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POWER SYSTEMS DEVELOPMENT FACILITY

**QUARTERLY TECHNICAL
PROGRESS REPORT**

JULY 1 - SEPTEMBER 30, 1994

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1.0 INTRODUCTION AND SUMMARY

This quarterly technical progress report summarizes the work completed during the third quarter, July 1 through September 30, 1994, 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 major emphasis during this reporting period was continuing the detailed design of the facility and integrating the particulate control devices (PCDs) into structural and process designs. Substantial progress in underground construction activities was achieved during the quarter. Incremental funding of the project was approved by DOE based on the Continuation Application for Budget Period 3. A nominal 75% design completion milestone was achieved during the last quarter, and meetings were held to review the

status of the current design and schedule of remaining activities. The PSDF design documents are being continually updated as newer information becomes available.

The detailed design of the PSDF continued with refinements to P&IDs, preparation of specification bid packages and a move towards freezing the design. The integration of PCDs and the sampling system in the MWK and FW portions of the process structure continued and detailed civil, electrical, instrumentation and controls, and mechanical design information were exchanged between the design teams. SRI continued with simplifying the design and casting of the particulate sampling system cyclone manifold for the PSDF, working with the engineering design teams to resolve interferences and preparing to issue drawings for construction. Purchase orders have been issued for fabrication of the insertion skids.

Construction is progressing at the site. Most of the construction activities during the quarter concentrated on underground pipe trenches and electrical ducts. The foundation for the fire protection tank and equipment were completed and piping is being installed. The erection of the warehouse/maintenance/analytical lab building is nearly complete, and the construction of the administrative building began. Steel erection is scheduled to begin in November. Following freezing of all subcontractors process designs, information to complete all balance-of-plant equipment designs are now available. All major equipment designs are expected to be completed by the end of the next quarter.

The contract negotiations between FW and its topping combustor subcontractor are in progress and are expected to be completed during the next quarter. Purchase order terms are being negotiated between FW and its gas turbine supplier. Design of all equipment in the FW train except topping combustor and gas turbine are progressing well. Issues associated with alkali getters were addressed in a meeting with FW in July. A Design and Operability Hazard Review (DHR) of the APFBC System was held, and the action items from the DHR meeting are being reviewed.

MWK moved further along with the detailed design of the transport train, committing to vendor engineering drawings and procurement and fabrication of all major equipment. A number of major equipment were fabricated and 15 of the 39 MWK train components were delivered to the site. "Construction Issue" P&IDs and a number of isometric drawings of different areas were issued. The design hazard review of the MWK transport train, including the PCDs, was completed in the last quarter. Many suggestions contained in the DHR report were implemented, and MWK will issue a final implementation status report.

The PCD equipment designs are progressing well. Purchase orders for equipment fabrication and procurement are being issued. Considerable progress has been made with the in-house testing of PCD internal components and filter media at IF&P and Westinghouse, respectively. MWK has modeled all CPC process equipment in their Intergraph system. The development of an Interactive video training/archiving system which incorporates all the PSDF modules was continued during this quarter, with considerable progress in the Advanced Gasifier and Batch Sampling and Realtime monitoring modules.

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), Nolan MultiMedia, and Southern Company Services (SCS).

2.0 REVIEW OF TECHNICAL PROGRESS

2.1 PROJECT MANAGEMENT

SCS amended all subcontractor's contracts with the Budget Period 3 incremental funding approved by DOE. SCS has scheduled a meeting with DOE and EPRI in early November to discuss project, cost and schedule status along with the proposed test plan for the MWK train. The project schedule has been updated, and SCS requested revised cash flow estimates from all subcontractors to meet the updated schedule. In the new schedule, the mechanical completion of the MWK train will be achieved by September 1995, followed by shakedown and characterization tests. Except for the topping combustor and the gas turbine, mechanical completion of the FW train will be achieved by the last quarter of 1995, and the mechanical completion of the entire train is projected for April 1996. The budget and cash flow information along with design and construction schedules and cost management reports are being assembled. These will be submitted to DOE and EPRI and will be used to facilitate the technical discussion of the project.

The PSDF steering committee, composed of representatives of DOE, EPRI, SCS and American Electric Power, met on August 25 to review progress and cash flow, and set the future direction for the project. SCS presented the construction sequence and progress and the scheduled date for structural steel erection. The steel erection start date is closely tied to the delivery schedule of the FW equipment. As with EPRI, DOE will be closely involved with the PSDF project by assigning and possibly relocating personnel to the site.

A meeting was held with MWK to discuss the design closeout activities. It is projected that all MWK design-related activities will end by November 15. FW and SCS held a Project Management Review meeting in Livingston on July 26, 1994. Discussions included the status of contracts, schedule, alkali getter supply, APFBC design hazard review, and approval of variance notices and bid tabulations. Delays in concluding the agreements with Westinghouse and Allison will impact receipt by FW of design information necessary to complete engineering as well as impacting delivery of the equipment to the field.

Negotiations were completed with FWDC and FWEC, and the contracts signed. Contract discussions with Westinghouse continued. Concerning Allison, FW has decided to use a purchase order for the gas turbine set instead of a subcontract. Allison submitted a lump sum bid for the gas turbine. Terms and conditions of the purchase order are still under discussion. FW has requested a "take-out" price on the hot gas inlet piping because Allison has stated they are "uncomfortable" undertaking the design.

2.2 PHASE 1 - CONCEPTUAL DESIGN ACTIVITIES

2.2.1 Task 1.4 Transport Reactor Development Unit

EERC has issued a cost proposal for close-out of the TRDU project. Negotiations are ongoing between EERC, SCS and DOE regarding the scope and cost of the close-out effort.

2.3 PHASE 2 - DETAILED DESIGN ACTIVITIES

2.3.1 Task 2.1 Detailed Design

2.3.1.1 MWK: PSDF Transport Train

The PSDF detailed design is nearly complete and several documents were issued for construction (IFC). During this reporting period, P&IDs with nomenclature, all instrument data sheets and drawings including logic descriptions and loop diagrams, and piping isometrics in areas "A" (thermal oxidizer) and "E" (heater pipes and pipe chase) were issued for construction. MWK is continuing to work on releasing isometrics in area "C" (reactor bay) and "B" (PCD bay) and all power plans, wiring diagrams and power details. The design of refractory lined orifices was completed.

To date, a total of fifteen equipment items were shipped to the site. Technical evaluation of the analyzer house and analyzers were completed and purchase orders for the refractory lined pipe and transport air dryer were issued.

A 75% design status review meeting was held on July 13 at MWK offices. MWK presented the current design status of the advanced gasifier train. Issues that were discussed included: alternative methods to preheat the PCDs; addition of a third cyclone, screw cooler and a fines handling system before the primary gas cooler in order to lower the particulates to 1,000 ppm at the PCD inlet; cyclone spoiling and other tests using existing equipment at MWK facilities; computer solids modeling of all CPC equipment; spatial problems associated with rotating the fines screw cooler; and the MWK design closeout plan. At the same meeting, CPC presented the status of the granular bed filter, as well as current procurement efforts and delivery schedule.

Based on discussions at the meeting and further conversations with the project participants, SCS asked MWK not to proceed further with the third cyclone design to lower the particulate concentration at the PCD inlet. MWK ensured SCS that the

refractory lined pipe has flanges at the proposed third cyclone location for later installation, if necessary.

The design hazard review of Westinghouse and Combustion Power PCD P&IDs was conducted and a final report issued. After studying several methods for PCD heatup, a scope of work document was issued with a final selection. Also, a scope document to study the Westinghouse and IFP PCD interchangeability was issued and subsequently approved. The design for the interchange of the screw cooler between the CPC and Westinghouse PCDs was completed.

Laboratory tests at Kellogg test facilities in Houston were conducted on cyclone spoiling and results incorporated into the existing cyclone design by the addition of two spoiling nozzles. A final test report on cyclone spoiling is given in Appendix A. Other major documents issued to SCS during this period include a test matrix for shakedown and characterization tests in gasification and combustion modes, clarifications and breakdown of various nitrogen users by required purity level and pressure, and a draft copy of portions of an operating and instruction manual. The operating and instruction manual is about 50% complete and is scheduled for issue in November.

MWK issued a report on the implementation status of the design hazard review action items. All heat and material balance instrumentation that were identified by SCS and MWK have been incorporated into the P&IDs. SCS comments on the P&IDs, as discussed in a meeting in May, were included in revising the P&IDs. Construction issue P&IDs were released by MWK in July.

A meeting was held to discuss all outstanding issues between MWK and SCS including the acceptance of the detailed engineering close-out plan. Several items were identified and work is progressing to resolve all the items. A final cost estimate for the MWK portion of the work was initiated.

A schedule of remaining design and procurement activities is included in Appendix B.

2.3.1.2 FW Team Activities

The Phase 2 detailed engineering and Phase 3 procurement activities continued. The following activities occurred during the third quarter of 1994:

A 75% design review meeting was held in Foster Wheeler's Livingston, NJ office on July 27, 1994, with representatives from DOE, EPRI, IF&P, FW, and SCS in attendance. A brief review of the APFBC design status was presented by the participants in the morning

session, and detailed design discussions held in the afternoon session. A copy of the meeting minutes is included in Appendix C.

FW issued Revision C of the FW APFBC P&IDs, line classification lists, and line specification summary (all dated 7/19/94) and Revision F of the equipment list (dated 7/19/94). In addition, plot plans, elevation drawings and the equipment elevation list were updated and issued, as well as a number of piping isometric drawings. Updated interlock logic diagrams, definitions and descriptions were issued, as well as the sequence control flow chart for the carbonizer coal feed system.

FW issued updated drawings for the char cooler and the carbonizer, equipment data for construction, electrical power installation detail drawings, the electrical drawing list, and the electric tracing line list for drums and hoppers. Details of Ingersoll Rand's Transport Air Compressor were issued, as were sample drawings of civil engineering bulks. The platform requirements at the surge hopper vent filters, drain hub requirements at the process structure base slab, and spares being procured by vessel vendors were defined.

FW and IF&P reviewed the layout and design of the carbonizer PCD. Variable speed drives were defined for the screw feeders. Oxygen meters were deleted from the coal lock hopper systems. Foster Wheeler defined the nitrogen purity requirements for all APFBC users, excluding the PCDs, for SCS use in finalizing the BOP nitrogen system specifications. Instrumentation in the char transfer system was reviewed to provide additional rotameters for better control of aeration nitrogen flows. FW outlined procedures for draining the FBHE, and issued recommendations of potential vendors for the gas turbine exhaust silencer.

FW and SCS continued prioritizing and expediting fabrication and delivery of refractory lined pipe based on construction requirements. SCS and FW held a meeting with the refractory lined pipe vendor, Interpro, on September 19, 1994 at FW's Livingston, NJ office to review the status of lined pipe. Discussions included improving delivery of the seven most critical spool pieces, welding requirements and weld testing, and review of piping isometrics.

SCS and FW conducted another interference check on the PDS model, identifying a number of additional interferences to be resolved. SCS reviewed the FW P&IDs and completed a first draft of APFBC heat and mass balance equations, based on the instrumentation shown on the FW P&IDs, Revision C.

A detailed project schedule of remaining design, engineering and procurement activities for the APFBC train is provided in Appendix D.

2.3.1.3 Balance-of-Plant Activities

Significant progress on several on the balance-of-plant system was made during the last quarter. The progress is summarized below.

Nitrogen System

The nitrogen system specification, which was issued in early August and put on hold shortly thereafter, was modified with an addendum and released to the bidders in early September. The addendum incorporated a requirement for dual purity systems, transferred surge tank sizing to SCS with option for vendors to furnish, and modified vaporizer capacity. It is expected that a dual purity system will reduce the operating costs of the nitrogen system as compared to a single, high purity nitrogen system. SCS engineering has continued to respond to vendor questions and requests for clarification during the remaining portion of September. Bids are due in mid October.

Ash Handling Systems

The detail design of the ash handling systems continued with the near completion of the P&ID's. Discussions concerning ash storage requirements continued, with the current philosophy to have only two ash storage silos, one 3600 ft³ silo (5 days storage) for ash from the FW process and a duplicate 3600 ft³ silo for ash from the MWK process (10 to 15 days storage). A decision concerning the need for cooling the Foster Wheeler ash has not been resolved.

Dense Phase Conveying Systems

A package of information which presented the conceptual ideas and layouts for all of the dense phase conveying systems was sent to three prospective vendors. The information covers dense phase options for pneumatic transporting and particle size distributions of ash, coal, limestone (sorbent), startup bed material and coke breeze. Meetings with the vendors are scheduled during the month of October to discuss the concerns and design options and possibilities.

Fire Protection

The design of the fire protection pump house neared completion. The design for this area should be completed in October which will provide an active fire protection system onsite.

Waste Water System

The detail design of the waste water system continues to be on hold as more definitive evaluations of the waste water flows are being performed.

Stacks

The sizing calculations for the MWK and FW stacks have been completed. The MWK stack calculations have been reviewed and approved by MWK. The draft of the stack specification has been completed and is now being reviewed internally. The current designs provide a free-standing 230 ft high stack for the MWK process and a 230 ft high side-supported stack for the FW process. A location for the two stacks has also been determined. The FW process stack will be supported from the process structure.

Coal and Limestone Systems

A resolution of the arrangement of the coal and limestone storage and preparation area was completed during August, allowing detail design to resume on equipment and systems to be procured for the area. Discussions have been ongoing during the previous months concerning the layout of the new equipment and structures to be constructed in the area, traffic flow and access, and reuse of existing structures.

The mill specifications for the coal and limestone preparation systems have been re-issued to the vendors for bids. The mills were postponed to investigate paste feed requirements for the Foster Wheeler process, coal/limestone area layouts, and feed requirements. The specifications provide for two coal mills and one limestone mill. Each process will have a dedicated coal mill. The processes will share the limestone mill which will be designed to grind to either size required by the processes. The expected delivery of the system is August 1995, which will provide a reasonable amount of time for installation before startup.

The draft of the revisions to the coal/limestone conveyor system specification was completed and is now being reviewed internally.

Tanks, Hoppers and Silos

The design of the miscellaneous tanks, silos and hoppers continues. During the month of September, designers inspected existing tanks left from the Liquefaction and

Agglomeration projects. Five tanks were determined to be acceptable and are now being incorporated into the designs of various mechanical systems.

Steam and Condensate Systems

During September work began on the detail design of the closed loop condensate system for the FW process. This system will supply water to the Foster Wheeler process, where it will be heated, then returned to balance-of-plant equipment for cooling and chemical treatment, and then conveyed back to the FW process. Design of the closed loop steam and condensate system for the MWK process also began. This system will provide condensate to the MWK process, where it will generate steam before returning the steam to SCS for condensing. The activities for the two systems include the marking of the conceptual P&ID's for the conversion into detail design drawings, pump sizing calculations, investigations into heat exchanger and cooling water requirements with vendors, and water quality investigations.

Cooling Water System

Detail design of the cooling water system began. Estimation of makeup water requirement based on evaporative losses and blowdown were developed for use in preliminary cooling tower sizing. Development of the cooling tower specification was begun.

Civil Engineering Design

Resolution of interferences between the structural steel and the equipment and piping continued during the quarter. Most interferences should now be resolved. Weights for the alkali getters to be supplied by FW are significantly higher than originally estimated. The drilled pier design loads are sufficient to handle the weight increases, but some redesign of the structural steel will be required.

Other civil engineering design items include:

- The MWK main compressor foundation drawing is in progress. It will be issued in October.
- The Thermal Oxidizer foundation design is completed. SCS is awaiting the final equipment weights from MWK to finalize the design and drawings.

- The stack foundations preliminary design is complete. SCS is waiting on vendor load information to complete the design of the foundations. The inquiry for the stacks is in progress.
- The coal and limestone storage area concrete drawings are 85% complete, and the remaining will be completed in October.
- The process structure concrete drawing is approximately 80% complete. SCS is awaiting vendor equipment load and locations information to finalize the drawing.
- The pipe trench drawings are being revised to reflect the access platform for MWK piping and valves. The drawings will be issued in October.
- Three demineralized water tank ring foundations have been designed, and the drawings will be issued in October.
- The coal handling building base slab drawing has been started and is approximately 25% complete.
- The detailed design of the Process Structure structural steel continues. SCS has received shop drawings from Qualico Steel for Sequence Two of the Process Structure.

2.3.1.4 Process Hazard Review

The hazard and operability analysis of the FW equipment items in the advanced PFBC train was carried out between August 8 and 18. The analysis for the associated PCDs, Westinghouse and IF&P, was carried out August 22 and 23. As contracts had not been signed, P&IDs were not available for the Allison turbo-compressor or the Westinghouse topping combustor. The P&IDs for these equipment items as well as burner and compressor vendor P&IDs will be reviewed at a later date.

FW, IF&P and Westinghouse presented and discussed the operational aspects of the process and filters, as well as start-up and shut-down issues and its effects on the balance of plant. Also discussed at the meeting were a number of "what if" scenarios which might occur during both normal and transient operations. The allocation of time was as follows: six days reviewing 20 Foster Wheeler P&IDs raised 259 comments; one day reviewing one P&ID for IF&P's carbonizer PCD raised 19 comments; and one day reviewing three P&IDs for Westinghouse's combustor PCD raised 18 comments. The study identified 296 deviations that could compromise the ability of equipment items to

meet the design intent and/or achieve satisfactory plant operation. These deviations were categorized as follows:

- 45 items as operability
- 106 items as safety concerns
- 145 items as operability and safety

These potential deviations were broken down as follows:

Safety related	40%
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• Environmental	1%
• Explosion	3%
• Fire	6%
• Uncontained equipment damage	15%
• Personnel injury	15%

Operability related	50%
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• Emergency shutdown	2%
• Controlled shutdown	10%
• Contained equipment damage	14%
• Process upsets	24%

Other issues	10%
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Westinghouse and IF&P have prepared responses to the deviations and where appropriate have modified their P&IDs. At present FW is reviewing the results in preparation for discussions with SCS on implementing the suggested modifications.

The hazard and operability analysis of the Westinghouse and CPC PCDs for the MWK train was carried out between July 11 and 13. A number of changes were recommended for each PCD; these are being incorporated with the revision of P&IDs. This task completes the analysis of the entire MWK train.

2.3.2 Task 2.2 Facility Design Document

The PSDF design documents are being updated with material received from all participants.

2.3.3 Task 2.3 Environmental Permitting and Compliance

The PSDF construction site was inspected routinely for the NPDES stormwater construction requirements. On September 23, stormwater runoff samples from the site were collected and submitted to an outside laboratory for analysis. The analytical results from these samples will be submitted in an annual report to the Alabama Department of Environmental Management (ADEM), as required by the permit. Alabama Waste Services was hired to remove construction debris from the site. Site personnel were briefed about what should and should not go into the waste receptacles.

The facility will be designed for dry ash disposal with provision in the design to include ash conditioning (water addition) equipment later, if needed. Equipment (vacuum system, wind breakers, etc) will be incorporated into the ash handling system to help minimize dust emissions, and SCS will work with the trucking company to develop procedures to minimize fugitive dust in transportation. In addition, SCS will work closely with the landfill owners to minimize the fugitive dust emissions while unloading and after the ash is on the ground.

The National Pollutant Discharge Elimination System (NPDES) permit application for the PSDF was prepared. The application will be submitted after a review of the proposed wastewater treatment system for the facility. Information is being gathered for Federal Aviation Agency (FAA) Form 7460-1 "Notice of Proposed Construction or Alteration" which pertains to markings and lighting for the PSDF emission stacks. Once the information is collected, it will be sent to the FAA for evaluation. The FAA indicated a reply with their recommendations should be issued within 30 days of receiving the application.

2.3.4 Task 2.4 Particle Characterization and Collection

On July 15, SRI released updated versions of all P&IDs for final review before preparation of the construction issue. The first draft of the wiring diagrams was finished and reviewed with SCS. The diagrams are now being revised to incorporate the comments received from SCS.

After reviewing the design of the sampling ports with SRI, FW agreed to redesign the nozzles to allow the use of removable sleeves and to use 12-in. nozzles in lieu of the 14-in. nozzles originally planned. SRI preferred 10-in. nozzles as in the MWK port design, but FW concluded that the nozzle skin temperature would be too high. Because of the unexpectedly large FW nozzles, it will be necessary to order four larger flanges for the SRI sleeves used in the FW ports.

SRI provided detailed drawings of the sampling system support structure and assisted MWK in the design of lateral restraints for the sampling systems. SRI and MWK also resolved a potential interference problem between SRI's inlet sampling system at an elevation of 152 ft and MWK's FD0520 at an elevation of 158 ft.

The manifold for the five-stage cyclone assembly was redesigned to simplify the geometry around the receptacles and to allow the insertion of ceramic cores into the wax pattern. SiCAM Corporation incorporated the design changes into the CAD model of the manifold and produced a new plastic model. SRI inspected the plastic model, noted the need for several minor changes, and sent the model to Howmet for casting.

At the project review meeting on August 10, SCS described a sampling problem that has been reported at several gasification facilities: sampling lines have become plugged with ammonium chloride, which is presumably formed by the reaction of ammonia and hydrogen chloride as the sample gas cools. To address this problem, SRI recommended the installation of a tee in the sampling line ahead of the condenser to allow periodic flushing with water.

SCS also expressed concern that the quartz filters planned for use in the sampling systems may interfere with the alkali measurements by releasing or adsorbing alkali vapor. SRI compared the amount of alkali vapor that could be released from the filter to the amount of alkali vapor that could be captured in the bauxite cartridge during a typical sampling run. The comparison showed that complete release of the filter alkali could cause a significant error in the alkali measurement when the actual alkali concentration in the process gas is below 0.2 ppmv. This problem could be avoided by preheating the filter in a muffle furnace to drive off any volatile alkali prior to use of the filter in the sampling system. Another potential source of error, adsorption of alkali vapor on the filter, could be assessed by sampling with two filters in series. The second filter could be analyzed before and after a sampling run to determine if the filter has captured any alkali vapor from the gas.

Other SRI work this quarter included:

- Procurement of the probe insertion mechanisms, port sleeves, ball valves, probes, cyclones, and prototype cyclone manifold
- Preparation of bid specifications for the linear actuators, motion controllers, NEMA enclosures, switches, and indicator lights
- Preparation of drawings of cascade impactor components

2.3.5 Task 2.5 Particle Control Technologies

Relocation of the Westinghouse PCD to the FW APFBC train and the IF&P PCD to the MWK train is an integral part of design, and the design issues associated with PCD interchangeability between the two trains at the PSDF are being addressed with PCD vendors, FW, MWK and SCS. An engineering analysis is being done for interchanging the PCDs, including calculation of piping loads and forces so that these requirements can be integrated into the design prior to fabrication.

Combustion Power Company PCD for the Transport Gasifier

Work continued on routing of interconnecting stainless steel, pressure piping, and details of the media valves stainless steel parts. CPC delayed this effort until late June to allow SCS time to review the supporting steelwork. Any changes in the supporting steel could have affected the pipe routing. Drawings received from MWK have defined the locations for interfaces for utilities.

Many minor changes were made to the P&ID and the electrical diagrams. These changes are in response to comments from SCS and MWK and from findings at the Design Hazards Review meeting. An Electrical Conduit and Cable Layout drawing was completed (drawing no. 1180-2328-01-345) and submitted for comments. Information to add to the drawing was received from MWK. The Electrical Instrument Location drawing (drawing no. 1180-2325-02-322) was also updated. Responses to SCS comments on these drawings were transmitted to SCS. Responses to comments from the design hazards review were submitted to SCS for review.

The Granular Bed Filter (GBF) wiring diagrams (drawing no. 1180-2343-01-343) were updated to revision 4 and submitted to SCS and MWK, and an electrical cable schedule with conduit sizes is being prepared (drawing no. 1180-2345-172-347). Revisions to cable types are being incorporated into the list, and conduit sizes will be added. Discussions with SCS resulted in a plan to incorporate the CPC PLC (programmable logic controller) capability with the SCS DCS logic. Control information is available through the CPC PLC to the SCS DCS and can be used to override any PLC function.

Complete responses to formal specifications have been received for major procurement items, including the baghouse, recuperative heat exchanger, auxiliary air-cooled heat exchanger, and boost blower. Specifications were submitted to SCS for pressure vessels, refractory lined piping and the refractory package. Other items include a blower for the air-cooled heat exchanger and a water cooled heat exchanger.

Purchase orders have been placed for the pressure vessels, internals, and refractory lined pipe with a fabricator in Memphis, TN. Drawings for some of the pressure vessels have been received by CPC and are being reviewed. Discussions are being held with SCS regarding scheduled delivery of equipment to the site. The recuperative and gas/air heat exchanger were ordered as a unit from a supplier in Houston, TX. Expected delivery date is March, 1995. Designs of these components are essentially complete. The specific equipment for which design is complete includes: lift pipe, vessel seal legs, media valves, and piping in and out of the recuperative heat exchanger. It is now clear that the critical path is fabrication of pressure vessels and refractory lined piping followed by installation of refractory. A summary of the status follows:

- Boost blowers: By the end of June, information to complete the review was received, but not incorporated. There were concerns that a low pressure heatup (5-10 psig) may affect the boost blower capacity. This low pressure mode of heating the GBF was presented by MWK at the April 19-20, 1994 coordination meeting. Discussions with MWK revealed a moderate pressure option (30 psig) for heatup. A pressure at the filter of 12 psig or greater for heatup will not impact the capacity of the boost blowers.
- Pressure vessels and refractory lined piping: These items were packaged to allow the fabricator to preassemble and confirm fit prior to installation of refractory. A paint specification is included. Quotes were received and reviewed at the end of June.
- Refractory package: This includes the refractory to line the pressure vessels and piping above. This package includes requirements for the refractory, quality assurance for refractory, and staltastic coating for pressure vessels. Three reasonable bids had been received by September. Two vendors proposed installation at the jobsite, the other proposed installation in his shop. Normally CPC does refractory work at the jobsite, but this is under review since SCS has requested that refractory work be completed off-site.
- Cooling air blower: For the air cooled heat exchanger, a blower is needed to provide cooling air. This blower is designed to deliver 2600 acfm at 1 psi which should be a standard package. All bids propose 20 hp fans.
- Water cooled heat exchanger: CPC has preliminary quotes on this small heat exchanger. A formal quote will be requested.

Industrial Filter & Pump PCD for the Carbonizer

IF&P attended the 75% design review meeting held in FW's Livingston, NJ offices. IF&P also attended a Design Hazards and Operability review meeting at Livingston on August 22 and 23, 1994. IF&P presented and discussed the operational aspects of the filter, as well as start-up and shut-down issues as they might affect the balance-of-plant. Also discussed at the meeting were a number of "what if" scenarios which might occur during both normal and transient operation of the carbonizer.

IF&P recently completed a test series designed to confirm the effectiveness of the novel PCD dirty gas inlet configuration. The tests utilized three filter elements mounted within a Lucite™ filter vessel, which was operated at ambient temperature and nearly atmospheric pressure. By scaling down the flow conditions anticipated in the full scale Wilsonville PCD, it was possible to match the dirty gas flow rate within the inlet pipe as well as the upward velocities and face velocities around the candle surfaces and at the candle surfaces.

Eagle-Picher MN-23 dust was used to simulate the carbonizer dust, as this material has similar particle size range and dry bulk density properties as that of the carbonizer dust anticipated. While it is recognized that certain parameters (such as gas viscosity and dust cohesiveness at elevated temperatures, the effect of elevated pressure on the ratio of gas-to-dust bulk density, etc.) are impossible to simulate under such test conditions, it was reassuring to observe a uniform distribution of dust on all of the candle surfaces as a result of the test.

Comparing these observations with the mathematical modeling of the dirty gas behavior within the IF&P PCD (as performed by METC), seems to indicate the inlet pipe configuration of the PCD will provide excellent uniformity of dust distribution, both axially and radially within the PCD, without the deleterious effects of erosion, impingement, and surges of dust onto the candles and tubesheet. In both the mathematical model and the experimental testing, the dirty gas was observed to expand radially outward from the end of the inlet pipe to the inner wall of the filter vessel, after which it gently flows simultaneously upward and radially inward to the candle surfaces, having had sufficient time (and space) to reduce speed and expand uniformly within the filter vessel. Moreover, this design minimizes the potentially disastrous effect of excessive dust accumulation at the candle-to-tubesheet junctures, which often results in irreversible dust bridging and catastrophic candle failure.

The issue of nitrogen purity requirements for the IF&P PCD has been addressed and resolved between SCS and IF&P. The issue of tubesheet strength and design tubesheet

pressure differential has been addressed by IF&P, FW, and SCS. As originally specified in the IF&P bid, the tubesheet will be designed for 15 psid maximum differential pressure. IF&P has agreed to supply "junction box" type connections for interfacing with the plant utilities at the PCD's location within the PSDF superstructure. Such "junction box" type connections will facilitate the installation and operation of the PCD within the plant. Connection sizes for the compressed air requirements to the PCD, medium pressure nitrogen, etc., have been finalized between FW and IF&P.

As a result of the design hazards review meeting, IF&P has agreed to install the air purge cannons within the PCD cone bottom as part of IF&P's scope, rather than considering them only as a future need. Installation of the air cannons will allow any accumulated dust within the PCD vessel to be immediately purged down into the piping located beneath the PCD.

Finally, IF&P has made a few final changes to the external design of the PCD, some of which were suggested by DOE, SCS, and FW. These changes included: (i) the provision of a spool piece at the inlet flange of the PCD to accommodate an internal expansion bellows and (ii) elimination of the nuclear level detector in favor of more reliable thermocouples, to detect any accumulation of ash in the cone bottom of the PCD. Once FW has calculated the nozzle stresses associated with IF&P's PCD design, materials procurement will take place.

Westinghouse PCDs for the Transport Gasifier and CPFBC

The Westinghouse PCD FL0301 will be located in the MWK transport reactor train and the second PCD FL0352 will filter gasses from the combustor (CPFBC) in the FW APFBC process. The schedule has been adjusted by SCS to provide delivery of FL0301 by February 13, 1995 and FL0352 by June 3, 1995. The latter delivery date will permit Westinghouse to obtain the most advantageous price from the FL0352 vessel vendor. Other elements of the Westinghouse project include qualification testing of alternate filter media, for future insertion into the PCD being designed to operate with the FL0301, and some companion programs which will serve to augment the technology base for the Westinghouse design and engineering. The revised schedules are shown in Appendix E.

Due to a recently discovered interference between nozzles 9E and 9F of FL0352 and the supporting iron structure, the nozzle has been moved to a $\pm 45^\circ$ location at the same elevation. All necessary drawings have been revised. Interface definition and preliminary design is now complete.

As part of the base program Westinghouse has conducted qualification tests of alternate filter media for possible future insertion into FL0301 should SCS exercise the option. The two filter media that were qualified are the CeraMem® cordierite cross flow filter module and 3M® Nextel™ 550 ceramic bags. The qualification tests consist of subjecting a Nextel™ 550 bag and a CeraMem GHR6-8 filter element to about 250 hours of testing in the Westinghouse high temperature, high pressure (HTHP) facility. Additionally, the 3M Nextel™ 550 bag fabric was subjected to 400 hours of flow-through testing with hot alkali/steam at 1600°F to assess its ability to resist chemical attack from typical coal combustion products. This task is now complete.

Detail design of the two PCDs is now complete except for detailing the structural support for the external pulse pipes and resolving action items created during the two hazard design reviews for the two PCD systems. Westinghouse's position on the resolution of these issues has been outlined in letters to SCS on September 20 and 26. The P&IDs for the two PCD systems have been revised and have been reissued for FL0301 and will be reissued for FL0352 shortly.

Based on Westinghouse's testing, it has been decided to use a 3 inch solenoid valve for both skids. Since the design was based on using a 3 inch valve, no perturbation in the schedule will occur. All of the backpulse and instrument skids are being designed to NEC Code Class 1, Div. 2, Groups C & D. At a meeting at SCS on June 10, it was decided that the location of the FL0352-ME01 skid did not merit a hazardous classification. This has now been changed for consistency and all equipment installed will be designed for hazardous location. Interconnection drawings are complete on FL0301 and were issued to MWK/SCS. A preliminary test matrix for the shakedown and characterization of FL0301 has been supplied to SCS.

2.3.6 Task 2.8 Experimental Test Plan

Comments made by MWK, Westinghouse, and Combustion Power on the plans for shakedown and characterization testing of the Transport Reactor train were incorporated into the test plans for operation as a combustor, and as a gasifier. The combustor plan, defining shakedown, characterization, and parametric testing, was issued to project participants as a draft document for discussion. Work continues on a similar document for operation as a gasifier.

Features of the combustion test plan include the following:

- Combustion testing will be completed before proceeding to operation as a gasifier. This will avoid problems during combustor operation arising from the ignition of carbon rich material deposited during gasification operation.
- To help achieve longer running periods during initial operation neither the reactor or the PCDs will operate at their maximum design conditions, i.e., the reactor will operate in the mid-pressure range below 260 psia and the PCDs will operate in the mid-temperature range below 1400°F. Once the plant is operating reliably the conditions will become progressively more arduous.
- The design coal for the PSDF is high sulfur Illinois #6 bituminous. At the time this was specified it was freely available from the adjacent Power plant, Plant Gaston. To comply with Phase 1 of the 1990 CAA Amendment Plant Gaston will switch to a low sulfur bituminous coal from either West Virginia or Alabama in January 1995. To reduce the cost of coal it is proposed that the PSDF use the same coal.
- The design sulfur sorbent is local Longview limestone. Facilities testing high temperature, high pressure candle filters have experienced difficulty removing the filter cake when using limestone. This difficulty has been alleviated by using dolomite and it is proposed that the PSDF do the same.
- Dolomite has only half the calcium content of limestone so to achieve the same Ca/S molar ratio twice as much sorbent has to be fed, increasing the sorbent preparation and feeding capacity. This increase can be avoided by using the low sulfur coal.
- Tests are proposed which will characterize both the PCDs and the reactor when operating in the combustion mode. Testing has been devised such that the three phases of hot operation blend into one another.
- The sequence of events is tabulated below.

Event	Schedule	Coal burning hours
Cold Commissioning	October 1995	None
Hot Commissioning	November and December 1995	200
Characterization Testing	January and February 1996	400
Parametric Testing	March to early June 1996	1000

- The 1600 coal burning hours achieved are expected to be divided equally between the Westinghouse candle filter and the Combustion Power moving granular bed filter. The efficacy of operation is expected to improve throughout the combustion phase and allow more coal burning hours per unit time to be achieved during the gasification phase.

2.4 PHASE 3 - CONSTRUCTION, PROCUREMENT AND INSTALLATION

2.4.1 Task 3.1 Procurement

MWK Advanced Gasifier train

MWK procurement activities are summarized in the Procurement and Material Status Report (Appendix A). Purchase orders have been issued for most items and fifteen of thirty eight items have been shipped to the site. Items that are still in the procurement process are the gas analyzers and the relay system. Technical evaluation of the analyzer house and analyzers bid proposals has been completed. Quotes have been received on the relay system.

Equipment shipped to the site includes:

BL0401	thermal oxidizer blower
BR0201	startup burner
BR0401	thermal oxidizer
BR0402	flare tip
BR0602	sulfator startup heater
CO0401	recycle gas booster compressor
CO0601	sulfator air compressor
CY0601	sulfator cyclone
DR0402	steam drum
DR0404	flare seal drum
DR0501	HTF surge drum
FL0401	compressor intake filter
HX0202	primary gas cooler
HX0204	transport air cooler
HX0405	compressor feed cooler

FW APFBC System

Phase 3 procurement activities continued. FW issued purchase orders for the following items:

- Carbonizer, from Mitternight Boiler, on 7/1/94
- Screw Feeders FD0251, FD0252, and FD0253, from Taunton Engineering, on 7/21/94
- Screw Cooler FD0256, from Christian Engineering, on 9/2/94
- Hot Valves VL0262, VL0451, and VL0452, from Zimmermann & Jansen, on 9/2/94
- Quench Packages PG0252 (Fuel Gas) and PG0253 (Vitiated Air), from Johnson March, on 8/30/94
- Weigh Systems, from BHL Electronics, on 9/9/94
- Char Cooler Fan FN0251, from Twin City Fan, on 9/13/94

FW issued bid tabulations for the following items:

- Quench Package PG0252
- Weigh Cells
- Fines Cooling Screw Feeder FD0256
- Alkali Getters AG0253 and AG0254
- Char Cooler Fan FN0251
- Hot Valves VL0262, VL0451, and VL0452

FW issued requisitions for procurement of thermocouples, control valves, hot valves, restriction orifices, pressure transmitters, differential pressure transmitters, on-off ball valves, self-contained pressure regulators, annubar gas flow instruments, knife gate valves, rotameters, oxygen analyzers, level switches, the emergency trip system, and weigh systems. The latest FW Component Schedule, dated September 30, 1994, is included in Appendix F.

Westinghouse Filters

The fabrication of the system for FL0301 is proceeding on schedule as shown in Appendix E. The vessel fabricator has been selected and the vessel purchase order has been placed. ASME code calculations have been completed and PE certified vessel drawings will be issued shortly. The maximum vessel weight to be supported by the structure has increased by 8T from 56T to 64T. Delivery by February 15, 1995 is scheduled. The fabricator for the tubesheet and the clusters has been selected. Purchase

orders for the tubesheet and cluster material have been placed. The purchase order for the FL0301-ME01 skid has been placed. The small skid FL0301-ME02 will be fabricated at Westinghouse STC. Purchase orders for all skid valves and components have been placed.

The fabrication of the system for FL0352 is proceeding according to the schedule shown in Appendix E. Changes from the proposal design have resulted in an increased cost for the PCD vessel. To minimize the cost impact, SCS has allowed us to negotiate price with a delivery date of 6/15/95. The purchase order for the vessel has been placed. Purchase orders for the tubesheet and cluster materials have been placed and the fabricator for the tubesheet and the clusters has been selected. A purchase order will be issued in early October. Purchase orders for the back pulse skid (FL0352-ME01) and instrument skids (FL0352-ME02) have been placed and all components have been ordered.

SRI Particulate Sampling

SRI and SCS have now finished the review of bids received on several components of the sampling systems. The following table summarizes the vendors selected and the purchase orders issued to date.

Item	Supplier	Date
Probe insertion mechanisms	Santek	07/28/94
Port sleeves	Santek	09/19/94
Steady rest parts	Santek	09/19/94
Ball valves	Marpac	09/29/94
Probe assemblies	Alloy Engg	10/04/94
Cyclone manifold (prototype)	Howmet	10/11/94
Cyclones	Alloy Engg	10/14/94

Bid specifications have been issued for the linear actuators, motion controllers, NEMA enclosures, switches, and indicator lights. In October, vendors for these items will be selected, and purchase orders will be issued. Drawings of the cascade impactor components are now being prepared and will be issued for quotes in October. The remaining components, which will be purchased in October or November, include: temperature transmitters, pressure transducers, solenoid valves, manual valves, check valves, flow meters, choke orifices, flow orifices, pressure regulators, tubing, and fittings. The objective is to deliver all sampling system components to Santek in December, so that Santek's functional testing of the systems can be completed in January 1995.

2.4.2 Task 3.3 Construction and Installation

Most of the construction activities during the quarter concentrated on underground pipe trenches and electrical ducts. All of the underground trenches and ducts should be completed in November. The erection of structural steel is scheduled to begin in November. The ASME B31.3 requirements with regard to proof testing, NDE and welding procedure requirements are being studied. Specific activities during the quarter included:

- Continued work on pipe trench. Completed two bottom pours and two wall pours during the month. Projected completion of the pipe trench is the end of October.
- Completed construction of all pull boxes. All pull boxes have been set except PB #'s 10,11,12 &13.
- Pouring of the fire protection tank foundation ring beam was completed, and the ring is ready to set the tank. Fire protection pump house equipment foundations were completed, and suction and discharge piping for the fire protection pumphouse building were installed.
- The thermal oxidizer, primary air cooler, cyclone separator and gas cooler from MWK were received this month.
- Construction of the administration building began this month. Foundations and planning are nearing completion.
- Duct runs were completed between pull boxes 1 and 2 (except for stub outs for MWK analyzer building), north from pull box 1 to process structure and pull box 5, from pull box 1 to the coal handling structure, and between pull boxes 1 and 6.
- Temporary power has been installed to the pole barn (an existing storage building), fabrication area and construction trailers.
- Installed cooling water supply and return piping.
- Completed the fire protection piping loop except for post indicators (for valves) and hydrants.
- Started disassembly of piping and valves on existing fire protection pumps.

- Continued construction of warehouse/maintenance building. This area is 99% complete.
- On September 8, SCS and MWK witnessed testing of the transport reactor's main air compressor at Atlas Copco's manufacturing/test facilities in Voorheesville, New York. The test was completed with a 0.7% deficiency in maximum flow output. This deficiency required Atlas Copco to replace the first stage internals in the compressor. A second witness test was completed on September 15, 1994, witnessed by MWK. This test indicated the maximum flow to be acceptable. Atlas Copco was given a punch list of minor items to be corrected prior to shipment.

2.4.3 Task 3.6 Preparations for Operations

Wilsonville Interactive Learning System (WILS)

Scripts and flowcharts for the Flare system, Solids Handling and Sulfator systems on the Advanced Gasifier/Transport Reactor train (dubbed "K-train" for purposes of the WILS project) were rewritten, based on additional materials supplied by SCS, and resubmitted. Production of the K-train module for the Technology Transfer section of WILS began in September. The Flare and Feed preparation systems were chosen to be first, in part because most of the materials needed were already available. These supporting materials were gathered from the PSDF Design Documents. Storyboards were then prepared to facilitate graphics production. Colorization of gas and solids streams is an important issue that was addressed during the K-train production. This is based in part on previous multimedia applications that were developed for the Cool Water Archive and other EPRI projects.

Production of the Realtime Monitors and Sampling/SRI module continued during this quarter. The computer programs are being streamlined using the newly released upgrade to the authoring software, Director 4.0. This process, which includes a Glossary with multiple functions and access to P&IDs, is nearing completion.

In order to bring the Realtime Monitors and Sampling Module into the Windows environment, a new piece of software, Director for Windows, is being used. Director for Windows works in conjunction with Director 4.0 and is the only method for bringing the files into Windows. WILS is now working well in the Windows environment.

The Realtime Monitors and Sampling module will be submitted for review in November on a Syquest cartridge. The module will include new P&IDs from SRI. The P&IDs have been scanned and retouched for maximum legibility. Scanning of P&IDs is far more

efficient than converting electronic files for use in the program; moreover, based on tests performed by Nolan, the image quality and legibility factors are remarkably similar. Following any corrections based on feedback from SCS and SRI, if any at this time, the Realtime Monitors and Sampling module will be "burned" onto a CD ROM disc, the first of many discs that will be made for the project.

The complexity of converting Microstation (Intergraph) files into a usable format for a 3D view of the process structure and fly-arounds is being reviewed. ModelVision, located in Madison, Alabama, has been selected for this work. They can take PSDF files and construct the appropriate digital images frame by frame without leaving the Intergraph system. Each electronic file can then be saved as a more usable format, such as a PICT file, which can then be brought into the WILS programming environment. This task will start once the work on the MWK intergraph files, including the CPC PCD model, are completed by MWK and SCS.

3.0 PLANS FOR FUTURE WORK

1. Orderly closure of the contract with UND/EERC.
2. In the next quarter, MWK will complete issuing documents for construction. All piping work in areas "B" and "C" will be completed and the isometrics will be released. The cable tray plans and details will be issued along with all power plans, wiring diagrams and power details, and material list and assemblies. The electrical load summary data base will be issued and the material take-offs for piping, instrumentation and electrical will be completed. The design work on alternate PCD heating methods will be started and all affected documents will be revised. After completing the vendor selection, purchase orders for the relay and gas analysis systems will be issued. All the action items from the "Outstanding Issues" review meeting will be resolved. A Production check (cost) estimate will be initiated and completed in the next quarter. The final report on MWK train design hazard review will be issued.
3. For the next reporting period, FW should complete contract negotiations with Westinghouse and issue a purchase order to Allison. Also, FW will continue placing orders for equipment within the present budget period constraints, based on bid tabulations approved by SCS. Work will continue on the balance of requisitions for issue for procurement, as well as instrumentation engineering and design. In addition, work will continue on integration of the PCDs and SRI sampling equipment. SCS and FW should complete review of the APFBC Design Hazard Review findings, and determine recommended action for each of the findings.
4. SCS will continue with construction activities at the site, including pouring the administration building foundation and erecting the building. Substantial progress will be made in the underground piping and electrical construction work. The erection of the process structural steel is scheduled to start in November. SCS will continue to work on balance-of-plant design and specifications. The nitrogen system and coal and limestone mill vendors will be selected. The specifications for the coal/limestone conveying system, and the MWK and FW stacks will be issued. Progress will be made in the detailed design of the ash handling, cooling water and steam and condensate systems. The foundation drawings for major equipment will be completed. Other tasks that will be performed in the future include completing a list of bulk items for SCS to procure by compiling information provided by FW and MWK.

5. In the next quarter, IF&P will complete the detailed design of the internals of the filter vessel to be installed at Wilsonville. Since nozzle stress calculations on the IF&P vessel have been received, bid specifications on the major equipment will be issued and reviewed by SCS. This will initiate the fabrication cycle for the IF&P PCD. Westinghouse will finalize the detailed design of FL0352 on the FW combustor. Issues such as accurate vessel weight, pulse gas piping material or heat tracing requirements, and air pressure requirements will be finalized. Combustion Power Company will continue with the fabrication and purchase order issuance process. The refractory pouring process will be expedited such that the piping in the lower elevations can be scheduled to arrive at the site earlier than those at higher elevations. The delivery schedule of all the CPC equipment and its impact on planned construction sequence are being addressed.
6. In the coming quarter, SRI will complete the procurement of the sampling system components. In October, procurement packages will be submitted to SCS, and orders will be placed for the linear actuators, motion controllers, NEMA enclosures, switches, and indicator lights. Orders for all remaining sampling system components will be placed in November. SRI will release the construction issue of SRI's P&IDs and the first official issue of SRI's wiring diagrams. The construction issue of the wiring diagrams will be released when terminal number assignments are available. Programming of the sampling system controllers will begin in December, and assembly and functional testing of the sampling systems will be completed in January 1995. The sampling cyclones and prototype cyclone manifold will be received in December and tested in the SRI wind tunnel and in the SRI combustor in January.
9. Continue preparation of an integrated test plan for the Advanced Gasifier train components and system for shakedown, characterization and normal operations.
10. Nolan will continue with the development of Wilsonville Interactive Learning System modules along with instructional design activities. Scripts for all four PCD modules in the HGCU section will be revised once Nolan receives updated information from SCS. Production of training modules for the K-train will start early next year, once SCS has completed the operations manuals. Completion of the initial training modules for the K-train is projected to be June 1995 to allow time for operations personnel to absorb training materials prior to commissioning the Transport Reactor train.

APPENDIX A

CYCLONE SPOILING TESTS

JOB 6704

**EXPERIMENTAL VERIFICATION
OF THE EFFECTIVENESS OF CYCLONE SPOILING
FOR THE WILSONVILLE TRANSPORT REACTOR**

**THE M.W. KELLOGG COMPANY
HOUSTON, TEXAS**

DATE: SEPTEMBER 1994

SUMMARY

Cyclone spoiling tests were performed using the Fluid Catalytic Cracking (FCC) cold flow model at the Kellogg Technology Development Center (KTDC) in Houston. The secondary cyclone of the FCC cold flow model, which was used for the spoiling test, was provided with four spoiling gas nozzles, two of which were located at 1.6 times the cyclone diameter from the inlet to the vortex tube and the other two located at 2.5 times cyclone diameter from the vortex tube entrance. Out of the two nozzles at each level, one was oriented perpendicular to the cone surface and the other was oriented tangential to the surface and opposed to the direction of rotation of the gas vortex.

The test results show that the most effective location of spoiling nozzle, for this cyclone, is 2.5 times the cyclone diameter from the inlet to the vortex tube. The nozzle oriented tangential to the conical surface and opposing the rotation of the vortex yielded the highest reduction in cyclone efficiency. For the nozzles located at 2.5 times the cyclone diameter, irrespective of the nozzle orientation, the higher the spoiling gas flow, the higher the reduction in cyclone efficiency obtained. At spoiling gas flow below approximately 4% of cyclone inlet gas flow for the test cyclone, there was negligible reduction in cyclone efficiency.

Recommendations were made to the cyclone fabricator to provide two additional spoiling gas nozzles for operational flexibility, one in the radish and the other at approximately 1.3 times the cyclone diameter from the vortex pipe entrance, both tangential to the surface and opposed to the rotation of the gas vortex. Because of nozzle interference with structural support beam and the cyclone flange, the new spoiling gas nozzle was located at 1.3 times the cyclone diameter instead of the desired location of 1.6 times the cyclone diameter.

INTRODUCTION

The operation of the Transport Reactor train of the Wilsonville PSDF requires that solids (fines) loading in the gas entering the particulate control device be varied from a nominal 4,000ppmw to as high as 10,000ppmw in combustion mode and 16,000ppmw in gasification mode. To generate dust concentration above 4,000ppmw, spoiling gas would be injected into the 'radish' of the primary cyclone to entrain dust into the reversing gas vortex. The spoiling gas injection rate and other pertinent design/operating parameters for the primary cyclone are summarized in Table 1 for combustion and gasification modes of operation.

Table 1: Transport Reactor Secondary Cyclone Design/ Operating Parameters

Mode	Combustion Mode	Gasification
Diameter, inches	18	18
Inlet Velocity, ft/s	25.8	55.7
Inlet Gas Flowrate, acfs	15.9	15.4
Inlet dust flowrate, lb/hr	6032	5754
Flowing density at inlet, lb/ft ³	0.11	0.104
Maximum spoiling gas flowrate, acfs	0.921	0.670
Maximum spoiling gas as % inlet flow	5.8	4.35
Spoiling gas nozzle size, inches	1.5	1.5
Maximum spoiling gas nozzle velocity, ft/s	75	54.6
Maximum spoiling gas momentum flux at nozzle exit, lb/ft-s	1803	1006
Primary Cyclone Efficiency, %		
Corresponding to exit dust loading of:		
4000 ppmw (base case)	98.24	98.61
10,000 ppmw (combustion mode)	93.36	
16,000 ppmw (Gasification mode)		94.71

TEST OBJECTIVE

The objective of the test program is to demonstrate cyclone spoiling concept and provide some semi-quantitative measurement on the effect of spoiling gas flow, nozzle location and orientation on the cyclone efficiency and make recommendation to the cyclone vendor on the adequacy of the spoiling system proposed for the transport reactor.

TEST EQUIPMENT

The cyclone spoiling tests were carried out in the atmospheric pressure FCC test model

at KTDC. A diagrammatic representation of the test rig is shown in Fig. 1. It is comprised of a 6 inch ID riser, four 6" ID primary cyclones arranged in parallel to the gas flow out of the riser, a 10.25" ID Dustex secondary cyclone used for cyclone spoiling test, a 12" ID standpipe equipped with a slide valve for solids circulation control and a baghouse. Although the secondary cyclone on the FCC cold flow model is not geometrically similar to the Transport Reactor primary cyclone, it is adequate to demonstrate the concept of cyclone spoiling in a cost effective manner. Approximately 6 ft sections of the diplegs of both the primary and secondary cyclones were enlarged to approximately 8" ID to facilitate measurement of the solids collection rate by the cyclones. The enlarged portions were constructed with Plexiglas.

Butterfly valves installed on the cyclone diplegs below the expanded sections allowed the solids flow to the standpipe to be temporarily interrupted by closing the valves and the solids collection rate determined by timing the rise in solids level in the expanded section (over 1.5 ft for primary cyclones and over 3 ft for the secondary cyclone). A filter bag was installed on the dust outlet pipe of the baghouse to collect solids escaping the primary cyclone. The dust content entering the secondary cyclone was not measured rather, it was calculated from the solids collected by the cyclone and the baghouse. To increase the dust loading to the secondary cyclone, the butterfly valve on one of the primary cyclone diplegs was closed and the dipleg was allowed to fill up into the cyclone thereby, flooding it. In this manner, the entering dust stream by-passed this cyclone into the gas plenum from where it entered the secondary cyclone.

The circulating material used was FCC catalyst nominally, 60 microns average particle size. The quantity of material required for running the test model precluded the use of char and ash as they were not available and considerable cost and time would have been expended to locate and prepare them for the test. Air was used as the fluidizing gas.

Spoiling gas was introduced at two levels. Each level had two injection nozzles, one, normal to the conical surface of the cyclone and the other, tangential to the cyclone opposing the direction of rotation of the gas vortex. The secondary cyclone with the nozzle location and orientation is shown in Fig. 2. Figure 3 shows how the nozzles are connected to the air supply system. This arrangement permitted the injection of spoiling gas through either a single or multiple nozzles at any one time.

DETERMINATION OF NOZZLE LOCATION AND FLOWRATE

Brief Background

The gas entering the tangential inlet near the top of the cyclone creates a vortex or spiral flow downwards between the walls of the gas discharge outlet pipe and the cylindrical body of the cyclone. The vortex continues downward and at some region near the bottom of the conical portion of the cyclone, it reverses its direction of axial flow but maintains its direction of rotation, so that an inner vortex is formed travelling upward to the gas outlet as shown in Fig. 4. The dust separated from the vortex through centrifugal force moves down along the cyclone walls to the dust exit due to the downward movement of the gas at the cyclone walls aided somewhat by gravity if the cyclone is installed vertically.

Cyclone Vortex Length

Alexander [1] observed that the gas vortex will have a stable turning point at some distance below the bottom of the vortex tube. This distance, which is called the vortex natural length, he found to be independent of the cyclone inlet velocity. Alexander developed an empirical equation relating the vortex length and the cyclone dimensions for a rectangular inlet cyclone as:

$$L = 2.3 D_e [D^2/ab]^{1/3} \dots\dots\dots(1)$$

Where:

- L is the vortex length (see Fig. 4)
- D_e is the inside diameter of the vortex tube (gas outlet tube)
- D is the cyclone inside diameter
- a is the cyclone inlet width
- b is the cyclone inlet height

Bryant et al. [2] in a separate experiment confirmed equation (1). They found the vortex length to be located between 1.6D and 2.0D.

The vortex length calculated from equation (1) for the secondary cyclone of the FCC cold flow model is 1.8 times the cyclone diameter. The cyclone manufacturer [3] suggested that the vortex length would be located at about 2.5 times the cyclone diameter.

Based on the foregoing, the spoiling gas nozzles for the secondary cyclone used for this study were located at approximately 1.6 and 2.5 times the cyclone diameter (see Fig. 2). It should be noted however that, the inlet of this cyclone slopes downwards and it is not truly tangential as that of the primary cyclone of the Wilsonville transport reactor (see Fig. 5) and also the vortex tube of this Dustex cyclone starts at the bottom of the cylindrical section of the cyclone (see Fig. 2). These differences will no doubt affect the vortex strength and the flow patterns in this cyclone which could be different from those inside tangential entry cyclones such as the primary cyclone of the Wilsonville transport reactor.

Spoiling Gas Flowrate and Pipe Size

After review of the characteristics of the FCC cold flow model, it was decided to use the gasification flow conditions as the bases for the studies. For sizing the spoiling gas nozzle, similarity of the momentum flux was maintained between the maximum spoiling gas flow under gasification conditions (see Table 1) and the test conditions. The operating parameters for the FCC cold flow model secondary cyclone are outlined in Table 2. The operating parameters for the primary cyclone of the Wilsonville transport reactor operating in gasification mode are also given in Table 2 for comparison.

Table 2: Secondary Cyclone Operating Parameters

	FCC Cold Flow Secondary Cyclone	Transport Reactor Primary Cyclone: Gasification Mode (for comparison)
Cyclone diameter, ins	10.25	18
Cyclone Inlet Velocity*, ft/s	45.7	55.7
Nominal inlet dust flowrate, lb/min	60	95.9
Flowing density, lb/ft ³	0.095	0.104
Nominal Operating Temp, F	77	1768
Nominal Operating Pressure, psig	0	290
Spoiling gas nozzle ID, ins	0.824	1.5
Spoiling gas flow/nozzle, scfm	0 to 40.9	0 to 212.42
Spoiling gas/nozzle:		
Velocity, ft/s	0 to 184	0 to 54.6
Momentum flux, lb/ft-s	0 to 2504	0 to 1006
Maximum spoiling gas as % inlet flow	0 to 6.4	0 to 4.35

* - Includes miscellaneous fluidization flows.

TEST DESCRIPTION AND RESULTS

Test Description

The test plan developed for this program is outlined in Appendix A. Initially, it was planned that by timing the solids collection rate in the enlarged secondary cyclone dipleg, the time to fill approximately 3' height of the dipleg would depend on the effectiveness of cyclone spoiling. Thus, it might not be necessary to collect and weigh the baghouse solids. However, during the early phase of the test, the difference in the fill time measured was not significant, even at a much higher spoiling gas flow than planned, to indicate the cyclone was being spoiled.

After a preliminary review of the test results, the original test plan was modified to include operating at a higher spoiling gas flowrate of 40.9 scfm (originally, the maximum gas flow was 26.2 scfm) and to limit the test to the tangential nozzles only. The spoiling gas flowrate of 40.9 scfm was limited by the capacity of the rotameter available. A filter bag was subsequently installed on the dust outlet to collect the baghouse dust.

During a typical run, air flow through the riser was established at the desired rate followed by opening of the slide valve to begin solids circulation. For a cyclone spoiling test, the spoiling gas flow was established prior to opening the slide valve. During the run, several measurements of the secondary cyclone dipleg fill time were taken. The run was terminated when either the baghouse filter differential pressure was close to 20 ins of water (its maximum allowable pressure drop) or the run duration was at least 20 minutes,

whichever came first. At the end of the run, the slide valve was closed and the riser air flow was stopped. The baghouse was allowed to continue cleaning the bags for additional 10 minutes. After this, the baghouse was shutdown and the amount of solids collected was weighed. The above procedure was repeated for the next test condition.

Results

For analyzing the test data collected, it was assumed that the efficiency of the baghouse was 100%. This was justified by visual observation that showed negligible dust content in the exhaust gas. The run results are summarized in Table 4. Baghouse and standpipe solid samples were collected during the run however, no solids analyses such as particle size distribution were performed.

The total air flow at inlet to the secondary cyclone including miscellaneous fluidization flows was 630 scfm.

Discussions

1. The location of spoiling gas nozzle is important. For the cyclone tested, spoiling gas introduced tangentially at approximately 1.6 times the cyclone diameter did not appear to affect the cyclone efficiency.
2. Spoiling gas introduced at approximately 2.5 times the cyclone diameter significantly 'spoiled' the cyclone efficiency. The degree of spoiling (reduction in cyclone efficiency) effectiveness depended on the spoiling gas flowrate being, for the tangential nozzle, as high as 9.8 percentage points and as low as 1 percentage point at spoiling gas flow of 6.4% and 3.8% inlet cyclone flow respectively. Below 3.8% (tangential nozzle) and 4% (perpendicular nozzle) inlet cyclone gas flow, the spoiling gas did not affect the cyclone efficiency. For the same spoiling gas flowrate, the tangential nozzle appeared to be more effective than the perpendicular nozzle.

The range of reduction in cyclone efficiency achieved in the present test program compares favorably with the 'targeted' maximum reduction in cyclone efficiency desired (4.9 and 3.9 percentage points for combustion and gasification modes of operation respectively (see Table 1)) for the primary cyclone of the Wilsonville transport reactor.

3. The spoiling of cyclone efficiency appeared to be insensitive to variation in inlet dust loading within the range of inlet dust flows tested.

RECOMMENDATIONS

At a review meeting held to discuss the test results, the following recommendations were made:

To increase the operational flexibility of the spoiling gas injection system, the following nozzles would be provided in addition to that provided by the vendor:

1. A tangential spoiling gas nozzle located in the radish at the same level as the one provided by the vendor (see Fig. 6).
2. A tangential spoiling gas nozzle located approximately 1.6 times the cyclone diameter from the vortex pipe entrance in the conical section of the cyclone. Because of interference with structural support beam and cyclone flange, the nozzle is located at 1.31 times the cyclone diameter from the vortex pipe entrance. This nozzle (see Fig. 7) is opposed to the direction of rotation of the gas vortex.
3. Both of these nozzles would be provided with blinds.

The above recommendations were communicated to the cyclone vendor for implementation.

REFERENCES

1. Alexander, R. M., Aust. Min. & Metall. N.S. Nos 152-153, 1949, 203-228.
2. Bryant, H. S. et al, Hydrocarbon Processing, June 1983, 87-90.
3. Personal communications, Dustex Corp., 1994

Table 4: Test Results

Run #	Run Date	Spilling gas nozzle	Spilling gas Flowrate, scfm	As % of cyclone inlet flow	Secondary cyclone collect., lb/min	Baghouse collect. rate, lb/min	Cyclone eff., %	Duration of run, minutes
1	8/8/94	None	0	0	37.29	0.525	98.61	23.019
2		B1	40.9	6.4	27.37	3.04	90.0	18.5
3		B1	40.9	6.4	40.3	4.092	90.8	9.61
4	8/9/94	None	0	0	41.05	0.0844	99.8	15.07
5		B1	40.9	6.4	45.35	4.52	90.9	7.15
6		B1	24.11	3.8	43.97	0.581	98.7	20.53
7		B1	13.81	2.2	53.43	0.378	99.3	8.93
8		B1	13.81	2.2	38.57	0.0336	99.9	18.15
9	8/10/94	None	0	0	48.64	0.1722	99.7	22.02
10		A1	40.9	6.4	38	0.103	99.7	22.6
11		A1	40.9	6.4	38.32	0.0678	99.8	27.36
12		B2	40.9	6.4	30.66	1.0	96.8	10.55
13		B2	40.9	6.4	60.91	3.04	95.3	8.25
14		B2	25.26	4.0	33.73	0.074	99.8	23.24

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APPENDIX A: TEST PLAN

RUN CONDITIONS:

1. Transport gas flow: 603 scfm
2. Slide valve opening: To achieve 80% design
Solids circulation rate: 400 to 440 lb/min

Targeted dust flow to second stage cyclone: 60 lb/min

Nomenclature:

H1 & H2 : Front Primary cyclone diplegs
H3 & H4: Rear primary cyclone diplegs

TEST #1:

Objective: Verify circulation rate using solids flow rates collected by the primary cyclones and secondary cyclone.

Test:

- 1-1. Measure solids collection rates for cyclone diplegs H1 to H4 and secondary cyclone dipleg.
- 1-2. Adjust slide valve and aeration flows till the targeted circulation rate is achieved.

The slide valve opening, bed level in the hopper and aeration rates in the hopper that gives the desired solids flow will become the standard operating condition for the rest of the test.

TEST #2

Objective

To achieve dust loading to secondary cyclone between 50 to 70 lb/min.

2-1. Maintain operating conditions for Test #1 and close primary cyclone dipleg H4. Measure solids collected by the remaining diplegs (primary and secondary). From this we can calculate amount of solids going to secondary if hydrodynamic conditions are reproducible. We may have to charge solids to maintain the solids level in the main hopper constant.

2-2. If dust leaving primary cyclones is low, close off diplegs H3 and H4. Repeat 2-1.

2-3. If dust loading after 2-1 is higher than desired, then we will decide what to do.

Test #3

Objective: Investigate spoiling gas injection on cyclone efficiency.

Parameters:

Maximum spoiling gas flow: 26.2 scfm

Minimum spoiling gas flow: 15 scfm

Secondary cyclone inlet dust loading

Operate under most favorable conditions obtained during Test #2

Spoiling gas nozzles identification:

Upper nozzles: A1 and A2

Lower nozzles: B1 and B2

Nozzle Orientation:

A1 and B1 are tangential; A2 and B2 are perpendicular.

Experimental Settings

Run #	Nozzle in service	Spoiling gas flowrate (scfm)	
		High	Low
3-1	A1	26.2	15
3-2	A2	26.2	15
3-3	B1	26.2	15
3-4	B2	26.2	
3-5	A1 & A2	26.2	
3-6	B1 & B2	26.2	
3-7	A1 & B1	26.2	
3-8	A1 & B2	26.2	
3-9	A2 & B1	26.2	
3-10	A2 & B2	26.2	
3-11	A1, A2, B1, B2	26.2	

NOTES

1. By measuring the solids collection rate by the second stage cyclone, the effect of spoiling on its efficiency can be demonstrated. However, we may want to collect baghouse solids at some spoiling gas flow rates to investigate the effect of spoiling on the exit dust size distribution. The baghouse solids will also be used for mass balance check.

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FIG. 1 SCHEMATIC DIAGRAM OF THE FCC COLD FLOW TEST UNIT

FIG. 2 FCC COLD FLOW MODEL SECONDARY CYCLONE SHOWING SPOILING GAS NOZZLES

FIG. 4 VORTEX AND EDDY FLOWS IN A CYCLONE

FIG. 5 SCHEMATIC DIAGRAM OF THE TRANSPORT REACTOR PRIMARY CYCLONE

FIG. 6 ADDITIONAL SPOILING GAS NOZZLE LOCATED IN THE RADISH.

FIG. 7 ADDITIONAL SPOILING GAS NOZZLE LOCATED IN THE CONICAL SECTION OF THE CYCLONE.

POWER SYSTEMS DEVELOPMENT FACILITY
APFBC Design Review Meeting
Livingston, New Jersey
July 27, 1994

Design Review

1. Introduction	8:00 am
2. Status of FWUSA Subcontracts	8:10 am
3. Changes in APFBC Process Design Since 50% Design Review	8:30 am
4. Status of FW Detail Design Activities	9:00 am

BREAK	10:00 am
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5. System Response Studies Overview	10:15 am
6. IF&P Review	10:45 am
7. Schedule Issues	11:15 pm
a) Equipment Delivery	
b) Construction Schedule and Status	
c) FW APFBC Process Hazards Analysis	
d) PCD Interchange	

LUNCH	12:00 pm
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Detail Design Discussions (may require breakout meetings)

1:00 pm

1. PCD Design Issues
 - a) system pressure relief
 - b) structural
 - c) questions/concerns about FW system response studies
 - d) by-pass connection on the dirty side of the filter for use during startup
 - e) ash fluffing provisions and H&MB measurements of the nitrogen
 - f) differential pressure to DCS, with alarm at 5 psid
 - g) July 8 letter and drawing - interfaces
2. Instrumentation
 - a) documentation
 - b) gas sampling system (mass spec, HC analyzer and ammonia analyzer)
 - c) analyzers
 - d) cable tray interface
 - e) DCS I/O termination assignments
 - f) latest copy of Instrument Reference Schedule
 - g) logic drawings
 - h) thermowell design
3. Electrical
 - a) documentation
 - b) turbine generator specifications
4. Civil
 - a) alkali getter installation alternatives
 - b) FBHE installation alternatives
 - c) IF&P vessel supports
5. Requisitions

APPENDIX B

**MWK TRANSPORT TRAIN:
PROJECT SCHEDULE AND PROCUREMENT STATUS**

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MASTER SCHEDULE				EARLY START	EARLY FINISH	PCT	1994																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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B-2

MASTER SCHEDULE				EARLY START	EARLY FINISH	PCT	1994				
							AUG	SEP	OCT	NOV	DEC
EQUIPMENT ANALYTICAL											
EXCHANGER ANALYTICAL							20OCT92A	22OCT93A	100		
VESSEL ANALYTICAL							10FEB93A	22OCT93A	100		
MACHINERY											
MACHINERY							23NOV92A		100	MACHINERY	
FURNACE											
FURNACES							12OCT92A	29JUL94A	100		
SOLIDS HANDLING											
SOLIDS HANDLING							12OCT92A		100	SOLIDS HANDLING	
PIPING DESIGN											
PIPING PLOT PLANS							11DEC92A	4JUN93A	100		
PIPING PLANNING RELEASE - AREA B							24MAY93A	4FEB94A	100		
PIPING PLANNING RELEASE - AREA C							24MAY93A	4FEB94A	100		
PIPING PLANNING RELEASE - AREA D							24MAY93A	1APR94A	100		
PIPING PLANNING RELEASE - AREA E							10SEP93A	21JAN94A	100		
PIPING PLANNING RELEASE - AREA A							20SEP93A	3FEB94A	100		
PIPING PDS MODEL, ISOs & KEY PLANS - AREA B							15DEC93A	13OCT94	97	RUN/REVIEW IDP LB/SB PIPING - "B" EXTRACT LB/SB ISOs & CHECK - ISSUE FOR CONSTRUCTION LB/SB ISOs - "B" IFC KEY PLANS AREA "B"	
PIPING PDS MODEL, ISOs & KEY PLANS - AREA C							5NOV93A	20OCT94	96	RUN/REVIEW IDP LB/SB PIPING - "C" INCORP. LB/SB ISO COMMENTS & RUN IDP - IFC LB/SB ISOs - AREA "C" IFC KEY PLANS AREA "C"	
PIPING PDS MODEL, ISOs & KEY PLANS - AREA D							17JAN94A	14OCT94	95	RUN/REVIEW IDP LB/SB PIPING - "D" EXTRACT LB/SB ISOs & CHECK - "D" ANNOT. PLANS - INT. REV. "D" INCORP. LB ISO COMMENTS & RUN IDP - "D" EXTRACT LB/SB ISOs - SIGN-OFF - "D" IFC LB/SB ISOs - AREA "D" IFC KEY PLANS AREA "D"	
PIPING PDS MODEL, ISOs & KEY PLANS - AREA E							3JAN94A	30SEP94A	100	IFC KEY PLANS AREA "E"	
PIPING PDS MODEL, ISOs & KEY PLANS - AREA A							29NOV93A	30SEP94A	100	EXTRACT LB/SB PLANS/ISOs - QV/QC LB/SB ISOs - "A" IFC LB/SB ISOs - "A" IFC KEY PLANS AREA "A"	
Plot Date		10OCT94		5C61		Sheet 2 of 4		REV. 1			
Data Date		30SEP94									
Project Start		1SEP92									
Project Finish		2JAN95									

M. W. KELLOGG COMPANY, PROJECT 6704
POWER SYSTEMS DEVELOPMENT FACILITY
MASTER SCHEDULE - SUMMARY

Date	Revision	Checked	Approved

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MASTER SCHEDULE				EARLY START	EARLY FINISH	PCT	1994					
							AUG	SEP	OCT	NOV	DEC	
PIPING MECHANICAL												
PIPING MECHANICAL							7JAN93A	14OCT94	98	GENERAL ADMINISTRATION		
EQUIPMENT MECHANICAL												
EQUIPMENT MECHANICAL							16NOV92A		100	EQUIPMENT MECHANICAL		
ELECTRICAL												
ELECTRICAL							2NOV92A	18NOV94	93	ELECTRICAL		
PROCUREMENT - EQUIPMENT												
BR0201 - START UP BURNER							28DEC92A	26AUG94A	100	BR0201, RELEASE TO FABRICATE		
BR0802 - SULFATOR START UP HEATER							17MAY93A	3JUN94A	100			
BR0401 - THERMAL OXIDIZER							8JAN93A	27SEP94A	100	BR0401, RELEASE TO FABRICATE		
BR0402 - FLARE							30JUL92A	18MAY94A	100			
HX0202 - PRIMARY GAS COOLER							19APR93A	31MAY94A	100			
HX0203 - COMBUSTOR HEAT EXCHANGER							14JUL93A	17OCT94	95	HX0203, RELEASE TO FABRICATE		
HX0204 - TRANSPORT AIR COOLER							11JUN93A	31MAY94A	100			
HX0402 - SECONDARY GAS COOLER							27APR93A	30NOV94	84	HX0402, RELEASE TO FABRICATE		
HX0405 - COMPRESSOR FEED COOLER							11JUN93A	31MAY94A	100			
HX0801 - SULFATOR HEAT RECOVERY EXCH.							27APR93A	30NOV94	84	HX0801, RELEASE TO FABRICATE		
SU0801 - SULFATOR							11JUN93A	10OCT94	99	SU0801, SUBMIT BID TAB		
										SU0801, RELEASE TO FABRICATE		
RX0201 - TRANSPORT REACTOR							3SEP93A	17OCT94	95	RX0201, RELEASE TO FABRICATE		
DR0402 - STEAM DRUM							17MAY93A	22JUN94A	100			
DR0404 - FLARE SEAL DRUM							24SEP93A	3JUN94A	100			
DR0501 - HTF SYSTEM SURGE DRUM							24SEP93A	3JUN94A	100			
CY0201 - REACTOR PRIMARY CYCLONE							8MAR93A	24OCT94	93	CY0201, RELEASE TO FABRICATE		
CY0202 - REACTOR SECONDARY CYCLONE - DELETED							8MAR93A	12APR93A	100			
CY0207 - DISENGAGER							8MAR93A	24OCT94	93	CY0207, RELEASE TO FABRICATE		
CO0201 - MAIN AIR COMPRESSOR							3JAN93A	27SEP94A	100	CO0201, RELEASE TO FABRICATE		

Plot Date
Data Date
Project Start
Project Finish

10OCT94
30SEP94
1SEP92
2JAN95

Activity Bar/Early Dates
Critical Designator
Progress Bar
Milestone/Flag Activity

8CS1

M. W. KELLOGG COMPANY, PROJECT 6704
POWER SYSTEMS DEVELOPMENT FACILITY
MASTER SCHEDULE - SUMMARY

Sheet 3 of 4

REV. 1

Date	Revision	Checked	Approved

(c) Primavera Systems, Inc.

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MASTER SCHEDULE		EARLY START	EARLY FINISH	PCT	1994				
					AUG	SEP	OCT	NOV	DEC
PROCUREMENT - EQUIPMENT									
ME0540 - HEAT TRANFER FLUID (HTF) SYSTEM					ME0540, RELEASE TO FABRICATE				
FL0401 - RECYCLE GAS BOOSTER COMPR. FILTER									
DY0210 - CONVEYOR AIR DRYER					DY0210, RELEASE TO FABRICATE				
SI0602 - SPENT SOLIDS SILO					SI0602, RELEASE TO FABRICATE				
CY0601 - SULFATOR CYCLONE					CY0601, RELEASE TO FABRICATE				
FD0206 - SPENT SOLIDS SCREW COOLER					FD0206, RELEASE TO FABRICATE				
FD0502 - FINES SCREW COOLER					FD0502, RELEASE TO FABRICATE				
FD0602 - SULFATOR SOLIDS SCREW COOLER					FD0602, RELEASE TO FABRICATE				
FD0210 - COAL FEEDER SYSTEM					FD0210, RELEASE TO FABRICATE (U.K.) FD0210, RELEASE TO FABRICATE (OHIO)				
FD0220 - LIMESTONE FEEDER SYSTEM					FD0220, RELEASE TO FABRICATE (U.K.) FD0220, RELEASE TO FABRICATE (OHIO)				
FD0510 - SPENT SOLIDS TRANSPORTER SYS.					FD0510, RELEASE TO FABRICATE (U.K.) FD0510, RELEASE TO FABRICATE (OHIO)				
FD0520 - FINES TRANSPORTER SYSTEM					FD0520, RELEASE TO FABRICATE (U.K.) FD0520, RELEASE TO FABRICATE (OHIO)				
FD0530 - SPENT SOLIDS FEEDER SYSTEM					FD0530, RELEASE TO FABRICATE (U.K.) FD0530, RELEASE TO FABRICATE (OHIO)				
FD0610 - SULFATOR LIMESTONE FEEDER					FD0610, RELEASE TO FABRICATE (U.K.) FD0610, RELEASE TO FABRICATE (OHIO)				
JACKETED TRANSITION PIECES									
PDV-384					PDV384, RELEASE TO FABRICATE				
REFRACTORY LINED PIPING					FABRICATION - REFRACTORY LINED PIPING ISSUE P.O. - REFRACTORY LINED PIPING				

Plot Date
Data Date
Project Start
Project Finish

10OCT94
30SEP94
1SEP92
2JAN95

Activity Bar/Early Dates
Critical Designator
Progress Bar
Milestone/Flag Activity

SC61

M. W. KELLOGG COMPANY, PROJECT 6704
POWER SYSTEMS DEVELOPMENT FACILITY
MASTER SCHEDULE - SUMMARY

Sheet 4 of 4

REV. 1

Date	Revision	Checked	Approved

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PROCUREMENT STATUS REPORT
AS OF 30-SEP-94

10-Oct-94

PURCHASE ORDER NUMBER TAG NUMBER, DESCRIPTION	REQUISITIONS COMPLETED		INQUIRIES ISSUED		QUOTES RECEIVED		TECH. EVAL. COMPLETED		COMMITMENTS(ENG ONLY)		P.O. ISSUED	
	PERIOD	TO DATE	PERIOD	TO DATE	PERIOD	TO DATE	PERIOD	TO DATE	PERIOD	TO DATE	PERIOD	TO DATE
6704-3311001-B810-01 BR0201, STARTUP BURNER		1		1		1		1		1		1
6704-3311001-B800-01 BR0401, THERMAL OXIDIZER/WASTE HEAT BOILER		1		1		1		1		1		1
6704-3311001-B710-01 BR0402, FLARE TIP		1		1		1		1		1		1
6704-3311001-B800-02 BR0602, SULFATOR STARTUP HEATER		1		1		1		1		1		1
6704-3311001-C900-01 HX0202, PRIMARY GAS COOLER		1		1		1		1		1		1
6704-3311001-C900-02 HX0402, SECONDARY GAS COOLER (REQUOTE) HX0601, SULFATOR HEAT RECOVERY EXCHANGER		1		1		1		1		1		1
6704-3311001-C900-03 HX0203, COMBUSTOR HEAT EXCHANGER		1		1		1		1		1		1
6704-3311001-C300-01 HX0204, TRANSPORT AIR COOLER HX0405, COMPRESSOR FEED COOLER (REQUOTE)		1		1		1		1		1		1
6704-3311001-D550-01 CY0201, REACTOR PRIMARY CYCLONE CY0207, DISENGAGER		1		1		1		1		1		1
6704-3311001-D411-01 DR0402, STEAM DRUM		1		1		1		1		1		1
6704-3311001-D411-02 DR0404, FLARE SEAL DRUM		1		1		1		1		1		1
6704-3311001-D413-01 DR0501, HTF SYSTEM SURGE DRUM		1		1		1		1		1		1
6704-3311001-D310-01 RX0201, TRANSPORT REACTOR		1		1		1		1		1		1
6704-3311001-D310-02 SUD601, SULFATOR		1		1		1		1		1		1
6704-3311001-J210-01 CO0201, MAIN AIR COMPRESSOR		1		1		1		1		1		1
6704-3311001-J220-01 CO0401, RECYCLE GAS BOOSTER COMPRESSOR		1		1		1		1		1		1
6704-3311001-J640-01 CO0601, SULFATOR AIR COMPRESSOR		1		1		1		1		1		1
6704-3311001-J630-01 BL0401, THERMAL OXIDIZER BLOWER		1		1		1		1		1		1
6704-3311001-L590-01 ME0540, HEAT TRANSFER FLUID(HTF) SYSTEM		1		1		1		1		1		1
6704-3311001-L420-01 FL0401, RECYCLE GAS INLET FILTER		1		1		1		1		1		1
6704-3311001-V611-01 CY0601, SULFATOR CYCLONE		1		1		1		1		1		1
6704-3311001-V612-01 SID602, SPENT SOLIDS SILO		1		1		1		1		1		1
6704-3311001-V652-01 FD0206, SPENT SOLIDS SCREW COOLER FD0502, FINES SCREW COOLER FD0602, SULFATOR SOLIDS SCREW COOLER		1		1		1		1		1		1
6704-3311001-V221-01 FD0210, COAL FEEDER SYSTEM FD0220, LIMESTONE FEEDER SYSTEM FD0510, SPENT SOLIDS TRANSPORTER SYSTEM FD0520, FINES TRANSPORTER SYSTEM FD0530, SPENT SOLIDS FEEDER SYSTEM FD0610, SULFATOR LIMESTONE FEEDER SYSTEM		1		1		1		1		1		1
6704-3311001-M878-01 REFRACTORY LINED PIPE & TRANSITION PIECES		1		1		1		1		1		1
6704-3311002-M878-01 PDV-384		1		1		1		1		1		1
6704-3311001-L410-01 AIR DRYER		1		1		1		1		1		1
6704-3311002-O234-01 & O230-01 ANALYZER HOUSE		1		1		1		1		1		1
6704-3311002-O247-01 RELAY SYSTEM		1		1		1		1		1		1
TOTAL EQUIPMENT ITEMS, 39 each	0	39	0	39	0	39	0	38	0	37	0	37

APPENDIX C

FW APFBC SYSTEM: DESIGN REVIEW MEETING MINUTES

PROJECT NOTE NO. 45-A

DATE August 15, 1994	WRITTEN BY N. Chakraborty	SHEET 1 OF 7	
MEETING WITH D.O.E. and Southern Company Services		FW CONTRACT - 13004161	
		FW PROPOSAL -	
LOCATION OF MEETING Livingston, NJ	DATE July 27, 1994		
PURPOSE OF MEETING			
75% Design Review			
ATTENDED BY			
<u>U.S. D.O.E.</u> D. Bonk R. Dennis D. Schmidt <u>EPRI</u> T. Boyd	<u>Foster Wheeler</u> N. Chakraborty J. Cofone (p/t) J. Crumm J. Hemmings (p/t) J. McClung M. Quandt D. Richard W. Wolowodiuk	<u>SCS</u> D. Elmore G. Griswold J. Horton K. Knight D. Moore T. Pinkston K. Walker <u>IF&P</u> C. Novotny	
ITEM	DESCRIPTION OF DISCUSSION	ACTION BY	COMP'L DATE
	The following items were discussed with SCS and DOE: 1. FW USA Subcontract 2. Process Changes from 50% to 75% Design 3. Status of Detail Design 4. System Response Studies 5. IF&P Carbonizer PCD		

**PROJECT NOTE NO. 45-A
CONTINUED**

DATE August 15, 1994		WRITTEN BY N. Chakraborty		SHEET 2 of 7	
ITEM	DESCRIPTION OF DISCUSSION	ACTION BY	COMP'L DATE		
	6. Equipment Delivery Schedule 7. SCS Plant Design and Construction Status 8. PDC Interchangeability 9. Carbonizer PCD and Plant Design 10. Other Items				
1.	<u>FW USA SUBCONTRACT</u>				
1.1	Allison for Gas Turbine Contractual terms and conditions appear to be a major problem with Allison. FW and Allison's lawyers are writing to each other. Further telephone discussions are expected this week. Allison is not interested in engineering, only release. Copies of latest Allison questions and FW clarification have been issued to SCS and DOE. SCS may try to arrange a joint discussion between Allison, FW, SCS and DOE.	SCS			
1.2	Westinghouse for Topping Combustor Contract negotiation is near the final stage. Westinghouse has been released to procure long lead items.				
1.3	FWEC and FWDC Subcontracts FWEC and FWDC have signed their subcontract agreements with FWUSA.				
2.	<u>PROCESS CHANGES FROM 50% TO 75% DESIGN</u> The following process changes have been implemented: Char Transfer System Redesign Bypass Quench System				

PROJECT NOTE NO. 45-A
CONTINUED

DATE August 15, 1994		WRITTEN BY N. Chakraborty		SHEET 3 of 7	
ITEM	DESCRIPTION OF DISCUSSION	ACTION BY	COMP'L DATE		
	Char Cooler Redesign Deletion of Baghouse Alkali Getter Design Increased Vessel Sizes Air Pulse for Combustor PCD Details of the changes are shown on copies of the viewgraphs in Attachment 2.				
3.	<u>STATUS OF DETAIL DESIGN</u> Status at Foster Wheeler USA detail design is as per copies of the viewgraphs in Attachment 3.				
4.	<u>SYSTEM RESPONSE STUDIES</u>				
4.1	FW has issued the following documents for SCS review: 4161-A-M50-D420, Rev. B2 Overall Plant Control Philosophy 4161-A-M50-D446, Rev. A1 Transient Effects Caused by Regeneration of PCD's 4161-A-M50-D447, Rev. A Vitiated Air Venting, Syngas Flaring and Quench Design Basis SCS will assure that DOE and EPRI have copies of these documents for their review. Documents will be updated by FW. These will be included in SCS Design Manual.	SCS JH/ SCS			

**PROJECT NOTE NO. 45-A
CONTINUED**

DATE August 15, 1994		WRITTEN BY N. Chakraborty		SHEET 4 of 7	
ITEM	DESCRIPTION OF DISCUSSION	ACTION BY	COMP'L DATE		
4.2	DOE informed that Gilbert Commonwealth is scheduled to give a presentation at Morgantown, Tuesday, 8/2/94, starting at 9:30 a.m. APFBC system commercial plant dynamic model will be reviewed. It may be desirable that engineers from FW attend the meeting. DOE will inform FW.	DOE			
5.	<u>IF&P CARBONIZER PCD</u> IF&P reported the following changes to the carbonizer PCD from 50% design stage: - Manway deleted from lower section - Bottom cone section is connected to the shell by a flange - Top head is removable - Added nozzles for dust fluffing blasters. (Blasters are not being supplied by IF&P) - Pressure relief has been deleted. One 20" flanged refractory lined nozzle is included. (SCS instructed IF&P to include refractory plug for all blind flanges). - Pulse ring has been relocated and lowered down. - Weight of the complete assembly is about 20,000 lb., bundle of candles weigh about 8,000 lbs, and each pulse valve weights about 700 lbs.	IF&P			
6.	<u>EQUIPMENT DELIVERY SCHEDULE</u> FW reported the equipment delivery status as indicated in Attachment 1.				

**PROJECT NOTE NO. 45-A
CONTINUED**

DATE August 15, 1994		WRITTEN BY N. Chakraborty		SHEET 5 of 7	
ITEM	DESCRIPTION OF DISCUSSION	ACTION BY	COMP'L DATE		
7.	<u>SCS PLANT DESIGN AND CONSTRUCTION STATUS</u>				
7.1	<p>SCS reported the following status:</p> <p>Allison and Westinghouse not being on board is a major problem.</p> <p>Nitrogen plant engineering is based on a 100 ton cryogenic plant and liquid nitrogen truck delivery.</p> <p>(Deleted)</p> <p>Construction labor broker is "TRECO", a Rust Engineering associate.</p> <p>Warehouse and laboratory is about 95% complete.</p> <p>Augered piles (about 5'Ø x 30/40 feet deep) have been driven for the process structure.</p> <p>Steel erection at coal handling building is scheduled to start on 8/22/94.</p> <p>Process structure steel erection is scheduled to start during October 1994.</p> <p>Administration building is being issued for inquiry.</p> <p>Temporary power is being designed.</p> <p>Ash disposal design is in progress</p> <p>Stack design is being finalized.</p>
7.2	(Deleted)				
7.3	Modularization of construction will be implemented. Higher section steel with equipment erected at grade will be lifted as one assembly.	SCS			

PROJECT NOTE NO. 45-A
CONTINUED

DATE August 15, 1994		WRITTEN BY N. Chakraborty		SHEET 6 of 7	
ITEM	DESCRIPTION OF DISCUSSION	ACTION BY	COMP'L DATE		
8.	<u>PCD INTERCHANGEABILITY</u> This work may be part of "Operation" budget. Minimal engineering by SCS/FW is required now. SCS will decide and inform FW.	SCS			
9.	<u>CARBONIZER PCD & PLANT DESIGN</u>				
9.1	PSV Upstream of PCD FW P&ID does not include any PSV upstream of PSV in the dirty gas side. This will be further reviewed at the Design Hazard review scheduled in August 1994. A nozzle has been included on the PCD for any future PSV, if required.	SCS			
9.2	Operating Weight IF&P to check and confirm the operating weight (for steel and support load) to include ash above the conical hopper area.	IF&P			
9.3	Nuclear Level Detector at Hopper IF&P was requested to issue the requisition for the nuclear level detector at the ash hopper. This will be attached to the hopper and not in FW piping. Signals shall be included in IFP/FW and interfaces.	IF&P NF			
9.4	Vessel Supports IF&P was requested to provide details of vessel supports including bolt spec., slide plates, etc.	IF&P			

**PROJECT NOTE NO. 45-A
CONTINUED**

DATE August 15, 1994		WRITTEN BY N. Chakraborty		SHEET 7 of 7	
ITEM	DESCRIPTION OF DISCUSSION	ACTION BY	COMPL DATE		
10.	<u>OTHER ITEMS</u>				
10.1	Gas Chromatograph SCS has reviewed FW letter on mass spec. as an alternate to gas analyzer. FW was requested to fully define vendor's scope of supply. DOE informed that their past experience with mass spec. and were not satisfactory.	JJC			
10.2	(Deleted)				
10.3	Inclined Thermocouples SCS requested FW to review whether the combustor thermocouples can be inserted horizontally instead of on an incline. 				

WILSONVILLE PSD FACILITY EQUIPMENT DELIVERY

EQUIPMENT DESCRIPTIONESTIMATED DELIVERY DATE

FILTERS & DIVERTER VALVES

9/94

FLARE, DRUMS, CARBONIZER CYCLONE

10/94

PREHEATERS

11/94

FEEDERS, AIR COMPRESSORS & HEAT EXCHANGERS

12/94 – 1/95

CARBONIZER

2/95

FBHE & COMBUSTOR PACKAGE (FWEC)

2/95 – 4/95

• CHAR COOLER

3/95

• AIR BY PASS QUENCH PACKAGE

4/95

• REFRACTORY LINED PIPE

4/95

• CHAR FUEL & VITIATED AIR VALVES

4/95

• *ALKALI GETTERS*

4/95

• TOPPING COMBUSTOR (WESTINGHOUSE)

5/95

• MAIN AIR COMPRESSOR PACKAGE (ALLISON)

7/95

• = NOT CONFIRMED – SUBCONTRACT OR P.O. NOT PLACED

Power Systems Development Facility – APFBC System
DOE / Southern Company Services – Wilsonville, Alabama

75% Design Review – July 27, 1994
Foster Wheeler, 8 Peach Tree Hill Road, Livingston, New Jersey
CIT Building Conference Room No. 1108

CHANGES FROM 50% DESIGN PACKAGE

Char Transfer System Redesign

Bypass Quench System

Char Cooler Redesign

Deletion of Baghouse

Alkali Getter Design

Increase Vessel Sizes

Air Pulse for Combustor PCD

Power Systems Development Facility – APFBC System
D O E / Southern Company Services – Wilsonville, Alabama

75% Design Review – July 27, 1994
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CHANGES FROM 50% DESIGN PACKAGE

→ Char Transfer System Redesign

Bypass Quench System

Char Cooler Redesign

Deletion of Baghouse

Alkali Getter Design

Increase Vessel Sizes

Air Pulse for Combustor PCD

WILSONVILLE APFBC

CHAR TRANSFER SYSTEM

- CONCEPT AT 50% DESIGN
 - SEAL CHAR TRANSFER LEGS FROM EACH SOURCE SEPARATELY
 - CHAR GOES VIA DRUM DR0258 TO COMBUSTOR
- WHY CHANGED
 - ELIMINATE EXPANSION JOINTS
 - REDUCE COMPLEXITY
 - DR0258 WOULD NOT FUNCTION AS A DRUM IN NORMAL OPERATION
- CURRENT CONCEPT
 - A COMMON SEAL/TRANSFER LEG USED FOR CHAR FROM EACH SOURCE
 - VL0262 FUNCTIONS AS EMERGENCY SHUTOFF VALVE

C-11

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WILSONVILLE APFBC

CHAR TRANSFER SYSTEM

- CONCEPT AT 50% DESIGN

WILSONVILLE APFBC

CHAR TRANSFER SYSTEM

WILSONVILLE APFBC

CHAR TRANSFER SYSTEM

WILSONVILLE APFBC

CHAR TRANSFER SYSTEM

PITTSBURGH NO 8 + DOLOMITE
CARBONIZER DRAIN PITTSBURGH NO 8 + DOLOMITE
PRIMARY CYCLONE CATCH PITTSBURGH NO 8 + DOLOMITE
SECONDARY CYCLONE CATCH PITTSBURGH NO 8 + DOLOMITE
PCD CATCH

Power Systems Development Facility – APFBC System
D O E / Southern Company Services – Wilsonville, Alabama

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CHANGES FROM 50% DESIGN PACKAGE

Char Transfer System Redesign

→ Bypass Quench System

Char Cooler Redesign

Deletion of Baghouse

Alkali Getter Design

Increase Vessel Sizes

Air Pulse for Combustor PCD

WILSONVILLE APFBC

BYPASS QUENCH

- ORIGINAL CONCEPT
 - BYPASS VITIATED AIR TO EXHAUST STACK VIA LINED PIPE.
 - BYPASS SYNGAS TO FLARE VIA LINED PIPE.
 - BURSTING DISCS IN PARALLEL TO BYPASS VALVES.
- WHY CHANGED
 - MATERIALS OF CONTRUCTION PROBLEMS.
 - TO HAVE REASONABLE TEMPERATURE DURING RELEASES.
- CURRENT CONCEPT
 - DURING BYPASS/RELIEF OPERATION GASES ARE QUENCHED WITH WATER UPSTREAM OF VALVES TO BELOW 600 DEG F.
 - PSV REPLACES BURSTING DISC

DESIGN INSTRUCTION

FOSTER WHEELER USA CORPORATION

PAGE 3 OF 6

CONTRACT	CLIENT	CLASSIFICATION	NUMBER	REV NO.	DATE
15-4161	SCS	BYPASS QUENCH DETAILS	50 - 016	B	05/06/94

VITIATED AIR BYPASS QUENCH ARRANGEMENT

NOTE: FOR DISTRIBUTION & ORIGINATING ENGINEER SEE PAGE 1

Power Systems Development Facility – APFBC System
D O E / Southern Company Services – Wilsonville, Alabama

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CHANGES FROM 50% DESIGN PACKAGE

Char Transfer System Redesign

Bypass Quench System

→ Char Cooler Redesign

Deletion of Baghouse

Alkali Getter Design

Increase Vessel Sizes

Air Pulse for Combustor PCD

WILSONVILLE APFBC

CHAR COOLER HX0255

- ORIGINAL CONCEPT
 - STEAM JACKETED PIPE IN PRESSURE CONTAINMENT SHELL
 - REJECTED STEAM AT 50 PSIG, UP TO 600 DEG F
- WHY CHANGED
 - MECHANICAL PROBLEMS.
- CURRENT CONCEPT
 - FINNED TUBE AS PRIMARY COOLING ELEMENT.
 - FORCED DRAFT OPERATION
 - KNIFE GATE AND BALL VALVE BELOW COOLER SERVE TO LOCK HOPPER CHAR THROUGH.

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HX0255 LONGITUDINALLY FINNED AIR COOLED CONCEPT

FOSTER WHEELER USA CORPORATION

PROCESS SPECIFICATION

SHEET 9 OF 9

 PERRYVILLE CORPORATE PARK
 CLINTON, NJ 08809

REV A1: 06/20/94

SKETCH 3: HX0255 FLOWSHEET

INTERLOCK LOGIC:

Power Systems Development Facility – APFBC System
D O E / Southern Company Services – Wilsonville, Alabama

75% Design Review – July 27, 1994
Foster Wheeler, 8 Peach Tree Hill Road, Livingston, New Jersey
CIT Building Conference Room No. 1108

CHANGES FROM 50% DESIGN PACKAGE

Char Transfer System Redesign

Bypass Quench System

Char Cooler Redesign

→ Deletion of Baghouse

Alkali Getter Design

Increase Vessel Sizes

Air Pulse for Combustor PCD

WILSONVILLE APFBC

FUGITIVE DUST BAG HOUSE

- SITUATION AT 50% DESIGN
 - VENT LINES (COAL, SORBENT, CHAR AND ASH)
DIRECTED TO A COMMON FUGITIVE DUST BAGHOUSE
- REASONS FOR CHANGE
 - TO SIMPLIFY OPERATION
 - TO AVOID MIXING HOT AIR WITH COAL DUST
- CURRENT SITUATION
 - COAL DRUMS VENT TO COAL SURGE HOPPER
 - SORBENT DRUMS VENT TO SORBENT SURGE HOPPER
 - ASH DRUMS VENT TO ASH HOPPER VIA CONVEYING LINE
 - CHAR DRUM VENTS TO ASH HOPPER

Power Systems Development Facility — APFBC System
D O E / Southern Company Services — Wilsonville, Alabama

75% Design Review — July 27, 1994
Foster Wheeler, 8 Peach Tree Hill Road, Livingston, New Jersey
CIT Building Conference Room No. 1108

CHANGES FROM 50% DESIGN PACKAGE

Char Transfer System Redesign

Bypass Quench System

Char Cooler Redesign

Deletion of Baghouse

➔ Alkali Getter Design

Increase Vessel Sizes

Air Pulse for Combustor PCD

WILSONVILLE APFBC

ALKALI GETTER

- CONCEPT AT 50% DESIGN
 - ALKALI GETTERS A PACKAGE FROM WESTINGHOUSE
- WHY CHANGED
 - WESTINGHOUSE ALKALI GETTERS NOT COMMERCIAL
 - WESTINGHOUSE PRICE HIGH FOR SCOPE OFFERED
- CURRENT CONCEPT
 - FOSTER WHEELER DESIGN FOR ALKALI GETTERS
 - CONSERVATIVE DESIGN HAS BEEN DEVELOPED

WILSONVILLE APFBC

ALKALI GETTER

		CARBONIZER	COMBUSTOR
INLET ALKALI	(PPM)	100 (EQM)	5 (Lee et al.)
ADSORBENT		Al ₂ O ₃ 1/8" PELLET	Al ₂ O ₃ 1/8" PELLET
BED DIAMETER		5'0"	7'6"
HEIGHT FOR 1500 HRS		8'5"	8'11"
AVAILABLE HEIGHT		15'0"	15'0"
PRESSURE DROP	(PSI/FT)	0.2	1.0

WILSONVILLE APFBC

ALKALI GETTER

PROPOSED
DESIGN VALUE
FOR W'VILLE
Sppm
CHECK
10ppm
(AT 1600°F
I.E. 871°C)

Alkali Vapor Concentration in
FBC Flue Gas as a Function of
Temperature

(FROM Lee et.al. DOE/METC 85/6025.)

WILSONVILLE APFBC

ALKALI GETTER

IONIZER ALKALI GETTER MASS TRANSFER

5 ft Dia, 1/8" pellets, 100 ppm in NaCl

CARBONIZER ALKALI GETTER MASS TRANSFER

5 ft Dia, 1/8" pellet, 100 ppm in NaCl

WILSONVILLE APFBC

ALKALI GETTER

CARBONIZER ALKALI GETTER

ITEM NO. AG0253

DESIGN PRESS. 300 PSIG
 DESIGN TEMP. 0°F TO 450°F METAL (1800°F INT.)
 VESSEL MAT'L: CARBON STEEL
 CODE: ASME SECT VIII, DIV. 1, STAMPED

WILSONVILLE APFBC

ALKALI GETTER

COMBUSTOR ALKALI GETTER
ITEM NO. A90254

Power Systems Development Facility – APFBC System
D O E / Southern Company Services – Wilsonville, Alabama

75% Design Review – July 27, 1994
Foster Wheeler, 8 Peach Tree Hill Road, Livingston, New Jersey
CIT Building Conference Room No. 1108

CHANGES FROM 50% DESIGN PACKAGE

Char Transfer System Redesign

Bypass Quench System

Char Cooler Redesign

Deletion of Baghouse

Alkali Getter Design

➔ Increase Vessel Sizes

Air Pulse for Combustor PCD

WILSONVILLE APFBC

COAL FEED DRUMS DR0252 AND DR0256

- REASON FOR CHANGE
 - INCREASE RESERVE COAL CAPACITY
- DIMENSIONS
 - DIAMETER CHANGED FROM 5 FT TO 6 FT
 - STRAKE LENGTH REMAINED 15 FT 6 IN
- EFFECT
 - TIME FROM NORMAL FULL TO LOW-LEVEL 50 MINS
 - TIME FROM LOW TO LOW-LOW LEVEL 90 MINS
 - TIME FROM LOW-LOW TO EMPTY 90 MINS

RELEASES				ISSUED FOR	
SWD REV.	DATE	DATE OF ORDER	PURCHASE SHELL AND HEAD MAT. SERIAL, PREPARE BUT DO NOT SUBMIT SHOP DETAIL DRAWINGS.		
			HOUSE CHECKED PORTER WHEELER DRAWINGS. PURCHASE ALL OTHER MATERIALS. FINALIZE AND SUBMIT CHECKED SHOP DETAIL DRAWING WITHIN ONE WEEK OF RELEASE DATE. PROCEED WITH COMPLETE FABRICATION.		
			FIELD CONSTRUCTION		

NOZZLE CHART					
COMMA NO.	SIZE	ANGI RATING	SERVICE	NO REQD	
1	8"	CL300RP	COAL INLET	1	
2	8"		COAL OUTLET	1	
3	2"		VENT	1	
4	2"		LT	1	
5					
6	6"		SIGHT PORT/HANDHOLD	1	
7	1 1/2"	CL300 FHA	FLUIDIZING AIR INLET	4	
8	1"	CL300RP	SAMPLING M BLD	1	
9	1"	FHA	PI	1	
10	1"		TI	1	
11	2"	CL300RP	SPARE M BLIND	1	
12	1"	FHA	TT	1	
13	20"	CL300RP	MAINWAY M HINGE	1	
14	4"	CL300RP	SPARE M BLIND	1	

CI	GM	REVISED AS INDICATED
B	3 1/2"	GM REVISED AS INDICATED
A	1 1/2"	GM ISSUED FOR REVIEW/APPROVAL

REV.	DATE	BY	DESCRIPTION	REVISIONS

VESSEL DATA			
ITEM NO.	DESCRIPTION	NO. REQD.	UNIT
1	SERVICE: COMBUSTOR COAL		
2	FEED DRUM		
3	OPER. PRESSURE ABOVE		
4	LIQUID LEVEL		
5	DESIGN PRESSURE		
6	OPER. LIQUID HOLD UP PRESS.		
7	OPER. PRESS. DROP THRU VESSEL		
8	MAX. RELIEF PRESS. AT TOP NO.		
9	MAX. OPER. TEMPERATURE		
10	DESIGN TEMPERATURE		
11	SPECIFIC GRAVITY PROCESS FLUID		
12	MM. DESIGN METAL TEMP.		
13	WIND DATA: ASCE 7-88, 70 MPH, EXPC.		
14	EARTHQUAKE DATA: ASCE 7-88, ZONE 1		
15	CODE: ASME VIII DIV 1 STAMPED: YES		
16	P.W.M.T. FOR CODE: NO FOR PROCESS: NO		
17	RADIOGRAPHED: SPOT NAT'L BD: YES		
18	JOINT EFFICIENCY: 85%		
19	CRACKS OR ALLOW. / INCHES: 1/4" C, 1/8" S		
20	MAT'L SHELL: SA 316 70		
21	MAT'L HEAD: SA 316 70		
22	MAT'L SUPPORT: SA 316 70		
23	MAT'L FLANGE: SA 106 70 SA 182 304		
24	MAT'L NOZZLE: SA 106 70 SA 316 304		
25	EXTERNAL BOLTING: SA 193 B7 SA 194 2H		
26	MAT'L GASKET: SA 240 304		
27	BARRELS: 1/4" GARLOCK BLUE GARD OR P		
28	TYPE OF HEAD: 211 ELLIP, 1/4 CONICAL		
29	INSULATION: NONE		
30	PRIMER: PRIMER ONLY		
31	COATS: ACS 10 / P-101		
32	PARTS:		
33	SHIPMENT: ONE PIECE		
34	VOLUME: 375 CU FT		
35	EMPTY WGT: 13,500 LBS		
36	WATER (ONLY) WGT: 23,500 LBS		
37	REMOVABLE TRAY WGT: N/A		
38	PACKING CATALYST ETC. WGT: N/A		
39	INSULATION WGT: N/A		
40	SHUTTLE WGT: 25,750 LBS

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REFERENCE DRAWINGS, REQUISITION NO. 4161-10A1, 1989, 30412, 83A1, 88A1, 97A1 AND 98A1 STOS 108 108 108 108 108 R&R DWGS. 4161-B-MIO DRO256 SHEET 2		CONTRACT NUMBER 15-4161	
DRAWN GW		DATE 7/19/92	
REVIEWED TK		DATE 7/19/92	
APPROVED		REQUISITION NUMBER 4161-1131F	
P.O. NUMBER			
DRAWING NUMBER 4161-B-MIO-DRO256 C1			
SHEET 1 OF 2			

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NEW

RELEASES				VESSEL DATA	
DWG REV.	DATE	ISSUED FOR	1	ITEM NO.	DR0256 NO. REQ'D ONE
C3	DATE OF ORDER	PURCHASE SHELL AND HEAD MATERIAL. PREPARE BUT DO NOT SUBMIT SHOP DETAIL DRAWINGS.	2	SERVICE:	COMBUSTOR COAL
		ISSUE CHECKED FOSTER WHEELER DRAWING. PURCHASE ALL OTHER MATERIALS. FINALIZE AND SUBMIT CHECKED SHOP DETAIL DRAWING WITHIN ONE WEEK OF RELEASE DATE. PROCEED WITH COMPLETE FABRICATION.	3	FEED DRUM	
		FIELD CONSTRUCTION	4	OPER. PRESSURE ABOVE	NORM: 175 PSIG
			5	LIQUID LEVEL	MAX: 265 PSIG
			6	DESIGN PRESSURE	INT: 300 PSIG
			7		EXT: NONE PSIG
			8	OPER. LIQUID HOLD-UP PRESS:	116 PSIG
			9	OPER. PRESS. DROP THRU VESSEL:	NEGL PSIG
			10	MAX. RELIEVING PRESS. AT TOP HD.	300 PSIG
			11	MAX. OPER. TEMPERATURE	150° F
			12	DESIGN TEMPERATURE:	300° F
			13	SPECIFIC GRAVITY (PROCESS FLUID):	112
			14	MIN. DESIGN METAL TEMP.:	0° F
			15	WIND DATA: ASCE 7-88, 70 MPH, EXP. C.	
			16	EARTHQUAKE DATA: ASCE 7-88, ZONE 1	
			17	CODE: ASME VIII DIV 1 STAMPED: YES	
			18	P.W.N.T. FOR CODE: NO FOR PROCESS NO	
			19	RADIOGRAPHED: SPOT NAT'L BD. YES	
			20	JOINT EFFICIENCY: 85%	
			21	CORROSION ALLOW. (MINIMUM): 1/16" C.S. 0.55	
			22	MAT'L SHELL:	SA-516-70
			23	MAT'L HEADS:	SA-516-70
			24	MAT'L SUPPORTS:	SA-516-70
			25	MAT'L FLANGES: SA-105/ SA-182 F304	
			26	MAT'L NOZZLES: SA-106-B/ SA-312-304	
			27	EXTERNAL BOLTING: SA-193-B7/ SA-194-2H	
			28	MAT'L CONE: SA-240-304	
			29	GASKETS: SEE NOTE #3	
			30	TYPE OF HEAD: 2 1/2 ELLIP. 1/4 CONICAL	
			31	INSULATION: NONE	
			32	PAINT: PRIMER ONLY	
			33	PRIMER: BCS-18 / P-101	
			34	COATS:	
			35	PARTS:	
			36	SHIPMENT: ONE PIECE	
			37	VOLUME:	545 CU. FT.
			38	EMPTY WGT:	19,000 LBS
			39	WATER (ONLY) WGT:	35,000 LBS
			40	REMOVABLE TRAY WGT:	N/A LBS
			41	PACKING, CATALYST, ETC. WGT:	N/A LBS
			42	INSULATION WGT:	N/A LBS
			43	QUINITE WGT:	N/A LBS
			44	OPER. LIQUID WGT:	37,500 LBS

CONN. NO.	SIZE	ANSI RATING	SERVICE	NO. REQ'D
1	8"	CL300RF	COAL INLET	1
2	8"		COAL OUTLET	1
3	2"		VENT	1
4	3/4"	CL600	LSH	1
6	6"	CL300RF	SIGHT PORT/HANDHOLE 7BLD	1
7	1/4"	CL600	FLUIDIZING N ₂ INLET	4
8	1"	CL300RF	SAMPLING M ₂ BLD	1
9	3/4"	CL600	PT	1
10	1"	CL600	TI	1
11	2"	CL300RF	SPARE M ₂ BLIND	1
12	1"	CL600	TI	1
13	20"	CL300RF	MANWAY M ₂ HINGE	1
14	4"	CL300RF	SPARE M ₂ BLIND	1
15	3/4"	CL600	LSL	1

REV.	DATE	BY	DESCRIPTION
C3	1/13/82	GW	REVISED AS INDICATED
C2	1/13/82	GW	REVISED AS INDICATED
C1	1/13/82	GW	REVISED AS INDICATED
B	1/13/82	GW	REVISED AS INDICATED
A	1/13/82	GW	ISSUED FOR REVIEW/APPROVAL

REFERENCE DRAWINGS, REQUIREMENTS, STANDARDS		DRAWN	GW	1/13/82
SPEC'S: 4161-10A1, 1989, 50A2, 83A1, 88A1, 97A1 AND 98A1		REVIEWED	TK	
STDS: 10B 13.5 AND 10B101		APPROVED		
REF. DWGS: 4161-B-MID-DR0256 SHEET 2				

DEPARTMENT OF ENERGY		CONTRACT NUMBER	
COMBUSTOR COAL FEED DRUM DR0256		15-4161	
APFBC SYSTEM		REQUISITION NUMBER	
POWER SYSTEMS DEVELOPMENT FACILITY		4161-1131-F	
		P.O. NUMBER	
		PP-3-115-4161	
		DRAWING NUMBER	
		1111 R 1111 DR0256	

WILSONVILLE APFBC

ASH DRUM DR0265

- REASON FOR CHANGE
 - INCREASE ASH SURGE CAPACITY IN ORDER TO PROVIDE A BUFFER AGAINST ASH SYTEM OPERATIONAL PROBLEMS.
- DIMENSIONS
 - DIAMETER CHANGED FROM 3 FT TO 6 FT
 - OVERALL LENGTH INCREASED FROM 8'4" TO 13'8"
 - VOLUME INCREASED FROM 36 CU FT TO 198 CU FT
 - VESSEL SAME SIZE AS ASH DEPRESSURIZATION DRUMS
- EFFECT
 - SURGE DRUM WILL RUN EMPTY OR NEAR EMPTY IN NORMAL OPERATION.
 - WILL FILL IN 4 TO 6 HOURS AT MAXIMUM ASH RATE.
 - ALLOWS PLANT TO CONTINUE IN OPERATION FOR SIGNIFICANT TIME IN EVENT OF ASH SYSTEM PROBLEMS.

OLD

RELEASES				VESSEL DATA	
DWG NO.	DATE	ISSUED FOR	ITEM NO.	DESCRIPTION	VALUE
		PURCHASE SHELL AND HEAD MATERIAL, PREPARE BUT DO NOT SUBMIT SHOP DETAIL DRAWINGS.	1	ITEM NO. DRO265	NO REQ'D: ONE
		ISSUE CHECKED POSTER WHEELER DRAWING, PURCHASE ALL OTHER MATERIALS, FINALIZE AND SUBMIT CHECKED SHOP DETAIL DRAWING WITHIN ONE WEEK OF RELEASE DATE. PROCEED WITH COMPLETE FABRICATION.	2	SERVICE: ASH SURGE DRUM	
		FIELD CONSTRUCTION	3		
			4	OPER. PRESSURE ABOVE	NORM. 175 PSIG
			5	LIQUID LEVEL	MAX: 225 PSIG
			6	DESIGN PRESSURE	INT: 300 PSIG
			7		EXT: NONE PSIG
			8	OPER. LIQUID HOLD-UP PRESS.	2.5 PSIG
			9	OPER. PRESS. DROP THRU VESSEL	N/EGL. PSIG
			10	MAX. RELIEVING PRESS. AT TOP NO.	300 PSIG
			11	MAX. OPER. TEMPERATURE	300° F
			12	DESIGN TEMPERATURE	350° F
			13	SPECIFIC GRAVITY (PROCESS FLUID)	1.0
			14	MIN. DESIGN METAL TEMP.	0° F
			15	WIND DATA: ASCE 7-88, 70MPH EXPT. C	
			16	EARTHQUAKE DATA: ASCE 7-88, ZONE 1	
			17	CODE: ASME VIII DIV 1 STAMPED: YES	
			18	P.W.M.T. FOR CODE: NO FOR PROCESS: NO	
			19	RADIOGRAPHED: SPOT NAT'L. BD: YES	
			20	JOINT EFFICIENCY: 85%	
			21	CORROSION ALLOW. 1/16" C.S. 0.33	
			22	MAT'L. SHELL: SA-416-70	
			23	MAT'L. HEADS: SA-416-70	
			24	MAT'L. SUPPORTS: SA-36 / SA-516-70	
			25	MAT'L. FLANGER: SA-105 / SA-182-F304	
			26	MAT'L. NOZZLES: SA-106-B / SA-512-304	
			27	EXTERNAL BOLTING: SA-193-B7 / SA-194-2H	
			28	MAT'L. CONE: SA-240-304	
			29	BASKETS 1/2" GARLOCK BLUE GARD OR EQ	
			30	TYPE OF HEAD: 2:1 ELLIPT. CONICAL	
			31	INSULATION: TYPE P.P. (BY OTHERS)	
			32	PAINT: PRIMER ONLY	
			33	PRIMER: BCS-28 / P-101	
			34	COATS:	
			35	PARTS:	
			36	SHIPMENT: ONE PIECE	
			37	VOLUME: 36 CU FT	
			38	EMPTY WGT: 3,200 LBS	
			39	WATER (ONLY) WGT: 2,200 LBS	
			40	REMOVABLE TRAY WGT: N/A LBS	
			41	PACKING, CATALYST, ETC. WGT: N/A LBS	
			42	INSULATION WGT: N/A LBS	
			43	GRUNITE WGT: N/A LBS	
			44	OPER. LIQUID WGT: 1,550 LBS	

NOZZLE CHART			
CONN. NO.	SIZE	AMBI. RATING	SERVICE
1	8"	CL 300 RF	INLET
2	2"		AIR INLET
3	8"		OUTLET
4	1 1/2"		LSH
5	2"		VENT
6	1 1/4"	CL 300 RF	FLUIDIZING AIR INLET
7	18"	CL 300 RF	MANWAY W/ HINGE
8	1"	CL 300 RF	PT

REV. DATE BY DESCRIPTION			
A	1/1/86	GW	ISSUED FOR REVIEW/APPROVAL

REFERENCE DRAWINGS, REQUIREMENTS, STANDARDS			
SPCS: 4161-10A1, 1989, 50A2, 83A1, 88A1			
STDS: 108 / 3.5 / 196			
RFR. DWG: 4161-B-MIO-DRO265 SHEET 2			

DEPARTMENT OF ENERGY			
ASH SURGE DRUM DRO265			
APFBC SYSTEM			
POWER SYSTEMS DEVELOPMENT FACILITY			
SOUTHERN CO. SERVICES			
WILSONVILLE ALABAMA			

CONTRACT NUMBER		REQUISITION NUMBER	
15-4161		4161-1131M	
P.O. NUMBER		DRAWING NUMBER	
		1161-B-MIO-DRO265	
		SHEET 1 OF 2	

NEW

GENERAL NOTES: B1

- INTERNAL WELDS TO BE GROUND SMOOTH & FLUSH
- NOZZLE PROJECTION MEASURED FROM INSIDE OF SHELL TO F/F. 10" FOR NOZZLES THROUGH 12" NPS. 12" FOR LARGER NOZZLES, UNLESS NOTED OTHERWISE.
- NOZZLE FLANGES SHALL BE WELD NECK TYPE.
- SPIRAL WOUND GSX. 304 SS 7 FLEXITE SUPER NON-ASB. WINDING 1 CS. OUTER RING GSX. TO BE SUPPLIED 7/8" TAPE, STRING OR OTHER WRAPPING AROUND SPIRAL WINDING.
- ALL COUPLINGS ARE TO BE SCREWED TYPE (N.R.T.).

ELEVATION B1

GROUNDING LUG DETAIL

RELEASES

DWG. REV.	DATE	ISSUED FOR
B1		PURCHASE SHELL AND HEAD MATERIAL. PREPARE BUT DO NOT SUBMIT SHOP DETAIL DRAWINGS.
		ISSUE CHECKED FOSTER WHEELER DRAWING. PURCHASE ALL OTHER MATERIALS. FINALIZE AND SUBMIT CHECKED SHOP DETAIL DRAWING WITHIN ONE WEEK OF RELEASE DATE. PROCEED WITH COMPLETE FABRICATION.
		FIELD CONSTRUCTION

NOZZLE CHART

CONN. NO.	SIZE	ANSI RATING	SERVICE	NO. REQ'D
1	16"	CL300RF	INLET	1
2	2"		AIR INLET	1
3	8"		OUTLET	1
4	3/4"	6000 CL6	LE	1
5	2"	CL300RF	VENT	1
6	1/4"	6000 CL6	FLUIDIZING AIR INLET	4
7	18"	CL300RF	MANWAY W/ HINGE	1
8	3/4"	6000 CL6	PT	1
9	1"	6000 CL6	TI	1
10	4"	CL300RF	PSV	1
11	2"	CL300RF	VENT	1
12	1/2"	6000 CL6	PURGE	1

VESSEL DATA

1	ITEM NO:	DRO265	NO. REQ'D:	ONE
2	SERVICE:	ASH SURGE DRUM		
3				
4	OPER. PRESSURE ABOVE	NORM	175	PSIG
5	LIQUID LEVEL	MAX:	225	PSIG
6	DESIGN PRESSURE	INT:	300	PSIG
7		EXT	NONE	PSIG
8	OPER. LIQUID HOLD UP PRESS:		44	PSIG
9	OPER. PRESS. DROP THRU VESSEL		NEG.	PSIG
10	MAX. RELIEVING PRESS. AT TOP HD:		300	PSIG
11	MAX. OPER. TEMPERATURE		500°	F
12	DESIGN TEMPERATURE:		650°	F
13	SPECIFIC GRAVITY (PROCESS FLUID):		1.0	
14	MIN. DESIGN METAL TEMP:		0°	F
15	WIND DATA: ASCE 7-88, 70MPH, EXPT. C			
16	EARTHQUAKE DATA: ASCE 7-88, ZONE 1			
17	CODE: ASME VIII DIV. 1 STAMPED:		YES	
18	P.W.H.T. FOR CODE: NO FOR PROCESS: NO			
19	RADIOGRAPHED: SPOT NAT'L BD:		YES	
20	JOINT EFFICIENCY:		85%	
21	CORROSION ALLOW. (MINIMUM):		1/16"	
22	MAT'L. SHELL:	SA-516-70		
23	MAT'L. HEADS:	SA-516-70		
24	MAT'L. SUPPORTS:	SA-36		
25	MAT'L. FLANGES:	SA-105		
26	MAT'L. NOZZLES:	SA-106-B		
27	EXTERNAL BOLTING: SA-193-B7/SA-194-2H			
28	MAT'L. CONE:	SA-516-70		
29	GASKETS:	SEE NOTE #4		
30	TYPE OF HEAD: 2:1 ELLIPT. CONICAL			
31	INSULATION: TYPE PP (BY OTHERS)			
32	PAINT:	PRIMER ONLY		
33	PRIMER:	BGS-381 P-101		
34	COATS:			
35	PARTS:			
36	SHIPMENT: ONE PIECE			
37	VOLUME:	198 CU. FT.		
38	EMPTY WGT:	10,000 LBS.		
39	WATER (ONLY) WGT:	13,000 LBS.		
40	REMOVABLE TRAY WGT:	N/A		
41	PACKING CATALYST ETC. WGT:	N/A		
42	INSULATION WGT:	N/A		
43	QUINITE WGT:	N/A		
44	OPER. LIQUID WGT:	9,500 LBS.		

B1	1/2/88	GW	REVISED AS INDICATED
A2	1/2/88	GW	REV'D AS INDICATED
A1	1/2/88	GW	ISSUED FOR REVIEW/APPROVAL
REV.	DATE	BY	DESCRIPTION

THIS DRAWING IS THE PROPERTY OF THE FOSTER WHEELER USA CORPORATION, PARSIPpany, NEW JERSEY, AND IS LENT WITHOUT COBINATION OTHER THAN THE BORROWER'S AGREEMENT THAT IT SHALL NOT BE LENT OR IMPROVED OR DIRECTLY OR INDIRECTLY NOT USED FOR ANY PURPOSE OTHER THAN THAT FOR WHICH IT IS SPECIFICALLY FURNISHED. THE APPARATUS SHOWN IN THE DRAWING IS COVERED BY PATENTS.

REFERENCE DRAWINGS, REQUIREMENTS, STANDARDS	DRAWN	GW	1/7/81
SPECS: 4161-10A1, 1983, 50A2, 83A1, 88A1, 97A1 AND 98A1	REVIEWED	TK	
STDS: 10813.5, 10810.1 AND 13B12.1	APPROVED		
REF. DWGS: 4161-B-MIO-DRO265 SHT. 2			

DEPARTMENT OF ENERGY

ASH SURGE DRUM
APFBC SYSTEM
POWER SYSTEMS DEVELOPMENT FACILITY
SOUTHERN CO. SERVICES

CONTRACT NUMBER

15-4161

REQUISITION NUMBER

4161-1131-M

P.O. NUMBER

PP-3-115-4161

DRAWING NUMBER

4161-B-MIO-DRO265

REV

B1

SHEET 1 OF 2

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Power Systems Development Facility – APFBC System
D O E / Southern Company Services – Wilsonville, Alabama

75% Design Review – July 27, 1994
Foster Wheeler, 8 Peach Tree Hill Road, Livingston, New Jersey
CIT Building Conference Room No. 1108

CHANGES FROM 50% DESIGN PACKAGE

Char Transfer System Redesign

Bypass Quench System

Char Cooler Redesign

Deletion of Baghouse

Alkali Getter Design

Increase Vessel Sizes

→ Air Pulse for Combustor PCD

DOE/SCS PSD FACILITY - APFBC SYSTEM
WILSONVILLE, ALABAMA

STATUS OF FOSTER WHEELER DETAIL DESIGN

AS OF 7/25/94

PROCESS ENGINEERING

DONE

- Finalized Process Flow Diagram
- Finalized Design Heat & Material Balance
- Released P&ID's to Project
- Issued Equipment Process Data
- Issued Process Data for Instruments

DOING/WILL DO

- Alkali Getter Design
- Finalize Plant Control
- Resolve PSV Requirement at PCD
- Review SCS Coke Breeze for Plant Start-up
- Review G/T Reverse Power Requirement
- Attend Hazop Review

DOE/SCS PSD FACILITY - APFBC SYSTEM
WILSONVILLE, ALABAMA

STATUS OF FOSTER WHEELER DETAIL DESIGN

AS OF 7/25/94

VESSEL & EXCHANGERS

DONE

- Issued Job Specs.
- Purchased all vessels and exchangers except Alkali Getter, Char Cooler and Lined Pipes
- Reviewing Vendor drawings and documents

WILL DO

- Vendor drawing review including FWEC
- Issued Purchase Requisition for Alkali Getter, Char Cooler and Lined Pipes

DOE/SCS PSD FACILITY - APFBC SYSTEM
WILSONVILLE, ALABAMA

STATUS OF FOSTER WHEELER DETAIL DESIGN

AS OF 7/25/94

MECHANICAL

DONE

- Issued Job Specs.
- Issued purchase requisition for all items
- Reviewing vendor drawings

WILL DO

- Engineering coordination with Allison and Westinghouse.

DOE/SCS PSD FACILITY - APFBC SYSTEM
WILSONVILLE, ALABAMA

STATUS OF FOSTER WHEELER DETAIL DESIGN

AS OF 7/25/94

PIPING

DONE

- Issued Job Specs.
- Issued Equipment Arrangement Plan released for construction
- Issued sample preliminary isos

WILL DO

- Piping Plans
- Issue isos released for construction
- Issued lined pipe load list
- Define hangers and supports, expansion joints
- M.T.O.

DOE/SCS PSD FACILITY - APFBC SYSTEM
WILSONVILLE, ALABAMA

STATUS OF FOSTER WHEELER DETAIL DESIGN

AS OF 7/25/94

INSTRUMENT

DONE

- Issued Job Specs.
- Issued dimensional data on vessel instruments
- Issued dimensional data on in-line instruments and control valves
- Issued requisitions
- Issued bid tab for weigh cells
- Issued I.R.S.

WILL DO

- SAMA, logic and sequence drawings
- Requisition E.T.S.
- Requisition Analyzers at Topping Combustor
- Installation Detail
- Instrument Location

DOE/SCS PSD FACILITY - APFBC SYSTEM
WILSONVILLE, ALABAMA

STATUS OF FOSTER WHEELER DETAIL DESIGN

AS OF 7/25/94

ELECTRICAL

DONE

- Issued Job Specs.
- Load List
- UPS and Auxiliary Generator loads list
- Area Classification Drawings

WILL DO

- Elementary Diagram
- Cable Tray Layout and Installation Detail
- ETS Ladder Diagram

DOE/SCS PSD FACILITY - APFBC SYSTEM
WILSONVILLE, ALABAMA

STATUS OF FOSTER WHEELER DETAIL DESIGN

AS OF 7/25/94

TECHNOLOGY

DONE

- Issued Job Specs.
- Define Materials of Construction

DOING

- Review stress analysis.

DOE/SCS PSD FACILITY - APFBC SYSTEM
WILSONVILLE, ALABAMA

STATUS OF FOSTER WHEELER DETAIL DESIGN

AS OF 7/25/94

PROJECT

DONE

- Issued Job Specs.
- Issued P&ID's for detail design
- Issued utility consumption data
- Issued interface data for SCS, PCD vendors and SRI
- Issued equipment list
- Issued DPT & MOC
- Issued header drawings
- Issued design packages
- Provide support for 50% package cost estimate
- Issued purchase requisition for flare, airheaters, quench packages and hot valves

WILL DO

- Trending including issue of DCN's and Variance support
- Reviewing vendor drawings for flare, air preheaters, quench package and hot valves
- Mechanical Catalog

DOE/SCS PSD FACILITY - APFBC SYSTEM
WILSONVILLE, ALABAMA

STATUS OF FOSTER WHEELER DETAIL DESIGN

AS OF 7/25/94

PROCUREMENT

DONE

- Issued Purchase Orders for all Equipment Items except:
 - Alkali Getter
 - Char Cooler
 - Lined Pipes
 - Allison Gas Turbine
 - Westinghouse Topping Combustor

BEING DONE

Issue purchase orders for:

- Quench Package
- Hot Valves

WILL BE DONE

Issue purchase order for Alkali Getter, Char Cooler and Lined Pipes

- Inspection and Expediting Plan

APPENDIX D

**FW APFBC SYSTEM:
DETAILED PROJECT SCHEDULE**

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[illegible]

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Sheet 10 of 12

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APPENDIX E

WESTINGHOUSE PCDs FOR THE TRANSPORT REACTOR AND FW CPFBC (Project Schedules)

Figure 1. Schedule for Delivery of Westinghouse PCDs to the PSDF

Figure 2. Schedule for Fabrication, Delivery, and Installation of PCD FL0301

Figure 3. Schedule for Fabrication, Delivery, and Installation of PCD FL0352

Figure 1

OVERALL SCHEDULE FOR DELIVERY OF PCDs TO THE PSDF, WILSONVILLE, ALABAMA

Figure 2

TASK 4 : FABRICATE, DELIVER AND INSTALL FL0301

Figure 3

TASK 5 : FABRICATE, DELIVER AND INSTALL FL0352

APPENDIX F

FW APFBC TRAIN: DETAILED COMPONENT SCHEDULE

COMPONENT SCHEDULE
EQUIPMENT LIST REVISION DATED - 7/19/94

ITEM ITEM DESC Comment	QTY	SPEC/REQ	INQ #	PO #		FW ISSUE SPEC/ REQ	SCS APPROVE SPEC/ REQ	FW ISSUE INQUIRY/ RFQ	FW RECEIVE BIDS/ QUOTES	FW COMPLETE BID TABS	SCS BID TAB APPROVAL	FW RELEASE PURCHASE ORDER	FW RECEIVE VENDOR DRAWINGS	SHIP F.O.B.	DELIVERY TO SITE/SHOP	FIELD NEED SLACK (IN WKS)
------------------------------	-----	----------	-------	------	--	-----------------------------	--------------------------------	--------------------------------	----------------------------------	-------------------------------	-------------------------------	------------------------------------	-------------------------------------	----------------	-----------------------------	------------------------------------

EQUIPMENT LIST CLASS: EXCHANGERS

HX0251 Process Air Cooler	1	1211A	109	PP-9	P A/F	1/03/94 1/04/94A =====	1/17/94 1/06/94A =====	1/31/94 1/07/94A =====	2/28/94 1/25/94A =====	3/14/94 2/25/94A =====	3/28/94 4/29/94A =====	4/11/94 6/20/94A =====	6/06/94 8/05/94A =====	9/19/94 1/02/95	10/03/94 1/09/95	12/14/94 12/14/94 -4
HX0255 Char Cooler Re-Design	1	1221A	120		P A/F	1/03/94 1/24/94A =====	1/17/94 1/25/94A =====	1/31/94 3/18/94A =====	2/16/94 4/01/94A =====	3/02/94 4/15/94A =====	3/16/94 4/29/94A =====	3/30/94 10/14/94 =====	5/25/94 12/09/94 =====	9/07/94 5/12/95	9/21/94 5/19/95	8/07/95 8/07/95 11
HX0256 Air Heater	1	1211E	109	PP-9	P A/F	1/03/94 1/04/94A =====	1/17/94 1/06/94A =====	1/31/94 1/07/94A =====	2/28/94 1/25/94A =====	3/14/94 2/25/94A =====	3/28/94 4/29/94A =====	4/11/94 6/20/94A =====	6/06/94 8/05/94A =====	9/19/94 1/02/95	10/03/94 1/09/95	12/14/94 12/14/94 -4

EQUIPMENT LIST CLASS: FBHE PACKAGE (BY FWEC)

CY0252 Combustor Cyclone	1	1291A			P A/F	1/03/94 1/31/94A =====	1/17/94 2/04/94A =====	1/24/94 2/11/94A =====	2/21/94 2/25/94A =====	3/07/94 3/25/94A =====	3/21/94 4/29/94A =====	4/04/94 7/15/94A =====	5/30/94 8/19/94A =====	1/09/95 2/17/95	1/23/95 2/24/95	8/07/95 8/07/95 23
HX0253 Fludized Bottom Ash Cooler	1	1291A			P A/F	1/03/94 1/31/94A =====	1/17/94 2/04/94A =====	1/31/94 2/11/94A =====	2/28/94 2/25/94A =====	3/14/94 3/25/94A =====	3/28/94 4/29/94A =====	4/11/94 7/15/94A =====	6/06/94 8/26/94A =====	1/02/95 3/10/95	1/16/95 3/17/95	5/08/95 5/08/95 7
LP1102 FBHE Ash Lined Pipe To Comb To El 152'	1				P A/F	1/03/94 1/31/94A =====	1/17/94 2/04/94A =====	1/31/94 2/11/94A =====	2/28/94 2/25/94A =====	3/14/94 3/25/94A =====	3/28/94 4/29/94A =====	4/11/94 7/15/94A =====	6/06/94 10/20/94 =====	1/02/95 6/02/95	1/16/95 6/09/95	2/13/95 2/13/95 -17
LP1102 FBHE Ash Lined Pipe Above To El 152'	1				P A/F	1/03/94 1/31/94A =====	1/17/94 2/04/94A =====	1/31/94 2/11/94A =====	2/28/94 2/25/94A =====	3/14/94 3/25/94A =====	3/28/94 4/29/94A =====	4/11/94 7/15/94A =====	6/06/94 9/16/94A =====	1/02/95 3/17/95	1/16/95 3/24/95	2/13/95 2/13/95 -6
PG0251 FBHE Package	1	1291A			P A/F	12/24/93 1/31/94A =====	12/31/93 2/04/94A =====	1/14/94 2/11/94A =====	2/11/94 2/25/94A =====	2/25/94 3/25/94A =====	3/11/94 4/29/94A =====	3/25/94 7/15/94A =====	5/20/94 9/30/94A =====	2/14/95 4/07/95	2/28/95 4/14/95	6/20/95 6/20/95 10
RX0252 Combustor	1	1291A			P A/F	12/24/93 1/31/94A =====	1/07/94 2/04/94A =====	1/21/94 2/11/94A =====	2/18/94 2/25/94A =====	3/04/94 3/25/94A =====	3/18/94 4/29/94A =====	4/01/94 7/15/94A =====	5/27/94 10/20/94 =====	2/21/95 4/07/95	3/07/95 4/14/95	5/08/95 5/08/95 3
VL0261 Combustor Cyclone J Valve	1	1291A			P A/F	1/03/94 2/08/94A =====	1/17/94 2/08/94A =====	1/31/94 2/18/94A =====	2/28/94 3/25/94A =====	3/14/94 4/15/94A =====	3/28/94 4/29/94A =====	4/11/94 7/15/94A =====	6/06/94 9/23/94A =====	1/16/95 2/17/95	1/30/95 2/24/95	8/07/95 8/07/95 23

EQUIPMENT LIST CLASS: MECHANICAL EQUIPMENT

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COMPONENT SCHEDULE
EQUIPMENT LIST REVISION DATED - 7/19/94

ITEM ITEM DESC Comment	QTY	SPEC/REQ	INQ #	PO #	FW ISSUE SPEC/ REQ	SCS APPROVE SPEC/ REQ	FW ISSUE INQUIRY/ RFQ	FW RECEIVE BIDS/ QUOTES	FW COMPLETE BID TABS	SCS BID TAB APPROVAL	FW RELEASE PURCHASE ORDER	FW RECEIVE VENDOR DRAWINGS	SHIP F.O.B.	DELIVERY TO SITE/SHOP	FIELD NEED SLACK (IN WKS)
FL0351 Carbonizer PCD Filter By I.F.P.	1				P A/F							5/20/94 5/20/94A =====			0
FL0352 Combustor PCD Filter By Westinghouse.	1				P A/F							5/20/94 5/20/94A =====			0

EQUIPMENT LIST CLASS: MECHANICAL - ALLISON

GNO0451 Electric Generator Package By Allison	1	1322A			P A/F						1/10/94 10/28/94	5/30/94 2/17/95	4/10/95 10/13/95	4/24/95 10/20/95	8/07/95 8/07/95 -11
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EQUIPMENT LIST CLASS: MECHANICAL - MATERIAL HANDLING

FL0253	1				P													0
Fugitive Dust Bag House Deleted					A/F													
FL0254	1	1356B	104	PP-8	P	12/06/93	12/20/93	1/03/94	1/31/94	2/14/94	2/28/94	3/14/94	5/09/94	8/29/94	9/12/94	8/07/95		
Coal Surge Hopper Filter					A/F	12/06/93A	12/13/93A	12/17/93A	1/18/94A	3/18/94A	4/29/94A	5/27/94A	7/15/94A	10/14/94	10/21/94	8/07/95		
						=====	=====	=====	=====	=====	=====	=====	=====					41
FL0255	1	1356B	104	PP-8	P	12/06/93	12/20/93	1/03/94	1/31/94	2/14/94	2/28/94	3/14/94	5/09/94	8/29/94	9/12/94	5/30/95		
Sorbent Surge Hopper Filter					A/F	12/06/93A	12/13/93A	12/17/93A	1/18/94A	3/18/94A	4/29/94A	5/27/94A	7/15/94A	10/14/94	10/21/94	5/30/95		
						=====	=====	=====	=====	=====	=====	=====	=====					32
VL0258	1				P													0
Baghouse Bottoms Valve Deleted					A/F													
VL0259	1	1347A	107	PP-5	P	12/06/93	12/20/93	1/03/94	1/31/94	2/14/94	2/28/94	3/14/94	5/09/94	9/26/94	10/10/94	1/03/95		
Coal Diverter Valve					A/F	12/06/93A	12/13/93A	12/17/93A	1/17/94A	2/18/94A	4/29/94A	5/27/94A	6/24/94A	10/14/94	10/21/94	1/03/95		
						=====	=====	=====	=====	=====	=====	=====	=====					11
VL0260	1	1347A	107	PP-5	P	12/06/93	12/20/93	1/03/94	1/31/94	2/14/94	2/28/94	3/14/94	5/09/94	9/26/94	10/10/94	1/03/95		
Dry Coal Diverter Valve					A/F	12/06/93A	12/13/93A	12/17/93A	1/17/94A	2/18/94A	4/29/94A	5/27/94A	6/24/94A	10/14/94	10/21/94	1/03/95		
						=====	=====	=====	=====	=====	=====	=====	=====					11

EQUIPMENT LIST CLASS: MECHANICAL - MATERIAL HANDLING

FD0251 Sorbent Feeder	1	1361E	110	PP-10	P A/F	12/17/93 12/17/94A =====	12/31/93 1/06/94A =====	1/14/94 1/11/94A =====	2/11/94 2/11/94A =====	2/25/94 4/15/94A =====	3/11/94 4/29/94A =====	3/25/94 7/22/94A =====	5/20/94 8/23/94A =====	10/14/94 12/02/94	10/28/94 12/09/94	3/30/95 3/30/95 16
FD0252 Carbonizer Coal Feeder	1	1361E	110	PP-10	P A/F	12/17/93 12/17/94A =====	12/31/93 1/06/94A =====	1/14/94 1/11/94A =====	2/11/94 2/11/94A =====	2/25/94 4/15/94A =====	3/11/94 4/29/94A =====	3/25/94 7/22/94A =====	5/20/94 8/23/94A =====	10/14/94 12/02/94	10/28/94 12/09/94	3/30/95 3/30/95 16

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COMPONENT SCHEDULE
EQUIPMENT LIST REVISION DATED - 7/19/94

ITEM ITEM DESC Comment	QTY	SPEC/REQ	INQ #	PO #		FW ISSUE SPEC/ REQ	SCS APPROVE SPEC/ REQ	FW ISSUE INQUIRY/ RFQ	FW RECEIVE BIDS/ QUOTES	FW COMPLETE BID TABS	SCS BID TAB APPROVAL	FW RELEASE PURCHASE ORDER	FW RECEIVE VENDOR DRAWINGS	SHIP F.O.B.	DELIVERY TO SITE/SHOP	FIELD NEED SLACK (IN WKS)
FD0253 Combustor Coal Feeder	1	1361E	110	PP-10	P A/F	12/17/93 12/17/93A =====	12/31/93 1/10/94A =====	1/14/94 1/11/94A =====	2/11/94 2/11/94A =====	2/25/94 4/15/94A =====	3/11/94 4/29/94A =====	3/25/94 7/22/94A =====	5/20/94 8/23/94A =====	10/14/94 12/02/94	10/28/94 12/09/94	3/30/95 3/30/95 16
FD0256 Fines Cooling Screw Feeder	1	1379B	100	PP-13	P A/F	12/17/93 12/17/93A =====	12/31/93 12/23/93A =====	1/14/94 12/24/93A =====	2/11/94 2/04/94A =====	2/25/94 4/01/94A =====	3/11/94 4/29/94A =====	3/25/94 9/14/94A =====	5/20/94 10/01/94	10/13/94 1/20/95	10/27/94 1/27/95	5/08/95 5/08/95 14

EQUIPMENT LIST CLASS: MECHANICAL - WESTINGHOUSE

BR0451 Topping Combustor Package By Westinghouse	1	1379A			P A/F							1/10/94 10/28/94	6/12/94 2/03/95	12/21/94 4/21/96	1/04/95 4/28/96	8/07/95 8/07/95 -38
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EQUIPMENT LIST CLASS: MECHANICAL EQUIPMENT

BL0251 Baghouse Fan Deleted	1				P A/F											0
CO0251 Booster Air Compressor	1	1322A	114	PP-6	P A/F	1/03/94 1/25/94A =====	1/17/94 1/28/94A =====	1/31/94 1/28/94A =====	2/28/94 2/25/94A =====	3/14/94 4/15/94A =====	3/28/94 4/29/94A =====	4/11/94 6/28/94A =====	6/06/94 10/01/94	1/27/95 1/20/95	2/10/95 1/27/95	5/08/95 5/08/95 14
CO0252 Transport Air Compressor	1	1322B	114	PP-6	P A/F	1/14/94 1/25/84A =====	1/28/94 1/28/94A =====	2/11/94 1/28/94A =====	3/11/94 2/25/94A =====	3/25/94 4/15/94A =====	4/08/94 4/29/94A =====	4/22/94 6/28/94A =====	6/17/94 9/16/94A =====	1/03/95 1/20/95	1/17/95 1/27/95	2/16/95 2/16/95 3
FNO251 Char Cooler Fan	1	1325B	119	PP-15	P A/F	7/22/94 7/20/94A =====	8/05/94 7/22/94A =====	8/12/94 7/29/94A =====	9/09/94 8/12/94A =====	9/23/94 9/09/94A =====	10/07/94 9/16/94A =====	10/21/94 9/23/94A =====	11/25/94 10/07/94	4/10/95 11/18/94	4/24/95 11/25/94	2/13/95 2/13/95 11

EQUIPMENT LIST CLASS: MISCELLANEOUS

AH0252 Carbonizer Air Preheater	1	1244A	105	PP-4	P A/F	12/06/93 12/06/93A =====	12/20/93 12/09/94A =====	1/03/94 12/17/93A =====	1/31/94 1/17/94A =====	2/14/94 2/25/94A =====	2/28/94 4/29/94A =====	3/14/94 5/27/94A =====	5/09/94 7/22/94A =====	10/03/94 1/09/95	10/17/94 1/16/95	5/30/95 5/30/95 19
AH0253 Combustor Air Preheater	1	1244B	105	PP-4	P A/F	12/06/93 12/06/93A =====	12/20/93 12/09/94A =====	1/03/94 12/17/93A =====	1/31/94 1/17/94A =====	2/14/94 2/25/94A =====	2/28/94 4/29/94A =====	3/14/94 5/27/94A =====	5/09/94 7/22/94A =====	10/03/94 1/09/95	10/17/94 1/16/95	12/14/94 12/14/94 -5
AH0254 Combustor Above Grid Air Preheater	1	1244C	105	PP-4	P A/F	12/06/93 12/06/93A =====	12/20/93 12/09/94A =====	1/03/94 12/17/93A =====	1/31/94 1/17/94A =====	2/14/94 2/25/94A =====	2/28/94 4/29/94A =====	3/14/94 5/27/94A =====	5/09/94 7/22/94A =====	10/03/94 1/09/95	10/17/94 1/16/95	5/08/95 5/08/95 16
AH0255 HX0253 Air Preheater	1	1244D	105	PP-4	P A/F	12/06/93 12/06/93A =====	12/20/93 12/09/94A =====	1/03/94 12/17/93A =====	1/31/94 1/17/94A =====	2/14/94 2/25/94A =====	2/28/94 4/29/94A =====	3/14/94 5/27/94A =====	5/09/94 7/22/94A =====	10/03/94 1/09/95	10/17/94 1/16/95	12/14/94 12/14/94 -5

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COMPONENT SCHEDULE
EQUIPMENT LIST REVISION DATED - 7/19/94

ITEM ITEM DESC Comment	QTY	SPEC/REQ	INQ #	PO #		FW ISSUE SPEC/ REQ	SCS APPROVE SPEC/ REQ	FW ISSUE INQUIRY/ RFQ	FW RECEIVE BIDS/ QUOTES	FW COMPLETE BID TABS	SCS BID TAB APPROVAL	FW RELEASE PURCHASE ORDER	FW RECEIVE VENDOR DRAWINGS	SHIP F.O.B.	DELIVERY TO SITE/SHOP	FIELD NEED SLACK (IN WKS)
BR0251 Flare	1	1928A	101	PP-7	P A/F	12/06/93 12/06/93A =====	12/20/93 12/09/94A =====	1/03/94 12/17/93A =====	1/31/94 1/19/94A =====	2/14/94 2/25/94A =====	2/28/94 4/29/94A =====	3/14/94 5/27/94A =====	5/09/94 7/08/94A =====	11/08/94 10/07/94	11/22/94 10/14/94	8/07/95 8/07/95 42
CY0251 Carbonizer Cyclone	1	1353A	100	PP-1	P A/F	12/06/93 12/06/93A =====	12/20/93 12/09/94A =====	1/03/94 12/17/93A =====	1/31/94 1/18/94A =====	2/14/94 2/11/94A =====	2/28/94 4/29/94A =====	3/14/94 5/27/94A =====	5/09/94 6/13/94A =====	11/28/94 1/20/95	12/12/94 1/27/95	8/07/95 8/07/95 27

EQUIPMENT LIST CLASS: PACKAGES

PG0252 Fuel Gas Air Bypass Quench Pkg	1	1919A	118	PP-11	P A/F	5/06/94 5/06/94A =====	5/20/94 5/20/94A =====	6/03/94 5/27/94A =====	7/01/94 6/13/94A =====	7/15/94 7/14/94A =====	7/29/94 8/26/94A =====	8/12/94 9/16/94A =====	10/07/94 11/11/94	3/31/95 1/31/95	4/14/95 2/07/95	8/07/95 8/07/95 26
PG0253 Vitiated Air Bypass Quench Package deleted	1				P A/F											0

EQUIPMENT LIST CLASS: REFRACTORY LINED PIPE

LP0601 Carbonizer Overhead	1	1161A	116		P A/F	1/21/94 1/21/94A =====	2/04/94 2/04/94A =====	2/18/94 2/18/94A =====	3/18/94 3/18/94A =====	4/01/94 5/20/94A =====	4/15/94 11/04/94	4/29/94 11/11/94	6/24/94 12/16/94	11/18/94 3/24/95	12/02/94 3/31/95	8/07/95 8/07/95 18
LP0612 Carbonizer Hot Start-up Air	1	1161A	116		P A/F	1/21/94 1/21/94A =====	2/04/94 2/04/94A =====	2/18/94 2/18/94A =====	3/18/94 3/18/94A =====	4/01/94 5/20/94A =====	4/15/94 11/04/94	4/29/94 11/11/94	6/24/94 12/16/94	11/18/94 3/24/95	12/02/94 3/31/95	5/30/95 5/30/95 9
LP0613 Carbonizer Char	1	1161A	116		P A/F	1/21/94 1/21/94A =====	2/04/94 2/04/94A =====	2/18/94 2/18/94A =====	3/18/94 3/18/94A =====	4/01/94 5/20/94A =====	4/15/94 10/07/94	4/29/94 10/14/94	6/24/94 11/18/94	11/18/94 1/16/95	12/02/94 1/23/95	12/28/94 12/28/94 -4
LP0801 Carbonizer Cyclone Overhead	1	1161A	116		P A/F	1/21/94 1/21/94A =====	2/04/94 2/04/94A =====	2/18/94 2/18/94A =====	3/18/94 3/18/94A =====	4/01/94 5/20/94A =====	4/15/94 11/04/94	4/29/94 11/11/94	6/24/94 12/16/94	11/18/94 3/24/95	12/02/94 3/31/95	8/07/95 8/07/95 18
LP0802 Carbonizer PCD Overhead	1	1161A	116		P A/F	1/21/94 1/21/94A =====	2/04/94 2/04/94A =====	2/18/94 2/18/94A =====	3/18/94 3/18/94A =====	4/01/94 5/20/94A =====	4/15/94 11/04/94	4/29/94 11/11/94	6/24/94 12/16/94	11/18/94 2/20/95	12/02/94 2/27/95	5/08/95 5/08/95 10
LP0803 Carbonizer Cyclone Bottoms	1	1161A	116		P A/F	1/21/94 1/21/94A =====	2/04/94 2/04/94A =====	2/18/94 2/18/94A =====	3/18/94 3/18/94A =====	4/01/94 5/20/94A =====	4/15/94 10/07/94	4/29/94 10/14/94	6/24/94 11/18/94	11/18/94 1/16/95	12/02/94 1/23/95	2/13/95 2/13/95 3
LP0804 Carbonizer Char to Combustor	1	1161A	116		P A/F	1/21/94 1/21/94A =====	2/04/94 2/04/94A =====	2/18/94 2/18/94A =====	3/18/94 3/18/94A =====	4/01/94 5/20/94A =====	4/15/94 11/04/94	4/29/94 11/11/94	6/24/94 12/16/94	11/18/94 2/20/95	12/02/94 2/27/95	5/08/95 5/08/95 10
LP0806 Carbonizer PCD Bottoms	1	1161A	116		P A/F	1/21/94 1/21/94A =====	2/04/94 2/04/94A =====	2/18/94 2/18/94A =====	3/18/94 3/18/94A =====	4/01/94 5/20/94A =====	4/15/94 11/04/94	4/29/94 11/11/94	6/24/94 12/16/94	11/18/94 2/20/95	12/02/94 2/27/95	5/08/95 5/08/95 10

COMPONENT SCHEDULE
EQUIPMENT LIST REVISION DATED - 7/19/94

ITEM ITEM DESC Comment	QTY	SPEC/REQ	INQ #	PO #	FW ISSUE SPEC/ REQ	SCS APPROVE SPEC/ REQ	FW ISSUE INQUIRY/ RFQ	FW RECEIVE BIDS/ QUOTES	FW COMPLETE BID TABS	SCS BID TAB APPROVAL	FW RELEASE PURCHASE ORDER	FW RECEIVE VENDOR DRAWINGS	SHIP F.O.B.	DELIVERY TO SITE/SHOP	FIELD NEED SLACK (IN WKS)
LP0815 Char Transfer Line	1	1161A	116	P A/F						4/15/94 10/07/94	4/29/94 10/14/94	6/24/94 11/18/94	11/18/94 1/16/95	12/02/94 1/23/95	12/14/94 12/14/94 -6
LP0910 Combustor Primary Hot Start-up air	1	1161A	116	P A/F	1/21/94 1/21/94A =====	2/04/94 2/04/94A =====	2/18/94 2/18/94A =====	3/18/94 3/18/94A =====	4/01/94 5/20/94A =====	4/15/94 10/07/94	4/29/94 10/14/94	6/24/94 11/18/94	11/18/94 1/16/95	12/02/94 1/23/95	12/14/94 12/14/94 -6
LP0913 Combustor Above Grid Start-up air	1	1161A	116	P A/F	1/21/94 1/21/94A =====	2/04/94 2/04/94A =====	2/18/94 2/18/94A =====	3/18/94 3/18/94A =====	4/01/94 5/20/94A =====	4/15/94 11/04/94	4/29/94 11/11/94	6/24/94 12/16/94	11/18/94 2/20/95	12/02/94 2/27/95	5/08/95 5/08/95 10
LP1001 Combustor Cyclone Overhead	1	1161A	116	P A/F	1/21/94 1/21/94A =====	2/04/94 2/04/94A =====	2/18/94 2/18/94A =====	3/18/94 3/18/94A =====	4/01/94 5/20/94A =====	4/15/94 11/04/94	4/29/94 11/11/94	6/24/94 12/16/94	11/18/94 3/24/95	12/02/94 3/31/95	8/07/95 8/07/95 18
LP1002 Combustor PCD Overhead	1	1161A	116	P A/F	1/21/94 1/21/94A =====	2/04/94 2/04/94A =====	2/18/94 2/18/94A =====	3/18/94 3/18/94A =====	4/01/94 5/20/94A =====	4/15/94 11/04/94	4/29/94 11/11/94	6/24/94 12/16/94	11/18/94 2/20/95	12/02/94 2/27/95	5/08/95 5/08/95 10
LP1004 Combustor PCD Bottoms	1	1161A	116	P A/F	1/21/94 1/21/94A =====	2/04/94 2/04/94A =====	2/18/94 2/18/94A =====	3/18/94 3/18/94A =====	4/01/94 5/20/94A =====	4/15/94 11/04/94	4/29/94 11/11/94	6/24/94 12/16/94	11/18/94 3/24/95	12/02/94 3/31/95	7/12/95 7/12/95 15
LP1334 Air Preheater Line	1	1161A	116	P A/F						4/15/94 10/07/94	4/29/94 10/14/94	6/24/94 11/18/94	11/18/94 1/16/95	12/02/94 1/23/95	12/14/94 12/14/94 -6
LP1401 Carbonizer Alkali Getter Outlet	1	1161A	116	P A/F	1/21/94 1/21/94A =====	2/04/94 2/04/94A =====	2/18/94 2/18/94A =====	3/18/94 3/18/94A =====	4/01/94 5/20/94A =====	4/15/94 11/04/94	4/29/94 11/11/94	6/24/94 12/16/94	11/18/94 2/20/95	12/02/94 2/27/95	2/13/95 2/13/95 -2
LP1402 Combustor Alkali Getter Outlet	1	1161A	116	P A/F	1/21/94 1/21/94A =====	2/04/94 2/04/94A =====	2/18/94 2/18/94A =====	3/18/94 3/18/94A =====	4/01/94 5/20/94A =====	4/15/94 11/04/94	4/29/94 11/11/94	6/24/94 12/16/94	11/18/94 2/20/95	12/02/94 2/27/95	2/13/95 2/13/95 -2
LP2501 Fuel Gas Bypass Deleted	1			P A/F											0
LP2502 Vitiated Air Bypass Deleted	1			P A/F											0
LP2532 Fuel Gas & Vitiated Air Quench Pkg Added	1			P A/F						4/15/94 10/28/94	4/29/94 11/11/94	6/24/94 12/16/94	11/18/94 3/24/95	12/02/94 3/31/95	5/08/95 5/08/95 5
LP2533 Fuel Gas & Vitiated Air Quench Pkg Added	1			P A/F						4/15/94 10/28/94	4/29/94 11/11/94	6/24/94 12/16/94	11/18/94 3/24/95	12/02/94 3/31/95	5/08/95 5/08/95 5

EQUIPMENT LIST CLASS: VALVES

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COMPONENT SCHEDULE
EQUIPMENT LIST REVISION DATED - 7/19/94

ITEM ITEM DESC Comment	QTY	SPEC/REQ	INQ #	PO #		FW ISSUE SPEC/ REQ	SCS APPROVE SPEC/ REQ	FW ISSUE INQUIRY/ RFQ	FW RECEIVE BIDS/ QUOTES	FW COMPLETE BID TABS	SCS BID TAB APPROVAL	FW RELEASE PURCHASE ORDER	FW RECEIVE VENDOR DRAWINGS	SHIP F.O.B.	DELIVERY TO SITE/SHOP	FIELD NEED SLACK (IN WKS)
VL0262 Char Valve	1	1162A	115	PP-14	P A/F	1/24/94 1/24/94A =====	2/07/94 1/27/94A =====	2/21/94 4/01/94A =====	3/21/94 4/08/94A =====	4/04/94 4/15/94A =====	4/18/94 8/26/94A =====	5/02/94 9/14/94A =====	6/27/94 10/12/94 =====	12/09/94 3/08/95 =====	12/23/94 3/15/95 =====	5/08/95 5/08/95 8
VL0263 Vitiated Air Bypass Valve Deleted	1				P A/F											0
VL0264 Fuel Gas Bypass Valve Deleted	1				P A/F											0
VL0451 Vitiated Air Valves	1	1511A	115	PP-14	P A/F	1/24/94 1/24/94A =====	2/07/94 1/27/94A =====	2/21/94 4/01/94A =====	3/21/94 5/13/94A =====	4/04/94 5/27/94A =====	4/18/94 8/26/94A =====	5/02/94 9/14/94A =====	6/27/94 10/12/94 =====	12/09/94 3/08/95 =====	12/23/94 3/15/95 =====	5/08/95 5/08/95 8
VL0452 Fuel Gas Valve	1	1511B	115	PP-14	P A/F	1/24/94 1/24/94A =====	2/07/94 1/27/94A =====	2/21/94 4/01/94A =====	3/21/94 5/13/94A =====	4/04/94 5/27/94A =====	4/18/94 8/26/94A =====	5/02/94 9/14/94A =====	6/27/94 10/12/94 =====	12/09/94 3/08/95 =====	12/23/94 3/15/95 =====	5/08/95 5/08/95 8

EQUIPMENT LIST CLASS: VESSELS - DRUMS

AG0253 Carbonizer Alkali Getter Added To FWUSA Design Scope	1	1123A	112		P A/F	7/22/94 7/29/94A =====	7/29/94 7/22/94A =====	8/05/94 7/29/94A =====	8/26/94 8/22/94A =====	9/09/94 9/09/94A =====	9/16/94 10/01/94 =====	9/23/94 10/07/94 =====	10/21/94 11/04/94 =====	3/24/95 2/17/95 =====	4/07/95 2/24/95 =====	2/13/95 2/13/95 -2
AG0254 Combustor Alkali Getter Added To FWUSA Design Scope	1	1124A	112		P A/F	7/22/94 7/29/94A =====	7/29/94 7/22/94A =====	8/05/94 7/29/94A =====	8/26/94 8/22/94A =====	9/09/94 9/09/94A =====	9/16/94 10/01/94 =====	9/23/94 10/07/94 =====	10/21/94 11/04/94 =====	3/24/95 2/17/95 =====	4/07/95 2/24/95 =====	2/13/95 2/13/95 -2
DR0251 Carbonizer Coal Surge Drum	1	1131A	106	PP-3	P A/F	12/06/93 12/06/93A =====	12/20/93 12/13/93A =====	1/03/94 12/17/93A =====	1/31/94 1/18/94A =====	2/14/94 2/25/94A =====	2/28/94 4/29/94A =====	3/14/94 5/27/94A =====	5/09/94 6/29/94A =====	10/03/94 10/28/94 =====	10/17/94 11/04/94 =====	2/13/95 2/13/95 14
DR0252 Carbonizer Coal Feed Drum	1	1131B	106	PP-3	P A/F	12/06/93 12/06/93A =====	12/20/93 12/13/93A =====	1/03/94 12/17/93A =====	1/31/94 1/18/94A =====	2/14/94 2/25/94A =====	2/28/94 4/29/94A =====	3/14/94 5/27/94A =====	5/09/94 6/29/94A =====	10/03/94 11/18/94 =====	10/17/94 11/25/94 =====	12/28/94 12/28/94 5
DR0253 Sorbent Surge Drum	1	1131C	106	PP-3	P A/F	12/06/93 12/06/93A =====	12/20/93 12/13/93A =====	1/03/94 12/17/93A =====	1/31/94 1/18/94A =====	2/14/94 2/25/94A =====	2/28/94 4/29/94A =====	3/14/94 5/27/94A =====	5/09/94 6/29/94A =====	10/03/94 10/28/94 =====	10/17/94 11/04/94 =====	2/13/95 2/13/95 14
DR0254 Sorbent Feed Drum	1	1131D	106	PP-3	P A/F	12/06/93 12/06/93A =====	12/20/93 12/13/93A =====	1/03/94 12/17/93A =====	1/31/94 1/18/94A =====	2/14/94 2/25/94A =====	2/28/94 4/29/94A =====	3/14/94 5/27/94A =====	5/09/94 6/29/94A =====	10/03/94 10/28/94 =====	10/17/94 11/04/94 =====	12/28/95 12/28/95 60
DR0255 Combustor Coal Surge Drum	1	1131E	106	PP-3	P A/F	12/06/93 12/06/93A =====	12/20/93 12/13/93A =====	1/03/94 12/17/93A =====	1/31/94 1/18/94A =====	2/14/94 2/25/94A =====	2/28/94 4/29/94A =====	3/14/94 5/27/94A =====	5/09/94 6/29/94A =====	10/03/94 11/18/94 =====	10/17/94 11/25/94 =====	2/13/95 2/13/95 11
DR0256 Combustor Coal Feed Drum	1	1131F	106	PP-3	P A/F	12/06/93 12/06/93A =====	12/20/93 12/13/93A =====	1/03/94 12/17/93A =====	1/31/94 1/18/94A =====	2/14/94 2/25/94A =====	2/28/94 4/29/94A =====	3/14/94 5/27/94A =====	5/09/94 6/29/94A =====	10/03/94 11/18/94 =====	10/17/94 11/25/94 =====	12/28/94 12/28/94 5

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COMPONENT SCHEDULE
EQUIPMENT LIST REVISION DATED - 7/19/94

ITEM ITEM DESC Comment	QTY	SPEC/REQ	INQ #	PO #		FW ISSUE SPEC/ REQ	SCS APPROVE SPEC/ REQ	FW ISSUE INQUIRY/ RFQ	FW RECEIVE BIDS/ QUOTES	FW COMPLETE BID TABS	SCS BID TAB APPROVAL	FW RELEASE PURCHASE ORDER	FW RECEIVE VENDOR DRAWINGS	SHIP F.O.B.	DELIVERY TO SITE/SHOP	FIELD NEED SLACK (IN WKS)
DR0257 Moisture Separator Drum	1	1131G	106	PP-3	P A/F	1/03/94 1/19/94A =====	1/17/94 1/19/94A =====	1/31/94 1/28/94A =====	2/14/94 2/11/94A =====	3/14/94 3/25/94A =====	3/28/94 4/29/94A =====	4/11/94 5/27/94A =====	6/06/94 6/29/94A =====	10/31/94 11/11/94	11/14/94 11/18/94	11/14/94 11/14/94 -1
DR0258 Carbonizer Cyclone Drain Drum Deleted	1				P A/F											0
DR0260 A/B Ash Depressurization Drums	2	1131K	106	PP-3	P A/F	12/06/93 12/06/93A =====	12/20/93 12/13/93A =====	1/03/94 12/17/93A =====	1/31/94 1/18/94A =====	2/14/94 2/25/94A =====	2/28/94 4/29/94A =====	3/14/94 5/27/94A =====	5/09/94 6/29/94A =====	10/03/94 10/28/94	10/17/94 11/04/94	12/14/94 12/14/94 6
DR0264 Oversize Char Drum	1	1131L	106	PP-3	P A/F	1/03/94 1/19/94A =====	1/17/94 1/20/94A =====	1/31/94 1/20/94A =====	2/28/94 2/11/94A =====	3/14/94 3/25/94A =====	3/28/94 4/29/94A =====	4/11/94 5/27/94A =====	6/06/94 6/29/94A =====	10/31/94 11/18/94	11/14/94 11/25/94	2/13/95 2/13/95 11
DR0265 Ash Surge Drum	1	1131M	106	PP-3	P A/F	1/03/94 1/19/94A =====	1/17/94 1/19/94A =====	1/31/94 1/20/94A =====	2/28/94 2/11/94A =====	3/14/94 3/25/94A =====	3/28/94 4/29/94A =====	4/11/94 5/27/94A =====	6/06/94 6/29/94A =====	10/31/94 11/18/94	11/14/94 11/25/94	2/13/95 2/13/95 11

EQUIPMENT LIST CLASS: VESSELS - HOPPERS

H00252 Coal Surge Hopper	1	1143A	111	PP-3	P A/F	1/03/94 1/05/94A =====	1/17/94 1/13/94A =====	1/31/94 1/14/94A =====	2/28/94 1/28/94A =====	3/14/94 3/04/94A =====	3/28/94 4/29/94A =====	4/11/94 5/27/94A =====	6/06/94 6/29/94A =====	10/31/94 11/18/94	11/14/94 11/25/94	8/07/95 8/07/95 36
H00253 Sorbent Surge Hopper	1	1143B	111	PP-3	P A/F	1/03/94 1/05/94A =====	1/17/94 1/13/94A =====	1/31/94 1/14/94A =====	2/28/94 1/28/94A =====	3/14/94 3/04/94A =====	3/28/94 4/29/94A =====	4/11/94 5/27/94A =====	6/06/94 6/29/94A =====	10/31/94 11/18/94	11/14/94 11/25/94	5/30/95 5/30/95 27

EQUIPMENT LIST CLASS: VESSELS - REACTORS

RX0251 Carbonizer	1	1121A	113	PP-2	P A/F	1/03/94 1/24/94A =====	1/17/94 1/25/94A =====	1/31/94 3/18/94A =====	2/28/94 4/08/94A =====	3/14/94 4/15/94A =====	3/28/94 4/29/94A =====	4/11/94 7/01/94A =====	6/06/94 8/19/94A =====	2/06/95 3/31/95	2/20/95 4/07/95	8/07/95 8/07/95 17
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