MAINTENANCE OF THE COAL SAMPLE BANK AND DATABASE

Quarterly Technical Progress Report

Reporting Period: 7/01/98 - 9/30/98

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ABSTRACT

This project generates and provides coal samples and accompanying analytical data for research by DOE contractors and others. The five-year contract has been completed and a six-month no-cost extension is under way; this will continue the limited distribution of samples and data to DOE, its contractors and grantees.

All activities specified under the five-year contract have been completed. Eleven DECS samples were collected, processed to a variety of particle sizes, heat-sealed in foil laminate bags under argon, and placed in refrigerated storage. All were analyzed for basic chemical composition, inorganic major and trace element composition including hazardous air pollutant elements, petrographic composition and characteristics, thermoplastic behavior (if applicable), and other properties relevant to commercial utilization. Most were also analyzed by NMR, py/gc/ms, and a standardized liquefaction test; trends and relationships observed were evaluated and summarized. Twenty-two DECS samples collected under the previous contract received further processing, and most of these were subjected to organic geochemical and standardized liquefaction tests as well. Selected DECS samples were monitored annually to evaluate the effectiveness of foil laminate bags for long-term sample storage. Twenty-three PSOC samples collected under previous contracts and purged with argon before storage were also maintained and distributed, for a total of 56 samples covered by the contract. During the five years, 524 samples in 1501 containers, 2075 data printouts, and individual data items from 30327 samples were distributed.

In the subject quarter, 45 samples, 101 data printouts, and individual data items from 1237 samples were distributed. Splits of the last two samples from the previous contract received processing to minus 0.25 mm; all DECS samples are now available for immediate distribution at minus 6 mm (-1/4 inch), minus 0.85 mm (- 20 mesh U.S.), and minus 0.25 mm (minus 60 mesh U.S.). The final annual monitoring of foil laminate bag storage was completed, with most samples showing little or no deterioration.

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EXECUTIVE SUMMARY

Maintenance of the Coal Sample Bank and Database

Quarterly Technical Progress Report 7/01/98 - 9/30/98

The mission of the DOE Coal Sample Bank and Database is to provide a variety of well-characterized, high-quality coal samples for public and private coal research. Eleven coal samples collected under the current contract and 45 from previous contracts, along with analytical data, are distributed on a continuing basis to DOE contractors and others performing coal research. This report represents the conclusion of the original five-year contract; a six-month no-cost extension will continue the limited distribution of samples and data.

Additional analyses of liquefaction behavior and organic geochemical characteristics are performed under the contract. The samples are stored to minimize deterioration, and 10 samples are analyzed annually to monitor the effectiveness of the storage methods. The fifth of these annual monitoring programs was completed during the subject quarter. Foil laminate bags purged with argon gas and stored under refrigeration continue to perform well in preserving the properties of the coal samples.

This report reflects the level of effort described in the revised work statement submitted to DOE on September 5, 1996, setting out a reduction in effort following a cut in the level of funding of the project.

INTRODUCTION

This five year project is intended to ensure the availability of well-characterized, high-quality coal samples for public and private coal research. It continues support of the DOE Coal Sample Bank and Database at The Pennsylvania State University. Eleven coal samples in the DECS- series have been collected, processed, packaged, and analyzed under the contract, and a resulting database is being maintained. These samples and data, as well as 45 samples collected under previous contracts, are distributed on a continuing basis to DOE contractors and others performing coal research. A six-month no-cost extension to the contract is now in place, allowing this distribution to continue.

Samples were chosen to maintain a sample bank of 56 coals representing the major U.S. coal fields and a variety of coal ranks and compositions. In addition to standard analyses, liquefaction tests and organic geochemical analyses have been performed. The samples are stored to minimize deterioration, and 10 samples are monitored annually by proximate, sulfur forms, and gaseous oxygen analysis to evaluate their condition. In the fourth year, additional monitoring was performed to evaluate the influence of various storage methods. The fifth annual monitoring program was completed during the subject quarter, showing that foil laminate bags continue to preserve the samples well.

RESULTS AND DISCUSSION

Task 1B. Storage and Inventory of Samples

All samples supported by the contract are stored in containers purged with argon before sealing; container locations are tracked by a computer inventory program. All DECS-series samples are sealed under argon in foil laminate bags and stored under refrigeration. PSOC-series samples are stored in drums or buckets at the Coal Sample Bank building, or in cans in the Coal and Organic Petrology Laboratories.

During the quarter, samples were distributed (see Task 1I) and inventory records were updated. Storage and inventory of sample containers is expected to continue routinely through the next quarter.

Task 1C. Monitoring of Sample Quality

It was planned that one 300 g (2/3 lb) bag of each DECS sample would be analyzed annually to monitor sample condition and evaluate the ability of the storage procedures to preserve the initial properties of the samples. This Task has been reduced in scope, to 10 samples per year, because of reduction in funding. Effort in the related study of liquefaction behavior (under Task 1F) over time was also reduced.

The fifth annual monitoring program was completed during the quarter. Results are reported in the Appendix. In general, the samples continue to maintain their properties with no change or very gradual change. Gieseler fluidity, sulfate sulfur, and calorific value are the principal indicators employed. Gieseler fluid parameters show greater variation than other analyses, with the fluid temperature range providing a more stable indicator than the maximum fluidity. Most samples show no decrease or a gradual decrease. DECS-15 and -17 show the most strongly decreasing trends, but still maintain a significant portion of their fluid behavior after 7 years in storage. Sulfate sulfur has not increased in most samples, showing that the storage protocol allows little or no oxidation of pyritic sulfur to sulfate. Increases in the sulfate sulfur trend beyond the 0.02% repeatability interval occur only in DECS-15 and 18, and only because of high levels in this quarter's analysis. Lower levels in the future could lower the trend to essentially level once again.

Task 1D. Collection and Processing of Replacement Samples

Collection and processing of 11 samples, as described in the Revised Statement of Work (Sept. 6, 1996), have been completed. Portions of each of the 22 DECS samples collected under the previous contract were processed to minus 0.25 mm (minus 60 mesh); the final two were completed during the quarter. When the stock of 2.3 kg (5 lb) bags of a specific sample has been distributed, additional bags are split out from larger bulk storage bags.

Task 1E. Basic Characterization of Coal Samples

All basic characterization of samples planned for collection under the contract has been completed. During the quarter, analyses for hazardous air pollutant elements were performed on samples DECS-1 through DECS-22, which had been collected under the previous contract. This completed the set of such analyses for all DECS samples (1 through 33); results are shown in Table 1.

Task 1F. Liquefaction Testing

In this Task, appropriate samples were subjected to a standardized liquefaction test and subsequent product workup. Analytical work in this Task has been completed, although the total number of samples tested was reduced following a cut in the level of funding. Review and synthesis of the data were presented in the previous Quarterly Technical Progress Report.

Task 1G. Investigation of Changes in Surface Chemistry During Storage

This Task has been discontinued.

Table 1. Hazardous Air Pollutant Element Analyses of DECS samples, in ppm dry coal.

DECS										
#	St	Rank	As	Ba	Cd	Cr	Pb	Hg	Se	Ag
1	TX	subC	3.	133.	<0.2	8.	9.	0.17	<1.0	<0.2
2	IL	hvCb	4.	40.	<0.2	18.	15.	0.05	<1.0	<0.2
3	CO	mvb	<1.	175.	<0.2	2.	5.	0.08	<1.0	<0.2
4	NM	hvCb	<1.	56.	<0.2	3.	6.	<0.02	<1.0	<0.2
5	UT	hvCb	<1.	69.	<0.2	4.	4.	<0.02	<1.0	<0.2
6	UT	hvAb	<1.	68.	<0.2	4.	3.	0.03	<1.0	<0.2
7	WY	hvCb	1.	20.	<0.2	2.	4.	0.02	<1.0	<0.2
8	WY	subC	2.	227.	<0.2	8.	6.	0.03	<1.0	<0.2
9	MT	subB	1.	191.	<0.2	3.	4.	0.04	<1.0	<0.2
10	MT	subB	<1.	91.	<0.2	4.	10.	<0.2	<1.0	<0.2
11	ND	ligA	2.	209.	<0.2	2.	4.	<0.02	<1.0	<0.2
12	PA	hvAb	6.	62.	<0.2	17.	6.	0.11	<1.0	<0.2
13	WV	mvb	18.	106.	0.9	9.	4.	0.08	<1.0	<0.2
14	WV	hvAb	36.	40.	1.9	18.	11.	0.40	<1.0	<0.2
15	UT	hvAb	<1.	49.	<0.2	4.	2.	0.06	<1.0	<0.2
16	UT	hvAb	<1.	54.	<0.2	13.	8.	0.06	<1.0	<0.2
17	UT	hvAb	<1.	51.	<0.2	4.	2.	0.04	<1.0	<0.2
18	KY	hvBb	4.	43.	<0.2	9.	8.	0.09	<1.0	<0.2
19	VA	lvb	12.	157.	0.8	6.	4.	0.08	<1.0	<0.2
20	KY	hvAb	3.	90.	0.8	8.	7.	0.06	<1.0	<0.2
21	PA	an	<1.	19.	<0.2	20.	12.	0.10	<1.0	<0.2
22	PA	hvAb	13.	43.	<0.2	29.	16.	0.60	<1.0	<0.2
23	PA	hvAb	13.	56.	<0.2	13.	6.	0.12	<1.0	<0.2
24	IL	hvCb	2.	48.	<0.3	22.	10.	0.11	4.0	<0.3
25	MT	ligA	2.	520.	<0.3	2.	9.	0.14	3.0	<0.3
26	WY	subB	1.	300.	<0.2	4.	5.	0.12	2.0	<0.2
27	WY	subA	2.	480.	<0.3	9.	13.	0.10	3.0	<0.3
28	AZ	hvCb	1.	310.	<0.2	2.	5.	0.04	2.0	<0.2
29	VA	hvAb	4.	98.	<0.2	6.	7.	0.04	1.0	<0.2
30	VA	mvb	19.	74.	<0.1	6.	4.	0.11	2.0	<0.1
31	KY	hvAb	5.	100.	<0.3	15.	17.	0.04	4.0	<0.3
32	WV	hvAb	5.	160.	<0.5	35.	27.	0.04	5.0	<0.5
33	OH	hvBb	4.	39.	<0.3	16.	<3.	0.09	5.0	<0.3

Task 1H. Organic Geochemistry

Selected DECS coal samples were subjected to a series of organic geochemical tests to provide baseline data for the various coals studied as part of this project. The tests were basically solid-state ^{13}C NMR (CPMAS, DDMAS and Bloch decay) analyses and pyrolysis/gas chromatography/mass spectrometry; review and synthesis of the data was presented in the previous Quarterly Technical Progress Report.

Task 1I. Distribution of Coal Samples to Users

During the period 7/01/98 - 9/30/98 a total of 45 samples (29 DOE Sample Bank samples and 16 other Penn State samples) of various sizes in 85 containers were distributed. See Task 2C for a list of sample and data recipients. This task will continue in the same manner through the next quarter. A summary of samples distributed during the five-year contract is shown in Table 2.

Task 2A. Programming

Programming of a new system for standard formatted report printouts of Coal Database data continued during the quarter. Methods to quickly produce reports for individual samples were reviewed. The mainframe computer printing system previously used was discontinued by the University's Center for Academic Computing on June 1, 1998. See also the discussion of the world wide web site under Task 2C, 'Distribution of Data to Users.'

Task 2B. Data Entry

Entry of basic characterization data for the 11 samples collected under the contract has been completed.

Task 2C. Distribution of Data to Users

During the quarter a total of 101 data printouts were distributed. In addition, 4 special data requests were filled by database searches and printed output or creation of a data disk, resulting in distribution of information on 1237 samples. Table 2 summarizes distribution of data through the five-year contract period. Requests for general Sample Bank and Database information were filled during the quarter. This task will continue in the same manner through the next quarter.

Table 2. Samples and data distributed 9/29/93 to 9/30/98 under contract number DE-AC22-93PC93051

	DOE samples (excl. DECS-17)			Other PSOC samples						Special data requests		
Quarter ending	Total	to DOE contractor	to others	Total	to DOE contractor	to others	Total samples	Total containers	Print-outs	#	limited information on # samples	Total requests
12/93	25	19	6	3	1	2	28	42	42	11	2229	23
3/94	8	5	3	4	1	3	12	25	25	4	543	18
6/94	16	13	3	30	0	30	46	56	157	7	422	23
9/94	36	26	10	32	6	26	68	155	104	8	1268	31
12/94	19	19	0	1	0	1	20	26	66	5	215	16
3/95	25	14	11	12	5	7	37	68	150	19	2530	38
6/95	94	30	64	16	1	15	110	125	60	10	449	29
9/95	20	10	10	1	1	0	21	47	41	3	790	21
12/95	13	6	7	2	0	2	15	31	48	5	235	15
3/96	16	14	2	3	2	1	19	28	136	8	325	19
6/96	31	22	9	34	3	31	65	103	84	16	3826	30
9/96	24	17	7	2	0	2	26	48	41	10	2018	17
12/96	18	17	1	9	4	5	27	49	139	17	3289	27
3/97	25	14	11	6	4	2	31	34	177	10	2117	21
6/97	15	11	4	27	3	24	42	88	66	17	1765	23
9/97	27	15	12	106	95	11	133	143	291	15	4002	20
12/97	39	26	13	2	1	1	41	50	160	6	102	17
3/98	9	9	0	2	0	2	11	18	139	121	2549	34
6/98	19	10	9	0	0	0	19	47	90	20	416	30
9/98	29	10	19	16	0	16	45	85	101	4	1237	452
TOTAL	508	307	201	305	127	179	788	1226	2075	316	30327	463
TOTAL including DECS-17*	524	323	201	305	127	179	804	1501	2075	316	30327	463

*including 225 bags of DECS-17 (16 requests)

Organizations supplied with coal samples and/or data during the quarter include:

APTI Geoscience Operations
Brown University, Engineering Division
Centenary College, Chemistry Department
Emission Monitoring, Inc.
Larsen, Mr. David
Pennsylvania State University, Energy and Geoenvironmental Engineering Dept. (2)
Shell Exploration and Production Technology Company (2)
University of Cincinnati, Chemical Engineering Department
University of Maryland of the Eastern Shore, Natural Sciences Department

The numbers in parentheses represent multiple requests which were separately processed.

Additional clients have received information via a world wide web site (<http://www.ems.psu.edu/COPL/>), which was accessed 585 times during the quarter by those outside the Coal and Organic Petrology Laboratories. It includes a table of basic data for the 56 samples supported under the current contract, and a searchable database of those and 522 other samples from the Penn State Coal Database. The Department of Energy Coal Sample Bank and Database section of the web site was accessed 154 times during the quarter, and pages for individual DECS samples were accessed 131 times.

CONCLUSIONS

The coal samples and data supported under this project are being used on an ongoing basis by DOE contractors and others performing coal research. Sample collection, processing, analysis, and monitoring has been completed.

Samples collected under the current contract are stored in argon under refrigeration in multilaminate bags which have demonstrated an ability to preserve the properties of the fresh coal. All 33 DECS samples are now available for immediate distribution in three sizes of foil laminate bags: 2.3 kg of minus 6.4 mm (-1/4 inch) coal, 300 g of minus 0.85 mm (-20 mesh U.S.) coal, and 75 g of minus 0.25 mm (-60 mesh U.S.) coal. Samples and data will continue to be distributed from the DOE Coal Sample Bank and Database to other DOE contractors during the six-month contract extension.

The fifth annual program to monitor sample preservation in foil laminate bags showed that most samples continue to exhibit little change in fluid behavior, sulfate sulfur levels and calorific value. Two samples showed a continuing trend of significant decrease in fluid properties, and two showed higher than usual sulfate sulfur in this annual monitoring program. Monitoring in future years would be useful to further examine these trends.

APPENDIX. Monitoring of DOE Sample Bank Coals to Evaluate Sample Condition after Storage

DECS-2	Illinois #6 seam		hvCb		Ro max= 0.52 %				
FOIL BAG	original analysis	21 of 256	100 of 256	109 of 256	114 of 256	136 of 256	138 of 256	152 of 256	155 of 256
particle size stored		-20 mesh	-20 mesh	-20 mesh	115 of 256 -20 mesh	-20 mesh	-20 mesh	-20 mesh	-20 mesh
note									
date sealed		8/ 06/ 90	8/ 06/ 90	8/ 06/ 90	8/ 06/ 90	8/ 06/ 90	8/ 06/ 90	8/ 06/ 90	8/ 06/ 90
date analyzed	2/ 28/ 90	1/ 25/ 91	11/ 27/ 92	6/ 14/ 93	3/ 23/ 94	5/ 23/ 95	2/ 13/ 96	7/ 31/ 97	7/ 28/ 98
PROXIMATE									
% moisture	10.4	10.3	10.1	9.8	9.6	10.2	10.0	10.2	9.9
% ash (dry basis)	16.2	16.1	16.2	15.9	16.1	15.9	16.0	16.1	16.3
SULFUR FORMS (dry %)									
total sulfur	4.51	4.33	4.54	4.50	4.64	4.62	4.59	4.63	4.78
sulfate	0.01	0.06	0.01	0.03	0.01	0.04	0.01	0.07	0.03
pyritic	2.27	2.27	2.31	2.06	1.92	2.06	2.27	2.35	2.46
organic	2.24	2.00	2.22	2.41	2.72	2.51	2.30	2.21	2.29
CALORIFIC VALUE (dry)									
Btu/lb	11880	11740	11814	11787	11895	11833	11813	11794	11752
GIESELER FLUIDITY									
maximum fluidity, ddpm	8	9	10	7	8	11	9	6	12
fluid range, °C	47	58	61	55	63	64	58	57	54
date analyzed	2/ 08/ 90	2/ 11/ 91	2/ 02/ 93	7/ 19/ 93	3/ 07/ 94	5/ 09/ 95	1/ 23/ 96	7/ 22/ 97	7/ 02/ 98
FREE SWELLING INDEX	3.5				3.5	3.5	2.5	3	5
GASEOUS OXYGEN									(a)
% in bag atmosphere					0.12	0.00	0.17	0.08	0.00
date analyzed					3/ 08/ 94	5/ 09/ 95	1/ 18/ 96	7/ 21/ 97	7/01/ 98

(a) less than usual accuracy but definitely no significant oxygen

APPENDIX. Monitoring of DOE Sample Bank Coals to Evaluate Sample Condition after Storage

DECS-8	Smith-Roland seam	subC	Ro max= 0.37 %					
FOIL BAG	original analysis	27 of 256	127 of 256	138 of 256	144 of 256	159 of 256	65 of 256	71 of 256
particle size stored		-20 mesh	-20 mesh	-20 mesh	-20 mesh	-20 mesh	-20 mesh	-20 mesh
note								
date sealed		10/ 22/ 90	10/ 22/ 90	10/ 22/ 90	10/ 22/ 90	10/ 22/ 96	10/ 22/ 90	10/ 22/ 90
date analyzed	10/ 30/ 90	10/ 21/ 92	6/ 03/ 93	3/ 23/ 94	5/ 09/ 95	2/ 13/ 96	8/ 01/ 97	7/ 28/ 98
PROXIMATE								
% moisture	28.4	28.3	28.6	28.1	28.6	28.7	28.6	28.9
% ash (dry basis)	13.8	12.8	13.1	13.0	13.6	13.0	13.1	13.0
SULFUR FORMS (dry %)								
total sulfur	0.73	0.77	0.81	0.95	0.87	0.80	0.78	0.82
sulfate	0.02	0.01	0.01	0.00	0.01	0.01	0.00	0.01
pyritic	0.28	0.20	0.22	0.22	0.27	0.25	0.31	0.31
organic	0.43	0.56	0.58	0.72	0.58	0.54	0.47	0.50
CALORIFIC VALUE (dry)						(a)		
Btu/lb	11168	11275	11287	11244	11210	11263	11223	11215
GASEOUS OXYGEN								(b)
% in bag atmosphere				0.08	0.14	0.28	0.13	0.00
date analyzed				3/ 08/ 94	5/ 09/ 95	1/ 18/ 96	7/ 21/ 97	7/ 02/ 98

(a) result from repeat analysis 4/29/96, change from Quarterly Technical Progress Report dated 4/25/96.

(b) less than usual accuracy but definitely no significant oxygen

APPENDIX. Monitoring of DOE Sample Bank Coals to Evaluate Sample Condition after Storage

DECS- 12	Pittsburgh seam	hvAb			Ro max= 0.87 %				
FOIL BAG	original analysis	86 of 256	117 of 256	120 of 256	132 of 256	142 of 256	155 of 256	173 of 256	62 of 256
particle size stored		-20 mesh	-20 mesh	-20 mesh	-20 mesh	-20 mesh	-20 mesh	-20 mesh	-20 mesh
note									
date sealed		7/ 30/ 90	7/ 30/ 90	7/ 30/ 90	7/ 30/ 90	7/ 30/ 90	7/ 30/ 90	7/ 30/ 90	7/ 30/ 90
date analyzed	8/ 23/ 90	7/ 31/ 91	10/ 23/ 92	6/ 04/ 93	3/ 23/ 94	5/ 23/ 95	2/ 13/ 96	7/ 30/ 97	7/ 29/ 98
PROXIMATE									
% moisture	2.40	2.47	2.99	1.98	2.35	2.46	2.23	2.41	2.31
% ash (dry basis)	10.25	11.05	10.35	9.52	9.86*	9.69	9.34	10.12	10.8
SULFUR FORMS (dry %)									
total sulfur	1.12	1.18	1.16	1.17	1.16	1.16	1.16	1.26	1.19
sulfate	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.01
pyritic	0.38	0.29	0.17	0.35	0.35	0.39	0.40	0.53	0.46
organic	0.73	0.88	0.98	0.82	0.81	0.76	0.74	0.73	0.73
CALORIFIC VALUE (dry)									
Btu/lb	13532	13337	13471	13563	13534	13603	13646	13481	13397
GIESELER FLUIDITY					(a)				
maximum fluidity, ddpm	20002	6458	4309	2173	7866	6986	17800	20489	9152
fluid range, °C	90	90	75	80	86	83	87	89	81
date analyzed	7/ 27/ 90	7/ 24/ 91	10/ 27/ 92	7/ 21/ 92	3/ 09/ 94	5/ 10/ 95	1/ 24/ 96	7/ 18/ 97	7/ 03/ 98
FREE SWELLING INDEX	7.5				8	8	8	9	8.5
GASEOUS OXYGEN									(b)
% in bag atmosphere					0.01	0.04	0.00	0.04	0.00
date analyzed					3/ 08/ 94	5/ 10/ 95	1/ 18/ 96	7/ 18/ 97	7/ 02/ 98

(a) based on two of three runs which agreed within ASTM limits

* correction of Quarterly Technical Progress Report dated 10/14/94

(b) less than usual accuracy but definitely no significant oxygen

APPENDIX. Monitoring of DOE Sample Bank Coals to Evaluate Sample Condition after Storage

DECS- 14 Upper Kittanning seam hvAb Ro max= 1.07 %								
FOIL BAG	original analysis	6 of 256	20 of 256	11 of 256	16 of 256	23 of 256	24 of 256	25 of 256
particle size stored		-20 mesh	-20 mesh	-20 mesh	-20 mesh	-20 mesh	-20 mesh	-20 mesh
note								
date sealed	2/ 15/ 91	2/ 08/ 91	2/ 08/ 91	2/ 08/ 91	2/ 08/ 91	2/ 08/ 91	2/ 08/ 91	2/ 08/ 91
date analyzed		11/ 27/ 92	6/ 15/ 93	3/ 24/ 94	5/ 23/ 95	2/ 13/ 96	7/ 31/ 97	7/ 28/ 98
PROXIMATE								
% moisture	1.5	1.7	1.4	1.8	1.7	1.6	1.7	1.6
% ash (dry basis)	10.5	10.3	10.6	10.5	10.7	10.3	10.8	10.4
SULFUR FORMS (dry %)								
total sulfur	1.80	1.71	1.80	1.79	1.86	1.90	1.96	1.89
sulfate	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
pyritic	0.94	0.08	1.02	1.01	1.03	1.15	1.25	1.14
organic	0.85	1.62	0.78	0.77	0.82	0.74	0.71	0.75
CALORIFIC VALUE (dry) Btu/lb	13678	13723	13701	13803	13602	13739	13621	13760
GIESELER FLUIDITY								
maximum fluidity, ddpm	29930	27625	23619	29836	29945	29953	28578	29814
fluid range, °C	109	108	104	108	110	108	108	110
date analyzed	2/ 19/ 91	2/ 04/ 93	7/ 23/ 93	3/ 10/ 94	5/ 16/ 95	1/ 24/ 96	7/ 23/ 97	7/ 03/ 98
FREE SWELLING INDEX	8			7.5	8	7.5	9.0	8.5
GASEOUS OXYGEN					(a)			(a)
% in bag atmosphere				0.04	0	0.08	0.06	0.00
date analyzed				3/ 08/ 94	5/ 15/ 95	1/ 18/ 96	7/ 22/ 97	7/ 02/ 98

(a) less than usual accuracy but definitely no significant oxygen

APPENDIX. Monitoring of DOE Sample Bank Coals to Evaluate Sample Condition after Storage

DECS-15	Lower Sunnyside seam		hvAb	Ro max= 0.80 %				
FOIL BAG	original analysis	3 of 256	6 of 256	5 of 256	8 of 256	10 of 256	11 of 256	14 of 256
particle size stored		-20 mesh	-20 mesh	-20 mesh	-20 mesh	-20 mesh	-20 mesh	-20 mesh
note								
date sealed	7/ 05/ 91	10/ 15/ 92	10/ 15/ 92	10/ 15/ 92	10/ 15/ 92	10/ 15/ 92	10/ 15/ 92	10/ 15/ 98
date analyzed		11/ 27/ 92	6/ 15/ 93	3/ 24/ 94	5/ 23/ 95	2/ 13/ 96	7/ 31/ 97	7/ 28/ 98
PROXIMATE								
% moisture	2.9	2.9	2.6	3.1	3.0	3.0	3.2	3.0
% ash (dry basis)	10.0	10.1	9.8	9.8	10.0	10.1	10.4	10.1
SULFUR FORMS (dry %)								
total sulfur	1.65	1.75	1.62	1.64	1.66	1.58	1.65	1.63
sulfate	0.05	0.03	0.02	0.02	0.02	0.05	0.05	0.07
pyritic	0.61	0.94	0.69	0.76	0.70	0.77	0.76	0.77
organic	0.99	0.78	0.91	0.87	0.94	0.76	0.83	0.79
CALORIFIC VALUE (dry) Btu/lb	13429	13275	13396	13553	13415	13295	13180	13334
GIESELER FLUIDITY								
maximum fluidity, ddpm	959	258	170	215	246	60	68	78
fluid range, °C	76	75	69	70	72	63	66	68
date analyzed	6/ 13/ 91	2/ 05/ 93	7/ 26/ 93	3/ 11/ 94	5/ 11/ 95	1/ 25/ 96	7/ 23/ 97	7/ 06/ 98
FREE SWELLING INDEX	4.5			4	4.5	3.5	5.5	5.5
GASEOUS OXYGEN					(a)			(a)
% in bag atmosphere				0.04	0	0.18	0.01	0.00
date analyzed				3/ 08/ 94	5/ 11/ 95	1/ 18/ 96	7/ 22/ 97	7/ 05/ 98

(a) less than usual accuracy but definitely no significant oxygen

APPENDIX. Monitoring of DOE Sample Bank Coals to Evaluate Sample Condition after Storage

DECS-17 REFRIGERATED, -20 MESH Blind Canyon seam hvAb Ro max=0.59 %								
FOIL BAG	original analysis	204 of 256	205 of 256	17 of 256	10 of 256	11 of 256	12 of 256	13 of 256
particle size stored		-20 mesh	-20 mesh	-20 mesh	-20 mesh	-20 mesh	-20 mesh	-20 mesh
note								
date sealed		12/ 04/ 91	12/ 04/ 91	12/ 04/ 91	12/ 04/ 91	12/ 04/ 91	12/ 04/ 91	12/ 04/ 91
date analyzed	8/ 27/ 91	4/ 16/ 93	6/ 15/ 93	4/ 26/ 94	5/ 23/ 95	2/ 13/ 96	7/ 31/ 97	7/ 28/ 98
PROXIMATE								
% moisture	3.7	3.9	3.8	3.9	4.1	4.0	4.1	4.0
% ash (dry basis)	6.6	6.6	6.7	6.4	6.5	6.7	6.7	6.4
SULFUR FORMS (dry %)								
total sulfur	0.44	0.43	0.42	0.47	0.44	0.43	0.43	0.44
sulfate	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01
pyritic	0.02	0.03	0.05	0.04	0.04	0.04	0.06	0.06
organic	0.41	0.39	0.36	0.43	0.39	0.38	0.37	0.37
CALORIFIC VALUE (dry)								
Btu/lb	13826	13869	13904	13926	13745	13942	13861	13872
GIESELER FLUIDITY								
maximum fluidity, ddpm	5	4	2	2	2	2	3	3
fluid range, °C	55	52	47	44	48	46	48	43
date analyzed	8/ 16/ 91	10/ 28/ 92	7/ 27/ 93	4/ 20/ 94	5/ 16/ 95	1/ 26/ 96	7/ 24/ 97	7/ 07/ 98
FREE SWELLING INDEX	2			2	2.5	1.5	2	4.5
GASEOUS OXYGEN					(a)			(a)
% in bag atmosphere				0.00	0	0.10	0.00	0.00
date analyzed				4/ 20/ 94	5/ 16/ 95	1/ 18/ 96	7/ 22/ 97	7/ 06/ 98

(a) less than usual accuracy but definitely no significant oxygen

APPENDIX. Monitoring of DOE Sample Bank Coals to Evaluate Sample Condition after Storage

DECS-18	Kentucky #9 seam	hvBb	Ro max= 0.56			
FOIL BAG	original analysis	3 of 256	2 of 256	5 of 256	8 of 256	15 of 256
particle size stored		-20 mesh	-20 mesh	-20 mesh	-20 mesh	-20 mesh
note						
date sealed		10/ 09/ 92	10/ 09/ 92	10/ 09/ 92	10/ 09/ 92	10/ 09/ 92
date analyzed	11/ 22/ 91	6/ 18/ 93	4/ 26/ 94	5/ 25/ 95	2/ 13/ 96	7/ 28/ 98
PROXIMATE						
% moisture	6.8	7.3	7.4	7.4	7.1	7.5
% ash (dry basis)	12.3	11.3	11.8	11.7	11.7	12.2
SULFUR FORMS (dry %)						
total sulfur	4.21	3.91	3.97	4.02	4.05	4.16
sulfate	0.01	0.04	0.04	0.03	0.01	0.13
pyritic	2.37	1.78	1.99	1.71	2.03	1.91
organic	1.83	2.10	1.94	2.27	2.01	2.13
CALORIFIC VALUE (dry)						
Btu/lb	12687	12763	12794	12723	12818	12688
GIESELER FLUIDITY						
maximum fluidity, ddpm	527	409	159	677	513	421
fluid range, °C	80	74	73	90	82	70
date analyzed	2/ 11/ 93	7/ 29/ 93	4/ 11/ 94	5/ 12/ 95	1/ 25/ 96	7/ 07/ 98
FREE SWELLING INDEX	2		3	4	3.5	6
GASEOUS OXYGEN				(a)		(a)
% in bag atmosphere			0.21	0	0.09	0.00
date analyzed			3/ 29/ 94	5/ 12/ 95	1/ 18/ 96	7/ 06/ 98

(a) less than usual accuracy but definitely no significant oxygen

APPENDIX. Monitoring of DOE Sample Bank Coals to Evaluate Sample Condition after Storage

DECS-23	Pittsburgh seam	hvAb		Ro max= 0.73 %	
FOIL BAG	original analysis	17 of 256	18 of 256	19 of 256	16 of 256
particle size stored		-20 mesh	-20 mesh	-20 mesh	-20 mesh
note					
date sealed		2/ 11/ 94	2/ 11/ 94	2/ 11/ 94	2/ 11/ 94
date analyzed	2/ 21/ 94	2/ 08/ 95	11/ 30/ 95	7/ 30/ 97	7/ 28/ 98
PROXIMATE					
% moisture	2.00	2.03	2.09	2.13	2.12
% ash (dry basis)	9.44	9.64	9.67	9.61	9.60
SULFUR FORMS (dry %)					
total sulfur	3.87	3.79	3.66	3.89	4.09
sulfate	0.01	0.01	0.00	0.00	0.01
pyritic	2.23	2.42	2.45	2.73	2.72
organic	1.63	1.36	1.20	1.16	1.36
CALORIFIC VALUE (dry)					
Btu/lb	13614	13553	13565	13487	13628
GIESELER FLUIDITY					
maximum fluidity, ddpm	30000	30000	30000	30002	30000
fluid range, °C	97	106	100	104	101
date analyzed	2/ 07/ 94	1/ 23/ 95	11/ 28/ 95	7/ 15/ 97	7/ 09/ 98
FREE SWELLING INDEX	7.5	7	7.5	9	7
GASEOUS OXYGEN		(a)			(a)
% in bag atmosphere		0	not	0.00	0.00
date analyzed		5/ 16/ 95	determined	7/ 15/ 97	7/ 06/ 98

(a) less than usual accuracy but definitely no significant oxygen

APPENDIX. Monitoring of DOE Sample Bank Coals to Evaluate Sample Condition after Storage

DECS-24	Illinois #6 seam	hvBb	Ro max= 0.49 %		
FOIL BAG	original analysis	105 of 328	106 of 328	107 of 328	133 of 328
particle size stored		-20 mesh	-20 mesh	-20 mesh	-20 mesh
note					
date sealed		7/ 19/ 94	7/ 19/ 94	7/ 19/ 94	7/ 19/ 94
date analyzed	9/ 07/ 94	2/ 08/ 95	11/ 29/ 95	7/ 30/ 97	7/ 28/ 98
PROXIMATE					
% moisture	13.2	13.4	13.4	13.4	13.4
% ash (dry basis)	13.4	13.5	13.6	13.5	13.4
SULFUR FORMS (dry %)					
total sulfur	5.53	5.92	5.76	5.75	5.87
sulfate	0.25	0.01	0.01	0.06	0.01
pyritic	2.64	2.86	2.77	2.96	2.99
organic	2.64	3.05	2.98	2.73	2.88
CALORIFIC VALUE (dry)					
Btu/lb	12162	12074	12242	12203	12300
GIESELER FLUIDITY					
maximum fluidity, ddpm	49	55	53	54	56
fluid range, °C	78	82	82	74	76
date analyzed	6/ 14/ 94	1/ 24/ 95	11/ 29/ 95	7/ 16/ 97	7/ 09/ 98
FREE SWELLING INDEX	3	3.5	3.5	6	5.5
GASEOUS OXYGEN		(a)			(a)
% in bag atmosphere		0	not	0.00	0.00
date analyzed		5/ 16/ 95	determined	7/ 15/ 97	7/ 06/ 98

(a) less than usual accuracy but definitely no significant oxygen

APPENDIX A. Monitoring of DOE Sample Bank Coals to Evaluate Sample Condition after Storage

DECS-29	Upper Banner No. 3 seam	hvAb	Ro max= 1.00 %
FOIL BAG	original analysis	37 of 328	
particle size stored		-20 mesh	
note			
date sealed		7/ 10/ 95	
date analyzed	8/ 10/ 95	7/ 28/ 98	
PROXIMATE			
% moisture	2.4	2.3	
% ash (dry basis)	6.4	6.4	
SULFUR FORMS (dry %)			
total sulfur	0.59	0.59	
sulfate	0.01	0.01	
pyritic	0.09	0.17	
organic	0.50	0.41	
CALORIFIC VALUE (dry)			
Btu/lb	14543	14521	
GIESELER FLUIDITY			
maximum fluidity, ddpm	8942	10538	
fluid range, °C	90	84	
date analyzed	6/ 29/ 95	7/ 10/ 98	
FREE SWELLING INDEX	8	8.5	
GASEOUS OXYGEN		(a)	
% in bag atmosphere		0.00	
date analyzed		7/ 06/ 98	

(a) less than usual accuracy but definitely no significant oxygen