VED

DEC 20 1993

OSTI

**HOT GAS CLEANUP TEST FACILITY FOR GASIFICATION AND
PRESSURIZED COMBUSTION**

**QUARTERLY TECHNICAL PROGRESS REPORT
OCTOBER 1 - DECEMBER 31, 1992**

Prepared by:

**SOUTHERN COMPANY SERVICES, INC.
800 Shades Creek Parkway
P. O. Box 2625
Birmingham, Alabama 35202-2625**

Work Performed Under DOE Cooperative Agreement No. DE-FC21-90MC25140

**THE UNITED STATES DEPARTMENT OF ENERGY
Morgantown Energy Technology Center
3610 Collins Ferry Road
P. O. Box 880
Morgantown, West Virginia 26507-0880**

MASTER

DISCLAIMER

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

**HOT GAS CLEANUP TEST FACILITY FOR GASIFICATION
AND PRESSURIZED COMBUSTION
QUARTERLY TECHNICAL PROGRESS REPORT
OCTOBER 1 - DECEMBER 31, 1992**

TABLE OF CONTENTS

1.0	INTRODUCTION AND SUMMARY	1-1
2.0	REVIEW OF TECHNICAL PROGRESS	2-1
2.1	Project Management	2-1
2.2	Phase 1 - Conceptual Design Activities	2-1
2.2.1	Task 1.4 Transport Reactor Development Unit	2-1
2.3	Phase 2 - Detailed Design Activities	2-5
2.3.1	Task 2.1 Detailed Design	2-5
2.3.1.1	MWK: PSDF Transport Train	2-5
2.3.1.2	FW Team Activities	2-6
2.3.1.3	Balance-of-Plant Activities	2-6
2.3.2	Task 2.3 Environmental Permitting and NEPA Support	2-8
2.3.3	Task 2.4 Particle Characterization and Collection'	2-9
2.3.4	Task 2.5 Particle Control Technologies	2-9
2.4	Publications and Presentations	2-10
3.0	PLANS FOR FUTURE WORK	3-1
4.0	REFERENCES	4-1

APPENDIX A TRDU EQUIPMENT PROCUREMENT LIST

APPENDIX B PARTICLE CHARACTERIZATION COLLECTION

1.0 INTRODUCTION AND SUMMARY

This quarterly technical progress report summarizes work completed during the Ninth Quarter of the First Budget Period, October 1 through December 31, 1992, 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 existing 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 (Phase 2), received and started evaluating the proposals for the Carbonizer/Transport and the circulating pressurized fluidized-bed combustor (CPFBC) particulate control devices (PCDs), and continue the installation of the transport reactor development unit (TRDU). Contract modifications for the project were made to include the detailed design expansion for the PSDF. A letter agreement to modify the FW subcontract for the detailed design expansion was established. The detailed design of the PSDF continued with a meeting being held with the engineering design team to address interface points and develop an integrated detailed working schedule for the project. SRI continued the design of the particulate sampling systems for the PSDF, providing piping specifications and drawings for the sampling to be reviewed by the engineering design team. The proposals for the Carbonizer/Transport PCDs were received in mid-November and were reviewed by the project review team. The proposals for the CPFBC were also received in early December. The Environmental Information Volume (EIV)

for the PSDF was submitted by SCS to DOE/METC in early November as part of the DOE National Environmental Policy Act (NEPA) process.

It should be noted that this report includes accounts of progress made by M. W. Kellogg (MWK), Foster Wheeler (FW), Southern Research Institute (SRI), and University of North Dakota Energy & Environmental Research Center (UNDEERC).

2.0 REVIEW OF TECHNICAL PROGRESS

2.1 PROJECT MANAGEMENT

Project management activities during this time period focused on contract modifications for the project based on the detailed design expansion and initiating the preparation of the Continuation Application for Budget Period No. 2. The SCS/DOE Cooperative Agreement was modified to include the detailed design expansion, and modifications to the subcontracts for the project were initiated.

A letter agreement between FW and SCS was established to initiate the FW portion of the detailed design for the PSDF. Negotiations are continuing between FW and SCS to amend the FW subcontract established in the conceptual design to include the detailed design work scope. FW issued purchase orders for their internal subsidiaries (Foster Wheeler Energy Corporation and Foster Wheeler Development Corporation) as well as Westinghouse for the topping combustor and Allison for the gas turbine/generation set, for the detailed design. Negotiations for amendments to the MWK and SRI subcontracts for the detailed design expansion also continued during this time period.

SCS contacted DOE/METC for clarification on the detailed design activities that could proceed prior to DOE NEPA approval for the project. A meeting was held between DOE/METC and SCS to discuss the project schedule and the submission of the Continuation Application for Budget Period No. 2. DOE requested that budget periods be changed from a work scope to an annual basis. Figure 2-1 illustrates the change in budget periods for the project along with the updated overall project schedule. Budget Period No. 2 will include the remainder of Phase 2 - Detailed Design and the initiation of Phase 3 - Installation once NEPA approval for the project is received. The end of Budget Period No. 1 is March 13, 1993.

2.2 PHASE 1 - CONCEPTUAL DESIGN ACTIVITIES

2.2.1 Task 1.4 Transport Reactor Development Unit

The transport reactor development unit (TRDU) work proceeded in several areas including procurement, process and instrumentation diagrams, structural tower modifications, refractory pouring, and instrumentation installation.

Modifications to the second, third, fourth, fifth, and sixth floors have been completed. The seventh floor work is continuing with integration of the hot gas cleanup loop. The floor grating has been placed on all levels temporarily. Permanent installation of the grating with access holes and kickplates surrounding the TRDU will occur after the reactor installation.

As of January 21, 1993, 21 of the 28 pieces of the reactor had been received by the EERC. Of the 21, 15 have been poured. Six sections are in the process of being poured. Table 2-1 lists the sections and status of each. The EERC had to grind down the refractory in the disengager and primary cyclone. The refractory was protruding past the flange face. The vendor was contacted, and the work will be back-charged.

The nonpressurized coal hoppers, pressurized coal hopper, and pressurized surge hopper have been constructed and will be installed beginning the week of January 18th. The limestone-ash (LASH) cooling auger design specifications are being reviewed. The air-handling relocation bid was received and construction should be completed by late February. The natural gas preheat burner is in the final design phases. The parts list has been generated and procurement will begin by late January. The steam superheater is being raised approximately 3 feet to facilitate the superheated steam piping. The support is in the design phase. The steam piping and manifold design have been finalized. Field wiring from the control panel to the junction boxes is underway. The control panel instrument additions have been completed. The instrumentation diagram is complete and is being reviewed internally. Appendix A includes the equipment procurement list and the status of each item. A functional specification for the cyclone dipleg heater has been prepared and issued.

The North Dakota State Health Department has determined that the TRDU does meet the requirements for a construction or operating permit. The LASH material will be analyzed prior to disposal or oxidation. If the material exceeds the Environmental Protection Agency allowable sulfide reactivity, the material will not be allowed to be oxidized.

A review meeting was held with MWK, SCS, and EERC to discuss the current status of various aspects of the TRDU project. Following are the highlights of the discussions:

1. The purchase, installation, and checkout of the boiler is the most critical item and the one most likely to affect the testing and operations schedules.
2. Discussions were held on the nozzle size and the type of pipe to be used for the differential pressure transmitters. The largest nozzle diameters on the TRDU is 1/2 inch; 1/4-inch tubes will be used for differential pressure measurements. If a larger diameter is needed, the refractory will be bored out.
3. The product gas will be flared all the time. The flare modifications will allow for flaring the product gas even during startup.

Table 2-1
Status of TRDU Spool Pieces

Section	Received	Poured	Partially cured
C	X	X	
D	X	X	
E	X		
F	X		
G			
H	X	X	
I			
J	X	X	X
K	X	X	X
L			
M	X	X	X
N	X	X	X
O			
P	X	X	X
Q			
R	X	X	X
S	X	X	X
T	X	X	X
U	X	X	X
CO	X		
OH1	X		
OH2			
OH3	X	X	X
OH4			
OH5	X	X	X
OH6	X	X	X
Mix T	X		
Mix B	X		

4. Regarding gas measurements, on-line gas chromatographs and FTIR instruments will be used to analyze the gas. The FTIR can measure CO, H₂S, and other gases with large dipole moments. It can detect these gases down to ppm levels, and it can provide data in seconds. The gas chromatograph will measure H₂, N₂, and other diatomic gases every 8 to 15 minutes. There are some existing CO and CO₂ monitoring devices and the EERC will look into the use of these instruments.
5. Presentations were made by EERC on an alkali sampling program and a trace metals modeling program that could potentially use data generated by the TRDU.

Requisitions have been revised and issued for the spring hangers and supports and vendor quotations have been reviewed. The spring hangers and supports have been committed for purchase.

Comments from SCS and EERC on the Startup, Shutdown, and Operating Philosophy and the Test Program have been reviewed by M. W. Kellogg Company. Finalized versions of these documents are being prepared.

2.3 PHASE 2 - DETAILED DESIGN ACTIVITIES

2.3.1 Task 2.1 Detailed Design

2.3.1.1 MWK: PSDF Transport Train

At the beginning of the quarter, changes to the overall piping and instrumentation diagram (P&ID) drawings and material balances were issued as Process Release 4. Work was started on Issue R of the P&IDs.

Requisition packages were issued for the Thermal Oxidizer, the Main Air Compressor, the Startup Burner, and the Sulfator Cyclone. Material Selection Guide, Material Safety Data Sheets, and the Electrical and Instrument specification for packaged equipment items were issued. Financial input was provided to SCS for the project continuation request. The PFD's were revised to include SCS's Equipment Numbering System.

Several tasks were completed but have not been issued, they were 1) Startup, Shutdown and Operating Philosophy; 2) material balance for the oxygen case; 3) Analytical design of the Sulfator; 4) preliminary specification for the high pressure cyclones; 5) shell temperature and heat loss calculations for the Transport Reactor -- to establish design conditions and shell sizes.

Other tasks that have been started were 1) Control Philosophy and the Overpressure Protection and Flare Philosophy; 2) analytical design of Vessels and Exchangers; 3) revision of plot plan and layout of current equipment list; 4) Mechanical design and layout of the reactor.

2.3.1.2 FW Team Activities: PSDF Advanced PFBC Train

A Second Letter of Agreement was executed with FW to increase the interim funding for Phase 2 work. Planning and scheduling for the overall execution of the Phase 2 work was completed through initial schedule release. The project is on schedule for activities to be completed or initiated during this reporting period. A potential problem with future schedule was identified with the topping combustor test program by Westinghouse. The long lead impact of both the turbine/generator and the topping combustor's fabrication/delivery cycle may require schedule adjustments in the future.

The Phase 2 detail engineering task force was set up and engineering work started. Coordination meetings were held with FWEC, FWDC, Allison, and Westinghouse for the Phase 2 design effort, and physical interfaces were defined. FW participated in a project team review of the PCDs for the transport reactor and carbonizer. Specific tasks accomplished by FW during this reporting period are:

- Purchase orders were issued to FWEC, FWDC, Allison, and Westinghouse with limited expenditure levels.
- Reviews of materials of construction and pressure/temperature were completed. Fifty-four project standards were completed and issued to SCS for comment.
- The fluid bed exchanger design was changed from a three vessel assembly to a one vessel unit. Coal and sorbent handling interfaces were defined.
- Equipment arrangement drawings were issued matching all levels of the Transport Gasifier structure. Equipment numbering, drawing title block, and drawing numbering were revised to conform to SCS requirements. Electrical area classification drawings were issued, as were drawings for nine unlined vessels. Process flow diagram, equipment list, and lined pipes list were also issued.

For future work, detail engineering will continue in accordance with the Phase 2 schedule. Contract completion for all detailed engineering is planned.

2.3.1.3 Balance-of-Plant Activities

During this reporting period, the primary activities of SCS Engineering focused on the development of an Engineering Coordination Procedure and development of an updated schedule integrating the activities of FW, MWK, SCS, and SRI based on a January 1995 startup date. Three separate meetings, one each with FW, MWK, and SRI, were held to define interface points, develop schedules, and review design progress. SCS also developed a 3-D CAD site layout with revision to include the location of the 230/4.160 KV substation. The 3-D site layout is illustrated in Figure 2-2.

Figure 2-2. Power systems development facility Wilsonville, Alabama

Other activities for the reporting period included:

- Subsurface investigation of the site.
- Continued general control system design.
- Revised the site layout drawing to reflect the true topographical elevations obtained during the site survey.
- Received and reviewed seven (7) vendor drawings/specifications from M.W. Kellogg and forty-five (45) vendor drawings/specifications from Foster Wheeler during the month of December 1992.
- Revised the conceptual design of the maintenance/warehouse facility to accommodate chemical lab, lockers and showers, which were all relocated from administrative/control building.
- Attended a bid review meeting on the PCD's to evaluate with project team for the ranking of the vendors for consideration on the project.
- Collected site conditions for transmittal to M.W. Kellogg.
- Reviewed generic specifications submitted by Foster Wheeler on their process design.
- Determined the MCI Mail and video conferencing capabilities for SCS for transmittal to M.W. Kellogg.
- Responded to questions from Foster Wheeler and M.W. Kellogg of design and site conditions as requested.

2.3.2 Task 2.3 Environmental Permitting and NEPA Support

An updated Environmental Information Volume (EIV) for the PSDF was submitted to DOE in November 1992 in support of the DOE NEPA process. The Action Description Memorandum for the PSDF was signed by DOE Headquarters agreeing that an Environmental Assessment (EA) was required for the project. SCS continues to supply additional technical information required for the EA document. The majority of the information has been supplied through the EIV and a few items are outstanding. These will be incorporated into the draft EA.

An environmental permitting strategy was developed for the PSDF and was included in the EIV. The critical path for the environmental permitting effort is obtaining an air permit from Alabama Department of Environmental Management (ADEM) prior to pouring foundations. A draft of the air permit application for the PSDF is being

prepared. This draft will be available for internal review in the first quarter of 1993. The air permit application will be submitted to the ADEM by the middle of February. It is anticipated that it will take about 6 months for the air permit to be issued. A storm water runoff permit for construction will also have to be obtained 30 days prior to the start of construction.

2.3.3 Task 2.4 Particle Characterization and Collection

In the last quarter of 1992, SRI focused on the detailed design of the particulate sampling system, the requirements for piping layout and ports, and the evaluation of particulate monitors. SRI responded to comments received from SCS and from Foster Wheeler on the process flow diagrams for the particulate sampling system. SRI representatives met with the SCS project engineering team to discuss SRI's requirements for piping layout and ports, data acquisition requirements, sampling probe operation procedures, and P&IDs. SRI's piping layout drawings were updated and resubmitted as design input. Revised P&IDs and an updated input/output (I/O) count was submitted to SCS. A three-dimensional AutoCAD drawing of the cyclone assembly and bauxite cartridge was produced. Details of the probe insertion mechanism were defined, and written operating procedures were developed. The design of the bauxite cartridge was modified to move the flanged connection out of the hot gas stream and to allow pressurization of the probe annulus.

The updated drawing, P&IDs, and piping requirements are included in Appendix B. SRI developed a tentative strategy for deploying the particulate monitors. Two SRI representatives participated in the technical evaluation of the proposals to supply the particulate control devices (PCDs) for the transport reactor and carbonizer.

The facility expansion resulted in a revision of SRI's Statement of Work (SOW). Tasks under the new Work Breakdown Structure (WBS) in which SRI participates include:

- Subtask 2.4.1 Design Interface
- Subtask 2.4.2 Particulate System Engineering
- Subtask 2.4.3 Alkali Measurement
- Task 2.5 Particulate Control Devices
- Task 2.8 Experimental Test Plan
- Subtask 2.9.1 SRI Project Management

2.3.4 Task 2.5 Particle Control Technologies

Six proposals for supplying the small capacity PCDs were received by SCS on November 12, 1992, and four proposals for the large capacity PCD were received on December 3, 1992. A meeting was held December 8-10 for evaluation of the small capacity PCDs in Birmingham with representatives from DOE, EPRI, FW, MWK, SCS, and SRI present. The top three proposals were selected and ranked. A meeting for evaluation of the large capacity PCD proposals was scheduled for January 26 and 27, 1993. The January

meeting included not only the final selection of the large capacity PCD, but also the final selection of all the small capacity PCDs, since the same company will not be selected to supply the small and large capacity applications, if this is practical.

The preferred vendors will be announced in the next quarterly report after SCS has successfully negotiated acceptable terms with the preferred vendors and officially notified the vendors of intent to award a contract. A draft report on the selected PCDs and the rationale used for selection will be completed by March 15.

2.4 PUBLICATIONS AND PRESENTATIONS

1. R.E. Sears, et al.
"Turbine and Hot Gas Cleanup at Wilsonville"
Presented at DOE/METC Heat Engines Contractors Conference Meeting
October 27-28, 1992 - Morgantown, WV
Presented by T.E. Pinkston

3.0 PLANS FOR FUTURE WORK

- 1. Complete the installation of the TRDU and begin shakedown of the unit.**
- 2. Prepare and submit the air permit application to ADEM for the PSDF.**
- 3. Review and comment on the Environmental Assessment of the PSDF prepared by DOE as part of the DOE NEPA approval process.**
- 4. Continue the detailed design of the PSDF.**
- 5. Prepare for the 25 percent detailed design meeting with DOE and update the Facility Design Documents to reflect the 25 percent design point.**
- 6. Complete the project team review of the PCD proposals, make recommendations to DOE on the PCD technologies for the PSDF, and finalize the PCD procurement.**
- 7. Continue the detailed design of the particulate sampling system for the PSDF.**
- 8. Finalize the negotiations for the Foster Wheeler subcontract and the Continuation Application for Budget Period No. 2 with DOE.**

APPENDIX A
TRDU EQUIPMENT PROCUREMENT LIST

EQUIPMENT	EST. COST	ACTUAL COST	VENDOR	TOTAL EST	TOTAL ACTUAL	P.O. NUMBER	P.O. DATE	NOTES	COMPLETED Y/N
TRDU EQUIPMENT COST		14-Jan-93							
FILE NAME: TRDU-EQ									
WINDOW NAME: COST									
EQUIPMENT	EST. COST	ACTUAL COST	VENDOR	TOTAL EST	TOTAL ACTUAL	P.O. NUMBER	P.O. DATE	NOTES	COMPLETED Y/N
AREA 100 - CONTROL ROOM									
10 INSTRUMENTATION									
10A ANALOG INPUT W/BACKPLANE	\$2,450	\$2,584.00	WESCO	89,645.00	\$4,971.85	326396	11/10/92	Tag: E4920 Area 100	
10B PSD1 W/BACKPLANE	\$310	\$882.00				326396	11/10/92	Tag: E4920 Area 100	
10C TC ANALOG INPUT W/BACKPLANE	\$1,800	\$1,498.00				326396	11/10/92	Tag: E4920 Area 100	
10L 40 INTRINSIC BARRIERS	\$4,750								
Bus House extension		\$7.85	Dalco Electronics				12/16/92	Tag: E4920 Panel Upgrade	
12 BURNER									
12C 1 FLAME DETECTOR	\$335								
AREA 200A - UTILITIES: GAS UTILITY PANEL				\$47,581.00	\$26,640.70				
1 PIPE									
1A 40 FEET - 2", SCHED. 40, 316H SS	\$1,200								
1/4 STAINLESS TUBING									
1D 5 20' X 3/8 BRASS TUBING	\$200								
1E 5 20' X 1/2 BRASS TUBING	\$200								
1F 5 20' X 3/4 BRASS TUBING	\$400								
2 CARBON STEEL PIPE AND FITTINGS	\$12,000								
EAPC design work NTE \$2K		\$1,856.00	EAPC Arch Engrs			325516	10/28/92	Design work complete	
COAL FEED PIPE	\$200								
Cap, pipe, weldneck, flange		\$175.40	Adv Fluid Controls			325779	11/4/92	Tag: E6021 Recvd	
Carbon steel plate, 4'x8'x.250"		\$108.00	N. Plains Steel			325780	11/4/92	Tag: E6021 Recvd	
2 Coal Nurse Hoppers		\$981.90	GF Welding			326099	11/12/92	Tag: E6021 Recvd	
10 INSTRUMENTATION									
10F 3 1-1/2" ELECTRIC BALL VALVES	\$1,500								
0-200psi Duragauge, tubing, fitting		\$651.60	Simone Engr Inc			325292	10/23/92	Tag: E6021 Recvd	
CHECK VALVES	\$581	\$218.30	Advanced Fluid Controls			327301	12/11/92	Tag: E6021 Area 200A	

EQUIPMENT	EST. COST	ACTUAL COST	VENDOR	TOTAL EST	TOTAL ACTUAL	P.O. NUMBER	P.O. DATE	NOTES	COMPLETED Y/N
FLOW CONTROL VALVES	\$5,400	\$3,960.50	Simone Eng, Inc.				12/22/92	Tag: E6021 Area 200A	
I/P	\$900								
5 PANEL ROOTS METERS	\$11,000	\$8,790.00	Cont&Mtrs and Bentec		327262 and 327261		12/10/92	Tag: E6021 Rcvd C&M 1/6/93	
11 PANEL ROTAMETERS	\$8,800	\$9,899.00	Brooks/ME Young Co				1/13/93	Tag: E6021 Area 200A	
BALL VALVES	\$4,200								
LOCAL PRESSURE GAUGES	\$1,000								
AREA 200B - UTILITIES: INSTRUMENTATION I/P PANEL				\$1,750.00	\$183.95				
1 PIPE									
1B 5 20' X 1/8 BRASS TUBING	\$200								
1C 5 20' X 1/4 BRASS TUBING	\$150								
10 INSTRUMENTATION									
10D 6 I/P 4-20 mA	\$1,400								
4 Meg upgrade Sys 310		\$183.95	Dell			322699	8/26/92		
AREA 200C - UTILITIES: BOILER				\$15,000.00	\$13,880.00				
BOILER	\$15,000	\$13,880.00	Bleal-Evans			327302	12/10/92	Tag: E Area 200C	
AREA 200D - UTILITIES: NATURAL GAS COMPRESSOR				\$7,000.00	\$17,382.00				
NATURAL GAS COMPRESSOR	\$7,000	\$17,382.00	J. H. Foster, NM, Inc			327295	12/10/92	Tag: E Area 200D	
AREA 300 - CARBONIZER				\$500.00	\$2,184.96				
PIPE									
8" sch 40, LR 90 elbow, 316ss, A312		\$386.90	Advanced Fluid Controls			320518	7/20/92	Tag: E4985 Recvd	
8" sch 40 welded, 316ss, A312		\$545.00	Advanced Fluid Controls			320518	7/20/92	Tag: E4985 Recvd	
4" sch 5, LR 90 elbow, 316ss, A312		\$68.00	Advanced Fluid Controls			320518	7/20/92	Tag: E4985 Recvd	
16"x16"x1" thick carbon steel plate									
SA 516 70		\$72.00	Advanced Fluid Controls			320693	7/21/92	Tag: E4985 Recvd	
4" sch 5 welded, 316ss, A312		\$90.00	Advanced Fluid Controls			320693	7/21/92	Tag: E4985 Recvd	

EQUIPMENT		EST. COST	ACTUAL COST	VENDOR	TOTAL EST	TOTAL ACTUAL	P.O. NUMBER	P.O. DATE	NOTES	COMPLETED Y/N
8" sch 40, 300# weldneck, raised face 316SS			\$842.00	Advanced Fluid Controls			323822	9/21/92	Tag: E4985 Recvd	
8"x4" concentric reducer, 304ss std wt			\$181.06	Advanced Fluid Controls			324910	10/14/92	Tag: E4985 rcvd - need NTRs	
CARBONIZER ELBOW		\$500								
AREA 400 - TRDU PROPER					\$175,162.00	\$110,879.84				
3 STAINLESS STEEL AND FITTINGS		\$7,000								
ADDITIONAL TUBING		\$1,000								
PAINT FOR STAINLESS STEEL			\$320.00	GF Supply				1/5/93	TAG: E4921 AREA 400	
5 FEEDER MODIFICATION										
5A SITE PORTS		\$150								
5B BAUMANN VALVE		\$570								
5C ROOTS METER		\$1,500								
5D ROTOMETER		\$250								
COAL FEEDER MODIFICATION		\$4,000								
SURGE HOPPER										
PIPE, FLANGES, GASKETS										
LOW PRESSURE COAL HOPPERS		\$3,800	\$3,939.04	Lilke				12/22/92	Tag: E4921 Area 400	
PRIMARY CYCLONE SAMPLE LOCKHOPPER		\$2,000								
304 SEAMLESS PIPE			\$98.75	Advanced Fluid Controls			328164	1/5/93	Tag: E4921 Area 400	
LASH LOCKHOPPER		\$2,500	\$1,497.65	Advanced Fluid Controls		327300 &	327300	12/11/92	Tag: E4921 Area 400	
FLANGE & COUPLINGS			\$143.60	Advanced Fluid Controls			328161	1/5/93	Tag: E4921 Area 400	
COOLING AUGER		\$16,000	\$12,376.00	Christian Engineering				12/11/92	Tag: E4921 Area 400	
AIR PREHEATER		\$50,000	\$35,140.00	Caloritech, Inc			327260	12/10/92	Tag: E4921 Area 400	
4 SSR		\$3,800	\$11,020.00	Border States Electric			327259	12/10/92	Tag: E4921 Area 400	
4 CONTROLLERS		\$1,600								
10 INSTRUMENTATION										
10E 6 BAUMANN VALVES		\$3,600								
10G 4 PRESSURE TRANSMITTERS		\$3,100	\$3,851.25	Simons Engr, Inc			325119	10/15/92	5 ea ordered - Recvd	

EQUIPMENT		EST. COST	ACTUAL COST	VENDOR	TOTAL EST	TOTAL ACTUAL	P.O. NUMBER	P.O. DATE	NOTES	COMPLETED Y/N
10H	14 DP TRANSMITTERS	\$13,125	\$12,151.50	Simone Eng, Inc			325119	10/15/92	14 ordered - Recvd	
10I	1 BAILEY TUNING BOARD	\$500								
10J	100 FT 24 PR TC CABLE	\$1,100	\$1,060.00	Simone Engr Inc			319772	7/10/92	Received 9/28/92	
10K	3000 FT SINGLE TC CABLE	\$1,200	\$630.00	Quest			321110	7/10/92	Received 9/28/92	
	3000 FT COMM WIRE		\$390.00	Simone Engr Inc			319772	7/10/92	Received 9/28/92	
10M	45 TYPE K THERMOCOUPLES	\$844	\$1,487.73	Simone Eng, Inc			324940	10/15/92	68 ordered - Recvd	
10O	K & B THERMOCOUPLE CONNECTORS	\$2,000	\$27.95	Omega Engineering	(more to come)		325027	10/15/92	Recvd Some	
10P	60 THERMOWELLS	\$3,800								
	5"x4" 310 ss round		\$198.20	Advanced Fluid Controls			324957	10/20/92	Tag: E4921 Recvd	
	1/4" sched 80, 310ss pipe		\$503.60	Apollo Piping			325377	10/29/92	Tag E4921 Recvd	
	303 SS TC connectors/SS reducing bshng		\$282.90	Quest			325647	11/2/92	Tag: E4921 Area 400	
10Q	32 ROTOMETERS 0-10 SCFH	\$3,900	\$2,558.50	Wm E. Young Co			325479	10/30/92	Tag: E4921 Recvd	
	INSTRUMENTATION TAGS	\$850								
	12 METERING VALVES	\$5,000								
	1 PRESSURE TRANSMITTER	\$1,550	See PO 325119 for this item							
	GAMMA RAY DENSITOMETER	\$6,400	\$5,967.00	MDT Controls			327303	12/11/92	Tag: E4921 Area 400	
	HIGH TEMPERATURE AIR FLEX HOSE	\$1,280								
11	REFRACTORY	\$28,000								
	Stainless steel needles Ribtec-310		\$2,487.70	Ribbon Tech Corp			325480	10/29/92	Tag: E4921 Recvd	
	Litewit Castable 20 Refractory		\$5,057.32	Gagnon Inc			325915	10/29/92	Tag: E4921 Recvd	
	Resco RS-3A and RS-17EC Refractory		\$6,795.00	Resco Products, Inc			325932	10/29/92	Tag: E4921 Recvd	
	Plastic Pipe-forms		\$350.40	Northern Plumbing			326802	11/30/92	Tag: E4921 Recvd	
	310 ss pipe		\$633.25	Advanced Fluid Controls			326828	12/1/92	Tag: E4921 Recvd	
	Fiberfrax Durablkts		\$437.50	Smith-Sharpe Co			327313	12/11/92	Tag: E4921 Area 400 Refrcty	
	Propane burner & orifices		\$288.00	Suburban Propane			327603	12/21/92	Tag: E4921 Area 400	
	Resco RS-3A and RS-17EC Refractory		\$1,187.00	Resco Products, Inc			328162	1/5/93	Tag: E4921 Area 400 Refrcty	
12	BURNER									
12A	2 1/2" 3' BRASS FLEX HOSE	\$175								
12B	1 1" 3' BRASS FLEX HOSE	\$110								
12D	1 SPARK PLUG	\$125								
12E	1 TRANSFORMER	\$200								
12F	1 PRESSURIZED BURNER	\$1,350								
12G	1 18" X 36" CARBON STEEL PIPE	\$413								
12H	1 36" CARBON STEEL BLANK	\$175								
12I	3 CHECK VALVES	\$195								

EQUIPMENT	EST. COST	ACTUAL COST	VENDOR	TOTAL EST	TOTAL ACTUAL	P.O. NUMBER	P.O. DATE	NOTES	COMPLETED Y/N
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
ADDITIONAL BURNER COST	\$2,000								
AREA 500 - QUENCH				\$9,850.00	\$8,024.67				

6 QUENCH MODIFICATIONS									
6A LIQUID LEVEL DETECTION	\$5,500	\$5,447.53	HDT CONTROLS			318182	6/17/92	Received 9/28/92	
rod source isotope, lead									
source shielding, scintillation									
counter detector, mounting									
clamps, 1B single channel amp									
6B HEATER AMP METERS	\$2,250							Received 9/28/92	
model 19 current sencor; led for;									
black, white wire for above									
45A Current transformers		\$913.50	Pyromatic Inc			318727	6/30/92		
40A AC Ammeters		\$922.50	Pyromatic, Inc			326526	11/19/92	Tag: E4993 Recvd 1/6/93	
2A Modulator AC Meters		\$700.00	Newark Electronics	(6 more to come)		326525	11/19/92	Tag: E4993 Recvd partial	
		\$41.14	Newark Electronics				1/8/93	Tag: E4993 Area 500	
9 CONDENSABLE SAMPLING	\$2,100								
AREA 600 - FLARE				\$2,500.00	\$0.00				

FLARE UPGRADE	\$2,500								
AREA 700 - HOT GAS CLEAN-UP				\$14,250.00	\$0.00				

7 HOT-GAS CLEANUP TEST LOOP									
7A 20 FEET - 2", SCHED. 40, HAINES 570	\$1,150								
7B FLANGES	\$2,000								
7C ADD'N HEATERS	\$10,000								
7D CONTROLS	\$1,100								
AREA 800 - BLENDER				\$10,000.00	\$450.00				

EQUIPMENT	EST. COST	ACTUAL COST	VENDOR	TOTAL EST	TOTAL ACTUAL	P.O. NUMBER	P.O. DATE	NOTES	COMPLETED Y/N
7417 - STRUCTURE				ERR	ERR				
4 STRUCTURAL BEAM WORK	\$5,500								
W8x28 Beams 20' long		\$484.68	Northern Plains Steel			315138	4/16/92	Recvd	
1/2" & 3/8" plates; 3"x4" angle		\$158.71	GF Welding			315351	4/22/92	Recvd	
A325 7/8 x 2 1/2 bolts; A325 7/8 - 9 nuts		\$53.50	Fasten All			316845	5/21/92	Recvd	
ATSM A - 436 1" hardened washer		\$11.50	Fasten All			316845	5/26/92	Recvd	
2-M nuts - 1"		\$33.00	Fasten All			316845	5/26/92	Recvd	
8-7 all thread rod		\$61.14	Fasten All			316845	5/26/92	Recvd	
1 1/2"x1/8" bearing bars;									
2'x24' floor grating		\$864.00	Northern Plains Steel			317196	6/22/92	Recvd	
3x1 1/2 channel; floor grating 3/16x1 1/4		\$367.75	GF Welding			317477	6/12/92	Recvd	
Hot railbd flat		\$129.74	GF Welding			317224	6/5/92	Recvd	
4 x 4 x 3/8" angle iron		\$7.06	GF Welding			318150	6/17/92	Recvd	
3/8"x4"x20', 1/8"x4"x20', A36 mild steel									
flat stk; 1 5/8" dia rd bar A36 mild steel		\$202.65	GF Welding			319591	7/8/92	Recvd	
1 1/2"x21'x schedule 40		\$509.25	N. Plumbing			319592	7/8/92	Recvd	
1/8"x4"x20' A36 mild steel flt stk; 1 5/8" dia									
rd bar mild steel cold rolled A36		\$217.80	Tri Steel Mfg Co.			319590	7/8/92	Recvd	
3/8x16x2.5" bolts, 3/8x16" nuts, 1/2x13x1.5"									
bolts, 1/2x13" nuts, 1/2x3" scrw & shoulder,									
masonry anchor, snl Jack chain, hitch pincil		\$117.41	Fastenal			319709	7/9/92	Recvd	
8x16" studs, 2N 1-8 nuts		\$441.36	Fastenal			319639	6/30/92	Recvd	
Shaft, precision ground and hardener									
1/4" dia, 5" long A10 material		\$180.00	PIC Company			320814	7/23/92	Recvd	
Spring compression music wire, zinc plated		\$57.60	LEE Spring Co.			321037	7/23/92	Recvd	
5a 1 1/2"x1/8" Bearing Bars;									
2'x24' floor grating		\$1,386.00	N Plains Steel			324684	10/12/92	Delivered 3'x24'	
W8x10 beam 25'		\$94.50	N Plains Steel			325478	10/29/92	Recvd	
W10x14 beam 12'		\$113.00	N Plains Steel			325478	10/29/92	Recvd	
W8x18 beam 70'		\$554.40	GF Welding			325477	10/29/92	Recvd	
18 floor brackets		\$91.98	GF Welding			325728	11/5/92	Recvd	
3" Channel		\$98.40	GF Welding			326178	11/16/92	Recvd	
1 1/2"x1/8" bearing bars, 3'x24' floor		\$1,386.00	N. Plains Steel			327434	12/14/92	Struc wrk	
24 1/2" x 12" x 1/2" steel pates sheared		\$69.98	GF Welding			327662	12/21/92	Struc wrk	

EQUIPMENT	EST. COST	ACTUAL COST	VENDOR	TOTAL EST	TOTAL ACTUAL	P.O. NUMBER	P.O. DATE	NOTES	COMPLETED Y/N
COAL/LIMESTONE BLENDER	\$10,000								
2a Motor controllers		\$450.00	ENT			326412	11/19/92	Tag: E6022 Area 800	
MISCELLANEOUS				\$44,500.00	\$11,872.45				
8 ELECTRICAL SUPPLIES	\$21,000								
Power Relays (6)		\$70.98	Border States			315210	4/15/92	Area 100 - Recvd	
Terminal Blocks (4), Terminal Lugs (4)		\$64.00	Omega Engr			324056	9/28/92	Tag: E4921 Recvd	
8-b Hoffman box w/panel, 1" sealoff		\$239.58	Border States			324040	9/28/92	Tag: E4921 Recvd	
200 Amp/20 Amp/Neu kit		\$718.08	Border States			325027	10/20/92	Tag: E4920 Recvd	
Wire		\$792.40	Border States			324958	10/20/92	Tag: E4920 Recvd	
Conduit, connectors, unistrut straps		\$71.47	Border States			325658	11/5/92	Tag: E4920 Recvd	
13 COMPUTER	\$3,000	\$3,015.00	Gateway 2000			320346	7/17/92	Recvd	
15 PANEL UPGRADE	\$6,000								
660MB Micropolis SCSI		\$1,649.00	Hard Drives International			321706	8/6/92	Recvd	
IBM Token ring card		\$1,128.00	UND Bookstore			321621	8/6/92	Recvd	
External Modem		\$359.00	Arlington Computer Products			323098	9/4/92		
Computer cable/ext/adptr (8 items)		\$57.35	Dalco Electronics			323972	9/25/92	Tag: E4920 Recvd	
Lighted Rocker sw and clear/amber lenses		\$86.25	Border States			325178	10/20/92	Tag: E4920 Recvd	
Fabricate panel face		\$300.88	GF Welding			325191	10/22/92	Tag: E4920 Recvd	
357 Process Controllers		\$1,763.18	MDT Controls			324945	10/15/92	Tag: E4920 Recvd	
Bus mouse ext		\$7.85	Dalco Electronics			327592	12/16/92	Tag: E4920 Area 100 Pnl Upg	
Tray covers		\$630.14	McFarlane Sheetmetal			328332	1/8/93	Tag: E4920 Area 100	
Head Sw/ring		\$167.70	Border States				1/13/93	Tag: E4920 Area 100	
16 SHIPPING	\$2,500								
Ship/Handle for LDO		\$452.51	Berthold Sys, Inc			324300	9/30/92	LDO rcvd 9/28/92	
Incoming Freight		\$69.08	GF Motor Freight			316438	5/14/92	Recvd	
REPAIR/MOVE - HVAC	\$12,000								
MISCELLANEOUS	\$0								
35 mesh classifier sieve		\$230.00	Kason Corp.			315139	4/10/92	Tag: 3368 Recvd	

EQUIPMENT	EST. COST	ACTUAL COST	VENDOR	TOTAL EST	TOTAL ACTUAL	P.O. NUMBER	P.O. DATE	NOTES	COMPLETED Y/N
-----	----	-----	-----	-----	-----	-----	-----	-----	-----
ADDITIONAL BEAM WORK	\$3,500								
3x3x1/4 angle iron		\$56.85				327539	12/17/92	Struc Wrk	
3x3x5/16 angle iron		\$73.21	GF Welding			327539	12/17/92	Struc Wrk	
Bolts, washers, nuts		\$238.72	Fastenall			327756	12/22/92	Struc Wrk	
FLOOR GRATING	\$3,000								
WELDING RODS	\$2,000								
14 SAFETY LIGHTING	\$5,000								
Industrial warning lights (amber)									
replacement bulbs		\$645.07	Industrial Safety			317091	5/28/92	Recvd	
Installation		\$67.20	UMD Plant Services				6/30/92	Recvd	
Warning lite Install		25.83	UMD Plant Services				11/30/92	Recvd	

		\$356,738	\$205,268.71						

APPENDIX B
PARTICLE CHARACTERIZATION AND COLLECTION

Appendix B

Particle Characterization and Collection

B.1 Detailed Design Interface (Task 2.4.1)

Under this task, SRI is working with SCS, Kellogg, and Foster Wheeler on sampling and monitoring requirements that affect the facility design. These requirements include the sizes and locations of ports and platforms, piping arrangements, and provisions for access to sampling equipment and instrumentation. In October, SRI responded to comments received from SCS and Foster Wheeler on the process flow diagrams for the particulate sampling systems.

In November, SRI representatives met with representatives of SCS to discuss several topics related to particulate sampling and monitoring. The meeting focused on four topics: (1) piping arrangement and layout of sampling and monitoring ports, (2) data acquisition requirements, (3) sampling probe operation and the need for remote control, and (4) P&IDs for SRI's sampling systems and monitors. SRI submitted updated piping and port layout drawings to SCS in November for transmittal to Kellogg with instructions to use them as design input. The layout drawings and SRI's requirements for piping and ports are discussed in more detail below.

To satisfy SRI's requirements for real-time and historical data acquisition, SCS suggested the use of a local area network of personal computers (PCs) connected to the distributed control system (DCS). It was agreed that SRI would have access to two PCs on the network, with one PC located in SRI's laboratory space at the site and one PC located in SRI's office. SRI prepared a table of the input and output signals associated with SRI's sampling and monitoring systems in order for SCS to prepare specifications for the DCS system. SRI projected a total of 175 signals: 61 analog signals and 114 digital signals. SRI's I/O count and the related P&IDs are discussed in more detail below.

SRI briefed SCS personnel on the operation of the SRI sampling probe with emphasis on the insertion and retraction procedures and sealing methods. The need for remote operation of the probe was also discussed. It was agreed that the probe would be operated initially in a semiautomatic mode, but the design of the insertion mechanism would allow for fully automatic operation of the probe after the operating procedures have been rigorously tested and proved. The design of the probe insertion mechanism is discussed in more detail below.

B.2 Particulate Sampling Equipment (Task 2.4.2)

During this quarter SRI continued to work on the design of the particulate sampling systems and the evaluation of particulate monitors. Specific items that were addressed this quarter included: piping and port layout; P&IDs for the sampling systems and monitors; design of the cyclone assembly, bauxite cartridge, and probe insertion

mechanism; development of procedures for probe insertion and retraction; evaluation of particulate monitors; and formulation of I/O requirements for data acquisition. The work performed on each of these items is discussed below.

Piping and Port Layout. The revised piping layout that was sent to SCS is illustrated in Figures B-1, B-2, and B-3. Figure B-1 shows plan and elevation views of the recommended layout of piping and ports at the inlet of the PCD. Figure B-2 shows the plan view of the recommended layout at the outlet of the PCD, and Figure B-3 shows the elevation view of the same layout. These layouts are very similar to those that were submitted in August, except that two ports are added for extractive monitors at the inlet and outlet of the PCD. SRI have also relocated the transmissometer and added labels to more clearly identify the ports.

The layouts were developed from Kellogg's piping layout contained in the conceptual design document. At present, Kellogg's piping layout is conceptual and subject to change during detailed design. If the suggested piping layout can be accommodated in Kellogg's design, it would ensure that the sampling and monitoring ports are properly located with adequate working space around the probes and monitors.

Various features of the piping and port layouts are explained in the following discussion. All comments about pipe dimensions and elevations are specific to the Kellogg system. The relative locations of the various sampling and monitoring ports and the requirements for straight runs of piping upstream and downstream of the sampling ports apply to both the Kellogg and Foster Wheeler systems. These requirements are generally for straight runs of 8 to 10 internal pipe diameters upstream of the sampling port and 3 to 5 pipe diameters downstream of the sampling port. It should be noted that SRI is providing a transmissometer for the Kellogg system only. If transmissometers are to be provided for the FW advanced PFBC system, at present it is assumed that they will be provided by Foster Wheeler.

As indicated in the drawings, SRI is proposing to have the sampling ports installed in piping that is common to both the Kellogg PCDs. This approach allows the use of a single sampling system at each location (inlet and outlet) regardless of which PCD is being tested. This approach also reduces the required number of sampling ports and the required space for probe removal. The inside diameter (ID) of the piping should be selected to achieve a gas velocity of 20 ft/sec in the common piping at the sampling locations. In the Kellogg system, this requirement dictates an ID of about 12 in. In the FW APFBC system, for a the carbonizer flow rate of 1500 acfm, the required ID would be about 15 in. For a flow rate of 6200 acfm with a circulating pressurized fluidized-bed combustor (CPFBC), the ID would be about 30 in.

Areas reserved for probe removal are marked on the drawings. SRI originally planned to provide two probes at each sampling location, with one probe actively sampling while the other probe is disassembled for sample recovery. SRI planned to provide a rack adjacent to the probe port for holding the inactive probe during removal and

Figure B-1. Plan and elevation views of the piping and port layout at the inlet of the PCD

T = Transmissometer -

Cut 6.0 ft x 6.0 ft hole in
grating for on line sample probe
elevation 97.0 ft

Westinghouse alkali probe
removal area - maintain clear

Figure B-2. Plan view of the piping and

Possible Locations

ate Monitor

Sniffer and other monitors

Overhead trolley for batch particulate probe handling

Batch particulate probe removal area - maintain clear

From PCD

port layout at the outlet of the PCD

This section of duct to have 12" inside diameter (I.D.) to lower gas velocity to approximately 20 ft/sec.

ort layout at the outlet of the PCD

reinstallation of the cyclones or impactors. SRI also planned to provide an overhead trolley to lift the probes from the rack to the probe insertion mechanism. These plans are now being reviewed and may be revised. SRI is considering a different approach in which the cyclone, impactor, or plug is removed and reinstalled with the probe held in place on the insertion mechanism. This approach might minimize the need for the rack and trolley, but they would probably still be needed for repairing or replacing damaged probes. To allow use of the trolley, the space set aside for probe handling should extend up to the overhead structure for the next level of grating.

A relatively long, horizontal run of piping is required for the transmissometer (opacity meter), and this requirement is reflected on the drawing of the PCD outlet location. The transmissometer can function at higher gas velocities than those required for the sampling probes, so the pipe diameter at this location can be whatever is otherwise required.

The drawings also show recommended locations of platforms for access to the transmissometer, sniffer, and other monitors. These platforms should be permanent with steps and railings. For the outlet sampling location, SRI would prefer the addition of a new level of grating at the 105-ft elevation, as indicated on the drawing of the outlet location.

Piping and Instrumentation Diagrams. P&IDs for the inlet and outlet sampling systems are shown in Figures B-4 and B-5, and a P&ID for the monitoring systems is shown in Figure B-6. These P&IDs reflect SRI's latest thinking on the instruments required for the sampling systems and monitors. The P&IDs serve as the basis for the updated I/O count given in Table B-1. As noted in the P&IDs and in the table, each sampling system includes the following instruments.

- Six temperature transmitters with local readout and connection to DCS
- One absolute pressure transmitter with local readout and connection to DCS
- One differential pressure transmitter with local readout and connection to DCS
- Four limit switches on double block-and-bleed valves with connections to insertion motor controller and DCS
- Four limit switches on insertion mechanism with connections to motor controller and DCS
- Four limit switches on nitrogen purge valves with connections to DCS
- Two limit switches on bleed valves with connections to DCS
- Three switches on motorized valves with connections to DCS
- One switch on the insertion motor with connections to DCS

There are 8 analog signals and 18 digital signals for each sampling system. For the three inlet and three outlet systems, there are a total of 48 analog signals and 108 digital signals. SRI estimates that the particulate monitors will contribute an additional 13 analog signals and an additional 6 digital signals.

Figure B-4. Piping and ins

Instrumentation diagram for inlet sampling system

Figure B-5. Piping and instrumentation

TABLE OF MATERIALS

ITEM	QTY	DESCRIPTION	MATERIAL	SPQ NO.

PROCESS FLOW DESCRIPTION:

- NITROGEN PURGE LINE:** Supplied by **NITROGEN FROM SCS**, passes through a pressure indicator (PI) and a valve to a manifold with four outlets.
- SAMPLE GAS HEAT EXCHANGER:** Receives **GAS** from an **ISOLATION VALVE (MOTORIZED)**. It includes a pressure indicator (PI) and two flowmeters (FBAM, FBAL).
- TRAP:** Receives gas from the heat exchanger and has a drain to the **SRI SAMPLE CONTAINER**.
- HEATED SECTION:** Contains a temperature indicator (TI), a temperature controller (TIC), and a temperature alarm (TAL).

TITLE BLOCK:

CLIENT APPROVAL:

BY	CHK	CHK	APR	PRJ
----	-----	-----	-----	-----

REV D: THIS DRAWING MAY CONTAIN INFORMATION WHICH IS PROPRIETARY TO SOUTHERN RESEARCH INSTITUTE, ITS CLIENTS, AND/OR ITS VENDORS. IT SHALL NOT BE DISCLOSED TO ANY THIRD PARTY WITHOUT SRI'S PRIOR WRITTEN PERMISSION.

SOUTHERN RESEARCH INSTITUTE
 WILSONVILLE
 HOT GAS CLEANUP
 TEST FACILITY

CLIENT: SOUTHERN COMPANY SERVICES

TITLE: PIPING AND INSTRUMENT DIAGRAM
 PCD OUTLET, PARTICULATE SAMPLING SYSTEM

SCALE: NONE

DATE: 11/10/92

SPQ NO.: P7252-005.R0

REVISIONS:

NO.	DATE	DESCRIPTION	BY	CHK	APR

BILL OF MATERIALS				
ITEM	QTY	DESCRIPTION	MATERIAL	STD NO.

CLIENT APPROVAL					
SEE APPROVAL	BY	CHKD	CHG	APPR	FILED
STD <div style="border: 1px solid black; width: 40px; height: 40px; display: flex; align-items: center; justify-content: center; font-size: 24px; font-weight: bold;">D</div> DATE	THIS DOCUMENT MAY CONTAIN INFORMATION WHICH IS PROPRIETARY TO SOUTHERN RESEARCH INSTITUTE, ITS CLIENTS, AND/OR ITS VENDORS. IT SHALL NOT BE DISCLOSED TO ANY THIRD PERSONS.				
<div style="text-align: center;"> SOUTHERN RESEARCH INSTITUTE UNIVERSITY ALABAMA SYSTEM WILSONVILLE HOT GAS CLEANUP TEST FACILITY </div>					
CLIENT	SOUTHERN COMPANY SERVICES				
TITLE	PIPING AND INSTRUMENT DIAGRAM PCD OUTLET, PARTICULATE SAMPLING SYSTEM				
DATE	NONE		STD NO. P7252-005.R0 SHEET OF		
DATE	11/10/92				

Figure B-6. Piping and instrumentation di

gram for particulate monitoring systems

Table B-1
Input and output signals for SRI's sampling and monitoring systems

		Number of signals or lines						
Sensor or switch	Signal	Inlet sampling system		Outlet sampling system		Particulate monitors		GRAND TOTAL
		Per system	Total	Per system	Total	Per PCD	Total	
Temperature transmitter	4 to 20 mA	6	18	6	18	0	0	36
Pressure transmitter	4 to 20 mA	1	3	1	3	0	0	6
Differential pressure transmitter	4 to 20 mA	1	3	1	3	2	6	12
Transmissometer	4 to 20 mA	0	0	0	0	1	1	1
Other monitor (optional)	4 to 20 mA	0	0	0	0	2	6	6
SUBTOTAL (ANALOG)	4 to 20 mA	8	24	8	24	5	13	61
Limit switch on ball valves	Digital	4	12	4	12	0	0	24
Limit switch on insertion mechanism	Digital	4	12	4	12	0	0	24
Solenoid on purge valves	Digital	4	12	4	12	2	6	30
Solenoid on bleed valves	Digital	2	6	2	6	0	0	12
Switch for motorized valve	Digital	3	9	3	9	0	0	18
Switch for insertion motor	Digital	1	3	1	3	0	0	6
SUBTOTAL (DIGITAL)	Digital	18	54	18	54	2	6	114

Cyclone Assembly and Bauxite Cartridge. During this quarter, SRI continued to work on the design of the modular cyclone assembly and bauxite cartridge. The design was modified to move the flanged connection to the outlet of the bauxite cartridge so that the bolts would not be exposed to the hot gas. A three-dimensional AutoCAD drawing of the design, shown in Figure B-7, was produced. SRI began to prepare the AutoCAD solids file that the pattern maker needs to fabricate the plastic pattern for inspection. The pattern maker needs the solids file to drive the selective laser sintering process used in making the plastic pattern of the cyclone manifold and bauxite cartridge. SRI will carefully inspect the plastic pattern to ensure that the sintering process has produced the intended design. After the accuracy of the plastic pattern has been verified, the pattern will be shown to various casting experts so that they can recommend an appropriate casting procedure.

Probe Insertion and Retraction Mechanism. SRI continued to work on the design of the insertion mechanism. SRI defined the details of the pusher assembly, developed written procedures for probe insertion and retraction, and developed a logic diagram for programming the insertion and retraction sequences. The insertion and retraction procedures were reviewed with SCS in November. SRI and SCS agreed that the insertion and retraction procedures should be automated, but not until the procedures are thoroughly debugged in the manual and semiautomatic modes. The insertion mechanism will be designed to allow its control by a PLC or a similar device.

In November, SRI reviewed our design of the insertion mechanism with particular attention to the force exerted on the process piping during probe insertion. Because of the magnitude of the forces involved and the possibility that the piping may not be anchored at the sampling location, SRI decided that the insertion mechanism should be rigidly connected to the sampling port. With the use of this rigid connection, no net force is exerted against the process pipe during probe insertion. By virtue of this rigid connection, however, the weight of the insertion mechanism, casing, and probe could exert a significant moment on the sampling port where it connects to the process pipe. SRI plans to minimize this moment by using pipe hangers to suspend the insertion mechanism, casing, and probe from overhead steel beams. SRI will estimate the weight to be suspended so that SCS can specify the pipe hangers to be used.

Particulate Monitors. SRI continued to gather information on particulate monitors during this quarter, with the objective of identifying those systems that are appropriate for use at Wilsonville. The systems that are under consideration include

- Transmissometers (Lear Siegler, Data Test)
- Laser-based instruments (Malvern, Insitex PCSV, PMS)
- Triboelectric detectors (Auburn Triboflow)
- Acoustic detectors (Jonas)
- Active filters (Industrial Filter and Pump Sniffer)

Figure B-7. Three-dimensional view of the cyclon
cartridge

e assembly manifold and bauxite

SRI's original budget for particulate monitors was based on the purchase of one transmissometer, nine Jonas acoustic detectors, and eight sniffers. The plans for deployment of monitors are still evolving, but the current plans are summarized below.

<u>Type of monitor</u>	<u>Number supplied by SRI for each system</u>		
	<u>Kellogg reactor</u>	<u>FW carbonizer</u>	<u>FW CPFBC</u>
Transmissometer	1	0	0
Sniffer	2	2	2
Triboelectric	2	1 or 2	1 or 2
Acoustic	2	1 or 2	1 or 2
Other optical	1	0	0

SRI plans to provide a transmissometer for the Kellogg system only; any transmissometers required for the Foster Wheeler systems will be provided by Foster Wheeler. The sniffers appear to be relatively low cost and will be provided by SRI for positions upstream and downstream of all PCDs. The triboelectric and acoustic detectors will be tested first on the Kellogg system. Deployment of the triboelectric and acoustic detectors on the Foster Wheeler systems will depend upon the results of the testing on the Kellogg system. The other optical detector will be tested under a no-cost arrangement with one of the monitor vendors.

SRI will be evaluating the Auburn triboelectric detector, the Jonas acoustic detector, and one of the other optical devices (the Insitac PCSV) under a contract with the Environmental Protection Agency (EPA). SRI expects that the results of this EPA-sponsored study will provide further guidance on the selection of monitors for Wilsonville.

SRI developed a sketch of our proposed sniffer installation and a rough draft of a P&ID for the sniffer. SRI contacted American Electric Power (AEP) concerning their experience with the use of sniffers at Tidd, but found that they were not using the sniffers as particulate monitors. At Tidd, the sniffers are used to protect the gas sampling system from particulate and droplet contamination. A triboelectric detector was also used briefly at Tidd, but it was being repaired at the time of contact with AEP. AEP's experience with the triboelectric detector was too limited to draw any conclusions. Data taken with a triboelectric detector at EPRI's Sholz test facility are now being analyzed and compared to theoretical calculations of electron boil-off at elevated temperatures.

SRI received one report of a successful application of the Jonas acoustic detector in the detection of scale and water droplets in a steam line in a geothermal energy process.

The user had no knowledge of the particle sizes being detected but indicated that the detector had successfully detected scale in the steam line.

Data Acquisition. Data acquisition requirements were discussed with SCS at a meeting in November. SCS agreed to provide SRI with two PCs on a local area network connected to the facility's DCS. SCS will program the personal computers so that they can emulate the main DCS displays and provide SRI access to the required process conditions, sampling parameters, and monitoring data. Each computer will run software that will allow the user to switch between the process, sampling, and monitoring displays. SRI plans to locate one of the computers in at the site and the other at SRI's office.

B.3 Alkali Measurement and Collection (Task 2.4.3)

The particulate sampling train is being designed to include an activated bauxite cartridge after the cyclone assembly or cascade impactor. The activated bauxite cartridge will adsorb alkali vapors (primarily gaseous NaCl and KCl) from the sample gas stream. The concentrations of the alkali vapors will be determined by extracting the bauxite and analyzing the extract for sodium and potassium. The bauxite cartridge will be an alumina tube packed with 8 to 10 mesh, spherical pellets of activated bauxite. The bauxite cartridge will be mated directly to the outlet of the backup filter for the cyclone assembly or cascade impactor. This arrangement will allow the front portion of the cartridge to protrude into the process gas stream, while the back portion of the cartridge is surrounded by stagnant process gas in the sample port. SRI believes that this arrangement will allow maintenance of the bauxite at a temperature that is only slightly below the process gas temperature, thereby minimizing loss of the alkali on metal surfaces. Extensive work with these cartridges at Argonne National Laboratory (ANL) has shown that any reduction in temperature can cause the loss of alkali vapor on metal surfaces, and the alkali cannot be recovered from the metal (Vogel, 1976; Lee and Johnson, 1979; Lee and Myles, 1986; Lee, 1992).

In October the design of the bauxite cartridge was modified to move the flanged connection to the outlet of the cartridge. The current design of the bauxite cartridge and integral cyclone interconnection manifold was illustrated in the three-dimensional AutoCAD drawing shown previously. Thermocouples mounted at the inlet and outlet of the bauxite cartridge will serve to monitor the heating of the cyclones and the cooling of the cartridge outlet by the purge nitrogen. In November the design was modified to run the inlet thermocouple sheath through the bauxite cartridge, as opposed to running it between the alumina tube and metal casing as originally conceived. The thermocouple sheath or wires will run through a pipe in the annulus between the inner sample tube and the outer pipe of the sampling probe. Since external pressurization of the hot outer pipe is not allowed by the pressure vessel code, the annulus must be pressurized with nitrogen or process gas. Methods of pressurizing the annulus and sealing around the thermocouple pipe are being investigated.

SRI reviewed Foster Wheeler's flow diagram and operating procedures for the Westinghouse alkali sampling probe. Foster Wheeler's operating procedures are detailed and understandable, but the Westinghouse system is designed for manual operation only. SCS and SRI should discuss whether the design should be modified to allow automatic operation of this probe.

Figure B-1. Plan and elevation views of the piping and port layout at the inlet of the PCD

Figure B-2. Plan view of the piping and port layout at the outlet of the PCD

Figure B-3. Elevation view of the piping and port layout at the outlet of the PCD

Figure B-4. Piping and instrumentation diagram for inlet sampling system

Figure B-5. Piping and instrumentation diagram for outlet sampling system

Figure B-6. Piping and instrumentation diagram for particulate monitoring systems

Figure B-7. Three-dimensional view of the cyclone assembly manifold and bauxite cartridge

Table B-1. Input and output signals for SRI's sampling and monitoring systems

DATE

FILMED

5 / 31 / 94

END