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INTEGRATED MHD BOTTOMING CYCLE

FIRST QUARTERLY REPORT FOR THE PERIOD —
SEPTEMBER 11 THROUGH OCTOBER 31, 1987

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MASTER

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1.0 EXECUTIVE SUMMARY

The Integrated MHD Bottoming Cycle project, DOE Agreement No. DE-AC22-87PC90281, progress for September and October relates to Task 1 - Modification of the Existing Coal Pulverizer and Dryer System, and Task 2 - Design, Fabrication, and Installation of an Automated Spent Seed/Ash Handling System. No activities were scheduled for Tasks 3 and 4 prior to or during this period.

The project team was assembled and committed to the project. Team members attended a kickoff meeting at the Pittsburgh Energy Technology Center. The design approaches for the pulverizer modifications, the spent seed/ash handling system, and the air heater replacement for the existing vitiation heater were presented.

Planning was initiated to distribute the authorized funding among the tasks. Work was started on the Management Plan, including the Work Plan, Milestone Schedule Plan, and Cost.

Information submitted by vendors for the Inert Gas Generator which will provide inert gas to dry Montana Rosebud Coal was transmitted to PETC and the University of Tennessee Space Institute (UTSI) for comment.

The DOE CFFF site was visited, and potential locations for the Inert Gas Generator and the Spent Seed/Ash Handling equipment were reviewed with UTSI. Drawings providing locations of existing equipment were provided by UTSI.

2.0 INTRODUCTION

As per the Agreement No. DE-AC22-87PC90281 dated September 11, 1987, the following quarterly report has been prepared. This quarterly progress report covers the period of September and October 1987 and represents the first two months of the project.

3.0 PROJECT DESCRIPTION

3.1 BACKGROUND

The Integrated MHD Bottoming Cycle project is part of the DOE MHD proof-of-concept program. Since 1985 the key components of the program have been:

- o The design, construction, and operation of (1) an integrated topping cycle (i.e., an MHD power train), (2) an integrated bottoming cycle (i.e., a heat recovery/seed recovery subsystem), and (3) a seed regeneration system.
- o Baseline subsystem development efforts to acquire the knowledge necessary to proceed with the integrated test facilities and the seed regeneration system.

These POC tests are critical to the advance of the technology to the retrofit stage.

Since 1985 the effort at the DOE Coal-Fired Flow Facility operated by the University of Tennessee at Tullahoma, Tennessee, has been directed toward preparing for and conducting long duration testing of the Integrated MHD Bottoming Cycle. To date, all the components of the bottoming cycle have been combined into an integrated bottoming cycle and 453 hours of testing have been completed with a high sulfur eastern coal, Illinois #6. Fourteen hours of testing have also been conducted with a low sulfur western coal, Montana Rosebud.

The major objectives of the current Integrated MHD Bottoming Cycle project, DOE Agreement No. DE-AC22-87PC90281, are:

- o Upgrading the DOE CFFF to permit continuous testing with Montana Rosebud coal. This requires modifications to the coal pulverizer and dryer subsystem.

- o Addition of an automatic spent seed/ash removal system for seed recovery. The system will contribute to more efficient and prototypical, continuous, long duration testing.
- o Providing a procurement-enabling package for an Intermediate Temperature Air Heater which will replace the existing vitiation heater, if necessary. This will contribute to more reliable and more prototypical long duration operation.
- o Participation on the MHD Technology Transfer, Integration, and Review Committee.

3.2 TASK DESCRIPTION

An overall project work breakdown structure is presented in Figure 1 as an overview of the DOE Integrated MHD Bottoming Cycle project.

The remainder of Section 3, Project Description, is a statement of work which provides a complete description of the tasks and subtasks of the project. The schedule for performing the tasks is shown in Figure 2.

The progress during this quarter is detailed in Section 4, Project Status. Planned activities for the next quarter are presented in Section 5, Planned Activities.

3.2.1 Task 1 - Modification of the Existing Pulverizer and Drying System (WBS 1.1)

3.2.1.1 Subtask 1.1 - Preliminary Design (WBS 1.1.1)

B&W will perform the preliminary design of the system for modifying the existing pulverizer and drying system. B&W will arrange to have preliminary designs of components prepared as necessary. The components will include site preparations, foundations, support structure, access platforms, stairs, ladders, lighting, etc. as required.

B&W will schedule, provide documentation, and participate in a Preliminary Design Review per the DOE Design Review Manual. The design review will evaluate the capability of the components and system to meet the following requirements:

1. Safely pulverize and dry 3.5 tons per hour (nominal) of a mixture of seed and either Illinois No. 6 or Montana Rosebud coal to a moisture content of 5% or less.
2. Be capable of local or remote control from the CFFF control room including start-up, operation, and shutdown. Preclude operation from the control room while people are working on the system.
3. Be compatible with the CFFF system functionally and physically.
4. Be capable of operation in adverse weather conditions, including rain and below-freezing temperatures.
5. Meet all applicable building, construction, safety, and health codes.
6. Be designed and constructed to facilitate inspection and maintenance.

B&W will document the commitments and agreements reached during the design review. B&W will select a vendor for the inert gas generator and release the vendor to perform the preliminary design with DOE approval.

3.2.1.2 Subtask 1.2 - Final Design, Material and Component Procurement, Fabrication, and Delivery to the CFFF (WBS 1.1.2)

B&W will perform the final design of the modifications to the existing pulverizer and drying system. During this design phase, B&W will order certain long lead materials or components with DOE approval. At the 90% completion of the system design, B&W will submit the documentation, drawings, etc. required for a Critical Design Review (CDR) per the DOE Design Review Manual. B&W will

arrange the time for the design review, participate in the design review, and document the commitments and agreements reached during the design review.

B&W will arrange to have the components fabricated and delivered to UTSI. UTSI will provide receiving inspection and storage. The components will have been assembled into subassemblies, subsystems, and systems to the maximum extent practical.

The components supplied by B&W will include:

1. An oil-fired inert gas generator consisting of an oil burner, lighter, combustion air blower, burner management system, heat exchanger, and cooling air fans.
2. Instrumentation and wiring for local control, and wiring to a terminal for others to hookup a remote control system.
3. Needed valves, piping, fittings, insulation, heat tracing, wiring, etc. for internal system connections.
4. The pulverizer and drying system side of connections such as the remote control system, the No. 2 oil system, instrumentation air, and electrical power. B&W will replace the SD HCN46581-201 interior of an existing CPPI panel board with an SD HCM2373-4M interior.
5. Foundations, support structures and associated platforms, ladders, stairs, lighting, etc.

B&W will prepare a draft Operational Readiness Document (ORD) with checklists for mechanical checkout.

3.2.1.3 Subtask 1.3 - Installation at the CFFF and
Mechanical Checkout (WBS 1.1.3)

B&W will hire local contractors for site preparation, installation of foundation, erection of support structures, and stairs, ladders, etc.

B&W will use UTSI trades people as available for installing the equipment on the platforms, foundations, etc. and for installing connecting piping, wiring, etc.

B&W will participate in the mechanical checkout of the equipment. Any equipment which must be operated will be operated by UTSI personnel at no charge to B&W.

B&W will arrange to have any modifications, additions, etc. made to correct discrepancies or deficiencies found during mechanical checkout. B&W will update the ORD, if necessary.

B&W will prepare a draft Operation and Maintenance Manual. This will include Operation and Maintenance Manuals from vendors where applicable.

B&W will comment on a system shakedown test plan prepared by UTSI. B&W will work with DOE and UTSI to resolve any comments.

3.2.1.4 Subtask 1.4 - System Shakedown (WBS 1.1.4)

B&W personnel will be available during the system shakedown to make any recommendations and decisions on unforeseen events.

B&W will correct any deficiencies in the B&W scope of supply discovered during the shakedown testing.

B&W will finalize the ORD and update the Operation and Maintenance Manual as required.

B&W will prepare a draft Acceptance Document. B&W will obtain the advice of vendors as deemed appropriate. The document will contain design and expected performance data, and data to be taken during test to evaluate equipment acceptability. To the extent practical, these specifications and predictions will be organized by component and subsystem to permit acceptance of individual components or subsystems.

3.2.1.5 Subtask 1.5 - Final System Acceptance Test (WBS 1.1.5)

B&W and selected vendor representatives will witness the Acceptance Test conducted by others. B&W will correct any deficiencies discovered during the acceptance test.

B&W will finalize the Operation and Maintenance Manual.

3.2.1.6 Subtask 1.6 - Management (WBS 1.1.6)

B&W will use its existing management system to monitor and control the schedule and costs. The B&W system provides for monitoring and controlling schedule and costs by task and subtasks.

As part of this task, B&W will work closely with DOE and UTSI to minimize interference with the testing at the CFFF.

3.2.2 Task 2 - Design, Fabrication, and Installation of an Automated Spent Seed/Ash Handling System (WBS 1.2)

3.2.2.1 Subtask 2.1 - Preliminary Design (WBS 1.2.1)

B&W will perform the preliminary design of an automated spent seed/ash handling system (SS/A HS). B&W will arrange to have preliminary designs of components prepared as necessary. The system will include site preparation, foundations, support structures, access platforms, ladders, etc. as required.

B&W will schedule, provide documentation, and participate in a Preliminary Design Review per the DOE Design Review Manual. The design review will evaluate the capability of the components and system to meet the following requirements:

1. Safely and automatically collect the spent seed/ash from 16 hoppers and, if practical, a 17th hopper, of the Superheater Test Module of the CFFF, weigh the spent seed/ash, and convey it to an existing

storage hopper. Provisions are required to discharge the spent seed/ash to alternate storage.

2. Safely and automatically collect the spent seed/ash from the two baghouse hoppers, weigh the spent seed/ash, and convey it to the existing storage hopper or alternate storage.
3. Safely and automatically collect the spent seed/ash from the four electrostatic precipitator hoppers, weigh the spent seed/ash, and convey it to the existing storage hopper or alternate storage.
4. Be capable of local or remote control from the CFFF control room including start-up, operation, and shutdown. Preclude operation from the control room while people are working on the system.
5. Be compatible with the CFFF system functionally and physically.
6. Be capable of operation in adverse weather conditions, including rain and below-freezing temperatures.
7. Meet all applicable building, construction, safety, and health codes.
8. Be designed and constructed to facilitate inspection and maintenance.

B&W will document the commitments and agreements reached during the design review.

3.2.2.2 Subtask 2.2 - Final Design, Material and Component Procurement, Fabrication, and Delivery to the CFFF (WBS 1.2.2)

B&W will perform the final design of the automated spent seed/ash handling system. During this design phase, B&W will order certain long lead materials or components with DOE approval. At the 90% completion of the system design, B&W will submit the documentation, drawings, etc. required for a

Critical Design Review (CDR) per the DOE Design Review Manual. B&W will arrange the time for the design review, participate in the design review, and document the commitments and agreements reached during the design review.

B&W will arrange to have the components fabricated and delivered to UTSI. UTSI will provide receiving inspection and storage. The components will have been assembled into subassemblies, subsystems, and systems to the maximum extent practical.

The components supplied by B&W will include:

1. Valves at each SHTM hopper to prevent excessive entrance of air or discharge of combustion gases as the hoppers are emptied.
2. Spent seed/ash grinder/crushers to process the hopper discharge to facilitate transport.
3. A system of conveyors to transport the spent seed/ash to a bin for weighing.
4. A conveying system to transport the spent seed/ash from the weighing bin to the storage hopper. The system will be equipped to divert the spent seed/ash to alternate storage.
5. Instrumentation and wiring for local control, and wiring to a terminal for others to a hookup to the remote control system. The instrumentation will provide a signal which will allow the above weights to be displayed in the control room.
6. Needed valves, piping, fittings, insulation, heat tracing, wiring, etc. for internal system connections.
7. The spent seed/ash handling system side of connections such as the remote control system, instrumentation, air, and electrical power.

8. Foundations, support structures and associated platforms, ladders, stairs, lighting, etc.

B&W will prepare a draft Operational Readiness Document (ORD) with checklists for mechanical checkout.

3.2.2.3 Subtask 2.3 - Installation at the CFFF and Mechanical Checkout (WBS 1.2.3)

B&W will hire local contractors for site preparation, installation of foundation, erection of support structures, and stairs, ladders, etc.

B&W will use UTSI trades people as available for installing the equipment on the platforms, foundations, etc. and for installing connecting piping, wiring, etc.

B&W will participate in the mechanical checkout of the equipment. Any equipment which must be operated will be operated by UTSI personnel at no charge to B&W.

B&W will arrange to have any modifications, additions, etc. made to correct discrepancies or deficiencies found during mechanical checkout. B&W will update the ORD, if necessary.

B&W will prepare a draft Operation and Maintenance Manual. This will include Operation and Maintenance Manuals from vendors where applicable.

B&W will comment on a system shakedown test plan prepared by UTSI. B&W will work with DOE and UTSI to resolve any comments.

3.2.2.4 Subtask 2.4 - System Shakedown (WBS 1.2.4)

B&W personnel will be available during the system shakedown to make any recommendations and decisions on unforeseen events.

B&W will correct any deficiencies in the B&W scope of supply discovered during the shakedown testing.

B&W will finalize the ORD and update the Operation and Maintenance Manual as required.

B&W will prepare a draft Acceptance Document. B&W will obtain the advice of vendors as deemed appropriate. The document will contain design and expected performance data, and data to be taken during test to evaluate equipment acceptability. To the extent practical, these specifications and predictions will be organized by component and subsystem to permit acceptance of individual components or subsystems.

3.2.2.5 Subtask 2.5 - Final System Acceptance Test (WBS 1.2.5)

B&W and selected vendor representatives will witness the Acceptance Test conducted by others. B&W will correct any deficiencies discovered during the acceptance test.

B&W will finalize the Operation and Maintenance Manual.

3.2.2.6 Subtask 2.6 - Management (WBS 1.2.6)

B&W will use its existing management system to monitor and control the schedule and costs. The B&W system provides for monitoring and controlling schedule and costs by task, subtasks, B&W labor category, and purchases.

As part of this task, B&W will work closely with DOE and UTSI to minimize interference with the testing at the CFFF.

3.2.3 Task 3 - Preparation of a Procurement/Installation Enabling Package for an Intermediate Temperature Air Heater (ITAH) System (WBS 1.3)

3.2.3.1 Subtask 3.1 - Design (WBS 1.3.1)

B&W will solicit additional information from the bidders to the B&W request for proposals for the ITAH. B&W will evaluate this information and the information previously obtained and recommend a vendor. A package including the bid request, the responses, the recommended vendor, and the reasons for the selection will be forwarded to DOE PETC.

With DOE/PETC concurrence, B&W will issue a purchase order for preliminary design of the ITAH. B&W will obtain information from the vendor sufficient to proceed with the preliminary design of the remaining portions of the system. B&W will provide a document package and arrange for a Preliminary Design Review per the DOE Design Review Manual. B&W will document the commitments and agreements reached during the design review.

B&W will revise the ITAH system design to reflect the commitments and agreements reached during the PDR. B&W will provide a revised document package and arrange for Critical Design Review meeting per the DOE Design Review Manual. The package will include specifications, sketches, drawings, calculations, catalogs, brochures, and other appropriate data for all the equipment including instruments, controls, support structures, and foundations. All interfaces will be defined.

B&W will prepare a draft Operational Readiness Document and a draft Operation and Maintenance Manual.

B&W will document the commitments and agreements reached during the design review and revise the draft documents as appropriate.

B&W will participate in a Design Readiness Review (DRR). B&W will document commitments and agreements reached during the DRR.

B&W will incorporate the changes as necessary to the system documentation package and include this in the Procurement/Installation Enabling Package. B&W will deliver this package with the Draft Final Report.

3.2.3.2 Subtask 3.2 - Cost Estimate for Procurement, Installation, and Checkout Testing (WBS 1.3.2)

B&W will re-estimate the costs for procurement, installation, and mechanical checkout of the system. The estimate will consider the changes made to the design as a result of the reviews.

3.2.3.3 Subtask 3.3 - Management (WBS 1.3.3)

B&W will use its existing management system to monitor and control the schedule and costs. The B&W system provides for monitoring and controlling schedule and costs by task, subtasks, purchases, and B&W labor category.

As part of this task, B&W will work closely with DOE and UTSI to minimize interference with the testing at the CFFF.

3.2.3.4 Task 4 - Participation on the MHD Technology Transfer, Integration, and Review Committee (WBS 1.4)

B&W will support the efforts of and participate on the MHD Technology Transfer, Integration, and Review Committee. This will include:

- o Distribution of B&W technical, topical, and progress reports to other members of the Committee as directed by DOE.
- o Documentation of results of informal discussions with other members of the Committee to define interface properties.
- o Attendance at periodic meetings of the Committee.

4.0 PROJECT STATUS

The period covered by this initial project quarterly report is September and October 1987. Progress will be discussed on a task and subtask basis.

4.1 TASK 1 - MODIFICATION OF THE EXISTING COAL PULVERIZER AND DRYER SYSTEM (WBS 1.1)

4.1.1 Subtask 1.1 - Preliminary Design (WBS 1.1.1)

The concept for modification of the existing coal pulverizer and dryer system was finalized. The coal will be dried in the pulverizer during the grinding. This requires increases of the temperature of the gas entering and leaving the pulverizer to be able to reduce the moisture of the Montana Rosebud Coal from about 25% to 5% or less.

Substantial modifications to the pulverizer will be required to accommodate these higher temperatures and achieve the required drying. These changes include:

The concentration of oxygen in the gas used to transport the pulverized coal from the pulverizer to the bag filter will have to be reduced to no more than 9%. The reduced concentration will reduce the possibility of fires in the pulverizer when the moisture content of the Montana Rosebud is lowered to 5% by weight.

The inert gas will be supplied by reaction of a portion of the oxygen in the air with No. 2 fuel oil. The inert gas generator will also be capable of operating with natural gas. The adiabatic flame will be about 2600°F at the oil-to-air ratio needed to reduce the oxygen level in the inert gas to the desired level. Air-cooled heat exchangers will be used to reduce the gas temperature to the desired value of 700°F or less.

Only one vendor responded to the request for quotation for the inert gas generator. This vendor also took some exceptions to the requirements. These exceptions were for the supply of equipment such as valves between the inert

gas generator and the pulverizer and for providing and installing insulation on the equipment for worker protection. These exceptions do not affect the performance or operation of the inert gas generator. B&W will provide this equipment and have it installed in the CFFF. The plans are being modified to reflect this change.

The vendor's conceptual design was submitted to DOE for review and comment.

4.1.2 Subtask 1.2 - Final Design, Material and Component
Procurement, Fabrication, and Delivery (WBS 1.1.2)

No activity scheduled on this task to date.

4.1.3 Subtask 1.3 - Installation at the CFFF and
Mechanical Checkout (WBS 1.1.3)

No activity scheduled on this task to date.

4.1.4 Subtask 1.4 - System Shakedown (WBS 1.1.4)

No activity scheduled on this task to date.

4.1.5 Subtask 1.5 - Final System Acceptance Test (WBS 1.1.5)

No activity scheduled on this task to date.

4.1.6 Subtask 1.6 - Management (WBS 1.1.6)

The project team has been assembled, and lines of communication have been developed. The project organization is shown in Figure 3. The project team will be responsible for the management of this and the other tasks in the project.

The Integrated MHD Bottoming Cycle project team is headed by Mr. P. B. Probert of B&W's Chemical Engineering Section, Research and Development

Division. As Project Manager, Mr. Probert directs the work of the B&W team and coordinates the project activities with DOE and within the B&W Company. He is the Project Manager on the MHD Heat Recovery Seed Recovery project, thus maintaining excellent continuity of B&W's participation in the DOE MHD program. Mr. Probert is assisted by Mr. S. C. Datsko on all day-to-day technical activities.

Mr. W. L. Coler from B&W's Contract Research Division is the Contract Manager and is responsible for the financial and contractual aspects of the project.

Within B&W, Mr. J. D. Martin, Hudson Engineering, is responsible for the design and construction of foundations, structural supports, and for installation of the equipment at the CFFF. In addition, Messrs. G. D. Lindstrom, R. R. Piepho, and R. Bruckner will coordinate engineering or procurement activities in their areas of expertise.

Mr. C. W. Wurst of UTSI will supervise UTSI trades personnel during installation of the equipment at the CFFF. He will receive direction from the B&W on-site supervisor. In addition, Mr. Wurst will be responsible for providing information on current and planned site configurations to assist in the location of the equipment to be furnished during the Integrated MHD Bottoming Cycle project.

The primary team members attended a kickoff and get-acquainted meeting at PETC. The design concept for the coal pulverizer/dryer system was presented at this meeting.

Preparation of the Management Plan, including the Work Plan, the Milestone Schedule Plan, and the Cost Plan was initiated.

4.2 TASK 2 - DESIGN, FABRICATION, AND INSTALLATION OF AN
AUTOMATED SPENT SEED/ASH HANDLING SYSTEM (WBS 1.2)

4.2.1 Subtask 2.1 - Preliminary Design (WBS 1.2.1)

Mr. Martin of B&W visited the CFFF site to obtain information on potential locations of major components of the system, such as the weight tank(s) and the storage hopper. This information is being used to select the location of these components and the routing from the CFFF components to these components. The objective is to provide an economical arrangement which will minimize interference with access to other parts of the facility.

4.2.2 Subtask 2.2 - Final Design, Material and Component Procurement,
Fabrication, and Delivery to the CFFF (WBS 1.2.2)

No activity on this subtask to date.

4.2.3 Subtask 2.3 - Installation at the CFFF and
Mechanical Checkout (WBS 1.2.3)

No activity on this subtask to date.

4.2.4 Subtask 2.4 - System Shakedown (WBS 1.2.4)

No activity on this subtask to date.

4.2.5 Subtask 2.5 - Final System Acceptance Test (WBS 1.2.5)æ

No activity on this subtask to date.

4.2.6 Subtask 2.6 - Management (WBS 1.2.6)

See 3.2.6 for general management activities. The requirements for the automatic spent seed/ash removal system were reviewed at the project kickoff meeting.

4.3 TASK 3 - PREPARATION OF A PROCUREMENT/INSTALLATION-ENABLING PACKAGE
FOR AN INTERMEDIATE TEMPERATURE AIR HEATER SYSTEM (WBS 1.3)

No activity on this task to date.

4.4 TASK 4 - PARTICIPATION ON THE MHD TECHNOLOGY TRANSFER,
INTEGRATION, AND REVIEW COMMITTEE (WBS 1.4)

No activity on this task to date.

5.0 ACTIVITIES PLANNED FOR NEXT QUARTER

Planned activities for the November/December 1987 and January 1988 quarter focus on initiation of monthly reporting, completion of the Management Plan, and completion of the preliminary design of the coal pulverizer and dryer system and of the spent seed/ash handling system. The activities will include preparation for and participation in the Technology Transfer, Integration, and Review Committee if a meeting is scheduled.

Significant plans in each task are:

Task 1 - Modification of the Existing Pulverizer and Dryer System (WBS 1.1)

The key activity is to procure the design services of an inert gas generator vendor. The vendor is needed to provide design information for the preliminary design review and initiation of final design and fabrication. A formal request for approval of the selected vendor will be made in the next quarter.

Task 2 - Design, Fabrication, and Installation of an Automated Spent Seed/Ash Handling System (WBS 1.2)

The key activities planned for the next quarter are the selection of the locations for storage hopper and the routing of conveyors between existing hoppers and the storage tanks. These selections and the selection logic will be will be documented in preparation for the preliminary design review. If possible, the design review will be scheduled and held.

Task 3 - Preparation of a Procurement/Installation-Enabling Package of an Intermediate Temperature Air Heater (WBS 1.3)

No activity in planned for this task at this time.

Task 4 - Participation on the MHD Technology, Transfer,
Integration, and Review Committee (WBS 1.4)

Activity on this task will depend upon the scheduling of a meeting by DOE.

6.0 SUMMARY

Integrated MHD Bottoming Cycle project progress for September and October 1987 is in the preparation of the management, the conceptual designs for the pulverizer/dryer system modification, and the locations of the components of the automated spent ash/seed handling system.

The vendor's concept for the inert gas generator can be designed to meet the project requirements. The design pressure will have to be increased and plans will have to be modified to obtain the 18-inch valves and the personnel protection insulation from others. Information on the design was forwarded to DOE for review and comment.

A trip was made to the DOE CFFF site to obtain information about potential locations for the inert gas generator and the spent seed/ash handling system components. This information is being used to select the location of the equipment and prepare layout drawings of the systems for the preliminary design review.

WORK BREAKDOWN STRUCTURE

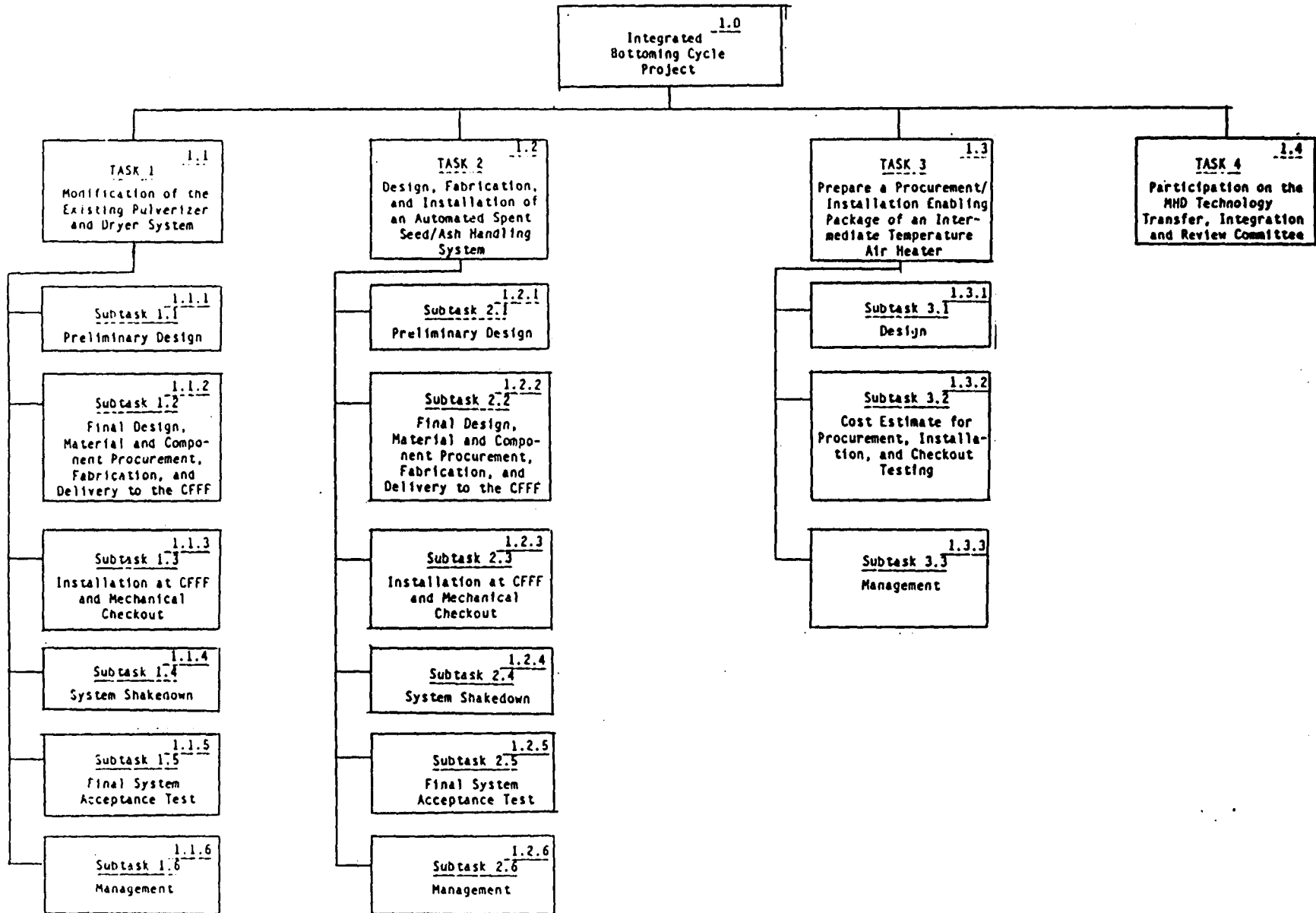
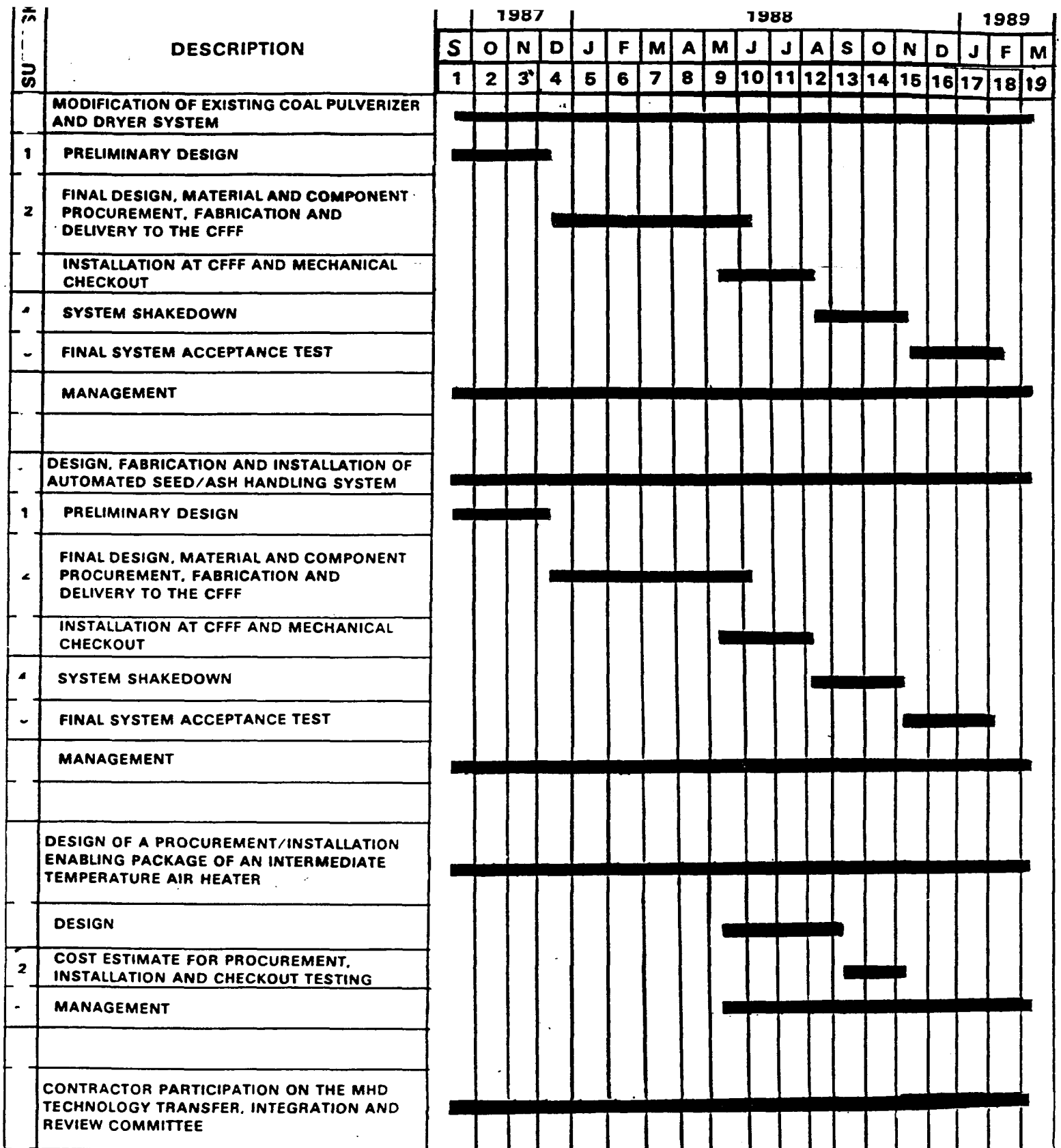


FIGURE 1



PROJECT SCHEDULE

FIGURE 2

Integrated MHD Bottoming Cycle

Project Organization

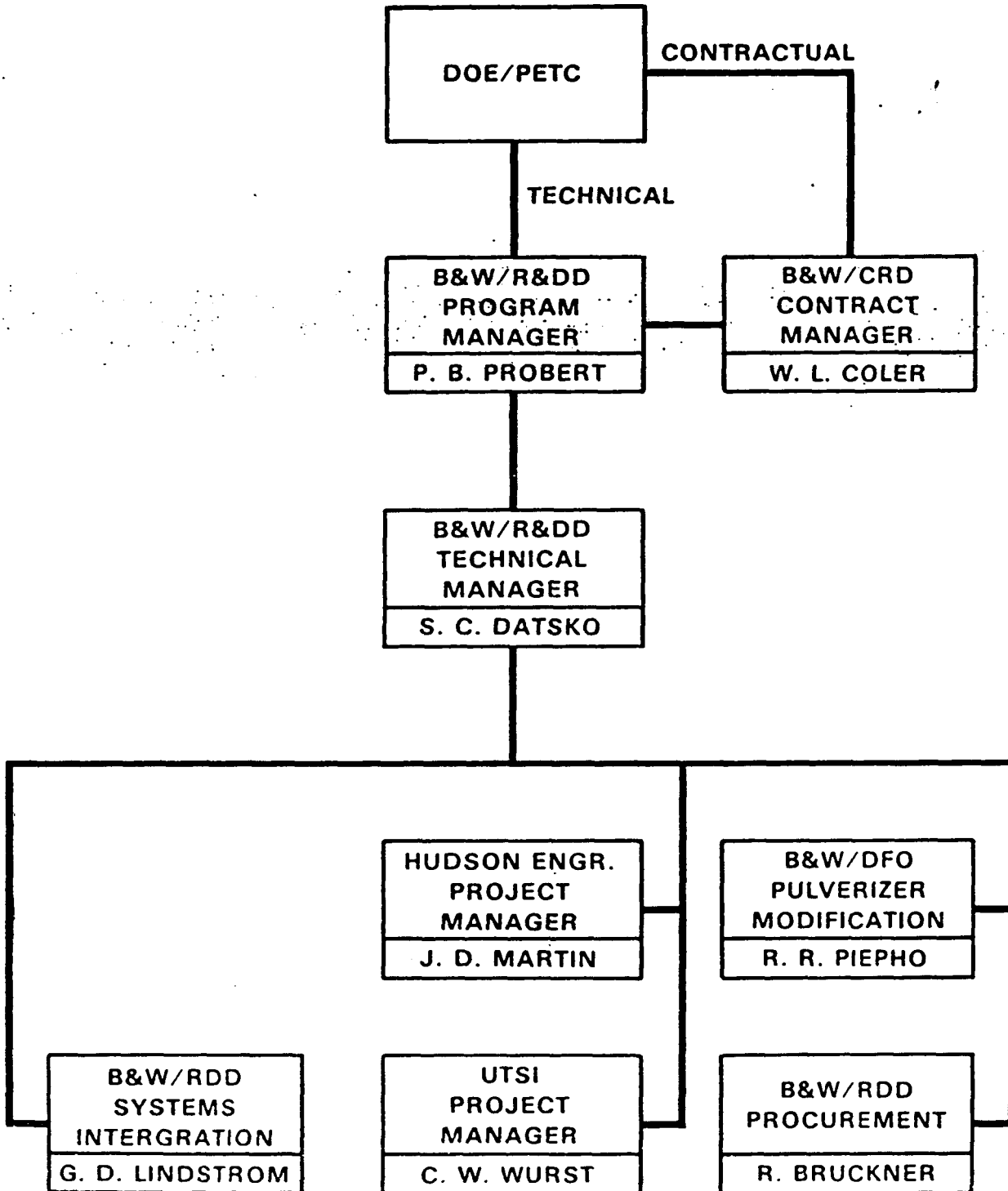


FIGURE 3