Contract No. DE-FC22-90PC90548

Quarterly Report

No. 5

LIFAC Sorbent Injection Desulfurization Demonstration Project

Presented By

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A Joint Venture Between

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U.S. Department of Energy

Pittsburgh Energy Technology Center
Pittsburgh, Pennsylvania 15236

October-December 1991

LIFAC SORBENT INJECTION
DESULFURIZATION DEMONSTRATION PROJECT

QUARTERLY REPORT NO. 5
OCTOBER - DECEMBER 1991

Submitted to

U. S. DEPARTMENT OF ENERGY

by

LIFAC NORTH AMERICA

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INTRODUCTION

In December 1990, 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 fifth Technical Progress Report covering the period October 1, 1991 through the end of December 1991. Due to the power plant's planned outage schedule, 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 International (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.

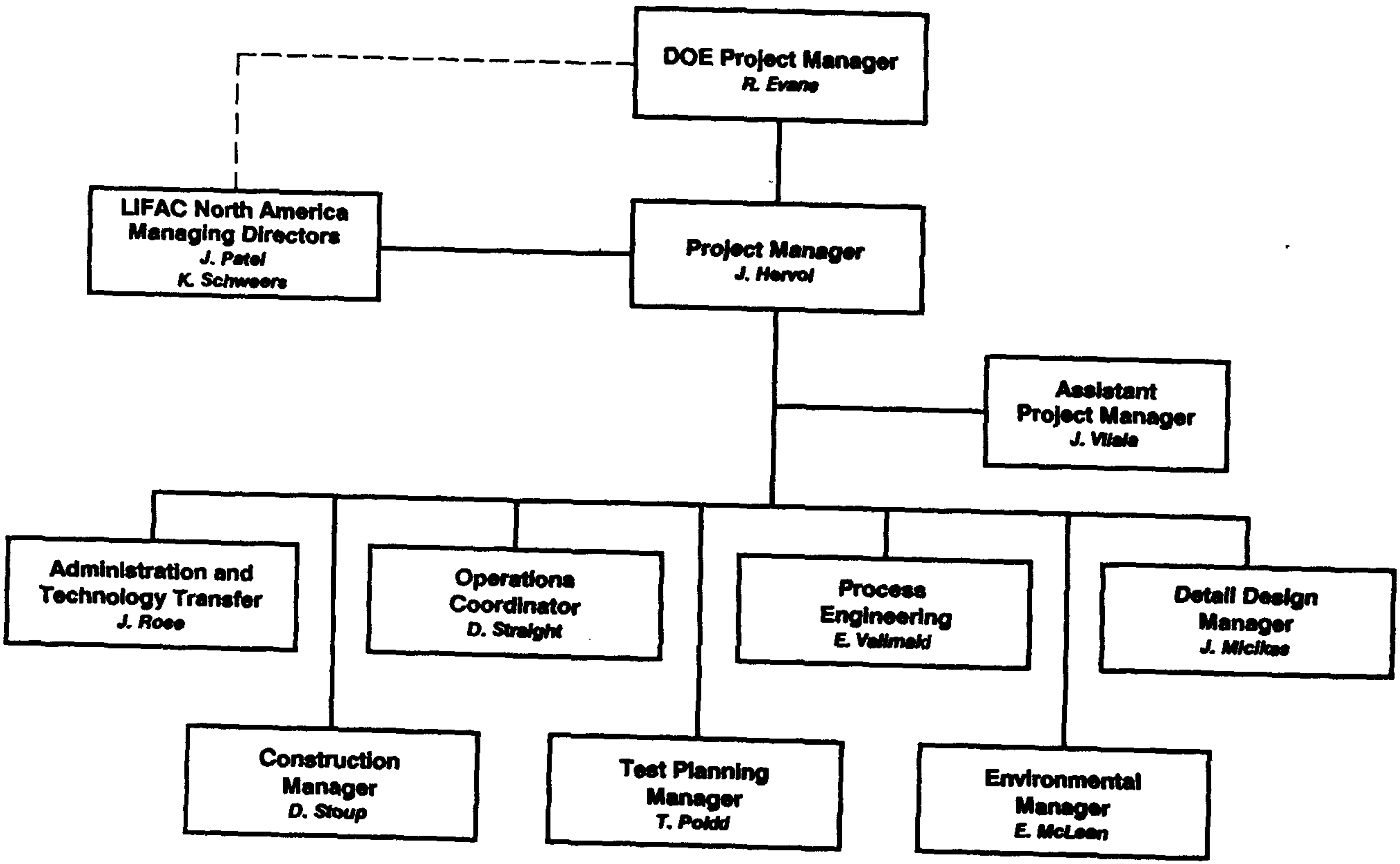
Process Development

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



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 EPS'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 will be used in the LIFAC demonstration, if possible. Another advantage of the site is that Whitewater Valley 2 is 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 will require sorbent injection at higher points in the furnace in order to prevent deadburning of the reagent and may decrease 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

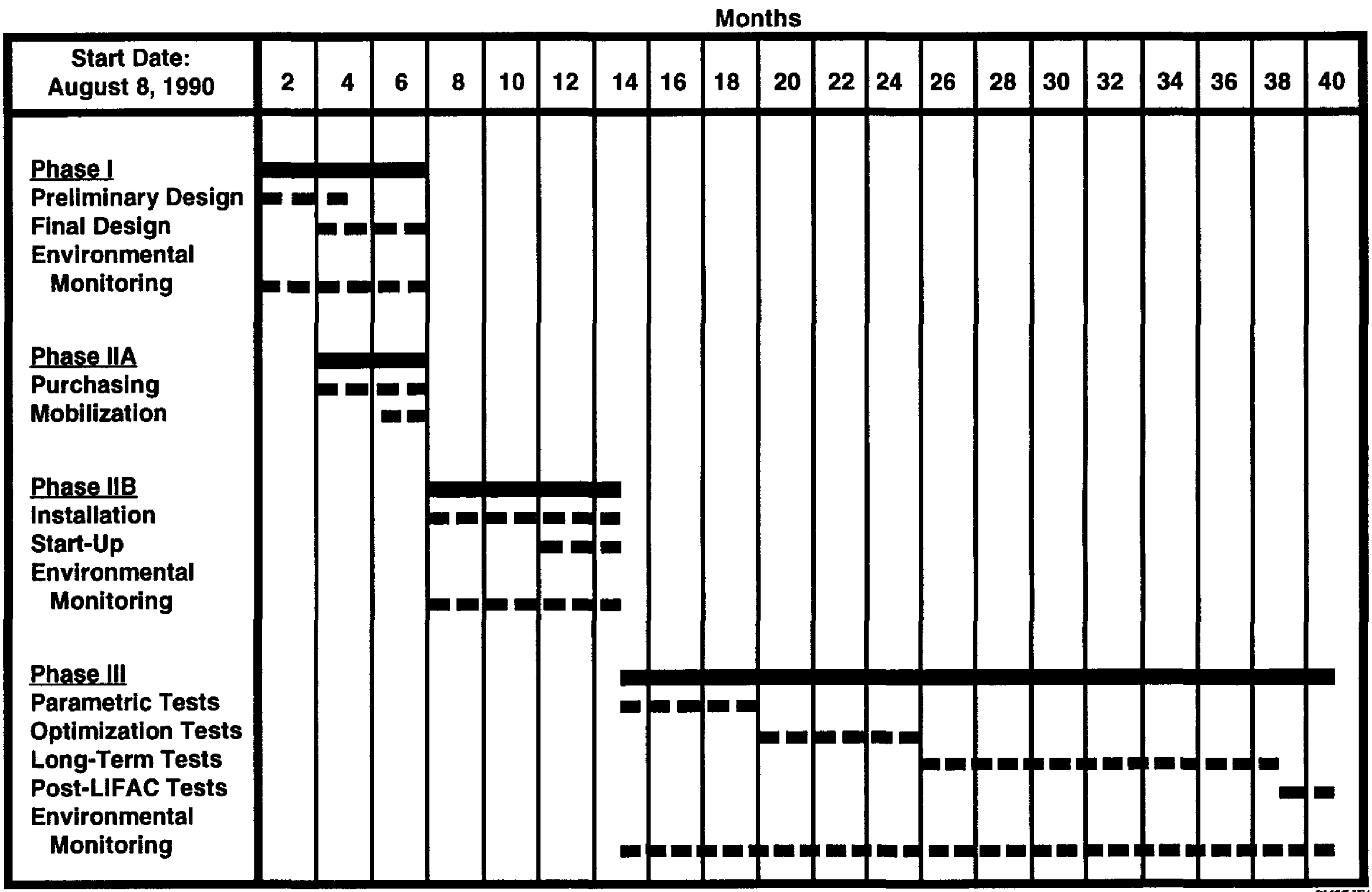
To demonstrate the technical viability of the LIFAC process to economically reduce sulfur emissions from the Whitewater Valley Unit No. 2, LIFAC NA is conducting a three-phase project.

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 a 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 and start-up were 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 a proposed expansion in project scope (awaiting approval), will require that the Design Phase be extended by about eleven months. Therefore, construction and start-up will not be completed until the end of May 1992. This represents a nine-month extension in the overall schedule. Figure 3 shows the revised project schedule. Total project duration will now be 48 months.

LIFAC Demonstration
Original Project Schedule



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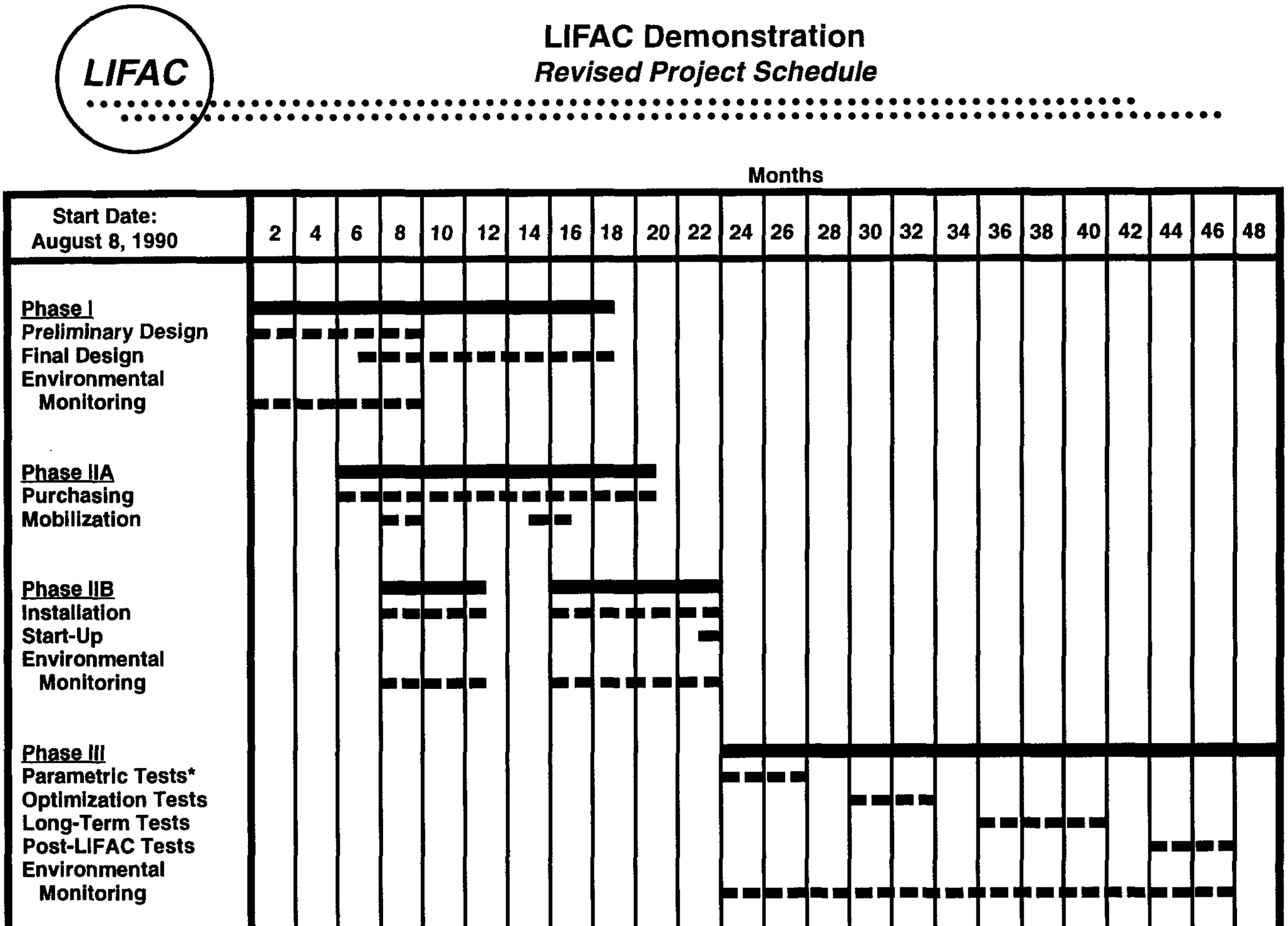
LIFAC Demonstration

Revised Project Schedule



* Includes baseline testing.

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TECHNICAL PROGRESS

The work performed during this period (October - December 1991) was consistent with the Statement of Work and the approved schedule change contained in the Cooperative Agreement. During this period, emphasis was placed on five separate tasks. In the Design Phase, emphasis was placed on completing the Engineering and Design task. In the Construction Phase, work continued on all four tasks including Project Management, Long Lead Procurement, Installation and Start-up, and Environmental Monitoring. Following is a summary of the work performed under these tasks.

Project Management (WBS 1.2.1B)

During the October through December period, management efforts and achievements included:

- **LIFAC Management Committee Meetings** - The LIFAC management committee held a formal management committee meeting on October 28, 1991 in the Pittsburgh, Pennsylvania offices of ICF Kaiser Engineers. The agenda of this meeting included:

    - The management committee approved ICF KE's plan to request from DOE an increase in scope and budget related to the recycling of wastes, ESP upgrade, more durable materials of construction, etc.

    - The project managers of ICF Kaiser Engineers and Tampella Power reported that they intended to begin construction at the site in the immediate future, and that they required additional ability to commit funds.

    - During the meeting, the management committee authorized additional financial commitments by ICF Kaiser Engineers in excess of its budget contained in its contract. LIFAC NA made this decision aware that the forthcoming request for expanded scope might not be approved by DOE, and therefore, DOE co-funding might not cover these added costs.

- The committee heard reports on regulatory and permitting developments, including a report that IDEM granted LIFAC NA a construction permit.

- The committee also heard reports related to: (1) schedule and budget, (2) relations with the host site utility, (3) fulfillment of the DOE Cooperative Agreement, and (4) interfaces with co-funders.

• **Joint LIFAC NA/DOE Cooperation** - For this period, LIFAC NA successfully implemented the Cooperative Agreement's management, administrative and technical provisions including DOE reporting and administrative requirements:

  - LIFAC NA provided to DOE required financial, project and cost reports including: (1) monthly technical progress, (2) cost management, and (3) federal assistance management summary reports. These reports met all DOE specifications related to committed costs.

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

• **Regulatory** - Overall, in the previous period, the project made significant progress resolving regulatory problems. However, due to the importance of this area, the LIFAC management committee continued to manage/oversee, and in some cases, directly participate (e.g. meeting with regulatory attorneys) in the permitting and approvals process. The environmental regulatory situation, discussed further elsewhere, is summarized here:

  - At the beginning of the period, IDEM provided LIFAC NA the construction permit which allowed work to begin at the site. The project initiated construction at the earliest possible start date.

- In the previous period, RP&L submitted a variance request which would increase RP&L's particulate emission limit. RP&L needed to increase its limit independent of the LIFAC process, but the utility included a clause into the request specifically addressing the LIFAC demonstration. IDEM did not decide on the variance request during this period.

- During this period, ICF Kaiser Engineers and Tampella Power prepared additional material on the characteristics of the LIFAC waste product and presented it to IDEM. The Indiana Department of Environmental Management officials reviewed our request for a solid waste disposal permit/approval, but did not decide; a decision is expected next period.

• **Funding Agreements** - LIFAC NA continued efforts to negotiate and finalize arrangements for participation/funding of other project participants:

  - Electric Power Research Institute - LIFAC project managers conferred with representatives of EPRI to discuss EPRI funding. EPRI formally requested from its board $250,000 for the project, with money to be earmarked to ESP tests. More information on funding and technical assistance is expected in the next reporting period.

  - Indiana Corporation for Science and Technology (CST) - LIFAC NA received $0.45 million during the period and expects to receive additional funding during the next period.

  - Black Beauty Coal Company - LIFAC NA believes that Black Beauty will provide most of the coal for the test program and replace the coal originally expected from Peabody Coal Company. LIFAC NA will continue to negotiate a contribution from Black Beauty towards the project.

  - Southdown/Kosmos Cement Company - During the previous reporting period, Southdown decided not to donate the limestone nor to pay transportation costs, but indicated willingness to discuss limestone supply and some contribution to the project. We are continuing to work with Southdown to negotiate limestone supply from Southdown which will involve some donation by Southdown. If these negotiations are not successful, LIFAC NA will purchase limestone based on the currently scheduled competitive solicitation.

- **Technology Transfer Activities** - During the period, LIFAC NA participated in the 1991 EPA/EPRI/DOE SO_2 Control Symposium as an exhibitor. As the start of the test program approaches, LIFAC plans to increase technology transfer activities including: preparing new posters highlighting the demonstration project, exhibiting and presenting joint papers at conferences, developing new marketing materials which describe the demonstration as on-going, and conducting site visits.

- **Scope Increase** - A formal request to increase the project scope was submitted to DOE for review and approval. The scope increase is to add sorbent recycle and other process improvements to the LIFAC system to improve SO_2 capture another 5 to 10 percentage points. Towards the end of this reporting period, strong indications were that DOE was going to approve the Scope increase and associated schedule change. Therefore, to save time and perhaps costs, LIFAC NA took it on their own risk to initiate the new scope activities.

Engineering and Design (WBS 1.1.2)

During this reporting period, engineering activities were completed. Remaining work was still concentrated in three areas:

- **Vendor Drawing Reviews/Approvals** - Engineers completed review of mechanical and structural detail drawings including:

  - Revised expansion joint details
  - Humidification nozzle assemblies (revised design)
  - Activation reactor (redesigned top section)
  - Ductwork details (redesigned inlet duct to reactor)

- Structural details for reactor support steel, stair tower and ductwork supports, and reactor enclosure building

Based on these reviews, the engineering drawings were updated and/or corrected so that the most up-to-date information could be provided to the construction contractors for installation.

- **Redesign of Reactor Humidification Section** - During the early part of this report period, engineers completed redesign of the reactor top section, including its impact on all engineering disciplines. Work included completion of:

  - Redesign of the reactor vessel top to improve air flow and humidification
  - Redesign of the water and air piping systems and nozzle headers for proper humidification
  - Redesign of the inlet duct section to match the new reactor top
  - Revisions to the electrical and instrumentation systems associated with the new reactor top
  - Review and modification of the HVAC requirements
  - Updating and correcting construction specifications

As the redesign efforts were completed, the engineering drawings were updated to incorporate the revised designs. By the end of the reporting period, all of the redesign work had been completed.

- **Detailed Design of Scope Increase** - Engineers completed all engineer and design activities associated with the proposed scope increase. Efforts concentrated on three main areas:

  - Design of a secondary air system to improve limestone injection/dispersion in the boiler
  - Design of the system to recycle spent sorbent from the ESP hoppers and reactor bottom to improve sorbent utilization and increase SO_2 capture

- Identify potential improvements to the ESP to handle additional solids loading due to recycle of spent sorbent. Preliminary estimates were obtained for Black & Veatch and Lodge Cottrell to add an additional field to the existing ESP.

Long Lead Procurement (WBS 1.2.1A)

Since it appeared that DOE was going to approve the proposed scope increase, ICF KE initiated the procurement activities associated with the necessary equipment. This included obtaining competitive bids for the design, purchase, and installation of the following items:

- Secondary air fan
- Revised boiler injection nozzles
- Sorbent recycle system
- ESP upgrades (addition of a new field)

Upon receipt of formal DOE approval, these items will be ordered for delivery to the site as soon as possible.

No additional activities will be done with respect to the ESP upgrade until after startup and preliminary testing has been completed.

Installation and Startup (WBS 1.2.2B)

On November 6, 1991, IDEM granted LIFAC NA its construction permit to begin erection in the activation area. However, in early October, IDEM exempted work in the limestone storage area from the permit process as it will have no environmental impact on the site. Therefore, construction activities in the limestone area were initiated on October 8, 1991.

Prior to any construction activities, subcontracts were released for:

- Pile driving and foundations
- Electrical installation
- Structural and mechanical erection
    - Steel and ductwork erection
    - Mechanical equipment placement

- Piping and instrumentation
- Roofing and siding

- Insulation and cladding

By period's end, all subcontractors had mobilized and initiated field activities.

Work during this reporting period was concentrated in three areas:

- **Limestone Storage Area** - Work in the limestone storage area was initiated on October 8. By the end of December, the following items were completed:

  - All foundations and gradewalls for the limestone building were completed.
  - The foundation for the limestone storage bin was completed.
  - All concrete pads were poured for exterior HVAC equipment and transformers.
  - Erection of the limestone storage bin was completed. The bin still remains to be hydrotested and painted.
  - All buried conduit and grounding beds were completed.
  - Steel erection on the limestone building was started and reached about 50% completion.
  - About 50% of all new equipment for the limestone building area arrived on site including motor control center, limestone transport equipment, HVAC equipment (partial delivery), and VFD transformers.

- **Boilerhouse/ESP Area** - Work in the boilerhouse area did not start until November. Mostly electrical work was performed in the boilerhouse area this period. By period's end, about 30-35 percent of all new conduit had been installed in the boilerhouse.

  Also, during this period, RP&L completed installation of the new dry-ash handling system and the new instrument air compressor and dryer.

Much of the boilerhouse equipment arrived on site this period including flue gas analyzers, humidification pump, VFD switchgear, and control room pen recorders.

The I/O panels and process control system were also tested in the shop and prepared for shipment to the site.

- **Reactor Area** - Work in the reactor area did not begin until after formal approval of the construction permit. By the end of December, subcontractors had completed the following activities:

  - All piles under the stair tower and duct support and the reactor support steel had been driven and approved.
  - Excavation for the stair tower pile cap was started.
  - The reactor fabricator/installer began delivery of reactor pieces and field fabrication. By period's end, the bottom section was fit up and was being welded; the first two shell courses were fit up and welding was progressing, and the internal deflector cone and drop sleeve was also fit up.
  - Structural steel and ductwork was being shop fabricated and reached about 50% completion.
  - Much of the reheat system equipment was delivered to the site as was the motor control center and miscellaneous minor items.
  - Reactor discharge equipment was shop fabricated and being held until needed next period.

Environmental Monitoring (WBS 1.2.3B)
No significant progress was made on this task during this period. However, followup calls and meetings were held with IDEM personnel concerning our letter describing the exothermic properties of LIFAC ash. IDEM had not taken any action on the waste disposal issue by the end of the reporting period.

Similarly, IDEM was still reviewing the variance request submitted last period, and no action was taken by the end of the period.

FUTURE PLANS

During the first quarter of 1992, emphasis will be placed on completion of the following activities:

- Receive formal approval of the scope increase.
- Complete limestone building erection.
- Complete installation of all HVAC equipment in the limestone building.
- Begin installation of the VFD.
- Complete all foundations in the reactor area.
- Complete structural steel erection of the stairtower.
- Begin field assembly of the activation reactor.
- Begin steel erection of the reactor building.
- Complete mechanical equipment installation in the boilerhouse.
- Procure all new sorbent recycle equipment.
- Finalize co-funding agreements.

Also, during the next period, all outstanding environmental issues with IDEM should be resolved. Technical and financial reporting will also continue.