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FINAL

TECHNICAL PROGRESS REPORT

For the period:

January 1, 1993, through December 31, 1993

Prepared for:

Rosebud SynCoal Partnership
Advanced Coal Conversion Process Demonstration
Colstrip, Montana

DOE Contract
DE-FC22-90PC89664

We have no objection from a patent standpoint to the publication or dissemination of this material.

Mark P Dvorscak 4/4/96

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United States Department of Energy
Pittsburgh Energy Technology Center

LEGAL NOTICE

Table of Contents

1.0 INTRODUCTION AND PURPOSE

This report describes the technical progress made on the Advanced Coal Conversion Process (ACCP) Demonstration Project from January 1, 1993, through December 31, 1993.

The ACCP Demonstration Project is a U.S. Department of Energy (DOE) Clean Coal Technology Project. The Cooperative Agreement defining this project is between DOE and the Rosebud SynCoal Partnership. In brief, Western Energy Company, which is a coal mining subsidiary of Entech, Inc., Montana Power Company's (MPC's) non-utility group in Colstrip, Montana, was the original proposer for the ACCP Demonstration Project and Cooperative Agreement participant. To further develop the ACCP technology, Entech created Western SynCoal Company. After the formation of the Rosebud SynCoal Partnership, Western Energy Company formally novated the Cooperative Agreement to the Rosebud SynCoal Partnership to facilitate continued participation in the Cooperative Agreement. The Rosebud SynCoal Partnership is a partnership between Western SynCoal Company and Scoria, Inc., a subsidiary of NRG Energy, Inc., Northern States Power's non-utility group.

This project demonstrates an advanced, thermal, coal drying process, coupled with physical cleaning techniques, that is designed to upgrade high-moisture, low-rank coals to a high-quality, low-sulfur fuel, registered as the SynCoal® process. The coal is processed through three stages (two heating stages followed by an inert cooling stage) of vibrating fluidized bed reactors that remove chemically bound water, carboxyl groups, and volatile sulfur compounds. After thermal processing, the coal is put through a deep-bed stratifier cleaning process to separate the pyrite-rich ash from the coal.

The SynCoal® process enhances low-rank, western coals, usually with a moisture content of 25 to 55 percent, sulfur content of 0.5 to 1.5 percent, and heating value of 5,500 to 9,000 British thermal units per pound (Btu/lb), by producing a stable, upgraded, coal product with a moisture content as low as 1 percent, sulfur content as low as 0.3 percent, and heating value up to 12,000 Btu/lb.

The 45-ton-per-hour unit is located adjacent to a unit train loadout facility at Western Energy Company's Rosebud coal mine near Colstrip, Montana. The demonstration plant is sized at about one-tenth the projected throughput of a multiple processing train commercial facility. The demonstration thermal processing and cooling equipment is currently near commercial size.

2.0 PROJECT PROGRESS

2.1 SIGNIFICANT ACCOMPLISHMENTS

Rosebud SynCoal Partnership's ACCP Demonstration Facility entered Phase III, Demonstration Operation, in April 1992 and operated in an extended startup mode through August 10, 1993, when the facility became commercial. Rosebud SynCoal Partnership instituted an aggressive program to overcome startup obstacles and now focuses on supplying product coal to customers. Significant accomplishments in the history of the SynCoal® process development are shown in Appendix A. Table 2.1 lists the significant accomplishments for the year to date.

Table 2.1. Significant Accomplishments for 1993

Period	Significant Accomplishments
January 1993	• Trucked 3,494 tons to Colstrip Units 3 and 4. • Continued process testing to reduce spontaneous combustion tendency. • Installed a CO_2 inerting system for the silos. • Produced 200 tons of passivated product that lasted 13 days in the open storage pile. • The plant had a 53 percent operating factor for the month with only a single train in operation. • Identified dryer reactor structural design problem. • Installed silo inerting system. • Started process fines handling modification design.
February 1993	• Stored approximately 1,200 tons of SynCoal® in an inerted product silo. • The plant had a 62 percent operating factor between January 1 and February 15. • Shipped 174 tons of SynCoal® to MPC's J.E. Corette Plant by rail. • Trucked 741 tons of SynCoal® to Colstrip Units 3 and 4. • Continued process testing to reduce spontaneous combustion tendency and dustiness.
March 1993	• Stored approximately 4,650 tons of SynCoal® in an inerted product silo. • Identified an environmentally compatible dust suppressant that inhibits dust release from the SynCoal® product. • Identified a car-topping compound to keep SynCoal® from flying out of open rail cars. • Shipped 352 tons of SynCoal® to MPC's J.E. Corette Plant by rail. • Trucked 277 tons of SynCoal® to Colstrip Units 3 and 4. • Continued process testing to reduce spontaneous combustion tendency and dustiness. • Completed annual Mine Safety & Health Administration (MSHA) safety training.

Table 2.1. Significant Accomplishments for 1993 (cont'd.)

April 1993	• Stored approximately 6,500 tons of SynCoal® in inerted product silos. • Completed first lignite test. • Continued testing methods to reduce spontaneous combustion tendency and dustiness.
May 1993	• Stored approximately 4,000 tons of SynCoal® in inerted product silos. • 462 tons of SynCoal® delivered to MPC Corette Plant by rail. • Started belt blending trials. • Continued testing methods to reduce spontaneous combustion tendency and dustiness. • Tested nearly 700 tons of BNI lignite as a potential process feedstock achieving approximately 11,000 Btu/lb heating value and substantially reducing the sulfur in the resultant product. • Tested over 500 tons of BNI lignite.
June 1993	• Stored approximately 4,000 tons of SynCoal® in inerted product silos. • Approximately 110 tons of SynCoal® delivered to industrial customers by truck. • Continued testing methods to reduce spontaneous combustion tendency and dustiness. • Shut down for maintenance and fines handling modifications June 6, 1993.
July 1993	• Stored approximately 4,000 tons of SynCoal® in inerted product silos. • Continued testing methods to reduce spontaneous combustion tendency and dustiness. • Identified two types of reactors and attendant processors for stability. • Identified a conditioning method that inhibits spontaneous combustion and dust. • Continued major maintenance and fines handling activities.

Table 2.1. Significant Accomplishments for 1993 (cont'd.)

August 1993	• Stored approximately 4,000 tons of SynCoal® in inerted product silos and open stockpiled 2,000 to 3,000 tons for managed pile stabilization. • Continued testing methods to reduce spontaneous combustion tendency and dustiness. • ACCP process evaluated for emission limits and found to be in compliance with air quality permit. • Stopped blending testing. • The facility became commercial on August 10, 1993. • Completed major outage with new fines handling system. Plant was operational with both trains in operation.
September 1993	• Stored approximately 9,000 tons of SynCoal® in inerted product silos and stabilized 2,000 to 3,000 tons in a managed open stockpile. • Continued testing methods to reduce spontaneous combustion tendency and dustiness. • The plant operated at an 84 percent operating factor and a 62 percent capacity factor for the month. • Shipped 3,778 tons of SynCoal® to various customers. • Tested nearly 700 tons of BNI lignite as a potential process feedstock achieving approximately 11,000 Btu/lb heating value and substantially reducing the sulfur in the resultant product. • Tested over 500 tons of BNI lignite.
October 1993	• Continued testing methods to reduce spontaneous combustion tendency and dustiness. • The plant operated at an 80 percent operating factor and a 66 percent capacity factor for the month. • Shipped 12,753 tons of SynCoal® to various customers. • Established a 75 percent availability rate. • Processed more coal since resuming operation in August than during the entire time from initial startup from the summer's maintenance outage (approximately 15 months). • Tested nearly 300 tons of Knife River, North Dakota, lignite as a potential process feedstock, achieving nearly 11,000 Btu/lb heating value and substantially reducing the sulfur content in the resultant product.

Table 2.1. Significant Accomplishments for 1993 (cont'd.)

November 1993	• **Continued testing methods to reduce spontaneous combustion tendency and dustiness.** • **The plant operated at an 88 percent operating factor and a 74 percent capacity factor for the month.** • **Shipped 14,349 tons of SynCoal® to various customers.** • **Started design of a product stability process step** • **Continued a 75 percent availability rate.**
December 1993	• **Continued testing methods to reduce spontaneous combustion tendency and dustiness.** • **The plant operated at a 74 percent monthly production availability rate and a 69 percent capacity factor for the month.** • **Shipped 16,951 tons of SynCoal® to various customers**

2.2 PROJECT PROGRESS SUMMARY

The ACCP Demonstration facility was shut down for a complete maintenance turnaround, similar to an annual power plants turnaround, from June 6 to August 13, 1993. This shut down allowed for the reestablishment of a dual train operation and the installation of a new fines conveying, cooling, and loadout system. During the 11 weeks since operations were resumed, the plant has processed over 60,600 tons of raw coal, the facility's operating factor has improved to about 85 percent, and raw coal feed rate has increased to nearly 65 percent of nominal design capacity for the quarter. To date, about 186,107 tons of raw coal have been fed to the process, producing about 113,000 tons of uncleaned and cleaned product. Over 63,000 tons have been test shipped. A conditioning method that inhibits spontaneous combustion and dust has been identified; however, work continues to identify further suppressant options.

In addition to tests run on the Rosebud SynCoal®, two distinct tests were performed on North Dakota lignite feedstocks. Both feedstocks were upgraded to approximately 11,000 Btu/lb with a significant reduction in both sulfur and ash content. An important finding was that a lower percentage of fines were produced than earlier experienced resulting in cleaner product production.

During the Fourth Quarter of 1993, modifications and maintenance work required the following actions.

- Cleaned process gas heat exchanger.
- Repaired baghouse.
- Repaired failed rotary airlock bearing.
- Replaced two fan bearings.

Modifications and maintenance work conducted during the Third Quarter of 1993 required the following actions.

- Cleaned a plugged fines chute.
- Cleaned a fouled process heat exchanger.
- Commissioned the redesign of the process fines conveying and handling system.

During the Second Quarter of 1993, modifications and maintenance work required the following actions.

- Repaired first stage fan motor.
- Repaired furnace temperature transmitter.
- Repaired a ruptured expansion joint.
- Installed the new dust handling system.

During the First Quarter of 1993, modifications and maintenance work required the following actions.

- Modified the drag conveying and processed fines conveying equipment.
- Repaired structural cracks in the second-stage dryer/reactor.
- Repaired first-stage baghouse due to electrical problems which caused freezing, blocking, and eventually smoldering in the baghouse.

The product produced to date has been exceptionally close to the design basis product from a chemical standpoint. The typical product analyses are shown in Table 2.2.

Table 2.2. ACCP Quarterly Analyses Summary

	TM	PA	PS	HHV	SO_2
First Quarter Product					
Average	2.22	9.29	0.56	11,864	0.95
Standard Deviation	0.42	0.79	0.13	119	0.23
Min.	1.62	8.49	0.47	11,502	0.79
Max.	3.41	11.45	1.02	11,975	1.75
Second Quarter Product					
Average	2.58	9.11	0.56	11,781	0.94
Standard Deviation	0.26	0.24	0.04	129	0.07
Min.	1.93	8.47	0.49	11,305	0.83
Max.	3.10	9.60	0.66	12,018	1.13
Third Quarter Product					
Average	3.47	9.36	0.59	11,622	1.02
Standard Deviation	2.87	0.82	0.06	359	0.09
Min.	1.79	6.90	0.45	9,649	0.90
Max.	19.91	11.24	0.79	11,968	1.35
Fourth Quarter Product					
Average	2.31	9.79	0.61	11,808	1.03
Standard Deviation	0.93	0.81	0.05	161	0.08
Min.	1.25	8.42	0.52	11,292	0.88
Max.	5.39	13.09	0.71	12,882	1.21

TM - % Total Moisture PS - % Sulfur SO_2 - lbs. of SO_2/MMBtu
PA - % Ash HHV - Btu/lb.

During the next reporting period, the focus will continue on understanding and remedying the product's spontaneous heating problem, evaluating additional dust inhibitors, testing product blending, completing initial engineering design and identifying equipment for installing the new stability enhancement process, and scheduling test burns.

3.0 PROCESS DESCRIPTION

In general, the ACCP is a thermal processing and conversion process that uses combustion products and superheated steam as fluidizing gas in vibrating fluidized bed reactors. Two fluidized stages are used to thermally and chemically alter the coal, and one water spray stage followed by one fluidized stage is used to cool the coal. Other systems that service and assist the coal conversion system include:

- Coal Conversion;
- Coal Cleaning;
- Product Handling;
- Raw Coal Handling;
- Emission Control;
- Heat Plant;
- Heat Rejection; and
- Utility and Ancillary.

3.1 ORIGINAL DESIGN PROCESS DESCRIPTION

The designed central processes are depicted in Figure 3.1 on the proceeding page. The following discusses plant design aspects and expected results. Modifications and operating results are summarized in Section 3.2.

Coal Conversion

The coal conversion is performed in two parallel processing trains. Each train consists of two, 5-feet-wide by 30-feet-long vibratory fluidized bed thermal reactors in series, followed by a water spray section, and a 5-feet-wide by 25-feet-long vibratory cooler. Each processing train is fed up to 1,139 pounds per minute of 2-by-½ inch coal.

In the first-stage dryer/reactors, the coal is heated by direct contact with hot combustion gases mixed with recirculated dryer makegas, removing primarily surface water from the coal. The coal exits the first-stage dryer/reactors at a temperature slightly above that required to evaporate water. After the coal exits the first-stage dryer/reactor, it is gravity fed to the second-stage thermal reactors, which further heats the coal using a recirculating gas stream, removing water trapped in the pore structure of the coal and promoting chemical dehydration, decarbonylation, and decarboxylation. The water, which makes up the superheated steam used in the second stage, is actually produced from the coal itself. Particle shrinkage that occurs in the second stage liberates ash minerals and passes on a unique cleaning characteristic to the coal.

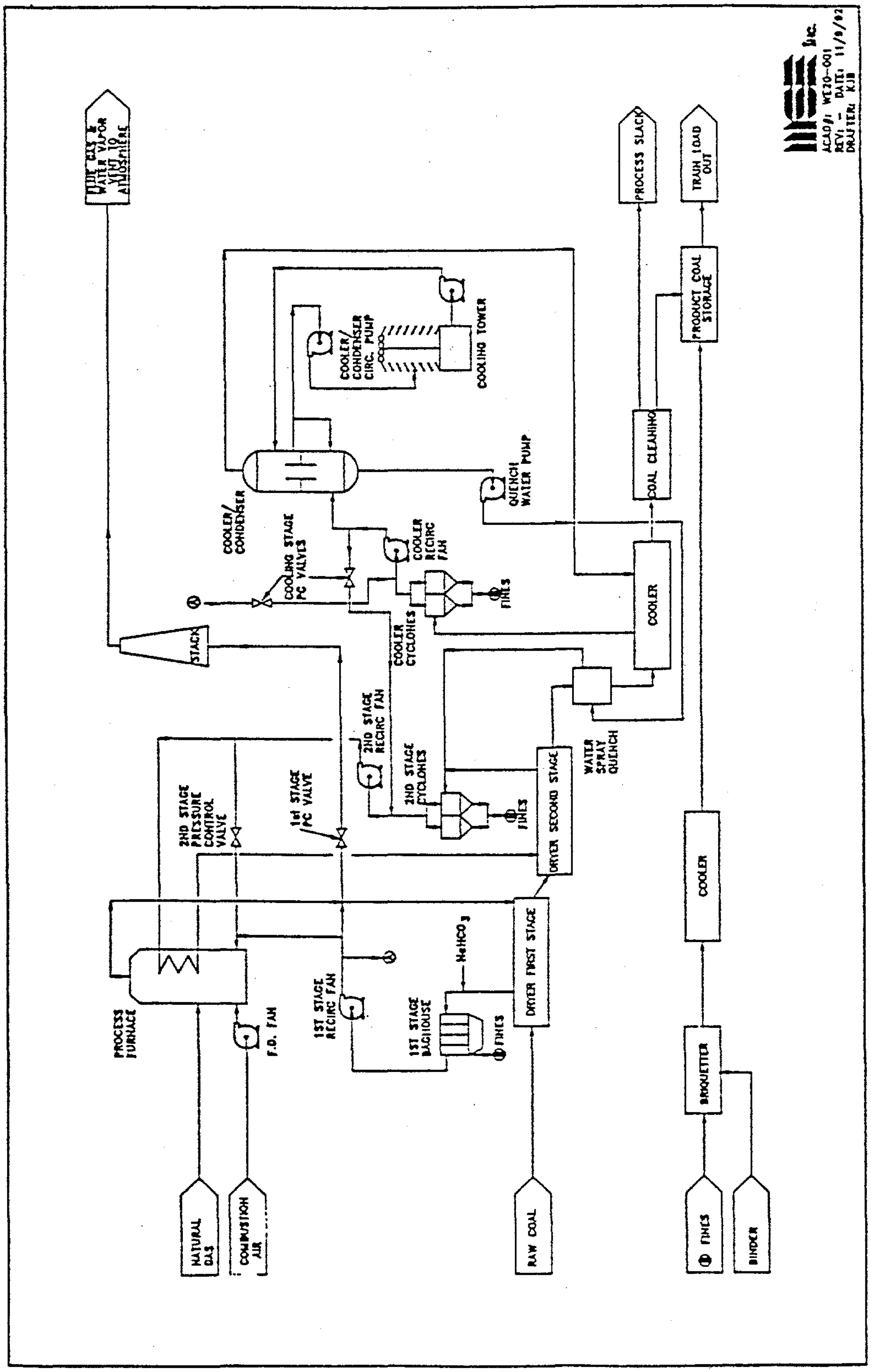

Figure 3.1 Central Processes

As the coal exits the second-stage thermal reactors, it falls through vertical quench coolers where process water is sprayed onto the coal to reduce the temperature. The water vaporized during this operation is drawn back into the second-stage thermal reactors. After water quenching, the coal enters the vibratory coolers where the coal is contacted by cool inert gas. The coal exits the vibratory cooler(s) at less than 150°F and enters the coal cleaning system. The gas that exits the vibratory coolers is dedusted in a twin cyclone and cooled by water sprays in direct contact coolers prior to returning to the vibratory coolers. Particulates are removed from the first-stage process gas by a pair of baghouses in parallel. The second-stage process gas is treated by a quad cyclone arrangement, and the cooler-stage process gas is treated by a twin cyclone arrangement.

Three interrelated recirculating gas streams are used in the coal conversion system; one each for the thermal reactor stages and one for the vibratory coolers.

Gases enter the process from either the natural gas-fired process furnace or from the coal itself. Combustion gases from the furnace are mixed with recirculated makegas in the first-stage dryer/reactors after indirectly exchanging some heat to the second-stage gas stream. The second-stage gas stream is composed mainly of superheated steam, which is heated by the furnace combustion gases in the heat exchanger. The cooler gas stream is made up of cooled furnace combustion gases that have been routed through the cooler loop.

A gas route is available from the cooler gas loop to the second-stage thermal reactor loop to allow system inerting. Gas may also enter the first-stage dryer/reactor loop from the second-stage loop (termed makegas) but without directly entering the first-stage dryer/reactor loop; rather, the makegas is used as an additional fuel source in the process furnace. The second-stage makegas contains various hydrocarbon gases that result from the thermal conversions associated with the mild pyrolysis and devolatilization. The final gas route follows the exhaust stream from the first-stage loop to the atmosphere.

Gas exchange from one loop to another is governed by pressure control on each loop, and after startup, will be minimal from the first-stage loop to the cooler loop and from the cooler loop to the second-stage loop. Gas exchange from the second-stage loop to first-stage loop (through the process furnace) may be substantial since the water vapor and hydrocarbons driven from the coal in the second-stage thermal reactors must leave the loop to maintain a steady state.

In each gas loop, particulate collection devices that remove dust from the gas streams protect the fans and, in the case of the first-stage baghouses, prevent any fugitive particulate discharge. Particulates are removed from the first-stage process gas by a pair of baghouses in parallel. The second-stage process gas is treated by a quad cyclone arrangement, and the cooler-stage process gas is treated by a twin cyclone arrangement.

Coal Cleaning

The coal entering the cleaning system is screened into four size fractions: plus ½ inch, ½ by ¼ inch, ¼ inch by 8 mesh, and minus 8 mesh. These streams are fed in parallel to four, deep-bed stratifiers (stoners) where a rough specific gravity separation is made using fluidizing air and a vibratory conveying action. The light streams from the stoners are sent to the product conveyor, and the heavy streams from all but the minus 8 mesh stream are sent to fluidized bed separators. The heavy fraction of the minus 8 mesh stream goes directly to the waste conveyor. The fluidized bed separators, again using air and vibration to effect a gravity separation, each split the coal into light and heavy fractions. The light stream is considered product, and the heavy or waste stream is sent to a 300-ton, storage bin to await transport to an off-site user or alternately back to a mined out pit disposal site. The converted, cooled, and cleaned SynCoal® product from coal cleaning enters the product handling system.

Product Handling

Product handling consists of the equipment necessary to convey the clean, granular SynCoal® product into two, 6,000-ton, concrete silos and to allow train loading with the existing loadout system. Additionally, the SynCoal® fines collected in various stage particulate collection systems are combined, cooled, and transferred to a 300-ton storage silo designed for truck loadout to make an alternative product.

Raw Coal Handling

Raw coal from the existing stockpile is screened to provide 1½-by-⅜ inch feed for the ACCP process. Coal rejected by the screening operation is conveyed back to the active stockpile. Properly sized coal is conveyed to a 1000-ton, raw coal, storage bin which feeds the process facility.

Emission Control

Sulfur dioxide emission control philosophy is based on injecting dry sorbents into the ductwork to minimize the release of sulfur dioxide to the atmosphere. Sorbents, such as trona or sodium bicarbonate, are injected into the first-stage gas stream as it leaves the first-stage dryer/reactors to maximize the potential for sulfur dioxide removal while minimizing reagent usage. The sorbents, having reacted with sulfur dioxide, are removed from the gas streams in the particulate removal systems. A 60-percent reduction in sulfur dioxide emissions should be realized.

The coal cleaning area fugitive dust is controlled by placing hoods over the sources of fugitive dust conveying the dust laden air to fabric filter(s). The bag filters can remove 99.99 percent of the coal dust from the air before discharge. All SynCoal® fines will report to the fines handling system and ultimately the SynCoal® fines product stream.

Heat Plant

The heat required to process the coal is provided by a natural gas-fired process furnace, which uses process makegas from the second-stage coal conversion as a supplemental fuel. This system is sized to provide a heat release rate of 74 MM Btu/hr. Process gas enters the furnace and is heated by radiation and convection from the burning fuel.

Heat Rejection

Most heat rejection from the ACCP is accomplished by releasing water and flue gas into the atmosphere through an exhaust stack. The stack design allows for vapor release at an elevation great enough that, when coupled with the vertical velocity resulting from a forced draft fan, dissipation of the gases will be maximized. Heat removed from the coal in the coolers is rejected using an atmospheric-induced, draft cooling tower.

Utility and Ancillary Systems

The coal fines that are collected in the conversion, cleaning, and material handling systems are gathered and conveyed to a surge bin. The coal fines are then agglomerated and returned to the product stream.

Inert gas is drawn off the cooler loop for other uses. This gas, primarily nitrogen and carbon dioxide, is used for other baghouse pulse. The makeup gas to the cooler loop is combustion flue gas from the stack. The cooling system effectively dehumidifies and cools the stack gas making the inert gas for the system. The cooler gas still has a relatively high dew point (about 90°F). Due to the thermal load this puts on the cooling system, no additional inert gas requirements can be met by this approach.

The common facilities for the ACCP Demonstration include a plant and instrument air system, a fire protection system, and a fuel gas distribution system.

The power distribution system includes a 15 kV service; a 15 kV/5 kV transformer; a 5 kV motor control center; two, 5 kV/480 V transformers; a 480 V load distribution center; and a 480 V motor control center.

The process is semi-automated, including dual control stations, dual programmable logic controllers, and distributed plant control and data acquisition hardware. Operator interface is necessary to set basic system parameters, and the control system adjusts to changes in the process measurements.

3.1.1 ORIGINAL EQUIPMENT

The originally designed and installed major equipment for the ACCP Demonstration Facility is shown in Table 3.1 on the following page.

Table 3.1. Advanced Coal Conversion Process Major Plant Equipment

System Description	Equipment Vendor	Type
Thermal Coal Reactors/Coolers	Carrier Vibrating Equipment, Inc.	PE
Belt Conveyors	Willis & Paul Group	MH
Bucket Elevators	FMC Corporation	MH
Coal Cleaning Equipment	Triple S Dynamics, Inc.	CC
Coal Screens	Hewitt Robbins Corporation	MH
Loading Spouts	Midwest International	MH
Dust Agglomerator	Royal Oak Enterprises, Inc.	DH
Silo Mass Flow Gates	SEI Engineers, Inc.	MH
Vibrating Bin Dischargers	Carman Industries, Inc.	MH
Vibrating Feeder	Kinergy Corporation	MH
Drag Conveyor	Dynamet	DH
Process Gas Heater	G.C. Broach Company	PE
Direct Contact Cooler	CMI-Schneible Company	PE
Particulate Removal System	Air-Cure Howden	EC
Dust Collectors	Air Cure Environmental, Inc.	EC
Air Compressors/Dryers	Colorado Compressor, Inc.	CF
Diesel Fire Pumps	Peerless Pump Company	CF
Forced Draft Fans	Buffalo Forge Company	PE
Pumps	Dresser Pump Division Dresser Industries, Inc.	PE
Electrical Equipment-4160	Toshiba/Houston International Corporation	CF
Electrical Equipment-LDC	Powell Electric Manufacturing Company	CF
Electrical Equipment-480v MCC	Siemens Energy & Automation, Inc.	CF
Main Transformer	ABB Power T&D Company	CF
Control Panels	Utility Control & Equipment Corporation	CF
Control Valves	Applied Control Equipment	CF
Plant Control System	General Electric Supply Company	CF
Cooling Tower	The Marley Cooling Tower Company	PE
Dampers	Effox, Inc.	PE
Dry Sorbent Injec. System	Natech Resources, Inc.	EC
Expansion Joints	Flexonics, Inc.	PE

MH - Materials Handling   PE - Process Equipment   EC - Emissions Control
CF - Common Facilities   CC - Coal Cleaning   DH - Dust Handling

3.2 AS-BUILT PROCESS DESCRIPTION

The ACCP facility has been modified as necessary during start-up and operation of the ACCP Demonstration Project. Equipment has been improved; additional equipment installed; and new systems designed, installed, and operated to improve the overall plant performance. Those adjustments are listed below and on the following pages.

Coal Conversion System

In 1992, several modifications were made to the vibratory fluidized bed reactors and processing trains to improve plant performance. An internal process gas bypass was eliminated, and the seams were welded out to reduce system leaks. Also, the reactor bed deck holes were bored out in both the first-stage dryer/reactors and the vibratory coolers to increase process gas flows.

The originally designed, two-train, fines conveying system could not keep up with the fines production. To operate closer to design conditions on the thermal coal reactors and coolers, obtain tighter control over operating conditions, and minimize product dustiness, the ACCP plant was converted to single train operation to reduce the overall fines loading prior to modifying the fines handling system during the outage of the summer 1993. One of the two process trains was removed from service by physically welding plates inside all common ducts at the point of divergence between the two process trains. This forced process gases to flow only through the one open operating process train.

In addition to the process train removal, the processed fines conveying equipment was simultaneously modified to reduce required throughput on drag conveyors. This was accomplished by adding a first-stage screw conveyor and straightening and shortening the tubular drag conveyors.

The ACCP design included a briquetter for agglomeration of the process fines. However, initial shakedown of the plant required the briquetting system be completely operational. Since the briquetting operation was delayed to focus on successfully operating the plant, the process design changes included fines disposal by slurrying them to an existing pit in the mine. During the Third Quarter 1992, a temporary fines slurry disposal system was installed. The redesigned process fines conveying and handling system was commissioned. Design of a replacement fines conveying system is now complete and delivering to a truck loadout slurry or the briquetter.

The main rotary airlocks were required to shear the pyrite and "bone" or rock that is interspersed with the coal; however, the design of the rotary airlocks was insufficient to convey this non-coal material. Therefore, the drive motors were retrofitted from 2 to 5 horse power for all eight process rotary airlocks. Also, an electrical current sensing circuit that reverses the rotary lock rotation was designed, tested, and applied to the rotary airlocks. This circuitry is able to sense a rotor stall and reverse the motor to clear the obstruction before tripping the motor circuit breaker.

The original plant startup tests also revealed explosion vent discrepancies in all areas, thus preventing extended operation of the plant. The design development for the vents was a cooperative effort between an explosion vent manufacturing company and the ACCP personnel and resulted in a unique explosion vent sealing system which was completed during the Second Quarter of 1993. The new explosion vent design was implemented during the Third Quarter of 1993 and has been performing well since.

Coal Cleaning

The coal entering the cleaning system is screened into four size fractions: plus ½ inch, ½ by ¼ inch, ¼ inch by 8 mesh, and minus 8 mesh. These streams are fed in parallel to four, deep-bed stratifiers (stoners) where a rough, specific, gravity separation is made using fluidizing air and a vibratory conveying action. The light streams from the stoners are sent to the product conveyor, and the heavy streams from all but the minus 8 mesh stream are sent to fluidized bed separators. The heavy fraction of the minus 8 mesh stream goes directly to the waste conveyor. The fluidized bed separators, again using air and vibration to effect a gravity separation, each split the coal into light and heavy fractions. The light stream is considered product, and the heavy or waste stream is sent to a 300-ton, storage bin to await transport back to the mined out pit disposal site. The dried, cooled, and cleaned product from coal cleaning enters the product handling system. Modifications were made in the Third Quarter of 1992 that allows product to be sent to the waste bin with minimal reconfiguration.

Product Handling

Work is continuing on testing and evaluating technologies to enhance product stabilization and reduce fugitive dustiness. During the Fourth Quarter of 1992, a liquid carbon dioxide storage and vaporization system was installed for testing product stability and providing inert gas for storage and plant startup/shutdown. During the Fourth Quarter of 1993, an additional inert gas system was installed.

The clean product coal is conveyed into two, 5,000-ton capacity, concrete silos that allow train loading with the existing loadout system. This capacity is due to the relatively low SynCoal® density.

Raw Coal Handling

Raw coal from the existing stockpile is screened to provide 1¼-by-½ inch feed for the ACCP process. Coal rejected by the screening operation is conveyed back to the active stockpile. Properly sized coal is conveyed to a 1,000-ton, raw coal, storage bin which feeds the process facility.

Emission Control

It was originally assumed that sulfur dioxide emissions would have to be controlled by injecting chemical sorbents into the ductwork. Preliminary data indicated that the addition of chemical sorbent would not be necessary to control sulfur dioxide emissions under the operating conditions. A mass spectrometer was installed during the Second Quarter to monitor emissions and process chemistry; however, the sorbent injection system is in place should a higher sulfur coal be processed or if process modifications are made and sulfur dioxide emissions need to be reduced.

The coal-cleaning area's fugitive dust is controlled by placing hoods over the fugitive dust sources conveying the dust laden air to fabric filter(s). The bag filters appear to be effectively removing coal dust from the air before discharge. The Department of Health and Environmental Sciences completed stack tests on the east and west baghouse outlet ducts and the first-stage drying gas baghouse stack during the Second Quarter of 1993. The emission rates of 0.0013 and 0.0027 (limit of 0.018 grains/dry standard cubic feet) (gr/dscf) and 0.015 gr/dscf (limit of 0.031), respectively, are well within the limits stated in the air quality permit.

Heat Plant

The heat required to process the coal is provided by a natural gas-fired process furnace, which uses process makegas from coal conversion as fuel. The vibration problems and conversion system problems discussed previously initiated removing and redesigning the process gas fans shaft seals to limit oxygen infiltration into the process gas. This system provides a maximum heat release rate of up to 74 MM Btu/hr depending on the feed rate.

Heat Rejection

Heat removed from the coal in the coolers is rejected indirectly through cooling water circulation using an atmospheric-induced, draft-cooling tower. A substantial amount of the heat added to the system is actually lost by releasing water vapor and flue gas into the atmosphere through an exhaust stack. The stack allows for vapor release at an elevation great enough that, when coupled with the vertical velocity resulting from a forced draft fan, maximized dissipation of the gases. The evaluation from the Second Quarter indicated the problem could be resolved by producing additional makeup water to the system. A 2-inch valve was installed on the cooling water line to the cooling tower to provide the necessary makeup water.

Utility and Ancillary Systems

The fines handling system consolidates the coal fines that are produced in the conversion, cleaning, and material handling systems. The fines are gathered by screw conveyors and transported by drag conveyors to a bulk cooling system. The cooled fines are stored in a 250-ton capacity bin until loaded into pneumatic trucks for off-site sales.

When off-site sales lag production, the fines are mixed with water in a specially designed tank and slurried back to the mine pit.

An inert gas system cools, dehumidifies, compresses, and dries stack gas. The inert gas, which contains mainly nitrogen and carbon dioxide, is used by the first-stage baghouse cleaning blowers and is also used as a blanket gas in the product and fines storage silos. The makeup gas to the cooler loop is combustion flue gas from the stack. The cooling system effectively dehumidifies and cools the stack gas making the inert gas for the system. The cooler gas still has a relatively high dew point (about 90°F). Due to the thermal load this puts on the cooling system, no additional inert gas requirements can be met by this approach.

The common facilities for the ACCP include a plant and instrument air system, a fire protection system, and a fuel gas distribution system.

The power distribution system was upgraded by installing an uninterruptible power supply (UPS) during the Second Quarter. The UPS system does not keep the plant running if there is a problem; however, it does keep the control system, emergency systems, and office lights operating.

The process is semi-automated, including dual control stations, dual programmable logic controllers, and distributed plant control and data acquisition hardware. Graphic interface programs are continually being modified and upgraded to improve the operator interface and provide more reliable information to the operators and engineers.

3.2.1 MODIFIED OR REPLACED EQUIPMENT

Facility modifications and maintenance work to date have been dedicated to obtaining an operational facility.

The modifications to the original system performed for the year to date (with modifications during this reporting period shown in bold print) are listed below.

Fourth Quarter 1993:

Processed Fines Handling System:
- **Modifications, except for the processed fines cooler performance testing, which is not yet scheduled, have been completed.**

Process Gas Heater:
- **The plant was shut down for a scheduled 24-hour maintenance outage to clean the process gas heat exchanger.**

Particulate Removal System:
- **Repaired failed rotary airlock bearing.**

Forced Draft Fans:
- **Replaced two fan bearings.**

Baghouse:
- **Conducted a scheduled baghouse repair.**

Third Quarter 1993:

Process Gas Heater:
- cleaned a fouled process heat exchanger;

Processed Fines Handling System:
- commissioned the redesign of the process fines conveying and handling system; and
- cleaned a plugged fines chute.

Second Quarter 1993:

Forced Draft Fans:
- repaired first-stage fan motor;

Process Gas Heater:
- repaired furnace temperature transmitter,
- repaired a ruptured expansion joint; and

Processed Fines Handling System:
- installed the new dust handling system.

First Quarter 1993:

Drag Conveyor:
- Designed a replacement fines conveying system.

Coal Thermal Reactor:
- Repaired a structural crack between the drive and the main housing of dryer R552. Insulation is being added to protect this area.

First-stage Baghouse:
- A mine electrical ground fault tripped the entire substation's power. After restarting, the plant was tripped by a voltage dip when a dragline started. This resulted in the fines in the dust collectors freezing from condensation and washdown water. The fines blocked the discharges. When the plant was restarted, fines backed up into the bags and began smoldering, thus, damaging the bags.

Table 3.2 shows the equipment that has either been modified or replaced from plant startup. If replacement was required, the new equipment is listed.

Table 3.2. Advanced Coal Conversion Process Modified Major Plant Equipment

System Description	Equipment Vendor	Type	Modified No/Yes	Replaced With
Thermal Coal Reactors/Coolers	Carrier Vibrating Equipment, Inc.	PE	/✓	
Belt Conveyors	Willis & Paul Group	MH	/	
Bucket Elevators	FMC Corporation	MH	/	
Coal Cleaning Equipment	Triple S Dynamics, Inc.	CC	/	
Coal Screens	Hewitt Robbins Corporation	MH	/✓	
Loading Spouts	Midwest International	MH	/	
Dust Agglomerator	Royal Oak Enterprises, Inc.	DH	/	
Silo Mass Flow Gates	SEI Engineers, Inc.	MH	/	
Vibrating Bin Dischargers	Carman Industries, Inc.	MH	/	
Vibrating Feeder	Kinergy Corporation	MH	/	
Drag Conveyor	Dynamet	DH	/✓	PFHS
Screw Conveyor	Farm Aid Equipment Company	MH	Added	PFHS
Processed Fines Handling Sys. (PFHS): Bucket Elevators Screw Conveyors Drag Conveyors Processed Fines Cooler Slurry Tank Agitator Slurry Tank Slurry and Pit Pumps Processed Fines Load Out Bin	Continental Screw Conveyor Corp. Continental Screw Conveyor Corp. AshTech Corporation Cominco Engineering Services, Ltd. Chemineer, Inc. Empire Steel Manufacturing Co. Goulds Pumps/Able Technical P & S Fabricators	DH DH DH DH DH DH DH DH	Added Added Added Added Added Added Added Added	
Process Gas Heater	G.C. Broach Company	PE	/	
Direct Contact Cooler	CMI-Schneible Company	PE	/✓	
Particulate Removal System	Air-Cure Howden	EC	/✓	
Dust Collectors	Air Cure Environmental	EC	/	
Air Compressors/Dryers	Colorado Compressor, Inc.	CF	/✓	
Diesel Fire Pumps	Peerless Pump Company	CF	/	
Forced Draft Fans	Buffalo Forge Company	PE	/✓	
Pumps	Dresser Pump Division Dresser Industries, Inc.	PE	/	
Electrical Equipment-4160	Toshiba/Houston International Corp.	CF	/	
Electrical Equipment-LDC	Powell Electric Manufacturing Corp.	CF	/	
Electrical Equipment-480v MCC	Siemens Energy & Automation, Inc.	CF	/	
Uninterruptible Power Supply	Best Power Technologies Company	CF	Added	
Main Transformer	ABB Power T&D Company	CF	/	
Control Panels	Utility Control & Equipment Corp.	CF	/	
Control Valves	Applied Control Equipment	CF	/	

Table 3.2. Advanced Coal Conversion Process Modified Major Plant Equipment (cont'd.)

Plant Control System	General Electric Supply Company	CF	/✓	
Cooling Tower	The Marley Cooling Tower Company	PE	/✓	
Dampers	Effox, Inc.	PE	/	
Dry Sorbent Injec. System	Natech Resources, Inc.	EC	/	
Expansion Joints	Flexonics, Inc.	PE	/✓	

MH - Materials Handling PE - Process Equipment EC - Emissions Control
CF - Common Facilities CC - Coal Cleaning DH - Dust Handling

4.0 TECHNICAL PROGRESS

4.1 FACILITY OPERATIONS/PLANT PRODUCTION

Table 4.1 summarizes the ACCP Demonstration Facility's operations and plant production levels that have been achieved through the reporting period and the facility's lifetime to date. Table 4.2 lists the ACCP Demonstration Facility's monthly shipments of the SynCoal® product.

The following calculations were used in Table 4.1:

- Period Hours = Days in Reporting Period x 24 Hours/Day
- Operating Factor = Operating Hours/Period Hours x 100
- Schedule Factor = (Period Hours - Non-scheduled Hours)/Period Hours x 100
- Scheduled Operating Factor = Operating Factor/Schedule Factor x 100
- Average Feed Rate = Tons Fed/Operating Hours

The difference between the feed coal and the amount of clean coal produced is due to water loss; samples removed for analysis; and processed fines, which are captured in the dust handling system and returned to the mine for disposal. Very little dust is actually lost to the atmosphere.

Approximately 7,678 tons of conditioned product coal were shipped to MPC's Corette Power Plant in Billings, Montana; 33,703 tons of untreated product coal were shipped to MPC's Colstrip Project, Units 3 and 4; 1,370 tons of conditioned product coal were shipped to NSP Bayfront; and 1,302 tons of product coal were shipped to industrial clients.

4.2 FACILITY TESTING

Facility modifications and maintenance work during this reporting period have been dedicated to obtaining a more reliable facility. However, since a reliable facility has been achieved, the facility testing to date has focused on understanding and controlling product stability and dust mitigation measures. Three tests have been performed at the facility during the Fourth Quarter of 1993; however, a listing of all of the tests conducted throughout the year are included in Table 4.3.

Table 4.1. ACCP Demonstration Project Monthly Operating Statistics

Month	Operating Hours	Operating Factor	Non-Scheduled Hours	Schedule Factor	Scheduled Operating Factor	Feed Tons	Ave. Feed Rate	Feed Capacity Factor	Total Shipments	Ending Silo Inventory	Comments
Jan. '93	396	53.2%	211	71.6%	74.3%	8,626	21.78	23.0%	3,658	0	Second-stage Dryer Structural Problem Encountered
Feb. '93	297	44.2%	308	54.2%	81.6%	6,544	22.03	17.5%	915	1,200	Continued Testing/ Baghouse Damage
Mar. '93	327	44.0%	248	66.7%	65.9%	6,565	20.08	17.5%	629	4,650	Continued Testing
1st Quarter 1993 Summary	1,020	47.2%	767	64.5%	73.2%	21,735	21.31	19.3%	5,202	4,650	
LTD Totals	**2,377**	**25.0%**	**3,905**	**58.9%**	**42.5%**	**50,421**	**21.21**		**10,768**		
April '93	353	49.0%	216	70.0%	70.0%	8,514	24.12	22.7%	745	6,500	
May '93	352	47.3%	168	77.4%	61.1%	9,175	26.07	24.5%	768	4,000	
June '93	106	14.7%	576	20.0%	73.6%	2,752	25.96	7.3%	199	4,000	
2nd Quarter 1993 Summary	811	37.1%	960	56.0%	66.3%	20,441	25.20	18.2%	1,712	4,000	
LTD Totals	**3,188**	**27.3%**	**4,865**	**58.4%**	**46.7%**	**70,862**	**22.23**		**12,480**		
July '93	0	0.0%	744	0.0%	0%	0	0.00	0.0%	655	4,000	
Aug. '93	368	49.5%	288	61.3%	80.7%	13,427	36.49	36.8%	2,361	4,500	
Sept. '93	605	84.0%	46	93.3%	90.0%	23,276	38.47	62.1%	3,545	9,000	
3rd Quarter 1993 Summary	973	44.1%	1,078	51.1%	86.3%	36,703	37.72	32.6%	6,561	9,000	
LTD Totals	**4,161**	**29.9%**	**5,943**	**57.2%**	**52.3%**	**107,565**	**25.85**		**19,041**		
Oct. '93	**599**	**80.5%**	**83**	**88.8%**	**90.6%**	**24,606**	**41.08**	**65.6%**	**12,753**	**6,600**	
Nov. '93	**637**	**88.5%**	**24**	**96.7%**	**91.5%**	**27,927**	**43.84**	**74.5%**	**14,349**	**5,800**	
Dec. '93	**592**	**79.6%**	**120**	**83.9%**	**94.9%**	**26,009**	**43.93**	**69.4%**	**16,951**	**1,900**	
4th Quarter 1993 Summary	**1,828**	**82.9%**	**227**	**89.8%**	**92.3%**	**78,542**	**42.95**	**69.9%**	**44,053**	**1,900**	
LTD Totals	**5,449**	**33.8%**	**6,170**	**61.7%**	**54.8%**	**186,107**	**34.15**		**63,094**		

Table 4.2. ACCP Demonstration Project Monthly Shipments

Month	Total Shipments	Shipments by Customer						
		Corette (tons)	Units 3 & 4	Bentonite	Wyoming Lime Prod.	Continental Lime	NSP Riverside	NSP Bayfront
Jan. '93	by rail/truck	200	3,458	0	0	0	0	0
Feb. '93	by rail/truck	174	741	0	0	0	0	0
Mar. '93	by rail/truck	352	277	0	0	0	0	0
1st Quarter 1993 Summary		726	4,476	0	0	0	0	0
Totals		3,870	6,505	0	0	0	0	0
April '93	by rail	745	0	0	0	0	0	0
May '93	by rail/truck	478	0	221	0	226	42	0
June '93	by rail/truck	0	0	199	0	0	0	0
2nd Quarter 1993 Summary		1,223	0	221	0	226	42	0
Totals		5,093	6,505	221	0	226	42	0
July '93	by rail/truck	400	0	255	0	0	0	0
Aug. '93	by rail/truck	2,099	0	262	0	0	0	0
Sept. '93	by rail/truck	1,155	632	487	0	0	229	0
3rd Quarter 1993 Summary		3,654	632	1,004	0	0	229	0
Totals		8,747	7,137	1,225	0	226	271	0
Oct. '93	by rail/truck	805	11,506	442	0	0	0	0
Nov. '93	by rail/truck	1,230	11,340	319	90	0	0	1,370
Dec. '93	by rail/truck	5,643	10,857	451	0	0	0	0
4th Quarter 1993 Summary		7,678	33,703	1,212	90	0	0	1,370
Totals		16,425	40,840	2,437	90	226	271	1,370

Table 4.3. ACCP Demonstration Plant Testing Summary

Test Number	Test Description	Test Dates
9217	Determined if a known moisture inhibiting process added on processed coal during the cold temperatures would prolong the life of the coal.	1/4/93
9218-B	Determined what the effects of purging the processed coal with water would have on the stability of the coal.	1/18/93
9301	Determined the effect of pacifying a large quantity of coal with CO_2 for shipping by rail.	2/1/93
9302	Determined the effects of pacifying product coal by increasing CO_2 in the cooler loop.	2/3/93
9303	Determined the effects of combining the CO_2 treatment with a known moisture inhibiting process.	2/3/93
9304	Determined the stability of pacifying a large quantity of product coal with CO_2 and shipping by rail.	3/8/93
9305	Determined what the effects of purging processed coal with CO_2 for various lengths of time would have on the stability of the coal.	2/9/93
9306	Developed a useable technique for measuring the stability of the coal and determining how fast and how much oxygen the coal absorbs from air.	3/30/93
9307	Test cancelled.	
9308	Compared the dust levels and stability of a blend of raw coal and SynCoal® to those of both 100 percent raw coal and 100 percent SynCoal®.	2/26/93
9309	Determined the effectiveness of adding a foam dust suppressant to treat coal dust at the Corette power plant.	3/2/93 - 3/3/93
9310	Determined if adding a particle charge chemistry emulsion would reduce the dustiness of the SynCoal® product.	3/6/93 - 3/16/93
9311	Determined the longevity and dust levels in SynCoal® and blended SynCoal® and managed the pile after it initially heated.	3/26/93
9312	Tested and evaluated the relationship between various treatments and moisture contents on the dustiness and stability of the SynCoal® product.	3/21/93 - 3/27/93

Table 4.3. ACCP Demonstration Plant Testing Summary (cont'd.)

9313	*Determined if a chemical treatment produces a stable product.*	4/5/93
9314	Determined the longevity and dust levels in SynCoal® and SynCoal® blends during rail car transit and while placed in a pile.	4/6/93
9315	Determined if a large test pile (500 tons) could be stabilized by incorporating pile management.	4/7/93
9316	Identified future fouling problems that might occur with the heat exchanger that will be installed for coal fines cooling.	4/9/93
9317	Determined if adding oil coupled with CO_2 treatment of SynCoal increased the life as well as decreased coal dustiness.	5/3/93
9318	Not conducted.	
9319	Determined the longevity and handling characteristics of SynCoal® blended with raw coal at two power plants and determined if coal could be blended successfully.	4/21/93
9320	Evaluated various moisture contents versus product stability.	5/13/93
9321	Test not completed during the reporting period.	
9322	Determined the rate expression for the oxygen absorption onto the SynCoal® product.	5/17/93
9323	Determined the dust levels and stability of various blends when sent to Montana Power Company's Corette plant.	5/9/93
9324	Determined the blend dustiness after spraying a known dust suppressant on the raw coal and the SynCoal® prior to blending.	5/24/93
9325	Not conducted.	

Table 4.3. ACCP Demonstration Plant Testing Summary (cont'd.)

9326	This demonstration determined five points: 1. the effectiveness of the ACCP Demonstration plant on BNI lignite; 2. a rough mass balance for lignite in the ACCP process; 3. raw lignite handling characteristics; 4. lignite process dust characteristics; and 5. product coal stability.	5/27/93
9327	Determined the stability of various blends of SynCoal® with raw coal. Dust levels were not a consideration in this test.	5/28/93
9328	Test not completed during the reporting period.	
9329	Determined the dust levels from compartmentalized blends using various dust suppressants on both the raw coal and SynCoal®.	7/16/93
9330	Determined the dust levels from belt blends using various dust suppressants on both the raw coal and SynCoal®.	7/19/93
9331	Not started.	
9332	Determined preliminary packed bed characteristics, including coal flowability and air flows.	7/21/93
9333	Pilot-scale air stabilizer testing.	7/2/93 - 8/18/94
9334	Characterized operations of a pilot-scale air stabilizer using fresh product coal and produced enough product coal for pile testing.	8/18/93 - 9/12/93
9335	Obtained a mass balance for coal flow into and out of the plant.	8/23/93
9336	Determined the effectiveness of the ACCP Demonstration Plant on BNI lignite, produced sufficient quantities of processed lignite and fines for testing and evaluation, performed a mass balance for lignite in the ACCP process.	9/20/93
9337	Not started.	
9338	Test not completed during the reporting period.	8/31/93 - 9/3/93

Table 4.3. ACCP Demonstration Plant Testing Summary (cont'd.)

9339	Operated the plant on a 1¼" x 0" feedstock and performed a mass balance with that feedstock.	9/9/93-09/10/93
9340	Tested air stabilization concept using various reactor residence times and processing temperatures.	9/21/93-10/5/93
9341	Determined the comparative stability of a tote-bin-size pile of DSE Conditioned SynCoal® after both had been passivated with CO_2 for three days.	9/16/93
9342A	Performed initial stabilization process tests.	9/27/93-9/30/93
9342C	Performed a time and temperature sweep on the coal processing between ½ hour and 6 hour residence time and temperature between 150°F and 210°F while measuring the WPG_1 values for the entire sweep.	10/1/93-10/11/93
9343	Not started.	
9344	Produced stabilized SynCoal using the tower-type reactor.	9/11/93
9345	Determined the effectiveness of the ACCP Demonstration plant on Knife River lignite, the overall mass balance for lignite in the ACCP process, and the raw lignite and process dust characteristics. Produced sufficient quantities of processed lignite for testing and air stabilizing the excess product.	10/19/94

4.3 PRODUCT TESTING

The product produced to date has been exceptionally close to the design basis product from a chemical standpoint but has not been acceptable from a physical standpoint due to instability (spontaneous heating) and dustiness. The coal appears to continue heating after processing. Product stability testing and engineering during the Fourth Quarter of 1993 mainly involved quantifying the ability to inhibit the spontaneous combustion tendency using an additional process reactor. The typical product analyses are shown in Table 4.4.

Table 4.4 ACCP Quality Analyses for 1993 Annual Report

Raw Coal

	SAMPID	SAMPDATE	TM	PA	PS	HHV	SO2	COMM
THIRD QUARTER, 1993	1165	08/26/93	24.26	8.47	0.86	8,902	1.93	930826E W-76
RAW COAL								

LEGEND	
TM	% Total Moisture
PA	% Ash
PS	% Sulfur
HHV	Btu/lb.
SO2	lbs. of SO2/MMBtu
COMM	Comments

Table 4.4 ACCP Quality Analyses for 1993 Annual Report (cont'd.)

Uncleaned Coal

	SAMPID	SAMPDATE	TM	PA	PS	HHV	SO2	COMM
FIRST QUARTER, 1993		01/04/93	3.13	10.95	0.68	11,504	1.18	
UNCLEANED COAL		01/05/93	2.10	10.74	1.00	11,608	1.72	
		01/05/93	1.92	12.26	1.02	11,646	1.75	
		01/06/93	1.81	11.32	1.13	11,567	1.95	
		01/07/93	1.95	10.89	0.93	11,706	1.59	
		01/08/93	1.47	12.97	1.21	11,519	2.10	
		01/19/93	2.19	11.38	1.12	11,569	1.94	
		01/20/93	2.28	12.54	1.28	11,458	2.23	
		01/22/93	2.12	12.02	1.12	11,520	1.94	
		01/22/93	2.32	12.64	1.37	11,409	2.40	
		01/23/93	2.07	11.60	1.01	11,596	1.74	
		01/25/93	1.98	12.95	1.36	11,445	2.38	
		02/02/93	2.16	12.89	1.59	11,407	2.79	
		02/08/93	2.25	12.26	1.17	11,468	2.04	
		02/09/93	2.29	12.77	1.17	11,393	2.05	
		02/10/93	2.11	12.26	1.08	11,498	1.88	
	AVERAGE		2.13	12.03	1.14	11,520	1.98	
	STANDARD DEVIATION		0.33	0.75	0.20	88	0.36	
	MIN		1.47	10.74	0.68	11,393	1.18	
	MAX		3.13	12.97	1.59	11,706	2.79	

	SAMPID	SAMPDATE	TM	PA	PS	HHV	SO2	COMM
SECOND QUARTER, 1993	622	05/09/93	2.57	13.06	1.24	11,244	2.21	9320 PRE3
UNCLEANED COAL								

THIRD QUARTER, 1993	1168	08/26/93	1.87	11.36	1.00	11,561	1.73	930826 F C-5 06
UNCLEANED COAL	1254	09/01/93	3.55	11.37	1.15	11,292	2.04	9334-1 PRIOR TO CLEANING
	AVERAGE		2.71	11.37	1.08	11,426	1.88	
	STANDARD DEVIATION		0.84	0.00	0.07	135	0.15	
	MIN		1.87	11.36	1.00	11,292	1.73	
	MAX		3.55	11.37	1.15	11,561	2.04	

LEGEND	
TM	% Total Moisture
PA	% Ash
PS	% Sulfur
HHV	Btu/lb.
SO2	lbs. of SO2/MMBtu
COMM	Comments

Table 4.4 ACCP Quality Analyses for 1993 Annual Report (cont'd.)

Product

	SAMPID	SAMPDATE	TM	PA	PS	HHV	SO2	COMM
FIRST QUARTER, 1993	11	01/04/93	3.41	11.02	0.72	11,502	1.25	no referee kept. Sample too small.
PRODUCT	23	01/05/93	2.52	9.21	0.54	11,841	0.91	
	24	01/05/93	2.06	9.14	0.55	11,899	0.92	
	25	01/05/93	2.28	9.34	0.55	11,872	0.93	
	26	01/05/93	2.17	11.45	1.02	11,644	1.75	
		01/06/93	1.83	9.14	0.53	11,926	0.89	
		01/09/93	1.94	9.38	0.54	11,917	0.91	
		01/10/93	1.64	9.28	0.49	11,968	0.82	
		01/12/93	1.62	9.14	0.53	11,975	0.89	
		01/16/93	1.99	9.13	0.57	11,922	0.96	
		01/18/93	2.27	9.26	0.53	11,873	0.89	
		02/03/93	2.25	8.54	0.50	11,899	0.84	
		02/05/93	2.67	8.53	0.47	11,855	0.79	
		02/06/93	2.10	8.70	0.49	11,935	0.82	
		02/07/93	2.34	8.49	0.47	11,933	0.79	
		02/08/93	2.35	8.83	0.50	11,867	0.84	
	AVERAGE		2.22	9.29	0.56	11,864	0.95	
	STANDARD DEVIATION		0.42	0.79	0.13	119	0.23	
	MIN		1.62	8.49	0.47	11,502	0.79	
	MAX		3.41	11.45	1.02	11,975	1.75	

Table 4.4 ACCP Quality Analyses for 1993 Annual Report (cont'd.)

Product (cont'd)

	SAMPID	SAMPDATE	TM	PA	PS	HHV	SO2	COMM
SECOND QUARTER, 1993	498	04/15/93	2.96	9.41	0.57	11,764	0.97	standard production to silo T-96.
PRODUCT	499	04/16/93	2.50	9.39	0.56	11,830	0.95	Standard production to silo T-96.
	500	04/17/93	2.55	9.37	0.53	11,797	0.90	Standard production to silo T-96.
	501	04/18/93	2.88	9.13	0.54	11,795	0.92	Standard production to silo T-96.
		04/19/93	3.10	9.10	0.54	11,754	0.92	
	509	04/20/93	3.07	9.07	0.54	11,754	0.92	Standard production to T 96 silo
	525	04/21/93	2.93	9.17	0.54	11,823	0.91	
		04/22/93	2.60	9.10	0.55	12,018	0.92	
	545	04/23/93	2.63	9.25	0.55	11,830	0.93	
	546	04/24/93	2.54	9.16	0.57	11,536	0.99	
	547	04/24/93	2.58	9.07	0.55	12,018	0.92	
	544	04/25/93	2.67	9.31	0.60	11,808	1.02	
	550	04/26/93	2.40	9.41	0.56	11,819	0.95	
	570	05/02/93	2.50	9.49	0.54	11,749	0.92	
	571	05/03/93	2.91	8.64	0.52	11,369	0.91	
	580	05/03/93	2.70	9.59	0.54	11,795	0.92	
		05/03/93	2.70	9.60	0.54	11,795	0.92	
	602	05/10/93	2.79	8.80	0.50	11,775	0.85	
		05/11/93	2.60	9.20	0.59	11,838	1.00	
	609	05/12/93	2.56	9.15	0.59	11,838	1.00	
	624	05/13/93	2.80	8.92	0.66	11,789	1.12	STANDARD PRODUCTION TO SILO T 96
	663	05/18/93	3.00	8.96	0.66	11,731	1.13	CONTINENTAL LIME 93-1
	668	05/21/93	2.56	8.65	0.55	11,855	0.93	
		05/22/93	2.40	9.20	0.56	11,825	0.95	
	658	05/23/93	2.93	9.13	0.55	11,743	0.94	
	667	05/23/93	2.68	9.17	0.59	11,748	1.00	60 MESH REPEATER
	667	05/23/93	2.38	9.17	0.56	11,825	0.95	
	660	05/24/93	2.26	9.14	0.53	11,866	0.89	
	659	05/25/93	2.23	8.92	0.52	11,910	0.87	
	669	05/26/93	2.56	8.98	0.57	11,833	0.96	
	669	05/26/93	2.76	8.93	0.56	11,805	0.95	60 MESH REPEATER
	666	05/27/93	2.57	9.09	0.58	11,800	0.98	
	695	06/03/93	2.41	9.08	0.49	11,834	0.83	
	693	06/05/93	2.18	9.23	0.55	11,822	0.93	
	694	06/05/93	2.22	9.07	0.57	11,452	1.00	
	AVERAGE		2.63	9.14	0.56	11,787	0.95	
	STANDARD DEVIATION		0.24	0.22	0.03	121	0.06	
	MIN		2.18	8.64	0.49	11,369	0.83	
	MAX		3.10	9.60	0.66	12,018	1.13	

Table 4.4 ACCP Quality Analyses for 1993 Annual Report (cont'd.)

Product (cont'd)

	SAMPID	SAMPDATE	TM	PA	PS	HHV	SO2	COMM
THIRD QUARTER 1993	1084	08/16/93	2.50	8.67	0.60	11,871	1.01	STANDARD PRODUCTION TO T95 SILO
PRODUCT	1100	08/18/93	3.45	8.76	0.61	11,633	1.05	STANDARD PRODUCTION TO T-95 SILO
	1106	08/19/93	2.32	9.34	0.58	11,833	0.98	STANDARD PRODUCTION TO T-95 SILO
	1104	08/20/93	2.42	10.02	0.60	11,745	1.02	STANDARD PROCTION TO T-95 SILO
	1105	08/21/93	2.71	9.56	0.61	11,765	1.04	STANDARD PRODUCTION TO T-95 SILO
	1148	08/22/93	2.12	10.54	0.54	11,779	0.92	STANDARD PRODUCTION TO T-95 SILO
	1146	08/23/93	1.79	11.24	0.79	11,697	1.35	STANDARD PRODUCTION TO T-95 SILO
		08/24/93	1.90	11.08	0.60	11,669	1.03	
		08/25/93	2.10	9.10	0.69	11,865	1.16	
	1169	08/26/93	2.20	8.45	0.59	11,887	0.99	930826B PRODUCT COAL
	1172	08/26/93	1.90	11.08	0.66	11,669	1.13	STANDARD PRODUCTION TO T-95 SILO
	1174	08/26/93	2.10	9.10	0.69	11,865	1.16	STANDARD PRODUCTION TO T-95 SILO
	1181	08/27/93	2.24	9.31	0.63	11,878	1.06	STANDARD PRODUCTION TO T-95 SILO
	1180	08/28/93	2.66	8.80	0.62	11,750	1.06	NORMAL PRODUCTION C-9-08
	1183	08/29/93	2.06	9.62	0.66	11,806	1.12	NORMAL PRODUCTION
	1205	08/29/93	2.48	9.91	0.59	11,761	1.00	STANDARD PRODUCTION TO T-95 SILO
	1204	08/30/93	2.69	10.53	0.62	11,635	1.07	STANDARD PRODUCTION TO T-95 SILO
	1233	08/31/93	2.00	10.31	0.53	11,736	0.90	STANDARD PRODUCTION TO T-95 SILO
	1258	09/03/93	2.93	8.81	0.60	11,854	1.01	BENTONITE 930903
	1261	09/03/93	4.47	9.09	0.56	11,524	0.97	STANDARD PRODUCTION TO T-96 SILO
	1262	09/04/93	4.38	8.74	0.53	11,557	0.92	STANDARD PRODUCTION TO T-96 SILO
	1263	09/05/93	4.40	9.28	0.55	11,557	0.95	STANDARD PRODUCTION TO T-96 SILO
	1264	09/06/93	4.81	8.79	0.55	11,534	0.95	STANDARD PRODUCTION TO T-96 SILO
	1292	09/07/93	4.06	10.13	0.56	11,400	0.98	STANDARD PRODUCTION TO T-96 SILO
	1342	09/09/93	3.42	9.09	0.59	11,625	1.02	STANDARD PRODUCTION TO T-95 SILO
	1341	09/12/93	4.74	9.60	0.58	11,433	1.01	STANDARD PRODUCTION TO T-95 SILO
	1340	09/13/93	4.11	9.44	0.57	11,590	0.98	STANDARD PRODUCTION TO T-95 SILO
	1343	09/14/93	4.60	9.21	0.55	11,490	0.96	STANDARD PRODUCTION TO T-96 SILO
		09/17/93	3.67	8.82	0.52	11,470	0.91	
		09/20/93	3.78	9.27	0.52	11,497	0.90	
	1403	09/21/93	3.33	9.31	0.61	11,502	1.06	STANDARD PRODUCTION TO T-96 SILO
	1402	09/22/93	3.15	9.30	0.62	11,484	1.08	ID# 930922 BENTONITE
		09/22/93	3.44	9.23	0.54	11,487	0.94	
	1420	09/23/93	3.44	9.30	0.54	11,678	0.92	T-96 STANDARD PRODUCTION
	1421	09/24/93	2.56	9.34	0.63	11,967	1.05	8 BELT TO T-96
	1439	09/28/93	17.16	7.09	0.55	10,033	1.10	WISX-1
	1448	09/29/93	2.21	9.17	0.56	11,824	0.95	STANDARD PRODUCTION TO MPC PER NOP-4
	1449	09/29/93	19.91	6.90	0.45	9,649	0.93	RAIL SHIPMENT TO NSP-1
	1445	09/30/93	2.45	9.07	0.53	11,784	0.90	MPC STANDARD PRODUCTION 9-30-93

Table 4.4 ACCP Quality Analyses for 1993 Annual Report (cont'd.)

Product (cont'd)

	1447	09/30/93	4.42	9.23	0.51	11,384	0.90	ID3 930930 BENTONITE
	AVERAGE		3.83	9.34	0.59	11,579	1.01	
	STANDARD DEVIATION		3.51	0.86	0.06	429	0.09	
	MIN		1.79	6.90	0.45	9,649	0.90	
	MAX		19.91	11.24	0.79	11,967	1.35	

Table 4.4 ACCP Quality Analyses for 1993 Annual Report (cont'd.)

PRODUCT (cont'd)

	SAMPID	SAMPDATE	TM	PA	PS	HHV	SO2	COMM
FOURTH QUARTER, 1993	1492	10/02/93	2.14	10.00	0.64	11,859	1.08	MPC STD. PRODUCTION
PRODUCT	1493	10/03/93	1.89	10.46	0.61	11,789	1.03	MPC STD. PRODUCTION
	1494	10/04/93	1.64	10.97	0.71	11,776	1.21	MPC STD. PRODUCTION
	1508	10/04/93	4.99	8.85	0.53	11,292	0.94	93-10-4 BENTONITE
		10/04/93	1.64	10.97	0.71	11,776	1.21	
	1495	10/05/93	2.02	10.02	0.67	11,790	1.14	MPC STD. PRODUCTION
	1496	10/06/93	1.76	10.16	0.64	11,872	1.08	MPC STD. PRODUCTION
		10/06/93	3.93	8.56	0.55	11,641	0.94	
	1497	10/07/93	1.66	9.92	0.62	11,861	1.05	
	1509	10/06/93	3.93	8.56	0.55	11,641	0.94	BENTONITE
	1510	10/06/93	3.86	8.54	0.54	11,671	0.93	BENTONITE
	1511	10/08/93	4.06	8.69	0.57	11,631	0.98	BENTONITE 10\08\93
	1513	10/08/93	1.80	9.92	0.56	11,857	0.94	STANDARD PRODUCTION C-13
		10/08/93	4.06	8.69	0.57	11,631	0.98	
	1514	10/09/93	1.89	9.32	0.55	11,941	0.92	C-08 STANDARD PRODUCTION
	1512	10/10/93	2.11	9.31	0.59	11,873	0.99	MPC STANDARD PRODUCTION
	1530	10/10/93	2.42	9.66	0.60	11,854	1.01	STD. PROD. C 08
	1529	10/11/93	3.40	9.94	0.54	11,590	0.93	C-08 TO T-95
	1531	10/11/93	1.64	9.83	0.54	11,860	0.91	MPC STD. PRODUCTION
	1546	10/12/93	1.71	9.61	0.55	11,863	0.93	MPC STD PROD
	1556	10/13/93	1.92	9.95	0.63	11,851	1.06	MPC STD PROD
	1573	10/14/93	1.68	9.84	0.66	11,889	1.11	MPC STD PROD
	1572	10/15/93	3.29	8.73	0.66	11,757	1.12	BENTONITE # 1&2
	1586	10/18/93	2.07	9.98	0.64	11,839	1.08	C-9,C-8 TO T-95
	1597	10/19/93	2.81	9.03	0.58	11,812	0.98	BENTONITE 1&2
	1602	10/19/93	3.48	9.58	0.57	11,708	0.97	C 08 TO T-96
	1616	10/20/93	3.07	9.06	0.62	11,747	1.06	931020 BENTONITE
	1617	10/20/93	2.94	9.64	0.63	11,806	1.07	STD PROD TO T 96
	1615	10/21/93	2.76	9.37	0.62	11,773	1.05	931021 BENTONITE
	1665	10/21/93	3.14	10.93	0.62	11,629	1.07	STD PROD TO T-96
	1666	10/22/93	2.12	13.09	0.64	11,466	1.12	STD PROD TO T-96
	1668	10/22/93	2.00	10.62	0.69	11,750	1.17	STD PROD TO T-95
	1667	10/23/93	2.03	10.53	0.67	11,800	1.14	STD PROD TO T 95
	1663	10/24/93	1.90	11.51	0.68	11,669	1.17	STD PROD TO T 95
	1664	10/25/93	1.62	11.41	0.61	11,787	1.04	STD PROD TO T 95
	1669	10/25/93	1.53	10.59	0.71	11,885	1.19	STD PROD
	1688	10/26/93	2.95	9.25	0.65	11,717	1.11	931026 BENTONITE
	1670	10/27/93	1.55	10.32	0.63	11,906	1.06	STD PROD TO MPC
	1689	10/27/93	2.93	8.72	0.63	11,781	1.07	931027 BENTONITE

Table 4.4 ACCP Quality Analyses for 1993 Annual Report (cont'd.)

Product (cont'd)

	1690	10/27/93	5.39	8.42	0.68	11,444	1.19	CORETTE/10-27-93
	1694	10/27/93	1.48	11.59	0.66	12,882	1.02	STD PROD TO T-95
	1687	10/28/93	3.27	8.88	0.62	11,733	1.06	931028 BENTONITE
	1695	10/28/93	1.56	10.13	0.65	11,890	1.09	STD PROD TO MPC
	1716	10/29/93	2.93	8.90	0.54	11,766	0.92	931029 BENTONITE
	1717	10/29/93	4.54	8.73	0.60	11,583	1.04	CORETTE 10-29-93
		10/29/93	1.55	10.15	0.62	11,891	1.04	
	1734	10/30/93	1.55	10.18	0.59	11,892	0.99	STD PROD TO MPC
	1732	10/31/93	1.48	10.26	0.59	11,878	0.99	STD PROD TO MPC
	1733	11/01/93	2.51	9.42	0.60	11,856	1.01	CORETTE 11-1-93
	1735	11/01/93	1.45	10.36	0.58	11,887	0.98	STD PROD
	1736	11/01/93	2.39	8.97	0.62	11,841	1.05	931101 BENTONITE
	1758	11/03/93	1.83	9.84	0.62	11,894	1.04	STANDARD PRODUCTION NOP 4
	1780	11/03/93	1.66	8.97	0.55	11,962	0.92	STD PROD TO MPC
	1779	11/04/93	2.79	8.94	0.52	11,793	0.88	931104 BENTONITE
	1789	11/05/93	1.74	9.82	0.55	11,897	0.92	STD PROD TO MPC
	1790	11/05/93	1.88	10.49	0.59	11,883	0.99	STD PROD TO T-95
	1791	11/06/93	1.46	9.90	0.55	11,916	0.92	STD PROD TO MPC
	1787	11/07/93	1.28	11.05	0.61	11,847	1.03	STD PROD TO MPC
	1817	11/08/93	1.46	10.60	0.57	11,834	0.96	ADM
	1823	11/09/93	1.34	10.42	0.62	11,882	1.04	ADM
		11/11/93	2.20	9.94	0.64	11,735	1.09	
		11/12/93	1.50	9.82	0.57	11,862	0.96	
		11/13/93	1.25	9.95	0.62	11,842	1.05	
		11/15/93	1.99	10.22	0.60	11,801	1.02	
		11/16/93	2.51	10.87	0.60	11,641	1.03	
		11/17/93	2.53	10.87	0.62	11,683	1.06	
		11/18/93	1.72	11.14	0.60	11,474	1.05	
		11/19/93	1.72	10.29	0.57	11,813	0.97	
		11/20/93	1.54	9.40	0.62	11,975	1.04	
		11/21/93	2.07	9.22	0.57	11,866	0.96	
	AVERAGE		2.33	9.88	0.61	11,797	1.03	
	STANDARD DEVIATION		0.93	0.88	0.05	183	0.08	
	MIN		1.25	8.42	0.52	11,292	0.88	
	MAX		5.39	13.09	0.71	12,882	1.21	

LEGEND	
TM	% Total Moisture
PA	% Ash
PS	% Sulfur
HHV	Btu/lb.
SO2	lbs. of SO2/MMBtu
COMM	Comments

Table 4.4 ACCP Quality Analyses for 1993 Annual Report (cont'd.)

Dust

	SAMPID	SAMPDATE	TM	PA	PS	HHV	SO2	COMM
THIRD QUARTER, 1993	1141	08/24/93	0.40	9.07	0.94	11,995	1.57	930824-A 2ND STAGE DUST
DUST	1142	08/24/93	10.91	10.42	0.80	10,339	1.55	930824-B 1ST STAGE DUST
	1143	08/24/93	9.57	10.70	0.81	10,458	1.55	930824-C 1ST STAGE DUST
	1144	08/24/93	4.88	10.92	1.14	11,057	2.06	930824-D COOLLER DUST
	1145	08/24/93	5.81	9.80	1.04	11,183	1.86	930824-E COAL CLEANING SYSTEM DUST
	1167	08/26/93	5.85	9.02	0.84	11,219	1.50	930826-C COMPOSITE FINES
	1173	08/26/93	0.56	9.05	0.89	11,917	1.49	930826-D 2ND STAGE DUST
	AVERAGE		5.43	9.85	0.92	11,167	1.07	
	STANDARD DEVIATION		3.72	0.77	0.12	592	0.20	
	MIN		0.40	9.02	0.80	10,339	1.49	
	MAX		10.91	10.92	1.14	11,995	2.06	

LEGEND	
TM	% Total Moisture
PA	% Ash
PS	% Sulfur
HHV	Btu/lb.
SO2	lbs. of SO2/MMBtu
COMM	Comments

Table 4.4 ACCP Quality Analyses for 1993 Annual Report (cont'd.)

Treated Product

	SAMPID	SAMPDATE	TM	PA	PS	HHV	SO2	COMM
SECOND QUARTER, 1993	682	06/02/93	11.20	8.09	0.58	10,704	1.08	9328-S1 REHYDRATION TEST
TREATED PRODUCT	714	06/11/93	17.29	7.29	0.50	9,997	1.00	9328a-2 REHYDRATED
	715	06/11/93	17.21	7.44	0.49	9,967	0.98	9328a-1 REHYDRATED
	743	06/18/93	14.69	8.06	0.51	10,201	1.00	9328-C1 15% MOISTURE
	744	06/18/93	14.91	8.36	0.49	10,155	0.97	9328-C2 15% MOISTURE
	763	06/25/93	5.80	8.53	0.60	11,382	1.05	9328 F1 15%H2O/DT100A
	780	06/29/93	6.80	8.72	0.54	11,211	0.96	9328-F2 15%H2O/DT-100A
	786	06/30/93	9.66	7.88	0.59	10,607	1.11	9328-D-3 15%H2O
	AVERAGE		12.20	8.05	0.54	10,528	1.02	
	STANDARD DEVIATION		4.21	0.47	0.04	509	0.05	
	MIN		5.80	7.29	0.49	9,967	0.96	
	MAX		17.29	8.72	0.60	11,382	1.11	

	SAMPID	SAMPDATE	TM	PA	PS	HHV	SO2	COMM
THIRD QUARTER 1993	883	07/16/93	9.98	8.51	0.54	10,849	1.00	ID# 9328 G1 15%H2O/DT-100A
TREATED PRODUCT	884	07/19/93	11.63	7.69	0.47	10,774	0.87	ID#9328-G2 PILE AFTER DUMPING
	891	07/19/93	13.11	7.96	0.56	10,492	1.07	ID#9328 H1 15%H2O/DT100A
	892	07/20/93	13.17	7.95	0.54	10,473	1.03	ID#9328 H2 REHYDRATED OVERNIGHT
	937	07/26/93	11.44	7.87	0.52	10,419	1.00	ID# 9328-H3 13% H2O/ DT100A
	938	07/26/93	9.98	8.19	0.50	10,746	0.93	ID# 9328-I2 15% H2O / DT-100A
	940	07/26/93	13.54	8.16	0.47	10,005	0.94	ID# 9328-G3 10% H2O/DT-100A
	939	07/27/93	3.90	10.17	0.74	11,180	1.32	ID#9321-P4-1 Z/Z 10 GPT
	953	07/27/93	15.08	7.97	0.57	10,274	1.11	7-27-93 5 CARS TO CORRETTE
	962	07/30/93	14.45	7.68	0.51	10,268	0.99	ID# 9328-I STD REHYDRATED 4 DAYS
	986	08/02/93	13.26	7.92	0.51	10,529	0.97	9328-j-1-1
	987	08/02/93	15.14	7.39	0.48	10,262	0.94	9328-J-2-1
	988	08/02/93	13.08	7.75	0.53	10,553	1.00	9328-J-3-1
	1179	08/24/93	13.28	7.60	0.61	10,465	1.17	10 CARS TO CORRETTE
	1290	09/07/93	15.20	7.68	0.61	10,243	1.19	15 CARS TO CORRETTE
	1444	09/30/93	1.93	8.01	0.49	11,872	0.83	ID# 9342-B1 CLEANED 3HR -170 F
	AVERAGE		11.76	8.03	0.54	10,588	1.02	
	STANDARD DEVIATION		3.71	0.61	0.07	430	0.12	
	MIN		1.93	7.39	0.47	10,005	0.83	
	MAX		15.20	10.17	0.74	11,872	1.32	

Table 4.4 ACCP Quality Analyses for 1993 Annual Report (cont'd.)

Treated Product (cont'd)

	SAMPID	SAMPDATE	TM	PA	PS	HHV	SO2	COMM
FOURTH QUARTER, 1993	1587	10/18/93	9.96	8.01	0.57	10,939	1.04	10-18-93 DSE HAULER TEST
TREATED PRODUCT	1596	10/18/93	12.57	8.30	0.53	10,567	1.00	DSE TEST:10-18-93
	AVERAGE		11.27	8.16	0.55	10,753	1.02	
	STANDARD DEVIATION		1.30	0.15	0.02	186	0.02	
	MIN		9.96	8.01	0.53	10,567	1.00	
	MAX		12.57	8.30	0.57	10,939	1.04	

LEGEND	
TM	% Total Moisture
PA	% Ash
PS	% Sulfur
HHV	Btu/lb.
SO2	lbs. of SO2/MMBtu
COMM	Comments

Table 4.4 ACCP Quality Analyses for 1993 Annual Report (cont'd.)

First Stage

	SAMPID	SAMPDATE	TM	PA	PS	HHV	SO2	COMM
THIRD QUARTER, 1993	1170	08/26/93	12.96	10.18	1.10	10,212	2.15	930826 R-41 G
FIRST STAGE	1171	08/26/93	11.18	9.11	0.72	10,505	1.37	930826 H R-42
	AVERAGE		12.07	9.65	0.91	10,358	1.76	
	STANDARD DEVIATION		0.89	0.54	0.19	147	0.39	
	MIN		11.18	9.11	0.72	10,212	1.37	
	MAX		12.96	10.18	1.10	10,505	2.15	

	SAMPID	SAMPDATE	TM	PA	PS	HHV	SO2	COMM
FOURTH QUARTER, 1993	1601	10/19/93	22.87	8.94	1.09	8,410	2.59	9345-6 R-41
FIRST STAGE								

LEGEND	
TM	% Total Moisture
PA	% Ash
PS	% Sulfur
HHV	Btu/lb.
SO2	lbs. of SO2/MMBtu
COMM	Comments

Table 4.4 ACCP Quality Analyses for 1993 Annual Report (cont'd.)

Waste Coal

	SAMPID	SAMPDATE	TM	PA	PS	HHV	SO2	COMM
THIRD QUARTER, 1993	1166	08/26/93	2.78	33.50	3.94	8,317	9.47	930826-A T-94 WASTE
WASTE COAL								

LEGEND	
TM	% Total Moisture
PA	% Ash
PS	% Sulfur
HHV	Btu/lb.
SO2	lbs. of SO2/MMBtu
COMM	Comments

5.0 PROCESS STABILITY/PILOT WORK

During the initial plant startup tests which occurred in January through June of 1992, the product was noted to be dusty and susceptible to spontaneous combustion. Stability investigations and dust mitigation tests are on-going to lower costs and continually refine the application and improve product quality. A summary of product stability and dust mitigation testing to date is described below.

5.1 PRODUCT STABILITY

The dried, cooled, and cleaned coal produced to date has exhibited spontaneous heating and combustion. When any significant mass of coal (more than 1 to 2 tons) is exposed to any significant air flow for periods ranging from 18 to 72 hours, the coal reaches temperatures necessary for spontaneous combustion or auto ignition to occur. Spontaneous heating of run-of-mine, low-rank coals has been a common problem but usually occurs after open air exposure periods of days or weeks, not hours. However, dried, low-rank coals have universally displayed spontaneous heating tendencies to a greater degree than raw, low-rank coals.

Additional process steps and applying additives to the coal both during and after the process are being tested to mitigate this problem.

Butte Pilot Plant Verification Tests

The Butte pilot plant was operated to confirm that the SynCoal® produced by the ACCP was equal in reactivity to that of the pilot plant. The spontaneous heating characteristic was not identified at the pilot stage because product was generated at a comparatively low rate which allowed enough time for the material to passively stabilize before being covered by subsequent layers of SynCoal®.

Oxidation Tests

Tests were performed on a bench-scale to determine the completeness of oxidation, the potential for accelerating the rate of oxidation, and the thermodynamics of oxidation. From these tests, the mass uptake of oxygen was determined, as well as the typical SynCoal® oxidation rate expressions. Once the oxidation test results were calculated, the values were then used to design the stabilization pilot-scale equipment.

Carbon Dioxide Trials

In the literature search on methods for controlling spontaneous combustion, carbon dioxide is described as a method to control spontaneous heating. Testing is on-going to determine the effectiveness of using carbon dioxide to prevent or delay spontaneous heating and to optimize the rate of application. However, the results from testing indicate a two- to four-fold increase in SynCoal® product life. Unfortunately, carbon dioxide is very expensive and not an economical solution to the spontaneous combustion problem.

Pore Blocking Trials

The literature search also indicated several compounds are commercially available to prevent spontaneous combustion by blocking the reactive sites on the surface of coal. Several chemicals were tested on SynCoal® at varying flow rates and concentrations. In addition to spray application tests, a pilot-scale, blender-type of application technique was tested. The trial tests indicated that extremely high chemical applications showed a marginal improvement in product stability.

Blending Trials

Based on a market analysis, it was determined that blending SynCoal® with raw coal may be an effective method of delivering fuel to market. Testing is being performed to determine the effectiveness of blending SynCoal® with raw coal in achieving a stable product, determining the optimum blend ratios, and identifying the resulting fuel characteristics. Preliminary results indicated a significant increase in the life of the SynCoal® product from blending specific quantities of product and raw coal; however, the product was extremely dusty.

Rehydration Testing and Shipping Treated SynCoal®

Based on the blending trials, rehydration is being conducted to determine the effectiveness of using water to control spontaneous combustion and to determine the optimum moisture content and water application method.

Preliminary results indicated an 8- to 16-fold increase in SynCoal® stability. The fuel value of the coal was reduced and visible water vapor was evident upon delivery of the treated product. These aspects are continuing to be evaluated to obtain optimum performance.

Pile Management Testing

Pile management tests were performed to determine whether periodic heat rejection would result in a stabilized product. Based on observations, SynCoal® can be stabilized with pile management over a two-week period. However, large land areas would be required at commercial-scale, and variable weather conditions may affect product quality.

Stabilization Process Step Pilot Testing

After ensuring operability of the equipment, process test variables, including residence time, air flow, material temperatures, feed coal size, and flow rate, were tested. Under operating conditions, the process variables were found to be dependent; therefore, care was required not to operate in a "run-away" mode. Preliminary results indicated that treated SynCoal® can be six times more stable than product just off the process.

Stabilization Process Step Demonstration Design

Based on the successful test results, a full demonstration scale process step was designed for retrofit into the ACCP. Two different designs, a slip stream at 8 tons per hour (tph) and a full ACCP throughput 48 tph design, were cost estimated. Complete construction of this plant addition is expected to take 13 months with a full year of process and product testing.

5.2 PRODUCT DUSTINESS

The product is basically dust free when it exits the processing facility due to numerous steps where the coal is fluidized in process gas or air, which removes the dust-size particles. The gas and air entrains any dust that has been produced since the last process step.

Typical to coal handling systems, each handling activity performed on the product coal after the coal leaves the process degrades the coal size and produces some dust. The fall into the product silos, which can be up to 90 feet, can be especially degrading to the coal. Quantifying dustiness of coals is difficult, but once the product coal has passed through the nine transfer points between the process and a rail car, the coal is visibly dustier than run-of-mine coal. The SynCoal® product is actually no dustier than the raw coal; the dust is just more fugitive. Because the SynCoal® product is dry, it does not have any inherent ability to adhere small particles to the coal surfaces. This allows any dust-size particles that are generated by handling to be released and become fugitive.

Transfer points have been modified to reduce impacts, methods of reducing degradation in the silos have been examined, and dust suppression options tested.

SynCoal® Attrition Study and Dust Suppressant Testing

SynCoal® dustiness was reviewed to determine a dust control strategy based on results obtained from attrition testing. Initial tests were accomplished with standard, water-based chemicals, which included surfactant, inorganic salts, and lignosulfonate-based suppressants. None of the products tested at normal economic concentration levels were effective at mitigating SynCoal® dustiness.

After water-based compounds proved to be ineffective for mitigating SynCoal® dustiness, more exotic and expensive compounds were tested and evaluated. These compounds included oil, anionic polymers, latex polymers, and various oil-based emulsions. Oil was found to be an effective though expensive dust suppressant when applied at the required rates; however, due to environmental concerns, oil was removed from consideration. Another effective suppressant that is also environmentally safe is an ionic polymer. However, this chemical is also expensive to apply and impacts the overall process economics. As a result of rail car testing, an effective car topping compound was located. No dust suppressant was found to work adequately on blends.

Zig-Zag Testing

In addition to spray application of chemicals, a pilot-scale, zig-zag blender was tested to apply dust suppressant compounds. The objectives of these tests were to maximize compound efficiency and to ensure spray application test results were not biased by inconsistent coating. The zig-zag blender test confirmed the results obtained by the spray method but indicated that expensive compounds could be substantially diluted with water if a more efficient application technique was used.

Chemically Enhanced Treatment Application

Tests involving adding water to the SynCoal® product in lieu of blending yielded the most promising results. Total inundation of SynCoal® with water reduced the amount of dust liberated at the point of transfer. This technique has allowed the SynCoal® product to be shipped out of the ACCP plant. The negative aspects appear to be a reduced fuel value, difficulties of winter application, and reduced acceptance of visible water vapor liberation upon delivery.

6.0 FUTURE WORK AREAS

Work continues on improving product stability and dustiness. Several unforeseen product issues, which were only identified by the demonstration project operation, have changed the required activities for the ACCP Demonstration Project. Budget modifications will have be made to the existing contract so as to include the following tasks:

- identifying efficient and effective handling techniques;
- demonstrating the benefits of SynCoal® in the smaller, more constrained industrial boilers and older, smaller, utility boilers;
- developing additional methods to reduce the product's spontaneous combustion potential; and
- demonstrating abilities to reduce the production costs.

APPENDIX A

Significant Accomplishments from Origination of Project to Date

SIGNIFICANT ACCOMPLISHMENTS
(SINCE CONCEPT INCEPTION)

September	**1981**	Western Energy contracts Mountain States Energy to review LRC upgrading concept called the Greene process.
June	**1982**	Mountain States Energy built and tested a small batch processor in Butte, Montana.
December	**1984**	Initial patent application filed for the Greene process, December 1984.
November	**1984**	Initial operation of a 150 lb/hr continuous pilot plant modeling the Greene thermal process at Montana Tech's Mineral Research Center in Butte, Montana.
November	**1985**	Added product cooling and cleaning capability to the pilot plant.
January	**1986**	Initiated process engineering for a demonstration-size Advanced Coal Conversion Process (ACCP) facility.
October	**1986**	Completed six month continuous operating test at the pilot plant with over 3,000 operating hours producing approximately 200 tons of SynCoal®.
October	**1986**	Western Energy submitted a Clean Coal I proposal to DOE for the ACCP Demonstration Project in Colstrip, Montana, October 18, 1986.
December	**1986**	Western Energy's Clean Coal proposal identified as an alternate selection by DOE.
November	**1987**	Internal Revenue Service issued a private letter ruling designating the ACCP product as a "qualified fuel" under Section 29 of the IRS code, November 6, 1987.
February	**1988**	First U.S. patent issued February 16, 1988, No. 4, 725,337.
May	**1988**	Western Energy submitted an updated proposal to DOE in response to the Clean Coal II solicitation, May 23, 1988.
December	**1988**	Western Energy was selected by DOE to negotiate a Cooperative Agreement under the Clean Coal I program.
May	**1989**	Second U.S. patent issued March 7, 1989, No. 4, 810,258.
June	**1990**	Reach a negotiated agreement with DOE on the Cooperative Agreement, June 13, 1990.

SIGNIFICANT ACCOMPLISHMENTS (cont'd.)
(SINCE CONCEPT INCEPTION)

September	**1990**	Signed Cooperative Agreement, after Congressional approval, September 13, 1990.
September	**1990**	Contracted project engineering with Stone & Webster Engineering Corporation, September 17, 1990.
December	**1990**	Formed Rosebud SynCoal Partnership, December 5, 1990.
December	**1990**	Started construction on the Colstrip site.
March	**1991**	Novated the Cooperative Agreement to the Rosebud SynCoal Partnership, March 25, 1991.
March	**1991**	Formal ground breaking ceremony in Colstrip, Montana, March 28, 1991.
December	**1991**	Initiated commissioning of the ACCP Demonstration Facility.
April	**1992**	Completed construction of the ACCP Demonstration Facility and entered Phase III, Demonstration Operation.
June	**1992**	Formal dedication ceremony for the ACCP Demonstration Project in Colstrip, Montana, June 25, 1992.
August	**1992**	Successfully tested product handling by shipping 40 tons of SynCoal® product to MPC's Unit #3 by truck.
October	**1992**	Completed 81 hour continuous coal run 10/2/92.
November	**1992**	Converted to a single process train operation.
December	**1992**	Produced a passivated product with a two-week storage life.
January	**1993**	Produced 200 tons of passivated product that lasted 13 days in the open storage pile.
February	**1993**	The plant had a 62 percent operating factor between January 1 and February 15.
March	**1993**	Identified an environmentally compatible dust suppressant that inhibits fugitive dust from the SynCoal® product. Completed annual MSHA safety training.
May	**1993**	Tested nearly 700 tons of BNI lignite as a potential process feedstock achieving approximately 11,000 Btu/lb heating value and substantially reducing the sulfur in the resultant product.

SIGNIFICANT ACCOMPLISHMENTS (cont'd.)
(SINCE CONCEPT INCEPTION)

May	**1993**	Tested over 500 tons of BNI lignite.
June	**1993**	Initiated deliveries of SynCoal® under long-term contracts with industrial customer.
July	**1993**	Identified a conditioned method that inhibits spontaneous combustion and dust.
August	**1993**	State evaluated emissions, and the ACCP process is in compliance with air quality permit. ACCP Demonstration Facility went commercial on August 10, 1993.
September	**1993**	Stored approximately 9,000 tons of SynCoal® in inerted product silos and stabilized 2,000 to 3,000 tons in a managed open stockpile.
September	**1993**	Operated at an 84 percent operating factor and a 62 percent capacity factor for the month.
September	**1993**	Tested nearly 700 tons of BNI lignite as a potential process feedstock achieving approximately 11,000 Btu/lb heating value and substantially reducing the sulfur in the resultant product.
September	**1993**	Tested over 500 tons of BNI lignite.
October	**1993**	Processed more coal since resuming operation in August than during the entire time from initial startup with the summer's maintenance outage (approximately 15 months).
October	**1993**	Tested North Dakota lignite as a potential process feedstock, achieving nearly 11,000 Btu/lb heating value and substantially reducing the sulfur content in the resultant product.
November	**1993**	Operated at an 88 percent operating factor and a 74 percent capacity factor for the month.
December	**1993**	Shipped 16,951 tons of SynCoal® to various customers.