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Prepared by:
American Electric Power Service Corporation
Columbus, Ohio 43215

Prepared for:
The United States Department of Energy
Under DOE Instrument No. DE-FC21 89MC-26042

April, 1992

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PFBC HGCU Test Facility
Technical Progress Report
First Quarter, CY 1992

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I. INTRODUCTION

This is the tenth technical progress report submitted to the Department of Energy (DOE) in connection with the Cooperative Agreement between DOE and Ohio Power Company for the Tidd PFBC Hot Gas Clean Up Test Facility. This report covers the period of work completed during the First Quarter of CY 1992.

During the reporting period, work focused on supporting field construction activities and expediting delivery of equipment. The project is on schedule. The current project schedule is attached in Appendix 1.

The following significant events occurred during this report period:

• The major components of the system were delivered to the site and installed during this quarter. These items included the APF vessel and its internals, backup and bypass cyclones, back pulse skid, back pulse air compressor, air preheater, ash screw cooler, ash collection lockhoppers, and hot gas piping and expansion joint assemblies.

• Contract Modification No. 5 was issued to Westinghouse during this quarter. This modification authorized partial funding for proof-of-concept testing of an alternate filter candle material at Karhula, Finland.

• Contract Modification No. 2 was issued to Babcock & Wilcox (B&W) during this quarter. This modification covered additional materials (hangers, steel) and certain work scope changes.
Proposals were solicited for ash sampling hardware and testing services. Two (of three requested) proposals were submitted and are under review.

We visited various vendor shops to check on fabrication of materials and expedite deliveries. The vendors included:

Fisher-Klosterman (Cyclones) - Louisville, KY
Norwalk Company (Back Pulse Compressor) - So. Norwalk, CT
Badger Industries (Expansion Joint Assemblies) - Zelienople, PA
Chiz Brothers (Piping Refractory & Insulation) - Elizabeth, PA

We conducted a tour of the Tidd HGCU facility for EPRI (Mr. Rich Brown) and answered various questions.

Project Status as of March 31, 1992:

All Task 1, 2 and 4 (engineering and procurement) work elements have been completed. Work is continuing on the Test Plan (including various operating procedures) (Task 3.2) which is now 60 percent complete. Also, a purchase order should be placed in the next quarter for ash sampling hardware and test services.

As of March 31, 1992, construction was approximately 72 percent complete and on schedule.
Tidd Plant began an outage on March 17, 1992, to replace the gas turbine LPT blading. The outage is expected to last eight (8) weeks. During the outage the HGCU piping tie-in will be made inside the combustor. Only the bypass cyclone will be tied into the HGCU System during the outage. The APF will be tied in during a subsequent outage.

II. WORK ACCOMPLISHED DURING THE REPORTING PERIOD

2.1 Detailed Design - Engineering

In addition to the items listed under Paragraph I, the following major items were completed this quarter:

- Developed various pre-op procedures for cleaning and leak testing piping systems.
- Grouped parameters to be trended on the POPS computer.
- Purchased spare bottom assemblies for the cyclone ash collection vessels which incorporate air purge nozzles.
- Revised the air and gas flow diagram to reflect minor as-built changes.

- Expedited delivery of material and provided site support, as necessary, during erection.

2.3 Westinghouse Engineering & Design

See Appendix 2.
3.2 Test Plan

Three normal operating procedures were written and routed for internal review during this quarter. The procedures cover the following:

"HGCU Advanced Particle Filter System"
"HGCU Ash Removal System"
"HGCU Closed Cycle Cooling Water System"

The following pre-op procedures were issued this quarter:

1) HGCU System Pneumatic Leak Test
2) Purging Back Pulse Air Supply Line
3) Purging Air Preheater Supply Line
4) Screw Cooler Pre-Operation and System Flashes
5) APF Ash Removal Vacuum Procedure
6) CCCWS Leak Test
7) Isolating APF from Tidd Combustor for Long-Term Operation Using Bypass Cyclone

The Test Plan document and detailed Test Plan were drafted, reviewed, and are being revised. The draft Test Plan was submitted to DOE for comment on March 18, 1992.
4.1 Combustor Modifications

A contract modification was issued to B&W for additional materials (bolts, gaskets, blind flange, pipe supports, platform and structural steel) and additional engineering and shop labor to incorporate piping changes requested by AEP. These changes were initiated to reduce the number of field welds and add an inspection port in the pipe from the primary cyclone.

Piping is in fabrication and expected to be on site in mid-April. Piping tie-in to the existing system will be completed during the next quarter.

4.3 Westinghouse APF

See Appendix 2.

4.4 APF 2

A contract modification was issued to Westinghouse to cover partial funding for proof-of-concept testing of Mullite candles at Karhula. The contract modification covers Westinghouse engineering, in-house testing, material fabrication, project management, filter equipment/facility interface effort, and the test support. See Appendix 2 for details of Westinghouse's progress on the Karhula Project.

4.8 Ash Removal System
4.8 Ash Removal System

4.8.1 Ash Cooling

The screw cooler, provided by Denver Equipment Co., was installed this quarter. The lubricating oil system for the gear reducer is being revised to incorporate continuous oil circulation via a pressurized lube oil system. The initial design required "on/off" oil pump operation to maintain proper oil level in the gear reducer.

All major equipment (heater, tank, cooler, and pumps) for the screw cooler Closed Cycle Cooling Water System (CCCWS) was installed this quarter. Installation of the CCCWS piping is in progress.

4.8.2 Ash Depressurization

The APF lockhopper and surge hopper, from United Conveyor Corporation (UCC), were installed this quarter. Installation of the 4" ash transport piping is in progress. UCC issued Installation, Operation and Maintenance Manuals for the system.

4.8.3 Cyclone Ash Removal

The backup and bypass cyclones and ash collection vessels were installed this quarter. A purchase order was issued for the cyclone ash piping (prefabricated bent sections). Ash piping was received and installation is proceeding.
A purchase order was issued to Fisher-Klosterman for two revised bottom plug assemblies for the ash collection vessels. The new plug assemblies incorporate two additional 3/4" lines to allow air to be injected into the vessel to agitate any ash which may build up in the lower portion of the vessel. Delivery is expected by May 15, 1992.

4.10 Instrumentation and Controls

All the instrumentation has been ordered. The instrument racks have been received at the site and are being installed.

On January 22, a meeting was held at Tidd with the electrical contractor to review the labor contract for the HGCU work.

On February 19, a meeting was held with SRI to review the testing requirements for HGCU.

On February 21, a meeting was held with TN Technologies to review the operation of the key interlocking system on the nuclear source level switch. This switch is to be used to indicate high ash levels in the APF.

4.12 Special Instrumentation

ANARAD, Inc. made two drawing submittals during the First Quarter. The gas analyzer system was fabricated and was being factory tested at the end of the quarter. Delivery to Tidd is scheduled for May 15, 1992.
After reviewing a proposal for ash sampling submitted by Southern Research Institute (SRI), it was decided to solicit competitive bids for this work. Request for quotations were solicited from SRI, Westinghouse, and Battelle. Westinghouse declined to bid. The proposals from SRI and Battelle include sampling hardware and five (5) days field testing services. Battelle's quote includes particle size distributing data; SRI's does not. Battelle took exception to some of our Terms and Conditions. We are working with them to resolve this.

4.13 Computer/DABAS

Logic development for the programmable logic controller is complete. The process control computer was tested at the factory and has been shipped to the site. The configurations, screens and database have been simulated in our lab and shipped to the site for checkout. The engineering work station that was purchased for configuration development has been shipped to the site for equipment checkout and troubleshooting.

On January 24, a meeting was held at Tidd with Performance Department personnel to review the configurations for the process control computer. These comments are incorporated in the final configuration design.
On March 24, a meeting was held with Performance Department personnel to review the configurations prior to them being shipped to the site.

4.14 Fire Protection

Portable fire extinguishers (dry chemical and CO₂) and mounting equipment were purchased this quarter.
APPENDIX 2

ADVANCED PARTICLE FILTER

Technical Progress Report No. 7
January through March 1992

Prepared by

Westinghouse Science and Technology Center
Pittsburgh, Pennsylvania

For

American Electric Power Service Corporation
Columbus, Ohio

AEPSC Contract No. C8014
TIDD ADVANCED PARTICLE FILTER

GENERAL

Activities during this quarter included continued refinement of startup and operation details and delivery and installation of all major Advanced Particle Filter (APF) components. All milestones have been completed on or ahead of the required schedule with the exception of the acceptance test which is due 9-15-92.

The compressor was reviewed and its operation witnessed with AEP personnel at Norwalk Co. Multiple reviews and final equipment checkouts were held at the vessel fabricator, cluster fabricator and back pulse skid assembler. Westinghouse personnel have been at the Tidd site for approximately two months to witness equipment unloading, handling and erection, to install candle filters and gasketing, and to assemble final thermocouple connections, pressure line connections and miscellaneous insulation. Several meetings have been held with AEP site personnel to resolve technical issues and to discuss schedule.

INFORMATIONAL MILESTONES

The final instruction manual for the pulse air supply compressor has been sent to AEP. Miscellaneous drawing details are undergoing revision.

APF SYSTEM DESIGN AND SUPPLY

Table 1 provides an overall status summary by major component. At this time all procurement is complete, however, many interconnections are incomplete. They include compressor to back pulse skid, back pulse skid to vessel and many air and electrical interface points on the vessel.
<table>
<thead>
<tr>
<th>Item</th>
<th>Reference Drawings</th>
<th>Supplier and Address</th>
<th>Scheduled Delivery</th>
<th>Purchase Order No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. APF Vessel, Flange</td>
<td>1302J20</td>
<td>Penn Iron Works</td>
<td>2/4/92 Complete</td>
<td>34-38901-PA (12/12/90)</td>
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<tr>
<td>Internal Liners</td>
<td>1302J21</td>
<td>700 Old Fritztown Rd.</td>
<td></td>
<td></td>
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<tr>
<td>and Piping</td>
<td>1505E61</td>
<td>Montrose Manor Reading, PA 19608</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Refractory Lining</td>
<td>1302J22</td>
<td>BMI</td>
<td>2/4/92 Complete</td>
<td>34-35890-PA (2/12/91)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27 Noblestown Rd. Carnegie, PA 15104</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. High Alloy Materials</td>
<td></td>
<td>Rolled Alloys</td>
<td></td>
<td>34-39644-PA (12/04/90)</td>
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<tr>
<td></td>
<td></td>
<td>Box 310 Temperance, Michigan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Tubesheet Structure</td>
<td>1505E87</td>
<td>Alloy Engineering Co.</td>
<td>2/6/92 Complete</td>
<td>34-42824-CM (3/21/91)</td>
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<tr>
<td></td>
<td></td>
<td>844 Thacker Street Berea, Ohio 44017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Candle Cluster and Mounts</td>
<td>1505E85</td>
<td>FC Machine Tool &amp; Design</td>
<td>2/11/92 Complete</td>
<td>34-38950-CA (7/12/91)</td>
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<tr>
<td></td>
<td>1505E26</td>
<td>1474 Main Street Cuyahoga Falls, Ohio 44221</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1D33216</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Candle Elements</td>
<td></td>
<td>Schumacher GmbH &amp; Co.</td>
<td>2/13/92 Complete</td>
<td>34-39379-CM (12/03/90)</td>
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<tr>
<td></td>
<td></td>
<td>Zur Flugelau 70 Crailsheim, Germany</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Postfach 15 62, D-7180</td>
<td></td>
<td></td>
</tr>
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<td>7. Pulse Compressor</td>
<td>1505E62</td>
<td>Norwalk Company, Inc.</td>
<td>1/20/92 Complete</td>
<td>34-40424-PM (1/30/91)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Box 5 N. Water Street South Norwalk, CT 06856</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Instrumentation and Controls</td>
<td>1505E73(1-2) Varied</td>
<td></td>
<td>1/16/92 Complete</td>
<td>Varied</td>
</tr>
<tr>
<td></td>
<td>1505E74</td>
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<td></td>
<td></td>
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<td></td>
<td>1505E75</td>
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<tr>
<td></td>
<td>1505E76(1-3)</td>
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<tr>
<td></td>
<td>1505E94</td>
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</tbody>
</table>
KARHULA ADVANCED PARTICLE FILTER

GENERAL

Activities during this quarter included pilot scale testing of Coors candles, refined hardware design and procurement of long lead time high alloy materials. Preliminary results of candle testing are encouraging. Modifications to accommodate site conditions for cluster installation include additional lifting lugs on the cluster and a fixture for temporarily holding the cluster at the bottom of the vessel. All raw material requiring long lead time has been ordered and some has been delivered. The inner disk is ready for shipment to the tubesheet fabricator. Weld qualifications are being initiated at the cluster fabricator. Castings for filter holders are being made.

PROOF-OF-CONCEPT TESTING

Testing now focuses on support of the Karhula filter system design. There are two major differences in the Karhula application relative to the Tidd application. First, Coors mullite candles will be used for the first time on this scale. Second, blowback pressure will be limited to 40 bar (588 psi), which means that confirmation of cleanability of these new candles with lower pulse intensities than designed for at Tidd is needed.

Consequently, the Westinghouse HTHP test facility was set up with five 1-meter Coors candles and Karhula ash feed for testing. The candle array test plenum design used was identical to that previously used for the Tidd ash with Schumacher candles. It was desired to clean the candles with pulse tank pressures no more than 250 psig in this test facility to duplicate the pulse intensity (pressure rise in plenum) achievable at Karhula with standard 2-inch solenoid valves. The following were the test conditions.
Temperature 1500 to 1550°F
Pressure 100 psig
Face Velocity 5.6 ft/min
Filtration/blowback cycles 43
Dust Loading, Inlet 5,000 ppmw (cycles 1 to 3)
10,000 ppmw (cycles 4 to 43)
Test Duration 146 hours

The virgin candle pressure drop was 13 iwg. The trigger pressure drop for blowback was set at 40 iwg. All five candles were blown back as a group with a single pulse into the common plenum. Blowback tank pressures were varied over the range of 150 to 400 psig, with excellent cleaning, as indicated by stable low baseline pressure drop, and by straight pressure drop ramps after each blowback. The following is a summary of baseline pressure drop performance versus cycle and tank pressure.

<table>
<thead>
<tr>
<th>Cycles</th>
<th>Tank Pressure, psig</th>
<th>Baseline Pressure Drop iwg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-12</td>
<td>250</td>
<td>15.8 to 17.8</td>
</tr>
<tr>
<td>13-14</td>
<td>400</td>
<td>19.2, 19.1</td>
</tr>
<tr>
<td>15</td>
<td>250</td>
<td>19.2</td>
</tr>
<tr>
<td>16-20</td>
<td>400</td>
<td>19.2 to 19.4</td>
</tr>
<tr>
<td>21-27</td>
<td>250</td>
<td>19.8 to 19.4</td>
</tr>
<tr>
<td>28-29</td>
<td>200</td>
<td>18.2, 18.3</td>
</tr>
<tr>
<td>30-40</td>
<td>150</td>
<td>19.0 to 20.4</td>
</tr>
<tr>
<td>41-43</td>
<td>200</td>
<td>19.9 to 19.2</td>
</tr>
</tbody>
</table>

Dust penetration was very low throughout the test period, averaging 0.55 ppmw.
While the above results are encouraging, it must be remembered that tests were done by reusing a single drum of Karhula ash multiple times. It is possible that this reduced the tenacity of the dust cake. To guard against the possible occurrence of more adhesive dust at Karhula, the use of larger pulse valves (3 or 4 inch) is being planned.