required using a single shredder with sizing screens. The size of the shredded tire pieces will be minus 2-inch. Tires will be conveyed to the processed wood receiving hopper and onto one of the two covered conveyors feeding the powerhouse. Given the composition of tires and the fact that tires will not be shredded to extremely small size, the generation of fugitive dust will be minimal from this process.

Two types of wood will be delivered to the site: processed (ground) and unprocessed (unground). Processed wood is expected to account for 75 percent of deliveries. Unprocessed wood is expected to be delivered in self unloading trucks. These trucks will back into individual bays and unload. The bays will have access from both ends. A front end loader will either stack the unprocessed wood in a pile or deliver it to the processing area. Processed wood will be delivered in trucks using a truck dump unloader feeding a receiving hopper. The hopper will feed either into a screw and thence to a radial unloader, or onto conveyors directly feeding the powerhouse. The unloader will drop the fuel directly into the ground wood pile.

Wood will be stored outside in two piles: processed and unprocessed. The total size of the wood storage area will be approximately 8 to 10 acres. The wood pile areas will be surfaced with crushed stone. Unprocessed wood will be transported to a wood processing area by using front end loaders.

Large size wood materials will be reduced in size in two stages. Tree trunks, utility poles, railroad ties, construction debris, etc. will be initially sized with a course hogger having a capacity of 25 ton/hr. The output from this unit will feed a trommel or other screening device. A magnetic separator will extract ferrous metal from the oversize material before it is sent to the final stage of size reduction in a hammermill-type hogger. Processed wood passing through the trommel (or screen) and discharging from the secondary hogger will be conveyed to the boiler fuel storage bin or stacked-out in the processed wood storage area. Fines from the on-site processing of wood will be collected and disposed of off site.

Mixing of solid fuels will be accomplished by direct feed of tires onto the active fuel feed conveyor. The mixed fuel will be fed into a storage bin located in front of the boiler. The storage bin will provide a minimum storage of fuel in the powerhouse, as required for fuel flow/surge control.

Landfill gas and propane will be piped directly into burners located in the boiler.

3.4 POWER PLANT EQUIPMENT

3.4.1 Boiler and Generator

The power plant will have a gross generation capability of 45 MW and a net capability of approximately 39.6 MW. It will utilize a traditional rankine cycle boiler and steam turbine-generator combination.

There will be one boiler and one steam turbine-generator. The boiler will have a steam generating capacity of 375,000 lb/hr. Steam will be generated at 1,250 psig and 950°F. The steam turbine-generator will have a nameplate rating of 45 MW. Steam for feedwater heating will be provided by three turbine extraction points. Based on the steam capacity of the steam turbine-generator and the minimal amount of auxiliary steam use, the boiler should never have to operate beyond its stated capacity.

As discussed above, propane will be used for startup, shutdown, and emergency purposes. The propane burner will have a heat input capacity of 180 MMBtu/hr.

Boiler steam will be used for sootblowing. However, only a nominal amount of steam will be used for this purpose. Sootblowing will occur on an intermittent basis, typically three times a day.

The boiler will be a conventional wood-fired boiler with membrane waterwall construction. The fuel feed will be via a spreader stoker design using either a traveling grate, a vibrating grate, or a reciprocating rate, depending upon boiler vendor selection. A spreader stoker design uses either pneumatic or mechanical fuel distributors located in the stoker front wall to distribute the fuel uniformly throughout the furnace. Fine particles of fuel entering the furnace are burned in suspension. Strategically located high pressure overfire air jets provide turbulence and thorough mixing of the fine fuel and air to assure complete combustion. The coarser, heavier particles of fuel are spread evenly on the grate forming a thin, fast-burning fuel bed.

The plant systems will be designed and operated so that optimum furnace combustion conditions will be maintained. As a result, a high combustion efficiency and low carbon monoxide emissions will be achieved. Some of the measures that will be taken to assure this are: consistent fuel sizing (low fines), proper feeder control, fuel blending, varying grate speed, proper air distribution, and air preheating.

The grate provides a platform on which the fuel can burn and the ash is conveyed away. The grate also serves as a means of introducing part of the combustion air requirements. The remainder of the combustion air is injected through overfire air ports located above the grates. In a traveling grate, the grate moves from the rear to the front where ash is discharged. Both the reciprocating and vibrating grate use intermittent grate movement or vibration to carry the fuel bed forward through the furnace and automatically discharge the ash off the forward end of the grates.

Gases from the furnace section of the boiler will pass through the superheater and steam generating section. Gases will leave the boiler and then pass through an economizer and air heater before entering the air pollution control system.

The 45-MW steam turbine-generator will be a three extraction condensing type unit equipped with a water cooled steam surface condenser. Water will be supplied to the condenser from a cooling tower. The cooling tower will be a multi-cell unit using a mechanical draft counterflow design. High efficiency drift eliminators will force three distinct changes in air direction to obtain exceptionally low drift rates. The RGS is being designed for zero discharge of waste water. Three wells on-site will provide both service and potable water.

3.4.2 Air Pollution Control System

Spray Dryer Absorber and Fabric Filter System

The air pollution control system for sulfur dioxide and particulate matter will use a spray dryer absorber (SDA) and fabric filter (FF) technology to control acid gases and particulate matter. In this system, lime is fed from a silo into a slaker to form a high solids slurry. The RGS system will incorporate redundant slakers. After being screened for grit removal, the solids slurry is stored in an agitated tank. The slurry is then pumped to the SDA where it is diluted before being introduced into an atomizer located at the inlet of the spray dryer absorber. The SDA will be equipped with multiple atomizers.

Flue gas enters the spray dryer absorber where it is brought in contact with the finely atomized lime - water slurry. Both acid gas absorption and gas cooling occur within the spray dryer absorber. Calcium hydroxide in the lime slurry reacts with sulfur dioxide and hydrogen chloride to form primarily calcium sulfite and calcium chloride. Proper residence time in the absorber allows drying of the reaction products into dry particles. Residence time is estimated to be 10 seconds. The flow of lime slurry is controlled to maintain a pre-set absorber outlet temperature. A portion of the dried particulate matter falls out in the SDA; however, the majority is carried onto the fabric filter. The expected calcium:sulfur molar ratio range is 2.5 - 3.75.

The fabric filter will be a pulse jet type using acid resistant fiberglass bags. The flue gas leaving the SDA is ducted into a parallel arrangement of fabric filter modules. Flue gas is pulled through the modules by an induced draft fan. Particulate matter is collected on the outside of the bags. The bags are periodically cleaned with a pulse of compressed air. Dust falls off the bags and into hoppers where it is evacuated by the ash handling system. The clean flue gas is drawn through the induced draft fan and discharged into the stack.

The fabric filter will be designed for adequate collection of fly ash at all boiler loads. Protection will be furnished to maintain temperatures above the dew point temperature. The maximum net air-to-cloth ratio, defined as one module out of service and all other modules operating, will not exceed 3.75 to 1. A minimum of six modules will be used. The pulse jet type bag cleaning system will be capable of cleaning a module either in service or out of service without affecting the outlet dust loading or opacity. Bag support cages will be galvanized steel wire mesh or welded wire with a minimum thickness of 16 gauge. Each module gas inlet will be above the ash hopper and will include all necessary turning vanes and distribution devices to assure even distribution of gas throughout the module and minimize reentrainment of ash into the gas stream. Inlet, outlet, and bypass dampers will be automated and will be the poppet type. The baghouse will be designed for a maximum inlet gas temperature of 500 °F.

The ash removal system will vary depending on the type of ash. Bottom ash will be removed using wet drag conveyors. The wetting of the bottom ash will minimize any fugitive dust emissions from that source. Solid waste from the sifting hoppers, economizers hoppers, SDA hoppers, and fabric filter hoppers will be removed by a combination of screw conveyors and/or drag conveyors. All ash conveyors will feed an ash silo equipped with an ash handling vent filter to minimize emissions during loading. The silo will also include an ash conditioner. The ash conditioner will moisten the waste to insure minimization of fugitive emissions. Ash will be removed from the site using trucks.

Due to the potential for the mixture of wet bottom ash, flyash, and SDA residue (with excess lime) to solidify, an alternative method of handling/storing of combined ash is also being considered. The alternative would entail the wetting (conditioning) of the dry flyash/SDA residue mixture to suppress fugitive dust before it is combined with the bottom ash from the wet drag conveyor. The combined ash would then be sent to an enclosed ash load-out area where it would be deposited in roll-on/roll-off ash containers. The enclosure would incorporate an ash handling vent filter to prevent dust migration outside of the structure. Provisions for a minimum of 90 hours of on-site storage of ash will be made with either alternative.

Nitrogen Oxides Control System

A combination of combustion controls and selective noncatalytic reduction (SNCR) will be used to control NO_X emissions from the facility. SNCR refers to add-on NO_X control techniques which reduce NO_X to N_2 without the use of catalysts. There are two commercially available systems: Exxon's "Thermal $DeNo_X$" which uses ammonia injection and the Electric Power Research Institute's "NO_XOut" (FuelTech) process which uses urea as the reagent. Since urea quickly decomposes to ammonia when heated to the appropriate temperatures, the process chemistry described below is applicable to both the ammonia and the urea SNCR systems.

Selective noncatalytic reduction uses ammonia to react with oxides of nitrogen in the combustion gas, forming nitrogen and water. Ammonia (NH_3) or urea is injected into the upper furnace area, where it reacts with NO_X. The desired reaction created by the use of SNCR occurs in the temperature range from 1,600 °F to 1,800 °F, with an optimum temperature of about 1,750 °F. The reaction is a homogeneous, gas-phase reaction; therefore, no catalyst is required. The reactions proceed in the presence of excess oxygen within a critical temperature range. The overall NO_X reduction reaction is summarized in the equation below:

$$NO + NH_3 + 0.25\,O_2 = N_2 + 1.5\,H_2O$$

The reduction of NO_X using SNCR requires a specific temperature window, residence time, and good mixing of the ammonia in the flue gas. If these conditions are achieved, the amount of ammonia injected into the flue gas will be based on the theoretical NH_3/NO_X mole ratio of 1. However, the temperature within the furnace will vary due to changes in various parameters, including the moisture and heat content of the fuel and the fuel feed rate. Irregular flow patterns in the furnace will prevent perfect mixing/distribution of the ammonia in the flue gas. At present, there are no monitoring and controlling systems with the capability for instantaneous control of a NO_X/NH_3 process. Since no method exists to continuously monitor uncontrolled NO_X within the furnace before the ammonia injection, the ammonia feed rate is established by a feedback control from a post-control NO_X monitor. Therefore, some lag time always exists between reading any higher or lower NO_X emissions and adjusting the NH_3 appropriately. Thus excess ammonia must be injected into the flue gas to ensure the desired reduction efficiency. The ammonia which does not react with NO_X will pass through the furnace. Unreacted NH_3 exiting the boiler is referred to as "ammonia slip."

The SNCR vendor helps locate the optimum furnace injection points to achieve efficient reagent mixing within the temperature window, and the facility operator makes adjustment to assure consistency of the furnace operation and/or minimize shifts in the temperature profile. This combination of careful attention to the design and operation of the system is used to maximize NO_X removal and minimize NH_3 slip.

3.5 VEHICLE TRAFFIC DURING STATION OPERATION

Wood and tires will be brought in by truck. The expected number of deliveries is approximately 70 to 130 trucks per day depending on the mix of 5-ton trucks, 8-ton trucks, and 25-ton vans. Lime for the scrubber system will be delivered by truck on an expected schedule of two trucks per week. Trucks will also be used to transport ash from the site to a landfill. Approximately four truck loads per day are expected for ash disposal, operating on a Monday through Saturday schedule. Additional vehicle traffic will include employee commuter traffic (from a total operational work force of approximately 36 employees) and miscellaneous traffic associated with supply deliveries, visitors, etc.

TABLE 3-1

RIDGE GENERATING STATION PROJECTED FUEL SUPPLY MIX

Fuel Source	Weight Percent Range
Construction and Demolition Material	40-60
Forest Residuals/Land Clearing	25-40
Wood Derived from Residential Yard Waste	15-29
Polk County North Central Landfill Gas	5-10
Industrial Waste Wood	5-10
Scrap Tires (15-20% heat input)	7-10

TABLE 3-2

RIDGE GENERATING STATION
ESTIMATED ANALYSIS FOR BOILER FUEL COMPONENTS

	Wood[a]	Tires	Landfill Gas
Percent by Weight			
Ash	7.93	6.55	
Sulfur	0.15	1.50	
Hydrogen (H_2)	3.86	6.78	6.67
Carbon	32.57	78.18	20.00
Water	29.23	1.02	
Nitrogen (N_2)	0.22	0.12	
Oxygen (0_2)	25.96	5.86	
Carbon Dioxide			73.33
Heating Value, Btu/lb	5,450	14,000	6,000

[a] These values are for the expected typical wood mix. The heating value of the wood component will vary depending on the mixtures of wood in use.

TABLE 3-3

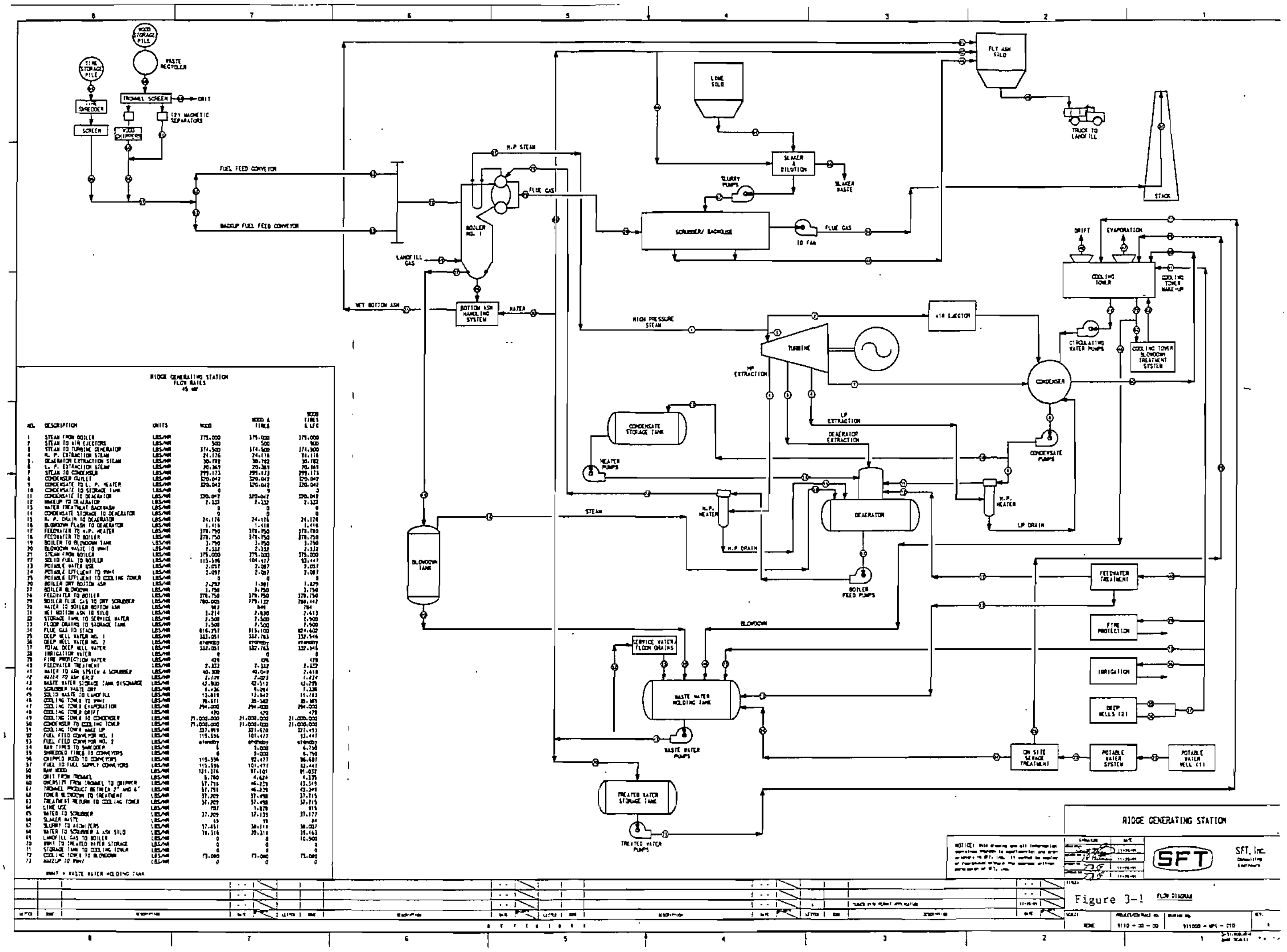
RIDGE GENERATING STATION
ESTIMATED ANALYSIS FOR BOILER FUEL MIXES

	100% Wood[a]	80% Wood 20% Tires[a]	75% Wood 15% Tires 10% Landfill Gas[a]
Percent by Weight			
Ash	7.93	7.81	7.04
Sulfur	0.15	0.27	0.22
Hydrogen (H_2)	3.86	4.12	4.33
Carbon	32.57	36.62	34.26
Water	29.23	26.73	24.45
Nitrogen (N_2)	0.22	0.21	0.19
Oxygen (O_2)	25.96	24.18	22.03
Carbon Dioxide			7.41
Heating Value, Btu/lb	5,450	6,208	6,061

[a] Percentages on a heat input basis.

Note: The heating values will vary depending on the mixtures of wood in use.

BEST AVAILABLE COPY



RIDGE GENERATING STATION
FLOW RATES
45 MW

NO.	DESCRIPTION	UNITS	WOOD	WOOD & TIRES	WOOD TIRES & LFG
1	STEAM FROM BOILER	LBS/HR	375,000	375,000	375,000
2	STEAM TO AIR EJECTORS	LBS/HR	500	500	500
3	STEAM TO TURBINE GENERATOR	LBS/HR	374,500	374,500	374,500
4	H. P. EXTRACTION STEAM	LBS/HR	24,176	24,176	24,176
5	DEAERATOR EXTRACTION STEAM	LBS/HR	30,782	30,782	30,782
6	L. P. EXTRACTION STEAM	LBS/HR	20,369	20,369	20,369
7	STEAM TO CONDENSER	LBS/HR	299,173	299,173	299,173
8	CONDENSER OUTLET	LBS/HR	320,047	320,047	320,047
9	CONDENSATE TO L. P. HEATER	LBS/HR	320,047	320,047	320,047
10	CONDENSATE TO STORAGE TANK	LBS/HR	0	0	0
11	CONDENSATE TO DEAERATOR	LBS/HR	320,047	320,047	320,047
12	MAKEUP TO DEAERATOR	LBS/HR	2,332	2,332	2,332
13	WATER TREATMENT BACKWASH	LBS/HR	0	0	0
14	CONDENSATE STORAGE TO DEAERATOR	LBS/HR	0	0	0
15	H. P. DRAIN TO DEAERATOR	LBS/HR	24,176	24,176	24,176
16	BLOWDOWN FLASH TO DEAERATOR	LBS/HR	1,418	1,418	1,418
17	FEEDWATER TO H.P. HEATER	LBS/HR	378,750	378,750	378,750
18	FEEDWATER TO BOILER	LBS/HR	378,750	378,750	378,750
19	BOILER TO BLOWDOWN TANK	LBS/HR	3,750	3,750	3,750
20	BLOWDOWN WASTE TO WHT	LBS/HR	2,332	2,332	2,332
21	STEAM FROM BOILER	LBS/HR	375,000	375,000	375,000
22	SOLID FUEL TO BOILER	LBS/HR	115,596	101,477	93,447
23	POTABLE WATER USE	LBS/HR	2,057	2,057	2,057
24	POTABLE EFFLUENT TO WHT	LBS/HR	2,057	2,057	2,057
25	POTABLE EFFLUENT TO COOLING TOWER	LBS/HR	0	0	0
26	BOILER DRY BOTTOM ASH	LBS/HR	2,297	1,981	1,879
27	BOILER BLOWDOWN	LBS/HR	3,750	3,750	3,750
28	FEEDWATER TO BOILER	LBS/HR	378,750	378,750	378,750
29	BOILER FLUE GAS TO DRY SCRUBBER	LBS/HR	780,005	779,132	780,442
30	WATER TO BOILER BOTTOM ASH	LBS/HR	917	849	794
31	WET BOTTOM ASH TO SILO	LBS/HR	3,214	2,830	2,673
32	STORAGE TANK TO SERVICE WATER	LBS/HR	2,500	2,500	2,500
33	FLOOR DRAINS TO STORAGE TANK	LBS/HR	2,500	2,500	2,500
34	FLUE GAS TO STACK	LBS/HR	816,757	815,100	824,602
35	DEEP WELL WATER NO. 1	LBS/HR	333,051	332,763	332,546
36	DEEP WELL WATER NO. 2	LBS/HR	standby	standby	standby
37	TOTAL DEEP WELL WATER	LBS/HR	333,051	332,763	332,546
38	IRRIGATION WATER	LBS/HR	0	0	0
39	FIRE PROTECTION WATER	LBS/HR	479	479	479
40	FEEDWATER TREATMENT	LBS/HR	2,332	2,332	2,332
41	WATER TO ASH SYSTEM & SCRUBBER	LBS/HR	40,300	40,049	2,618
42	WATER TO ASH SILO	LBS/HR	2,707	2,023	1,824
43	WASTE WATER STORAGE TANK DISCHARGE	LBS/HR	42,900	42,517	42,295
44	SCRUBBER WASTE DRY	LBS/HR	8,436	8,264	7,136
45	SOLID WASTE TO LANDFILL	LBS/HR	13,619	12,947	11,783
46	COOLING TOWER TO WHT	LBS/HR	38,671	38,542	38,385
47	COOLING TOWER EVAPORATION	LBS/HR	294,000	294,000	294,000
48	COOLING TOWER DRIFT	LBS/HR	479	479	479
49	COOLING TOWER TO CONDENSER	LBS/HR	21,000,000	21,000,000	21,000,000
50	CONDENSER TO COOLING TOWER	LBS/HR	21,000,000	21,000,000	21,000,000
51	COOLING TOWER MAKE UP	LBS/HR	327,919	321,470	327,455
52	FUEL FEED CONVEYOR NO. 1	LBS/HR	115,596	101,477	93,447
53	FUEL FEED CONVEYOR NO. 2	LBS/HR	standby	standby	standby
54	RAW TIRES TO SHREDDER	LBS/HR	0	9,000	6,750
55	SHREDDED TIRES TO CONVEYORS	LBS/HR	0	9,000	6,750
56	CHIPPED WOOD TO CONVEYORS	LBS/HR	115,596	92,477	86,697
57	FUEL TO FUEL SUPPLY CONVEYORS	LBS/HR	115,596	101,477	93,447
58	RAW WOOD	LBS/HR	121,376	97,101	91,032
59	GRIT FROM TROMMEL	LBS/HR	5,780	4,624	4,335
60	OVERSIZE FROM TROMMEL TO CHIPPER	LBS/HR	57,798	46,239	43,349
61	TROMMEL PRODUCT BETWEEN 2" AND 6"	LBS/HR	57,798	46,239	43,349
62	TOWER BLOWDOWN TO TREATMENT	LBS/HR	37,209	37,498	37,715
63	TREATMENT RETURN TO COOLING TOWER	LBS/HR	37,209	37,498	37,715
64	LIME USE	LBS/HR	787	1,070	915
65	WATER TO SCRUBBER	LBS/HR	37,209	37,139	37,177
66	SLAKER WASTE	LBS/HR	65	91	84
67	SLURRY TO ATOMIZERS	LBS/HR	37,451	38,111	38,027
68	WATER TO SCRUBBER & ASH SILO	LBS/HR	39,316	39,314	39,163
69	LANDFILL GAS TO BOILER	LBS/HR	0	0	10,900
70	WHT TO TREATED WATER STORAGE	LBS/HR	0	0	0
71	STORAGE TANK TO COOLING TOWER	LBS/HR	0	0	0
72	COOLING TOWER TO BLOWDOWN	LBS/HR	73,000	73,000	73,000
73	MAKEUP TO WHT	LBS/HR	0	0	0

WHT = WASTE WATER HOLDING TANK

RIDGE GENERATING STATION

SFT, Inc.
Consulting Engineers

Figure 3-1 FLOW DIAGRAM

BEST AVAILABLE COPY

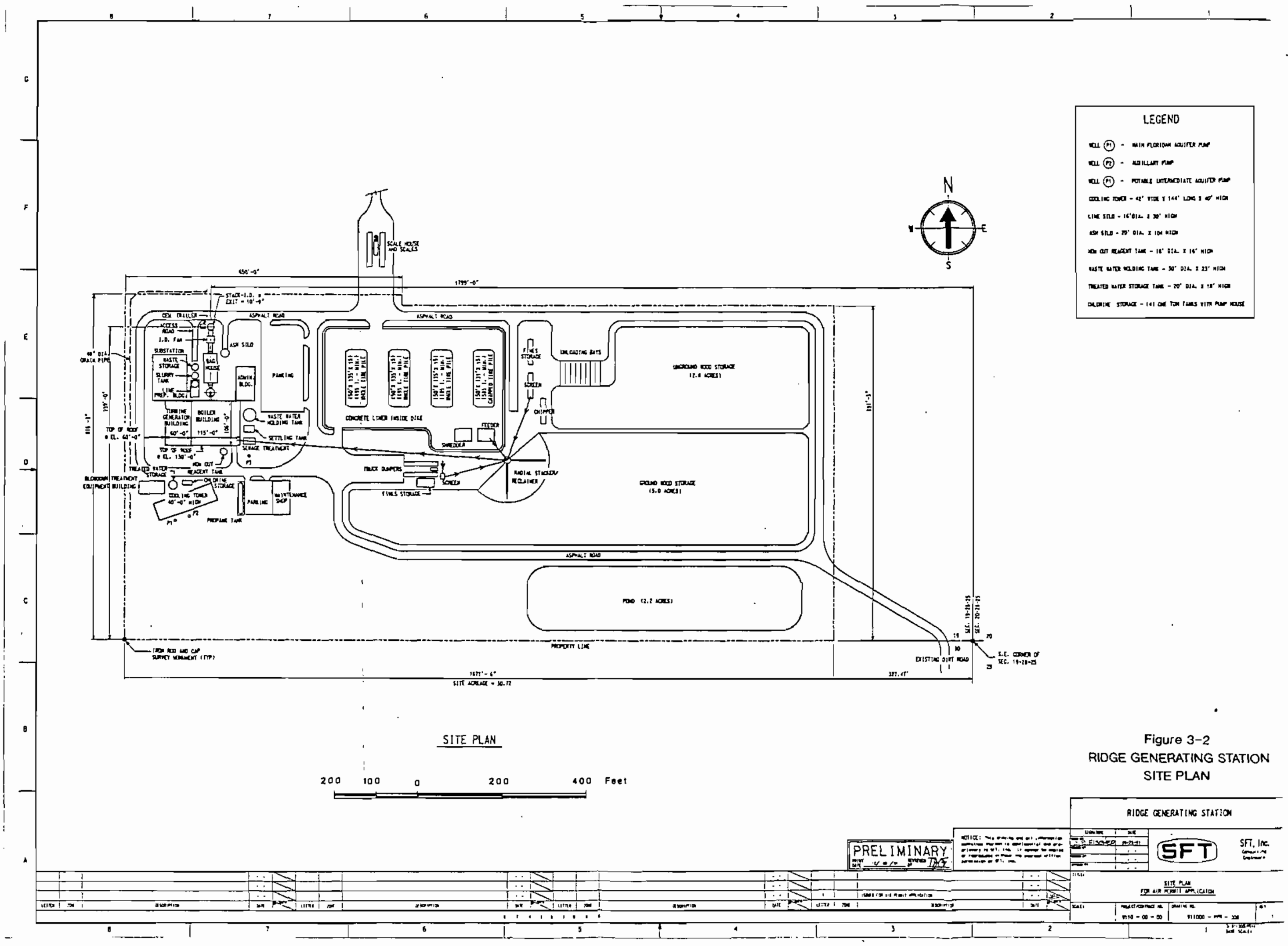


Figure 3-2
RIDGE GENERATING STATION
SITE PLAN

that burn either wood only or tires only. The information available for combination wood- and tire-fired boilers pertains primarily to facilities not equipped with spray dryer absorbers and fabric filters as proposed for RGS.

Before presenting an estimate of emissions, the following points should be noted:

- The use of a spray dryer absorber/fabric filter will result in control of toxic air pollutants as well as sulfur dioxide and particulate matter. Hydrogen chloride, for example, will be controlled effectively by this method. The SDA/FF will result in very high removal efficiencies for non-volatile metals and has been demonstrated to be effective at controlling certain organic emissions. Published toxic air pollutant emission factors (for wood burning emissions especially) do not typically reflect use of SDA/FF controls.

- Some of the toxic air pollutant emission factors cited for wood combustion are based on tests for woodstoves and residential fireplaces. These factors are not appropriate for large wood-fired boilers. Not only would emission rates for boilers be much lower (per pound of fuel burned), some of the substances emitted by woodstoves and fireplaces would not be emitted from boilers due to the much more efficient oxidizing environment of a boiler (greater temperature, combustion time, and turbulence).

- One of the EPA publications cited to identify the toxic air pollutants that might be emitted from various emission sources is "Control Technologies for Hazardous Air Pollutants" (U.S. Environmental Protection Agency, 1986). This publication contains an entry for wood combustion. However, the types of emission sources for the wood combustion category consist of furnaces, boilers, and woodstoves/fireplaces, with no comment as to whether the identified pollutants pertain to all three sources or just to one or two. As indicated above, this distinction is important because emissions from woodstoves and fireplaces may not be applicable to boilers. Therefore, although the EPA "Control Technologies" publication was consulted, other references are considered more relevant to RGS boiler emissions.

Estimated toxic air pollutant emissions from the RGS boiler are listed in Table 4-5. These emission rates have been conservatively estimated from available data and apply to emissions at maximum continuous rating. Emissions at 75 percent and 50 percent load levels would be approximately 0.75 and 0.50 times those shown for MCR. For completeness sake, Table 4-5 contains an emission rate for lead (a criteria pollutant) and for the non-criteria regulated pollutants that have a defined significant emission rate and that are also listed in Table 4-1. Emission rate calculations provided in Appendix B.

As will be shown in Section 6.0, the estimated toxic air pollutant emission rates in Table 4-5 result in compliance with the Florida no-threat levels by a wide margin.

The toxic air pollutants listed in Table 4-5 are divided into three categories: metals, non-metal inorganic compounds, and organic compounds. The specific substances selected for listing are those that are expected to be emitted in greatest quantities, or those that are often considered to be of most potential concern from a human exposure standpoint even though emitted in small quantities. The substances expected to be emitted in greatest amount are zinc in the metals category (resulting from the combustion of tires), and ammonia and hydrogen chloride in the non-metal inorganics category. Representing those substances often considered of most potential concern from an exposure standpoint (and that generally have the lowest acceptable ambient concentration levels) are the remaining metals in Table 4-5 (arsenic, beryllium, etc.), formaldehyde, and benzene. The polycyclic organic matter sometimes associated with wood combustion are expected to be effectively controlled through efficient furnace operation.

Substances that might theoretically be emitted from the combustion of any treated wood that may be included in the construction and demolition fraction of the wood fuel are expected to be negligible. The construction and demolition materials will be processed to remove non-woody contaminants prior to combustion. The wood fuel is expected to contain only a small percentage of treated wood. In addition, the boiler operating features designed to promote complete combustion will help minimize emissions of any organic treatment chemicals that may evolve from the burning of treated wood. Likewise, the highly efficient scrubber and baghouse will help minimize emissions of organic or metallic compounds present in treated wood.

4.2 ADDITIONAL PARTICULATE MATTER POINT SOURCES

Two point sources of particulate matter emissions will exist in addition to the boiler. Both sources will be minor. One source is the lime silo vent filter and the other is the ash handling vent filter. Expected lime and ash quantities are listed in Figure 3-1.

The lime silo will be operated about twice a week for approximately an hour at a time. PM emissions will be controlled through use of a bin vent filter limiting emissions to 0.02 gr/ft^3. At an expected flow rate of 1,400 ft^3/min through the filter, estimated PM emissions are 0.24 lb/hr. For an operating schedule of two hours a week, annual PM emissions would be only about 0.013 ton/yr.

Ash will be conveyed to the ash silo (or the ash load-out area in the alternate design) by mechanical or belt conveyors. The ash silo or ash load-out area will be equipped with an ash handling vent filter limiting PM emissions to 0.02 gr/ft^3. At a flow rate of 1400 ft^3/min estimated PM emissions are 0.24 lb/hr. Therefore, the annual PM emissions are expected to be approximately 1.05 ton/yr.

The total annual PM emissions from both vent filters combined are expected to be slightly more than 1 ton/yr.

4.3 OTHER EMISSION SOURCES

4.3.1 Fugitive Dust Emissions

Potential fugitive dust sources include unprocessed wood unloading, storage, chipping, and handling; processed wood unloading, storage and handling; tire unloading, storage, shredding, and handling; and vehicle movements. Factors that will act to reduce fugitive dust emissions are summarized in Section 5.0.

4.3.2 Cooling Tower

A single, multi-cell mechanical draft cooling tower will be used to supply cooling water to the condenser. Drift emissions will be minimized through use of high efficiency drift eliminators. Particulate emissions resulting from evaporation of drift droplets are expected to be minimal.

TABLE 4-1

RIDGE GENERATING STATION
BOILER OPERATING AND EMISSION CHARACTERISTICS
AT MAXIMUM CONTINUOUS RATING

	Fuel[a]		
Characteristic	100% Wood	80% Wood 20% Tires	75% Wood 15% Tires 10% Landfill Gas
• Operating Data			
Heat Input, MMBtu/hr	630	630	630
Steam Generated, lb/hr	375,000	375,000	375,000
Wood Burned, lb/hr	115,596	92,477	86,697
Tires Burned, lb/hr	0	9,000	6,750
Landfill Gas Burned, lb/hr	0	0	10,500
Total Fuel Burned, lb/hr	115,596	101,477	103,947
• Stack Data			
Stack Height, ft	325	325	325
Stack Diameter, ft	10	10	10
Flue Gas Temperature, °F	170	170	170
Flue Gas Volume, ft^3/min (actual)	226,556	224,693	227,553
Flue Gas Velocity, ft/s (actual)	48.1	47.7	48.3
• Pollutant[b] Emission Rate, lb/hr			
Particulate Matter (PM and PM_{10})	12.6	12.6	12.6
Sulfur Dioxide	69.4	109.4	92.5
Nitrogen Oxides (as NO_2)	94.5	94.5	94.5
Carbon Monoxide	315.0	315.0	315.0
Volatile Organic Compounds	22.1	22.1	22.1
Lead[c]	0.25	0.25	0.25
Beryllium[c]	0.0063	0.0063	0.0063
Mercury[c]	0.022	0.022	0.022
Fluorides	Negligible	Negligible	Negligible
Asbestos	Negligible	Negligible	Negligible
Vinyl Chloride	Negligible	Negligible	Negligible
Sulfuric Acid Mist	Negligible	Negligible	Negligible
Hydrogen Sulfide	Negligible	Negligible	Negligible
Total Reduced Sulfur	Negligible	Negligible	Negligible
Reduced Sulfur Compounds	Negligible	Negligible	Negligible

[a] Fuel percentages on a heat input basis.

[b] Pollutants with a defined significant emission rate in PSD regulations.

[c] The highest estimated emission rate for any fuel mix is shown in each column.

TABLE 4-2

RIDGE GENERATING STATION BOILER OPERATING AND EMISSION CHARACTERISTICS AT 75 PERCENT LOAD

	Fuel[a]		
Characteristic	100% Wood	80% Wood 20% Tires	75% Wood 15% Tires 10% Landfill Gas
• Operating Data			
Heat Input, MMBtu/hr	473	473	473
Steam Generated, lb/hr	281,250	281,250	281,250
Wood Burned, lb/hr	86,697	69,358	65,023
Tires Burned, lb/hr	0	6,750	5,063
Landfill Gas Burned, lb/hr	0	0	7,875
Total Fuel Burned, lb/hr	86,697	76,108	77,960
• Stack Data			
Stack Height, ft	325	325	325
Stack Diameter, ft	10	10	10
Flue Gas Temperature, °F	170	170	170
Flue Gas Volume, ft^3/min (actual)	169,917	168,520	170,665
Flue Gas Velocity, ft/s (actual)	36.1	35.8	36.2
• Pollutant[b] Emission Rate, lb/hr			
Particulate Matter (PM and PM$_{10}$)	9.5	9.5	9.5
Sulfur Dioxide	52.0	82.0	69.3
Nitrogen Oxides (as NO$_2$)	70.9	70.9	70.9
Carbon Monoxide	236.5	236.5	236.5
Volatile Organic Compounds	16.5	16.5	16.5
Lead[c]	0.19	0.19	0.19
Beryllium[c]	0.0047	0.0047	0.0047
Mercury[c]	0.017	0.017	0.017
Fluorides	Negligible	Negligible	Negligible
Asbestos	Negligible	Negligible	Negligible
Vinyl Chloride	Negligible	Negligible	Negligible
Sulfuric Acid Mist	Negligible	Negligible	Negligible
Hydrogen Sulfide	Negligible	Negligible	Negligible
Total Reduced Sulfur	Negligible	Negligible	Negligible
Reduced Sulfur Compounds	Negligible		Negligible

[a] Fuel percentages on a heat input basis.

[b] Pollutants with a defined significant emission rate in PSD regulations.

[c] The highest estimated emission rate for any fuel mix is shown in each column.

TABLE 4-3

RIDGE GENERATING STATION BOILER OPERATING AND EMISSION CHARACTERISTICS AT 50 PERCENT LOAD

	Fuel[a]		
Characteristic	100% Wood	80% Wood 20% Tires	75% Wood 15% Tires 10% Landfill Gas
• Operating Data			
Heat Input, MMBtu/hr	315	315	315
Steam Generated, lb/hr	187,500	187,500	187,500
Wood Burned, lb/hr	57,798	46,239	43,349
Tires Burned, lb/hr	0	4,500	3,375
Landfill Gas Burned, lb/hr	0	0	5,250
Total Fuel Burned, lb/hr	57,798	50,739	51,974
• Stack Data			
Stack Height, ft	325	325	325
Stack Diameter, ft	10	10	10
Flue Gas Temperature, °F	170	170	170
Flue Gas Volume, ft/^{3} (actual)	120,471	119,715	121,142
Flue Gas Velocity, ft/^{3} (actual)	25.6	25.4	25.7
• Pollutant[b] Emission Rate, lb/hr			
Particulate Matter (PM and PM_{10})	6.3	6.3	6.3
Sulfur Dioxide	34.7	54.7	46.2
Nitrogen Oxides (as NO_2)	47.3	47.3	47.3
Carbon Monoxide	157.5	157.5	157.5
Volatile Organic Compounds	11.0	11.0	11.0
Lead[c]	0.13	0.13	0.13
Beryllium[c]	0.0032	0.0032	0.0032
Mercury[c]	0.011	0.011	0.011
Fluorides	Negligible	Negligible	Negligible
Asbestos	Negligible	Negligible	Negligible
Vinyl Chloride	Negligible	Negligible	Negligible
Sulfuric Acid Mist	Negligible	Negligible	Negligible
Hydrogen Sulfide	Negligible	Negligible	Negligible
Total Reduced Sulfur	Negligible	Negligible	Negligible
Reduced Sulfur Compounds	Negligible	Negligible	Negligible

[a] Fuel percentages on a heat input basis.

[b] Pollutants with a defined significant emission rate in PSD regulations.

[c] The highest estimated emission rate for any fuel mix is shown in each column.

TABLE 4-4

RIDGE GENERATING STATION
ESTIMATED BOILER EMISSION RATES COMPARED TO PSD SIGNIFICANT EMISSION LEVELS

Pollutant	Estimated Emissions Assuming Continuous Operation at Maximum Continuous Rating (ton/yr)			PSD Significant Emission Level (ton/yr)
	100% Wood[a]	80% Wood 20% Tires[a]	75 % Wood 15% Tires 10% Landfill Gas[a]	
Particulate Matter (PM/PM_{10})	55.2	55.2	55.2	25 (PM) 15 (PM_{10})
Sulfur Dioxide	304.0	479.2	405.2	40
Nitrogen Oxides	413.9	413.9	413.9	40
Carbon Monoxide	1,379.7	1,379.7	1,379.7	100
Volatile Organic Compounds	96.8	96.8	96.8	40
Lead[b]	1.1	1.1	1.1	0.6
Beryllium[b]	0.03	0.03	0.03	0.0004
Mercury[b]	0.096	0.096	0.096	0.1
Fluorides	Negligible	Negligible	Negligible	3
Asbestos	Negligible	Negligible	Negligible	0.007
Vinyl Chloride	Negligible	Negligible	Negligible	1
Sulfuric Acid Mist	Negligible	Negligible	Negligible	7
Hydrogen Sulfide	Negligible	Negligible	Negligible	10
Total Reduced Sulfur	Negligible	Negligible	Negligible	10
Reduced Sulfur Compounds	Negligible	Negligible	Negligible	10

[a] Percentages on a heat input basis.

[b] The highest estimated emission rate for any fuel mix is shown in each column.

TABLE 4-5

RIDGE GENERATING STATION ESTIMATED TOXIC AIR POLLUTANT EMISSIONS AT MAXIMUM CONTINUOUS RATING

Pollutant	Highest Emissions (lb/hr) for Any Fuel Mix
• Metals	
arsenic	0.019
beryllium	0.0063
cadmium	0.033
chromium VI	0.016
lead	0.25
mercury	0.022
nickel	0.063
zinc	0.63
• Non-Metal Inorganics	
ammonia	17.8
hydrogen chloride	3.2
• Organics	
benzene	5.0
formaldehyde	1.7

5.0 EMISSION CONTROLS AND COMPLIANCE WITH EMISSION STANDARDS

5.1 BEST AVAILABLE CONTROL TECHNOLOGY FOR BOILER

5.1.1 Introduction

The regulated pollutants subject to PSD review as a result of boiler emissions are particulate matter, sulfur dioxide, nitrogen oxides, carbon monoxide, volatile organic compounds, lead, and beryllium. These pollutants are assessed in the following best available control technology (BACT) evaluation.

BACT evaluations must be performed following EPA's "top-down" BACT approach. The top-down approach first entails identifying the technically feasible alternatives applicable to a given type of emission source. The most stringent of the technically feasible alternatives is then evaluated in terms of economic, energy, and environmental factors. If the "top" alternative is justifiable on the basis of these factors, it is selected as the BACT alternative and less stringent alternatives need not be considered. If the top alternative is shown to be not justified, the next most stringent alternative is evaluated. This process continues until a justifiable alternative remains. This then becomes the proposed BACT alternative. It should also be noted that the term "alternatives" can refer not only to different types of control methods, but also to different emission rates potentially achievable by the same method.

Another aspect of BACT evaluations is consideration of "unregulated" pollutants. EPA's North County remand decision requires that the environmental impact of pollutants not subject to PSD review be taken into account when evaluating the BACT emission control alternatives for PSD-regulated pollutants. Examples of non-PSD pollutants applicable to the RGS boiler BACT evaluation include metals (other than Pb and Be), hydrogen chloride, and specific organic compounds.

Information sources considered for the BACT evaluation consist of the following:

- The EPA BACT/LAER Information System, BACT/LAER Clearinghouse.
- Federal, state, and local air quality permits.
- Federal, state, and local agency representatives identified as contacts for similar sources.
- Control equipment vendors.
- Other sources such as trade journals and publications.

Table 5-1 was developed from these sources and contains a summary of wood-fired boilers similar in size to the RGS boiler. Three other facilities have been identified as permitted to burn tires as the sole fuel. Information on these facilities is presented in Table 5-2. A number of additional facilities have been identified as burning wood and tires. These facilities are generally hog fuel boilers located at pulp and paper mills. Included among these facilities are the following:

- Fort Howard Paper, Green Bay, Wisconsin
- Great Southern Paper, Cedar Springs, Georgia
- Inland-Rome Paper, Rome, Georgia
- Nekoosa Paper, Tomahawk, Wisconsin
- Willamette Industries, Albany, Oregon
- Jefferson Smurfit Paper, Newberg, Oregon
- Champion International, Bucksport, Maine
- Port Townsend Paper, Port Townsend, Washington

In each of these cases tire-firing was added to an existing boiler with little or no change made to air pollution control equipment.

The search for emission source information did not disclose any facilities that were originally permitted, designed, and built to burn a mixture of wood and tires. A wood/tire facility in Michigan was identified which is currently in the permitting process.

The pollutants assessed in the BACT evaluation can be grouped into three categories: combustion products not including acid gases, acid gases, and products of incomplete combustion. The RGS boiler emissions subject to BACT evaluation within these three categories are as follows:

- Combustion products not including acid gases: PM/PM_{10}, Pb, Be
- Acid gases: SO_2, NO_x
- Products of incomplete combustion: CO, VOC's

PM and metals (the non-acid combustion products) are most often controlled by flue gas particulate collection devices. NO_x is most often controlled in newer wood- or tire-fired boilers by using a selective noncatalytic reduction system. Due to the low sulfur content of wood, SO_2 emissions are generally uncontrolled from wood-fired boilers. SO_2 emissions from tire-fired boilers are typically controlled using a scrubber. CO and VOC's (the products of incomplete combustion) are most often controlled by operating practices that promote complete combustion.

The facilities listed in Table 5-1 include fluid bed combustors as well as conventional boilers. Because of the considerable design and operating differences between fluid bed combustors and non-fluid bed boilers, the information for fluid bed combustors is not considered applicable to the RGS project. The reason for not selecting a fluid bed combustor for the RGS project is that this technology has not been demonstrated for tire combustion, and it is anticipated that operational problems would occur if one were used.

5.1.2 Particulate Matter

Technically Feasible Control Technologies -- PM

The generally recognized techniques for particulate matter control are fabric filters, electrostatic precipitators (ESP's), venturi scrubbers, and cyclone-type mechanical collectors.

Ranking of Control Technology Alternatives -- PM

A review of the various information sources previously listed indicated that wood-fired boilers are equipped almost exclusively with ESP's, mechanical collectors, and venturi scrubbers. Baghouses have historically been avoided on wood-fired units due to the potential fire hazard they present. However, at RGS the proposed emissions control system includes installation of a spray dryer absorber prior to the particulate control device. This design arrangement mitigates the potential for carryover of "sparklers," thereby greatly decreasing the chance of a fire occurring in the particulate control device. When particulate control equipment is located downstream of a spray dryer absorber, a fabric filter is recognized as the "top" control technology. Fabric filtration is proposed for the RGS facility. Therefore, no other control alternatives need be considered. In addition, collection efficiency is enhanced when a fabric filter is used in conjunction with an SDA due to agglomeration of finer particles into larger ones. A fabric filter is not as sensitive as other particulate control devices, such as an ESP, to changes in gas volume, composition, inlet concentration, and temperature. Fabric filters will accept surges in gas flow and particulate concentration with no significant increase in particulate emissions. Fluctuations in fly ash resistivity, which affects particulate removal with an ESP, is not a problem with a fabric filter.

A fabric filter also serves as BACT for PM_{10}. Fabric filters are capable of achieving the highest PM_{10} removal efficiency of the applicable control devices.

Ranking of Emission Rate Alternatives -- PM

The minimum level of control that must be achieved by a given emission source is the level that complies with applicable emission standards. As discussed in Section 5.3, the emission standard considered applicable to the RGS project requires a PM emission rate not to exceed 0.10 lb/MMBtu heat input. However, newer wood and tire burning facilities have been permitted at lower levels. The three tire burners listed in Table 5-2 all use scrubber/baghouse combinations and have maximum allowable particulate limits in the range of 0.02 - 0.03 lb/MMBtu. The one wood-fired boiler permitted with a baghouse is limited to 0.03 lb/MMBtu. The most recently permitted wood-fired unit identified is a unit at the Beaver-Livermore facility. This facility was permitted September 5, 1991, with a particulate limit of 0.02 lb/MMBtu. It is the fourth unit listed in Table 5-1.

Non-PSD Pollutant Considerations -- PM

Use of fabric filtration for control of PM emissions will achieve control of any pollutants appearing in particulate form. This would include various heavy metals such as zinc emissions from tire combustion. The major advantage of fabric filter systems over ESP systems is their improved control efficiency for particulate in the submicron particle size range. Since small particles have a greater relative surface area than larger ones, it is believed that trace metals and noncondensible organics tend to accumulate on the smaller particulate matter. Hence, the fabric filter's greater capability for removing particulate matter also enhances its ability to remove trace metals and noncondensible organics.

As noted above, the FF's ability to remove submicron particles enhances its capability to remove trace metals and condensible organics. The actual formation mechanisms of particles containing trace metal constituents are not completely understood. It is theorized that the removal mechanisms are condensation and/or absorption coupled with collection in the particulate control device. The temperature of the flue gas and efficiency of particle collection (especially in the submicron size range) are, therefore, the two most important factors affecting trace metal emissions removal in the flue control system. Most of the metal compounds potentially emitted by the facility have condensation points well above 300°C and are typically removed by the particulate removal device with a high efficiency.

Non-volatile trace metal emissions represent a concentration of the metal in the PM exiting the facility. The removal of trace metal PM emissions, which would include arsenic, beryllium, cadmium, chromium (total and hexavalent), lead, nickel, zinc, and to a lesser degree mercury, is accomplished by the fabric filter, but it is assisted by the action of the SDA. Reducing the flue gas temperature in the SDA aids in condensation and the agglomeration of particles for easier collection in the FF. The high uniform collection efficiency of the FF across all particle size ranges also contributes to trace metal PM emission control. Therefore, RGS will be applying the most efficient control system to control trace metals.

Selected BACT -- PM

An emission rate of 0.02 lb/MMBtu using fabric filtration is proposed as BACT. This selection represents the "top" control alternative. Furthermore, based on modeling results, an emission rate of 0.02 lb/MMBtu will result in an insignificant particulate matter ambient impact.

5.1.3 Sulfur Dioxide

The SO_2 control method generally acceptable for wood-fired units is fuel selection because of the inherently low sulfur content of most wood fuels. SO_2 control for facilities using tires as the primary fuel is generally achieved using a scrubber/fabric filter combination. Post-combustion methods for SO_2 control include spray dryer absorbers, wet scrubbers, and dry sorbent injection (DSI) with either a fabric filter or ESP.

Ranking of Control Technology Alternatives -- SO_2

The SO_2 BACT control hierarchy would Rank SDA and wet scrubbers as the "top" level of control. Either an SDA or a wet scrubber is capable of achieving 80 percent SO_2 removal and 95 percent HCL removal reliably on a long-term basis. DSI Systems cannot achieve equally stringent control requirements on a continuous, long-term basis. Therefore, DSI would not be considered BACT.

The energy and economic impacts of an SDA and a wet scrubber are not equal. A wet scrubber has a larger pressure drop requiring more energy, and the capital costs for wastewater treatment add significantly to the economics. In addition, from an environmental perspective, wet scrubbers have significant disadvantages compared to the proposed SDA system. Wet scrubber systems use large quantities of water, produce wet sludge which must be stabilized before disposal (requiring large predisposal storage capacity), require high maintenance due to scaling and corrosion of equipment in the system, and require costly reheat for equipment protection and adequate plume dispersion. For these reasons, when fuel sulfur content requires the use of a flue gas desulfurization system, the SDA/FF SO_2 removal method is most often selected for non-fluid bed boilers burning fuels other than fossil fuels. This method represents the "top" SO_2 control technology. No other control technology has been demonstrated to achieve greater control of acid gas emissions in the United States. Since an SDA/FF system is proposed for the RGS facility, no other control technology alternatives need be considered in the BACT evaluation.

Ranking of Emission Rate Alternatives -- SO_2

The specific SO_2 emission rates resulting from application of a given control technology will depend of fuel sulfur content as well as on the removal efficiency of the control device. Fuel sulfur content variability is compounded in the case of the RGS facility since the facility will be designed to burn wood, tires, and landfill gas at different percentages. Because of fuel and sulfur content variability, it is not appropriate to compare SO_2 emissions from the RGS facility to units that burn only wood or only tires. For example, the SO_2 emission limits shown in Table 5-1 for wood-fired boilers tend to be low due in large part to the low sulfur content of most wood fuels. A mix of wood fuels will be combusted at RGS. Some of these fuels, such as the wood fuel derived from C&D materials, are expected to have higher sulfur contents. The SDA/FF design being developed for RGS will achieve a removal efficiency of approximately 80 percent. Based on the expected range of fuel sulfur content, this control efficiency will result in SO_2 emissions of 0.17 lb/MMBtu or less on a 24-hour block average basis.

Non-PSD Pollutant Considerations -- SO_2

Use of an SDA/FF system for SO_2 will also result in control of acid gases such as HCl. As previously discussed, the SDA/FF system provides the combination of factors that are most favorable for trace metal emissions removal. As the spray droplets in the lime slurry evaporate and the flue gas is cooled, the metals condense and impact or absorb onto the smaller particles in the gas stream. The greater submicron removal efficiency of the FF results in higher overall metal removal efficiencies for the SDA-based system. Removal efficiencies for heavy metals in the SDA/fabric filter system will exceed 99 percent. The SDA in conjunction with the fabric filter will also remove a smaller percentage of volatile trace metals, such as mercury which may occur in very low concentrations in the RGS fuel mix. Removal efficiency for mercury is expected to be approximately 50 percent. This removal is accomplished through a variety of mechanisms, which include vapor condensation in the SDA and adsorption/absorption in the fabric filter. In addition, control of some organic compounds is accomplished in SDA/FF systems. For example, while dioxin emissions attributable to this type of facility are negligible, SDA/FF systems have been demonstrated to reduce dioxin emissions by approximately 90 percent.

Selected BACT Alternative -- SO_2

The control approach selected as BACT for SO_2 is use of a dry scrubber/fabric filtration system limiting SO_2 emissions to 0.17 lb/MMBtu on a 24-hour block average basis. Based on modeling results, an emission rate of 0.17 lb/MMBtu will result in an insignificant ambient impact.

5.1.4. Nitrogen Oxides

Technically Feasible Alternatives -- NO_X

The technically feasible control alternatives consist of combustor design, add-on controls, or a combination of the two. The candidate add-on control methods for large combustion sources in general are selective noncatalytic reduction (SNCR) and selective catalytic reduction (SCR). While SCR has been demonstrated to be effective on a developmental basis on oil-, gas- and coal-fired boilers and has been commercially applied to several gas-fired combustion processes in the United States, SCR has not been commercially proven at wood-fired or tire-fired boiler facilities. Based on the information sources previously cited, SCR technology has not been used at existing or proposed wood- and/or tire-fired boilers. SCR technology for wood- and/or tire-fired combustion is therefore not considered a sufficiently proven method to be considered as a technically feasible alternative for the RGS project.

Ranking of Control Technology Alternatives -- NO_X

Use of SNCR can achieve a greater NO_X control efficiency than combustor design alone. A combination of SNCR and combustor design should theoretically be able to achieve greater control than either method individually. This combination approach, which represents the "top" control method, is proposed for the RGS facility. Therefore, no other control method need be considered in the BACT evaluation. Features of the furnace designed for installation at the RGS facility that will help minimize NO_X emissions include an enlarged furnace volume and installation of an overfire air system.

Ranking of Emission Rate Alternatives -- NO_X

NO_X formation is influenced by both the amount of nitrogen in the fuel and the combustion technology applied. The expected average fuel mix on a heat input basis is 75 percent wood, 15 percent tires, and 10 percent landfill gas. On a weight basis, this equates to 83 percent wood, 7 percent tires, and 10 percent landfill gas. Given these percentages, the combustion process and, hence, NO_X formation will be dominated by wood firing. Therefore, NO_X emissions from the RGS facility should be evaluated based on units burning 100 percent wood.

The list in Table 5-1 contains three fluid bed units. As pointed out previously, however, fluid bed combustors are not appropriate for comparison to conventional boilers. The non-fluid bed boilers in Table 5-1 show a NO_X range of 0.11 - 1.19 lb/MMBtu. The RGS facility is designed based on stoker firing. Therefore, the most appropriate BACT reference is to stoker-fired units using SNCR.

Nine units are listed in Table 5-1 that use SNCR and are not fluid bed units. Two of these units have a NO_X limit of 0.11 lb/MMBtu. Five have a limit of 0.15 lb/MMBtu. One has a limit of 0.21 lb/MMBtu, and one has a limit of 246.6 ton/yr. A mix of wood fuels will be combusted at RGS. Some of these fuels, such as the wood fuel derived from yard waste, are expected to have a higher nitrogen content than others. Using this higher nitrogen fuel will increase NO_X emissions. Therefore, based on the fuel mix, it is anticipated that an SNCR system at RGS will result in NO_X emissions in the upper range of the nine units identified in Table 5-1 as using SNCR on a non-fluid bed boiler.

Non-PSD Pollutant Considerations -- NO_X

As discussed in Section 3.4.2, the two types of SNCR systems, ammonia injection and urea injection, will result in ammonia emissions. These emissions, referred to as ammonia slip, occur when the injected reagent does not react completely with NO_X. Ammonia emissions are minimized by careful design and operation, but they are an unavoidable byproduct of achieving better control of NOX emissions. As will be discussed in Section 6.0, modeling of the ammonia emissions estimated for the RGS boiler indicates that the ambient concentrations resulting from ammonia slip will be less than the no threat levels defined by DER.

Selected BACT Alternative -- NO_X

The alternative selected as BACT for RGS NO_X emissions is use of SNCR and combustion design to achieve a NO_X emission rate of 0.15 lb/MMBtu on a 24-hour block average basis. This alternative is consistent with the most recent BACT determination made for a wood-fired unit (Beaver-Livermore) and is commensurate with fuel nitrogen content levels expected over the anticipated fuel mix. Based on modeling results, an emission rate of 0.15 lb/MMBtu will result in an insignificant ambient impact.

5.1.5 Carbon Monoxide

Technically Feasible Alternatives -- CO

In fuel burning equipment, CO emissions result from incomplete combustion. Procedures accepted as BACT for CO control consist of techniques to enhance combustion efficiency. As far as is known, no boiler owners have installed or proposed installation of add-on control systems for CO.

Ranking of Control Technology Alternatives -- CO

The approach proposed as BACT for CO emissions from the RGS facility is use of good combustion practices. This approach is consistent with the control methods accepted as BACT for other wood- and/or tire-fired boilers as indicated by a review of the BACT/LAER Clearinghouse entries, and is the "top" control method. Therefore, no other control technology need be considered.

Ranking of Emission Rate Alternatives -- CO

Combustion practices that minimize CO will generally increase NO_X production. Therefore, selection of a CO emission rate has to be made in conjunction with the NO_X emission limit selection. The five units in Table 5-1 which have a NO_X limit of 0.15 lb/MMBtu have CO limits of 0.3 to 0.4 lb/MMBtu. Another consideration in selecting a CO emission rate is the effect of tire burning on CO emissions. Boiler vendors have indicated that CO emissions will increase when tires are co-fired with wood. In addition, a recent study on emissions from tire burning facilities was published by Malcolm Pirnie, Inc., entitled "Air Emissions Associated With the Combustion of Scrap Tires for Energy Recovery." This report includes CO emissions data on five boilers. The results, summarized in Table 5-3, show that adding tires to the base fuel increased CO emissions in four of five facilities. These increases ranged from 35 to 88 percent. Based on these data, burning tires with wood at RGS is expected to increase CO emissions as compared to burning wood alone.

An emission limit of 0.5 lb/MMBtu (24-hour block average) has been selected as BACT. This limit is based upon a review of actual CO emissions data at several operating wood-fired boilers, and giving consideration to the mix of wood fuels anticipated to be fired, as well as the information which indicates that CO emissions will increase when tires are co-fired with wood in the boiler.

Non-PSD Pollutant Considerations -- CO

The good combustion practices employed to reduce CO emissions will also help reduce emissions of organic compounds.

Selected BACT Alternative -- CO

The alternative selected as BACT for CO emissions is good combustion practices. The furnace will be designed to provide conditions conducive to good combustion. The methods that will be used to ensure high combustion efficiency and minimize CO and VOC emissions from the combustion process include:

- High combustion temperatures
- Sufficiently long residence times
- Good fuel mixing and fuel bed management
- Controlled distribution of combustion air
- High combustion gas turbulence.

These methods will achieve an emission limit of 0.5 lb/MMBtu on a 24-hour block average basis, excluding periods of start-up and shut down. The proposed CO limit is slightly higher than the limits established for recently permitted wood-fired facilities with a NO_X limit of 0.15 lb/MMBtu. This high end value is warranted due to the proposed fuel mix at this facility.. Based on modeling results, an emission rate of 0.5 lb/MMBtu will result in an insignificant ambient impact.

5.1.6 Volatile Organic Compounds (VOC's) -- VOC's

Technically Feasible Alternatives -- VOC's

Control technologies for VOC emissions from industrial processes include incineration, carbon adsorption, absorption, and condensation. However, due to their low concentrations in a high volume of flue gas, wood-fired boiler VOC emissions are such that carbon adsorption, absorption, and condensation would be ineffective add-on control technologies. These control methods are therefore considered not technically feasible for the project. Thermal incineration of VOC's is the most appropriate technology, and is accomplished in a boiler furnace by a combination of residence time, temperature, and mixing velocities. Maintaining good combustion practices to assure proper residence time, temperature, and turbulence is the only feasible control technology applicable to the RGS project.

Ranking of Control Technology Alternatives -- VOC's

Proper combustion practices is the top VOC control technology for boilers. The same methods used to ensure high combustion efficiency and reduce CO emissions are also used to minimize VOC emissions. Since good combustion practices are being proposed for RGS facility, no other control technology alternatives need to be considered in the BACT analysis.

Ranking of Emission Rate Alternatives -- VOC's

For non-fluid bed boilers, Table 5-1 shows a range of permitted VOC emission limits from 0.016 - 0.126 lb/MMBtu. A VOC emission limit is available for only one of the tire-fired units in Table 5-2. This limit is listed as 0.032 lb/MMBtu.

Non-PSD Pollutant Considerations -- VOC's

Control of VOC emissions as a general class of organics will of course also control the specific organic compounds that make up this class.

Selected BACT Alternatives -- VOC's

The alternative selected as BACT for VOC emissions from the RGS project is good combustion practices with an emission limit of 0.035 lb/MMBtu. This emission limit is in the lower end of the range shown for other wood-fired units and is similar to the one tire-fired plant having a VOC limit.

5.1.7 Lead

As discussed above, the BACT selected for particulate matter (fabric filtration) is also applicable to metals such as lead which remain primarily in particulate form following combustion. The proposed maximum Pb emission rate is .0004 lb/MMBtu.

5.1.8 Beryllium

As discussed above, the BACT selected for particulate matter (fabric filtration) is also applicable to metals such as beryllium which remain primarily in particulate form following combustion. The proposed maximum Be emission rate is 0.00001 lb/MMBtu.

5.1.9 BACT Summary

Table 5-4 presents a summary of the control technologies and emission rates proposed as BACT for PM, SO_2, NO_X, CO, VOC's, Pb, and Be.

5.2 OTHER EMISSION CONTROL CONSIDERATIONS

5.2.1. Toxic Air Pollutants from Fuel Combustion

As previously indicated, the control methods proposed for the regulated pollutants emitted in significant amounts will also serve to reduce emissions of many toxic air pollutants. On the other hand, emissions of one toxic air pollutant (ammonia) are an unavoidable byproduct of the proposed control method for NO_X. The following summary addresses toxic air pollutant emissions from the RGS boiler.

Hydrogen Chloride - HCl will be controlled by the SO_2 acid gas control system (SDA/FF). The expected removal efficiency of uncontrolled HCl emissions is approximately 95 percent.

Metals - Metals that remain in particulate form during combustion will be effectively controlled by the fabric filtration system. As discussed above, the SDA/FF provides the combination of factors that are most favorable for trace metal emissions removal. The removal efficiencies for the majority of the heavy metals (i.e., non-volatile metals) will exceed 99 percent, with a lower removal efficiency expected for the more volatile metals.

Specific Organic Compounds - Good operating practices for VOC control in general will also act to control emissions of specific organic compounds. In addition, a spray dryer/fabric filter control system for acid gases and particulate matter has been found effective in removing a significant portion of the organic compounds from the flue gases of some combustors.

Ammonia - Ammonia emissions will occur only as a result of "ammonia slip" from the SNCR system that will be used to control NO_X emissions. The presence of ammonia is therefore a tradeoff involved in controlling NO_X emissions. Keeping ammonia emissions to a minimum will be achieved by proper design and operation of the SNCR system.

5.2.2 Other Particulate Matter Emission Sources

Ash Silo and Lime Silo

Particulate emissions from the ash silo and lime silo will be controlled by bin vent filters. The expected outlet dust loadings from these filters is 0.02 gr/ft^3. In addition, loading and unloading operations involving the ash and lime silos will occur on an intermittent basis. The lime silo is expected to be loaded about twice a week for about an hour per loading. The ash silo will be in use about six times per day for about an hour each time.

The alternative ash handling system that is being considered eliminates the ash silo and its vent filter. With the alternate design an enclosed ash loadout structure is included which will have its own ash handling vent filter. Because both bottom ash and the combined fly ash/SDA residue will be wetted before being loaded into containers, fugitive dust emissions are expected to be less than with the ash silo option. If the ash loadout area is incorporated into the plant design, it will be located within 50 ft of the proposed ash silo, adjacent to the baghouse, SDA, and boiler. The ash handling vent filter will be on the roof of that structure, and will have an expected outlet dust loading of 0.02 gr/ft^3.

Cooling Tower

Particulate emissions from the cooling tower will be controlled by an effective drift elimination design. The cooling tower will be equipped with high efficiency drift eliminators forcing three distinct changes in air direction and obtaining extremely low drift rates.

Fugitive Dust Sources

Factors that will serve to minimize fugitive dust emissions are as follows:

- Unprocessed wood unloading, storage, chipping and handling - The unprocessed wood portion of the RGS fuel supply is expected to make up less than 19 percent of the average boiler heat input. By virtue of the relatively small quantity and the size of the unprocessed material, unloading and storage are not expected to create a significant fugitive dust source. The chipping or hogging of these materials may produce fines or dust. Therefore, measures will be taken in fuel procurement to minimize deliveries of loads which could result in dust generation. For the atypical loads which could cause dusting, wood yard operators will have available service water hose stations which will be used for wash-down and dust suppression. Fines which are generated in the hogging operations will be collected by mechanical or pneumatic means, stored temporarily, then sent to an approved landfill.

- Processed wood unloading, storage and handling - Processed or ground wood will be received in covered trucks and will be unloaded into the receiving hopper using a hydraulic truck unloader. From the receiving hopper, sized fuel will be added to the fuel pile via the radial stacker. To minimize windborn dust as the wood chips fall off the stacker onto the pile, the height of the stacker will be adjusted by woodyard operators. The use of the stacker reclaimer will not generate dust emissions, and the use of a covered fuel conveyor to the boiler house will keep windswept emissions from that source to a minimum.

- Tire unloading, storage, shredding, and handling - Tires will be received as whole tires and fragments, but not powdered. Tire materials as received will not be inherently dusty when unloaded and stored. The tire fragments resulting from shredding will be relatively large (minus 2-inch) and should not result in excessive dust emissions during the shredding process or when conveyed to the boiler.

- Vehicle movements - On-site roads will be paved, and the surface of the wood storage area will be compacted crushed stone which will minimize dust from vehicle movement in that area. In addition, a water truck will be maintained on-site, and the driving surfaces will be wetted as needed to control dust.

5.3 COMPLIANCE WITH EMISSION STANDARDS

5.3.1 Applicable Standards

40 CFR 60, Subpart Db

Portions of the federal new source performance standards (NSPS) in 40 CFR 60, Subpart Db, pertaining to industrial - commercial - institutional steam generating units with a heat input capacity greater than 100 MMBtu/hr are considered applicable to the RGS project. However, not all of the standards in Subpart Db are applicable. The applicable standards are (1) the emission rate standard for particulate matter when combusting wood or a mixture of wood and other fuels, and (2) the opacity standard. The standard for sulfur dioxide is not applicable because it pertains to coal and oil combustion. The standard for nitrogen oxides is 0.30 lb/MMBtu for facilities that simultaneously combust natural gas with wood, municipal-type solid waste, or other solid fuel, except coal. However, this standard does not apply if the facility has a federally enforceable requirement that limits operation of the facility to an annual capacity factor of 10 percent or less for natural gas. RGS is willing to accept such a permit condition.

The Subpart Db particulate standard applicable to wood combustion (40 CFR 60.43b(c)(1)) is 0.10 lb/MMBtu heat input. The proposed RGS boiler emission rate of 0.02 lb/MMBtu will easily meet this standard.

The applicable opacity standard (40 CFR 60.43b(f)) requires that discharges will be limited to an opacity of 20 percent (6-minute average), except for one 6-minute period per hour when opacity can increase to 27 percent. The RGS boiler will be operated to comply with this standard.

Florida Rule 17-2.610(2) and 17-2.610(3)

Florida Rule 17-2.610 contains general particulate emission limiting standards. Rule 17-2.610(2), the general visible emissions standard, is considered applicable to the RGS ash handling system and lime silo. This standard requires limiting discharges to less than 20 percent opacity. The vent filters installed for control of ash and lime emissions will achieve this requirement. Rule 17-2.610(3) pertains to unconfined emissions of particulate matter from sources such as vehicular movement, transportation of materials, loading, unloading, storing, and handling. RGSLP will take reasonable precautions to reduce fugitive dust emissions, including paving of on-site roads.

5.3.2 Standards Not Considered Applicable

The following standards are not considered applicable to the RGS project for the reasons stated:

- 40 CFR 60, Subpart Da, the federal NSPS for electric utility steam generating units with a heat input greater than 250 MMBtu/hr using fossil fuel. -- Subpart Da applies to units burning fossil fuels alone or in combination with other fuels. At least 250 MMBtu/hr of fossil fuels must be burned for a unit to be an affected facility. The only fossil fuel that will be burned in the RGS boiler is propane. The propane burner design will limit heat input from propane to 180 MMBtu/hr. Since the total fossil fuel heat input will be less than 250 MMBtu/hr, the facility is not subject to Subpart Da.

- 40 CFR 60, Subpart Ea, the federal NSPS for municipal waste combustors (MWC's) with a capacity greater than 250 tons per day of municipal-type solid waste (MSW) or refuse-derived fuel (RDF). --- RGS will not be subject to the standards in Subpart Ea because 30 percent or less (by weight) of the fuel feed stream will be comprised of municipal solid waste (MSW) as defined in 40 CFR 60, Subpart Ea. To satisfy the criteria for exclusion of co-fired combustors from the standards, RGS will accept a federally enforceable permit condition which limits the percent of MSW in the fuel stream to no more than 30 percent, by weight, measured on a daily basis. RGS will also comply with all applicable reporting requirements contained in Subpart Ea.

- 40 CFR 61, Subpart C, the national emission standard for hazardous air pollutants pertaining to beryllium. --- The provisions of this subpart apply to extraction plants, ceramic plans, foundries, incinerators, and propellant plants which process beryllium ore, beryllium, beryllium oxide, beryllium alloys, or beryllium-containing waste. The RGS facility is not in one of these affected source categories. It is not an incinerator within the bounds of this standard because incinerator is defined as "any furnace used in the process of burning waste for the primary purpose of reducing the volume of the waste by removing combustible matter." The primary purpose of the RGS facility is to produce electric power.

- 40 CFR 60, Subpart E, the federal NSPS for incinerators with a charging rate greater than 50 tons per day of solid waste. --- These standards are not considered applicable for two reasons. First, the Subpart E definition of "incinerator" is a "furnace used in the process of burning solid waste for the purpose of reducing the volume of the waste by removing combustible matter." The purpose of the RGS project is to produce power, not to reduce the volume of waste. Second, "solid waste" means refuse, more than 50 percent of which is municipal type waste on a weight basis. As discussed above, the fuel burned in the RGS boiler will contain less than 50 percent MSW by weight.

- Florida Rule 17-2.610(1), the process weight table of the general particulate emission limiting standards. --- The process weight table emission rates are not applicable to ash and lime handling because ash and lime materials are not used to produce a finished product.

Note that federal NSPS are also referenced in Florida Rule 17-2.660. Conclusions above regarding the applicability or inapplicability of federal NSPS also pertain to 17-2.660.

TABLE 5-1

BACT/LAER CLEARINGHOUSE DATA FOR WOOD-FIRED BOILERS

BACT/LAER Clearinghouse Data

WOOD FIRED BOILERS

	CODE	PERMIT ISSUE	SIZE MMBtu/Hr	NOx Lb/MMBtu	PM Lb/MMBtu	CO Lb/MMBtu	VOC Lb/MMBtu	SO2 Lb/MMBtu	NOTES
1)	#VT-0004	Jul-90	300	0.150	.001 gr/dsc	0.300	0.030		Mech Coll & ESP, NH3 Inj, Limit VE, BAP & NH3
2)	CA-0294	Jul-88	230	0.094	0.018	0.150	0.027	0.027	FBC, NH3 Inj., Multicl & ESP, Limestone Inj.
3)	#VT-0002	May-84	670	0.200	.007 gr/dsc	*1500 ppmv		*0.3 % fuel	Mech Dust Collector & ESP ,gas NOx 0.13, low NOx burners
4)	ME-*****	Sep-91	534	0.150	0.020	0.300	0.016	0.014	Comb Control, multiclone, dry ESP, urea injection, CEMS
5)	CA-0261	Nov-87	127	0.180	0.022	0.173	0.126		Limit 8000 H/yr, Multicl & ESP, Ccomb Controls
6)	CA-0295	Not Built	216	0.063	0.029	0.038	0.027	0.027	FBC, NH3 Inj., Limestone Inj., Multicl & Baghouse
7)	#CA-0172	Apr-85	*18.4 T/H Lu	0.140	.010 gr/dscf				FBC, Htd Stgd Air Addition, Multicyc. & ESP
8)	MI-0139	Dec-89	300	0.150	0.030	0.350	0.070	0.018	Mech Coll & ESP, Boiler Des, Comb Contr, SNCR, Lim BAP
9)	MI-0147	Jan-90	293	0.210	0.030	0.350	0.069	0.017	Mech Coll, Baghouse, Good Comb Contr, Limit BAP & NH3, SNCR
10)	MI-0151	Mar-90	450	0.150	0.030	0.400	0.050		Multiclone, ESP, Stack Monitor, SNCR, Design & Oper Practices, Limit
11)	MI-0180	none	523	0.150	0.030	0.400	0.043		ESP, SNCR, Comb Controls
12)	CA-0235	Mar-87	198	0.110	0.032	0.217			Thermal DeNOx, Low Exc Air, ESP & Multicl Precleaner
13)	CA-0188	Jan-85	309	0.200	0.040	0.400			HP overfire air sys., Multiclones & ESP
14)	NC-0046	Jan-89	666	0.350	0.041	0.660	0.077		Auto Comb Controls, Cyclone Sep & ESP
15)	#CA-0071	Sep-83	162	*130 ppmv	.020 gr/dscf				Stgd Comb, CEM-NOx, O2, CO, Baghouse
16)	#CA-0194	Jan-87	357	0.157	.020 gr/dscf				ACFB, Boiler design, ESP
17)	KY-0001	Jun-80	400		0.075				
18)	GA-0020	Nov-86	290		0.100				Multicyclone & Venturi Scrubber
19)	MS-0009	Mar-87	151	0.300	0.100	0.476		0.038	Multiclone & Scrubber, Low Exc Air, Comb Design

BACT/LAER Clearinghouse Data

WOOD FIRED BOILERS

TABLE 5-1 (continued)

	CODE	PERMIT ISSUE	SIZE MMBtu/Hr	NOx Lb/MMBtu	PM Lb/MMBtu	CO Lb/MMBtu	VOC Lb/MMBtu	SO2 Lb/MMBtu	NOTES
20)	NC-0002	Mar-81	*120 kLb/H s	*35.23 Lb/	0.100	*44.04 Lb/H		*33.03 Lb/H	Venturi Scrubber & Multiclone, Low S Fuel, Equip Oper
21)	#CA-0039	Oct-82	145	*139 T/Yr	.035 gr/dsc	*126 T/Yr	*55 T/Yr	*21 T/Yr	Multiclone & Venturi Scrubber, Comb Parm. Control
22)	ME-0003	Aug-82	84		0.120			0.136	Multiclones [Common stack w/Dryer]
23)	ME-0004	Jan-82	25		0.150				ESP
24)	VA-0132	May-88	4		0.200	0.480			Gas Gen & Boiler, Limit Formaldehyde (.12 Lb/H)
25)	ID-0005	Dec-82	88	0.200	0.241	0.200			2 Stgd Multiclones [See Note]
26)	SC-0005	Jun-81	172	1.190	0.250				Bark/Woodwste, Mech Coll &ESP, Equip Oper & Design
27)	TX-0057	Jan-80	*70 kLb/H		*10.7 Lb/H				Scrubber in series w/Scrubber
28)	NC-0007	Jan-80	*165 kLb/H		*246 T/Yr				Bagfilters, Cyc & Venturi Scrubber
29)	CA-0265	Mar-88	*38.5 MW	*246.7 T/Y	*65.7 T/Yr	*674.5 T/Y	*92.97 T/Y	*20.49 T/Yr	Multiclone & ESP, Stgd Comb, NH3 Inj, complete Comb
30)	CA-0268	May-88	335	0.110		0.500			Secondary Air Inj., NH3 Injection
31)	CA-0272	Nov-88	287			2.056	0.122		[mod. source] Good Oper & Comb Practices, Stgd Comb
32)	MI-0165	Aug-90							[small] Limit BAP, Cyclone
33)	MI-0166	Aug-90	5						Limit BAP
34)	MS-0009*	Mar-87	137	0.200		0.036			Gas Firing, Low Exc Air, Comb Design
35)	NC-0022	Jan-82	22				*917 T/Y		Limit wood use to limit VOC

\# PM level as listed in gr/dscf. Conversion to Lb/mmBtu is approximate.

***** as listed in permit, not from BACT/LAER Clearinghouse.

TABLE 5-2

100 PERCENT TIRE-FIRED BOILERS MAXIMUM PERMIT LIMITS

Facility	Heat Input (MMBtu/hr)	Permitted Emission Rates				
		PM (lb/MMBtu)	SO_2 (lb/MMBtu)	NO_X (lb/MMBtu)	CO (lb/MMBtu)	VOC's (lb/MMBtu)
Modesto, California	188	0.02	0.06	0.11	0.08	0.033
Sterling, Connecticut	362	0.03	0.11	0.12	0.17	--
Moapa, Nevada	605	0.03	0.19	0.18	0.19	--

TABLE 5-3

EFFECT OF BURNING TIRES ON CO EMISSIONS

			CO EMISSIONS		
Location	Fuels	Units	Without Tires	With Tires	Percent Change in CO Emissions Due to Burning Tires
Nekoosa Packaging Tomahawk, Wisconsin	Coal, Bark & Tires	lb/hr	223	301	+ 35.0
Uniroyal Goodrich Tire Eau Claire, Wisconsin	Coal and Tires	lb/hr	3.1	1.1	- 64.5
Virginia Polytechnic Institute	Coal and Tires	lb/MMBtu	0.17	0.32	+ 88.2
Monsanto Company Sauget, Illinois	Coal and Tires	lb/hr	0.38	0.53	+ 39.4
Energy Product of Idaho	RDF and Tires	ppm	20.0	30.0	+ 50.0

TABLE 5-4

RIDGE GENERATING STATION
SUMMARY OF PROPOSED BACT APPROACH

Pollutant	Proposed Best Available Control Technology	Proposed Emission Limit (lb/MMBtu)
PM	Fabric Filtration	0.02
SO_2	Spray Dryer with Fabric Filtration	0.17[a]
NO_X	Combustor Design and Selective Noncatalytic Reduction System	0.15[a]
CO	Good Combustion Practices	0.5[a, b]
VOCs	Good Combustion Practices	0.035
Pb	Fabric Filtration	0.0004
Be	Fabric Filtration	0.00001

[a] On a 24-hour block average basis

[b] Excluding periods of start-up and shut down.

6.0 PRIMARY AMBIENT AIR QUALITY IMPACT ANALYSIS

6.1 MODELING APPROACH

The dispersion modeling analysis for the project was designed to assess the potential impact on ambient air quality of emissions from the proposed RGS project. As indicated previously, the operation of this facility is expected to result in "significant" emissions (as defined by DER and EPA) of carbon monoxide, nitrogen oxides, particulate matter (PM and PM_{10}), sulfur dioxide, volatile organic compounds, lead, and beryllium. In addition to the pollutants with "significant" emission rates, a modeling analysis was also performed for several toxic air pollutants that are subject to the Florida air toxics permitting strategy.

Prior to initiating the air quality impact analysis described in this section, Dames & Moore prepared and submitted to Mr. Cleve Holladay of DER a dispersion modeling protocol dated November 1, 1991. The dispersion models, meteorological data, and modeling approach used to develop impact analysis results are in accordance with this protocol.

6.1.1 Dispersion Model

Dispersion modeling results were obtained using the most recent version of EPA's short-term Industrial Source Complex (ISCST) model and SCREEN model. The ISCST model was used to determine annual average concentrations as well as short-term concentrations (24-hours or less).

6.1.2 Ridge Generating Station Emission Source Data

The boiler will be the dominant emission source at RGS and was the only RGS source considered for the modeling evaluation. Tables 4-1, 4-2, and 4-3 show boiler emission rates and stack conditions for the 100 percent wood case, the 80 percent wood/20 percent tire case, and the wood/tire/landfill gas case. The wood/tire combination fuel has either higher emission rates or essentially the same emission rates compared to other fuel cases. Also, wood/tire combustion results in the lowest exhaust gas velocities for all load levels. Since the expected exhaust gas exit temperature is the same for all three fuel cases, lowest plume rise will occur with the wood/tire fuel case. Taking into account both emission rates and plume dispersion characteristics, the wood/tire fuel case is the worst-case fuel from an air quality standpoint and was the only case evaluated in the modeling analysis.

Three boiler load levels were considered for modeling: maximum continuous rating, 75 percent load, and 50 percent load. To help determine which of these load levels to include in the detailed ISCST modeling assessment, they were first evaluated with the SCREEN model. The 50 percent load level clearly resulted in the lowest concentrations, but the results for the MCR and 75 percent load levels were similar. Therefore, detailed ISCST evaluations were performed for both the MCR and 75 percent load levels.

RGS boiler emission characteristics in metric units as used for modeling purposes are listed in Table 6-1. A normalized emission rate of 1.0 g/s was used in each ISCST modeling run so that concentrations for different pollutants could be obtained easily by scaling. Actual emission rates in g/s are listed in Table 6-2.

As will be shown later, RGS emissions result in maximum concentrations that are less than the PSD significant impact levels. Assessing the interaction of the RGS boiler with other emission sources is therefore not required. Consequently, this application does not contain an inventory for other emission sources or a modeling analysis involving other sources.

6.1.3 Meteorological Input Data

The meteorological data base used with the ISCST model consisted of five years (1982-1986) of national weather service surface and upper air observations from Tampa, Florida. Data were obtained in processed format from DER.

6.1.4 Receptor Specification

As is typical for PSD evaluations, the initial modeling calculations were made for RGS emissions to determine if these emissions will produce a significant impact (with reference to defined significant impact levels). In this analysis, no attempt was made to exclude areas within the site boundary under the concept that on-site locations are not "ambient air" locations. Preliminary modeling results from both SCREEN and ISCST indicated that predicted maximum concentrations occur at distances beyond the RGS site boundary. Specifically, initial modeling demonstrated that maximum predicted concentrations occur at distances beyond 250 m.

The significant impact analysis was conducted using a polar coordinate grid centered on the boiler stack. The first set of calculations specified receptors along radial lines spaced 10 degrees apart. For these first calculations, receptors were specified at intervals of 250 m beginning at a distance of 250 m and going out to a distance of 3,000 m from the boiler stack. Calculations were made with all five years of meteorological data for MCR conditions and 75 percent load level conditions.

The predicted normalized concentrations from these initial calculations were then tabulated in a list showing the maximum predicted concentration for each averaging period, for each meteorological data year, and for both load levels. The ten maximum contrations thus obtained for each averaging period were listed in descending order. The highest of the yearly maximum concentrations, plus any other yearly maximum concentrations within 10 percent of the highest, were then evaluated in a second set of calculations using a polar receptor grid consisting of radials spaced 2 degrees apart and a distance spacing of 100 m. This approach provides an estimate of maximum concentrations to a receptor spacing resolution of 100 m.

An example will illustrate the details of this process. From the first set of calculations, the predicted maximum (normalized) 24-hour concentrations for each year and load level are shown below in ranked order, together with the direction and distance of the receptor where the maximum was predicted. (In this listing, the concentrations for the 75 percent load level represent an emission rate of 0.75 g/s for comparison with an emission rate of 1.0 g/s at MCR.)

Concentration	Year	Load	Direction	Distance
0.31082	1983	MCR	250°	1,500 m
0.30128	1982	MCR	360°	1,750 m
0.28378	1983	75%	250°	1,500 m
0.27785	1986	MCR	90°	1,250 m
0.27312	1984	MCR	250°	1,250 m
0.27284	1982	75%	360°	1,500 m
0.26790	1985	MCR	80°	1,500 m
0.25211	1986	75%	90°	1,250 m
0.24588	1985	75%	80°	1,250 m
0.24489	1984	75%	90°	1,250 m

From this ranking, only the second and third yearly maximum values are within 10 percent of the highest value. Therefore, the top three values were evaluated further. The receptor grid specified for further evaluation of the highest value consisted of directions 246°, 248°, 250°, 252°, and 254°, and distances of 1,300, 1,400, 1,500, 1,600, and 1,700 m. A similar method was used to specify receptors for further evaluation of the second and third yearly maximum concentrations in the rank order.

Modeling results obtained from the significant impact analysis were also used to assess compliance with the DER toxic air pollutant no-threat levels (NTL's). Therefore, toxic air pollutant concentrations attributable to RGS boiler emissions were determined to a receptor spacing resolution of 100 m.

Modeling was also conducted to determine the impact of RGS boiler emissions within the nearest PSD Class I area, the Chassahowitzka National Wilderness Area (a part of the Chassahowitzka National Wildlife Refuge). This area is located on the Gulf Coast about 100 km to the northwest of the RGS site at its closest point. The receptor coordinates used to represent the Chassahowitzka PSD Class I area were obtained from DER. DER supplied UTM coordinates for receptors used in a previous evaluation. These receptors represent the landward side of the area. The receptor coordinates obtained from DER are as follows (in meters):

340300 E, 3165700 N
340300 E, 3167700 N
340300 E, 3169800 N
340700 E, 3171990 N
342000 E, 3174000 N
343000 E, 3176200 N
343700 E, 3178300 N
342400 E, 3180600 N
341100 E, 3183400 N

These points were modeled as discrete receptors with respect to the RGS boiler stack UTM coordinates of 416690 E, 3100380 N.

6.1.5 Model Option Selection

The ISCST model contains options that determine the way in which calculations are made. The choice of options was made consistent with EPA's current recommended approach by specifying the regulatory default option. Due to the RGS site location in an undeveloped part of Polk County, the selected terrain option was rural terrain.

6.1.6 Good Engineering Practice Stack Height

GEP stack height is determined on the basis of the dimensions of "nearby" structures. "Nearby" means a structure that is within a distance of 5L from a stack, where L is the lesser of the structure height or maximum projected width.

Table 6-3 lists the dimensions of taller structures that are within 5L of the RGS boiler stack. The location of these structures is shown in Figure 3-2. Also shown in Table 6-3 is the GEP stack height calculated for each structure. The greatest GEP height is produced by the upper tier of the boiler building. The GEP height associated with this structure is 325 ft.

The proposed height of the RGS boiler stack is the GEP height of 325 ft. Because this height does not exceed the GEP level, the entire height can be credited in the modeling analysis. Furthermore, because the proposed height equals GEP height, building downwash effects need not be considered.

6.2 SIGNIFICANT IMPACT DETERMINATION

Predicted maximum normalized concentrations (emission rate = 1.0 g/s) are shown in Tables 6-4 and 6-5 for MCR and 75 percent load levels. These concentrations can be multiplied by the emission rates in Table 6-2 to obtain total concentrations. The annual concentrations are based on an assumed continuous operation at either MCR or 75 percent load.

Maximum concentrations considering both MCR and 75 percent load are listed in Table 6-6 for SO_2, NO_2, PM, CO, and Pb. Maximum SO_2, NO_2, PM, and CO concentrations are well below the significant impact levels. The maximum Pb concentration is well below the national and Florida ambient air quality standard. (A significant impact level does not exist for Pb.)

The conclusion from these results is that emissions from the proposed boiler will not produce a significant impact within the area surrounding the RGS site. In accordance with PSD assessment policies, no further modeling is needed to demonstrate that the proposed project is acceptable from the standpoint of PSD Class II increment consumption and compliance with NAAQS and FAAQS.

6.3 IMPACT ON NEAREST PSD CLASS I AREA

The significant impact concept is not as well defined for PSD Class I areas as it is for PSD Class II areas. However, EPA has suggested significance levels for use in assessing SO_2, NO_2, and PM concentrations within PSD Class I areas (U.S. Environmental Protection Agency, 1991).

Predicted maximum concentrations within the Chassahowitzka PSD Class I area attributable to RGS boiler emissions are listed in Table 6-7. These maximum concentrations are less than the EPA-suggested PSD Class I significance levels. The conclusion is, therefore, that the RGS project will have an insignificant impact on the nearest PSD Class I area. This is a reasonable conclusion given the large distance separating the RGS site from the Chassahowitzka National Wilderness area. Of further note is that the modeling technique employed to evaluate PSD Class I impacts made no allowance for chemical transformation or other depletion of pollutants during the time required for plume transport over a distance of 100 km. Nor was any attempt made to compensate for the fact that the steady-state meteorological conditions assumed by the ISCST model are unlikely to persist from the point of emissions release to the point of impact. The predicted PSD Class I area concentrations reported in Table 6-7 are therefore likely to be very conservative.

6.4 COMPLIANCE WITH FLORIDA AIR TOXICS PERMITTING STRATEGY

The Florida air toxics permitting strategy was developed for the purpose of controlling toxic emissions from stationary sources to levels that would not endanger public health. The strategy is based on comparing the predicted ambient impacts of individual toxic air pollutants with ambient exposure levels considered protective of public health. Acceptable ambient exposure levels, referred to as no-threat levels (NTL's), have been developed by the Florida Air Toxics Working Group composed of DER and local county air toxics staff representatives. NTL's are tabulated in a document entitled the "Florida Air Toxics Working List," and are revised as needed to match changes in accepted concentration values.

To evaluate the effect of toxic air pollutant emissions from the RGS boiler, predicted maximum concentration (based on all five years of meteorological data) have been compared with appropriate NTL's. The NTL's used for this comparison were verified with DER to confirm that currently accepted values were used.

Table 6-8 contains a comparison of predicted maximum concentrations with the Florida NTL's. As can be seen, predicted maximum concentrations are less than the NTL's. Therefore, predicted concentrations attributable to toxic air pollutant emissions from the RGS boiler comply with the Florida air toxics permitting strategy.

TABLE 6-1

RIDGE GENERATING STATION BOILER EMISSION CHARACTERISTICS AS USED FOR MODELING ANALYSIS[a]

	Load Level	
Emission Characteristic	MCR	75% Load
Emission rate, g/s	1.0[b]	1.0[b]
Stack Height, m	99.06	99.06
Stack Diameter, m	3.05	3.05
Exit Temperature, K	349.82	349.82
Exit Velocity, m/s	14.54	10.91

[a] Data for the 80% wood/20% tires fuel mix.

[b] Normalized emission rate used for model input. Modeling results can be scaled using the actual emission rates in Table 6-2.

TABLE 6-2

RIDGE GENERATING STATION
EMISSION RATES FOR CONVERSION OF NORMALIZED CONCENTRATIONS

To convert the predicted normalized concentrations in Tables 6-4 and 6-5 to total concentrations, use the following emission rates. These rates apply to the RGS boiler firing an 80% wood/20% tires fuel mix.

Pollutant	MCR Emission Rate (g/s)	75% Load Level Emission Rate (g/s)
Sulfur Oxides (as SO_2)	13.78	10.33
Nitrogen Oxides (as NO_2)	11.91	8.93
Particulate Matter (PM/PM_{10})	1.59	1.20
Carbon Monoxide	39.69	29.80
Lead	0.032	0.024
Beryllium	0.0008	20.0006

TABLE 6-3

RIDGE GENERATING STATION
GOOD ENGINEERING PRACTICE STACK HEIGHT CALCULATIONS

Structure	Structure Dimensions		GEP Stack Height[a] (ft)
	Height (ft)	Maximum Projected Width (ft)	
Upper Part of Boiler Building	130	156	325
Lower Part of Boiler Building + Turbine Generator Building	60	205	150
Baghouse	56	76	140
Ash Silo	104	20	134
Lime Silo	30	16	54

[a] GEP height = H + 1.5L, where H is the structure height and L is the lesser of the structure height or maximum projected width.

TABLE 6-4
RIDGE GENERATING STATION
SUMMARY OF PREDICTED MAXIMUM NORMALIZED CONCENTRATIONS FOR BOILER EMISSIONS OPERATING AT MAXIMUM CONTINUOUS RATING
(EMISSION RATE = 1.0 g/s)

		Predicted Maximum Normalized Concentrations (μg/m^3)				
Year of Meterological Data	Receptor Resolution	1-Hour	3-Hour	8-Hour	24-hour	Annual
1982	250 m 100 m	2.119 ---	1.072 ---	0.678 ---	0.301 0.319 (1700 m/2°)	0.019 ---
1983	250 m 100 m	2.048 ---	1.247 ---	0.686 ---	0.311 ---	0.016 ---
1984	250 m 100 m	2.055 ---	1.273 ---	0.765 ---	0.273 ---	0.019 ---
1985	250 m 100 m	2.494 ---	1.182 ---	0.627 ---	0.268 ---	0.024 ---
1986	250 m 100 m	2.082 ---	1.303 1.355 (700 m/92°)	0.834 0.884 (1300 m/86°)	0.278 ---	0.030 0.030 (1500 m/86°)

Notes:

1. Predicted concentrations based on stack parameters for 80% wood/20% tires fuel mix.
2. [m/°] designation refers to distance in meters and azimuth direction in degrees relative to RGS boiler stack for the 100-m receptor resolution concentrations.
3. To obtain total concentrations, multiply the normalized concentrations in this table by the appropriate emission rates in Table 6-2.
4. The concentrations shown for the 100-m receptor resolution are the highest values obtained for each averaging period considering both MCR and 75 percent load conditions. These values are used to compute the concentrations in Table 6-6. The highest 1-hour value was obtained for the 75% load level and is listed in Table 6-5.

TABLE 6-5
RIDGE GENERATING STATION
SUMMARY OF PREDICTED MAXIMUM NORMALIZED CONCENTRATIONS FOR BOILER EMISSIONS
OPERATING AT 75 PERCENT LOAD LEVEL
(EMISSION RATE = 1.0 g/s)

		Predicted Maximum Normalized Concentrations ($\mu g/m^3$)				
Year of Meterological Data	Receptor Resolution	1-Hour	3-Hour	8-Hour	24-hour	Annual
1982	250 m 100 m	3.868 4.212 (600 m/92°)	1.289 ---	0.818 ---	0.364 ---	0.023 ---
1983	250 m 100 m	2.461 ---	1.459 ---	0.833 ---	0.378 ---	0.020 ---
1984	250 m 100 m	2.434 ---	1.474 ---	0.894 ---	0.326 ---	0.023 ---
1985	250 m 100 m	2.714 ---	1.373 ---	0.751 ---	0.328 ---	0.029 ---
1986	250 m 100 m	2.491 ---	1.514 ---	1.008 ---	0.336 ---	0.036 ---

Notes:

1. Predicted concentrations based on stack parameters for 80% wood/20% tires fuel mix.
2. [m/°] designation refers to distance in meters and azimuth direction in degrees relative to RGS boiler stack for the 100-m receptor resolution concentrations.
3. To obtain total concentrations, multiply the normalized concentrations in this table by the appropriate emission rates in Table 6-2.
4. The concentratoins shown for the 100-m recptor resolution are the highest values obtained for each averaging period considering both MCR and 75 percent load conditions. These values are used to compute the concentrations in Table 6-6. The highest 3-hour, 8-hour, 24-hour, and annual concentrations were obtained for MCR (100% load) conditions and are listed in Table 6-4.

TABLE 6-6

RIDGE GENERATING STATION
SUMMARY OF PREDICTED MAXIMUM CONCENTRATIONS FOR POLLUTANTS WITH SIGNIFICANT IMPACT LEVELS

Pollutant and Averaging Period	Maximum Predicted Concentration[a] ($\mu g/m^3$)	Significant Impact Level ($\mu g/m^3$)
Sulfur Dioxide		
3-Hour	18.7	25
24-Hour	4.4	5
Annual	0.4	1
Nitrogen Dioxide		
Annual	0.4	1
Particulate Matter		
24-Hour	0.5	5
Annual	0.05	1
Carbon Monoxide		
1-Hour	125.5	2,000
8-Hour	35.1	500
Lead Quarterly	0.001[b]	1.5[c]

[a] Based on operating year-round at maximum continuous rating or at 75 percent load firing an 80% wood/20% tires fuel mix. Concentrations shown are maximum concentrations for all five years of meteorological data.

[b] This is the predicted maximum annual average concentration used to represent the maximum quarterly concentration.

[c] This is a national and Florida ambient air quality standard and not a significant impact level.

TABLE 6-7

RIDGE GENERATING STATION SUMMARY OF PREDICTED MAXIMUM CONCENTRATIONS WITHIN THE CHASSAHOWITZKA PSD CLASS I AREA ATTRIBUTABLE TO BOILER EMISSIONS

Pollutant and Averaging Period	Predicted Maximum Concentration[a] ($\mu g/m^3$)	PSD Class I Increments ($\mu g/m^3$)	EPA Suggested[b] Significance Levels ($\mu g/m^3$)
Sulfur Dioxide			
3-Hour	0.71	25	1.23
24-Hour	0.16	5	0.275
Annual	0.01	2	0.1
Nitrogen Dioxide			
Annual	0.01	2.5	0.1
Particulate Matter			
24-Hour	0.02	10	1.35
Annual	0.001	5	0.27

[a] Based on modeling with all 5 years of meteorological data at both MCR and 75 percent load conditions.

[b] Reference: U.S. Environmental Protection Agency, 1991.

TABLE 6-8

RIDGE GENERATING STATION
SUMMARY OF PREDICTED MAXIMUM CONCENTRATIONS OF TOXIC AIR POLLUTANTS ATTRIBUTABLE TO BOILER EMISSIONS

	Maximum Predicted Concentrations ($\mu g/m^3$)			Florida DER No-Threat Levels[b] ($\mu g/m^3$)		
Pollutant	8-Hour	24-Hour	Annual	8-Hour	24-Hour	Annual
Arsenic	0.002	0.0008	7.2×10^{-5}	2	0.48	2.3×10^{-4}
Beryllium	0.0007	0.0003	2.4×10^{-5}	0.02	0.005	4.2×10^{-4}
Cadmium	0.004	0.001	1.2×10^{-4}	0.5	0.12	5.6×10^{-4}
Chromium VI	0.002	0.0006	6.0×10^{-5}	0.5	0.12	8.3×10^{-5}
Lead	0.03	0.01	9.5×10^{-4}	1.5	0.36	9.0×10^{-2}
Mercury	0.002	0.0009	8.4×10^{-5}	0.5	0.12	0.3
Nickel	0.007	0.003	2.4×10^{-4}	0.5	0.12	4.2×10^{-3}
Zinc	0.07	0.03	-	50	12	-
Ammonia	2.0	0.7	0.07	180	43.2	1.0
Hydrogenchloride	0.4	0.1	0.01	70	16.8	7.0
Formaldehyde	0.2	0.07	6.4×10^{-3}	4.5	1.08	7.7×10^{-2}
Benzene	0.6	0.2	0.02	30	7.2	0.12

[a] Based on operating year-round at maximum continuous rating or 75 percent load firing an 80% wood/20% tires fuel mix.

[b] Including any relevant federal reference air concentrations, reference specific doses (divided by 10), or inhalation reference concentrations.

7.0 OTHER IMPACT CONSIDERATIONS

7.1 VISIBILITY

For PSD sources, the principal visibility impacts of concern are impacts on visibility conditions within the nearest PSD Class I area. The nearest such area, as previously discussed, is the Chassahowitzka National Wilderness Area located (at its closest point) about 100 km from the site of the proposed RGS project.

The effect of RGS emissions on visibility conditions within the Chassahowitzka PSD Class I Area has been evaluated by a Level-1 plume visual impact screening analysis using the latest version of the EPA VISCREEN model. The input data used for visibility impact analysis are as follows:

primary particulate matter emissions -	12.6 lb/hr
nitrogen oxides emissions (as NO_2) -	94.5 lb/hr
minimum distance from source to Class I area -	100 km
maximum distance from source to Class I area -	120 km
background visual range -	25 km

The emission rates are for operation of the RGS boiler at maximum continuous rating.

VISCREEN modeling results are shown in Table 7-1. Based on the Level-1 screening criteria, VISCREEN results indicate that RGS emissions will not have an adverse impact on visibility conditions within the Chassahowitzka PSD Class I Area.

7.2 VEGETATION AND SOILS

Effects on vegetation and soils associated with power generating facilities are primarily related to SO_2 and NO_X emissions. Since RGS SO_2 and NO_X emissions are predicted to have an insignificant impact, adverse effects on vegetation and soils are highly unlikely.

7.3 ASSOCIATED GROWTH

When RGS begins operation, approximately 40 employees will be needed for the facility. Adding this small number of employees to the area work force will not result in significant residential or commercial growth. Furthermore, the project on its own is not expected to produce significant industrial growth in central Florida. Also, the project will be a net generator of electricity and will not require additional power generation (and associated additional emissions) from existing power generating utilities. Therefore, the secondary air quality impacts related to residential, commercial, or industrial growth associated with the project are expected to be minor.

7.4 NONATTAINMENT AREAS

Polk County is currently considered in attainment with all ambient air quality standards. The nearest designated nonattainment area is the Hillsborough/Pinellas County ozone nonattainment area. Ozone precursor emissions from RGS are not expected to interfere with strategies to achieve compliance with the ozone standard in the Tampa/St. Petersburg area.

TABLE 7-1

```
              Visual Effects Screening Analysis for
                Source: RIDGE GENERATING STATION
                Class I Area: CHASSAHOWITZKA NWA


                ***   Level-1 Screening   ***
Input Emissions for

   Particulates    12.60  LB /HR
   NOx (as NO2)    94.50  LB /HR
   Primary NO2       .00  LB /HR
   Soot              .00  LB /HR
   Primary SO4       .00  LB /HR


    **** Default Particle Characteristics Assumed

              Transport Scenario Specifications:

    Background Ozone:                  .04 ppm
    Background Visual Range:         25.00 km
    Source-Observer Distance:       100.00 km
    Min. Source-Class I Distance:   100.00 km
    Max. Source-Class I Distance:   120.00 km
    Plume-Source-Observer Angle:     11.25 degrees
    Stability:   6
    Wind Speed:   1.00 m/s

                           R E S U L T S

Asterisks (*) indicate plume impacts that exceed screening criteria

         Maximum Visual Impacts INSIDE  Class I Area
          Screening Criteria ARE NOT Exceeded
                                    Delta E       Contrast
                                  ===========   ============
Backgrnd Theta Azi Distance Alpha Crit  Plume   Crit  Plume
======== ===== === ======== ===== ====  =====   ====  =====
 SKY      10.  84.  100.0    84.  2.00   .019    .05   .000
 SKY     140.  84.  100.0    84.  2.00   .005    .05  -.000
 TERRAIN  10.  84.  100.0    84.  2.00   .001    .05   .000
 TERRAIN 140.  84.  100.0    84.  2.00   .000    .05   .000


         Maximum Visual Impacts OUTSIDE Class I Area
          Screening Criteria ARE NOT Exceeded
                                    Delta E       Contrast
                                  ===========   ============
Backgrnd Theta Azi Distance Alpha Crit  Plume   Crit  Plume
======== ===== === ======== ===== ====  =====   ====  =====
 SKY      10.  75.   96.8    94.  2.00   .020    .05   .000
 SKY     140.  75.   96.8    94.  2.00   .005    .05  -.000
 TERRAIN  10.  60.   91.5   109.  2.00   .002    .05   .000
 TERRAIN 140.  60.   91.5   109.  2.00   .000    .05   .000
```

8.0 PSD PRECONSTRUCTION MONITORING EXEMPTION REQUEST

As previously discussed, the RGS project is subject to PSD review for the following regulated pollutants: SO_2, NO_X, CO, PM/PM_{10}, VOC's (and O_3), Pb, and Be. An exemption from PSD preconstruction ambient air quality monitoring requirements is requested on the basis of the reasons discussed below. Included in these exemption requests is a reference to the *de minimis* ambient impact levels that can serve as a basis for a monitoring exemption at the discretion of the reviewing agency. The *de minimis* levels for the regulated pollutants subject to PSD review for RGS are as follows:

sulfur dioxide -	13 $\mu g/m^3$ (24-hour average)
nitrogen dioxide -	14 $\mu g/m^3$ (annual average)
carbon monoxide -	575 $\mu g/m^3$ (8-hour average)
particulate matter (PM_{10}) -	10 $\mu g/m^3$ (24-hour average)
ozone -	100 ton/yr of VOC emissions
lead -	0.1 $\mu g/m^3$ (3-month average)
beryllium -	0.001 $\mu g/m^3$ (24-hour average)

Sulfur Dioxide

The maximum predicted 24-hour SO_2 concentration attributable to RGS emissions is 4.4 $\mu g/m^3$. This concentration is less than the *de minimis* level. A monitoring exemption is requested on the basis of the maximum predicted concentration being less than the *de minimis* level.

Nitrogen Dioxide

The maximum predicted annual average NO_2 concentration attributable to RGS NO_X emissions is 0.4 $\mu g/m^3$ which is less than the *de minimis* level. A monitoring exemption is requested on the basis of the maximum predicted concentration being less than the *de minimis* level.

Carbon Monoxide

The maximum predicted 8-hour average CO concentration attributable to RGS emissions is 35.1 $\mu g/m^3$ which is less than the *de minimis* level. A monitoring exemption is requested on the basis of the maximum predicted concentration being less than the *de minimis* level.

Particulate Matter

The maximum predicted 24-hour average PM concentration attributable to RGS emissions is 0.5 $\mu g/m^3$ which is less than the *de minimis* level. A monitoring exemption is requested on the basis of the maximum predicted concentration being less than the *de minimis* level.

Ozone

Estimated VOC emissions from RGS are 96.6 ton/yr. A monitoring exemption for ozone is requested on the basis of project-related VOC emissions being less than the *de minimis* level of 100 ton/yr.

Lead

The maximum predicted annual average Pb concentration attributable to RGS emissions is 0.01 $\mu g/m^3$ which is less than the *de minimis* level (assuming the maximum annual concentration represents a 3-month average.) A monitoring exemption is requested on the basis of the maximum predicted concentration being less than the *de minimis* level.

Beryllium

The maximum predicted 24-hour average Be concentration attributable to RGS emissions is 0.0003 $\mu g/m^3$ which is less than the *de minimis* level. A monitoring exemption is requested on the basis of the maximum predicted concentration being less than the *de minimis* level.

9.0 REFERENCES

Caron, A., Messmer, R. and Hoy, D., 1990. Project progress report: the emissions of selected air contaminants from wood-residue fired boilers. In Proceedings of 1990 NCASI West Coast Regional Meeting.

Dow Corning Corp., 1989. Report of tire chip test burn performed March 9-29, 1989.

Drabek J. and Willenberg, J., 1987. Measurement of polynuclear aromatic hydrocarbons and metals from burning tire chips for supplementary fuel. Presented at 1987 TAPPI Environmental Conference, April 26-29, 1987, Portland, Oregon.

Genesse Generating Station, 1991. Air emission permit application for Genesse Generating Station, Michigan.

Grasso, D.T. and Atkins, R.S., Environmental Risk Limited, 1990. The composition of recycled wood fuel and its environmental permitting implications. Presented at the ACA/CIPCA Fourth Annual Meeting and Exposition, Hartford, C.T., September 16-17,1990.

Malcolm Pirnie, Inc., 1991. Air emissions associated with the combustion of scrap tires for energy recovery.

National Council of the Paper Industry for Air and Stream Improvement, 1983. A polycyclic organic materials emissions study for industrial wood-fired boilers. Technical Bulletin No. 400.

National Council of the Paper Industry for Air and Stream Improvement, 1985. Summary of west coast experience with emissions from wood-residue fired boilers while burning tire derived fuel (TDF) as a supplemental fuel. Technical Bulletin No. 465.

Oxford Energy Co., 1988. Final emission test report for Modesto Energy Company waste tire to energy facility, Westley, California.

Oxford Energy Co., 1990. Stack test report (for the Oxford Energy Company facility at Westley, California, October 9-10, 1990).

U.S. Environmental Protection Agency, 1986. Control technologies for hazardous air pollutants. Air and Energy Engineering Research Laboratory, EPA/625/6-86/014.

U.S. Environmental Protection Agency, 1990. Toxic air pollutant emission factors - a compilation for selected air toxic compounds and sources, second edition. Office of Air Quality Planning and Standards, EPA-450/2-90-011.

U.S. Environmental Protection Agency, 1991. Class I area significant impact level. Memorandum from John Calcagni, Director, Air Quality Management Division, September 10, 1991.

Washington Department of Ecology, 1986. Source test for Port Townsend Paper Company (February 25 and March 5, 1986).

Washington Department of Ecology, 1986. Source test for Crown Zellerbach, Port Angeles, Washington (May 20, 1986).

APPENDIX A

PERMIT APPLICATION FORM

$7500 pd.
12-20-91
Recpt.#180724

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32301

AC53-206244
PSD-FL-183

BOB GRAHAM
GOVERNOR
VICTORIA J. TSCHINKEL
SECRETARY

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: New ☒ New[1] ☐ Existing[1]

APPLICATION TYPE: ☐ Construction ☐ Operation ☐ Modification

COMPANY NAME: Ridge Generating Station Limited Partnership COUNTY: Polk
By: Decker Energy - Ridge, Inc., General Partner

Identify the specific emission point source(s) addressed in this application (i.e. Lime Kiln No. 4 with Venturi Scrubber; Peaking Unit No. 2, Gas Fired) Boiler and Related Equipment

SOURCE LOCATION: Street State Road 542 and Taylor Rd. City Auburndale

UTM: East 416690 m North 3100380 m

Latitude ___° ___' ___"N Longitude ___° ___' ___"W

APPLICANT NAME AND TITLE: Macauley Whiting, Jr., President - Decker Energy - Ridge, Inc.*

APPLICANT ADDRESS: P.O. Box 2397, Winter Park, FL 32790

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of Ridge Generating Station Limited Partnership

I certify that the statements made in this application for a construction permit are true, correct and complete to the best of my knowledge and belief. Further, I agree to maintain and operate the pollution control source and pollution control facilities in such a manner as to comply with the provision of Chapter 403, Florida Statutes, and all the rules and regulations of the department and revisions thereof. I also understand that a permit, if granted by the department, will be non-transferable and I will promptly notify the department upon sale or legal transfer of the permitted establishment.

*Attach letter of authorization

Signed: Macauley Whiting, Jr.

Macauley Whiting, Jr., President - Decker Energy - Ridge, Inc.*
Name and Title (Please Type)

Date: 12-10-91 Telephone No. 407/628-8900

B. PROFESSIONAL ENGINEER REGISTERED IN FLORIDA (where required by Chapter 471, F.S.)

This is to certify that the engineering features of this pollution control project have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the treatment and disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgment, that

---

[1] See Florida Administrative Code Rule 17-2.100(57) and (104)

*Decker Energy - Ridge, Inc. is a General Partner of Ridge Generating Station, L.P.

the pollution control facilities, when properly maintained and operated, will discharge an effluent that complies with all applicable statutes of the State of Florida and the rules and regulations of the department. It is also agreed that the undersigned will furnish, if authorized by the owner, the applicant a set of instructions for the proper maintenance and operation of the pollution control facilities and, if applicable, pollution sources.

THOMAS J. FITZPATRICK
0044846

Signed Thomas J. Fitzpatrick, 12/10/91

Thomas J. Fitzpatrick
Name (Please Type)

SFT, Inc.
Company Name (Please Type)

6629 W. Central Ave., Toledo, OH 43617
Mailing Address (Please Type)

Florida Registration No. 0044846 Date: 1991 Telephone No. 419/843-8200

SECTION II: GENERAL PROJECT INFORMATION

A. Describe the nature and extent of the project. Refer to pollution control equipment, and expected improvements in source performance as a result of installation. State whether the project will result in full compliance. Attach additional sheet if necessary.

The project consists of a power generating facility with a boiler that will burn wood, tires, and landfill gas. Pollution control equipment will meet BACT requirements and will result in compliance with all applicable standards (see attached report)

B. Schedule of project covered in this application (Construction Permit Application Only)

Start of Construction July 1992 Completion of Construction July 1994

C. Costs of pollution control system(s): (Note: Show breakdown of estimated costs only for individual components/units of the project serving pollution control purposes. Information on actual costs shall be furnished with the application for operation permit.)

To be determined

D. Indicate any previous DER permits, orders and notices associated with the emission point, including permit issuance and expiration dates.

None

E. Requested permitted equipment operating time: hrs/day 24 ; days/wk 7 ; wks/yr 52 ;

if power plant, hrs/yr 8760; if seasonal, describe:

F. If this is a new source or major modification, answer the following questions. (Yes or No)

1. Is this source in a non-attainment area for a particular pollutant?	No
a. If yes, has "offset" been applied?	
b. If yes, has "Lowest Achievable Emission Rate" been applied?	
c. If yes, list non-attainment pollutants.	
2. Does best available control technology (BACT) apply to this source? If yes, see Section VI.	Yes
3. Does the State "Prevention of Significant Deterioriation" (PSD) requirement apply to this source? If yes, see Sections VI and VII.	Yes
4. Do "Standards of Performance for New Stationary Sources" (NSPS) apply to this source?	Yes
5. Do "National Emission Standards for Hazardous Air Pollutants" (NESHAP) apply to this source?	No

H. Do "Reasonably Available Control Technology" (RACT) requirements apply to this source? No

a. If yes, for what pollutants?

b. If yes, in addition to the information required in this form, any information requested in Rule 17-2.650 must be submitted.

Attach all supportive information related to any answer of "Yes". Attach any justification for any answer of "No" that might be considered questionable.

[BOILER]

SECTION III: AIR POLLUTION SOURCES & CONTROL DEVICES (Other than Incinerators)

A. Raw Materials and Chemicals Used in your Process, if applicable:

Description	Contaminants		Utilization Rate - lbs/hr	Relate to Flow Diagram
	Type	% Wt		
(see attached report)				

B. Process Rate, if applicable: (See Section V, Item 1) Not applicable

1. Total Process Input Rate (lbs/hr): ______

2. Product Weight (lbs/hr): ______

C. Airborne Contaminants Emitted: (Information in this table must be submitted for each emission point, use additional sheets as necessary)

Boiler emissions

Name of Contaminant	Emission[1]		Allowed[2] Emission Rate per Rule 17-2	Allowable[3] Emission lbs/hr	Potential[4] Emission		Relate to Flow Diagram
	Maximum lbs/hr	Actual T/yr			lbs/yr	T/yr	
SO_2							See
PM/PM_{10}	(See attached report)						attached
NO_x							report
CO							
VOC's							

[1] See Section V, Item 2. (See attached report for other contaminants)

[2] Reference applicable emission standards and units (e.g. Rule 17-2.600(5)(b)2. Table II, E. (1) - 0.1 pounds per million BTU heat input)

[3] Calculated from operating rate and applicable standard.

[4] Emission, if source operated without control (See Section V, Item 3).

[BOILER]

D. Control Devices: (See Section V, Item 4)

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles Size Collected (in microns) (If applicable)	Basis for Efficiency (Section V Item 5)
(See attached report)				

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
(See attached report)			

*Units: Natural Gas--MMCF/hr; Fuel Oils--gallons/hr; Coal, wood, refuse, other--lbs/hr.

Fuel Analysis: (See attached report)

Percent Sulfur: ____________ Percent Ash: ____________

Density: ____________ lbs/gal Typical Percent Nitrogen: ____________

Heat Capacity: ____________ BTU/lb ____________ BTU/gal

Other Fuel Contaminants (which may cause air pollution): ____________

F. If applicable, indicate the percent of fuel used for space heating. Not applicable.

Annual Average ____________ Maximum ____________

G. Indicate liquid or solid wastes generated and method of disposal.

Fly ash and bottom ash will be disposed of in a landfill permitted to accept such materials.

[BOILER]

H. Emission Stack Geometry and Flow Characteristics (Provide data for each stack):

Stack Height: (See attached report) ft. Stack Diameter: ____ ft.

Gas Flow Rate: ____ ACFM ____ DSCFM Gas Exit Temperature: ____ °F.

Water Vapor Content: ____ % Velocity: ____ FPS

SECTION IV: INCINERATOR INFORMATION (NOT APPLICABLE)

Type of Waste	Type 0 (Plastics)	Type I (Rubbish)	Type II (Refuse)	Type III (Garbage)	Type IV (Pathological)	Type V (Liq.& Gas By-prod.)	Type VI (Solid By-prod.)
Actual lb/hr Incinerated							
Uncontrolled (lbs/hr)							

Description of Waste ____

Total Weight Incinerated (lbs/hr) ____ Design Capacity (lbs/hr) ____

Approximate Number of Hours of Operation per day ____ day/wk ____ wks/yr. ____

Manufacturer ____

Date Constructed ____ Model No. ____

	Volume $(ft)^3$	Heat Release (BTU/hr)	Fuel		Temperature (°F)
			Type	BTU/hr	
Primary Chamber					
Secondary Chamber					

Stack Height: ____ ft. Stack Diamter: ____ Stack Temp. ____

Gas Flow Rate: ____ ACFM ____ DSCFM* Velocity: ____ FPS

*If 50 or more tons per day design capacity, submit the emissions rate in grains per standard cubic foot dry gas corrected to 50% excess air.

Type of pollution control device: [ ] Cyclone [ ] Wet Scrubber [ ] Afterburner

[ ] Other (specify) ____

[ASH HANDLING VENT FILTER]

SECTION III: AIR POLLUTION SOURCES & CONTROL DEVICES (Other than Incinerators)

A. Raw Materials and Chemicals Used in your Process, if applicable:

Description	Contaminants		Utilization Rate - lbs/hr	Relate to Flow Diagram
	Type	% Wt		
Boiler Ash	PM	100	(See attached	report)

B. Process Rate, if applicable: (See Section V, Item 1) (See attached report)

1. Total Process Input Rate (lbs/hr): ____________________

2. Product Weight (lbs/hr): ____________________

C. Airborne Contaminants Emitted: (Information in this table must be submitted for each emission point, use additional sheets as necessary)

Name of Contaminant	Emission[1]		Allowed[2] Emission Rate per Rule 17-2	Allowable[3] Emission lbs/hr	Potential[4] Emission		Relate to Flow Diagram
	Maximum lbs/hr	Actual T/yr			lbs/yr	T/yr	
PM/PM_{10}	(See attached		report)				

[1] See Section V, Item 2.

[2] Reference applicable emission standards and units (e.g. Rule 17-2.600(5)(b)2. Table II, E. (1) - 0.1 pounds per million BTU heat input)

[3] Calculated from operating rate and applicable standard.

[4] Emission, if source operated without control (See Section V, Item 3).

[ASH HANDLING VENT FILTER]

. Control Devices: (See Section V, Item 4)

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles Size Collected (in microns) (If applicable)	Basis for Efficiency (Section V Item 5)
Bin Vent Filter	PM	0.02 gr/ft^3	Unknown	Vendor Data

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
NOT APPLICABLE			

*Units: Natural Gas--MMCF/hr; Fuel Oils--gallons/hr; Coal, wood, refuse, other--lbs/hr.

Fuel Analysis:

Percent Sulfur: ______ Percent Ash: ______

Density: ______ lbs/gal Typical Percent Nitrogen: ______

Heat Capacity: ______ BTU/lb ______ BTU/gal

Other Fuel Contaminants (which may cause air pollution): ______

F. If applicable, indicate the percent of fuel used for space heating.

Annual Average ______ Maximum ______

G. Indicate liquid or solid wastes generated and method of disposal.

[ASH HANDLING VENT FILTER]

H. Emission Stack Geometry and Flow Characteristics (Provide data for each stack):

Stack Height: ______________ ft. Stack Diameter: ______________ ft.

Gas Flow Rate: 1,400 ACFM ______________ DSCFM Gas Exit Temperature: Ambient °F.

Water Vapor Content: ______________ % Velocity: ______________ FPS

SECTION IV: INCINERATOR INFORMATION

NOT APPLICABLE

Type of Waste	Type 0 (Plastics)	Type I (Rubbish)	Type II (Refuse)	Type III (Garbage)	Type IV (Pathological)	Type V (Liq.& Gas By-prod.)	Type VI (Solid By-prod.)
Actual lb/hr Incinerated							
Uncontrolled (lbs/hr)							

Description of Waste ______________

Total Weight Incinerated (lbs/hr) ______________ Design Capacity (lbs/hr) ______________

Approximate Number of Hours of Operation per day ______ day/wk ______ wks/yr. ______

Manufacturer ______________

Date Constructed ______________ Model No. ______________

	Volume $(ft)^3$	Heat Release (BTU/hr)	Fuel		Temperature (°F)
			Type	BTU/hr	
Primary Chamber					
Secondary Chamber					

Stack Height: ______ ft. Stack Diamter: ______________ Stack Temp. ______________

Gas Flow Rate: ______________ ACFM ______________ DSCFM* Velocity: ______________ FPS

*If 50 or more tons per day design capacity, submit the emissions rate in grains per standard cubic foot dry gas corrected to 50% excess air.

Type of pollution control device: ☐ Cyclone ☐ Wet Scrubber ☐ Afterburner

☐ Other (specify) ______________

[LIME SILO]

SECTION III: AIR POLLUTION SOURCES & CONTROL DEVICES (Other than Incinerators)

A. Raw Materials and Chemicals Used in your Process, if applicable:

Description	Contaminants		Utilization Rate - lbs/hr	Relate to Flow Diagram
	Type	% Wt		
Lime	PM	100	(See attached report)	

B. Process Rate, if applicable: (See Section V, Item 1) (See attached report)

1. Total Process Input Rate (lbs/hr): ______

2. Product Weight (lbs/hr): ______

C. Airborne Contaminants Emitted: (Information in this table must be submitted for each emission point, use additional sheets as necessary)

Name of Contaminant	Emission[1]		Allowed[2] Emission Rate per Rule 17-2	Allowable[3] Emission lbs/hr	Potential[4] Emission		Relate to Flow Diagram
	Maximum lbs/hr	Actual T/yr			lbs/yr	T/yr	
PM/PM_{10}	(See attached report)						

[1] See Section V, Item 2.

[2] Reference applicable emission standards and units (e.g. Rule 17-2.600(5)(b)2. Table II, E. (1) - 0.1 pounds per million BTU heat input)

[3] Calculated from operating rate and applicable standard.

[4] Emission, if source operated without control (See Section V, Item 3).

[LIME SILO]

. Control Devices: (See Section V, Item 4)

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles Size Collected (in microns) (If applicable)	Basis for Efficiency (Section V Item 5)
Bin Vent Filter	PM	0.02 gr/ft^3	Unknown	Vendor Data

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
NOT APPLICABLE			

*Units: Natural Gas--MMCF/hr; Fuel Oils--gallons/hr; Coal, wood, refuse, other--lbs/hr.

Fuel Analysis:

Percent Sulfur: ______________ Percent Ash: ______________

Density: ______________ lbs/gal Typical Percent Nitrogen: ______________

Heat Capacity: ______________ BTU/lb ______________ BTU/gal

Other Fuel Contaminants (which may cause air pollution): ______________

F. If applicable, indicate the percent of fuel used for space heating.

Annual Average ______________ Maximum ______________

G. Indicate liquid or solid wastes generated and method of disposal.

[LIME SILO]

H. Emission Stack Geometry and Flow Characteristics (Provide data for each stack):

Stack Height: ____________ ft. Stack Diameter: ____________ ft.

Gas Flow Rate: 1,400 ACFM ____________ DSCFM Gas Exit Temperature: ambient °F.

Water Vapor Content: ____________ % Velocity: ____________ FPS

SECTION IV: INCINERATOR INFORMATION

NOT APPLICABLE

Type of Waste	Type O (Plastics)	Type I (Rubbish)	Type II (Refuse)	Type III (Garbage)	Type IV (Pathological)	Type V (Liq.& Gas By-prod.)	Type VI (Solid By-prod.)
Actual lb/hr Incinerated							
Uncontrolled (lbs/hr)							

Description of Waste ____________

Total Weight Incinerated (lbs/hr) ____________ Design Capacity (lbs/hr) ____________

Approximate Number of Hours of Operation per day ______ day/wk ______ wks/yr. ______

Manufacturer ____________

Date Constructed ____________ Model No. ____________

	Volume (ft)^3	Heat Release (BTU/hr)	Fuel		Temperature (°F)
			Type	BTU/hr	
Primary Chamber					
Secondary Chamber					

Stack Height: ____________ ft. Stack Diamter: ____________ Stack Temp. ____________

Gas Flow Rate: ____________ ACFM ____________ DSCFM* Velocity: ____________ FPS

*If 50 or more tons per day design capacity, submit the emissions rate in grains per standard cubic foot dry gas corrected to 50% excess air.

Type of pollution control device: [ ] Cyclone [ ] Wet Scrubber [ ] Afterburner

[ ] Other (specify) ____________

Brief description of operating characteristics of control devices:

Ultimate disposal of any effluent other than that emitted from the stack (scrubber water, ash, etc.):

NOTE: Items 2, 3, 4, 6, 7, 8, and 10 in Section V must be included where applicable.

SECTION V: SUPPLEMENTAL REQUIREMENTS

Please provide the following supplements where required for this application.

1. Total process input rate and product weight -- show derivation [Rule 17-2.100(127)]
   Not applicable
2. To a construction application, attach basis of emission estimate (e.g., design calculations, design drawings, pertinent manufacturer's test data, etc.) and attach proposed methods (e.g., FR Part 60 Methods 1, 2, 3, 4, 5) to show proof of compliance with applicable standards. To an operation application, attach test results or methods used to show proof of compliance. Information provided when applying for an operation permit from a construction permit shall be indicative of the time at which the test was made. (see attached report)
3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test).
   (see attached report)
4. With construction permit application, include design details for all air pollution control systems (e.g., for baghouse include cloth to air ratio; for scrubber include cross-section sketch, design pressure drop, etc.)
   (see attached report)
5. With construction permit application, attach derivation of control device(s) efficiency. Include test or design data. Items 2, 3 and 5 should be consistent: actual emissions = potential (1-efficiency).
   (see attached report)
6. An 8 1/2" x 11" flow diagram which will, without revealing trade secrets, identify the individual operations and/or processes. Indicate where raw materials enter, where solid and liquid waste exit, where gaseous emissions and/or airborne particles are evolved and where finished products are obtained.
   (see attached report)
7. An 8 1/2" x 11" plot plan showing the location of the establishment, and points of airborne emissions, in relation to the surrounding area, residences and other permanent structures and roadways (Example: Copy of relevant portion of USGS topographic map).
   (see attached report)
8. An 8 1/2" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram.
   (see attached report)

9. The appropriate application fee in accordance with Rule 17-4.05. The check should be made payable to the Department of Environmental Regulation.

10. With an application for operation permit, attach a Certificate of Completion of Construction indicating that the source was constructed as shown in the construction permit.

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

A. Are standards of performance for new stationary sources pursuant to 40 C.F.R. Part 60 applicable to the source?

[X] Yes [ ] No

Contaminant	Rate or Concentration
(See attached report)	

B. Has EPA declared the best available control technology for this class of sources (If yes, attach copy)

[ ] Yes [ ] No

Contaminant	Rate or Concentration
(See attached report)	

C. What emission levels do you propose as best available control technology?

Contaminant	Rate or Concentration
(See attached report)	

D. Describe the existing control and treatment technology (if any). Not applicable

1. Control Device/System:
2. Operating Principles:
3. Efficiency:*
4. Capital Costs:

*Explain method of determining

5. Useful Life:

6. Operating Costs:

7. Energy:

8. Maintenance Cost:

9. Emissions:

Contaminant	Rate or Concentration

10. Stack Parameters

a. Height: ft.

b. Diameter: ft.

c. Flow Rate: ACFM

d. Temperature: °F.

e. Velocity: FPS

E. Describe the control and treatment technology available (As many types as applicable, use additional pages if necessary).

1. (See attached report)

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Cost:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

2.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Cost:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

[1] Explain method of determining efficiency.

[2] Energy to be reported in units of electrical power - KWH design rate.

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

3.

a. Control Device: b. Operating Principles:

c. Efficiency:[1] d. Capital Cost:

e. Useful Life: f. Operating Cost:

g. Energy:[2] h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

4.

a. Control Device: b. Operating Principles:

c. Efficiency:[1] d. Capital Costs:

e. Useful Life: f. Operating Cost:

g. Energy:[2] h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

F. Describe the control technology selected: (see attached report)

1. Control Device: 2. Efficiency:[1]

3. Capital Cost: 4. Useful Life:

5. Operating Cost: 6. Energy:[2]

7. Maintenance Cost: 8. Manufacturer:

9. Other locations where employed on similar processes:

a. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

---

[1] Explain method of determining efficiency.

[2] Energy to be reported in units of electrical power - KWH design rate.

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

b. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

10. Reason for selection and description of systems:

[1] Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

SECTION VII - PREVENTION OF SIGNIFICANT DETERIORATION

A. Company Monitored Data None

1. ______ no. sites ______ TSP ______ ( ) SO^{2}* ______ Wind spd/dir

Period of Monitoring ___/___/___ to ___/___/___
month day year month day year

Other data recorded ______________________

Attach all data or statistical summaries to this application.

Specify bubbler (B) or continuous (C).

2. Instrumentation, Field and Laboratory

a. Was instrumentation EPA referenced or its equivalent? ☐ Yes ☐ No

b. Was instrumentation calibrated in accordance with Department procedures?

☐ Yes ☐ No ☐ Unknown

B. Meteorological Data Used for Air Quality Modeling

1. 5 Year(s) of data from 01 / 01 / 82 to 12 / 31 / 86
month day year month day year

2. Surface data obtained from (location) Tampa, Florida

3. Upper air (mixing height) data obtained from (location) Tampa, Florida

4. Stability wind rose (STAR) data obtained from (location) Not applicable

C. Computer Models Used

1. ISCST (not modified) Modified? If yes, attach description.

2. Modified? If yes, attach description.

3. Modified? If yes, attach description.

4. Modified? If yes, attach description.

Attach copies of all final model runs showing input data, receptor locations, and principle output tables.

D. Applicants Maximum Allowable Emission Data

Pollutant	Emission Rate	
TSP	(See attached report)	grams/sec
SO^2	(See attached report)	grams/sec

E. Emission Data Used in Modeling

Attach list of emission sources. Emission data required is source name, description of point source (on NEDS point number), UTM coordinates, stack data, allowable emissions, and normal operating time. (See attached report)

F. Attach all other information supportive to the PSD review. (See attached report)

G. Discuss the social and economic impact of the selected technology versus other applicable technologies (i.e., jobs, payroll, production, taxes, energy, etc.). Include assessment of the environmental impact of the sources.

(See attached report)

H. Attach scientific, engineering, and technical material, reports, publications, journals, and other competent relevant information describing the theory and application of the requested best available control technology.

(See attached report)

APPENDIX B

CALCULATION OF EMISSION RATES FOR RIDGE GENERATING STATION BOILER

APPENDIX B

CALCULATION OF EMISSION RATES FOR RIDGE GENERATING STATION BOILER

The following calculations apply to generation at maximum continuous rating (MCR or 100 percent load). Heat input, fuel consumption, and emission rates at lower load levels are expected to be approximately in proportion to conditions at MCR. Therefore, emissions at 75 percent and 50 percent loads can be calculated by multiplying MCR emission rates by 0.75 and 0.50.

The emission rates shown in this application are expressed in pounds per hour. Maximum annual emission rates can be calculated conservatively by assuming continuous year-round operation at MCR. Hence, annual emissions in tons per year equal:

$$(\text{lb/hr}) \times (8{,}760\ \text{hr/yr})/(2{,}000\ \text{lb/ton}) = 4.38 \times (\text{lb/hr})$$

Table B-1 contains a summary of emission rate calculations by fuel mix for each pollutant. The calculation equations in this table use letter designations for the calculation variables. These letter designations are defined in Table B-2. Derivations of calculation variables are given in Table B-3.

TABLE B-1

RIDGE GENERATING STATION BOILER EMISSION RATE CALCULATIONS FOR MAXIMUM CONTINUOUS RATING

	EMISSION RATES (LB/HR) BY FUEL TYPE (FUEL PERCENTAGES ON A HEAT INPUT BASIS)		
POLLUTANT	100% WOOD	80% WOOD 20% TIRES	75% WOOD 15% TIRES 10% LANDFILL GAS
sulfur oxides (as SO_2)	B x C x E x H = 69.4	B x C x E x H = 109.4	B x C x E x H = 92.5
particulate matter/PM_{10}	A x I = 12.6	A x I = 12.6	A x I = 12.6
nitrogen oxides (as NO_2)	A x J = 94.5	A x J = 94.5	A x J = 94.5
carbon monoxide	A x K = 315.0	A x K = 315.0	A x K = 315.0
volatile organic compounds	A x L = 22.1	A x L = 22.1	A x L = 22.1
lead[a]	A x M = 0.25	A x M = 0.25	A x M = 0.25
hydrogen chloride[a]	A x F = 3.2	A x F = 3.2	A x F = 3.2
beryllium[a]	A x N = 0.0063	A x N = 0.0063	A x N = 0.0063
mercury[a]	A x O = 0.022	A x O = 0.022	A x O = 0.022
ammonia[a]	P x Q x R = 17.8	P x Q x R = 17.8	P x Q x R = 17.8
arsenic[a]	A x S = 0.019	A x S = 0.019	A x S = 0.019
cadmium[a]	A x T = 0.033	A x T = 0.033	A x T = 0.033
chromium VI[a]	A x U = 0.016	A x U = 0.016	A x U = 0.016
nickel[a]	A x V = 0.063	A x V = 0.063	A x V = 0.063
zinc[a]	A x W = 0.63	A x W = 0.63	A x W = 0.63
benzene[a]	A x X = 5.0	A x X = 5.0	A x X = 5.0
formaldehyde[a]	A x Y = 1.7	A x Y = 1.7	A x Y =1.7

Note: Calculation variables are defined in Table B-2.

[a] Highest estimated emissions for any fuel mix shown in each column.

TABLE B-2

RIDGE GENERATING STATION BOILER EMISSION RATE CALCULATION VARIABLES FOR MAXIMUM CONTINUOUS RATING

	CALCULATION VALUES BY FUEL TYPE (FUEL PERCENTAGES ON A HEAT INPUT BASIS)		
VARIABLE	100% WOOD	80% WOOD 20% TIRES	75% WOOD 15% TIRES 10% LANDFILL GAS
A = heat input, MMBTU/hr	630	630	630
B = fuel consumption, lb/hr	115,596	101,477	103,947
C = SO_2 dry scrubber/ fabric filter efficiency factor (1 - 80%/100%)	0.2	0.2	0.2
E = fuel sulfur content fraction	0.0015	0.00269	0.00222
F = HCl emission factor[a], lb/MMBTU	0.005	0.005	0.005
H = ratio of SO_2 to S	2	2	2
I = PM emission factor, lb/MMBTU	0.02	0.02	0.02
J = NO_X emission factor, lb/MMBTU	0.15	0.15	0.15
K = CO emission factor, lb/MMBTU	0.50	0.50	0.50
L = VOC emission factor, lb/MMBTU	0.035	0.035	0.035
M = Pb emission factor[a], lb/MMBTU	0.0004	0.0004	0.0004
N = Be emission factor[a], lb/MMBTU	0.00001	0.00001	0.00001
O = Hg emission factor[a], lb/MMBTU	0.000035	0.000035	0.000035
P = NH_3 volume (ppmv) divided by 10^6	$35.36/10^6$	$35.18/10^6$	$35.26/10^6$
Q = flue gas volume, ft^3/hr (@ 170°F)	13,593,360	13,481,580	13,653,180
R = factor to convert ft^3 of NH_3 @ 170°F flue gas exit temperature	0.037	0.037	0.037
S = arsenic emission factor[a], lb/MMBtu	0.0003	0.0003	0.0003

TABLE B-2

RIDGE GENERATING STATION BOILER EMISSION RATE CALCULATION VARIABLES FOR MAXIMUM CONTINUOUS RATING
(continued)

	CALCULATION VALUES BY FUEL TYPE (FUEL PERCENTAGES ON A HEAT INPUT BASIS)		
VARIABLE	100% WOOD	80% WOOD 20% TIRES	75% WOOD 15% TIRES 10% LANDFILL GAS
T = cadmium emission factor[a], lb/MMBtu	0.000052	0.000052	0.000052
U = chromium emission factor[a], lb/MMBtu	0.000026	0.000026	0.000026
V = nickel emission factor[a], lb/MMBtu	0.0001	0.0001	0.0001
W = zinc emission factor[a], lb/MMBtu	0.001	0.001	0.001
X = benzene emission factor[a], lb/MMBtu	0.008	0.008	0.008
Y = formaldehyde emission factor[a], lb/MMBtu	0.0027	0.0027	0.0027

[a] Represents highest emission factor for any fuel combination.

TABLE B-3

RIDGE GENERATING STATION BOILER
DERIVATION OF EMISSION RATE CALCULATION VARIABLES

VARIABLE[a]	DERIVATION
A	design data
B	design data and expected fuel heating value
C	design data
E	test data
F	estimated based on review of test data and other literature
H	basic chemistry
I	design data
J	design data
K	design data
L	design data
M	estimated based on review of test data and other literature
N	estimated based on review of test data and other literature
O	estimated based on review of test data and other literature
P	design data
Q	design data
R	17 lb/lb mole x lb mole/358.8 ft^3 (@ 32 °F) x (460 + 32 °R)/(460 + 170 °R) = 0.037
S	estimated based on review of test data and other literature
T	estimated based on review of test data and other literature
U	estimated based on review of test data and other literature
V	estimated based on review of test data and other literature
W	estimated based on review of test data and other literature
X	estimated based on review of test data and other literature
Y	estimated based on review of test data and other literature
Z	estimated based on review of test data and other literature

[a] Variable defined in Table B-2.

APPENDIX C

MODELING PRINTOUTS LIST

APPENDIX C

MODELING PRINTOUTS LIST

Printouts of modeling results are being submitted in a separate package. This package also contains diskettes with the output files from which printouts were produced. The following files/printouts are provided:

File Number	Met. Year	Load Level	PSD Area	Averaging Period	Grid
RGS82P15	1982	100%	Class II	All	10°, 250-m spacing
RGS83P15	1983	100%	Class II	All	10°, 250-m spacing
RGS84P15	1984	100%	Class II	All	10°, 250-m spacing
RGS85P15	1985	100%	Class II	All	10°, 250-m spacing
RGS86P15	1986	100%	Class II	All	10°, 250-m spacing
RGS82P16	1982	75%	Class II	All	10°, 250-m spacing
RGS83P16	1983	75%	Class II	All	10°, 250-m spacing
RGS84P16	1984	75%	Class II	All	10°, 250-m spacing
RGS85P16	1985	75%	Class II	All	10°, 250-m spacing
RGS86P16	1986	75%	Class II	All	10°, 250-m spacing
RGCI82P4	1982	100%	Class I	All	[Discrete Receptors]
RGCI83P4	1983	100%	Class I	All	[Discrete Receptors]
RGCI84P4	1984	100%	Class I	All	[Discrete Receptors]
RGCI85P4	1985	100%	Class I	All	[Discrete Receptors]
RGCI86P4	1986	100%	Class I	All	[Discrete Receptors]
RGCI82P5	1982	75%	Class I	All	[Discrete Receptors]
RGCI83P5	1983	75%	Class I	All	[Discrete Receptors]
RGCI84P5	1984	75%	Class I	All	[Discrete Receptors]
RGCI85P5	1985	75%	Class I	All	[Discrete Receptors]
RGCI86P5	1986	75%	Class I	All	[Discrete Receptors]

File Number	Met. Year	Load Level	PSD Area	Averaging Period	Grid
RGS82P21	1982	75%	Class II	1-hour	2°, 100-m spacing
RGS83P17	1983	100%	Class II	3-hour	2°, 100-m spacing
RGS84P17	1984	100%	Class II	3-hour	2°, 100-m spacing
RGS85P17	1985	100%	Class II	3-hour	2°, 100-m spacing
RGS86P17	1986	100%	Class II	3-hour	2°, 100-m spacing
RGS84P18	1984	100%	Class II	8-hour	2°, 100-m spacing
RGS86P18	1986	100%	Class II	8-hour	2°, 100-m spacing
RGS86P18A	1986	75%	Class II	8-hour	2°, 100-m spacing
RGS82P19	1982	100%	Class II	24-hour	2°, 100-m spacing
RGS83P19	1983	100%	Class II	24-hour	2°, 100-m spacing
RGS83P19A	1983	75%	Class II	24-hour	2°, 100-m spacing
RGS86P20	1986	100%	Class II	Annual	2°, 100-m spacing

RGS100SC	Screen Results for 100% Load
RGS75SC	Screen Results for 75% Load
RGS50SC	Screen Results for 50% Load

1050216-NA-AC
PSO-183

RUN 9/28/06 4:13