

# PFBC Hot Gas Cleanup Test Program

Quarterly Report  
April - June 1995

Work Performed Under Contract No.: DE-FC21-89MC26042

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

By  
American Electric Power Service Corporation  
1 Riverside Plaza  
Columbus, Ohio 43215

July 1995

**MASTER** *ds*

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

## DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

This report has been reproduced directly from the best available copy.

Available to DOE and DOE contractors from the Office of Scientific and Technical Information, 175 Oak Ridge Turnpike, Oak Ridge, TN 37831; prices available at (615) 576-8401.

Available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161; phone orders accepted at (703) 487-4650.

## I. INTRODUCTION

This is the twenty-third Technical Progress Report submitted to the Department of Energy (DOE) in connection with the cooperative agreement between the DOE and Ohio Power Company for the Tidd PFBC Hot Gas Clean Up Test Facility. This report covers the work completed during the Second Quarter of CY 1995.

During this quarter, the Tidd APF was opened and the internals removed for inspection. Final equipment inspections were also performed. A draft of the final report for the program was nearing completion at the end of the quarter.

## II. WORK ACCOMPLISHED DURING THE REPORTING PERIOD

### 2.1 Detailed Design and Engineering

Most of the engineering activity this quarter was devoted to equipment inspections and report preparation. Results of the final inspections are discussed below.

#### Filter Vessel

The inside surface of the APF head was inspected following completion of the test program. A section of the head liner and Z-Block insulation was removed to expose the inside surface of the head. Heavy corrosion was apparent and portions of the metal were so corroded that large (3 to 4 inch) pieces of corroded metal about 1/16 to 1/8-inch thick would flake off the surface by pulling with one finger. Following this observation, shell thickness data were obtained using an ultrasonic instrument. It was

found that thickness of the top portion of the head was averaged 7.6% below the nominal 1.50 inches, and up to 12.2% below nominal at the thinnest point measured. The thickness of the bottom portion of the outlet nozzle near the nozzle-to-head weld was found to be 4.5% to 7.8% below the nominal 7/8 inch. It was evident that the carbon steel exposed to the flowing hot gas experienced significant corrosion. The remainder of the APF head which did not exhibit hot spots due to flowing hot gas was in excellent condition with the epoxy surface coating still intact.

#### Filter Internals

On 5/11 the APF internals were removed from the filter vessel. As previously observed by the boroscopic inspection, 20 of 22 of the Dupont PRD66 candles were broken, all in plenum B Top. In addition, two Coors alumina-mullite candles were broken (rather than one), one near the top in plenum A Top and the other about 2/3 down from the top in plenum A Middle. No ash bridging was seen. The residual ash cake layer thickness on the candles ranged from about 1/8" on the Coors alumina-mullite candles to about 3/8" on the Vitrapore silicon carbide candles. During removal cracks were seen in two candles, one alumina-mullite the other an original Schumacher silicon carbide surveillance candle. Both candles broke during removal and handling. Hard ash deposits were found in the bottom 6 to 12 inches of these cracked candles. In addition, a 3M candle was found to be cracked near the bottom after it was removed. No indication of an ash leak path was seen at the gasket area of any of these candles, but it appeared that ash accumulated in the bottom portion of these candles which resulted in cracking of the candles.

The outlet side of the filter was inspected and about 1/16" of ash was found on the top of the tubesheet. The vertical surfaces in the outlet side did not have ash accumulations. Some ash dust was found in the

venturi outlet pipes. If ash which leaked into the outlet side of the filter due to the broken Dupont candles became entrained by the backpulse air, it could explain how ash accumulated in the bottom of the other candles. However, the fail-safe devices removed from the candles did not show signs of ash on the outlet side.

The shroud was removed from the vessel for inspection. It appeared to be in generally good condition with no erosion was of the impingement plate opposite the inlet nozzle. This was of concern after the ash loading and particle size were increased during the last test period. One problem was noted with the shroud. The four support brackets were bent upward due to deformation of the shroud. This occurred even after the shroud material thickness was increased to 1/4 inch and a stiffening ring was added at the top of the shroud to mitigate this problem prior to the last test period. It was apparent that the shroud thickness was still insufficient to prevent distortion.

Upon removal of the shroud, the filter liner was exposed for better inspection. The upper portion of the liner was in generally good condition, except near the very top where it had been distorted by the weight of the shroud support brackets. However, severe distortion and warpage was apparent in the lower half of the liner. This distortion was much worse than observed in previous inspections and probably resulted from operating the APF at very high temperatures (above 1550F) during the last test period. It appeared that the liner could not expand properly and buckled inward as a result. The hopper cone appeared to be in good condition; only the cylindrical sections were warped. Ash had accumulated behind the liner at points where it had buckled inward and this may have prevented the liner from returning to its original position upon cooling.

The tubesheet support cone was inspected by removing some of the insulation from the upper side of the cone, and it appeared to be in excellent condition. Dye penetrant tests were conducted on the seam and circumferential welds on the inner cone, and no indications were noted.

The insulating plug used in the APF manway deteriorated severely. The 310 stainless steel metal used to contain the insulation corroded to such a degree that it essential fell apart upon removal. The plug was exposed to flue gas below the dew point which aggressively attacked the stainless steel in the plug. However, the manway nozzle which had been coated with epoxy was in good condition.

#### Backpulse System

Two of the Atkomatic solenoid valves and the COAX valve (used in the last test period) were disassembled for inspection. The COAX valve did not show any signs of degradation. The two Atkomatic valves appeared to be in excellent condition. Some very minor surface scratches were seen in localized areas on the pistons indicating that the Stellite coating held up very well. The valve body bores showed very minor surface pitting, but felt very smooth.

#### Backup Cyclone

The backup cyclone was inspected through the manway nozzle and found in good condition. Cracks in the refractory noted after the first test period did not appear to be much worse. However, a portion of the refractory liner used at the level detector location appeared to be eroded. The stainless steel sheet metal used to contain the refractory on the manway door was pitted but still in one piece. The ash line outlet

and air nozzles at the bottom of the cyclone were in good condition. A solid plug of ash about 4 inches deep was found in the bottom of the ash removal vessel.

#### Ash Removal System .

A section of the alternate ash line was removed and sectioned to determine if it had experienced erosion. No erosion was noted. The restrictive orifice in the alternate ash line was removed and inspected. The orifice, which was a tungsten carbide nozzle, appeared in excellent condition as was the tee downstream of the orifice.

The screw cooler internals were inspected using a boroscope. No problems were noted, however, fibrous material apparently from broken second generation filter candles was wrapped around the screw in several locations. The screw cooler end housings were removed to expose the hydraulic motor and bearings. No problems were apparent. However, ash was seen both end housings indicating that the pressure sealing system had not been totally effective in keeping ash out of the housings.

#### Hot Gas Piping

A section of a pipe spool including a portion of an expansion joint bellows was cut out for inspection. The Hastelloy liner between the refractory and the outer pipe and the outer bellows were in excellent condition. The carbon steel surface under the Hastelloy was not corroded at all. The refractory was not cracked and was intact. This expansion joint had been pumped with insulation which could be seen in the expansion joint convolutions.

### 2.3 Westinghouse Engineering and Design

Westinghouse activities this quarter included inspection of the APF internals after removal from the filter, posttest material surveillance testing, and preparation of input for the final report. Detail results from the examination of filter elements will be included in the next quarterly report.

### III. MANPOWER REPORT AND COST DATA

As of June 30, 1995, the AEPSC Engineering, Design and Project Support cumulative work-hours were 73,600.3 or 107% of the total 69,097 revised work-hours projected for the project. Figure 1 compares the actual work-hours expended versus the current estimate. For the reporting period, a total of 617.5 hours were charged to the project by AEPSC personnel.

The actual DOE's cost expenditure during the First Quarter 1995 was \$128,172. As of June 30, 1995, the cumulative DOE's cost expenditures were \$22,411,296. Figure 2 depicts the cumulative expenditure forecast for the project which includes Westinghouse cost share. During the Second Quarter 1995, Westinghouse was paid a total of \$81,608. Total payments to Westinghouse through June 30, 1995, were \$7,465,167.

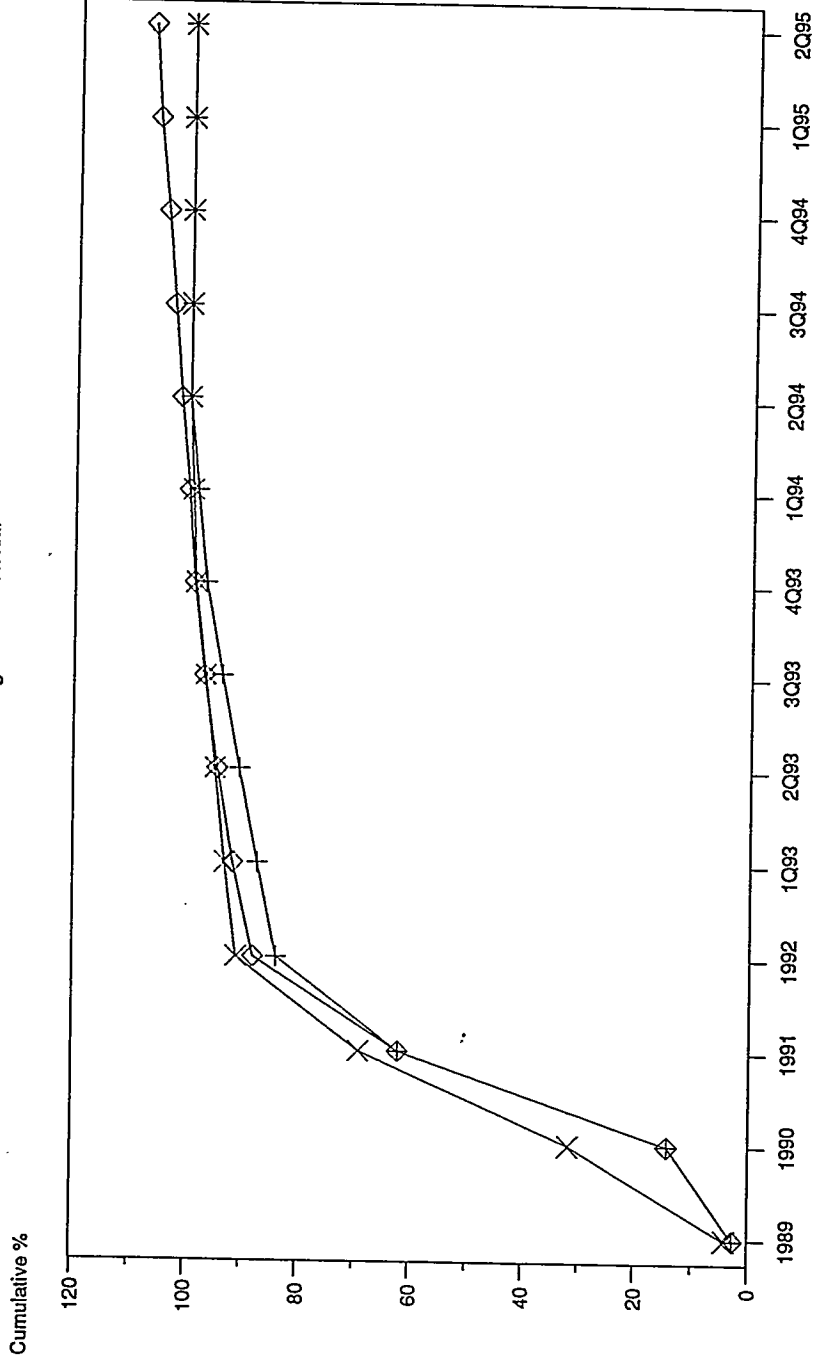
JDH2NDQTR

PFBC HGPU Test Facility  
DOE Instrument No. DE-FC21 89MC26042

Technical Progress Report No. 23  
Second Quarter CY 1995



PFBC Hot Gas Clean-Up Test Program  
 AEPSC Eng., Design & Project Support Work-Hours  
 Budget Versus Actual



Original — x —  
 Current — + —  
 Actual — ◊ —

	1989	1990	1991	1992	1993	2Q93	3Q93	4Q93	1Q94	2Q94	3Q94	4Q94	1Q95	2Q95
Original	4.0	31.8	69.2	90.9	93.1	94.9	96.7	98.6	99.3	100.0	100.0	100.0	100.0	100.0
Current	2.6	14.3	62.2	83.8	87.2	90.5	93.7	96.7	98.4	100.0	100.0	100.0	100.0	100.0
Actual	2.6	14.3	62.2	87.9	91.6	94.5	96.9	98.9	100.0	101.6	103.0	104.3	106.0	107.0

Figure 1