Pulsed Atmospheric Fluidized-Bed Combustion

**Quarterly Report
October - December 1994**

January 1995

Work Performed Under Contract No.: DE-FC21-90MC27229

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

By
ThermoChem, Inc.
Columbia, Maryland

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P.O. Box 880
Morgantown, West Virginia 26507-0880

By
ThermoChem, Inc.
5570 Sterrett Place, No. 210
Columbia, Maryland 21044

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Executive Summary

The report of activities for the fourth quarter of 1994 is summarized below:

Design Activities

- Process. No changes in the process design encountered during this period.
- Mechanical. Minor modifications were made in the steam/water pressure pipe routing from and to boiler shell. This was primarily done to accommodate the bed module orientation change reported in last quarter. Refractory target cone lifting arrangement was designed and drawing made. Few changes were made in the pulse combustor jacket tail pipe inlet configuration and coal feed system.
- Civil and Structural. The ash silo pad elevation was lowered to match the nearest access road level. No changes in the structural design and drawings were made.
- Electrical and Instrumentation. Grounding system drawing was revised to comply Duke Fluor Daniel's recommendations. In the controls and instrumentation area, functional drawings showing major control schemes were completed.

Fabrication Activities. Major equipment fabrication and reconditioning was completed during this period. Pulse combustor components fabrication are in the final stages of completion.

Site Construction Activities. The foundation work was completed on Dec 31, 94 as scheduled. The underground electrical work was completed as well. The erection site was mobilized and the major equipment installation initiated. The refractory lining of some of the fabricated components was completed.

Planned Activities for Next Quarter. Erection of major equipments, installation of perimeter ground loop, construction of Control Room Building, specifications for the above ground electrical work and detailed drawings for controls and instrumentation.

Schedule. The project is currently on schedule and there is no change in the schedule reported last quarter.

SECTION 1.0 DESIGN

1.1 Process Design

The process configuration remained unchanged during this quarter.

1.2 Mechanical Design

1.2.1 Fluid Bed

The steam/water mixture piping layout from and to boiler shell was modified to reflect the revised bed module orientation. The steam/water mixture piping from bed modules and pulse combustor jacket was designed to have equal pressure drop and flexural rigidity (Figure 1). A rotating screw mechanism was designed to move the refractory target cone vertically up inside fluid bed (Figure 2).

1.2.2 Pulse Combustor Components

Design modifications were incorporated in the pulse combustor water jacket design (Figure 3). Previous design had a removable stainless steel insert (reducer) at the tail pipe inlet. In the revised design, the same is replaced with an integral reducer, attached to the tail pipe by butt welding. The reducer thickness is maintained same as the tail pipe (6" NB 120 sch). This modification work is currently being executed by an A.S.M.E. code approved boiler manufacturing company.

1.2.3 Feed System

Coal feed distribution into the fluid bed via four independent feed points using rotary isolation valve was discussed during the last quarter. The pick up hopper size in the coal distribution drawing was modified to have lower angle of repose (Figures 4 & 5). This revised arrangement will improve the coal flow from hopper to pneumatic lines.

Figure 1 PAFBC Piping Plan - Steam Circuit

Figure 2 Target Cone Traversing System

Figure 4 Coal/Limestone Handling System

Figure 5 Coal/Limestone Hopper

1.2.4 Ash System

No change in the ash feed system design are required, except the elbows on the pneumatic conveying lines will be replaced by cross.

1.3 Civil and Structural Design

The ash silo pad elevation in the original foundation drawing was 3' higher than the access road level. The pad level was lowered to match the nearby access road level and this will make the ash loading into the truck easier. Now the trucks can go directly under the silo and carry the collected ash.

1.4 Electrical Design

Duke Fluor Daniel's Electrical Engineer visited the PAFBC site during this quarter and inspected the under ground electrical work. After this visit, minor changes in the perimeter ground loop layout was recommended by Duke Fluor and the loop drawings are revised (Figure 6).

1.5 Controls and Instrumentation Design

Functional diagrams showing the control schemes were made for combustion control, draft control, drum level control and pulse combustor temperature control. Independent single loop controllers combined with I/P converters are used in each of these control schemes (Figures 7-10).

Section 2.0 FABRICATION ACTIVITIES

2.1 Major Equipment

Fabrication of major equipments, gas ductings and reconditioning of most of the used equipments were completed. Most of the heavy equipments were already shipped. Arrangements are being made to transport rest of the completed equipments to site.

Figure 6 Perimeter Ground Loop

Figure 7 Functional Diagram - Combustion Control

Figure 8 Functional Diagram - Draft Control

Figure 9 Functional Diagram - Drum Level Control

Figure 10 Functional Diagram - Pulse Combustor Temperature Control

The following equipment fabrication is in the final stages of completion:

- Pulse combustor air plenum
- Pulse combustor aero valves
- Pulse combustor fine coal injector
- Pulse combustor top plate

The following equipment reconditioning is in the final stages of completion:

- Screw conveyer connecting truck dump hopper to coal mill
- Screw conveyer connecting classifier to bucket elevator
- Fabrication of the structural steel coming around the combustor vessel was completed. The pulse combustor steam/water jacket was shipped to A.S.M.E. code shop, to modify the tail pipe inlet and add instrument connections.

2.2 Boiler Modification

The modifications on the boiler shell (enlargement and opening of new nozzles) were carried out by an A.S.M.E. code approved boiler repairer. After the modification, the boiler shell was subjected to hydro static test at 225 psig pressure and the test witnessed by code approved inspector.

Section 3.0 SITE CONSTRUCTION ACTIVITIES

The foundation work was completed on Dec 31, 1995 as scheduled. The work was inspected by registered civil Engineering firm in the state of South Carolina. The underground electrical work for the embedded conduits and grounding was completed as well.

The erection site was mobilized with Thermochem opening its site office at Clemson university.

The installation of following heavy equipments are **already completed**.

- Combustor vessel

- Fine coal silo
- Lime stone silo
- Structural steel columns and beam

The following major equipments are already shipped and ready for installation.

- Coarse coal silo
- Ash silo
- Economizer
- Bag house

Arrangements are being made to ship the following equipments within the next two weeks.

- Boiler inlet ash hopper
- Boiler outlet duct
- Economizer ash hopper
- Economizer outlet duct
- Distributor air inlet duct
- I.D. Fan outlet duct
- Exhaust stack

Refractory lining work on the following equipments are completed and will be shipped during next week.

- Hot cyclone
- Inlet gas duct to cyclone
- Solids return duct (Dipleg and J valve)
- Refractory Target cone

Section 4.0 PLANNED ACTIVITIES FOR NEXT QUARTER

4.1 Design

- Complete design and drawings for controls and instrumentation
- Design and drawings for control panel and wiring
- Isometric drawing for steam/water mixture pressure piping
- Review of piping, control and instrumentation drawings by Duke Fluor

4.2 Fabrication

- Complete pulse combustor components fabrication
- Complete reconditioning of all balance equipments

4.3 Site Construction

- Shipping of balance components to Clemson site
- Installation of rest of the heavy equipments and ductings
- Installation of under ground perimeter ground loop
- Refractory lining work for bed modules at vendors shop
- Installation of pressure piping from and to boiler
- Construction of control room building

Section 5.0 SCHEDULE

The schedule reflecting the above targets and milestones is provided in Figure 11. There is no change in the schedule submitted during last quarter.

Section 6.0 THERMOCHEM SITE CORRESPONDENCE

All site correspondence can be addressed to the following address:

ThermoChem
Clemson University Site Office
Central Energy Facility
Klugh Avenue
Clemson SC 29634

Phone: (803) 656-7111
Fax : (803) 656-7112

Figure 11 - Clemson PAFBC Project Schedule