Power Systems Development Facility

Quarterly Report

July 1 - September 30, 1996

Work Performed Under Contract No.: DE-FC21-90MC25140

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

By
Southern Company Services, Inc.
Power Systems Development Facility
Post Office Box 1069
Wilsonville, Alabama 35186

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

ng

DISCLAIMER

**Portions of this document may be illegible
in electronic image products. Images are
produced from the best available original
document.**

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.

POWER SYSTEMS DEVELOPMENT FACILITY
QUARTERLY TECHNICAL PROGRESS REPORT
JULY 1 - SEPTEMBER 30, 1996

TABLE OF CONTENTS

1.0 INTRODUCTION AND SUMMARY	1-1
2.0 REVIEW OF TECHNICAL PROGRESS	2-1
2.1 Project Management	2-1
2.2 Phase 2 - Detailed Design Activities	2-1
2.2.1 Task 2.1 Detailed Design	2-1
2.2.1.1 MWK: PSDF Transport Train	2-1
2.2.1.2 FW Team Activities	2-1
2.2.1.3 Balance-of-Plant Activities	2-2
2.2.1.4 Process Hazard Review	2-2
2.2.2 Task 2.3 Environmental Permitting and Compliance and Safety Issues	2-3
2.3 Phase 3 - Construction, Procurement and Installation	2-4
2.3.1 Task 3.3 Construction and Installation	2-4
2.3.2 Task 3.6 Preparations for Operations	2-8
3.0 PLANS FOR FUTURE WORK	3-1
Appendix A	A-1

1.0 INTRODUCTION AND SUMMARY

This quarterly technical progress report summarizes the work completed during the third quarter, July 1 through September 30, 1996, under the Department of Energy (DOE) Cooperative Agreement No. DE-FC21-90MC25140 entitled "Hot Gas Cleanup Test Facility for Gasification and Pressurized Combustion." The objective of this project is to evaluate hot gas particle control technologies using coal-derived gas streams. This will entail the design, construction, installation, and use of a flexible test facility which can operate under realistic gasification and combustion conditions. The major particulate control device issues to be addressed include the integration of the particulate control devices into coal utilization systems, on-line cleaning techniques, chemical and thermal degradation of components, fatigue or structural failures, blinding, collection efficiency as a function of particle size, and scale-up of particulate control systems to commercial size.

The conceptual design of the facility was extended to include a within scope, phased expansion of the existing Hot Gas Cleanup Test Facility Cooperative Agreement to also address systems integration issues of hot particulate removal in advanced coal-based power generation systems. This expansion included the consideration of the following modules at the test facility in addition to the original Transport Reactor gas source and Hot Gas Cleanup Units:

1. Carbonizer/Pressurized Circulating Fluidized Bed Gas Source.
2. Hot Gas Cleanup Units to mate to all gas streams.
3. Combustion Gas Turbine.
4. Fuel Cell and associated gas treatment.

This expansion to the Hot Gas Cleanup Test Facility is herein referred to as the Power Systems Development Facility (PSDF).

The most significant accomplishment during this reporting period was achieving the first coal combustion shakedown test run with the M. W. Kellogg (MWK) transport reactor. About 80 hours of on-stream coal feeding was achieved during August 18 - 21. Dolomite was fed as the sorbent. This shakedown test run produced successful demonstrations for the Startup Burner operation at higher firing rates and reactor pressures, reactor circulation and temperature control, solids feeding into the reactor, operation of the Westinghouse filter vessel and backpulse system, and operation of Spent Solids, Fines

Discharge and Transfer systems. Coke breeze assisted combustion preheat and coal combustion start-up sequence were also successfully demonstrated.

Prior to the above accomplishment, construction on the MWK process equipment and related balance of plant equipment was completed and commissioning was also finished. Additional reactor leak tests, hot solids circulation tests and coke breeze assisted combustion were performed prior to the coal combustion run.

Design efforts on Foster Wheeler (FW) train continued. Electrical design and instrumentation reviews were completed. The Multistage Annular Swirl Burner (MASB) was delivered to the site and placed in covered storage until needed. Construction of the FW combustor loop resumed at the beginning of July. Refractory cure out occurred in August although the desired upper temperatures could not be reached at this time. The remaining cure out will occur at the controlled heat-up as part of start-up.

Planning on the FW construction sequence continued with the tabulation of the required materials and equipment, and identification of task sequences was begun. FW-supplied equipment requiring cure out was prepared for storage and weatherized for the winter. Remaining equipment was prepared for long-term storage.

It should be noted that this report includes accounts of progress made by Foster Wheeler (FW), M. W. Kellogg (MWK), Combustion Power Company (CPC), Industrial Filter & Pump (IF&P), Westinghouse, Southern Research Institute (SRI), and Southern Company Services (SCS).

2.0 REVIEW OF TECHNICAL PROGRESS

2.1 PROJECT MANAGEMENT

The Cooperative Agreement for the Power Systems Development Facility, DE-FC21-90MC25140, between Southern Company Services and the United States Department of Energy is currently scheduled to expire on March 13, 1997, which is the end of Budget Period 5. SCS has prepared and submitted a Request for Contract Renewal (RCR) for this Cooperative Agreement. This Request for Contract Renewal was submitted to the Department of Energy on September 30, 1996. The RCR covers annual Budget Periods #6 through #10. The scope of Budget Periods #6 and #7 will include the following: (1) completion of the construction phase of the Advanced Pressurized Fluidized Bed Combustion Module (APFBC) which includes Foster Wheeler's technology for second generation Pressurized Fluidized Bed Combustion (PFBC), associated Particulate Control Devices (PCDs), the Compressor/Turbine Module, related Balance of Plant facilities, and the operation and testing of these modules; and (2) the continued operation and testing of the Advanced Gasifier Module which involves M.W. Kellogg's transport reactor, associated Particulate Control Devices and related Balance of Plant facilities. Budget Periods #7 through #10 will cover the operation and testing of these modules plus the operation and testing of the Fuel Cell Module.

2.2 PHASE 2 - DETAILED DESIGN ACTIVITIES

2.2.1 Task 2.1 Detailed Design

2.2.1.1 MWK: PSDF Transport Train

The detailed design is complete.

2.2.1.2 FW Team Activities

Design completion

Electrical design work and instrumentation reviews were completed. Problems were experienced in updating drawings using the Intergraph model and considerable effort from on-site staff and Foster Wheeler was required to make the system fully operational. Much effort was spent on compiling construction costs and in completing the inventory to determine what items remained to be purchased. During the preparation for the

refractory cure of the FW combustor, several interferences with the structural steel were identified. Design effort was required in resolving these problems.

A visit was made to American Boa in Atlanta to inspect two expansion joints (EJ-0802, located after the carbonizer PCD, and EJ-1002-1/2, located after the combustor PCD) prior to their pressure test. Both bellows failed their pressure tests and had to be repaired. They are expected to be delivered to the site at the end of October.

Combustion Turbine and MASB

A group of PSDF staff witnessed the operation of an Allison 501 at the Shell Yellowhammer refinery in Mobile, Alabama. US Turbine recommended this facility as the closest 501 now running. Shell shared detailed information about the 501 and the advice given at the meeting should be helpful as the PSDF prepares for simple cycle operation. Subjects covered included: operations and maintenance (O&M), spare parts, instrumentation and controls (I&C), startup experience, and training.

The MASB was delivered to the site during August and placed in covered storage for safe keeping. Items still to be purchased include the thermocouple traversing mechanism, flame detectors and the gas analysis equipment. This latter item will require analyzers for the two inlet streams, fuel gas and vitiated air, and the single flue gas discharge stream.

2.2.1.3 Balance-of-Plant Activities

The balance-of-plant design, engineering, procurement and construction support activities are complete.

2.2.1.4 Process Hazard Review

Due to modifications in design of several sections of the plant since the 1995 design hazard review, various process areas were reviewed again in June as listed in the progress report for the second quarter of 1996. Additional areas reviewed again in July included steam condensate (Area 2000), steam condensate cooler, service and instrument air (Area 2200), auxiliary fuel (Area 2300), fire protection (Area 2400) and the propane crossover between low and high pressure propane (Area 2300). The Design Hazard Review questions for the Westinghouse PCD were formally answered. All significant design problems were corrected. One design hazard review was conducted

in August on the FD0210 and FD0220 proposed vent modifications. This was a joint review with MWK and SCS.

2.2.2 Task 2.3 Environmental Permitting and Compliance and Safety Issues

Environmental Issues: The NPDES Discharge Monitoring Report (DMR) for the second quarter of 1996 was submitted to the Alabama Department of Environmental Management (ADEM) on July 24. In late June, Mr. Nathan Hartman from the ADEM Air Division toured the facility. The ADEM grants permission to start a facility provided it is constructed according to the information that was given in the Air Permit Application. On July 23, a letter was received from the ADEM granting permission to commence operations. On July 18, two ADEM Air Compliance Test Field Engineers visited the facility. After a facility tour, a discussion was held on the Compliance Test Protocol. The Air Compliance test protocol was prepared in August and submitted for ADEM review on September 5. The test protocol has to be reviewed by the ADEM at least 30 days before the compliance test is scheduled. On September 30, a notice was received from ADEM that the test protocol had been accepted without comment and a preliminary meeting with ADEM was not required. Once the compliance test procedure is in place and acceptable, Sanders Engineering, the vendor chosen for emissions testing, will be notified in advance of the test date and will then conduct the test according to the approved procedure. On September 13, an abbreviated Title V Operating Permit Application was submitted to ADEM Air Division. The complete Title V Operating Permit Application was to be completed and due to ADEM in December 1996. However, a postponement was requested since much of the facility emission information would not be available in time to complete the application by December.

The first load of ash was generated in August. Samples of the ash were taken and submitted for TCLP and sulfide analysis. The results showed the ash had no hazardous waste characteristics. Both ADEM Land Division and BFI have to approve the disposal of solid waste. BFI is the company who will handle non-hazardous waste generated at the facility and it will be landfilled at their subtitle D Pine View Facility about 60 miles away. The appropriate forms for waste disposal approval were completed and submitted to BFI. The ash container remains on site until the approval process has been completed. This procedure has to be completed only once for each waste.

Safety Issues: Monthly Safety Meetings for July, August, and September focused on the subjects of respirators, Hazard Communication, and driver/fall protection, respectively. Arrangements were made for FireMaster Corporation to conduct fire safety training and

fire fighting methods for the employees. In late September, plans were made for a visit by the Wilsonville Volunteer Fire Department. The PSDF Confined Space Rescue Team had practice sessions with Plant E. C. Gaston's Rescue Team in August and September. Refresher training classes for clearance procedures were held in August. The Environmental Coordinator and two warehouse personnel attended a Department of Transportation (DOT) training class on hazardous materials on September 30. The purpose of this class was to certify warehouse personnel on the DOT requirements for shipping and receiving hazardous materials.

2.3 PHASE 3 - CONSTRUCTION, PROCUREMENT AND INSTALLATION

2.3.1 Task 3.3 Construction and Installation

Combustion Power Company

The installation of the CPC granular bed filter system continued in August and September with the assembly of the recuperative heat exchanger and installation of small bore piping. All mechanical installation is complete except for some small bore piping and all instrumentation. Electrical installation is in its early stages. CPC has sent the majority of the documentation for the system to SCS, except for the Operation and Maintenance manual.

Industrial Filter and Pump

In July, IF&P addressed a number of the design revisions that were requested by SCS in the May design review meeting at the PSDF site. IF&P continued to implement fabrication changes to their external equipment per the design modifications requested. IF&P will not be working on the fabrication of the PCD internals until SCS releases the funding required. This is anticipated to occur in October 1996. However, during the month of August, IF&P submitted their budget estimates through March 2002. These estimates were reviewed by SCS in September and returned with suggestions for revision, after which IF&P re-submitted the estimates.

Southern Research Institute

Construction continued working on the installation of both the inlet and outlet particulate collection systems throughout the quarter. The installation of both systems will be complete in October and SRI will proceed with cold shakedown of the inlet system. The control hardware and software for operation of the systems was decided

upon and established during the quarter. Hot shakedown of the inlet system is anticipated to occur during combustion characterization tests in November.

Work continued throughout the quarter on the prototype cyclone manifold, which is scheduled for completion and delivery in October. SiCAM Corporation produced the wax patterns for the second cyclone manifold casting, and Howmet has made the ceramic mold for pouring the casting in October. The precutter, impactor shell, and bauxite canister for the cascade impactor were modified by ThermaFab Alloy during the quarter and they are to begin work in October on the impactor internals. Impactor substrate material testing is on-going. Also, the ceramic liners for the bauxite cartridges were completed and satisfactorily tested at high temperature during the quarter.

APFBC System

Work to install the auxiliary boiler commenced and a startup team was formed. The unit was sufficiently ready to start commissioning at the end of September.

Construction of the combustor loop restarted at the beginning of July in preparation for curing the refractory in the loop at the beginning of August. All this equipment was supplied by FWEC who prefer to erect vessels containing refractory prior to curing. All other vessels were supplied by FWUSA who prefer to cure the refractory prior to erection. Consideration had been given to waiting to cure the refractory as part of plant startup. It was decided to do it now primarily to ensure that any refractory problems arising did not interfere with the progress of startup. This was a particular concern as some of the refractory will have been poured over two years prior to the likely startup date of late-summer 1997.

The major vessels were already in the structure; the combustor itself, the FBHE, the solids return line from the FBHE, and the J-valve. On July 8, the combustor cyclone was lifted and bolted into position making the connection between the head of the combustor and the J-valve. Next, the solids transfer line from the J-valve to the FBHE was installed. This was a single piece of pipe, including two bends, and proved awkward to get into position around the existing structural beams and supports. Then the pipe section taking the fluidizing gas from the FBHE to the combustor was installed. This consisted of four pipe sections and so was much easier to install. Finally, the bottom ash cooler was lifted into the structure and bolted into position. The section taking the fluidizing gas to the combustor has an expansion bellow. When all the sections were connected and the bolts finally torqued, the restraining pieces in the spring

hangers and the expansion joints were released, allowing the assembled sections to expand as designed.

Once the pipe sections were in position, work commenced on installing the grating and any floor beams left out for access during assembly. Potential interference points between vessel ports and the grating and support beams were identified and eliminated.

Hotworks visited the site at the beginning of July to identify the best location of their burners for the refractory cure out. FWEC had selected Hotworks to complete the refractory cure and SCS assumed management responsibility for the task. Seven burner locations were identified; one in the ash cooler, two in the combustor, one in the solids return line from the FBHE, two in the FBHE, and one in the J-valve. The FBHE is divided into four compartments, two of which contain heat transfer tubes. The only ports available for these latter two compartments meant that the burners would fire directly onto the tubes. Although the material is 304 stainless and could be exposed to 1100°F, Hotworks was concerned that this temperature could be exceeded locally through radiation from the flame. Passing water through the tubes was discussed, but this would remove too much heat, thus, not allowing the minimum curing temperature of 1050°F to be reached. Cooling the tubes with air would remove less heat but Hotworks was still concerned about the tubes overheating. It was proposed that these two compartments not be fired, but be heated by a combination of conduction through the walls and convection from the hot gases circulating in the common region above the compartments. One considered alternative was to increase the convection component by venting an amount of gas through ports at the bottom of the bundle. This approach was not adopted for two reasons; the pressure driving force was not known, thus making the size of restriction flow orifice required difficult to determine; and the hot gas would have to be vented away to a safe location, making both an increased complexity and a source of pressure drop, further reducing an already low driving force.

The burners were to be supported by plates with a central hole 1/2-inch greater than the outer diameter of the burner. The hot gases from the seven burners were to be vented through the top of the combustor and the top of the cyclone. As the path of least resistance was through the combustor, it was recommended that metal discs be installed over the two openings to act as dampers and help balance gas flows, and also the temperatures, throughout the system. The system would be at a slight positive pressure of 2 or 3 inches of water and this would be sufficient to force gas through the ports mounted on the vessels. This could result in the ports being exposed to temperatures in excess of their working limit. To prevent this, a layer of insulating blanket was placed

over the end of the port and held in position by the wooden flanges used to protect the surface of the ports during transportation and construction.

Hotworks personnel were on site for five days in mid-August to complete the refractory dry out of the FW combustor loop. The job went smoothly but it was not possible to reach the required temperature of 1200°F in the lower reaches of the two FBHE compartments containing the tubes. This was not considered too disadvantageous as the refractory would have to go through a controlled heat-up as part of startup, and the "remaining" cure out could be done at that time.

During post-run inspections several cracks were noted but they were less than 1/16-inch wide. There were gaps of around 1/4-inch in the refractory at the joints of the sections making up the combustor. When these fill with solids during operation, the expansion and contraction of the gap could result in ratchetting and cause local failure of the refractory. To preclude this possibility the gaps were filled with refractory cement. The external flange faces were wire brushed, coated with a protective material to prevent wet corrosion, and then covered with plastic sheeting. A vent was placed at the top of the vessel to allow the system to "breathe". The flanges of the carbonizer and the combustor PCD were similarly treated.

Planning on the FW Construction sequence continued, with the tabulation of the required materials and equipment and sequencing of tasks begun. The Foster Wheeler Development Corporation designed refractory-lined vessels, which required cure-out of the refractory, were prepared for storage and weatherized for the winter. The remainder of the FW-supplied equipment was also prepared for long-term storage by connecting motor heaters, covering equipment, and setting up both the Booster Compressor and the Transport Air Compressor for temporary operation to exercise the machinery.

Transport Reactor Train

Construction on the MWK process equipment required for combustion is complete with the exception of minor punch-list work. Construction is finished on equipment required for operation of the MWK transport reactor as a gasifier. The gasification equipment is undergoing check-out and testing.

2.3.2 Task 3.6 Preparations for Operations

Commissioning Related Activities

Balance of Plant system testing and commissioning continued this quarter. Startup and testing of the on-site Air Separation Plant was completed. The high pressure air compressor was torn down during an outage and the valves and heads remachined for a better seal, solving an overheating problem and improving the compressor's capacity. The ash handling system operated without any significant problems, and samples of the ash were taken for analysis in preparation for disposal in a regulated landfill. The ash tested as non-hazardous (i.e., no sulfides and passed the TCLP testing).

During the second quarter, three major Start-Up milestones in the commissioning of the Transport Reactor were completed: (1) complete system pressure test, (2) Transport Reactor refractory cure, and (3) fluidization trials. In the beginning of the third quarter, the piping change to swap the gas flow path from the CPC Granular Bed Filter to the Westinghouse Filter Vessel was completed. Because the work broke the existing pressure boundary, another pressure test of the Transport Reactor system was conducted. At the completion of leak tests, the Transport Reactor was loaded with alumina solids, circulation established, and the Start-Up Burner lit off. The modifications made to the Start-Up Burner continued to allow satisfactory operation, however, the problems with coking in the main burner gun tip continued to limit the fuel flow into the reactor. The reactor mixing zone temperatures reached almost 1100°F before a second failure of the reactor's pressure let-down valve forced a reactor shut-down. The valve had been eroded again by alumina, although the source of the eroding material was not clearly identified at that time. Just before the failure some coke breeze was injected into the reactor, although the temperature rise seen was not sufficient to indicate complete combustion was established.

During this run, many of the systems were operated as they will be during test campaigns, with only minor problems. During the ensuing outage, several minor issues were addressed: the baghouse ash transport system, several instrumentation transmitters, and safety valve mountings. The Baghouse Ash Screw Feeder was found to be turning backwards. The transport system had some minor control logic problems that were masked by a faulty level probe on the dispense vessel hopper. Trash was removed from some transport vessels and lines. Some of the transmitters' calibrations were found to have been inadvertently reprogrammed during a calibration check. The vibration intolerance of several pilot operated safety valves was corrected by redesigned installation.

Details of some of the commissioning activities are given below:

Feedstock preparation: Feedstock preparation and transport equipment (mills, conveyors, etc.) were operated in support of the reactor shake-down run.

Work continues to optimize the sizing of the feedstock materials and select the best start-up bed material for use in the reactor. Several ash samples have been collected from power plants within the Southern Company over the past several months and analyzed for the potential use as a start up bed material. The desired size range is 75 to 700 microns. The samples obtained from Plant Gaston fines and bottoms piles were either too fine or too coarse. See samples 3-147 and 3-148 in the results listed in Appendix A. A sample of bottom ash was obtained from Plant Miller. Although this sample appeared promising at first, 35% of the ash is larger than 1000 microns. Also this ash tends to be friable and may lead to more fines production. See Sample 3-153 in Appendix A. A sample of bottoms reject (or processed fines) was obtained from Plant Bowen. For this sample a LOI was performed and then the size analysis was done both before and after LOI analysis. See samples 3-301 and 3-301 (2) in Appendix A. Both size analyses are similar indicating the material did not break up. This material is a potential candidate for use as the startup bed material. About 25% is larger than 1000 microns so to use this material would require separating the coarse material out and being able to dry the material in the sorbent mill. The sorbent silo would need to be emptied to use this route of processing.

BOP Dense Phase Transport Systems: In July, the FD0104 (coal to MWK coal bin) and FD0154 (sorbent to MWK sorbent bin) and their conveying lines were tested to ensure no moisture was present in these lines. The two dense phase transporters were cycled to check their status but without solids. The FD0154 was tested later on ground dolomite. The discharge line plugged when first tried. Closing the inlet slide gate valve half way to slow the dolomite addition improved the transporter's performance. Both FD0154 and FD0104 were used during the July 20 to July 27 initial operation period. Also FD0140 was used to feed alumina to the MWK coal bin for transfer into the reactor. The FD0104, FD0154, and FD0140 have worked well. On August 18, the FD0140 system would not transport coke breeze to the FD0210 feeder. Water from a heavy rain storm entered the feed bin and caused the FD0140 lines to plug. The cover on the FD0140 bin has been weather proofed so that water will not blow into the bin.

The FD0810 transporter to transport sulfator ash and FD0610 (sulfator sorbent addition) have been installed and functionally checked, but have not been put in service.

MWK Dense Phase Transport Systems: Over 31 issues and problems developed during the startup for the transport system. The bin spheri valve on FD0210 (coal feeder) was on instrument air. The supply was changed to low pressure nitrogen, so that if the spheri valve seal were to fail, air would not be flowing into the coal bin. The air supply to the 3-way spheri valves from FD0140 (coke breeze/bed material feeder) was also changed to low pressure nitrogen for the same reasons as for FD0210. As reported for the last quarter, the major problem with the coal/sorbent feeders was in feeding alumina -- the motor torque is not enough to keep rotation. Some of the problems involving the Clyde feeders and other transport equipment were as follows:

FD0220-- Set points for gas flows were changed within the control system.

The lock vessel spheri valve would not open and stay open in the test configuration (manual valve closed below storage bin). The lock vessel pressure equalization valve was opening too fast after the valve was to open which caused the pressure to increase in the lock vessel which would close the valve. The control sequence was modified with a timer sequence.

FD0210-- When starting up FD0210 the lock vessel spheri valve had the same problem as FD0220. Added timing sequence as done with FD0220.

Spans within the control logic, dependent upon reactor pressure values, were increased. Also, lower limit values for pressure switches were changed.

FD0104 and FD0154-- Coal and limestone transporters were tested by cycling them to FD0210 bin and FD0220 bin, respectively.

Loose wiring discovered in level probes.

Proximity probe on 3-way valve was broken.

Correct/modify control system true/false logic and add screens where settings can more readily be changed.

Additional items-- For FD0530, improper relay operation prevented switches from operating ash silo correctly.

Pressure differential switches were operating in reverse on operation of FD0530.

Increased outlet pressure limit controlling FD0530 feeder motor operation to allow the needed, longer motor operation.

Modify true/false logic for interlocks on FD0810.

All of the above (plus other) items were corrected by the end of July.

After modifications, the Clyde Pneumatic Conveying transporters are working fairly well. Below is an equipment history sketch for the quarter.

FD0210

- 6/18/96 Alumina was added to reactor. A spacer had been placed in the rotofeeder per the experience with FD0530. The bottom of the rotofeeder had moisture and would not transport. Rotofeeder was taken apart and cleaned out.
- 6/29/96 Tried to add alumina. Rotofeeder was binding. Would turn for short period of time and would stop.
- 8/4/96 The rotofeeder would not transfer solids to the reactor. Pieces of grating were found plugging the 1" discharge line. The grating pieces apparently came from the FD0140 where the decking was being added.
- 8/6/96 The cause of the reactor letdown valve, PV287, erosion was traced to solids carryover from the FD0210 and FD0220 vent lines to upstream of the PV287 valve. These vents and valves were intended to allow a flow through the dispense vessel while maintaining the dispense vessel at a pressure a few psig above the conveying line pressure. These vents now have valves that will remain closed. A design of the vents back to the silos above the feeders has been done, however it was found in the 8/18/96 run period that the rotofeeders would operate without the vents. Differential pressure (between the dispense vessel and the nitrogen supply to the purge valves) controllers were added to reduce the flow rate through the dispense vessels when operating at low pressures. (When operating at 50 psig, the supply pressure is 315 psig which causes too much flow through the flow orifices. Control of the upstream pressure should reduce the amount of flow.)

8/16/96 The FD0210 feeder would not transfer solids. Upon taking the bottom off, epoxy paint chips were found. The vessel was coated on the inside with epoxy. Most of the loose epoxy was removed from the inside of the vessel. On 8/18 The FD0210 tripped due to the top lock vessel spheri valve failing to fully close. By enabling and disabling the fill cycle, the spheri valve closed and the feeder was started. After coal was added to FD0210, the operation became smoother.

8/18/96 With coal feed, the rotofeed motor would run at low speeds with only occasional help.

8/27/96 Due to the plugging that occurs between the rotofeeder outlet and where the solids enters a smaller pipe, a valve has been added at the elbow to allow rod out of plugs or to blow into the line.

FD0220

6/28/96 Line from rotofeeder is small, and plugs easily. Rotofeeder stops frequently.

7/29/96 Lock vessel spheri valves were reported to be malfunctioning, however on empty test they performed well. Overfilling of the lock vessel may have caused the valves to jam.

8/5/96 Level probe in dispense vessel would not function. Probe was adjusted and later readjusted with alumina in a bucket. Pressure drop in transfer line from the rotofeeder was erratic on fines recycle.

8/6/96 The cause of the reactor letdown valve, PV287, erosion was traced to solids carryover from the FD0210 and FD0220 vent lines to upstream of the PV287 valve. These vents and valves were intended to allow a flow through the dispense vessel while maintaining the dispense vessel at a pressure a few psig above the conveying line pressure. These vents now have valves that will remain closed. A design of the vents back to the silos above the feeders has been done, however it was found in the 8/18/96 run period that the rotofeeders would operate without the vents. Differential pressure (between the dispense vessel and the nitrogen supply to the purge valves) controllers were added to reduce the flow rate through

the dispense vessels when operating at low pressures. (When operating at 50 psig, the supply pressure is 315 psig which causes too much flow through the flow orifices. Control of the upstream pressure should reduce the amount of flow.)

- 8/15/96 The FD0220 dispense vessel pressure went to 300 psig with 70 psig on the transfer line and the motor would not run. The dispense vessel pressure was lowered to 70 psig. Without the large differential pressure the motor would run. The feeder was turned on and the new pressure controller was set to 1 psig. The problem was the lower ring valves were always open, allowing the material to pack in the bottom of the feeder. When plugged, the dispense vessel will increase in pressure up to the supply pressure. On 8/16 the pressure tubing within the purge control cabinet ruptured. Fortunately the cabinet relief valves were adequate for the flow. Most of the tubing fittings were changed to Swagelock fitting.
- 8/27/96 Due to the plugging that occurs between the rotofeeder outlet and where the solids enters a smaller pipe, a valve has been added at the elbow to allow rodding out of plugs or blowing into the line.
- 10/7/96 Lock vessel spheri valve seal was leaking. Found O-ring pinched. O-ring was replaced and seal was also replaced. After this repair the nitrogen used for the spheri valve seal was small as indicated by the FV490 valve position.
- FD0510
- 6/21/96 Alumina was transferred from the reactor standpipe. Both Spheri Valves would not rotate. The gap for the bottom Spheri Valve was increased to add clearance. The pressure seal was replaced. The upper Spheri Valve was loosened by increasing pressure on the actuator piston.
- 7/17/96 Top Spheri Valve would not rotate. Maintenance took off air lines to one side of the actuator and was able to get it to rotate.
- 8/6/96 The top spheri valve on FD0510 would not rotate closed. After working with the pressure to the cylinder that rotates the valve, the valve would rotate closed. The FD0206 and FD0510 were run for a few minutes each

hour to avoid condensation. Other than the sticking spheri valve, the feeder worked well.

10/2/96 Dispense vessel spheri valve seal leaking. Seal was replaced.

FD0520

7/18/96 The bottom Spheri Valve would not completely close. The Spheri Valve was removed. Some chunks of refractory were found on top of the hemisphere. The top of the hemisphere was scored. The pressure seal was replaced and the spacing was increased. The top of the hemisphere was polished with sand paper.

7/23-24/96 Discharge clogged several times with refractory pieces but was cleared by rodding into the discharge line. Due to the reduction in cross section between the vessel and 2" discharge line, there is little tolerance for larger particles.

10/2/96 Dispense vessel level probe will not function. Found a loose connector in the wiring. Connector was repaired.

FD0530

3/96 Alumina was transferred from the FD0530 bin to FD0220. The rotofeeder bound tight. The motor could not be rotated by hand. The rotofeeder was taken to the shop. The plate on top of the rotor was scored and the area near the shaft indicated metal to metal galling with the metal possibly causing the binding. The gap between the rotor and the top plate was increased by using shims.

6/28/96 Alumina was transferred from the FD0530 bin to the ash silo. The motor would stop continuously. The rotofeeder could not be operated continuously until the feeder was nearly empty.

7/13/96 Alumina was transferred from the FD0530 bin to the ash silo. The feeder worked for about fifteen minutes before it quit.

7/24/96 Level probe in dispense vessel was indicating the vessel was full when it was not full. Also the rotofeeder motor would trip continuously.

FD0610

9/96 Functional checks were written for FD0610 (limestone/sorbent to the sulfator). To be completed in October.

FD0810

9/96 Functional checks were written for FD0810 (sulfator ash to the ash silo). To be completed in October.

FD0602

9/96 Functional checks were written for FD0602 (screw cooler on sulfator ash to FD0810). To be completed in October.

Main Air Compressor: The Main Air Compressor has operated well in automatic and provided the required air demand for the process. Process operations have proven that the previous tuning problems have been corrected. The effectiveness of the control systems was evident during the first coal feed run when the positioner arm on the pressure letdown valve broke and the reactor pressure increased from 150 to 260 psig in 30 seconds. The Main Air Compressor made the necessary adjustments to the inlet guide vane and blowoff valve position without surging or unloading. The compressor has run for a total of 1200 hours since May 1996.

Reactor Startup Burner: The Reactor Start-Up Heater did not pass the functional tests in May, due to damage to both the ignitor rod and the flame detection rod. Both SCS and Kellogg were in discussions and participated in an effort to redesign the burner to better and more safely meet the design specifications. Several modifications were made to temporarily use the existing equipment, and the burner has since been operating. However, concerns still exist that must be addressed during a redesign: the lack of safe turn-down in fuel flow, the lack of automatic compensation for reactor pressure variations, and separate pilot combustion air. This redesign effort was completed in July, and the new fabricated elements were hydrostatically tested in the vendor's fabrication shop before shipping. The redesign addressed the cooling and clearance requirements for both the flame rod and the ignitor, the sealing requirements of the moving ignitor system, and interferences in the welds causing porosity. A redesigned burner tip was also fabricated to reduce the coking due to overheating, allow better turn-down and also repositioning the flame to allow a third more heat release, using the

higher pressure available in the BOP propane system (provided to meet FW specifications, rather than the original MWK boundary specifications).

Transport Reactor: June 26 - July 1 Hot Solids Circulation Tests: For this test, the gas from the reactor was sent through the empty CPC filter vessel, by-passing BR0401, and from there through the baghouse to the stack. Due to recycle gas compressor commissioning tests in June, almost all of the solids were drained from the transport reactor. The reactor J-leg and standpipe were empty of solids. The solids remaining inside HX0203 filled its J-leg and its standpipe up to its boot. After completion of recycle gas compressor tests, and in preparation for hot solids circulation, the solids withdrawn were loaded into the reactor through FD0210 rotofeeder on 6/29/96 with the reactor at 50 psig pressure. This method of feeding inert materials into the reactor is preferred to the alternate method of feeding through the fill nozzle on the reactor standpipe. In the latter method, the reactor has to be at atmospheric pressure.

Since the reactor J-leg was not sealed initially, all the reactor aeration and fluidization flows were set to standby (minimum) flows. Alumina was fed into the reactor mixing zone and then moved by gravity into the reactor J-leg and the burner J-leg. Once the J-legs were sealed, gas flow through the reactor mixing zone was increased. Subsequent alumina that was fed into the mixing zone was transported through the riser, separated by the cyclone system, into the reactor standpipe. The transport air was supplied through the primary combustion nozzles located in the mixing zone. When the solids level in the reactor standpipe was close to the HX0203 solids entry, additional solids fed from FD0210 transferred by gravity into HX0203. At the end of solids transfer, the solid levels in HX0203 and reactor standpipe were below the desired normal operating levels because the amount of solids inventoried was less than the amount of solids required to fill the reactor to the desired operating levels. Despite this shortfall, hot solids circulation could be achieved at a reasonable circulation rate. The only drawback was the increase in solids loss through the primary cyclone since its dipleg would not be sealed.

During the solids transfer from the FD0210 system into the reactor, several operational problems with the FD0210 rotofeeder were experienced. Some were caused by the higher bulk density and flowability of alumina compared to that of coal. This was the first time solids were transferred from FD0210 into the reactor under pressure. Once the problems were solved, the solids transfer was smooth.

The differential pressure in the lower reactor standpipe increased as the standpipe was being filled with the solids with minimum aeration in the standpipe. Further addition of

solids resulted in transfer of solids from standpipe to HX0203 as the reactor standpipe lower differential pressure stayed constant. At the same time, the HX0203 lower and middle differential pressure readings showed a gradual increase. Fluidization of the reactor standpipe caused the bed in the standpipe to expand, and thereby, transferring more solids into the HX0203. The lower reactor standpipe differential pressure decreased and the middle differential pressure in HX0203 showed a corresponding increase.

Solids circulation was initiated through the reactor J-leg and HX0203 J-leg on 6/30/96 by increasing the fluidization/aeration flows to the J-legs. The differential pressures on the Riser increased gradually which indicated the transport of solids through the Riser and circulation through the J-legs.

In preparation for lighting the BR0201 pilot, the solids that accumulated inside the burner J-leg were conveyed into the reactor mixing zone by increasing the burner quench air flow, aided by fluidization flow from the aeration nozzles located on the burner J-leg. After the burner leg was cleared of solids, the burner pilot was lit. The combustion and quench air flows were set for an initial flue gas temperature of 500°F at the burner exit.

In preparation for lighting of BR0201, the reactor and HX0203 J-leg aeration rates were reduced in order to increase the air flow through the burner. Because solids circulation was initiated at 50 psig reactor pressure and at approximately 200°F, a considerable quantity of air was required to maintain solids circulation through the J-legs. The air flowrate required to fire BR0201, maintain the burner exit temperature at minimum (850°F with main burner in service), and also to maintain J-leg aeration at the current level would have exceeded the targeted riser superficial velocity. To prevent this from happening, the J-leg aeration flows were reduced, and the excess air was supplied through the burner. The main burner was lit, and the burner exit temperature increased from 500°F to 850°F.

The burner firing at minimum turndown was much higher than design due to problems in operating the burner at lower firing rates. This higher firing rate required higher combustion and quench air flowrates through the burner in order to minimize the increase in the flue gas exit temperature at startup. Such high air flowrates through the burner along with lower reactor and HX0203 J-legs aeration rates resulted in riser velocities much higher than desired.

An hour after the startup of the BR0201 main burner, the downcomers on the primary gas cooler (HX0202) and the secondary gas cooler (HX0402) were opened and their blowdown valves were closed. This temporarily converted the heat exchangers to air preheaters instead of being fired tube boilers. This prevented moisture condensation in downstream equipment and pipes and also provided heat from the DR0402 for preheating the PCD above the dew point. After the BR0201 main burner was lit, the gas temperature downstream of the reactor was adequate for steam generation inside the heat exchangers and the heat exchangers were put in steam generation mode.

Aeration flow through the reactor J-leg was reduced and the flow through HX0203 J-leg was increased to induce more solids circulation through HX0203. This was done due to the presence of more solids in HX0203 than the reactor standpipe. Also, as the solids in the reactor standpipe expanded, they overflowed into HX0203. The solids circulating through the reactor J-leg ended up in HX0203. The aeration flowrate through the bottom of the mixing zone was increased and this resulted in a large increase in solids circulation rate through the Riser.

An additional 700 lb. of alumina were added later, but this amount was too little to increase the levels in the reactor to the desired values. During the entire run, the differential pressure on the primary cyclone dipleg was low which indicated that the dipleg was empty of solids. The temperature profiles in the dipleg showed that there was a gas flow up through the dipleg from the reactor standpipe into the cyclone resulting in spoiling of the cyclone with a reduction in its efficiency.

The burner quench air flow was reduced and the firing rate of the burner was gradually increased to increase the burner exit temperature from 850 to 1,600°F. The cyclone exit temperature (TI443) increased from 450 to 610°F. The TI443 was still rising when, due to a leak in PV287, the burner firing rate was reduced at 02:00 on 7/1/96.

Before the unit was shutdown, the main burner turndown was tested by reducing the propane flowrate to design turndown conditions. The burner was steady at the low propane flowrate. The solid circulation through the reactor and heat exchanger J-legs was stopped by decreasing the aeration rates. The operation of FD0206 was briefly tested by withdrawing about 700°F solids from the reactor standpipe. The screw cooler operated well at these conditions with a solids exit temperature of about 150°F.

The system was shutdown at 08:10 on 7/1/96. On inspection, PV287 showed severe erosion due to high velocity jetting by alumina-laden gas. The reactor riser pillow top, primary cyclone, cyclone dipleg, fines screw cooler (FD0502) inlet transition spool

piece, and HX0202 and HX0402 were inspected with a borescope. The reactor and cyclone refractories were in good condition. Both HX0202 and HX0402 were found to be in good condition with no observable erosion due to alumina. However, the HX0402 tubes showed abnormal signs of corrosion. The tube thickness was measured and was found to be within acceptable range.

Transport Reactor: July 19 - 27 Coke Breeze Assisted Combustion: The objective of this test was to demonstrate coke breeze assisted combustion followed by coal feed in the transport reactor up to 260 psig operating pressure. This was the first coal combustion test scheduled after hot shakedown with solids circulation. The gas flow path was lined up through the Westinghouse PCD.

PV-287, which was eroded during the previous run, was replaced prior to this run. Also, CO0201 was tuned and the safety interlocks in the reactor loop were tested and proven to be functional. All pressure relief valves were rechecked for calibration, then installed and tested. The relief valve on the discharge of the recycle gas compressor was found to lift prematurely probably due to vibration induced by CO0401 which is a reciprocating compressor. The pilot of the relief valve was relocated upon recommendations from MWK and the supplier.

Prior to the run, the starting bed material was drained from the transport reactor standpipe and transport reactor J-leg to permit borescope inspection of the inlet to FD0206. Also FD0502 under the PCD was inspected with borescope. Both the transition pieces upstream of the screw coolers and the entrance to the coolers were found to be free of debris. The refractory surface was found to be in good condition.

In preparation for the run, the heat transfer fluid system and BR0401, in addition to all other utilities required for the run, were started on July 19. The reactor system was also pressure tested. The leaks around the tubesheet in the Westinghouse PCD vessel were fixed and the vessel was reassembled. With only minor leaks in the system at pressures higher than 185 psig, it was decided to proceed with the test, but operate the reactor at a maximum pressure of 160 psig instead of the 260 psig planned.

On 7/22/96, after the leak test was completed, the PT and PDT instrument bleeds were balanced at 260, 210 and 50 psig. The reactor pressure was held at 50 psig to start the shakedown run. The DR0402 vent was closed to begin pressurization of the drum. When the drum pressure reached 50 psig, the risers on HX0202 and HX0402 were opened and their downcomers were cracked open. All process aeration flows were set to predetermined standby flowrates. After completing the preheating of the PCD, the

process air flowrates were reduced to allow inert solids (alumina) addition into the reactor through the coal feeder (FD0210). This was done to allow the solids fed into the mixing zone to fill the reactor J-leg creating a seal between the mixing zone and reactor standpipe. The PCD backpulse system and associated ash removal systems were started prior to feeding the solids from FD0210. Due to low solids level in the reactor, the ash transport system, FD0530, was lined up to transfer solids captured in the PCD to FD0220 for subsequent feeding into the reactor.

Once the reactor J-leg was sealed with addition of inert solids, the transport air flowrate was increased to convey additional starting bed material that was being added to the mixing zone to the reactor standpipe and then into HX0203 after the solids level in the standpipe reached the solids inlet to HX0203. The total amount of starting bed material loaded did not fill the reactor standpipe and HX0203 to the desired operating levels. However, the levels were adequate to start solids circulation in the reactor. It was planned to add more solids later during the preheat period.

The BR0201 pilot was lit at 03:16 on 7/23/96. The quench air flow to the burner was adjusted to get a burner exit temperature of 500°F. After establishing solids circulation through the HX0203 and reactor J-legs, the reactor pressure was increased from 50 psig to 60 psig. Shortly thereafter, the FD0520 outlet was plugged. Unable to transfer solids collected inside the PCD into the reactor, the solids circulation in the reactor was reduced to decrease the carryover to the PCD while FD0520 was being repaired. Meanwhile, FD0510 was run every 2 hours to prevent moisture condensation. Unable to clear the plug in FD0520, BR0201 was shut down, solids circulation stopped and the aeration reduced to standby flows, PCD backpulse shut off and the reactor depressurized to 5 psig to permit maintenance work to be done on FD0520.

A spool piece at the exit of FD0520 was removed and small refractory pieces that plugged the discharge line were removed. The PCD backpulse was started and FD0502 and FD0520 systems were run for an hour to verify their operation and ensure that all the broken refractory pieces were removed.

The reactor loop was pressured back to 50 psig. The solids that collected inside the BR0201 J-leg were blown out into the mixing zone and standpipe and the burner pilot was lit. After three hours, the reactor pressure was increased to 60 psig and the main burner gun was lit. Both HX0202 and HX0402 were lined up for steam production because the gas temperature at their inlet was higher than the DR0402 temperature.

During heat-up of the reactor system, the FD0520 outlet plugged several times. Each time, the sample port at the exit of FD0520 was removed and discharge line rodded out to clear the plugging. After completing the PCD preheat, additional alumina (startup inert bed material) was added into the reactor from FD0210. Solids circulation through both the reactor and HX0203 J-legs was started an hour later.

At 01:00 on 7/24/96, the burner firing rate was increased at 150°F/hr to begin ramping up the burner exit temperature, which was about 1000°F, and increase solids heat up rate. Additional alumina was added into the reactor to increase the solids level in the standpipe and HX0203. The Riser exit temperature began to increase and the reactor pressure was increased to 70 psig pressure to reduce the superficial Riser gas velocity. The cooling water flow to the facility was momentarily interrupted to bring the nitrogen system on-line. This caused CO0201 to trip which in turn tripped solids conveying systems and the fines screw cooler. The compressor was back on-line after a few minutes interruption.

The propane firing rate was dropping gradually, and finally the burner tripped 2 hours later. The burner was relit, however, the propane flow could not be increased beyond a firing rate of 3.4 MBtu/hr. The reduction in propane flow resulted in a decrease in burner heat input into the reactor which caused the reactor temperatures to drop. After talks with the burner vendor, the burner exit temperature was increased to provide more heat input into the reactor. Also, the solids circulation rate through the reactor was manipulated to increase the mixing zone temperature and to prepare for feeding coke breeze before the burner failed.

Coke breeze was being used to yield a reactor temperature between 1300 and 1400°F prior to coal injection. When the mixing zone temperatures reached above 900°F, coke breeze was fed into the reactor. The increases in the reactor temperature profiles indicated that the coke breeze was smoldering, but the temperatures were not high enough for complete combustion. However, at 04:10 on 7/26/96, the propane flowrate suddenly dropped causing the reactor temperatures to drop because the heat released from coke breeze combustion was too low to compensate for the drop in heat input from the burner. Unsuccessful attempts were made to increase the propane flowrate by increasing propane supply pressure. Also, the circulation through the reactor was periodically reduced and then increased to increase the temperature in the mixing zone. However, due to the lower heat input, the mixing zone temperature was not high enough for coke breeze combustion.

At 14:46, an attempt was made to start FD0206. The screw appeared jammed and would not start. The problems with starting FD0206 coupled with propane flow problems to BR0201 caused an early termination of the shakedown test run.

After the reactor had cooled down, the main burner gun was removed and carbon (coke) deposits were found blocking the burner holes. Nitrogen was blown through a nozzle close to the drive end of FD0206. This appeared to clear the plugging and the screw started without any difficulty. However, to ascertain that the jamming was not caused by refractory pieces, the solids in reactor J-leg and standpipe were drained and the FD0206 inlet was inspected with a borescope. No refractory pieces or foreign debris were found.

The FD0220 middle spheri valve was removed and examined, and re-assembled with higher tolerances to prevent binding problems experienced during the run. The seal ring was found corroded and pitted in some places.

Several refractory lined areas (riser cross-over, between the standpipe and solids cooler, exit of Westinghouse PCD and mixing zone) were inspected with a borescope. The refractory in these areas did not show any signs of being eroded. Thermowells in high erosion areas were removed and checked. The thermowell and its associated thermocouple (TI-356) in the riser cross-over were eroded. The eroded tip was ground, capped, and re-installed. Several thermowells in the riser and mixing zone showed erosion wear. These were rotated 180° and re-installed.

Coal Combustion Procedures were revised to incorporate lessons learned from operations thus far. Sub-bituminous coal was procured and prepared as backup to coke breeze for the next combustion startup. Sub-bituminous coal contains more volatile matter than coke breeze and would therefore ignite at a lower temperature than coke breeze.

Transport Reactor: July 29 - August 7 Coal Combustion Shakedown Run: The PCD and initial reactor loop pre-heat philosophy used for this run was different from the previous runs. With no solids in the reactor, the reactor/PCD system would be heated up using the Startup burner to high temperatures. In the reactor, the hot combustion gases would flow through the Mixing zone upwards through the Riser, through the reactor j-leg and up the Standpipe and Cyclone. In this manner, the refractory would be heated up first before solids were loaded into the Standpipe. This was done in an attempt to shorten the reactor preheat time. Because the Combustor heat exchanger j-leg was sealed by solids, this loop was not preheated.

The test run began with the Transport reactor at 50 psig and the Startup burner exit temperature at 500°F before ramp-up. After the reactor pressure was increased to 65 psig, the Startup burner main burner was lit and burner exit temperatures were gradually increased with hold periods. After reaching high reactor temperatures, solids were transferred into the reactor and solids circulation initiated.

During solids circulation a cooling water pump tripped causing the Process air compressor to trip on a high inlet air temperature to the third stage. The Startup burner also tripped due to loss of combustion air and the reactor bed slumped due to the loss of aeration/fluidization air. The problem with the cooling water system was solved and thirty minutes later solid circulation and heat up of the reactor was resumed without any difficulty. Throughout the reactor pre-heat period, solids circulation through the Combustor heat exchanger and the reactor j-leg were optimized to achieve as high a refractory and solids heat up rate as possible. The reactor pressure was increased to about 75 psig to reduce the Riser superficial velocity without reducing the burner firing rate as the Riser exit temperature increased.

The burner firing was increased to increase the reactor temperatures. Coke breeze was inventoried into the Coal feeder system in preparation for coke breeze combustion pre-heat. The Mixing zone temperatures were around 1100°F. Just when the coke breeze injection to the reactor was starting, a leak developed on the downstream side in the body of the process pressure letdown valve. The reactor operation was prematurely terminated before coke breeze could be injected into the reactor.

Upon inspection of various pieces of equipment and pipes, it was found that the solids to the process pressure letdown valve were being carried through the vent system in the coal and sorbent feed vessels via eroded vent valves. The vent gas from these systems re-enters the off-gas piping just upstream of the process pressure letdown valve. The vent system design was temporarily modified to prevent any such solids carryover.

Transport Reactor: August 14-21 Coal Combustion Shakedown Test Run: Prior to the run, a redesigned main burner tip was installed on the Startup burner. With this redesign, the firing rate of the burner was increased from an operating maximum of 3.6 to 5.0 MBtu/hr. In addition, the burner can be operated at pressures up to 100 psig. Also, the internals of the pressure let-down valve were modified and re-installed, and several other problems were addressed. At the start of the run, the Westinghouse PCD was preheated and then the transport reactor loop was pre-heated for approximately 10 hours with flue gas from the Startup burner while circulating solids through the reactor following the procedure and lessons learned from previous operations.

The reactor pressure was gradually increased from 50 psig to 100 psig to allow additional heat input into the system, and thus, shortening the pre-heat time on propane firing. Coke breeze was used to assist reactor preheat after the reactor temperature reached over 1100°F. Small amounts of coke breeze were injected into the reactor, and a temperature rise indicated combustion was taking place. Before the temperatures stabilized and continuous injection of the coke breeze initiated, the Startup burner tripped due to overheating of the pilot gun at the higher pressure. The pilot was repaired, the main gun inspected for fouling (minor) and the burner restarted. Because of resident heat in the refractory, the reactor came to temperature in 12 hours, and coke breeze combustion in the reactor was established.

When coke breeze ignition was established, the Startup burner was gradually turned off and was finally shut down. The reactor preheat with coke breeze combustion was continued until the reactor temperature was high enough to prevent coal tar formation. Coal was then injected into the reactor. At 9:00 am on Sunday August 18, the process gas analyzer began to show combustion products from coal combustion (NO_x and SO₂) and appreciable drop in oxygen level. Locally available Calumet mine Alabama bituminous coal and Plum Run dolomite were used as the test coal and sorbent for this run.

The Combustor heat exchanger was used to control the reactor temperature through manipulation of its J-leg aeration flow. The reactor pressure was gradually increased from 100 psig to 160 psig during coal combustion. The Riser temperature was maintained between 1600 - 1650°F. During the test run, a hot re-start was attempted three hours after completely shutting down the reactor loop by slumping the bed and turning down the aeration flows to minimum standby flows. Once the startup sequence was initiated, it took less than half-an-hour to feed coal and observe immediate combustion and establish control of the process. About 80 hours of on-stream coal feeding was achieved resulting in approximately 32.2 tons of coal fed to the unit. The coal rate for August 18 to August 20 was about 800 lb/hr as calculated by the weigh cells on the coal bin. On August 20 the coal rate was increased to about 1000 lb/hr. Figure 1 on the next page displays the coal rate with the corresponding coal rotofeeder speeds. Dolomite was used as make up bed material because of low starting bed level in the reactor and heat exchanger. Consequently, its feed rate was higher than required for *insitu* sulfur capture. The dolomite rate is more difficult to calculate since the FD0530 ash was recirculated back to FD0220 until 18:00 hours on August 20. On August 18, 640 pounds of dolomite were added over a 3 hour period along with the recycled fines. On August 19, 2573 pounds of new dolomite were added during the day. On August 20

and 21, 15,304 pounds and 7,849 pounds were added, respectively. The test was terminated prematurely due to large carryover of calcined dolomite and fine ash to the PCD.

This shakedown test run produced successful demonstrations for the Startup burner operation at higher firing rates and reactor pressures, reactor circulation and temperature control, solids feeding into the reactor, operation of Westinghouse filter vessel and backpulse system, and operation of Spent solids, Fines discharge and transfer systems. Coke breeze assisted combustion preheat and coal combustion start-up sequence were also successfully demonstrated.

Westinghouse PCD and PCD Backpulse System: The flow-path for the MWK train was switched in early July from the CPC vessel to the Westinghouse vessel in preparation for Transport Reactor start-up and shake-down on coal. During pre-operational pressure checks in the second week of July, the main vessel flange of FL0301 connecting the vessel body to the head was discovered to be leaking too much to proceed with start-up of the MWK Transport Reactor. Plans for operation were postponed while the problem of the leaking flange was examined further during the week of July 15. It was determined that certain characteristics of the vessel head were hindering adequate mating of the sealing surfaces. After correcting these problems, combined with a modified torquing procedure for the flange bolts, all significant leakage up to 180 psig was eliminated, as was evident from pre-operational pressure tests during the weekend of July 20 and 21. The PCD system was deemed ready for operation, which would commence on July 22.

At 4:30 PM, July 22, 1996, the Westinghouse back-pulse system (FL0301-ME01) was placed into automatic operation, pulse cleaning under conditions of filter differential pressure trigger (75 in. w.g.), automatic timed cleaning (every 30 minutes), or manual initiation, whichever condition being met first. The Norwalk high pressure air compressor supplied the pulse skid with approximately 400 psig air from a reservoir maintained between 1300 psig and 600 psig. The pulse system was started due to the circulation of alumina being conducted in the MWK Transport Reactor, which was in preparation for feeding coke breeze to sustain reactor fire. Alumina was being passed over to the PCD from its circulation in the reactor loop.

On July 26, the reactor system was shut down due to several problems: coking of the burner tip, solids in the baghouse (downstream of the PCD) that could not be removed, an inability to remove solids from the reactor standpipe, and the inability to sustain a coke breeze fire at 1000°F reactor temperature. The PCD pulse system continued to

clean for the rest of the day of July 26 and was shut down after the main air compressor was off-line.

The priorities for the shutdown of July 26 were the burner and the reactor solids removal system, so no work was done on the PCD until July 30 when the man-way door on the head of the vessel was opened to inspect the clean gas side of the tubesheet. This was necessary because of the concern about solids in the baghouse downstream of the PCD. The tubesheet was perfectly clean, so it was hypothesized that the solids in the baghouse consisted of alumina that had remained downstream of the PCD from the refractory cure-out through the empty CPC vessel in June. This theory was consistent with particle size distribution data obtained from samples of both the solids from the PCD ash removal system and solids from the baghouse. The baghouse solids particle size and appearance were more similar to alumina than that of the PCD, and there was an unusual rust-like color interspersed in the baghouse solids that was not present in alumina samples taken from the PCD ash removal system. All of this pointed to the fact that the solids in the baghouse originated downstream of the PCD.

By July 30, all apparent outage items had been addressed, and pressure testing was begun in preparation to bring the plant back on-line. The plan for this run was to attempt to burn subbituminous coal instead of coke breeze at a higher burner temperature, but the run was prematurely ended when a main pressure let-down valve downstream of the PCD would not hold pressure during the pre-operational pressure tests. It was discovered that the valve had been significantly eroded by the alumina left in the system downstream of the PCD after refractory cure-out. Much of the valve had to be replaced, which delayed start-up until the beginning of August. It was hypothesized at this time that the mysterious rust color in the baghouse solids probably originated from the erosion of the pressure let-down valve. Throughout this last run in July, the PCD showed no significant leakage and functioned properly within its design parameters.

SCS completed a shakedown test of approximately 80 hours of coal firing on 8/22. During this test, the PCD worked as designed. However, due to operations problems with the Transport Reactor and the PCD ash removal system, solids accumulated in the hopper of the PCD. Towards the end of the run, the solids level buried the lower level of filter elements in ash, and the filter differential pressure dramatically increased to a point where operation was halted.

Upon examination of the filter vessel, it was found that 13 of 36 candles on the top plenum survived and only one of 55 elements survived on the bottom. In spite of the

large number of broken elements, there was very little dust in the head of the filter, indicating that the filter failsafes worked very well. Upon disassembly and inspection it was found that the failsafes were plugged with ash. There was no evidence of ash bridging or buildup of ash on the dust shed. This was probably due to the fact that the PCD temperature never exceeded 700°F. The ash was a fine powder which showed no signs of caking. The chemical composition of the ash was a combination of bed material, dolomite and coal ash. The mean particle size varied from 3-20 microns throughout the run.

A review of the test run with Westinghouse, Kellogg and SCS was conducted on September 18, 1996, after SCS personnel had completed extensive review of the operational data from all start-up and combustion runs. All parties agreed on warning signs for potential damage to the filter vessel, and these were implemented into the operational procedures of the PCD. It is certain that in future runs, SCS personnel will be well aware of impending trouble with solids carry-over into the vessel.

The entire month of September was spent in data analysis and maintenance of the MWK system, including the Westinghouse PCD. A completely new set of Pall candles (and two Schumacher candles from Roger Chen at WVU) was installed and the Flexitallic gaskets which had been previously used on the vessel flanges were replaced with Garlock gaskets which have performed much better at less cost. Current plans are to continue in October with combustion characterization using the Westinghouse PCD FL0301.

Spent Fines Removal System (FD0502/FD0520): The system was operated throughout the commissioning and combustion runs of July and August with minimal problems, all of which could be explained as start-up anomalies. It was continuously run during Transport Reactor operation and was an integral part of the analysis of solids carry-over to the PCD. No significant maintenance was necessary on the system during the September outage. The rate of solids to FD0530 was set by the screw speed on FD0502 (about 3 rpm) for the 8/18 through 8/21 period. Little solids were taken out of FD0206/FD0510 since these were only run for a few minutes every hour. The FD0520 lock hopper pressure indicated that the lock hopper was filled about 5 times per hour. At about 1.4 cubic feet per fill, this gives 7 cubic feet/hour. This gives a rate of about 420 lb/hr.

Thermal Oxidizer: The Thermal Oxidizer was designed to function as an incinerator for the process gas during gasification runs. Since the auxiliary boiler has not been completed, it has been used to supply steam to the propane vaporizer. It is also being

used to heat the steam and condensate system and to generate steam to preheat the PCDs. The Thermal Oxidizer has operated well with some minor instrumentation problems. In addition to being an efficient way to heat the steam and condensate system it has met the steam demands for both the PCD preheat and the propane vaporizer. The Thermal Oxidizer has run for a total of 1800 hours and has been fired as high as 14 MMBtu/hr. During July the Thermal Oxidizer refractory was inspected. Only hairline cracks less than 1/8" wide were found. These cracks are believed to be caused by the differential thermal expansion of the metal shell and refractory. The cracks were mapped and the refractory will be monitored with annual inspections.

Process Gas Sampling: In July the installation of heated instrument tubing bundle running from the main process sample port to the AX464 Preconditioner Box was completed. The tube-in-tube gas cooler located in the AX464 Preconditioner Box was bypassed since the process temperature of the sample gas is significantly lower than the original design temperature.

The refrigeration dryer was not cooling properly and found to be very low on freon. The unit was recharged; however, the refrigeration dryer worked acceptably for only a few days. In September the refrigeration dryer was shipped to the manufacturer for repair.

The Process Gas Sampling system was checked out and brought on-line in early August. During the checkout of the NGA 2000 gas analyzer, one of the communication cards was found to be bad and was sent out for repair.

The Process Gas Sampling system O₂, NO_x, CO, and SO₂ analyzers were on-line for all but four hours of the eighty hour August run on coal. The sample system had to be taken off-line when the pressure regulator located in the AX464 Preconditioner Box became plugged. Most of the material that plugged the regulator appeared to be rust from the secondary heat exchanger. In order to avoid additional plugging problems, the regulator was moved downstream of a filter.

A service representative from Applied Automation visited the site in early September to check out and calibrate the Gas Chromatograph (GC). Several unsuccessful attempts were made to calibrate the GC. During the troubleshooting, the Applied Automation representative found that an incorrect application program was loaded into the GC and that one of the GC columns was bad. The correct program and a replacement column were ordered.

During this quarter, the remote sample conditioning boxes were mounted, and the design for the sample draw-off system was finalized.

Medium- and Low-Pressure Nitrogen System: In August BOC replaced the five instruments that were damaged by lightning. BOC also installed, in their Liquid Storage Facility control cabinet, a local 24V power supply and signal isolators on all of the signal wires tied into the DCS system. With the local 24V power supply and the signal isolators in place, it will be easier to troubleshoot future problems.

In early August BOC successfully started their air separation plant and provided nitrogen to the MWK process.

In August, BOC installed the correctly rated solenoid vent valves on the medium-pressure Liquid Nitrogen Storage Facility tanks. The solenoid vent valves allow for the heat release required when the medium-pressure, liquid nitrogen product is not being used. BOC also installed a flowmeter to measure the liquid product unloaded into the medium-pressure tanks.

High-Pressure Nitrogen System: SCS received copies of the operating manual in July to be reviewed prior to establishing a date for Compressed Air Products (CAP) and Rix personnel to visit the site for commissioning activities. The PLC program still had not arrived for review as the month of July closed, so commissioning was pushed to September. Construction and installation of the system were completed and an as-built P&ID was generated.

Blow-down of the inlet piping was completed on 8/1 to clear the lines of debris left over from construction/installation. The discharge piping was pressure tested to maximum operating pressure on 8/2 and no leaks were discovered downstream of the compressors. The PLC program was received in August and reviewed in preparation for commissioning of the system, scheduled for mid-September. After a cursory review by SCS Technical staff, consistency problems in the PLC were identified and discussed with the lead start-up engineer from CAP. These were changed, and a pre-commissioning revision of the PLC was established for use in the start-up activities of the system in September.

In mid-September, Rix and CAP came on site for preliminary commissioning activities. After analysis of the system by Rix, CAP, and SCS personnel, it was determined that the systems were not in sufficient mechanical condition for operational commissioning activities to proceed. Also, the PLC program was deficient and needed to be re-

programmed. CAP left the site, and SCS began to pursue remedies for the mechanical problems with the compressors at CAP's expense, and SCS technical and controls personnel began a detailed analysis of the PLC program in preparation for the return of CAP and Rix in October for continued commissioning attempts.

Sulfator: In preparation to commence checkout of the sulfator system, the figure eight blinds were lined up to isolate the Sulfator from the Transport Reactor. The spool piece in the PCD preheat line was removed since the Sulfator Startup Heater is not being used, at this time, to preheat the PCD.

As part of the system checkout, the Sulfator Air Compressor motor was bump started and was found to have bad bearings. The motor was shipped offsite and repaired. The Sulfator Air Compressor was started for the first time at the end of September and test run for 4 hours. Two cross-members had to be added in order to stiffen the compressor frame. A positioner was added to the vent valve (FV620) in order to give better flow control of the process air to the sulfator.

At the end of September the Sulfator was air cured for 48 hours and then the BR0602 pilot was lit and burned for 24 hours as part of the initial cureout of the Sulfator. The cureout of the Sulfator will continue in October.

Propane System: A steam bypass line was installed around the temperature control valve in order to provide steam to the vaporizer at low propane demand periods.

Heat Transfer Fluid (HTF) System: The HTF system is used to cool the solids that are removed from the transport reactor standpipe, the sulfator, and the fines from the particulate collection devices (PCD's). During the third quarter, the HTF system was operated approximately 28 days in support of MWK startup operations. The system operated normally after a three-way valve that was misaligned was removed and reinstalled.

Baghouse (FL0700): The Final Hot Gas Clean-up System was required for service in July and August as part of the MWK start-up and shakedown attempts. The system functioned as designed with a few minor start-up challenges. No maintenance was needed for the September outage, although SCS is still pursuing options for replacement of the defective level probes in the baghouse solids collection trough.

Baghouse Ash Removal and Storage (FD0820 and SI0814): The baghouse ash removal system (FD0820) and the ash storage silo system (SI0814) operated successfully during all start-up attempts. No maintenance was required in September.

Flare System: The purpose of the flare and its systems is to gather and ignite any spontaneous releases of combustible gases resulting from unit upsets or controlled depressurizing/purging of equipment. The flare system consists of a collection header, flare seal drum, flare tip, and flame front generator. The flare system walkdown was completed during this quarter. The loop checks were also performed in preparation to complete the functional checks. The functional checks involved checking the flame front generator hardwire logic and the flare seal drum level control. All checks were satisfactorily completed with the exception of one bad switch and two bad relays which had to be replaced. Other prechecks were identified and are scheduled for late November with the final commissioning expected in December.

Instrument Air System: A common instrument air header, upstream of the instrument air dryers, was installed. With the common header in place, all of the dryers can be left on and the dryers will receive air flow regardless of which instrument air compressor is operating.

Closed Loop Cooling and Circulating Water Systems: The MWK closed loop cooling water system provides water for cooling to process equipment in the MWK train. After returning from the MWK system, the water is cooled by exchanging heat with the circulating water system in a plate-and-frame heat exchanger. In the SCS closed loop cooling water system, cooling water is supplied to process equipment in the Balance of Plant area. After returning from the BOP equipment, the water is cooled by exchanging heat with the circulating water system in another plate-and-frame heat exchanger. The circulating water system provides cooling water to the MWK, SCS, and FW closed loop cooling systems and to the MWK steam and condensate system and to the FW condenser.

The circulating water and the SCS closed loop systems ran nearly continuously while the MWK closed loop system was operated as needed during the third quarter. A water hammer in July caused a slip joint to fail where the circulating water lines return to the cooling tower. While repairs were being made to the affected line, the MWK, the SCS, and the FW return lines all had their slip joints bolted together and had a thrust plate installed to prevent future failures. This was the second slip joint to fail in the circulating water system. The float valve that regulates the flow of make up water to the cooling tower basin from the raw water tank continues to malfunction. The valve does

not close when the basin reaches a normal operating level. The pH probe that regulates the pH in the circulating water system has also been replaced. The cooling tower vendor has inspected the excessive vibration in the cooling tower fans and has agreed to replace the fiberglass fan supports with steel supports.

The two closed loop systems have operated with little trouble. The sample cooler for the steam drum does not have adequate cooling water flow from the MWK closed loop system. The cause has yet to be determined.

Training of the operators in taking water samples and injecting chemicals was conducted this quarter.

Service Water System: The service water system provides water to the utility stations, water to the flare seal drum, water for blowdown cooling, and makeup to the cooling tower. The service water system pumped about 1.5 million gallons of water during the quarter. Most was used for feed to the cooling towers although a substantial amount was used to cool the blowdown from the steam drum as it left the flash drum. No significant problems have been experienced during the operation of the service water system.

Waste Water Treatment/Chemical Injection: Construction of the waste water treatment was completed and the waste water basin began normal operation during the quarter. Other than for a few minor pH excursions, the waste water basin has not required chemical treatment. The basin normally maintains a pH between 6.0 and 8.5 without any caustic or acid addition. Testing has shown that the suspended solids levels have been within acceptable limits without the addition of alum. The flowmeter for the basin was struck by lightning on July 7 and was repaired. The pH probe in the flocculation chamber was broken and had to be replaced.

The chemical injection system consists of the following areas: 1) Circulating water system - sulfuric acid for pH control and a corrosion inhibitor are added to the common basin; and an algaecide and sodium hypochlorite as a biocide are added using a pot feeder; blowdown is dechlorinated by the addition of sodium bisulfate. 2) Closed loop cooling water systems - molybdates added in a pot feeder as a corrosion inhibitor. 3) Steam and condensate system - treated with a pH controller, oxygen scavenger, and phosphate. 4) Waste water treatment - aluminum sulfate (to flocculate suspended solids) and an acid and an alkali (for controlling pH) are added. These systems were operated without any difficulty during this reporting period.

Maintenance

Work continues in preparing a work order system database, filing equipment maintenance information for reference, and developing procedures and spare parts requirements. The growing database of recommended spares is being increased as more experience is being gained in plant operations.

Maintenance Inspection and Procedures

Monitoring and inspection of equipment continued. Inspections utilizing the borescope continued, to record on videotape the condition of various refractory-lined piping and vessels, the reactor start-up burner pilot and main burner tips, and to check for plugging or ash buildup. The videotapes will be used for comparison after the burner has been operated for a period of time to determine the degradation.

An infrared scan of the MWK system was conducted on July 24 and on August 18 to verify uniform heat distribution on the outer surfaces (an earlier scan had been conducted on June 13). This is being done on all heated vessels/piping as start-up progresses to provide a baseline database, and will continue to be done during operation to monitor for insulation degradation. As with the earlier scan, no severe hot spots were detected. The July 24 scan included the Westinghouse PCD (FL0301) and associated piping.

Baseline thickness measurements continued using the ultrasonic thickness gage on elbows/tees in solids service. These baseline readings have been taken on all pneumatic conveying elbows/tees to establish a baseline database.

As pumps/compressors were started, vibration readings were taken to define the initial operational state of each machine and provide a baseline set of data for future comparisons. Baseline vibration readings have been taken on 45 pieces of equipment (pumps, compressors, fans, blowers). All of this information is stored in a database that is used for trending and data analysis.

Laboratory Services

Throughout the third quarter of 1996, the lab was staffed with three personnel for lab support during the operation of the M.W. Kellogg process. The laboratory is equipped to perform several analyses required to support PSDF operation. These procedures may be categorized as follows: cooling water and steam/condensate systems analysis,

particle size analysis, evaluation of potentially hazardous waste properties, and miscellaneous analyses.

The lab can perform the following analyses for the water and steam/condensate systems:

No.	TEST	METHOD
1.	Dissolved Oxygen	Test kit, meter
2.	pH	Indicator, meter
3.	Total Orthophosphate	Spectrophotometer
4.	Soluble Orthophosphate	Spectrophotometer
5.	Phosphate	Spectrophotometer
6.	Free Chlorine (ppm)	Test kit
7.	Total Chlorine (ppm)	Test Kit
8.	Free Chlorine (ppb)	Titration
9.	Total Chlorine (ppb)	Titration
10.	Molybdate	Spectrophotometer
11.	Conductivity	Meter
12.	Calcium Hardness	Titration
13.	Total Hardness	Titration
14.	Alkalinity	Titration
15.	Iron	Spectrophotometer
16.	Sulfite	Titration
17.	Phosphonate	Spectrophotometer
18.	Heterotrophic Bacteria	Test Kit
19.	Sulfate Reducer Bacteria	Test Kit

The laboratory is equipped to evaluate various properties of process solids streams. Two methods are available in the PSDF lab to measure particle size distributions. A standard sieve analysis utilizes a Ro-Tap sieve shaker and 8-in. full-height sieves with openings from 0.75 in. to 45 micrometers. The practical lower limit for dry sieve analysis is 45 micrometers. The dry sieves can be used to size process solids on an as-received basis and can be used to determine particle size distributions of pulverized coal and dolomite. The standard dry sieve analysis is augmented by an L&N Microtrac laser diffraction particle size analyzer capable of determining particle size distribution in a range of particle diameters from 0.45 to 704 micrometers.

The lab is also equipped to evaluate gross physical characteristics of coal, ash, and spent solids, and to prepare coal and sorbent samples for analysis by an outside laboratory.

The laboratory is equipped to determine bulk density of solids, loss-on-ignition of coal and ash, and surface moisture content of coal and limestone. Sample preparation equipment includes an air-drying oven, a sample splitter (riffle), a crusher to reduce the sample either to minus 8 mesh (less than 2.36 mm) or to minus 4 mesh (less than 4.75 mm) and a pulverizer to further reduce the material to minus 30 mesh (less than 600 micrometers).

The laboratory is also prepared to evaluate potentially hazardous properties of spent reactor solids and PCD fine material prior to disposal. The glassware and reagents needed to determine the reactive sulfide content of the solids are ready for use. The laboratory is also prepared to test the material for liquid content, reactivity, and ignitability prior to its leaving the PSDF site for disposal.

During the third quarter, equipment was purchased to perform the analytical work to determine the alkali metals content of process gas. The equipment purchased includes a sodium ion-specific electrode, a potassium ion-specific electrode, and standards and filling solutions needed to perform these analyses. A programmable meter that had been used for ammonia measurements at the SCR project at Plant Crist was obtained for these analyses.

The Labworks Laboratory Information Management System (LIMS) that was purchased from Analytical Automation Specialists, Inc., was installed on two workstations in the laboratory during the third quarter. The system is functional and is being used to process all samples that are submitted to the laboratory for analysis. All samples are assigned a laboratory identification number when they are logged onto the LIMS and the progress of each sample is tracked through the various steps necessary to perform the analysis by the LIMS. These steps routinely include log-in, results entry, validation, and reporting. The capability of the system to include identifying information and comments along with the analysis results is being fully utilized. A method was also developed to electronically transfer data from the Alabama Power Company laboratory at Alabaster. The method currently in use involves the transfer of data via email as attached ASCII files. This data is collated and imported into the PSDF LIMS using software supplied by Analytical Automation Systems, Inc.

During the third quarter, 208 samples were logged onto the LIMS. Of these, 29 were submitted to the APCO laboratory at Alabaster for analysis. The samples submitted were of coal, reactor solids, PCD solids, heat transfer fluid, corrosion deposits, and limestone or dolomite. The analyses requested included water content, metals content, ultimate, proximate, CHN, ash fusion temperature (oxidizing and reducing), ash

minerals, anions (primarily sulfate) in a water extract of a corrosion deposit, TCLP metals, and reactive sulfide of solids for disposal, and PAH's. The majority of the remainder of the 208 samples were analyzed at the PSDF laboratory either for constituent concentrations in cooling water samples or for particle size distribution of solids samples.

At present, analytical results are being provided to the PSDF staff by means of the PSDF email system or as hard copy. Efforts continue to establish a means of using the LIMS system to distribute validated data, either directly to the PSDF staff or indirectly through the PI system.

Data Analysis and Management

The configuration of the plant information (PI) system continues. Over 1300 tags have been configured. Displays of most important plant systems have been created by the process engineers and have been made available to everyone on-site, with some exceptions for security reasons. Process Book 1.3 and Datalink 1.6, client applications for the plant information system, have been received and installed. The 3.1 version of the Data Archive software (point by point security) has not yet been received. The formal 6 month trial evaluation of this software commences when this 3.1 version is received.

3.0 PLANS FOR FUTURE WORK

During the next quarter, the Transport reactor train will be operated in combustion mode with sand as the startup bed material. Both characterization and performance tests will be carried out. After shake-down and characterization in combustion mode, the Transport Reactor will be reconfigured as a gasifier. Startup of those required systems for gasification will continue during the next quarter, primarily with operations walkdowns and commissioning of the Sulfator system and the auxiliary boiler. As each component is turned over, the E&I Journeymen begin testing the instrumentation, the breaker controls, and the functional control from the DCS or PLC; after which the Startup teams begin to test the operation of the components and the function of the system.

All construction on the FW process will temporarily be stopped while a Request for Quotation (RFQ) is prepared for the remainder of the construction. The RFQ will be issued during the next quarter.

A project review meeting will be held in October to primarily discuss commissioning of the transport reactor system.

APPENDIX A

Bed Fill Material Sample Analyses

Sample ID PSDF-3-148
 Sample Location Ash Pond at Plant Gaston
 Sample Description Coarse Ash
 Sample Date 1-Jul-96
 Analysis Date 1-Jul-96
 Analysis Type Sieve Analysis
 Run Number 1
 Initial Sample Weight, g 50.0

Sieve Designation	Sieve Opening, d	Final Weight, grams	Tare Weight, grams	Mass Retained, d, grams	% Retained d	Weight % > d	% Passing
#16	1180µm	424.2	401.4	22.8	45.4%	45.4%	54.6%
#20	850µm	440.7	436.4	4.3	8.6%	54.0%	46.0%
#40	425µm	388.9	382.5	6.4	12.7%	66.7%	33.3%
#50	300µm	340.0	337.4	2.6	5.2%	71.9%	28.1%
#100	150µm	318.9	314.9	4.0	8.0%	79.9%	20.1%
#200	75µm	306.0	301.9	4.1	8.2%	88.0%	12.0%
#325	45 µm	307.9	305.3	2.6	5.2%	93.2%	6.8%
Pan	< 45 µm	285.6	282.2	3.4	6.8%	100.0%	0.0%
total wt,g				50.2	100.0%		

Sample ID PSDF-3-147
 Sample Location Ash Pond at Plant Gaston
 Sample Description Fine Ash
 Sample Date 1-Jul-96
 Analysis Date 1-Jul-96
 Analysis Type Sieve Analysis
 Run Number 1
 Initial Sample Weight, g 50.0

Sieve Designation	Sieve Opening, μm	Final Weight, grams	Tare Weight, grams	Mass Retained, grams	% Retained	Weight % > d	% Passing
#16	1180 μm	401.5	401.4	0.1	0.2%	0.2%	99.8%
#20	850 μm	436.5	436.4	0.1	0.2%	0.4%	99.6%
#40	425 μm	382.8	382.6	0.2	0.4%	0.8%	99.2%
#50	300 μm	337.6	337.4	0.2	0.4%	1.2%	98.8%
#100	150 μm	316.6	315.0	1.6	3.2%	4.4%	95.6%
#200	75 μm	308.5	301.9	6.6	13.3%	17.7%	82.3%
#325	45 μm	314.5	305.4	9.1	18.3%	35.9%	64.1%
Pan	< 45 μm	314.1	282.2	31.9	64.1%	100.0%	0.0%
total wt,				49.8	100.0%		
				g			

Sample ID PSDF-3-153
 Sample Location Plant Miller
 Sample Description Bottom Ash
 Sample unknow
 Date n
 Analysis Date 8-Jul-96
 Analysis Type Sieve Analysis
 Run 1
 Number
 Initial Sample Weight, g 65.8

Sieve Designation	Sieve Opening, d	Final Weight, grams	Tare Weight, grams	Mass Retained, d, grams	% Retained d	Weight % > d	% Passing
#16	1180µm	422.2	401.3	20.9	31.9%	31.9%	68.1%
#20	850µm	442.8	436.4	6.4	9.8%	41.6%	58.4%
#40	425µm	391.3	382.5	8.8	13.4%	55.0%	45.0%
#50	300µm	341.4	337.3	4.1	6.2%	61.3%	38.7%
#100	150µm	323.0	315.3	7.7	11.7%	73.0%	27.0%
#200	75µm	310.2	301.9	8.3	12.7%	85.7%	14.3%
#325	45 µm	309.9	305.3	4.6	7.0%	92.7%	7.3%
Pan	< 45 µm	287.0	282.2	4.8	7.3%	100.0%	0.0%
total wt, g				65.6	100.0%		

Sample ID PSDF-3-301
 Sample Location Plant Bowen Processed
 Fines

Sample
 Description
 Sample
 Date

Analysis Date 8/28/96
 Analysis Type Sieve Analysis
 Run 1

Bulk Density; 0.96 g/cc

Number
 Initial Sample 60.5
 Weight, g

Sieve Designation	Sieve Opening, d	Final Weight, grams	Tare Weight, grams	Mass Retained, grams	% Retained	Weight % > d	% Passing
#16	1180µm	416.3	401.3	15.0	24.8%	24.8%	75.2%
#20	850µm	438.4	436.4	2.0	3.3%	28.1%	71.9%
#40	425µm	386.5	382.4	4.1	6.8%	34.9%	65.1%
#50	300µm	340.7	337.4	3.3	5.5%	40.4%	59.6%
#100	150µm	327.0	315.0	12.0	19.9%	60.3%	39.7%
#200	75µm	316.2	301.9	14.3	23.7%	83.9%	16.1%
#325	45µm	311.2	305.3	5.9	9.8%	93.7%	6.3%
Pan	< 75 µm	285.9	282.1	3.8	6.3%	100.0%	0.0%
				total wt, g	60.4	100.0%	

Sample ID PSDF-3-301(2)
 Sample Location Plant Bowen Processed
 Sample Description Fines
 Sample Date After
 Analysis Date 8/28/96 LOI
 Analysis Type Sieve Analysis 0.09
 Run Number 1 Note: Bottom ash samples may
 Initial Sample 97.3 during LOI due to reduced
 Weight, g compounds in the ash.

Sieve Designation	Sieve Opening, d	Final Weight, grams	Tare Weight, grams	Mass Retained, grams	% Retained	Weight % > d	% Passing
#16	1180µm	424.9	401.3	23.6	24.2%	24.2%	75.8%
#20	850µm	440.1	436.4	3.7	3.8%	28.0%	72.0%
#40	425µm	389.3	382.4	6.9	7.1%	35.1%	64.9%
#50	300µm	342.8	337.3	5.5	5.6%	40.8%	59.2%
#100	150µm	335.4	315.1	20.3	20.8%	61.6%	38.4%
#200	75µm	325.1	301.9	23.2	23.8%	85.4%	14.6%
#325	45µm	314.0	305.3	8.7	8.9%	94.4%	5.6%
Pan	< 75 µm	287.6	282.1	5.5	5.6%	100.0%	0.0%
total wt, g				97.4	100.0%		