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ENGINEERING DEVELOPMENT OF ADVANCED
COAL-FIRED LOW-EMISSION BOILER SYSTEMS

QUARTERLY TECHNICAL PROGRESS REPORT

Submitted by:

Babcock & Wilcox
a McDermott Company
Contract Research Division, Barberton
PO Box 351
Barberton, Ohio 44203

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QUARTERLY TECHNICAL PROGRESS REPORT

Reporting Period - April 1 - June 30, 1993

I. Work Completed

Task 1.0 - Project Planning

1. Work was begun on Subtask 3.1 Design Deficiency Analysis, and 3.2 R&DT Plan Formulation, while work continued on Subtask 2.5, Subsystem Preliminary Engineering Design. All three referenced subtasks involve development and submittal of detail reports to DOE. With all three subtasks proceeding in parallel, some revisions in planned report completion submittal was necessary to assure proper overall coordination and exchange between subtask. Activity schedules were reviewed and revised as necessary.
2. B&W participated in the DOE Combustion 2000 Workshop in Pittsburgh presenting B&W's LEBS Team activities. The workshop was attended by key B&W Team members and B&W upper management.
3. Technical papers were completed for presentation at the upcoming PETC's Annual Contractors Conference and the '93 IJPG Conference. An abstract for an additional paper was submitted for the '93 AFRC International Symposium. A copy of each is included in this report's Attachments.
4. In preparation for Advisory Committee selection, work on establishing appropriate contact and extent of interest with various utilities and parties has begun.

Task 2.0 - Concept Development

Subtask 2.4 - Concept Selection Report

1. All recommended changes and revisions to the draft were completed. A Final Concept Selection Report was submitted by B&W May 13, 1993, and accepted by DOE without further comment.

Subtask 2.5 - Subsystem Preliminary Design

Activity - NOx Subsystem

1. A meeting was held at PSIT's Andover, MA office in April. The purpose of the meeting was to discuss the NOx control system part of the preliminary engineering design, and recommendations/requirements on burner/windbox, air injection ports, reburner, furnace and furnace venturi designs. Subsequently, PSIT prepared and submitted to B&W for review draft descriptions and recommendations on boiler and

combustion control philosophy and NOx subsystem design.

2. A follow-up NOx Subsystem review meeting was held in May with PSIT in Barberton to discuss and finalize NOx and boiler control methods and boiler design issues.

Activity - SO₂/Particulate Subsystem

1. Functional design parameters and other process information needed to begin development of the subsystem preliminary design were jointly developed between R&DD and EED with R&DD's lead. Subsequently, draft material balances, system flow diagrams and equipments list were developed by EED. A SO₂/Particulate Subsystem review meeting was then held to discuss and finalize the subsystem design prior to completing the subsystem preliminary design.
2. Work has now been completed on development of preliminary material balances, equipment design and selection, preliminary general arrangement drawings, budgetary subsystem cost estimates and design report for the complete subsystem; limestone injection, dry scrubber, lime recycle and baghouse.
3. A final subsystem team review was held to review the final preliminary design. All appropriate subsystem design information has been forwarded as required to other subsystems for their use including BOP plant design, generating unit cost analysis, boiler design and plant control system design.

Activity - Boiler Subsystem Design

1. Final steam turbine conditions for preliminary design were established jointly with Raytheon and boiler full load output and performance revised accordingly. Furnace sizing calculations were completed for advanced staging and an outline dimension sketch of the furnace and furnace temperature profiles were developed and forwarded to other subsystem teams for their information and use. Joint meetings between the Lead Boiler Designer and other subsystem teams were held as necessary to assure proper integration and exchange of information between teams.
2. The number of burners, burner pattern arrangement, windbox air supply duct arrangement, and number of pulverizers were reviewed and finalized based on established design and control requirements. It was found that the windbox and burner arrangement would be simplified and all design and control requirement met with one less pulverizer than previously selected. The number of pulverizers has been revised from five

to four. With number of pulverizers finalized, other final performance, design and control requirements were specified and forwarded to Pulverizer Design for initiation of final preliminary pulverizer design.

3. Preliminary sketches of the furnace setting with dimensions and other appropriate data was distributed to appropriate boiler design groups. The purpose of this work was to define and/or establish unique mechanical and support requirements and furnace water circulation requirements.
4. A preliminary convection pass arrangement and heating surface requirements were established. Initial computer runs indicate, as expected, that establishing even a preliminary arrangement to meet steam duty requirements was going to be a challenge. This due to slightly lower furnace exit gas temperatures (result of NO_x control conditions) and higher final steam temperatures (result of increasing plant efficiency) than typical of conventional design. Work on the furnace and convection pass design for the base preliminary unit was completed only to the extent necessary to identify design deficiencies, prepare an arrangement drawing and determine budgetary cost.
5. Engineering work has been completed to the extent planned in this subtask for the base preliminary unit, Advanced Overfire Air, including preliminary designs for the furnace, convection pass, pulverizers, airheaters, flues and ducts, preliminary general arrangement drawings, and budgetary cost estimates. Work is nearly complete on design of the LEBS unit control system based on control methods and philosophy established in the NO_x Control Subsystems. A budgetary cost estimate was also developed by B&W and Raytheon for a conventional (2400 psi/1000F/1000F) boiler unit for comparison to the LEBS plant.
6. All appropriate information has been forwarded to Raytheon for use in completing BOP subsystem designs, site plot plans and preliminary generating plant cost analysis and comparison to a conventional plant.

Activity - Balance-of-Plant

1. Full load steam cycle conditions for subsystem preliminary design were finalized with emphasis on improving cycle efficiency. Final selected full load steam conditions were 4500 psia/1050F/1075F/1100F at the turbine. Subsequently, part load steam conditions were developed for 70%, 50% and 25% load.

2. Work was begun on developing preliminary BOP subsystem designs and cost quotations, on subsystems unique to LEBS.
3. Work was completed on investigations of chimney liner requirements in conjunction with LIDS process conditions, defining preferred plant layout arrangement for boiler, pulverizer and turbine bay areas, and description of cost estimate basis and cost analysis to be conducted by Raytheon on the preliminary design. The description of cost estimate basis and cost analysis was subsequently submitted to DOE for their review.

Task 3.0 - Research, Development and Test Plan

Subtask 3.1 - Design Deficiency Analysis

Activity - All Subsystems

1. Work has begun with the SO₂/Particulate subsystem group being assigned as lead for this activity. A proposed outline for the report was prepared, as was a schedule for completing this document. Inputs to the Design Deficiency Report were subsequently solicited from each of the subsystem teams.
2. Based on preliminary inputs solicited from each of the subsystem teams, a draft list of LEBS plant design deficiencies was developed. This list was subsequently reviewed and edited at a meeting of the project team. Writing assignments were then made to each respective subsystem team necessary for completing the report. This includes appropriate descriptions, technical approach to resolving, resource and schedule requirements for each uncertainty.
3. Draft write-ups from each subsystem have been developed and jointly reviewed and commented on by subsystem team leaders. Remaining activities necessary to complete this report for submittal by mid July have been finalized.

Subtask 3.2 - RD&T Plan Formulation

Activity - All Subsystems

1. Work has begun with the NO_x subsystem team being assigned as lead for preparation of the RD&T Plan. A proposed outline for the report has been completed as well as schedule activities for the writing of the plan. The bulk of the writing of the RD&T Plan will follow the draft of the Design Deficiency Report.

2. A meeting was held to finalize and interface activities between the development of the Design Deficiency Report and the RD&T Report.

II. Work in Progress

Task 2.0 - Concept Development

Subtask 2.5 - Subsystem Preliminary Design

Activity

1. While most of the design and arrangement work on the base preliminary unit design is complete (as necessary to support Task 3.0), much work remains to be completed on alternate designs and in support of a Design Report. This work, however, was put on hold within B&W in order to free people as necessary to continue and complete work needed in Task 3.
2. Work continues at PSIT on completing design information on all three NOx subsystem preliminary designs and compiling documentation for the preliminary design report.
3. Work continues at Raytheon on completing preliminary BOP subsystem designs, including cost quotations, on subsystems unique to LEBS. Work has begun on preparing site plot plans and general arrangement drawings for the generating plant and on development of generating plant cost analysis and comparison to a conventional plant.

Task 3.0 - Research, Development and Test Plan

Subtask 3.1 - Design Deficiency Analysis

Activity - All Subsystems

1. Based on review comments to initial draft descriptions, work continues on completing final write-ups for the Design Deficiency Analysis.

Subtask 3.2 - RD&T Formulation

Activity - All Subsystems

1. Work has begun on expanding the draft report outline to a detail level to help guide writing of the report. Consistency with the design deficiency report is being reviewed.

III. Work Not Completed

All major work necessary for overall program progress completed to-date.

IV. Work Plan Status

Upon finalizing resource and schedule requirements to complete the Preliminary Engineering Design, and Design Deficiency Analysis, and the RD&T Plan, it was necessary to make some revisions in planned activities and scheduled submittals. Essentially all three subtasks are ongoing simultaneously and the same people are involved in each. Revisions made are as follows:

Subtask 2.5 - Preliminary Engineering Design

While much work remains in completing all work including a Design Report, sufficient work has or will be completed to support identification of design deficiency. Once cost estimate work necessary to support Raytheon's cost analysis study was completed in June, work on remaining items and writing of the Design Report was delayed to free resources for Subtasks 3.1 and 3.2. A firm date for completion of the Preliminary Engineering Design Report will be determined later. This delay does not affect overall program progress.

Subtask 3.1 - Design Deficiency Analysis

To properly complete this analysis and report, considerable interaction must happen with both the Preliminary Engineering Design and RD&T Plan Formulation. All pertinent issues must have been addressed in the Preliminary Engineering Design. The last of which is results of the cost analysis which will not be completed until early July. While the technical approach, resources and schedule requirements are considered in developing the design deficiency analysis, details of schedule and determining required specific resources for resolving deficiencies will be performed in the RD&T Plan Formulation. Again, results will not be available until early July. To assure appropriate exchange of information and consistency between reports, the completion date for the Design Deficiency Report has been revised to July 9, 1993. This delay again does not affect overall program progress.

Subtask 3.2 - RD&T Plan Formulation

To properly complete the RD&T Plan, a significant effort from all subsystem teams is required. After reviewing informational development and exchange needed, it was decided to utilize existing float within the schedule and revise the submittal date for the RD&T

Plan to August 16, 1993. This still allows time for review and comment by DOE prior to starting Task 4, September 1, 1993, as originally planned.

Attachments

1. Combustion 2000 Workshop, Overheads
2. PETC's Annual Contractors Conference, Paper
3. '93 IJPG Conference, Paper
4. '93 AFRC International Symposium, Abstract

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removed.*

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