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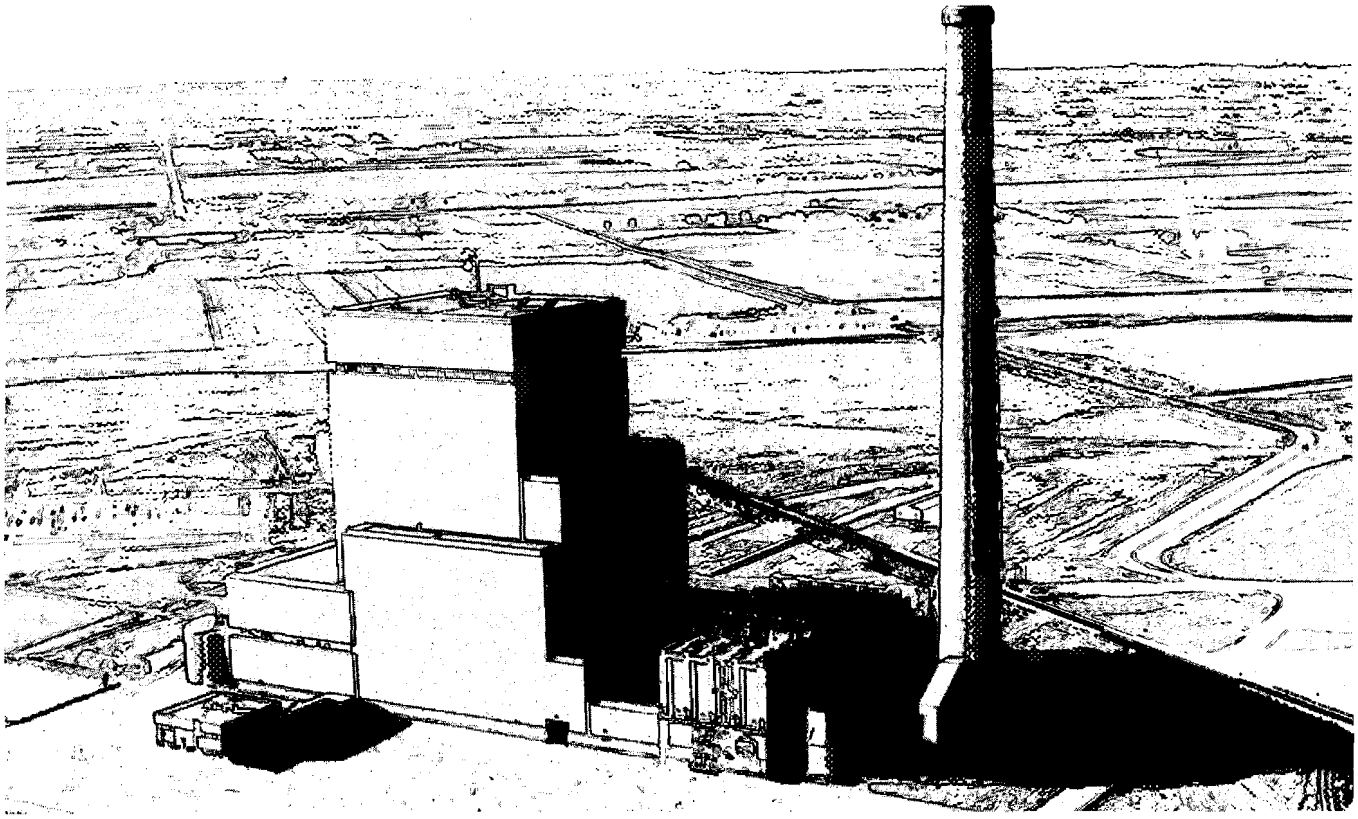
Results of Combustion and Emissions Testing when Co-Firing Blends of Binder-Enhanced Densified Refuse-Derived Fuel (b-dRDF) Pellets and Coal in a 440 MW_e Cyclone Fired Combustor

Volume 2: Field Data and Laboratory Analysis



A Joint Effort

Energy Systems Division
Argonne National Laboratory
Operated by the University of Chicago
for the U.S. Department of Energy
under Contract W-31-109-Eng-38
Author: O. Ohlsson

National Renewable
Energy Laboratory
Managed by Midwest Research Institute
for the U.S. Department of Energy
under Contract DE-AC36-83CH10093
Technical Monitor: Philip B. Shepherd

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Foreword

This report contains the data resulting from the co-firing of b-dRDF pellets and coal in a 440-MW_e cyclone-fired combustor. these tests were conducted under a Collaborative Research and Development Agreement (CRADA). The CRADA partners included the U.S. Department of Energy (DOE), National Renewable Energy Laboratory (NREL), Argonne National Laboratory (ANL), Otter Tail Power Company, Green Isle Environmental, Inc., XL Recycling Corporation, and Marblehead Lime Company. The report is made up of three volumes. Volume 1 contains a description of the test facility, the test program, test results, and study conclusions and recommendations; Volume 2 contains the field data and laboratory analysis of each individual run; Volume 3 contains other supporting information, along with quality assurance documentation and safety and test plans. With this multi-volume approach, readers can find information at the desired level of detail, depending on individual interest or need.

Contents

Foreword iii

Flue Gas Emissions Data Package 1
- Orsat and Moisture Analyses
- Particulate Loading Determinations 9
- Opacity Determinations 12
- Trace Metals Sampling Data 19
- PCDD/PCDF, PAH and PCB Sampling Data 24
- HCl, Total Chlorine, HF, HBr Determinations 37
- BTX Determinations 46

Ash Residue Analyses 48
- Toxicity Characteristic Leaching Procedure (TCLP) - Bottom Ash 49
- Toxicity Characteristic Leaching Procedure (TCLP) - Economizer Fly Ash 54
- Toxicity Characteristic Leaching Procedure (TCLP) - ESP Fly Ash 57
- Compositional Analysis - Bottom Ash 64
- Compositional Analysis - Economizer Fly Ash 67
- Compositional Analysis - ESP Fly Ash 70
- Ash Physical Characteristics - Bottom Ash 77
- Ash Physical Characteristics Economizer Fly Ash 82
- Ash Physical Characteristics - ESP Fly Ash 85
- Results of Mineral Ash Analysis - Bottom Ash 92
- Results of Mineral Ash Analysis - ESP Fly Ash 97

Feedstock Analysis 104
- Proximate and Ultimate Analysis - Coal 105
- Proximate and Ultimate Analysis - RDF 111
- Total Chlorine Analysis - Coal and RDF 115
- Trace Metals Analysis - Coal 118
- Trace Metals Analysis - RDF 124
- Eight Point Ash Fusion Analysis - Coal 128
- Eight Point Ash Fusion Analysis - RDF 133

List of Tables

		Page
1.	Results of Orsat and Moisture Analyses - Trace Metals (EPA Methods 3&4)	3
2.	Results of Orsat and Moisture Analyses - PCDD (EPA Methods 3&4)	4
3.	Results of Orsat and Moisture Analyses - Particulates (EPA Methods 3&4)	5
4.	Results of Orsat and Moisture Analyses - Trace Metals (EPA Methods 3&4)	6
5.	Results of Orsat and Moisture Analyses - PCDD (EPA Methods 3&4)	7
6.	Results of Orsat and Moisture Analyses - Particulate (EPA Methods 3&4)	8
7.	Results of Particulate Loading Determinations - (Method 5) Coal only test, 10/26/92	10
8.	Results of Particulate Loading Determinations - (Method 5) Blended fuel test, 10/27/92	11
9.	Results of Opacity Observations (Method 9) - Coal only test, 10/26/92	13
10.	Results of Opacity Observations (Method 9) - Coal only test 10/26/92	14
11.	Results of Opacity Observations (Method 9) - Coal only test	15
12.	Results of Opacity Observations (Method 9) - Blended fuel test	16
13.	Results of Opacity Observations (Method 9) - Blended fuel test	17
14.	Results of Opacity Observations (Method 9) - Blended fuel test	18
15.	Trace Metals Determinations - Coal only test	20
16.	Results of MMM5 Sampling - Coal only test	21
17.	Trace Metals Determinations - Blended fuel test	22
18.	Results of MMM5 Sampling - Blended fuel test	23
19.	Results of PCDD/PCDF Determinations - Coal only test	25
20.	Results of PCDD/PCDF Determinations - Coal only test	26
21.	Results of PCDD/PCDF Determinations - Coal only test	27
22.	Sampling Data for PCDD/PCDF Test - Coal only test	28
23.	Results of PCDD/PCDF Determinations - Blended fuel tests	29

List of Tables (continued)

Page

24. Results of PCDD/PCDF Determinations - Blended fuel tests 30

25. Results of PCDD/PCDF Determinations - Blended fuel tests 31

26. Sampling Data for PCDD/PCDF Test - Blended fuel tests 32

27. PAH Determinations - Coal only test 33

28. PAH Determinations - Coal only test 34

29. PAH Determination - Blended fuel test 35

30. Sampling Data for PAH Test - Blended fuel test 36

31. HCl Determinations - Coal only test 38

32. HCl Determinations - Blended fuel test 39

33. Cl_2 Determinations - Coal only test 40

34. Cl_2 Determinations - Blended fuel test 41

35. HF Determinations - Coal only test 42

36. HF Determinations - Blended fuel test 43

37. HBr Determinations - Coal only test 44

38. HBr Determinations - Blended fuel test 45

39. BTX Calculations - Coal only test 47

40. BTX Calculations - Blended fuel test 47

41. TCLP test, Bottom Ash - Coal only test 50

42. TCLP test, Bottom Ash - Coal only test 51

43. TCLP test, Bottom Ash - Blended fuel test 52

44. TCLP test, Bottom Ash - Blended fuel test 53

45 TCLP test, Economizer Fly Ash - Coal only test 55

46. TCLP test, Ecomomizer Fly Ash - Blended fuel test 56

List of Tables (continued)

Page

47. TCLP test, ESP Fly Ash - Coal only test 58

48. TCLP test, ESP Fly Ash - Coal only test 59

49. TCLP test ESP Fly Ash - Coal only test 60

50. TCLP test, ESP Fly Ash - Blended fuel test 61

51. TCLP test, ESP Fly Ash - Blended fuel test 62

52. TCLP test, ESP fly Ash - Blended fuel test 63

53. Compositional Analysis, Bottom Ash - Coal only test 65

54. Compositional Analysis, Bottom Ash - Blended fuel test 66

55. Compositional Analysis, Economizer Fly Ash - Coal only test 68

56. Compositional Analysis, Economizer Fly Ash - Blended fuel test 69

57. Compositional Analysis, ESP Fly Ash - Coal only test 71

58. Compositional Analysis, ESP Fly Ash - Coal only test 72

59. Compositional Analysis, ESP Fly Ash - Coal only test 73

60. Compositional Analysis, ESP Fly Ash - Blended fuel test 74

61. Compositional Analysis, ESP Fly Ash - Blended fuel test 75

62. Compositional Analysis, ESP Fly Ash - Blended fuel test 76

63 Ash Physical Characteristics, Bottom Ash - Coal only test 78

64. Ash Physical Characteristics, Bottom Ash - Coal only test 79

65. Ash Physical Characteristics, Bottom Ash - Blended fuel test 80

66. Ash Physical Characteristics, Bottom Ash - Blended fuel test 81

67. Ash Physical Characteristics, Economizer Fly Ash - Coal only test 83

68 Ash Physical Characteristics, Economizer Fly Ash - Blended fuel test 84

69. Ash Physical Characteristics, ESP Fly Ash - Coal only test 86

70. Ash Physical Characteristics, ESP Fly Ash - Coal only test 87

List of Tables (continued)

Page

71. Ash Physical Characteristics, ESP Fly Ash - Coal only test 88

72 Ash Physical Characteristics, ESP Fly Ash - Blended fuel test 89

73. Ash Physical Characteristics, ESP Fly Ash - Blended fuel test 90

74. Ash Physical Characteristics, ESP Fly Ash - Blended fuel test 91

75. Mineral Ash Analysis, Bottom Ash - Coal only test 93

76. Mineral Ash Analysis, Bottom Ash - Coal only test 94

77. Mineral Ash Analysis, Bottom Ash - Blended fuel test 95

78. Mineral Ash Analysis, Bottom Ash - Blended fuel test 96

79. Mineral Ash Analysis, ESP Fly Ash - Coal only test 98

80. Mineral Ash Analysis, ESP Fly Ash - Coal only test 99

81. Mineral Ash Analysis, ESP Fly Ash - Coal only test 100

82. Mineral Ash Analysis, ESP Fly Ash - Blended fuel test 101

83. Mineral Ash Analysis, ESP Fly Ash - Blended fuel test 102

84. Mineral Ash Analysis, ESP Fly Ash - Blended fuel test 103

85. Proximate and Ultimate Analysis - Coal 106

86. Proximate and Ultimate Analysis - Coal 107

87. Proximate and Ultimate Analysis - Coal 108

88. Proximate and Ultimate Analysis - Coal 109

89. Proximate and Ultimate Analysis - Coal 110

90. Proximate and Ultimate Analysis - RDF 112

91. Proximate and Ultimate Analysis - RDF 113

92. Proximate and Ultimate Analysis - RDF 114

93. Total Chlorine Analysis - Coal 116

94. Total Chlorine Analysis - RDF 117

List of Tables (concluded)

Page

95. Trace Metals Analysis - Coal, Coal only test 119

96. Trace Metals Analysis - Coal, Blended fuel test 120

97. Trace Metals Analysis - Coal, Blended fuel test 121

98. Trace Metals Analysis - Coal, Blended fuel test 122

99. Trace Metals Analysis - Coal, Blended fuel test 123

100. Trace Metals Analysis - RDF, Blended fuel test 125

101. Trace Metals Analysis - RDF, Blended fuel test 126

102. Trace Metals Analysis - RDF, Blended fuel test 127

103. Eight Point Ash Fusion Temperature, Coal, Coal only test 129

104. Eight Point Ash Fusion Temperature, Coal, Blended fuel test 130

105. Eight Point Ash Fusion Temperature, Coal, Blended fuel test 131

106. Eight Point Ash Fusion Temperature, Coal, Blended fuel test 132

107. Eight Point Ash Fusion Temperature, RDF, Blended fuel test 134

108. Eight Point Ash Fusion Temperature, RDF, Blended fuel test 135

109. Eight Point Ash Fusion Temperature, RDF, Blended fuel test 136

Flue Gas Emissions

Orsat and Moisture Analyses

Test No. 1
No. 1 Boiler Stack
(Trace Metals)

TABLE 1

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Run 1	Run 2	Run 3
Date of run	10-26-92	10-26-92	10-26-92
Dry basis (orsat)			
carbon dioxide.....	12.50	12.60	12.60
oxygen.....	7.90	7.80	7.80
nitrogen.....	79.60	79.60	79.60
Wet basis (orsat)			
carbon dioxide.....	10.75	10.87	10.80
oxygen.....	6.79	6.73	6.69
nitrogen.....	68.43	68.69	68.23
water vapor.....	14.03	13.71	14.29
Dry molecular weight.....	30.32	30.33	30.33
Wet molecular weight.....	28.59	28.64	28.57
Specific gravity.....	0.987	0.989	0.987
Water mass flow.....(LB/HR)	0.00	0.00	0.00
FO	1.040	1.040	1.040

Test No. 2
Boiler Stack
(PCDD)

TABLE 2

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Run 1	Run 2	Run 3
Date of run	10-26-92	10-26-92	10-26-92
Dry basis (orsat)			
carbon dioxide.....	12.60	12.60	12.70
oxygen.....	7.80	7.90	7.80
nitrogen.....	79.60	79.50	79.50
Wet basis (orsat)			
carbon dioxide.....	10.88	10.87	10.96
oxygen.....	6.73	6.82	6.73
nitrogen.....	68.70	68.58	68.60
water vapor.....	13.69	13.73	13.71
Dry molecular weight.....	30.33	30.33	30.34
Wet molecular weight.....	28.64	28.64	28.65
Specific gravity.....	0.989	0.989	0.990
Water mass flow.....(LB/HR)	0.00	0.00	0.00
FO	1.040	1.032	1.031

Test No. 3
No. 1 Boiler Stack

TABLE 3

(Particulate)

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Run 1	Run 2	Run 3
Date of run	10-26-92	10-26-92	10-26-92
Dry basis (orsat)			
carbon dioxide.....	12.60	12.60	10.70
oxygen.....	7.90	7.80	9.40
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	79.50	79.60	79.90
Wet basis (orsat)			
carbon dioxide.....	10.84	10.79	9.23
oxygen.....	6.80	6.68	8.11
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	68.39	68.15	68.93
water vapor.....	13.98	14.38	13.73
Dry molecular weight.....	30.33	30.33	30.09
Wet molecular weight.....	28.61	28.55	28.43
Specific gravity.....	0.988	0.986	0.982
Water mass flow.....(LB/HR)	567503	582227	566393
FO	1.032	1.040	1.075

Test No. 6
No. 1 Boiler Stack

TABLE 4

(Trace Metals)

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Run 1	Run 2	Run 3
Date of run	10-27-92	10-27-92	10-27-92
Dry basis (orsat)			
carbon dioxide.....	12.10	12.10	11.50
oxygen.....	7.80	7.80	8.40
nitrogen.....	80.10	80.10	80.10
Wet basis (orsat)			
carbon dioxide.....	10.45	10.41	9.89
oxygen.....	6.73	6.71	7.23
nitrogen.....	69.15	68.88	68.92
water vapor.....	13.67	14.01	13.96
Dry molecular weight.....	30.25	30.25	30.18
Wet molecular weight.....	28.57	28.53	28.48
Specific gravity.....	0.987	0.986	0.984
Water mass flow.....(LB/HR)	0.00	0.00	0.00
FO	1.083	1.083	1.087

Test No. 7
Boiler Stack
(PCDD)

TABLE 5

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Run 1	Run 2	Run 3
Date of run	10-27-92	10-27-92	10-27-92
Dry basis (orsat)			
carbon dioxide.....	12.10	12.00	11.60
oxygen.....	7.80	7.90	8.40
nitrogen.....	80.10	80.10	80.00
Wet basis (orsat)			
carbon dioxide.....	10.44	10.37	10.06
oxygen.....	6.73	6.82	7.28
nitrogen.....	69.09	69.20	69.38
water vapor.....	13.75	13.61	13.28
Dry molecular weight.....	30.25	30.24	30.19
Wet molecular weight.....	28.56	28.57	28.57
Specific gravity.....	0.987	0.987	0.987
Water mass flow.....(LB/HR)	0.00	0.00	0.00
FO	1.083	1.083	1.078

Test No. 8
No. 1 Boiler Stack
(Particulate)

TABLE 6

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Run 1	Run 2	Run 3
Date of run	10-27-92	10-27-92	10-27-92
Dry basis (orsat)			
carbon dioxide.....	12.00	11.40	11.50
oxygen.....	7.90	8.50	8.40
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	80.10	80.10	80.10
Wet basis (orsat)			
carbon dioxide.....	10.17	9.77	9.81
oxygen.....	6.69	7.28	7.16
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	67.88	68.63	68.30
water vapor.....	15.25	14.32	14.73
Dry molecular weight.....	30.24	30.16	30.18
Wet molecular weight.....	28.37	28.42	28.38
Specific gravity.....	0.980	0.982	0.980
Water mass flow.....(LB/HR)	611399	569802	584006
FO	1.083	1.088	1.087

Particulate Loading Determinations

Test No. 3
No. 1 Boiler Stack TABLE 7

Results of Particulate Loading Determinations-------Method 5

	Run 1	Run 2	Run 3
Date of run	10-26-92	10-26-92	10-26-92
Time run start/end.....(HRS)	930/1040	1105/1220	1255/1412
Static pressure.....(IN.WC)	-1.50	-1.50	-1.50
Cross sectional area (SQ.FT)	458.69	458.69	458.69
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	163.0	160.0	160.0
desiccant.....(GRAMS)	17.0	27.0	19.0
total.....(GRAMS)	180.0	187.0	179.0
Total particulate material..			
.....collected(grams)	0.0226	0.0299	0.0381
Gas meter coefficient.....	1.0000	1.0000	1.0000
Barometric pressure..(IN.HG)	28.71	28.71	28.71
Avg. orif.pres.drop..(IN.WC)	2.71	2.78	2.86
Avg. gas meter temp..(DEF-F)	68.2	75.8	80.0
Volume through gas meter....			
at meter conditions...(CF)	54.10	55.13	56.11
standard conditions.(DSCF)	52.23	52.48	53.01
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.244	.244	.244
Avg.stack gas temp ..(DEG-F)	292	293	296
Volumetric flow rate.....			
actual.....(ACFM)	2157871	2153446	2202878
dry standard.....(DSCFM)	1245124	1235468	1268220
Isokinetic variation.....(%)	98.8	100.1	98.5
Particulate concentration...			
actual.....(GR/ACF)	0.00385	0.00504	0.00638
dry standard.....(GR/DSCF)	0.00668	0.00879	0.01109
Particle mass rate...(LB/HR)	71.253	93.094	120.556
F-factor .....(DSCF/MMBTU)	9590	9590	9590
Emission factor...(LB/MMBTU)	0.015	0.019	0.028

Test No. 8
No. 1 Boiler Stack

TABLE 8

Results of Particulate Loading Determinations-------Method 5

	Run 1	Run 2	Run 3
Date of run	10-27-92	10-27-92	10-27-92
Time run start/end.....(HRS)	930/1037	1100/1215	1240/1359
Static pressure.....(IN.WC)	-1.50	-1.50	-1.50
Cross sectional area (SQ.FT)	458.69	458.69	458.69
Pitot tube coefficient.....	.840	.840	.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	161.0	166.0	158.0
desiccant.....(GRAMS)	37.0	15.0	30.0
total.....(GRAMS)	198.0	181.0	188.0
Total particulate material..			
.....collected(grams)	0.0338	0.0365	0.0459
Gas meter coefficient.....	1.0000	1.0000	1.0000
Barometric pressure..(IN.HG)	28.46	28.46	28.46
Avg. orif.pres.drop..(IN.WC)	2.70	2.67	2.72
Avg. gas meter temp..(DEF-F)	69.0	78.1	82.7
Volume through gas meter....			
at meter conditions...(CF)	54.27	54.36	55.08
standard conditions.(DSCF)	51.86	51.07	51.31
Total sampling time....(MIN)	60.00	60.00	60.00
Nozzle diameter.....(IN)	.244	.244	.244
Avg.stack gas temp ..(DEG-F)	292	298	304
Volumetric flow rate.....			
actual.....(ACFM)	2147256	2148738	2159099
dry standard.....(DSCFM)	1210873	1215524	1205176
Isokinetic variation.....(%)	100.9	99.0	100.3
Particulate concentration...			
actual.....(GR/ACF)	0.00567	0.00624	0.00770
dry standard.....(GR/DSCF)	0.01006	0.01103	0.01380
Particle mass rate...(LB/HR)	104.370	114.905	142.584
F-factor .....(DSCF/MMBTU)	9520	9520	9520
Emission factor...(LB/MMBTU)	0.022	0.025	0.031

Opacity Determinations

Test No. 1
No. 1 Boiler Stack TABLE 9

Results of Opacity Observations ---------- EPA Method 9

PERCENT OPACITY	OPTICAL DENSITY	RELATIVE FREQUENCY (%)
0	0.0000	0.00
5	0.0223	0.00
10	0.0458	75.00
15	0.0706	25.00
20	0.0969	0.00
25	0.1249	0.00
30	0.1549	0.00
35	0.1871	0.00
40	0.2219	0.00
45	0.2596	0.00
50	0.3010	0.00
55	0.3468	0.00
60	0.3979	0.00
65	0.4559	0.00
70	0.5229	0.00
75	0.6021	0.00
80	0.6690	0.00
85	0.8239	0.00
90	1.0000	0.00
95	1.3010	0.00
99	2.0000	0.00

Avg Opac11.25 Avg OD 0.0520 Time average

Observer: Jeff Bergstrom
Cert. Date: 09-01-92
Date of Observation: 10-26-92
Time of Observation: 1300-1306

Test No. 2
No. 1 Boiler Stack TABLE 10

Results of Opacity Observations ---------- EPA Method 9

PERCENT OPACITY	OPTICAL DENSITY	RELATIVE FREQUENCY (%)
0	0.0000	0.00
5	0.0223	0.00
10	0.0458	100.00
15	0.0706	0.00
20	0.0969	0.00
25	0.1249	0.00
30	0.1549	0.00
35	0.1871	0.00
40	0.2219	0.00
45	0.2596	0.00
50	0.3010	0.00
55	0.3468	0.00
60	0.3979	0.00
65	0.4559	0.00
70	0.5229	0.00
75	0.6021	0.00
80	0.6690	0.00
85	0.8239	0.00
90	1.0000	0.00
95	1.3010	0.00
99	2.0000	0.00

Avg Opac10.00 Avg OD 0.0458 Time average

Observer: Jeff Bergstrom
Cert. Date: 09-01-92
Date of Observation: 10-26-92
Time of Observation: 1300-1306

Test No. 3
No. 1 Boiler Stack

TABLE 11

Results of Opacity Observations ---------- EPA Method 9

PERCENT OPACITY	OPTICAL DENSITY	RELATIVE FREQUENCY (%)
0	0.0000	0.00
5	0.0223	0.00
10	0.0458	100.00
15	0.0706	0.00
20	0.0969	0.00
25	0.1249	0.00
30	0.1549	0.00
35	0.1871	0.00
40	0.2219	0.00
45	0.2596	0.00
50	0.3010	0.00
55	0.3468	0.00
60	0.3979	0.00
65	0.4559	0.00
70	0.5229	0.00
75	0.6021	0.00
80	0.6690	0.00
85	0.8239	0.00
90	1.0000	0.00
95	1.3010	0.00
99	2.0000	0.00

Avg Opac10.00 Avg OD 0.0458 Time average

Observer: Jeff Bergstrom
Cert. Date: 09-01-92
Date of Observation: 10-26-92
Time of Observation: 1345-1351

Test No. 4
No. 1 Boiler Stack TABLE 12

Results of Opacity Observations ---------- EPA Method 9

PERCENT OPACITY	OPTICAL DENSITY	RELATIVE FREQUENCY (%)
0	0.0000	0.00
5	0.0223	0.00
10	0.0458	100.00
15	0.0706	0.00
20	0.0969	0.00
25	0.1249	0.00
30	0.1549	0.00
35	0.1871	0.00
40	0.2219	0.00
45	0.2596	0.00
50	0.3010	0.00
55	0.3468	0.00
60	0.3979	0.00
65	0.4559	0.00
70	0.5229	0.00
75	0.6021	0.00
80	0.6690	0.00
85	0.8239	0.00
90	1.0000	0.00
95	1.3010	0.00
99	2.0000	0.00

Avg Opac10.00 Avg OD 0.0458 Time average

Observer: Jeff Bergstrom
Cert. Date: 09-01-92
Date of Observation: 10-27-92
Time of Observation: 1100-1106

Test No. 5
No. 1 Boiler Stack TABLE 13

Results of Opacity Observations ---------- EPA Method 9

PERCENT OPACITY	OPTICAL DENSITY	RELATIVE FREQUENCY (%)
0	0.0000	0.00
5	0.0223	0.00
10	0.0458	100.00
15	0.0706	0.00
20	0.0969	0.00
25	0.1249	0.00
30	0.1549	0.00
35	0.1871	0.00
40	0.2219	0.00
45	0.2596	0.00
50	0.3010	0.00
55	0.3468	0.00
60	0.3979	0.00
65	0.4559	0.00
70	0.5229	0.00
75	0.6021	0.00
80	0.6690	0.00
85	0.8239	0.00
90	1.0000	0.00
95	1.3010	0.00
99	2.0000	0.00

Avg Opac10.00 Avg OD 0.0458 Time average

Observer: Jeff Bergstrom
Cert. Date: 09-01-92
Date of Observation: 10-27-92
Time of Observation: 1130-1136

Test No. 6
No. 1 Boiler Stack TABLE 14

Results of Opacity Observations ---------- EPA Method 9

PERCENT OPACITY	OPTICAL DENSITY	RELATIVE FREQUENCY (%)
0	0.0000	0.00
5	0.0223	0.00
10	0.0458	100.00
15	0.0706	0.00
20	0.0969	0.00
25	0.1249	0.00
30	0.1549	0.00
35	0.1871	0.00
40	0.2219	0.00
45	0.2596	0.00
50	0.3010	0.00
55	0.3468	0.00
60	0.3979	0.00
65	0.4559	0.00
70	0.5229	0.00
75	0.6021	0.00
80	0.6690	0.00
85	0.8239	0.00
90	1.0000	0.00
95	1.3010	0.00
99	2.0000	0.00

Avg Opac10.00 Avg OD 0.0458 Time average

Observer: Jeff Bergstrom
Cert. Date: 09-01-92
Date of Observation: 10-27-92
Time of Observation: 1150-1156

Trace Metals Sampling Data

TABLE 15

Summary of the Results of the October 26, 1992 Trace Metals Determinations on the No. 1 Boiler at the Otter Tail Power Big Stone Plant.

Item	Run 1	Run 2	Run 3
(Concentration ug/Nm³)			
Antimony	0.35<	0.34<	0.35<
Arsenic	0.71<	0.68<	0.71<
Barium	5.34	5.58	5.34
Beryllium	0.01<	0.01<	0.01<
Cadmium	0.39	0.34<	0.35<
Chromium	1.20	0.68	0.71
Copper	2.55	2.07	2.16
Lead	0.80	0.77	0.72
Mercury	20.08	18.02	19.60
Nickel	1.45	0.82	0.92
Selenium	8.91	6.80<	3.54<
Silver	0.35<	0.34<	0.35<
Zinc	36.02	26.76	20.88
(Emission rate 10^{-3}LB/HR)			
Antimony	1.640<	1.631<	1.616<
Arsenic	3.281<	3.263<	3.232<
Barium	24.771	26.754	24.402
Beryllium	0.049<	0.049<	0.048<
Cadmium	1.805	1.631<	1.616<
Chromium	5.578	3.263	3.232
Copper	11.811	9.951	9.858
Lead	3.691	3.687	3.297
Mercury	93.179	86.461	89.527
Nickel	6.726	3.915	4.202
Selenium	41.340	32.627<	16.160<
Silver	1.640<	1.631<	1.616<
Zinc	167.165	128.386	95.345

A trailing '<' indicates that the true value is below the detection limit.

Test No. 1
No. 1 Boiler Stack

TABLE 16

Results of Multi-Metal Modified Method 5 (4M5) Sampling.....

	Run 1	Run 2	Run 3
Date of run	10-26-92	10-26-92	10-26-92
Time run start/end.....(HRS)	0930-1146	1234-1445	1530-1739
Static pressure.....(IN.WC)	-1.30	-1.30	-1.30
Cross sectional area (SQ.FT)	458.69	458.69	458.69
Pitot tube coefficient.....	0.840	0.840	0.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	319.0	319.0	308.0
desiccant.....(GRAMS)	27.0	31.0	45.0
total.....(GRAMS)	346.0	364.0	353.0
Gas meter coefficient.....	0.9984	0.9984	0.9984
Barometric pressure..(IN.HG)	28.11	28.71	28.74
Avg. orif.pres.drop..(IN.WC)	2.42	2.56	2.34
Avg. gas meter temp..(DEF-F)	69.6	78.4	83.0
Volume through gas meter....			
at meter conditions...(CF)	106.23	109.91	106.46
standard conditions.(DSCF)	99.93	103.90	99.84
standard conditions..(NM^3)	2.830	2.942	2.827
Total sampling time....(MIN)	120.00	120.00	120.00
Nozzle diameter.....(IN)	.239	.239	.239
Avg.stack gas temp ..(DEG-F)	293	297	308
Volumetric flow rate.....			
actual.....(ACFM)	2195985	2226372	2162775
dry standard.....(DSCFM)	1239616	1281627	1219951
Isokinetic variation.....(%)	99.0	99.5	100.5

TABLE 17

Summary of the Results of the October 27, 1992 Trace Metals Determinations on the No. 1 Boiler at the Otter Tail Power Big Stone Plant.

Item	Run 1	Run 2	Run 3
(Concentration ug/Nm³)			
Antimony	0.34<	0.58<	0.54<
Arsenic	0.69<	1.16<	1.08<
Barium	4.99	22.38	20.01
Beryllium	0.01<	0.02<	0.02<
Cadmium	0.34<	0.58<	0.54<
Chromium	0.79	2.08	1.94
Copper	2.96	5.55	8.50
Lead	0.83	2.23	5.99
Mercury	8.39	20.12	22.75
Nickel	0.45	2.26	1.88
Selenium	6.88<	5.78<	6.45
Silver	0.34<	0.58<	0.54<
Zinc	22.67	52.97	56.95
(Emission rate 10^{-3}LB/HR)			
Antimony	1.620<	2.738<	2.689<
Arsenic	3.240<	5.475<	5.378<
Barium	23.492	105.944	100.036
Beryllium	0.049<	0.082<	0.081<
Cadmium	1.620<	2.738<	2.689<
Chromium	3.726	9.855	9.681
Copper	13.933	26.281	42.489
Lead	3.904	10.567	29.957
Mercury	39.531	95.267	113.751
Nickel	2.106	10.676	9.412
Selenium	32.402<	27.376<	32.270
Silver	1.620<	2.738<	2.689<
Zinc	106.765	250.761	284.781

A trailing '<' indicates that the true value is below the detection limit.

Test No. 6
No. 1 Boiler Stack TABLE 18

Results of Multi-Metal Modified Method 5 (4M5) Sampling.....

	Run 1	Run 2	Run 3
Date of run	10-27-92	10-27-92	10-27-92
Time run start/end.....(HRS)	0930-1141	1220-1432	1505-1717
Static pressure.....(IN.WC)	-1.30	-1.30	-1.30
Cross sectional area (SQ.FT)	458.69	458.69	458.69
Pitot tube coefficient.....	0.840	0.840	0.840
Water in sample gas			
condenser.....(ML)	0.0	0.0	0.0
impingers.....(GRAMS)	316.0	193.0	189.0
desiccant.....(GRAMS)	29.0	18.0	37.0
total.....(GRAMS)	345.0	230.0	226.0
Gas meter coefficient.....	0.9984	0.9984	0.9984
Barometric pressure..(IN.HG)	28.46	28.47	28.47
Avg. orif.pres.drop..(IN.WC)	2.45	0.89	1.02
Avg. gas meter temp..(DEF-F)	64.0	79.6	80.5
Volume through gas meter....			
at meter conditions...(CF)	106.69	65.59	70.62
standard conditions.(DSCF)	102.70	61.09	65.68
standard conditions..(NM^3)	2.908	1.730	1.860
Total sampling time....(MIN)	120.00	120.00	120.00
Nozzle diameter.....(IN)	.239	.184	.184
Avg.stack gas temp ..(DEG-F)	293	305	314
Volumetric flow rate.....			
actual.....(ACFM)	2191977	2247543	2398363
dry standard.....(DSCFM)	1258138	1264532	1335649
Isokinetic variation.....(%)	100.2	100.1	101.9

PCDD/PCDF, PAH and PCB Sampling Data

TABLE 19

Summary of the Results of the October 26, 1992 Dioxin Determinations on the No. 1 Boiler Stack at the OTP Big Stone Plant in Big Stone, South Dakota. (Homolog Analysis)

Homolog	RUN 1	RUN 2	RUN 3
(Concentration ng/Nm³)			
TCDD	.011<	.003<	.011<
PeCDD	.011<	.003<	.011<
HxCDD	.011<	.003<	.011<
HpCDD	.025	.011	.04<
OCDD	.19<	.15	.24
TCDF	.007<	.007	.007<
PeCDF	.007<	.004	.007<
HxCDF	.007<	.007	.011<
HpCDF	.011<	.003<	.011<
OCDF	.018<	.007	.018<
(Emission Rate 10^{-9}g/sec)			
TCDD	.64<	.17<	.64<
PeCDD	.64<	.17<	.64<
HxCDD	.64<	.17<	.64<
HpCDD	1.5	.64	2.4<
OCDD	11<	8.8	14
TCDF	.43<	.43	.43<
PeCDF	.43<	.21	.43<
HxCDF	.43<	.43	.64<
HpCDF	.64<	.19<	.64<
OCDF	1.1<	.43	1.1<

TABLE 20

Summary of the Results of the October 26, 1992 Dioxin Determinations on the No. 1 Boiler Stack at the OTP Big Stone Plant in Big Stone, South Dakota. (2,3,7,8-Isomer Analysis)

Isomer	RUN 1	RUN 2	RUN 3
(Concentration ng/Nm³)			
2,3,7,8-TCDD	.011<	.003<	.011<
1,2,3,7,8-PeCDD	.011<	.003<	.011<
1,2,3,4,7,8-HxCDD	.015<	.004<	.014<
1,2,3,6,7,8-HxCDD	.011<	.002<	.011<
1,2,3,7,8,9-HxCDD	.011<	.003<	.011<
1,2,3,4,6,7,8-HpCDD	.025	.014<	.022<
2,3,7,8-TCDF	.007<	.007	.007<
1,2,3,7,8-PeCDF	.007<	.002<	.007<
2,3,4,7,8-PeCDF	.007<	.002<	.007<
1,2,3,4,7,8-HxCDF	.007<	.002<	.011<
1,2,3,6,7,8-HxCDF	.007<	.002<	.007<
1,2,3,7,8,9-HxCDF	.007<	.007	.011<
2,3,4,6,7,8-HxCDF	.011<	.003<	.011<
1,2,3,4,6,7,8-HpCDF	.007<	.003<	.007<
1,2,3,4,7,8,9-HpCDF	.015<	.003<	.014<
(Emission Rate 10^{-8}g/sec)			
2,3,7,8-TCDD	.64<	.17<	.64<
1,2,3,7,8-PeCDD	.64<	.17<	.64<
1,2,3,4,7,8-HxCDD	.86<	.21<	.86<
1,2,3,6,7,8-HxCDD	.64<	.11<	.64<
1,2,3,7,8,9-HxCDD	.64<	.17<	.64<
1,2,3,4,6,7,8-HpCDD	1.5	.86<	1.3<
2,3,7,8-TCDF	.43<	.43	.43<
1,2,3,7,8-PeCDF	.43<	.11<	.43<
2,3,4,7,8-PeCDF	.43<	.11<	.43<
1,2,3,4,7,8-HxCDF	.43<	.11<	.64<
1,2,3,6,7,8-HxCDF	.43<	.11<	.43<
1,2,3,7,8,9-HxCDF	.43<	.43	.64<
2,3,4,6,7,8-HxCDF	.64<	.17<	.64<
1,2,3,4,6,7,8-HpCDF	.43<	.15<	.43<
1,2,3,4,7,8,9-HpCDF	.86<	.17<	.86<

TABLE 21

Summary of the Results of the October 26, 1992 Dioxin Determinations on the No. 1 Boiler Stack at the OTP Big Stone Plant in Big Stone, South Dakota.

	TEF	2,3,7,8-TCDD Equivalents RUN 1	RUN 2	RUN 3
(Concentration ng/Nm³)				
2,3,7,8-TCDD	1	.011<	.003<	.011<
other TCDDs	.01	0<	0<	0<
2,3,7,8-PeCDD	.5	.005<	.001<	.005<
other PeCDDs	.005	0<	0<	0<
2,3,7,8-HxCDD	.04	.001<	.0003<	.001<
other HxCDDs	.0004	.00001<	.000002<	.00001<
2,3,7,8-HpCDD	.001	.00003	.00001<	.00002<
other HpCDDs	.00001	.000001	1.03E-06<	.0000011<
2,3,7,8-TCDF	.1	.0007<	.0007	.0007<
other TCDFs	.001	.000001<	0	0<
2,3,7,8-PeCDF	.1	.001<	.0004<	.001<
other PeCDFs	.001	.000007<	0<	.000007<
2,3,7,8-HxCDF	.01	.0003<	.0001<	.0004<
other HxCDFs	.0001	.000003<	.0000006<	.000003<
2,3,7,8-HpCDF	.001	.00002<	.000005<	.00002<
other HpCDFs	.00001	.0000001<	.00000002<	.0000001<
Totals		.020<	.006<	.020<
(Emission rate 10^{-8}g/sec)				
2,3,7,8-TCDD	1	.64<	.17<	.64<
other TCDDs	.01	0<	0<	0<
2,3,7,8-PeCDD	.5	.32<	.086<	.32<
other PeCDDs	.005	0<	0<	0<
2,3,7,8-HxCDD	.04	.086<	.02<	.086<
other HxCDDs	.0004	.0006<	.0001<	.0006<
2,3,7,8-HpCDD	.001	.001	.0009<	.001<
other HpCDDs	.00001	0	.000002<	.00001<
2,3,7,8-TCDF	.1	.043<	.043	.043<
other TCDFs	.001	0<	0	0<
2,3,7,8-PeCDF	.1	.086<	.021<	.086<
other PeCDFs	.001	.0004<	0<	.0004<
2,3,7,8-HxCDF	.01	.019<	.008<	.024<
other HxCDFs	.0001	.0001<	.00004<	.0002<
2,3,7,8-HpCDF	.001	.001<	.0003<	.001<
other HpCDFs	.00001	.000002<	.0000004<	.000002<
Totals		1.2<	.35<	1.2<

Toxicity Equivalence Factors (TEFs) used in the calculation of the above TTEs are those currently recommended by 'Iterim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and Dibenzofurans (CDDs and CDFs)' J.S. Bellin and D.G. Barnes, USEPA Risk Assesment Forum, October 1986.

Test No. 2
No. 1 Boiler Stack

TABLE 22

Sampling Data for PCDD and PCDF Test-------SW846 Method 0010

	Run 1	Run 2	Run 3
Date of run	10-26-92	10-26-92	10-26-92
Time run start/end.....(HRS)	930/1145	1225/1435	1515/1730
Static pressure.....(IN.WC)	-1.30	-1.30	-1.30
Cross sectional area (SQ.FT)	458.69	458.69	458.69
Pitot tube coefficient.....	0.840	0.840	0.840
Water in sample gas			
condenser.....(ML)	286.0	304.0	307.0
impingers.....(GRAMS)	0.0	0.0	0.0
desiccant.....(GRAMS)	42.0	29.0	24.0
total.....(GRAMS)	328.0	333.0	331.0
Gas meter coefficient.....	1.0001	1.0001	1.0001
Barometric pressure..(IN.HG)	28.71	28.71	28.71
Avg. orif.pres.drop..(IN.WC)	2.13	2.22	2.21
Avg. gas meter temp..(DEF-F)	64.2	72.4	75.1
Volume through gas meter....			
at meter conditions...(CF)	100.23	102.94	103.04
standard conditions.(DSCF)	97.37	98.49	98.08
standard conditions..(NM^3)	2.757	2.789	2.777
Total sampling time....(MIN)	120.00	120.00	120.00
Nozzle diameter.....(IN)	.234	.234	.234
Avg.stack gas temp ..(DEG-F)	293	297	306
Volumetric flow rate.....			
actual.....(ACFM)	2162852	2199055	2217321
dry standard.....(DSCFM)	1251732	1265532	1260836
Isokinetic variation.....(%)	99.6	99.7	99.6

TABLE 23

Summary of the Results of the October 27, 1992 Dioxin Determinations on the No. 1 Boiler Stack at the OTP Big Stone Plant in Big Stone, South Dakota. (Homolog Analysis)

Homolog	RUN 1	RUN 2	RUN 3
(Concentration ng/Nm³)			
TCDD	.004<	.007<	.011<
PeCDD	.004<	.007<	.014<
HxCDD	.007<	.007<	.018<
HpCDD	.018	.022	.028<
OCDD	.21	.18	.20
TCDF	.004<	.015	.046
PeCDF	.004<	.007	.011<
HxCDF	.007	.007<	.014<
HpCDF	.015	.007<	.018<
OCDF	.026	.011	.035<
(Emission Rate 10^{-8}g/sec)			
TCDD	.21<	.43<	.63<
PeCDD	.21<	.43<	.84<
HxCDD	.43<	.43<	1.1<
HpCDD	1.1	1.3	1.7<
OCDD	12	11	12
TCDF	.21<	.86	2.7
PeCDF	.21<	.43	.63<
HxCDF	.43	.43<	.84<
HpCDF	.85	.43<	1.1<
OCDF	1.5	.64	2.1<

TABLE 24

Summary of the Results of the October 27, 1992 Dioxin Determinations on the No. 1 Boiler Stack at the OTP Big Stone Plant in Big Stone, South Dakota. (2,3,7,8-Isomer Analysis)

Isomer	RUN 1	RUN 2	RUN 3
(Concentration ng/Nm³)			
2,3,7,8-TCDD	.004<	.007<	.011<
1,2,3,7,8-PeCDD	.004<	.007<	.014<
1,2,3,4,7,8-HxCDD	.007<	.007<	.021<
1,2,3,6,7,8-HxCDD	.004<	.007<	.014<
1,2,3,7,8,9-HxCDD	.007<	.007<	.018<
1,2,3,4,6,7,8-HpCDD	.018	.015	.028<
2,3,7,8-TCDF	.004<	.011	.021
1,2,3,7,8-PeCDF	.004<	.007<	.011<
2,3,4,7,8-PeCDF	.004<	.004<	.011<
1,2,3,4,7,8-HxCDF	.007	.007<	.014<
1,2,3,6,7,8-HxCDF	.004<	.004<	.011<
1,2,3,7,8,9-HxCDF	.007<	.007<	.014<
2,3,4,6,7,8-HxCDF	.007<	.007<	.018<
1,2,3,4,6,7,8-HpCDF	.011	.004<	.014<
1,2,3,4,7,8,9-HpCDF	.007	.007<	.025<
(Emission Rate 10^{-8}g/sec)			
2,3,7,8-TCDD	.21<	.43<	.63<
1,2,3,7,8-PeCDD	.21<	.43<	.84<
1,2,3,4,7,8-HxCDD	.43<	.43<	1.3<
1,2,3,6,7,8-HxCDD	.21<	.43<	.84<
1,2,3,7,8,9-HxCDD	.43<	.43<	1.1<
1,2,3,4,6,7,8-HpCDD	1.1	.86	1.7<
2,3,7,8-TCDF	.21<	.64	1.3
1,2,3,7,8-PeCDF	.21<	.43<	.63<
2,3,4,7,8-PeCDF	.21<	.21<	.63<
1,2,3,4,7,8-HxCDF	.43	.43<	.84<
1,2,3,6,7,8-HxCDF	.21<	.21<	.63<
1,2,3,7,8,9-HxCDF	.43<	.43<	.84<
2,3,4,6,7,8-HxCDF	.43<	.43<	1.1<
1,2,3,4,6,7,8-HpCDF	.64	.21<	.84<
1,2,3,4,7,8,9-HpCDF	.43<	.43<	1.5<

TABLE 25

Summary of the Results of the October 27, 1992 Dioxin Determinations on the No. 1 Boiler Stack at the OTP Big Stone Plant in Big Stone, South Dakota.

	TEF	2,3,7,8-TCDD Equivalents RUN 1	RUN 2	RUN 3
(Concentration ng/Nm³)				
2,3,7,8-TCDD	1	.004<	.007<	.011<
other TCDDs	.01	0<	0<	0<
2,3,7,8-PeCDD	.5	.002<	.004<	.007<
other PeCDDs	.005	0<	0<	0<
2,3,7,8-HxCDD	.04	.0007<	.0009<	.002<
other HxCDDs	.0004	.000004<	.000006<	.00001<
2,3,7,8-HpCDD	.001	.00002	.00001	.00003<
other HpCDDs	.00001	0	.00000007	.000001<
2,3,7,8-TCDF	.1	.0004<	.001	.002
other TCDFs	.001	0<	.000004	.00002
2,3,7,8-PeCDF	.1	.0007<	.001<	.002<
other PeCDFs	.001	.000004<	.000004<	.00001<
2,3,7,8-HxCDF	.01	.0003<	.0003<	.0006<
other HxCDFs	.0001	.000002<	.000002<	.000004<
2,3,7,8-HpCDF	.001	.00002<	.00001<	.00004<
other HpCDFs	.00001	1.03E-06<	1.03E-06<	.0000002<
Totals		.008<	.014<	.025<
(Emission rate 10^{-8}g/sec)				
2,3,7,8-TCDD	1	.21<	.43<	.63<
other TCDDs	.01	0<	0<	0<
2,3,7,8-PeCDD	.5	.11<	.21<	.42<
other PeCDDs	.005	0<	0<	0<
2,3,7,8-HxCDD	.04	.043<	.052<	.13<
other HxCDDs	.0004	.0003<	.0003<	.0008<
2,3,7,8-HpCDD	.001	.001	.0009	.002<
other HpCDDs	.00001	0	.000004	0<
2,3,7,8-TCDF	.1	.021<	.064	.13
other TCDFs	.001	0<	.0002	.001
2,3,7,8-PeCDF	.1	.043<	.064<	.13<
other PeCDFs	.001	.0002<	.0002<	.0006<
2,3,7,8-HxCDF	.01	.015<	.015<	.034<
other HxCDFs	.0001	.0001<	.0001<	.0003<
2,3,7,8-HpCDF	.001	.001<	.0006<	.002<
other HpCDFs	.00001	.000002<	.000002<	.000002<
Totals		.44<	.84<	1.5<

Toxicity Equivalence Factors (TEFs) used in the calculation of the above TTEs are those currently recommended by 'Iterim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and Dibenzofurans (CDDs and CDFs)' J.S. Bellin and D.G. Barnes, USEPA Risk Assesment Forum, October 1986.

Test No. 7
No. 1 Boiler Stack

TABLE 26

Sampling Data for PCDD and PCDF Test-------SW846 Method 0010

	Run 1	Run 2	Run 3
Date of run	10-27-92	10-27-92	10-27-92
Time run start/end.....(HRS)	930/1137	1245/1451	1530/1735
Static pressure.....(IN.WC)	-1.30	-1.30	-1.30
Cross sectional area (SQ.FT)	458.69	458.69	458.69
Pitot tube coefficient.....	0.840	0.840	0.840
Water in sample gas			
condenser.....(ML)	300.0	302.0	301.0
impingers.....(GRAMS)	0.0	0.0	0.0
desiccant.....(GRAMS)	27.0	23.0	25.0
total.....(GRAMS)	327.0	325.0	326.0
Gas meter coefficient.....	1.0001	1.0001	1.0001
Barometric pressure..(IN.HG)	28.71	28.46	28.47
Avg. orif.pres.drop..(IN.WC)	2.08	2.19	2.33
Avg. gas meter temp..(DEF-F)	64.6	75.0	77.1
Volume through gas meter....			
at meter conditions...(CF)	99.50	102.88	106.58
standard conditions.(DSCF)	96.58	97.10	100.27
standard conditions..(NM^3)	2.735	2.749	2.839
Total sampling time....(MIN)	120.00	120.00	120.00
Nozzle diameter.....(IN)	.234	.234	.234
Avg.stack gas temp ..(DEG-F)	296	310	316
Volumetric flow rate.....			
actual.....(ACFM)	2149904	2230474	2261591
dry standard.....(DSCFM)	1238918	1252714	1264999
Isokinetic variation.....(%)	99.8	99.3	101.5

TABLE 27

Summary of the Results of the October 26, 1992 PAH Determinations on the Boiler Stack at the Otter Tail Power Big Stone Plant in Big Stone, South Dakota.

Item	RUN 1	RUN 2	RUN 3
(Concentration ug/Nm³)			
Naphthalene	1.9	.47	1.9
Acenaphthylene	.032<	.032<	.032<
Acenaphthene	.036<	.036<	.036<
Fluorene	.036<	.036<	.036<
Phenanthrene	.13	.19	.13
Anthracene	.029<	.029<	.029<
Fluoranthene	.044<	.043<	.043<
Pyrene	.054<	.054<	.054<
Benzo-a-anthracene	.065<	.065<	.065<
Chrysene	.033<	.033<	.033<
Benzo-b-fluoranthene	.036<	.036<	.036<
Benzo-k-fluoranthene	.062<	.061<	.061<
Benzo-a-pyrene	.044<	.043<	.043<
Dibenzo-a,h-anthracene	.032<	.032<	.032<
Benzo-g,h,i-perylene	.044<	.043<	.043<
Indeno,1,2,3-pyrene	.033<	.033<	.033<
(Emission Rate 10^{-8}g/sec)			
Naphthalene	1110	278	1110
Acenaphthylene	19<	19<	19<
Acenaphthene	21<	21<	21<
Fluorene	21<	21<	21<
Phenanthrene	77	111	77
Anthracene	17<	17<	17<
Fluoranthene	26<	26<	26<
Pyrene	32<	32<	32<
Benzo-a-anthracene	39<	39<	39<
Chrysene	20<	20<	20<
Benzo-b-fluoranthene	21<	21<	21<
Benzo-k-fluoranthene	36<	36<	36<
Benzo-a-pyrene	26<	26<	26<
Dibenzo-a,h-anthracene	19<	19<	19<
Benzo-g,h,i-perylene	26<	26<	26<
Indeno,1,2,3-pyrene	20<	20<	20<

Test No. 2
Boiler Stack

TABLE 28

Sampling Data for PAH Determinations-------SW846 Method 0010

	Run 1	Run 2	Run 3
Date of run	10-26-92	10-26-92	10-26-92
Time run start/end.....(HRS)	930/1145	1225/1435	1515/1730
Static pressure.....(IN.WC)	-1.30	-1.30	-1.30
Cross sectional area (SQ.FT)	458.69	458.69	458.69
Pitot tube coefficient.....	0.840	0.840	0.840
Water in sample gas			
condenser.....(ML)	286.0	304.0	307.0
impingers.....(GRAMS)	0.0	0.0	0.0
desiccant.....(GRAMS)	42.0	29.0	24.0
total.....(GRAMS)	328.0	333.0	331.0
Gas meter coefficient.....	1.0001	1.0001	1.0001
Barometric pressure..(IN.HG)	28.71	28.71	28.71
Avg. orif.pres.drop..(IN.WC)	2.13	2.22	2.21
Avg. gas meter temp..(DEF-F)	64.2	72.4	75.1
Volume through gas meter....			
at meter conditions...(CF)	100.23	102.94	103.04
standard conditions.(DSCF)	97.37	98.49	98.08
standard conditions..(NM^3)	2.757	2.789	2.777
Total sampling time....(MIN)	120.00	120.00	120.00
Nozzle diameter.....(IN)	.234	.234	.234
Avg.stack gas temp ..(DEG-F)	293	297	306
Volumetric flow rate.....			
actual.....(ACFM)	2162852	2199055	2217321
dry standard.....(DSCFM)	1251732	1265532	1260836
Isokinetic variation.....(%)	99.6	99.7	99.6

TABLE 29

Summary of the Results of the October 27, 1992 PAH Determinations on the Boiler Stack at the Otter Tail Power Big Stone Plant in Big Stone, South Dakota.

Item	RUN 1	RUN 2	RUN 3
(Concentration ug/Nm³)			
Naphthalene	3.8	.20	.12
Acenaphthylene	.032<	.032<	.031<
Acenaphthene	.037<	.036<	.035<
Fluorene	.037<	.036<	.035<
Phenanthrene	.11	.069	.078
Anthracene	.029<	.029<	.028<
Fluoranthene	.044<	.044<	.042<
Pyrene	.055<	.055<	.053<
Benzo-a-anthracene	.066<	.065<	.063<
Chrysene	.034<	.033<	.032<
Benzo-b-fluoranthene	.037<	.036<	.035<
Benzo-k-fluoranthene	.062<	.062<	.06<
Benzo-a-pyrene	.044	.044<	.042<
Dibenzo-a,h-anthracene	.032<	.032<	.031<
Benzo-g,h,i-perylene	.044<	.044<	.042<
Indeno,1,2,3-pyrene	.034<	.033<	.032<
(Emission Rate 10^{-6}g/sec)			
Naphthalene	2220	120	71
Acenaphthylene	19<	19<	19<
Acenaphthene	21<	21<	21<
Fluorene	21<	21<	21<
Phenanthrene	66	41	47
Anthracene	17<	17<	17<
Fluoranthene	26<	26<	26<
Pyrene	32<	32<	32<
Benzo-a-anthracene	38<	39<	39<
Chrysene	20<	20<	20<
Benzo-b-fluoranthene	21<	21<	21<
Benzo-k-fluoranthene	36<	37<	36<
Benzo-a-pyrene	26	26<	26<
Dibenzo-a,h-anthracene	19<	19<	19<
Benzo-g,h,i-perylene	26<	26<	26<
Indeno,1,2,3-pyrene	20<	20<	20<

Test No. 7
Boiler Stack

TABLE 30

Sampling Data for PAH Determinations-------SW846 Method 0010

	Run 1	Run 2	Run 3
Date of run	10-27-92	10-27-92	10-27-92
Time run start/end.....(HRS)	930/1137	1245/1451	1530/1735
Static pressure.....(IN.WC)	-1.30	-1.30	-1.30
Cross sectional area (SQ.FT)	458.69	458.69	458.69
Pitot tube coefficient.....	0.840	0.840	0.840
Water in sample gas			
condenser.....(ML)	300.0	302.0	301.0
impingers.....(GRAMS)	0.0	0.0	0.0
desiccant.....(GRAMS)	27.0	23.0	25.0
total.....(GRAMS)	327.0	325.0	326.0
Gas meter coefficient.....	1.0001	1.0001	1.0001
Barometric pressure..(IN.HG)	28.71	28.46	28.46
Avg. orif.pres.drop..(IN.WC)	2.08	2.19	2.33
Avg. gas meter temp..(DEF-F)	64.6	75.0	77.1
Volume through gas meter....			
at meter conditions...(CF)	99.50	102.88	106.58
standard conditions.(DSCF)	96.58	97.10	100.23
standard conditions..(NM^3)	2.735	2.749	2.838
Total sampling time....(MIN)	120.00	120.00	120.00
Nozzle diameter.....(IN)	.234	.234	.234
Avg.stack gas temp ..(DEG-F)	296	310	316
Volumetric flow rate.....			
actual.....(ACFM)	2149785	2230474	2304996
dry standard.....(DSCFM)	1238986	1252714	1288763
Isokinetic variation.....(%)	99.8	99.3	99.6

HCl, Total Chlorine, HF, HBr Determinations

Test No. 4
No. 1 Boiler Stack TABLE 31

Results of HCl Determinations ----------

	Run 1	Run 2	Run 3
Date of run	10-26-92	10-26-92	10-26-92
Time run start/end.....(HRS)	1530-1630	1650-1750	1815-1915
Barometric pressure..(IN.HG)	28.71	28.71	28.71
Meter temperature....(DEG-F)	85.92	101.00	104.67
Meter correction coefficient	0.9939	0.9939	0.9939
Volume through gas meter.... at meter conditions...(CF)	2.332	2.372	2.382
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	14.00	14.00	14.00
Volumetric flow rate (DSCFM)	1240000	1240000	1240000
HCl in sample.....(uG)	408.29	363.04	63.35
HCl concentration.....			
(GR/DSCF).....	0.0029	0.0026	0.0005
(MG/DSCM).....	6.7	6.0	1.1
(PPM-WET).....	3.8	3.4	0.6
(PPM-DRY).....	4.4	4.0	0.7
(PPM-DRY @ 7% O2).....	4.7	4.2	0.7
HCl emission rate....(LB/HR)	31.1	28.0	4.9

HCl = Hydrogen chloride

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 9
No. 1 Boiler Stack TABLE 32

Results of HCl Determinations

	Run 1	Run 2	Run 3
Date of run	10-27-92	10-27-92	10-27-92
Time run start/end.....(HRS)	1413-1513	1534-1634	1657-1757
Barometric pressure..(IN.HG)	28.46	28.46	28.46
Meter temperature....(DEG-F)	84.67	97.50	100.33
Meter correction coefficient	0.9939	0.9939	0.9939
Volume through gas meter.... at meter conditions...(CF)	2.373	2.401	2.419
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	14.75	14.75	14.75
Volumetric flow rate (DSCFM)	1210000	1210000	1210000
HCl in sample.....(uG)	3182.99	3404.11	3239.56
HCl concentration.....			
(GR/DSCF).....	0.0226	0.0244	0.0232
(MG/DSCM).....	51.7	56.0	53.1
(PPM-WET).....	29.1	31.5	29.9
(PPM-DRY).....	34.1	36.9	35.0
(PPM-DRY @ 7% O2).....	37.9	41.0	38.9
HCl emission rate....(LB/HR)	234.2	253.4	240.5

HCl = Hydrogen chloride

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 4
No. 1 Boiler Stack

TABLE 33

Results of Cl2 Determinations ----------

	Run 1	Run 2	Run 3
Date of run	10-26-92	10-26-92	10-26-92
Time run start/end.....(HRS)	1530-1630	1650-1750	1815-1915
Barometric pressure..(IN.HG)	28.71	28.71	28.71
Meter temperature....(DEG-F)	85.92	101.00	104.67
Meter correction coefficient	0.9939	0.9939	0.9939
Volume through gas meter.... at meter conditions...(CF)	2.332	2.372	2.382
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	14.00	14.00	14.00
Volumetric flow rate (DSCFM)	1240000	1240000	1240000
Cl2 in sample.....(uG)	413.43	124.44	120.33
Cl2 concentration.....			
(GR/DSCF).....	0.0030	0.0009	0.0009
(MG/DSCM).....	6.8	2.1	2.0
(PPM-WET).....	2.0	0.6	0.6
(PPM-DRY).....	2.3	0.7	0.7
(PPM-DRY @ 7% O2).....	2.5	0.7	0.7
Cl2 emission rate....(LB/HR)	31.5	9.6	9.3

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 9
No. 1 Boiler Stack TABLE 34

Results of Cl2 Determinations ----------

	Run 1	Run 2	Run 3
Date of run	10-27-92	10-27-92	10-27-92
Time run start/end.....(HRS)	1413-1513	1534-1634	1657-1757
Barometric pressure..(IN.HG)	28.46	28.46	28.46
Meter temperature....(DEG-F)	84.67	97.50	100.33
Meter correction coefficient	0.9939	0.9939	0.9939
Volume through gas meter.... at meter conditions...(CF)	2.373	2.401	2.419
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	14.75	14.75	14.75
Volumetric flow rate (DSCFM)	1210000	1210000	1210000
Cl2 in sample.....(uG)	11.21	18.31	10.28<
Cl2 concentration.....			
(GR/DSCF).....	0.0001	0.0001	0.0001<
(MG/DSCM).....	0.2	0.3	0.2<
(PPM-WET).....	0.1	0.1	0.0<
(PPM-DRY).....	0.1	0.1	0.1<
(PPM-DRY @ 7% O2).....	0.1	0.1	0.1<
Cl2 emission rate....(LB/HR)	0.8	1.4	0.8<

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 4
No. 1 Boiler Stack TABLE 35

Results of HF Determinations ----------

	Run 1	Run 2	Run 3
Date of run	10-26-92	10-26-92	10-26-92
Time run start/end.....(HRS)	1530-1630	1650-1750	1815-1915
Barometric pressure..(IN.HG)	28.71	28.71	28.71
Meter temperature....(DEG-F)	85.92	101.00	104.60
Meter correction coefficient	0.9939	0.9939	0.9939
Volume through gas meter.... at meter conditions...(CF)	2.332	2.372	2.382
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	14.00	14.00	14.00
Volumetric flow rate (DSCFM)	1240000	1240000	1240000
HF in sample.....(uG)	73.71	126.36	55.60
HF concentration.....			
(GR/10^3DSCF).....	0.5287	0.9157	0.4038
(uG/DSCM).....	1210.	2097.	924.80
(PPB-DRY).....	1455.	2521.	1111.
(PPB-WET).....	1251.	2168.	956.08
HF emis. rate....(10^{-3}LB/HR)	5619.05	9731.88	4291.41

HF = Hydrogen fluoride

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 9
No. 1 Boiler Stack TABLE 36

Results of HF Determinations ----------

	Run 1	Run 2	Run 3
Date of run	10-27-92	10-27-92	10-27-92
Time run start/end.....(HRS)	1413-1513	1534-1634	1657-1757
Barometric pressure..(IN.HG)	28.46	28.46	28.46
Meter temperature....(DEG-F)	84.67	97.50	100.33
Meter correction coefficient	0.9939	0.9939	0.9939
Volume through gas meter.... at meter conditions...(CF)	2.373	2.401	2.419
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	14.75	14.75	14.75
Volumetric flow rate (DSCFM)	1210000	1210000	1210000
HF in sample.....(uG)	82.56	115.83	127.41
HF concentration.....			
(GR/10^3DSCF).....	0.5857	0.8313	0.9122
(uG/DSCM).....	1341.	1903.	2089.
(PPB-DRY).....	1612.	2288.	2511.
(PPB-WET).....	1374.	1951.	2141.
HF emis. rate....(10^{-3}LB/HR)	6074.04	8621.33	9460.73

HF = Hydrogen fluoride

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 4
No. 1 Boiler Stack TABLE 37

Results of HBr Determinations ----------

	Run 1	Run 2	Run 3
Date of run	10-26-92	10-26-92	10-26-92
Time run start/end.....(HRS)	1530-1630	1650-1750	1815-1915
Barometric pressure..(IN.HG)	28.71	28.71	28.71
Meter temperature....(DEG-F)	85.92	101.00	104.67
Meter correction coefficient	0.9939	0.9939	0.9939
Volume through gas meter.... at meter conditions...(CF)	2.332	2.372	2.382
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	14.00	14.00	14.00
Volumetric flow rate (DSCFM)	1240000	1240000	1240000
HBr in sample.....(uG)	4.53	4.42	4.32
HBr concentration.....			
(GR/10^3DSCF).....	0.0325	0.0320	0.0314
(uG/DSCM).....	74.38	73.40	71.82
(PPB-DRY).....	22.11	21.82	21.35
(PPB-WET).....	19.02	18.77	18.36
HBr emis. rate...(10^{-3}LB/HR)	345.17	340.62	333.28

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 9
No. 1 Boiler Stack TABLE 38

Results of HBr Determinations ----------

	Run 1	Run 2	Run 3
Date of run	10-27-92	10-27-92	10-27-92
Time run start/end.....(HRS)	1413-1513	1534-1634	1657-1757
Barometric pressure..(IN.HG)	28.46	28.46	28.46
Meter temperature....(DEG-F)	84.67	97.50	100.33
Meter correction coefficient	0.9939	0.9939	0.9939
Volume through gas meter.... at meter conditions...(CF)	2.373	2.401	2.419
Total sampling time....(MIN)	60.0	60.0	60.0
Moisture content.....(%V/V)	14.75	14.75	14.75
Volumetric flow rate (DSCFM)	1210000	1210000	1210000
HBr in sample.....(uG)	22.85	20.43	21.06
HBr concentration.....			
(GR/10^3DSCF).....	0.1621	0.1466	0.1508
(uG/DSCM).....	371.28	335.79	345.34
(PPB-DRY).....	110.38	99.82	102.66
(PPB-WET).....	94.09	85.10	87.52
HBr emis. rate...(10^{-3}LB/HR)	1681.21	1520.49	1563.75

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

BTX Determinations

TABLE 39

BTX Calculation

	Test/Run	Mass (ug)	Vstd (DSCF)	Concentration (ppm.d)	Concentration (LB/DSCF)	Gas Flow (DSCFM)	Mass Rate (LB/HR)
Benzene	5/1	1.5	2.106	0.008	1.57E-09	1240000	0.117
	5/2	1.5	2.08	0.008	1.59E-09	1240000	0.118
	5/3	1.5	2.092	0.008	1.58E-09	1240000	0.118
Toluene	5/1	1.5	2.106	0.007	1.57E-09	1240000	0.117
	5/2	1.5	2.08	0.007	1.59E-09	1240000	0.118
	5/3	1.5	2.092	0.007	1.58E-09	1240000	0.118
Xylene	5/1	1.5	2.106	0.006	1.57E-09	1240000	0.117
	5/2	1.5	2.08	0.006	1.59E-09	1240000	0.118
	5/3	1.5	2.092	0.006	1.58E-09	1240000	0.118

TABLE 40

BTX CALCULATION

	Test/Run	Mass (ug)	Vstd (DSCF)	Concentration (ppm.d)	Concentration (LB/DSCF)	Gas Flow (DSCFM)	Mass Rate (LB/HR)
Benzene	10/1	1.5	2.078	0.008	1.59E-09	1210000	0.116
	10/2	1.5	2.066	0.008	1.6E-09	1210000	0.116
	10/3	1.5	2.054	0.008	1.61E-09	1210000	0.117
Toluene	10/1	1.5	2.078	0.007	1.59E-09	1210000	0.116
	10/2	1.5	2.066	0.007	1.6E-09	1210000	0.116
	10/3	1.5	2.054	0.007	1.61E-09	1210000	0.117
Xylene	10/1	1.5	2.078	0.006	1.59E-09	1210000	0.116
	10/2	1.5	2.066	0.006	1.60E-09	1210000	0.116
	10/3	1.5	2.054	0.006	1.61E-09	1210000	0.117

Ash Residue Analyses

Toxicity Characteristic Leaching Procedure (TCLP) - Bottom Ash

TABLE 41

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-122

Results of Toxicity Characteristic Leaching Procedure

Sample Identification: 10/26/92, 1100 HRS
Sample Type: Bottom Ash

Analyte	Method	Concentration (mg/L)
pH	EPA 150.1	5.0
Alkalinity	EPA 310.1	1540
Total dissolved solids	EPA 160.1	5520
Chloride	EPA 300.0	0.90
Sulfate	EPA 300.0	12
Antimony	SW-846, 6010	< 0.02
Arsenic	SW-846, 7060	< 0.006
Barium	SW-846, 6010	3.64
Beryllium	SW-846, 6010	< 0.02
Cadmium	SW-846, 6010	< 0.02
Chromium	SW-846, 6010	< 0.02
Copper	SW-846, 6010	< 0.02
Lead	SW-846, 6010	0.06
Mercury	SW-846, 7470	<0.0001
Nickel	SW-846, 6010	< 0.02
Selenium	SW-846, 7740	< 0.002
Silver	SW-846, 6010	< 0.02
Thallium	SW-846, 6010	< 8.0
Zinc	SW-846, 6010	0.14

TABLE 42

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-123

Results of Toxicity Characteristic Leaching Procedure

Sample Identification: 10/26/92, 1430 HRS

Sample Type: Bottom Ash

Analyte	Method	Concentration (mg/L)
pH	EPA 150.1	5.0
Alkalinity	EPA 310.1	1520
Total dissolved solids	EPA 160.1	5650
Chloride	EPA 300.0	0.42
Sulfate	EPA 300.0	7.9
Antimony	SW-846, 6010	< 0.2
Arsenic	SW-846, 7060	< 0.006
Barium	SW-846, 6010	5.82
Beryllium	SW-846, 6010	< 0.02
Cadmium	SW-846, 6010	< 0.02
Chromium	SW-846, 6010	< 0.02
Copper	SW-846, 6010	< 0.02
Lead	SW-846, 6010	0.068
Mercury	SW-846, 7470	<0.0001
Nickel	SW-846, 6010	0.034
Selenium	SW-846, 7740	< 0.02
Silver	SW-846, 6010	< 0.02
Thallium	SW-846, 6010	< 8.0
Zinc	SW-846, 6010	0.700

TABLE 43

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-128

Results of Toxicity Characteristic Leaching Procedure

Sample Identification: 10/27/92, 1300 HRS
Sample Type: Bottom Ash

Analyte	Method	Concentration (mg/L)
pH	EPA 150.1	5.1
Alkalinity	EPA 310.1	1440
Total dissolved solids	EPA 160.1	5460
Chloride	EPA 300.0	0.36
Sulfate	EPA 300.0	4.3
Antimony	SW-846, 6010	< 0.2
Arsenic	SW-846, 7060	< 0.006
Barium	SW-846, 6010	3.80
Beryllium	SW-846, 6010	< 0.02
Cadmium	SW-846, 6010	< 0.02
Chromium	SW-846, 6010	< 0.02
Copper	SW-846, 6010	0.09
Lead	SW-846, 6010	< 0.06
Mercury	SW-846, 7470	<0.0001
Nickel	SW-846, 6010	0.04
Selenium	SW-846, 7740	< 0.02
Silver	SW-846, 6010	0.04
Thallium	SW-846, 6010	< 8.0
Zinc	SW-846, 6010	0.13

TABLE 44

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-129

Results of Toxicity Characteristic Leaching Procedure

Sample Identification: 10/27/92, 1600 HRS

Sample Type: Bottom Ash

Analyte	Method	Concentration (mg/L)
pH	EPA 150.1	5.1
Alkalinity	EPA 310.1	1530
Total dissolved solids	EPA 160.1	5760
Chloride	EPA 300.0	0.21
Sulfate	EPA 300.0	78
Antimony	SW-846, 6010	< 0.2
Arsenic	SW-846, 7060	< 0.006
Barium	SW-846, 6010	1.95
Beryllium	SW-846, 6010	< 0.02
Cadmium	SW-846, 6010	< 0.02
Chromium	SW-846, 6010	< 0.02
Copper	SW-846, 6010	0.20
Lead	SW-846, 6010	0.06
Mercury	SW-846, 7470	<0.0001
Nickel	SW-846, 6010	0.05
Selenium	SW-846, 7740	< 0.04
Silver	SW-846, 6010	< 0.02
Thallium	SW-846, 6010	< 8.0
Zinc	SW-846, 6010	0.292

Toxicity Characteristic Leaching Procedure (TCLP) - Economizer Fly Ash

TABLE 45

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-124

Results of Toxicity Characteristic Leaching Procedure

Sample Identification: 10/26/92, 1300-1500 HRS

Sample Type: Economizer Fly Ash

Analyte	Method	Concentration (mg/L)
pH	EPA 150.1	8.9
Alkalinity	EPA 310.1	1540
Total dissolved solids	EPA 160.1	9770
Chloride	EPA 300.0	0.17
Sulfate	EPA 300.0	940
Antimony	SW-846, 6010	< 0.2
Arsenic	SW-846, 7060	0.19
Barium	SW-846, 6010	0.508
Beryllium	SW-846, 6010	< 0.02
Cadmium	SW-846, 6010	< 0.02
Chromium	SW-846, 6010	0.022
Copper	SW-846, 6010	< 0.02
Lead	SW-846, 6010	< 0.06
Mercury	SW-846, 7470	<0.0001
Nickel	SW-846, 6010	0.06
Selenium	SW-846, 7740	< 0.02
Silver	SW-846, 6010	< 0.02
Thallium	SW-846, 6010	< 8.0
Zinc	SW-846, 6010	0.02

TABLE 46

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-132

Results of Toxicity Characteristic Leaching Procedure

Sample Identification: 10/27/92, 1300-1600 HRS
Sample Type: Economizer Fly Ash

Analyte	Method	Concentration (mg/L)
pH	EPA 150.1	7.3
Alkalinity	EPA 310.1	2940
Total dissolved solids	EPA 160.1	9950
Chloride	EPA 300.0	1.3
Sulfate	EPA 300.0	1200
Antimony	SW-846, 6010	< 0.2
Arsenic	SW-846, 7060	0.22
Barium	SW-846, 6010	0.364
Beryllium	SW-846, 6010	< 0.02
Cadmium	SW-846, 6010	< 0.02
Chromium	SW-846, 6010	< 0.02
Copper	SW-846, 6010	0.02
Lead	SW-846, 6010	0.06
Mercury	SW-846, 7470	<0.0001
Nickel	SW-846, 6010	0.18
Selenium	SW-846, 7740	< 0.12
Silver	SW-846, 6010	< 0.02
Thallium	SW-846, 6010	< 8.0
Zinc	SW-846, 6010	0.274

Toxicity Characteristics Leaching Procedure (TCLP) - ESP Fly Ash

TABLE 47

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-125

Results of Toxicity Characteristic Leaching Procedure

Sample Identification: 10/26/92, 0900-1100 HRS

Sample Type: ESP Fly Ash

Analyte	Method	Concentration (mg/L)
pH	EPA 150.1	8.9
Alkalinity	EPA 310.1	3120
Total dissolved solids	EPA 160.1	10600
Chloride	EPA 300.0	0.44
Sulfate	EPA 300.0	1700
Antimony	SW-846, 6010	< 0.2
Arsenic	SW-846, 7060	0.15
Barium	SW-846, 6010	1.04
Beryllium	SW-846, 6010	< 0.02
Cadmium	SW-846, 6010	< 0.02
Chromium	SW-846, 6010	0.158
Copper	SW-846, 6010	< 0.02
Lead	SW-846, 6010	< 0.06
Mercury	SW-846, 7470	0.0002
Nickel	SW-846, 6010	0.03
Selenium	SW-846, 7740	0.3
Silver	SW-846, 6010	< 0.02
Thallium	SW-846, 6010	< 8.0
Zinc	SW-846, 6010	0.02

TABLE 48

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-126

Results of Toxicity Characteristic Leaching Procedure

Sample Identification: 10/26/92, 1300-1500 HRS

Sample Type: ESP Fly Ash

Analyte	Method	Concentration (mg/L)
pH	EPA 150.1	8.9
Alkalinity	EPA 310.1	3160
Total dissolved solids	EPA 160.1	11000
Chloride	EPA 300.0	0.74
Sulfate	EPA 300.0	1700
Antimony	SW-846, 6010	< 0.2
Arsenic	SW-846, 7060	0.12
Barium	SW-846, 6010	1.02
Beryllium	SW-846, 6010	< 0.02
Cadmium	SW-846, 6010	< 0.02
Chromium	SW-846, 6010	0.17
Copper	SW-846, 6010	< 0.02
Lead	SW-846, 6010	< 0.06
Mercury	SW-846, 7470	<0.0001
Nickel	SW-846, 6010	0.03
Selenium	SW-846, 7740	0.52
Silver	SW-846, 6010	< 0.02
Thallium	SW-846, 6010	< 8.0
Zinc	SW-846, 6010	0.02

TABLE 49

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-127

Results of Toxicity Characteristic Leaching Procedure

Sample Identification: 10/26/92, 1500-1800 HRS

Sample Type: ESP Fly Ash

Analyte	Method	Concentration (mg/L)
pH	EPA 150.1	9.0
Alkalinity	EPA 310.1	3320
Total dissolved solids	EPA 160.1	11600
Chloride	EPA 300.0	0.67
Sulfate	EPA 300.0	1600
Antimony	SW-846, 6010	< 0.2
Arsenic	SW-846, 7060	0.14
Barium	SW-846, 6010	0.834
Beryllium	SW-846, 6010	< 0.02
Cadmium	SW-846, 6010	< 0.02
Chromium	SW-846, 6010	0.206
Copper	SW-846, 6010	< 0.02
Lead	SW-846, 6010	< 0.06
Mercury	SW-846, 7470	<0.0001
Nickel	SW-846, 6010	0.04
Selenium	SW-846, 7740	0.536
Silver	SW-846, 6010	< 0.02
Thallium	SW-846, 6010	< 8.0
Zinc	SW-846, 6010	0.03

TABLE 50

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-133

Results of Toxicity Characteristic Leaching Procedure

Sample Identification: 10/27/92, 1000-1300 HRS
Sample Type: ESP Fly Ash

Analyte	Method	Concentration (mg/L)
pH	EPA 150.1	9.1
Alkalinity	EPA 310.1	3180
Total dissolved solids	EPA 160.1	10500
Chloride	EPA 300.0	7.0
Sulfate	EPA 300.0	1500
Antimony	SW-846, 6010	< 0.2
Arsenic	SW-846, 7060	0.13
Barium	SW-846, 6010	1.09
Beryllium	SW-846, 6010	< 0.02
Cadmium	SW-846, 6010	< 0.02
Chromium	SW-846, 6010	0.234
Copper	SW-846, 6010	< 0.02
Lead	SW-846, 6010	< 0.06
Mercury	SW-846, 7470	<0.0001
Nickel	SW-846, 6010	< 0.02
Selenium	SW-846, 7740	0.538
Silver	SW-846, 6010	< 0.02
Thallium	SW-846, 6010	< 8.0
Zinc	SW-846, 6010	< 0.02

TABLE 51

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-134

Results of Toxicity Characteristic Leaching Procedure

Sample Identification: 10/27/92, 1300-1600 HRS
Sample Type: ESP Fly Ash

Analyte	Method	Concentration (mg/L)
pH	EPA 150.1	9.2
Alkalinity	EPA 310.1	3140
Total dissolved solids	EPA 160.1	10600
Chloride	EPA 300.0	16
Sulfate	EPA 300.0	1400
Antimony	SW-846, 6010	0.24
Arsenic	SW-846, 7060	0.099
Barium	SW-846, 6010	1.09
Beryllium	SW-846, 6010	< 0.02
Cadmium	SW-846, 6010	< 0.02
Chromium	SW-846, 6010	0.336
Copper	SW-846, 6010	< 0.02
Lead	SW-846, 6010	< 0.06
Mercury	SW-846, 7470	<0.0001
Nickel	SW-846, 6010	< 0.03
Selenium	SW-846, 7740	0.634
Silver	SW-846, 6010	< 0.02
Thallium	SW-846, 6010	< 8.0
Zinc	SW-846, 6010	< 0.02

TABLE 52

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-135

Results of Toxicity Characteristic Leaching Procedure

Sample Identification: 10/27/92, 1700 HRS
Sample Type: ESP Fly Ash

Analyte	Method	Concentration (mg/L)
pH	EPA 150.1	9.2
Alkalinity	EPA 310.1	3190
Total dissolved solids	EPA 160.1	11000
Chloride	EPA 300.0	17
Sulfate	EPA 300.0	1600
Antimony	SW-846, 6010	0.36
Arsenic	SW-846, 7060	0.083
Barium	SW-846, 6010	1.23
Beryllium	SW-846, 6010	< 0.02
Cadmium	SW-846, 6010	< 0.02
Chromium	SW-846, 6010	0.476
Copper	SW-846, 6010	< 0.02
Lead	SW-846, 6010	< 0.06
Mercury	SW-846, 7470	0.0002
Nickel	SW-846, 6010	< 0.02
Selenium	SW-846, 7740	0.584
Silver	SW-846, 6010	< 0.02
Thallium	SW-846, 6010	< 8.0
Zinc	SW-846, 6010	< 0.02

Compositional Analysis - Bottom Ash

TABLE 53

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-123

Results of Compositional Analysis

Sample Identification: 10/26/92, 1430 HRS

Sample Type: Bottom Ash

Analyte	Method	Concentration (mg/Kg) As Received
Chloride	EPA 300.0	1
Sulfate	EPA 300.0	73
Antimony	SW-846, 6010	9.0
Arsenic	SW-846, 7060	7.8
Barium	SW-846, 6010	4780
Beryllium	SW-846, 6010	2.1
Cadmium	SW-846, 6010	1.8
Chromium	SW-846, 6010	47.6
Copper	SW-846, 6010	270
Lead	SW-846, 6010	19
Mercury	SW-846, 7470	< 0.005
Nickel	SW-846, 6010	23.7
Selenium	SW-846, 7740	< 0.47
Silver	SW-846, 6010	< 0.9
Thallium	SW-846, 6010	< 470
Zinc	SW-846, 6010	76.7

TABLE 54

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-129

Results of Compositional Analysis

Sample Identification: 10/27/92, 1600 HRS
Sample Type: Bottom Ash

Analyte	Method	Concentration (mg/Kg) As Received
Chloride	EPA 300.0	2
Sulfate	EPA 300.0	110
Antimony	SW-846, 6010	11
Arsenic	SW-846, 7060	< 1
Barium	SW-846, 6010	3760
Beryllium	SW-846, 6010	1.9
Cadmium	SW-846, 6010	1.3
Chromium	SW-846, 6010	45.7
Copper	SW-846, 6010	276
Lead	SW-846, 6010	19.7
Mercury	SW-846, 7470	0.024
Nickel	SW-846, 6010	22.9
Selenium	SW-846, 7740	< 0.49
Silver	SW-846, 6010	< 0.9
Thallium	SW-846, 6010	< 490
Zinc	SW-846, 6010	72.3

Compositional Analysis - Economizer Fly Ash

TABLE 55

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-124

Results of Compositional Analysis

Sample Identification: 10/26/92, 1300-1500 HRS
Sample Type: Economizer Fly Ash

Analyte	Method	Concentration (mg/Kg) As Received
Chloride	EPA 300.0	4
Sulfate	EPA 300.0	27000
Antimony	SW-846, 6010	< 6.9
Arsenic	SW-846, 7060	32.1
Barium	SW-846, 6010	5730
Beryllium	SW-846, 6010	2.5
Cadmium	SW-846, 6010	1.7
Chromium	SW-846, 6010	28.9
Copper	SW-846, 6010	36
Lead	SW-846, 6010	22
Mercury	SW-846, 7470	0.017
Nickel	SW-846, 6010	18
Selenium	SW-846, 7740	< 0.49
Silver	SW-846, 6010	< 0.9
Thallium	SW-846, 6010	< 490
Zinc	SW-846, 6010	80.4

TABLE 56

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-132

Results of Compositional Analysis

Sample Identification: 10/27/92, 1300-1600 HRS
Sample Type: Economizer Fly Ash

Analyte	Method	Concentration (mg/Kg) As Received
Chloride	EPA 300.0	19
Sulfate	EPA 300.0	23000
Antimony	SW-846, 6010	16
Arsenic	SW-846, 7060	6.1
Barium	SW-846, 6010	4490
Beryllium	SW-846, 6010	2.3
Cadmium	SW-846, 6010	3.4
Chromium	SW-846, 6010	48.1
Copper	SW-846, 6010	366
Lead	SW-846, 6010	62.8
Mercury	SW-846, 7470	0.018
Nickel	SW-846, 6010	25.9
Selenium	SW-846, 7740	< 0.44
Silver	SW-846, 6010	< 0.88
Thallium	SW-846, 6010	< 440
Zinc	SW-846, 6010	191

Compositional Analysis - ESP Fly Ash

TABLE 57

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-125

Results of Compositional Analysis

Sample Identification: 10/26/92, 0900-1100 HRS

Sample Type: ESP Fly Ash

Analyte	Method	Concentration (mg/Kg) As Received
Chloride	EPA 300.0	9.8
Sulfate	EPA 300.0	29000
Antimony	SW-846, 6010	8.3
Arsenic	SW-846, 7060	2.5
Barium	SW-846, 6010	2880
Beryllium	SW-846, 6010	2.6
Cadmium	SW-846, 6010	1.7
Chromium	SW-846, 6010	30.1
Copper	SW-846, 6010	76.5
Lead	SW-846, 6010	48.4
Mercury	SW-846, 7470	0.168
Nickel	SW-846, 6010	23.5
Selenium	SW-846, 7740	1.6
Silver	SW-846, 6010	< 0.8
Thallium	SW-846, 6010	< 430
Zinc	SW-846, 6010	120

TABLE 58

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-126

Results of Compositional Analysis

Sample Identification: 10/26/92, 1300-1500 HRS

Sample Type: ESP Fly Ash

Analyte	Method	Concentration (mg/Kg) As Received
Chloride	EPA 300.0	19
Sulfate	EPA 300.0	25000
Antimony	SW-846, 6010	7.9
Arsenic	SW-846, 7060	< 19
Barium	SW-846, 6010	477
Beryllium	SW-846, 6010	2.6
Cadmium	SW-846, 6010	1.7
Chromium	SW-846, 6010	29.6
Copper	SW-846, 6010	82.4
Lead	SW-846, 6010	31
Mercury	SW-846, 7470	0.424
Nickel	SW-846, 6010	24.9
Selenium	SW-846, 7740	1.3
Silver	SW-846, 6010	< 0.9
Thallium	SW-846, 6010	< 480
Zinc	SW-846, 6010	101

TABLE 59

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-127

Results of Compositional Analysis

Sample Identification: 10/26/92, 1500-1800 HRS

Sample Type: ESP Fly Ash

Analyte	Method	Concentration (mg/Kg) As Received
Chloride	EPA 300.0	13
Sulfate	EPA 300.0	37000
Antimony	SW-846, 6010	8.1
Arsenic	SW-846, 7060	31.8
Barium	SW-846, 6010	3860
Beryllium	SW-846, 6010	2.3
Cadmium	SW-846, 6010	1.2
Chromium	SW-846, 6010	30.1
Copper	SW-846, 6010	87.9
Lead	SW-846, 6010	66.8
Mercury	SW-846, 7470	0.47
Nickel	SW-846, 6010	25.3
Selenium	SW-846, 7740	0.96
Silver	SW-846, 6010	1.3
Thallium	SW-846, 6010	< 480
Zinc	SW-846, 6010	96.6

TABLE 60

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-133

Results of Compositional Analysis

Sample Identification: 10/27/92, 1000-1300 HRS
Sample Type: ESP Fly Ash

Analyte	Method	Concentration (mg/Kg) As Received
Chloride	EPA 300.0	110
Sulfate	EPA 300.0	44000
Antimony	SW-846, 6010	12
Arsenic	SW-846, 7060	41
Barium	SW-846, 6010	4200
Beryllium	SW-846, 6010	2.4
Cadmium	SW-846, 6010	2.3
Chromium	SW-846, 6010	31.1
Copper	SW-846, 6010	198
Lead	SW-846, 6010	116
Mercury	SW-846, 7470	0.28
Nickel	SW-846, 6010	26.8
Selenium	SW-846, 7740	0.68
Silver	SW-846, 6010	1.2
Thallium	SW-846, 6010	< 490
Zinc	SW-846, 6010	190

TABLE 61

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-134

Results of Compositional Analysis

Sample Identification: 10/27/92, 1300-1600 HRS

Sample Type: ESP Fly Ash

Analyte	Method	Concentration (mg/Kg) As Received
Chloride	EPA 300.0	260
Sulfate	EPA 300.0	41000
Antimony	SW-846, 6010	26
Arsenic	SW-846, 7060	33.5
Barium	SW-846, 6010	1700
Beryllium	SW-846, 6010	2.2
Cadmium	SW-846, 6010	3.7
Chromium	SW-846, 6010	39.0
Copper	SW-846, 6010	398
Lead	SW-846, 6010	153
Mercury	SW-846, 7470	0.337
Nickel	SW-846, 6010	28.6
Selenium	SW-846, 7740	0.71
Silver	SW-846, 6010	3.8
Thallium	SW-846, 6010	< 470
Zinc	SW-846, 6010	420

TABLE 62

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-135

Results of Compositional Analysis

Sample Identification: 10/27/92, 1700 HRS
Sample Type: ESP Fly Ash

Analyte	Method	Concentration (mg/Kg) As Received
Chloride	EPA 300.0	370
Sulfate	EPA 300.0	26000
Antimony	SW-846, 6010	22
Arsenic	SW-846, 7060	33.5
Barium	SW-846, 6010	3220
Beryllium	SW-846, 6010	2.0
Cadmium	SW-846, 6010	5.3
Chromium	SW-846, 6010	41.9
Copper	SW-846, 6010	558
Lead	SW-846, 6010	175
Mercury	SW-846, 7470	0.49
Nickel	SW-846, 6010	29.6
Selenium	SW-846, 7740	0.93
Silver	SW-846, 6010	3.9
Thallium	SW-846, 6010	< 470
Zinc	SW-846, 6010	547

Ash Physical Characteristics - Bottom Ash

TABLE 63

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-122

Ash Physical Characteristics

Sample Identification: 10/26/92, 1100 HRS
Sample Type: Bottom Ash

Analyte	Method	Units	As Received
pH	SW-846, 9045	pH units	8.3
Loss on ignition	ASTM D3174	%	1.08
Moisture	ASTM D3173	%	5.17

TABLE 64

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-123

Ash Physical Characteristics

Sample Identification: 10/26/92, 1430 HRS

Sample Type: Bottom Ash

Analyte	Method	Units	As Received
pH	SW-846, 9045	pH units	8.4
Loss on ignition	ASTM D3174	%	0.92
Moisture	ASTM D3173	%	5.16

TABLE 65

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-128

Ash Physical Characteristics

Sample Identification: 10/27/92, 1300 HRS

Sample Type: Bottom Ash

Analyte	Method	Units	As Received
pH	SW-846, 9045	pH units	9.4
Loss on ignition	ASTM D3174	%	0.98
Moisture	ASTM D3173	%	5.08

TABLE 66

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-129

Ash Physical Characteristics

Sample Identification: 10/27/92, 1600 HRS

Sample Type: Bottom Ash

Analyte	Method	Units	As Received
pH	SW-846, 9045	pH units	8.8
Loss on ignition	ASTM D3174	%	0.96
Moisture	ASTM D3173	%	4.76

Ash Physical Characteristics - Economizer Fly Ash

TABLE 67

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-124

Ash Physical Characteristics

Sample Identification: 10/26/92, 1300-1500 HRS
Sample Type: Economizer Fly Ash

Analyte	Method	Units	As Received
pH	SW-846, 9045	pH units	11.1
Loss on ignition	ASTM D3174	%	0.96
Moisture	ASTM D3173	%	0.08

TABLE 68

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-132

Ash Physical Characteristics

Sample Identification: 10/27/92, 1300-1600 HRS

Sample Type: Economizer Fly Ash

Analyte	Method	Units	As Received
pH	SW-846, 9045	pH units	10.9
Loss on ignition	ASTM D3174	%	1.37
Moisture	ASTM D3173	%	0.05

Ash Physical Characteristics - ESP Fly Ash

TABLE 69

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-125

Ash Physical Characteristics

Sample Identification: 10/26/92, 0900-1100 HRS
Sample Type: ESP Fly Ash

Analyte	Method	Units	As Received
pH	SW-846, 9045	pH units	12.0
Loss on ignition	ASTM D3174	%	0.69
Moisture	ASTM D3173	%	0.09

TABLE 70

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-126

Ash Physical Characteristics

Sample Identification: 10/26/92, 1300-1500 HRS

Sample Type: ESP Fly Ash

Analyte	Method	Units	As Received
pH	SW-846, 9045	pH units	12.2
Loss on ignition	ASTM D3174	%	0.69
Moisture	ASTM D3173	%	0.07

TABLE 71

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-127

Ash Physical Characteristics

Sample Identification: 10/26/92, 1500-1800 HRS
Sample Type: ESP Fly Ash

Analyte	Method	Units	As Received
pH	SW-846, 9045	pH units	12.2
Loss on ignition	ASTM D3174	%	0.69
Moisture	ASTM D3173	%	0.06

TABLE 72

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-133

Ash Physical Characteristics

Sample Identification: 10/27/92, 1000-1300 HRS
Sample Type: ESP Fly Ash

Analyte	Method	Units	As Received
pH	SW-846, 9045	pH units	12.2
Loss on ignition	ASTM D3174	%	0.79
Moisture	ASTM D3173	%	0.06

TABLE 73

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-134

Ash Physical Characteristics

Sample Identification: 10/27/92, 1300-1600 HRS

Sample Type: ESP Fly Ash

Analyte	Method	Units	As Received
pH	SW-846, 9045	pH units	12.2
Loss on ignition	ASTM D3174	%	0.76
Moisture	ASTM D3173	%	0.05

TABLE 74

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-135

Ash Physical Characteristics

Sample Identification: 10/27/92, 1700 HRS

Sample Type: ESP Fly Ash

Analyte	Method	Units	As Received
pH	SW-846, 9045	pH units	12.3
Loss on ignition	ASTM D3174	%	0.56
Moisture	ASTM D3173	%	0.05

Results of Mineral Ash Analysis - Bottom Ash

TABLE 75

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-122

Results of Mineral Ash Analysis[1]

Sample Identification: 10/26/92, 1100 HRS
Sample Type: Bottom Ash

Parameter	% by Weight Ignited Basis	% by Weight As Received
Silica (SiO_2)	33.922	33.556
Alumina (Al_2O_3)	13.593	13.446
Titania (TiO_2)	0.681	0.673
Ferric oxide (Fe_2O_3)	9.492	9.389
Lime (CaO)	22.737	22.492
Magnesia (MgO)	8.195	8.106
Potassium oxide (K_2O)	0.228	0.226
Sodium oxide (Na_2O)	2.336	2.310
Sulfur trioxide (SO_3)	0.85	0.841
Phos. pentoxide (P_2O_5)	0.353	0.349
Manganese oxide (Mn_3O_4)	0.226	0.224
Barium oxide (BaO)	0.720	0.713
Under(over)determined[2]	6.667	
Loss on ignition		1.08

[1]Analyses performed in accordance with ASTM D3682 and D1757 by ICP emission spectrometry.

[2]Under(over)determined in the case of the ignited basis results corresponds to the sum of the determinant errors in the individual analyses of the various reported analyte plus the percent by weight of any minerals in the sample for which an analysis was not performed (a positive value corresponds to underdetermined and a negative value to overdetermined).

TABLE 76

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-123

Results of Mineral Ash Analysis[1]

Sample Identification: 10/26/92, 1430 HRS
Sample Type: Bottom Ash

Parameter	% by Weight Ignited Basis	% by Weight As Received
Silica (SiO_2)	33.550	33.241
Alumina (Al_2O_3)	14.266	14.135
Titania (TiO_2)	0.722	0.715
Ferric oxide (Fe_2O_3)	10.148	10.055
Lime (CaO)	23.303	23.089
Magnesia (MgO)	8.514	8.436
Potassium oxide (K_2O)	0.248	0.245
Sodium oxide (Na_2O)	2.474	2.451
Sulfur trioxide (SO_3)	0.85	0.842
Phos. pentoxide (P_2O_5)	0.369	0.366
Manganese oxide (Mn_3O_4)	0.242	0.239
Barium oxide (BaO)	0.723	0.716
Under(over)determined[2]	4.591	
Loss on ignition		0.92

[1]Analyses performed in accordance with ASTM D3682 and D1757 by ICP emission spectrometry.

[2]Under(over)determined in the case of the ignited basis results corresponds to the sum of the determinant errors in the individual analyses of the various reported analyte plus the percent by weight of any minerals in the sample for which an analysis was not performed (a positive value corresponds to underdetermined and a negative value to overdetermined).

TABLE 77

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-128

Results of Mineral Ash Analysis[1]

Sample Identification: 10/27/92, 1300 HRS
Sample Type: Bottom Ash

Parameter	% by Weight Ignited Basis	% by Weight As Received
Silica (SiO_2)	33.854	33.522
Alumina (Al_2O_3)	14.156	14.018
Titania (TiO_2)	0.956	0.947
Ferric oxide (Fe_2O_3)	9.118	9.029
Lime (CaO)	23.136	22.909
Magnesia (MgO)	7.851	7.774
Potassium oxide (K_2O)	0.235	0.233
Sodium oxide (Na_2O)	2.446	2.422
Sulfur trioxide (SO_3)	0.85	0.842
Phos. pentoxide (P_2O_5)	0.359	0.356
Manganese oxide (Mn_3O_4)	0.245	0.242
Barium oxide (BaO)	0.615	0.609
Under(over)determined[2]	6.179	
Loss on ignition		0.98

[1]Analyses performed in accordance with ASTM D3682 and D1757 by ICP emission spectrometry.

[2]Under(over)determined in the case of the ignited basis results corresponds to the sum of the determinant errors in the individual analyses of the various reported analyte plus the percent by weight of any minerals in the sample for which an analysis was not performed (a positive value corresponds to underdetermined and a negative value to overdetermined).

TABLE 78

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-129

Results of Mineral Ash Analysis[1]

Sample Identification: 10/27/92, 1600 HRS
Sample Type: Bottom Ash

Parameter	% by Weight Ignited Basis	% by Weight As Received
Silica (SiO_2)	34.580	34.248
Alumina (Al_2O_3)	14.694	14.553
Titania (TiO_2)	1.187	1.176
Ferric oxide (Fe_2O_3)	8.820	8.736
Lime (CaO)	22.881	22.661
Magnesia (MgO)	7.434	7.363
Potassium oxide (K_2O)	0.233	0.230
Sodium oxide (Na_2O)	2.555	2.531
Sulfur trioxide (SO_3)	0.85	0.842
Phos. pentoxide (P_2O_5)	0.402	0.398
Manganese oxide (Mn_3O_4)	0.230	0.228
Barium oxide (BaO)	0.589	0.584
Under(over)determined[2]	5.544	
Loss on ignition		0.96

[1]Analyses performed in accordance with ASTM D3682 and D1757 by ICP emission spectrometry.

[2]Under(over)determined in the case of the ignited basis results corresponds to the sum of the determinant errors in the individual analyses of the various reported analyte plus the percent by weight of any minerals in the sample for which an analysis was not performed (a positive value corresponds to underdetermined and a negative value to overdetermined).

Results of Mineral Ash Analysis - ESP Fly Ash

TABLE 79

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-125

Results of Mineral Ash Analysis[1]

Sample Identification: 10/26/92, 0900-1100 HRS
Sample Type: ESP Fly Ash

Parameter	% by Weight Ignited Basis	% by Weight As Received
Silica (SiO_2)	33.113	32.888
Alumina (Al_2O_3)	13.688	13.595
Titania (TiO_2)	0.686	0.681
Ferric oxide (Fe_2O_3)	5.244	5.208
Lime (CaO)	19.903	19.767
Magnesia (MgO)	7.215	7.166
Potassium oxide (K_2O)	0.905	0.899
Sodium oxide (Na_2O)	5.658	5.620
Sulfur trioxide (SO_3)	0.85	0.844
Phos. pentoxide (P_2O_5)	0.388	0.385
Manganese oxide (Mn_3O_4)	0.216	0.215
Barium oxide (BaO)	0.586	0.582
Under(over)determined[2]	11.548	
Loss on ignition		0.68

[1]Analyses performed in accordance with ASTM D3682 and D1757 by ICP emission spectrometry.

[2]Under(over)determined in the case of the ignited basis results corresponds to the sum of the determinant errors in the individual analyses of the various reported analyte plus the percent by weight of any minerals in the sample for which an analysis was not performed (a positive value corresponds to underdetermined and a negative value to overdetermined).

TABLE 80

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-126

Results of Mineral Ash Analysis[1]

Sample Identification: 10/26/92, 1300-1500 HRS
Sample Type: ESP Fly Ash

Parameter	% by Weight Ignited Basis	% by Weight As Received
Silica (SiO_2)	32.813	32.689
Alumina (Al_2O_3)	13.730	13.678
Titania (TiO_2)	0.671	0.669
Ferric oxide (Fe_2O_3)	4.655	4.637
Lime (CaO)	19.614	19.539
Magnesia (MgO)	7.079	7.053
Potassium oxide (K_2O)	1.047	1.043
Sodium oxide (Na_2O)	6.287	6.263
Sulfur trioxide (SO_3)	0.85	0.847
Phos. pentoxide (P_2O_5)	0.366	0.365
Manganese oxide (Mn_3O_4)	0.224	0.223
Barium oxide (BaO)	0.505	0.503
Under(over)determined[2]	12.158	
Loss on ignition		0.38

[1]Analyses performed in accordance with ASTM D3682 and D1757 by ICP emission spectrometry.

[2]Under(over)determined in the case of the ignited basis results corresponds to the sum of the determinant errors in the individual analyses of the various reported analyte plus the percent by weight of any minerals in the sample for which an analysis was not performed (a positive value corresponds to underdetermined and a negative value to overdetermined).

TABLE 81

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-127

Results of Mineral Ash Analysis[1]

Sample Identification: 10/26/92, 1500-1800 HRS
Sample Type: ESP Fly Ash

Parameter	% by Weight Ignited Basis	% by Weight As Received
Silica (SiO_2)	32.923	32.696
Alumina (Al_2O_3)	13.617	13.523
Titania (TiO_2)	0.658	0.653
Ferric oxide (Fe_2O_3)	4.883	4.849
Lime (CaO)	20.291	20.151
Magnesia (MgO)	7.303	7.253
Potassium oxide (K_2O)	0.957	0.950
Sodium oxide (Na_2O)	5.927	5.886
Sulfur trioxide (SO_3)	0.85	0.844
Phos. pentoxide (P_2O_5)	0.387	0.384
Manganese oxide (Mn_3O_4)	0.215	0.213
Barium oxide (BaO)	0.515	0.511
Under(over)determined[2]	11.476	
Loss on ignition		0.69

[1]Analyses performed in accordance with ASTM D3682 and D1757 by ICP emission spectrometry.

[2]Under(over)determined in the case of the ignited basis results corresponds to the sum of the determinant errors in the individual analyses of the various reported analyte plus the percent by weight of any minerals in the sample for which an analysis was not performed (a positive value corresponds to underdetermined and a negative value to overdetermined).

TABLE 82

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-133

Results of Mineral Ash Analysis[1]

Sample Identification: 10/27/92, 1000-1300 HRS
Sample Type: ESP Fly Ash

Parameter	% by Weight Ignited Basis	% by Weight As Received
Silica (SiO_2)	31.306	31.058
Alumina (Al_2O_3)	13.205	13.101
Titania (TiO_2)	0.715	0.709
Ferric oxide (Fe_2O_3)	4.359	4.324
Lime (CaO)	19.808	19.651
Magnesia (MgO)	7.017	6.962
Potassium oxide (K_2O)	1.017	1.009
Sodium oxide (Na_2O)	6.721	6.667
Sulfur trioxide (SO_3)	0.85	0.843
Phos. pentoxide (P_2O_5)	0.388	0.385
Manganese oxide (Mn_3O_4)	0.218	0.216
Barium oxide (BaO)	0.479	0.476
Under(over)determined[2]	13.919	
Loss on ignition		0.79

[1]Analyses performed in accordance with ASTM D3682 and D1757 by ICP emission spectrometry.

[2]Under(over)determined in the case of the ignited basis results corresponds to the sum of the determinant errors in the individual analyses of the various reported analyte plus the percent by weight of any minerals in the sample for which an analysis was not performed (a positive value corresponds to underdetermined and a negative value to overdetermined).

TABLE 83

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-134

Results of Mineral Ash Analysis[1]

Sample Identification: 10/27/92, 1300-1600 HRS
Sample Type: ESP Fly Ash

Parameter	% by Weight Ignited Basis	% by Weight As Received
Silica (SiO_2)	30.778	30.587
Alumina (Al_2O_3)	13.545	13.461
Titania (TiO_2)	0.851	0.846
Ferric oxide (Fe_2O_3)	4.402	4.375
Lime (CaO)	20.451	20.324
Magnesia (MgO)	6.998	6.955
Potassium oxide (K_2O)	1.118	1.111
Sodium oxide (Na_2O)	6.538	6.498
Sulfur trioxide (SO_3)	0.85	0.845
Phos. pentoxide (P_2O_5)	0.411	0.408
Manganese oxide (Mn_3O_4)	0.224	0.223
Barium oxide (BaO)	0.472	0.469
Under(over)determined[2]	13.361	
Loss on ignition		0.62

[1]Analyses performed in accordance with ASTM D3682 and D1757 by ICP emission spectrometry.

[2]Under(over)determined in the case of the ignited basis results corresponds to the sum of the determinant errors in the individual analyses of the various reported analyte plus the percent by weight of any minerals in the sample for which an analysis was not performed (a positive value corresponds to underdetermined and a negative value to overdetermined).

TABLE 84

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-135

Results of Mineral Ash Analysis[1]

Sample Identification: 10/27/92, 1700 HRS
Sample Type: ESP Fly Ash

Parameter	% by Weight Ignited Basis	% by Weight As Received
Silica (SiO_2)	32.281	32.103
Alumina (Al_2O_3)	13.653	13.578
Titania (TiO_2)	0.964	0.958
Ferric oxide (Fe_2O_3)	4.311	4.288
Lime (CaO)	20.241	20.129
Magnesia (MgO)	6.723	6.686
Potassium oxide (K_2O)	1.161	1.154
Sodium oxide (Na_2O)	6.407	6.372
Sulfur trioxide (SO_3)	0.85	0.845
Phos. pentoxide (P_2O_5)	0.387	0.385
Manganese oxide (Mn_3O_4)	0.207	0.206
Barium oxide (BaO)	0.435	0.432
Under(over)determined[2]	12.380	
Loss on ignition		0.55

[1]Analyses performed in accordance with ASTM D3682 and D1757 by ICP emission spectrometry.

[2]Under(over)determined in the case of the ignited basis results corresponds to the sum of the determinant errors in the individual analyses of the various reported analyte plus the percent by weight of any minerals in the sample for which an analysis was not performed (a positive value corresponds to underdetermined and a negative value to overdetermined).

Feedstock Analyses

Proximate and Ultimate Analysis - Coal

INTERPOLL LABORATORIES, INC.
Fuel Laboratory
(612) 786-6020

12/24/92

Client: ARGONNE NATIONAL LABORATORY

Laboratory Log Number: 7328-113-3640

Sample Identification: COAL 1000-1300 HRS 10/26/92

Proximate and Ultimate Analysis WT %

Proximate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			40.73
Ash		16.14	9.57
Volatile Matter	54.90	46.04	27.29
Fixed Carbon (calculation)	45.10	37.82	22.42
Sulfur	1.93	1.62	0.96
Heating Value, BTU/LB.	12444	10435	6185

Ultimate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			40.73
Ash		16.14	9.57
Carbon	73.34	61.50	36.45
Hydrogen	4.06	3.40	2.02
Nitrogen	1.16	0.97	0.58
Oxygen (calculated)	19.50	16.35	9.69
Sulfur	1.93	1.62	0.96

Respectfully submitted,

Jeannie F. O'Neil, Manager
Inorganic Chemistry Group

9586

INTERPOLL LABORATORIES, INC.
Fuel Laboratory
(612) 786-6020

12/24/92

Client: ARGONNE NATIONAL LABORATORY

Laboratory Log Number: 7328-115-3641

Sample Identification: COAL 070-1000 HRS 10/27/92

Proximate and Ultimate Analysis WT %

Proximate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			41.39
Ash		12.69	7.44
Volatile Matter	51.38	44.87	26.30
Fixed Carbon (calculation)	48.62	42.45	24.88
Sulfur	1.49	1.30	0.76
Heating Value, BTU/LB.	12303	10742	6296

Ultimate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			41.39
Ash		12.69	7.44
Carbon	73.29	64.00	37.51
Hydrogen	4.20	3.67	2.15
Nitrogen	1.11	0.97	0.57
Oxygen (calculated)	19.91	17.38	10.19
Sulfur	1.49	1.30	0.76

Respectfully submitted,

Jeannie F. O'Neil, Manager
Inorganic Chemistry Group

9695

TABLE 87

INTERPOLL LABORATORIES, INC.

Fuel Laboratory
(612) 786-6020

12/24/92

Client: ARGONNE NATIONAL LABORATORY

Laboratory Log Number: 7328-116-3642

Sample Identification: COAL 1000-1300 HRS 10/27/92

Proximate and Ultimate Analysis WT %

Proximate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			41.70
Ash		12.36	7.20
Volatile Matter	54.57	47.83	27.88
Fixed Carbon (calculation)	45.43	39.82	23.21
Sulfur	1.42	1.25	0.73
Heating Value, BTU/LB.	12209	10701	6238

Ultimate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			41.70
Ash		12.36	7.20
Carbon	72.92	63.91	37.26
Hydrogen	3.78	3.31	1.93
Nitrogen	1.14	1.00	0.58
Oxygen (calculated)	20.74	18.18	10.60
Sulfur	1.42	1.25	0.73

Respectfully submitted,

Jeannie F. O'Neil, Manager
Inorganic Chemistry Group

9562

TABLE 88

INTERPOLL LABORATORIES, INC.
Fuel Laboratory
(612) 786-6020

12/24/92

Client: ARGONNE NATIONAL LABORATORY

Laboratory Log Number: 7328-117-3643

Sample Identification: COAL 1300-1600 HRS 10/27/92

Proximate and Ultimate Analysis WT %

Proximate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			40.47
Ash		13.83	8.23
Volatile Matter	50.84	43.81	26.08
Fixed Carbon (calculation)	49.16	42.36	25.22
Sulfur	1.52	1.31	0.78
Heating Value, BTU/LB.	12248	10554	6283

Ultimate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			40.47
Ash		13.83	8.23
Carbon	72.98	62.89	37.44
Hydrogen	3.80	3.27	1.95
Nitrogen	1.14	0.98	0.59
Oxygen (calculated)	20.56	17.72	10.55
Sulfur	1.52	1.31	0.78

Respectfully submitted,

Jeannie F. O'Neil

Jeannie F. O'Neil, Manager
Inorganic Chemistry Group

9558

TABLE 89

INTERPOLL LABORATORIES, INC.
Fuel Laboratory
(612) 786-6020

12/24/92

Client: ARGONNE NATIONAL LABORATORY

Laboratory Log Number: 7328-118-3644

Sample Identification: COAL 6:OO PM 10/27/92

Proximate and Ultimate Analysis WT %

Proximate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			41.00
Ash		14.10	8.32
Volatile Matter	55.51	47.69	28.14
Fixed Carbon (calculation)	44.49	38.21	22.55
Sulfur	1.44	1.24	0.73
Heating Value, BTU/LB.	12180	10463	6173

Ultimate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			41.00
Ash		14.10	8.32
Carbon	72.55	62.32	36.77
Hydrogen	3.98	3.42	2.02
Nitrogen	1.13	0.97	0.57
Oxygen (calculated)	20.90	17.95	10.59
Sulfur	1.44	1.24	0.73

Respectfully submitted,

Jeannie F. O'Neil

Jeannie F. O'Neil, Manager
Inorganic Chemistry Group

9594

Proximate and Ultimate Analysis - RDF

INTERPOLL LABORATORIES, INC.
Fuel Laboratory
(612) 786-6020

12/24/92

Client: ARGONNE NATIONAL LABORATORY

Laboratory Log Number: 7328-119-3645

Sample Identification: RDF 0700-1000 HRS 10/27/92

Proximate and Ultimate Analysis WT %

Proximate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			13.11
Ash		13.44	11.67
Volatile Matter	89.88	77.80	67.60
Fixed Carbon (calculation)	10.12	8.76	7.61
Sulfur	0.38	0.33	0.28
Heating Value, BTU/LB.	7134	6176	5366

Ultimate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			13.11
Ash		13.44	11.67
Carbon	53.11	45.97	39.94
Hydrogen	6.66	5.76	5.01
Nitrogen	0.43	0.37	0.33
Oxygen (calculated)	39.43	34.13	29.65
Sulfur	0.38	0.33	0.28

Respectfully submitted,

Jeannie F. O'Neil, Manager
Inorganic Chemistry Group

12282

TABLE 91

INTERPOLL LABORATORIES, INC.
Fuel Laboratory
(612) 786-6020

12/24/92

Client: ARGONNE NATIONAL LABORATORY

Laboratory Log Number: 7328-120-3646

Sample Identification: RDF 1000-1300 HRS 10/27/92

Proximate and Ultimate Analysis WT %

Proximate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			18.43
Ash		14.39	11.74
Volatile Matter	83.46	71.45	58.29
Fixed Carbon (calculation)	16.54	14.16	11.55
Sulfur	0.34	0.29	0.24
Heating Value, BTU/LB.	7749	6634	5412

Ultimate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			18.43
Ash		14.39	11.74
Carbon	49.18	42.10	34.34
Hydrogen	6.23	5.34	4.35
Nitrogen	0.59	0.51	0.41
Oxygen (calculated)	43.66	37.38	30.49
Sulfur	0.34	0.29	0.24

Respectfully submitted,

Jeannie F. O'Neil, Manager
Inorganic Chemistry Group

10081

TABLE 92

INTERPOLL LABORATORIES, INC.
Fuel Laboratory
(612) 786-6020

12/24/92

Client: ARGONNE NATIONAL LABORATORY

Laboratory Log Number: 7328-121-3647

Sample Identification: RDF 6:00 PM 10/27/92

Proximate and Ultimate Analysis WT %

Proximate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			18.80
Ash		15.32	12.44
Volatile Matter	80.38	68.07	55.27
Fixed Carbon (calculation)	19.62	16.62	13.49
Sulfur	0.32	0.28	0.22
Heating Value, BTU/LB.	8638	7315	5940

Ultimate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			18.80
Ash		15.32	12.44
Carbon	49.44	41.87	33.99
Hydrogen	6.14	5.20	4.22
Nitrogen	0.79	0.67	0.54
Oxygen (calculated)	43.31	36.68	29.78
Sulfur	0.32	0.28	0.22

Respectfully submitted,

Jeannie F. O'Neil

Jeannie F. O'Neil, Manager
Inorganic Chemistry Group

9070

Total Chlorine Analysis - Coal and RDF

TABLE 93

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Laboratory Log No. 7328

Results of Total Chlorine Analysis

Sample Type: Coal

Log No.	Sample Identification	Total Chlorine % w/w
7328-113	10/26/92, 1000-1300 HRS	0.008
7328-115	10/27/92, 0700-1000 HRS	0.006
7328-116	10/27/92, 1000-1300 HRS	0.005
7328-117	10/27/92, 1300-1600 HRS	0.006
7328-118	10/27/92, 6:00 PM	0.005

TABLE 94

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Laboratory Log No. 7328

Results of Total Chlorine Analysis

Sample Type: RDF

Log No.	Sample Identification	Total Chlorine % w/w
7328-119	10/27/92, 0700-1000 HRS	0.128
7328-120	10/27/92, 1000-1300 HRS	0.117
7328-121	10/27/92, 6:00 PM	2.16

Trace Metal Analysis - Coal

TABLE 95

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-113

Results of Trace Metals Analysis

Sample Identification: 10/26/92, 1000-1300 HRS

Sample Type: Coal

Metal	Method	Concentration (mg/Kg) As Received
Antimony	SW-846, 6010	< 5.9
Arsenic	SW-846, 7060	3.63
Barium	SW-846, 6010	1090
Beryllium	SW-846, 6010	0.98
Cadmium	SW-846, 6010	< 0.8
Chromium	SW-846, 6010	18
Copper	SW-846, 6010	29
Lead	SW-846, 6010	29
Mercury	SW-846, 7470	0.087
Nickel	SW-846, 6010	11
Selenium	SW-846, 7740	< 0.4
Silver	SW-846, 6010	0.99
Thallium	SW-846, 6010	< 840
Zinc	SW-846, 6010	23

TABLE 96

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-115

Results of Trace Metals Analysis

Sample Identification: 10/27/92, 0700-1000 HRS
Sample Type: Coal

Metal	Method	Concentration (mg/Kg) As Received
Antimony	SW-846, 6010	2.5
Arsenic	SW-846, 7060	0.53
Barium	SW-846, 6010	228
Beryllium	SW-846, 6010	0.99
Cadmium	SW-846, 6010	< 0.3
Chromium	SW-846, 6010	12
Copper	SW-846, 6010	64
Lead	SW-846, 6010	12
Mercury	SW-846, 7470	< 0.005
Nickel	SW-846, 6010	13
Selenium	SW-846, 7740	< 0.3
Silver	SW-846, 6010	< 0.3
Thallium	SW-846, 6010	< 290
Zinc	SW-846, 6010	22.0

TABLE 97

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-116

Results of Trace Metals Analysis

Sample Identification: 10/27/92, 1000-1300 HRS
Sample Type: Coal

Metal	Method	Concentration (mg/Kg) As Received
Antimony	SW-846, 6010	< 3.2
Arsenic	SW-846, 7060	3.1
Barium	SW-846, 6010	853
Beryllium	SW-846, 6010	0.87
Cadmium	SW-846, 6010	0.53
Chromium	SW-846, 6010	26.7
Copper	SW-846, 6010	28.2
Lead	SW-846, 6010	39
Mercury	SW-846, 7470	< 0.005
Nickel	SW-846, 6010	8.5
Selenium	SW-846, 7740	0.47
Silver	SW-846, 6010	0.97
Thallium	SW-846, 6010	< 460
Zinc	SW-846, 6010	123

TABLE 98

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-117

Results of Trace Metals Analysis

Sample Identification: 10/27/92, 1300-1600 HRS
Sample Type: Coal

Metal	Method	Concentration (mg/Kg) As Received
Antimony	SW-846, 6010	< 2.7
Arsenic	SW-846, 7060	3.5
Barium	SW-846, 6010	2800
Beryllium	SW-846, 6010	0.69
Cadmium	SW-846, 6010	< 0.4
Chromium	SW-846, 6010	11
Copper	SW-846, 6010	18
Lead	SW-846, 6010	11
Mercury	SW-846, 7470	< 0.005
Nickel	SW-846, 6010	7
Selenium	SW-846, 7740	< 0.2
Silver	SW-846, 6010	< 0.4
Thallium	SW-846, 6010	< 390
Zinc	SW-846, 6010	9.8

TABLE 99

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-118

Results of Trace Metals Analysis

Sample Identification: 10/27/92, 6:00 PM
Sample Type: Coal

Metal	Method	Concentration (mg/Kg) As Received
Antimony	SW-846, 6010	12
Arsenic	SW-846, 7060	4.3
Barium	SW-846, 6010	273
Beryllium	SW-846, 6010	0.66
Cadmium	SW-846, 6010	1.5
Chromium	SW-846, 6010	12
Copper	SW-846, 6010	15
Lead	SW-846, 6010	206
Mercury	SW-846, 7470	< 0.005
Nickel	SW-846, 6010	6
Selenium	SW-846, 7740	0.23
Silver	SW-846, 6010	< 0.3
Thallium	SW-846, 6010	< 330
Zinc	SW-846, 6010	107

Trace Metal Analysis - RDF

TABLE 100

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-119

Results of Trace Metals Analysis

Sample Identification: 10/27/92, 0700-1000 HRS
Sample Type: RDF

Metal	Method	Concentration (mg/Kg) As Received
Antimony	SW-846, 6010	62
Arsenic	SW-846, 7060	1.5
Barium	SW-846, 6010	108
Beryllium	SW-846, 6010	< 0.17
Cadmium	SW-846, 6010	1.1
Chromium	SW-846, 6010	19.0
Copper	SW-846, 6010	163
Lead	SW-846, 6010	16.8
Mercury	SW-846, 7470	0.107
Nickel	SW-846, 6010	9.6
Selenium	SW-846, 7740	< 0.09
Silver	SW-846, 6010	0.84
Thallium	SW-846, 6010	< 170
Zinc	SW-846, 6010	124

TABLE 101

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-120

Results of Trace Metals Analysis

Sample Identification: 10/27/92, 1000-1300 HRS

Sample Type: RDF

Metal	Method	Concentration (mg/Kg) As Received
Antimony	SW-846, 6010	43
Arsenic	SW-846, 7060	2.27
Barium	SW-846, 6010	173
Beryllium	SW-846, 6010	0.17
Cadmium	SW-846, 6010	1.0
Chromium	SW-846, 6010	34.5
Copper	SW-846, 6010	201
Lead	SW-846, 6010	13
Mercury	SW-846, 7470	0.675
Nickel	SW-846, 6010	10
Selenium	SW-846, 7740	< 0.09
Silver	SW-846, 6010	4.5
Thallium	SW-846, 6010	< 170
Zinc	SW-846, 6010	159

TABLE 102

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-121

Results of Trace Metals Analysis

Sample Identification: 10/27/92, 6:00 PM
Sample Type: RDF

Metal	Method	Concentration (mg/Kg) As Received
Antimony	SW-846, 6010	19
Arsenic	SW-846, 7060	< 0.19
Barium	SW-846, 6010	81.2
Beryllium	SW-846, 6010	< 0.19
Cadmium	SW-846, 6010	1.1
Chromium	SW-846, 6010	26.0
Copper	SW-846, 6010	132
Lead	SW-846, 6010	16
Mercury	SW-846, 7470	0.190
Nickel	SW-846, 6010	10.7
Selenium	SW-846, 7740	< 0.095
Silver	SW-846, 6010	1.3
Thallium	SW-846, 6010	< 190
Zinc	SW-846, 6010	190

Eight Point Ash Fusion Analysis - Coal

TABLE 103

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-113

Results of Eight Point Ash Fusion Analysis

Sample Identification: 10/26/92, 1000-1300 HRS
Sample Type: Coal

	Fusion Temperature of Ash, ^0F	
	Oxidizing Atmosphere	Reducing Atmosphere
Initial Deformation, IT	2163	2100
Softening Temperature, ST	2198	2120
Softening Temperature, HT	2210	2130
Fluid Temperature, FT	2250	2173

TABLE 104

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-116

Results of Eight Point Ash Fusion Analysis

Sample Identification: 10/27/92, 1000-1300 HRS
Sample Type: Coal

	Fusion Temperature of Ash, ^0F	
	Oxidizing Atmosphere	Reducing Atmosphere
Initial Deformation, IT	2151	2113
Softening Temperature, ST	2197	2125
Softening Temperature, HT	2210	2138
Fluid Temperature, FT	2225	2180

TABLE 105

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-117

Results of Eight Point Ash Fusion Analysis

Sample Identification: 10/27/92, 1300-1600 HRS
Sample Type: Coal

	Fusion Temperature of Ash, °F	
	Oxidizing Atmosphere	Reducing Atmosphere
Initial Deformation, IT	2110	2110
Softening Temperature, ST	2163	2143
Softening Temperature, HT	2198	2180
Fluid Temperature, FT	2210	2197

TABLE 106

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-118

Results of Eight Point Ash Fusion Analysis

Sample Identification: 10/27/92, 6:00 PM
Sample Type: Coal

	Fusion Temperature of Ash, °F	
	Oxidizing Atmosphere	Reducing Atmosphere
Initial Deformation, IT	2160	2109
Softening Temperature, ST	2187	2125
Softening Temperature, HT	2205	2143
Fluid Temperature, FT	2220	2190

Eight Point Ash Fusion Analysis - RDF

TABLE 107

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-119

Results of Eight Point Ash Fusion Analysis

Sample Identification: 10/27/92, 0700-1000 HRS
Sample Type: RDF

	Fusion Temperature of Ash, °F	
	Oxidizing Atmosphere	Reducing Atmosphere
Initial Deformation, IT	2321	2300
Softening Temperature, ST	2334	2339
Softening Temperature, HT	2373	2362
Fluid Temperature, FT	2426	2404

TABLE 108

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-120

Results of Eight Point Ash Fusion Analysis

Sample Identification: 10/27/92, 1000-1300 HRS
Sample Type: RDF

	Fusion Temperature of Ash, °F	
	Oxidizing Atmosphere	Reducing Atmosphere
Initial Deformation, IT	2288	2285
Softening Temperature, ST	2304	2334
Softening Temperature, HT	2315	2358
Fluid Temperature, FT	2348	2384

TABLE 109

INTERPOLL LABORATORIES, INC.
(612)786-6020

Argonne National Laboratory,
Big Stone Plant
Sample Log No. 7328-121

Results of Eight Point Ash Fusion Analysis

Sample Identification: 10/27/92, 6:00 PM
Sample Type: RDF

	Fusion Temperature of Ash, °F	
	Oxidizing Atmosphere	Reducing Atmosphere
Initial Deformation, IT	2305	2280
Softening Temperature, ST	2330	2319
Softening Temperature, HT	2369	2350
Fluid Temperature, FT	2408	2395

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This research project characterized the effects of burning a combination of binder-enhanced densified refuse-derived fuel (b-dRDF) pellets and coal in a commercial-scale electrical generating facility. Pelletized b-dRDF has been burned in coal combustors, but only in quantities of less than 3% in large utility systems. This research investigated using b-dRDF in quantities up to 20%. Through this research, project participants gained operating, technical, and economic viability data that will be critical for the near-term commercial use of b-dRDF.

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