International Paper
Project XL
Application

International Paper
Androscoggin Mill
Jay, Maine

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Project Summary

International Paper's Androscoggin mill (IP), located in Jay, Maine is proposing to develop, test and implement a computer generated predictive emissions monitoring (PEM) system to correlate operating parameters to emission rates and predict pollutant emissions on a continuous basis for the mill's waste fuel incinerator (WFI). This computer-generated model would provide tangible compliance guidelines for stack emissions that would exceed current federal and state monitoring frequency regulations and enhance environmental protection. The model will assist in optimizing stack emissions thereby allowing the mill to operate at reduced emission rates without impacting production. Additionally, the model could have broad applicability to other sources of air pollution including stacks with high moisture content or those seeking to optimize operational controls while reducing emissions. International Paper in conjunction with the Town of Jay, Maine (a project cosposor) and interested stakeholders will develop a protocol based on the PEM real time output to provide recommendations on optimal operating conditions to reduce emission rates and assure continual compliance with license limits.

Pollutants to be modeled would include particulate matter (PM), SO_2, NOx, and CO although emphasis would be placed on particulates. The PEM, a sophisticated, advanced monitoring system would provide the necessary data for ensuring continuous compliance. The Town of Jay and the State of Maine (project cosponsors) will play integral roles in project development. They may also conduct one or more relative accuracy tests (RATA) to help validate the PEM, the cosponsors will also play an important role in reviewing all relevant data used to evaluate the model capabilities. The PEM model would provide industry and the surrounding community with non-biased, credible, and reliable information on plant emissions on a continuous basis.

International Paper is seeking regulatory flexibility in two areas. The first is to allow minor exceedances above the permit limits to develop emission prediction capability above the permit limits. This would occur for several weeks and be performed both during the model development and model validation phases. The permit limits are based on state regulations that have generally been approved within the state implementation plan (SIP). Any permitted exceedances would be agreed upon before hand and be limited to days where the potential to exceed ambient air quality standards would be minimal. The second area of flexibility is from the frequency of stack testing and the replacement of continuous emission monitoring (CEMs) with the PEMs. These are primarily embodied in state regulations that have been approved by EPA within the SIP which is considered to be federally enforceable.

1. INTRODUCTION

1.A. Background

The Clean Air Act establishes National Ambient Air Quality Standards (NAAQS) for criteria air pollutants including Particulate Matter (PM). Recent studies have found that current concentrations of Particulate Matter may lead to increased health effects including cardio-pulmonary disorders. Because of these studies, new more stringent Particulate Matter Ambient Air Quality Standards were proposed in 1997 which has increased public awareness and interest in particulate matter and its sources. Ambient air concentrations of pollutants including particulate matter often have both a geographical (or regional) component and an industrial component. As an example of a geographical component, in some areas of the southwest, dust from wind erosion can be a significant contributor to ambient concentrations of particulate matter. An example of an industrial component, industrial processes, fuel combustion and transportation are often significant contributors to ambient PM concentrations in urban areas (National Air Quality and Emissions Trends Report, 1995). Many communities and regulators would like to know how industries impact local ambient air concentrations and whether they can be a significant source of local pollution. The Town of Jay was interested in determining the emissions from International Paper on a more frequent basis than what is currently required so they may assure the residents of proper emission rates.

Problems obtaining this information exist because currently approved monitoring methods do not include continuous monitoring for particulate matter for saturated stacks (high moisture content). Emissions from a number of different types of industrial stacks can only be measured through stack testing which is generally only performed once every two years or once every year. The steam from these saturated stacks limit the type of emissions monitoring that can be performed for particulate matter. Opacity meters are often used for continuous monitoring of PM for stacks with no moisture, but the meters become highly inaccurate when moisture is present (the steam or water vapor is measured as a particle).

Continuous Emission Monitors (CEMS) have been effective in monitoring pollutants such as SOx and NOx and are required for several types of emission sources through federal regulation. Recently, CEMs have been shown to be effective in monitoring PM in the saturated stacks of hazardous waste incinerators, and a draft methodology has been proposed in the federal register. However, CEMs may require frequent calibration and maintenance thus incurring high annual costs. Additionally CEMS only provide information on emission levels - a PEM would provide information on emissions levels as well as the operating parameters most strongly influencing them.

1.B. Objectives

One of the objectives of this project is to provide assurances of acceptable emissions of particulates and other pollutants on a continuous basis. To satisfy this objective as well as others, International Paper proposes to develop a PEM system for their Waste Fuel Incinerator (WFI). The PEM would use a high order nonlinear regression mathematical model using an advanced neural network to predict emissions from process operation data.

The second objective is to develop a model based on the PEM real-time results to provide feedback on operation controls of the WFI to reduce emissions. Optimally the model could assist in maximizing production while also decreasing emissions.

The third objective of this project is to meet the Town's desire to assure that no exceedances of permit limits will occur from the WFI. The mill uses a compliance assurance action plan which was developed as part of the Jay Air Permit No. 5 (Appendix A). This plan used information obtained during five years of stack testing and identifies key operational parameters affecting emissions such as temperature, oil firing rate and scrubber pressure drop. The plan then goes on to set specific actions when these parameters move outside acceptable ranges. Unlike a CEM system, a PEM system can identify the most important parameters as well as more accurately determine the ranges that affect emission rates. The PEM would identify the key parameters necessary for compliance by developing a mathematical relationship between operational parameters and emission rates so that a quantitative relationship would be developed and priorities for action could be established. As an example, the compliance assurance plan identifies that if the scrubber flow decreases below 1300 gals/minute - a violation may occur and steps must be taken to increase the flow drop. The PEM would be able to specifically state what the anticipated increase in emissions may be and then furthermore identify the operational actions IP should take to prevent emission violations from occurring.

The model could:

- numerically correlate operating parameters to emission rates;
- accurately predict emission rates on a continuous basis;
- identify optimal operating conditions to achieve lowest possible emission rates while maintaining efficient production;
- provide alarms to provide immediate notification of potential exceedances;

For purposes of the this XL project International Paper would commit to:

- develop an innovative technology;
- develop a protocol (similar to a compliance assurance plan) using the real-time output of the PEM to assure continual compliance;

- work towards a 10% reduction in emissions per unit of production based on license levels;
- operate WFI with the operational data from the PEM so they remain below 90% of the license limit; and
- making the PEM estimates enforceable.

1.C. Facility Process Description

The Androscoggin mill is a large, integrated kraft pulp and paper mill. Wood chips are cooked in 1 of 2 continuous digesters with a cooking chemical, called white liquor. As chips are continuously fed into a digester, cooked pulp (brown stock) is removed and separated from the spent (used) cooking liquor by washers. The separated pulp fibers are moved to the bleach plant, and the spent cooking liquor goes through a recovery process described below. In the bleach plant the pulp is allowed to react with a chlorine dioxide (ClO_2) mixture to further aid in the bleaching process. Washers then filter the fibers out of this solution and the fibers pass on to a caustic (NaOH) and peroxide (H_2O_2) solution and back to a chlorine dioxide solution that extracts the remaining lignin. Washers then filter the fibers, called bleached stock, out of this solution. The fibers are now essentially ready for use.

The recovery of the cooking liquor chemicals after they are spent is possible in the kraft process. After the spent cooking liquor, called black liquor, is separated from the cooked pulp, it is concentrated by evaporating much of its water content. This concentrates the organic lignin cooked out of the wood chips as well as the inorganic chemicals. This concentrated black liquor is then burned in one of two recovery boilers where the organics provide the fuel to produce steam and the inorganic chemicals form smelt which flows out the bottom of the boiler into the smelt dissolving tank to form green liquor, the beginnings of the new cooking liquor. The lime from the two on-site lime kilns is then reacted with a green liquor solution to form white liquor, which is the new cooking liquor used in the digesters. The spent lime (lime mud) is washed to remove the remaining alkaline material. The filtrate is called weak wash and is used as make-up. Lime mud is generated to quicklime in the lime kiln. New lime solution is made by combining the regenerated quicklime with green liquor, weak wash, or water in the lime slaker.

The lime kilns are used to reburn lime mud ($CaCO_3$) and convert it to lime (CaO). The lime is then slaked and causticized with green liquor from the recovery boilers to form white liquor. The white liquor is reintroduced to the kraft cycle. Under current technology, particulate (PM) emissions from the lime kilns are only measured during annual stack tests, while indicator parameters, such as firing temperature, of particulate matter emissions are monitored continuously. An opacity monitor can not be used as a surrogate because of the high moisture content caused by the scrubber. Total reduced sulfur (TRS) is monitored at the kilns using a CEM. Other emissions SO_2, NOx, and CO) are not being monitored except during stack tests.

The mill generates power to run the facility using two on-site power boilers, a waste fuel incinerator (WFI), and two recovery boilers. The power boilers burn No. 6 fuel oil and the WFI burns No. 6 fuel oil (waste oil), bark, paper, and sludge. (The recovery boilers also produce steam for the facility.) Some electricity is purchased from Central Maine Power Company.

The waste fuel incinerator (WFI) is used to produce steam from the combustion of fossil fuel, wood residue (bark), papermill sludge, waste paper, and waste oil. Like the lime kiln, particulate matter (PM) emissions from the WFI are only measured during annual stack tests, while indicator parameters of particulate matter are monitored continuously. An opacity monitor can not be used as a surrogate because of the high moisture content caused by the scrubber. Other emissions (SO_2 and NOx) are presently being measured using CEMs. Carbon monoxide is being monitored through stack tests.

2. PROJECT DESCRIPTION/ENVIRONMENTAL RESULTS

International Paper proposes to develop an alternative emission monitoring system at its Jay, Maine facility using a predictive emissions monitor system developed utilizing a computer model with a neural network to predict particulate matter, sulfur dioxide, nitrogen oxide, carbon monoxide, and carbon dioxide emissions from the mill's waste fuel incinerator. IP in conjunction with the Town of Jay and interested stakeholders will develop a protocol using the PEM to provide feedback on operational controls to maintain optimal emission rates and prevent potential license exceedances. If the PEM development is successful, this system will replace existing applicable continuous emission monitors and stack testing requirements. A successful PEM will improve operational efficiency while reducing emissions. It will identify actions which will maintain reduced emission rates and will help to prevent license exceedances.

Presently, the mill uses a compliance assurance action plan which was developed as part of the Jay Air Permit No. 5 (Appendix A). This plan was developed using information obtained during five years of stack testing and general operator knowledge. It identifies key parameters which may effect emissions and sets specific actions when these parameters move outside acceptable ranges. A PEM system would do two things, reinforce the parameters chosen (confirm they are correct) and would also identify additional key parameters necessary to operate the incinerator in compliance by developing a mathematical relationship between operational parameters and emission rates. The PEM can also be used to optimize operations by reducing emissions while increasing power production.

Using these key parameters, the PEM provides instantaneous compliance information, allowing the mill to react expeditiously to potential non-compliance situations. Under this project, IP will commit to taking action such as process adjustments when predicted emissions get to within 90 percent of the permitted limits with the goal being to maintain emissions below 90% of the limits. Such actions will be triggered before the exceedance and potential environmental harm has occurred. This proactive compliance is not always possible through traditional CEMs and stack tests.

PEM project success will allow for minimizing emissions while maintaining power production. Traditional "end-of-the-pipe" periodic stack testing and continuous monitoring will no longer be necessary to ensure compliance. Periodic evaluation of the model will be required using verification techniques determined with stakeholder input.

3. REGULATORY FLEXIBILITY

International Paper is seeking regulatory flexibility in two areas. The first is to allow a number of very short (several hours) exceedances above the license limits to develop emission prediction capability above the license limit. The model cannot be developed if all ranges are not encountered during model development. The testing and potential exceedances would occur during the model development and model validation phases. Each phase would last approximately one month. The license limits are based on state regulations that have generally been approved within the state implementation plan (SIP). The second area of flexibility is from the frequency of stack testing and the replacement of continuous emission monitoring (CEMs) with the PEMs. These are primarily embodied in state regulations that have been approved by EPA within the SIP. Because regulations within the SIP have been reviewed and approved by EPA, they are considered to be federally enforceable.

3.A. Justification for Short-Term Exceedances

Computer models perform best when predicting emissions within the parameter and emission ranges used in model development. PEMs evaluate multiple variables and their interrelationships are very complex. The PEM may not adequately describe the relationship between changes in operating emissions of a given pollutant at elevated emission levels unless the model includes these conditions during development. Emission level estimates may not be accurate beyond the tested range (and there is no way to test it unless the limits are exceeded.) Short-term exceedances of the license limits will be necessary during development and validation phases to allow for testing under a full range of potential conditions to increase the models ability for predicting accurate emission rates.

Qualifying conditions when these exceedances could occur might include:
- a specified duration (several hours per day only),
- advance notification (to allow only for excursions occurring as part of the model development and testing program),

Actual qualifying conditions would be developed during Final Project Agreement (FPA) development with stakeholder input. It must be emphasized that IP is not seeking blanket amnesty - very specifically only during development and testing phases. Advanced written warning would be given. Exceedances occurring outside of designated time periods would still be subject to enforcement.

3.B. Replacement of Stack Tests and CEMs with PEMs

The second area of regulatory flexibility is for replacement of sampling methods. If the PEM is successful, International Paper seeks to replace current CEMs and stack testing requirements with the PEM analysis. Although, a certain frequency of RATA tests will continue to assure that the PEM remains accurate over the life of the project. Additionally, the number of RATA tests and the frequency of those tests would be determined during FPA development and modified based on observations, and experience gained during the project implementation phase and agreed upon by stakeholders. A starting point for negotiations would likely be quarterly verification computer tests for the first year and annual RATA test for the years after. In exchange for reducing stack test frequency and reducing CEM requirements, International Paper would agree to make PEM results enforceable.

3.C. Federally Enforceable SIP Requirements

Stack testing and CEM requirements are primarily embodied in state regulations that have been approved by EPA within the SIP. Because these state regulations have been reviewed and approved by EPA, they are considered to be federally enforceable. Flexibility from the state SIP may be needed and a process to allow this may need to be addressed. Since the state will likely be a cosponsor of the project, flexibility in state enforcement of the SIP will be will not be a problem. Specifically federal flexibility of the SIP will be needed.

4. COST SAVINGS AND PAPERWORK REDUCTION

The estimated annual savings are about $50,000 per year in expenses. These savings will be achieved through a reduction in maintenance and paperwork associated with existing NOx and SO_2 CEMs. Modification of annual stack testing may provide additional savings of $20,000 per year.

Capital cost avoidance will be about $50,000. These savings will be realized by elimination of the future necessity to purchase CO and PM CEMs. Purchasing of these monitors may be required by the Town of Jay for assured compliance.

PEM development for the WFI is estimated to be $200,000, and PEM validation would be an additional $100,000. All cost savings will be realized only after the model is completed (and offset by the model development and testing.)

5. STAKEHOLDER SUPPORT

The stakeholder process is essential to the success and eventual implementation of the PEM system. Efforts will be made to encourage active community and state participation. The Town of Jay is a project cosponsor, and Maine Department of Environmental Protection, who will likely be project cosponsor, are already involved in developing this project with International Paper.

Potential non-governmental participants in the project include but are not limited to the Natural Resource Council of Maine, the Maine Lung Association, and Environmental Defense Fund. Governmental agencies that will be invited to act as direct participants include members of the Town of Jay Planning Board, members of the Town of Jay selectmen, the Town of Jay code enforcement officer, the commissioner of Maine DEP, members of the Maine DEP Air Bureau, the Penobscot Indians and Federal Land Managers of National Parks near the mill site. Industrial member associations asked to participate include the Maine Pulp and Paper Association, National Council of Air and Stream Improvement, Emission monitor manufacturers and members of the American Forest and Paper Association. Other organizations will be welcomed as participants if they are willing to dedicate the required time.

The above identified potential participants will be welcome to assume the role of commentors if they can not meet the time and resource commitments of being a direct participant. Comments from other organizations and individuals will be welcomed throughout the stakeholder process.

The general public will be notified and asked to participate via a public notice in the local paper and radio announcements by local stations. These notifications will be made after the XL proposal is accepted by EPA.

A minimum of six (or more as needed) stakeholder meetings will be held between EPA's acceptance of IP's proposal and Final Project Agreement development. These meetings will solicit input to enhance the project and ensure its success. The first meeting will provide an overview of the project description, establish a goal for the group, and set ground rules for participation. In addition, attendees will receive a description of the paper making process, facility power generation, the role of the waste fuel incinerator, and compliance requirements. A mill tour may be conducted after this discussion if time permits. The second meeting will finalize the ground rules, continue the process/compliance discussions and answer any questions generated by the group. At this meeting, the mill will present information on a

pilot PEM study on the lime kiln which is currently ongoing (see Appendix B). The third meeting will develop the proposed project details and answer any questions generated by meeting two. The fourth and fifth meetings will answer any questions concerning the project and allow for the final project proposal development. Any subsequent meetings will focus on answering questions concerning the final project.

Meetings will be every three to four weeks over a six-month period with additional meetings scheduled as needed. The sponsors will convene the meeting, with, at least, a two-week notice to participants. Meeting notes will be maintained and distributed. All meetings will be professionally facilitated by an independent facilitator. The first meeting will be held at the Androscoggin mill in Jay, Maine. The location for subsequent meetings will be determined at that time.

During project implementation, the stakeholder group will be invited to participate and/or observe the work. Weekly updates will be provided via internet and mail during project startup and decrease to quarterly when there is only a limited amount of new information. Emission/parameter correlations will be provided as they become available. Other pertinent project information will be posted. Final project results will be presented at a scheduled stakeholder group meeting.

All recommendations made by the stakeholders will receive consideration. Decisions on how to best incorporate stakeholder suggestions will rest with International Paper and the project sponsors.

6. INNOVATION/MULTI-MEDIA POLLUTION PREVENTION

PEMs are an innovative technology that provide valuable continuous information on particulate matter and other pollutant emissions. PEMs have been developed for simple stacks (such as gas fired boilers), but have had very limited application for complex stacks such as waste fuel incinerators. This proposal would seek to develop and use PEMs to estimate PM and other pollutant emission rates from a complex saturated stack. This would be one of the first applications of this technology to the national issue of continuously monitoring these types of complex emission sources.

Successful implementation of this project would provide continuous information on PM emission rates for sources that - to date - have no federally approved methods to monitor particulate matter on a continuous basis (from saturated stacks). However very recently two federal register notices came out regarding PM CEM. The first one described an EPA study on the successful use of CEMs to monitor PM continuously in a saturated stack. The second notice proposed the use of PM CEMs for hazardous waste incinerators. To date there has been no

federal regulation requiring their use and their wide spread use has not occurred.

Perhaps more importantly, PEMs can provide a linkage between emission rates and the operational parameters that affect them. Traditional monitoring techniques are often considered "end-of-pipe" and measure emissions but do not provide information on operational parameters affecting the emissions or how to reduce those emissions. The PEM system identifies statistically significant operating parameters and uses them to predict emission parameter settings. The operator can then use this information to decrease emissions while maintaining production. Understanding the relationship between process variables and subsequent emissions is one of the first steps in pollution prevention planning.

To that end, International Paper proposes to establish a non-enforceable goal (aspiration) to reduce emissions by 10 percent based on permit limits. The method to accomplish this goal will be through process optimization which will be determined during the model development and testing phase. If the results are favorable, IP will seek to optimize production and emissions so that emissions decrease while production remains the same or possibly increases. IP will commit to examining the potential and work to achieve this goal; however, IP can not make a firm commitment to reduce emissions only to attempt to reduce emissions.

Parameters to identify pollution prevention efforts may include:

- emission rates (such as PM lbs/hr, or SO_2 lbs/hr), or
- emission rates per pound of steam.

The compliance assurance action plan (see Appendix A) currently identifies key emission parameters and sets specific actions (response actions) when these parameters move outside acceptable ranges. This action plan will be augmented and modified once the PEM is developed. It will allow for the more accurate setting of ranges to initiate response actions as well as identify other response actions that may more directly affect emission rates. The compliance assurance plan will be used to prevent violations as well as reduce emissions.

7. TRANSFERABILITY

A successful project will allow for the potential technological transfer to other emission sources at the facility as well as others across the country. Not only will this project be transferable, but also this project will help demonstrate that PEM technology may be transferable to "complex" boilers, kilns, and incinerators rather than simply the gas fired boilers where PEMs are currently being used on a limited basis.

8. FEASIBILITY

PEM systems have been implemented at several facilities to monitor SO_2 and NOx emissions. International Paper's Androscoggin mill, EPA, Maine DEP, and Town of Jay are completing a pilot project developing a PEM for the "B" lime kiln for particulate matter, SO_2, NOx, CO, and TRS. The PEM is in the process of being verified by the Town of Jay (see Appendix B for preliminary results).

Project initiation and implementation costs will exceed $200,000. Attempts will be made to use the lime kiln experience to reduce projected expenditures. The mill has budgeted appropriately to complete the project.

9. MONITORING, REPORTING, AND EVALUATION

The stakeholder group as well as the general public cosponsors and EPA will be invited to observe the project during initiation and implementation. Weekly and quarterly reports will be provided via the internet and regular mail. An internet site will likely be developed to post quarterly reports on emissions once emission predictions are validated during RATA testing.

A PEM verification program will be developed similar to an EPA relative accuracy test (RATA). Project success will be determined by satisfactory completion of these RATA tests.

The field portion of the project will be conducted during the spring/summer of 1999. It will take 4 to 6 weeks. After results/report are received, the PEM models will then be developed. This model development will take 4 to 6 weeks. Initial RATA verification will be completed in the fall of 1999. This data analysis will take about 2 to 4 weeks. The PEM will be put on-line once it is certified. Records will be maintained on emissions and actions taken to increase operational efficiency and emission reduction. All this work will be done in conjunction with mill operations.

10. SHIFTING OF RISK BURDEN

The project will not shift any environmental or safety burdens within the community. If successful, environmental, as well as safety concerns will be reduced since the PEM will allow proactive measures to be taken before emissions exceed permit limits.

11. CONCLUSION

International Paper's Androscoggin mill (IP), located in Jay, Maine is proposing to develop, test and implement a computer generated predictive emissions monitoring (PEM) system to predict pollutant emissions on a continuous basis. This sophisticated, advanced monitoring system would provide the necessary data for ensuring continuous compliance. The Town of Jay and the State of Maine will play integral roles in project development and evaluation. They will also help evaluate the emission monitoring system and review the data from the model. This computer-generated model would provide tangible compliance guidelines for stack emissions that would exceed current federal and state monitoring requirements and enhance environmental protection. The model will allow the mill to operate below the permitted limits without jeopardizing production.

Appendix A
COMPLIANCE ASSURANCE ACTION PLAN

Concept

Compliance assurance plans are a proactive systematic emissions monitoring approach integrated with normal day to day operations to assure that emission limits are not exceeded. The principal motivation has been to assure a more continuous knowledge of emission compliance than is gained from annual or semiannual stack testing. This is particularly meaningful for emissions such as particulate emissions (PM) that are not continuously monitored.

In practice, a compliance assurance plan identifies key emission parameters and sets specific actions (response actions) when these parameters are outside acceptable ranges. Under the present compliance assurance plan for IP's waste fuel incinerator (WFI), IP monitors scrubber media flow rate, scrubber differential pressure, oil firing rate, total steam, scrubber media solids, SO_2 CEM, sulfur fuel content and NOx CEM. WFI compliance with SO_2 and NOx emission limits is determined by CEMs. The other operating parameters are monitored by IP to confirm that they are within ranges associated with PM emission compliance.

Current parameter ranges for IP's compliance assurance plan are set based on operating experience and five years of stack test data. There have been no formal studies to correlate the WFI operating variables to PM emission limits other than review of the previous WFI stack testing reports to ascertain compliance conditions. Because of the complexity of the system and large number of parameters involved, there has been no approach to develop an overall system that uses these variables collectively to determine compliance. The proposed XL project would meet these two shortcomings. It would increase our knowledge about the correlation of operating variables to emissions and thus would allow initiation of response actions based on more precise operating ranges. It would also identify any other meaningful variables and ranges that have not yet been discovered, which could be used to make compliance conditions more predictable. Additionally, the model developed by this project would potentially replace the current manual approach with an empirical and more reliable in-line systems approach to continuously assure compliance.

The Town of Jay and International Paper Compliance Assurance Plan

The compliance assurance action plan currently identifies key emission parameters and sets specific actions (response actions) when these parameters move outside acceptable ranges. It was developed by the Androscoggin mill and the Town of Jay, and is incorporated into the Town of Jay's air permit issued to the mill, and is considered an enforceable part of the permit. This action plan will be augmented and modified once the PEM is developed. It will allow for the more accurate and better setting of ranges to initiate response actions as well as identify other response actions that may also affect emission rates.

Attached as part of this Appendix is the current Compliance Assurance Plan for the Waste Fuel Incinerator.

Appendix B

Memo on Preliminary Lime Kiln PEM Performance