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Quarterly Report

No.12

LIFAC Sorbent Injection Desulfurization Demonstration Project

Presented By

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A Joint Venture Between

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Presented To

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Pittsburgh Energy Technology Center
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July - September 1993

LIFAC SORBENT INJECTION
DESULFURIZATION DEMONSTRATION PROJECT

QUARTERLY REPORT NO. 12

JULY - SEPTEMBER 1993

Submitted to

U. S. DEPARTMENT OF ENERGY

by

LIFAC NORTH AMERICA

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INTRODUCTION

In December 1989, the U.S. Department of Energy selected 13 projects for funding under the Federal Clean Coal Technology Program (Round III). One of the projects selected was the project sponsored by LIFAC North America, (LIFAC NA), titled "LIFAC Sorbent Injection Desulfurization Demonstration Project." The host site for this $22 million, three-phase project is Richmond Power and Light's Whitewater Valley Unit No. 2 in Richmond, Indiana. The LIFAC technology uses upper-furnace limestone injection with patented humidification of the flue gas to remove 75-85% of the sulfur dioxide (SO_2) in the flue gas.

In November 1990, after a ten (10) month negotiation period, LIFAC NA and the U.S. DOE entered into a Cooperative Agreement for the design, construction, and demonstration of the LIFAC system. This report is the twelfth Technical Progress Report covering the period July 1, 1993 through the end of September 1993. Due to the power plant's planned outage in March 1991, and the time needed for engineering, design and procurement of critical equipment, DOE and LIFAC NA agreed to execute the Design Phase of the project in August 1990, with DOE funding contingent upon final signing of the Cooperative Agreement.

BACKGROUND

Project Team

The LIFAC demonstration at Whitewater Valley Unit No. 2 is being conducted by LIFAC North America, a joint venture partnership between:

- ICF Kaiser Engineers - A U.S. company based in Oakland, California, and a subsidiary of ICF Kaiser International, Inc. (ICF) based in Fairfax, Virginia.

- Tampella Power Corp. - A U.S. subsidiary of a large diversified international company, Tampella Corp., based in Tampere, Finland and the original developer of the LIFAC technology.

LIFAC NA is responsible for the overall administration of the project and for providing the 50 percent matching funds. Except for project administration, however, most of the actual work is being performed by the two parent firms under service agreements with LIFAC NA. Both parent firms work closely with Richmond Power and Light and the other project team members, including ICF Resources, the Electric Power Research Institute (EPRI), Indiana Corporation for Science and Technology (ICS&T), and Black Beauty Coal Company. LIFAC NA is having ICF Kaiser Engineers manage the demonstration project out of its Pittsburgh office, which provides excellent access to the DOE representatives of the Pittsburgh Energy Technology Center. Figure 1 shows the management structure being used throughout the three phases of the project.

LIFAC NA administers the project through a Management Committee that decides the overall policies, budgets, and schedules. All funding sources, invoicing, and information flows to LIFAC NA where the managing partners ensure that the project, funding and expenditures are consistent and in-line with the established policies, budgets, schedules and procedures.

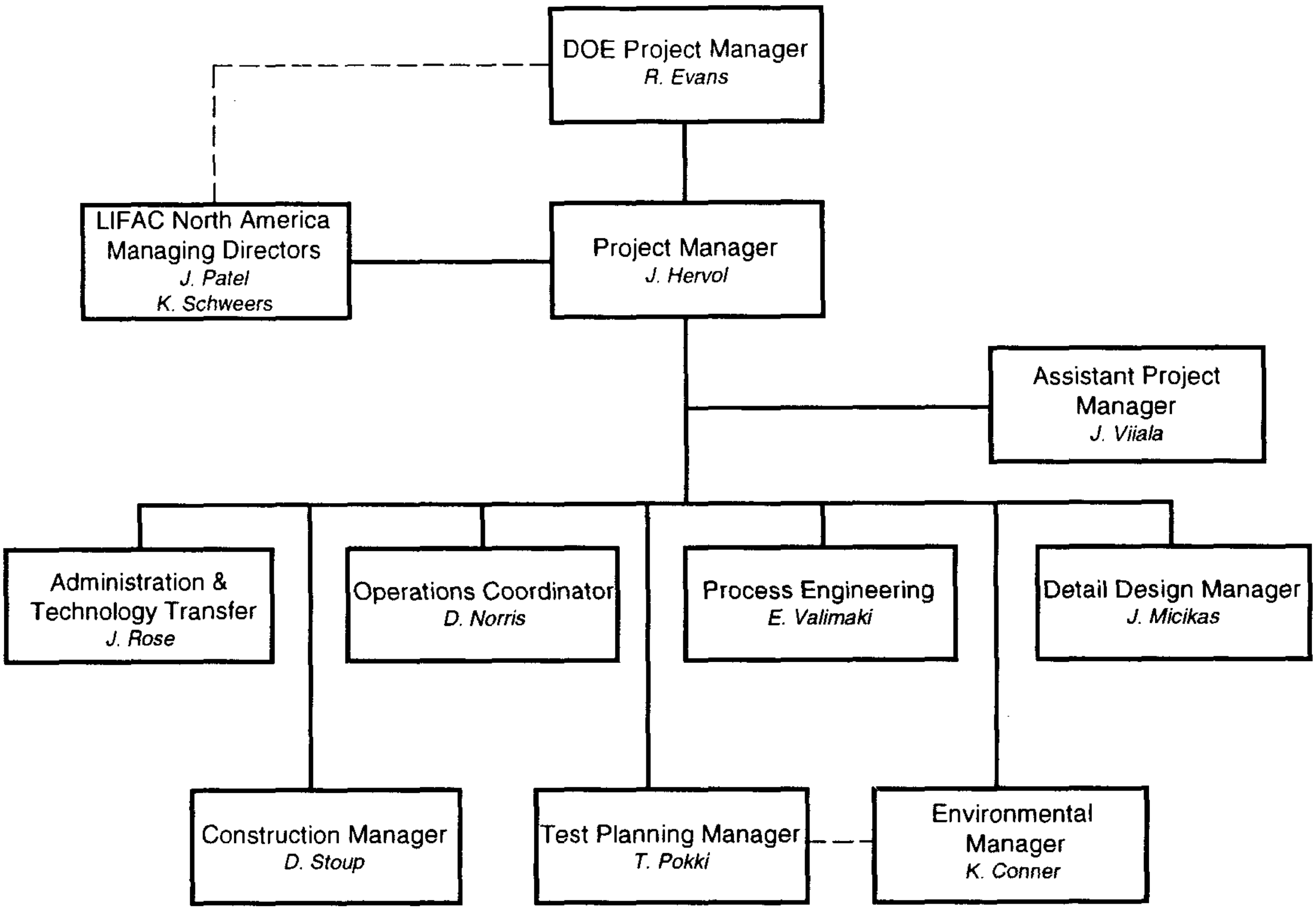
Process Development

In 1983, Finland enacted acid rain legislation which applied limits on SO_2 emissions sufficient to require that flue gas desulfurization systems have the capability to remove about eighty percent (80%) of the sulfur dioxide in the flue gas. This level could be met by conventional scrubbers, but could not be met by then available sorbent injection technology. Therefore, Tampella began developing an alternative system which resulted in the LIFAC process.

Initially, development included laboratory-scale and pilot-plant tests. Full-scale limestone injection tests were conducted at Tampella's Inkeroinen facility, a 160 MW coal-fired boiler using high-ash, low-sulfur Polish coal. At Ca:S ratios of 3:1, sulfur removal was less than 50%. Better results could have been attained using lime, but was rejected because the cost of lime is much higher than that of limestone.

In-house investigations by Tampella led to an alternative approach involving humidification in a separate vertical chamber which became known as the LIFAC Process. In cooperation with Pohjolan Voima Oy, a Finnish utility, Tampella installed a full-scale limestone injection facility on

Project Organization



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a 220 MW coal-fired boiler located at Kristiinankaupunki. At this facility, a slipstream (5000 SCFM) containing the calcined limestone was used to test a small-scale activation reactor (2.5 MW) in which the gas was humidified. Reactor residence times of 3 to 12 seconds resulted in SO_2 removal rates up to 84%. Additional LIFAC pilot-scale tests were conducted at the 8 MW (thermal) level at the Neste Kulloo combustion laboratory to develop the relationships between the important operating and design parameters. Polish low-sulfur coal was burned to achieve 84% SO_2 removal.

In 1986, full-scale testing of LIFAC was conducted at Imatran Voima's Inkoo power plant on a 250 MW utility boiler. An activation chamber was built to treat a flue gas stream representing about 70 MW. Even though the boiler was 250 MW, the 70 MW stream represented about one-half of the flue gas feeding one of the plant's two ESP's (i.e., each ESP receives a 125 MW gas stream). This boiler used a 1.5% sulfur coal and sulfur removal was initially 61%. By late 1987, SO_2 removal rates had improved to 76%. In 1988, a LIFAC activation reactor was added to treat an additional 125 MW -- i.e., an entire flue gas/ESP stream-worth of flue gas from this same boiler. This newer activation reactor is achieving 75-80% SO_2 removal with Ca:S ratios between 2:1 and 2.5:1. In 1988, the first tests using high-sulfur U.S. coals were run at the pilot scale at the Neste Kulloo Research Center, using a Pittsburgh No. 8 coal containing 3% sulfur. SO_2 removal rates of 77% were achieved at a Ca:S ratio of 2:1.

This LIFAC demonstration project will be conducted on a 60 MW boiler burning high-sulfur U.S. coals to demonstrate the commercial application of the LIFAC process to U.S. utilities.

Process Description

LIFAC combines upper-furnace limestone injection followed by post-furnace humidification in an activation reactor located between the air preheater and the ESP. The process produces a dry and stable waste product that is partially removed from the bottom of the activation reactor and partially removed at the ESP.

Finely pulverized limestone is pneumatically conveyed and injected into the upper part of the boiler. Since the temperatures at the point of injection are in the range of 1800-2000° F, the limestone ($CaCO_3$) decomposes to form lime (CaO). As the lime passes through the furnace, initial desulfurization reactions take place. A portion of the SO_2 reacts with the CaO to form calcium sulfite ($CaSO_3$), part of which then oxidizes to form calcium sulfate ($CaSO_4$). Essentially all of the sulfur trioxide (SO_3) reacts with the CaO to form $CaSO_4$.

The flue gas and unreacted lime exit the boiler and pass through the air preheater. On leaving the air preheater, the gas/lime mixture is directed to the patented LIFAC activation reactor. In the reactor, additional sulfur dioxide capture occurs after the flue gas is humidified with a water spray. Humidification converts lime (CaO) to hydrated lime, $Ca(OH)_2$, which enhances further SO_2 removal. The activation reactor is designed to allow time for effective humidification of the flue gas, activation of the lime, and reaction of the SO_2 with the sorbent. All the water droplets evaporate before the flue gas leaves the activation reactor. The activation reactor is also designed specifically to minimize the potential for solids build-up on the walls of the chamber. The net effect is that at a Ca:S ratio in the range of 2:1 to 2.5:1, 70-80% of the SO_2 is removed from the flue gas.

The flue gas leaving the activation reactor then enters the existing ESP where the spent sorbent and fly ash are removed from the flue gas and sent to the disposal facilities. ESP effectiveness is also enhanced by the humidification of the flue gas. The solids collected by the ESP consist of fly ash, $CaCO_3$, $Ca(OH)_2$, CaO, $CaSO_4$, and $CaSO_3$. To improve utilization of the calcium, and increase SO_2 reduction to between 75 and 85%, a portion of the spent sorbent collected in the bottom of the activation reactor and/or in the ESP hoppers is recycled back into the ductwork just ahead of the activation reactor.

Process Advantages

The LIFAC technology has similarities to other sorbent injection technologies using humidification, but employs a unique patented vertical reaction chamber located down-stream of the boiler to facilitate and control the sulfur capture and other chemical reactions. This chamber improves the overall reaction efficiency enough to allow the use of pulverized limestone rather than more expensive reagents such as lime which are often used to increase the efficiency of other sorbent injection processes.

Sorbent injection is a potentially important alternative to conventional wet lime and limestone scrubbing, and this project is another effort to test alternative sorbent injection approaches. In comparison to wet systems, LIFAC, with recirculation of the sorbent, removes less sulfur dioxide - 75-85% relative to 90% or greater for conventional scrubbers - and requires more reagent material. However, if the demonstration is successful, LIFAC will offer these important advantages over wet scrubbing systems:

- LIFAC is relatively easy to retrofit to an existing boiler and requires less area than conventional wet FGD systems.

- LIFAC is less expensive to install than conventional wet FGD processes.

- LIFAC's overall costs measured on a dollar-per-ton SO_2 removed basis are less, an important advantage in a regulatory regime with trading of emission allocations.

- LIFAC produces a dry, readily disposable waste by-product versus a wet product.

- LIFAC is relatively simple to operate.

HOST SITE DESCRIPTION

The site for the LIFAC demonstration is Richmond Power and Light's Whitewater Valley 2 pulverized coal-fired power station (60 MW), located in Richmond, Indiana. Whitewater Valley 2, which began service in 1971, is a Combustion Engineering tangentially-fired boiler which uses high-sulfur bituminous coal from Western Indiana. Actual power generation produced by the unit approaches 65 megawatts. As such, it is one of the smallest existing, tangentially-fired units in the United States. The furnace is 26-feet, 11-inches deep and 24-feet, 8-inches wide. It has a primary and secondary superheater. Tube sizes and spacings are designed to achieve the highest possible heat-transfer rates with the least potential for gas-side fouling. The unit also has an inherent low draft-loss characteristic because of the lack of gas turns. At full load 540,000 lbs/hr. of steam are generated. The heat input at rated capacity is 651 x 10^6 Btu per hour. The design superheater outlet pressure and temperature are 1320 psi at 955°F. The unit has a horizontal shaft basket-type air preheater. The temperature leaving the economizer is about 645°F, while the stack gas temperature is about 316°F. The balanced-draft unit has 12 burners.

In 1980 the unit was fitted and fully optimized with a state-of-the-art Low-NO_x Concentric Firing System (LNCFS). The LNCFS represents a very cost effective means of reducing NO_x emissions in comparison with other retrofit possibilities. The system works on the principal of directing secondary air along the sides of the furnace and creating a fuel rich zone in the center of the furnace. With the LNCFS, the excess air can be maintained below 20 percent. Additionally, the installation reduces ash accumulation on the furnace walls increasing heat absorption and reducing attemperation requirements. With the LNCFS, each corner of the furnace has a tangential windbox consisting of three coal compartments and four auxiliary air compartments. At full load with all three 593 RB pulverizers operating, primary transport air from the pulverizers amounts to 23 percent of the total combustion air. Pulverizer capacity is 26,400 lbs/hr. with 52 grind coal and 70 percent minus 200 mesh.

Whitewater Valley 2 has a Lodge Cottrell cold side precipitator which was erected with the boiler. The precipitator treats 227,000 actual cubic feet per minute of 316°F flue gas with 45,000 square feet of collection area. The unit has two mechanical fields and four electrical fields and achieves 99 percent removal efficiency (from 3.9 gr/ft^3 to 0.04 gr/ft^3). The ESP performance was optimized by Lodge Cottrell when Richmond Power and Light purchased new controllers in 1985.

Whitewater Valley Unit 2's overall efficiency of 87.47 percent at full load has shown little variation over the years. The unit's average heat rate is 10,280 Btu/Kwh. At 60 percent of full load, the unit's efficiency increases to 88.17 percent. The unit uses approximately 0.935 pounds of coal per Kwh and generates 8.51 pounds of steam per Kwh.

The primary emissions monitored at the station are SO_2 and opacity. SO_2 emissions are calculated based on the coal analysis and are limited to 6 lbs/MBtu. Opacity is monitored using an in-situ meter at the stack and is currently limited to 40 percent. Current SO_2 emissions for the unit are approximately 4 lbs/MBtu, while opacity at full load ranges from 15 to 20 percent. Opacity at low load (40MW) ranges from 3 to 5 percent. Limited testing was conducted in November of 1986 for NO_x emissions. Results from the test work indicated that NO_x emissions averaged 0.65 lbs/MBtu.

Whitewater Valley 2 has several important qualities as a LIFAC demonstration site. One of these is that Whitewater Valley 2 was the site of a prior joint EPA/EPRI demonstration of LIMB sorbent injection technology. Much of the sorbent injection equipment remains on site and is being used in the LIFAC demonstration. Another advantage of the site is that Whitewater Valley 2 was a challenging candidate for a retrofit due to the cramped conditions at the site. The plant is thus typical of many U.S. power plants which are potential sites for application of LIFAC. In addition, the Whitewater Valley 2 boiler is small relative to its capacity; hence, it has high-temperature profiles relative to other boilers. This situation requires sorbent injection at higher points in the furnace to minimize deadburning of the reagent, but it decreases residence times needed for sulfur removal. Whitewater Valley 2 will show LIFAC's performance under operational conditions most typical of U.S. power plants. The project will demonstrate LIFAC on high-sulfur U.S. coals and is a logical extension of the Finnish demonstration work and important for LIFAC's commercial success in the U.S.

PROJECT SCHEDULE

To demonstrate the technical viability of the LIFAC process to economically reduce sulfur emissions from the Whitewater Valley Unit No. 2, LIFAC NA is conducting a three-phase project.

Phase I: Design
Phase IIA: Long Lead Procurement
Phase IIB: Construction
Phase III: Operations

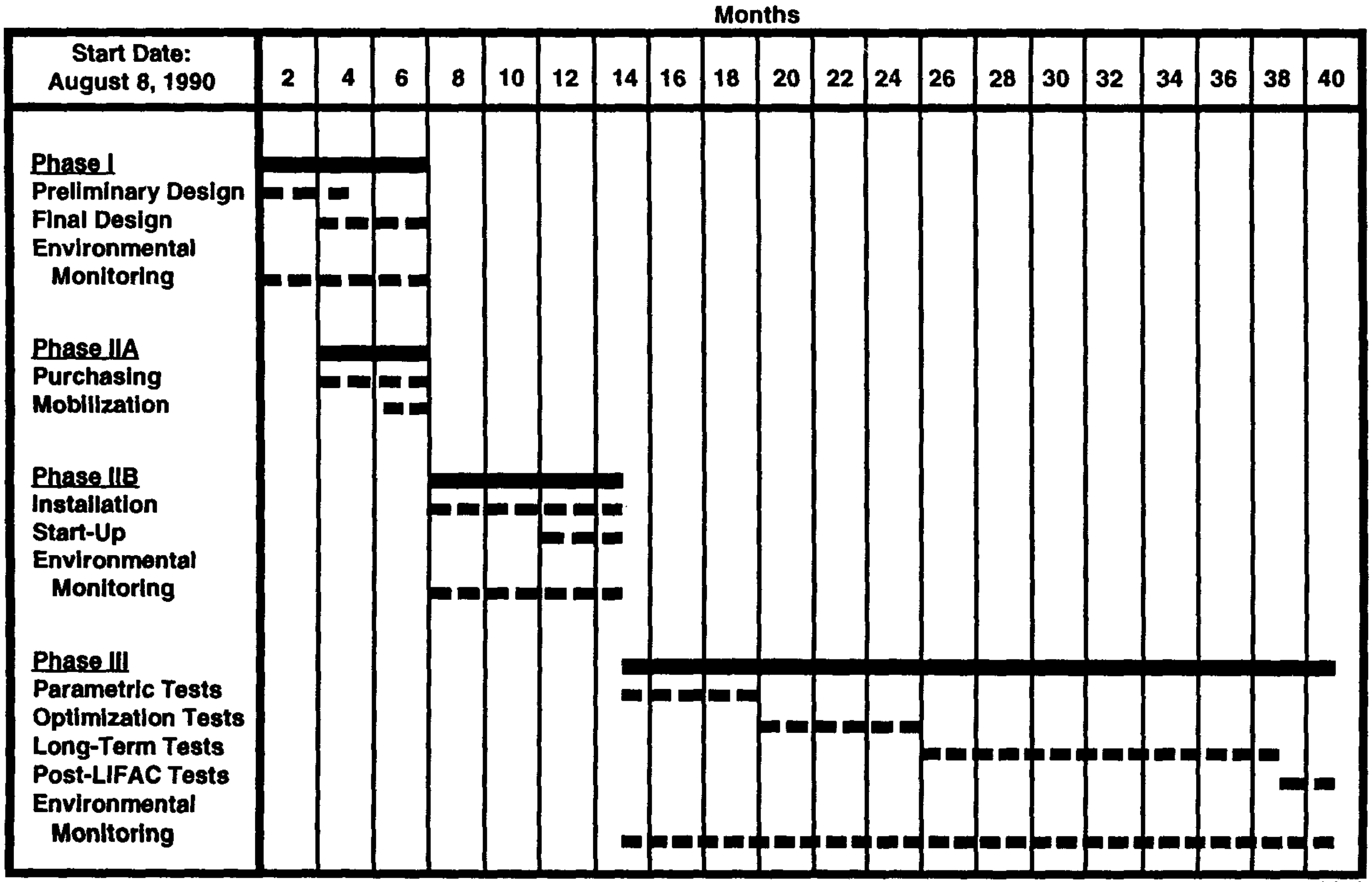
Except Phase IIA, each phase is comprised of three (3) tasks, a management and administration task, a technical task and an environmental task. The design phase began on August 8, 1990 and was scheduled to last six (6) months. Phase IIA, long lead procurement, overlaps the design phase and was expected to require about four (4) months to complete. The construction phase was then to continue for another seven (7) months, while the operations phase was scheduled to last about twenty-six (26) months. Figure 2 shows the original estimated project schedule which is based on an August 8, 1990 start date and a planned outage of Whitewater Valley 2 during March 1991.

It is during this outage that all the tie-ins and modifications to existing Unit No. 2 equipment were made. This required that the construction phase begin in early February, 1991 -- construction was to be completed by the end of August 1991. Operations and testing were to begin in September 1991 and continue for 26 months. However, during previous reporting periods, the project encountered delays in receiving its construction permit. These delays, along with some design changes, and an approved expansion in project scope required that the Design Phase be extended by about eleven months. Therefore, construction was not completed until early June 1992. This represents a nine-month extension in the overall schedule. During the last half of 1992, problems were encountered during startup and commissioning of some of the LIFAC components and systems. These problems required the parametric tests to be delayed until the first quarter 1993 which subsequently required adjustments in the entire testing schedule. During the initial parametric tests conducted during the first quarter this year, problems were encountered with increased opacity levels. These problems (see quarterly report No. 10) forced an extension in the parametric test schedule. Due to these delays, an adjustment was made during the last reporting period to the testing schedule (see Figure 3). These delays, however, will not

LIFAC

LIFAC Demonstration

Original Project Schedule



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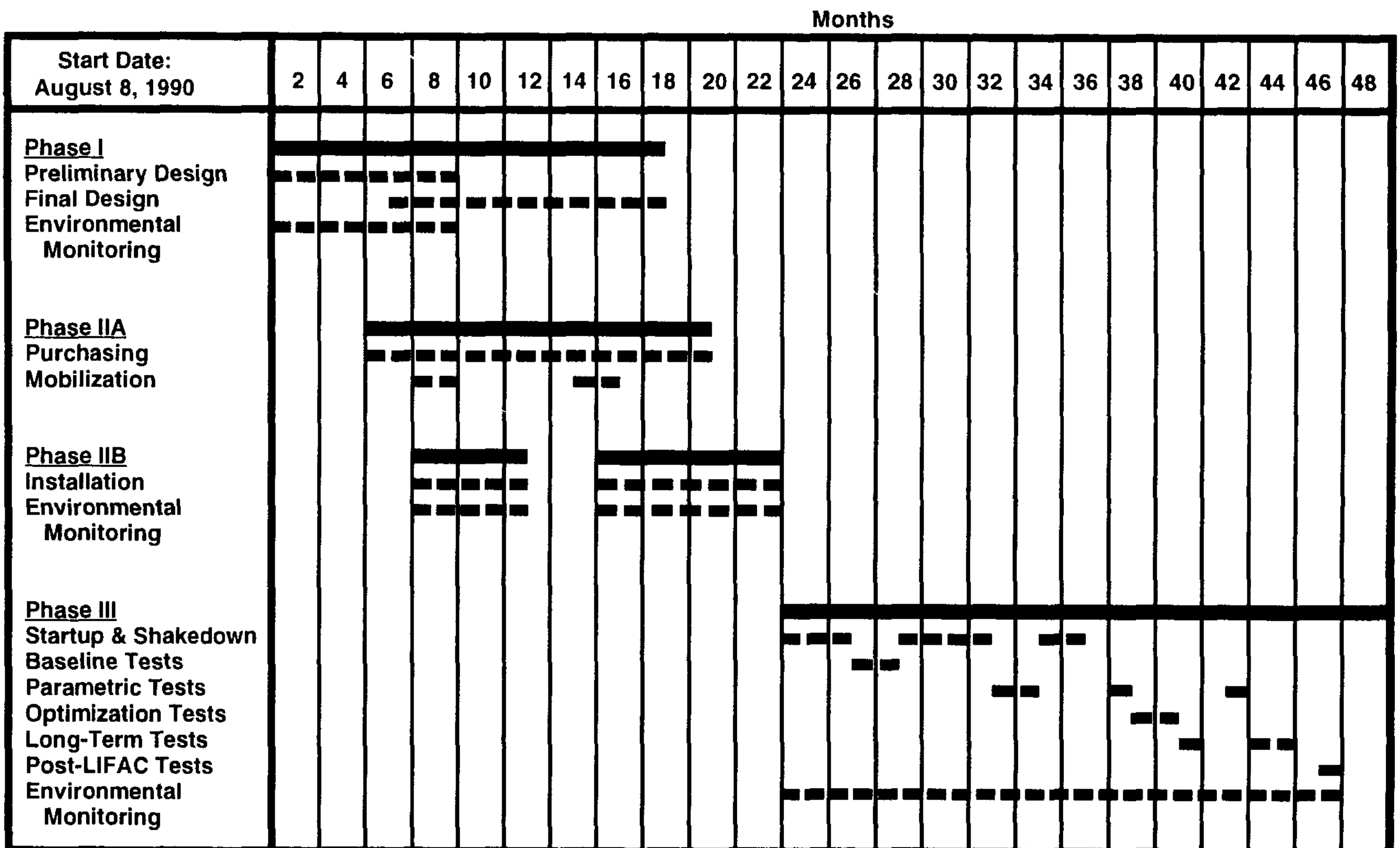
LIFAC Demonstration

Current Project Schedule

(Revised June 1993)



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impact the overall duration of the Operations Phase and the total project duration will remain at 48 months.

TECHNICAL PROGRESS

During this report period (July-September, 1993), the ESP evaluation was completed and two recommendations made to improve LIFAC and ESP performance/interaction. Parametric testing was nearly completed. The Baseline Environmental Report was finalized and prepared for submission to DOE. Three presentations were made at symposiums held in August and September.

Project Management (WBS 1.3.1)

During July through September 1993, management efforts and achievements included:

- **LIFAC Management Committee Meetings** - During the quarter, the Committee held one informal telephone conference to discuss project status, problems, and potential solutions.

    - Results of the ESP study were reviewed with the Committee with most of the discussion centered around the two proposed upgrades and the final estimated costs. The Committee approved the two upgrades, and the costs were approved.

    - Preliminary test results (see later discussion) were reviewed with the Committee. Prior test period results were poor due to high opacity problems. However, the ESP study revealed a revised operating procedure which resulted in LIFAC being operated at closer to design conditions which produced acceptable SO_2 reductions (65-75%).

- **Joint LIFAC NA - DOE Cooperation** - During this period, LIFAC NA continued to implement the Cooperative Agreement's management and administrative and technical provisions including DOE reporting and administrative requirements.

- LIFAC NA sent invoices to DOE during the period consistent with DOE requirements that the project report invoiced and committed costs on a phase-and-task basis.

- LIFAC NA management reviewed progress on the numerous periodic reports such as the Cost Management Report, the Financial Assistance Management Summary Report, Monthly Progress Report, Quarterly Reports, Milestone Status Reports, etc.

- **Regulatory** - On July 9, 1993, RP&L received the variance extension for the LIFAC project, which is good through June 30, 1994. LIFAC NA continues to monitor the negotiations between RP&L, Indiana Department of Environmental Management, and EPA Region V. RP&L has requested a variance for day-to-day operations until a formal change in the SIP limits for TSP is approved.

- **Funding Agreements** - All funding agreements have been concluded. The State of Indiana has contributed $800,000 to the project for construction; Black Beauty Coal Company is contributing $378,750 in incremental coal costs; and the Electric Power Research Institute is contributing up to $250,000 for ESP studies and some trace element work.

- **Technology Transfer** - During this reporting period, LIFAC NA presented technical papers at three technical conferences:

  - 1993 SO_2 Control Symposium, August 24-27, 1993
  - Second Annual Clean Coal Technology Conference, September 7-9, 1993
  - SO_2 Capture Seminar - "Sorbent Options and Considerations," September 19-21, 1993

Testing and Data Analysis (WBS 1.3.2)

Test Procedures - Parametric testing resumed in late August and continued through all of September. There were a total of five test periods this quarter. With the steam reheat system working at its maximum potential the treated flue gas temperature is increased ~30°F to around 160°F.

However, to sustain the efficiency of the ESP and keep opacity down, it is necessary to reheat the flue gas to approximately 200°F. This was ultimately achieved by slightly opening the by-pass damper and mixing hot, untreated flue gas with the activation reactor outlet stream. The performance of the ESP gradually improves if the LIFAC process is continuously in operation for several days. The quantity of ash byproduct separated from the flue gas in the reactor was greater than expected. Consequently, the logistics of ash hauling and removal have become complicated. The process was shut down periodically for 1-2 hour intervals in order to attain baseline SO_2 levels. Coal samples were taken hourly and sulfur content was consistent at slightly above 2.0%.

Parametric Testing

- Two limestone qualities were tested this period, 80% below 200 mesh and 80% below 325 mesh, both with high $CaCO_3$ content.

- The effects of varying the calcium to sulfur molar ratio parameter were studied. These tests encompassed ratios between 1:1 and 3.5:1.

- A variety of activation reactor bottom temperatures were tested this quarter. The approach to saturation temperature ranged from 2°F to 12°F.

- Activation reactor humidification settings were tested by documenting the effects of different atomizing air settings.

- The mass flow ratio of recycled ESP ash was varied by changing the speed settings of the rotary feeders under the ESP hoppers.

Testing Results

- Total SO_2 capture during parametric testing ranged between 50% and 83%. The average total SO_2 reduction was approximately 75% with a 60MW boiler load, a Ca:S molar ratio of 2:1, and a reactor bottom temperature of ~130°F. Figure 4 illustrates average sulfur dioxide reductions for the three primary stages of the LIFAC process.

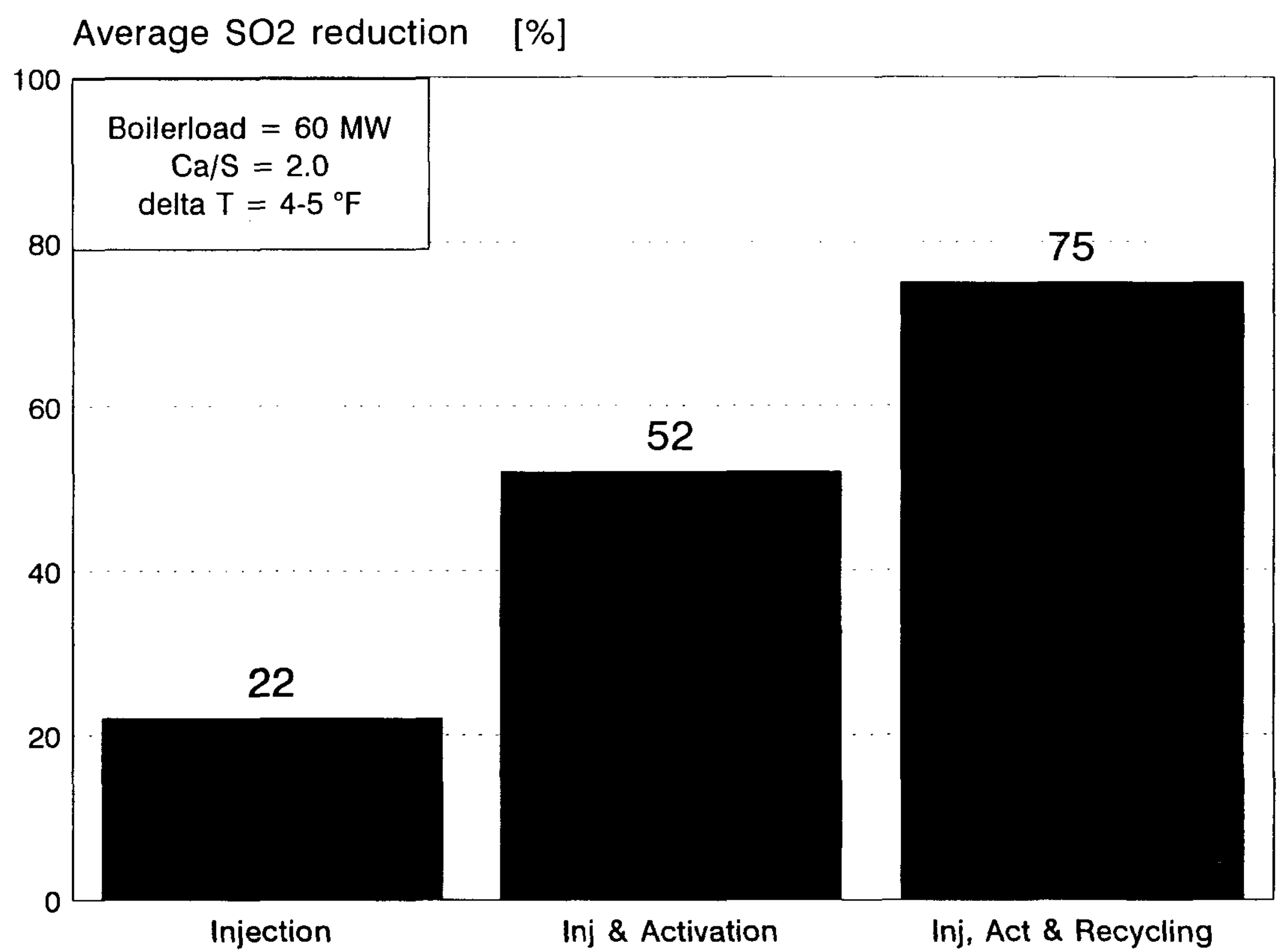

FIGURE 4 PARAMETRIC EFFECTS

- Fine limestone proved to capture more sulfur dioxide than coarse limestone. The smaller particle size of the fine limestone generates more surface area for the necessary reactions to take place. The difference in total SO_2 reduction between the two qualities of limestone exceeded 25 percentage points at low boiler loads and 20 percentage points at high load. Figure 5 shows injection and total sulfur dioxide removed for each tested limestone at low boiler load, while Figure 6 exhibits the same study at high load.

- Total SO_2 reduction improved between 5% and 10% when operating at lower boiler loads. For both limestone qualities the reaction environment (Lower furnace temperatures, longer residence times, etc.) proved to be more suitable for the LIFAC process at lower loads. Figure 7 is a plot of total sulfur dioxide reduction with varying boiler load for each tested limestone.

- An increase in the Ca:S molar ratio results in a higher percentage of SO_2 reduction. Ca:S ratios ranging from 1:1 to 3.5:1 were tested for both limestone qualities. The trend in Figure 8 depicts how reduction increases as more limestone is injected.

- Activation reactor parameters such as reactor bottom temperature and atomizing air pressure have an effect on total SO_2 reduction. The reactor becomes more efficient as the reactor bottom temperature approaches saturation temperature. However, the approach to saturation temperature is limited due to the possibility of plugging the finned steam reheat tubes as the exiting flue gas gets too moist. Therefore, 3-4°F above saturation temperature was determined to be optimal at this point in the test program. Three different atomizing air pressures were tested this quarter (45, 50, 65 psig). As atomizing air pressure is increased the humidification water droplet size decreases. When atomizing air pressure becomes too low the droplets do not evaporate while residing in the reactor. This occurrence decreases the efficiency of the humidification process

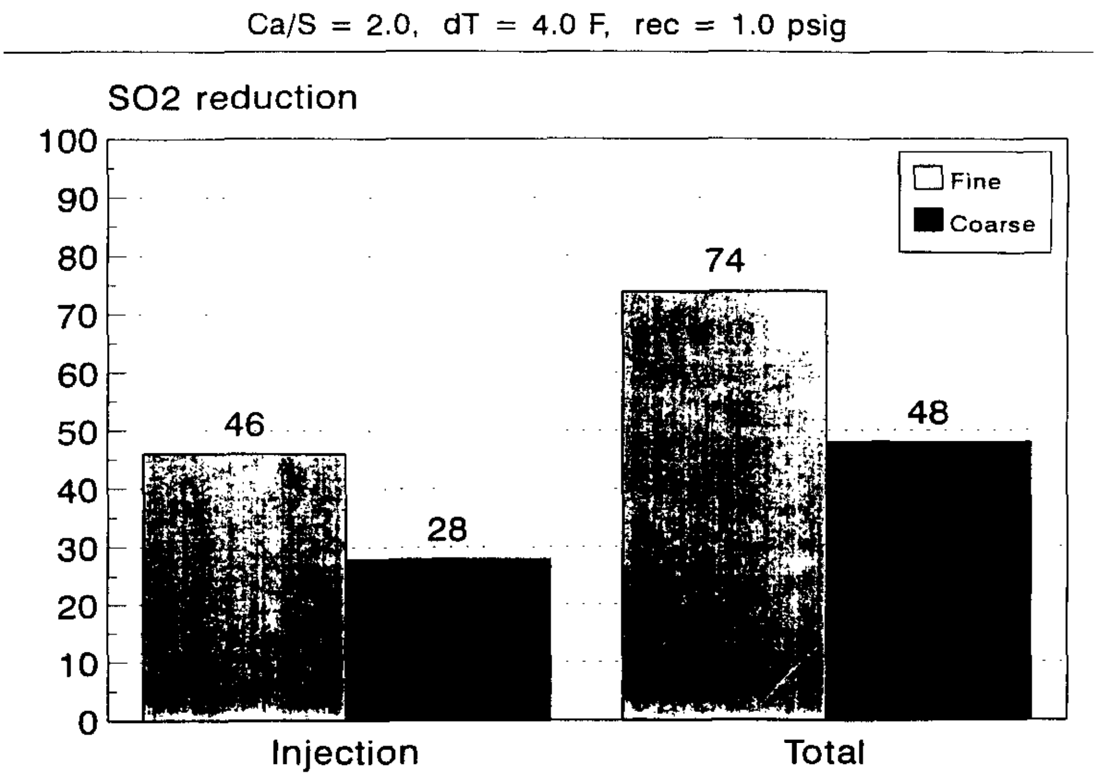

FIGURE 5: AVERAGE REDUCTION AT 42 MW

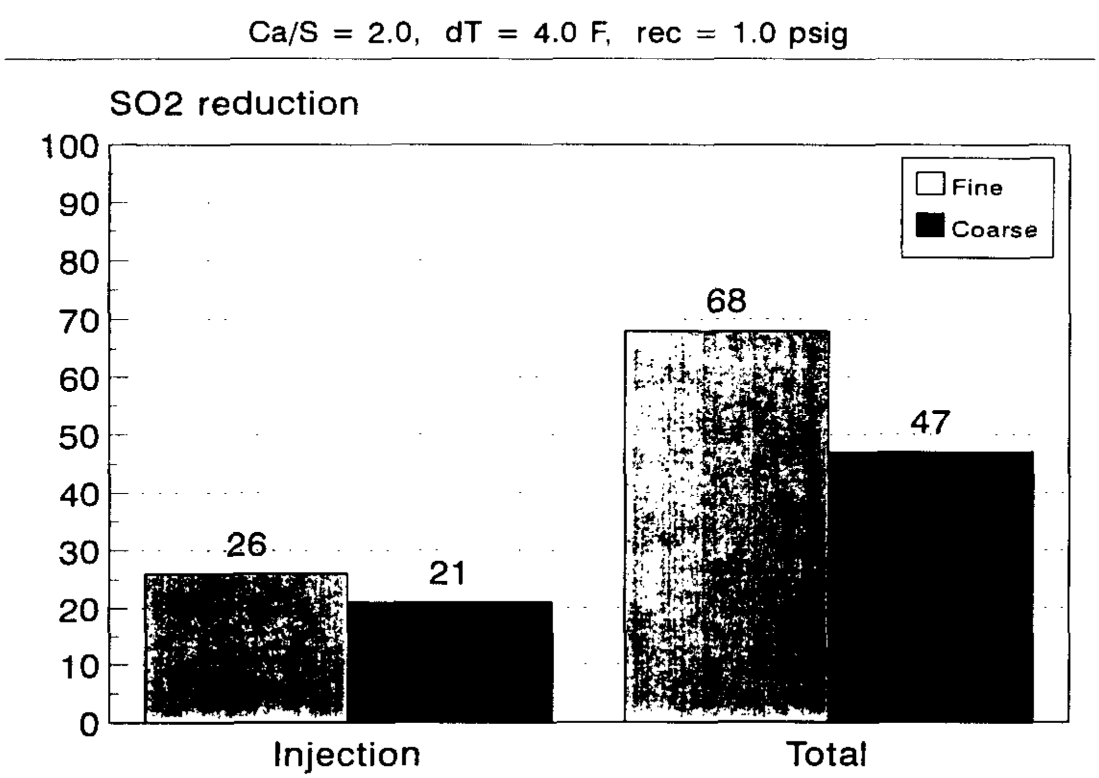

FIGURE 6: AVERAGE REDUCTION AT 60 MW

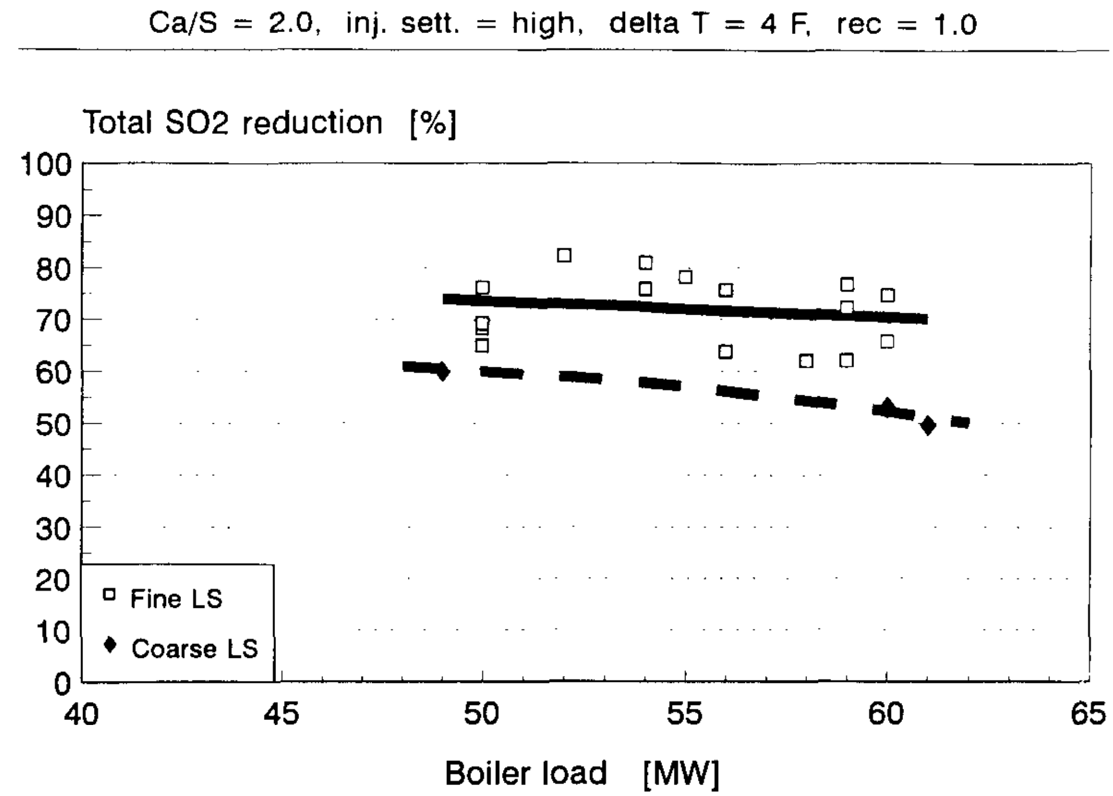

FIGURE 7: EFFECT OF BOILER LOAD

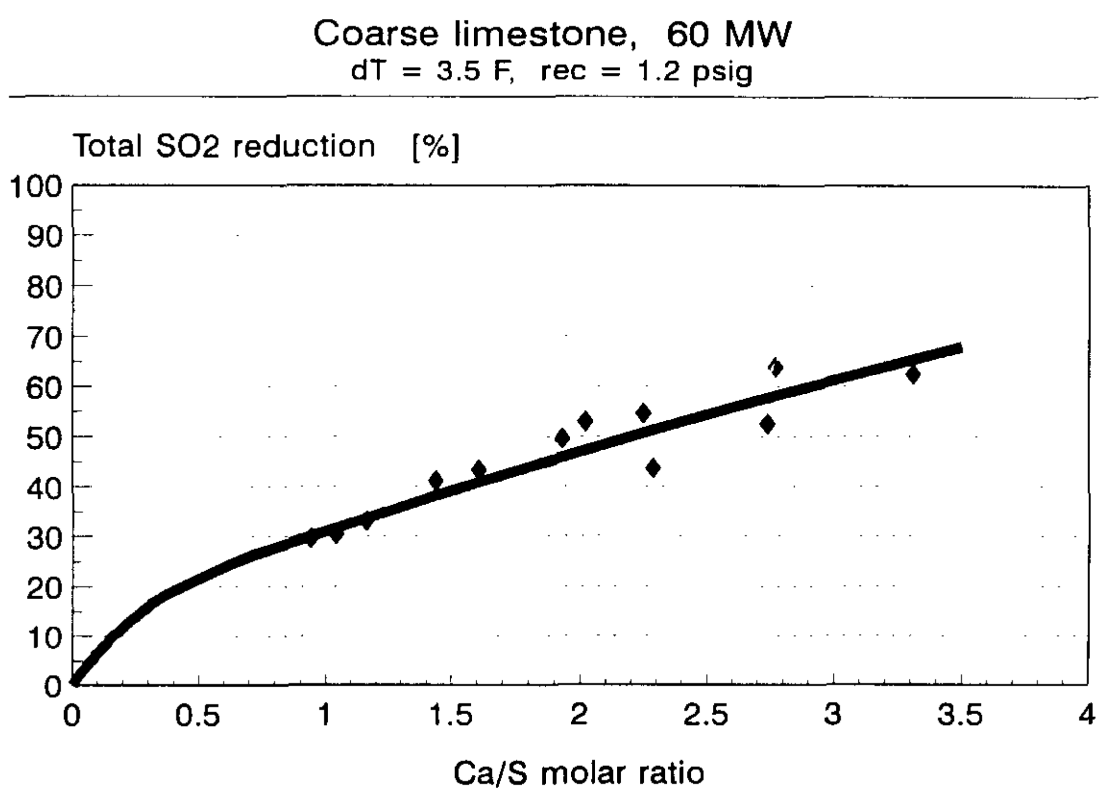

FIGURE 8: EFFECT OF Ca/S MOLAR RATIO

and the ash byproduct becomes wet. An atomizing air setting of 50 psig proved to be ideal. Figure 9 shows total SO_2 reduction vs. reactor bottom temperature. Figure 10 illustrates the effects of atomizing air pressure.

- ESP ash recycling contributes an additional 15-25% sulfur dioxide reduction to the LIFAC process. Maintaining a pressure of 1.0 to 1.2 psig in the recycle line was found to be an optimal setting. This pressure is accomplished with speed settings of 30% for each of the two rotary feeders under the ESP hoppers. Increasing this parameter could cause the hoppers to empty during operation.

Modifications and Improvements

- Limestone feeding has been inconsistent while in automatic mode. It was necessary to switch to manual mode in order to stabilize the limestone flow. This problem eliminates the capability of controlling limestone flow by entering the desired Ca:S molar ratio and toggling to a remote position.

- Most of the rubber hose for limestone transport was replaced with steel pipe. The existing rubber hoses continue to deteriorate due to the abrasive limestone and should eventually be replaced.

- The humidification water control valve was replaced and currently yields accurate flow control. Since the valve is pneumatically controlled, it was necessary to run an instrument air line from the desiccant dryer to the valve.

- Ingersoll Rand serviced compressor #2 during this quarter. The contactor interlocking for the startup of the compressor was repaired.

- The mechanical limit switches on the double dump valves continue to malfunction. The devices need to be disassembled, cleaned, and reassembled periodically. Ultimately, the switches should be replaced with proximity limit switches.

60 MW, Ca/S = 2.0, fine LS, rec = 1.0

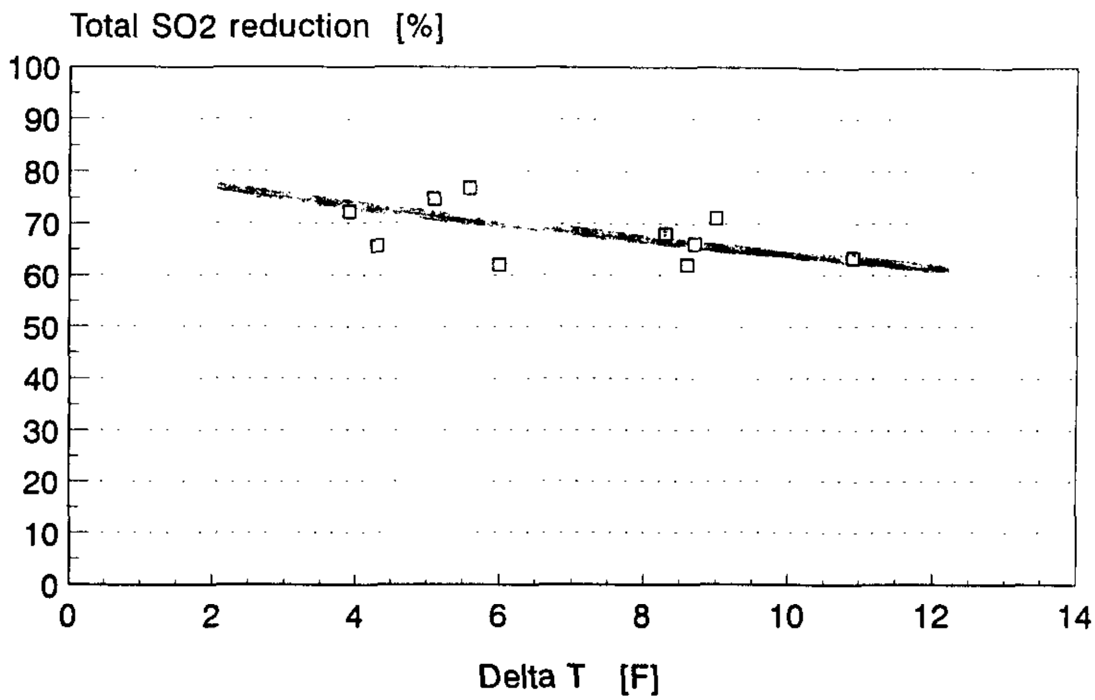

FIGURE 9: EFFECT OF REACTOR BOTTOM TEMPERATURE

Boiler load 60 MW, fine LS, Ca/S = 2.0, inj. sett. = high, delta T = 4 F, rec = 1.0

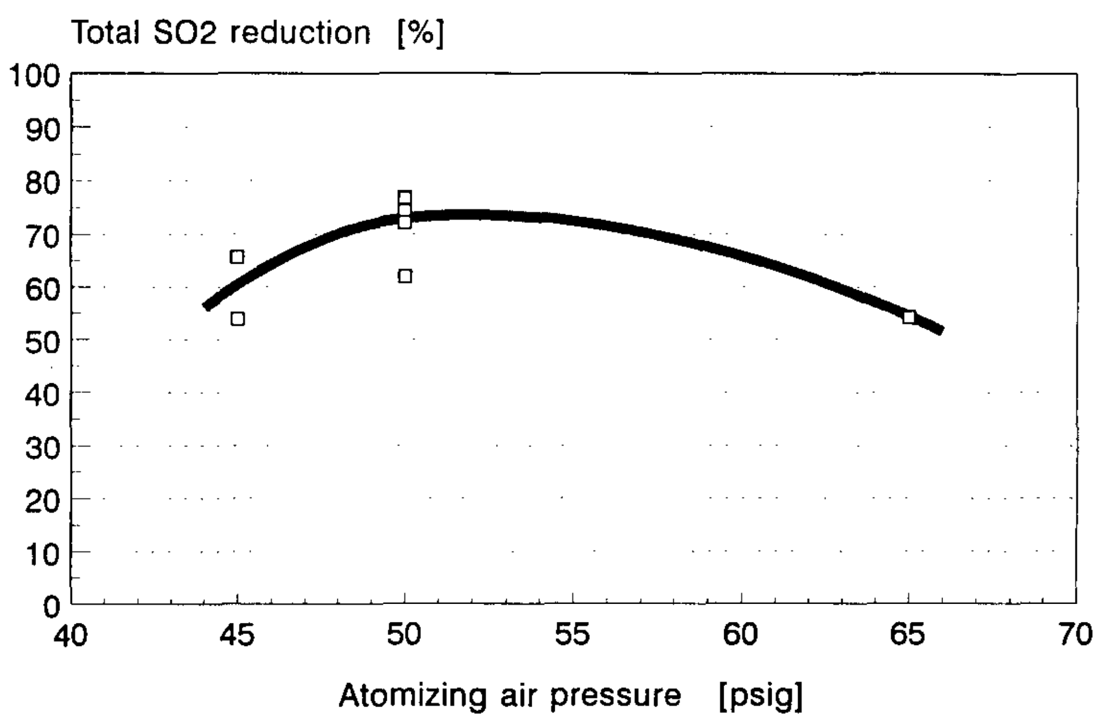

FIGURE 10: EFFECT OF ATOMIZING AIR PRESSURE

- The existing limestone unloading piping from the truck to the splitter was modified by eliminating the first three elbow fittings and installing rubber hose directly to the vertical line along the limestone building. This was done to eliminate line plugging during unloading.

Environmental Monitoring (WBS 1.3.3)
RP&L received the variance extension for the LIFAC project which is good through June 30, 1994.

The Baseline monitoring report was finalized at the end of this reporting period and will be submitted to DOE at the beginning of the next period. The Baseline results are summarized below:

Gaseous Emissions: (Test conducted at duct breaching downstream of the ID Fan.)

	Test Date	
Parameter	**9/02/92**	**12/18/92**
SO_2	4.63 lb/MBtu	-
TSP	0.025 lb/MBtu	0.18 lb/MBtu
Opacity	8-20%	8-20%
NO_x	375 ppmv	-
CO_2	14.8%	-
CO	19.9 ppmv	-

The December 18, 1992 baseline stack test was run due to the low TSP results (0.025 lb/MBtu) obtained on September 2, 1992. The resulting 0.18 lb/MBtu is more in line with historical TSP results.

Solid Waste and By Product: (September 2, 1992)

Parameter	Economizer Hoppers	ESP Hoppers
TCLP	BDL	BDL except 1.3 mg/l arsenic
Sulfates (mg/l)	100	260
Alkalinity (mg $CaCO_3$)	87	299
Volatile Organics	BDL except 46 ug/kg methylene chloride	BDL except 730 ug/kg carbon disulfide 2200 ug/hg toluene
PH	11.90	-

BDL - Below Detectable Limits

Although arsenic was detected in the ESP hopper ash, its level is below the 5.0 mg/l regulatory limit. Also, methylene chloride, carbon disulfide, and toluene are not regulated as a hazardous waste.

Aqueous Effluent: (Sample collected at RP&L's outfall from their series of ponds.)

Parameter	9/02/93
Alkalinity	111 mg $CaCO_3$

During the later part of September 1993, LIFAC NA conducted some additional ash and aqueous baseline sampling as well as the first round of environmental monitoring with LIFAC in operation. On September 22, 1993, baseline ash samples were collected from the economizer hoppers, ESP inlet hoppers, and boiler bottom hopper. The sample team also began monitoring the plant's feedwater since its incoming quality is believed to be impacting compliance with effluent criteria in accordance with RP&L' NPDES Discharge Permit. Feedwater for the plant is either pumped from the river, or during dry seasons, is pumped from the local sanitary treatment plant's effluent discharge.

On September 23 and 24, 1993, the first round of environmental monitoring tests were conducted with LIFAC in operation. Monitoring included emissions with a stack test being conducted for each day. Since Unit 1 was off line during the sampling event, emissions were monitored at the 250 foot level of the stack and not at the duct breaching as done during baseline testing. Ash samples were collected at the economizer hoppers, LIFAC bottom hoppers, ESP inlet and outlet hoppers, and boiler bottom ash disposal bin. The sampling team continued to monitor the feedwater to the plant which, at this time, was coming from the treatment plant effluent. The team also sampled the boiler bottom ash discharge water since it is believed that immediate impacts will not be seen at the pond outfall as a result of LIFAC operations due to the long residence time through the pond system. The team plans to utilize RP&L's pond discharge analyses as required under their permit to identify any long-term trends after LIFAC has been running.

FUTURE PLANS

- Submit the Baseline Testing and Baseline Environmental Reports.
- Complete parametric testing and begin optimization testing.
- Install the two ESP upgrades during the planned outage period and assess impacts on LIFAC and ESP performance.
- Continue mechanical and electrical repairs to the LIFAC system to maintain process performance.
- Receive and evaluate the analytical results from the September 23 and 24 environmental tests.
- Submit the compliance report to IDEM for the September 23 and 24 stack tests.
- Conduct the next round of environmental monitoring tests in November.
- Hold a formal project review meeting.
- Conduct a preliminary market assessment for LIFAC installations.