DOE/PC/89650--T5

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INNOVATIVE CLEAN COAL TECHNOLOGY (ICCT)

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

DOE Contract
DE-FC22-90PC89650

SCS Contract
195-88-026

Quarterly Report No. 2
For the Period
July - September, 1990

November 15, 1990

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Patents Cleared by Chicago on 11/17 1990

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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:

- use of fiberglass reinforced plastic (FRP) to construct the absorber vessel, wet ducts, and chimney (stack),
- elimination of flue gas reheat,
- elimination of the need for a spare absorber, and
- 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 July-September 1990 quarter, activities in both Phase I and Phase II were continued. In Phase I, permitting activities were continued by both SCS and Georgia Power to obtain air and gypsum disposal permits. Work on the Environmental Monitoring Plan continued based on the Environmental Monitoring Plan Outline submitted during the pre-award period. An initial set of groundwater samples were obtained from the gypsum stack site. Conceptual process engineering activities were substantially completed with agreement between Chiyoda and SCS on several issues. Detailed engineering activities included development of specifications, inquiry packages, evaluation of bids, and award of contracts in several areas. Detailed design of the FRP vessels (JBR, prescrubber, and limestone storage tank) was begun by SCS and Ershigs. Georgia Power Company Construction Management personnel began to set up for construction at Plant Yates. A groundbreaking ceremony was conducted at Plant

Yates in August, and an initial project review meeting with DOE and EPRI was conducted at that time.

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 diked 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

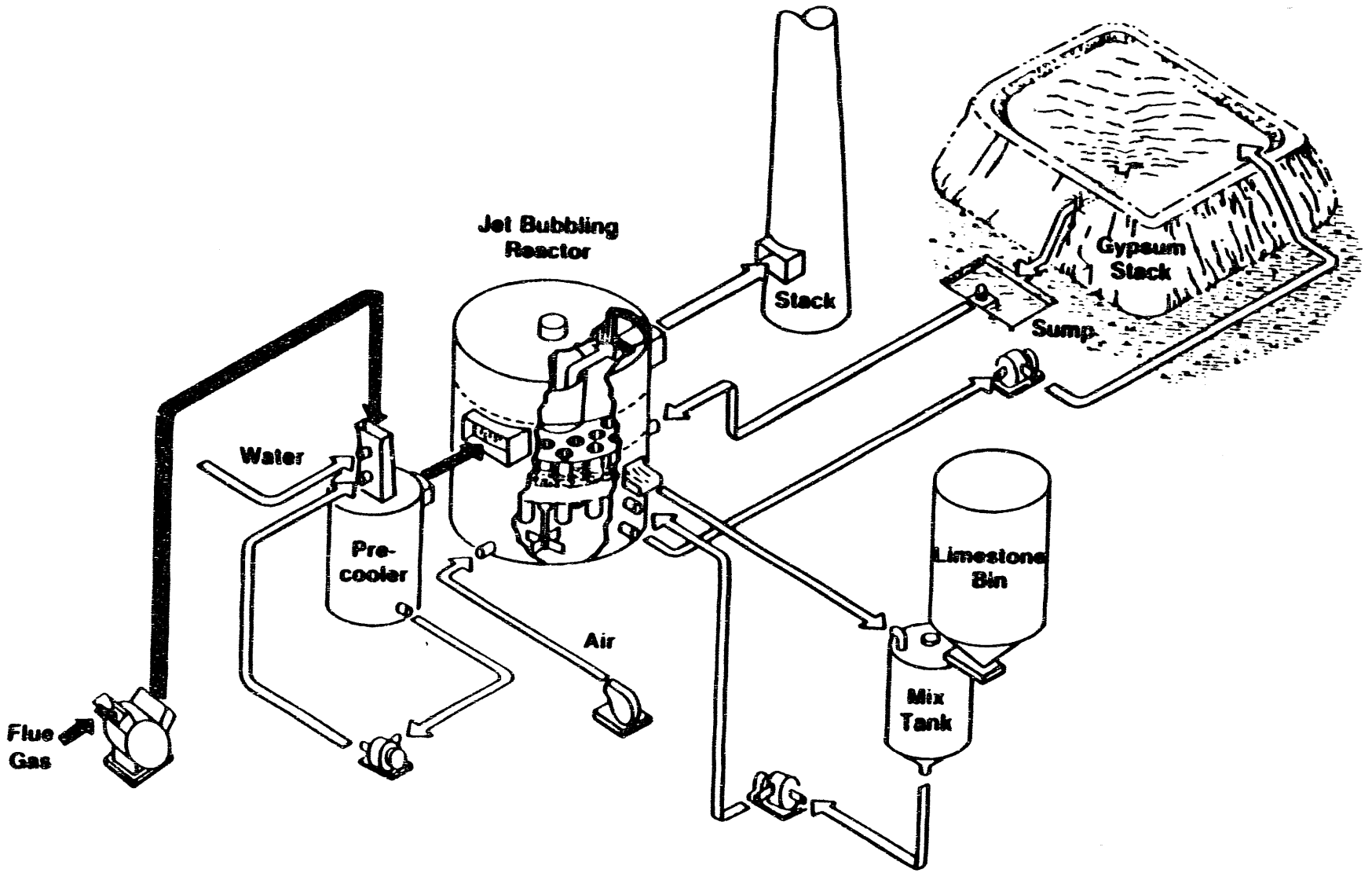


Figure 1 - CT-121 Process Flow Diagram

power plant retrofit applications and 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:

- 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

Progress during the July-September 1991, quarter is summarized below. Most of the activities were in the environmental and engineering tasks.

PHASE I - PERMITTING AND PRELIMINARY ENGINEERING

Task 1 - Development of Environmental Monitoring Program

An initial draft of the Environmental Monitoring Plan was developed by Radian and reviewed by SCS during the quarter. This draft plan includes a quality assurance/quality control project plan and sampling and analyses procedures manual. Revisions will be made so that the EMP can be submitted to DOE during the next quarter.

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. Information regarding emissions during construction has been collected from the fiberglass manufacturer, and initial discussions have been held with the state. The State of Georgia has formally agreed that no air permit is required for fiberglass construction activities. The fiberglass manufacturer will be responsible for disposal of any solid waste which is categorized as hazardous.

Georgia Power and SCS also continued work on the air permit application required for operations. An application was prepared and submitted to the Georgia Environmental Protection Division for approval. The State responded with some a request for addition information and clarification.

Work on the gypsum stack permit also continued. A geotechnical report of the gypsum site was completed (see Task 4) and initial conversations were held with the state regarding liner requirements. A formal permit application including the design and operating plan is expected to be submitted in the next quarter.

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

Conceptual process engineering continued during the period. A meeting was held in August with Chiyoda to resolve several key process issues. Based on the results of this meeting, the process flow diagram, plant layout drawing, and general arrangement drawings were revised. The major activity remaining in preliminary engineering is the development of a system design basis document which is expected to be completed in the next quarter.

Task 5 - Gypsum Stack Site Characterization and Groundwater Well Siting Activities

Activities to support the gypsum stack permitting effort were continued during the quarter. A geotechnical report was completed and sent to Georgia Power Company for inclusion in the permit application. Groundwater wells were installed at five locations around the gypsum stack site.

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 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 continued for the FRP manufacturing contract. A letter agreement with Ershigs was signed to maintain the project schedule. Final negotiations for the FRP contract are expected to be concluded in December, 1990.

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. Based on the options available, a synthetic liner will be proposed for the Yates gypsum stack site.

Preliminary agricultural studies with gypsum from other FGD sites in the United States continued at the University of Georgia. Additional gypsum samples from the University of Illinois CT-121 process were shipped to 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

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 May 1992 startup date. The following summarize progress in the detailed engineering task:

- Evaluated bids and awarded contracts for the scrubber control building, fan, fan motor, limestone ball mill system, 115kV transformer, 4160V and 480V motor control centers and switchgear. A contract was negotiated for 4160V/480V power transformer pending final resolution of terms and conditions.

- Developed specifications and sent inquiry packages to vendors for the limestone storage and transfer system, plant air compressor, and digital data acquisition and control system.

- Began development of specifications for the oxidation air blowers, continuous emissions monitoring system, vertical pumps, horizontal pumps, and agitators.

- Held weekly meetings among Civil, Electrical, I&C, Mechanical, and Process Engineering Disciplines to facilitate communications. Weekly conference calls were held with the Construction Manager. Monthly Project review meetings were held at Plant Yates.

- Continued design of FRP vessels with Ershigs.

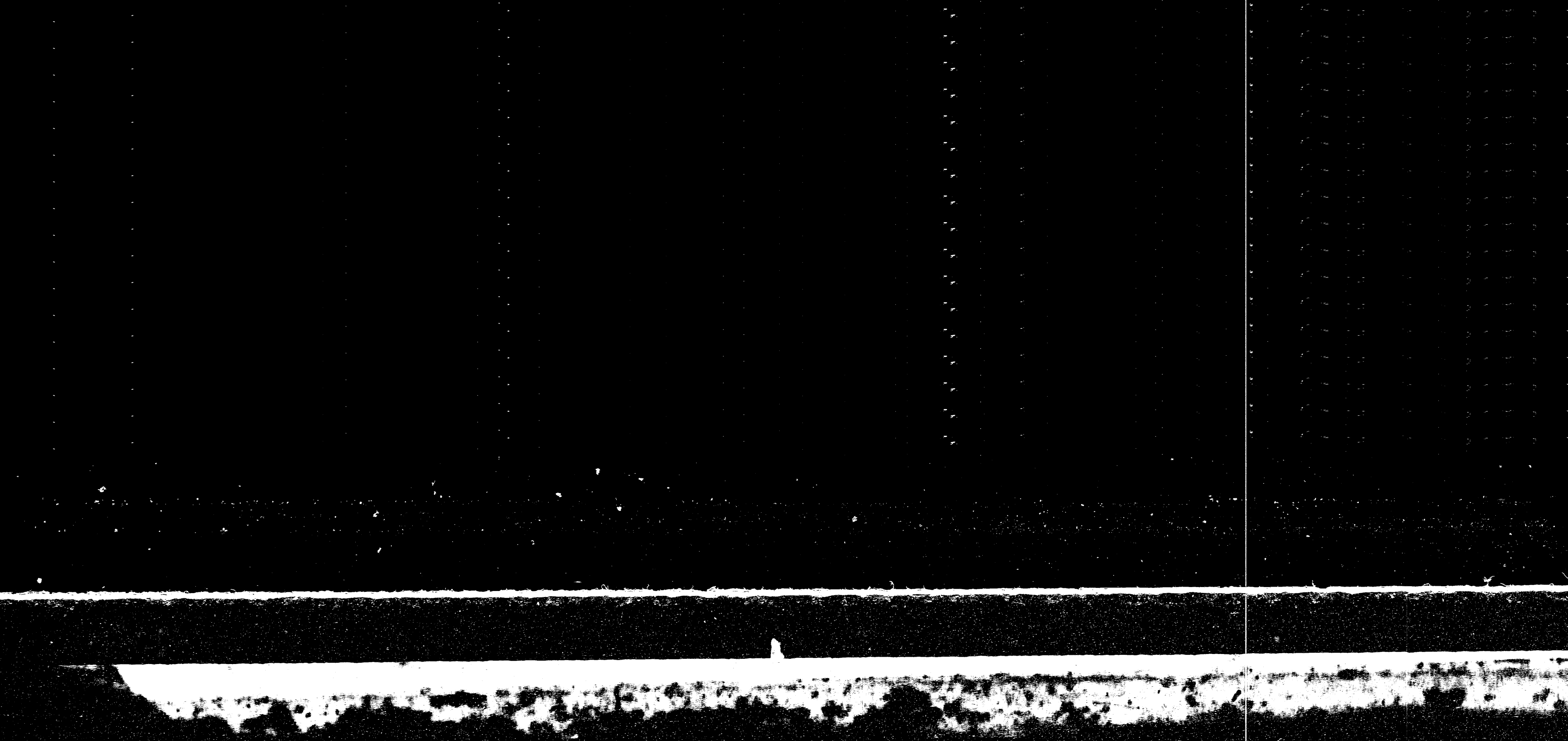
- Began foundation design for JBR, prescrubber, limestone storage tank, and chimney.

Task 4 - Construction

Construction site activities were begun with the set up of construction management offices. A new parking lot was completed since one of the existing lots is being used in the CT-121 process. Construction activities should increase significantly next quarter.

Task 8 - Baseline Groundwater Monitoring

An initial set of groundwater samples were collected in September from the wells around the gypsum stack site. Analyses of these samples were begun. Additional sets of samples are planned every two months for the next year.



Section 5

PLANNED ACTIVITIES

During the October - December 1990 quarter, the following activities are planned:

- Continue permitting activities. Clarify questions concerning the air permit. Complete gypsum stack design, prepare design and operating plan, and submit gypsum stack permit to State of Georgia.
- Submit Environmental Monitoring Plan to DOE. Include a Sampling and Analysis Manual and a Quality Assurance/Quality Control Plan.
- Write the system design basis document.
- 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. Approve required drawings so that construction can begin.
- Complete specifications for steel ductwork and structural steel and issue inquiry package.
- Complete development of specifications, issue inquiry packages receive and evaluate bids, and award contracts for the oxidation air blowers, continuous emissions monitoring system, vertical pumps, horizontal pumps, dampers and agitators.
- Evaluate bid and award contract for data acquisition and plant control systems.
- Complete specification, issue inquiry package to vendors, receive and evaluate bids and award contract for continuous emissions monitoring system.
- Complete bid evaluations and award contract for limestone storage and transfer system.
- Pour temporary foundation and mobilize for FRP manufacturing. Begin winding of JBR.
- Construct scrubber building foundation and begin construction of JBR and prescrubber foundations.

END

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9/10/92