

LIMB DEMONSTRATION PROJECT EXTENSION

QUARTERLY REPORT NO. 10
FOR THE PERIOD - AUGUST, SEPTEMBER, AND OCTOBER, 1989

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1.0 EXECUTIVE SUMMARY

The LIMB Demonstration Project Extension (DOE Agreement No. DE-FC22-87PC79798) progress for August, September, and October, 1989, was made in the continuation of Phase I, Design and Permitting, and Phase II, Coolside and LIMB Construction, Start-Up and Shakedown and Phase III, Operation, Data Collection, Reporting and Disposition.

Project Management activities have focused on continuing the optimization of the Coolside process and Coolside testing under high sulfur coal. In addition, Project Management procured and coordinated the transfer of field data and information to vendors to assist them in their study of the lime feed and flyash removal systems. Improved performance of these systems are required during Coolside and LIMB extension operations.

Phase I - Design and Permitting, activities were limited to updating drawings to as-built conditions. This phase is essentially complete.

Under Phase II - Coolside and LIMB Construction, minor modifications were made to the acid injection system and humidification chamber in order to improve system operations. Only minimal work under Task 3 - LIMB System Start-up, remains to be completed in this Phase. Task 3 is scheduled to begin in the last two weeks of February, 1990. It will involve some preparation and change over in shifting from Coolside testing to LIMB Extension testing.

Under Phase III - Operation, Data Collection, Reporting and Disposition, optimization of the Coolside process was completed in this quarter on September 30, 1989. In addition, the caustic system was started for the first time and the hydrated lime injector tests were completed.

Demonstration of the Coolside process using high sulfur coal started on October 2, 1989. Preliminary data for Coolside has tracked fairly close to the pilot study results which were 65% to 70% SO₂ removal. Tests were run at calcium to sulfur ratios of 2.0 and sodium to calcium ratios of 0.1 when firing 2.5 to 3.0 sulfur coal.

Coolside testing is scheduled to be completed February 16, 1990.

2.0 INTRODUCTION

As per the Cooperative Agreement No. DE-FC22-87PC79798 dated June 25, 1987, the following quarterly report has been prepared for Phases I, II and III of the LIMB Demonstration Project Extension. This DOE project includes "Coolside" technology and LIMB multiple sorbent injection. The period covered by this quarterly report is August, September, October 1989. This report represents the tenth three month period of the project.

The subject of this report is progress during the quarter for Phase I - Design and Permitting, Phase II - Coolside/LIMB Construction, Start-Up and Phase III - Operation, Data Collection, Reporting and Disposition.

Under Phase I, Task 2, activities were limited to updating drawings to as-built conditions. This phase is essentially complete except for collecting all associated costs.

Under Phase II, Task 2, the air blowing ash agitators, installed last quarter were evaluated and appear to be performing as designed. Other minor modifications were made to improve operations.

Under Phase III, Task 1, Project Management activities focused on improving the performance of the lime feed system and flyash removal system.

Task 2 activities included the completion of the Optimization of the Coolside process and Testing of the Coolside process.

3.0 PROJECT DESCRIPTION:

3.1 BACKGROUND

3.1.1 EPA Base LIMB

The DOE LIMB Demonstration Project Extension is a continuation of the EPA Limestone Injection Multistage Burner (LIMB) Demonstration which is presently under way.

The EPA LIMB program was initiated in 1981, although work in related areas had been conducted by EPA and others prior to that time. The LIMB program is structured to provide an understanding of the controlling factors in the LIMB process and to establish a basis for private sector commercialization of the technology. EPA ultimately expects to show that LIMB is a low cost control technology capable of producing moderate SO_x and NO_x control (50-60 percent) with applicability for retrofit to the major portion of the existing coal-fired boiler population.

The current EPA Wall-Fired LIMB Demonstration is a four-year project that includes design and installation of a LIMB system at the 105-MW Unit 4 boiler at Ohio Edison's Edgewater Station in Lorain, Ohio. The project plan calls for a full year of operating and testing to demonstrate its capabilities. In addition to the EPA the major project participants are the State of Ohio, Ohio Edison, and Babcock & Wilcox (B&W).

The basic goal of the LIMB demonstration is to extend LIMB technology development to a full-scale application on a representative wall-fired utility boiler. The successful retrofit of LIMB to an existing boiler is expected to demonstrate that (a) reductions of 50 percent or greater in SO_x and NO_x emissions can be achieved at a fraction of the cost of add-on FGD systems, (b) boiler reliability, operability, and steam production can be maintained at levels existing prior to LIMB retrofit, and (c) technical difficulties attributable to LIMB operation, such as additional slagging and fouling, changes in ash disposal requirements, and an increased particulate load, can be resolved in a cost-effective manner. The primary fuel to be used will be an Ohio bituminous coal having a nominal sulfur content of 3 percent or greater.

The demonstration project consists of several distinct phases: a preliminary phase to develop the LIMB process design applicable to the host boiler, a construction and start-up phase, and an operating and evaluation phase. The first major activity, the development of the Edgewater LIMB design was completed in January 1986, and detailed engineering is now complete. Major boiler-related components were installed during a September 1986 boiler outage. Start-up activities began in March of 1987 with tuning of the low NO_x burners. Sorbent injection activities were under way as of July 1987.

3.1.2 Humidification

As a modification to the Base LIMB work, the applicability of flue gas humidification as a supplement to the LIMB process for the purpose of improving particulate collection and SO₂ capture efficiencies is being evaluated. The reason for this investigation is that the LIMB process may cause some degradation in the performance of electrostatic precipitators. This degradation will be the result of three factors:

1. The dust loading to the ESP will more than double.
2. The particle size distribution of the injected sorbent may be finer and therefore more difficult to capture than the normal flyash from coal combustion.
3. The sorbent has a chemical affinity for SO₃. This will result in a lowering of the acid dew point and consequently increasing of the resistivity of the ash.

Humidification may provide a low-cost option that would restore ESP performance on LIMB retrofitted boilers. In addition, humidification of flue gas has been shown to increase SO₂ capture by rendering sorbent particles more reactive. The amount of humidification required to improve SO₂ capture efficiency and to restore ESP performance may present operational problems. The EPA Humidification program will result in a humidification system design aimed at minimizing operational problems and maximizing SO₂ capture and particulate removal enhancement. The effect of humidification will be determined during the EPA LIMB Demonstration testing at Ohio Edison's Edgewater Unit 4.

The incentives to humidify to as close an approach to saturation as possible are:

1. Particulate emissions from the small ESPs designed for burning high-sulfur coal can possibly be kept in compliance without the high cost of additional particulate collection area.
2. Additional SO₂ removal can be achieved by taking advantage of the unused sorbent from the boiler.

However, the extent of SO₂ removal will be strongly dependent upon how much the flue gas temperature is reduced. The risk of scaling, pluggage, and other operating problems also increases sharply as the gas temperature approaches adiabatic saturation.

It is because of the risk of scaling and pluggage that the humidification demonstration is being carried out in a bypass flue. With the humidifier installed in a bypass flue, initial operating problems will not interrupt boiler operation. Various operating conditions at closer approaches to saturation can be tried without fear of shutting down the boiler should a wall deposition problem develop. This bypass will be used for EPA humidification

work and for the DOE LIMB and Coolside process demonstrations, of which humidification is an integral part. Funding for the bypass will be provided as part of the DOE LIMB Demonstration Project Extension.

3.2 DOE LIMB DEMONSTRATION PROJECT EXTENSION OVERVIEW

The purpose of the DOE LIMB Demonstration Project Extension is to extend the data base on LIMB technology and to expand DOE's list of Clean Coal Technologies by demonstrating the Coolside process as part of the project.

The main objectives of this project are:

1. To demonstrate the general applicability of LIMB technology by testing 3 coals and 4 sorbents (total of 12 coal/sorbent combinations) at the Ohio Edison Edgewater plant.
2. To demonstrate that Coolside is a viable technology for improving precipitator performance and reducing sulfur dioxide emissions while acceptable operability is maintained.

To achieve these objectives, B&W will perform a three-phase project consistent with the DOE PON:

PHASE I: DESIGN AND PERMITTING
PHASE II: CONSTRUCTION AND START-UP ("SHAKEDOWN")
Phase II A: Site Preparation and Long-Lead Time Item Procurement
Phase II B: Coolside/LIMB Construction, Start-up and Shakedown
PHASE III: OPERATION, DATA COLLECTION, REPORTING AND DISPOSITION

Since the DOE LIMB Demonstration Project Extension is a continuation of an ongoing EPA Project, it was necessary at the start of the project to divide Phase II into IIA and IIB to avoid project schedule delays on both projects. Phase IIA entailed certain site preparation and long-lead time item procurement activities which had to take place before actual construction and start-up could commence. Most of these activities were completed during the boiler outage originally scheduled by Ohio Edison from September 28, 1987 through December 20, 1987 to perform major turbine maintenance. The outage actually lasted until late January 1988. It provided the opportunity to perform the flue gas duct revisions needed for the tie-in of the bypass duct once its construction was complete.

Phase IIB consisted of Coolside/LIMB Construction, Start-up and Shakedown activities. This Phase started on August 26, 1987, one month prior to the outage "window". Time was needed to perform pre-outage activities and to assure that outage construction work was organized and ready to begin on schedule. Phase IIB construction consisted primarily of the bypass flue, where the humidifier is installed, and the Coolside feed system.

Originally the bypass was to be completed in time to allow EPA humidification testing to be performed during the last four months of Base LIMB operation. However, preliminary LIMB test results indicated that electrostatic precipitator (ESP) performance suffered as a result of sorbent injection. Humidification is now considered necessary to improve ESP performance and to

allow long term LIMB testing to occur. LIMB and Humidification testing will continue simultaneously after humidifier construction is complete. Thus, a delay in EPA LIMB testing is necessary until the bypass is ready.

EPA LIMB testing with humidification was scheduled to begin in July 1988. Once EPA testing is complete, Phase III of the DOE LIMB Demonstration Project Extension is scheduled to begin operations on July 17, 1989 by testing the Coolside process for a four (4) month period. Afterwards, the LIMB Extension testing, which is scheduled to run for fourteen (14) months, will begin.

For the purposes of this quarterly report which includes updated schedule information, Phases IIA and IIB activities have been combined into Phase II as was done in Quarterly Report Number 4. Phase IIA is considered to be complete.

Figures 1, 2, and 3 represent the revised schedules for Phase I, Phase II (combined original Phases IIA and IIB) and Phase III respectively. The DOE LIMB Demonstration Project Extension schedule has been lengthened by three (3) months, from a total of forty-three (43) months to forty-six (46) months, because the start of Coolside testing has been delayed to complete EPA LIMB testing.

A complete Statement of Work is included in Section III, Project Description of the first quarterly report for the project, dated September 15, 1987. It provides the reader, who is not familiar with the project, a complete description of the tasks and subtasks to be undertaken.

4.0 PROJECT STATUS

The period covered by this project Quarterly Report Number 10 is August, September, and October, 1989. Progress will be discussed on a task basis for each of Phases I, II and III.

4.1 PHASE I - DESIGN AND PERMITTING (WBS 1.1)

Phase I entails project management, Coolside system design, LIMB system preparation and permitting activities.

4.1.1 Task 1 - Project Management (WBS 1.1.1)

The ninth quarterly report covering the period of May, June and July, 1989 for this project was completed and issued to DOE PETC in October, 1989.

4.1.1.1 SUBTASK 1.1 - COOLSIDE MANAGEMENT AND REPORTING (WBS 1.1.1.1). At the end of the quarter, Phase I was essentially 99% complete. B&W requested a no-cost extension to Phase I in order to collect all of the costs.

4.1.1.2 SUBTASK 1.2 - LIMB EXTENSION MANAGEMENT AND REPORTING (WBS 1.1.1.2). At the end of the quarter, Phase I was essentially 99% complete. B&W requested a no-cost extension to Phase I in order to collect all of the costs.

4.1.2 Task 2 - Coolside System Design (WBS 1.1.2)

Coolside system design includes sorbent selection, pilot performance tests and detailed engineering.

4.1.2.1 SUBTASK 2.1 - TEST PROGRAM DEVELOPMENT (WBS 1.1.2.1). The purchase order and subcontract with Radian has been formally executed and Radian is on-site for taking emissions data during Coolside.

A purchase authorization was released to Radian to implement the work described in the Environmental Monitoring Plan. Radian, B&W and DOE met with Kimble to investigate the possibilities of installing a test cell for monitoring hydrologic impacts.

4.1.2.2 SUBTASK 2.2 - CONSOL TECHNOLOGY TRANSFER (WBS 1.1.2.2). Consol made an oral presentation for the Ohio Coal Development Office - sponsored open house on August 10, 11, and 14, 1989.

Consol's workscope under this subtask was completed during the quarter.

4.1.2.3 SUBTASK 2.3 - DETAILED ENGINEERING (WBS 1.1.2.3). This subtask is 99% complete. Only updating drawings to as-built conditions occurred this quarter.

4.1.3 Task 3 - LIMB System Preparation (WBS 1.13)

The LIMB system preparation activities are designed to update the current LIMB system documentation in use for the EPA testing.

4.1.3.1 SUBTASK 3.1 - TEST PROGRAM DEVELOPMENT (WBS 1.1.2.1) The activities under this subtask are complete.

4.1.3.2 SUBTASK 3.2 - COALS/SORBENTS SELECTION (WBS 1.1.3.2) The activities under this subtask are complete.

4.1.4 Task 4 - Permitting and Licensing (WBS 1.1.4)

Permitting activities are focused on waste characterization to develop the information necessary to fulfill permit requirements. In addition, efforts to fulfill project environmental monitoring requirements are addressed in this task.

4.1.4.1 SUBTASK 4.1 - COOLSIDE PERMITTING (WBS 1.1.4.1).

Kimble Clay & Limestone Company advised B&W that they do not have a contract with State Sales and that they want to do business directly with B&W. B&W met with the representatives of the Kimble landfill on October 6, 1989 and reached an agreement for a firm disposal price per ton, through March 30, 1991, for disposal of Coolside and LIMB Extension ash. Purchase orders and subcontracts will be drawn up for execution early in the next quarter. State Sales' subcontract will be modified accordingly. The ash disposal operation continued throughout negotiations without delays.

4.2 PHASE II COOLSIDE & LIMB CONSTRUCTION, START-UP AND SHAKEDOWN (WBS 1.2)

Phase II consists of actual construction of the Coolside system, including the humidifier, followed by start-up and shakedown activities which make the system ready for the testing program.

4.2.1 Task 1 - Project Management (WBS 1.2.1)

Project management activities pertain to both the Coolside and LIMB construction, start-up and shakedown efforts.

4.2.1.1 SUBTASK 1.1 - COOLSIDE MANAGEMENT AND REPORTING (WBS 1.2.1.1).
No activity to report.

4.2.1.2 SUBTASK 1.2 - LIMB EXTENSION MANAGEMENT AND REPORTING (WBS 1.2.2.1).
No activity to report.

4.2.2 Task 2 - Coolside Construction & Start-Up (WBS 1.2.2)

Coolside start-up and construction activities include materials procurement during construction plus installation of the Coolside sorbent feed system and humidifier bypass system.

4.2.2.1 SUBTASK 2.1 - MATERIALS PROCUREMENT (WBS 1.2.2.1). The activities under this subtask are complete.

4.2.2.2 SUBTASK 2.2 - SORBENT FEED SYSTEM INSTALLATION (WBS 1.2.2.2). It is noted that a significant portion of the existing LIMB sorbent feed system will be used for Coolside. The equipment includes the LIMB sorbent storage silo and the pneumatic conveying system that brings sorbent to the feed silo. The present feed silo and the dilute phase metering and pneumatic conveying systems up to the present distributor bottles will also be utilized for the Coolside demonstration.

The Coolside sorbent feed system installation includes the installation of new piping from the end of the present dilute phase pneumatic conveying system to a point in the bypass duct upstream of the humidifier. This piping includes another distributor bottle to assure good sorbent distribution in the humidifier. The distributor bottle will allow multiple injection points into the duct as opposed to a single injection point.

A second system that is considered part of Coolside equipment requirements is the ash recycle system. This system will recycle a portion of the ash collected in the electrostatic precipitator back to the inlet of the humidifier bypass duct. It is made up of an ash pneumatic conveying system, delivery piping to the inlet of the bypass duct, and another distributor bottle.

The activities under this subtask are complete.

4.2.2.3 SUBTASK 2.3 - BYPASS INSTALLATION (WBS 1.2.2.3). The bypass duct construction was completed and the duct was placed into service during EPA LIMB testing with humidification. B&W completed installation of a rapper system for removal of solids built-up on the humidification spray lances during the last quarter.

The activities under this subtask are complete.

4.2.2.4 SUBTASK 2.4 - START-UP AND SHAKEDOWN (WBS 1.2.2.4). The air blowing ash agitators for the humidification chamber floor, which were installed during the last quarter, were evaluated and appear to be performing an adequate cleaning job. The extension of all of the injection feed points to a point in line with the atomizers has been effective in stopping the lime build-up on top of the lances.

Additional modifications were made this quarter to improve operations:

- o Added thirty (30) feet of PVC piping downstream of acid injection point in discharge of Hydrovator water to pond, allowing additional mixing before pH sensor in controlling pond pH.
- o Added two (2) more air blower pipes to prevent buildup on Humidification chamber floor.

4.2.3 Task 3 - LIMB System Start-Up (WBS 1.2.3)

Effort under this task is anticipated to be minimal, since the LIMB system will have been operational for the EPA base LIMB program prior to this testing. Nevertheless, some preparation and change over will be necessary in shifting from the DOE Coolside testing to the LIMB Demonstration Extension Testing.

4.2.3.1 SUBTASK 3.1 - MATERIALS PROCUREMENT (WBS 1.2B.3.1). The coals and sorbents will be procured under this subtask. Activities will include arranging transportation, scheduling and expediting deliveries, storage at the site, verifying that materials meet specifications, etc.

The objective of this subtask is to finalize the procurement of three (3) different coals and four (4) different sorbents.

This activity is not scheduled to begin as yet.

4.2.3.2 SUBTASK 3.2 - PREOPERATION PREPARATIONS (WBS 1.2B.3.2). Activities under this subtask will include inspection of equipment and instrumentation, and repair or replacement of system components where necessary prior to beginning LIMB Extension testing.

The sorbent feed system delivery points will need to be changed from the Coolside injection area upstream of the humidifier back to the upper regions of the boiler for LIMB operation.

The objective of this subtask is to prepare the LIMB equipment for continuous operation after Coolside testing is complete.

These activities are not scheduled to occur as yet.

4.2.3.3 SUBTASK 3.3 - START-UP AND SHUTDOWN (WBS 1.2B.3.3). Start-Up and check-out of any equipment or instrumentation that was repaired or replaced during the previous subtasks will be done. Since the first series of coal and sorbent combinations that will be tested will use the EPA Base LIMB coal, little or no shutdown of the coal feed system and burner system will be necessary. Some adjustment to new sorbent may be required. Later in the project when the coal is changed, shutdown will be necessary as is typical with any coal change at the plant.

The objective of this subtask is to begin operation of the LIMB system to verify system capability for continuous operation.

This activity is not scheduled to occur as yet.

4.3 PHASE III - OPERATION, DATA COLLECTION, REPORTING AND DISPOSITION (WBS 1.3)

Phase III entails the actual testing of the Coolside process for an approximate four (4) month period followed by an additional thirteen (13) month period of LIMB Demonstration Project Extension testing. Phase I - Design and Permitting and Phase II - Construction and Start-up will have been substantially completed by the provided scheduled start date of Phase III providing the ground work to begin testing.

4.3.1 Task 1 - Project Management (WBS 1.3.1)

Project management activities pertain to both the Coolside and LIMB Extension operation, data collection, reporting and disposition.

4.3.1.1 SUBTASK 1.1 - COOLSIDE MANAGEMENT AND REPORTING (WBS 1.3.1.1) During the first month of the quarter B&W Project Management coordinated procurement of field data and vendor information necessary to improve the performance of the lime feed and flyash removal systems. Improved performance of these systems are required during conditions of maximum boiler load and maximum stoichiometry during Coolside operations.

B&W Project Management then coordinated the transfer of field data to Allen-Sherman-Hoff to assist in their review of the existing flyash collector system. A-S-H tested the secondary collector's bags and ran a test on Coolside ash at an outside facility. B&W Project Management also reviewed the design of the lime feed system between the Acrison weigh feeder and the distributor bottle to determine capacity limiting features of the equipment in service.

At the end of the quarter B&W received Allen-Sherman-Hoff's proposal for inspecting the ash handling system for proper operation, including conditioning of aeration and transport air, component wear, and operating temperatures. A-S-H will summarize their recommendation in a report due next quarter. They have been verbally released to proceed with the inspection which will be made early next quarter. The Fuller Company has also been authorized to inspect the lime feed system and make recommendations for improving the capacity to meet LIMB Extension loading requirements.

4.3.1.2 SUBTASK 1.2 - LIMB EXTENSION MANAGEMENT AND REPORTING (WBS 1.3.1.2)
This activity is not scheduled to occur as yet.

4.3.2 Task 2 - Coolside Operation and Evaluation (WBS 1.3.2)

Activities under this task will be directed at setting the Coolside operating parameters and demonstrating and evaluating Coolside technology.

4.3.2.1 SUBTASK 2.1 - OPTIMIZATION (WBS 1.3.2.1). Following the Start-up, which was covered as part of Phase II, B&W will demonstrate that the equipment is capable of operating within the design range and will make modifications that it deems necessary. This activity pertains to the Coolside sorbent feed system, the ash recycle equipment and the caustic injection system. Operating characteristics of greatest importance are the sorbent and ash recycle distribution achieved at the inlet to the humidifier and ease of handling of the ash at low approaches to saturation temperature. It is as a result of these concerns that modifications may become necessary.

During the quarter optimization of the Coolside process continued prior to using high sulfur coal. Several different test conditions were established with Ca/S ratios ranging from 1.0 to 2.0, with and without NaOH injection, and with spray down to 20°F approach to saturation. NaOH was injected at sodium to calcium ratios of 0.05 and 0.10.

The caustic system (sodium addition) was started this quarter for the first time. Minor problems developed with the caustic control system which delayed testing, but these were worked out in a few days and testing continued.

Also during the quarter the hydrated lime injector tests were completed. The injector array did not significantly affect SO₂ removal. The injector array which was designed to concentrate the hydrated lime in the plane of the water atomizers was selected for future tests. The Coolside material balances and continuous analyzer accuracy tests were completed.

To prevent solids accumulations on the humidifier floor prior to the atomizer lance array, two (2) additional dust puffers were installed. Lance sootblowers were installed to prevent deposits building on the top surface of the lance. Coolside operations was shut down during the quarter to accommodate the installation of the puffers.

In conjunction with the normal testing, CONSOL had a stack gas testing crew on-site. They performed EPA approved stack gas testing at the humidifier inlet and outlet. They also tested for particle size and particulate loading.

The plastic facing on the Dravo-Wellman mixer conditioner paddles were found to be separating from the steel backing on an increasing number of paddles. B&W requested the vendor to review the adhesive's suitability for this application especially in preparation for the higher temperatures (from lime in ash) expected during the LIMB Extension. Six (6) replacement paddles were also requested.

Optimization of the Coolside process was completed on September 30, 1989.

4.3.2.2 SUBTASK 2.2 - TESTING PROGRAM (WBS 1.3.2.2). Demonstration of the Coolside process using high sulfur coal started on October 2, 1989. 335.5 hours of Coolside injection occurred during October. In general, the Coolside process was available for continuous operation during October, however, boiler operations and Coolside equipment problems occurred.

Tests were run at Ca/S ratios of 1.0 to 2.0 and Na/Ca ratios of 0.1. Humidifier outlet temperatures were maintained at a twenty degree (20°) approach to saturation. Preliminary data for Coolside has tracked fairly close to the pilot study results (65-70% removal). The main operational problem has been with the close approach temperature. Outlet thermocouples become coated with ash/sorbent and then respond slowly. Build-up of ash and sorbent on the humidification chamber floor and between the outlet turning vanes indicate that we have been occasionally spraying wet.

The Coolside process is scheduled to be operated until February 15, 1990.

4.3.2.3 SUBTASK 2.3 - EVALUATION AND REPORTING (WBS 1.3.2.3). Evaluation of the test data generated from the four (4) month test program will include: 1) data reduction and 2) a determination of the overall effectiveness of the tested Coolside process.

Upon completion of the data evaluation, a Final Report will be written that addresses the technical performance of the Coolside System, an evaluation of the System in terms of its design, capital and operating costs, operational and maintenance features.

This activity is not scheduled to occur as yet.

4.3.2.4 SUBTASK 2.4 - DISPOSITION (WBS 1.3.2.4). After completion of all Coolside testing, the disposition of the sorbent injection system will be determined.

This activity is not scheduled to occur as yet.

4.3.3. Task 3 - LIMB Extension Operation and Evaluation (WBS 1.3.3.)

4.3.3.1 SUBTASK 3.1 - TESTING PROGRAM (WBS 1.3.3.1). Three (3) coals and four (4) sorbents will be tested during an approximate thirteen (13) month period. One promoted sorbent may be tested with the EPA Base LIMB 3.0%-sulfur coal. As indicated under Project Management - General, the twelfth element of the matrix which would include a promoted sorbent is being eliminated since EPA testing will have already evaluated a lignosulfonated lime.

Each remaining coal/sorbent combination will be tested for approximately one (1) month. The one month of testing will be divided into three (3) distinct test periods - Change-over, Optimization and Continuous Operation.

This activity is not scheduled to occur as yet.

4.3.3.2 SUBTASK 3.2 - EVALUATION AND REPORTING (WBS 1.3.3.2). Evaluation of the test data generated from the thirteen (13) month program will include: 1) data reduction, 2) a technoeconomic study of test results, and 3) a determination of the overall effectiveness of the tested LIMB process in achieving the project performance goals. Upon completion of the evaluation, a detailed report will be prepared.

This activity is not scheduled to occur as yet.

4.3.3.3 SUBTASK 3.3 - DISPOSITION (WBS 1.3.3.3). After completion of the LIMB Extension testing, disposal of all equipment installed as part of this contract will be determined during this subtask.

This activity is not scheduled to occur as yet.

5.0 PLANNED ACTIVITIES

Planned activities for the next quarter, November, December 1989, and January 1990, will be almost entirely Phase III, Coolside operations. This will involve testing of the Coolside process on high sulfur coal while feeding Mississippi lime and Black River lime. The testing will also include using recycle Coolside ash and the addition of NaOH to the humidification water.

Consol will continue to schedule and perform the Coolside testing under the general supervision of the Project Team Technical Manager. Radian will continue to monitor emissions during test operations. Radian will also implement the environmental monitoring plan during this quarter.

B&W will continue to address O.E.C. concerns on the capability of the existing ash removal system to handle Coolside ash at higher loads, Ca/S ratios and recycle quantities. Also the design changes of the lime feed system will be finalized to improve its capacity.

6.0 SUMMARY

Phase I - Design and Permitting - is essentially complete. The solid waste landfill operator indicated that they did not have a contract with the LIMB ash hauler and that they would rather do business directly with B&W. A purchase order and a subcontract agreement were drawn up for execution early next quarter.

Phase II - Construction, Shakedown and Start-up - activities included minor modifications to the acid feed system and humidification chamber to improve system operations. This phase will be complete at the conclusion of LIMB Extension shakedown and start-up.

Phase III - Operation, Data Collection, Reporting and Disposition - Project Management included the procurement and coordination of information necessary to improve the performance of the lime feed system and flyash removal system. Optimization of the Coolside process was completed and the initiation of Coolside testing begun using high sulfur coal.

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FIGURE 1

Phase I - Design & Permitting

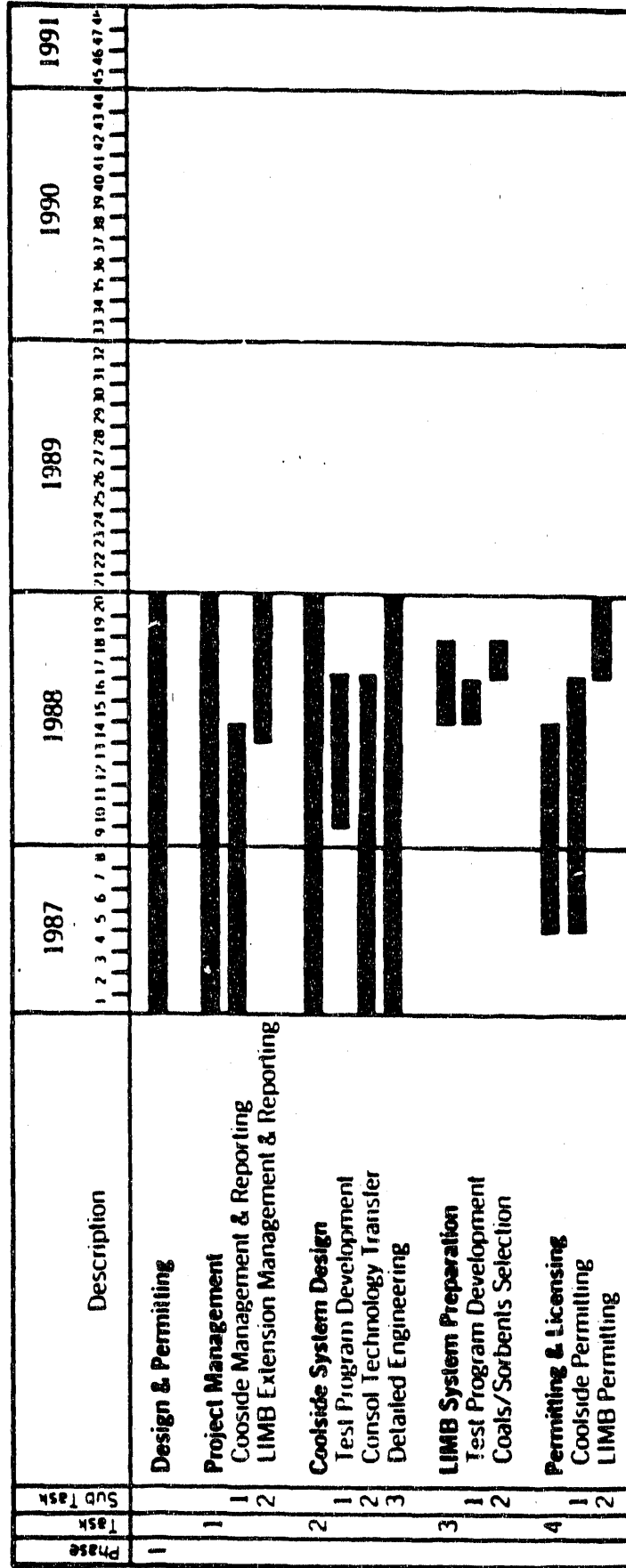


FIGURE 2
Phase II - Coolside/LIMB Construction, Start-Up & Shakedown

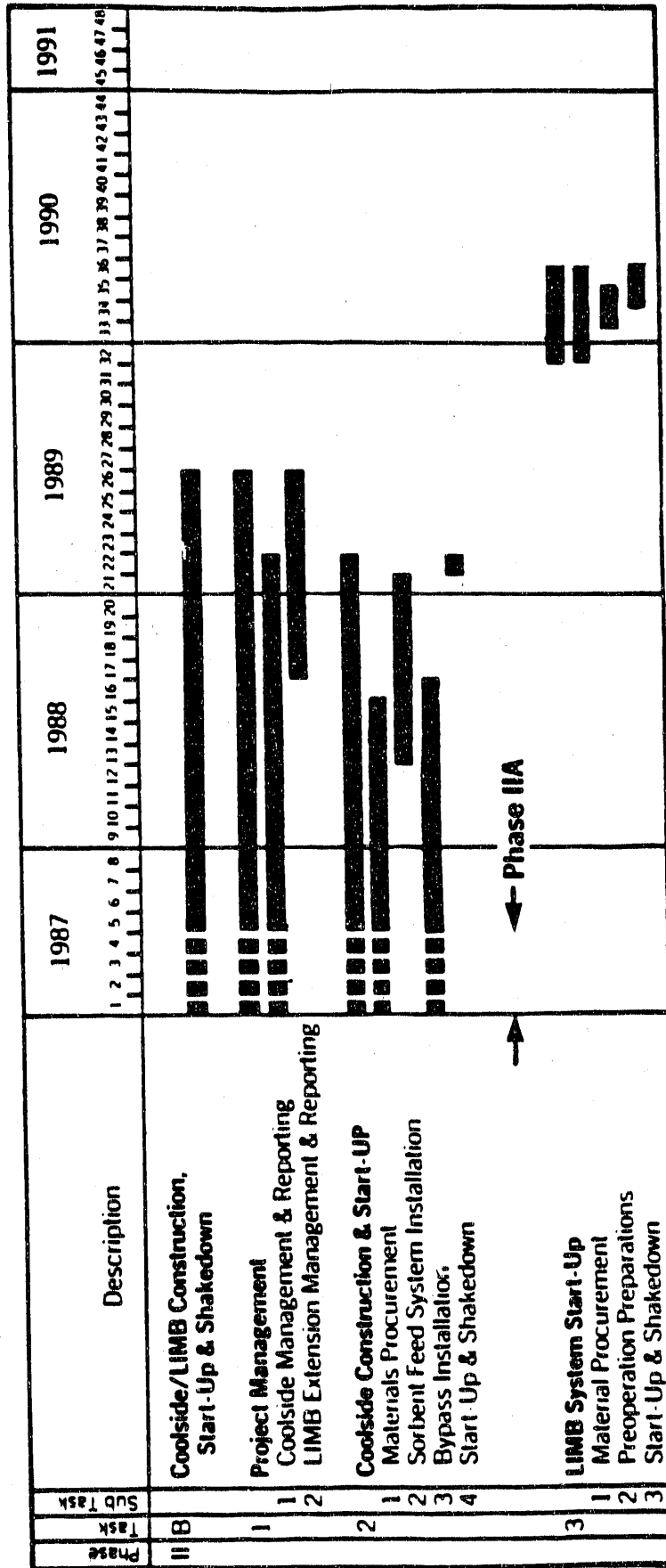
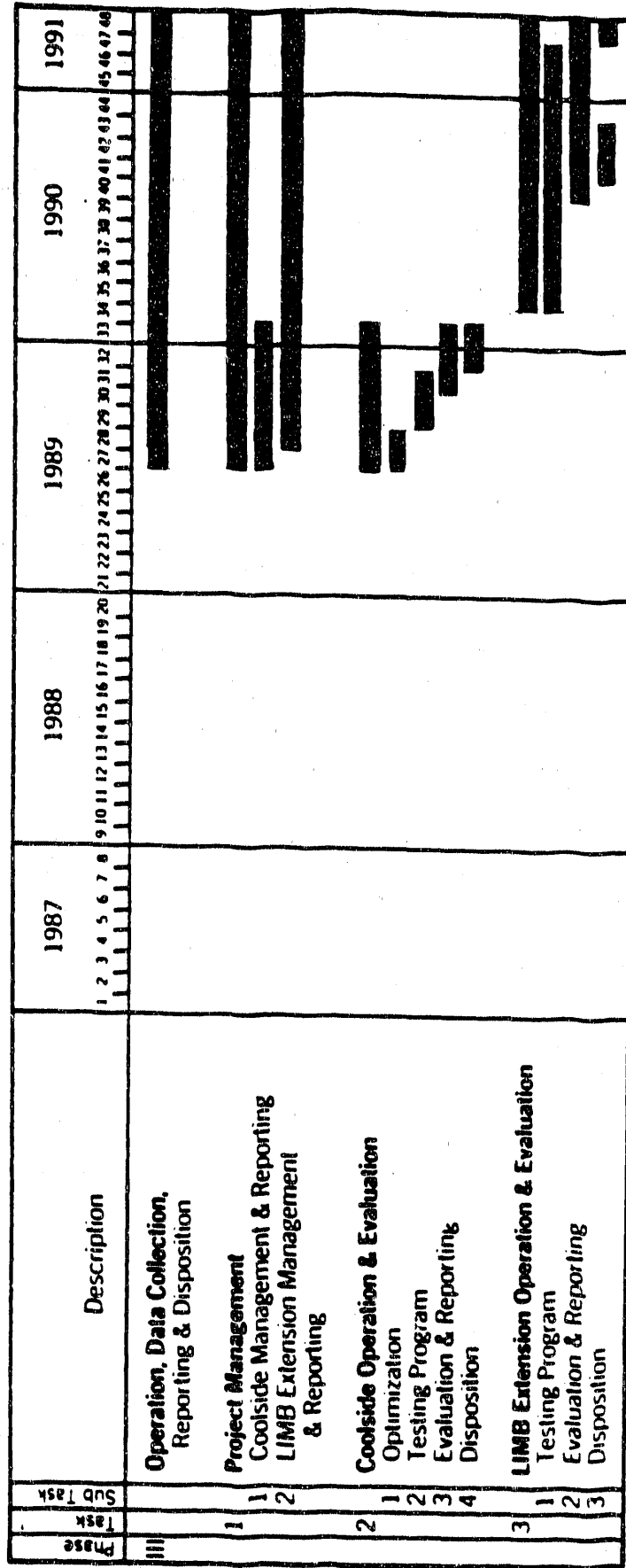


FIGURE 3

Phase III - Operation, Data Collection Reporting & Disposition



**DATE
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8/25/92