INNOVATIVE CLEAN COAL TECHNOLOGY

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INNOVATIVE CLEAN COAL TECHNOLOGY (ICCT)

DEMONSTRATION OF INNOVATIVE APPLICATIONS OF TECHNOLOGY FOR COST REDUCTIONS TO THE CT-121 FGD PROCESS

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For the Period
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DOE Contract
DE-FC22-90PC89650

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C-90-000284

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LEGAL NOTICE

Section 1

SUMMARY

The objective of this project is to demonstrate on a commercial scale several innovative applications of cost-reducing technology to the Chiyoda Thoroughbred-121 (CT-121) process. CT-121 is a second generation flue gas desulfurization (FGD) process which is considered by the Electric Power Research Institute (EPRI) and Southern Company Services (SCS) to be one of the most reliable and lowest cost FGD options for high-sulfur coal-fired utility boiler applications. In both greenfield and retrofit situations demonstrations of the following innovative design approaches will further reduce the cost and provide a clear advantage to CT-121 relative to competing technologies:

- Use of fiberglass reinforced plastic (FRP) to construct the absorber vessel, wet ducts, and chimney (stack),
- Elimination of flue gas reheat,
- Elimination of the spare absorber, and
- Use of a single vessel for simultaneous particulate and SO_2 removal.

The demonstration will be performed at Georgia Power Company's Plant Yates Unit No. 1 (100 MW capacity) near Newnan, Georgia. The project will be funded by the U. S. Department of Energy (DOE), SCS (on behalf of the entire Southern electric system), and EPRI. SCS is the participant responsible for managing all aspects of this project. The project is being conducted in the following three phases:

Phase I - Permitting and Preliminary Engineering;
Phase II - Detailed Engineering, Construction, and Startup; and
Phase III - Operation, Testing, and Disposition.

Since April, all environmental permits and FAA approvals have been granted by the issuing authorities with the exception of the gypsum stack design and operating plan permit which is expected within the next 60 days.

Phase II activities reached a peak during the April-June quarter as major components were fabricated and delivered to the site. Internal installation and finishing work continues on the JBR while the FRP chimney only lacks the last few support steel pieces to be complete. Concrete work continues, including containment sumps, ball mill foundation and duct supports. The limestone slurry tank has been finished and acoustically tested but will require additional work on the floor before it will be acceptable. Also, a mechanical contractor has been selected and should begin work in August. There have also been numerous visitors to the site from the Southern Company, DOE, EPRI, Bechtel and Chiyoda.

Section 2

INTRODUCTION

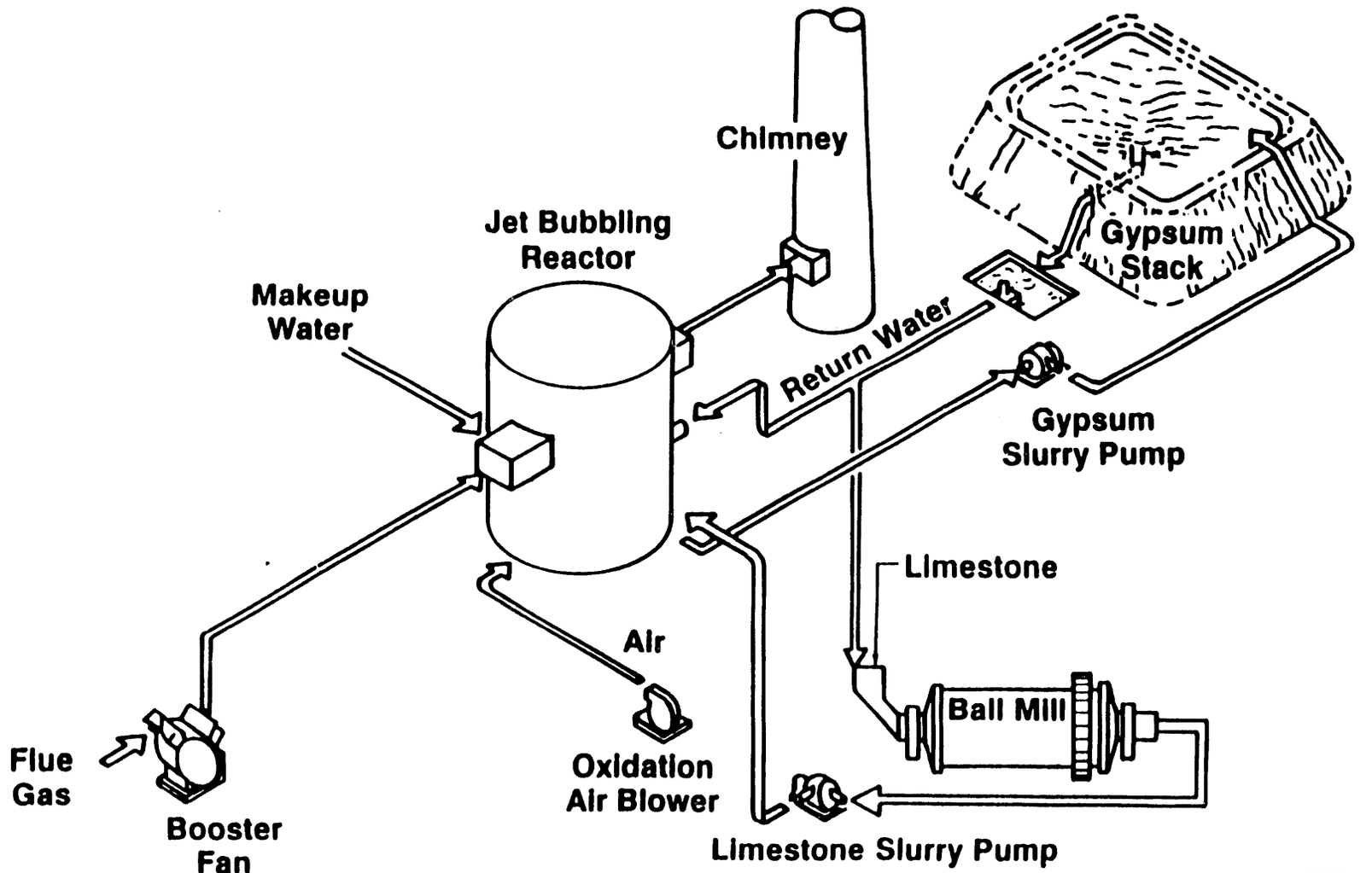
The Innovative Clean Coal Technology (ICCT) Program is designed to demonstrate clean coal technologies that are capable of retrofitting or repowering existing facilities to achieve significant reduction in sulfur dioxide (SO_2) and/or nitrogen oxides (NOx) emissions. The technologies selected for demonstration are capable of being commercialized in the 1990s and are expected to be more cost effective than current technologies.

The Yates ICCT project is jointly funded by the U.S. Department of Energy, the Electric Power Research Institute (EPRI), and by Southern Company Services (SCS) on behalf of the entire Southern electric system. The project's objective is to demonstrate innovative applications of technology for cost reduction for the Chiyoda Thoroughbred-121 (CT-121) process. The CT-121 process is a second generation, flue gas desulfurization (FGD) process that EPRI and SCS consider to be one of the least cost FGD processes in its current commercial configuration. Further cost reductions investigated at Plant Yates should make this process more competitive and attractive to electric utilities.

The CT-121 process is a wet FGD process that removes SO_2, can achieve simultaneous particulate control, and can produce a salable by-product (gypsum) thereby eliminating solid waste production. Figure 1 shows a flow schematic of the process. CT-121 removes SO_2 and particulate matter in a unique limestone-based scrubber called the JBR (Jet Bubbling Reactor). As flue gas bubbles up from beneath the slurry, SO_2 is absorbed, and particulate matter is removed from the gas. An agitator circulates the slurry to ensure that fresh reactants are always available in the bubbling or froth zone so that SO_2 removal can proceed at a rapid rate. Air is introduced into the bottom of the JBR to oxidize the absorbed SO_2 to sulfate, and limestone is added to neutralize the acid slurry and form gypsum. The JBR is designed to allow time for complete oxidation of the SO_2, for complete reaction of the limestone, and for growth of large gypsum crystals. This gypsum slurry is continuously withdrawn from the JBR and is dewatered in a gypsum stack. The stacking technique involves filling a diked area with gypsum slurry, allowing the gypsum solids to settle undisturbed, removing the separated, clear liquid from the top of the stack and returning it to the process.

The CT-121 process is in commercial use both in Japan and in the United States. At the University of Illinois, a 45 MW process began operations in 1988 on stoker boiler flue gas. But this would not be considered a typical utility boiler application in the U.S. as would the Yates project. In Japan, commercial CT-121 systems are used to treat the flue gas from boilers which burn oil or low-sulfur coal. Some of the oil-fired units do not include particulate control devices upstream of the CT-121 processes.

Simplied Flow Diagram of CT-121 and Related Processes



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The purpose of the Yates ICCT project is to demonstrate the process on a typical utility boiler burning high-ash, high-sulfur U.S. coal. Several design modifications at Plant Yates should reduce the estimated cost of the present CT-121 process by up to 23 percent for power plant retrofit applications and up to 50 percent for new power plant installations. This will be accomplished while maintaining 90 percent SO_2 removal and high particulate removal efficiency. A reusable gypsum byproduct will also be produced during the project.

The major cost-reducing design changes to be demonstrated are:

- Use of less expensive materials of construction
- Elimination of a spare absorber module
- Elimination of flue gas reheat
- Simultaneous SO_2 and particulate removal in a single vessel.

Utility scale units with the CT-121 system currently include a prescrubber for the control of soluble chloride concentration and use JBRs made of stainless steel, which is relatively expensive. Also, outlet ducts typically are lined or made of alloys, and the chimney is lined. But liners have to be replaced after a period of time which is always expense and inconvenient. For this demonstration project, the prescrubber, JBR, outlet duct, and chimney will be made of solid fiberglass-reinforced plastic (FRP). FRP has been shown in the chemical industry to be unaffected by chloride or other corrosion mechanisms normally experienced in FGD processes. A successful demonstration of FRP in this project will eliminate the need for a prescrubber in the CT-121 process and will demonstrate a material which is less expensive that 316L stainless steel.

Current Federal New Source Performance Standards (NSPS) require that spare scrubbers normally be installed on utility FGD systems if a utility should have to bypass its FGD system to stay online. This project is intended to demonstrate that the CT-121 process using a JBR made of FRP is highly reliable and does not require a spare absorber module to effectively control SO_2 emissions.

Another cost-saving modification to be demonstrated in this project is the elimination of flue gas reheat downstream of the scrubber as is often designed into current FGD installations. The flue gas leaving any wet scrubber is at its water dewpoint, and, without reheat, subsequent cooling in the ductwork and stack causes moisture to condense into small droplets. These water droplets absorb traces of SO_2 and form highly acidic droplets that cause severe corrosion in all downstream metals like ducts and stacks. In addition, these droplets tend to "rain out" near the base of the stack, causing damage to surrounding structures and vehicles. To prevent these problems, this project will use operating techniques and equipment designs that will eliminate the need for costly reheating.

The final cost-saving modification is the simultaneous removal of SO_2 and particulate matter in the JBR. Typically, an electrostatic precipitator (ESP) or fabric filter is used upstream of the scrubber to remove particulate matter. In the CT-121 process, greater than 90 percent of the SO_2 and 99 percent of the particulate matter in the entering flue gas can be removed in the JBR. When used in new power plants, the elimination of the ESP or fabric filter will result in substantial capital and operating cost reductions. In existing plants, a retrofit JBR should significantly reduce other costs for preexisting particulate collection equipment.

This project is being constructed at Georgia Power Company's Plant Yates, Unit No. 1 located about 40 miles southwest of Atlanta between Newnan and Carrollton. The CT-121 system to be installed for this demonstration project will treat the whole flue gas stream generated by the 100 MW Unit 1 boiler. The coal to be burned during the project will be a blend of Illinois 5 and 6 coals and will contain between 2.5 and 3 percent sulfur coal.

The demonstration project will be conducted over an 81-month period with project activities including environmental monitoring, permitting, design, construction, operation, process evaluation, and gypsum by-product evaluation. The project is organized into three phases: (1) Phase I - Permitting and Preliminary Engineering; (2) Phase II - Detailed Engineering, Construction, and Startup; and (3) Phase III - Operation, Testing, and Disposition. Phase I is scheduled for 8 months, Phase II is scheduled for 27 months with a six-month overlap with Phase I, and Phase III is scheduled for 52 months. Operations are planned for 24 months with the remainder of Phase III activities dedicated to gypsum byproduct utilization and gypsum stack groundwater monitoring studies. The cooperative agreement was signed April 2, 1990, and the project completion date is projected to be mid-1996. The total estimated project costs are $35,843,678. The co-funders are SCS ($11,297,032), DOE ($17,546,646), and EPRI ($7,000,000).

Section 3

PROJECT DESCRIPTION

Within the three phases of the project, the following tasks will be conducted to effectively demonstrate a reduced-cost CT-121 process:

Phase I - Permitting and Preliminary Engineering

- Task 1 - Development of Environmental Monitoring Program
- Task 2 - Permitting Activities
- Task 3 - Preliminary Engineering
- Task 4 - Gypsum Stack Site Characterization and Groundwater Well Siting Activities
- Task 5 - Process Engineering Support
- Task 6 - Georgia Power Engineering Coordination
- Task 7 - Project Management and Reporting
- Task 8 - Preliminary Gypsum Stacking and Byproduct Studies

Phase II - Detailed Design, Construction, and Startup

- Task 1 - Detailed Design Engineering
- Task 2 - Process Engineering Support
- Task 3 - Georgia Power Engineering Coordination
- Task 4 - Construction
- Task 5 - Test Plan Development
- Task 6 - Training of Operations and Maintenance Personnel
- Task 7 - Startup
- Task 8 - Baseline Groundwater Monitoring
- Task 9 - Environmental Data Management and Reporting
- Task 10 - Project Management and Reporting
- Task 11 - Phase II Gypsum Stack Design and Byproduct Studies

Phase III - Operations, Testing, and Disposition

- Task 1 - Operations and Maintenance
- Task 2 - Process Evaluation
- Task 3 - Gypsum Stacking and Byproduct Evaluation
- Task 4 - Groundwater Monitoring
- Task 5 - Environmental Data Management and Reporting
- Task 6 - Economic Analysis
- Task 7 - Disposition
- Task 8 - Project Management and Reporting

Section 4

PROJECT STATUS

Progress during the April - June 1991, quarter is summarized below. Activities continued in the environmental and engineering tasks, and construction activities were brought into full swing.

PHASE I - PERMITTING AND PRELIMINARY ENGINEERING

Task 1 - Development of Environmental Monitoring Program

The Environmental Monitoring Plan was completed by Radian, reviewed by SCS, and submitted to DOE during the last quarter in 1990. This plan includes a quality assurance/quality control plan and sampling and analyses procedures manual. DOE review continues.

Task 2 - Permitting Activities

The permits required for the project are in three categories: (1) those required during construction, (2) air permits required for operation, and (3) water permits for operation of the process and the gypsum stack. Georgia Power and SCS have continued efforts in all three areas. Previously, Georgia Power obtained permission to conduct fiberglass manufacturing operations at Plant Yates. The air permit for cleaned flue gas has been approved by the state and the FAA has waived any requirement for aviation markers on the FRP chimney. Currently, the state is reviewing the Design & Operating Plan (D & O Plan) for the gypsum stack submitted this quarter after a preliminary request for addition information and clarification. The final D & O Plan approval is expected sometime in late August or early September. Also, a permit for the construction and operation of the chimney elevator was found to be required by an unrelated State office. The permit was quickly secured by SCS.

Task 3 - Preliminary Engineering and Task 5 - Process Engineering Support

Conceptual process engineering continued during this period. Most process decisions had been made during previous meetings and correspondence with Chiyoda. A representative from Chiyoda visited Yates in June for verification of the SCS concept.

Task 4 - Gypsum Stack Site Characterization and Groundwater Well Siting Activities

Activities to support the gypsum stack permitting effort were completed during the previous quarter. Initial ground clearing has started but further construction will not proceed significantly until the state has approved the D&O plan (see Task 2 above).

Task 6 - Georgia Power Engineering Coordination

Phase I activities in this area have been completed. Similar coordination activities are being continued in Phase II.

Task 7 - Project Management and Reporting

These activities have been completed for Phase I. Similar activities continue in Phase II.

Task 8 - Preliminary Gypsum Stacking and Byproduct Studies

The activities in Phase I have been completed. Additional work is continuing in Phase II as originally proposed. There is also the consideration of providing large quantities of gypsum to several wallboard manufacturers. This would require additional equipment for gypsum washing and is an unfunded, optional activity presently under consideration.

PHASE II - DETAILED DESIGN, CONSTRUCTION, AND STARTUP

Task 1 - Detailed Engineering
Task 2 - Process Engineering Support
Task 3 - Georgia Power Engineering Coordination

The engineering schedule continues to be highly integrated with a number of activities close to the critical path. Thus far, the changes required in schedule in engineering and construction have not affected the projected May 1992 startup date. The following summarize progress in the detailed engineering task:

- Evaluated bids and awarded contracts for the digital data acquisition and control system, miscellaneous power transformer, limestone handling equipment, vertical and horizontal centrifugal pumps, agitators, plant air compressor and motor and oxidation air blowers.

- Vendors for the flue gas dampers and continuous emissions monitors were selected and contracts awarded; dampers have been delivered.

- Mist eliminator vendors responded to RFP and evaluations continue with DynaGen's participation.

- Completed design of FRP vessels and completed negotiations with Ershigs concerning the FRP equipment. Problems were identified in the installation quality of the bottom of the Limestone Slurry Tank and bottom of the JBR (Ershigs has scheduled repair work in the next quarter). Due to a cost increase from the 1988 budgetary estimate, SCS elected to eliminate the prescrubber from the design and to build the mist eliminator housing of an alloy clad material rather than FRP. These changes do not affect the project objectives and may result in a reduction in estimated project cost. The primary reason for the cost increase for Ershigs was a change in the design basis from that assumed in 1988. The contract between Ershigs and SCS was signed in January 1991.

- Weekly meetings were held between Civil, Electrical, I&C, Mechanical and Process Engineering Disciplines to facilitate communications. Weekly conference calls were held with the Construction Manager and the SCS Project Manager visited the site at least weekly. Monthly Project review meetings have been held at Plant Yates regularly. Weekly Start-Up Team meetings will begin in August.

- Initiated flow modeling work with DynaGen to design liquid collectors for wet duct and chimney operation completed. Full flow modelling at DynaGen's labs will be conducted in August.

Task 4 - Construction

Construction site activities were begun in ernest during the final quarter of 1990 and continue through June. Georgia Power's completion list includes concrete work for all foundations, the control building, sumps, duct support piers, inlet spray section, slurry tank, wash water tank, ball mill and limestone conveyor system. The control room building was completed and is being used as a temporary fabrication shop for several crafts while motor control equipment begins to be installed. After the winding and mounting of the JBR shell and limestone slurry tank, Ershigs' temporary work area was cleared away to make room for the construction of the limestone conveyor system. Numerous major pieces of equipment have been delivered and are temporarily sited in the laydown area such as slurry pumps, vertical sump pumps, flue gas dampers, JBR sparger tubes, duct work and the ball mill. Installation of electrical equipment continues with the FGD transformer being "dressed out" by Georgia Power this quarter, conduit trays going up inside the power house and the 4060 KV bus duct in place. Handwork on the FRP details of the JBR continue such as inlet and outlet flange overlayment, lower deck beams and placement of the JBR dome. The joining and finishing of the JBR inlet spray sections was also completed.

Task 8 - Baseline Groundwater Monitoring

All baseline sampling will be completed with the collection of the last set of samples in July. A written report will be prepared describing results. Review of the project monitoring plan for the operating period is underway by the Georgia Geological Survey.

Task 10 - Project Management and Reporting

The management information system continues to be used to control budget and schedule and to help fulfill DOE reporting requirements. Monthly reports have been submitted. Weekly meeting with lead engineers and construction management and monthly project review meetings were conducted. Negotiations with Ershigs for the FRP manufacturing contract were completed in December.

Task 11 - Phase II Gypsum Stack Design and Byproduct Studies

Two of the initial steps in obtaining a permit for the gypsum stacking area have been completed - - zoning approval from Coweta County and site acceptability approval from the Georgia Geological Survey. The last permitting step is approval of the Design & Operating Plan (D & O Plan) by the Georgia Environmental Protection Division (EPD). Using design information from Ardaman on the gypsum stacking area, the D & O Plan has been completed and submitted for review. Preliminary comments from the EPD indicate that no significant difficulties are apparent and that the permit should be issued within the next 60 days.

The University of Georgia has continued its limited, preliminary investigation and screening of plants which might be candidates for gypsum stack revegetation and for crop yield experiments after process startup. Also, four wallboard manufacturers have agreed to participate in laboratory and manufacturing evaluations of Yates FGD gypsum. Test plan arrangements are currently under negotiations. All four wallboard manufacturers have indicated that the Yates material will probably be too high in 'as-is' moisture and chloride content for immediate use. Therefore, SCS and Georgia Power are presently investigating the requirements for gypsum dewatering and washing prior to shipment for possible expansion of the project's scope.

Section 5

PLANNED ACTIVITIES

During the July - September 1991 quarter, the following activities are planned:

- Continue interaction with the State of Georgia on remaining permitting activities.
- Continue all construction activities (specifically mechanical and electrical) to keep the project on schedule.
- Begin putting together the Operator Training Plan, the Start-Up Plan and review the Operating Test Plan.
- Monitor the conclusion of Ershigs' onsite work on the JBR and limestone slurry tank.
- Begin intensive work on the construction of the gypsum stack.
- Continue all environmental, project management, and reporting activities.

END

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