TIDD PFBC Demonstration Project

Quarterly Report July - September 1994

January 1995

Work Performed Under Contract No.: DE-FC21-87MC24132

For
U.S. Department of Energy
Office of Fossil Energy
Morgantown Energy Technology Center
Morgantown, West Virginia

By
Ohio Power Company
Columbus, Ohio

MASTER

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Office of Fossil Energy
Morgantown Energy Technology Center
P.O. Box 880
Morgantown, West Virginia 26507-0880

By
Ohio Power Company
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Columbus, Ohio 43220

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GLOSSARY OF ACRONYMS AND ABBREVIATIONS USED IN THIS REPORT

AARP	Annunciator Alarm Response Procedures
AB	ASEA Babcock - A business partnership between a subsidiary of ABBC and the Babcock & Wilcox Company (USA)
AEP	American Electric Power Company, Inc.
AEPSC	American Electric Power Service Corporation, a subsidiary of AEP
AFC	Approved for Construction
AFL	Approved for Layout
ABBC	ABB Carbon - a subsidiary of ASEA-Brown Boveri (subcontractor)
AOP	Abnormal Operating Procedure
B&W	The Babcock & Wilcox Company (subcontractor)
BWCC	The Babcock & Wilcox Construction Company (subcontractor)
BOP	Balance of Plant
CBI	Chicago Bridge and Iron, Inc. (subcontractor)
CSWD	Cable Schematics Wiring Drawings
CTF	Component Test Facility
DOE	Department of Energy (United States)
DRC	Design Review Committee
E&SC	Electrical Equipment Service Corporation (subcontractor)
ECP	Engineering Control Procedure
EMP	Environmental Monitoring Plan
EOP	Emergency Operating Procedure
EPA	Environmental Protection Agency
ESP	Electrostatic Precipitator
FAT	Net 90 - Factory Acceptance Test

GLOSSARY OF ACRONYMS AND ABBREVIATIONS USED IN THIS REPORT

GSU	Generator Step-up Transformer
GT	Gas Turbine
HPT	High Pressure Tubine
HVAC	Heating, Ventilating & Air Conditioning
I&C	Instrumentation & Control
IOI	Initial Operating Instructions
LPT	Low Pressure Turbine
MCR	Material Control Record
MCS	Management Command System
MCC	Motor Control Center
MED	Mechanical Engineering Division
NDE	Nondestructive Examination
NEMA	National Electric Manufacturers Association
NOP	Normal Operating Procedure
NOVAA	North Ohio Valley Air Authority
NPDES	National Pollutant Discharge Elimination System
OEPA	Ohio Environmental Protection Agency
OCDO	Ohio Coal Development Office - a part of Ohio Department of Development
OPCo	Ohio Power Company
PES	Plant Electrical Systems
PFBC	Pressurized Fluidized Bed Combustion
PMP	Project Management Plan
POPS	Plant Operations and Performance System

GLOSSARY OF ACRONYMS AND ABBREVIATIONS USED IN THIS REPORT

ppb	Parts Per Billion
PTI	Permit to Instal
PTO	Permit to Operate
PWHT	Post Weld Heat Treatment
RDR	Request for Drawing Revision
RFQ	Request for Quotation
SD-0	System Description (Rev. 0)
SD-1	System Description (Rev. 1)
SD-2	System Description (Rev. 2)
SD-2.5	System Description (Rev. 2.5)
SD-3.0	System Description (Final)
SPCC	Spill Prevention Control & Countermeasures

I. INTRODUCTION AND SUMMARY

This is the thirty-first Technical Progress Report submitted to the Department of Energy in connection with the Cooperative Agreement between the DOE and the Ohio Power Company for the Tidd PFBC Demonstration Plant. This report covers the period from October 1, 1994, to December 31, 1994.

Major activities during this period include:

- The unit operated for 1216 hours on coal, bringing the grand total for coal fire through the end of the quarter to 10,297 hours.
- The unit availability for the fourth quarter was 54.15%. The unit availability for 1994 was 54.7%.
- There were two gas turbine starts, two bed preheater starts, and three operating periods on coal.
- During this quarter, total gross generation was 64,439 MWH, the peak unit output for one hour was 68 MWH, and the coal consumption was 31,846 tons.
- Six performance tests were conducted during this quarter.
- The draft report on the first three years of operation was submitted to the DOE.

Major activities planned for the next period include:

- Operation of the unit at higher loads, and with different coals.
- Finalize the report on the first three years of operation.
- Develop the decommissioning plan for the Plant.

II. DESIGN AND PERMITTING

A. Engineering and Design Division

Boiler

Due to the intergranular stress corrosion cracking that was determined to be the cause of the secondary superheater (SSH) tube leaks experienced in September 1994 (platen no. 8), a decision was made to pull a different SSH platen and inspect for similar attack on the TP 304H stainless steel tubes. During the outage in late October 1994 platen No. 13 was cut loose and pulled up into the freeboard to perform this inspection.

Structural Integrity Associates Inc. (SI) was hired to perform an ultrasonic (UT) inspection of both SSH circuits (No. 25 and 26) of that platen. A special UT method to detect cracks at the I.D. surface of tubes developed by SI was

employed. All bends in both circuits and selected straight sections were examined, and no indications of significant I.D.-initiated cracking was found.

In addition, one bend from each of the SSH circuits was removed for metallurgical examination. The bends removed were from the same location as the failures that occurred in September in the other SSH platen, and were cut out along with an adjoining section of straight tubing. Microscopic examination of the bends revealed intergranular attack a few grains deep on the neutral axis of both of the bends; however, no signs of cracking were found. The straight sections showed no signs of intergranular attack.

The intergranular attack found on the neutral axis of the bends is similar to what was found in the bend of SSH circuit No. 16 in September. Due to the many potential contributing factors it is not determinable why the attack on SSH circuit No. 15 (the tube that initially failed) propagated through the tube wall and the attack on the other three bends sampled so far did not.

Gas Turbine

The gas turbine was found with heavy erosion of the LPT inner inlet guide vane ring on October 25, 1994. The guide vane ring was disassembled and weld repaired. The LPT blades were also found with erosion at the base of the suction side of the blade. The sharp eroded edges were rounded over and the old RT-22 erosion coating removed from the blades. A chrome carbide, erosion-resistant coating was applied to the repaired inner guide vane ring and the LPT blades.

A repaired LPT blade was sent to Stress Technology, Inc., to compare to a previous finite element model for resonant frequency analysis. The repaired blade resonant frequencies did not deviate significantly from the blade when it was new.

The gas turbine LPT outlet disk cooling air temperature increased beyond the maximum allowable on December 12, 1994, when the unit air flow loading was maximized to near 740 KPPH. Combustor bed level and air flow were decreased to reduce the disk cooling air temperature to 600°F. A modification to the cooling air system was being studied at the end of the quarter.

Gas Turbine Intercooler

Upon taking the unit out of service in late October, an additional tube leak was discovered in the intercooler. A sample taken of the tube inlet section (the portion that passes through the 4" deep tube sheet, of which only the first inch is rolled) revealed an O.D. (air side) initiated failure in the crevice region beyond the rolled area. The failure, which was a localized pit, appeared to be caused by corrosive attack in a mechanically induced indentation in the tube. Other indentations, which likely occurred during fabrication of the intercooler, were noted with chemical attack present within them. No evidence of corrosive attack or material degradation was found outside of the indentation areas, thus the possibility of a future tube rupture, which would be detrimental to the downstream high pressure compressor, was discounted.

In light of the large number of tube leaks that occurred and the belief that they all occurred in the tube sheet region, a decision was made to install sleeves at the inlets and outlets of the middle 16 rows of the 20 row high intercooler bundle. The bottom two rows were excluded from sleeving since they were of thicker wall and had not experienced any leaks, whereas the top two rows were plugged since they were not readily accessible.

Sorbent System

Replaced the last sections of steel pipe with ceramic lined pipe in the sorbent injection transport piping located outside of the combustor vessel. Also replaced the ceramic lined sorbent distribution piping inside of the combustor vessel.

B. Environmental

All monthly and quarterly environmental monitoring reports were filed with the North Ohio Valley Air Authority and Ohio EPA, as required.

The DOE's Environmental Monitoring Plan (EMP) requires quarterly reports be filed within sixty days of the end of each quarter. In compliance with that requirement, the EMP quarterly report for the third quarter of 1994 was submitted to DOE.

Monitoring of solid, liquid, and gaseous waste streams as required by the operations phase of the EMP was performed throughout the quarter.

On December 27, 1994, OPCo submitted a request to the Ohio EPA for the renewal of the NPDES permit which expires in June 1995.

On September 30, a RATA (Relative Accuracy Test Audit) was conducted on the NO_x and SO₂ meters as part of the certification of the CEMS system. Results of the testing are 7.09% relative accuracy for the SO₂ meter and 13.6% relative accuracy for the NO_x meter, which are within the requirement of 20% relative accuracy.

C. Performance Testing

Six performance tests (Nos. 78 through 83) were conducted since the last reporting period. Test 78 was conducted with National Lime Bucyrus #18-mesh "designer" limestone. Test 80 was conducted with National Lime Carey #12-mesh "designer" dolomite. The remaining tests were conducted with Plum Run Greenfield #12-mesh "site prepared" dolomite. All tests were conducted with the four point pneumatic sorbent injection system while burning Pittsburgh #8 coal at bed levels between 114 and 125 inches.

During Test 78 (October 1994), the unit was operated on limestone for approximately 36 hours. During this time period the bed showed signs of gradual deterioration exhibited by the gradual decline of bed density and heat transfer as bed and evaporator temperatures became less uniform; a small amount of sinters

was discovered in the bed ash drains. The test was ended prematurely by switching back to dolomite. Sorbent utilization was good; a Ca/s ratio (adjusted to 90% sr, 1580f bed temperature) of 1.91 was achieved at 117-inch bed level. On a mass basis this is equivalent to the results obtained with the Plum Run Greenfield #12-mesh "designer" dolomite. This was the longest period to date that the unit was able to operate on limestone. It's believed that the improved operation with limestone compared to the earlier attempts of 1992-1993 (when operation with limestone resulted in unit trips) is due to the finer, more uniformly sized particles and the slightly higher magnesium content of the Bucyrus #18-mesh limestone compared to the Delaware limestone.

During test 80 (December 1994) the unit was operated with National Lime Carey #12-mesh "designer" dolomite at 125-inch bed level. Sorbent utilization was not as good as expected. Preliminary results indicate that a Ca/s ratio (adjusted to 90% sr, 1580f bed temperature) of 1.81 was achieved. Based on the results of previous tests with the same dolomite at 115-inch bed level a Ca/s ratio of approximately 1.65 to 1.70 was expected. Sorbent size and chemistry analyses have not yet been received which are required for further test evaluation and explanation of results.

The results for the remaining four tests conducted in December with Plum Run Greenfield #12-mesh "site prepared" dolomite were also not quite as good as expected. An average Ca/s ratio (adjusted to 90% sr, 1580f bed temperature) of 1.87 was achieved at 115-inch bed level and 1.74 At 125-inch bed level. These results are approximately 10% over the expected Ca/s ratios based on previous tests using the same dolomite. Again, sorbent size and chemistry analyses have not yet been received for these tests.

Preliminary test results are presented in Table 1 and Figure 1.

Test plans for the final quarter of the Tidd test program include continued evaluation of Plum Run Greenfield #12-mesh "designer" and "site prepared" dolomites at higher unit loads; possible testing with fines separated from the sorbent and injected dry, wet, or discarded; and testing with alternate coals and sorbents (including a possible test with limestone and a higher ash fusion temperature coal).

III. PROJECT SUPPORT

Submitted to DOE the draft report on the first three years of operations at Tidd.

Analyses and cost estimates continue to be developed for the decommissioning of the Tidd Plant, including decommissioning of the coal yard, removal of the flue duct to the Cardinal stack, elimination of the railroad crossings, and decommissioning of the water wells.

Table 1. Preliminary Test Results

TEST RESULTS SUMMARY

01/10/95

	TEST NUMBER		78	79	80	81	82	83
	TEST DATE		10/13/94	12/07/94	12/14/94	12/19/94	12/21/94	12/30/94
	TEST PERIOD		1100-1430	0800-1600	1200-0500	0800-1600	0000-0800	0800-1600
OPERATING DATA								
n/a	BED LEVEL (CALC)	INCHES	117.1	114.0	125.4	125.9	125.7	125.2
886	ST GEN MW	MW	41.5	46.7	50.0	50.3	50.6	50.5
885	GT GEN MW	MW	10.3	10.6	14.0	13.8	14.3	13.8
n/a	COAL PASTE FLOW (CALC)	PPH	60782	65344	71087	74548	72781	71991
217	MEAN BED TEMP	F	1571.1	1576.1	1573.7	1573.7	1573.7	1574.8
691,692	INT VALVE INLET TEMP	F	1427.2	1423.8	1509.2	1501.3	1507.9	1500.8
191	AVG. BED OUTLET O2	PERCENT	4.9	3.8	3.6	3.5	3.5	3.4
260	MEAN CYCLONE TEMP IN.	F	1460.0	1442.7	1530.3	1522.7	1528.0	1520.3
604	AIR FLOW (INDICATED)	KPPH	659.8	664.8	715.0	718.9	719.9	716.9
864	FEEDWATER FLOW (MVS)	KPPH	362.8	393.5	420.6	422.2	425.6	424.0
EMISSIONS								
710	SO2 LVG ESP (RAW)	PPM	175.5	187.3	211.1	136.2	196.5	191.6
709	NOX LVG ESP (RAW)	PPM	129.9	111.8	114.3	121.1	119.8	124.1
n/a	NOX LVG ESP (CALC)	LB/MMBTU	0.22	0.18	0.18	0.19	0.19	0.19
n/a	SO2 LVG ESP (CALC)	LB/MMBTU	0.47	0.47	0.52	0.34	0.48	0.47
FEEDSTOCK ANALYSIS								
	COAL SULFUR (D/B)	WT. PCT.	3.20	2.99	3.44	3.49	3.28	2.82
	COAL SO2	LB/MMBTU	4.90	4.65	5.34	5.62	5.15	4.41
	PASTE MOISTURE (A/F)	WT. PCT.	27.82	26.57	26.50	26.50	26.50	26.50
	SORBENT CaO (D/B)	WT. PCT.	40.87	29.00	29.00	29.00	29.00	29.00
	SORBENT SMD (from ELH)	MICRONS	305	later	later	later	later	later
CALCULATED RESULTS								
	FIRING RATE	MWT	168.1	181.1	197.3	199.5	200.1	198.3
	SULFUR CAPTURE	PERCENT	90.5	89.9	90.2	94.0	90.6	89.4
	Ca/S TEST	RATIO	1.99	1.88	1.85	2.03	1.74	1.87
	Ca/S @ 90%, 1580 TBED	RATIO	1.91	1.87	1.81	1.63	1.68	1.90
	Ca/S @ 95%, 1580 TBED	RATIO	2.49	2.43	2.35	2.13	2.18	2.47
	COAL FLOW (DRY)	PPH (D/B)	43872	47982	52249	54793	53494	52914
	TOTAL SORBENT FLOW	PPH	11940	16260	20030	23370	18480	16800
	SORBENT IN PASTE	PERCENT	0.0	0.0	0.0	0.0	0.0	0.0
	BED ASH FLOW	PPH	7000	5940	13000	9380	7000	6052
	CYCLONE ASH FLOW	PPH	10374	14418	11061	19532	16484	15709
	PERCENT CYCLONE ASH	PERCENT	59.7	70.8	46.0	67.6	70.2	72.2
	HEAT BALANCE CLOSURE	PERCENT	98.2	99.5	98.9	99.1	98.9	98.9
	CALCIUM CLOSURE	PERCENT	95.1	later	later	later	later	later
	SULFUR CLOSURE	PERCENT	98.6	later	later	later	later	later
	CYC ASH SULPHATION	PERCENT	30.4	later	later	later	later	later
	BED ASH SULPHATION	PERCENT	58.8	later	later	later	later	later

Figure 1. Ca/S Ratio vs. Bed Height at 90% S. R., 1580F Bed Temp.

TIDD PFBC DEMONSTRATION PLANT
Ca/S RATIO VS. BED HEIGHT AT 90% S.R., 1580F BED TEMP.
TESTS 48-77, 79-83

baseut5 9-JAN-95

Description	1994 Year	Project Total
Number of Startups	18	115
Gas Turbine Operating Hours	5035.4	12433.8
Coal Fire Operating Hours	4766.8 See Note 1	10297.4
Steam Turbine Operating Hours	4790.7	10559.1
Unit Availability	54.7%	28.7%
Unit Availability 4th Year 3/1/94 - 12/31/94	58%	N/A
Unit Capacity Factor @ 70 MWG	35.7%	17.1%
Unit Output Factor @ 70 MWG	65.3%	59.7%
Total Gross Generation MWHr	2219011 See Note 2	441045

Note 1: Represents 86.2% of coal fire hours accumulated prior to 1/1/94.

Note 2: Represents 98.6% of total gross generation achieved prior to 1/1/94.

The following is a summary of accumulated operating data for the period October 1 through December 31, 1994:

Steam Turbine Generation	52,320 MWH
Gas Turbine Generation	12,119 MWH
Total Gross Generation	64,439 MWH
Peak Generation for 1 Hour	68 MWH
 Total Oil Fire Operating Time	 12.1 Hours
Total Coal Fire Operating Time	1216.3 Hours
 Total Coal Injected	 31,846 Tons
Total Sorbent Injected	18,543 KLB

The unit was operated for a total of 1235.5 hours (including gas turbine air warming). There were two gas turbine starts, two bed preheater starts, and three operating periods with coal fire. The peak gross output of 68 MWH was for the period of 1000 - 1100 hours on December 12, 1994. The availability of the unit for 1994 was 54.69%.

The Hot Gas Clean Up system was in service from October 1 through 21, only.

The unit remained in service at the end of the quarter.

The run continued from the 3rd quarter.

On October 2, 1994, bed temperature was lowered to 1540°F due to high temperatures in the bed ash removal system.

On October 4, 1994, the bed ash removal bucket elevator belt splice required repair. A vacuum service truck was used to remove bed ash from the atmospheric hopper while the splice was repaired. Also on October 4th, the plant started receiving #20 PR (Greenfield and Peebles mix) designer sorbent for the upcoming test. (Delivery by bulk truck.)

On October 5, 1994, bed level was raised in an attempt to determine what parameter would be the limit for full load. Air flow again was the stopping parameter at 715 kpph due to LPT shaft speed. (Outside air temperature was 44°F.) A bed level of 129" was achieved at a bed temperature of 1580°F. Steam flow was 420 kpph, which resulted in 64.4 MW. Another restriction was that the precipitator inlet duct pressure was also at the limit of 25" of water pressure.

Bed level was reduced to 116" and air flow lowered to 670 kpph in preparation for the test on #20 PR designer sorbent. The #20 PR sorbent started into the bed at about 0900 hours on October 5.

On October 6, 1994, bed level was lowered to 108" due to the higher density and resultant fuel flow requirements caused by the #20 sorbent. A unit performance test was conducted from 1100 hours on October 6 through 1100 hours on October 7, 1994. Bed bottom temperatures were running hot while performing this test. Due to these high temperatures, the planned 95% sulfur retention test on #20 PR designer sorbent was cancelled.

On October 7, 1994, the HGCU APF emergency ash line developed a leak and was removed from service. The alternate ash line was placed in service while the leak was weld repaired. When returning the emergency ash line to service it plugged. The alternate ash line was also restricted when trying to place it in service. Both of these lines were unplugged and the emergency ash line returned to service.

Bed temperature was lowered to 1500°F on the evening of October 7, 1994, to help with the removal of the hot bed material in the bed bottom and the resultant high bed ash removal system temperatures.

On October 8, 1994, after the hot material in the bed bottom was worked through, bed temperature was increased to 1580°F. When increasing bed temperature it was again noted that the duct opacity noticeably decreases above 1560°F bed temperature.

On October 11, 1994, the #18 Bucyrus Limestone started arriving on the plant site. When this material was introduced into the bed on October 12, 1994, the density started to decrease noticeably.

On October 12, number 6 paste pump was removed from service due to a problem with the "S" tube not traveling completely. A solenoid was replaced and the pump was returned to service.

On October 13, the bed density continued to decrease and by early afternoon bed temperatures and evaporator tube temperatures were erratic to the point of cancelling the test that was in progress. This test was started at 1100 hours and was aborted at 1430 hours. Bed temperature was lowered to 1480°F and plant prepared #12 Plum Run Greenfield dolomite was used as sorbent feed.

The unit was run at these conditions for the next several days to clean up the bed and to recover from the effects of the limestone.

On October 17, 1994, the sorbent preparation system sizer was tested in the "scalping - dedusting" mode. This is a double screen set up to eliminate the -50 mesh particles. Tests were run over the next three days on the sorbent preparation system sizer. While doing these tests, designer NL Carey sorbent was used to supplement the plant preparation system.

On October 17, 1994, #11 primary cyclone was completely spoiled to reevaluate the APF candle cleaning with the larger particles going to the APF.

On October 20, the steam turbine auto voltage regulator started swinging. The regulator was placed in manual while the Performance Department investigated the problem. The problem could not be corrected on-line and the regulator was left in manual for the remainder of the run.

On October 21, the gas turbine LPC was Carbo-blasted.

In preparation for a scheduled shut down of the unit, the coal bunkers, the sorbent 200 ton storage vessel, and the sorbent injection vessels were emptied for outage work.

The combustor was tripped at 1139 hours on October 21, 1994. The bed material was cooled with the gas turbine and then the turbine was removed from service at 1451 hours. The combustor was further cooled and then released to maintenance for outage work.

2. Start-Up TD-SU-94-12-01 November 30 - December 2, 1994

The combustor was released by the Maintenance Department at 1630 hours on November 30, 1994.

The gas turbine was rolled at 1006 hours on December 1, 1994, but tripped at 1021 hours.

The gas turbine was again rolled at 1141 hours, paralleled at 1156 hours and air flow established through the combustor at 1207 hours on December 1, 1994. During the air warming period, vibration was experienced on the gas turbine #3/4 bearing. This vibration was as high as 250 mils/sec at times.

Oil fire was established at 1715 hours.

The steam turbine was rolled at 1220 hours. Checks were made on the voltage regulator controls and limits. The steam turbine was paralleled at 0006 hours on December 2, 1994.

A coal fire was established at 0107 hours on five pumps. A hydraulic oil leak was found on #6 paste pump. Coal fire was accomplished with bed temperature at 1100°F as a test for sparge duct life extension. The #6 paste pump was placed in service at 0403 hours following the hydraulic leak repair.

Sorbent injection was started at 0247 hours.

Bed level was increased and once through boiler operation achieved at 0638 hours.

At 0650 hours a leak was discovered on an instrument connection on the boiler injection tank piping. Due to the inability to isolate this leak, the combustor was tripped at 0655 hours on December 2.

In order to isolate the boiler injection tank for repairs to be made, boiler circulation had to be taken off. The gas turbine was tripped at 1346 hours, boiler circulation stopped, and the

repair made to the boiler injection tank piping.

3. Start-Up TD-SU-94-12-02 December 2, 1994 - January 2, 1995

The boiler injection tank was released by the Maintenance Department at 1437 hours on December 2, 1994, following a weld repair to the piping tee.

The gas turbine was rolled at 1730 hours, paralleled at 1743 hours, and air flow established through the combustor at 1752 hours on December 2. The vibration on the gas turbine #3/ 4 bearing was similar to the previous start up.

An oil fire was established at 1915 hours.

The steam turbine was rolled and paralleled at 2238 hours.

A coal fire was established at 2314 hours. Coal fire was again accomplished with bed temperature at 1100°F as a test for sparge duct life extension. The #1 paste pump would not pump and coal fire was established with 5 paste pumps. The #1 paste pump was reversed, clean blown and placed in service at 0023 hours on December 3, 1994.

While increasing air flow the #2 gas turbine bearing vibration increased into alarm while the #3/ 4 bearing vibration decreased.

Sorbent injection was started at 0042 hours on December 3.

After air flow was increased where the LPT shaft speed was above the 4500 rpm critical speed range, the vibration on #2 bearing decreased below the alarm point.

Bed level was increased and once through boiler operation achieved at 0144 hours on December 3, 1994.

The duct opacity was higher than normal (35%) during most of the start up until bed temperature was increased to 1580°F.

Bed level was held at about 95" with bed temperature at 1580°F while the bed matured.

On December 4, 1994, bed level was raised to 115" in preparation for unit performance testing on National Lime #12 designer sorbent. Due to warm ambient temperatures, this testing was delayed.

A test was conducted at 115" bed level and 1580°F bed temperature at 90% sulfur retention on normal plant prepared PRG sorbent from 0800 hours to 1600 hours on December 7, 1994.

Approximately 200 tons of Minnehaha coal was received during this week and was test crushed. The crusher worked well with this coal but the firing rate increased about 15% due to the lower BTU of the coal and the sorbent injection demand decreased significantly due to the lower sulfur content in the coal.

On December 12, 1994, unit load was increased to find what would be the load limiting parameter. Air flow was increased to 740 kpph and bed level was increased to 130" with bed temperature at 1580°F. Steam flow was at 440 kpph with total plant output being 68.5 MW.

A short time later the LPT outlet disc cooling temperature increased into alarm. Unit load reduction was required to keep this disc cooling air temperature below the 620°F limit (123" bed level with 720 kpph air flow sufficiently reduced this disc temperature).

On December 13, 1994, #12 designer National Lime sorbent was introduced into the bed.

Density remained constant at about 43 lbs/ ft³. A unit performance test was started at 1200 hours on December 14 at 123" bed level, 1580°F bed temperature with 720 kpph air flow using #12 NL designer sorbent. This test was ended at 0600 hours on December 15, 1994.

On December 18, 1994, conditions were set for a 95% sulfur retention test at 122" bed level and 1580°F bed temperature. The actual test started at 0800 hours on December 19 and lasted until 1600 hours, with a bed ash production test following.

Sulfur retention was then lowered to 90% and held for the bed to stabilize at these conditions.

A unit performance test at 122" bed level, 1580°F bed temperature, and 90% sulfur retention was conducted from 0000 hours to 0800 hours on December 21, 1994.

At the completion of this test bed level was lowered to 115" and bed temperature reduced to 1540°F for easier operating conditions for the holiday weekend.

Unit load was increased on December 29 for stabilization for a unit performance test on December 30, 1994.

A unit performance test was conducted at 122" bed level, 1580°F bed temperature, and 90% sulfur retention with plant prepared #12 PRG sorbent from 0800 hours to 1600 hours on December 30, 1994.

V. MAINTENANCE

1. Outage TD-OT-94-11-01 October 21 - December 1, 1994

GAS TURBINE

Inspected, cleaned and metalized LPT blades for erosion.

Inspected, cleaned and metalized LPT inlet guide vanes for erosion.

Repaired disc cooling air supply valves.

Repaired leak in intercooler, plugged top two rows, and sleeved remaining tubes 6 inches in on each end.

Replaced check valve and added HSOV in cleaning compressor discharge line.

Tested DC lube oil pump.

Liquid cleaned LPT.

HOT GAS CLEAN UP

Removed head for candle replacement.

Removed worn out BUC ash line, rotated BUC ash collection chamber and installed new BUC ash line.

Replaced BUC ash pickup nozzle.

Replaced #2 expansion joint.

Replaced HCV-J926 (lockhopper equalizing valve).

Repaired HCV-J927.

Repaired shroud in APF.

Isolated from PFBC.

COMBUSTOR/BOILER

Completed boiler air test.

Vacuum cleaned freeboard, combustor bottom, sparge ducts, windbox and preheater.

Inspected stack breeching damper.

Inspected rupture disks.

Repaired lap joints on economizer inlet duct.

Repaired actuator coil on PCV-M001B (SSH vent valve).

Pulled number thirteen secondary superheater platen, removed tube samples and reinstalled platen.

CYCLONE ASH

Inspected and cleaned primary ash cyclones.

Air tested primary ash lines and replaced several gaskets in internal ash coolers.

Inspected and cleaned secondary ash cyclones.

Air tested secondary ash lines and repaired leaks.

Repaired worn ash lines on #22, 25, 26, and 27 cyclones.

Modified #11 primary cyclone to be straight through gas flow. (No cyclone action.)

Replaced cyclone ash silo fluidizing blower.

FUEL PREPARATION

Replaced blades on coal water mixer.

Machined moveable roll wheel on crusher.

Replaced reject screw feeder outboard seal.

FUEL INJECTION

Replaced all six fuel nozzles.

Adjusted paste pump "S" tube seal fits.

Calibrated all six paste pumps.

SORBENT PREPARATION

Rebuilt drying mill hammers, rotor and liner.

Repaired cyclone separator.

Metalized system fan rotor and blades.

Repaired velocity separator and expansion joint above separator.

Ran production rate test on sizer screen set up in the "scalping/ dedusting" mode.

SORBENT INJECTION

Replaced spool pieces between combustor and isolation valves with ceramic lined spool pieces.

Modified HCV-B840 and HCV-B850 to fit to new ceramic lined spool pieces.

Installed purge air on valve cavities for HCV-B818, HCV-B828, HCV-B831 and HCV-B832.

Installed larger valve operators on HCV-B831 and HCV-B832.

Replace ceramic lined piping on injection lines inside of the combustor.

Replaced the fine filter on the sorbent booster compressor.

Inspected and cleaned sorbent booster compressor inlet guide vane assembly.

Replaced expansion joints between 200 ton storage vessel and injection vessels.

MISCELLANEOUS

Repaired leak on boiler ventilation bag house.

Made repairs and adjustment to steam turbine voltage regulator.

Replaced valve plug on LCV-U200A.

Inspected and cleaned O₂ analyzer blowdown line and valve.

Installed larger valve operators on HCV-J270 and HCV-J280 (bed ash reinjection).

Filled bed ash reinjection vessels with sand and bed material for startup.

Conducted interlock checks.

V. MANPOWER REPORT

As of December 31, 1994, AEPSC actual work-hours for the Phase III accounted for 46.1% of the total budget of 135,098. Figure 2 represents the budget versus actual work-hours for this phase.

For the reporting period, a total of 2,877 hours were charged to the project by AEPSC personnel.

	1Q91	2Q91	3Q91	4Q91	1Q92	2Q92	3Q92	4Q92	1Q93	2Q93	3Q93	4Q93	1Q94	2Q94	3Q94	4Q94
Budget	10.6	21.7	31.3	39.4	47.7	54.1	60.4	66.8	73.1	78.7	84.3	89.7	93.3	96.5	99.9	100.0
Actual	0.7	3.6	7.1	10.1	14.4	17.8	21.6	25.2	29.5	32.5	34.8	37.4	39.3	41.8	44.0	46.1

VI. COST DATA

1. Project Cost Status

The actual cost shared expenditures during the Fourth Quarter 1994 were \$67,446. As of December 31, 1994, the cumulative cost shared expenditures for Phase I, II, and III were \$178,993,751.

Figure 3 depicts the cumulative expenditure forecast for the project from Calendar Year (CY) 1986 to CY 1994. This cash flow curve represents the entire project, all three phases, including expenditures that are not cost shared with DOE.

(in Millions)																	
	Thru 90	1Q91	2Q91	3Q91	4Q91	1Q92	2Q92	3Q92	4Q92	1Q93	2Q93	3Q93	4Q93	1Q94	2Q94	3Q94	4Q94
Forecast	156.9	163.1	166.5	169.8	173.1	176.5	179.8	183.1	186.5	189.8	193.1	196.5	199.8	202.0	202.4	202.4	202.4
Actual	142.2	146.2	149.6	152.7	159.0	161.8	164.4	169.4	173.3	175.4	177.2	179.9	183.2	185.5	185.9	186.0	186.1

Figure 4 is a projection of the quarterly expenditures for all participants. It also identifies the actual quarterly expenditures through the Fourth Quarter 1994.

(in Millions)																
	1Q91	2Q91	3Q91	4Q91	1Q92	2Q92	3Q92	4Q92	1Q93	2Q93	3Q93	4Q93	1Q94	2Q94	3Q94	4Q94
Forecast	0.080	0.320	0.339	0.918	0.573	0.437	0.488	0.587	0.391	0.348	0.600	1.060	0.059	0.000	0.000	0.000
Actual	0.080	0.320	0.339	0.918	0.573	0.437	0.488	0.587	0.391	0.348	0.451	0.752	0.515	0.000	0.000	6.200

The following table summarizes the project expenditures as of December 31, 1994, of all participants:

	Total Expended as of			
	<u>DOE</u>	<u>OCDO</u>	<u>OPCO</u>	<u>12/31/94</u>
<u>Phase I</u>				
Design & Permitting	\$8,469,449	\$5,000,000	\$8,069,734	\$21,539,183
<u>Phase II</u>				
Construction & Start-up	\$49,095,184	\$5,000,000	\$68,128,704	\$122,223,888
<u>Phase III</u>				
Operation, Data Collection, Reporting & Disposition	<u>\$6,200,000</u>	<u>-0-</u>	<u>\$28,060,680</u>	<u>\$35,230,680</u>
Total:	\$63,764,633	\$10,000,000	\$105,229,118	\$178,993,751

The following represents the financial status of the Tidd PFBC Demonstration Project - Phase III - 4th year, as of December 31, 1994:

Expenditures

Operations (Est. \$12,457,000) \$8,726,322*

Funding Source

-USDOE Share of Cost Growth	(\$3,564,633)	3,564,633
-USDOE Cost Sharing	(\$3,192,360)	1,467,519
-OCDO Cash Contribution	(\$2,600,000)	1,336,000
-OPCO Coal Contribution	(\$2,300,007)	1,940,490
-ABBC Contribution	(\$ 400,000)	150,300
-B&W Contribution	(\$ 400,000)	<u>267,380</u>

Total Funding To-Date \$8,726,322

Remaining Portion of Expenditures to be Recovered

\$ (0)

2. Contracts Awarded During Third Quarter 1994

Major contractual commitments were issued during this reporting period totalled

\$51,000 and are summarized as follows:

<u>Purchase Order</u>	<u>Description (Contractor)</u>	<u>Contracted Costs</u>
84116	Advanced Particle Filter Fail-Safe Regenerator Devices	\$51,000

*Expenditures do not include the 1994 Unvouchered Charges totaling \$720,098.

Figure 5 is the Phase III DOE quarterly actual and projected expenditures.

	(in Millions)																	
	Thru 90	1Q91	2Q91	3Q91	4Q91	1Q92	2Q92	3Q92	4Q92	1Q93	2Q93	3Q93	4Q93	1Q94	2Q94	3Q94	4Q94	To-date
Forecast	143.289	6.082	3.044	3.063	3.298	3.161	3.212	3.311	3.116	3.072	3.427	3.334	5.889	5.888	0.354	0.000	0.000	193.540
Actual	132.688	4.107	3.373	3.121	5.521	3.659	2.603	4.967	3.402	2.721	1.979	2.478	4.397	3.423	0.384	0.103	0.067	178.993

Figure 6 is the 4th Year Operations Quarterly Actual and Projected DOE Share of Expenditures.

	1Q94		2Q94		3Q94		4Q94		1Q95
PROJECTE	813000.0	**	2439000.0	**	1641000.0	**	1117000.0	**	748000.0
ACTUAL	0.0	**	3565000.0	**	615700.0	**	851800.0	**	0.0