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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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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. Demonstrations of the following innovative design approaches will further reduce the cost and provide a clear advantage to CT-121 relative to competing technology:

1. use of fiberglass reinforced plastic (FRP) to construct the absorber vessel, wet ducts, and chimney (stack),

2. elimination of flue gas reheat,

3. elimination of the need for a spare absorber, and

4. use of a single vessel to obtain 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.

During the time prior to award and in the April-May 1990 quarter, activities in both Phase I and Phase II were initiated. In Phase I, Permitting activities were begun by both SCS and Georgia Power. Work on the Environmental Monitoring Plan continued based on the Environmental Monitoring Plan Outline submitted during the pre-award period. Preliminary engineering activities included setting the system design basis and submitting this basis to Chiyoda, interaction with Chiyoda to make the process flow diagram final, review of Chiyoda's basic engineering package, and development of a revised Critical Path Method (CPM) schedule for the Project's engineering and construction activities. Project engineering management also developed a project specific management information system to track schedule and budget for engineering and equipment procurement. Construction management interacted with engineering to develop the integrated CPM schedule for engineering and construction. An overall management information system for the project was

completed to monitor, schedule and budget for the entire project and to fulfill DOE reporting requirements. Negotiations with previously selected subcontractors were also completed. The Phase II activities were focused on preparation of specifications and inquiry packages for the long lead-time equipment.

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.

This 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 will only 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 Jet Bubbling Reactor (JBR). In the JBR, flue gas bubbles beneath the slurry, SO_2 is absorbed, and particulate matter is removed from the gas. The agitator circulates slurry to ensure that fresh slurry is 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. The gypsum slurry is continuously withdrawn from the JBR and can be dewatered in a gypsum stack. The stacking technique involves filling a dyked area with gypsum slurry, allowing the gypsum solids to settle, and removing clear liquid from the top of the stack and returning it to the process.

The CT-121 process is in commercial use in Japan and in the United States. At the University of Illinois, a 45 MW process began operations in 1988 on a stoker boiler, which is not a typical utility boiler. In Japan, commercial CT-121 processes 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.

The purpose of this ICCT project is to demonstrate the process on high-ash and high-sulfur U.S. coal using several design modifications that will reduce the estimated cost of the present CT-121 process by 23 percent for power plant retrofit applications and 50 percent for new power plant installations. This will be accomplished while maintaining 90 percent SO_2

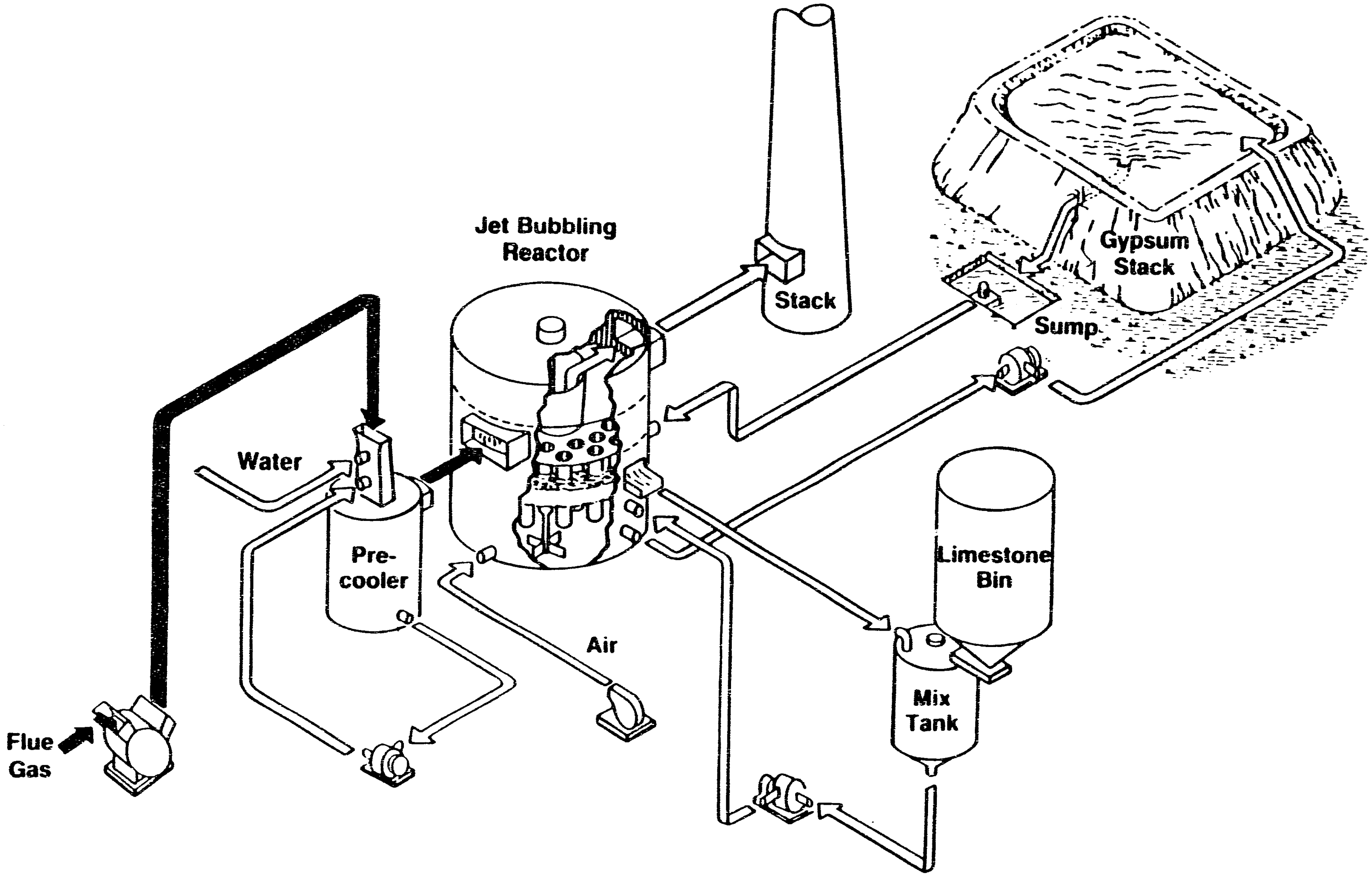

Figure 1 - CT-121 Process Flow Diagram

removal and high particulate removal efficiency. A reuseable gypsum byproduct will also be produced during the project.

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

- using less expensive materials of construction,
- eliminating a spare absorber module,
- eliminating flue gas reheat, and
- combining SO_2 and particulate removal in a single vessel.

Utility scale units with the CT-121 processes currently include a prescrubber for control of soluble chloride concentration and use JBRs made of stainless steel, which is relatively expensive. Typically, outlet ducts are lined or made of alloys, and the chimney is lined. Liners have to be replaced after a period of time which adds additional expense and inconvenience. For this demonstration project, the prescrubber, JBR, outlet duct, and chimney will be made of solid fiberglass-reinforced plastic (FRP) which is 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. 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. The flue gas leaving any 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 acid droplets that cause severe corrosion in ducts and stacks. In addition, these droplets tend to fall 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 simultaneous removal of SO_2 and particulate matter in the JBR. Typically, an electrostatic precipitator 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. Thus, the CT-121 process provides a cost effective alternative to conventional wet FGD systems.

This project will be performed at Georgia Power Company's Plant Yates, Unit No. 1. This plant is located about 40 miles southwest of Atlanta near Newnan and Carrollton. The CT-121 process 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

Per agreement with DOE, SCS began some preliminary activities prior to the official signing of the Cooperative Agreement in order to maintain the project schedule. The Cooperative Agreement was signed by DOE on April 2, 1990. Progress during the first quarter (and the period prior to signing of the Cooperative Agreement) is summarized below.

PHASE I - PERMITTING AND PRELIMINARY ENGINEERING

Task 1 - Development of Environmental Monitoring Program

The Environmental Monitoring Plan Outline developed during the pre-award period was accepted by DOE as the final outline. Work has begun on the development of the Environmental Monitoring Plan, including the quality assurance/quality control project plan and sampling and analyses procedure manual.

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 initiated efforts in all three areas. Information regarding emissions during constuction has been collected from the fiberglass manufacturer, and initial discussions have been held with the state. A preliminary opinion that no air permit is required for construction has been given verbally by the State. Georgia Power has sent a letter documenting estimated emissions and is waiting for a formal determination from the State. The fiberglass manufacturer will be responsible for disposal of any solid waste which is categorized as hazardous.

Georgia Power and SCS have also begun work on the air permit application required for operations. A draft application has been prepared, and Georgia Power is waiting for the process flow diagram to be finalized before the air permit application is completed and submitted to the State.

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

Progress on a number preliminary engineering activities was accomplished during the quarter. Data -- including flue gas flow rate and composition, unit heat rate, and service water composition -- were collected from Plant Yates. These data were included in a design basis document which was transmitted to Chiyoda in January. Chiyoda's basic engineering package was received in late April, and SCS began its review at that time. Communications between SCS and Chiyoda continued through the quarter to clarify and refine the process design and equipment layout issues. Based on this progress, the process flow diagram is essentially complete at this time. SCS engineers also traveled to the 45 MW CT-121 process located in Champaign, Illinois to gain a better understanding of the design requirements.

A project specific management information system for engineering and equipment procurement was also developed during the initial stages of the project. As part of the initial effort, Engieering and Construction input were collected and coordinated to produce an integrated engineering and construction schedule for the Yates project. The MIS system, in conjunction with the CPM schedule, allows expenditures and commitments to be tracked and controlled. Engineering submitted reports of schedule and budget status monthly to the Project Manager. Weekly meetings of the lead discipline engineers were held to facilitate communications.

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

Activities to support the gypsum stack permitting effort were begun during the quarter. Soil samples were collected and analyzed and geotechnical information was assembled. The local clay was tested for possible use as liner material. Preliminary groundwater well locations have been proposed and plans made to discuss well location with the State. Plans to install the wells were also begun.

Task 6 - Georgia Power Engineering Coordination

A number of meetings have been held between SCS and Georgia Power Construction and Plant personnel. Frequent conversations between the lead discipline engineers at SCS and plant engineering staff have been conducted to ensure that the plant perspective has been considered in engineering and procurement decisions.

Task 7 - Project Management and Reporting

The first activity undertaken in this task was development of an overall project management information system capable of tracking overall budget and schedule information. This system is in place and is being used to control budget and schedule and to help fulfill DOE reporting requirments. Monthly reports have been submitted as has the Project Evaluation Plan for the first budget period.

In addition, contracts with all named subcontractors (except Ershigs) have been negotiated and are in place. The Ershigs FRP equipment manufacturing contract has not been completed as yet because of its complexity and close ties to some of the engineering activities not yet completed. While this contract negotiation is somewhat behind the planned schedule, the planned October 15 start date for on-site FRP manufacturing plant set should not be delayed.

Kickoff meetings with Georgia Power and other contractors have been held, and coordination meetings of all aspects of the project have been conducted on a monthly basis.

Task 8 - Preliminary Gypsum Stacking and Byproduct Studies

In this task, SCS has coordinated with Ardaman and Associates to collect site and laboratory data required to perform gypsum stack design calculations. Clay, local to the Plant Yates site, has been evaluated for its potential use as a gypsum stack liner material. This information will be presented to the State, and liner decision will be reached.

Preliminary agricultural studies with gypsum from other FGD sites in the United States have begun at the University of Georgia. The results of these preliminary tests will be used to complete final test plans for the agricultural studies with the Plant Yates CT-121 gypsum.

PHASE II - DETAILED DESIGN, CONSTRUCTION, AND STARTUP

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

Because of the tight schedule planned for this project, some detailed engineering activities have begun concurrently with preliminary engineering. The first activities undertaken were specification and procurement efforts for the long lead-time equipment. Other activities in support of the first construction activities have also begun. The following summarize progress in the detailed engineering task:

- Developed specifications and sent inquiry packages to vendors for fan, limestone pulverizer system, 115kV transformer, and control building. Received and began evaluation of bids for this equipment.

- Developed specifications and sent inquiry packages to vendors for the fan motor, 4160V and 480V motor control centers, 4160V/480V power transformer, and 4160V and 480V switchgear.

- Held weekly meetings among Civil, Electrical, I&C, Mechanical, and Process Engineering Disciplines to facilitate communications.

- Began developing specifications for the data aquisition and control systems and for the limestone conveyor system.

- Communicated with Ershigs and Chiyoda regarding the construction of the FRP vessels. Identified important issues and began to resolve these in preparation for final negotiations with Ershigs.

Task 4 - Construction

While not specifically identified in Phase I as preliminary activities, a number of preliminary construction activities were conducted in the initial months to support the project. A constuctibility review was performed to establish the most effective way of completing the project. An activity coding system was developed to form the basis of the construction scheduling and control system. Construction management also developed a final construction plan and worked with Engineering management to develop the master engineering and construction project schedule (Rev. 0). Construction management personnel have attended monthly project meetings to ensure that Construction's perspective is incorporated in all important engineering decisions.

Section 5

PLANNED ACTIVITIES

During the July - August, 1990 quarter the following activities are planned:

- Continue permitting activities. Submit draft air permit to State of Georgia. Meet with State to discuss gypsum stack liner requirments and groundwater monitoring requirements.

- Submit draft Environmental Monitoring Plan to DOE. Include a Sampling and Analysis Manual and a Quality Assurance/Quality Control Plan.

- Complete preliminary engineering and write the system design basis document.

- Hold project groundbreaking ceremony at Plant Yates.

- Hold first project review committee meeting with DOE and EPRI.

- Award limestone pulverizer system, fan, fan motor, control building, 115kV transformer, 4160V and 480V motor control centers, 4160V/480V power transformer, and 4160V and 480V switchgear.

- Finalize contract with Ershigs for FRP equipment. Review intial drawings and begin foundation design for JBR, prescrubber, chimney, and ductwork.

- Prepare specifications for steel ductwork and structual steel and issue inquiry package.

- Complete specification and issue inquiry packages for vertical and horizontal centrifugal pumps. Receive bids and begin evaluations.

- Complete specifications for data aquisition and plant control systems and issue inquiry package.

- Begin preparation of continuous emissions monitoring system specification.

- Develop specifications, issue inquiry package, receive bids, and begin evaluations for limestone conveyor system.

END

DATE FILMED

9/01/92