Attachment B

Historical RDF Boiler Stack Test Data
2001-2004

Interpoll Laboratories, Inc.
4500 Ball Road N.E.
Circle Pines, Minnesota 55014-1819

TEL: (763) 786-6020
FAX: (763) 786-7854

RESULTS OF THE MAY 26 –JUNE 2, 2004 AIR EMISSION COMPLIANCE TEST ON THE NOS. 1 - 3 BOILERS AT THE GREAT RIVER ENERGY GENERATING STATION IN ELK RIVER, MINNESOTA

Submitted to:

GREAT RIVER ENERGY
17845 Highway 10 East
Elk River, Minnesota 55330

Attention:

Debra Nelson

Reviewed by:

Kathleen Eickstadt
Department Coordinator
Field Services Department

Report Number 4-20232C
August 9, 2004
KE/kce

2 SUMMARY AND DISCUSSION

The results of the air emission compliance tests on the Nos. 1 - 3 Boilers are presented in Tables 1 - 4. An overview of the results is presented in the table below:

PARAMETER		*Limit*	Average
Particulate			
	DRY + ORGANIC WET CATCH		
	(GR/DSCF)	N/A	0.0015
	(GR/DSCF @ 7% O_2)	0.02	0.0018
	(GR/DSCF @ 12% CO_2)	N/A	0.0018
	*(LB/TON RDF)	N/A	0.0419
	DRY CATCH ONLY		
	(GR/DSCF)	N/A	0.0014
	(GR/DSCF @ 7%O_2)	0.012	0.0017
	(GR/DSCF @ 12% CO_2)	N/A	0.0017
	* Based on 53.55 Ton/Hr RDF Feed Rate		
Hydrogen Chloride			
	Inlet		
	(ppm,d)	N/A	453.6
	(ppm,d @ 7%O_2)	N/A	581.7
	Stack		
	(ppm,d)	N/A	1.40
	(ppm,d @7%O_2)	29	1.79
	(LB/HR)	N/A	1.52
	*(LB/TON RDF)	N/A	0.025
REMOVAL EFFICIENCY	(%)	95	99.68

* Based on 60.74 Ton/Hr Feed RDF Feed Rate

PARAMETER		Limit	Average
Trace Metals			
arsenic	(ug/dscm)	N/A	< 0.531
	(ug/dscm @7% O_2)	N/A	< 0.752
	*(LB/TON RDF)	N/A	< 7.84E-06
beryllium	(ug/dscm)	N/A	< 0.212
	(ug/dscm @7% O_2)	N/A	< 0.301
	*(LB/TON RDF)	N/A	< 3.13E-06
cadmium	(ug/dscm)	N/A	0.069
	(ug/dscm @7% O_2)	40	0.099
	*(LB/TON RDF)	N/A	1.03E-06
chromium	(ug/dscm)	N/A	2.044
	(ug/dscm @7% O_2)	N/A	2.896
	*(LB/TON RDF)	N/A	3.020E-05
lead	(ug/dscm)	N/A	0.472
	(ug/dscm @7% O_2)	440	0.669
	*(LB/TON RDF)	N/A	6.97E-06
mercury	(ug/dscm)	N/A	< 0.139
	(ug/dscm @7% O_2)	50	< 0.198
	*(LB/TON RDF)	N/A	< 2.051E-06
nickel	(ug/dscm)	N/A	1.389
	(ug/dscm @7% O_2)	N/A	1.976
	*(LB/TON RDF)	N/A	2.052E-05
selenium	(ug/dscm)	N/A	< 0.531
	(ug/dscm @7% O_2)	N/A	< 0.752
	*(LB/TON RDF)	N/A	< 7.84E-06
Dioxins			
	(ng/dscm@12% CO_2 as 2,3,7,8-TCDD TEF)	N/A	0.144
	(TOTAL ng/dscm @ 7% O_2)	30	5.785
	**(LB/TON RDF)	N/A	5.228E-08

* Based on 45.51 TON/HR RDF
** Based on 60.73 TON/HR RDF

No difficulties were encountered in the field or in the laboratory evaluation of the samples. On the basis of these facts and a complete review of the data and results, it is our opinion that the concentrations and emission rates reported herein are accurate and closely reflect the actual values which existed at the time the tests were performed.

Table 1 Summary of the Results of the May 26, 27-28, 2004 Dioxin Emission Compliance Test on the Boiler Stack at the Great River Energy Facility Located in Elk River, Minnesota.

Item		Run 1	Run 2	Run 3	Average
Date of test		5/26/04	5/27-28/04	05-28-04	
Time runs were done	(Hrs)	0830 / 1235	0959 / 1046	1108 / 1511	
Volumetric Flow					
Actual	(ACFM)	339752	325112	322094	328986
Standard	(DSCFM)	191754	179175	172952	181294
Gas Temperature	(°F)	301	306	321	309
Moisture Content	(%v/v)	15.64	17.04	17.66	16.78
Gas Composition	(%v/v, dry)				
Carbon Dioxide		9.42	10.38	9.90	9.90
Oxygen		10.06	8.87	9.50	9.48
Nitrogen		80.52	80.75	80.60	80.62
Isokinetic Variation	(%)	99.3	101.3	100.4	100.3
Analytical Results					
Mass / Dioxins	(ng/S)	25.860	5.616	26.980	19.81867
Mass/ 2,3,7,8-TCDD TEF	(ng/S)	0.62	0.19	0.68	0.49667
Concentration-Dioxins	(Total ng/dscm @ 7% O2)	7.449	1.801	8.105	5.785
	(2,3,7,8-TCDD TEF ng/dscm @ 12% CO2)	0.1771	0.0518	0.2030	0.144
Mass Rate / Dioxins	(LB/HR)	4.170E-06	1.046E-06	4.310E-06	3.175E-06
Mass Rate / Dioxins	(LB/ton)	6.870E-08	1.723E-08	7.090E-08	5.228E-08

Interpoll Laboratories, Inc.
4500 Ball Road N.E.
Circle Pines, Minnesota 55014-1819

TEL: (763) 786-6020
FAX: (763) 786-7854

RECEIVED JUL 17 2003

RESULTS OF THE JUNE 3-6, 2003 AIR EMISSION COMPLIANCE TEST ON THE NOS. 1 - 3 BOILERS AT THE GREAT RIVER ENERGY GENERATING STATION IN ELK RIVER, MINNESOTA

Submitted to:

GREAT RIVER ENERGY
P.O. Box 800
Elk River, Minnesota 55330-0800

Attention:

Debra Nelson

Reviewed by:

Kathleen Eickstadt
Department Coordinator
Field Services Department

Report Number 3-18846
July 3, 2003
KE/kce

2 SUMMARY AND DISCUSSION

The results of the air emission compliance tests on the Nos. 1 - 3 Boilers are presented in Tables 1 - 4. An overview of the results is presented in the table below:

PARAMETER	*Limit*	Average
Particulate		
DRY + ORGANIC WET CATCH		
.....(GR/DSCF)	N/A	0.0023
.....(GR/DSCF @ 7% O_2)	0.02	0.0029
.....(GR/DSCF @ 12% CO_2)	N/A	0.0026
.....*(LB/TON RDF)	N/A	0.0582
DRY CATCH ONLY		
.....(GR/DSCF)	N/A	0.0019
.....(GR/DSCF @ 7%O_2)	0.012	0.0025
.....(GR/DSCF @ 12% CO_2)	N/A	0.0022

* Based on 54.49 Ton/Hr RDF Feed Rate

Hydrogen Chloride		
Inlet		
.....(ppm,d)	N/A	527.6
.....(ppm,d @ 7%O_2)	N/A	799.22
Stack		
.....(ppm,d)	N/A	0.55
.....(ppm,d @7%O_2)	29	0.89
.....(LB/HR)	N/A	0.49
.....*(LB/TON RDF)	N/A	0.011
REMOVAL EFFICIENCY.....(%)	95	99.89

* Based on 45.28 Ton/Hr Feed RDF Feed Rate

Trace Metals

arsenic	(ug/dscm)	N/A	< 0.482
	(ug/dscm @7% O_2)	N/A	< 0.786
	*(LB/TON RDF)	N/A	< 6.59E-06
beryllium	(ug/dscm)	N/A	< 0.241
	(ug/dscm @7% O_2)	N/A	< 0.393
	*(LB/TON RDF)	N/A	< 3.30E-06
cadmium	(ug/dscm)	N/A	0.258
	(ug/dscm @7% O_2)	40	0.42
	*(LB/TON RDF)	N/A	3.52E-06
chromium	(ug/dscm)	N/A	1.285
	(ug/dscm @7% O_2)	N/A	2.097
	*(LB/TON RDF)	N/A	1.757E-05
lead	(ug/dscm)	N/A	13.23
	(ug/dscm @7% O_2)	440	21.58
	*(LB/TON RDF)	N/A	0.000181
mercury	(ug/dscm)	N/A	0.24
	(ug/dscm @7% O_2)	50	0.39
	*(LB/TON RDF)	N/A	3.296E-06
nickel	(ug/dscm)	N/A	1.28
	(ug/dscm @7% O_2)	N/A	2.096
	*(LB/TON RDF)	N/A	1.76E-05
selenium	(ug/dscm)	N/A	< 0.48
	(ug/dscm @7% O_2)	N/A	< 0.79
	*(LB/TON RDF)	N/A	< 6.59E-06

Dioxins

(ng/dscm@12% CO_2 as 2,3,7,8-TCDD TEF) -0.418		N/A	0.088 ng/s
(TOTAL ng/dscm @ 7% O_2)		30	1.821
**(LB/TON RDF)		N/A	2.034E-08

* Based on 45.11 TON/HR RDF
** Based on 54.7 TON/HR RDF

No difficulties were encountered in the field or in the laboratory evaluation of the samples. On the basis of these facts and a complete review of the data and results, it is our opinion that the concentrations and emission rates reported herein are accurate and closely reflect the actual values which existed at the time the tests were performed.

Table 1. Summary of the Results of the June 3-6, 2003 Dioxin Emission Compliance Test on the Incinerator Stack at the Great River Energy Facility Located in Elk River, Minnesota.

Item		Run 1	Run 2	Run 3	Average
Date of test		06-03-03	06-04-03	06-06-03	
Time runs were done	(Hrs)	0835 / 1240	1050 / 1452	0805 / 1210	
Volumetric Flow					
Actual	(ACFM)	297439	280573	305711	294574
Standard	(DSCFM)	164278	155236	166069	161861
Gas Temperature	(°F)	312	310	312	311
Moisture Content	(%v/v)	16.70	16.55	17.57	16.94
Sample Volume	(Nm3)	4.22	3.91	4.22	4.12
Equiv RDF Feed Rate	(Tons/Hr)	54.7	54.7	54.7	54.7
Gas Composition	(%v/v, dry)				
Carbon Dioxide		10.41	10.70	10.83	10.65
Oxygen		10.17	9.76	9.73	9.89
Nitrogen		79.42	79.54	79.44	79.47
Isokinetic Variation	(%)	101.7	99.8	100.7	100.7
Analytical Results					
Mass / Dioxins	(ng/S)	11.370	2.849	3.617	5.945
Mass / 2,3,7,8-TCDD TEF	(ng/S)	0.170	0.041	0.053	0.088
Concentration-Dioxins	(Total ng/Nm^3 @ 7% O_2)	3.489	0.908	1.066	1.821
Concentration-TEF	(2,3,7,8-TCDD TEF ng/Nm^3 @12% CO_2)	0.8273	0.1799	0.2480	0.418
Mass Rate / Dioxins	(LB/HR)	2.15E-06	5.28E-07	6.63E-07	1.11E-06
Mass Rate / Dioxins	(LB/Ton)	3.92E-08	9.65E-09	1.21E-08	2.03E-08

Interpoll Laboratories, Inc.
4500 Ball Road N.E.
Circle Pines, Minnesota 55014-1819

TEL: (763) 786-6020
FAX: (763) 786-7854

RESULTS OF THE MAY 28-29 AND JUNE 4-5, 2002 AIR EMISSION COMPLIANCE TEST ON THE NOS. 1 - 3 BOILERS AT THE GREAT RIVER ENERGY GENERATING STATION IN ELK RIVER, MINNESOTA

Submitted to:

GREAT RIVER ENERGY
P.O. Box 800
Elk River, Minnesota 55330-0800

Attention:

Debra Nelson

Reviewed by:

Kathleen Eickstadt
Department Coordinator
Field Services Department

Report Number 2-17388C
July 30, 2002
KE/kce

2 SUMMARY AND DISCUSSION

The results of the air emission compliance tests on the Nos. 1 - 3 Boilers are presented in Tables 1 - 4. An overview of the results is presented in the table below:

PARAMETER	*Limit*	Average
Particulate		
DRY + ORGANIC WET CATCH		
.....(GR/DSCF)	N/A	0.0052
.....(GR/DSCF @ 7% O_2)	0.02	0.0071
.....(GR/DSCF @ 12% CO_2)	N/A	0.0071
.....*(LB/TON RDF)	N/A	0.105
DRY CATCH ONLY		
.....(GR/DSCF)	N/A	0.0034
.....(GR/DSCF @ 7%O_2)	0.012	0.0047
.....(GR/DSCF @ 12% CO_2)	N/A	0.0047

* Based on 45.51 Ton/Hr RDF Feed Rate

Hydrogen Chloride		
Inlet		
.....(ppm,d)	N/A	1010
.....(ppm,d @ 7%O_2)	N/A	1073
Stack		
.....(ppm,d)	N/A	1.60
.....(ppm,d @7%O_2)	29	1.91
.....(LB/HR)	N/A	1.47
.....*(LB/TON RDF)	N/A	0.0257
REMOVAL EFFICIENCY.....(%)	95	99.81

* Based on 57.41 Ton/Hr Feed RDF Feed Rate

Trace Metals

arsenic	(ug/dscm)	N/A	< 3.40
	(ug/dscm @7% O_2)	N/A	< 4.64
beryllium	(ug/dscm)	N/A	< 0.97
	(ug/dscm @7% O_2)	N/A	< 1.33
cadmium	(ug/dscm)	N/A	≤ 0.65
	(ug/dscm @7% O_2)	40	≤ 0.88
	*(LB/TON RDF)	N/A	≤ 8.93E-06
chromium	(ug/dscm)	N/A	≤ 3.23
	(ug/dscm @7% O_2)	N/A	≤ 4.40
	*(LB/TON RDF)	N/A	≤ 4.46E-05
lead	(ug/dscm)	N/A	1.78
	(ug/dscm @7% O_2)	440	2.42
	*(LB/TON RDF)	N/A	2.46E-05
mercury	(ug/dscm)	N/A	≤ 0.54
	(ug/dscm @7% O_2)	50	≤ 0.74
	*(LB/TON RDF)	N/A	≤ 7.41E-06
nickel	(ug/dscm)	N/A	≤ 6.46
	(ug/dscm @7% O_2)	N/A	≤ 8.80
selenium	(ug/dscm)	N/A	< 4.37
	(ug/dscm @7% O_2)	N/A	< 5.97

Dioxins

(ng/dscm@12% CO_2 as 2,3,7,8-TCDD TEF)		N/A	0.15
	(TOTAL ng/dscm @ 7% O_2)	30	2.29
	**(LB/TON RDF)	N/A	1.80E-08

* Based on 45.51 TON/HR RDF
** Based on 57.68 TON/HR RDF

No difficulties were encountered in the field or in the laboratory evaluation of the samples. On the basis of these facts and a complete review of the data and results, it is our opinion that the concentrations and emission rates reported herein are accurate and closely reflect the actual values which existed at the time the tests were performed.

Table 4. Summary of the Results of the June 4-5, 2002 Dioxin Emission Compliance Test on the Nos. 1-3 Boilers at the Great River Energy Facility in Elk River, Minnesota.

Item		Run 1	Run 2	Run 3	Average
Date of test		6/4,5/02	6/4,5/02	6/4,5/02	
Time runs were done	(Hrs)	0825 / 1300	1325 / 1733	0740 / 1147	
Volumetric Flow					
Actual	(ACFM)	290109	310508	313303	304640
Standard	(DSCFM)	157362	166032	166054	163149
Gas Temperature	(°F)	317	320	320	319
Moisture Content	(%v/v)	17.22	18.09	19.23	18.18
Gas Composition	(%v/v, dry)				
Carbon Dioxide		9.20	11.00	11.39	10.53
Oxygen		10.30	8.49	7.88	8.89
Nitrogen		80.50	80.51	80.73	80.58
Isokinetic Variation	(%)	98.8	99.7	100.7	99.7
Analytical Results					
ng/dscm@12%CO2 as 2,3,7,8-TCDD TEF		0.283	0.061	0.102	0.149
ng/dscm@ 7% O2		4.670	0.830	1.360	2.287
LB/TON RDF		3.640E-08	7.980E-09	1.370E-08	1.936E-08

Interpoll Laboratories, Inc.
4500 Ball Road N.E.
Circle Pines, Minnesota 55014-1819

TEL: (763) 786-6020
FAX: (763) 786-7854

RESULTS OF THE MAY 15-18, 2001 AIR EMISSION COMPLIANCE TEST ON THE NOS. 1 - 3 BOILERS AT THE GREAT RIVER ENERGY GENERATING STATION IN ELK RIVER, MINNESOTA

Submitted to:

GREAT RIVER ENERGY
P.O. Box 800
Elk River, Minnesota 55330-0800

Attention:

Deb Nelson

Reviewed by:

Kathleen Eickstadt
Department Coordinator
Field Services Department

Report Number 1-15889
July 23, 2001
KE/kce

2 SUMMARY AND DISCUSSION

The results of the air emission compliance tests on the Nos. 1 - 3 Boilers are presented in Tables 1 - 4. An overview of the results is presented in the table below:

PARAMETER	*Limit*	Average
Particulate		
DRY + ORGANIC WET CATCH		
.....(GR/DSCF)	N/A	0.00086
.....(GR/DSCF @ 7% O_2)	0.02	0.0011
.....(GR/DSCF @ 12% CO_2)	N/A	0.0011
.....*(LB/TON RDF)	N/A	0.024
DRY CATCH ONLY		
.....(GR/DSCF)	N/A	0.00064
.....(GR/DSCF @ 7%O_2)	0.012	0.00080
.....(GR/DSCF @ 12% CO_2)	N/A	0.00080
* Based on 49.11 Ton/Hr RDF Feed Rate		
Opacity		
Stack		
.....(%)	10	0
Hydrogen Chloride		
Inlet		
.....(ppm,d)	N/A	699
.....(ppm,d @ 7%O_2)	N/A	888
Stack		
.....(ppm,d)	N/A	< 1.1
.....(ppm,d @7%O_2)	29	< 1.3
.....(LB/HR)	N/A	< 0.9
.....*(LB/TON RDF)	N/A	< 0.019
REMOVAL EFFICIENCY .....(%)	95	> 99.85

* Based on 49.08 Ton/Hr Feed RDF Feed Rate

Trace Metals

arsenic	(ug/dscm)	N/A	< 3.78
	(ug/dscm @7% O_2)	N/A	< 4.47
beryllium	(ug/dscm)	N/A	< 0.54
	(ug/dscm @7% O_2)	N/A	< 0.64
cadmium	(ug/dscm)	N/A	< 0.54
	(ug/dscm @7% O_2)	40	< 0.64
	*(LB/TON RDF)	N/A	6.24E-6
chromium	(ug/dscm)	N/A	74.6
	(ug/dscm @7% O_2)	N/A	86.0
	(LB/TON RDF)	N/A	8.62E-04
lead	(ug/dscm)	N/A	14.04
	(ug/dscm @7% O_2)	440	16.7
	*(LB/TON RDF)	N/A	1.66E-04
mercury	(ug/dscm)	N/A	0.70
	(ug/dscm @7% O_2)	50	0.76
	*(LB/TON RDF)	N/A	8.08E-06
nickel	(ug/dscm)	N/A	12.2
	(ug/dscm @7% O_2)	N/A	14.3
	*(LB/TON RDF)	N/A	1.41E-04
selenium	(ug/dscm)	N/A	< 4.85
	(ug/dscm @7% O_2)	N/A	< 5.74

Dioxins

(ng/dscm@12% CO_2 as 2,3,7,8-TCDD TEF)	N/A	0.27
(TOTAL ng/dscm @ 7% O_2)	30	1.4
**(LB/TON RDF)	N/A	1.51E-08

* Based on 55.45 TON/HR RDF
** Based on 59.0 TON/HR RDF

No difficulties were encountered in the field or in the laboratory evaluation of the samples. On the basis of these facts and a complete review of the data and results, it is our opinion that the concentrations and emission rates reported herein are accurate and closely reflect the actual values which existed at the time the tests were performed.

Table 4a Summary of the Results of the May 16-17, 2001 Dioxin Emission Engineering Test on the Nos. 1-3 Boilers at the Great River Energy Plant Located in Elk River, Minnesota.

Homolog	RUN 1	RUN 2	RUN 3
(Concentration ng/Nm³)			
TCDD	.046	.040	.035
PeCDD	.069	.040	.071
HxCDD	.16	.078	.15
HpCDD	.14	.069	.15
OCDD	.11	.13	.14
TCDF	.18	.15	.16
PeCDF	.19	.13	.20
HxCDF	.23	.15	.38
HpCDF	.19	.11	.31
OCDF	.06	.052	.083
(Emission Rate 10^{-8}g/sec)			
TCDD	.37	.32	.27
PeCDD	.55	.32	.54
HxCDD	1.3	.62	1.2
HpCDD	1.1	.55	1.1
OCDD	.84	1.1	1.1
TCDF	1.5	1.2	1.2
PeCDF	1.5	1.1	1.5
HxCDF	1.8	1.2	2.9
HpCDF	1.5	.84	2.3
OCDF	.48	.41	.63

59 TDR/HR RDF

	Avg (g/s)	lb/hr	lb/ton
TCDD	.32	2.54×10^{-8}	4.31×10^{-10}
TCDF	1.3	1.03×10^{-9}	1.74×10^{-11}
Pol. CDD	.752	5.97×10^{-8}	1.01×10^{-9}
Pol. CDF	1.34	1.06×10^{-9}	1.80×10^{-11}

0022046-9/2

36005/11

Table 4b Summary of the Results of the May 16-17, Dioxin Emission Compliance Test on the Nos 1-3 Boilers at the Great River Energy Plant in Elk River, Minnesota.

Isomer	RUN 1	RUN 2	RUN 3
(Concentration ng/Nm³)			
2,3,7,8-TCDD	.0005<	.002<	.002<
1,2,3,7,8-PeCDD	.006<	.004<	.007
1,2,3,4,7,8-HxCDD	.011	.004	.011
1,2,3,6,7,8-HxCDD	.014	.006	.013
1,2,3,7,8,9-HxCDD	.014	.005	.013
1,2,3,4,6,7,8-HpCDD	.087	.047	.094
2,3,7,8-TCDF	.006	.006	.006
1,2,3,7,8-PeCDF	.013	.010	.015
2,3,4,7,8-PeCDF	.019	.010	.022
1,2,3,4,7,8-HxCDF	.037	.002<	.057
1,2,3,6,7,8-HxCDF	.037<	.018<	.043<
1,2,3,7,8,9-HxCDF	.044	.028	.064
2,3,4,6,7,8-HxCDF	.011	.005<	.015
1,2,3,4,6,7,8-HpCDF	.15	.092	.2
1,2,3,4,7,8,9-HpCDF	.021	.010	.031
(Emission Rate 10^{-8}g/sec)			
2,3,7,8-TCDD	.004<	.018<	.013<
1,2,3,7,8-PeCDD	.05<	.030<	.056
1,2,3,4,7,8-HxCDD	.092	.032	.081
1,2,3,6,7,8-HxCDD	.11	.049	.099
1,2,3,7,8,9-HxCDD	.11	.041	.097
1,2,3,4,6,7,8-HpCDD	.70	.38	.72
2,3,7,8-TCDF	.052	.045	.045
1,2,3,7,8-PeCDF	.10	.081	.12
2,3,4,7,8-PeCDF	.15	.083	.17
1,2,3,4,7,8-HxCDF	.3	.019<	.43
1,2,3,6,7,8-HxCDF	.3<	.14<	.32<
1,2,3,7,8,9-HxCDF	.35	.23	.49
2,3,4,6,7,8-HxCDF	.089	.04<	.12
1,2,3,4,6,7,8-HpCDF	1.2	.73	1.5
1,2,3,4,7,8,9-HpCDF	.17	.081<	.23

Table 4c Summary of the Results of the May 16-17, Dioxin Emission Compliance Test on the No. 1-3 Boilers at the Great River Energy Plant in Elk River, Minnesota.

	TEF	2,3,7,8-TCDD Equivalents RUN 1	RUN 2	RUN 3
(Concentration ng/Nm³)				
2,3,7,8-TCDD	1	.0005<	.002<	.002<
other TCDDs	.01	.0005<	.0004<	.0003<
2,3,7,8-PeCDD	.5	.003<	.002<	.004
other PeCDDs	.005	.0003<	.0002<	.0003
2,3,7,8-HxCDD	.04	.002	.0006	.001
other HxCDDs	.0004	.00005	.00003	.00005
2,3,7,8-HpCDD	.001	.00009	.00005	.00009
other HpCDDs	.00001	.0000005	.0000002	.0000005
2,3,7,8-TCDF	.1	.0006	.0006	.0006
other TCDFs	.001	.0002	.0001	.0001
2,3,7,8-PeCDF	.1	.003	.002	.004
other PeCDFs	.001	.0002	.0001	.0002
2,3,7,8-HxCDF	.01	.001<	.0005<	.002<
other HxCDFs	.0001	.00001<	.00001<	.00002<
2,3,7,8-HpCDF	.001	.0002	.0001<	.0002
other HpCDFs	.00001	.0000002	.00000004<	.0000017
Totals		.012<	.009<	.014<
(Emission rate 10^{-8}g/sec)				
2,3,7,8-TCDD	1	.004<	.018<	.013<
other TCDDs	.01	.004<	.003<	.003<
2,3,7,8-PeCDD	.5	.025<	.015<	.028
other PeCDDs	.005	.003<	.001<	.002<
2,3,7,8-HxCDD	.04	.013	.005	.011
other HxCDDs	.0004	.0004	.0002	.0003
2,3,7,8-HpCDD	.001	.0007	.0004	.0007
other HpCDDs	.00001	.000004	.000002	.000004
2,3,7,8-TCDF	.1	.005	.005	.004
other TCDFs	.001	.001	.001	.001
2,3,7,8-PeCDF	.1	.025	.016	.028
other PeCDFs	.001	.001	.0009	.001
2,3,7,8-HxCDF	.01	.010<	.004<	.014<
other HxCDFs	.0001	.00008<	.00008<	.0002<
2,3,7,8-HpCDF	.001	.001	.0008<	.002
other HpCDFs	.00001	.000004	.000001<	.000008
Totals		.093<	.071<	.11<

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

Great River Energy					Report No. 1-15889	
Elk River, MN		**Unit 1-3 Boiler Stack**				
5/15-18/00						
(ng/Nm3)	**RUN 1**	**RUN 2**	**RUN 3**	Avg	TEF	Avg(TEF)
TCDD	0.046	0.04	0.035	0.040	1	0.04
PeCDD	0.069	0.04	0.071	0.06	.5	0.03
HxCDD	0.16	0.078	0.15	0.129	0.1	0.0129
HpCDD	0.14	0.069	0.15	0.1196	0.01	0.001196
OCDD	0.11	0.13	0.14	0.126	0.001	0.000126
TCDF	0.18	0.15	0.16	0.16$\overline{3}$	0.1	0.016$\overline{3}$
PeCDF	0.19	0.13	0.2	0.17$\overline{3}$	0.5	0.086
HxCDF	0.23	0.15	0.38	0.25$\overline{3}$	0.1	0.025$\overline{3}$
HpCDF	0.19	0.11	0.31	0.20$\overline{3}$	0.01	0.00203
OCDF	0.06	0.052	0.083	0.065	0.001	0.000065
Total	1.375	0.949	1.679			0.2159
Oxygen	8.21	7.91	8.01			
Total @ 7%O2(dry)	**1.5**	**1.0**	**1.8**			
CO2	11.12	11.45	11.32			
Total @ 12% CO2(dry)	**1.48**	**0.99**	**1.78**			

RECEIVED SEP 6 2000

Interpoll Laboratories, Inc.
4500 Ball Road N.E.
Circle Pines, Minnesota 55014-1819

TEL: (612) 786-6020
FAX: (612) 786-7854

RESULTS OF THE MAY 15-17, 2000 AIR EMISSION COMPLIANCE TEST ON THE NOS. 1 - 3 BOILERS AT THE GREAT RIVER ENERGY GENERATING STATION IN ELK RIVER, MINNESOTA

Submitted to:

GREAT RIVER ENERGY
P.O. Box 800
Elk River, Minnesota 55330-0800

Attention:

Nathan Domyahn

Reviewed by:

Kathleen Eickstadt
Department Coordinator
Field Services Department

Report Number 0-14487
July 24, 2000
EJ/ehj

2 SUMMARY AND DISCUSSION

The results of the air emission compliance tests on the Nos. 1 - 3 Boilers are presented in Tables 1 - 6. An overview of the results is presented in the table below:

PARAMETER	*Limit*	Average
Particulate		
DRY + ORGANIC WET CATCH		
..... (GR/DSCF)	N/A	0.0022
..... (GR/DSCF @ 7% O_2)	0.02	0.0030
..... (GR/DSCF @ 12% CO_2)	N/A	0.0041
..... *(LB/TON RDF)	N/A	0.080
DRY CATCH ONLY		
..... (GR/DSCF)	N/A	0.0019
..... (GR/DSCF @ 7%O_2)	0.012	0.0026
..... (GR/DSCF @ 12% CO_2)	N/A	0.0082
* Based on 42.04 Ton/Hr RDF Feed Rate		
Opacity		
Stack		
..... (%)	10	5
Hydrogen Chloride		
Inlet		
..... (ppm,d)	N/A	506
..... (ppm,d @ 7%O_2)	N/A	572
Stack		
..... (ppm,d)	N/A	3.5
..... (ppm,d @7%O_2)	29	4.0
..... (LB/HR)	N/A	3.7
..... *(LB/TON RDF)	N/A	0.071
REMOVAL EFFICIENCY ..... (%)	95	99.29

* Based on 51.90 Ton/Hr Feed RDF Feed Rate

Trace Metals

arsenic	(ug/dscm)	N/A	< 5.33
	(ug/dscm @7% O_2)	N/A	< 7.37
beryllium	(ug/dscm)	N/A	< 0.16
	(ug/dscm @7% O_2)	N/A	< 0.22
cadmium	(ug/dscm)	N/A	< 0.27
	(ug/dscm @7% O_2)	40	< 0.37
	*(LB/TON RDF)	N/A	4.78E-6
chromium	(ug/dscm)	N/A	1.77
	(ug/dscm @7% O_2)	N/A	2.45
	(LB/TON RDF)	N/A	2.89E-05
lead	(ug/dscm)	N/A	4.79
	(ug/dscm @7% O_2)	440	6.62
	*(LB/TON RDF)	N/A	7.82E-05
mercury	(ug/dscm)	N/A	0.51
	(ug/dscm @7% O_2)	50	0.72
	*(LB/TON RDF)	N/A	8.44E-06
nickel	(ug/dscm)	N/A	4.59
	(ug/dscm @7% O_2)	N/A	6.33
	*(LB/TON RDF)	N/A	7.52E-05
selenium	(ug/dscm)	N/A	< 5.33
	(ug/dscm @7% O_2)	N/A	< 7.37

Dioxins

(ng/dscm@12% CO_2 as 2,3,7,8-TCDD TEF)		N/A	1.41
	(TOTAL ng/dscm @ 7% O_2)	30	1.35
	**(LB/TON RDF)	N/A	1.54E-08

* Based on 42.04 TON/HR RDF
** Based on 51.31 TON/HR RDF

The second dioxin determination appears to have been contaminated either in the field or the laboratory and must be considered invalid. All dioxin emission calculations are based on the average of Run 1 and Run 3. No other difficulties were encountered in the field or in the laboratory evaluation of the samples. On the basis of these facts and a complete review of the data and results, it is our opinion that the concentrations and emission rates reported herein are accurate and closely reflect the actual values which existed at the time the tests were performed.

Table 4a Summary of the Results of the May 16-17, 2000 Dioxin Emission Compliance Test on the No. 1-3 Boilers at the Great River Energy Plant in Elk River, Minnesota.

	TEF	2,3,7,8-TCDD Equivalents RUN 1	RUN 2	RUN 3
(Concentration ng/Nm³)				
2,3,7,8-TCDD	1	.004<	.029	.003<
other TCDDs	.01	.0002<	3.1	.0002<
2,3,7,8-PeCDD	.5	.003<	.21	.002<
other PeCDDs	.005	.0006<	3.4	.00005<
2,3,7,8-HxCDD	.04	.002<	.071	.001<
other HxCDDs	.0004	.0001<	.39	.000003<
2,3,7,8-HpCDD	.001	.0003	.002	.00004
other HpCDDs	.00001	.000002	.005	.0000012
2,3,7,8-TCDF	.1	.0004<	.013	.0002<
other TCDFs	.001	.0001<	.01	.00007<
2,3,7,8-PeCDF	.1	.002	.24	.0007
other PeCDFs	.001	.00007	.015	.00004
2,3,7,8-HxCDF	.01	.0005<	.12	.0003<
other HxCDFs	.0001	.000005<	.002	.000002<
2,3,7,8-HpCDF	.001	.00008	.011	.00004<
other HpCDFs	.00001	.0000013	.00004	.0000002<
Totals		.013<	7.6	.008<
(Emission rate 10^{-8}g/sec)				
2,3,7,8-TCDD	1	.036<	.25	.024<
other TCDDs	.01	.002<	27	.001<
2,3,7,8-PeCDD	.5	.022<	1.8	.019<
other PeCDDs	.005	.005<	29	.0004
2,3,7,8-HxCDD	.04	.014<	.61	.009<
other HxCDDs	.0004	.001<	3.3	.00003<
2,3,7,8-HpCDD	.001	.002	.018	.0003
other HpCDDs	.00001	.00002	.042	.000002
2,3,7,8-TCDF	.1	.003<	.11	.002<
other TCDFs	.001	.0008<	.083	.0006<
2,3,7,8-PeCDF	.1	.015	2.0	.006
other PeCDFs	.001	.0006	.13	.0004
2,3,7,8-HxCDF	.01	.005	1.0<	.002<
other HxCDFs	.0001	.00005	.021<	.00002<
2,3,7,8-HpCDF	.001	.0007	.096	.0003<
other HpCDFs	.00001	.000004	.0004	.000003<
Totals		.11<	66<	.066<

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

Table 4b Summary of the Results of the May 16-17, 2000 Dioxin Emission Compliance Test on the No. 1-3 Boilers at the Great River Energy Plant in Elk River, Minnesota.

Isomer	RUN 1	RUN 2	RUN 3
(Concentration ng/Nm³)			
2,3,7,8-TCDD	.004<	.029	.003<
1,2,3,7,8-PeCDD	.005<	.42	.005<
1,2,3,4,7,8-HxCDD	.012	.67	.010<
1,2,3,6,7,8-HxCDD	.020	.69	.009<
1,2,3,7,8,9-HxCDD	.009<	.42	.009<
1,2,3,4,6,7,8-HpCDD	.27	2.1	.038
2,3,7,8-TCDF	.004<	.13	.002<
1,2,3,7,8-PeCDF	.008	.40	.003
2,3,4,7,8-PeCDF	.010	2	.004
1,2,3,4,7,8-HxCDF	.014	3.8	.007<
1,2,3,6,7,8-HxCDF	.015	3.6	.007<
1,2,3,7,8,9-HxCDF	.017	3.6	.006<
2,3,4,6,7,8-HxCDF	.008<	.73	.009<
1,2,3,4,6,7,8-HpCDF	.068	10	.025
1,2,3,4,7,8,9-HpCDF	.013	.67	.014
(Emission Rate 10^{-8}g/sec)			
2,3,7,8-TCDD	.036<	.25	.024<
1,2,3,7,8-PeCDD	.043<	3.6	.038<
1,2,3,4,7,8-HxCDD	.1	5.8	.087<
1,2,3,6,7,8-HxCDD	.17	6	.073<
1,2,3,7,8,9-HxCDD	.073<	3.6	.075<
1,2,3,4,6,7,8-HpCDD	2.3	18	.32
2,3,7,8-TCDF	.030<	1.1	.015<
1,2,3,7,8-PeCDF	.068	3.5	.028
2,3,4,7,8-PeCDF	.085	17	.032
1,2,3,4,7,8-HxCDF	.12	33	.062<
1,2,3,6,7,8-HxCDF	.13	31	.055<
1,2,3,7,8,9-HxCDF	.14	31	.053<
2,3,4,6,7,8-HxCDF	.064<	6.3	.071<
1,2,3,4,6,7,8-HpCDF	.57	90	.21
1,2,3,4,7,8,9-HpCDF	.11	5.8	.12<

Table 4c Summary of the Results of the May 16-17, 2000 Dioxin Emission Compliance Test on the No. 1-3 Boilers at the Great River Energy Plant in Elk River, Minnesota.

Homolog	RUN 1	RUN 2	RUN 3
(Concentration ng/Nm³)			
TCDD	.025	315	.019
PeCDD	.12	674	.014
HxCDD	.36	967	.036
HpCDD	.48	495	.068
OCDD	.46	1.2	.097
TCDF	.1	9.8	.072
PeCDF	.093	17	.052
HxCDF	.11	36	.007<
HpCDF	.12	15	.061
OCDF	.061	1.3	.038<
(Emission Rate 10^{-8}g/sec)			
TCDD	.21	2710	.16
PeCDD	.98	5811	.11
HxCDD	3.0	8331	.30
HpCDD	4	4260	.56
OCDD	3.8	10	.81
TCDF	.83	84	.60
PeCDF	.77	150	.43
HxCDF	.90	307	.060<
HpCDF	.98	131	.51
OCDF	.51	11	.32<

Great River Energy					Report No. 0-14487	
Elk River, MN		Unit 1-3 Boiler Stack				
5/16-17/00				1&3only		
(ng/Nm3)	RUN 1	RUN 2	RUN 3	Avg	TEF	Avg TEF
TCDD	0.025	315	0.019	0.22	1	0.22
PeCDD	0.12	674	0.014	0.067	0.5	0.0335
HxCDD	0.36	967	0.036	0.198	0.1	0.0198
HpCDD	0.48	495	0.068	0.274	0.01	0.00274
OCDD	0.46	1.2	0.097	0.2785	0.001	0.002785
TCDF	0.1	9.8	0.072	0.086	0.1	0.0086
PeCDF	0.093	17	0.052	0.07275	0.5	0.03625
HxCDF	0.11	36	0.007	0.0585	0.1	0.00585
HpCDF	0.12	15	0.061	0.0905	.01	0.000905
OCDF	0.061	1.3	0.038	0.0495	.001	0.0000495
Total	1.929	2531.3	0.464			.33 TEF
Oxygen	8.95	8.65	8.55			
Total @ 7%O2(dry)	**2.2**	**2872.3**	**0.5**			
CO2	10.1	10.3	10.4			
Total @ 12% CO2(dry)	**2.29**	**2949.09**	**0.54**			

Interpoll Laboratories, Inc.
4500 Ball Road N.E.
Circle Pines, Minnesota 55014-1819

TEL: (612) 786-6020
FAX: (612) 786-7854

RESULTS OF THE NOVEMBER 2 AND 3, 1999 AIR EMISSION COMPLIANCE RETEST ON THE NOS. 1 - 3 BOILERS AT THE GREAT RIVER ENERGY GENERATING STATION IN ELK RIVER, MINNESOTA

Submitted to:

GREAT RIVER ENERGY
P.O. Box 800
Elk River, Minnesota 55330-0800

Attention:

Nathan Domyahn

Reviewed by:

Kathleen Eickstadt
Department Coordinator
Field Services Department

Report Number 9-13720
December 17, 1999
EJ/ehj

2 SUMMARY AND DISCUSSION

The results of the air emission compliance retest on the Nos. 1 - 3 Boilers are presented in Table 1. An overview of the results is presented in the table below:

PARAMETER	*Limit*	Average
Dioxins		
..... (TOTAL ng/dscm @ 7% O_2)	30	1.2
..... **(LB/TON RDF)	N/A	1.18×10^{-8}

** Based on 58.19 TON/HR RDF

No difficulties were encountered in the field or in the laboratory evaluation of the samples. On the basis of these facts and a complete review of the data and results, it is our opinion that the concentrations and emission rates reported herein are accurate and closely reflect the actual values which existed at the time the tests were performed.

Table 1a Summary of the Results of the November 2 and 3, 1999 Dioxin Emission Compliance Test on the No. 1-3 Boilers at the Great River Energy Plant in Elk River, Minnesota.

	TEF	2,3,7,8-TCDD Equivalents RUN 1	RUN 2	RUN 3
(Concentration ng/Nm³)				
2,3,7,8-TCDD	1	.0005<	.001<	.001<
other TCDDs	.01	.0001<	.0001<	.00008<
2,3,7,8-PeCDD	.5	.001	.001	.0009
other PeCDDs	.005	.0001	.0002	.0001
2,3,7,8-HxCDD	.04	.0007	.0009	.0005
other HxCDDs	.0004	.00003	.00004	.00003
2,3,7,8-HpCDD	.001	.00008	.00009	.00006
other HpCDDs	.00001	.0000005	.0000006	.0000004
2,3,7,8-TCDF	.1	.0002	.0003	.0002
other TCDFs	.001	.00006	.00008	.00005
2,3,7,8-PeCDF	.1	.001	.002	.001
other PeCDFs	.001	.00008	.0001	.00006
2,3,7,8-HxCDF	.01	.0006	.0006	.0004
other HxCDFs	.0001	.000008	.000008	.000005
2,3,7,8-HpCDF	.001	.0001	.0001	.00007
other HpCDFs	.00001	.0000014	.0000004	.0000012
Totals		.005<	.007<	.005<
(Emission rate 10^{-8}g/sec)				
2,3,7,8-TCDD	1	.005<	.011<	.009<
other TCDDs	.01	.0009<	.001<	.0007<
2,3,7,8-PeCDD	.5	.011	.012	.008
other PeCDDs	.005	.001	.002	.001
2,3,7,8-HxCDD	.04	.006	.008	.005
other HxCDDs	.0004	.0003	.0004	.0002
2,3,7,8-HpCDD	.001	.0007	.0008	.0005
other HpCDDs	.00001	.000005	.000006	.000004
2,3,7,8-TCDF	.1	.002	.003	.002
other TCDFs	.001	.0005	.0007	.0005
2,3,7,8-PeCDF	.1	.014	.016	.01
other PeCDFs	.001	.0007	.0009	.0005
2,3,7,8-HxCDF	.01	.005	.005	.003
other HxCDFs	.0001	.00007	.00007	.00004
2,3,7,8-HpCDF	.001	.001	.001	.0006
other HpCDFs	.00001	.000006	.000005	.000004
Totals		.049<	.062<	.041<

Table 1b Summary of the Results of the November 2-3, 1999 Dioxin Emission Compliance Test on the No. 1-3 Boilers at the Great River Energy Plant in Elk River, Minnesota.

Isomer	RUN 1	RUN 2	RUN 3
(Concentration ng/Nm³)			
2,3,7,8-TCDD	.0005<	.001<	.001<
1,2,3,7,8-PeCDD	.002	.003	.002
1,2,3,4,7,8-HxCDD	.004	.005	.003
1,2,3,6,7,8-HxCDD	.008	.011	.007
1,2,3,7,8,9-HxCDD	.005	.007	.004
1,2,3,4,6,7,8-HpCDD	.076	.090	.057
2,3,7,8-TCDF	.002	.003	.002
1,2,3,7,8-PeCDF	.006	.008	.005
2,3,4,7,8-PeCDF	.009	.010	.006
1,2,3,4,7,8-HxCDF	.016	.018	.010
1,2,3,6,7,8-HxCDF	.015	.016	.01
1,2,3,7,8,9-HxCDF	.018	.018	.011
2,3,4,6,7,8-HxCDF	.008	.007	.005
1,2,3,4,6,7,8-HpCDF	.11	.097	.059
1,2,3,4,7,8,9-HpCDF	.019	.016	.012
(Emission Rate 10^{-8}g/sec)			
2,3,7,8-TCDD	.005<	.011<	.009<
1,2,3,7,8-PeCDD	.022	.024	.016
1,2,3,4,7,8-HxCDD	.036	.041	.026
1,2,3,6,7,8-HxCDD	.075	.095	.058
1,2,3,7,8,9-HxCDD	.049	.064	.038
1,2,3,4,6,7,8-HpCDD	.69	.80	.51
2,3,7,8-TCDF	.021	.026	.015
1,2,3,7,8-PeCDF	.058	.073	.040
2,3,4,7,8-PeCDF	.079	.090	.057
1,2,3,4,7,8-HxCDF	.15	.16	.090
1,2,3,6,7,8-HxCDF	.14	.14	.088
1,2,3,7,8,9-HxCDF	.17	.16	.10
2,3,4,6,7,8-HxCDF	.075	.065	.042
1,2,3,4,6,7,8-HpCDF	.97	.86	.53
1,2,3,4,7,8,9-HpCDF	.18	.14	.10

Table 1c Summary of the Results of the November 2-3, 1999 Dioxin Emission Compliance Test on the No. 1-3 Boilers at the Great River Energy Plant in Elk River, Minnesota.

Homolog	RUN 1	RUN 2	RUN 3
(Concentration ng/Nm³)			
TCDD	.011	.014	.009
PeCDD	.025	.038	.027
HxCDD	.090	.12	.078
HpCDD	.13	.15	.098
OCDD	.23	.25	.16
TCDF	.059	.082	.053
PeCDF	.096	.12	.07
HxCDF	.14	.14	.086
HpCDF	.17	.15	.10
OCDF	.082	.063	.049
(Emission Rate 10^{-8}g/sec)			
TCDD	.10	.12	.077
PeCDD	.22	.34	.24
HxCDD	.82	1.1	.69
HpCDD	1.2	1.4	.88
OCDD	2.1	2.2	1.4
TCDF	.54	.73	.48
PeCDF	.88	1.0	.62
HxCDF	1.3	1.3	.77
HpCDF	1.6	1.4	.9
OCDF	.75	.56	.44

Interpoll Laboratories, Inc.
4500 Ball Road N.E.
Circle Pines, Minnesota 55014-1819

TEL: (612) 786-6020
FAX: (612) 786-7854

RESULTS OF THE MAY 18-20, 1999 AIR EMISSION COMPLIANCE TESTS ON THE NOS. 1 - 3 BOILERS AT THE GREAT RIVER ENERGY GENERATING STATION IN ELK RIVER, MINNESOTA

Submitted to:

GREAT RIVER ENERGY
P.O. Box 800
Elk River, Minnesota 55330-0800

Attention:

Nathan Domyahn

Reviewed by:

Kathleen Eickstadt
Department Coordinator
Field Services Department

Report Number 9-12791
June 22, 1999
EJ/ehj

2 SUMMARY AND DISCUSSION

The results of the air emission compliance tests on the Nos. 1 - 3 Boilers are presented in Tables 1 - 7. An overview of the results is presented in the table below:

PARAMETER	*Limit*	Average
Particulate		
DRY + ORGANIC WET CATCH		
..... (GR/DSCF)	N/A	0.00736
..... (GR/DSCF @ 7% O_2)	0.02	0.0109
..... (GR/DSCF @ 12% CO_2)	N/A	0.01046
..... *(LB/TON RDF)	N/A	0.259
DRY CATCH ONLY		
..... (GR/DSCF)	N/A	0.0058
..... (GR/DSCF @ 7%O_2)	0.012	0.0085
..... (GR/DSCF @ 12% CO_2)	N/A	0.00818
* Based on 45.41 Ton/Hr RDF Feed Rate		
Opacity		
Stack		
..... (%)	10	0
Hydrogen Chloride		
Inlet		
..... (ppm,d)	N/A	457
..... (ppm,d @ 7%O_2)	N/A	586
Stack		
..... (ppm,d)	N/A	7.8
..... (ppm,d @7%O_2)	29	10
..... (LB/HR)	N/A	7.97
..... *(LB/TON RDF)	N/A	0.165
REMOVAL EFFICIENCY ..... (%)	95	97.25

* Based on 48.41 Ton/Hr Feed RDF Feed Rate

Trace Metals

arsenic	(ug/dscm)	N/A	< 0.95
	(ug/dscm @7% O_2)	N/A	< 1.41
beryllium	(ug/dscm)	N/A	< 0.14
	(ug/dscm @7% O_2)	N/A	< 0.21
cadmium	(ug/dscm)	N/A	< 0.32
	(ug/dscm @7% O_2)	40	< 0.46
	*(LB/TON RDF)	N/A	4.78E-6
chromium	(ug/dscm)	N/A	1.75
	(ug/dscm @7% O_2)	N/A	2.59
	(LB/TON RDF)	N/A	2.64E-05
lead	(ug/dscm)	N/A	4.16
	(ug/dscm @7% O_2)	440	6.16
	*(LB/TON RDF)	N/A	6.22E-05
mercury	(ug/dscm)	N/A	< 0.95
	(ug/dscm @7% O_2)	50	< 1.41
	*(LB/TON RDF)	N/A	< 1.44E-05
nickel	(ug/dscm)	N/A	6.48
	(ug/dscm @7% O_2)	N/A	9.29
	*(LB/TON RDF)	N/A	9.77E-05
selenium	(ug/dscm)	N/A	< 3.80
	(ug/dscm @7% O_2)	N/A	< 5.60

Dioxins

(ng/dscm@12% CO_2 as 2,3,7,8-TCDD TEF)		N/A	≤ 0.0178
	(TOTAL ng/dscm @ 7% O_2)	30	< 4.0
	**(LB/TON RDF)	N/A	< 1.4E-07

* Based on 47.29 TON/HR RDF
** Based on 52.74 TON/HR RDF

No difficulties were encountered in the field or in the laboratory evaluation of the samples. On the basis of these facts and a complete review of the data and results, it is our opinion that the concentrations and emission rates reported herein are accurate and closely reflect the actual values which existed at the time the tests were performed.

Table 3. Summary of the Results of the May 19, 1999 Dioxin Determinations on the No. 1-3 Boilers at the Great River Energy Plant Located in Elk River, Minnesota.

	TEF	2,3,7,8-TCDD Equivalents RUN 1	RUN 2	RUN 3
(Concentration ng/Nm³)				
2,3,7,8-TCDD	1	.002	.002	.0008<
other TCDDs	.01	.0004	.0005	.0001<
2,3,7,8-PeCDD	.5	.003	.006	.0009
other PeCDDs	.005	.0004	.0006	.0001
2,3,7,8-HxCDD	.04	.002	.004	.0005
other HxCDDs	.0004	.00006	.0001	.00002
2,3,7,8-HpCDD	.001	.0002	.0005	.00004
other HpCDDs	.00001	.000001	.000003	.0000003
2,3,7,8-TCDF	.1	.0005	.0006	.0002
other TCDFs	.001	.0002	.0002	.00008
2,3,7,8-PeCDF	.1	.003	.007	.001
other PeCDFs	.001	.0002	.0004	.00006
2,3,7,8-HxCDF	.01	.001	.003	.0004
other HxCDFs	.0001	.00002	.00004	.000005
2,3,7,8-HpCDF	.001	.0003	.0009	.00008
other HpCDFs	.00001	.000001	.000003	.0000003
Totals		.013	.027	.004<
(Emission rate 10^{-8}g/sec)				
2,3,7,8-TCDD	1	.016	.021	.007<
other TCDDs	.01	.003	.004	.0009<
2,3,7,8-PeCDD	.5	.024	.051	.008
other PeCDDs	.005	.003	.005	.0009
2,3,7,8-HxCDD	.04	.016	.037	.004
other HxCDDs	.0004	.0006	.001	.0002
2,3,7,8-HpCDD	.001	.002	.004	.0004
other HpCDDs	.00001	.00001	.00003	.000003
2,3,7,8-TCDF	.1	.004	.005	.002
other TCDFs	.001	.001	.002	.0007
2,3,7,8-PeCDF	.1	.028	.059	.009
other PeCDFs	.001	.002	.003	.0005
2,3,7,8-HxCDF	.01	.011	.028	.003
other HxCDFs	.0001	.0002	.0004	.00004
2,3,7,8-HpCDF	.001	.003	.008	.0007
other HpCDFs	.00001	.00001	.00004	.000004
Totals		.11	.23	.037<

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.

Table 4. Summary of the Results of the May 19, 1999 Dioxin Determinations on the No. 1-3 Boilers at the Great River Energy Plant Located in Elk River, Minnesota.

Isomer	RUN 1	RUN 2	RUN 3
(Concentration ng/Nm³)			
2,3,7,8-TCDD	.002	.002	.0008<
1,2,3,7,8-PeCDD	.006	.012	.002
1,2,3,4,7,8-HxCDD	.010	.028	.003
1,2,3,6,7,8-HxCDD	.019	.044	.005
1,2,3,7,8,9-HxCDD	.016	.035	.004
1,2,3,4,6,7,8-HpCDD	.18	.47	.045
2,3,7,8-TCDF	.005	.006	.002
1,2,3,7,8-PeCDF	.012	.025	.004
2,3,4,7,8-PeCDF	.020	.044	.006
1,2,3,4,7,8-HxCDF	.038	.088	.011
1,2,3,6,7,8-HxCDF	.031	.085	.009
1,2,3,7,8,9-HxCDF	.050	.13	.013
2,3,4,6,7,8-HxCDF	.011	.029	.003
1,2,3,4,6,7,8-HpCDF	.29	.76	.071
1,2,3,4,7,8,9-HpCDF	.041	.12	.011
(Emission Rate 10^{-8}g/sec)			
2,3,7,8-TCDD	.016	.021	.007<
1,2,3,7,8-PeCDD	.049	.10	.017
1,2,3,4,7,8-HxCDD	.089	.24	.027
1,2,3,6,7,8-HxCDD	.17	.38	.046
1,2,3,7,8,9-HxCDD	.13	.3	.030
1,2,3,4,6,7,8-HpCDD	1.5	4.1	.38
2,3,7,8-TCDF	.040	.051	.017
1,2,3,7,8-PeCDF	.11	.21	.036
2,3,4,7,8-PeCDF	.18	.38	.055
1,2,3,4,7,8-HxCDF	.32	.76	.090
1,2,3,6,7,8-HxCDF	.27	.73	.079
1,2,3,7,8,9-HxCDF	.43	1.1	.11
2,3,4,6,7,8-HxCDF	.097	.25	.026
1,2,3,4,6,7,8-HpCDF	2.5	6.5	.60
1,2,3,4,7,8,9-HpCDF	.35	1.0	.090

Table 5. Summary of the Results of the May 19, 1999 Dioxin Determinations on the No. 1-3 Boilers at the Great River Energy Plant Located in Elk River, Minnesota.

Homolog	RUN 1	RUN 2	RUN 3
(Concentration ng/Nm³)			
TCDD	.041	.054	.012
PeCDD	.079	.14	.024
HxCDD	.21	.47	.064
HpCDD	.30	.82	.077
OCDD	.57	1.6	.13
TCDF	.17	.24	.083
PeCDF	.23	.44	.071
HxCDF	.31	.76	.083
HpCDF	.44	1.2	.11
OCDF	.19	.50	.042
(Emission Rate 10^{-8}g/sec)			
TCDD	.35	.46	.10
PeCDD	.67	1.2	.20
HxCDD	1.8	4.1	.55
HpCDD	2.6	7.0	.66
OCDD	4.9	14	1.1
TCDF	1.5	2.1	.71
PeCDF	1.9	3.8	.60
HxCDF	2.7	6.5	.71
HpCDF	3.8	10	.96
OCDF	1.6	4.3	.36

Attachment C

Ash Composition Data

TABLE C-1. ERS COMBINED ASH - Total Composition & Physical Characteristics

ALUMINUM (mg/kg)	1997 Annual	1998 Annual	1999 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	49,000	37,000	38,000	18,000	22,000	15,000	19,000	88,000	30,000	53,000
Replicate 2	42,000	56,000	41,000	15,000	25,000	27,000	32,000	30,000	25,000	22,000
Replicate 3	61,000	41,000	50,000	17,000	23,000	19,000	21,000	28,000	26,000	23,000
Replicate 4	42,000	36,000	45,000	18,000	23,000	20,000	31,000	31,000	27,000	29,000
Replicate 5	61,000	40,000	49,000	50,000	26,000	18,000	33,000	27,000	22,000	26,000
Replicate 6	48,000	39,000	43,000	17,000	25,000	18,000	31,000	28,000	22,000	23,000
Average	**50,500**	**41,500**	**44,333**	**22,500**	**24,000**	**19,500**	**27,833**	**38,667**	**25,333**	**29,333**
Standard Dev.	**8,643**	**7,342**	**4,633**	**13,517**	**1,549**	**4,037**	**6,145**	**24,213**	**3,077**	**11,877**
Outliers?	**No**	**56,000**	**No**	**50,000**	**No**	**No**	**No**	**88,000**	**No**	**53,000**
Corrected Average	**50,500**	**38,600**	**44,333**	**17,000**	**24,000**	**19,500**	**27,833**	**28,800**	**25,333**	**14,000**
Corrected Std Dev	**8,643**	**calculate**	**4,633**	**calculate**	**1,549**	**4,037**	**6,145**	**1,643**	**3,077**	**2,881**

ARSENIC (mg/kg)	1997 Annual	1998 Annual	1999 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	24	41	10	23	26	38	41	22	29	39
Replicate 2	26	37	20	29	38	30	39	36	44	59
Replicate 3	26	37	20	20	23	30	45	34	42	34
Replicate 4	35	38	10	22	51	45	45	31	34	36
Replicate 5	25	42	20	27	31	49	44	34	30	53
Replicate 6	28	37	10	23	37	46	32	34	33	34
Average	**27.33**	**38.67**	**15.00**	**24.00**	**34.33**	**39.67**	**41.00**	**31.83**	**35.3**	**42.5**
Standard Dev.	**4**	**2**	**5**	**3**	**10**	**8**	**5**	**5**	**6**	**11**
Outliers?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Corrected Average	**27**	**39**	**15**	**24**	**34**	**40**	**41**	**32**	**35**	**43**
Corrected Std Dev	**4**	**2**	**5**	**3**	**10**	**8**	**5**	**5**	**6**	**11**

CADMIUM (mg/kg)	1997 Annual	1998 Annual	1999 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	22	31	25	22	26	28	32	15	23	40
Replicate 2	16	37	26	27	35	35	29	26	31	49
Replicate 3	27	26	27	20	33	32	36	28	31	31
Replicate 4	34	29	26	22	46	41	36	25	27	38
Replicate 5	23	33	25	24	34	42	33	28	23	38
Replicate 6	26	29	31	17	34	41	25	28	30	38
Average	**24.67**	**30.83**	**26.67**	**22.00**	**34.67**	**36.50**	**31.83**	**25.00**	**27.50**	**39.00**
Standard Dev.	**6**	**4**	**2**	**3**	**6**	**6**	**4**	**5**	**4**	**6**
Outliers?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Corrected Average	**25**	**31**	**27**	**22**	**35**	**37**	**32**	**25**	**28**	**39**
Corrected Std Dev	**6**	**4**	**2**	**3**	**6**	**6**	**4**	**5**	**4**	**6**

TABLE C-1. ERS COMBINED ASH - Total Composition & Physical Characteristics

LEAD (mg/kg)	1997 Annual	1998 Annual	1999 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	1,100	1,300	950	980	1,000	1,200	1,900	3,400	2,300	2,000
Replicate 2	2,500	1,100	1,000	800	1,400	1,400	1,900	2,200	2,000	2,100
Replicate 3	1,000	1,100	1,000	920	1,100	1,400	1,600	1,500	1,800	1,800
Replicate 4	1,500	2,900	1,000	890	1,400	1,300	2,000	1,800	2,100	1,800
Replicate 5	890	1,100	1,000	1,200	50	1,300	1,900	1,100	1,600	2,600
Replicate 6	1,500	1,100	1,400	830	1,200	1,300	1,700	1,500	1,600	3,900
Average	**1,415**	**1,433**	**1,058**	**937**	**1,025**	**1,317**	**1,833**	**1,917**	**1,900**	**2,367**
Standard Dev.	**590**	**723**	**169**	**144**	**504**	**75**	**151**	**813**	**283**	**807**
Outliers?	**No**	**2,900**	**1,400**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Corrected Average	**1,415**	**1,140**	**990**	**937**	**1,025**	**1,317**	**1,833**	**1,917**	**1,900**	**2,367**
Corrected Std Dev	**590**	**calculate**	**calculate**	**144**	**504**	**75**	**151**	**813**	**283**	**807**

MANGANESE (mg/kg)	1997 Annual	1998 Annual	1999 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	1,200	910	860	620	1,100	910	550	1,100	550	820
Replicate 2	950	840	870	540	610	840	750	590	500	650
Replicate 3	1,100	860	820	560	660	740	570	710	680	640
Replicate 4	920	820	920	480	540	520	810	800	640	680
Replicate 5	1,000	760	910	730	550	510	610	520	610	590
Replicate 6	1,000	820	880	550	650	580	630	610	540	590
Average	**1,028**	**835**	**877**	**580**	**685**	**683**	**653**	**722**	**587**	**662**
Standard Dev.	**104**	**50**	**36**	**86**	**209**	**171**	**104**	**210**	**68**	**85**
Outliers?	**No**	**No**	**No**	**No**	**1,100**	**No**	**No**	**No**	**No**	**No**
Corrected Average	**1,028**	**835**	**877**	**580**	**602**	**683**	**653**	**722**	**587**	**662**
Corrected Std Dev	**104**	**50**	**36**	**86**	**calculate**	**171**	**104**	**210**	**68**	**85**

MERCURY (mg/kg)	1997 Annual	1998 Annual	1999 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	3.2	4.2	6.0	8.5	5.0	5.1	4.9	2.6	3.4	5.2
Replicate 2	3.7	5.6	6.4	4.1	4.0	4.9	4.8	3.4	4.6	6.6
Replicate 3	3.7	4.1	7.0	3.4	4.0	4.2	5.6	3.9	4.4	5.1
Replicate 4	5.3	5.4	6.5	3.6	5.0	5.8	5.6	3.1	3.7	5.2
Replicate 5	4.2	4.7	7.3	3.9	6.0	6.1	5.6	4.4	3.0	5.6
Replicate 6	5.0	5.4	6.0	2.2	7.0	5.2	4.4	3.6	3.7	6.1
Average	**4.2**	**4.9**	**6.5**	**4.3**	**5.17**	**5.22**	**5.15**	**3.50**	**3.80**	**5.63**
Standard Dev.	**0.8**	**0.7**	**0.5**	**2.2**	**1.2**	**0.7**	**0.5**	**0.6**	**0.6**	**0.6**
Outliers?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Corrected Average	**4.2**	**4.9**	**6.5**	**4.3**	**5.2**	**5.2**	**5.2**	**3.5**	**3.8**	**5.6**
Corrected Std Dev	**0.8**	**0.7**	**0.5**	**2.2**	**1.2**	**0.7**	**0.5**	**0.6**	**0.6**	**0.6**

TABLE C-1. ERS COMBINED ASH - Total Composition & Physical Characteristics

NICKEL (mg/kg)	1997 Annual	1998 Annual	1999 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	92	110	66	140	68	51	73	59	72	200
Replicate 2	210	82	370	51	64	56	170	120	83	110
Replicate 3	110	1500	93	79	69	41	75	70	100	59
Replicate 4	130	57	110	32	77	63	75	74	65	47
Replicate 5	100	120	150	59	47	5	81	46	81	53
Replicate 6	160	60	87	110	68	55	44	50	89	92
Average	**134**	**322**	**146**	**79**	**66**	**45**	**86.3**	**69.8**	**81.7**	**93.5**
Standard Dev.	**45**	**578**	**113**	**40**	**10**	**21**	**43**	**27**	**12**	**58**
Outliers?	**No**	**1,500**	**370**	**No**	**No**	**No**	**170**	**No**	**No**	**No**
Corrected Average	**134**	**85.8**	**101**	**79**	**66**	**45**	**70**	**70**	**82**	**94**
Corrected Std Dev	**48**	**calculate**	**calculate**	**45**	**10**	**21**	**15**	**27**	**12**	**58**

SELENIUM (mg/kg)	1997 Annual	1998 Annual	1999 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	1.0	< 4.0	< 2.0	3.0	3.0	< 5.0	< 5.0	< 13.0	< 5.9	< 10.0
Replicate 2	0.9	< 4.0	< 2.0	3.0	3.0	< 5.0	< 5.0	< 13.0	< 5.9	J 5.0
Replicate 3	0.8	< 4.0	< 2.0	3.0	3.0	< 5.0	< 5.0	< 13.0	< 5.9	< 10.0
Replicate 4	1.2	< 4.0	< 2.0	3.0	3.0	< 5.0	< 5.0	< 13.0	< 5.9	< 10.0
Replicate 5	0.8	< 4.0	< 2.0	3.0	3.0	< 5.0	< 5.0	< 13.0	J 3.0	< 10.0
Replicate 6	1.0	< 4.0	< 2.0	3.0	3.0	< 5.0	< 5.0	< 13.0	J 3.0	< 10.0
Average	**1.0**	**4.0**	**2.0**	**3.0**	**3.0**	**5.0**	**5.0**	**13.0**	**4.9**	**9.2**
Standard Dev.	**0.1**	**0.0**	**#| 0.0**	**#| 0.0**	**#| 0.0**	**#| 0.0**	**#| 0.0**	**#| 0.0**	**1.5**	**2.0**
Outliers?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Corrected Average	**1.0**	**4.0**	**2.0**	**3.0**	**3.0**	**5.0**	**5.0**	**13.0**	**4.9**	**9.2**
Corrected Std Dev	**0.1**	**0.0**	**0.0**	**0.0**	**0**	**0**	**0**	**0**	**1**	**2**

ZINC (mg/kg)	1997 Annual	1998 Annual	1999 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	2,200	2,800	2,100	2,000	2,600	2,400	3,300	2,100	3,700	3,800
Replicate 2	2,500	2,600	2,500	2,000	3,500	2,900	3,500	3,200	6,300	4,700
Replicate 3	5,400	3,500	2,800	1,900	3,300	2,900	3,700	400	3,900	3,400
Replicate 4	3,700	2,600	4,400	1,900	4,300	4,000	3,900	3,200	3,900	3,600
Replicate 5	2,100	3,100	2,500	2,300	3,700	3,500	3,600	3,200	4,200	3,600
Replicate 6	2,600	2,400	2,700	1,500	3,700	3,500	2,900	3,500	4,800	3,900
Average	**3,083**	**2,833**	**2,833**	**1,933**	**3,517**	**3,200**	**3,483**	**2,600**	**4,467**	**3,833**
Standard Dev.	**1,270**	**403**	**804**	**258**	**560**	**573**	**349**	**1,182**	**977**	**459**
Outliers?	**No**	**No**	**4,400**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Corrected Average	**3,083**	**2,833**	**2,520**	**1,933**	**3,517**	**3,200**	**3,483**	**2,600**	**4,467**	**3,833**
Corrected Std Dev	**1,335**	**451**	**calculate**	**286**	**560**	**573**	**349**	**1,182**	**977**	**459**

TABLE C-1. ERS COMBINED ASH - Total Composition & Physical Characteristics

pH	1997 Annual	1998 Annual	1999 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	11.8	12.1	11.7	11.9	12.0	12.0	12.0	11.5	11.5	11.6
Replicate 2	11.8	12.0	11.7	11.9	12.0	12.0	11.9	11.5	11.5	11.6
Replicate 3	11.7	12.1	11.7	11.8	11.6	11.6	11.9	11.5	11.5	11.6
Replicate 4	11.9	12.1	11.5	11.9	12.0	12.0	11.9	11.4	11.5	12.0
Replicate 5	11.8	12.0	11.8	11.8	12.0	12.0	11.9	11.4	11.5	12.0
Replicate 6	11.8	12.0	11.5	11.8	11.9	11.9	11.9	11.4	11.5	12.0
Average	**11.8**	**12.1**	**11.7**	**11.9**	**11.9**	**11.9**	**11.9**	**11.5**	**11.5**	**11.8**
Standard Dev.	**0.1**	**0.1**	**0.1**	**0.1**	**0.2**	**0.2**	**0.0**	**0.1**	**0.0**	**0.2**
Outliers?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Corrected Average	**11.8**	**12.1**	**11.7**	**11.9**	**11.9**	**11.9**	**11.9**	**11.5**	**11.5**	**11.8**
Corrected Std Dev	**0.1**	**0.1**	**0.1**	**0.1**	**0.2**	**0.2**	**0.0**	**0.1**	**0.0**	**0.2**

% MOISTURE	1997 Annual	1998 Annual	1999 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	21.4	21.4	25.2	12.9	21.0	24.6	30.0	19.0	24.5	23.9
Replicate 2	20.2	22.4	19.9	24.5	24.3	20.9	25.4	23.9	23.0	24.2
Replicate 3	15.8	19.5	24.5	20.5	25.1	21.6	24.4	22.3	23.8	22.7
Replicate 4	19.8	21.7	15.7	19.8	22.0	19.6	23.7	24.7	22.6	21.2
Replicate 5	19.3	18.1	17.3	26.1	23.6	22.5	24.5	23.2	24.7	23.6
Replicate 6	21.0	16.5	18.7	25.2	24.1	22.1	22.5	21.6	21.4	23.0
Average	**19.6**	**19.9**	**20.2**	**21.5**	**23.4**	**21.9**	**25.1**	**22.5**	**23.3**	**23.1**
Standard Dev.	**2.0**	**2.3**	**3.9**	**4.9**	**1.5**	**1.7**	**2.6**	**2.0**	**1.3**	**1.1**
Outliers?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Corrected Average	**19.6**	**19.9**	**20.2**	**21.5**	**23.4**	**21.9**	**25.1**	**22.5**	**23.3**	**23.1**
Corrected Std Dev	**2.0**	**2.3**	**3.9**	**4.9**	**1.5**	**1.7**	**2.6**	**2.0**	**1.3**	**1.1**

COMBUSTIBLES(%)	1997 Annual	1998 Annual	1999 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	8.4	7.7	8.6	11.3	15.8	11.9	11.0	7.4	8.7	10.3
Replicate 2	6.4	9.0	6.9	11.2	8.9	10.8	10.4	9.8	7.6	9.2
Replicate 3	9.1	12.6	8.4	12.3	9.8	11.2	9.6	8.3	8.3	9.4
Replicate 4	6.5	6.4	5.2	11.4	9.0	15.2	9.4	11.1	10.1	10.5
Replicate 5	6.1	23.5	12.3	19.6	9.3	17.8	11.2	9.6	8.1	11.9
Replicate 6	7.9	8.1	10.7	13.1	8.4	13.8	10.8	9.7	10.6	10.2
Average	**7.4**	**11.2**	**8.7**	**13.2**	**10.2**	**13.5**	**10.4**	**9.3**	**8.9**	**10.2**
Standard Dev.	**1.2**	**6.4**	**2.5**	**3.2**	**2.8**	**2.7**	**0.7**	**1.3**	**1.2**	**1.0**
Outliers?	**No**	**No**	**No**	**19.6**	**15.8**	**No**	**No**	**No**	**No**	**No**
Corrected Average	**7.4**	**11.2**	**8.7**	**11.9**	**9.1**	**13.5**	**10.4**	**9.3**	**8.9**	**10.2**
Corrected Std Dev	**1.2**	**6.4**	**2.5**	**calculate**	**calculate**	**2.7**	**0.7**	**1.3**	**1.2**	**1.0**

TABLE C-1. ERS COMBINED ASH - Total Composition & Physical Characteristics

BARIUM (mg/kg)	'97 Annual	'98 Annual	'99 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	1,300	510	490	180	250	260	390	590	690	380
Replicate 2	770	510	450	150	290	720	390	410	390	420
Replicate 3	1,300	600	400	110	510	240	280	370	350	340
Replicate 4	1,400	520	340	120	310	470	360	480	610	470
Replicate 5	**3,500**	690	380	150	310	270	320	350	430	430
Replicate 6	1,500	470	450	190	370	320	360	350	390	420
Average	**1,628**	**550**	**418**	**150**	**340**	**380**	**350**	**425**	**477**	**410**
Standard Dev.	**951**	**81**	**55**	**32**	**92**	**186**	**43**	**95**	**139**	**45**
Outliers?	**3,500**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Corrected Average	**1,254**	**550**	**418**	**150**	**340**	**380**	**350**	**425**	**477**	**410**
Corrected Std. Dev.	**calculate**	**48**	**58**	**35**	**91.9**	**186.2**	**42.9**	**94.6**	**138.9**	**44.7**

BORON (mg/kg)	'97 Annual	'98 Annual	'99 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	110	180	150	38	120	110	160	160	180	130
Replicate 2	98	170	200	38	130	150	150	160	130	140
Replicate 3	120	170	190	38	160	130	150	140	120	140
Replicate 4	100	160	180	51	160	120	150	190	140	160
Replicate 5	91	180	170	6	130	97	160	130	120	140
Replicate 6	130	160	200	37	160	110	150	140	130	140
Average	**108**	**170**	**182**	**35**	**143**	**120**	**153**	**153**	**137**	**142**
Standard Dev.	**15**	**9**	**19**	**15**	**19**	**19**	**5**	**22**	**23**	**10**
Outliers?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Corrected Average	**108**	**170**	**182**	**35**	**143**	**120**	**153**	**153**	**137**	**142**
Corrected Std. Dev.	**15**	**9**	**19**	**15**	**18.6**	**18.6**	**5.2**	**21.6**	**22.5**	**9.8**

CALCIUM (mg/kg)	'97 Annual	'98 Annual	'99 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	130,000	130,000	170,000	150,000	120,000	180,000	210,000	130,000	200,000	210,000
Replicate 2	130,000	110,000	170,000	140,000	160,000	190,000	210,000	170,000	210,000	220,000
Replicate 3	140,000	120,000	170,000	120,000	160,000	190,000	230,000	170,000	210,000	210,000
Replicate 4	150,000	130,000	160,000	130,000	180,000	200,000	240,000	180,000	220,000	210,000
Replicate 5	140,000	140,000	170,000	150,000	160,000	200,000	230,000	150,000	170,000	210,000
Replicate 6	140,000	140,000	170,000	110,000	140,000	190,000	200,000	180,000	200,000	220,000
Average	**138,333**	**128,333**	**168,333**	**133,333**	**153,333**	**191,667**	**220,000**	**163,333**	**201,667**	**213,333**
Standard Dev.	**7,528**	**11,690**	**4,082**	**16,330**	**20,656**	**7,528**	**15,492**	**19,664**	**17,224**	**5,164**
Outliers?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Corrected Average	**138,333**	**128,333**	**168,333**	**133,333**	**153,333**	**191,667**	**220,000**	**163,333**	**201,667**	**213,333**
Corrected Std. Dev.	**7,528**	**11,690**	**4,082**	**16,330**	**20,655.9**	**7,527.7**	**15,491.9**	**19,663.8**	**17,224.0**	**5,164.0**

TABLE C-1. ERS COMBINED ASH - Total Composition & Physical Characteristics

CHROMIUM (mg/kg)	'97 Annual	'98 Annual	'99 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	66	95	44	59	130	61	J 40	66	97	51
Replicate 2	71	97	81	38	110	87	200	63	50	1,400
Replicate 3	110	93	80	38	110	54	J 53	76	69	66
Replicate 4	60	67	50	31	130	81	J 53	100	56	46
Replicate 5	86	89	50	36	130	73	J 40	52	52	53
Replicate 6	88	120	62	33	130	52	J 53	50	73	51
Average	**80**	**94**	**61**	**39**	**123**	**68**	**73**	**68**	**66**	**278**
Standard Dev.	**18**	**17**	**16**	**10**	**10**	**15**	**62**	**18**	**18**	**550**
Outliers?	**No**	**No**	**No**	**59**	**No**	**No**	**200**	**No**	**No**	**1,400**
Corrected Average	**80**	**94**	**61**	**35**	**123**	**68**	**48**	**68**	**66**	**53**
Corrected Std. Dev.	**19**	**19**	**15**	**calculate**	**10.3**	**14.5**	**7.1**	**18.4**	**17.7**	**8**

COPPER (mg/kg)	'97 Annual	'98 Annual	'99 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	7,700	1,200	1,000	470	810	670	560	1,100	1,000	460
Replicate 2	590	1,200	3,400	460	910	590	670	700	390	510
Replicate 3	2,300	**9,200**	20,000	540	480	490	510	520	340	600
Replicate 4	1,200	710	15,000	370	510	630	670	570	12,000	680
Replicate 5	1,200	710	1,700	1,200	440	360	880	580	520	2,100
Replicate 6	**26,000**	720	3,800	590	840	450	51,000	630	1,100	400
Average	**6,498**	**2,290**	**7,483**	**605**	**665**	**532**	**9,048**	**683**	**2,558**	**792**
Standard Dev.	**9,904**	**3,394**	**7,986**	**301**	**210**	**118**	**20,552**	**213**	**4,636**	**649**
Outliers?	**26,000**	**9,200**	**No**	**1,200**	**No**	**No**	**51,000**	**1,100**	**12,000**	**2,100**
Corrected Average	**2,598**	**908**	**7,483**	**486**	**665**	**532**	**658**	**600**	**670**	**530**
Corrected Std. Dev.	**calculate**	**calculate**	**8,698**	**calculate**	**210.0**	**118.4**	**142.4**	**68**	**355**	**111**

IRON (mg/kg)	'97 Annual	'98 Annual	'99 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	23,000	17,000	16,000	18,000	17,000	9,600	7,300	13,000	20,000	11,000
Replicate 2	29,000	16,000	17,000	3,700	11,000	11,000	11,000	11,000	9,900	23,000
Replicate 3	22,000	17,000	19,000	6,500	33,000	6,900	8,100	14,000	31,000	14,000
Replicate 4	26,000	22,000	15,000	3,400	9,500	9,300	8,800	13,000	13,000	8,600
Replicate 5	22,000	16,000	16,000	8,300	8,700	9,200	8,800	8,300	21,000	11,000
Replicate 6	23,000	19,000	16,000	24,000	14,000	8,400	8,800	12,000	13,000	11,000
Average	**24,167**	**17,833**	**16,500**	**10,650**	**15,533**	**9,067**	**8,800**	**11,883**	**17,983**	**13,100**
Standard Dev.	**2,787**	**2,317**	**1,378**	**8,436**	**9,091**	**1,359**	**1,231**	**2,030**	**7,715**	**5,144**
Outliers?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Corrected Average	**24,167**	**17,833**	**16,500**	**10,650**	**15,533**	**9,067**	**8,800**	**11,883**	**17,983**	**13,100**
Corrected Std. Dev.	**2,787**	**2,317**	**1,378**	**8,436**	**9,091.0**	**1,358.9**	**1,231.3**	**2,030.2**	**7,715.0**	**5,143.9**

TABLE C-1. ERS COMBINED ASH - Total Composition & Physical Characteristics

MAGNESIUM (mg/kg)	'97 Annual	'98 Annual	'99 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	11,000	9,400	11,000	5,600	5,700	7,200	11,000	7,100	9,100	7,500
Replicate 2	12,000	9,700	11,000	5,700	6,700	7,900	7,500	7,900	8,000	7,900
Replicate 3	13,000	8,800	11,000	5,900	8,600	6,900	7,500	7,100	8,700	9,000
Replicate 4	12,000	9,100	10,000	5,900	6,900	7,300	6,800	9,800	14,000	8,600
Replicate 5	13,000	8,900	9,100	8,800	6,500	7,700	6,800	6,400	7,600	8,500
Replicate 6	11,000	9,200	12,000	6,200	6,800	9,000	8,100	7,500	7,600	8,500
Average	**12,000**	**9,183**	**10,683**	**6,350**	**6,867**	**7,667**	**7,950**	**7,633**	**9,167**	**8,333**
Standard Dev.	**894**	**331**	**1,001**	**1,218**	**952**	**745**	**1,573**	**1,172**	**2,443**	**539**
Outliers?	**No**	**No**	**No**	**8,800**	**No**	**No**	**No**	**No**	**14,000**	**No**
Corrected Average	**12,000**	**9,183**	**10,683**	**5,860**	**6,867**	**7,667**	**7,950**	**7,633**	**8,200**	**8,333**
Corrected Std. Dev.	**894**	**331**	**1,001**	**calculate**	**952.2**	**744.8**	**1,573.2**	**1,172.5**	**674.5**	**539.1**

SILVER (mg/kg)	'97 Annual	'98 Annual	'99 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	25	43	100	6	9	6	8	5	9	9
Replicate 2	24	66	40	5	7	7	9	8	10	10
Replicate 3	< 20	73	70	308	7	7	8	8	9	10
Replicate 4	22	31	50	4	9	9	9	7	9	10
Replicate 5	< 20	32	50	5	7	7	8	11	7	10
Replicate 6	< 20	36	40	4	8	8	7	7	9	12
Average	**21.8**	**46.8**	**58.3**	**55.3**	**7.8**	**7.3**	**8.1**	**7.6**	**8.8**	**10.2**
Standard Dev.	**2.2**	**18.2**	**23.2**	**123.8**	**1.0**	**1.1**	**1.0**	**1.9**	**0.9**	**0.9**
Outliers?	**No**	**No**	**No**	**308.0**	**No**	**No**	**No**	**No**	**No**	**12.0**
Corrected Average	**21.8**	**46.8**	**58.3**	**4.7**	**7.8**	**7.3**	**8.1**	**7.6**	**8.8**	**9.8**
Corrected Std. Dev.	**1.8**	**20.2**	**12.2**	**calculate**	**1.0**	**1.1**	**1.0**	**1.9**	**0.9**	**0.2**

SODIUM (mg/kg)	'97 Annual	'98 Annual	'99 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	35,000	27,000	34,000	11,000	16,000	14,000	15,000	17,000	17,000	17,000
Replicate 2	39,000	27,000	33,000	11,000	16,000	17,000	17,000	17,000	17,000	18,000
Replicate 3	32,000	33,000	28,000	10,000	16,000	15,000	16,000	15,000	17,000	16,000
Replicate 4	34,000	29,000	35,000	11,000	16,000	15,000	17,000	18,000	16,000	18,000
Replicate 5	34,000	26,000	28,000	12,000	16,000	15,000	17,000	15,000	14,000	18,000
Replicate 6	34,000	30,000	27,000	9,300	14,000	15,000	17,000	15,000	16,000	18,000
Average	**34,667**	**28,667**	**30,833**	**10,717**	**15,667**	**15,167**	**16,500**	**16,167**	**16,167**	**17,500**
Standard Dev.	**2,338**	**2,582**	**3,545**	**939**	**816**	**983**	**837**	**1,329**	**1,169**	**837**
Outliers?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Corrected Average	**34,667**	**28,667**	**30,833**	**10,717**	**15,667**	**15,167**	**16,500**	**16,167**	**16,167**	**17,500**
Corrected Std. Dev.	**2,338**	**2,582**	**3,545**	**939**	**816.5**	**983.2**	**836.7**	**1,329.2**	**1,169.0**	**836.7**

TABLE C-1. ERS COMBINED ASH - Total Composition & Physical Characteristics

STRONTIUM(mg/kg)	'97 Annual	'98 Annual	'99 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	270	250	270	750	160	270	200	260	260	210
Replicate 2	200	230	240	180	180	320	240	270	210	210
Replicate 3	260	240	260	170	220	230	240	620	210	230
Replicate 4	230	290	230	180	180	270	270	230	210	250
Replicate 5	290	280	230	200	180	230	250	190	220	330
Replicate 6	240	280	240	150	180	230	240	210	220	210
Average	**248**	**262**	**245**	**272**	**183**	**258**	**240**	**297**	**222**	**240**
Standard Dev.	**32**	**25**	**16**	**235**	**20**	**36**	**23**	**161**	**19**	**47**
Outliers?	**No**	**No**	**No**	**750**	**No**	**No**	**No**	**620**	**260**	**No**
Corrected Average	**248**	**262**	**245**	**176**	**183**	**258**	**240**	**232**	**214**	**240**
Corrected Std. Dev.	**32**	**25**	**16**	**calculate**	**19.7**	**36.0**	**22.8**	**33**	**5**	**46.9**

TIN (mg/kg)	'97 Annual	'98 Annual	'99 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	53	84	27	85	76	96	* 190	71	82	110
Replicate 2	110	72	65	79	94	110	* 120	97	97	130
Replicate 3	81	69	59	68	76	96	* 150	97	220	96
Replicate 4	77	80	78	70	120	120	* 150	90	85	140
Replicate 5	54	**310**	20	66	140	130	* 130	92	78	130
Replicate 6	170	44	74	47	100	120	* 110	110	97	140
Average	**91**	**110**	**54**	**69**	**101**	**112**	**142**	**93**	**110**	**124**
Standard Dev.	**44**	**99**	**25**	**13**	**25**	**14**	**29**	**13**	**55**	**18**
Outliers?	**No**	**310**	**No**	**No**	**No**	**No**	**No**	**No**	**220**	**No**
Corrected Average	**91**	**70**	**54**	**69**	**101**	**112**	**142**	**93**	**88**	**124**
Corrected Std. Dev.	**44**	**calculate**	**25**	**13**	**25.2**	**13.9**	**28.6**	**12.8**	**8.8**	**17.7**

CHLORIDE (mg/kg)	'97 Annual	'98 Annual	'99 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	45,000	46,000	41,000	46,000	70,000	70,000	51,000	45,000	48,000	55,000
Replicate 2	52,000	42,000	45,000	66,000	57,000	58,000	65,000	48,000	63,000	47,000
Replicate 3	47,000	43,000	53,000	33,000	63,000	52,000	56,000	49,000	60,000	46,000
Replicate 4	53,000	42,000	53,000	32,000	57,000	59,000	63,000	43,000	59,000	52,000
Replicate 5	42,000	38,000	36,000	61,000	56,000	58,000	77,000	44,000	70,000	55,000
Replicate 6	50,000	49,000	21,000	57,000	69,000	58,000	59,000	37,000	47,000	49,000
Average	**48,167**	**43,333**	**41,500**	**49,167**	**62,000**	**59,167**	**61,833**	**44,333**	**57,833**	**50,667**
Standard Dev.	**4,262**	**3,777**	**12,062**	**14,497**	**6,325**	**5,879**	**8,954**	**4,274**	**8,886**	**3,933**
Outliers?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Corrected Average	**48,167**	**43,333**	**41,500**	**49,167**	**62,000**	**59,167**	**61,833**	**44,333**	**57,833**	**50,667**
Corrected Std. Dev.	**4,262**	**3,777**	**12,062**	**14,497**	**6,324.6**	**5,879.3**	**8,953.6**	**4,274.0**	**8,886.3**	**3,932.8**

TABLE C-1. ERS COMBINED ASH - Total Composition & Physical Characteristics

SULFATE (mg/kg)	'97 Annual	'98 Annual	'99 Annual	2000 Annual	2001 Annual	2002 Annual	2003 Annual	2004 Annual	2005 Annual	2006 Annual
Replicate 1	1,400	2,900	610	1,200	2,700	8,400	4,000	3,400	1,800	2,300
Replicate 2	1,600	2,600	1,000	1,300	5,300	5,600	3,700	1,900	2,100	2,200
Replicate 3	1,600	2,600	1,300	1,800	3,100	3,200	2,000	2,200	1,700	2,200
Replicate 4	1,900	3,000	880	1,000	6,400	3,300	3,100	2,700	2,200	1,300
Replicate 5	1,600	3,400	1,100	1,000	2,700	3,800	3,100	1,800	2,100	1,600
Replicate 6	1,700	3,800	500	1,200	2,100	5,100	3,100	3,000	2,300	1,300
Average	**1,633**	**3,050**	**898**	**1,250**	**3,717**	**4,900**	**3,167**	**2,500**	**2,033**	**1,817**
Standard Dev.	**163**	**472**	**301**	**295**	**1,719**	**1,972**	**686**	**639**	**234**	**471**
Outliers?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Corrected Average	**1,633**	**3,050**	**898**	**1,250**	**3,717**	**4,900**	**3,167**	**2,500**	**2,033**	**1,817**
Corrected Std. Dev.	**163**	**472**	**301**	**295**	**1,718.6**	**1,971.8**	**686.1**	**638.7**	**233.8**	**470.8**