HEALY CLEAN COAL PROJECT

SPRAY DRYER ABSORBER SYSTEM
DEMONSTRATION TEST REPORT

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STONE & WEBSTER ENGINEERING CORPORATION
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ABSTRACT

The Healy Clean Coal Project (HCCP) was selected by the U.S. Department of Energy (DOE) under Round III of the Clean Coal Technology Program. The facility is located at Healy, a town 250 miles north of Anchorage, Alaska (near Denali National Park), on a land adjacent to the existing Golden Valley Electric Association, Inc. (GVEA) Healy Unit No. 1 power plant. The project is owned and financed by the Alaska Industrial Development and Export Authority (AIDEA), and is co-funded by the U.S. DOE. The coal supplier is Usibelli Coal Mine, Inc., located adjacent to the Healy plant.

The technology demonstrated at HCCP combines the TRW Clean Coal Combustion System and the Babcock and Wilcox (B&W)/Joy Spray Dryer Absorber (SDA) System into a single, integrated, combustion/emission control process. These technologies have been designed to achieve reductions in emission of sulfur dioxide (SO_2), oxides of nitrogen (NO_x), and particulate matter, thereby meeting future energy needs from coal-fired generation in an environmentally acceptable manner while burning a variety of coals.

The Flue Gas Desulfurization (FGD) System at the Healy Plant consists of a SDA, followed by a baghouse with attendant lime preparation and other sub-systems. The system was started up in January 1998, has been in operation since then and has performed satisfactorily meeting the emission requirements.

A Demonstration Test Program was conducted between November 3 and November 15, 1999. A total of seventeen tests was conducted to study the effect of four variables, namely, unit load (gas flow rate/gas residence time), approach to saturation or flue gas exit temperature, reagent stochiometry or limestone feed rate, and steam reactivation of feed slurry or slurry feed temperature. Each variable was studied at two levels and four tests were conducted for each variable. One randomly selected test was repeated several days after the first one was conducted to confirm reproducibility of test and validate test procedures and methodology. All tests were considered acceptable. The results indicate:

- The SDA system at the HCCP with furnace limestone injection can achieve high SO_2 removal efficiencies in excess of 90% even with very low 0.15% sulfur coal with reasonable reagent stoichiometry of 1.4 to 1.8.

- The system can be operated at an approach to saturation temperature range of 30°F to 40°F, the temperature range of several conventional lime-based, semi-dry FGD systems with SO_2 removal efficiencies in excess of 90%.

- Heat activation of SDA feed slurry appears to be a very significant process parameter, next only to the approach temperature that determines SDA performance with respect SO_2 removal. This is an important finding of this demonstration test program. Even though, steam heating the feed slurry entails operating cost, this is an option that must be considered in furnace limestone injection systems followed by SDA-baghouse. Economics of the approach

will depend primarily on delivered cost of lime and steam, which are site-specific. Operation at the HCCP suggests steam heating is relatively easy to operate and maintain.

- Of the four process parameters investigated, the order of significance with respect to SO_2 removal are:

  - Approach to saturation temperature
  - Heat activation of recycle solids
  - Reagent ratio
  - Unit load (gas flow/gas residence time)

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1.0 EXECUTIVE SUMMARY

The HCCP was selected by the U.S. DOE under Round III of the Clean Coal Technology Program. The facility is located at Healy, a town 250 miles north of Anchorage, Alaska (near Denali National Park), on a land adjacent to the existing GVEA Healy Unit No. 1 power plant. Construction was completed in November 1997, with coal-fired demonstration operations starting in January 1998.

The project was owned and financed by AIDEA, and was co-funded by the U.S. DOE. GVEA of Fairbanks, Alaska provided the plant operators. The plant engineer was Stone & Webster Engineering Corporation (SWEC). The coal supplier was Usibelli Coal Mine, Inc., located adjacent to the Healy plant.

The technology demonstrated at HCCP combines the TRW Clean Coal Combustion System and the B&W/Joy SDA System into a single, integrated, combustion/emission control process. These technologies have been designed to achieve reductions in emission of SO_2, NO_x, and particulate matter, thereby meeting future energy needs from coal-fired generation in an environmentally acceptable manner while burning a variety of coals.

The FGD System at the HCCP consists of a SDA, followed by a baghouse with attendant lime preparation and other sub-systems. The system was supplied by Joy Environmental Technologies Inc., which was subsequently acquired by B&W. The system was started up in January 1998, has been in operation since the start-up and has performed satisfactorily in meeting the emission requirements.

A Demonstration Test Program specified in the DOE Demonstration Test Program was conducted between November 3 and November 15, 1999. The objective of the program was to characterize the SDA system by investigating the effect of various process parameters on system performance so that the data generated can be used to design other systems with different coal characteristics and performance requirements. The parameters to be studied include:

- Sulfur level (coal sulfur content).
- Unit load (gas flow/gas residence time).
- Approach to saturation temperature (flue gas temperature at spray dryer exit).
- Reagent ratio (calcium to sulfur dioxide or stoichiometric ratio).
- Activation of recycles solids.

This report summarizes the results and conclusion of this demonstration test program.

The following parameters were measured/monitored during the tests.

- SDA Inlet
  - Particulate Loading
  - Temperature
  - Moisture Content
  - SO_2
  - Oxygen Content
  - Static Pressure
- SDA Outlet
  - Temperature
  - Static Pressure
- Stack
  - Particulate Loading
  - SO_2 Concentration
  - Temperature
  - Moisture Content
  - Oxygen Content
- Limestone
  - Sample
  - Feed Rate
- Coal
  - Sample
  - Feed Rate (from Plant Distributed Control System (DCS))
- Air Preheater Hopper Ash Sample
- Surge Bin Ash Sample
- Electrical Power Consumption
- Stack Opacity (from Plant Continuous Emission Monitoring System or CEMS)
- Relevant Unit Operating Parameters (from Plant DCS)

A total of seventeen tests was conducted and one of which was a validation to verify the repeatability of system performance. The repeatability was good based on this test result, and all tests were considered acceptable. The results indicate:

- The SDA system at the HCCP with furnace limestone injection can achieve high SO_2 removal efficiencies in excess of 90% even with very low sulfur coal with 0.15% sulfur content at reasonable reagent stoichiometry of 1.4 to 1.8.

- The system can be operated at an approach to saturation temperature range of 30°F to 40°F, the temperature range of several conventional lime-based, semi-dry FGD systems with SO_2 removal efficiencies in excess of 90%.

- Heat activation of SDA feed slurry appears to be a very significant process parameter, next only to the approach temperature that determines SDA performance with respect SO_2 removal. This is an important finding of this demonstration test program. Even though, steam heating the feed slurry entails operating cost, this is an option that must be considered in furnace limestone injection systems followed by SDA-baghouse.

  Economics of the steam heating approach will be site-specific and will depend primarily on delivered cost of lime and steam at plant site. Operation at the HCCP suggests that steam heating is relatively easy to operate and maintain.

- Of the process parameters investigated, the order of significance with respect to SO_2 removal is:
  - Approach to saturation temperature
  - Heat activation recycle solids
  - Reagent ratio
  - Unit load (gas flow/gas residence time)

2.0 INTRODUCTION

2.1 Healy Clean Coal Project (HCCP)

The HCCP was selected by the U.S. DOE under Round III of the Clean Coal Technology Program. After more than five years of planning, design, and permitting activities, the project celebrated its ground-breaking ceremony at Healy, Alaska on May 30, 1995. The facility is located at Healy 250 miles north of Anchorage (near Denali National Park), Alaska on a land adjacent to the existing GVEA Healy Unit No. 1 power plant. Construction was completed in November 1997, with coal-fired operations starting in January 1998.

The project is owned and financed by AIDEA, and is cofunded by the U.S. DOE. GVEA of Fairbanks, Alaska provided the plant operators. The plant engineer was SWEC. The coal supplier is Usibelli Coal Mine, Inc., located adjacent to the Healy Unit No. 1 power plant.

The technology currently being demonstrated in the HCCP combines the TRW Clean Coal Combustion System and the B&W/Joy SDA System into a single, integrated, combustion / emission control process. These technologies have been designed to achieve reductions in emission of SO_2, NO_x, and particulate matter, thereby meeting future energy needs from coal-fired generation in an environmentally acceptable manner while burning a variety of coals.

The TRW Combustion System achieves low NO_x emissions through a combination of well-controlled fuel and air staging. The combustor also removes approximately 80 to 90 percent of the coal ash as a slag by-product. For SO_2 removal, limestone is injected at the exit of the combustor and results in the production of a flash calcined lime material (FCM) in the furnace. Some of the SO_2 in the combustion flue gas is removed in furnace. The FCM is subsequently used downstream in the SDA System, consisting of a spray dryer absorber and a pulse jet baghouse supplied by B&W/Joy, where most of the SO_2 is removed to meet the emission requirement.

2.2 Coal and Ash Characteristics

The coals to be fired in the HCCP Combustion System (shown in Table 2.1) are low sulfur, high moisture, low heating value fuels from the nearby Usibelli Coal Mine. The three columns of data represent the average composition of run-of-mine coal (ROM), waste coal, and performance coal. ROM coal is run-of-mine coal, where care was taken in the mining operation to minimize the amount of overburden and lenses included with the coal. Waste coal is not subject to this selective separation process and hence has a lower heating value and a higher ash content. Performance coal consists of a blend of 50 percent ROM and 50 percent waste coal. The actual coals burned were representative of the long-term characteristics of the mine.

Table 2.1
Coal and Ash Characteristics
(% by Weight, as received basis)

	ROM Coal	Waste Coal	Performance Coal
Proximate Analysis			
Moisture	26.35	23.87	25.11
Ash	8.20	25.00	16.60
Volatile	34.56	27.00	30.78
Fixed, Carbon	30.89	24.13	27.51
TOTAL	100.00	100.00	100.00
Ultimate Analysis			
Moisture	26.35	23.87	25.11
Ash	8.20	25.00	16.60
Carbon	45.55	35.59	40.57
Hydrogen	3.45	2.70	3.07
Nitrogen	0.59	0.46	0.53
Sulfur	0.17	0.13	0.15
Oxygen	15.66	12.23	13.94
Chlorine	0.03	0.02	0.03
TOTAL	100.00	100.00	100.00
Elemental Ash Analysis	38.61	74.58	65.59
Silicon Dioxide	16.97	9.16	11.09
Aluminum Oxide	0.81	0.43	0.52
Titanium Dioxide	7.12	4.18	4.90
Ferric Oxide	23.75	6.32	10.62
Calcium Oxide	4.54	1.32	1.87
Potassium Oxide	1.02	1.21	1.16
Sodium Oxide	0.66	0.65	0.65
Sulfur Trioxide	5.07	1.36	2.28
Phosphorus Pentoxide	0.48	0.24	0.30
Strontium Oxide	0.23	0.07	0.11
Barium Oxide	0.44	0.15	0.22
Manganese Oxide	0.06	0.05	0.04
Undetermined	1.24	0.29	0.55
TOTAL, %	100.00	100.00	100.00

2.3 HCCP Technology Description

2.3.1 General

The HCCP integrates a slagging, multi-staged coal combustor system with an innovative sorbent injection/spray dryer absorber/baghouse exhaust gas scrubbing system. Twin 350 million Btu/hr combustors designed by TRW are used to supply hot gases to a conventional Foster Wheeler bottom-fired boiler. The TRW combustors minimize NOx emissions, remove 80 to 90% of ash, and provide a first stage SO_2 removal system. The final flue gas cleaning equipment was supplied by B&W (formerly Joy Environmental Technologies Inc., of Houston, Texas) consisting of a single atomizer spray dryer and a pulse jet baghouse.

2.3.2 SDA System

The FGD System at the HCCP consists of a SDA followed by a baghouse with attendant lime preparation and other sub-systems. The System was supplied by Joy Environmental Technologies Inc., which was subsequently acquired by B&W. A schematic diagram of the SDA System is shown in Figure 2-1. Flue gas from the boiler with 10 to 20% of the fly ash and flash calcined lime material (FCM) is passed through the SDA, where it is contacted with fine droplets of recycled FCM slurry. The slurry is atomized and sprayed into the gas stream by a rotary atomizer. The gas is cooled and SO_2 in the gas stream is reacted and removed by the alkaline material in the slurry. The amount of slurry sprayed into the gas stream is controlled to maintain the SDA exit gas temperature above the adiabatic saturation temperature. The gas is then passed through a pulse-jet baghouse to remove the reaction products, unreacted FCM and fly ash from the gas before it is discharged through the stack to the atmosphere. A portion of this collected material is slurried and recycled to SDA and the rest is removed for disposal.

2.4 System Performance Test

The SDA System was installed and started up in the spring of 1998. It has been in operation since startup and has performed well meeting and most of the time exceeding the SO_2 emission performance requirements.

Although the SDA System had been in operation for more than a year, no formal performance test had been done. A formal performance test program as required by Contract No. HCCP-007 between AIDEA and B&W/Joy and as generally described in the Demonstration Test Plan was conducted between June 7 and June 11, 1999. Based on the test results it was concluded that the system has met all the performance guarantees. A DOE Topical Report summarizing details of the performance test program, test plan, test procedures, test methods, plant operational details during the test, test results and a comparison of the actual system performance with performance guarantees as per the Contract has already been issued in April 2000 (Reference 1).

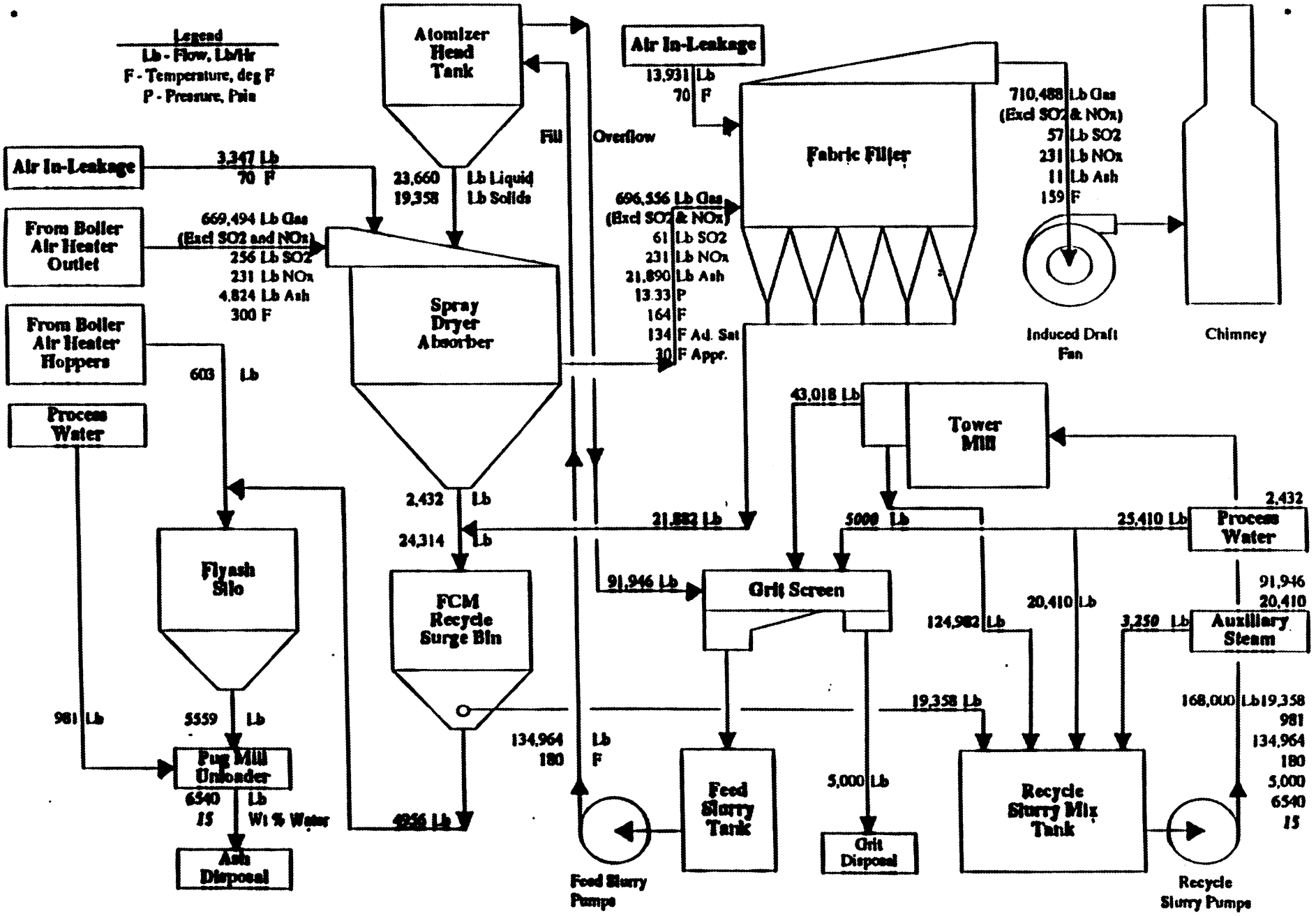


Figure 1 - Flue Gas Desulphurization, Fabric Filter, Flyash and Stack Gas

3.0 SYSTEM DEMONSTRATION TEST PROGRAM

3.1 General

The Demonstration Test Program was conducted between November 3 and November 15, 1999. The objective of the program was to characterize the SDA system by investigating the effect of various process parameters on system performance so that the data generated can be used to design other systems with different coal characteristics and performance requirements. The parameters to be studied include:

- Sulfur level (coal sulfur content)
- Unit load (gas flow/gas residence time)
- Approach to saturation temperature (flue gas temperature at spray dryer exit).
- Reagent ratio (calcium to sulfur dioxide or stoichiometric ratio).
- Heat Activation of recycles solids

A conceptual plan and the proposed test described in a report titled, "HCCP Demonstration Test Program," prepared by SWEC and Steigers Corporation, dated July 1998, is summarized in Table 3.1 (Reference 2). The details of the test program from the HCCP Demonstration Test Program pertaining to the SDA System are included as Appendix A.

Table 3.1
HCCP SDA Technology Characterization Proposed Test Matrix

Inlet SO_2 Concentration	Reagent Ratio (Ca/SO_2)	Approach to Saturation, °F	Recycle Grind	Recycle
Low	1.95	33	Design	No Supplemental Heat Activation
	1.75	18		With Supplemental Heat Activation
Medium	1.95	33	Design	No Supplemental Heat Activation
	1.75	18		With Supplemental Heat Activation
High	1.95	33	Design	No Supplemental Heat Activation
	1.75	18		With Supplemental Heat Activation

Based on review of SWEC/Steigers Corporation Demonstration Test Program document and a report titled, "Healy Clean Coal Project (HCCP) – Demonstration Test Program, Topical Report: Combustion System Operation" by TRW, dated March 31, 2000 (Reference 3), the following test program for the SDA system was developed. The basis and other details of the proposed program are presented here.

3.2 Basis

3.2.1 Sulfur Level (Coal Sulfur Content)

The test plan requires that the tests be done at three different sulfur levels, i.e., low, medium, and high. There is no mention of specific sulfur content associated with these qualitative "levels". A summary of the ROM coal, performance coal and the waste coal for average sulfur content, SO_2/MM Btu, coal flow rate, coal flow/MMBtu, calcium oxide introduced with ash per MMBtu and per hour are summarized in Table 3.2.

Table 3.2
Summary of Average Sulfur Contents and SO_2 Emissions of ROM, Performance and Waste Coals

No.	Parameter	ROM	Perf. Coal	Waste Coal
1	Sulfur Content, % wt.	0.17	0.15	0.13
2	HHV, Btu/lb	7,815	6,960	6,105
3	Ash, % wt	8.2	16.6	25.00
4	CaO in ash, % wt	23.75	10.62	6.32
5	Coal Feed Rate, lb/hr*	82,278	92,400	105,323
6	Coal Feed, lb/MMBtu	127.96	143.67	163.80
7	Uncontrolled SO_2, lb./hr*	279.75	277.20	273.84
8	Uncontrolled SO_2, lb/MMBtu	0.435	0.431	0.426
9	CaO in ash, lb./hr*	1,601	1,626	1,665
10	CaO in ash, lb/MMBtu	2.49	2.53	2.59

* At Target Performance Heat Input Rate of 643 MMBtu/hr.

As can be seen from the table, the variation in the average sulfur content, the uncontrolled SO_2 emission, both on an hourly and a MMBtu input basis are on the average very close to one another for the three coals. The same is true for the CaO introduced with the ash. Therefore, it is difficult to test at three levels of sulfur content as per the HCCP Demonstration Test Program using the ROM coal, the waste coal, or a combination of the coal blends. One way to test at different sulfur levels is to use coals with sufficiently different sulfur content, say a difference of at least 0.2% or so. This approach was not possible given the remote location of the plant. Therefore, the sulfur level was not deliberately varied and tested at pre-determined levels. It varied due to variation of the coal composition and be at levels as determined by the sulfur content of the feed coal to the plant during the tests.

3.2.2 Unit Load (Gas Flow/Gas Residence Time) (Gas Residence Time)

This is not one of the parameters included in the original conceptual plan. However, because of the significance of this parameter in SDA and baghouse performance with respect to SO_2 removal, the effect of this parameter was investigated. This was done by performing the test at two different unit loads, namely at approximately 40 MWe to 42 MWe and 50 MWe to 55 MWe, which in turn resulted in different gas flow rates and attendant resident times in SDA vessel and baghouse.

3.2.3 Approach to Saturation Temperature

This is an important process parameter that significantly influences system performance. Because of the potential condensation with attendant bag blinding problem, two approaches to saturation temperatures, 44°F and 34°F were chosen for testing instead of 34°F and 18°F as originally proposed in the conceptual test plan. It is of interest to note that almost all commercial SDA systems operate in the approach to temperature range of 35°F to 45°F to avoid condensation and associated problems.

3.2.4 Reagent Ratio (Calcium to Sulfur Dioxide)

The conceptual plan requires that the system be characterized at two reagent ratios or limestone feed rates. The limestone feed rates could not be varied over a wide range since the unit has to be in compliance during the test period, which meant that the SO_2 emission cannot exceed 32 ppmv. The limestone feed was varied from 700 lb/hr to 1,350 lb/hr depending on unit load to achieve as wide a reagent ratio as possible.

3.2.5 Heat Activation of Recycle Solids

The reaction products collected in the baghouse and the spray dryer absorber vessel consists of a large fraction of unreacted lime. The lime utilization can be significantly improved by recycling a portion of the collected solids as being done in the HCCP SDA system. In fact the source of solid of SDA feed slurry is the solids collected by the baghouse and removed from the SDA vessel. The reagent utilization can be further improved by heating the recycle solids. The heat activation improves slaking, i.e., conversion of unreacted calcium oxide in the recycle solids to calcium hydroxide. This was done using steam heating the feed slurry. The normal temperature of the feed slurry without steam heating was in the range of 100°F to 110°F. With steam heating, this was increased to 145°F to 155°F.

3.3 Test Matrix

The test matrix and the actual sequence of testing that accommodates the test plan and minimizes the transition period between tests are summarized in Tables 3.3 & 3.4.

Table 3.3
Test Matrix

Test	Coal Sulfur Content	Unit Load (Gas Flow Rate/Gas Residence Time)	Heat Activation	Limestone Feed Rate (Reagent Ratio)	Approach to Saturation Temperature (°F)
1	As Available	50	No	1.75	45
2			No	1.75	35
3			No	1.75	45
4			No	1.75	35
5			Yes	1.75	45
6			Yes	1.75	35
7			Yes	1.95	45
8			Yes	1.95	35
9	As Available	40	No	1.95	45
10			No	1.95	35
11			No	1.75	45
12			No	1.75	35
13			Yes	1.75	45
14			Yes	1.75	35
15			Yes	1.95	45
16			Yes	1.95	35
17	Repeat one of the above tests to confirm data reproducibility and validity				

Table 3.4
Test Sequence and Test Parameters

Test No.	Date	Unit Load (Gross, MWe)	Limestone Feed Rate (lb/min)	Approach to Satn. Temp. (°F)	Feed Slurry Temp. (°F)
1.1	04-Nov-99	42.1	17.1	44	111.2
1.2	04-Nov-99	42.4	16.9	44	154.6
1.3	04-Nov-99	42.3	17.0	34	154.8
1.4	06-Nov-99	42.0	17.2	34	102.1
2.1	07-Nov-99	57.7	22.2	34	109.6
2.2	07-Nov-99	56.4	22.3	34	147.6
2.3	08-Nov-99	58.0	22.2	44	151.2
2.4	08-Nov-99	57.9	22.3	44	102.6
3.1	10-Nov-99	58.1	17.3	34	104.1
3.1 A*	12-Nov-99	58.3	17.9	35	107.0
3.2	10-Nov-99	58.1	17.1	36	153.6
3.3	11-Nov-99	58.3	17.3	44	153.4
3.4	11-Nov-99	58.0	17.8	41	110.7
4.1	13-Nov-99	42.1	11.5	44	107.1
4.2	14-Nov-99	41.8	12.2	44	152.9
4.3	14-Nov-99	42.2	11.5	34	153.0
4.4	15-Nov-99	42.1	12.6	34	109.1

Note: Repeat of Test 3.1A. The tests were done two days apart to confirm data validity and reproducibility.

The actual test date, start, finish and duration of each test and the time at which samples were taken are summarized in Table 3.5. The samples taken at each sampling time indicated include:

- Coal Feeder A and Feeder B
- Limestone
- SDA Feed Slurry
- SDA Hopper Ash
- SDA Surge Bin Ash
- Air Heater Hopper Ash
- Baghouse Hopper Ash (East and West Hoppers)

Table 3.5
Test and Sampling Details – Date, Time, Sampling Time and Test Duration

Test No.	Date	Time	Start	Finish	Duration
1.1	Nov 3 1999	08:00	08:00		
1.1	Nov 3 1999	12:00			
1.1	Nov 3 1999	16:00		19:00	11:00
1.2	Nov 4 1999	08:00	08:00		
1.2	Nov 4 1999	12:00			
1.2	Nov 4 1999	16:00			
1.2	Nov 4 1999	20:00		20:00	12:00
1.3	Nov 4 1999	00:00	21:00		
1.3	Nov 5 1999	04:00			
1.3	Nov 5 1999	08:00		09:00	12:00
1.4	Nov 5 1999	23:00	23:00		
1.4	Nov 6 1999	02:00			
1.4	Nov 6 1999	05:00		06:00	7:00
2.1	Nov 7 1999	02:00	00:00		
2.1	Nov 7 1999	05:00			
2.1	Nov 7 1999	08:00		06:00	6:00
2.2	Nov 7 1999	14:00	13:00		
2.2	Nov 7 1999	17:00			
2.2	Nov 7 1999	20:00			
2.2	Nov 7 1999	23:00		23:00	10:00
2.3	Nov 8 1999	02:00	01:00		
2.3	Nov 8 1999	05:00			
2.3	Nov 8 1999	08:00		09:00	8:00

2.4	Nov 8 1999	20:00	20:00		
2.4	Nov 8 1999	23:00			
2.4	Nov 9 1999	02:00		04:00	8:00
3.1	Nov 9 1999	17:00	16:00		
3.1	Nov 9 1999	20:00			
3.1	Nov 9 1999	23:00		01:00	9:00
3.2	Nov 10 1999	11:00	10:00		
3.2	Nov 10 1999	14:00			
3.2	Nov 10 1999	17:00		19:00	9:00
3.3	Nov 10 1999	23:00	21:00		
3.3	Nov 11 1999	02:00			
3.3	Nov 11 1999	05:00			
3.3	Nov 11 1999	08:00		08:00	9:00
3.4	Nov 11 1999	17:00	15:00		
3.4	Nov 11 1999	20:00			
3.4	Nov 11 1999	23:00		23:00	8:00
3.1A	Nov 12 1999	05:00	04:00		
3.1A	Nov 12 1999	08:00			
3.1A	Nov 12 1999	11:00		12:00	8:00
4.1	Nov 13 1999	02:00	01:00		
4.1	Nov 13 1999	05:00			
4.1	Nov 13 1999	08:00		10:00	9:00
4.2	Nov 13 1999	14:00	13:00		
4.2	Nov 13 1999	17:00			
4.2	Nov 13 1999	20:00			
4.2	Nov 13 1999	23:00		24:00	11:00

4.3	Nov 14 1999	02:00	02:00		
4.3	Nov 14 1999	05:00			
4.3	Nov 14 1999	08:00		10:00	8:00
4.4	Nov 14 1999	23:00	22:00		
4.4	Nov 15 1999	02:00			
4.4	Nov 15 1999	05:00		10:00	12:00

4.0 TEST PROCEDURES AND TESTING

4.1 Test Parameters and Data Collection

The following unit operating parameters were taken from the plant DCS System: (I) Load, (ii) Steam Flow, (iii) Throttle Pressure, (iv) Main Steam Temperature, (v) Coal Flow Rate-Feeder A, (vi) Coal Flow Rate-Feeder B, (vii) Total Coal Flow-Feeder A, (viii) Total Coal Flow-Feeder B, (ix) Limestone Flow Rate, (x) Total Limestone Flow, (xi) Feeder Load Cell (% Reading), (xii) Oxygen Content of Flue Gas at CEMS, (xiii) Oxygen Content of Flue Gas at Boiler Outlet, (xiv) Flue Gas Temperature at Stack, (xv) SDA Inlet SO_2, (xvi) SDA Inlet Pressure, (xvii) SDA Inlet Temperature, (xviii) SDA Outlet Temperature, (xix) Baghouse Differential Pressure, (xx) Induced Draft Fan Inlet Pressure, (xxi) Baghouse Outlet Temperature, (xxii) ID Fan Discharge Temperature, (xxiii) Stack SO_2, (xxiv) Stack SO_2 One-Hour Average, (xxv) Stack NO_x One-Hour Average, (xxvi) Stack CO_2, (xxvii) Stack Opacity, (xxviii) Atomizer Feed Slurry Temperature, (xxix) Atomizer Feed Slurry Density, (xxx) Atomizer Feed Slurry Flow, (xxxi) SDA Differential Pressure, and (xxxii) Atomizer Power.

Details pertaining to the above and other test parameters are summarized in the following tables. Comments pertaining to each parameter are also included.

Table 4.1
Data Collection – Test Parameters

No.	Test Parameter/ Variable	Test Method/ Instrumentation	Comments
1	SO_2 Concentration at SDA System Inlet	Plant Instrumentation	SO_2 concentration at SDA inlet is measured using existing plant instrumentation by the plant DCS system on a continuous basis.
2	SO_2 Concentration at SDA System Outlet, i.e., Stack	N/A	SO_2 concentration at system outlet is measured in the stack by the Continuous Emission Monitoring System (CEMS) and the SDA system removal efficiency is calculated from the inlet and outlet concentrations using appropriate corrections for temperature difference, oxygen content, moisture content between the inlet and exit flue gas.

No.	Test Parameter/ Variable	Test Method/ Instrumentation	Comments
3	Opacity at SDA System Outlet, i.e., Stack	Plant Opacity Monitor	Though not required by the test protocol the opacity reading of the opacity meter at CEMS location in the stack is recorded and checked periodically for compliance during the test program.
4	Plant Gross Power Output	Plant DCS	Hourly readings from plant DCS were recorded and average value of these hourly readings during the test period were used.
5	Coal Feed Rate	Plant DCS	Hourly readings for both Feeder A and Feeder B were taken from the plant DCS and average values for these hourly readings during the test period were used to calculate the total coal feed rate to the boiler.
6	Limestone Feed Rate	Plant DCS. Limestone feeder weigh cell (2LH-F27) and flow totalizer.	Hourly readings from plant DCS were recorded and average value of these hourly readings during the test period was used.
7	Flue Gas Temperature at SDA Inlet	Plant DCS.	Hourly readings from plant DCS were recorded and average value of these hourly readings during the test period was used.
8	Flue Gas Temperature at SDA Outlet (Baghouse Inlet)	Plant DCS.	Hourly readings from plant DCS were recorded and average value of these hourly readings during the test period was used.
9	Flue Gas Temperature at Baghouse Outlet (Stack Inlet)	Plant DCS.	Hourly readings from plant DCS were recorded and average value of these hourly readings during the test period was used.
10	Adiabatic Saturation Temperature of Flue Gas	Wet bulb temperature measurement using specifically designed measuring device.	Manual readings were taken approximately every 30 minutes. The adiabatic saturation temperature remained remarkably constant throughout the test period, at approximately 136°F. This was confirmed by repeated measurements.

No.	Test Parameter/ Variable	Test Method/ Instrumentation	Comments
11	SDA Feed Slurry Flow Rate	Plant DCS.	Hourly readings from plant DCS were recorded. Average calculated from these hourly readings during the test period were used.
12	SDA Feed Slurry Solids Content	Plant DCS.	Hourly readings from plant DCS were recorded. Average calculated from these hourly readings during the test period were used.
13	SDA Feed Slurry Temperature	Plant DCS.	Hourly readings from plant DCS were recorded. Average calculated from these hourly readings during the test period were used.
14	Atomizer Power Consumption	Plant DCS.	Hourly readings from plant DCS were recorded.
15	Coal Samples	Grab samples from Feeder A and Feeder B	Sampling Frequency: Every hour. Sample Size: Minimum 2 lb (each sample). Sampling Location: Coal belt feeder discharge (from Feeder A and Feeder B). Other: Samples are collected in plastic bags, properly identified and sealed immediately after sampling and stored indoors at room condition for future analysis

4.2 Test Samples

4.2.1 Samples and Sample Analysis

The following table summarizes the number of samples, the sample details, and the analysis to be performed on each sample for the Demonstration Test Program.

Table 4.2
Samples, Sampling Frequency/Size and Sample Analysis

No.	Sample	Frequency/Size	Location	Type of Analysis
1	Coal	4 hours during the test/2-3 lb	Coal Feeder A & B	Ultimate, Proximate, Heating Value, Ash Analysis
2	Limestone	4 hours during the test/2-3 lb	Limestone Feeder Discharge	Sieve analysis (upped 325 mesh), Ca, Mg, CO_3 and Inerts
3	SDA Feed Slurry	4 hours during the test/1-2 litre	SDA Feed Pump Discharge at SDA Feed Inlet	Solids Content, CaO, $CaCO_3$, MgO, $MgCO_3$, $CaSO_3$.1/2H2O, $CaSO_4.2H_20$ and Acid Insolubles
4	SDA Hopper Ash	4 hours during the test/2-3 lb	Hopper Discharge	CaO, $CaCO_3$, MgO, $MgCO_3$, $CaSO_3.1/2H_2O$, $CaSO_4.2H_20$ and Acid Insolubles
5	Surge Bin Ash Sample	4 hours during the test/2-3 lb	Ash Discharge at Surge Bin inlet	CaO, $CaCO_3$, MgO, $MgCO_3$, $CaSO_3.1/2H_2O$, $CaSO_4.2H_20$ and Acid Insolubles
6	Air Pre-Heater Hopper Ash	4 hours during the test/2-3 lb	Hopper Discharge	CaO, $CaCO_3$, MgO, $MgCO_3$, $CaSO_3.1/2H_2O$, $CaSO_4.2H_20$ and Acid Insolubles
7	Bag House Hopper Ash (Composite sample from all hoppers)	4 hours during the test/2-3 lb	Hopper Discharge	CaO, $CaCO_3$, MgO, $MgCO_3$, $CaSO_3.1/2H_2O$, $CaSO_4.2H_20$ and Acid Insolubles

4.2.2 Procedures for Preparing Samples for Shipment to Laboratories

Samples were sent to external laboratories for anlysis. Procedure followed for preparing the samples for storage and shipments are as follows:

- **Coal:**
  - Take coal sample from Feeder A discharge.
  - Take two 1-lb. samples from the bag. Pack each sample in separate zip-lock bag and mark each with date, time and the feeder designation (Feeder A) for shipping to labs for analysis. Weigh the sample bag (need only approximate weight). Keep the rest of the Feeder A sample and store it for future use and reference.
  - At the end of the above procedure, there will be three (two 1 lb. and the original) Feeder A samples.
  - Seal the top of zip-lock bag with duct tape or masking tape so that there is no spill during shipment.

- Repeat the same procedure for sample from Feeder B corresponding to the same day and time.
- Repeat the same procedure for all other samples.

- **Limestone**
  - Take limestone sample from limestone feeder discharge.
  - Take approximately half of the sample collected in a separate zip-lock bag. Mark the date, time and any other detail on the bag with a permanent marker. Weigh the sample bag (need only approximate weight).
  - Seal the top of zip-lock bag with duct tape or masking tape so that there is no spill during shipment.

- **SDA Feed Slurry**
  - Take SDA feed slurry sample from SDA feed pump discharge.
  - Shake the container vigorously to mix the sample. Please make sure that there is no settled solid the bottom and all the settled solids are mixed well and are in suspension.
  - Quickly transfer approximately half of the sample collected to another plastic container. Mark the container with date, time and other details with a permanent marker time. Weigh the sample container (need only approximate weight). Please wrap using duct tape or use other means to seal the lid, so that there will be no leak during shipment.

- **Air Pre-Heater (APH) Ash Hopper Sample**
  - Take APH ash hopper sample from hopper discharge.
  - Take approximately half of the sample collected in a separate zip-lock bag. Mark the date, time and any other detail on the bag with a permanent marker. Weigh the sample bag (need only approximate weight).
  - Seal the top of zip-lock bag with duct tape or masking tape so that there is no spill during shipment.

- **Surge Bin Ash Sample:**
  - Take surge bin ash sample from ash discharge at surge bin inlet.
  - Take approximately half of the sample collected in a separate zip-lock bag. Mark the date, time and any other detail on the bag with a permanent marker. Weigh the sample bag (need only approximate weight).
  - Seal the top of zip-lock bag with duct tape or masking tape so that there is no spill during shipment.

4.3 Operation and Observations

The testing was started on November 3 and completed on November 15, 1999. The tests were conducted on a twenty-four hour per day and seven-day per week basis. Throughout the test program, the SWEC representatives inspected all testing activities as the tests were in progress including spot checking the meter readings being recorded by test crew and initialing them as

appropriate. Some general and specific observations and comments on plant and SDA system operation during the test period are as follows:

- The HCCP is a mine-mouthed power plant with a very limited coal storage capacity at the plant site. Coal is used as mined and consequently the coal characteristics are difficult to control or modify.

- All pertinent parameters directly related to SO_2 emission, such as, uncontrolled SO_2 emission, limestone feed rate and flue gas temperature at SDA inlet were within the minimum and maximum ranges of the Contract.

- Heat input to the boiler was less than the Contract range for the full load condition. This parameter depends on coal characteristics and boiler operating requirement/condition during the tests and hence is difficult to control or modify.

5.0 RESULTS AND DISCUSSION

5.1 General

Details of the data collected for all the seventeen tests are summarized in Appendix B. Analyses of coal, limestone, and various slurry and ash samples collected during the tests are summarized in the appendices as follows:

- Coal - Appendix C
- Ash - Appendix D
- Limestone - Appendix E
- Particle Size Distribution - Appendix F
- SDA Feed Slurry - Appendix G
- SDA Ash - Appendix H
- Surge Bin Ash - Appendix I
- Air Heater Hopper Ash - Appendix J
- Bag house Hopper Ash (East and West) - Appendix K

5.2 Effect of Unit Load (Gas Flow Rate/Gas Residence Time)

The effect of unit load on SDA system performance is summarized in Table 5.1 and shown in Figure 5.1 for a Ca/SO_2 reagent ratio of 1.8 and in Figure 5.2 for a reagent ratio of 1.3. The operational parameter details are summarized in Table 5.2 for both reagent ratios.

Table 5.1
Effect of Unit Load (Gas Flow Rate/Gas Residence Time) on SDA System Performance

Test No.	Gross Load (Mwe)	Gas Residence Time (Seconds)	Lime-Stone Feed Rate (lb/min)	Ca/SO_2 Ratio	Approach to Satn. (^{o}F)	Slurry Temp (^{o}F)	SDA Inlet SO_2 (ppm)	Stack SO_2 (ppm)	Removal Eff. (%)	Diff. In Eff. (%)
High Stoichiometric Ratio; Approach to Saturation 42°F; No Heat Activation										
1.1	42.1	11.9	17.1	1.7	42.3	111.2	112.8	15.5	86.3	
2.4	57.9	8.6	22.3	1.8	42.3	102.6	119.0	36.1	69.6	16.7
High Stoichiometric Ratio; Approach to Saturation 42°F; Heat Activation										
1.2	42.4	11.8	16.9	1.9	42.2	154.6	101.7	7.0	93.1	
2.3	58.0	8.6	22.2	1.8	42.1	151.2	115.8	22.7	80.4	12.8
High Stoichiometric Ratio; Approach to Saturation 32°F; No heat Activation										
1.4	42.0	11.9	17.2	1.7	32.1	102.1	118.8	6.4	94.6	
2.1	57.7	8.7	22.2	1.7	31.9	109.6	122.4	20.7	83.1	11.5
High Stoichiometric Ratio; Approach to Saturation 32°F; Heat Activation										
1.3	42.3	11.8	17.0	1.9	32.0	154.8	101.9	0.7	99.3	
2.2	56.4	8.9	22.3	1.8	32.5	147.6	123.2	4.9	96.0	3.3
Low Stoichiometric Ratio; Approach to Saturation 40°F; No Heat Activation										
4.1	42.1	11.9	11.5	1.2	41.4	107.1	120.5	31.6	73.8	
3.4	58.0	8.6	17.8	1.3	38.9	110.7	132.8	34.0	74.4	0.6
Low Stoichiometric Ratio; Approach to Saturation 42°F; Heat Activation										
4.2	41.8	12.0	12.2	1.2	41.1	152.9	134.9	29.3	78.3	
3.3	58.3	8.6	17.3	1.4	42.0	153.4	131.7	26.9	79.6	1.3
Low Stoichiometric Ratio; Approach to Saturation 32°F; No Heat Activation										
4.4	42.1	11.9	12.6	1.4	32.0	109.1	131.2	9.1	93.1	
3.1	58.1	8.6	17.3	1.4	32.0	104.1	118.0	7.5	93.7	
3.1 A	58.3	8.6	17.9	1.3	32.3	107.0	125.1	8.8	93.0	0.4*
Low Stoichiometric Ratio; Approach to Saturation 32 °F; Heat Activation										
4.3	42.2	11.8	11.5	1.4	31.6	153.0	134.6	2.2	98.4	
3.2	58.1	8.6	17.1	1.2	33.9	153.6	129.3	4.7	96.4	2.0

Note: Shaded areas show change in process parameters.
* Difference in removal efficiency between the average of Tests 3.1 & 3.1A and Test 4.4

Table 5.2 Operational Parameter Details - Effect of Unit Load (Gas Flow Rate) on SDA System Performance

Test No.	Date	GrossLoad (MWe)	Coal Feed Feeder A ($x10^3$ lb/hr)	Coal Feed Feeder B ($x10^3$ lb/hr)	Limestone Feed (lb/min)	SDA Inlet Temp (°F)	SDA Exit Temp (°F)	BH Exit Temp (°F)	SDA/BH Ave Temp (°F)	Adiabatic Satn. Temp (°F)	Approach to Satn. (°F)	Slury Temp (°F)	Slurry Solids (Wt.%)	Slurry Flow (GPM)	SDA Inlet SO2 (ppm)	Stack SO2 (ppm)	Diff. In SO2 (ppm)	Removal Eff. (%)	Diff. In Removal Eff. (%)
High Stoichiometric Ratio; Approach to Saturation 43 F; No Heat Activation																			
1.1	04-Nov-99	42.1	36.5	36.5	17.1	268.8	180.2	176.4	178.3	136.0	42.3	111.2	42.0	31.3	112.8	15.5	97.3	86.3	
2.4	08-Nov-99	57.9	45.2	44.2	22.3	274.8	180.1	176.4	178.3	136.0	42.3	102.6	41.7	41.1	119.0	36.1	82.9	69.6	16.7
High Stoichiometric Ratio; Approach to Saturation 43 F; Heat Activation																			
1.2	04-Nov-99	42.4	30.8	33.1	16.9	267.8	180.3	176.2	178.2	136.0	42.2	154.6	42.1	32.3	101.7	7.0	94.7	93.1	
2.3	08-Nov-99	58.0	46.4	44.8	22.2	272.4	180.2	176.0	178.1	136.0	42.1	151.2	41.4	42.2	115.8	22.7	93.0	80.4	12.8
High Stoichiometric Ratio; Approach to Saturation 32 F; No heat Activation																			
1.4	06-Nov-99	42.0	36.0	35.9	17.2	271.4	169.6	166.6	168.1	136.0	32.1	102.1	41.9	35.9	118.8	6.4	112.3	94.6	
2.1	07-Nov-99	57.7	48.1	45.3	22.2	271.1	169.7	166.0	167.9	136.0	31.9	109.6	41.7	44.1	122.4	20.7	101.7	83.1	11.5
High Stoichiometric Ratio; Approach to Saturation 32 F; Heat Activation																			
1.3	04-Nov-99	42.3	32.6	32.6	17.0	267.3	170.0	165.9	168.0	136.0	32.0	154.8	42.0	35.9	101.9	0.7	101.1	99.3	
2.2	07-Nov-99	56.4	46.1	42.7	22.3	271.2	170.1	166.9	168.5	136.0	32.5	147.6	41.9	45.5	123.2	4.9	118.3	96.0	3.3
Low Stoichiometric Ratio; Approach to Saturation 43 F; No Heat Activation																			
4.1	13-Nov-99	42.1	36.1	34.1	11.5	281.3	179.5	175.3	177.4	136.0	41.4	107.1	41.8	35.6	120.5	31.6	88.9	73.8	
3.4	11-Nov-99	58.0	48.7	46.8	17.8	273.4	177.0	172.8	174.9	136.0	38.9	110.7	42.0	42.6	132.8	34.0	98.8	74.4	0.6
Low Stoichiometric Ratio; Approach to Saturation 43 F; Heat Activation																			
4.2	14-Nov-99	41.8	36.3	34.3	12.2	277.8	179.5	174.8	177.1	136.0	41.1	152.9	41.4	36.3	134.9	29.3	105.6	78.3	
3.3	11-Nov-99	58.3	46.1	44.1	17.3	271.8	180.0	176.1	178.0	136.0	42.0	153.4	42.0	42.5	131.7	26.9	104.8	79.6	1.3
Low Stoichiometric Ratio; Approach to Saturation 32 F; No Heat Activation																			
3.1	10-Nov-99	58.1	45.2	44.2	17.3	272.1	169.9	166.0	168.0	136.0	32.0	104.1	42.0	44.8	118.0	7.5	110.5	93.7	
3.1 A	12-Nov-99	58.3	47.9	45.8	17.9	273.2	170.6	166.0	168.3	136.0	32.3	107.0	42.0	45.1	125.1	8.8	116.3	93.0	
4.4	15-Nov-99	42.1	34.9	32.9	12.6	274.9	170.4	165.6	168.0	136.0	32.0	109.1	41.7	36.9	131.2	9.1	122.1	93.1	0.3*
Low Stoichiometric Ratio; Approach to Saturation 32 F; Heat Activation																			
3.2	10-Nov-99	58.1	45.3	43.5	17.1	270.5	171.9	167.8	169.9	136.0	33.9	153.6	40.5	46.9	129.3	4.7	124.6	96.4	
4.3	14-Nov-99	42.2	36.1	34.0	11.5	278.9	169.7	165.6	167.6	136.0	31.6	153.0	42.1	40.2	134.6	2.2	132.4	98.4	2.0

Note:
Shaded areas show change in process parameters
* Difference in the removal efficiency between the average of Tests 3.1 & 3.1A and Test 4.4

FIGURE 5.1: Effect of Unit Load (Gas Flow Rate) on Removal Efficiency (High Ca/SO_2 Ratio)

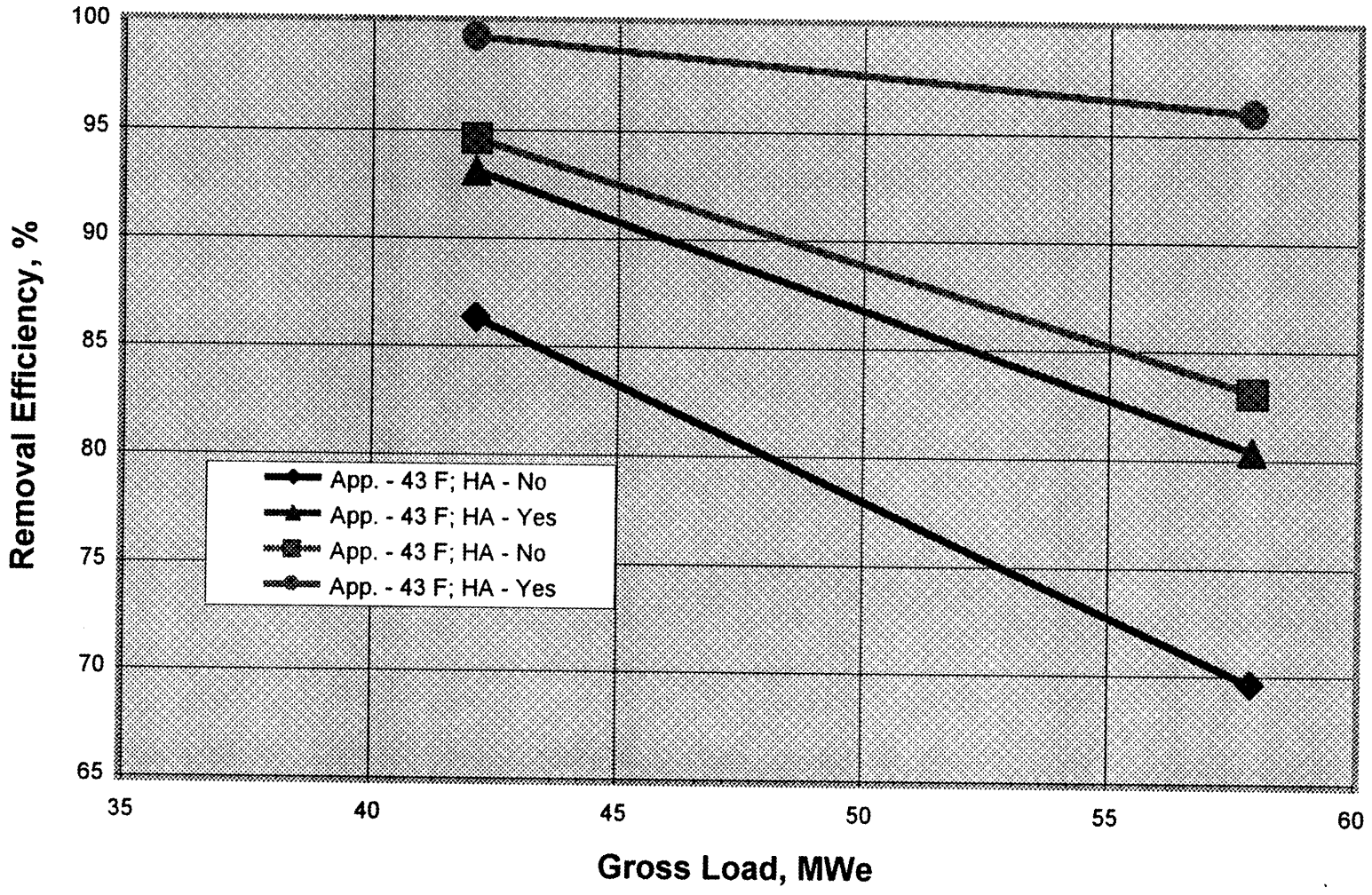
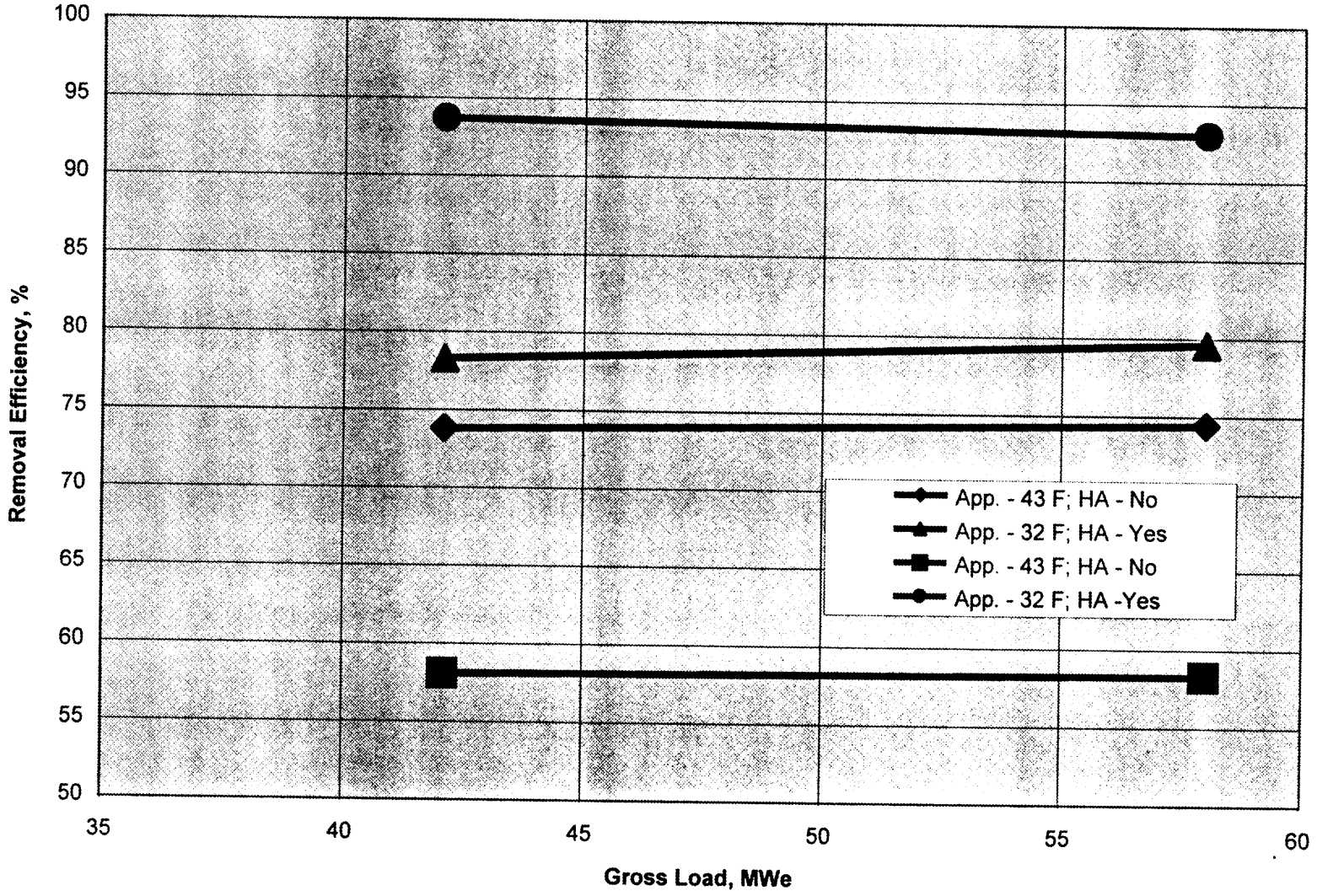


FIGURE 5.2: Effect of Gross Load (Gas Flow Rate) on Removal Efficiency (Low Ca/SO_2 Ratio)



The residence time for flue gas in the SDA vessel was estimated based on gas flow rate and the total vessel volume. It ranged from approximately 8 seconds at low load to 12 seconds at full load conditions. The effect of residence time depends on the reagent ratio at which the system is operated. The details are discussed in the following paragraphs.

As can be seen, increasing the gas residence time, at higher Ca/SO_2 ratio tends to improve the system performance and increase SO_2 removal efficiency, under all operating conditions, i.e., at different approach temperatures, and with and without heat activation. The improvement ranged from 3.3% to 16.7% (Tests 1.3 & 2.2 and 1.1 & 2.4). However, the difference tends to decrease and becomes negligible or indistinguishable (within experimental uncertainties) when the Ca/SO_2 ratio is decreased. For example, at an approach temperature of 42°F, without heat activation, the difference in the removal efficiency was 16.7% for a Ca/SO_2 ratio of 1.8 (Tests 1.1 & 2.4) and less than 1% at a Ca/SO_2 ratio of approximately 1.3 (Tests 3.3 & 4.2). At lower Ca/SO_2 conditions, it appears that the rate limiting parameter is the availability (lack there of) of reagent than the reaction rate or the residence time available.

At higher Ca/SO_2 ratios, the removal efficiency is more sensitive to residence time at higher approach temperature than at lower approach temperature. For example, the difference was 16.7% at an approach temperature of 42°F (Tests 1.1 and 2.1) and only 11.5% at an approach temperature of 32°F (Tests 1.4 and 2.3), with no heat activation. A similar trend was observed with heat activation. The corresponding values were 12.7% (Tests 1.2 and 2.3) and 3.3% (Tests 1.3 and 2.2). This is to be expected since at higher approach temperature, SO_2 removal is generally inhibited and any increase in residence time that helps removal, would have a greater impact than at lower approach temperature, the condition at which SO_2 removal is generally favored.

5.3 Effect of Approach to Saturation Temperature

The effect of approach to saturation temperature on SDA system performance is summarized in Table 5.3, the operational parameter details is summarized in Table 5.4, the effect of approach to saturation temperature on removal efficiency is given in Figures 5.3 and 5.4.

Table 5.3
Effect of Approach to Saturation Temperature on SDA System Performance

Test No.	Gross Load (Mwe)	Gas Residence Time (Seconds)	Lime-Stone Feed Rate (lb/min)	Ca/SO_2 Ratio	Approach to Satn. ($^{\circ}$F)	Slurry Temp ($^{\circ}$F)	SDA Inlet SO_2 (ppm)	Stack SO_2 (ppm)	Removal Eff. (%)	Diff. In Eff. (%)
Low Load; High Stoichiometric Ratio; No Heat Activation										
1.4	42.0	11.9	17.2	1.7	32.1	102.1	118.8	6.4	94.6	
1.1	42.1	11.9	17.1	1.7	42.3	111.2	112.8	15.5	86.3	8.3
Low Load; High Stoichiometric Ratio; Heat Activation										
1.3	42.3	11.8	17.0	1.9	32.0	154.8	101.9	0.7	99.3	
1.2	42.4	11.8	16.9	1.9	42.2	154.6	101.7	7.0	93.1	6.1
Low Load; Low Stoichiometric Ratio; No Heat Activation										
4.4	42.1	11.9	12.6	1.4	32.0	109.1	131.2	9.1	93.1	
4.1	42.1	11.9	11.5	1.2	41.4	107.1	120.5	31.6	73.8	19.3
Low Load; Low Stoichiometric Ratio; Heat Activation										
4.3	42.2	11.8	11.5	1.4	31.6	153.0	134.6	2.2	98.4	
4.2	41.8	12.0	12.2	1.2	41.1	152.9	134.9	29.3	78.3	20.1
High Load; High Stoichiometric Ratio; No Heat Activation										
2.1	57.7	8.7	22.2	1.7	31.9	109.6	122.4	20.7	83.1	
2.4	57.9	8.6	22.3	1.8	42.3	102.6	119.0	36.1	69.6	13.5
High Load; High Stoichiometric Ratio; Heat Activation										
2.2	56.4	8.9	22.3	1.8	32.5	147.6	123.2	4.9	96.0	
2.3	58.0	8.6	22.2	1.8	42.1	151.2	115.8	22.7	80.4	15.6
High Load; Low Stoichiometric Ratio; No Heat Activation										
3.1	58.1	8.6	17.3	1.4	32.0	104.1	118.0	7.5	93.7	
3.1 A	58.3	8.6	17.9	1.3	32.3	107.0	125.1	8.8	93.0	
3.4	58.0	8.6	17.8	1.3	38.9	110.7	132.8	34.0	74.4	19.0*
High Load; Low Stoichiometric Ratio; Heat Activation										
3.2	58.1	8.6	17.1	1.2	33.9	153.6	129.3	4.7	96.4	
3.3	58.3	8.6	17.3	1.4	42.0	153.4	131.7	26.9	79.6	16.8

Note: Shaded areas show change in process parameters.
* Difference in removal efficiency between the average of Tests 3.1 & 3.1A and Test 3.4

Table 5.4 Operational Parameter Details - Effect of Approach to Saturation Temperature on SDA System Performance

Test No.	Date	Power Output Gross (MWe)	Resid. Time (Sec)	Coal Feed Feeder A ($x10^3$ lb/hr)	Coal Feed Feeder B ($x10^3$ lb/hr)	Limestone Feed (lb/min)	Ca/SO2	SDA Inlet Temp. (°F)	SDA Exit Temp. (°F)	BH Exit Temp. (°F)	SDA/BH Ave. Temp. (°F)	Adiabatic Satn. Temp. (°F)	Approach to Satn. (°F)	Slury Temp (°F)	Slurry Solids (Wt.%)	Slurry Flow (GPM)	SDA Inlet SO2 (ppm)	Stack SO2 (ppm)	Diff. In SO2 (ppm)	Removal Eff. (%)	Diff. In Removal Eff. (%)
Low Load; High Stoichiometric Ratio; No Heat Activation																					
1.4	06-Nov-99	42.0	11.9	36.0	35.9	17.2	1.7	271.4	169.6	166.6	168.1	136.0	32.1	102.1	41.9	35.9	118.8	6.4	112.3	94.6	
1.1	04-Nov-99	42.1	11.9	36.5	36.5	17.1	1.7	268.8	180.2	176.4	178.3	136.0	42.3	111.2	42.0	31.3	112.8	15.5	97.3	86.3	8.3
Low Load; High Stoichiometric Ratio; Heat Activation																					
1.3	04-Nov-99	42.3	11.8	32.6	32.6	17.0	1.9	267.3	170.0	165.9	168.0	136.0	32.0	154.8	42.0	35.9	101.9	0.7	101.1	99.3	
1.2	04-Nov-99	42.4	11.8	30.8	33.1	16.9	1.9	267.8	180.3	176.2	178.2	136.0	42.2	154.6	42.1	32.3	101.7	7.0	94.7	93.1	6.1
Low Load; Low Stoichiometric Ratio; No Heat Activation																					
4.4	15-Nov-99	42.1	11.9	34.9	32.9	12.6	1.3	274.9	170.4	165.6	168.0	136.0	32.0	109.1	41.7	36.9	131.2	9.1	122.1	93.1	
4.1	13-Nov-99	42.1	11.9	36.1	34.1	11.5	1.2	281.3	179.5	175.3	177.4	136.0	41.4	107.1	41.8	35.6	120.5	31.6	88.9	73.8	19.3
Low Load; Low Stoichiometric Ratio; Heat Activation																					
4.3	14-Nov-99	42.2	11.8	36.1	34.0	11.5	1.2	278.9	169.7	165.6	167.6	136.0	31.6	153.0	42.1	40.2	134.6	2.2	132.4	98.4	
4.2	14-Nov-99	41.8	12.0	36.3	34.3	12.2	1.2	277.8	179.5	174.8	177.1	136.0	41.1	152.9	41.4	36.3	134.9	29.3	105.6	78.3	20.1
Full Load; High Stoichiometric Ratio; No Heat Activation																					
2.1	07-Nov-99	57.7	8.7	48.1	45.3	22.2	1.7	271.1	169.7	166.0	167.9	136.0	31.9	109.6	41.7	44.1	122.4	20.7	101.7	83.1	
2.4	08-Nov-99	57.9	8.6	45.2	44.2	22.3	1.8	274.8	180.1	176.4	178.3	136.0	42.3	102.6	41.7	41.1	119.0	36.1	82.9	69.6	13.5
Full Load; High Stoichiometric Ratio; Heat Activation																					
2.2	07-Nov-99	56.4	8.9	46.1	42.7	22.3	1.8	271.2	170.1	166.9	168.5	136.0	32.5	147.6	41.9	45.5	123.2	4.9	118.3	96.0	
2.3	08-Nov-99	58.0	8.6	46.4	44.8	22.2	1.8	272.4	180.2	176.0	178.1	136.0	42.1	151.2	41.4	42.2	115.8	22.7	93.0	80.4	15.6
Full Load; Low Stoichiometric Ratio; No Heat Activation																					
3.1	10-Nov-99	58.1	8.6	45.2	44.2	17.3	1.4	272.1	169.9	166.0	168.0	136.0	32.0	104.1	42.0	44.8	118.0	7.5	110.5	93.7	
3.1 A	12-Nov-99	58.3	8.6	47.9	45.8	17.9	1.4	273.2	170.6	166.0	168.3	136.0	32.3	107.0	42.0	45.1	125.1	8.8	116.3	93.0	
3.4	11-Nov-99	58.0	8.6	48.7	46.8	17.8	1.3	273.4	177.0	172.8	174.9	136.0	38.9	110.7	42.0	42.6	132.8	34.0	98.8	74.4	19.0*
Full Load; Low Stoichiometric Ratio; Heat Activation																					
3.2	10-Nov-99	58.1	8.6	45.3	43.5	17.1	1.4	270.5	171.9	167.8	169.9	136.0	33.9	153.6	40.5	46.9	129.3	4.7	124.6	96.4	
3.3	11-Nov-99	58.3	8.6	46.1	44.1	17.3	1.4	271.8	180.0	176.1	178.0	136.0	42.0	153.4	42.0	42.5	131.7	26.9	104.8	79.6	16.8

Note:
Shaded areas show change in process parameters
* Difference in the removal efficiency between the average of Tests 3.1 & 3.1A and Test 3.4

Figure 5.3: Effect of Approach to Saturation Temperature on Removal Efficiency (Low Unit Load)

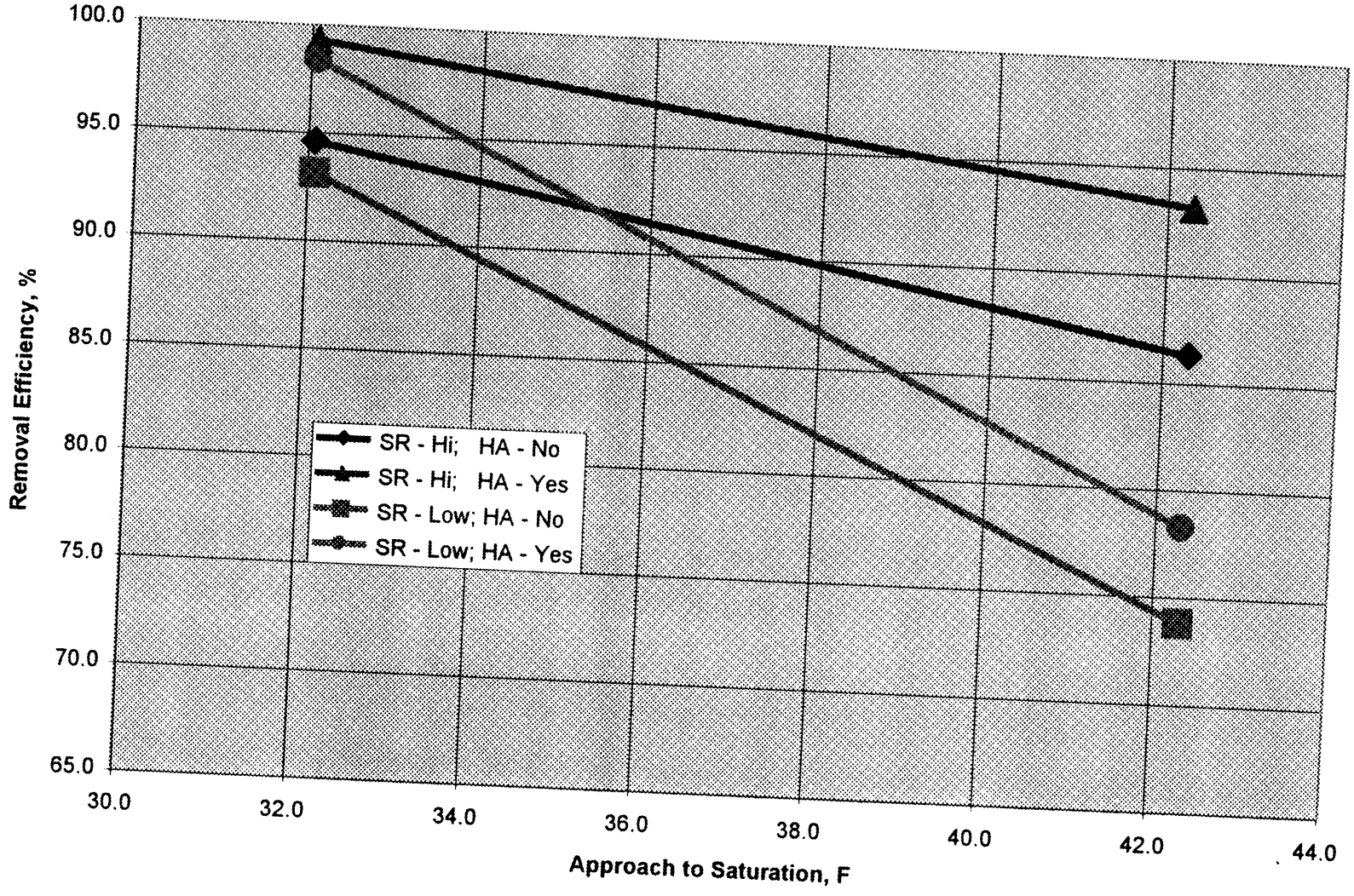
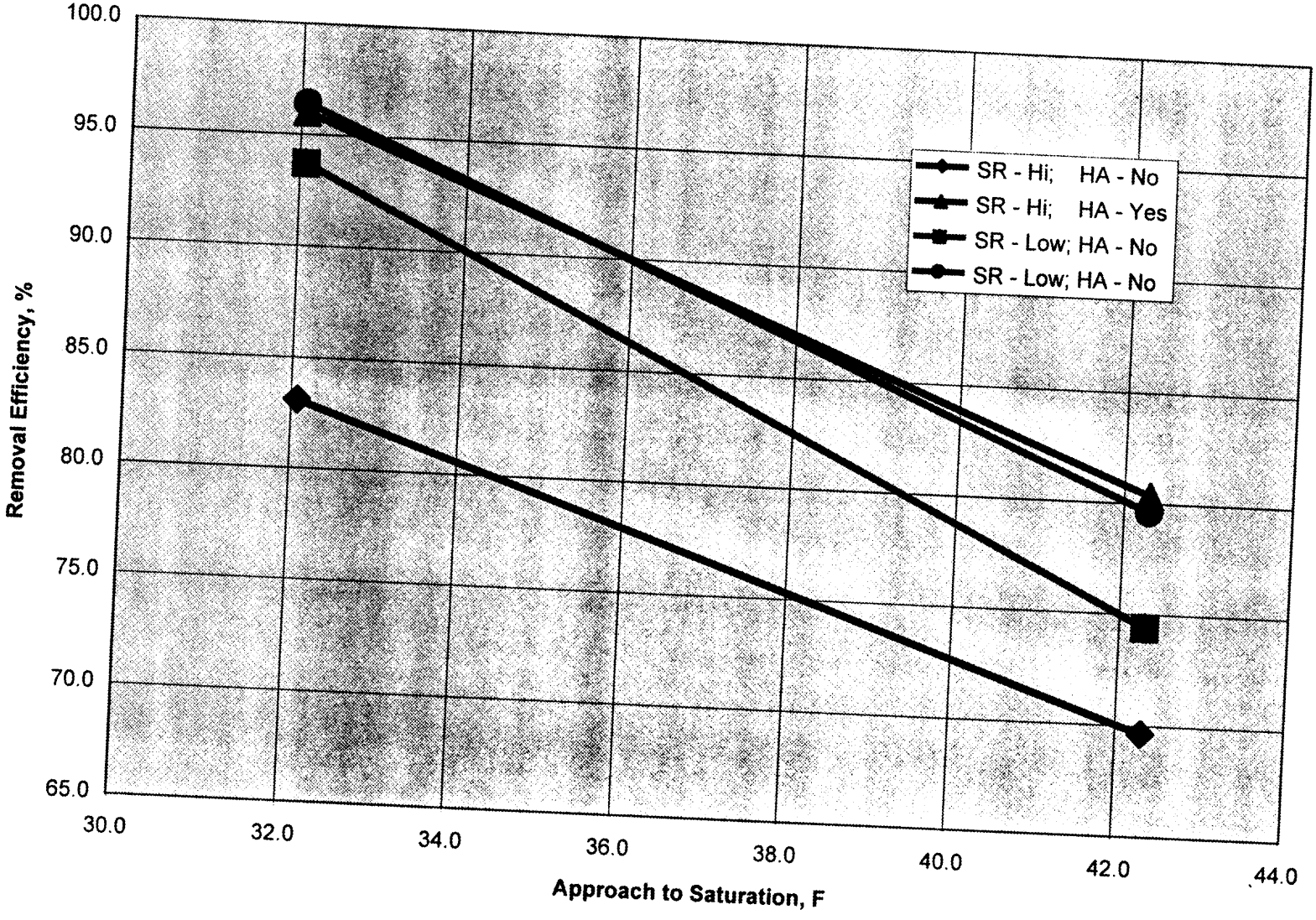


Figure 5.4: Effect of Approach to Saturation Temperature on Removal Efficiency (High Unit Load)



Approach to saturation temperature or hereafter referred to as approach temperature, was calculated as the difference between the adiabatic saturation temperature and the average of the SDA exit temperature and the baghouse exit temperature. The average of the SDA exit temperature and the baghouse exit temperature instead of the SDA exit temperature was chosen because this average truly reflects the removal temperature effect occurring in the baghouse. Two ranges of approach temperature were investigated: 41°F to 43°F and 31°F to 33°F. The adiabatic saturation temperature remained remarkably constant at approximately 136°F throughout the test period.

As can be seen under all operating conditions, i.e., different loads, different Ca/SO_2 ratios, and with and without heat activation, SO_2 removal tends to increase with decrease in the approach temperature. The improvement ranged from 13.5% to 18.6% at full load condition (Tests 2.1 & 2.4 and (Tests 3.1 & 3.4) and 6.1% to 20.1% at low load conditions (Tests 1.2 & 1.3 and 4.2 & 4.3). Even at the most favorable operating conditions with respect to other parameters, such as at low load, at high Ca/SO_2 stoichiometric ratio and with heat activation, a decrease in the approach temperature from 42.2°F to 32°F (decrease of 10.2°F increased the removal efficiency from 93.1% to 99.3% or by 6.1% (Tests 1.2 and 1.3). For comparison at the least favorable conditions relative to other parameters, i.e., high load, low Ca/SO_2 stoichiometric ratio and with no heat activation, the effect was as might be expected much more significant. The removal efficiency increased from 79.6% to 96.4% or by 16.8%, when the approach temperature was decreased from 42°F to 33.9°F (a decrease of only 8.1°F).

The results suggest that approach to saturation is the most significant process parameter that determines SDA performance with respect SO_2 removal.

5.4 Effect of Reagent Ratio

Reagent to sulfur or sulfur dioxide stoichiometric ratio is an important process parameter in that it has economic significance for plant operation. It determines the amount limestone required for the system. This in turn affects operating costs such as, reagent cost, storage and material handling costs, and ash/reaction product handling and disposal costs. A higher Ca/SO_2 not only results in higher operating cost, it also increases maintenance cost due to increased wear on the material handling systems resulting from more frequent operation and/or operating at higher capacity factor.

The Ca/SO_2 ratio was calculated based on coal feed rate, limestone feed rate, coal sulfur content (appendix C) and limestone analysis and purity (Appendix D). The Ca/SO_2 ratio does not include calcium oxide from coal ash.

The effect of Ca/SO_2 ratio is the most difficult parameter to investigate. This is done by changing the limestone feed rate to the boiler. When the feed rate is changed, sufficient time must be allowed to ensure that the entire boiler system, the reagent collecting and processing system, the SDA vessel and the baghouse system have reached steady state conditions corresponding to the new limestone feed rate. Within the constraints of plant operation and

available test duration, a maximum of 18 hours was allowed between the tests to reach steady state conditions between tests. Some of anomalies observed in the test results as discussed below in detail are perhaps due to the uncertainty of reaching the steady state operating conditions.

The Ca/SO_2 stoichiometric ratio was studied at two levels: 1.2 – 1.4 (low) to 1.7 to 1.8 (high). The effect of changing the stoichiometric ratio on SDA system performance is summarized in Table 5.5, the operational parameter details are summarized in Table 5.6, the effect of reagent ratio on removal efficiency is shown in Figures 5.5 and 5.6.

Table 5.5
Effect Ca/SO_2 Stoichiometric Ratio on SDA System Performance

Test No.	Gross Load (Mwe)	Gas Residence Time (Seconds)	Lime-Stone Feed Rate (lb/min)	Ca/SO_2 Ratio	Approach to Satn. (°F)	Slurry Temp (°F)	SDA Inlet SO_2 (ppm)	Stack SO_2 (ppm)	Removal Eff. (%)	Diff. In Eff. (%)
Low Load; Approach to Saturation 42 F; No Heat Activation										
4.1	42.1	11.9	11.5	1.2	41.4	107.1	120.5	31.6	73.8	
1.1	42.1	11.9	17.1	1.7	42.3	111.2	112.8	15.5	86.3	12.5
Low Load; Approach to Saturation 42 F; Heat Activation										
4.2	41.8	12.0	12.2	1.2	41.1	152.9	134.9	29.3	78.3	
1.2	42.4	11.8	16.9	1.9	42.2	154.6	101.7	7.0	93.1	14.9
Low Load; Approach to Saturation 32 F; No heat Activation										
4.4	42.1	11.9	12.6	1.4	32.0	109.1	131.2	9.1	93.1	
1.4	42.0	11.9	17.2	1.7	32.1	102.1	118.8	6.4	94.6	1.5
Low Load; Approach to Saturation 32 F; Heat Activation										
4.3	42.2	11.8	11.5	1.4	31.6	153.0	134.6	2.2	98.4	
1.3	42.3	11.8	17.0	1.9	32.0	154.8	101.9	0.7	99.3	0.9
High Load; Approach to Saturation 40 F; No Heat Activation										
3.4	58.0	8.6	17.8	1.3	38.9	110.7	132.8	34.0	74.4	
2.4	57.9	8.6	22.3	1.8	42.3	102.6	119.0	36.1	69.6	4.8
High Load; Approach to Saturation 42 F; Heat Activation										
3.3	58.3	8.6	17.3	1.4	42.0	153.4	131.7	26.9	79.6	
2.3	58.0	8.6	22.2	1.8	42.1	151.2	115.8	22.7	80.4	0.8
High Load; Approach to Saturation 32 F; No Heat Activation										
3.1	58.1	8.6	17.3	1.4	32.0	104.1	118.0	7.5	93.7	
3.1 A	58.3	8.6	17.9	1.3	32.3	107.0	125.1	8.8	93.0	
2.1	57.7	8.7	22.2	1.7	31.9	109.6	122.4	20.7	83.1	10.3*
High Load; Approach to Saturation 32 F; Heat Activation										
3.2	58.1	8.6	17.1	1.2	33.9	153.6	129.3	4.7	96.4	
2.2	56.4	8.9	22.3	1.8	32.5	147.6	123.2	4.9	96.0	0.4

Note: Shaded areas show change in process parameters.
* Difference in removal efficiency between the average of Tests 3.1 & 3.1A and Test 2.1

Table 5.6 Operational Parameter Details - Effect of Reagent Ratio (Ca/SO_2) on SDA System Performance

Test No.	Date	Power Output Gross (MWe)	Resid. Time (Sec)	Coal Feed Feeder A $x10^3$ lb/hr	Coal Feed Feeder B $x10^3$ lb/hr	Limestone Feed (lb/min)	Ca/SO2	SDA Inlet Temp. (°F)	SDA Exit Temp. (°F)	BH Exit Temp. (°F)	SDA/BH Ave. Temp. (°F)	Adiabatic Satn. Temp. (°F)	Approach to Satn. (°F)	Slury Temp (°F)	Slurry Solids (Wt.%)	Slurry Flow (GPM)	SDA Inlet SO2 (ppm)	Stack SO2 (ppm)	Diff. In SO2 (ppm)	Removal Eff. (%)	Diff. In Removal Eff. (%)
Low Load; Approach to Saturtion 43 F; No Heat Activation																					
4.1	13-Nov-99	42.1	11.9	36.1	34.1	11.5	1.2	281.3	179.5	175.3	177.4	136.0	41.4	107.1	41.8	35.6	120.5	31.6	88.9	73.8	
1.1	04-Nov-99	42.1	11.9	36.5	36.5	17.1	1.7	268.8	180.2	176.4	178.3	136.0	42.3	111.2	42.0	31.3	112.8	15.5	97.3	86.3	12.5
Low Load; Approach to Saturtion 43 F; Heat Activation																					
4.2	14-Nov-99	41.8	12.0	36.3	34.3	12.2	1.2	277.8	179.5	174.8	177.1	136.0	41.1	152.9	41.4	36.3	134.9	29.3	105.6	78.3	
1.2	04-Nov-99	42.4	11.8	30.8	33.1	16.9	1.9	267.8	180.3	176.2	178.2	136.0	42.2	154.6	42.1	32.3	101.7	7.0	94.7	93.1	14.9
Low Load; Approach to Saturtion 32 F ; No Heat Activation																					
4.4	15-Nov-99	42.1	11.9	34.9	32.9	12.6	1.3	274.9	170.4	165.6	168.0	136.0	32.0	109.1	41.7	36.9	131.2	9.1	122.1	93.1	
1.4	06-Nov-99	42.0	11.9	36.0	35.9	17.2	1.7	271.4	169.6	166.6	168.1	136.0	32.1	102.1	41.9	35.9	118.8	6.4	112.3	94.6	1.5
Low Load; Approach to Saturtion 32 F; Heat Activation																					
4.3	14-Nov-99	42.2	11.8	36.1	34.0	11.5	1.2	278.9	169.7	165.6	167.6	136.0	31.6	153.0	42.1	40.2	134.6	2.2	132.4	98.4	
1.3	04-Nov-99	42.3	11.8	32.6	32.6	17.0	1.9	267.3	170.0	165.9	168.0	136.0	32.0	154.8	42.0	35.9	101.9	0.7	101.1	99.3	0.9
Full Load; Approach to Saturtion 40 F; No Heat Activation																					
3.4	11-Nov-99	58.0	8.6	48.7	46.8	17.8	1.3	273.4	177.0	172.8	174.9	136.0	38.9	110.7	42.0	42.6	132.8	34.0	98.8	74.4	
2.4	08-Nov-99	57.9	8.6	45.2	44.2	22.3	1.8	274.8	180.1	176.4	178.3	136.0	42.3	102.6	41.7	41.1	119.0	36.1	82.9	69.6	4.8
Full Load; Approach to Saturtion 43 F; Heat Activation																					
3.3	11-Nov-99	58.3	8.6	46.1	44.1	17.3	1.4	271.8	180.0	176.1	178.0	136.0	42.0	153.4	42.0	42.5	131.7	26.9	104.8	79.6	
2.3	08-Nov-99	58.0	8.6	46.4	44.8	22.2	1.8	272.4	180.2	176.0	178.1	136.0	42.1	151.2	41.4	42.2	115.8	22.7	93.0	80.4	0.8
Full Load; Approach to Saturtion 32 F ; No Heat Activation																					
3.1	10-Nov-99	58.1	8.6	45.2	44.2	17.3	1.4	272.1	169.9	166.0	168.0	136.0	32.0	104.1	42.0	44.8	118.0	7.5	110.5	93.7	
3.1 A	12-Nov-99	58.3	8.6	47.9	45.8	17.9	1.4	273.2	170.6	166.0	168.3	136.0	32.3	107.0	42.0	45.1	125.1	8.8	116.3	93.0	
2.1	07-Nov-99	57.7	8.7	48.1	45.3	22.2	1.7	271.1	169.7	166.0	167.9	136.0	31.9	109.6	41.7	44.1	122.4	20.7	101.7	83.1	10.3*
Full Load; Approach to Saturtion 32 F; Heat Activation																					
3.2	10-Nov-99	58.1	8.6	45.3	43.5	17.1	1.4	270.5	171.9	167.8	169.9	136.0	33.9	153.6	40.5	46.9	129.3	4.7	124.6	96.4	
2.2	07-Nov-99	56.4	8.9	46.1	42.7	22.3	1.8	271.2	170.1	166.9	168.5	136.0	32.5	147.6	41.9	45.5	123.2	4.9	118.3	96.0	0.4

Note:
Shaded areas show change in process parameters
* Difference in the removal efficiency between the average of Tests 3.1 & 3.1A and Test 2.1

Figure 5.5: Effect of Reagent Ratio (Ca/SO_2) on Removal Efficiency (Low Unit Load)

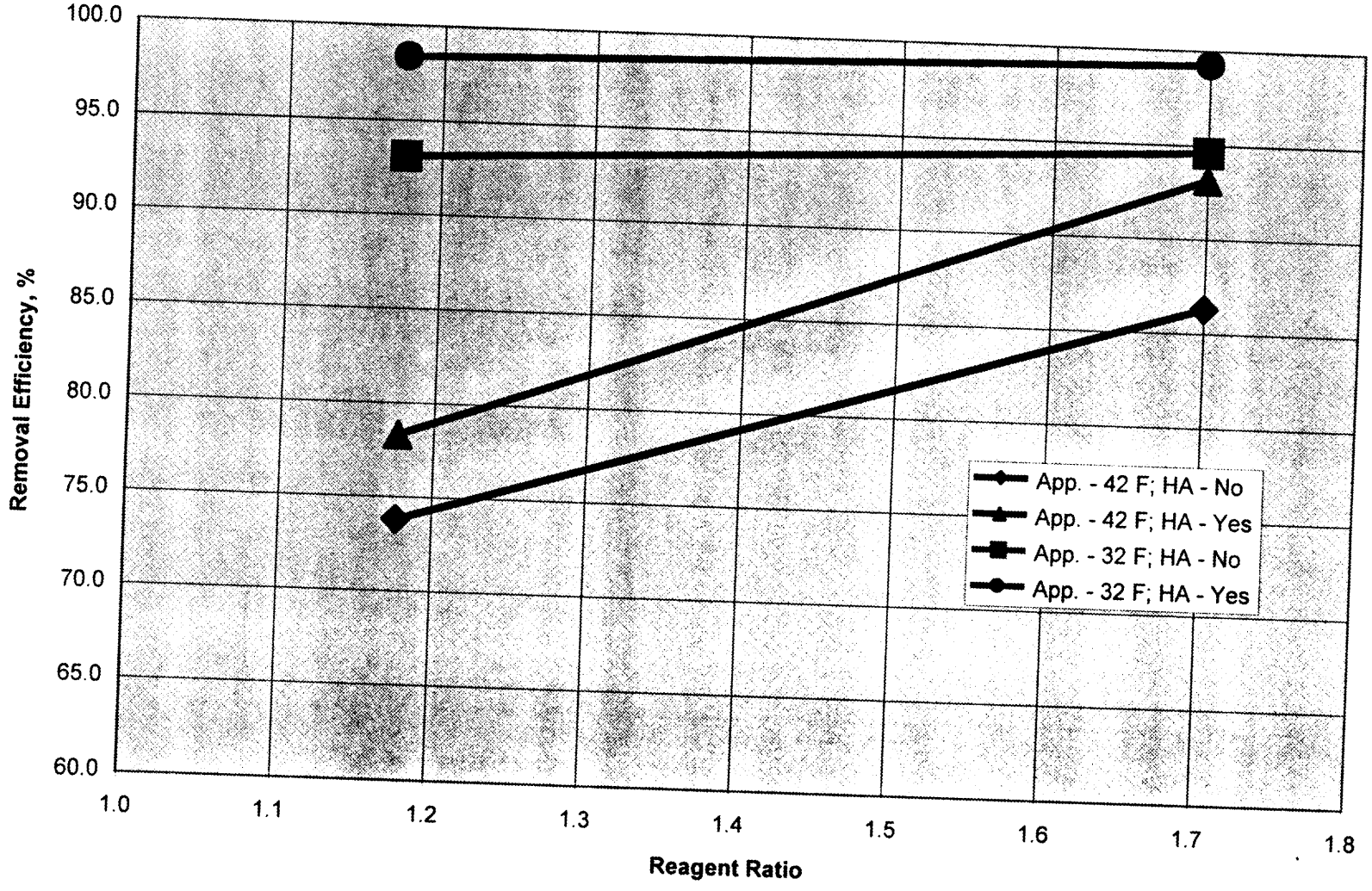
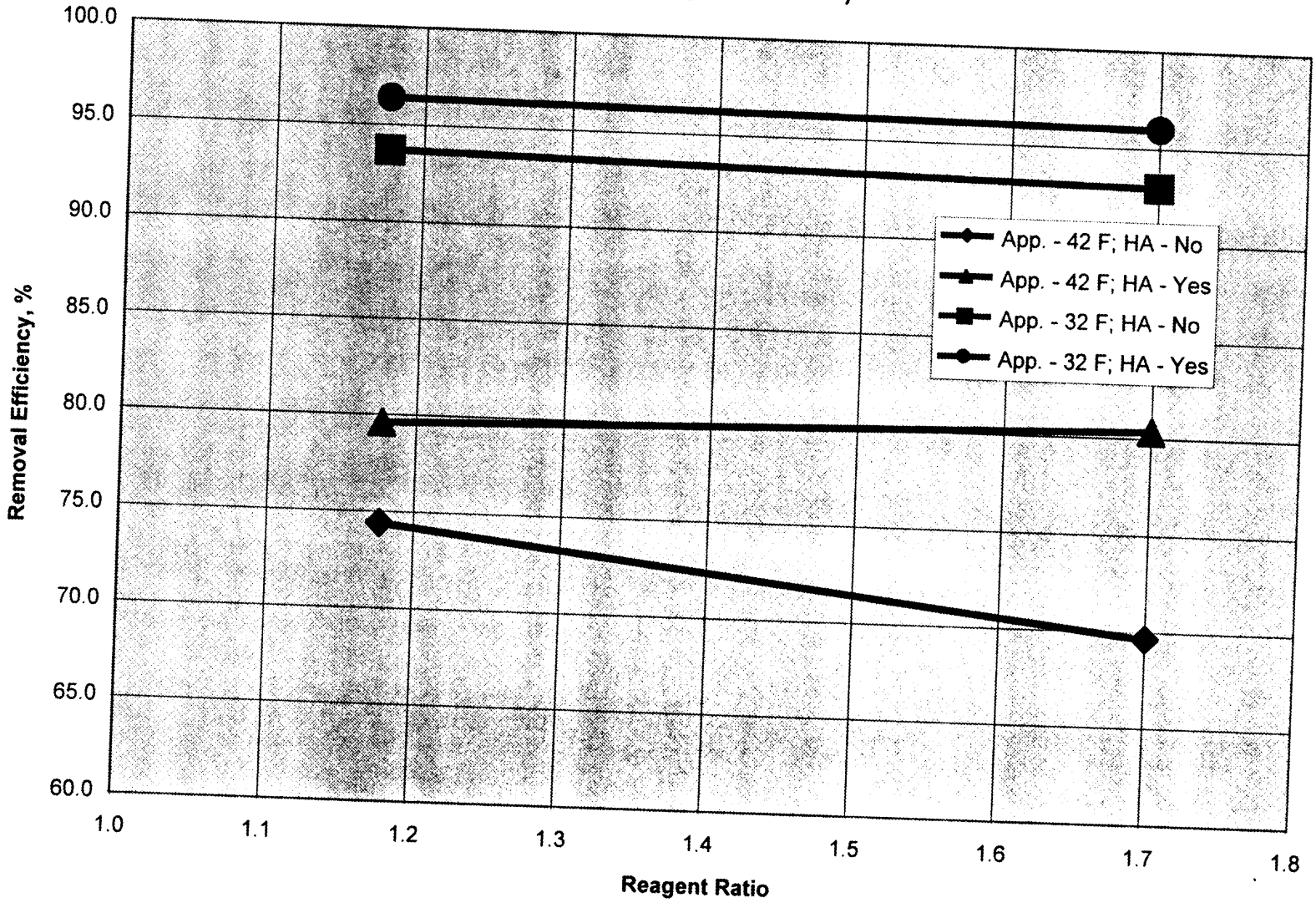


Figure 5.6: Effect of Reagent Ratio (Ca/SO_2) on Removal Efficiency (High Unit Load)



As can be seen at low load conditions under all operating conditions, i.e., at different approach temperatures, and with and without heat activation, SO_2 removal tends to increase with increase in Ca/SO_2 stoichiometric ratio. The improvement ranged from 0.9% to 14.9% (Tests 1.3 & 4.3 and Tests 1.2 & 4.2) depending on other parameters. For example, the improvement was 12.5% Tests 1.1 & 4.1) at the approach temperature range of 43°F with no heat activation, and 14.9% with heat activation (Tests 1.2 and 4.2). The improvement tends to decrease at lower approach to saturation temperature. This observation once again underscores the significance of approach temperature in determining the SDA performance. At an approach temperature range of 32°F, the improvement was only 1.5 with no heat activation % (Tests 1.4 and 4.4) and 0.9% activation with heat activation (Tests 1.3 and 4.3).

At high load conditions, in general, a positive improvement was observed albeit small (less than 1%) with heat activation. For example, the improvement was 0.8% at an approach temperature of 42°F and 0.4% at 33°F. It is of interest to note the improvement tends to decrease with decrease in the approach temperature as in the case of low load conditions. With no heat activation increasing the Ca/SO_2 ratio seems to have an unexpected fluctuating effect. This is probably because of effect of other more significant process parameters, which tend to vary within a range during the experiments. For example, for Tests 2.4 and 3.4, the approach temperature difference was approximately 3°F. Since the approach temperature has more effect on SO_2 removal, this lower temperature during test 3.4 resulted in higher removal efficiency despite a lower Ca/SO_2 ratio in the absence of heat activation.

As mentioned earlier, the investigation of changing the Ca/SO_2 ratio is the most difficult parameter to study because of the difficulty in ensuring that a true steady state conditions corresponding to the new Ca/SO_2 ratio has been reached. This may partly explain the results corresponding to full load conditions, as it is more difficult and takes longer to reach steady state conditions at full load.

5.5 Effect of Heat Activation of Feed Slurry

At the HCCP, limestone is injected into the exit of the combustor. It is flash calcined to calcium oxide in the furnace and collected with flyash in the baghouse. The calcium oxide collected with ash is mixed with water in the SDA feed slurry tank and fed to the absorber. Conversion of quick lime or CaO to slaked lime or hydrated lime [$Ca(OH)_2$] occurs in the SDA feed tank. In other words the SDA feed tank and attendant verti-mill functions as the lime slaker. It is a well-known phenomenon, slaking efficiency or conversion of quick lime to hydrated lime increases with increase in slaking temperature. Increasing the feed slurry temperature by external steam heating essentially increases the slaking temperature and hence the conversion of quick lime to useable hydrated lime in the feed slurry.

The temperature of feed slurry at normal operating conditions without any external heat was in the range of 100°F. To study the effect of heat activation or increasing the slaking temperature, the feed slurry was steam heated to approximately 150°F. Based on feed tank volume, it was

estimated that a minimum of 2 hours was required for one complete change over of slurry volume. Approximately 6 hours were allowed between tests to ensure complete change over and steady state conditions. The results confirm that the time allowed was sufficient for the system to reach the steady state condition with respect to feed slurry or slaking temperature.

The results are summarized in Table 5.7, the operational parameter details are summarized in Table 5.8, and the effect of heat activation on feed slurry on removal efficiency is shown in Figures 5.7 and 5.8.

Table 5.7
Effect Heat Activation of Feed Slurry on SDA System Performance

Test No.	Gross Load (MWe)	Gas Residence Time (Seconds)	Lime-Stone Feed Rate (lb/min)	Ca/SO_2 Ratio	Approach to Satn. (°F)	Slurry Temp (°F)	SDA Inlet SO_2 (ppm)	Stack SO_2 (ppm)	Removal Eff. (%)	Diff. in Eff. (%)
Low Load; Approach to Saturation 42°F; Low Stoichiometric Ratio										
4.1	42.1	11.9	11.5	1.2	41.4	107.1	120.5	31.6	73.8	
4.2	41.8	12.0	12.2	1.2	41.1	152.9	134.9	29.3	78.3	4.5
Low Load; Approach to Saturation 42°F; High Stoichiometric Ratio										
1.1	42.1	11.9	17.1	1.7	42.3	111.2	112.8	15.5	86.3	
1.2	42.4	11.8	16.9	1.9	42.2	154.6	101.7	7.0	93.1	6.8
Low Load; Approach to Saturation 32°F; Low Stoichiometric Ratio										
4.4	42.1	11.9	12.6	1.4	32.0	109.1	131.2	9.1	93.1	
4.3	42.2	11.8	11.5	1.4	31.6	153.0	134.6	2.2	98.4	5.3
Low Load; Approach to Saturation 32°F; High Stoichiometric Ratio										
1.4	42.0	11.9	17.2	1.7	32.1	102.1	118.8	6.4	94.6	
1.3	42.3	11.8	17.0	1.9	32.0	154.8	101.9	0.7	99.3	4.7
Full Load; Approach to Saturation 40°F; Low Stoichiometric Ratio										
3.4	58.0	8.6	17.8	1.3	38.9	110.7	132.8	34.0	74.4	
3.3	58.3	8.6	17.3	1.4	42.0	153.4	131.7	26.9	79.6	5.2
Full Load; Approach to Saturation 42°F; High Stoichiometric Ratio										
2.4	57.9	8.6	22.3	1.8	42.3	102.6	119.0	36.1	69.6	
2.3	58.0	8.6	22.2	1.8	42.1	151.2	115.8	22.7	80.4	10.7
Full Load; Approach to Saturation 32°F; Low Stoichiometric Ratio										
3.1	58.1	8.6	17.3	1.4	32.0	104.1	118.0	7.5	93.7	
3.1 A	58.3	8.6	17.9	1.3	32.3	107.0	125.1	8.8	93.0	
3.2	58.1	8.6	17.1	1.2	33.9	153.6	129.3	4.7	96.4	3.0*
Full Load; Approach to Saturation 32°F; High Stoichiometric Ratio										
2.1	57.7	8.7	22.2	1.7	31.9	109.6	122.4	20.7	83.1	
2.2	56.4	8.9	22.3	1.8	32.5	147.6	123.2	4.9	96.0	12.9

Note: Shaded areas show change in process parameters.
* Difference in removal efficiency between the average of Tests 3.1 & 3.1A and Test 3.2

Table 5.8 Operational Parameter Details - Effect of Heat Activation of Feed Slurry on SDA System Performance

Test No.	Date	Power Output Gross (MWe)	Resid. Time (Sec)	Coal Feed Feeder A ($x10^3$ lb/hr	Coal Feed Feeder B ($x10^3$ lb/hr	Limestone Feed (lb/min)	Ca/SO2	SDA Inlet Temp. (°F)	SDA Exit Temp. (°F)	BH Exit Temp. (°F)	SDA/BH Ave. Temp. (°F)	Adiabatic Satn. Temp. (°F)	Approach to Satn. (°F)	Slury Temp (°F)	Slurry Solids (Wt.%)	Slurry Flow (GPM)	SDA Inlet SO2 (ppm)	Stack SO2 (ppm)	Diff. In SO2 (ppm)	Removal Eff. (%)	Diff. In Removal Eff. (%)
Low Load; Approach to Saturtion 43 F; Low Stochiometric Ratio																					
4.1	13-Nov-99	42.1	11.9	36.1	34.1	11.5	1.2	281.3	179.5	175.3	177.4	136.0	41.4	107.1	41.8	35.6	120.5	31.6	88.9	73.8	
4.2	14-Nov-99	41.8	12.0	36.3	34.3	12.2	1.2	277.8	179.5	174.8	177.1	136.0	41.1	152.9	41.4	36.3	134.9	29.3	105.6	78.3	4.5
Low Load; Approach to Saturtion 43 F; High Stochiometric Ratio																					
1.1	04-Nov-99	42.1	11.9	36.5	36.5	17.1	1.7	268.8	180.2	176.4	178.3	136.0	42.3	111.2	42.0	31.3	112.8	15.5	97.3	86.3	
1.2	04-Nov-99	42.4	11.8	30.8	33.1	16.9	1.9	267.8	180.3	176.2	178.2	136.0	42.2	154.6	42.1	32.3	101.7	7.0	94.7	93.1	6.8
Low Load; Approach to Saturtion 32 F ; Low Stoichiometric Ratio																					
4.4	15-Nov-99	42.1	11.9	34.9	32.9	12.6	1.3	274.9	170.4	165.6	168.0	136.0	32.0	109.1	41.7	36.9	131.2	9.1	122.1	93.1	
4.3	14-Nov-99	42.2	11.8	36.1	34.0	11.5	1.2	278.9	169.7	165.6	167.6	136.0	31.6	153.0	42.1	40.2	134.6	2.2	132.4	98.4	5.3
Low Load; Approach to Saturtion 32 F ; High Stoichiometric Ratio																					
1.4	06-Nov-99	42.0	11.9	36.0	35.9	17.2	1.7	271.4	169.6	166.6	168.1	136.0	32.1	102.1	41.9	35.9	118.8	6.4	112.3	94.6	
1.3	04-Nov-99	42.3	11.8	32.6	32.6	17.0	1.9	267.3	170.0	165.9	168.0	136.0	32.0	154.8	42.0	35.9	101.9	0.7	101.1	99.3	4.7
Full Load; Approach to Saturtion 43 F; Low Stochiometric Ratio																					
3.4	11-Nov-99	58.0	8.6	48.7	46.8	17.8	1.3	273.4	177.0	172.8	174.9	136.0	38.9	110.7	42.0	42.6	132.8	34.0	98.8	74.4	
3.3	11-Nov-99	58.3	8.6	46.1	44.1	17.3	1.4	271.8	180.0	176.1	178.0	136.0	42.0	153.4	42.0	42.5	131.7	26.9	104.8	79.6	5.2
Full Load; Approach to Saturtion 43 F; HIgh Stochiometric Ratio																					
2.4	08-Nov-99	57.9	8.6	45.2	44.2	22.3	1.8	274.8	180.1	176.4	178.3	136.0	42.3	102.6	41.7	41.1	119.0	36.1	82.9	69.6	
2.3	08-Nov-99	58.0	8.6	46.4	44.8	22.2	1.8	272.4	180.2	176.0	178.1	136.0	42.1	151.2	41.4	42.2	115.8	22.7	93.0	80.4	10.7
Full Load; Approach to Saturtion 32 F; Low Stochiometric Ratio																					
3.1	10-Nov-99	58.1	8.6	45.2	44.2	17.3	1.4	272.1	169.9	166.0	168.0	136.0	32.0	104.1	42.0	44.8	118.0	7.5	110.5	93.7	
3.1 A	12-Nov-99	58.3	8.6	47.9	45.8	17.9	1.4	273.2	170.6	166.0	168.3	136.0	32.3	107.0	42.0	45.1	125.1	8.8	116.3	93.0	
3.2	10-Nov-99	58.1	8.6	45.3	43.5	17.1	1.4	270.5	171.9	167.8	169.9	136.0	33.9	153.6	40.5	46.9	129.3	4.7	124.6	96.4	3.0*
Full Load; Approach to Saturtion 32 F; High Stochiometric Ratio																					
2.1	07-Nov-99	57.7	8.7	48.1	45.3	22.2	1.7	271.1	169.7	166.0	167.9	136.0	31.9	109.6	41.7	44.1	122.4	20.7	101.7	83.1	
2.2	07-Nov-99	56.4	8.9	46.1	42.7	22.3	1.8	271.2	170.1	166.9	168.5	136.0	32.5	147.6	41.9	45.5	123.2	4.9	118.3	96.0	12.9

Note:
Shaded areas show change in process parameters
* Difference in the removal efficiency between the average of Tests 3.1 & 3.1A and Test 3.2

Figure 5.7: Effect of Heat Activation of Feed Slurry on Removal Efficiency (Low Unit Load)

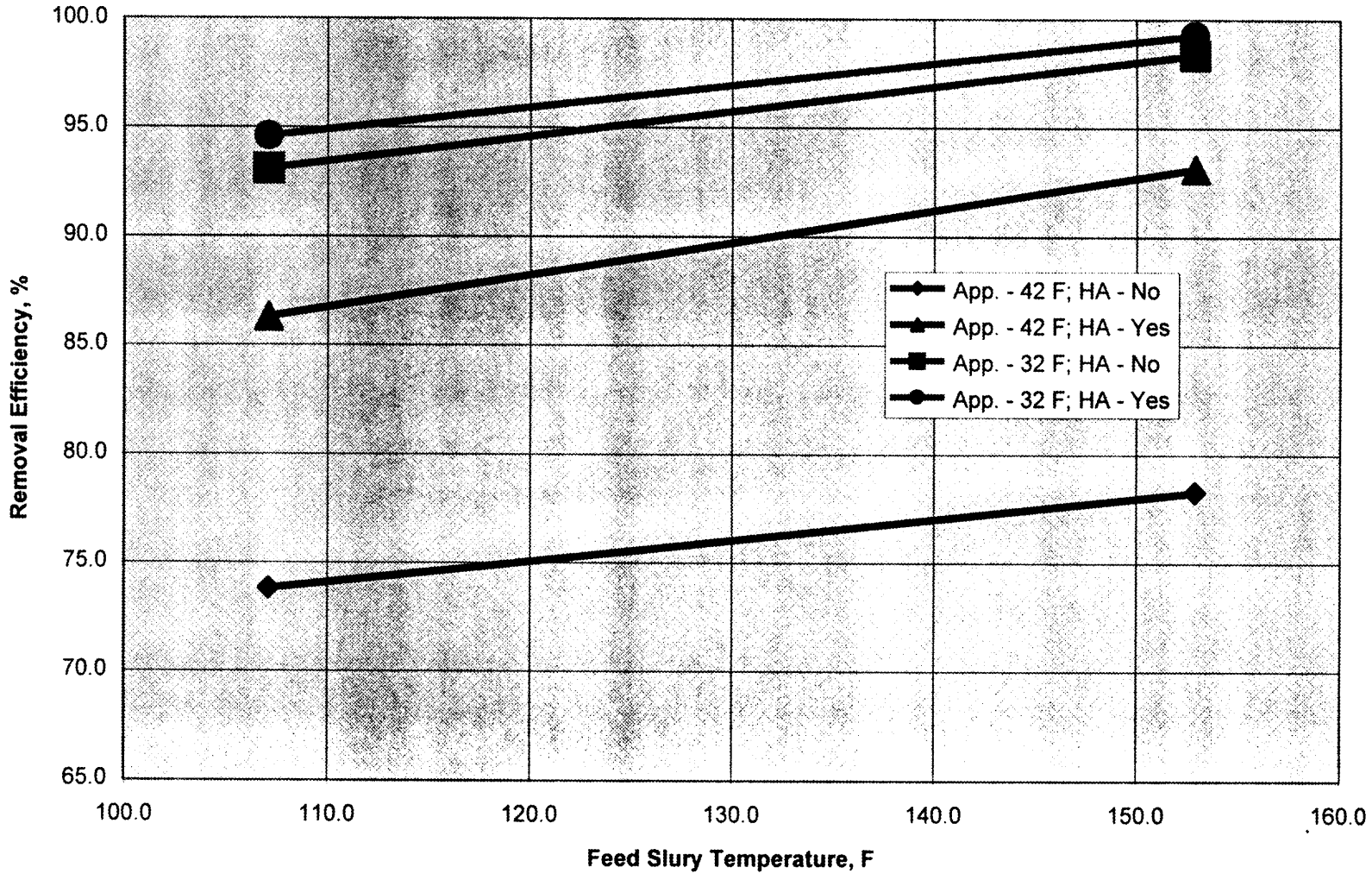
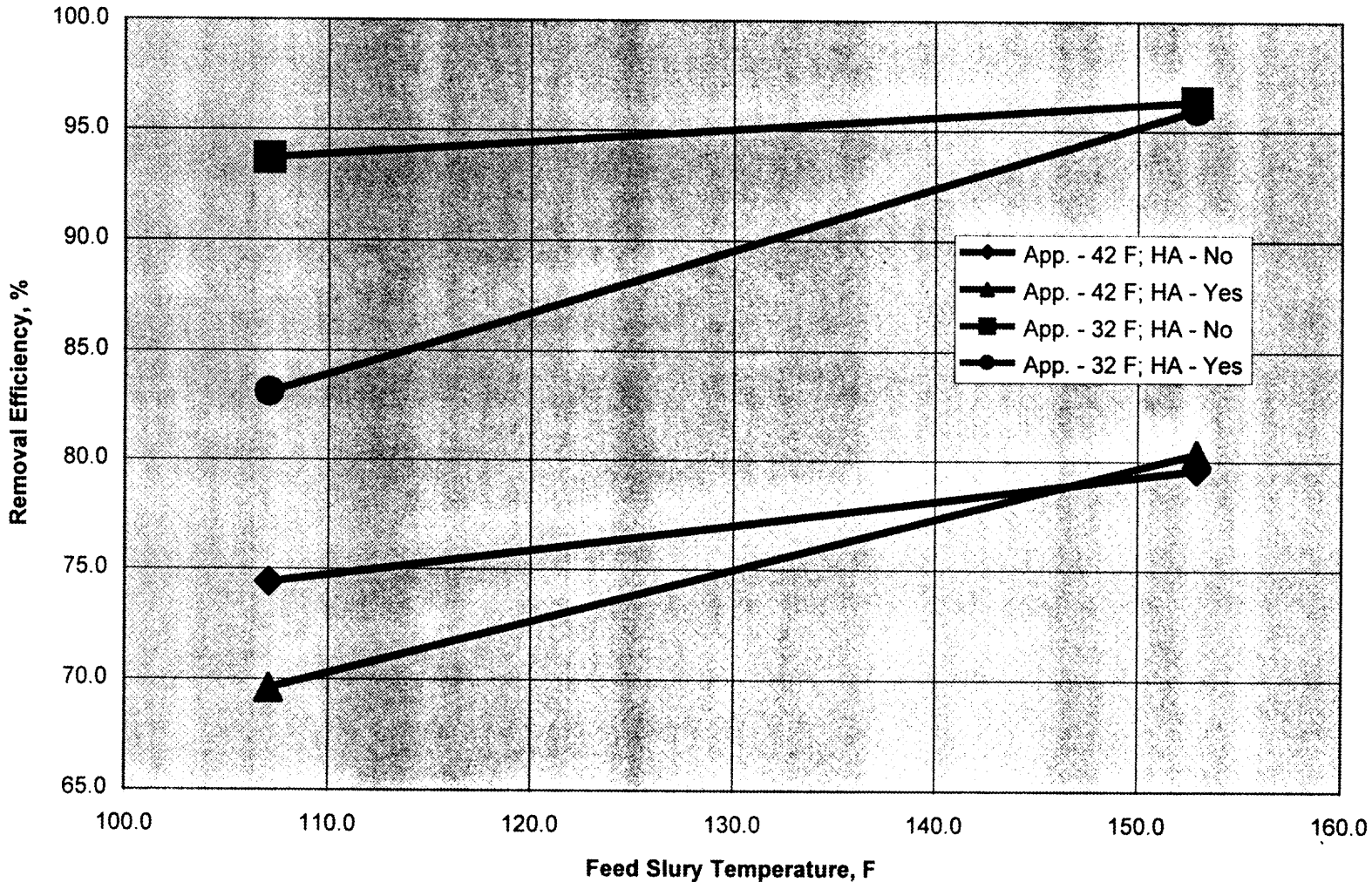


Figure 5.8: Effect of Heat Activation of Feed Slurry on Removal Efficiency (High Unit Load)



As can be seen under all operating conditions, i.e., at different loads, different approach temperatures and at different Ca/SO_2 ratios, SO_2 removal tends to increase with heat activation. The improvement ranged from 4.5% to 6.8% at low load condition and 3.0% to 12.9% at full load conditions. Even at the most favorable operating conditions with respect to other parameters, such as at low load, at high Ca/SO_2 stoichiometric ratio and at low approach temperature, the efficiency increased from 94.6% to 99.3% or by 4.7% with heat activation (Test 1.3 & 1.4).

The results suggest that heat activation is perhaps the second most significant process parameter. It is next only to the approach temperature that determines SDA performance with respect SO_2 removal in a limestone injection followed by spray dryer absorber-baghouse semi-dry flue gas desulfurization system.

This is an important finding of this demonstration test program. Even though steam heating the feed slurry entails operating cost, depending on the relative cost of lime and steam, this is an option that must be considered in optimizing the system performance and O&M cost. It must be pointed out that steam heating slurry is relatively easy and the heating system and attendant equipment have relatively low capital cost and easy to operate and maintain. Economics of the approach is site-specific and will depend primarily on the cost of lime and steam at the plant.

Since the response time of system performance for increasing the feed slurry temperature is relatively short, less than 15 minutes or so, and it takes less than 3 hours for the entire system to reach steady-state condition, this approach can even be used intermittently on an as needed basis, when a temporary boost in system performance is required. For example, it can be used when the an unexpectedly high-sulfur coal seam is encountered or when other operating parameters such as lowering the approach temperature or decreasing the load cannot be used due to system operational constraints.

6.0 SUMMARY

A demonstration test program as required by Contract No. HCCP-007 between AIDEA and B&W/Joy was conducted between November 3 and November 15, 1999. The objective of the program was to characterize the SDA system by investigating the effect of various process parameters on system performance so that the data generated can be used to design other systems with different coal characteristics and performance requirements. The parameters to be studied include:

- Coal sulfur content
- Approach to saturation temperature (flue gas temperature at spray dryer exit)
- Calcium to sulfur ratio (reagent ratio)
- Activation of recycle solids to improve SDA performance with respect to SO_2 removal with attendant improvement reagent utilization

The results indicate:

- The SDA system at the HCCP with furnace limestone injection can achieve high SO_2 removal efficiencies in excess of 90% even with very low sulfur coal with 0.15% sulfur content at reasonable reagent stoichiometry of 1.2 to 1.4.

- The system can be operated at an approach to saturation temperature range of 30°F to 40°F, the temperature range of several conventional lime based semi-dry FGD systems with SO_2 removal efficiencies in excess of 90%. Significant improvement in SO_2 removal achieved at lower approach temperature.

- Heat activation of SDA feed slurry appears to be a very significant process parameter, next only to the approach temperature that determines SDA performance with respect SO_2 removal. This is an important finding of this demonstration test program. Even though, steam heating the feed slurry entails operating cost, this is an option that must be considered in furnace limestone injection systems followed by SDA/baghouse. Economics of the approach will depend primarily on delivered cost of lime and steam, which are site-specific. Operation at the HCCP suggests steam heating is relatively easy to operate and maintain.

- Of the four process parameters investigated, the order of significance with respect to SO_2 removal are:
  - Approach to saturation temperature
  - Heat activation of recycle solids
  - Reagent ratio
  - Unit load (gas flow rate/gas residence time)

List of Acronyms and Abbreviations

acf	-	Actual Cubic Foot
acfm	-	Actual Cubic Feet per Minute
APH	-	Air Pre-Heater
AIDEA	-	Alaska Industrial Development and Export Authority
BH	-	Baghouse
B&W	-	Babcock and Wilocox
B&W/Joy	-	Babcock and Wilcox/Joy Environmental Technologies Inc.
Btu	-	British Thermal Unit
CEMS	-	Continuous Emission Monitoring System
DCS	-	Distributed Control System
DOE	-	Department of Energy
EPA	-	Environmental Protection Agency
^{0}F	-	Degrees Fahrenheit
FCM	-	Flash Calcined Material
FGD	-	Flue Gas Desulfurization
gr	-	Grain
GVEA	-	Golden Valley Electricity Association, Inc.
HCCP	-	Healy Clean Coal Project
HHV	-	Higher Heating Value
MAF	-	Moisture and Ash Free
MW	-	Megawatt
NO_x	-	Nitrogen Oxides
S	-	Sulfur
SDA	-	Spray Dryer Absorber
SO_2	-	Sulfur Dioxide
SWEC	-	Stone & Webster Engineering Corporation

References

1. Healy Clean Coal Project – Spray Dryer Absorber System Performance Test Report. Prepared by Stone & Webster Engineering Corporation. April 1999.

2. Healy Clean Coal Project – Demonstration Test Program. Prepared by Stone & Webster Engineering Corporation and Steigers Corporation. July 1998.

3. Healy Clean Coal Project – Demonstration Test Program, Topical Report: Combustion System Operation. Prepared by TRW Corporation. March 31, 2000

APPENDIX A

CONCEPTUAL SDA SYSTEM DEMONSTRATION TEST PROGRAM

SDA DEMONSTRATION PROGRAM

SDA technology system characterization refers to the tests recommended for study of how the SDA System responds to incremental change in process conditions. The SDA technology characterization test program assumes that the parameters given in Table A-1 are achievable and that the equipment and control system can accommodate these variables. The characterization test matrix is subject to changes at anytime within the given outlines pending the evaluation of the previous test results and their agreement with the project goals. Additionally, characterization test parameters may need to be adjusted once data from combustor optimization are available. These changes will be addressed in the Emissions Control System Operating Report. Test procedures will be provided with this report.

Initial Performance SDA System

A brief series of tests will be conducted on the SDA/Fabric Filter (FF) System for preliminary adjustment of operating parameters. This initial performance tuning is required to ready these systems for compliance testing.

SDA/FF Characterization Testing

Table A-1 summarizes the characterization testing matrix.

The following information is required for SDA/FF Technology Characterization testing:

- Coal feed rate, coal analysis, limestone feed rate, and limestone composition.
- Air heater hoppers drop out solids analysis.
- Ash analysis for alkaline components.
- FF recycle stream analysis.
- FCM – Sample at inlet to SDA for available calcium oxide.
- Recycle slurry for available calcium oxide/calcium hydroxide and reactivity.

The testing will explore SDA operation with different SO_2 inlet concentrations to the SDA based upon various levels of sulfur removal achieved in the TRW combustors, coal quality and plant load.

Table A-1
HCCP SDA Technology Characterization Proposed Test Matrix

Inlet SO_2 Concentration	Reagent Ratio (Ca/SO_2)	Approach to Saturation	Recycle Grind	Recycle
Low	1.95	33	Design	No Supplemental Heat Activation
	1.75	18		With Supplemental Heat Activation
Medium	1.95	33	Design	No Supplemental Heat Activation
	1.75	18		With Supplemental Heat Activation
High	1.95	33	Design	No Supplemental Heat Activation
	1.75	18		With Supplemental Heat Activation

These tests will be conducted at various plant loads. Sulfur dioxide capture will be characterized throughout the system including the combustors, SDA, and fabric filter system.

APPENDIX B

TEST DATA

Demonstration Test Data

No.	Test No.	Date	Time	Load	Coal Feed Feeder A	Coal Feed Feeder B	Limestone Feed	SDA Inlet Temp	SDA Exit Temp	BH Exit Temp	Adiabatic Satn. Temp	Slury Temp	Slurry Solids, %	Slurry Flow (GPM)	SDA Inlet SO2	Stack	Comments
	1.1 Start	**03-Nov-99**	8:04	40.7	36.2	36.2	17.2	271	183	176	136	109	42.1	33.27	118.8	19.9	
			9:04	42.3	36.2	36.2	16.9	270	180	176	136	110	41.6	30.38	122.3	13.1	
			10:04	42.3	36.4	36.4	17.2	274	180	178	136	111	42.3	30.49	120.3	17.1	
			11:04	41.9	36.6	36.6	17.2	264	180	177	136	111	41.9	30.9	123.7	15.5	
			12:04	42.2	37.0	37.0	17.2	266	181	176	136	112	42.1	31.7	112.4	14.7	
			13:04	42.2	36.6	36.5	17.3	267	180	176	136	112	41.9	31.3	108.4	12.1	
			14:04	42.0	36.1	36.2	16.9	268	179	176	136	112	41.9	32.1	111.7	13.9	
			15:04	42.0	36.4	36.4	17.0	268	179	176	136	112	42.1	31.8	115.2	12.6	
			16:03	42.1	36.3	36.5	17.1	270	180	176	136	111	41.8	31.2	110.9	16.3	
			17:03	42.5	36.4	36.3	17.3	269	181	177	136	111	42.2	31.2	100.8	16.8	
			18:03	42.5	36.6	36.7	17.1	269	179	177	136	111	41.9	31.6	100.1	14.1	
	1.1 Finish	**03-Nov-99**	19:03	42.2	36.7	36.9	17.1	269	180	176	136	112	42.0	29.3	108.6	19.3	
	1.1	**Average**		**42.1**	**36.5**	**36.5**	**17.1**	**268.8**	**180.2**	**176.4**	**136.0**	**111.2**	**42.0**	**31.3**	**112.8**	**15.5**	
			20:03	45.1	43.1	43.1	16.8	265	180	177	136	112	41.0	32.0	107.9	17.1	Load & Coal feed went up
			21:03	45.4	38.1	37.6	16.6	264	180	177	136	113	41.4	32.9	110.2	16.2	
			22:03	42.7	35.3	35.4	17.2	267	178	177	136	114	42.0	30.7	103.5	14.1	
			23:03	42.5	35.4	35.4	17.1	266	180	176	136	113	41.4	31.3	102.3	16.4	
																	Steam to heat activate slurry
	1.2 Stat	**04-Nov-99**	8:00	43.0	33.7	33.8	16.5	268	180	177	136	154	43.0	32.6	103.3	9.3	turned on at 24:00hrs
			9:00	42.9	33.3	33.2	16.6	268	180	176	136	154	42.1	31.9	97.3	7.2	
			10:00	42.4	33.1	33.1	17.2	266	180	176	136	155	41.8	31.4	96.0	8.6	
			11:00	42.1	33.3	33.4	16.7	267	181	176	136	155	41.8	31.8	102.5	5.8	
			12:00	42.2	33.4	33.4	17.0	268	181	176	136	155	42.0	32.7	93.6	6.9	
			13:00	42.5	3.1	33.1	16.8	269	180	176	136	154	41.7	33.3	100.7	4.9	
			14:00	42.4	32.8	32.7	16.9	270	180	176	136	155	41.9	32.7	93.4	5.7	
			15:00	42.0	32.9	33.0	16.9	271	180	176	136	154	42.5	33.2	99.3	4.2	
			16:00	42.2	32.7	32.7	16.8	271	180	176	136	155	41.8	33.1	108.3	5.4	
			17:00	42.3	32.8	32.8	17.1	272	180	176	136	154	42.1	33.4	99.9	3.4	
			18:00	42.3	32.7	32.7	17.0	268	181	176	136	154.8	42.1	33.6	104.9	7.0	
			19:00	42.2	33.0	33.0	16.9	260	180	176	136	155	42.2	29.4	107.5	12.8	
	1.2 Finish	**04-Nov-99**	20:00	42.2	33.1	33.1	17.0	264	181	177	136	155	42.3	30.4	115.5	9.6	
	1.2	**Average**		**42.4**	**30.8**	**33.1**	**16.9**	**267.8**	**180.3**	**176.2**	**136.0**	**154.6**	**42.1**	**32.3**	**101.7**	**7.0**	
	1.3 Start	**04-Nov-99**	21:00	42.5	33.1	33.1	17.2	268	170	167	136	155	41.7	36.3	106.0	1.0	
			22:00	42.1	33.1	33.1	17.0	267	170	166	136	155	42.1	35.9	110.5	0.8	
			23:00	42.5	32.8	32.8	17.0	268	170	166	136	155	41.8	36.6	109.3	0.8	

	05-Nov-99	0:00:00	42.0	32.3	32.3	17.0	265	170	165	136	155	41.8	35.2	98.8	0.6	
		1:00	42.2	32.5	32.5	16.9	265	170	166	136	155	42.1	35.0	100.4	0.6	
		2:00	42.2	32.5	32.5	17.0	267	170	166	136	154	42.1	35.8	94.3	0.7	
		3:00	42.4	33.0	33.0	17.0	268	170	166	136	155	41.9	36.4	100.1	0.8	
		4:00	42.3	33.2	33.2	16.8	269	170	166	136	155	41.6	36.2	100.5	0.8	
		5:00	42.8	32.5	32.5	16.9	273	170	166	136	154	41.9	38.4	101.5	0.6	
		6:00	42.2	32.0	32.0	17.3	266	170	166	136	155	42.3	35.2	93.8	0.6	
		7:00	42.2	32.2	32.2	17.2	266	170	166	136	155	41.7	35.2	95.8	0.8	
		8:00	42.3	32.2	32.2	17.1	267	170	166	136	155	42.6	35.4	98.0	0.6	
1.3 Finish	**05-Nov-99**	9:00	42.3	32.8	32.7	17.2	266	170	165	136	154	42.1	35.4	115.3	0.8	
	1.3	**Average**	**42.3**	**32.6**	**32.6**	**17.0**	**267.3**	**170.0**	**165.9**	**136.0**	**154.8**	**42.0**	**35.9**	**101.9**	**0.7**	
Transition		10:00	42.1	33.1	33.0	17.1	264	170	166	136	143.9	41.8	34.7	97.4	0.8	Steam turned off
1.3 to 1.4		11:00	42.1	33.0	32.9	17.3	264	170	166	136	136	42.1	35.4	115.9	0.9	Feed slurry is cooling from 155 F
		12:00	41.9	33.1	33.0	16.8	267	169	166	136	132	42.3	35.7	101.0	0.8	
		13:00	42.1	33.5	33.4	17.1	269	170	166	136	127	41.6	36.0	110.8	0.8	
		14:00	42.3	33.7	33.7	17.3	269	170	166	136	123	41.9	35.7	107.4	0.9	
		15:00	42.2	33.5	33.5	17.3	271	171	166	136	120	42.0	35.9	116.2	1.1	
		16:00	41.9	33.7	33.6	17.3	271	170	166	136	117	41.6	36.8	117.4	1.0	
		17:00	42.3	33.6	33.6	17.4	273	170	167	136	116	42.7	37.9	117.5	1.0	
		18:00	42.3	33.9	33.9	17.4	271	169	165	136	113	41.3	34.6	100.5	1.3	Added air lance to hasten cooling
		19:00	42.5	33.6	33.7	17.3	269	170	165	136	113	42.2	34.8	108.4	2.3	
		20:00	42.0	33.9	33.9	16.9	271	170	165	136	110	41.6	35.5	104.4	1.6	
		21:00	42.1	34.0	34.0	17.1	271	170	166	136	110	42.0	35.4	111.8	2.7	
		22:00	42.1	34.5	34.5	17.1	272	170	166	136	108	41.9	35.8	105.0	2.8	
		23:00	42.2	34.8	34.7	17.2	272	170	166	136	107	41.7	37.9	112.7	1.4	
1.4 Start	**06-Nov-99**	0:00	42.1	34.9	34.8	17.1	273	169	167	136	106	42.2	35.3	114.0	4.0	
		1:00	42.0	35.2	35.1	16.7	270	170	167	136	105	41.6	35.1	108.4	4.8	
		2:00	42.1	35.3	35.4	17.1	270	169	167	136	103	42.1	35.7	112.8	4.2	
		3:00	42.0	35.8	35.8	17	271	169	167	136	101	42.1	36.2	127.7	6.9	
		4:00	42.1	36.2	36.2	17.2	272	170	166	136	100	41.7	35.9	122.8	9.3	
		5:00	41.8	37.1	37.1	17.2	271	170	166	136	100	42.5	36.0	123.1	8.8	
1.4 Finish	**06-Nov-99**	6:00	42.1	37.2	37.2	17.8	273	170	166	136	100	41.1	36.7	122.5	6.9	
	1.4	**Average**	**42.0**	**36.0**	**35.9**	**17.2**	**271.4**	**169.6**	**166.6**	**136.0**	**102.1**	**41.9**	**35.9**	**118.8**	**6.4**	
Transition	**06-Nov-99**	6:14	42.0	37.2	37.1	22.6	273	170	166	136	100	41.6	36.7	122.1	6.9	LS feed iincreased to 22.5 lb/min.
1.4 to 2.1		7:00	42.2	37.5	37.5	22.7	273	169	166	136	102	42.9	36.4	125.6	6.6	
		8:00	51.4	47.0	47.0	22.5	277	170	166	136	102	41.9	47.1	133.1	11.4	Unit load increased to 55 MWe
		9:00	55.2	48.5	48.4	22.5	275	169	170	136	103	42.3	45.4	134.2	12.8	
		10:00	55.4	48.1	48.1	22.3	274	168	166	136	103	41.5	41.6	135.6	21.5	
		11:00	55.3	48.8	48.7	22.4	270	172	167	136	104	42.2	44.9	136.5	24.0	
		12:00	55.6	50.1	50.2	22.5	272	170	168	136	103	41.7	44.9	134.7	19.4	
		13:00	56.1	49.4	49.4	22.7	272	170	167	136	104	42.3	44.8	141.5	26.1	
		14:00	55.4	50.0	50.1	22.4	272	170	167	136	104	42.1	45.1	145.3	26.4	
		15:00	58.7	49.1	49.1	22.4	273	170	166	136	104	41.8	45.3	140.8	27.7	
		16:00	56.4	45.1	45.0	22.5	274	173	167	136	104	42.3	46.9	131.4	24.6	
		17:00	55.3	46.3	46.3	22.8	272	170	166	136	104	41.9	44.0	126.8	24.5	

		18:00	57.1	47.4	47.4	22.7	274	170	167	136	105	41.9	44.5	134.6	23.5	
		19:00	57.5	47.3	47.3	22.5	274	168	169	136	106	42.0	44.4	129.4	29.4	Problem With Atomizer & SDA Inlet t
		20:00	55.7	45.9	45.9	22.1	272	172	216	136	107	41.0	48.6	116.3	40.1	Problem With Atomizer & SDA Inlet t
		21:00	57.7	48.7	48.7	21.9	273	170	167	136	109	42.5	45.1	125.4	19.1	
		22:00	54.9	45.9	43.7	22.4	274	163	171	136	109	41.9	52.2	118.8	2.9	
	06-Nov-99	23:00	57.2	46.5	44.6	22.7	269	171	166	136	112	42.4	43.3	117.9	18.8	
2.1 Start	07-Nov-99	0:00	58.3	46.8	44.9	21.9	269	170	166	136	111	41.6	45.0	125.4	17.8	
		1:00	58.6	47.2	43.1	22.3	272	169	166	136	111	41.1	41.9	113.3	18.9	
		2:00	57.7	47.8	43.9	22.4	270	170	166	136	112	42.8	43.4	135.8	23.8	
		3:00	55.6	50.6	47.8	22.4	271	170	166	136	107	39.5	45.3	131.0	17.9	
		4:00	59.2	49.8	46.8	22.1	273	169	166	136	109	42.9	45.8	108.5	19.4	
		5:00	56.8	47.1	45.1	22.2	271	170	165	136	108	41.1	42.9	119.5	21.7	
2.1 Finish	07-Nov-99	6:00	57.9	47.1	45.4	22.2	272	170	167	136	109	42.7	44.2	123.0	25.2	
	2.1	Average	57.7	48.1	45.3	22.2	271.1	170	166	136	110	41.7	44.1	122.4	20.7	
Transition 2.1 to 2.2	07-Nov-99	7:00	58.4	46.9	45.9	22.1	270	170	166	136	114	41.5	44.3	133.2	25.7	Heating Slurry
		8:00	58.1	47.1	46.1	22.0	270	169	166	136	125	42.0	46.3	130.2	22.3	Heating Slurry
		9:00	57.8	46.1	44.9	22.1	270	170	166	136	134	42.2	45.1	120.7	27.1	Heating Slurry
		10:00	56.0	46.3	35.4	22.0	270	170	166	136	139	41.9	41.4	137.3	27.4	Heating Slurry
		11:00	48.3	46.2	20.4	22.4	275	171	167	136	143	41.2	38.7	107.0	13.4	
		12:00	47.4	46.7	20.4	22.2	270	169	169	136	148	41.0	39.1	99.8	10.3	
2.2 Start	07-Nov-99	13:00	54.4	45.8	45.6	22.7	269	170	166	136	151	42.2	45.0	105.6	6.5	
		14:00	58.6	47.0	46.0	22.1	276	169	167	136	150	42.1	48.0	155.6	3.2	
		15:00	58.9	45.0	43.8	22.1	271	173	166	136	148	41.7	47.0	121.7	3.2	
		16:00	57.8	46.0	44.9	22.7	269	170	165	136	147	42.1	45.1	124.2	5.1	
		17:00	57.8	46.2	45.3	22.1	270	171	166	136	148	41.9	45.3	139.0	6.0	
		18:00	57.6	44.1	43.0	22.7	271	169	169	136	147	42.2	46.5	125	5	
		19:00	56.3	46.3	45.5	22.6	271	170	167	136	147	41.8	46.6	123.2	3.4	
		20:00	57.4	47.3	46.3	21.9	271	169	166	136	147	42	44.5	118.7	3.7	
		21:00	58.0	47.6	45.8	22.0	272	170	169	136	146	41.7	47.9	124.5	4.3	
2.2 Finish	07-Nov-99	22:00	56.5	44.8	43.0	22.0	273	171	166	136	145	41.9	45.6	118.2	3.7	
	2.2	Average	56.4	46.1	42.7	22.3	271.2	170.1	166.9	136.0	147.6	41.9	45.5	123.2	4.9	
Transition 2.2 to 2.3		23:00	56.7	46.7	44.7	21.9	269	181	173	136	147	41.7	40.2	116.9	29.66	
	08-Nov-99	0:00	57.9	47.6	45.6	22.4	271	180	176	136	150	42	41.8	125.3	28.9	
2.3 Start	08-Nov-99	1:00	58.1	46.0	43.9	21.9	274	180	176	136	151	42.3	43.6	116	22.7	
		2:00	57.8	47.3	45.3	22.2	275	180	177	136	151	42.3	43.4	120.9	20.2	
		3:00	58.4	46.1	44.0	22.6	274	180	175	136	151	41.3	42.8	113.5	20.6	
		4:00	58.5	45.5	43.5	22.4	271	180	176	136	155	39.9	42.4	109.3	21.8	
		5:00	57.6	45.9	44.9	22.1	271	180	177	136	153	40.6	41.2	138.8	23.9	
		6:00	58.2	45.7	44.8	22.1	271	180	176	136	153	41.3	41.3	116.9	24.8	
		7:00	58.2	46.1	45.1	22.3	274	181	176	136	153	40.9	40.9	99.5	18.9	
		8:00	58.7	46.1	45.1	22.3	272	180	177	136	151	42.1	43.4	106.5	20.8	
2.3 Finish	08-Nov-99	9:00	58.0	46.9	45.8	22.4	274	180	177	136	148	40.8	43.0	110.1	17.9	

	2.3	**Average**	**58.0**	**46.4**	**44.8**	**22.2**	**272.4**	**180.2**	**176.0**	**136.0**	**151.2**	**41.4**	**42.2**	**115.8**	**22.7**	
Transition	**08-Nov-99**	10:00	58.5	45.8	44.9	22.2	271	180	176	136	134	41.7	42.5	112.0	20.6	Slurry Cooling / Heat activation off
2.3 to 2.4		11:00	58.0	46.0	45.0	21.6	272	180	176	136	126	40.8	42.4	108.0	20.4	Slurry Cooling / Heat activation off
		12:00	58.1	46.9	45.9	22.2	273	180	176	136	121	40.4	41.6	115.6	21.9	Slurry Cooling / Heat activation off
		13:00	59.1	42.3	41.4	21.9	276	179	177	136	117	42.2	41.1	113.6	25.9	Slurry Cooling / Heat activation off
		14:00	56.8	43.1	42.1	22.4	272	180	176	136	113	41.0	39.3	111.6	33.6	Slurry Cooling / Heat activation off
		15:00	58.3	42.4	41.5	21.3	271	179	175	136	112	41.0	39.9	128.1	35.6	System balancing
		16:00	55.2	42.5	41.6	21.5	273	181	177	136	111	41.7	40.2	132.0	39.1	System balancing
		17:00	57.8	43.8	42.8	22.0	273	179	175	136	110	42.5	41.5	125.1	36.8	System balancing
		18:00	57.9	43.6	42.7	22.1	273	178	174	136	106	41.9	41.9	118.2	34.1	
	08-Nov-99	19:00	57.8	44.7	43.8	22.4	275	178	174	136	104	42.1	41.2	133.0	35.6	
2.4 Start	**08-Nov-99**	20:00	57.9	46.0	45.2	22.6	272	180	176	136	103	42.0	39.7	125.5	37.7	
		21:00	57.3	42.7	41.8	22.4	275	179	176	136	102	42.1	41.0	111.7	31.0	
		22:00	57.4	44.7	43.8	22.1	277	180	177	136	101	42.6	41.0	110.2	32.4	
		23:00	58.1	44.8	43.9	22.2	274	181	176	136	102	41.7	41.0	129.4	38.8	
	09-Nov-99	0:00	57.8	45.3	44.2	21.9	276	180	177	136	102	39.9	41.2	115.0	36.6	
		1:00	58.4	44.9	44.0	22.4	274	180	176	136	103	41.0	41.3	122.8	37.1	
		2:00	57.9	45.8	44.8	22.2	276	181	177	136	103	41.8	42.8	115.3	34.1	
		3:00	57.9	45.9	44.9	22.6	275	180	177	136	103	42.4	41.1	119.9	37.6	
2.4 Finish	**09-Nov-99**	4:00	58.2	46.3	45.2	22.3	274	180	176	136	104	42.1	41.1	121.5	40.0	
	2.4	**Average**	**57.9**	**45.2**	**44.2**	**22.3**	**274.8**	**180.1**	**176.4**	**136.0**	**102.6**	**41.7**	**41.1**	**119.0**	**36.1**	
Transition	**09-Nov-99**	5:00	57.9	46.5	45.5	22.5	277	168	165	136	104	42.0	46.7	123.5	4.9	SDA exit temp drop
2.4 to 3.1		6:00	58.2	46.6	45.5	17.2	274	168	164	136	105	42.0	47.2	133.5	6.2	Limestone feed drop
		7:00	58.0	46.6	45.8	17.4	275	168	164	136	105	42.4	47.4	126.2	5.0	System balance
		8:00	58.8	45.3	44.2	17.5	276	168	164	136	106	42.1	48.0	117.3	4.1	System balance
		9:00	58.5	44.2	43.2	17.2	277	168	164	136	106	42.4	47.9	114.8	3.8	System balance
		10:00	59.0	45.6	44.6	17.4	274	170	165	136	106	41.3	44.4	111.3	7.9	System balance
		11:00	58.9	43.0	42.1	17.3	272	170	165	136	106	42.0	45.2	100.5	7.7	System balance
		12:00	57.7	42.9	41.9	17.5	273	170	166	136	107	43.5	44.2	100.0	7.2	System balance
		13:00	58.2	43.0	41.9	17.3	271	170	166	136	105	40.9	43.6	107.8	7.7	System balance
		14:00	58.1	43.4	42.4	16.7	270	170	165	136	106	42.3	43.5	116.0	7.7	System balance
		15:00	57.9	44.1	43.1	17.5	270	170	166	136	105	41.9	44.0	115.2	6.4	System balance
3.1 Start	**09-Nov-99**	16:00	57.4	46.1	45.2	17.2	272	169	166	136	105	41.6	44.7	115.5	6.0	
		17:00	57.4	47.0	46.0	17.2	272	170	166	136	105	42.3	43.8	117.2	6.2	
		18:00	58.1	45.8	44.8	17.4	273	169	167	136	105	41.8	46.2	121.0	5.7	
		19:00	58.2	46.2	45.3	17.3	273	170	165	136	104	42.3	45.7	126.1	5.2	
		20:00	58.3	45.1	44.3	17.5	275	169	166	136	103	42.1	45.4	108.6	5.5	
		21:00	58.2	45.7	44.8	17.2	271	171	166	136	103	41.8	44.6	121.5	9.1	
		22:00	59.3	43.8	42.9	17.1	272	170	166	136	103	42.1	45.1	119.9	8.9	
		23:00	57.9	43.8	42.8	17.7	270	170	167	136	104	42.2	43.8	114.1	7.1	
		0:00	58.1	43.8	42.7	17.1	271	171	165	136	104	41.7	43.8	122.1	9.6	
3.1 Finish	**10-Nov-99**	1:00	58.0	44.2	43.3	17.1	272	170	166	136	105	42.1	44.6	113.8	11.5	
	3.1	**Average**	**58.1**	**45.2**	**44.2**	**17.3**	**272.1**	**169.9**	**166.0**	**136.0**	**104.1**	**42.0**	**44.8**	**118.0**	**7.5**	

Transition	**10-Nov-99**	2:00	58.4	44.0	43.1	17.2	273	170	166	136	138	40.6	44.4	132.0	8.3	Slurrry Heating
3.1 to 3.2		3:00	57.9	44.9	43.9	17.3	271	170	165	136	157	41.4	45.2	127.4	10.2	Slurrry Heating
		4:00	57.9	45.6	44.6	17.6	272	170	166	136	153	42.6	47.7	127.7	4.9	Slurrry Heating
		5:00	58.0	45.8	44.7	17.1	273	170	166	136	152	41.3	48.2	124.8	2.5	Slurrry Heating
		6:00	58.1	46.4	45.4	17.3	273	170	166	136	154	42.2	48.8	130.7	2.1	Slurrry Heating
		7:00	58.8	45.4	44.4	17.4	274	170	166	136	153	41.7	49.1	126.0	2.3	
		8:00	58.6	44.1	42.9	17.5	272	170	167	136	153	42.1	47.4	142.3	3.7	
		9:00	58.2	44.3	43.3	17.2	269	169	166	136	154	41.7	45.5	132.0	4.8	
3.2 Start	**10-Nov-99**	10:00	58.1	44.1	43.1	17.8	267	170	165	136	153	41.9	45.0	132.5	6.9	
		11:00	58.1	44.5	43.5	17.1	267	170	166	136	153	27.0	45.5	129.3	5.7	
		12:00	58.1	44.8	43.8	17.4	269	171	165	136	154	41.5	46.6	137.8	5.4	
		13:00	58.0	45.2	43.2	17.0	271	170	166	136	153	42.1	47.1	130.1	5.5	
		14:00	58.4	45.2	43.3	17.0	271	168	165	136	153	41.7	48.9	126.3	3.7	
		15:00	58.3	44.8	42.7	17.1	271	170	165	136	154	41.9	46.3	136.0	5.6	
		16:00	58.3	45.2	43.0	17.1	269	170	165	136	154	42.3	46.9	131.8	4.9	
		17:00	57.7	46.2	44.1	16.9	271	170	166	136	154	41.9	47.7	122.4	2.9	
		18:00	58.3	45.6	43.6	16.8	273	170	165	136	154	41.6	47.3	117.7	3.5	
3.2 Finish	**10-Nov-99**	19:00	58.1	46.0	44.0	17.0	272	170	166	136	154	41.9	48.1	125.5	3.0	
	3.2	**Average**	**58.1**	**45.2**	**43.4**	**17.1**	**270.1**	**169.9**	**165.4**	**136.0**	**153.6**	**40.4**	**46.9**	**128.9**	**4.7**	
Transition																
3.2 to 3.3		20:00	57.7	46.2	44.2	17.0	274	192	192	136	154	41.9	41.8	132.8	111.9	
3.3 Start		21:00	58.5	46.6	44.7	17.4	270	180	176	136	153	41.7	42.8	125.8	24.5	
		22:00	58.8	45.9	43.9	17.3	274	180	175	136	153	41.9	43.4	125.0	23.1	
		23:00	58.2	46.4	44.3	17.4	271	181	176	136	154	41.5	42.3	120.7	25.2	
	11-Nov-99	0:00	58.5	45.6	43.7	17.8	272	180	176	136	153	42.0	42.1	139.9	28.0	
		1:00	58.1	45.9	43.8	17.1	274	179	176	136	154	42.6	42.2	138.3	27.2	
		2:00	58.0	46.4	44.4	16.1	270	180	176	136	154	41.5	41.8	139.2	27.4	
		3:00	58.3	45.4	43.2	17.2	272	180	176	136	153	42.3	43.0	118.9	24.6	
		4:00	57.6	46.7	44.6	17.6	273	180	176	136	153	42.0	42.4	121.1	23.2	
		5:00	58.1	47.3	45.3	17.2	272	179	177	136	153	42.0	44.7	141.6	22.9	
		6:00	58.1	46.7	44.6	17.2	272	180	177	136	153	42.2	41.7	144.0	37.6	
		7:00	58.5	45.9	43.9	17.1	270	181	176	136	154	41.7	41.6	143.7	31.2	
3.3 Finish	**11-Nov-99**	8:00	58.9	44.8	42.8	17.8	272	180	176	136	154	42.5	42.6	121.7	27.3	
	3.3	**Average**	**58.3**	**46.1**	**44.1**	**17.3**	**271.8**	**180.0**	**176.1**	**136.0**	**153.4**	**42.0**	**42.5**	**131.7**	**26.9**	
Transition	**11-Nov-99**	9:00	58.0	45.0	42.0	17.2	273	180	176	136	140	42.6	41.6	106.6	27.8	
3.3 to 3.4		10:00	57.9	45.7	43.6	17.4	272	192	199	136	136	39.3	37.42	143.5	72.8	Problem with slurry pumps
		11:00	58.6	45.4	43.1	17.2	276	173	169	136	129	40.9	46.39	141.9	8.7	
		12:00	58.5	44.5	42.6	17.3	275	***171***	168	136	***117***	42.3	46.2	125.6	7.9	
		13:00	57.8	46.3	44.1	17.8	272	***176***	168	136	***114***	41.4	42.2	119.3	17.1	SDA Exit Temp Increasing & Sluryy
		14:00	58.8	46.9	44.9	17.7	272	***178***	174	136	114	42.5	42.5	126.4	34.7	SDA Exit Temp Increasing
3.4 Start	**11-Nov-99**	15:00	57.9	47.5	45.6	17.5	272	***179***	175	136	112	42.2	42.2	122.9	37.0	
		16:00	58.0	47.3	45.4	17.5	273	***179***	175	136	112	41.9	41.1	129.3	40.7	

		17:00	***57.9***	***48.1***	***46.5***	***17.7***	***271***	***177***	***173***	***136***	***111***	***42.0***	***41.4***	***147.5***	***40.8***	***High SO2 - Note the system***
		18:00	57.5	48.4	46.3	17.6	272	176	172	136	111	42.0	42.6	140.8	35.8	***can still handle it!***
		19:00	58.22	48.6	46.64	18.08	273	176	172	136	110.2	41.7	42.5	142.5	36.9	
		20:00	58.3	48.6	46.7	18.2	274	177	172	136	110	42.0	43.1	129.2	31.5	
		21:00	58.0	49.3	47.4	18.1	274	176	172	136	110	41.7	43.4	125.0	26.0	
		22:00	58.0	50.2	48.3	17.7	276	176	171	136	110	42.2	43.7	129.2	27.6	
3.4 Finish	**11-Nov-99**	23:00	58.2	50.3	48.2	17.7	276	177	173	136	110	41.9	43.8	128.8	29.5	
3.4	**Average**		**58.0**	**48.7**	**46.8**	**17.8**	**273.4**	**177.0**	**172.8**	**136.0**	**110.7**	**42.0**	**42.6**	**132.8**	**34.0**	
Transition	**12-Nov-99**	0:00	***58.3***	***49.5***	***47.5***	***18.2***	***278***	***186***	***189***	***136***	***110***	***41.0***	***33.2***	***133.6***	***67.0***	Slurry Flow Reduced to 33.2 gpm
3.4 to 3.1A		0:15	58.3	49.7	47.3	17.8	278	176	177	136	110	42.4	46.7	115.5	26.1	
		0:30	58.2	49.3	47.2	17.7	280	179	156	136	110	42.4	46.0	125.0	26.2	
		0:45	58.1	49.0	47.1	17.8	277	175	173	136	110	42.6	45.9	118.3	22.2	
		1:00	58.3	49.4	47.1	17.3	275	174	171	136	109	42.1	46.0	121.6	18.7	
		2:00	57.8	49.5	47.6	17.6	274	173	169	136	108	42.0	45.3	124.5	13.2	
		3:00	58.5	48.1	46.0	17.9	274	171	167	136	107.6	42.2	45.6	114.8	10.3	
3.1A Start	**12-Nov-99**	4:00	58.6	47.7	45.5	17.8	273	170	165	136	107.11	42.2	46.2	121.7	6.7	
		5:00	58.3	47.2	45.2	17.4	274	170	166	136	106.71	41.7	45.8	119.2	7.5	
		6:00	58.1	46.8	45.0	17.7	275	170	165	136	107.3	42.2	46.5	128.4	6.8	
		7:00	58.3	47.1	45.1	17.7	***272***	***175***	167.24	136	107.17	42.2	45.0	***119.2***	***15.4***	***SDA Exit Temp increased***
		8:00	58.2	47.7	45.3	17.7	***274***	***171***	166.17	136	108.03	42.3	45.6	***132.0***	***9.8***	***and the system responded!.***
		9:00	58.1	47.9	45.9	18.0	273	169	165	136	107.59	41.7	46.2	119.7	7.4	
		10:00	58.1	48.6	46.7	18.0	275	170	167	136	107.02	42.0	46.1	127.5	8.6	
		11:00	58.1	48.6	46.6	18.5	271	170	167	136	106.16	42.1	45.7	126.9	8.4	
3.1A Finish	**12-Nov-99**	12:00	58.5	49.1	47.1	18.2	272	170	166	136	105.5	41.6	39.2	131.2	8.4	
3.1 A	**Average**		**58.3**	**47.9**	**45.8**	**17.9**	**273.2**	**170.6**	**166.0**	**136.0**	**107.0**	**42.0**	**45.1**	**125.1**	**8.8**	
Transition	**12-Nov-99**	13:00	51.8	42.3	40.6	18.2	270	170	165.2	136	105.9	41.6	34.4	126.0	10.3	
3.1 A to 4.1		14:00	41.5	35.1	33.3	18.4	266	169	165	136	106.7	42.2	32.6	111.0	8.8	
		15:00	41.9	36.1	34.1	12.3	263	170	165	136	106.63	41.8	33.5	111.41	15.0	
		16:00	42.0	35.7	33.6	11.7	262	171	166	136	106.32	42.1	34.6	113.9	18.3	
		17:00	42.0	35.8	33.9	11.7	263	170	166	136	105.75	42.12	33.31	111.1	13.3	
		18:00	40.0	35.8	33.9	11.7	262	170	166	136	105.78	42.2	32.1	126.1	18.1	
		19:00	42.5	35.7	33.7	11.8	260	170	167	136	106.38	42.0	32.5	109.4	20.4	
		20:00	41.8	35.8	33.6	11.4	260	170	165	136	107.89	42.7	32.2	108.4	18.5	
		21:00	41.8	36.1	33.8	11.7	261	170	165.5	136	107.96	42.0	31.4	115.8	14.4	
		22:00	42.0	35.5	33.5	11.3	255	171	165.9	136	108.26	42.2	27.6	110.9	20.8	
		23:00	42.1	35.6	33.6	11.4	260	170	166	136	108.47	42.1	33.8	114.7	21.6	
	13-Nov-99	0:00	41.9	36.0	33.9	11.5	267	177	166	136	107.97	42.1	38.3	107.9	33.2	
4.1 Start	**13-Nov-99**	1:00	42.1	36.1	34.1	11.6	287	181	173	136	107.85	41.0	34.8	117.1	28.1	
		2:00	41.8	36.0	34.0	11.4	284	180	176	136	106.68	41.3	35.0	121.7	30.8	
		3:00	42.2	36.2	34.3	11.5	280	180	175	136	107.14	41.7	35.8	111.0	30.8	
		4:00	42.0	35.9	33.9	11.4	282	179	176	136	107.93	42.8	35.2	117.3	32.3	
		5:00	42.0	36.2	34.2	11.5	281	180	176	136	106.94	41.4	35.8	119.3	32.7	
		6:00	42.0	36.3	34.3	11.0	282	180	176	136	107.17	42.3	36.3	121.0	31.8	
		7:00	42.0	36.2	34.1	11.0	283	179	176	136	106.47	41.8	40.6	129.1	34.8	

		8:00	42.0	35.9	34.0	11.9	281	180	176	136	106.6	41.7	34.2	122.5	26.9
		9:00	42.3	35.9	33.8	11.8	278	178	174.84	136	106.57	41.9	34.5	120.2	32.1
4.1 Finish	**13-Nov-99**	10:00	42.3	36.0	34.0	11.6	275	178	174	136	107.55	42.0	34.0	125.8	35.3
	4.1	**Average**	**42.1**	**36.1**	**34.1**	**11.5**	**281.3**	**179.5**	**175.3**	**136.0**	**107.1**	**41.8**	**35.6**	**120.5**	**31.6**
Transition	**13-Nov-99**	11:00	42.0	36.1	34.0	11.9	276	179	174	136	146.78	41.4	37.2	121.7	33.1
4.1 to 4.2		12:00	43.7	37.0	34.7	11.8	279	178	171.22	136	154.06	41.0	36.9	131.3	32.2
4.2 Start		13:00	40.9	36.2	34.2	11.7	279	177	172.25	136	153.05	43.1	37.1	139.6	27.9
		14:00	42.9	36.2	34.2	11.9	279	177	171.59	136	153.34	41.2	35.5	129.3	30.8
		15:00	42.7	36.2	34.2	11.5	279	179	173.15	136	152.96	42.3	37.4	130.4	30.1
		16:00	40.9	36.1	34.2	11.9	277	180	174.44	136	153.02	42.1	37.6	135.1	32.4
		17:00	42.2	36.2	34.2	12.6	278	178	176	136	153.23	40.5	34.6	129.1	27.5
		18:00	41.5	36.7	35.0	12.4	278	182	176	136	152.9	39.6	34.0	129.6	27.2
		19:00	42.0	36.8	34.9	12.5	274	181	176	136	152.9	39.6	35.9	131.1	32.7
		20:00	41.2	36.4	34.3	12.0	272	178	175	136	153.05	39.7	35.3	146.0	33.8
		21:00	40.6	35.8	34.0	12.3	279	180	175	136	153.09	41.9	37.9	143.4	33.2
		22:00	42.0	36.1	34.3	12.4	280	181	176	136	152.66	42.5	35.2	136.5	31.0
		23:00	42.0	36.6	34.7	12.3	283	181	176	136	151.65	41.4	34.6	131.2	20.6
4.2 Finish	**14-Nov-99**	0:00	42.3	36.1	34.1	12.4	276	180	176	136	152.79	42.6	41.1	137.2	24.7
	4.2	**Average**	**41.8**	**36.3**	**34.3**	**12.2**	**277.8**	**179.5**	**174.8**	**136.0**	**152.9**	**41.4**	**36.3**	**134.9**	**29.3**
Transition															
4.2 to 4.3	**14-Nov-99**	1:00	42.1	36.1	34.2	12.4	272	180	176	136	153.12	41.0	41.1	132.0	29.4
4.3 Start	**14-Nov-99**	2:00	42.0	36.6	34.5	11.3	278	170	167	136	153.08	42.5	42.1	136.7	2.3
		3:00	42.1	36.3	34.4	11.2	279	169	166	136	152.76	42.0	42.1	141.3	1.5
		4:00	42.4	36.6	34.6	11.2	281	170	166	136	152.9	41.8	42.3	133.0	1.4
		5:00	42.2	36.0	34.0	10.9	282	170	165	136	152.87	42.2	41.4	139.7	1.3
		6:00	42.1	36.0	33.9	11.3	284	169	165.78	136	152.95	41.9	40.4	137.0	1.0
		7:00	42.3	35.8	33.6	11.2	281	169	165.43	136	152.93	41.9	37.8	129.8	1.7
		8:00	42.0	35.8	33.7	12.1	278	170	165.07	136	153.05	42.5	38.7	130.4	2.4
		9:00	42.3	35.6	33.6	12.5	273	170	164.36	136	153.03	41.9	38.4	128.8	4.1
4.3 Finish	**14-Nov-99**	10:00	42.8	35.9	33.7	12.1	274	170	166	136	153.04	42.5	38.4	135.0	3.9
	4.3	**Average**	**42.2**	**36.1**	**34.0**	**11.5**	**278.9**	**169.7**	**165.6**	**136.0**	**153.0**	**42.1**	**40.2**	**134.6**	**2.2**
Transition	**14-Nov-99**	11:00	42.2	35.4	33.4	12.3	274	171	165.9	136	142.13	43.3	37.8	135.5	6.0
4.3 to 4.4		12:00	42.1	35.6	33.7	12.4	271	171	165.7	136	131.01	41.7	37.5	132.4	5.1
		13:00	42.0	35.8	33.6	11.9	271	171	166	136	125.14	43.0	37.6	128.5	6.2
		14:00	42.3	36	34.1	12.33	272	170	165	136	121.26	43.1	37.68	134.6	7.5
		15:00	42.4	35.6	33.5	11.4	273	170	165	136	117.34	41.8	38.1	129.8	6.7
		16:00	42.1	35.5	33.5	11.2	274	169	165	136	114.29	41.6	37.3	117.8	6.5
		17:00	42.0	35.4	33.3	11.8	275	270	165	136	112.95	41.9	38.6	130.0	7.5
		18:00	42.4	42.4	42.4	42.4	274	42.4	166	136	112	42.3	36.966	119.6	6.7
		19:00	41.3	35.0	33.0	11.7	274	171	166	136	111.5	41.7	37.3	128.3	9.3
		20:00	41.9	41.9	41.9	41.9	272	170	166	136	111.5	42.3	38.3	125.0	7.6
		21:00	42.5	34.4	32.2	11.9	275	169	165	136	110.4	41.3	35.4	128.3	5.5
4.4 Start		22:00	42.0	34.8	32.8	12.2	273	170	164	136	110	41.2	34.0	129.3	13.9

		23:00	42.2	34.8	32.8	12.1	267	170	166	136	109.7	40.9	35.7	142.2	10.4
	15-Nov-99	0:00	42.4	35.0	32.9	11.9	270	170	166	136	109.7	40.9	36.4	135.7	11.4
		1:00	42.2	34.9	32.8	12.1	273	171	165	136	109.4	41.9	36.1	136.0	11.4
		2:00	42.2	34.7	32.6	12.7	273	171	166	136	109.1	42.2	36.5	129.0	11.1
		3:00	42.0	34.9	32.8	12.6	275	170	166	136	108.8	41.7	37.5	136.9	11.1
		4:00	42.0	34.7	32.8	12.6	276	170	165	136	108.3	41.0	37.1	129.6	7.6
		5:00	41.9	34.7	32.8	12.9	277	171	166	136	108.4	41.6	37.2	120.6	8.7
		6:00	42.2	35.0	33.0	12.6	278	170	166	136	109.1	41.8	38.4	136.2	7.5
		7:00	41.0	35.3	33.5	12.9	279	172	166	136	109.3	42.4	40.4	139.4	5.4
		8:00	42.1	35.0	33.1	12.7	281	170	165	136	108.6	42.0	37.1	116.4	5.0
		9:00	43.3	35.0	32.6	13.1	278	169	166	136	109.1	42.5	36.1	131.5	8.5
	4.4 Finish	10:00	41.5	34.7	32.7	13.2	274	171	166	136	109.28	41.8	37.0	122.8	6.0
	4.4	**Average**	**42.1**	**34.9**	**32.9**	**12.6**	**274.9**	**170.4**	**165.6**	**136.0**	**109.1**	**41.7**	**36.9**	**131.2**	**9.1**

APPENDIX C

COAL ANALYSIS

COAL ANALYSIS – FEEDER "A" SAMPLE

Sample No. 1 (November 3, 1999; 08:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	26.72	-----	Moisture, %	26.72	-----
Ash, %	16.94	23.12	Carbon, %	39.43	53.81
Volatile, %	31.05	42.37	Hydrogen, %	2.87	3.92
Fixed Carbon, %	25.29	34.51	Nitrogen, %	0.52	0.71
	100.00	100.00	Sulfur, %	0.14	0.19
			Ash, %	16.94	23.12
High Heating Value, Btu/lb	6,606	9,015	Oxygen (diff.), %	13.38	18.25
Sulfur, %	0.14	0.19		100.00	100.00
Heating Value MAF, Btu/lb		11,726			
Alk. As Sodium Oxide	0.33	0.45			

Sample No. 2 (November 3, 1999; 12:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.56	-----	Moisture, %	27.56	-----
Ash, %	15.48	21.37	Carbon, %	39.75	54.87
Volatile, %	31.13	42.97	Hydrogen, %	2.97	4.10
Fixed Carbon, %	25.83	35.66	Nitrogen, %	0.53	0.73
	100.00	100.00	Sulfur, %	0.14	0.20
			Ash, %	15.48	21.37
High Heating Value, Btu/lb	6,687	9,231	Oxygen (diff), %	13.57	18.73
Sulfur, %	0.14	0.20		100.00	100.00
Heating Value MAF, Btu		11,740			
Alk. As Sodium Oxide	0.28	0.39			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 3 (November 3, 16:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.01	-----	Moisture, %	28.01	-----
Ash, %	15.69	21.79	Carbon, %	39.12	54.34
Volatile, %	30.82	42.81	Hydrogen, %	2.91	4.04
Fixed Carbon, %	25.48	35.40	Nitrogen, %	0.50	0.70
	100.00	100.00	Sulfur, %	0.14	0.20
			Ash, %	15.69	21.79
High Heating Value, Btu/lb	6,570	9,126	Oxygen (diff), %	13.63	18.93
Sulfur, %	0.14	0.20		100.00	100.00
Heating Value MAF, Btu/lb		11,669			
Alk. As Sodium Oxide	0.32	0.44			

Sample No. 4 (November 4, 1999; 08:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.25	-----	Moisture, %	27.25	-----
Ash, %	12.20	16.77	Carbon, %	41.95	57.67
Volatile, %	32.23	44.30	Hydrogen, %	3.16	4.35
Fixed Carbon, %	28.32	38.93	Nitrogen, %	0.56	0.77
	100.00	100.00	Sulfur, %	0.15	0.20
			Ash, %	12.20	16.77
High Heating Value, Btu/lb	7,083	9,736	Oxygen (diff), %	14.73	20.24
Sulfur, %	0.15	0.20		100.00	100.00
Heating Value MAF, Btu/lb		11,698			
Alk. As Sodium Oxide	0.20	0.28			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 5 (November 4, 1999; 12:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	26.63	-----	Moisture, %	26.63	-----
Ash, %	11.92	16.24	Carbon, %	42.53	57.97
Volatile, %	32.61	44.45	Hydrogen, %	3.13	4.27
Fixed Carbon, %	28.84	39.31	Nitrogen, %	0.56	0.77
	100.00	100.00	Sulfur, %	0.15	0.20
			Ash, %	11.92	16.24
High Heating Value, Btu/lb	7,177	9,782	Oxygen (diff), %	15.08	20.55
Sulfur, %	0.15	0.20		100.00	100.00
Heating Value MAF, Btu/lb		11,679			
Alk. As Sodium Oxide	0.21	0.28			

Sample No. 6 (November 4, 1999; 16:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	26.77	-----	Moisture, %	26.77	-----
Ash, %	11.57	15.80	Carbon, %	42.70	58.31
Volatile, %	32.80	44.79	Hydrogen, %	3.16	4.32
Fixed Carbon, %	28.86	39.41	Nitrogen, %	0.56	0.77
	100.00	100.00	Sulfur, %	0.15	0.20
			Ash, %	11.57	15.80
High Heating Value, Btu/lb	7,189	9,817	Oxygen (diff), %	15.09	20.60
Sulfur, %	0.15	0.20		100.00	100.00
Heating Value MAF, Btu/lb		11,659			
Alk. As Sodium Oxide	0.19	0.26			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 7 (November 4, 1999; 20:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	26.88	-----	Moisture, %	26.88	-----
Ash, %	11.53	15.77	Carbon, %	42.68	58.37
Volatile, %	32.74	44.78	Hydrogen, %	3.18	4.35
Fixed Carbon, %	28.85	39.45	Nitrogen, %	0.58	0.79
	100.00	100.00	Sulfur, %	0.15	0.20
			Ash, %	11.53	15.77
High Heating Value, Btu/lb	7,166	9,801	Oxygen (diff), %	15.00	20.52
Sulfur, %	0.15	0.20		100.00	100.00
Heating Value MAF, Btu/lb		11,636			
Alk. As Sodium Oxide	0.19	0.26			

Sample No. 8 (November 4, 1999; 24:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.27	-----	Moisture, %	27.27	-----
Ash, %	11.47	15.77	Carbon, %	42.61	58.58
Volatile, %	32.63	44.86	Hydrogen, %	3.16	4.35
Fixed Carbon, %	28.63	39.37	Nitrogen, %	0.57	0.79
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	11.47	15.77
High Heating Value, Btu/lb	7,132	9,806	Oxygen (diff), %	14.77	20.30
Sulfur, %	0.15	0.21		100.00	100.00
Heating Value MAF, Btu/lb		11,642			
Alk. As Sodium Oxide	0.17	0.24			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 9 (November 5, 1999; 04:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.05	-----	Moisture, %	27.05	-----
Ash, %	10.83	14.84	Carbon, %	43.03	58.99
Volatile, %	32.78	44.94	Hydrogen, %	3.14	4.31
Fixed Carbon, %	29.34	40.22	Nitrogen, %	0.58	0.79
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	10.83	14.84
High Heating Value, Btu/lb	7,199	9,869	Oxygen (diff), %	15.22	20.86
Sulfur, %	0.15	0.21		100.00	100.00
Heating Value MAF, Btu/lb		11,589			
Alk. As Sodium Oxide	0.18	0.25			

Sample No. 10 (November 5, 1999; 08:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	26.64	-----	Moisture, %	26.64	-----
Ash, %	12.48	17.01	Carbon, %	42.09	57.38
Volatile, %	32.55	44.37	Hydrogen, %	3.09	4.21
Fixed Carbon, %	28.33	38.62	Nitrogen, %	0.58	0.79
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	12.48	17.01
High Heating Value, Btu/lb	7,037	9,593	Oxygen (diff), %	14.97	20.40
Sulfur, %	0.15	0.21		100.00	100.00
Heating Value MAF, Btu/lb		11,559			
Alk. As Sodium Oxide	0.21	0.28			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 11 (November 5, 1999; 23:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	26.11	-----	Moisture, %	26.11	-----
Ash, %	13.99	18.93	Carbon, %	41.53	56.20
Volatile, %	32.51	44.00	Hydrogen, %	3.03	4.10
Fixed Carbon, %	27.39	37.07	Nitrogen, %	0.58	0.78
	100.00	100.00	Sulfur, %	0.15	0.20
			Ash, %	13.99	18.93
High Heating Value, Btu/lb	6,961	9,421	Oxygen (diff), %	14.61	19.79
Sulfur, %	0.15	0.20		100.00	100.00
Heating Value MAF, Btu/lb		11,621			
Alk. As Sodium Oxide	0.23	0.31			

Sample No. 12 (November 6, 1999; 02:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	26.44	-----	Moisture, %	26.44	-----
Ash, %	16.01	21.77	Carbon, %	39.60	53.84
Volatile, %	31.79	43.22	Hydrogen, %	2.89	3.93
Fixed Carbon, %	25.76	35.01	Nitrogen, %	0.57	0.78
	100.00	100.00	Sulfur, %	0.16	0.22
			Ash, %	16.01	21.77
High Heating Value, Btu/lb	6,628	9,010	Oxygen (diff), %	14.33	19.46
Sulfur, %	0.16	0.22		100.00	100.00
Heating Value MAF, Btu/lb		11,517			
Alk. As Sodium Oxide	0.30	0.41			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 13 (November 6, 1999; 05:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	25.93	-----	Moisture, %	25.93	-----
Ash, %	16.92	22.84	Carbon, %	39.39	53.18
Volatile, %	31.70	42.80	Hydrogen, %	2.93	3.95
Fixed Carbon, %	25.45	34.36	Nitrogen, %	0.57	0.77
	100.00	100.00	Sulfur, %	0.16	0.22
			Ash, %	16.92	22.84
High Heating Value, Btu/lb	6,589	8,895	Oxygen (diff), %	14.10	19.04
Sulfur, %	0.16	0.22		100.00	100.00
Heating Value MAF, Btu/lb		11,528			
Alk. As Sodium Oxide	0.32	0.43			

Sample No. 14 (November 7, 1999; 02:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	26.39	-----	Moisture, %	26.39	-----
Ash, %	18.62	25.30	Carbon, %	37.91	51.5
Volatile, %	31.04	42.17	Hydrogen, %	2.78	3.78
Fixed Carbon, %	23.95	32.53	Nitrogen, %	0.54	0.73
	100.00	100.00	Sulfur, %	0.14	0.19
			Ash, %	18.62	25.3
High Heating Value, Btu/lb	6,331	8,601	Oxygen (diff), %	13.62	18.5
Sulfur, %	0.14	0.19		100.00	100.00
Heating Value MAF, Btu/lb		11,514			
Alk. As Sodium Oxide	0.38	0.52			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 15 (November 7, 1999; 05:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.11	-----	Moisture, %	28.11	-----
Ash, %	12.90	17.95	Carbon, %	40.75	56.69
Volatile, %	31.90	44.37	Hydrogen, %	3.08	4.29
Fixed Carbon, %	27.09	37.68	Nitrogen, %	0.56	0.78
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	12.90	17.95
High Heating Value, Btu/lb	6,812	9,475	Oxygen (diff), %	14.45	20.08
Sulfur, %	0.15	0.21		100.00	100.00
Heating Value MAF, Btu/lb		11,548			
Alk. As Sodium Oxide	0.21	0.29			

Sample No. 16 (November 7, 1999; 08:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.43	-----	Moisture, %	27.43	-----
Ash, %	14.69	20.24	Carbon, %	40.12	55.29
Volatile, %	31.63	43.58	Hydrogen, %	2.96	4.08
Fixed Carbon, %	26.25	36.18	Nitrogen, %	0.56	0.77
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	14.69	20.24
High Heating Value, Btu/lb	6,684	9,211	Oxygen (diff), %	14.09	19.41
Sulfur, %	0.15	0.21		100.00	100.00
Heating Value MAF, Btu/lb		11,548			
Alk. As Sodium Oxide	0.26	0.36			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 17 (November 7; 14:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.62	-----	Moisture, %	28.62	-----
Ash, %	11.24	15.74	Carbon, %	41.56	58.22
Volatile, %	31.99	44.81	Hydrogen, %	3.08	4.32
Fixed Carbon, %	28.15	39.45	Nitrogen, %	0.56	0.79
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	11.24	15.74
High Heating Value, Btu/lb	6,920	9,694	Oxygen (diff), %	14.79	20.72
Sulfur, %	0.15	0.21		100.00	100.00
Heating Value MAF, Btu/lb		11,505			
Alk. As Sodium Oxide	0.17	0.24			

Sample No. 18 (November 7, 1999; 17:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.98	-----	Moisture, %	28.98	-----
Ash, %	13.20	18.59	Carbon, %	39.95	56.25
Volatile, %	31.38	44.19	Hydrogen, %	2.95	4.15
Fixed Carbon, %	26.44	37.22	Nitrogen, %	0.56	0.79
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	13.20	18.59
High Heating Value, Btu/lb	6,691	9,421	Oxygen (diff), %	14.21	20.01
Sulfur, %	0.15	0.21		100.00	100.00
Heating Value MAF, Btu/lb		11,572			
Alk. As Sodium Oxide	0.21	0.30			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 19 (November 7, 1999; 20:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.57	-----	Moisture, %	28.57	-----
Ash, %	13.37	18.72	Carbon, %	40.21	56.29
Volatile, %	31.43	44.00	Hydrogen, %	2.98	4.17
Fixed Carbon, %	26.63	37.28	Nitrogen, %	0.56	0.78
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	13.37	18.72
High Heating Value, Btu/lb	6,712	9,396	Oxygen (diff), %	14.16	19.83
Sulfur, %	0.15	0.21		100.00	100.00
High Heating Value MAF, Btu/lb		11,560			
Alk. As Sodium Oxide	0.22	0.30			

Sample No. 20 (November 7, 1999; 23:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.83	-----	Moisture, %	28.83	-----
Ash, %	12.06	16.94	Carbon, %	41.13	57.79
Volatile, %	31.66	44.48	Hydrogen, %	2.98	4.19
Fixed Carbon, %	27.45	38.58	Nitrogen, %	0.55	0.77
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	12.06	16.94
Heating Value MAF, Btu/lb	6,889	9,679	Oxygen (diff), %	14.30	20.10
Sulfur, %	0.15	0.21		100.00	100.00
High Heating Value, MAF Btu/lb		11,653			
Alk. As Sodium Oxide	0.19	0.27			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 21 (November 8, 1999; 02:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.80	-----	Moisture, %	28.80	-----
Ash, %	11.56	16.24	Carbon, %	41.40	58.14
Volatile, %	31.67	44.48	Hydrogen, %	3.02	4.24
Fixed Carbon, %	27.97	39.28	Nitrogen, %	0.56	0.78
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	11.56	16.24
High Heating Value, Btu/lb	6,923	9,724	Oxygen (diff), %	14.51	20.39
Sulfur, %	0.15	0.21		100.00	100.00
Heating Value MAF, Btu/lb		11,609			
Alk. As Sodium Oxide	0.18	0.25			

Sample No. 22 (November 8, 1999, 08:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.18	-----	Moisture, %	28.18	-----
Ash, %	13.52	18.82	Carbon, %	40.51	56.40
Volatile, %	31.46	43.80	Hydrogen, %	2.93	4.08
Fixed Carbon, %	26.84	37.38	Nitrogen, %	0.55	0.76
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	13.52	18.82
High Heating Value, Btu/lb	6,760	9,413	Oxygen (diff), %	14.16	19.73
Sulfur, %	0.15	0.21		100.00	100.00
Heating Value MAF, Btu/lb		11,595			
Alk. As Sodium Oxide	0.21	0.30			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 23 (November 8, 1999; 20:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.19	-----	Moisture, %	28.19	-----
Ash, %	10.91	15.19	Carbon, %	42.36	58.99
Volatile, %	32.18	44.81	Hydrogen, %	3.06	4.26
Fixed Carbon, %	28.72	40.00	Nitrogen, %	0.58	0.81
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	10.91	15.19
High Heating Value, Btu/lb	7,089	9,872	Oxygen (diff), %	14.75	20.54
Sulfur, %	0.15	0.21		100.00	100.00
Heating Value MAF, Btu/lb		11,640			
Alk. As Sodium Oxide	0.16	0.23			

Sample No. 24 (November 8, 1999, 23:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	26.31	-----	Moisture, %	26.31	-----
Ash, %	18.49	25.09	Carbon, %	38.46	52.19
Volatile, %	30.77	41.75	Hydrogen, %	2.72	3.69
Fixed Carbon, %	24.43	33.16	Nitrogen, %	0.57	0.77
	100.00	100.00	Sulfur, %	0.13	0.18
			Ash, %	18.49	25.09
High Heating Value, Btu/lb	6,379	8,656	Oxygen (diff), %	13.32	18.08
Sulfur, %	0.13	0.18		100.00	100.00
Heating Value MAF, Btu/lb		11,555			
Alk. As Sodium Oxide	0.43	0.58			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 25 (November 9, 1999; 02:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.78	-----	Moisture, %	27.78	-----
Ash, %	12.47	17.27	Carbon, %	41.48	57.44
Volatile, %	31.92	44.20	Hydrogen, %	2.94	4.07
Fixed Carbon, %	27.83	38.53	Nitrogen, %	0.58	0.81
	100.00	100.00	Sulfur, %	0.14	0.20
			Ash, %	12.47	17.27
High Heating Value, Btu/lb	6,895	9,547	Oxygen (diff), %	14.61	20.21
Sulfur, %	0.14	0.20		100.00	100.00
Heating Value MAF, Btu/lb		11,540			
Alk. As Sodium Oxide	0.19	0.27			

Sample No. 26 (November 9, 1999; 17:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.08	-----	Moisture, %	28.08	-----
Ash, %	11.21	15.59	Carbon, %	42.43	58.99
Volatile, %	32.08	44.61	Hydrogen, %	3.10	4.31
Fixed Carbon, %	28.63	39.80	Nitrogen, %	0.55	0.77
	100.00	100.00	Sulfur, %	0.17	0.23
			Ash, %	11.21	15.59
High Heating Value, Btu/lb	7,093	9,862	Oxygen (diff), %	14.46	20.11
Sulfur, %	0.17	0.23		100.00	100.00
Heating Value MAF, Btu/lb		11,683			
Alk. As Sodium Oxide	0.18	0.25			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 27 (November 9, 1999; 20:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.65	-----	Moisture, %	27.65	-----
Ash, %	13.44	18.58	Carbon, %	40.92	56.56
Volatile, %	31.60	43.68	Hydrogen, %	3.00	4.15
Fixed Carbon, %	27.31	37.74	Nitrogen, %	0.54	0.74
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	13.44	18.58
High Heating Value, Btu/lb	6,907	9,547	Oxygen (diff), %	14.30	19.76
Sulfur, %	0.15	0.21		100.00	100.00
Heating Value MAF, Btu/lb		11,726			
Alk. As Sodium Oxide	0.23	0.31			

Sample No. 28 (November 9, 1999; 23:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.34	-----	Moisture, %	27.34	-----
Ash, %	12.87	17.71	Carbon, %	41.86	57.61
Volatile, %	31.72	43.65	Hydrogen, %	3.12	4.29
Fixed Carbon, %	28.07	38.64	Nitrogen, %	0.54	0.75
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	12.87	17.71
High Heating Value, Btu/lb	7,014	9,653	Oxygen (diff), %	14.12	19.43
Sulfur, %	0.15	0.21		100.00	100.00
Heating Value MAF, Btu/lb		11,730			
Alk. As Sodium Oxide	0.23	0.31			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 29 (November 10, 1999; 02:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.33	-----	Moisture, %	27.33	-----
Ash, %	13.43	18.48	Carbon, %	41.20	56.70
Volatile, %	31.43	43.25	Hydrogen, %	3.05	4.20
Fixed Carbon, %	27.81	38.27	Nitrogen, %	0.52	0.72
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	13.43	18.48
High Heating Value, Btu/lb	6,964	9,583	Oxygen (diff), %	14.32	19.69
Sulfur, %	0.15	0.21		100.00	100.00
Heating Value MAF, Btu/lb		11,755			
Alk. As Sodium Oxide	0.21	0.29			

Sample No. 30 (November 10, 1999; 11:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.79	-----	Moisture, %	27.79	-----
Ash, %	11.08	15.35	Carbon, %	42.56	58.94
Volatile, %	31.85	44.11	Hydrogen, %	3.18	4.40
Fixed Carbon, %	29.28	40.54	Nitrogen, %	0.55	0.76
	100.00	100.00	Sulfur, %	0.17	0.23
			Ash, %	11.08	15.35
High Heating Value, Btu/lb	7,155	9,909	Oxygen (diff), %	14.67	20.32
Sulfur, %	0.17	0.23		100.00	100.00
Heating Value MAF, Btu/lb		11,706			
Alk. As Sodium Oxide	0.19	0.26			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 31 (November 10, 1999; 14:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.87	-----	Moisture, %	27.87	-----
Ash, %	10.88	15.08	Carbon, %	42.56	59.01
Volatile, %	31.92	44.26	Hydrogen, %	3.24	4.49
Fixed Carbon, %	29.33	40.66	Nitrogen, %	0.56	0.78
	100.00	100.00	Sulfur, %	0.17	0.23
			Ash, %	10.88	15.08
High Heating Value, Btu/lb	7,164	9,932	Oxygen (diff), %	14.72	20.41
Sulfur, %	0.17	0.23		100.00	100.00
Heating Value MAF, Btu/lb		11,696			
Alk. As Sodium Oxide	0.18	0.25			

Sample No. 32 (November 10, 1999; 17:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.24	-----	Moisture, %	27.24	-----
Ash, %	11.58	15.91	Carbon, %	42.55	58.48
Volatile, %	31.98	43.95	Hydrogen, %	3.21	4.41
Fixed Carbon, %	29.20	40.14	Nitrogen, %	0.55	0.76
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	11.58	15.91
High Heating Value, Btu/lb	7,168	9,851	Oxygen (diff), %	14.72	20.23
Sulfur, %	0.15	0.21		100.00	100.00
Heating Value MAF, Btu/lb		11,715			
Alk. As Sodium Oxide	0.20	0.28			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 33 (November 10, 1999; 23:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.77	-----	Moisture, %	27.77	-----
Ash, %	12.37	17.13	Carbon, %	41.69	57.72
Volatile, %	31.65	43.82	Hydrogen, %	3.13	4.34
Fixed Carbon, %	28.21	39.05	Nitrogen, %	0.53	0.73
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	12.37	17.13
High Heating Value, Btu/lb	7,032	9,736	Oxygen (diff), %	14.36	19.87
Sulfur, %	0.15	0.21		100.00	100.00
Heating Value MAF, Btu/lb		11,749			
Alk. As Sodium Oxide	0.23	0.32			

Sample No. 34 (November 11, 1999; 05:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.46	-----	Moisture, %	27.46	-----
Ash, %	13.30	18.33	Carbon, %	41.41	57.09
Volatile, %	31.57	43.52	Hydrogen, %	3.00	4.13
Fixed Carbon, %	27.67	38.15	Nitrogen, %	0.52	0.72
	100.00	100.00	Sulfur, %	0.16	0.22
			Ash, %	13.30	18.33
High Heating Value, Btu/lb	6,924	9,545	Oxygen (diff), %	14.15	19.51
Sulfur, %	0.16	0.22		100.00	100.00
Heating Value MAF, Btu/lb		11,687			
Alk. As Sodium Oxide	0.32	0.44			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 35 (November 11, 1999; 08:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.28	-----	Moisture, %	27.28	-----
Ash, %	12.68	17.43	Carbon, %	41.40	56.93
Volatile, %	31.77	43.69	Hydrogen, %	3.12	4.29
Fixed Carbon, %	28.27	38.88	Nitrogen, %	0.54	0.74
	100.00	100.00	Sulfur, %	0.16	0.22
			Ash, %	12.68	17.43
High Heating Value, Btu/lb	7.012	9,643	Oxygen (diff), %	14.82	20.39
Sulfur, %	0.16	0.22		100.00	100.00
Heating Value MAF, Btu/lb		11,679			
Alk. As Sodium Oxide	0.22	0.30			

Sample No. 36 (November 11, 1999; 17:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.39	-----	Moisture, %	27.39	-----
Ash, %	13.72	18.89	Carbon, %	40.59	55.90
Volatile, %	31.56	43.47	Hydrogen, %	2.98	4.11
Fixed Carbon, %	27.33	37.64	Nitrogen, %	0.54	0.74
	100.00	100.00	Sulfur, %	0.17	0.23
			Ash, %	13.72	18.89
High Heating Value, Btu/lb	6,824	9,398	Oxygen (diff), %	14.61	20.13
Sulfur, %	0.17	0.23		100.00	100.00
Heating Value MAF, Btu/lb		11,587			
Alk. As Sodium Oxide	0.24	0.34			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 37 (November 11, 1999; 20:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.42	-----	Moisture, %	27.42	-----
Ash, %	15.30	21.08	Carbon, %	39.79	54.82
Volatile, %	31.02	42.74	Hydrogen, %	2.92	4.02
Fixed Carbon, %	26.26	36.18	Nitrogen, %	0.53	0.73
	100.00	100.00	Sulfur, %	0.16	0.22
			Ash, %	15.30	21.08
High Heating Value, Btu/lb	6,651	9,164	Oxygen (diff), %	13.88	19.13
Sulfur, %	0.16	0.22		100.00	100.00
Heating Value MAF, Btu/lb		11,612			
Alk. As Sodium Oxide	0.28	0.39			

Sample No. 38 (November 12, 1999; 05:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.77	-----	Moisture, %	28.77	-----
Ash, %	11.77	16.52	Carbon, %	41.11	57.72
Volatile, %	31.49	44.21	Hydrogen, %	2.98	4.19
Fixed Carbon, %	27.97	39.27	Nitrogen, %	0.53	0.75
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	11.77	16.52
High Heating Value, Btu/lb	6,869	9,644	Oxygen (diff), %	14.69	20.61
Sulfur, %	0.15	0.21		100.00	100.00
Heating Value MAF, Btu/lb		11,552			
Alk. As Sodium Oxide	0.20	0.27			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 39 (November 12, 1999; 08:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.31	-----	Moisture, %	28.31	-----
Ash, %	12.92	18.02	Carbon, %	40.62	56.66
Volatile, %	31.59	44.06	Hydrogen, %	2.98	4.16
Fixed Carbon, %	27.18	37.92	Nitrogen, %	0.54	0.75
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	12.92	18.02
High Heating Value, Btu/lb	6,776	9,452	Oxygen (diff), %	14.48	20.20
Sulfur, %	0.15	0.21		100.00	100.00
Heating Value MAF, Btu/lb		11,530			
Alk. As Sodium Oxide	0.21	0.29			

Sample No. 40 (November 12, 1999; 11:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.72	-----	Moisture, %	27.72	-----
Ash, %	13.54	18.73	Carbon, %	40.92	56.61
Volatile, %	31.58	43.69	Hydrogen, %	2.98	4.12
Fixed Carbon, %	27.16	37.58	Nitrogen, %	0.54	0.75
	100.00	100.00	Sulfur, %	0.14	0.20
			Ash, %	13.54	18.73
High Heating Value, Btu/lb	6,785	9,387	Oxygen (diff), %	14.16	19.59
Sulfur, %	0.14	0.20		100.00	100.00
Heating Value MAF, Btu/lb		11,550			
Alk. As Sodium Oxide	0.24	0.33			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 41 (November 13, 1999; 02:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.34	-----	Moisture, %	28.34	-----
Ash, %	11.97	16.71	Carbon, %	41.46	57.86
Volatile, %	31.59	44.08	Hydrogen, %	2.96	4.13
Fixed Carbon, %	28.10	39.21	Nitrogen, %	0.53	0.74
	100.00	100.00	Sulfur, %	0.15	0.21
			Ash, %	11.97	16.71
High Heating Value, Btu/lb	6,906	9,637	Oxygen (diff), %	14.59	20.35
Sulfur, %	0.15	0.21		100.00	100.00
Heating Value MAF, Btu/lb		11,570			
Alk. As Sodium Oxide	0.19	0.27			

Sample No. 42 (November 13, 1999; 05:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.31	-----	Moisture, %	28.31	-----
Ash, %	12.02	16.76	Carbon, %	41.37	57.70
Volatile, %	31.67	44.18	Hydrogen, %	3.00	4.19
Fixed Carbon, %	28.00	39.06	Nitrogen, %	0.54	0.76
	100.00	100.00	Sulfur, %	0.16	0.22
			Ash, %	12.02	16.76
High Heating Value, Btu/lb	6,915	9,645	Oxygen (diff), %	14.60	20.37
Sulfur, %	0.16	0.22		100.00	100.00
Heating Value MAF, Btu/lb		11,587			
Alk. As Sodium Oxide	0.20	0.28			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 43 (November 13, 1999; 08:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.75	-----	Moisture, %	28.75	-----
Ash, %	12.53	17.59	Carbon, %	41.00	57.54
Volatile, %	31.41	44.08	Hydrogen, %	2.90	4.07
Fixed Carbon, %	27.31	38.33	Nitrogen, %	0.53	0.74
	100.00	100.00	Sulfur, %	0.17	0.24
			Ash, %	12.53	17.59
High Heating Value, Btu/lb	6,849	9,612	Oxygen (diff), %	14.12	19.82
Sulfur, %	0.17	0.24		100.00	100.00
Heating Value MAF, Btu/lb		11,664			
Alk. As Sodium Oxide	0.21	0.30			

Sample No. 44 (November 13, 1999; 14:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.54	-----	Moisture, %	28.54	-----
Ash, %	12.26	17.15	Carbon, %	40.81	57.11
Volatile, %	31.55	44.15	Hydrogen, %	2.94	4.11
Fixed Carbon, %	27.65	38.70	Nitrogen, %	0.54	0.75
	100.00	100.00	Sulfur, %	0.16	0.23
			Ash, %	12.26	17.15
High Heating Value, Btu/lb	6,799	9,515	Oxygen (diff), %	14.75	20.65
Sulfur, %	0.16	0.23		100.00	100.00
Heating Value MAF, Btu/lb		11,485			
Alk. As Sodium Oxide	0.20	0.28			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 45 (November 13, 1999; 17:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.37	-----	Moisture, %	28.37	-----
Ash, %	12.54	17.50	Carbon, %	41.01	57.25
Volatile, %	31.61	44.13	Hydrogen, %	2.96	4.13
Fixed Carbon, %	27.48	38.37	Nitrogen, %	0.54	0.75
	100.00	100.00	Sulfur, %	0.17	0.24
			Ash, %	12.54	17.50
High Heating Value, Btu/lb	6,813	9,511	Oxygen (diff), %	14.41	20.13
Sulfur, %	0.17	0.24		100.00	100.00
Heating Value MAF, Btu/lb		11,528			
Alk. As Sodium Oxide	0.21	0.29			

Sample No. 46 (November 13, 1999; 20:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.54	-----	Moisture, %	28.54	-----
Ash, %	12.68	17.74	Carbon, %	40.70	56.95
Volatile, %	31.57	44.18	Hydrogen, %	2.94	4.12
Fixed Carbon, %	27.21	38.08	Nitrogen, %	0.54	0.75
	100.00	100.00	Sulfur, %	0.17	0.24
			Ash, %	12.68	17.74
High Heating Value, Btu/lb	6,808	9,527	Oxygen (diff), %	14.43	20.20
Sulfur, %	0.17	0.24		100.00	100.00
Heating Value MAF, Btu/lb		11,582			
Alk. As Sodium Oxide	0.23	0.32			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 47 (November 13, 1999; 23:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.21	-----	Moisture, %	28.21	-----
Ash, %	12.18	16.96	Carbon, %	41.19	57.37
Volatile, %	31.58	43.99	Hydrogen, %	3.01	4.19
Fixed Carbon, %	28.03	39.05	Nitrogen, %	0.54	0.75
	100.00	100.00	Sulfur, %	0.17	0.23
			Ash, %	12.18	16.96
High Heating Value, Btu/lb	6,905	9,618	Oxygen (diff), %	14.70	20.50
Sulfur, %	0.17	0.23		100.00	100.00
Heating Value MAF, Btu/lb		11,582			
Alk. As Sodium Oxide	0.20	0.28			

Sample No. 48 (November 14, 1999; 02:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.45	-----	Moisture, %	28.45	-----
Ash, %	12.45	17.40	Carbon, %	40.92	57.19
Volatile, %	31.36	43.83	Hydrogen, %	2.97	4.15
Fixed Carbon, %	27.74	38.77	Nitrogen, %	0.54	0.75
	100.00	100.00	Sulfur, %	0.18	0.25
			Ash, %	12.45	17.40
High Heating Value, Btu/lb	6,851	9,575	Oxygen (diff), %	14.49	20.26
Sulfur, %	0.18	0.25		100.00	100.00
Heating Value MAF, Btu/lb		11,592			
Alk. As Sodium Oxide	0.21	0.29			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 49 (November 14, 1999; 05:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.06	-----	Moisture, %	28.06	-----
Ash, %	12.48	17.35	Carbon, %	41.13	57.17
Volatile, %	31.68	44.03	Hydrogen, %	3.01	4.18
Fixed Carbon, %	27.78	38.62	Nitrogen, %	0.54	0.75
	100.00	100.00	Sulfur, %	0.17	0.23
			Ash, %	12.48	17.35
High Heating Value, Btu/lb	6,913	9,610	Oxygen (diff), %	14.61	20.32
Sulfur, %	0.17	0.23		100.00	100.00
Heating Value MAF, Btu/lb		11,627			
Alk. As Sodium Oxide	0.21	0.29			

Sample No. 50 (November 14, 1999; 08:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	27.87	-----	Moisture, %	27.87	-----
Ash, %	12.23	16.95	Carbon, %	41.34	57.32
Volatile, %	31.72	43.98	Hydrogen, %	3.03	4.20
Fixed Carbon, %	28.18	39.07	Nitrogen, %	0.54	0.75
	100.00	100.00	Sulfur, %	0.17	0.23
			Ash, %	12.23	16.95
High Heating Value, Btu/lb	6,954	9,641	Oxygen (diff), %	14.82	20.55
Sulfur, %	0.17	0.23		100.00	100.00
Heating Value MAF, Btu/lb		11,609			
Alk. As Sodium Oxide	0.20	0.28			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 51 (November 14, 1999; 23:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.20	-----	Moisture, %	28.20	-----
Ash, %	11.68	16.27	Carbon, %	41.67	58.03
Volatile, %	31.78	44.26	Hydrogen, %	2.98	4.15
Fixed Carbon, %	28.34	39.47	Nitrogen, %	0.54	0.75
	100.00	100.00	Sulfur, %	0.17	0.23
			Ash, %	11.68	16.27
High Heating Value, Btu/lb	7,003	9,754	Oxygen (diff), %	14.76	20.57
Sulfur, %	0.17	0.23		100.00	100.00
Heating Value MAF, Btu/lb		11,649			
Alk. As Sodium Oxide	0.20	0.27			

Sample No. 52 (November 15, 1999; 02:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.05	-----	Moisture, %	28.05	-----
Ash, %	12.12	16.85	Carbon, %	41.49	57.66
Volatile, %	31.72	44.08	Hydrogen, %	3.01	4.18
Fixed Carbon, %	28.11	39.07	Nitrogen, %	0.53	0.74
	100.00	100.00	Sulfur, %	0.17	0.23
			Ash, %	12.12	16.85
High Heating Value, Btu/lb	6,944	9,651	Oxygen (diff), %	14.63	20.34
Sulfur, %	0.17	0.23		100.00	100.00
Heating Value MAF, Btu/lb		11,607			
Alk. As Sodium Oxide	0.20	0.28			

COAL ANALYSIS – FEEDER "A" SAMPLE (CONT'D)

Sample No. 53 (November 15, 1999; 05:00 hr)					
Proximate Analysis	As Received	Dry Basis	Ultimate Analysis	As Received	Dry Basis
Moisture, %	28.39	-----	Moisture, %	28.39	-----
Ash, %	11.01	15.37	Carbon, %	42.03	58.69
Volatile, %	31.81	44.42	Hydrogen, %	3.02	4.22
Fixed Carbon, %	28.79	40.21	Nitrogen, %	0.54	0.75
	100.00	100.00	Sulfur, %	0.16	0.22
			Ash, %	11.01	15.37
High Heating Value, Btu/lb	6,997	9,771	Oxygen (diff), %	14.85	20.75
Sulfur, %	0.16	0.22		100.00	100.00
Heating Value MAF, Btu/lb		11,546			
Alk. As Sodium Oxide	0.18	0.26			

APPENDIX D

ASH ANALYSIS

ASH ANALYSIS

Weight Percent – Ignited Basis												
Sample Number	1	2	3	4	5	6	7	8	9	10	11	12
	11/03/99; 08:00 hr	11/03/99; 12:00 hr	11/03/99; 16:00 hr	11/04/99; 08:00 hr	11/04/99; 12:00 hr	11/04/99; 16:00 hr	11/04/99; 20:00 hr	11/04/99; 24:00 hr	11/05/99, 04:00 hr	11/05/99, 08:00 hr	11/05/99; 23:00 hr	11/06/99; 02:00 hr
Constituent												
Silicon dioxide	63.62	62.44	62.00	55.93	56.36	54.13	53.08	52.57	52.58	54.50	56.99	58.25
Aluminum oxide	13.77	14.42	15.09	15.12	15.37	17.15	16.27	16.96	16.27	16.03	16.94	13.20
Titanium dioxide	0.61	0.63	0.58	0.64	0.67	0.68	0.75	0.69	0.68	0.69	0.73	0.63
Iron oxide	4.76	4.85	4.66	6.07	5.35	5.33	5.62	5.75	5.80	5.69	4.94	5.59
Calcium oxide	10.09	10.59	10.51	13.98	13.99	14.34	15.44	15.35	15.86	14.67	12.68	13.98
Magnesium oxide	2.01	2.02	1.79	2.41	2.43	2.47	2.80	2.77	2.72	2.55	2.36	2.38
Potassium oxide	1.76	1.73	1.63	1.54	1.61	1.53	1.56	1.51	1.53	1.59	1.61	1.57
Sodium oxide	0.80	0.68	0.94	0.66	0.68	0.63	0.61	0.50	0.67	0.62	0.57	0.86
Sulfur trioxide	1.89	1.93	2.06	2.81	2.70	2.91	2.97	2.98	2.99	2.78	2.36	2.73
Phosphorus pentoxide	0.19	0.19	0.22	0.25	0.24	0.25	0.27	0.28	0.27	0.27	0.25	0.21
Strontium oxide	0.10	0.10	0.10	0.11	0.11	0.10	0.11	0.11	0.11	0.11	0.11	0.11
Barium oxide	0.36	0.39	0.39	0.43	0.45	0.44	0.48	0.49	0.48	0.46	0.43	0.45
Manganese oxide	0.04	0.03	0.03	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.04
Undetermined	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Silica Value	79.05	78.15	78.52	71.35	72.14	70.97	68.99	68.77	68.32	70.40	74.04	72.63
Base: Acid Ratio	0.2	0.26	0.25	0.34	0.33	0.34	0.37	0.37	0.38	0.35	0.30	0.34
T_{250} Temperature	2664°F	2643°F	2656°F	2487°F	2504°F	2496°F	2448°F	2451°F	2433°F	2474°F	2564°F	2495°F
Type of Ash	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic
Fouling Index	0.80	0.68	0.94	0.66	0.68	0.63	0.61	0.50	0.67	0.62	0.57	0.86
Slagging Index	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx

ASH ANALYSIS

Weight Percent – Ignited Basis												
Sample Number	13	14	15	16	17	18	19	20	21	22	23	24
	11/06/99; 05:00 hr	11/07/99; 02:00 hr	11/07/99; 05:00 hr	11/07/99; 08:00 hr	11/07/99; 14:00 hr	11/07/99; 17:00 hr	11/07/99; 20:00 hr	11/07/99; 23:00 hr	11/08/99, 02:00 hr	11/08/99, 08:00 hr	11/08/99; 20:00 hr	11/08/99; 23:00 hr
Constituent												
Silicon dioxide	62.58	62.29	55.87	57.64	51.66	56.64	56.64	55.51	54.66	57.13	48.59	56.12
Aluminum oxide	15.92	15.28	17.51	15.64	17.06	15.56	15.71	15.22	16.59	17.36	18.22	15.67
Titanium dioxide	0.70	0.63	0.72	0.73	0.74	0.76	0.73	0.71	0.71	0.73	0.76	0.91
Iron oxide	4.46	4.88	5.11	5.32	5.74	5.24	5.34	5.50	5.36	4.89	5.95	7.31
Calcium oxide	9.37	9.70	12.99	12.65	15.99	13.46	13.41	14.55	14.52	12.40	17.13	11.38
Magnesium oxide	1.89	2.02	2.36	2.52	2.82	2.62	2.50	2.68	2.51	2.22	3.02	3.40
Potassium oxide	1.80	1.86	1.67	1.74	1.59	1.74	1.70	1.64	1.61	1.68	1.52	1.64
Sodium oxide	0.71	0.84	0.49	0.62	0.47	0.47	0.50	0.50	0.47	0.48	0.51	1.24
Sulfur trioxide	1.82	1.72	2.48	2.32	3.01	2.69	2.60	2.80	2.74	2.34	3.35	1.60
Phosphorus pentoxide	0.23	0.22	0.22	0.25	0.27	0.25	0.25	0.20	0.24	0.21	0.29	0.20
Strontium oxide	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.12	0.11	0.10	0.11	0.10
Barium oxide	0.39	0.38	0.44	0.43	0.51	0.43	0.48	0.46	0.44	0.42	0.51	0.36
Manganese oxide	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04
Undetermined	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.03
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Silica Value	79.92	78.96	73.20	73.77	67.79	72.65	72.72	70.95	70.94	74.54	65.06	71.76
Base: Acid Ratio	0.23	0.25	0.31	0.31	0.38	0.32	0.32	0.35	0.34	0.29	0.42	0.34
T_{250} Temperature	2728°F	2671°F	2548°F	2543°F	2432°F	2510°F	2515°F	2480°F	2493°F	2578°F	2391°F	2487°F
Type of Ash	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic
Fouling Index	0.71	0.84	0.49	0.62	0.47	0.47	0.50	0.50	0.47	0.48	0.51	1.24
Slagging Index	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx

ASH ANALYSIS

Weight Percent – Ignited Basis												
Sample Number	25	26	27	28	29	30	31	32	33	34	35	36
	11/09/99; 02:00 hr	11/09/99; 17:00 hr	11/09/99; 20:00 hr	11/09/99; 23:00 hr	11/10/99; 02:00 hr	11/10/99; 11:00 hr	11/10/99; 14:00 hr	11/10/99; 17:00 hr	11/10/99, 23:00 hr	11/11/99, 05:00 hr	11/11/99; 08:00 hr	11/11/99; 17:00 hr
Constituent												
Silicon dioxide	55.61	54.30	59.29	58.14	59.16	54.35	53.46	57.35	56.28	57.56	60.01	58.65
Aluminum oxide	15.75	15.09	13.68	14.12	14.47	14.79	14.55	13.16	15.23	13.46	15.38	14.54
Titanium dioxide	0.71	0.68	0.73	0.73	0.67	0.66	0.69	0.66	0.60	0.63	0.75	0.64
Iron oxide	5.46	5.76	5.16	5.36	5.11	5.83	6.05	5.42	5.48	5.75	4.83	5.35
Calcium oxide	14.26	15.79	13.45	13.54	12.87	15.65	16.43	15.17	14.12	13.77	11.37	13.00
Magnesium oxide	2.55	2.54	2.34	2.33	2.10	2.59	2.72	2.52	2.22	2.37	2.41	2.27
Potassium oxide	1.65	1.52	1.67	1.67	1.50	1.50	1.54	1.56	1.55	1.97	1.78	1.62
Sodium oxide	0.45	0.60	0.59	0.65	0.59	0.72	0.63	0.71	0.85	1.10	0.53	0.71
Sulfur trioxide	2.68	2.85	2.32	2.69	2.76	3.05	3.09	2.61	2.90	2.55	2.12	2.47
Phosphorus pentoxide	0.27	0.21	0.18	0.19	0.19	0.23	0.21	0.21	0.18	0.20	0.27	0.21
Strontium oxide	0.11	0.11	0.11	0.11	0.10	0.11	0.11	0.12	0.10	0.11	0.11	0.11
Barium oxide	0.46	0.50	0.44	0.43	0.44	0.48	0.48	0.47	0.45	0.49	0.41	0.39
Manganese oxide	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.04
Undetermined	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Silica Value	71.40	69.27	73.89	73.25	74.66	69.31	67.96	71.28	72.06	72.45	76.33	73.99
Base: Acid Ratio	0.34	0.37	0.31	0.32	0.30	0.38	0.40	0.36	0.34	0.35	0.27	0.31
T_{250} Temperature	2495°F	2444°F	2531°F	2510°F	2564°F	2441°F	2413°F	2468°F	2499°F	2480°F	2603°F	2540°F
Type of Ash	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic
Fouling Index	0.45	0.60	0.59	0.65	0.59	0.72	0.63	0.71	0.85	1.10	0.53	0.71
Slagging Index	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx

ASH ANALYSIS

Weight Percent – Ignited Basis												
Sample Number	37	38	39	40	41	42	43	44	45	46	47	48
	11/11/99; 20:00 hr	11/12/99; 05:00 hr	11/12/99; 08:00 hr	11/12/99; 11:00 hr	11/13/99; 02:00 hr	11/13/99; 05:00 hr	11/13/99; 08:00 hr	11/13/99; 14:00 hr	11/13/99, 17:00 hr	11/13/99, 20:00 hr	11/13/99; 23:00 hr	11/14/99; 02:00 hr
Constituent												
Silicon dioxide	62.70	56.28	58.41	58.92	55.22	54.95	55.21	55.88	55.26	54.07	54.63	56.16
Aluminum oxide	13.03	12.70	12.59	13.51	14.36	14.32	13.85	13.37	14.12	14.72	13.67	13.54
Titanium dioxide	0.62	0.62	0.56	0.62	0.59	0.62	0.60	0.64	0.65	0.64	0.65	0.62
Iron oxide	4.94	5.94	6.11	5.30	6.03	6.13	6.19	6.26	6.20	6.60	6.38	6.29
Calcium oxide	11.53	15.89	14.30	13.43	15.28	15.60	15.02	15.13	15.22	14.97	15.54	14.77
Magnesium oxide	2.12	2.68	2.41	2.40	2.54	2.74	2.71	2.80	2.75	2.78	2.86	2.62
Potassium oxide	1.71	1.54	1.51	1.65	1.52	1.54	1.54	1.54	1.56	1.55	1.51	1.61
Sodium oxide	0.71	0.65	0.64	0.66	0.61	0.63	0.69	0.61	0.61	0.76	0.66	0.60
Sulfur trioxide	1.90	2.85	2.65	2.73	2.96	2.55	3.28	2.85	2.75	3.00	3.21	2.91
Phosphorus pentoxide	0.18	0.18	0.21	0.18	0.20	0.21	0.19	0.20	0.19	0.20	0.20	0.19
Strontium oxide	0.11	0.12	0.11	0.11	0.11	0.12	0.12	0.12	0.11	0.11	0.11	0.11
Barium oxide	0.41	0.51	0.45	0.45	0.53	0.54	0.55	0.56	0.53	0.55	0.53	0.54
Manganese oxide	0.04	0.04	0.05	0.04	0.05	0.05	0.05	0.04	0.05	0.05	0.05	0.04
Undetermined	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Silica Value	77.13	69.66	71.91	73.60	69.84	69.19	69.77	69.79	69.57	68.95	68.79	70.34
Base: Acid Ratio	0.28	0.38	0.35	0.32	0.37	0.38	0.38	0.38	0.38	0.38	0.39	0.37
T_{250} Temperature	2603°F	2431°F	2479°F	2515°F	2449°F	2435°F	2442°F	2440°F	2441°F	2431°F	2422°F	2452°F
Type of Ash	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic
Fouling Index	0.71	0.65	0.64	0.66	0.61	0.63	0.69	0.61	0.61	0.76	0.66	0.60
Slagging Index	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx

ASH ANALYSIS

Weight Percent – Ignited Basis													
Sample Number	49	50	51	52	53								
	11/14/99; 05:00 hr	11/14/99; 08:00 hr	11/14/99; 23:00 hr	11/15/99; 02:00 hr	11/15/99; 05:00 hr								
Constituent													
Silicon dioxide	55.96	54.74	52.93	54.77	54.94								
Aluminum oxide	13.92	15.75	14.69	13.98	12.77								
Titanium dioxide	0.66	0.66	0.62	0.60	0.61								
Iron oxide	6.01	5.96	6.54	6.26	6.49								
Calcium oxide	14.88	14.61	16.00	15.37	16.52								
Magnesium oxide	2.68	2.61	2.68	2.63	2.89								
Potassium oxide	1.56	1.48	1.51	1.56	1.55								
Sodium oxide	0.65	0.65	0.69	0.65	0.65								
Sulfur trioxide	2.83	2.70	3.47	3.34	2.66								
Phosphorus pentoxide	0.20	0.19	0.17	0.17	0.19								
Strontium oxide	0.11	0.11	0.11	0.11	0.12								
Barium oxide	0.50	0.50	0.54	0.51	0.56								
Manganese oxide	0.04	0.04	0.05	0.05	0.05								
Undetermined	0.00	0.00	0.00	0.00	0.00								
	100.00	100.00	100.00	100.00	100.00								
Silica Value	70.36	70.25	67.73	69.30	67.96								
Base: Acid Ratio	0.37	0.36	0.40	0.38	0.41								
T_{250} Temperature	2456°F	2469°F	24.09°F	2434°F	2397°F								
Type of Ash	Lignitic	Lignitic	Lignitic	Lignitic	Lignitic								
Fouling Index	0.65	0.65	0.69	0.65	0.65								
Slagging Index	xxxx	xxxx	xxxx	xxxx	xxxx								

APPENDIX E

LIMESTONE - CHEMICAL ANALYSIS (TYPICAL)

LIMESTONE - CHEMICAL ANALYSIS

Percent Dry Basis					
Sample No.	1	2	3	4	5
	06/08/99; 08:00 hr	06/09/99; 04:00 hr	06/09/99; 18:00 hr	06/10/99; 04:00 hr	06/10/99; 14:00 hr
Parameter					
Calcium, Ca	38.93	39.59	39.80	39.70	39.58
Carbonate, CO_3	59.22	59.13	58.70	58.85	59.15
Magnesium, Mg	0.42	0.30	0.34	0.35	0.33
Inerts	1.19	0.60	0.55	0.54	0.53

Note: Results are reported in weight percent on a dry basis.

APPENDIX F

LIMESTONE – PARTICLE SIZE DISTRIBUTION (TYPICAL)

LIMESTONE – PARTICLE SIZE DISTRIBUTION

	Percent Weight							
Sample No.	1	2	3	4	5	6	7	8
	06/08/99; 08:00 hr	06/08/99; 12:00 hr	06/09/99; 04:00 hr	06/09/99; 18:00 hr	06/10/99; 04:00 hr	06/10/99; 14:00 hr	06/11/99; 04:00 hr	06/11/99; 14:00 hr
Retained On								
+ 80 Mesh	0.08	0.11	0.20	0.17	0.11	0.16	0.02	0.14
+ 100 Mesh	1.05	0.99	1.06	1.07	1.08	1.00	0.79	0.98
+ 140 Mesh	3.06	3.12	3.31	3.13	3.52	3.19	2.98	3.44
+ 200 Mesh	8.10	8.40	8.76	8.09	10.86	8.41	8.36	9.29
+ 270 Mesh	60.94	63.12	60.91	59.64	63.02	56.53	53.60	59.63
+ 325 Mesh	0.13	0.09	0.11	0.09	0.11	13.54	3.12	3.99
- 325 Mesh	26.64	24.17	25.65	27.81	21.30	17.17	31.13	22.53
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

APPENDIX G

SDA FEED SLURRY ANALYSIS

SDA FEED SLURRY

Test No.	Date	Time	Analysis Report No	Parameters									
				Calcium Oxide, CaO	Calcium, Ca	Magnesium, Mg	Sulfite, SO_3	Carbonate, CO_3	Sulfate, SO_4	$CaSO_3 \bullet 1/2H_2O$	$CaSO_4 \bullet 2H_2O$	Total Solid	Acid Insoluble
1.1	11/03/99	1600	04-1216-01	21.95	15.67	1.47	4.45	2.51	1.96	Not Detected	Not Detected	43.87	48.18
Average				21.95	15.67	1.47	4.45	2.51	1.96			43.87	48.18
2.1	11/04/99	0800	04-1216-06	20.11	14.36	1.34	4.40	2.22	1.71	Not Detected	Not Detected	42.09	48.68
2.2	11/04/99	1200	04-1216-05	20.64	14.74	1.33	4.43	4.43	1.90	Not Detected	Not Detected	60.24	45.47
2.3	11/04/99	1600	04-1216-04	21.83	15.59	1.38	4.69	2.38	2.06	Not Detected	Not Detected	49.16	47.89
2.4	11/04/99	2000	04-1216-03	22.09	15.78	1.43	4.73	2.43	2.04	Not Detected	Not Detected	48.60	47.06
2.5	11/04/99	2400	04-1216-02	21.46	15.33	1.34	4.82	2.64	1.80	Not Detected	Not Detected	48.23	47.56
Average				21.23	15.16	1.36	4.61	2.82	1.90	Not Detected	Not Detected	49.66	47.33
3.1	11/05/99	0400	04-1216-09	21.77	15.55	1.40	5.03	2.44	1.68	Not Detected	Not Detected	51.37	46.72
3.2	11/05/99	0800	04-1216-08	21.84	15.59	1.44	4.46	2.95	1.96	Not Detected	Not Detected	53.54	46.80
3.3	11/05/99	2300	04-1216-07	21.38	15.27	1.57	5.09	3.92	2.09	<3.00?	Not Detected	45.27	46.56
Average				21.66	15.47	1.47	4.86	3.1	1.91			50.06	46.69
4.1	11/06/99	0200	04-1216-10	21.77	15.54	1.47	5.48	2.34	1.88	<3.00?	Not Detected	44.89	47.90
4.2	11/06/99	0500	04-1216-11	20.85	14.89	1.45	5.28	2.09	1.52	<3.00?	Not Detected	47.37	49.17
Average				21.31	15.22	1.46	5.38	2.22	1.7			46.13	48.54
5.1	11/07/99	0200	04-1216-14	19.46	13.90	1.39	4.25	2.03	1.17	<3.00	Not Detected	51.53	52.88
5.2	11/07/99	0500	04-1216-15	18.56	13.25	1.25	4.15	2.65	1.17	Not Detected	Not Detected	63.73	51.51
5.3	11/07/99	0800	04-1216-12	20.19	14.41	1.40	4.40	1.87	1.22	Not Detected	Not Detected	49.81	52.24
5.4	11/07/99	1400	04-1216-13	20.44	14.60	1.39	4.50	3.04	1.33	Not Detected	Not Detected	63.52	50.11
5.5	11/07/99	1700	04-1216-17	20.53	14.66	1.46	4.57	2.40	1.59	Not Detected	Not Detected	57.93	50.00
5.6	11/07/99	2000	04-1216-16	20.38	14.55	1.39	4.52	2.43	1.58	<3.00?	Not Detected	59.20	50.21
5.7	11/07/99	2300	04-1216-18	20.71	14.79	1.47	4.69	2.22	1.40	Not Detected	Not Detected	54.68	47.11
Average				20.04	14.31	1.39	4.44	2.38	1.35			57.2	50.58
6.1	11/08/99	0200	04-1216-22	20.72	14.80	1.43	4.69	2.64	1.83	<3.00	Not Detected	54.05	49.42
6.2	11/08/99	0500	04-1216-21	19.37	13.83	1.34	4.19	2.34	1.28	Not Detected	Not Detected	52.58	49.00
6.3	11/08/99	0800	04-1216-23	21.09	15.06	1.40	4.54	2.08	1.74	<3.00	Not Detected	49.07	47.23
6.4	11/08/99	2000	04-1216-20	22.29	15.92	1.49	4.76	2.27	2.15	Not Detected	Not Detected	49.01	47.03
6.5	11/08/99	2300	04-1216-19	22.20	15.85	1.55	4.56	2.23	1.53	<3.00?	Not Detected	48.33	46.71

Test No.	Date	Time	Analysis Report No	Parameters									
				Calcium Oxide, CaO	Calcium, Ca	Magnesium, Mg	Sulfite, SO_3	Carbonate, CO_3	Sulfate, SO_4	$CaSO_3 \bullet 1/2H_2O$	$CaSO_4 \bullet 2H_2O$	Total Solid	Acid Insoluble
Average				21.13	15.09	1.44	4.55	2.31	1.71			50.61	47.88
7.1	11/09/99	0200	04-1216-25	22.04	15.74	1.49	4.53	2.76	1.89	Not Detected	Not Detected	46.91	44.12
7.2	11/09/99	1700	04-1216-26	23.22	16.58	1.61	5.09	4.26	1.07	<3.00	Not Detected	61.18	45.18
7.3	11/09/99	2000	04-1216-24	22.49	16.06	1.56	5.20	2.29	1.77	Not Detected	Not Detected	49.19	44.98
7.4	11/09/99	2300	04-1216-27	23.11	16.50	1.62	5.24	2.52	1.79	<5.00	Not Detected	46.26	45.86
Average				22.72	16.22	1.57	5.02	2.96	1.63			50.89	45.04
8.1	11/10/99	1100	04-1216-29	21.97	15.69	1.40	5.54	2.72	1.63	<5.00	Not Detected	46.02	55.90
8.2	11/10/99	1400	04-1216-30	21.23	15.16	1.26	5.65	2.75	1.68	<3.00	Not Detected	54.99	44.50
8.3	11/10/99	1700	04-1216-28	23.04	16.45	1.58	5.86	2.77	1.16	<5.00	Not Detected	45.63	44.30
8.4	11/10/99	2300	04-1216-31	22.67	16.19	1.50	5.81	2.71	1.19	<5.00	Not Detected	52.28	43.92
Average				22.23	15.87	1.44	5.72	2.74	1.42			49.73	47.16
9.1	11/11/99	0200	04-1216-34	22.73	16.23	1.57	5.86	2.57	1.28	<5.00	Not Detected	46.84	44.56
9.2	11/11/99	0500	04-1216-36	22.82	16.29	1.55	5.78	2.51	1.35	<5.00	Not Detected	48.51	44.27
9.3	11/11/99	0800	04-1216-32	22.65	16.17	1.55	5.66	2.30	1.09	<5.00	Not Detected	50.64	45.26
9.4	11/11/99	1700	04-1216-37	22.88	16.33	1.54	5.66	2.40	1.51	<5.00	Not Detected	46.52	44.74
9.5	11/11/99	2000	04-1216-35	22.45	16.03	1.55	5.56	2.47	1.30	<5.00	Not Detected	54.38	42.09
9.6	11/11/99	2300	04-1216-33	22.05	15.74	1.48	5.41	2.49	1.72	<3.00?	Not Detected	51.60	45.70
Average				22.6	16.13	1.54	5.66	2.46	1.38			49.75	44.44
10.1	11/12/99	0500	04-1216-39	22.34	15.95	1.58	5.37	2.22	1.35	<5.00	Not Detected	48.09	44.11
10.2	11/12/99	0800	04-1216-38	22.94	16.38	1.52	5.56	2.23	1.62	<5.00	Not Detected	48.30	43.37
10.3	11/12/99	1100	04-1216-40	23.28	16.62	1.64	5.62	2.30	1.36	<5.00	Not Detected	47.62	44.46
Average				22.85	16.32	1.58	5.52	2.25	1.44			48.00	43.98
11.1	11/13/99	0200	04-1216-45	21.89	15.63	1.55	5.43	2.42	0.13	<3.00	Not Detected	56.29	45.95
11.2	11/13/99	0500	04-1216-41	21.99	15.70	1.56	5.42	2.31	0.43	<5.00	Not Detected	45.62	46.54
11.3	11/13/99	0800	04-1216-44	21.49	15.34	1.57	5.40	2.56	0.14	<3.00	Not Detected	60.01	46.06
11.4	11/13/99	1400	04-1216-42	21.74	15.52	1.55	5.53	2.11	0.15	<5.00	Not Detected	47.07	46.91
11.5	11/13/99	1700	04-1216-43	21.70	15.49	1.66	5.51	2.08	1.21	<3.00	Not Detected	51.40	46.66
11.6	11/13/99	2000	04-1216-46	21.77	15.54	1.67	5.34	2.14	0.12	<3.00?	Not Detected	54.73	46.52
Average				21.76	15.54	1.59	5.44	2.27	0.36			52.52	46.44

APPENDIX H

SDA HOPPER ASH ANALYSIS

SDA HOPPER ASH

Test No.	Date	Time	Analysis Report No.	Parameters								
				Calcium Oxide, CaO	Calcium, Ca	Magnesium, Mg	Sulfite, SO_3	Carbonate, CO_3	Sulfate, SO_4	$CaSO_3 \bullet 1/2H_2O$	$CaSO_4 \bullet 2H_2O$	Acid Insoluble
1.1	11/03/99	1600	04-1223-01	23.76	16.96	1.34	4.10	2.36	0.30	5.00	Not Detected	49.77
Average				23.76	16.96	1.34	4.10	2.36	0.30			49.77
2.1	11/04/99	0800	04-1223-02	25.33	18.08	1.47	3.55	2.49	1.23	6.00	Not Detected	50.81
2.2	11/04/99	1200	04-1223-03	24.06	17.18	1.35	4.26	3.08	0.52	<5.00	Not Detected	50.28
2.3	11/04/99	1600	04-1223-04	25.00	17.85	1.40	4.35	3.42	0.69	<5.00	Not Detected	49.59
2.4	11/04/99	2000	04-1223-05	24.68	17.62	1.40	4.62	3.16	0.99	<5.00	Not Detected	47.86
2.5	11/04/99	2400	04-1223-06	25.08	17.91	1.47	4.73	3.66	0.39	5.00	Not Detected	48.10
Average				24.83	17.73	1.42	4.3	3.16	0.76	Not Detected	Not Detected	49.33
3.1	11/05/99	0400	04-1223-07	24.52	17.51	1.47	4.68	3.82	0.73	<5.00?	Not Detected	45.90
3.2	11/05/99	0800	04-1223-08	25.20	17.99	1.41	4.66	4.08	0.82	5.00	Not Detected	45.47
Average				24.86	17.75	1.44	4.67	3.95	0.78			45.69
4.1	11/06/99	0200	04-1223-09	22.62	16.15	1.22	4.93	3.87	0.98	<5.00	Not Detected	49.28
Average				22.62	16.15	1.22	4.93	3.87	0.98			49.28
5.1	11/07/99	0200	04-1223-10	23.20	16.56	1.35	3.75	3.37	0.31	<5.00	Not Detected	53.04
5.2	11/07/99	0500	04-1223-11	24.06	17.18	1.43	3.18	3.03	0.78	<5.00?	Not Detected	51.69
5.3	11/07/99	0800	04-1223-12	24.19	17.27	1.44	4.03	3.63	0.24	<5.00	Not Detected	57.64
5.4	11/07/99	1400	04-1223-13	24.04	17.16	1.47	4.11	2.37	0.55	<5.00	Not Detected	57.87
5.5	11/07/99	1700	04-1223-14	23.09	16.49	1.41	3.80	2.38	0.27	<5.00	Not Detected	47.16
5.6	11/07/99	2000	04-1223-15	23.69	16.91	1.43	4.04	2.18	0.13	5.00	Not Detected	47.38
5.7	11/07/99	2300	04-1223-16	24.54	17.52	1.45	3.73	1.84	0.27	<5.00	Not Detected	54.12
Average				23.83	17.01	1.43	3.81	2.69	0.36			52.7
6.1	11/08/99	0200	04-1223-17	24.27	17.33	1.37	3.82	1.81	0.08	6.00	Not Detected	44.77
6.2	11/08/99	0500	04-1223-18	25.11	17.93	1.47	3.70	2.06	0.29	<5.00	Not Detected	38.97
6.3	11/08/99	0800	04-1223-19	24.14	17.24	1.39	3.72	1.96	0.18	5.00	Not Detected	48.84
6.4	11/08/99	2000	04-1223-20	27.02	19.29	1.52	3.63	1.87	0.19	5.00	Not Detected	47.22
6.5	11/08/99	2300	04-1223-21	27.15	19.38	1.43	3.71	2.01	0.15	<5.00	Not Detected	46.48
Average				25.54	18.23	1.44	3.72	1.94	0.18			45.26
7.1	11/09/99	0200	04-1223-22	28.21	20.14	1.53	3.55	2.10	0.75	<5.00	Not Detected	46.62
7.2	11/09/99	1700	04-1223-23	26.27	18.76	1.56	4.34	1.90	0.56	5.00	Not Detected	47.55

Test No.	Date	Time	Analysis Report No.	Parameters								
				Calcium Oxide, CaO	Calcium, Ca	Magnesium, Mg	Sulfite, SO_3	Carbonate, CO_3	Sulfate, SO_4	$CaSO_3 \bullet 1/2H_2O$	$CaSO_4 \bullet 2H_2O$	Acid Insoluble
7.3	11/09/99	2000	04-1223-24	26.03	18.59	1.54	4.53	2.01	0.20	8.00	Not Detected	47.12
7.4	11/09/99	2300	04-1223-25	26.04	18.59	1.48	4.72	2.23	0.19	5.00	Not Detected	47.43
Average				26.64	19.02	1.53	4.29	2.06	0.43			47.18
8.1	11/10/99	1100	04-1223-26	25.79	18.42	1.55	5.06	2.11	0.35	5.00	Not Detected	46.50
8.2	11/10/99	1400	04-1223-27	25.73	18.37	1.57	5.33	2.00	0.34	5.00	Not Detected	46.28
8.3	11/10/99	1700	04-1223-28	25.22	18.00	1.53	5.14	2.22	0.19	<5.00	Not Detected	47.50
8.4	11/10/99	2300	04-1223-29	25.63	18.30	1.48	4.63	2.35	0.35	<5.00	Not Detected	47.65
Average				25.59	18.27	1.53	5.04	2.17	0.31			46.98
9.1	11/11/99	0200	04-1223-30	25.94	18.52	1.58	4.59	2.24	0.30	<5.00	Not Detected	47.68
9.2	11/11/99	0500	04-1223-31	24.74	17.66	1.41	4.37	2.02	0.53	<5.00	Not Detected	50.69
9.3	11/11/99	0800	04-1223-32	26.21	18.71	1.53	3.75	1.95	0.25	<5.00	Not Detected	48.75
9.4	11/11/99	1700	04-1223-33	25.35	18.10	1.44	4.10	2.72	0.26	<5.00	Not Detected	49.77
9.5	11/11/99	2000	04-1223-34	25.24	18.02	1.45	4.14	2.46	0.07	<5.00	Not Detected	50.54
9.6	11/11/99	2300	04-1223-35	24.99	17.85	1.48	4.12	2.41	0.42	5.00	Not Detected	50.56
Average				25.41	18.14	1.48	4.18	2.3	0.31			49.67
10.1	11/12/99	0500	04-1223-36	25.45	18.17	1.53	4.39	2.57	0.24	5.00	Not Detected	47.89
10.2	11/12/99	0800	04-1223-37	25.39	18.13	1.49	4.56	2.48	0.41	5.00	Not Detected	47.09
10.3	11/12/99	1100	04-1223-38	26.64	17.59	1.39	4.46	2.87	0.23	Not Detected	Not Detected	47.68
Average				25.83	17.96	1.47	4.47	2.64	0.29			47.55
11.1	11/13/99	0200	04-1223-39	24.49	17.49	1.56	4.79	2.85	0.52	5.00	Not Detected	49.49
11.2	11/13/99	0500	04-1223-40	23.60	16.85	1.50	4.78	2.77	0.71	<5.00	Not Detected	49.11
11.3	11/13/99	0800	04-1223-41	23.67	16.90	1.55	4.92	2.77	0.43	<5.00	Not Detected	49.02
11.4	11/13/99	1400	04-1223-42	23.21	16.58	1.50	5.14	2.89	1.28	<5.00	Not Detected	48.15
11.5	11/13/99	1700	04-1223-43	22.95	16.39	1.45	5.06	2.62	1.08	<5.00	Not Detected	49.49
11.6	11/13/99	2000	04-1223-44	23.49	16.77	1.55	4.74	2.80	1.26	<5.00	Not Detected	48.10
11.7	11/13/99	2300	04-1223-45	23.92	17.08	1.54	4.67	2.65	1.60	5.00	Not Detected	49.08
Average				23.62	16.87	1.52	4.87	2.76	0.98			48.92
12.1	11/14/99	0200	04-1223-46	22.97	16.40	1.59	5.03	2.69	1.24	5.00	Not Detected	48.31
12.2	11/14/99	0500	04-1223-47	22.92	16.37	1.60	5.24	2.73	1.03	<5.00	Not Detected	48.22
12.3	11/14/99	0800	04-1223-48	23.16	16.54	1.64	5.41	2.43	1.15	5.00	Not Detected	48.66
12.4	11/14/99	2000	04-1223-49	24.29	17.34	1.66	5.57	2.51	1.69	6.00	Not Detected	45.15
Average				23.34	16.66	1.62	5.31	9.9	1.28			47.59
13.1	11/15/99	0200	04-1223-50	24.40	17.42	1.67	5.85	2.37	1.82	5.00	Not Detected	46.94

Test No.	Date	Time	Analysis Report No.	Parameters								
				Calcium Oxide, CaO	Calcium, Ca	Magnesium, Mg	Sulfite, SO_3	Carbonate, CO_3	Sulfate, SO_4	$CaSO_3 \bullet 1/2H_2O$	$CaSO_4 \bullet 2H_2O$	Acid Insoluble
13.2	11/15/99	0500	04-1223-51	24.31	17.36	1.63	5.86	2.73	1.42	<5.00	Not Detected	46.59
Average				24.36	17.39	1.65	5.86	2.55	1.62			46.77

APPENDIX I

SURGE BIN ASH ANALYSIS

SURGE BIN ASH

Test No.	Date	Time	Analysis Report No.	Parameters								
				Calcium Oxide, CaO	Calcium, Ca	Magnesium, Mg	Sulfite, SO_3	Carbonate, CO_3	Sulfate, SO_4	$CaSO_3 \bullet 1/2H_2O$	$CaSO_4 \bullet 2H_2O$	Acid Insoluble
1.1	11/03/99	0800	04-1222-01	23.86	17.04	1.47	4.65	2.90	1.27	5.00	Not Detected	50.17
1.2	11/03/99	1200	04-1222-02	23.38	16.69	1.48	4.76	3.16	1.65	<5.00	Not Detected	50.02
1.3	11/03/99	1600	04-1222-03	21.64	15.45	1.29	4.65	2.96	1.57	<5.00?	Not Detected	50.08
Average				22.96	19.68	1.41	4.69	3.01	1.50			50.09
2.1	11/04/99	0800	04-1222-04	22.38	15.98	1.43	4.79	2.83	1.70	<5.00	Not Detected	49.25
2.2	11/04/99	1200	04-1222-05	22.35	15.96	1.55	4.82	2.72	1.76	<5.00	Not Detected	49.97
2.3	11/04/99	1600	04-1222-06	22.36	15.97	1.50	4.87	2.51	1.85	<5.00	Not Detected	49.90
2.4	11/04/99	2000	04-1222-07	22.29	15.91	1.52	4.83	1.91	1.96	<5.00?	Not Detected	49.17
2.5	11/04/99	2400	04-1222-08	22.09	15.77	1.48	5.03	2.42	2.02	Not Detected	Not Detected	44.16
Average				22.29	15.92	1.50	4.87	2.48	1.86	Not Detected	Not Detected	48.49
3.1	11/05/99	0400	04-1222-09	22.59	16.13	1.47	5.16	2.77	2.13	<5.00	Not Detected	45.48
3.2	11/05/99	0800	04-1222-10	23.08	16.48	1.54	5.54	2.75	1.88	<5.00	Not Detected	45.72
3.3	11/05/99	2300	04-1222-11	22.45	16.03	1.53	5.40	2.21	1.85	<5.00	Not Detected	47.13
Average				22.71	16.21	1.51	5.37	2.58	1.95			46.11
4.1	11/06/99	0200	04-1222-12	21.96	15.68	1.45	5.39	1.77	1.98	5.00	Not Detected	48.09
4.2	11/06/99	0500	04-1222-13	21.56	15.39	1.46	5.39	1.68	1.72	<5.00	Not Detected	48.28
Average				21.76	15.54	1.46	5.39	1.73	1.85			48.19
5.1	11/07/99	0200	04-1222-14	20.40	14.57	1.44	4.63	1.84	1.43	<5.00	Not Detected	51.92
5.2	11/07/99	0500	04-1222-15	20.22	14.44	1.44	4.61	1.73	1.32	5.00	Not Detected	52.38
5.3	11/07/99	0800	04-1222-16	20.24	14.45	1.49	4.48	1.24	0.70	5.00	Not Detected	52.05
5.4	11/07/99	1400	04-1222-17	21.06	15.04	1.48	4.62	0.81	0.78	5.00	Not Detected	52.32
5.5	11/07/99	1700	04-1222-18	20.97	14.98	1.44	4.70	1.24	0.72	<5.00	Not Detected	50.70
5.6	11/07/99	2000	04-1222-19	21.65	15.46	1.56	4.79	1.53	0.23	<5.00	Not Detected	50.33
5.7	11/07/99	2300	04-1222-.20	21.31	15.22	1.51	4.87	1.29	0.24	5.00	Not Detected	50.47
Average				20.84	14.88	1.48	4.67	1.38	0.77			51.45
6.1	11/08/99	0200	04-1222-21	21.09	15.06	1.44	4.82	0.92	0.41	<5.00	Not Detected	50.77
6.2	11/08/99	0500	04-1222-22	21.99	15.70	1.53	4.54	0.55	0.63	<5.00	Not Detected	50.09
6.3	11/08/99	0800	04-1222-23	22.18	15.84	1.63	4.77	1.09	0.52	5.00	Not Detected	50.42
6.4	11/08/99	2000	04-1222-24	23.15	16.53	1.62	4.78	1.09	0.68	<5.00	Not Detected	49.39
6.5	11/08/99	2300	04-1222-25	23.15	16.53	1.55	4.86	1.05	0.28	<5.00	Not Detected	48.62

Test No.	Date	Time	Analysis Report No.	Parameters								
				Calcium Oxide, CaO	Calcium, Ca	Magnesium, Mg	Sulfite, SO_3	Carbonate, CO_3	Sulfate, SO_4	$CaSO_3 \bullet 1/2H_2O$	$CaSO_4 \bullet 2H_2O$	Acid Insoluble
Average				22.31	15.93	1.55	4.75	0.94	0.50			49.86
7.1	11/09/99	0200	04-1222-26	22.53	16.09	1.51	4.54	0.78	0.48	5.00	Not Detected	49.81
7.2	11/09/99	1700	04-1222-27	23.18	16.55	1.49	5.31	0.96	0.61	5.00	Not Detected	47.46
7.3	11/09/99	2000	04-1222-28	23.97	17.12	1.65	5.31	1.46	0.62	5.00	Not Detected	47.47
7.4	11/09/99	2300	04-1222-29	23.53	16.80	1.59	5.43	1.28	0.68	5.00	Not Detected	48.74
Average				23.30	16.64	1.56	5.15	1.12	0.6			48.37
8.1	11/10/99	1100	04-1222-30	23.59	16.84	1.60	5.81	1.43	0.97	<5.00	Not Detected	46.85
8.2	11/10/99	1400	04-1222-31	23.80	16.99	1.65	6.10	1.04	0.73	5.00	Not Detected	46.56
8.3	11/10/99	1700	04-1222-32	24.04	17.16	1.65	6.20	2.05	0.99	9.00	Not Detected	46.58
8.4	11/10/99	2300	04-1222-33	23.86	17.03	1.66	5.90	1.97	0.76	5.00	Not Detected	47.22
Average				23.82	17.01	1.64	6.00	1.62	0.86			46.8
9.1	11/11/99	0200	04-1222-34	24.00	17.14	1.63	6.03	1.89	0.52	8.00	Not Detected	45.30
9.2	11/11/99	0500	04-1222-35	23.10	16.49	1.53	5.80	2.20	0.75	8.00	Not Detected	46.19
9.3	11/11/99	0800	04-1222-36	23.62	16.86	1.70	5.82	2.21	1.11	6.00	Not Detected	44.63
9.4	11/11/99	1700	04-1222-37	23.86	17.04	1.68	5.86	2.04	1.14	8.00	Not Detected	46.17
9.5	11/11/99	2000	04-1222-38	23.01	16.43	1.56	5.69	2.04	1.55	5.00	Not Detected	45.72
9.6	11/11/99	2300	04-1222-39	23.11	16.50	1.64	5.66	1.88	0.60	6.00	Not Detected	46.74
Average				23.45	16.74	1.62	5.81	2.04	0.95			45.79
10.1	11/12/99	0500	04-1222-40	23.09	16.49	1.61	5.59	1.97	0.97	5.00	Not Detected	47.98
10.2	11/12/99	0800	04-1222-41	23.61	16.85	1.69	5.86	1.86	0.78	5.00	Not Detected	46.81
Average				23.35	16.67	1.65	5.73	1.92	0.88			47.4
11.1	11/13/99	0200	04-1222-42	22.28	15.91	1.60	5.72	1.91	0.93	6.00	Not Detected	48.09
11.2	11/13/99	0500	04-1222-43	22.66	16.18	1.63	5.65	1.96	0.28	6.00	Not Detected	48.30
11.3	11/13/99	0800	04-1222-44	22.00	15.71	1.60	5.66	1.85	0.58	8.00	Not Detected	47.84
11.4	11/13/99	1400	04-1222-45	22.02	15.73	1.60	5.68	1.76	0.23	<5.00	Not Detected	48.60
11.5	11/13/99	1700	04-1222-46	22.11	15.79	1.64	5.73	2.06	0.20	5.00	Not Detected	47.24
11.6	11/13/99	2000	04-1222-47	22.47	16.04	1.68	5.61	1.62	0.63	<5.00	Not Detected	48.11
11.7	11/13/99	2300	04-1222-48	22.45	16.03	1.69	5.67	1.38	0.23	8.00	Not Detected	48.82
Average				22.28	15.91	1.63	5.67	1.79	0.44			48.14
12.1	11/14/99	0200	04-1222-49	22.13	15.80	1.67	5.52	1.68	0.78	<5.00	Not Detected	48.39
12.2	11/14/99	0500	04-1222-50	22.41	16.00	1.67	5.60	1.76	0.69	10.00	Not Detected	48.03
12.3	11/14/99	0800	04-1222-51	22.33	15.94	1.70	5.81	1.28	0.65	<5.00	Not Detected	47.15
12.4	11/14/99	2300	04-1222-52	22.38	15.98	1.67	6.12	1.25	0.98	6.00	Not Detected	47.61

Test No.	Date	Time	Analysis Report No.	Parameters								
				Calcium Oxide, CaO	Calcium, Ca	Magnesium, Mg	Sulfite, SO_3	Carbonate, CO_3	Sulfate, SO_4	$CaSO_3 \bullet 1/2H_2O$	$CaSO_4 \bullet 2H_2O$	Acid Insoluble
Average				22.31	15.93	1.68	5.76	1.49	0.78			47.8
13.1	11/15/99	0200	04-1222-53	22.36	15.97	1.66	6.12	1.26	0.81	5.00	Not Detected	46.51
13.2	11/15/99	0500	04-1222-54	23.28	16.62	1.75	6.38	1.50	0.63	5.00	Not Detected	45.20
Average				22.82	16.30	1.71	6.25	1.38	0.72			45.86

APPENDIX J

AIR HEATER HOPPER ASH ANALYSIS

AIR HEATER HOPPER ASH

Test No.	Date	Time	Analysis Report No.	Parameters								
				Calcium Oxide, CaO	Calcium, Ca	Magnesium, Mg	Sulfite, SO_3	Carbonate, CO_3	Sulfate, SO_4	$CaSO_3 \bullet 1/2H_2O$	$CaSO_4 \bullet 2H_2O$	Acid Insoluble
1.1	11/03/99	0800	04-1218-01	22.57	16.11	0.76	0.74	1.39	0.43	Not Detected	Not Detected	65.30
1.2	11/03/99	1200	04-1218-02	30.30	21.63	1.31	1.22	1.21	1.16	Not Detected	Not Detected	51.88
1.3	11/03/99	1600	04-1218-03	23.64	16.88	0.98	0.85	2.20	1.17	Not Detected	Not Detected	64.12
Average				25.50	18.21	1.02	0.94	1.60	0.92			60.43
2.1	11/04/99	0800	04-1218-04	24.63	17.58	1.01	1.14	2.94	1.06	Not Detected	Not Detected	61.25
2.2	11/04/99	1200	04-1218-05	25.38	18.12	1.12	1.16	2.38	1.03	Not Detected	Not Detected	62.97
2.3	11/04/99	1600	04-1218-06	25.45	18.17	0.94	0.80	2.53	0.71	Not Detected	Not Detected	61.46
2.4	11/04/99	2000	04-1218-07	27.51	19.64	0.99	0.82	2.70	0.61	Not Detected	Not Detected	57.75
2.5	11/04/99	2400	04-1218-08	31.61	22.57	1.23	0.96	3.92	0.73	Not Detected	Not Detected	52.81
Average				26.92	19.22	1.06	0.98	2.89	0.83	Not Detected	Not Detected	59.25
3.1	11/05/99	0400	04-1218-09	29.88	21.34	1.19	1.47	3.09	1.41	Not Detected	Not Detected	51.75
3.2	11/05/99	0800	04-1218-10	29.29	20.91	1.20	1.51	2.82	1.75	Not Detected	Not Detected	44.12
3.3	11/05/99	2300	04-1218-11	28.08	20.05	0.97	0.75	3.87	0.50	Not Detected	Not Detected	51.14
Average				29.08	20.77	1.12	1.24	3.26	1.22			49.00
4.1	11/06/99	0200	04-1218-12	28.05	20.03	1.13	1.01	2.57	1.13	Not Detected	Not Detected	33.36
4.2	11/06/99	0500	04-1218-13	26.63	19.01	1.01	0.83	2.88	0.66	Not Detected	Not Detected	34.81
Average				27.34	19.52	1.07	0.92	2.73	0.90			34.09
5.1	11/07/99	0200	04-1218-14	21.70	15.49	0.89	0.77	3.17	0.84	Not Detected	Not Detected	61.16
5.2	11/07/99	0500	04-1218-15	24.67	17.61	1.13	0.63	2.20	0.73	Not Detected	Not Detected	58.82
5.3	11/07/99	0800	04-1218-16	25.02	17.86	1.16	0.86	2.70	0.77	Not Detected	Not Detected	50.31
5.4	11/07/99	1400	04-1218-17	30.02	21.43	1.27	0.74	3.81	0.57	Not Detected	Not Detected	51.16
5.5	11/07/99	1700	04-1218-18	27.04	19.30	1.30	1.00	2.28	0.89	Not Detected	Not Detected	56.72
5.6	11/07/99	2000	04-1218-19	27.90	19.92	1.29	0.74	2.49	0.60	Not Detected	Not Detected	56.09
5.7	11/07/99	2300	04-1218-.20	26.16	18.67	1.14	0.67	2.67	0.63	Not Detected	Not Detected	55.83
Average				26.07	18.61	1.17	0.77	2.76	0.72			55.73
6.1	11/08/99	0200	04-1218-21	28.19	20.13	1.25	0.64	2.99	0.54	Not Detected	Not Detected	52.15
6.2	11/08/99	0500	04-1218-22	28.49	20.34	1.34	0.71	2.12	1.17	Not Detected	Not Detected	49.08
6.3	11/08/99	0800	04-1218-23	28.17	20.12	1.35	0.78	2.61	1.13	Not Detected	Not Detected	34.14

Test No.	Date	Time	Analysis Report No.	Parameters								
				Calcium Oxide, CaO	Calcium, Ca	Magnesium, Mg	Sulfite, SO_3	Carbonate, CO_3	Sulfate, SO_4	$CaSO_3 \bullet 1/2H_2O$	$CaSO_4 \bullet 2H_2O$	Acid Insoluble
6.4	11/08/99	2000	04-1218-24	31.14	22.23	1.35	0.80	3.10	0.74	Not Detected	Not Detected	48.88
6.5	11/08/99	2300	04-1218-25	31.38	22.41	1.38	0.93	3.07	0.80	Not Detected	Not Detected	48.13
Average				29.47	21.05	1.33	0.77	2.78	0.88			46.48
7.1	11/09/99	0200	04-1218-26	30.13	21.51	1.51	1.13	2.80	1.42	Not Detected	Not Detected	48.57
7.2	11/09/99	1700	04-1218-27	28.83	20.58	1.22	0.65	1.83	0.59	Not Detected	Not Detected	58.93
7.3	11/09/99	2000	04-1218-28	24.23	17.30	1.01	0.58	2.39	0.81	Not Detected	Not Detected	59.46
7.4	11/09/99	2300	04-1218-29	27.82	19.86	1.23	0.81	3.01	0.68	Not Detected	Not Detected	50.72
Average				27.75	19.81	1.24	0.79	2.51	0.88			54.42
8.1	11/10/99	1100	04-1218-30	26.68	19.05	1.24	0.91	2.43	1.08	Not Detected	Not Detected	51.78
8.2	11/10/99	1400	04-1218-31	25.75	16.39	1.17	1.00	2.62	1.21	Not Detected	Not Detected	58.98
8.3	11/10/99	1700	04-1218-32	27.01	19.29	1.30	1.05	2.83	1.30	Not Detected	Not Detected	53.60
8.4	11/10/99	2300	04-1218-33	26.61	19.00	1.21	0.66	2.31	0.67	Not Detected	Not Detected	58.03
Average				26.51	18.43	1.23	0.91	2.55	1.07			55.60
9.1	11/11/99	0200	04-1218-34	24.35	17.39	1.10	0.67	2.76	0.65	Not Detected	Not Detected	58.52
9.2	11/11/99	0500	04-1218-35	23.65	16.89	1.01	0.62	2.53	0.44	Not Detected	Not Detected	52.58
9.3	11/11/99	0800	04-1218-36	24.10	17.21	1.10	0.71	2.58	0.65	Not Detected	Not Detected	60.14
9.4	11/11/99	1700	04-1218-37	24.60	17.56	0.95	0.63	2.56	0.59	Not Detected	Not Detected	59.94
9.5	11/11/99	2000	04-1218-38	22.55	16.10	0.91	0.64	2.65	0.57	Not Detected	Not Detected	43.06
9.6	11/11/99	2300	04-1218-39	23.48	16.76	0.94	0.81	2.77	0.75	Not Detected	Not Detected	61.28
Average				23.79	16.99	1.00	0.68	2.64	0.61			55.92
10.1	11/12/99	0500	04-1218-40	23.60	16.99	1.10	0.63	2.83	0.61	Not Detected	Not Detected	54.62
10.2	11/12/99	0800	04-1218-41	24.33	17.37	1.12	0.79	2.81	0.98	Not Detected	Not Detected	57.36
Average				23.97	17.18	1.11	0.71	2.82	0.80			55.99
11.1	11/13/99	0200	04-1218-42	22.96	16.39	1.00	0.67	2.57	0.90	Not Detected	Not Detected	59.97
11.2	11/13/99	0500	04-1218-43	24.64	17.59	1.09	0.70	2.75	0.54	Not Detected	Not Detected	58.12
11.3	11/13/99	0800	04-1218-44	23.22	16.58	1.03	0.69	2.37	0.80	Not Detected	Not Detected	58.01
11.4	11/13/99	1400	04-1218-45	24.18	17.27	1.02	0.76	2.72	0.83	Not Detected	Not Detected	39.55
11.5	11/13/99	1700	04-1218-46	24.59	17.56	1.10	0.64	2.95	0.91	Not Detected	Not Detected	59.52
11.6	11/13/99	2000	04-1218-47	24.29	17.34	1.21	1.06	2.63	1.34	Not Detected	Not Detected	57.88
11.7	11/13/99	2300	04-1218-48	22.43	16.02	0.95	0.74	3.06	0.56	Not Detected	Not Detected	61.18
Average				23.76	16.96	1.06	0.75	2.72	0.84			56.32
12.1	11/14/99	0200	04-1218-49	24.21	17.29	1.14	1.37	2.74	1.35	Not Detected	Not Detected	61.02
12.2	11/14/99	0500	04-1218-50	23.35	16.67	1.10	0.93	2.47	0.39	Not Detected	Not Detected	60.22

Test No.	Date	Time	Analysis Report No.	Parameters								
				Calcium Oxide, CaO	Calcium, Ca	Magnesium, Mg	Sulfite, SO_3	Carbonate, CO_3	Sulfate, SO_4	$CaSO_3 \bullet 1/2H_2O$	$CaSO_4 \bullet 2H_2O$	Acid Insoluble
12.3	11/14/99	0800	04-1218-51	23.97	17.12	1.19	0.61	2.68	0.58	Not Detected	Not Detected	60.63
12.4	11/14/99	2300	04-1218-52	25.70	18.35	1.22	1.30	2.93	0.80	Not Detected	Not Detected	57.59
Average				24.31	17.36	1.16	1.05	2.71	0.78			59.87
13.1	11/15/99	0200	04-1218-53	27.98	19.96	1.34	1.09	2.89	0.89	Not Detected	Not Detected	55.68
13.2	11/15/99	0500	04-1218-54	28.39	20.27	1.19	0.80	3.18	0.65	Not Detected	Not Detected	56.38
Average				28.19	20.12	1.27	0.95	3.04	0.77			56.03

APPENDIX K

BAGHOUSE HOPPER ASH ANALYSIS

BAG HOUSE HOPPER ASH (WEST)

Test No.	Date	Time	Analysis Report No.	Parameters								
				Calcium Oxide, CaO	Calcium, Ca	Magnesium, Mg	Sulfite, SO_3	Carbonate, CO_3	Sulfate, SO_4	$CaSO_3 \bullet 1/2H_2O$	$CaSO_4 \bullet 2H_2O$	Acid Insoluble
1.1	11/03/99	0800	04-1225-01	21.77	15.54	1.37	4.57	1.15	1.30	<5.00	Not Detected	51.47
1.2	11/03/99	1200	04-1225-02	22.29	15.91	1.45	4.83	1.32	1.74	6.00	Not Detected	52.15
1.3	11/03/99	1600	04-1225-03	22.37	15.97	1.38	4.63	1.33	1.51	6.00	Not Detected	52.52
Average				22.14	15.81	1.40	4.68	1.27	1.52			52.05
2.1	11/04/99	0800	04-1225-04	22.09	15.77	1.47	4.82	1.36	1.75	<5.00	Not Detected	51.80
2.2	11/04/99	1200	04-1225-05	22.62	16.15	1.44	4.74	1.24	1.90	<5.00	Not Detected	51.57
2.3	11/04/99	1600	04-1225-06	22.19	15.84	1.51	5.01	1.45	2.17	<5.00	Not Detected	50.76
2.4	11/04/99	2000	04-1225-07	22.87	16.33	1.48	5.02	1.41	2.17	<5.00	Not Detected	50.97
2.5	11/04/99	2400	04-1225-08	23.78	16.98	1.53	5.02	1.48	1.82	<5.00?	Not Detected	50.46
Average				22.71	16.21	1.49	4.92	1.39	1.96	Not Detected	Not Detected	51.11
3.1	11/05/99	0400	04-1225-09	23.10	16.49	1.51	5.18	1.63	1.92	6.00	Not Detected	49.51
3.2	11/05/99	0800	04-1225-10	24.33	17.37	1.57	5.24	1.79	1.81	6.00	Not Detected	48.44
Average				23.72	16.93	1.54	5.21	1.71	1.87			48.98
4.1	11/08/99	0800	04-1225-11	22.49	16.06	1.50	4.98	1.01	1.14	5.00	Not Detected	51.64
4.2	11/08/99	2000	04-1225-12	23.35	16.67	1.53	4.96	1.07	1.73	<5.00	Not Detected	49.98
4.3	11/08/99	2300	04-1225-13	23.22	16.58	1.55	4.91	1.16	1.57	<5.00	Not Detected	50.27
Average				23.02	16.44	1.53	4.95	1.08	1.48			50.63
5.1	11/09/99	0200	04-1225-14	23.95	17.10	1.64	4.84	1.08	1.33	6.00	Not Detected	49.71
5.2	11/09/99	1700	04-1225-15	24.14	17.23	1.67	5.56	1.29	1.32	6.00	Not Detected	48.69
5.3	11/09/99	2000	04-1225-16	24.14	17.23	1.66	5.56	1.37	1.39	7.00	Not Detected	48.27
5.4	11/09/99	2300	04-1225-17	24.32	17.37	1.63	5.36	1.38	1.39	6.00	Not Detected	48.02
Average				24.14	17.23	1.65	5.33	1.28	1.36			48.67
6.1	11/10/99	1100	04-1225-18	24.14	17.24	1.60	5.53	1.37	1.37	6.00	Not Detected	47.63
6.2	11/10/99	1400	04-1225-19	23.98	17.12	1.60	5.88	1.42	1.87	6.00	Not Detected	47.98
6.3	11/10/99	1700	04-1225-20	24.10	17.21	1.60	6.14	1.35	1.77	10.00	Not Detected	47.27
6.4	11/10/99	2300	04-1225-21	24.75	17.67	1.59	5.47	1.31	1.80	5.00	Not Detected	47.93
Average				24.24	17.31	1.60	5.76	1.36	1.70			47.70
7.1	11/11/99	0200	04-1225-22	23.32	16.65	1.54	6.05	1.32	1.67	6.00	Not Detected	48.37
7.2	11/11/99	0500	04-1225-23	23.54	16.81	1.58	5.92	1.41	1.86	6.00	Not Detected	47.70

Test No.	Date	Time	Analysis Report No.	Parameters								
				Calcium Oxide, CaO	Calcium, Ca	Magnesium, Mg	Sulfite, SO_3	Carbonate, CO_3	Sulfate, SO_4	$CaSO_3 \bullet 1/2H_2O$	$CaSO_4 \bullet 2H_2O$	Acid Insoluble
7.3	11/11/99	0800	04-1225-25	23.95	17.10	1.57	5.39	1.09	1.80	7.00	Not Detected	48.76
7.4	11/11/99	1700	04-1225-26	23.71	16.93	1.60	5.87	1.14	1.87	7.00	Not Detected	48.36
7.5	11/11/99	2000	04-1225-27	23.29	16.63	1.58	5.68	1.12	1.78	7.00	Not Detected	46.12
7.6	11/11/99	2300	04-1225-28	22.78	16.27	1.57	5.70	1.13	1.67	<5.00	Not Detected	49.29
Average				23.43	16.73	1.57	5.77	1.20	1.78			48.10
8.1	11/12/99	0500	04-1225-29	22.97	16.40	1.59	5.60	1.03	1.82	6.00	Not Detected	51.66
8.2	11/12/99	0800	04-1225-30	23.62	16.87	1.64	5.78	1.14	1.75	7.00	Not Detected	47.87
Average				22.03	15.73	1.41	4.7	1.24	1.52			51.81
9.1	11/13/99	0200	04-1225-31	22.88	16.33	1.60	5.53	1.24	1.54	6.00	Not Detected	49.39
9.2	11/13/99	0500	04-1225-32	22.64	16.16	1.65	5.65	1.14	1.64	6.00	Not Detected	49.44
9.3	11/13/99	0800	04-1225-33	22.59	16.13	1.63	5.56	1.15	1.74	5.00	Not Detected	48.37
9.4	11/13/99	1400	04-1225-34	22.63	16.16	1.72	5.61	1.07	1.83	<5.00	Not Detected	49.19
9.5	11/13/99	1700	04-1225-35	22.48	16.05	1.64	5.73	1.19	1.80	5.00	Not Detected	48.88
9.6	11/13/99	2000	04-1225-36	22.58	16.12	1.69	5.78	1.09	1.84	6.00	Not Detected	49.37
9.7	11/13/99	2300	04-1225-37	22.61	16.14	1.68	5.52	1.13	1.92	5.00	Not Detected	49.63
Average				22.71	16.21	1.49	4.92	1.39	1.96			51.11
10.1	11/14/99	0200	04-1225-38	22.61	16.14	1.64	5.30	0.99	1.98	5.00	Not Detected	49.75
10.2	11/14/99	0500	04-1225-39	22.18	15.84	1.62	5.43	1.12	2.06	5.00	Not Detected	49.40
10.3	11/14/99	0800	04-1225-24	22.31	15.93	1.72	5.92	1.25	1.75	5.00	Not Detected	49.34
Average				24.03	17.15	1.56	5.23	1.75	1.84			48.71

BAG HOUSE HOPPER ASH (EAST)

Test No.	Date	Time	Analysis Report No.	Parameters								
				Calcium Oxide, CaO	Calcium, Ca	Magnesium, Mg	Sulfite, SO_3	Carbonate, CO_3	Sulfate, SO_4	$CaSO_3 \bullet 1/2H_2O$	$CaSO_4 \bullet 2H_2O$	Acid Insoluble
1.1	11/03/99	0800	04-1224-01	25.09	17.91	1.49	4.19	1.33	1.57	<5.00	Not Detected	50.65
1.2	11/03/99	1200	04-1224-02	24.26	17.32	1.50	4.62	1.40	1.61	5.00	Not Detected	51.46
Average				24.68	17.62	1.50	4.41	1.37	1.59			51.06
2.1	11/04/99	0800	04-1224-03	22.71	16.22	1.49	4.84	1.38	1.71	<5.00?	Not Detected	51.59
2.2	11/04/99	1200	04-1224-04	23.02	16.44	1.54	4.72	1.44	1.73	<5.00	Not Detected	51.40
2.3	11/04/99	1600	04-1224-05	22.17	15.83	1.40	5.03	1.38	1.61	6.00	Not Detected	50.42
2.4	11/04/99	2000	04-1224-06	22.22	15.86	1.41	5.23	1.63	1.95	5.00	Not Detected	49.73
2.5	11/04/99	2400	04-1224-07	23.19	16.56	1.49	5.14	1.57	1.71	6.00	Not Detected	49.12
Average				22.66	16.18	1.47	4.99	1.48	1.74	Not Detected	Not Detected	50.45
3.1	11/05/99	0400	04-1224-08	22.66	16.18	1.52	5.46	1.62	1.71	6.00	Not Detected	49.53
3.2	11/05/99	0800	04-1224-09	23.82	17.01	1.54	5.38	1.75	1.66	8.00	Not Detected	48.81
Average				23.24	16.60	1.53	5.42	1.69	1.69			49.17
4.1	11/06/99	0200	04-1224-10	22.46	16.04	1.54	5.73	1.55	1.78	6.00	Not Detected	49.77
4.2	11/06/99	0500	04-1224-11	21.81	15.57	1.50	5.56	1.62	1.45	5.00	Not Detected	51.03
Average				22.14	15.81	1.52	5.65	1.59	1.62			50.40
5.1	11/07/99	0200	04-1224-12	20.22	14.44	1.50	4.02	0.85	1.30	<5.00	Not Detected	55.53
5.2	11/07/99	0500	04-1224-13	19.98	14.23	1.39	4.75	0.87	1.31	<5.00	Not Detected	55.42
5.3	11/07/99	0800	04-1224-14	20.34	14.52	1.47	4.59	1.06	1.16	5.00	Not Detected	54.89
5.4	11/07/99	1400	04-1224-15	21.24	15.16	1.49	4.84	1.12	1.20	<5.00	Not Detected	53.69
5.5	11/07/99	1700	04-1224-16	22.07	15.76	1.49	4.42	1.00	1.74	<5.00	Not Detected	52.91
5.6	11/07/99	2000	04-1224-17	21.72	15.51	1.49	4.53	1.09	1.25	<5.00	Not Detected	52.78
5.7	11/07/99	2300	04-1224-18	22.19	15.85	1.57	4.89	1.33	1.11	6.00	Not Detected	51.77
Average				21.11	15.07	1.49	4.58	1.05	1.30			53.86
6.1	11/08/99	0200	04-1224-19	21.78	15.55	1.51	4.91	1.15	1.24	5.00	Not Detected	51.45
6.2	11/08/99	0500	04-1224-20	22.08	15.77	1.48	4.88	1.17	1.18	<5.00	Not Detected	50.83
6.3	11/08/99	0800	04-1224-21	22.61	16.14	1.55	4.88	1.29	1.25	6.00	Not Detected	50.57
6.4	11/08/99	2000	04-1224-22	23.73	16.94	1.59	4.95	1.11	1.75	7.00	Not Detected	49.85
6.5	11/08/99	2300	04-1224-23	24.11	17.21	1.62	4.83	1.04	1.71	6.00	Not Detected	49.23
Average				22.86	16.32	1.55	4.89	1.15	1.43			50.39

Test No.	Date	Time	Analysis Report No.	Parameters								
				Calcium Oxide, CaO	Calcium, Ca	Magnesium, Mg	Sulfite, SO_3	Carbonate, CO_3	Sulfate, SO_4	$CaSO_3 \bullet 1/2H_2O$	$CaSO_4 \bullet 2H_2O$	Acid Insoluble
7.1	11/09/99	0200	04-1224-24	23.58	16.84	1.60	4.75	1.12	1.71	<5.00	Not Detected	49.19
7.2	11/09/99	1700	04-1224-25	24.40	17.42	1.64	5.19	1.28	1.67	7.00	Not Detected	48.38
7.3	11/09/99	2000	04-1224-26	23.73	16.94	1.56	5.32	1.21	1.61	8.00	Not Detected	48.90
7.4	11/09/99	2300	04-1224-27	24.17	17.26	1.59	5.17	1.37	1.79	5.00	Not Detected	48.56
Average				23.97	17.12	1.60	5.11	1.25	1.70			48.76
8.1	11/10/99	1100	04-1224-28	23.70	16.92	1.57	5.67	1.40	1.83	6.00	Not Detected	49.97
8.2	11/10/99	1400	04-1224-29	23.85	17.03	1.60	6.04	1.38	1.76	5.00	Not Detected	47.30
8.3	11/10/99	1700	04-1224-30	24.17	17.26	1.58	5.54	1.34	2.04	<5.00	Not Detected	47.28
8.4	11/10/99	2300	04-1224-31	23.73	16.94	1.53	5.41	1.40	1.91	<5.00	Not Detected	47.59
Average				24.68	17.62	1.5	4.41	1.37	1.59			51.06
9.1	11/11/99	0200	04-1224-32	23.50	16.78	1.59	5.98	1.22	1.88	<5.00	Not Detected	48.00
9.2	11/11/99	0800	04-1224-33	23.99	17.13	1.59	5.65	1.23	2.17	6.00	Not Detected	47.39
9.3	11/11/99	1700	04-1224-34	23.21	16.57	1.51	5.70	1.18	1.93	<5.00	Not Detected	46.99
9.4	11/11/99	2000	04-1224-35	23.12	16.51	1.47	5.69	1.31	2.38	5.00	Not Detected	46.98
9.5	11/11/99	2300	04-1224-36	22.95	16.38	1.52	5.60	1.16	1.84	7.00	Not Detected	48.52
Average				22.56	16.11	1.44	5.1	1.52	1.75			49.93
10.1	11/12/99	0500	04-1224-37	22.58	16.12	1.49	5.38	1.14	1.97	<5.00	Not Detected	48.50
10.2	11/12/99	0800	04-1224-38	23.72	16.94	1.69	5.53	1.08	1.87	7.00	Not Detected	48.46
Average				23.24	16.6	1.53	5.42	1.69	1.69			49.17
11.1	11/13/99	0200	04-1224-39	22.91	16.36	1.53	5.38	1.19	1.92	<5.00	Not Detected	48.73
11.2	11/13/99	0500	04-1224-40	22.89	16.34	1.66	5.52	1.23	1.96	<5.00	Not Detected	49.80
11.3	11/13/99	0800	04-1224-41	22.31	15.93	1.58	5.51	1.14	1.94	<5.00	Not Detected	49.00
11.4	11/13/99	1400	04-1224-42	22.41	16.00	1.59	5.45	1.55	1.95	<5.00	Not Detected	49.25
11.5	11/13/99	1700	04-1224-43	22.35	15.95	1.62	5.41	1.38	2.09	<5.00	Not Detected	49.14
11.6	11/13/99	2000	04-1224-44	22.39	15.98	1.62	5.00	1.24	2.11	5.00	Not Detected	49.39
11.7	11/13/99	2300	04-1224-45	22.23	15.87	1.66	5.24	0.57	1.96	6.00	Not Detected	48.79
Average				21.00	14.99	1.48	4.71	1.08	1.39			53.81
12.1	11/14/99	0200	04-1224-46	22.68	16.19	1.67	4.74	1.08	2.02	<5.00	Not Detected	49.17
12.2	11/14/99	0500	04-1224-47	22.50	16.07	1.64	4.71	1.04	2.07	<5.00	Not Detected	48.77
12.3	11/14/99	0800	04-1224-48	22.15	15.82	1.69	4.99	1.01	2.34	6.00	Not Detected	46.88
12.4	11/14/99	2300	04-1224-49	22.54	16.09	1.64	5.97	0.85	2.46	7.00	Not Detected	45.16
Average				21.66	15.46	1.49	4.79	1.12	1.24			52.05
13.1	11/15/99	0200	04-1224-50	23.67	16.90	1.79	5.68	1.17	2.51	7.00	Not Detected	43.76

Test No.	Date	Time	Analysis Report No.	Parameters								
				Calcium Oxide, CaO	Calcium, Ca	Magnesium, Mg	Sulfite, SO_3	Carbonate, CO_3	Sulfate, SO_4	$CaSO_3 \bullet 1/2H_2O$	$CaSO_4 \bullet 2H_2O$	Acid Insoluble
13.2	11/15/99	0500	04-1224-51	22.57	16.11	1.69	6.79	1.13	2.60	<5.00	Not Detected	44.62
Average				23.49	16.77	1.59	4.86	1.1	1.57			49.81

Test No.	Date	Time	Analysis Report No.	Parameters								
				Calcium Oxide, CaO	Calcium, Ca	Magnesium, Mg	Sulfite, SO_3	Carbonate, CO_3	Sulfate, SO_4	$CaSO_3 \bullet 1/2H_2O$	$CaSO_4 \bullet 2H_2O$	Acid Insoluble
8.1	11/10/99	1100	04-1224-28	23.70	16.92	1.57	5.67	1.40	1.83	6.00	Not Detected	49.97
8.2	11/10/99	1400	04-1224-29	23.85	17.03	1.60	6.04	1.38	1.76	5.00	Not Detected	47.30
8.3	11/10/99	1700	04-1224-30	24.17	17.26	1.58	5.54	1.34	2.04	<5.00	Not Detected	47.28
8.4	11/10/99	2300	04-1224-31	23.73	16.94	1.53	5.41	1.40	1.91	<5.00	Not Detected	47.59
Average				23.86	17.04	1.57	5.67	1.38	1.89			48.04
9.1	11/11/99	0200	04-1224-32	23.50	16.78	1.59	5.98	1.22	1.88	<5.00	Not Detected	48.00
9.2	11/11/99	0800	04-1224-33	23.99	17.13	1.59	5.65	1.23	2.17	6.00	Not Detected	47.39
9.3	11/11/99	1700	04-1224-34	23.21	16.57	1.51	5.70	1.18	1.93	<5.00	Not Detected	46.99
9.4	11/11/99	2000	04-1224-35	23.12	16.51	1.47	5.69	1.31	2.38	5.00	Not Detected	46.98
9.5	11/11/99	2300	04-1224-36	22.95	16.38	1.52	5.60	1.16	1.84	7.00	Not Detected	48.52
Average				23.35	16.67	1.54	5.72	1.22	2.04			47.58
10.1	11/12/99	0500	04-1224-37	22.58	16.12	1.49	5.38	1.14	1.97	<5.00	Not Detected	48.50
10.2	11/12/99	0800	04-1224-38	23.72	16.94	1.69	5.53	1.08	1.87	7.00	Not Detected	48.46
Average				23.15	16.53	1.59	5.46	1.11	1.92			48.48
11.1	11/13/99	0200	04-1224-39	22.91	16.36	1.53	5.38	1.19	1.92	<5.00	Not Detected	48.73
11.2	11/13/99	0500	04-1224-40	22.89	16.34	1.66	5.52	1.23	1.96	<5.00	Not Detected	49.80
11.3	11/13/99	0800	04-1224-41	22.31	15.93	1.58	5.51	1.14	1.94	<5.00	Not Detected	49.00
11.4	11/13/99	1400	04-1224-42	22.41	16.00	1.59	5.45	1.55	1.95	<5.00	Not Detected	49.25
11.5	11/13/99	1700	04-1224-43	22.35	15.95	1.62	5.41	1.38	2.09	<5.00	Not Detected	49.14
11.6	11/13/99	2000	04-1224-44	22.39	15.98	1.62	5.00	1.24	2.11	5.00	Not Detected	49.39
11.7	11/13/99	2300	04-1224-45	22.23	15.87	1.66	5.24	0.57	1.96	6.00	Not Detected	48.79
Average				22.50	16.06	1.61	5.36	1.19	1.99			49.16
12.1	11/14/99	0200	04-1224-46	22.68	16.19	1.67	4.74	1.08	2.02	<5.00	Not Detected	49.17
12.2	11/14/99	0500	04-1224-47	22.50	16.07	1.64	4.71	1.04	2.07	<5.00	Not Detected	48.77
12.3	11/14/99	0800	04-1224-48	22.15	15.82	1.69	4.99	1.01	2.34	6.00	Not Detected	46.88
12.4	11/14/99	2300	04-1224-49	22.54	16.09	1.64	5.97	0.85	2.46	7.00	Not Detected	45.16
Average				22.47	16.04	1.66	5.10	1.00	2.22			47.50
13.1	11/15/99	0200	04-1224-50	23.67	16.90	1.79	5.68	1.17	2.51	7.00	Not Detected	43.76
13.2	11/15/99	0500	04-1224-51	22.57	16.11	1.69	6.79	1.13	2.60	<5.00	Not Detected	44.62
Average				23.12	16.51	1.74	6.24	1.15	2.56			44.19