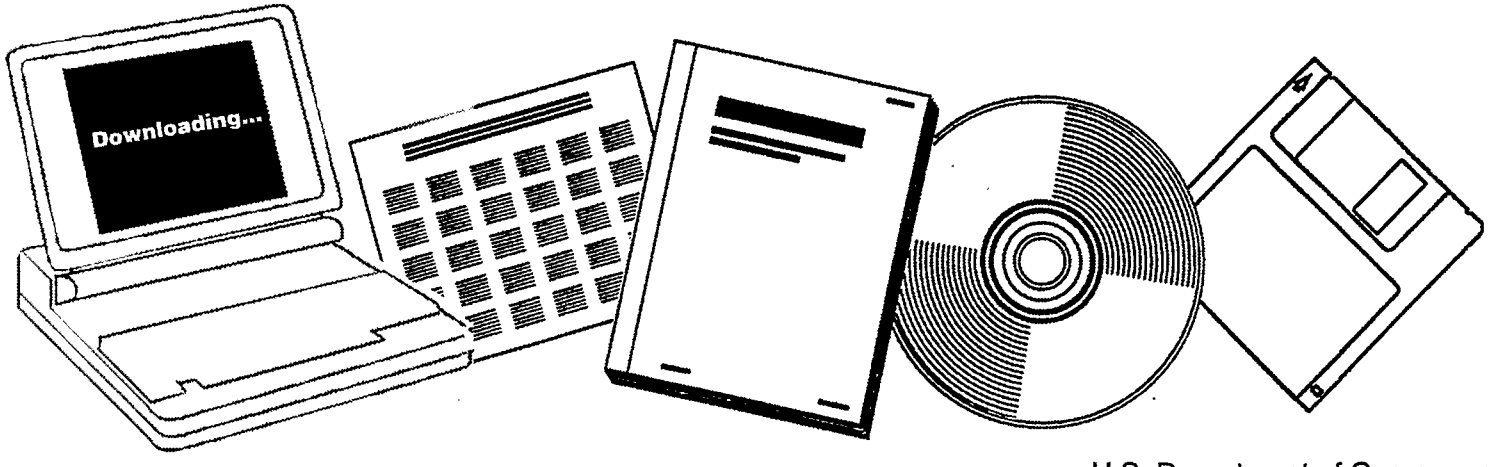
COAL GASIFICATION PROGRAM. MONTHLY PROGRESS REPORTS, JANUARY--DECEMBER 1973

BATTELLE COLUMBUS LABS., OHIO

1973



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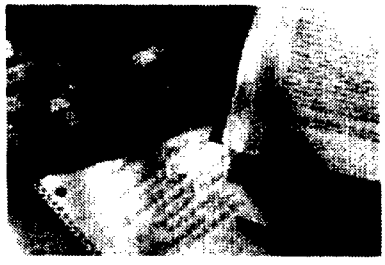

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FE--1513-T-1

COAL GASIFICATION PROGRAM

Monthly Progress Reports for the
Period January - December 1973

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

Prepared for

Office of Coal Research
U. S. Department of the Interior

OCR Contract No. 14-32-0001-1513

FE--1513-T-1

CONTENTS

PR#1
BCL-MPR-1

Contract No. 14-32-0001-1513

INTRODUCTION

This initial progress report covers work completed by Battelle on the Coal Gasification Program since receipt of authorization[1,2]* from the American Gas Association to proceed. Included is our proposed schedule, anticipated rate of expenditure for the remainder of calendar year 1973, organization of the program, and a description of work to be undertaken during the next reporting period (i.e., February 15 - March 15).

WORK COMPLETED

A-1. Review of Design Calculations

The initial activity on the program involved a review of design calculations previously made for the Process Development Unit. Heat and material balances were made for operation using a typical Eastern bituminous coal. Hydraulic balances for critical operations within the PDU were also made and a review of the auxiliary equipment required for PDU operation was concluded.

A-2. Preparation of Bid Specificiations

After review of design calculations (Phase A, part 1), a preliminary flowsheet for the Battelle PDU was established. Both specific recommendations for items of equipment to be used in the PDU and general specifications relating to the quality of the plant desired were prepared. This information was issued on December 19 as a Bid Package[3] suitable for use by engineering contractors to prepare their bids for the detailed design and construction of the Battelle PDU. The specifications and bid package were prepared in consultation with C. F. Braun and Company.

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*References are listed on page 10.

A-3 and A-4. Solicitation and Evaluation of Bids

On December 20, a meeting was held at Battelle-Columbus with representatives of eight engineering contractors preselected for the bidding.(4) Representatives of AGA, OCR, and Braun were also present at the meeting. An oral presentation of the Bid Package was made by Battelle and the prospective bidders received a copy of the package.

Bids were received on January 15 from six of the eight contractors (two of the original eight elected not to bid). A preliminary evaluation of the bids was made independently by Battelle and subsequently by representatives of Battelle, AGA, OCR, and Braun jointly. This review led to elimination of three bidders. The three remaining bidders were visited during the week of January 21 by a team comprised of AGA, OCR, Braun, and Battelle representatives. Revised bids were rendered by these organizations on February 5. Based on the supplemental input from the three bidders, a recommendation was made(5) that Chemico be awarded the subcontract for design and construction of the Battelle PDU. A letter of intent(6) was issued to Chemico on February 14.

Work Related to the Environmental Impact of the PDU

The Ecology and Environmental Systems Division at Battelle-Columbus has conducted discussions with the State of Ohio EPA officials to determine what State permissions are required for operation of the PDU at the West Jefferson site. The current status of these talks is that a written description of the intended operation is being prepared for submission to the office of the head of the State EPA.

In addition to preparation of a statement of PDU operations as they relate to the environment for the State, written information has been provided to Mr. Howard Smith (OCR's Environmental Officer). This information was provided as a result of Mr. Smith's January 31 visit to Battelle-Columbus. During his visit, we discussed environmental aspects of the PDU with him and Mr. Smith visited the site of the planned PDU.

Coal Acquisition

Representative half-ton lots of two high-sulfur, highly caking Eastern bituminous coals have been obtained. Arrangements have also been made to obtain a sample of another caking coal of a low-sulfur content.

Battelle has contacted the Island Creek Coal Company to explore the feasibility of a cooperative arrangement* to obtain the Eastern-bituminous, low-sulfur (less than 1 percent) coal. Such a coal could serve as a steady supply for PDU operations and eliminate any conceivable criticism of the PDU operation from an environmental standpoint.

Coal Characterization

A half-ton lot of one of the high-sulfur coals has been broken into smaller samples and portions of these were ground to sizes which will be typical of the feeds to the PDU.

Ash fusibility tests and thermal analyses of ash samples from the high-sulfur coal have been conducted to permit comparison of the results with previous Battelle studies. Only limited work has been performed.

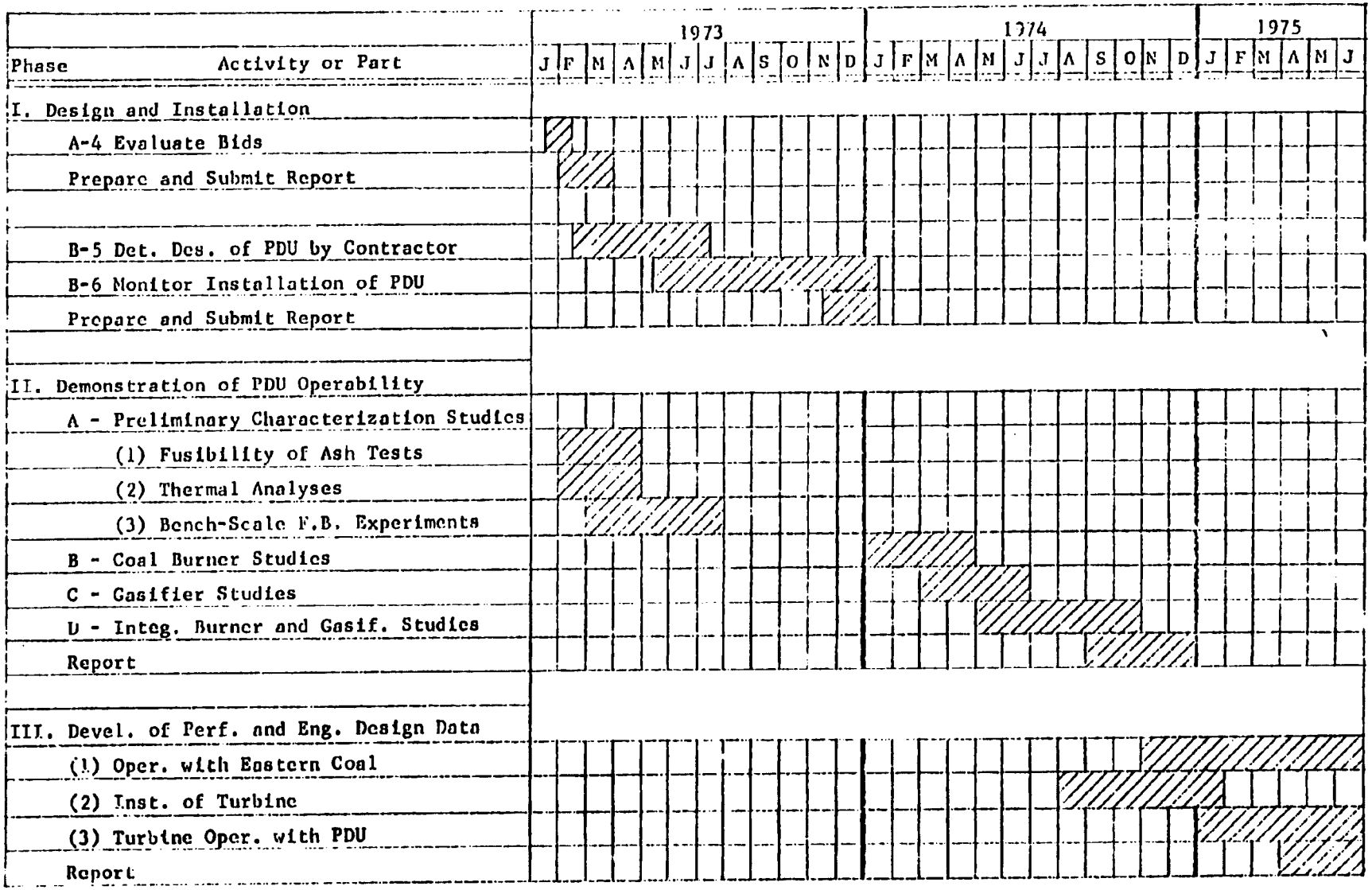
Experiments in bench-scale fluidized beds are in progress. The objectives of these experiments are: (1) to produce ash agglomerates from burning an Eastern bituminous coal and to compare the results with those of previous experience with this type of coal, and (2) to examine the behavior of caking coals when they are fed to a gasifier operating under conditions similar in most respects to those which are planned for the Battelle PDU.

SCHEDULE AND EXPENDITURES

The proposed schedule for the remainder of the program is shown in bar chart form in Table 1. This schedule corresponds to Battelle's

*The conditions of any such cooperative arrangement are, of course, subject to the approval of the OCR contracting officer.

TABLE 1. OVERALL PROGRAM SCHEDULE
BATTELLE PDU



proposed contract modification of February 14,[7] and takes into account the 2-week period of delay in the schedule previously proposed by Chemico[8] in their bid for the detailed design and installation of the pilot plant. The delay is due to the need for a revised cost proposal. The revised proposal requested resulted in a 2-week delay in issue of the letter of intent to a contractor.

As can be noted in the schedule, Phase I-A is completed with the exception of the phase report which is currently being prepared. The original estimated cost for completion of Phase I-A was $92,805. As of February 1, the latest date for which total accumulated expenditures have been compiled, a total of $83,675 has been expended on the program. Current activities are on or ahead of schedule and within estimated costs.

Table 2 shows the monthly estimated rate of expenditure for the remainder of 1973. Expenditures by both Battelle and Battelle's subcontractor, Chemico, are shown. Because a subcontract has not been concluded with Chemico, terms of the payment of the total contract price of $1,870,000 to them are not yet known. For purposes of estimation in Table 2, it has been assumed that the costs associated with engineering design, procurement and administration ($147,000) will be paid in four equal monthly payments commencing in February. Two-thirds of the remaining contract price has been assumed to be paid in equal monthly payments commencing in June. An estimated monthly expenditure rate for 1974 and 1975 will be included in the next progress report.

ORGANIZATION OF THE PROGRAM

The Coal Gasification Program is to be administered by the Minerals and Metallurgical Processing Division and overall responsibility for the program is assigned to W. M. Goldberger, Division Chief. During this reporting period an organizational structure for the program has been determined and several of the key staff assignments have been made from within Battelle.

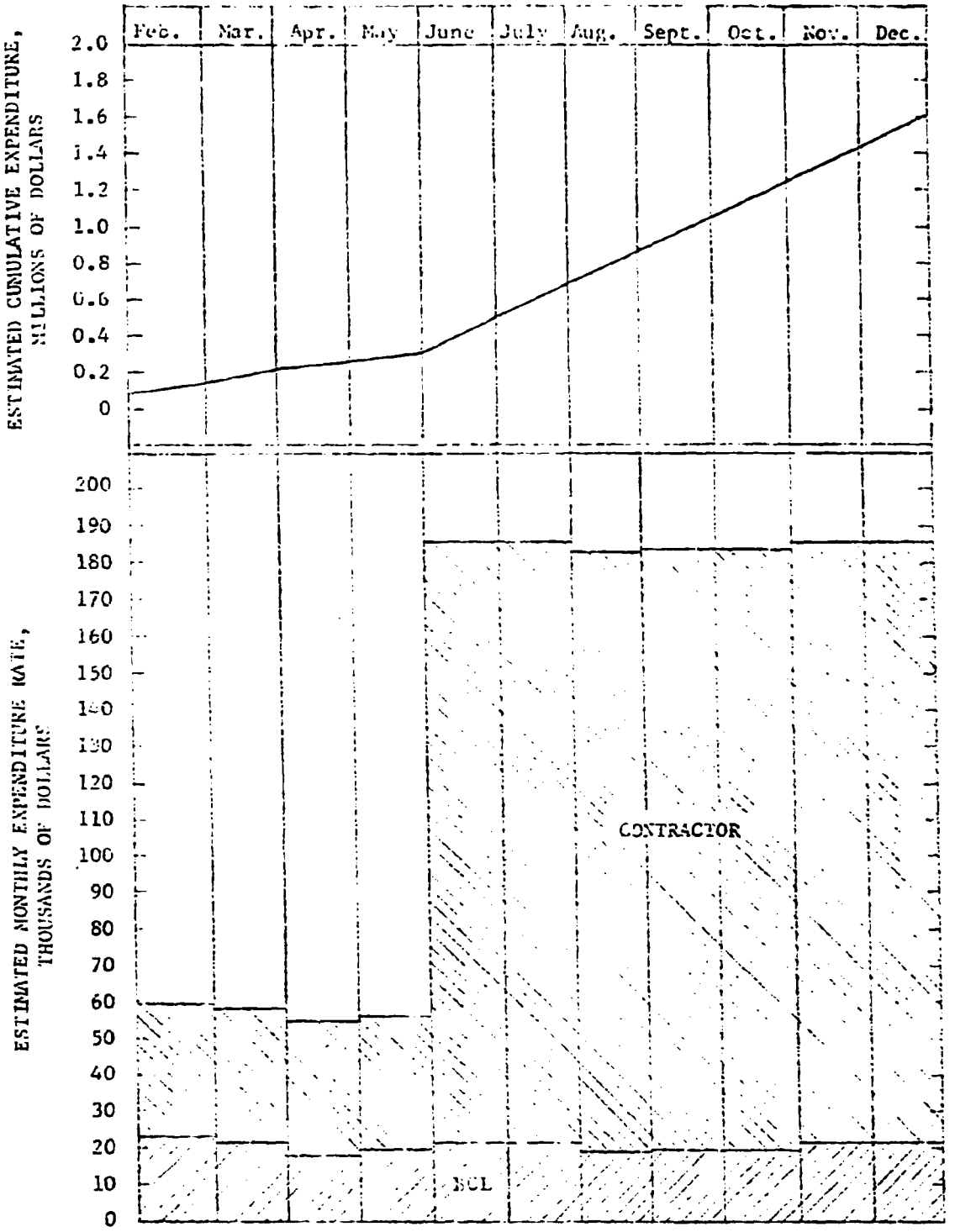


TABLE 2. ESTIMATED RATE OF MONTHLY EXPENDITURE AND CUMULATIVE EXPENDITURE ON THE BATTELLE PDU FOR THE REMAINDER OF 1973

All activities of the program are to be directed by the Project Manager. Mr. W. C. Corder is assigned as the Project Manager. The organization of the program comprises three functional groups: (1) Project Engineering, (2) Process Engineering, and (3) Operations. Each group is to be headed by a Group Leader who reports directly to the Project Manager. In addition to the functional groups, various advisors and consultants will play a key role in the program. A summary of the scope of work to be performed by the various groups is as follows.

Advisors

Advisors are specialists who are either full-time Battelle staff members or have a permanent arrangement with Battelle whereby a significant portion (but not all) of their time can be spent within the confines of Battelle and be devoted to the Coal Gasification Program. Within this classification are Howard R. Batchelder, A. W. Lemmon, William J. Grunenwald, J. G. Wiley, and others. Biographical information on each of these individuals as well as other key personnel and their assignment in the program is included in the Appendix.

Consultants

Outside consultants who provide specific inputs in their area of technology will be used on an as-needed basis. We have already used the services of Dr. Frederick A. Zenz in the determination of hydraulic balances and fluidization aspects critical to PDU operation. If required, the services of other outside consultants will be employed.

Project Engineering

This group, led by Robert R. Adams, has the assignment to monitor and expedite the activities of the subcontractor during the engineering design and installation of the pilot plant. This will entail periods of providing resident engineers at the offices of the subcontractor to expedite

approvals as needed during the final engineering design, specification and purchase commitment phases of work. The Group Leader will coordinate these activities of the subcontractor and Battelle in relation to all aspects of the installation of the process plant and its relation to Battelle buildings and services.

Process Engineering

This group will provide the planning of experimental work, data processing, engineering design and reporting functions for the PDU. It is not anticipated that this group will be formed until later in 1973.

Operations

This group will provide all activities concerning operation of the Process Development Unit (PDU), bench-scale apparatus, and other laboratory projects and activities associated directly with the program. A Group Leader will be assigned in the next 3 months to coincide with the final design of the West Jefferson facility. During the fall, the PDU operating staff will be assembled comprising shift engineers, operators, and analysts.

WORK PLANNED FOR NEXT REPORTING PERIOD

Report on Phase I-A

Work will continue on the preparation of the Phase I-A report. The report will summarize the PDU design, equipment specifications, and recommendations for installation of the PDU as reported in the Bid Package and updated by work completed by Battelle's subcontractor.

Detailed Design of the PDU by the Subcontractor (Phase I-B)

Chemico is currently working to complete the detailed design of the PDU. Initially, Battelle will have several staff members working with Chemico to establish the final design basis and the general flowsheet for the PDU. It is planned that the Battelle Project Engineer will be in residence on March 1 at the contractor's site to act as liaison and expedite approvals to the extent required. Major activity on the detailed design aspect of the PDU is anticipated in the forthcoming reporting period.

Coal Source Selection

It is anticipated that selection of a supply of the coal for the PDU will be completed during this reporting period.

Preliminary Characterization Studies

Studies to chemically, thermally, and mineralogically analyze and characterize coal from the specific source selected as the major supply will be conducted. These studies will include continued atmospheric fluidized-bed operations both to produce ash agglomerates for fluidization studies and to examine the behavior of caking coal fed to a fluidized bed operating under conditions similar to the PDU.

REFERENCES

(1) Letter from F. Donald Hart to Battelle dated August 17, 1972.

(2) Letter from Ab Flowers to W. M. Goldberger dated September 12, 1972.

(3) Bid Package: Coal-Gasification Process-Development Unit, issued by Battelle's Columbus Laboratories, December 19, 1972 (copies to Dr. George Hill, Dr. Ab Flowers, and Dr. Roger Detman).

(4) Letter to Mr. Douglas T. King and Dr. George R. Hill from W. M. Goldberger dated December 6, 1972.

(5) Letter to Mr. Paul J. McNeill from Roger L. Evans dated February 14, 1973.

(6) Letter to Mr. Richard G. Savage from R. L. Evans dated February 14, 1973 (carbon copies to AGA, OCR, and Braun).

(7) Letter to Mr. Paul J. McNeill from Roger L. Evans dated February 14, 1973.

(8) Proposal from Chemical Construction Corporation to Battelle dated January 12, 1973 (carbon copies to OCR, AGA, and Braun).

BCL-MPR--2

PROGRESS REPORT NO. 2

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

March 20, 1973

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

PROGRESS REPORT NO. 2

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

from

BATTELLE
Columbus Laboratories

March 20, 1973

INTRODUCTION

This second progress report covers work completed by Battelle on the Coal Gasification Program during the period February 15-March 15. Included are anticipated expenditures for the remainder of the program and a description of work to be conducted during the next reporting period.

WORK COMPLETED

Detailed Engineering Design of the PDU

Chemico has prepared process flow diagrams, prepared requisition specifications for some items of equipment*, and has developed a new plot plan for the PDU. Several working sessions have been held between Battelle and Chemico to coordinate the Chemico work. One session concerned the transfer of solids between the burner and gasifier of the PDU. F. Zenz (consultant to Battelle) and L. Rice from C. F. Braun participated.

Also during this reporting period, R. Adams has been assigned as the Battelle Project Engineer for liaison between Battelle and Chemico to expedite approvals; he has established an office at Chemico's headquarters. R. Adams is now assisting Chemico in the study of the West Jefferson site and in the coordination between Chemico and Battelle.

*Particular emphasis on long-term delivery items.

We have also prepared a modified hydraulic balance for the burner-gasifier solids transfer system and a preliminary process control methodology for the PDU operation. Engineering calculations have also been completed on the segregation of solids in the gasifier vessel and on the possibility of temperature excursions in case of accident during operation.

Coal Acquisition

Discussions were held with Island Creek Coal Company about acquiring a low-sulfur, Eastern bituminous coal for the PDU operation. A half-ton sample of the Island Creek Coal was supplied for tests at Battelle.

Arrangements are being made to furnish samples of the Island Creek Coal and of a Pittsburgh No. 8 coal to pulverizer equipment suppliers for testing.

Coal Characterization

Bench-scale fluidized-bed experiments were continued to (1) examine the possibility that the caking coal to be used will require pretreatment prior to gasification, and (2) produce ash agglomerates from the Eastern bituminous coal to compare with previous experience. This work is in progress.

Work Related to the Environmental Impact of the PDU

Further contact and discussions regarding the planned operation at West Jefferson have been held with the State EPA. We intend to prepare a statement for the State EPA of the PDU program of operation.

SCHEDULE AND EXPENDITURES

A proposed schedule for the program was presented in the first monthly progress report. Table 2 of the first monthly was a bar chart showing the estimated rate of expenditure by Battelle and Battelle's subcontractor (Chemico) during the remainder of 1973. Figure 1 of this report is an expansion of Table 2 in the first monthly and indicates estimated expenditures month-by-month over the duration of the program. No changes are expected in the overall schedule.

As of March 1, the latest date for which accumulated expenditures have been compiled, a total of $100,547.17 has been expended on the program by Battelle*. An additional $20,000 is estimated to have been spent by Chemico as of March 1. The February expenditures by both Battelle ($17,050.46) and Chemico are lower than those predicted in Figure 1. The reason for the lower-than-predicted expenditure relates to delay in achieving final contracts with OCR and a subcontract agreement between Battelle and Chemico.

WORK PLANNED FOR NEXT REPORTING PERIOD

Report on Phase I-A

The Phase I-A report will be completed and submitted during the coming reporting period.

Detailed Design of the PDU by the Subcontractor (Phase I-B)

Activity on the detailed design of the PDU by Chemico is to continue. It is expected that several of the Battelle staff will actively work with Chemico in providing input to the final design.

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*In the first progress report, cumulative expenditures to February 1 were reported as $83,675. More complete accounting indicates that only $83,496.71 had been expended as of that date.

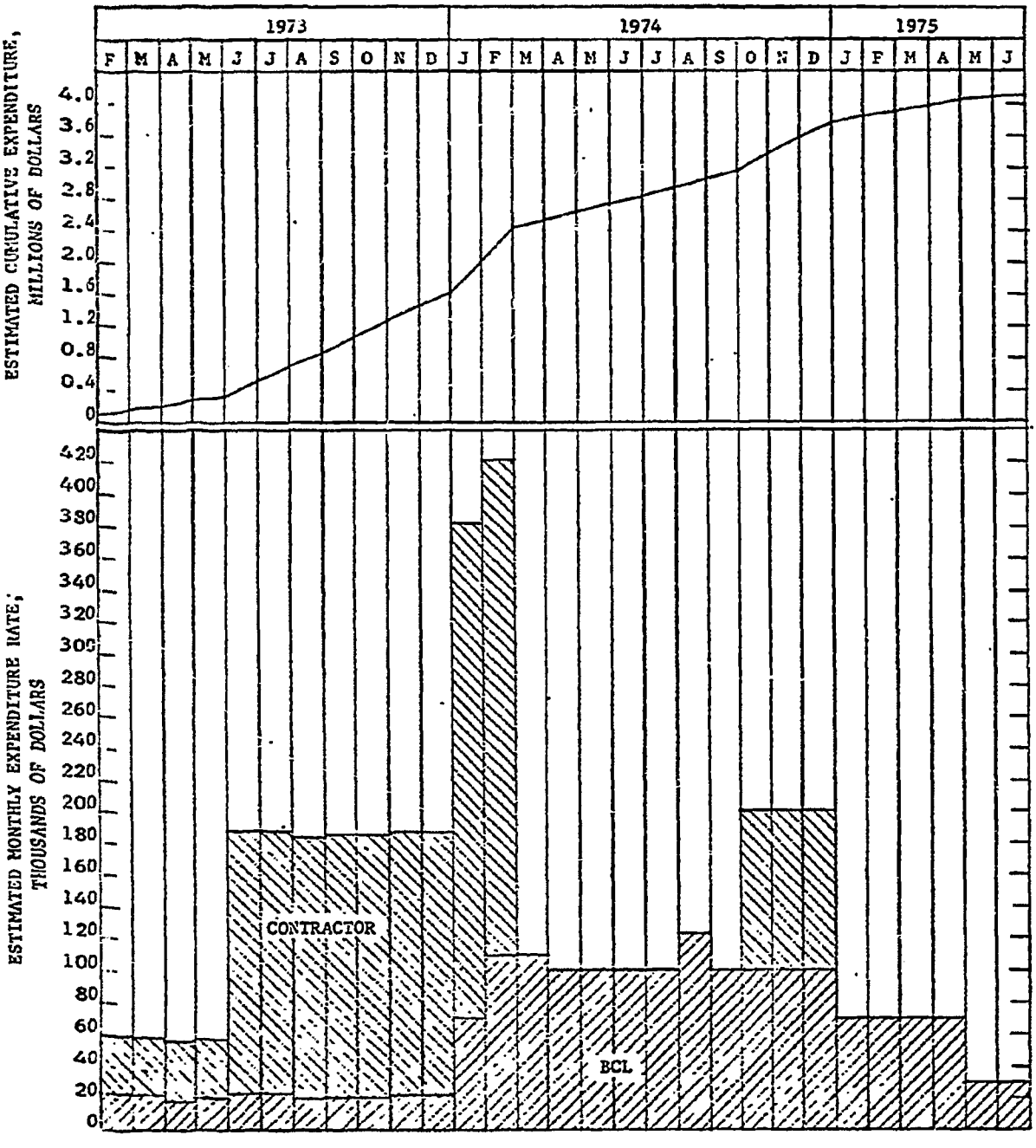

FIGURE 1. ESTIMATED RATE OF MONTHLY EXPENDITURE AND CUMULATIVE EXPENDITURES ON THE BATTELLE PDU FOR THE DURATION OF THE EXPERIMENTAL PROGRAM

In conjunction with the detailed design it is anticipated that specifications on several items of equipment will be issued by Chemico. Also for certain long-term delivery items of equipment, purchase orders may be issued.

It is expected that the PDU design will have advanced, during the next reporting period, to a point where R. Adams will spend approximately 3/5 of his time at Chemico's offices for the purpose of expediting approvals and providing the necessary coordination between Chemico and Battelle.

Small-Scale Fluidized-Bed Burner-Gasifier System Assembly

As a portion of Phase II-A-3 of our proposal, it was planned that a small-scale fluidized-bed assembly would be fabricated. Consideration is being given to the fabrication from glass of rough-scale models of the PDU burner and gasifier. When the assembly is complete it should be possible to better determine the influence of operating parameters on the segregation of solids in the gasifier and to examine the solids circulation between vessels. It is expected that the glass system may be assembled and initial tests completed during this reporting period.

Other Activities

It is expected that other activities which have already been initiated will be pursued during the forthcoming reporting period. For example, we plan to pursue with Island Creek Coal Company the possible supply of coal. We also plan to advise the State of Ohio EPA of our planning. It is also our intention to continue the coal characterization work of Phase II-A.

Bcx.MPR--63

PROGRESS REPORT NO. 3

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

April 19, 1973

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

PROGRESS REPORT NO. 3

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

from

BATTELLE
Columbus Laboratories

April 19, 1973

INTRODUCTION

This third progress report describes work completed by Battelle on the Coal Gasification Program during the period March 15-April 15. Included are estimates of expenditures for the period, cumulative expenditures to date, and a description of work to be done during the next reporting period.

WORK COMPLETED

Contractual

The contract between OCR and Battelle-Columbus was fully negotiated and signed during this reporting period. Negotiations were also held between Battelle and Chemico concerning the subcontract for the detailed engineering design and installation of the PDU. Chemico is reviewing the subcontract draft proposed by Battelle. Based on review with Chemico of this draft, it appears that there are no major points of difference and we anticipate that a revised document will be submitted to OCR for the required review and approvals within 2 weeks.

Detailed Engineering Design of the PDU

Chemico Activity

A new schedule of activities has been prepared by Chemico. This schedule generally complies with the one stipulated in the subcontract draft.

The Chemico schedule is shown in Table 1. There has been some delay in the first two items on the schedule due to delay in execution of the contracts. Chemico is now rapidly scaling up to full effort and it is expected that they will be on schedule after the middle of this month.

Chemico has been concentrating, since the first of April, primarily on the development of specifications for the more critical* items of equipment such as the coal preparation equipment, compressors, and the Burner and Gasifier vessels. They have prepared and submitted purchase specifications for three items of equipment. Purchase specifications for most of the other items of critical equipment have been prepared but, as of this date, they have not been issued. It is expected that Chemico will place the orders by May 31 as scheduled.

Because preparation of final process flow diagram details is less critical to meeting the overall schedule, less emphasis was placed on their preparation. The preliminary flow diagrams prepared by Chemico based on those in the Bid Package are now being revised and modified to represent the final design of the PDU. We expect the issuance of these and corresponding data sheets during the next few weeks.

In addition to equipment specifications and flowsheets, Chemico is developing a plan for equipment location within and in the vicinity of Battelle's Building JS-2. Also, elevation drawings are being prepared for some of the more critical sections of the PDU to assist in the specification of foundations and structural supports.

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*Items of equipment likely to be long-term delivery items.

TABLE 1. CHEMICO SCHEDULE

Item	To Be Completed By
Process Flow Diagrams and Data Sheets	April 15, 1973
Requisitions for Critical Items	April 20, 1973
Preliminary Site Layout	May 18, 1973
Preliminary Process P & I's	May 31, 1973
Purchase Orders for all Critical Items	May 31, 1973
Structural Steel Design	June 1, 1973
Electrical Equipment Requisition	June 1, 1973
Instrumentation Panel Board Requisition	June 15, 1973
Instrument Requisitions	June 29, 1973
Foundation Drawings	June 29, 1973
Start of Construction (Foundations)	July 6, 1973
Requisitions for Noncritical Items	July 15, 1973
Production Design Engineering and Service Flow Sheets	July 27, 1973
Start of Structural Steel Erection	August 10, 1973
Purchase Orders for all Noncritical Items	August 15, 1973
Final Piping Drawings	August 24, 1973
Piping Requisitions	August 31, 1973
Final Process P & I's	August 31, 1973
Power and Lighting Drawings	September 7, 1973
Foundations Complete	September 14, 1973
Start of Equipment Installation	September 14, 1973
Structural Work Complete	September 21, 1973
Electrical Subcontract Requisition	September 21, 1973
Start of Piping Installation	October 12, 1973
Start of Electrical Installation	October 26, 1973
Start of Instrumentation Installation	November 17, 1973
Equipment Installation Complete	December 28, 1973
PDU Completed	January 15, 1974
Initial Start-Up	January 16, 1974

Battelle Activity

R. Adams, the Battelle Project Engineer, has been spending approximately one-half of each week at Chemico's office since late in March. In addition to this technical liaison activity, information has been obtained and a procedure established which will permit virtually continuous monitoring of Chemico's expenditure on this program. Because the schedule will entail high expenditures within a short period, a continuous monitoring of the contractor's costs is to be maintained by Mr. Adams.

The Battelle project staff has been providing input to the final detailed design when required. The mechanism for such input has been through technical meetings between Chemico and Battelle engineers at which specific sections or items of equipment in the PDU are discussed and decisions are made. Sessions have been held on the coal pulverization equipment, process control, and the Burner-Gasifier hydraulic design. It is our intention to request the participation of C. F. Braun and Company in discussions of certain aspects of the PDU.

Coal Acquisition

Discussions were previously held with Island Creek Coal Company about acquiring a low-sulfur, Eastern bituminous coal for the PDU operation. A sample of the Island Creek Coal identified as being from the Pevler Mine in Eastern Kentucky was obtained. Subsequent experiments with the coal confirmed that it had very high ash fusion temperatures (e.g., initial softening greater than 2700 F). Based on limited bench-scale, fluidized-bed experiments, the Pevler coal ash is not readily agglomerated at temperatures in the range 1950-2200 F. On the other hand, similar experiments recently made with Pittsburgh No. 8 coal confirm that operation in the self-agglomerating burner is as would be predicted based on earlier experiments at Battelle. We, therefore, are basing our final design on, and planning initial operation with, Pittsburgh No. 8 coal.

We plan to explore the possibility that the coal for the PDU can be acquired on a donated or cost basis. Any assistance that OCR might provide on this would be most helpful.

Coal Characterization

Bench-scale experiments were made and these established that the behavior of a recently received sample of Pittsburgh No. 8 coal in a self-agglomerating fluidized bed is in conformance with previous experience at Battelle. Stable operation of the bench-scale combustor was observed over time periods of several hours in the temperature range of 1920-2050 F and the operations probably could have been sustained indefinitely.

We have initiated experiments to compare the processing of "nonpretreated" coal and "pretreated" coal. In the first experiments, nonpretreated Pittsburgh No. 8 coal was fed to a bench-scale fluidized bed of sand at rates per unit of cross section and temperatures similar to those planned for PDU Gasifier operation. Nitrogen rather than steam was used as the carrier gas. It is believed that this is a more severe condition with respect to caking than will exist in the PDU Gasifier. Excessive tar formation was observed in all experiments and the feeding of the nonpretreated coal could not be sustained.

A quantity of the Pittsburgh No. 8 coal has been pretreated under conditions similar to those planned for the PDU. It is our intention to repeat the above experiments using the pretreated coal.

Associated with coal characterization studies were tests conducted by the Williams Patent Crusher and Pulverizer Company. These were made at the Williams facility in St. Louis, Missouri, using laboratory-scale roller mill equipment on both Pittsburgh No. 8 and Pevler coals. The purpose of the tests was to determine if the desired split in size fractions could be simultaneously obtained with the Williams equipment. The results of these tests which were witnessed by Battelle and Chemico are currently being evaluated.

Report on Phase I-A

The Phase I-A report, consisting of a description of activities associated with the preliminary PDU design and equipment selection, preparation of the Bid Package, and evaluation of bids is in the final stages of duplication and preparation. We plan to issue the report by April 25, 1973.

Small-Scale Fluidized-Bed Burner-Gasifier System Assembly

The units of a working model* in glass of the Burner and Gasifier have been fabricated. We are in the process of making the assembly.

Work Related to the Environmental Impact of the PDU

A statement was prepared and transmitted to the Office of the Director of Ohio's Environmental Protection Agency outlining the calculated inputs and outputs, program of operation, location, and the measures to be taken by Battelle to protect the environment. Our plans were discussed with the Director and his staff. Additional discussions will be held with EPA after they have reviewed our statement.

We are planning to file the necessary documents for applying for a permit to operate the planned stack. To facilitate this filing the services of the Property Management Group at Battelle-Columbus are to be used. This group has filed the required papers and obtained permits for other experimental developments at the West Jefferson site.

SCHEDULE AND EXPENDITURES

The latest date for which accumulated expenditures have been compiled was April 1. The total cumulative expenditure by Battelle-Columbus as of that date is $121,775, and that estimated** by Chemico is $29,000. The combined expenditure is about 3.7 percent of the total budget.

As noted in a previous section, it appears that there will be a minor delay in Item 1 and Item 2 of the Chemico work which is within

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* The model scale is approximately 1.5 inches equals one foot.

** In the absence of a fully negotiated subcontract, Battelle has not received billings from Chemico.

Phase I of the overall program schedule (see the schedule in the First Monthly Progress Report). We do not believe that the delay is serious and we do not expect any problems in meeting the scheduled start-up date. Battelle-Columbus work underway in Phase II is ahead of schedule.

In general, the cumulative expenditures are less than what was originally anticipated at this time. Expenditures by Chemico for March are substantially less than were estimated and the Battelle expenditure is about as estimated (see previous progress reports).

WORK PLANNED FOR NEXT REPORTING PERIOD

Detailed Design of the PDU by the Subcontractor (Phase I-B)

It is expected that the work at Chemico will continue in accordance with the schedule of Table 1. Battelle's staff will continue to work actively with Chemico to provide input for the detailed design.

During the next reporting period a meeting is scheduled with the Operating Committee of OCR. It is expected that the progress to date on the detailed design can be reviewed in as much depth as desired at that time.

Studies in the Glass Model

Assembly of the scale model of the Burner-Gasifier System will be completed and experiments will be started in this system. The objective of the experiments will be to examine the circulation of solids between the Burner and Gasifier and the segregation of solids in the Gasifier.

Other Activities

We will continue the experiments in bench-scale fluidized beds concerned with producing ash agglomerates. Several tests will be made with pretreated coal. Acquisition of coal, and further discussions regarding environmental impact, will be pursued.

BCL-MPR--4

PROGRESS REPORT NO. 4

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

from

BATTELLE
Columbus Laboratories

May 15, 1973

INTRODUCTION

This progress report describes work completed by Battelle on the Coal Gasification Program during the period April 15 - May 15. Included are estimates of expenditures for the period, cumulative expenditures to date, an estimate of the current status of the work with respect to the program schedule, and a description of work planned for the next reporting period.

WORK COMPLETED

Contractual

The subcontract between Battelle and Chemico for the detailed engineering design, construction, and installation of the PDU was negotiated to the satisfaction of ourselves and Chemico during this reporting period. The subcontract has been sent to OCR and AGA for the necessary review and approval.

Detailed Engineering Design of the PDU

Chemico Activity

Chemico's schedule as presented in the third monthly progress report is repeated here for convenience. It was noted in the previous monthly report that some delay was being experienced in the first two scheduled items. The current status of these items is as follows:

- Process Flow Diagrams and Data Sheets. This item was scheduled to be completed by April 15. The Process Flow Diagrams and data sheets were issued by Chemico on May 11. Chemico explained that the delay in issuance of the Process Flow Diagrams was due to their desire to place more available manpower on the development of the engineering details necessary for the preparation of requisitions for some of the critical equipment items*.

- Requisitions for Critical Items. Most of the requisitions for critical items of equipment have now been prepared. A major exception is the requisition for the Burner and Gasifier vessels which Chemico has informed us is now being prepared and will issue by mid-May.

As of the first of May, requisitions for 29 items on the equipment list had been released by the engineering groups at Chemico for preliminary bids. In a number of cases a requisition covers more than one equipment item. These requisitions are at various stages of their cycle: Some have been reviewed by Battelle and have been issued to vendors and initial quotations received, others still reside in the purchasing offices of Chemico.

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* Items of equipment likely to be long-term delivery items.

TABLE 1. CHEMICO SCHEDULE

Item	To Be Completed By
Process Flow Diagrams and Data Sheets	April 15, 1973
Requisitions for Critical Items	April 20, 1973
Preliminary Site Layout	May 18, 1973
Preliminary Process P & I's	May 31, 1973
Purchase Orders for all Critical Items	May 31, 1973
Structural Steel Design	June 1, 1973
Electrical Equipment Requisition	June 1, 1973
Instrumentation Panel Board Requisition	June 15, 1973
Instrument Requisitions	June 29, 1973
Foundation Drawings	June 29, 1973
Start of Construction (Foundations)	July 6, 1973
Requisitions for Noncritical Items	July 15, 1973
Production Design Engineering and Service Flow Sheets	July 27, 1973
Start of Structural Steel Erection	August 10, 1973
Purchase Orders for all Noncritical Items	August 15, 1973
Final Piping Drawings	August 24, 1973
Piping Requisitions	August 31, 1973
Final Process P & I's	August 31, 1973
Power and Lighting Drawings	September 7, 1973
Foundations Complete	September 14, 1973
Start of Equipment Installation	September 14, 1973
Structural Work Complete	September 21, 1973
Electrical Subcontract Requisition	September 21, 1973
Start of Piping Installation	October 12, 1973
Start of Electrical Installation	October 26, 1973
Start of Instrumentation Installation	November 17, 1973
Equipment Installation Complete	December 28, 1973
PDU Completed	January 15, 1974
Initial Start-Up	January 16, 1974

In spite of the initial delay in some items of the schedule, in part due to the delay in selection of Chemico as the PDU subcontractor, there is every indication that the Chemico activity will be on schedule by the end of May.

Through their adjustment of some priorities, Chemico has been able to devote more time to activities which are further down on their schedule and, as a consequence, are probably further along at present than might otherwise be surmized. The status of the other items early on the Chemico schedule appears to be as follows:

- Preliminary Site Layout. It appears that the necessary decisions regarding the site layout have been made. It is currently expected that this item will be completed on schedule.

- Preliminary Process P&I's. First draft P&I's for Sections* 300, 400, 500, and 600 of the PDU were submitted to Battelle and to C. F. Braun for review and comment. Sections 100 and 200 are being discussed with potential pulverizer suppliers. A review session regarding process control was held between Battelle and Chemico on May 3, at which Braun's as well as Battelle's comments were discussed. Modified, preliminary P&I's are being developed by Chemico based on this meeting. Assuming that no unexpected problems develop in the review process, this item should be completed by the scheduled date of May 31.

- Purchase Orders for All Critical Items. The orders for all equipment items considered critical are scheduled to be issued by May 31. As of the present time, it must be recognized that there could be slippage in the deadline for this item, although this would not necessarily delay the PDU completion. Chemico is experiencing delay in receiving the desired

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* The section numbers and the corresponding descriptive section names are

Section	Name
100	Coal Receiving and Storage
200	Coal Preparation and Grinding
300	Coal Pretreatment
400	Coal Feed System
500	Coal Gasification
600	Gas Treatment.

three quotations on some of the equipment items. For example, as of the last report from Chemico, only one bid had been received on the coal grinding package.

The first request for approval of an equipment item, that for the compressors, was forwarded to OCR by Battelle on April 27. Every effort will be made to get the desired bids for other equipment as rapidly as possible, to submit the authorization requests expeditiously, and to issue the purchase orders at the earliest possible date. To expedite purchases Battelle will, if necessary, purchase items directly* and make an appropriate modification to the subcontract later. Priority will be given to those items expected to be most critical to the completion schedule.

- Structural Steel Design. This item is scheduled to be completed by June 1. According to Chemico, delivery schedules on fabricated steel in many areas of the country have become much more critical during the past month. Battelle and Chemico are attempting to determine if this is true in Central Ohio. At this point, most of the decisions critical to the structure, to be made by Battelle and Chemico, have been made. Some of the structural details, however, will depend upon the receipt of certified engineering drawings from the equipment suppliers. If the issuance of purchase orders is delayed, this could delay the completion of structural drawings and the ordering and delivery of the fabricated steel. An attempt will be made to minimize the possibility of any such delays by negotiating the steel fabricating orders on the basis of unit prices and then furnishing the drawings for the fabrication of individual section assemblies as rapidly as the necessary details are available.

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* This could become necessary if final approvals of the subcontract were delayed and vendors would be unwilling to commence work under a letter of intent. Of course, any such purchases would be as recommended by Chemico and approved by OCR and AGA.

- Electrical Equipment Requisition. This item is scheduled for completion by June 1. At this time, it appears that this schedule can be met.

Battelle Activity

The Battelle Project Engineer has continued to spend a major portion of his time in Chemico's offices for the purposes of coordination, expediting approvals, and day-to-day monitoring of the subcontractor's activities. The Battelle project staff has also held a number of technical sessions with the Chemico engineers for the purpose of providing our input to the PDU design.

Additionally, the Property Management group at Battelle is becoming more actively involved in the detailed design of the PDU from the standpoint of coordinating activities related to site modification with the Chemico work.

Coal Acquisition

We are continuing to explore the possibility that coal for the PDU can be acquired on a donated or cost basis. In this regard, initial contacts are being established with the Ohio Coal Producers Association.

Coal Characterization

To permit a higher level of concentration on the solids transfer system planned for the PDU, and on the factors influencing char-ash separation in the Gasifier, preference has been given to assembly and operation of a scale model of the Burner-Gasifier System over the characterization studies. We do not anticipate that deferment of this work will have a significant influence upon the schedule.

Report on Phase 1-A

The report, which consists of a description of activities undertaken in Phase I-A of the program which culminated in selection of the engineering contractor to build the PDU, was issued during this reporting period.

Small-Scale Fluidized-Bed Burner-Gasifier System Assembly

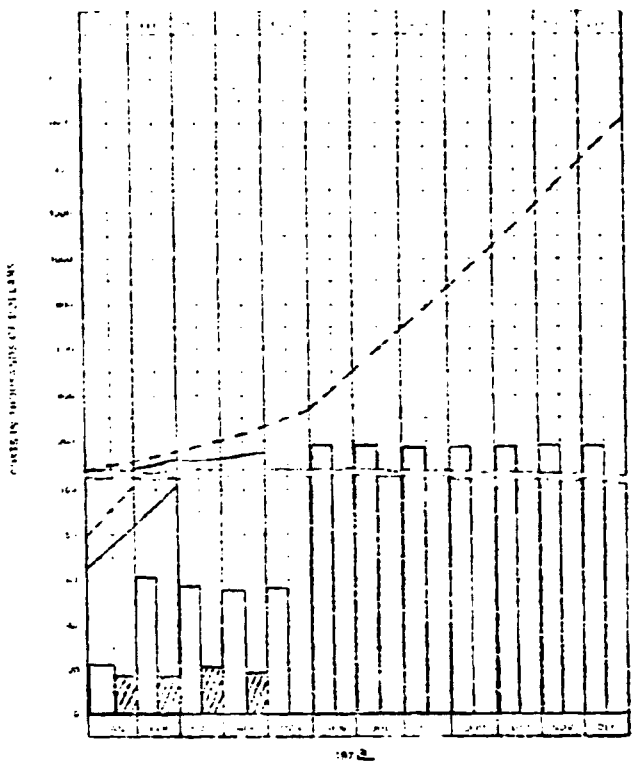
A working model of the Burner-Gasifier System has been installed. The model is a 1/8-scale model of the Burner-Gasifier System and is fabricated from glass and plastic. Initial tests have been made to attempt simulation of PDU flow rates. These tests are continuing and we expect to perform some controlled experiments within the month.

Work Related to Environmental Impact of the PDU

We are beginning to prepare the necessary documents for application for a permit to operate a stack at West Jefferson now that completed Process Flow Diagrams have been received.

SCHEDULE AND EXPENDITURES

The latest date for which accumulated expenditures have been compiled is May 1. The total cumulative expenditure by Battelle is, as indicated on the Task Cost and Manpower Projection Chart (Table 2), $141,467. Inasmuch as the subcontract has not been fully negotiated yet, we have not received billings from Chemico. They estimate their total cumulative expenditures on the program, as of April 1, to be $50,000. Therefore, the combined cumulative expenditure is about $192,000, or about 4.7 percent of the total budget.



Plan	4.4	5.8	5.5	4.2	4.6	5.1	5.1	4.1	4.2	4.7	4.2	5.3
Act	5.2	5.3	4.7	4.4								

Plan	15.6	21.4	20	16.2	16.4	17.9	17.9	16.8	17.2	17.2	17.2	15.8
Act	12.5	19.3	17.1	17.0								

Plan	0	36.8	20.7	36.5	26.7	26	164.4	164	164.2	164	164.2	164
Act	0	0	0	0								

Plan	0	0	0	0	2.5	1	0	0	0	0	0	0
Act	0	0	0	0.25								

Plan	2.9	2.2	2.0	2.2	2.4	3.1	3.6	3.0	2.3	2.3	4.4	2.1
Act	1.3	2.8	4.1	2.4								

Plan	21.5	28.8	28.7	25.2	29	26	165.5	162.6	153.7	163.5	172.8	165.9
Act	17.8	17.1	21.2	19.7								

KEY TO CHART

Attention: Costs for technical services division personnel were inadventently excluded from the direct labor and overhead category in this report. A revised Task Cost and Manpower Projection Chart will be forthcoming within 7 days.

At present, we see no reason why the overall program schedule contained in our First Monthly Progress Report will not be adhered to.

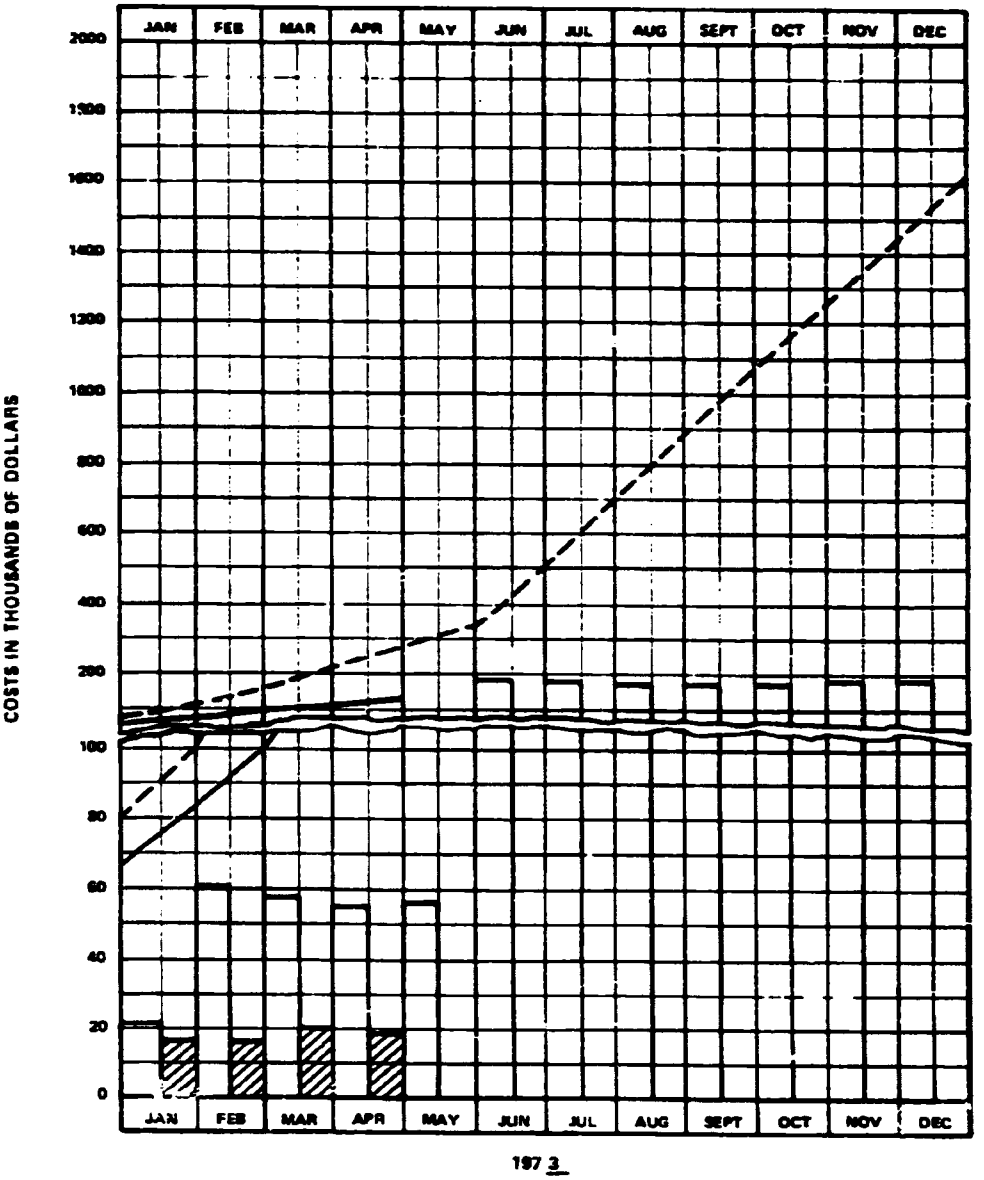
WORK PLANNED FOR THE NEXT REPORTING PERIOD

It is expected that the Chemico work will continue in general conformance with the schedule of Table 1. Battelle's staff will continue actively working with Chemico to expedite design and installation of the PDU.

The meeting with the Operating Committee of OCR, originally scheduled for May 3, failed to materilize. It is now expected that the meeting will be held during the latter part of May.

In addition to the work related to monitoring the design and installation of the PDU, Battelle will continue other activities noted in this report which are already in progress.

BATTELLE PDU
TASK COST AND MANPOWER PROJECTIONS
MONTH ENDING APRIL 30 , 1973



MANPOWER (MAN-MONTHS)

Pred.	4.4	5.8	5.5	4.2	4.6	5.1	5.1	4.1	4.2	4.7	4.2	5.3
Act.	5.3	4.4	5.3	5.0								

DIRECT LABOR & OVERHEAD COSTS (THOUSANDS OF DOLLARS)

Pred.	18.6	21.4	20	16.2	14.4	17.9	17.9	16.8	17.2	17.2	17.2	19.8
Act.	16.6	14.3	17.8	17.6								

SUBCONTRACT AND CONSULTANT COSTS (THOUSANDS OF DOLLARS)[1]

Pred.	0	36.8	36.7	36.8	36.7	164	164.2	164	164.2	164	164.2	164
Act.	0	0.7	0.3	0								

NON-EXPENDABLE EQUIPMENT (THOUSANDS OF DOLLARS)[2]

Pred.	0	0	0	0	0	0	0	0	0	0	0	0
Act.	0	0			0			0	0	0		

1973

MANPOWER (MAN-MONTHS)

Pred.	4.4	5.8	5.5	4.2	4.6	5.1	5.1	4.1	4.2	4.7	4.2	5.3
Act.	5.3	4.4	5.3	5.0								

DIRECT LABOR & OVERHEAD COSTS (THOUSANDS OF DOLLARS)

Pred.	18.6	21.4	20	16.2	14.4	17.9	17.9	16.8	17.2	17.2	17.2	19.8
Act.	16.6	14.3	17.8	17.6								

SUBCONTRACT AND CONSULTANT COSTS (THOUSANDS OF DOLLARS)[1]

Pred.	0	36.8	36.7	36.8	36.7	164	164.2	164	164.2	164	164.2	164
Act.	0	0.7	0.3	0								

NON-EXPENDABLE EQUIPMENT (THOUSANDS OF DOLLARS)[2]

Pred.	0	0	0	0	0	0	0	0	0	0	0	0
Act.	0	0	0	0	0	0	0	0	0	0	0	0

MATERIALS, SUPPLIES, TRAVEL AND ODC (THOUSANDS OF DOLLARS)[3]

Pred.	2.9	2.2	2	2.2	3.4	3.1	3.8	3	2.3	2.3	4.4	2.1
Act.	1.2	2.1	3.1	2.1								

TOTAL (THOUSANDS OF DOLLARS)

Pred.	21.5	60.4	58.7	55.2	57	186	185.9	183.8	183.7	183.5	185.8	185.9
Act.	17.8	17.1	21.2	19.7								

KEY TO GRAPH:

- PREDICTED TOTAL COSTS
- ACTUAL TOTAL COSTS
- PREDICTED CUMULATIVE
- ACTUAL CUMULATIVE

NOTES:

(1) OUTSIDE CONSULTANTS

(2) NON-EXPENDABLE EQUIPMENT TO BE PURCHASED BY SUBCONTRACTOR IS INCLUDED IN SUBCONTRACT CATEGORY

(3) COST OF BATTELLE RESIDENT CONSULTANTS INCLUDED IN THIS CATEGORY

2

BCL.MPR--5

TECHNICAL SECTION

of

PROGRESS REPORT NO. 5

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

June 15, 1973

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

TECHNICAL SECTION

of

PROGRESS REPORT NO. 5

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

from

BATTELLE
Columbus Laboratories

June 15, 1973

INTRODUCTION AND PROJECT OBJECTIVE

This progress report describes work completed by Battelle on the Coal Gasification Program during the period May 15-June 15. The section which follows is the technical section. The Administrative and Financial section is appended.

The general objective of the current contract is development of a two-stage fluidized-bed process utilizing a self-agglomerating fluidized-bed burner as part of a practical and economical method for producing synthesis gas (a mixture of hydrogen and carbon monoxide) from coal. The developed process is to be useful as a part of a synthetic pipeline-gas producing system, as a fuel gas system, or for other purposes.

Pursuant to the general objective, a 25-ton-a-day of coal Process Development Unit (PDU) is to be erected and operated and the following aspects of the process explored:

- The operability of a self-agglomerating fluidized-bed coal burner operating on an Eastern bituminous coal under pressure and using air for combustion.
- The mechanical feasibility of continuously circulating a burden of hot-ash agglomerates between fluidized-bed burner and fluidized-bed gasifier vessels at 100 psig of pressure

and the rates and temperatures required for effective heat transfer.

- The operability of integrated fluidized-bed burner and gasifier vessels both fed by Eastern bituminous coal (or char in the case of the burner) and operating at 100 psig of pressure. The gasifier is to be fluidized by steam and the endothermic heat of gasification is to be provided by the circulating burden of hot-ash agglomerates.
- The operability over extended time periods of a power-recovery turbine using hot, fluidized-bed burner effluent gases as the turbine working fluid.
- The factors which influence the long-term operability of the process. Included is to be the gathering of data on all key process variables and their affect on the characteristics of the process.

Concurrent with operation of the PDU, sufficient process data and information will be acquired to permit scale-up of the process to its next logical stage of development.

SUMMARY

During this reporting period, work continued by Chemico on detailed engineering design of the PDU and procurement of equipment. The Battelle project staff held several working meetings with Chemico; the purpose of which was to make our inputs to the final design of the PDU. Test work was initiated at Battelle on the scale model of the Burner-Gasifier System and several qualitative-type experiments were made. Activity by Battelle on subjects previously initiated; for example, coal acquisition, also continued.

During this reporting period, Battelle was advised by Chemico that the January 15, 1974, date for completion of all components of the PDU cannot be met. We are working with Chemico to develop a new schedule incorporating a sequenced start-up of components of the PDU beginning in mid January 1974. The influence of delay in the final completion date of the PDU on the completion date of the overall Battelle program is being evaluated.

WORK COMPLETED

Contractual

The subcontract between Battelle and Chemico for the detailed design, construction, and installation of the PDU was submitted to OCR and AGA for review and approval during the previous reporting period. Due to subcontract modifications requested by AGA, formal approval has not yet been received. Based on the Sponsors' Telex authorization of the expenditure of funds, Chemico was authorized by Battelle to commit funds up to $900,000.

Detailed Engineering Design of the PDU

Chemico Activity

Chemico's schedule as presented in the third monthly progress report is repeated in this report in the "schedule" subsection as Table 1A. The current status of early items on the schedule is as follows.

- Process Flow Diagrams and Data Sheets. The Process Flow Diagrams were issued by Chemico on May 11. Based on simultaneous and independent reviews of the Process Flow Diagrams by Battelle and C. F. Braun, suggestions were made which will result in minor changes in these diagrams. Chemico is in the process of evaluating these suggestions and making modifications. Revised Process Flow Diagrams are expected soon.

- Requisitions for Critical* Items. In the prior monthly report, it was noted that requisitions for most of the critical items of equipment had been prepared. A major exception was the requisition for the Burner and Gasifier vessels. This requisition was issued by Chemico during the week of May 13.

*Items of equipment requiring more than 16 weeks for delivery.

In some instances it has been necessary to reissue modified requisitions based on the reviews of Battelle and C. F. Braun. It is our understanding that essentially all of the requisitions for critical items of equipment have either been sent to vendors or will be by June 22.

• Preliminary Site Layout. A preliminary site layout has been agreed upon by Chemico and Battelle. The preliminary layout was approved this week by Battelle.

• Preliminary Process P & I's. A review session with Chemico was held on May 24 concerning the P & I's. The P & I's examined at that time were modifications incorporating Battelle's and C. F. Braun's remarks of May 3 on the first draft P & I's. Additional modifications were made to the drawings available on May 24 and Chemico issued their preliminary P & I's for examination by Battelle on June 8.

• Purchase Orders for All Critical Items. A purchase order for the process air compressors was issued on May 17 to Ingersoll Rand. No other purchase orders have been placed. Quotations from suppliers of coal pulverizers and of lock hopper vessels have been received and Chemico is in their final stages of bid evaluation for these items.

The placing of orders for critical items of equipment is considered of major importance to maintaining the present schedule.

• Structural Steel Design. Chemico is making a preliminary determination of the structural steel requirements to permit steel bidding by local steel fabricators and erectors on a unit basis. The development of the detailed structural design is also proceeding.

• Electrical Equipment Requisition. It is expected that requisitions for critical items of electrical equipment such as PDU supply transformers and reduced voltage starters will be out for bids by June 22.

- Instrumentation Panel Board Requisition. We have received information on the size of the control panel and, consequently, the required control room size from Chemico.

- Instrument Requisitions. We are informed by Chemico that requisitions for bids on instrumentation will be completed by July 27.

- Foundation Drawings. The preparation of foundation drawings is being scheduled to allow Chemico to go out for bids on the equipment foundations by June 25.

- Start of Construction-Foundations. We are informed by Chemico that this activity will be initiated by August 6.

- Requisitions for Noncritical Items. Indications based on talks with Chemico are that these requisitions will be out by July 6.

Battelle Activity

Mr. R. R. Adams, the Battelle Project Engineer, is continuing to maintain an office at Chemico for his coordination activity. Working meetings between the project staff of Battelle and the Chemico staff have been held to review the design being developed by Chemico.

The Property Management group at Battelle has initiated activities to coordinate their work with that of Chemico. This group has been instrumental in determining the layout of the PDU and work is in progress to clear certain areas of the site and make provisions to accommodate the PDU. An electrical transformer required to accommodate the PDU is in the process of being ordered by Battelle as a part of the facility to be furnished by Battelle. Members of Chemico's project staff have visited the site and have held discussions with Battelle's Property Management group.

To assist in preparing the final design of the gasifier vessel and in selection of process control equipment, project staff from Chemico

and Battelle are scheduled to meet with the staff of the CO_2 Acceptor Process Pilot Plant at Rapid City on June 14. Lou Rice from C. F. Braun will be present at this meeting.

Small-Scale Fluidized-Bed Burner-Gasifier System Assembly

Tests using the 1/8-scale model of the Burner-Gasifier System were initiated during this reporting period. These tests involved the use of coal and/or char and alumina or bauxite as solids for fluidization and solids transport. Qualitative tests of transport and cycling of solids through the Burner and Gasifier indicate continuous circulation can be readily accomplished. Circulation at various rates can be facilitated by either varying the transport gas rates or by the use of glass cocks inserted in the transport lines to simulate valves.

It was noted that effective segregation of ash material and coal occurs when gas velocities in the lower section of the Gasifier are maintained low enough to avoid slugging. Additional tests to study the stripping of coal from ash are in progress.

Modifications to the model of the gasifier vessel have been made to examine the behavior of the system when gas is injected around the conical transition zone. Operations with the heavier solids maintained in both the transition zone of the gasifier model and in the lower zone have been examined. It is anticipated that some quantitative experiments will be conducted during the next reporting period.

Work Related to Environmental Impact of the PDU

We plan to file for a permit to operate a stack at West Jefferson when the revised Process Flow Diagrams and data sheets are received from Chemico.

Coal Acquisition

There have been no further developments regarding our initial contacts with the Ohio Coal Producers Association in reference to acquiring coal on a donated or cost basis. We plan to contact one or more Ohio coal companies individually.

OCR Operating Committee Meeting

On May 31, the OCR Operating Committee visited Battelle-Columbus to review our progress on the Program. Present were Dewey Dykstra and Ray Archer from OCR and Dennis Duncan from AGA. Several Battelle staff associated with the project attended the half-day meeting and Chemico was also represented.

The general format for the meeting was as follows:

2:00-2:10 Opening Remarks (W. M. Goldberger)
2:10-2:25 Overview of Program Activities (W. C. Corder)
2:25-2:35 Introduction of Chemico and Chemico Activity (R. R. Adams)
2:35-3:10 Chemico Remarks (E. M. Ezcurra)
3:10-3:40 Observe Operation of Working Glass Model of Burner-Gasifier
3:40- Informal Discussion.

In addition to discussion of schedule and costs, we briefly reviewed some of the PDU drawings which Chemico had brought to the meeting.

PROBLEMS

As stated in the subsection of this report entitled "Detailed Engineering Design of the PDU", the initial schedule for detailed design, construction, and installation of the Battelle PDU is not being met.

In an effort to see if the January 15, 1974, completion date for the PDU could be adhered to, a meeting was held in New York on June 8 primarily to discuss the schedule and costs. The meeting was attended by

members of the Battelle-Columbus Laboratories and Chemico project teams and by representatives of upper management of both organizations. Battelle-Columbus' Contracts Officer was also in attendance.

The salient points regarding the schedule discussed at the meeting were: (1) Chemico cannot now assure completion of all components of the Battelle PDU by January 15, 1974, as originally planned, (2) their current target date for completion of all components is probably March 1, (3) some components of the PDU can probably be completed by January 15 as currently scheduled allowing limited start-up of the PDU shortly after the first of the year, and (4) the Battelle Coal Gasification PDU continues to be considered an important project to Chemico.

As reasons for their schedule slippage, Chemico cites contractual problems, greater devotion to "value engineering" or examining the playoffs than originally anticipated, and examination of some aspects of the PDU which were not originally planned (e.g., alternative plot plans).

If the completion date in the Chemico schedule is delayed significantly, this will probably have an influence on the overall Battelle program schedule. At the present time such a delay in the overall schedule, if any, cannot be properly assessed.

RECOMMENDATIONS

To resolve the scheduling problem in the best possible way and to permit start-up of some components in January, Battelle is working with Chemico to formulate a new schedule for design and construction to which Chemico believes a firm commitment can be made. Included in the inputs to be made to Chemico by Battelle for purposes of the new schedule will be a tentative start-up sequence for various components of the PDU. It is expected that the new schedule will be completed within the next 3 weeks.

WORK PLAN AND SCHEDULE

It is expected that work on the program will continue in general conformance with the schedule shown in Table 1B - Overall Program Schedule, Battelle PDU. Until a new schedule for the detailed design, construction, and installation of the PDU is developed, the Chemico schedule (Table 1A) must be assumed as that which will be followed for Phase 1B of the overall program.

Battelle's staff will continue actively working with Chemico to develop a new schedule and to in other ways expedite the design and installation of the PDU. In addition, Battelle will continue other activities noted in this report which are already in progress.

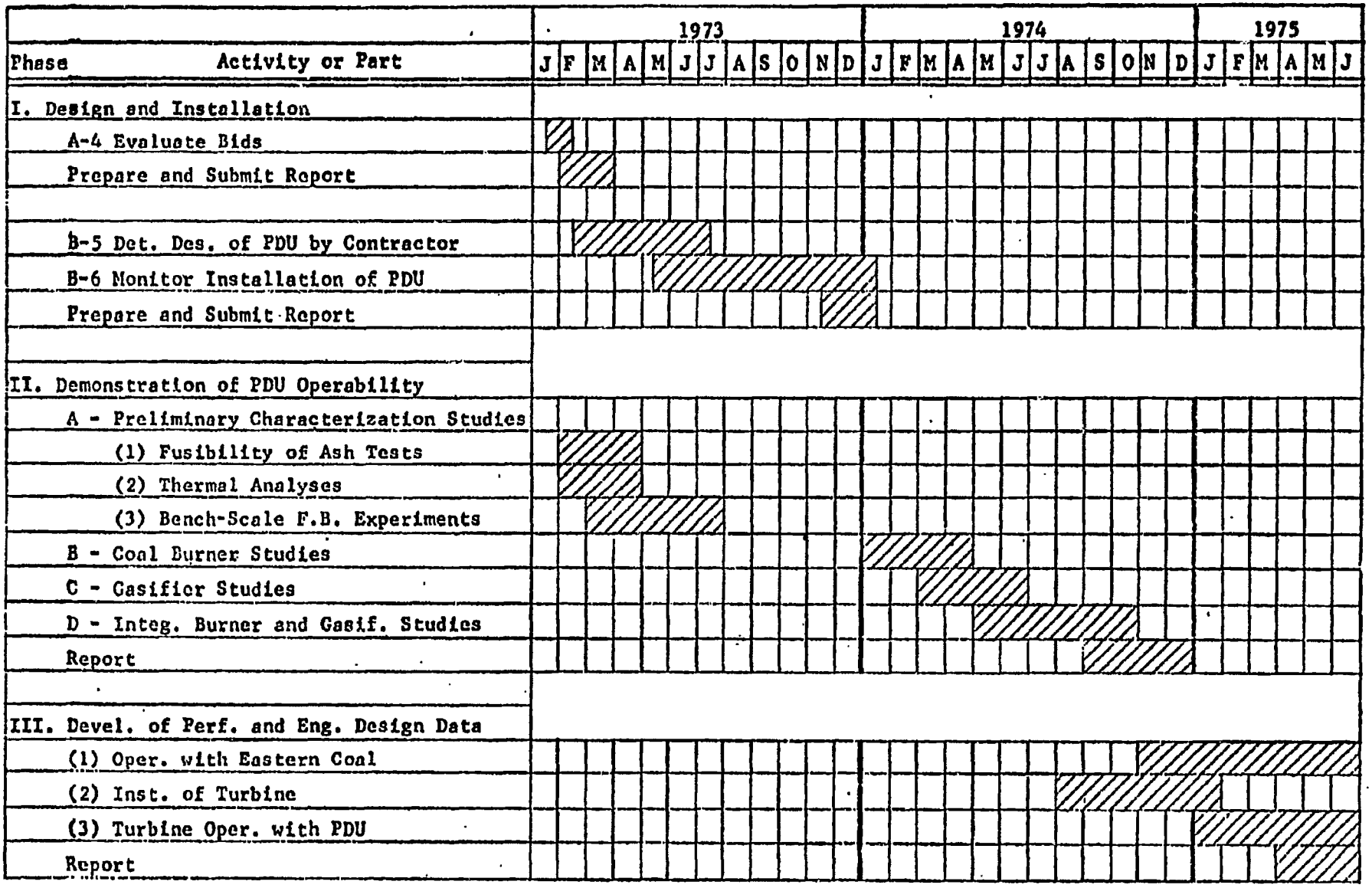
During the forthcoming reporting period, it is planned that coal characterization and fluidized-bed studies started and reported previously will be continued. These studies were interrupted temporarily to concentrate on studies conducted in the scale model of the Burner-Gasifier System.

Initial contacts are planned with possible suppliers of the gas turbine package during the forthcoming reporting period. It is expected that initial technical discussions will be with qualified organizations on an individual basis.

TABLE 1A. CHEMICO SCHEDULE

Item	To Be Completed By
Process flow diagrams and data sheets	April 15, 1973
Requisitions for critical items	April 20, 1973
Preliminary site layout	May 18, 1973
Preliminary process P & I's	May 31, 1973
Purchase orders for all critical items	May 31, 1973
Structural steel design	June 1, 1973
Electrical equipment requisition	June 1, 1973
Instrumentation panel board requisition	June 15, 1973
Instrument requisitions	June 29, 1973
Foundation drawings	June 29, 1973
Start of construction (foundations)	July 6, 1973
Requisitions for noncritical items	July 15, 1973
Production design engineering and service flow sheets	July 27, 1973
Start of structural steel erection	August 10, 1973
Purchase orders for all noncritical items	August 15, 1973
Final piping drawings	August 24, 1973
Piping requisitions	August 31, 1973
Final process P & I's	August 31, 1973
Power and lighting drawings	September 7, 1973
Foundations complete	September 14, 1973
Start of equipment installation	September 14, 1973
Structural work complete	September 21, 1973
Electrical subcontract requisition	September 21, 1973
Start of piping installation	October 12, 1973
Start of electrical installation	October 26, 1973
Start of instrumentation installation	November 17, 1973
Equipment installation complete	December 28, 1973
PDU completed	January 15, 1974
Initial start-up	January 16, 1974

TABLE 1B. OVERALL PROGRAM SCHEDULE, BATTELLE PDU



FINANCIAL SECTION

of

PROGRESS REPORT NO. 5

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

June 15, 1973

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

BCL.MPR--6

TECHNICAL SECTION

of

PROGRESS REPORT NO. 6

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

July 13, 1973

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

TECHNICAL SECTION

of

PROGRESS REPORT NO. 6

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

from

BATTELLE
Columbus Laboratories

July 13, 1973

INTRODUCTION AND PROJECT OBJECTIVE

This progress report describes work completed by Battelle on the Coal Gasification Program during the period June 15-July 15. The section which follows is the technical section. The Administrative and Financial section is appended.

The general objective of the current contract is development of a two-stage fluidized-bed process utilizing a self-agglomerating fluidized-bed burner as part of a practical and economical method for producing synthesis gas by steam gasification of coal. The developed process is to be useful as a part of a system for producing synthetic pipeline gas or for other purposes.

Pursuant to the general objective, a 25-ton-a-day-of-coal Process Development Unit (PDU) is to be erected and operated and the following aspects of the process explored:

- The operability of a self-agglomerating fluidized-bed coal burner operating on an Eastern bituminous coal under pressure and using air for combustion.
- The mechanical feasibility of continuously circulating a burden of hot-ash agglomerates between fluidized-bed burner and fluidized-bed gasifier vessels at 100 psig of pressure

and the rates and temperatures required for effective heat transfer.

- The operability of integrated fluidized-bed burner and gasifier vessels both fed by Eastern bituminous coal (or char in the case of the burner) and operating at 100 psig of pressure. The gasifier is to be fluidized by steam and the endothermic heat of gasification is to be provided by the circulating burden of hot-ash agglomerates.
- The operability over extended time periods of a power-recovery turbine using hot, fluidized-bed burner effluent gases as the turbine working fluid.
- The factors which influence the long-term operability of the process. Included is to be the gathering of data on all key process variables and their affect on the characteristics of the process.

Concurrent with operation of the PDU, sufficient process data and information will be acquired to permit scale-up of the process to its next logical stage of development.

SUMMARY

During this reporting period, work was continued by Chemico on the detailed design of the Battelle Coal Gasification PDU. A new schedule for the design and installation of the PDU was also developed by Chemico and presented to Battelle during this reporting period.

Activities previously initiated by Battelle related to the PDU operation were continued. Several quantitative experiments were completed in the Burner-Gasifier scale model. A meeting was held with the Ohio EPA regarding the PDU operation. A more detailed analysis of suitable coals for use in the PDU was conducted. Work was pursued by the Battelle Plant Facilities Department in relation to site modification.

WORK COMPLETED

Contractual

The subcontract between Battelle and Chemico for the detailed design, construction, and installation of the PDU is being negotiated on the basis of subcontract modifications requested by AGA. Chemico was provided with a written purchase order for $900,000 by Battelle on June 26.

Detailed Engineering Design of the PDU

Chemico Activity

As noted in the previous monthly report and in a subsequent letter to OCR and AGA*, Battelle has been advised by Chemico that the January 15, 1974 completion date for all components of the PDU cannot be met. In the previous monthly report we stated that we were working with Chemico to develop a new schedule incorporating a sequenced start-up of components of the PDU. On June 26, Chemico presented the schedule shown in Table 1 on page 11 of this report. The new Chemico schedule incorporates the milestone dates listed on page 12. We have been assured by Chemico that the new schedule is realistic from both overall and construction standpoints. The schedule on page 11 is the one currently being followed by Chemico.

Scheduled items which have received major emphasis from Chemico during this reporting period and the status of these are as follows.

- Process Flow Diagrams and Data Sheets. The process flow diagrams for the process sections of the PDU were first issued by Chemico on May 11 (Issue 0). Subsequently, they have provided us with updated

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* Letter from Battelle to Mr. Neal Cochran and Dr. Ab Flowers, dated July 5, 1973.

FINANCIAL SECTION

of

PROGRESS REPORT NO. 5

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

from

BATTELLE
Columbus Laboratories

June 15, 1973

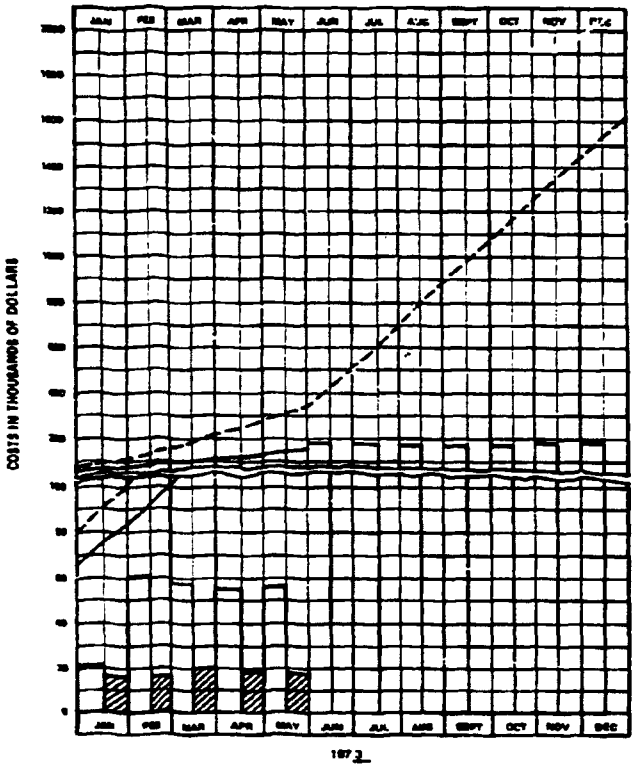
Included in this section is the Task Cost and Manpower Projection form for the month ending May 31, 1973. Inasmuch as the subcontract has not been fully negotiated, we have not made disbursement of funds to Chemico. They estimate their total cumulative expenditures on the program, as of June 1, to be $96,000, excluding a purchase order commitment of $97,880.

The total cumulative expenditure by Battelle is, as indicated on the Task Cost and Manpower Projection chart, $160,567 as of June 1. Therefore, the combined cumulative expenditures on the program are about $257,000, or 6.3 percent of the total budget.

We have no firm information at this point which would indicate a deviation of costs from the budget. Chemico has informed us that their engineering cost projections are possibly higher than those originally predicted. Specific information on overall subcontract costs will be available to us in late July.

TABLE 2.

BATTELLE PDU
TASK COST AND MANPOWER PROJECTIONS
MONTH ENDING MAY 31 , 1973



MANPOWER (MAN-MONTHS)

Pred.	4.4	5.8	5.5	4.2	4.6	5.1	5.1	4.1	4.2	4.7	4.2	5.3
Act.	5.3	4.4	5.3	5.0	4.2							

DIRECT LABOR & OVERHEAD COSTS (THOUSANDS OF DOLLARS)

Pred.	18.6	21.4	20	16.2	14.4	17.9	17.9	16.8	17.2	17.2	17.2	19.8
Act.	18.6	14.3	17.8	17.6	15.9							

SUBCONTRACT AND CONSULTANT COSTS (THOUSANDS OF DOLLARS)[1]:

Pred.	0	36.8	36.7	36.8	36.7	164	164.2	164	164.2	164	164.2	164
Act.	0	8.7	8.3	0	0							

NON-EXPENDABLE EQUIPMENT (THOUSANDS OF DOLLARS)[2]

Pred.	0	0	0	0	0	0	0	0	0	0	0	0
Act.	0	0	0	0	0							

MATERIALS, SUPPLIES, TRAVEL AND OGC (THOUSANDS OF DOLLARS)[3]

Pred.	2.9	2.2	2	2.2	3.4	3.1	3.8	3	2.3	2.3	4.6	2.1
Act.	1.2	2.1	3.1	2.1	3.2							

TOTAL (THOUSANDS OF DOLLARS)

Pred.	21.5	60.4	58.7	55.2	57	186	186.9	183.8	183.7	183.5	185.8	186.9
Act.	17.8	17.1	21.2	19.7	19.1							

KEY TO GRAPH:

PREDICTED TOTAL COSTS — ACTUAL TOTAL COSTS

PREDICTED CUMULATIVE — ACTUAL CUMULATIVE

NOTES:

(1) OUTSIDE CONSULTANTS

(2) NON-EXPENDABLE EQUIPMENT TO BE PURCHASED BY SUBCONTRACTOR IS INCLUDED IN SUBCONTRACT CATEGORY

(3) COST OF BATTELLE RESIDENT CONSULTANTS INCLUDED IN THIS CATEGORY

• Construction Schedule. A preliminary Critical Path Method grid for the PDU construction is being developed by Chemico. As shown in Table 1 on page 11, construction mobilization will begin in mid-September with actual ground breaking scheduled on the first of October.

Battelle Activity

Mr. R. R. Adams, the Battelle Project Engineer, is continuing in his technical liaison and coordination activities at Chemico. Meetings have been held between Chemico and other Battelle technical staff, primarily concerned with instrumentation and control of the PDU.

On June 14, project staff from Chemico and Battelle met with the staff of the CO_2 Acceptor Process Pilot Plant in Rapid City. Mr. Lou Rice of C. F. Braun was present. As a result of the very useful discussions held, various features which were not included in the original Battelle PDU design are being incorporated into our final design of the PDU gasifier vessel and into process control equipment.

The Plant Facilities Department at Battelle is continuing to coordinate Battelle's work on the facility with that of Chemico. Assistance was provided by this department in the determination of locations of various items of auxiliary equipment in the plot plan. An additional enclosure to house the compressors and other PDU auxiliary equipment at the West Jefferson site is planned. A preliminary safety analysis of the intended PDU operation has been conducted. In addition, a cursory analysis of probable noise levels in the vicinity of the PDU site has been concluded. The Plant Facilities Department has also been assisting in steps to obtain the necessary permission from the State of Ohio EPA for operation of the PDU.

Small-Scale Fluidized-Bed Burner-Gasifier System Assembly

Several quantitative experiments were conducted using a 1/8-scale model of the Burner-Gasifier System. These experiments were conducted using two different gasifier vessel designs. Experiments were

issues of these diagrams (Issues 1 and 2). The later issues incorporate modifications and suggestions made by Battelle and C. F. Braun. Issue 2 is being examined at Battelle.

Process flow diagrams for the utility sections of the PDU are being prepared by Chemico's Piping Analytical Group.

- Requisitions for Critical Items*. Additional requisitions for critical items were prepared and in several cases sent to vendors. Purchase orders were placed for several of the coal storage and feed bins and for the coal pulverization system. Chemico estimates that about 23 percent of the equipment, based on the number of pieces, has been purchased. A short supply of steel plate for the vessel fabrication poses a potential delivery problem for these items. This is discussed in the "Problems" subsection of this report.

- Process P and I Diagrams. An additional review of the preliminary P and I diagrams issued on June 8 was held with Chemico on June 28. C. F. Braun and Company's telexed comments were also discussed at this meeting. Final approval of the preliminary P and I's was made by Battelle on July 2 and Chemico has issued a letter inviting instrument vendors to quote on the instrument package for the PDU.

- Structural Steel Design. Chemico initiated civil engineering work and has made a preliminary structural steel take-off. A requisition intended to allow preselection of structural steel suppliers on a unit-cost basis was issued during this reporting period.

- Electrical Equipment Requisition. The sizing of critical items of electrical equipment, such as PDU supply transformers and reduced voltage starters, has been completed by Chemico. Plot plan locations have also been agreed upon. The issue of requisitions is expected soon.

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* Items of equipment requiring a long delivery time.

primarily to examine the fluidized behavior of solids and to determine the segregation of simulated ash material from coal. Continuous solids circulation between vessels was also examined.

The results of the quantitative experiments are currently being evaluated and additional studies are in progress. It is expected that sufficient information will have been gathered to permit its incorporation into our next progress report.

Mathematical Model of the Gasification Process

Under the auspices of a summer program for university students sponsored by Battelle, we are developing a computerized mathematical model of the gasification process to assist in the engineering design of the Burner-Gasifier Section of the PDU. Also, after PDU operations begin, meaningful comparisons of experimental data with calculated results can be made using the model.

Work Related to Environmental Impact of the PDU

During this reporting period, a meeting was held with the Advisor to the Assistant Director and Chief of the Industrial Section of the Ohio Environmental Protection Agency. This meeting was to further explain plans for operation of the PDU at West Jefferson.

Because the planned PDU operations are experimental and are, therefore, anticipated to be intermittent and of limited duration, the EPA will consider the possibility of authorizing an exemption under Article AP-9-06(b) of the State Regulations*. This article states in part that "where necessary for administrative reasons, the Board may exempt, for limited periods of time, certain classes of air contaminant sources, of relatively minor significance, from the requirement of obtaining permits to operate or variances from the Board".

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* Regulations of the Ohio Air Pollution Control Board relative to the Source Registration and Permit System, adopted January 28, 1972, and effective February 15, 1972.

No commitment was provided by the EPA, however, the results of the meeting were considered encouraging. The process flowsheets, calculated stack analysis, and other information is now being reviewed by the technical staff of the Ohio EPA and a response is expected within 4 to 6 weeks. Our opinion, based on this recent meeting and prior contacts with the State authorities, is that operation of the PDU without sulfur dioxide abatement equipment will be permitted with two stipulations: (1) sufficient offsite monitoring will be done to assure that the dispersion achieved is within acceptable limits, and (2) Battelle will agree to adjust the PDU operations as necessary to comply with an air pollution alert due to unusual atmospheric conditions.

Coal Acquisition

We have concluded, as advised by OCR*, a detailed review of information on Eastern bituminous coals to identify the coal considered best for the PDU operations. Ideally, the coal best suited for the operations can be obtained from a single seam and have the following characteristics.

(1) Low sulfur content (an environmental factor only).

(2) Relatively low ash fusion temperature with fusion temperature relatively uniform throughout the seam.

(3) The seam location reasonably close to the PDU so that a reliable delivery of the coal can be assured in quantities compatible with our operating schedule.

We have identified three coals of interest.**

Pittsburgh No. 8 (Southeastern Ohio)

Our greatest self-agglomerating fluidized-bed experience in general and also on the current program has been with coal from the

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* Letter to William C. Corder from Dewey I. Dykstra, dated June 21, 1973.

** Battelle has received samples of coal from Island Creek Coal Company's Pevler Mine and Illinois' No. 6 seam coal.

Pittsburgh No. 8 seam. Pittsburgh No. 8 coal, for which we can obtain local delivery in quantities and at time intervals compatible with the operating schedule, generally contains more than 4 percent sulfur.

Blue Gem Seam (Knox County, Kentucky)

The Richland Coal Company of Barbourville, Kentucky is presently mining the Blue Gem seam at a rate in excess of 600 tons per day. A 200-lb sample of the coal is being sent to Battelle. The proximate analysis and other information on this coal (washed, stoker grade) as provided by the company is as follows.

Moisture	2.6%
Volatiles	36.7%
Fixed Carbon	57.2%
Sulfur	0.8%
Ash	3.5%
Ash Fusion Data	
Initial deformation temperature	1975 F
Softening temperature	2309 F
Fluid temperature	2480 F

Pittsburgh Seam (Fairmont Field, West Virginia)

The Pittsburgh seam of West Virginia varies in sulfur content from about 1.8% to 3.8%. Its ash fusion point is reported to vary between 1970 and 1990 F. Ash content varies between 5.6 and 9.2%. Coal mined at a single site would likely reduce this variability, as the seam is known to vary laterally in character, particularly from east to west, with the eastern portion being optimum. Arrangements were made to obtain a 200-lb sample of the coal for evaluation.

These coals will be examined and their behavior in the self-agglomerating fluidized bed determined. This behavior will be compared with that of the Pittsburgh No. 8 seam coal previously used. This information, along with the decision of the Ohio EPA on the requested exemption, should permit us to select the coal to be used.

Coal Characterization and Bench-Scale Fluidized-Bed Studies

It was reported in the previous monthly that coal characterization studies, including bench-scale fluidized-bed studies, would be conducted. This work, however, was delayed pending the receipt of additional coal samples.

Turbine Specification

Organizations capable of providing the gas turbine needed for PDU operations during Phase II of the current program have been identified. Initial contacts with these organizations are being made to determine their interest in the turbine phase of the project.

PROBLEMS AND RECOMMENDATIONS

Major concern is the 2-month delay anticipated by Chemico for completion and turnover of all components of the PDU as noted in Chemico's new schedule. There also is uncertainty on delivery of certain key items of process equipment.

If a sequenced start-up of key components of the PDU can begin in February, 1974, completion of the overall program on schedule may still be possible. We are currently reviewing the possible influence of the delay on both the overall program costs and schedule. Table 2 (see page 13) is our most recent estimate of the overall schedule. The significant differences in this projected schedule from that previously reported are that initial PDU operations will not start until later and the total period for turbine operation is reduced. However, the 2,000-hour period of turbine operation stipulated in the contract is not altered. We now estimate that about 4-1/2 months are available for the turbine operations, including the required 2,000-hour turbine operating period. Any further delay in the PDU installation schedule would make it very unlikely that the overall program can be completed by June 30, 1975.

Initial responses show that many equipment vendors are unable to promise reasonable delivery times*. This appears to be particularly true when steel plate is involved in the order**. Delivery dates approaching 6 months could cause delay on the construction schedule.

In an attempt to expedite deliveries of equipment, and especially steel plate, the Contracts Administration Department of Battelle is exploring the possibility of obtaining a Government priority on deliveries to Chemico subcontractors for this program.

WORK PLAN AND SCHEDULE

We plan to continue work on the program in general conformance with the schedule shown in Table 2. We are informed that the schedule shown in Table 1 is the official Chemico schedule being followed. It is expected that during the forthcoming reporting period Chemico will have issued the requisitions for virtually all major items of equipment. Several additional purchase orders for the more critical items of equipment will also have been issued. Chemico effort will continue on completion of the final P and I diagrams, line sizing and piping analytical work, development of civil engineering drawings (including foundations and structural steel), and electrical drawings.

Battelle will continue to make our inputs to the PDU design and assist Chemico in expediting the design and installation of the unit. In addition, we will continue the activities reported to be in progress in this report. Of the activities not directly related to PDU design and installation, major emphasis will be given to coal selection, turbine specification, and environmental impact of the PDU. It is planned that work will be initiated on designing modifications to the West Jefferson site during the next reporting period.

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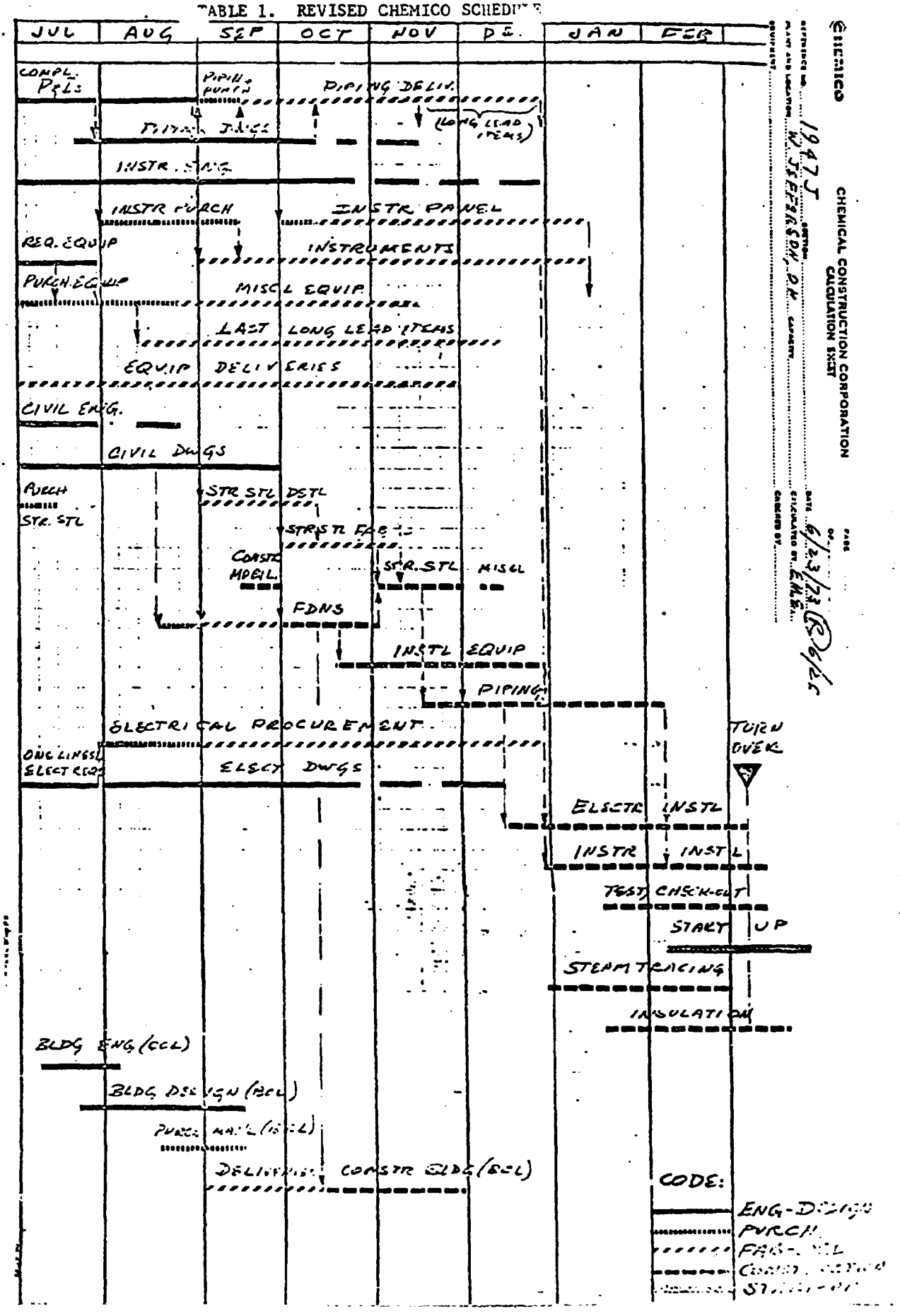
* Delivery times promised by all vendors responding to the requisition on coal hoppers ranged from 26 to 32 weeks.

** "Steel Shortage Slows Chemical Construction", Chemical Week, June 20, 1973, pp 27-28.

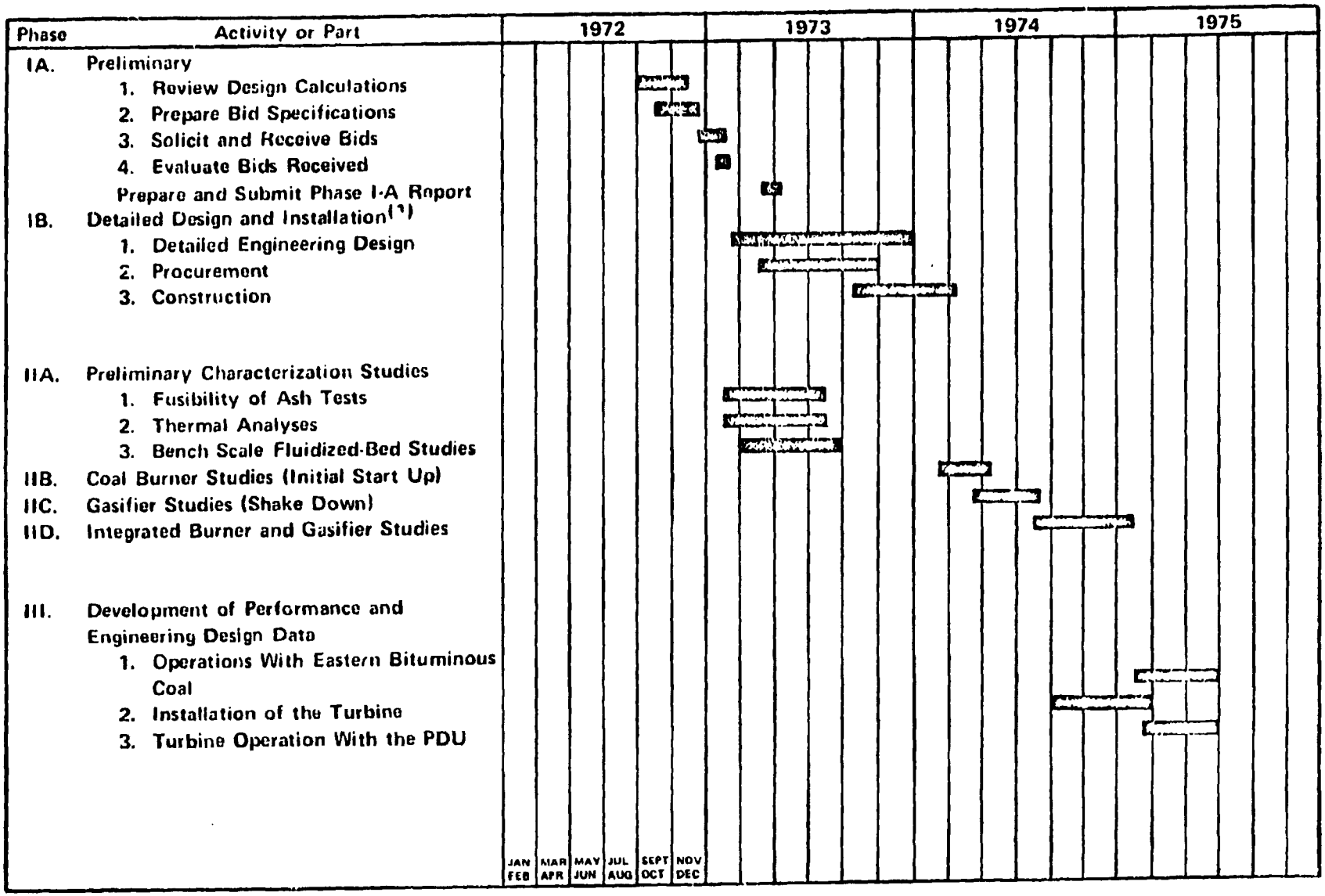
TABLE 1. REVISED CHEMICO SCHEDULE



MILESTONE DATES CORRESPONDING TO THE NEW CHEMICO SCHEDULE

Milestone	Achievement Date
Complete D-R Equipment Requisitions	July 27, 1973
Complete Electrical Equipment Requisitions	July 27
Complete Major Inst. Reqn. Incl. Panel	Sept. 28
Structural Steel Dwgs. (Feed Struct.)	Aug. 31
Foundation Dwgs. (Feed Struct.)	Sept. 14
Combustor-Gasifier Struct. Dwgs.	Sept. 28
All Equipment Purchased	Aug. 31
P & I Prelim. Piping Issue	July 27
P & I Advanced Piping Issue	Aug. 31
Piping Dwgs., Preliminary	Oct. 12
Piping Dwgs., Complete	Nov. 16
Start Construction	Oct. 1
Start Steel Erection	Nov. 5
Start Equipment Installation	Oct. 22
Start Piping Installation	Nov. 16
Start Electrical Installation	Dec. 14
All Equipment Delivered	Dec. 14
All Equipment Installed	Dec. 28
Partial Turn-Over for Initial Start-Up	Feb. 9, 1974
Complete Turn-Over for Start-Up	March 9

TABLE 2.
OVERALL PROGRAM SCHEDULE
BATTELLE PROCESS DEVELOPMENT UNIT
FOR
SELF-AGGLOMERATING GASIFICATION PROCESS



(1) Under subcontract with Chemical Construction Corporation.

FINANCIAL SECTION

of

PROGRESS REPORT NO. 6

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

July 13, 1973

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

FINANCIAL SECTION

of

PROGRESS REPORT NO. 6

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

from

BATTELLE
Columbus Laboratories

July 13, 1973

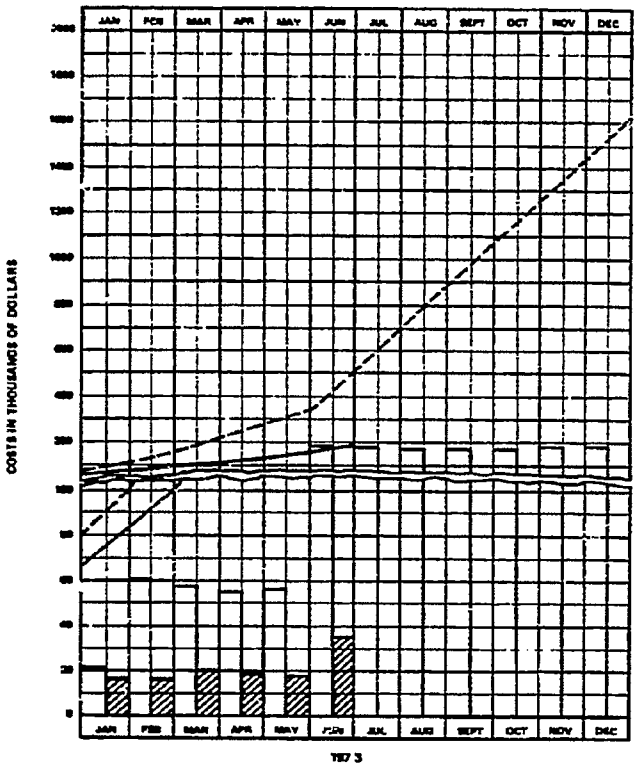
Included in this section as Table 3 is the Task Cost and Manpower Projection form for the month ending June 30, 1972. We have made a disbursement of $12,816.00 to Chemico which covers their fee from February 15, 1973 to May 15, 1973. We have approved a billing for an additional $79,844.22 to cover Chemico's costs from February through May and their fee for the period May 16 to June 16. The latter payment has not as yet been made so it is not included in the Task Cost and Manpower Projection form.

Chemico estimates their expenditures for the month of June at $33,000. Consequently, the total expenditures of Chemico to date on the program are about $126,000, not including approved purchase order commitments of $247,526.

The cumulative expenditures of Battelle, including payments to Chemico to date are, as shown in Table 4 and drawn on Table 3, about $195,812. The total amount either spent or committed is about $556,180 or 13.6 percent of the encumbered funds.

TABLE 3.

BATTELLE PDU
TASK COST AND MANPOWER PROJECTIONS
MONTH ENDING JUNE 30, 1973



MANPOWER (MAN-MONTHS)

Pred.	4.4	5.8	6.5	4.2	4.6	5.1	5.1	4.1	4.2	4.7	4.2	5.3
Act.	5.3	4.4	5.9	5.0	4.2	5.3						

DIRECT LABOR & OVERHEAD COSTS (THOUSANDS OF DOLLARS)

Pred.	18.6	21.4	20	16.2	14.4	17.9	17.9	16.8	17.2	17.2	17.2	19.8
Act.	18.6	14.3	17.8	17.6	15.9	18.3						

SUBCONTRACT AND CONSULTANT COSTS (THOUSANDS OF DOLLARS)[1]

Pred.	0	36.8	36.7	36.8	36.7	164	164.2	164	164.2	164	164.2	164
Act.	0	0.7	0.3	0	0	12.8						

NON-EXPENDABLE EQUIPMENT (THOUSANDS OF DOLLARS)[2]

Pred.	0	0	0	0	0	0						
Act.	0	0	0	0	0	0						

MATERIALS, SUPPLIES, TRAVEL AND ODC (THOUSANDS OF DOLLARS)[3]

Pred.	7.9	2.2	2	2.2	3.4	3.1	3.8	3	2.3	2.3	4.4	2.1
Act.	1.2	2.1	3.1	2.1	3.2	4.1						

TOTAL (THOUSANDS OF DOLLARS)[4]

Pred.	21.5	60.4	58.7	55.2	57	186	185.9	183.8	183.7	183.5	185.8	186.9
Act.	17.8	17.1	21.2	19.7	19.1	35.2						

KEY TO GRAPH:

PREDICTED TOTAL COSTS — ACTUAL TOTAL COSTS

PREDICTED CUMULATIVE — ACTUAL CUMULATIVE

NOTES:

(1) OUTSIDE CONSULTANTS

(2) NON-EXPENDABLE EQUIPMENT TO BE PURCHASED BY SUBCONTRACTORS INCLUDED IN SUBCONTRACT CATEGORY

(3) COST OF BATTELLE PRESIDENT CONSULTANTS INCLUDED IN THIS CATEGORY

(4) DOES NOT INCLUDE BATTELLE FEE

TABLE 4. SUMMARY OF APPROXIMATE COSTS*

Expenditures on program through June 1	$160,567
Chemico billing paid in June	12,816
Battelle internal expenditure on program during June	22,429
Total cumulative expenditures as of July 1	$195,812
Chemico billing received but not paid in June	79,844
Chemico estimated expenditure in June	33,000
Purchase order commitments	247,526
Expended or committed	$556,182

* Costs do not include the Battelle fee.

As stated in our preceding monthly progress report, we have no firm information at this point which indicates a deviation of costs from the budget. However, it appears that Chemico engineerings costs may be higher than those which they originally predicted. Battelle is assessing the effect of the PDU completion delay on overall program costs. We also expect updated information on subcontract cost projections from Chemico. More specific information on both overall and subcontract costs will be available during the forthcoming reporting period.

BATTELLE-COLUMBUS LABORATORIES PERSONNEL ASSIGNED TO PROJECT*

(1) W. M. Goldberger
(2) W. C. Corder
(3) R. R. Adams
(4) R. J. Kuryvial
(5) D. G. Bauer
(6) H. C. Meeks
(7) J. W. Lowman
(8) B. J. Shankle
(9) E. A. Wasto
(10) H. R. Batchelder (Staff Consultant)

CHEMICAL CONSTRUCTION CORPORATION PERSONNEL ASSIGNED TO PROJECT*

(1) F. W. Peterson
(2) E. M. Ezcurra
(3) E. Coles
(4) J. Fisher
(5) H. Osborne

* Only staff who devote significant portions of their time to the program are listed. Various others have temporary assignments.

BCR. MPR--7

TECHNICAL SECTION

of

PROGRESS REPORT NO. 7

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

August 20, 1973

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

TECHNICAL SECTION

of

PROGRESS REPORT NO. 7

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

from

BATTELLE
Columbus Laboratories

August 20, 1973

INTRODUCTION AND PROJECT OBJECTIVE

This progress report describes work completed by Battelle on the Coal Gasification Program during the period July 15-August 15. The section that follows is the Technical section. The Administrative and Financial section is appended.

The general objective of the current contract is development of a two-stage fluidized-bed process utilizing a self-agglomerating fluidized-bed burner as part of a pratical and economical method for producing synthesis gas by steam gasification of coal. The developed process is to be useful as a part of a system for producing synthetic pipeline gas or for other purposes.

Pursuant to the general objective, a 25-ton-a-day-of-coal Process Development Unit (PDU) is to be erected and operated and the following aspects of the process explored:

- The operability of a self-agglomerating fluidized-bed coal burner operating on an Eastern bituminous coal under pressure and using air for combustion.
- The mechanical feasibility of continuously circulating a burden of hot-ash agglomerates between fluidized-bed burner and fluidized-bed gasifier vessels at 100 psig of pressure

and the rates and temperatures required for effective heat transfer.

- The operability of integrated fluidized-bed burner and gasifier vessels both fed by Eastern bituminous coal (or char in the case of the burner) and operating at 100 psig of pressure. The gasifier is to be fluidized by steam and the endothermic heat of gasification is to be provided by the ciruclating burden of hot-ash agglomerates.
- The operability over extended time periods of a power-recovery turbine using hot, fluidized-bed burner effluent gases as the turbine working fluid.
- The factors that influence the long-term operability of the process. Included is to be the gathering of data on all key process variables and their effect on the characteristics of the process.

Concurrent with operation of the PDU, sufficient process data and information will be acquired to permit scale-up of the process to its next logical stage of development.

SUMMARY

During this reporting period, work was continued by Chemico on the detailed design and procurement of equipment for the Battelle Coal Gasification PDU. A new cost estimate for the design and installation of the PDU was also developed by Chemico and was verbally relayed to Battelle during this reporting period.

Activities previously initiated by Battelle related to the PDU operation were continued. Quantitative experiments were concluded in the Burner-Gasifier scale model. Detailed analysis of suitable coals for use in the PDU was continued. "Hot" fluidized-bed experiments were reinitiated to examine the behavior of coals in the self-agglomerating fluidized bed and to further characterize coals under consideration for use in the PDU. Additional communication with the Ohio EPA regarding the PDU operation took place. Correspondence was initiated with the local gas company to explore the quantity of uninterrupted natural gas which could be made available to

us at the West Jefferson site. Detailed safety analyses of the components of the PDU operation were expanded upon. Work was pursued by the Battelle Plant Facilities Department in relation to site modification. A simplified computer model of the PDU Burner-Gasifier system was completed and a brief parametric study was made using this model.

WORK COMPLETED

Contractual

The subcontract between Battelle and Chemico for the detailed design, construction, and installation of the PDU is being negotiated on the basis of subcontract modifications requested by AGA. Chemico is continuing work authorized by a written purchase order of June 26 from Battelle.

Detailed Engineering Design of the PDU

Chemico Activity

Chemico's current schedule is that presented in our previous monthly progress report and repeated here, for convenience, as Table 1. Associated milestone dates are given in Table 2.

Scheduled items which have received primary emphasis from Chemico during this reporting period and the status of these are as follows.

- Process Flow Diagrams and Data Sheets. As noted in our previous monthly report, the latest process flow diagrams from Chemico (combination of those identified as Issues 1 and 2) were being examined at Battelle. We understand that C. F. Braun has also examined the combination of Issues 1 and 2 of the process flow diagrams.

  The process flow diagrams are still undergoing some minor change with the intent of reducing costs, where possible, without sacrificing quality. As examples, some

TABLE 1. REVISED CHEMICO SCHEDULE

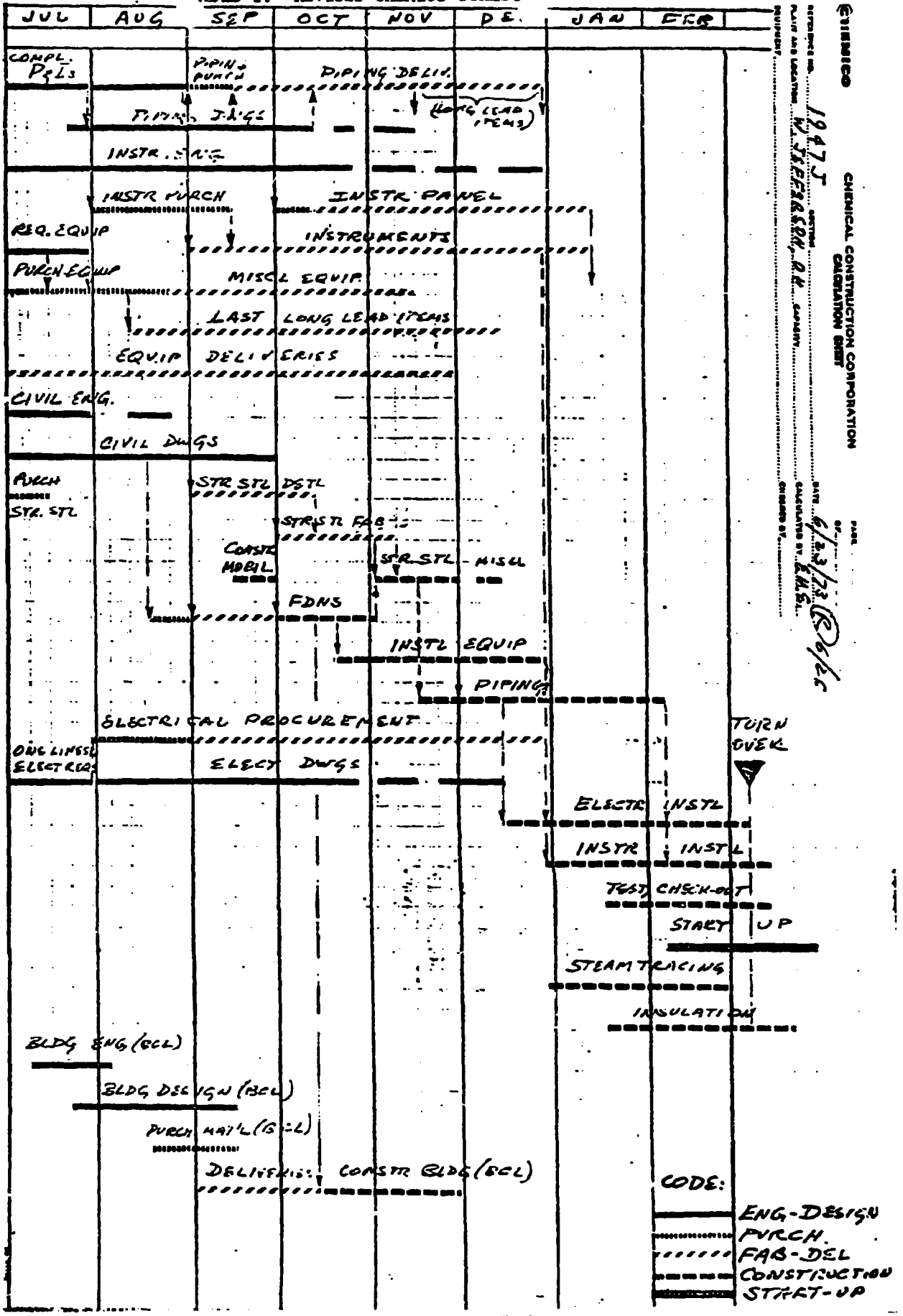


TABLE 2. MILESTONE DATES CORRESPONDING TO THE NEW CHEMICO SCHEDULE

Milestone	Achievement Date
Complete D-R Equipment Requisitions	July 27, 1973
Complete Electrical Equipment Requisitions	July 27
Complete Major Inst. Reqn. Incl. Panel	Sept. 28
Structural Steel Dwgs. (Feed Struct.)	Aug. 31
Foundation Dwgs. (Feed Struct.)	Sept. 14
Combustor-Gasifier Struct. Dwgs.	Sept. 28
All Equipment Purchased	Aug. 31
P & I Prelim. Piping Issue	July 27
P & I Advanced Piping Issue	Aug. 31
Piping Dwgs., Preliminary	Oct. 12
Piping Dwgs., Complete	Nov. 16
Start Construction	Oct. 1
Start Steel Erection	Nov. 5
Start Equipment Installation	Oct. 22
Start Piping Installation	Nov. 16
Start Electrical Installation	Dec. 14
All Equipment Delivered	Dec. 14
All Equipment Installed .	Dec. 28
Partial Turn-Over for Initial Start-Up	Feb. 9, 1974
Complete Turn-Over for Start-Up	March 9

of the bucket elevators will probably be replaced with pneumatic conveyors and the Burner-Gasifier system start-up heater and pretreater heater are being combined into one unit.

We expect to receive updated process flow diagrams from Chemico soon. We also are awaiting the flow diagrams for the utility sections of the PDU.

- Requisitions and Purchases for Critical Items*. A listing of the items of equipment for the PDU which are in some stage of the procurement cycle is shown in Table 3. The current status of each item is as indicated.

  We estimate that the listing shown represents about 60 percent of the expected PDU requisitions and all except about 10 items which are relatively critical with regard to the schedule. Items not listed but shown on the process flowsheets are still at the engineering-design stage and specifications for the requisitions have not been developed yet.

  The Chemico schedule and associated milestone dates shown in Tables 1 and 2 indicate that D-R** and electrical equipment requisitions should have been completed on July 27. This milestone has not been achieved.

- Process P&I Diagrams. Based on our approval of the preliminary P&I diagrams, Chemico issued a letter inviting instrument vendors to quote on panel-mounted instruments. They also are proceeding with the engineering of final P&I's.

  Bids on the panel instruments were received from three organizations; a fourth declining to bid. The lack of a clear indication of superiority of one bidder over another has resulted in the necessity for Chemico to request second quotations and clarification of certain points from the bidders. Recommendations and selection of a supplier are anticipated within the forthcoming reporting period.

---

* Items requiring more than 16 weeks for delivery.

** Direct-Requisition.

TABLE 3. STATUS OF PDU EQUIPMENT PROCUREMENT

1. Purchase orders have been issued on the following items:

Section 100

G-101 Coal Pulverizer Surge Hopper

Section 200

D-201 Inert Gas Generator
K-201 Main Fan
K-202 Auxiliary Fan
K-203 Combustion Air Blower
O-201 Coal Pulverizer
P-201 Cyclone Separator
P-203 Bag Filter

Section 400

G-401A Combustor Feed Bin
G-401B Gasifier Feed Bin
G-402 Combustor Feed Pressure Hopper
G-403 Combustor Feed Injection Hopper
G-404 Pretreated Coal Receiving Bin
G-405 Gasifier Feed Pressure Hopper
G-406 Gasifier Feed Injection Hopper

Section 700

G-701A&B Process Air Receivers
K-701A&B Process Air Compressors

2. Bids have been received on the following items and are currently being evaluated:

Section 500

H-501 Combustor Vessel
H-502 Gasifier Vessel

General

U-Vs Miscellaneous Instruments (Unit Price)

3. The following items are out for bids:

Section 300

J-301 Oil-Solids Pump
O-301 Screw Conveyor Cooler
P-301 Coal Pretreater Cyclone

TABLE 3. (Cont)

Section 400

P-401A&B Bag Filters

Section 500

O-502 Ash and Char Conveyor Cooler
P-501 Combustor Cyclone
P-502 Gasifier Cyclone

Section 600

E-604 Recycle Make Gas Cooler
J-601A&B Venturi Circulating Pumps
J-602A&B Venturi Circulating Pumps

Section 700

D-702 Inert Gas Generator
G-702 Inert Gas Receiver

Section 800

D-802 Package Steam Boiler
D-803 Steam Superheater

General

C-01 Structural Steel (Unit Price)
A-190 Reinforcing Bars (Unit Price)
A-191 Anchor Bolts (Unit Price)
U-030 Analyzer System
U- Load Cells

4. Requisitions have been drafted on the following items and are currently being reviewed or revised:

Section 300

D-301 Pretreater Gas Heater

Section 500

D-501 Start-up Heater
H-501 Combustor Refractories
H-502 Gasifier Refractories

Section 600

K-603 Recycle Make Gas Booster

TABLE 3. (Cont)

Section 700	
G-703	Instrument Air Receiver
K-702	Emergency Instrument Air Compressor
K-703A&B	Natural Gas Boosters
Section 800	
R-803	Water Cooling Tower
R-804	Water Treatment System
General	
V-020	Transformer Substations

- Structural Steel Design and Civil Engineering. Requisitions were prepared and are out for unit-price bids on the foundation reinforcing bars and anchor bolts. Work is continuing on the structural steel drawings due for completion on August 31 and the foundation drawings which are to be completed by September 14.

Battelle Activity Directly Related to Detailed Design of the PDU

Substantial amounts of time have been devoted to reviewing the specifications in the requisitions issued by Chemico. We have also formulated our final conceptual design of the gasifier vessel incorporating recent information based on discussions with Mr. Lou Rice from Braun, the CO_2 Acceptor Process personnel, and Dr. Frederick Zenz, as well as experience with operation of the scale model of the Burner-Gasifier system. This has been transmitted to Chemico and they are completing the detailed drawings for submission to their bidders on the gasifier vessel. Various other technical points concerning the PDU have been examined at Battelle and, in his role of project engineer, R. R. Adams has resolved these points with Chemico.

The Plant Facilities Department at Battelle has continued to provide us assistance with obtaining necessary permissions from the State EPA and local utilities. A soil report which was given to Chemico was prepared by a local organization. The taking of core samples for the report was coordinated by the Plant Facilities Department. Design work on an additional enclosure to house compressors and other PDU auxiliaries at West Jefferson has commenced. A more detailed analysis of the PDU operation from the standpoint of compliance with OSHA regulations has been conducted.

- Work related to Environmental Impact of the PDU. We have received further information from the Ohio Environmental Protection Agency (OEPA) based on their examination of information given them and reported in our sixth monthly progress report. We have been told that the State looks upon our development as in their interest and in the interest of the objectives of the OEPA. This is particularly true because of the process' potential application to Ohio coals.

It was requested by the OEPA that we submit two "permit to construct" applications. One for the PDU itself and one for the steam generator. In compliance with this request, the necessary applications have been submitted. Action on the applications is expected within 30 to 60 days. We have no reason to be other than encouraged that operation of the PDU will be permitted from our conversations with OEPA.

• Work Related to Assuring Sufficient Natural Gas at the PDU Site. We have informed the local gas company (Columbia Gas of Ohio, Inc.) in writing of our anticipated increase in natural gas consumption at the site during the period of PDU operations. Based on prior and subsequent conversations with them, we believe the demand can be handled.

It might be pointed out that the Ohio Public Utilities Commission is currently attempting to assign priorities to various consumers for use if natural gas rationing becomes necessary. The best information we presently have is; on a priority scale of 1 = highest = residential and 9 = industrial, the West Jefferson facility is assigned a 2 priority. Battelle's metropolitan Columbus site has a 4 priority.

• Examination of Planned PDU Operations in Regard to Compliance with OSHA Regulations. We have reviewed the plans for the PDU and its operation with the group at Battelle primarily responsible for assuring safety and compliance of Battelle's activities with OSHA requirements. This was a detailed review of information presently available. Based on this review, it appears that the PDU design as it is progressing will be in compliance.

• Turbine Specification. We have discussed some of the turbine supplier contacts made by C. F. Braun in regard to their task no. 0028 "Mechanical Development" with Braun staff. We are proceeding to arrange meetings with the turbine suppliers identified in these discussions as well as with other suppliers.

Other Work Related Indirectly to PDU Design

Small-Scale Fluidized-Bed Burner-Gasifier System Assembly

Experiments using the 1/8-scale model of the Burner-Gasifier system shown in Figure 1 were concluded during this reporting period. We are still analyzing the results of these experiments and are preparing a separate report on the glass model operation.

The primary intent of the experiments was to confirm that agglomerated ash could be continuously cycled between the Burner (upper vessel in Figure 1) and Gasifier (lower vessel) at mass flow rates* comparable with those expected to be used in the PDU. A second purpose of the experiments was to examine the degree of segregation which occurs between the agglomerated ash particles and coal in the gasifier vessel and the influence of geometry, particle size difference between ash and coal, particle density difference between ash and coal, and other operating variables. The influence of the char-ash interface level on bridging and bed fluidization was also observed. In addition, the influence of operating variables on the amount of coal in ash returned to the burner from the gasifier bottom and ash in the coal (or char) overflow from the gasifier was observed.

Because we wished to operate the glass scale model at room temperature and atmospheric pressure to observe segregation and other phenomena noted, it was decided not to use ash agglomerates and coal char as will be used in the PDU. The ash was simulated by various solids such as alumina, bauxite, and sand. Coal and coal-char mixtures were used to represent the char. Air was used as the fluidizing gas for both vessels. Several gasifier vessel geometries were used, including the one shown in Figure 1. These are described in the special report now being prepared.

We found it readily possible to circulate the simulated ash agglomerates at mass flow rates of from 1/2 to 2/3 the rates anticipated for PDU operation. At higher rates the discharge tube at the bottom of

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* Mass flow rate is defined as pounds of solids per hour per square foot of transfer line cross section.

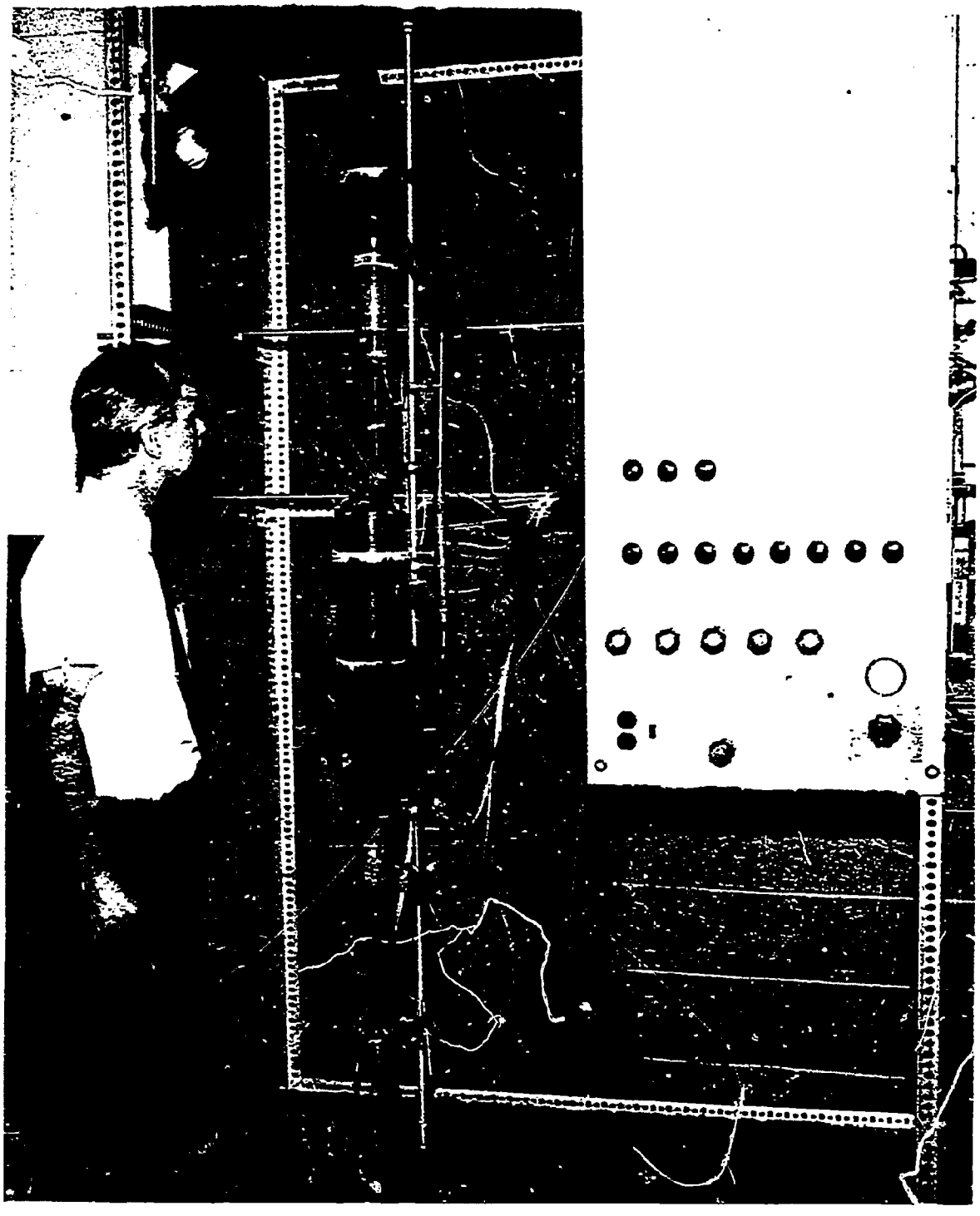


FIGURE 1. SCALE MODEL OF BURNER GASIFIER SYSTEM

the gasifier sucked air into it and restricted the solids discharge rate. We are planning to remedy this problem in the PDU Gasifier by: (1) using a larger discharge line, and (2) considering attachment of a conical entrance to the discharge line above the gasifier distributor plate to disengage solids from gas.

Preliminary conclusions based on experiments with the scale model which we have factored into the final design of the gasifier vessel are:

(1) A dual-diameter vessel with a tapered transition zone between diameters is preferable to a vessel continuously tapered from the distributor plate to the char discharge point. This confirms our original concept regarding the design and is the geometry shown in Figure 1.

(2) To cause a rapid and high amount of segregation between char and simulated ash, particle density difference should be maximized, the char-ash interface should be maintained below the start of the transition zone, and operation of the gasifier should be at a gas velocity very close to minimum fluidization in the small-diameter section of the gasifier.

(3) Gas injectors located at the transition zone, in addition to the gas inlets through the distributor plate, are useful in that they allow increased flexibility in gasifier operation.

Mathematical Model of the Gasification Process

As noted in the previous monthly progress report, a computerized mathematical model of the gasification process was being developed to assist in design and operation of the Burner-Gasifier section of the PDU. This work was being done under the summer program for university students sponsored by Battelle. This model incorporates thermodynamic, but not kinetic, aspects of the gasification process. Using the model, a series of cases were calculated in which the effect of factors such as steam-to-carbon ratio, ash agglomerate circulation rate and temperature, etc, on the quality of the make gas were examined.

A file report is being prepared summarizing work concluded on the mathematical model.

Coal Acquisition

We have partially concluded an examination of the coal from the Blue Gem Seam noted in our previous monthly report. This coal appears to meet the criteria we desire for initial PDU operations with the exception that the ash fusion temperature may be lower than desired. Stable operation of a self-agglomerating fluidized bed at temperatures greater than about 1800-1900 F with the Blue Gem coal was difficult to achieve.

We have found that the Pittsburgh seam coal from Fairmont Field, West Virginia, also noted in our previous monthly, is not likely to meet the criteria desired for initial PDU operations. Consequently, we are not pursuing obtaining a sample of this coal.

Our present intention with regard to obtaining coal is to prepare a specification for coal to be used in initial PDU operations and send it to several coal suppliers. These suppliers will be invited to bid on a contract to supply coal according to our specifications. The coal obtained will, in all probability, be a Pittsburgh seam coal.

Coal Characterization and Bench-Scale Fluidized-Bed Studies

Experiments directed at coal characterization, including bench-scale fluidized-bed studies which were initiated in March but were interrupted in April to allow greater emphasis on the scale model, were continued during this reporting period. The emphasis was on examining coal from the Blue Gem Seam and comparing it with coal from the Pittsburgh No. 8 seam. We are presently analyzing our results to date and expect to make a full report on them in our next monthly progress report.

PROBLEMS AND RECOMMENDATIONS

The main problems which are of present concern are those related to the anticipated increase in subcontract costs described in the financial section and the PDU installation schedule.

The schedule shown in Table 1 was presented to us on June 26 by Chemico and we were assured that they believed the new schedule was realistic from both overall and construction standpoints. Two of the three initial milestones on the new Chemico schedule; namely, completion of D-R equipment requisitions and electrical equipment requisitions, have not been achieved. In light of this, it appears unlikely that equipment purchases will be completed by August 31 as scheduled. At present, we have not determined the influence on the construction schedule caused by missing these milestones.

In response to our exploration of the possibility of obtaining a Government priority on delivery of certain materials, we have been informed that this is not possible. The reason is that a defense contract is not involved.

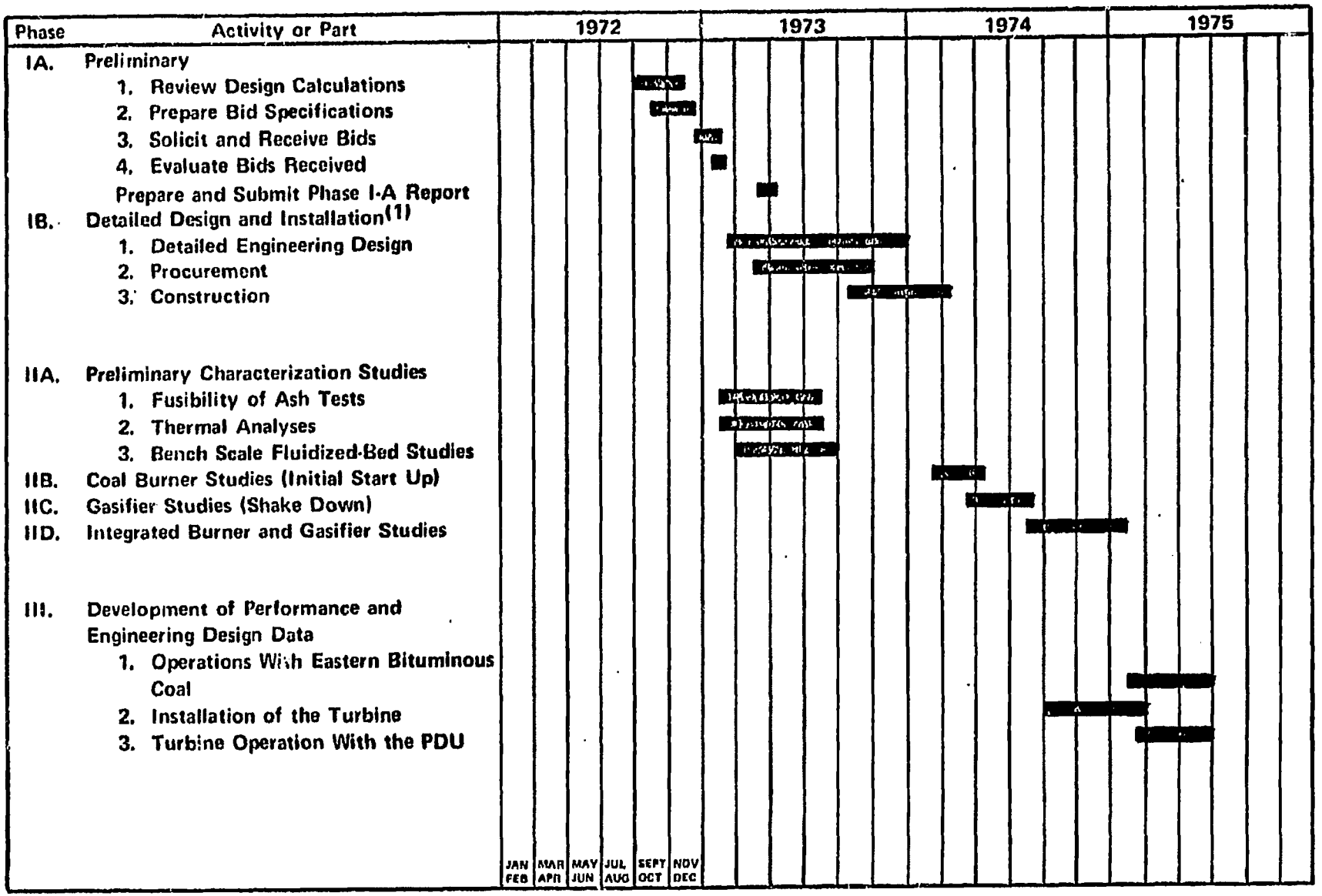
We intend to continue our efforts to provide motivation and assistance to lead to scheduled completion of the PDU.

WORK PLAN AND SCHEDULE

It is anticipated that work will continue on the program in accordance with the overall schedule presented in Table 4. The characterization studies of Phase IIA will be concluded during the forthcoming reporting period.

Activities reported to be in progress in this report will continue. Major emphasis will be given to the expediting of Chemico's requisitions and preparation of bid analyses and recommendations for purchase. Regarding other work on the program at Battelle, our major effort will be to conclude the coal characterization studies and select a source of coal.

TABLE 4.
OVERALL PROGRAM SCHEDULE
BATTELLE PROCESS DEVELOPMENT UNIT
FOR
SELF-AGGLOMERATING GASIFICATION PROCESS



(1) Under subcontract with Chemical Construction Corporation.

FINANCIAL SECTION

of

PROGRESS REPORT NO. 7

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

August 20, 1973

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

FINANCIAL SECTION

of

PROGRESS REPORT NO. 7

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

from

BATTELLE
Columbus Laboratories

August 20, 1973

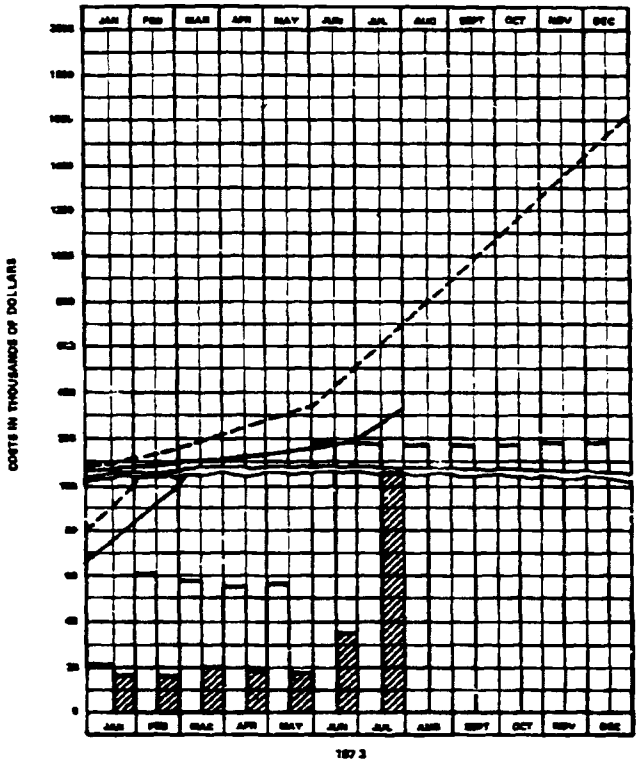
Included in this section as Table A-1 is the Task Cost and Manpower Projection form for the month ending July 31, 1973. During this reporting period we paid one billing of $30,655.65 to Chemico which covers their engineering expenses and fee from June 16, 1973, to July 15, 1973. Another billing for $79,844.22 to cover Chemico's costs from February through May and their fee for the period May 16 to June 16 was alsc paid. Total payments to date to Chemico are $123,315.87.

Chemico estimates their expenditures for the month of July at $28,000. Consequently, the total expenditures of Chemico to date on the program are estimated to be about $151,300, not including approved purchase order commitments of $247,526.

The cumulative expenditures of Battelle, including payments to Chemico to date are, as shown in Table A-2 and drawn on Table A-1, about $327,110. The total amount either spent or committed is about $602,636 or 14.7 percent of the encumbered funds.

TABLE A-1.

BATTELLE PDU
TASK COST AND MANPOWER PROJECTIONS
MONTH ENDING JULY 31, 1973



MANPOWER (MAN-MONTHS)

Proj.	4.4	5.8	5.5	4.2	4.8	5.7	5.1	4.1	4.2	4.7	4.2	5.3
Act.	5.3	4.4	5.3	5.0	4.2	5.3	5.7					

DIRECT LABOR & OVERHEAD COSTS (THOUSANDS OF DOLLARS)

Proj.	18.6	21.4	20	16.2	14.4	17.9	17.8	16.8	17.2	17.2	17.2	16.8
Act.	18.6	14.3	17.8	17.8	16.9	18.3	18.8					

SUBCONTRACT AND CONSULTANT COSTS (THOUSANDS OF DOLLARS)[1]

Proj.	0	38.8	38.7	36.9	38.7	164	164.2	164	164.2	164	164.2	164
Act.	0	0.7	0.3	0	0	12.8	110.5					

NON-EXPENDABLE EQUIPMENT (THOUSANDS OF DOLLARS)[2]

Proj.	0	0	0	0	0	0	0					
Act.	0	0	0	0	0	0	0					

MATERIALS, SUPPLIES, TRAVEL AND ODC (THOUSANDS OF DOLLARS)[3]

Proj.	2.9	2.2	2	2.2	3.4	3.1	3.8	3	2.3	2.3	4.4	2.1
Act.	1.2	2.1	3.1	2.1	3.2	4.1	2.2					

TOTAL (THOUSANDS OF DOLLARS)[4]

Proj.	21.5	60.4	58.7	55.2	57	186	185.9	183.8	183.7	182.5	185.8	185.9
Act.	17.8	17.1	21.2	19.7	19.1	36.2	131.8					

KEY TO GRAPH:

- PROJECTED TOTAL COSTS
- ACTUAL TOTAL COSTS
- PROJECTED CUMULATIVE
- ACTUAL CUMULATIVE

NOTES:

(1) OUTSIDE CONSULTANTS

(2) NON-EXPENDABLE EQUIPMENT TO BE PURCHASED BY SUBCONTRACTORS IS INCLUDED IN SUBCONTRACT CATEGORY

(3) COST OF BATTELLE RESIDENT CONSULTANTS INCLUDED IN THIS CATEGORY

(4) DOES NOT INCLUDE BATTELLE FEE

TABLE A-2. SUMMARY OF APPROXIMATE COSTS[a]

Expenditures on Program Through July 1	$195,812
Chemico Billings Paid in July	110,500
Battelle Internal Expenditure on Program During July	20,798
Total Cumulative Expenditures as of August 1	$327,110
Chemico Estimated Expenditure in July	28,000
Purchase Order Commitments	247,526
Expended or Committed	$602,636

(a) Costs do not include the Battelle fee.

On August 9 we obtained verbally from Chemico the updated subcontract cost projections which we noted in our previous monthly progress report, were expected in late July. The subcontract costs now projected by Chemico are substantially in excess of the estimate upon which the subcontract award was based (probably 60 or more percent). This is the first notification that we have obtained from Chemico of any major expected increase in subcontract costs. We notified AGA and OCR of this new cost estimate by phone on August 13 and 15, respectively. As of the date of this report, formal, written notification of the anticipated cost increase has not been received. Neither have specific reasons for the expected increase or a breakdown of the newly projected costs been received. We expect to receive this information no later than August 22.

BATTELLE-COLUMBUS LABORATORIES PERSONNEL ASSIGNED TO PROJECT*

(1) W. M. Goldberger
(2) W. C. Corder
(3) R. R. Adams
(4) R. J. Kuryvial
(5) D. G. Bauer
(6) H. C. Meeks
(7) J. W. Lowman
(8) B. J. Shankle
(9) E. A. Wasto
(10) H. R. Batchelder (Staff Consultant)

CHEMICAL CONSTRUCTION CORPORATION PERSONNEL ASSIGNED TO PROJECT*

(1) F. W. Peterson
(2) E. M. Ezcurra
(3) E. Coles
(4) J. Fisher
(5) H. Osborne

---

* Only staff who devote significant portions of their time to the program are listed. Various others have temporary assignments.

BCL-MPR-8

TECHNICAL SECTION

of

PROGRESS REPORT NO. 8

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

September 14, 1973

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

TECHNICAL SECTION

of

PROGRESS REPORT NO. 8

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

from

BATTELLE
Columbus Laboratories

September 14, 1973

INTRODUCTION AND PROJECT OBJECTIVE

This progress report describes work completed by Battelle on the Coal Gasification Program during the period August 15-September 14. The section that follows is the technical section. The administrative and financial section is appended.

The general objective of the current contract is development of a two-stage fluidized-bed process utilizing a self-agglomerating fluidized-bed burner as part of a practical and economical method for producing synthesis gas by steam gasification of coal. The developed process is to be useful as a part of a system for producing synthetic pipeline gas or for other purposes.

Pursuant to the general objective, a 25-ton-a-day-of-coal Process Development Unit (PDU) is to be erected and operated and the following aspects of the process explored:

- The operability of a self-agglomerating fluidized-bed coal burner operating on an Eastern bituminous coal under pressure and using air for combustion.
- The mechanical feasibility of continuously circulating a burden of hot-ash agglomerates between fluidized-bed burner and fluidized-bed gasifier vessels at 100 psig of pressure

and the rates and temperatures required for effective heat transfer.

- The operability of integrated fluidized-bed burner and gasifier vessels both fed by Eastern bituminous coal (or char in the case of the burner) and operating at 100 psig of pressure. The gasifier is to be fluidized by steam and the endothermic heat of gasification is to be provided by the circulating burden of hot-ash agglomerates.
- The operability over extended time periods of a power-recovery turbine using hot, fluidized-bed burner effluent gases as the turbine working fluid.
- The factors that influence the long-term operability of the process. Included is to be the gathering of data on all key process variables and their effect on the characteristics of the process.

Concurrent with operation of the PDU, sufficient process data and information will be acquired to permit scale-up of the process to its next logical stage of development.

SUMMARY

During this reporting period, work was continued by Chemico on the detailed design and procurement of equipment for the Battelle Coal Gasification PDU. The new cost estimate for the design and installation of the PDU developed by Chemico was examined with them by Battelle and is being transmitted to the Sponsors.

Activities previously initiated by Battelle not directly related to the PDU installation were continued but at a somewhat reduced level of effort from previous or future reporting periods. The most substantial activity on the program in this reporting period by Battelle has been in working with the subcontractor both on technical and administrative matters. Dara from the coal characterization work to date has been examined and we have concluded that more experimental work is desirable. Other major activity by Battelle has been that related to site preparation and obtaining permits.

WORK COMPLETED

Contractual

The subcontract between Battelle and Chemico for the detailed design, construction, and installation of the PDU is being negotiated on the basis of subcontract modifications requested by ACA. Chemico is continuing work authorized by a written purchase order of June 26 from Battelle.

Detailed Engineering Design of the PDU

Chemico Activity

Chemico's current schedule is repeated here as Table 1. Associated milestone dates are given in Table 2.

Primary emphasis during this reporting period by Chemico has been on preparation of an updated cost estimate for the PDU, equipment requisitions, summaries of bids for equipment received, and recommendations for purchase. Other scheduled items which have received emphasis from Chemico during this reporting period are as follows.

- Process Flow Diagrams and Data Sheets. Updated process flow diagrams are being prepared at Chemico to reflect modifications to the PDU design made since June. We expect these to be issued shortly.

We have received preliminary copies of certain of the flow diagrams for utility sections of the PDU including those for the cooling water, inert gas, and natural gas distribution systems. These are being examined at Battelle and checked and finalized for issuance by Chemico.

- Requisitions and Purchases for Critical Items*. A listing of the items of equipment for the PDU which are in some stage of the procurement cycle is shown in Table 3. The current status of each item is as indicated.

*Items requiring more than 16 weeks for delivery.

TABLE 1. REVISED CHEMICO SCHEDULE

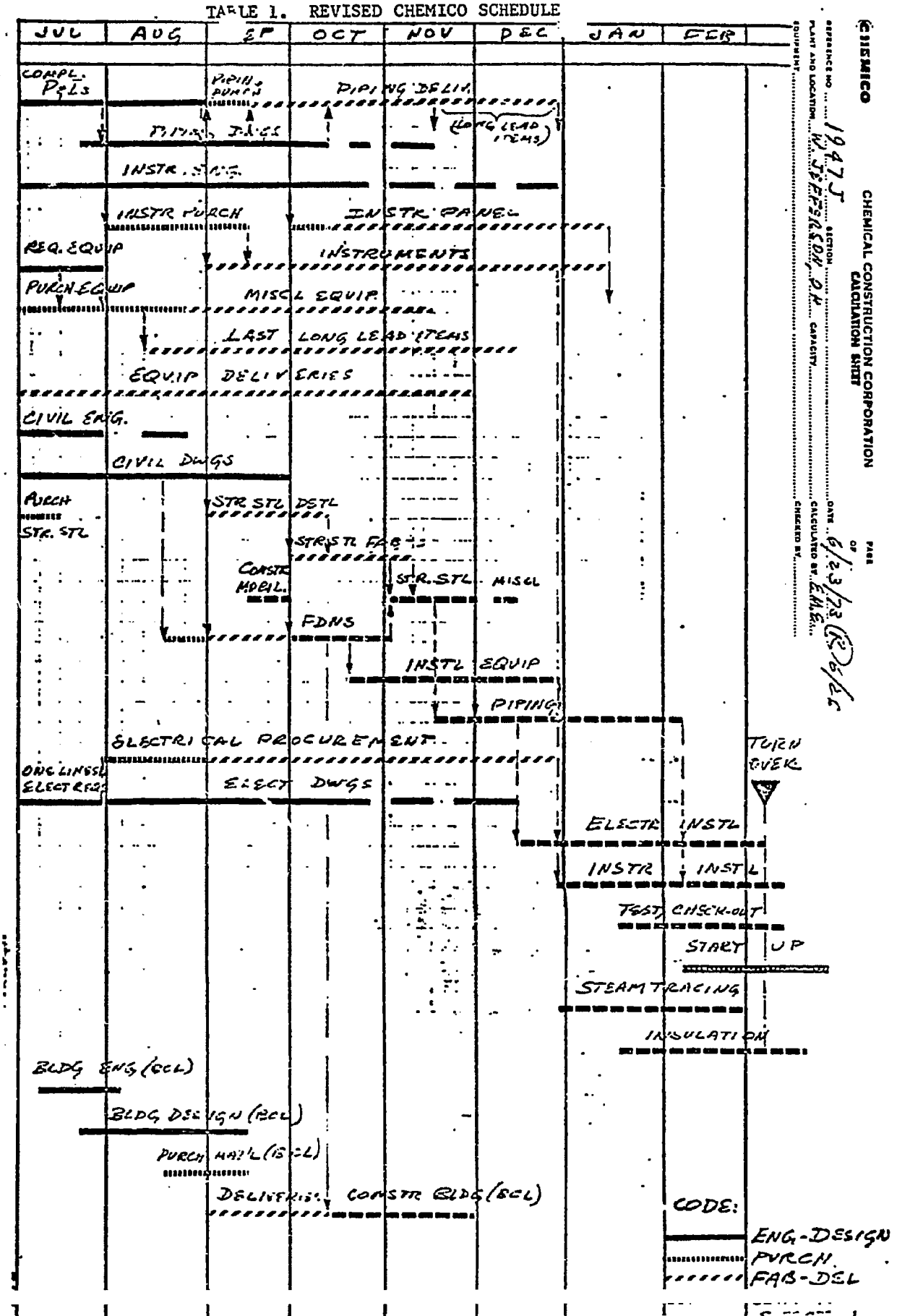


TABLE 2. MILESTONE DATES CORRESPONDING TO THE NEW CHEMICO SCHEDULE

Milestone	Achievement Date
Complete D-R Equipment Requisitions	July 27, 1973
Complete Electrical Equipment Requisitions	July 27
Complete Major Inst. Reqn. Incl. Panel	Sept. 28
Structural Steel Dwgs. (Feed Struct.)	Aug. 31
Foundation Dwgs. (Feed Struct.)	Sept. 14
Combustor-Gasifier Struct. Dwgs.	Sept. 28
All Equipment Purchased	Aug. 31
P & I Prelim. Piping Issue	July 27
P & I Advanced Piping Issue	Aug. 31
Piping Dwgs., Preliminary	Oct. 12
Piping Dwgs., Complete	Nov. 16
Start Construction	Oct. 1
Start Steel Erection	Nov. 5
Start Equipment Installation	Oct. 22
Start Piping Installation	Nov. 16
Start Electrical Installation	Dec. 14
All Equipment Delivered	Dec. 14
All Equipment Installed	Dec. 28
Partial Turn-Over for Initial Start-Up	Feb. 9, 1974
Complete Turn-Over for Start-Up	March 9

TABLE 3. STATUS OF PDU EQUIPMENT PROCUREMENT

1. Purchase orders have been authorized for the following items:

Section 100

G-101	Coal Pulverizer Surge Hopper	(OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 2)

Section 200

D-201	Inert Gas Generator	OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 3
K-201	Main Fan	
K-202	Auxiliary Fan	
K-203	Combustion Air Blower	
O-201	Coal Pulverizer	
P-201	Cyclone Separator	
P-203	Bag Filter	

Section 400

G-401A	Combustor Feed Bin	OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 2
G-401B	Gasifier Feed Bin	
G-402	Combustor Feed Pressure Hopper	
G-403	Combustor Feed Injection Hopper	
G-404	Pretreated Coal Receiving Bin	
G-405	Gasifier Feed Pressure Hopper	
G-406	Gasifier Feed Injection Hopper	

Section 700

G-701A&B	Process Air Receivers	(OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 1)
K-701A&B	Process Air Compressors	

General

Panel Instruments	(OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 4)

2. Bids have been received by Chemico on the following items. These bids have been reviewed by Chemico, their recommendations have been made to Battelle and requests for authority to purchase have been submitted to OCR/AGA.

General

Unit Price Quotation for Structural Steel	(OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 7)

TABLE 3. (Cont.)

Section 500

H-501	Combustor Vessel	(Unit cost basis as per OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 6)
H-502	Gasifier Vessel	

Section 600

E-604	Recycle Make Gas Cooler	("Information Only" - OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 5)

3. Initial bids or revised bids have been received on the following items by Chemico. They are currently evaluating the bids and will transmit their recommendations to us very soon.

Section 300

O-301	Screw Conveyor Cooler
P-301	Coal Pretreater Cyclone

Section 500

O-502	Ash and Char Conveyor Cooler
P-501	Combustor Cyclone
P-502	Gasifier Cyclone

4. The following items are out for bids:

Section 300

J-301	Oil-Solids Pump

Section 400

P-401A&B	Bag Filters

Section 600

J-601A&B	Venturi Circulating Pumps
J-602A&B	Venturi Circulating Pumps

Section 700

D-702	Inert Gas Generator
G-702	Inert Gas Receiver

Section 800

D-802	Package Steam Boiler
D-803	Steam Superheater

TABLE 3. (Cont.)

General

A-190 Reinforcing Bars (Unit Price)
A-191 Anchor Bolts (Unit Price)
U-030 Analyzer System
U- Load Cells

5. Requisitions have been drafted on the following items and are currently being reviewed or revised:

Section 100

G-102 Coal Receiving Hopper

Section 500

D-501 Start-up Heater
H-501 Combustor Refractories
H-502 Gasifier Refractories
G-501 Combustor Cyclone Receiving Hopper
G-502 Combustor Cyclone Letdown Hopper
G-503 Gasifier Cyclone Receiving Hopper
G-504 Gasifier Cyclone Letdown Hopper
G-505 Char Receiving Hopper
G-506 Char Letdown Hopper
G-509 Gasifier Ash Letdown Hopper
G-510 Combustor Ash Letdown Hopper
G-511 Cooler Conveyor Receiving Hopper

Section 600

K-603 Recycle Make Gas Booster

Section 700

G-703 Instrument Air Receiver
K-702 Emergency Instrument Air Compressor
K-703A&B Natural Gas Boosters

Section 800

R-803 Water Cooling Tower
R-804 Water Treatment System

General

V-020 Transformer Substations

The listing shown represents about 65 percent of the expected PDU requisitions. Items not listed but shown on the process flowsheets are still at the engineering-design stage and specifications for the requisitions have not been developed yet.

The Chemico schedule and associated milestone dates shown in Tables 1 and 2 indicate that D-R* and electrical equipment requisitions should have been completed on July 27. All equipment is indicated to be purchased by August 31. These milestones have not been achieved.

We have been informed by Chemico that the supplier of the process air compressors has requested shipping instructions to the Battelle West Jefferson site.

- Process P&I Diagrams. A supplier of the major items of panel instrumentation has been selected and work is proceeding with the engineering of final P&I's. An advanced issue of the P&I's scheduled for August 31 was not received. However, we are informed that this will issue soon.

- Structural Steel Design and Civil Engineering. A supplier for the structural steel has been selected and recommended to OCR/AGA as is indicated in Table 3. The structural steel and foundation drawings due to be issued on August 31 and September 14, respectively, have been delayed.

Battelle Activity Directly Related to Detailed Design of the PDU

Time has been devoted to reviewing the specifications in the requisitions issued by Chemico. Also, additional studies have been made by Battelle of what can be done in emergency situations to assure an orderly shutdown of the PDU. We have held discussions related to this technical matter as well as on administrative matters with Chemico. Other technical points concerning the PDU have been examined at Battelle. R. R. Adams, our project engineer, has continued his activity with Chemico and has become more involved with coordinating the Chemico work with that

*Direct-Requisition.

of the Plant Facilities Department at Battelle.

A portion of the area adjacent to Building JS-2 at our West Jefferson site has been cleared and graded by Battelle in preparation for receipt of the PDU equipment. Battelle's Plant Facilities Department has completed a preliminary design on an additional enclosure to be built by Battelle at the West Jefferson site to enclose compressors and other PDU auxiliaries. It is anticipated that work on this structure as well as new required access roads will begin in about a month. A more detailed analysis of the PDU operation from the standpoint of compliance with OSHA and other regulations, particularly as they regard noise, is in progress.

- Work Related to Environmental Impact of the PDU. In the previous monthly progress report, we noted that the State of Ohio EPA had requested we submit two "permit to construct" applications. These applications were submitted and are under review by the State authorities. Questions which have arisen in EPA's review have been answered by the project staff.

- Work Related to Assuring Sufficient Natural Gas at the PDU Site. Our preliminary information from the local gas company (Columbia Gas of Ohio, Inc.) is that the requirement for PDU can be met. It is our understanding that the total anticipated requirement of the West Jefferson site is being reviewed by Columbia to determine if modifications must be made to the natural gas substation at the site and to the distribution system.

- Determination of Electrical Area Classifications for the PDU. This subject has been reviewed at Battelle and, in conjunction with Chemico, a final determination is in progress to assign the proper classification to each area of the PDU.

- Turbine Specification. We have held a discussion with Elliott Company and provided them with information on our need for the expansion turbine.

This information is currently being examined by Elliott's technical staff. Another meeting is tentatively planned in October to explore the requirement further with this supplier.

Other contacts are being made with turbine suppliers and we expect discussions with them also during the forthcoming reporting period.

Other Work Related Indirectly to PDU Design

Small-Scale Fluidized-Bed Burner-Gasifier System Assembly

The conclusion of experiments using a 1/8-scale model of the Burner-Gasifier system was noted in the previous monthly progress report. A separate report describing the operation and results of the experiments is in the process of final editing.

Mathematical Model of the Gasification Process

The file report summarizing work concluded on a computerized mathematical model of the gasification process being developed in the PDU is also being edited and we expect it to be available in about 1 month.

Coal Acquisition

Pressures of other matters have precluded us from issuing a specification for bidding on coal to be supplied for the PDU operation as we had planned to do during this reporting period. Our intention with regard to obtaining coal is still to prepare a specification for coal to be used in initial PDU operations and send it to several coal suppliers. These suppliers will be invited to bid on a contract to supply coal according to our specifications.

Coal Characterization and Bench-Scale Fluidized-Bed Studies

Results of experiments concerning coal characterization, including bench-scale fluidized-bed studies, have been analyzed. Comparisons of brief experiments made in the self-agglomerating fluidized bed using three Eastern bituminous coals were made with the results of work with Pittsburgh No. 8 coal. In general, the results are in agreement with the more extensive earlier work with Pittsburgh No. 8 coal. However, the data are quite limited, are scattered, and are consequently inconclusive regarding the other coals.

Some of the discrepancies in data generated are believed related to air distribution problems encountered with the fluidized-bed equipment used. Several more experiments in another fluidized-bed vessel are being conducted to better determine the influence gas distribution may have had on the results.

PROBLEMS AND RECOMMENDATIONS

The problems of present concern are, as noted in the previous monthly progress report, related to the anticipated increase in subcontract costs described in the financial section and, the PDU installation schedule.

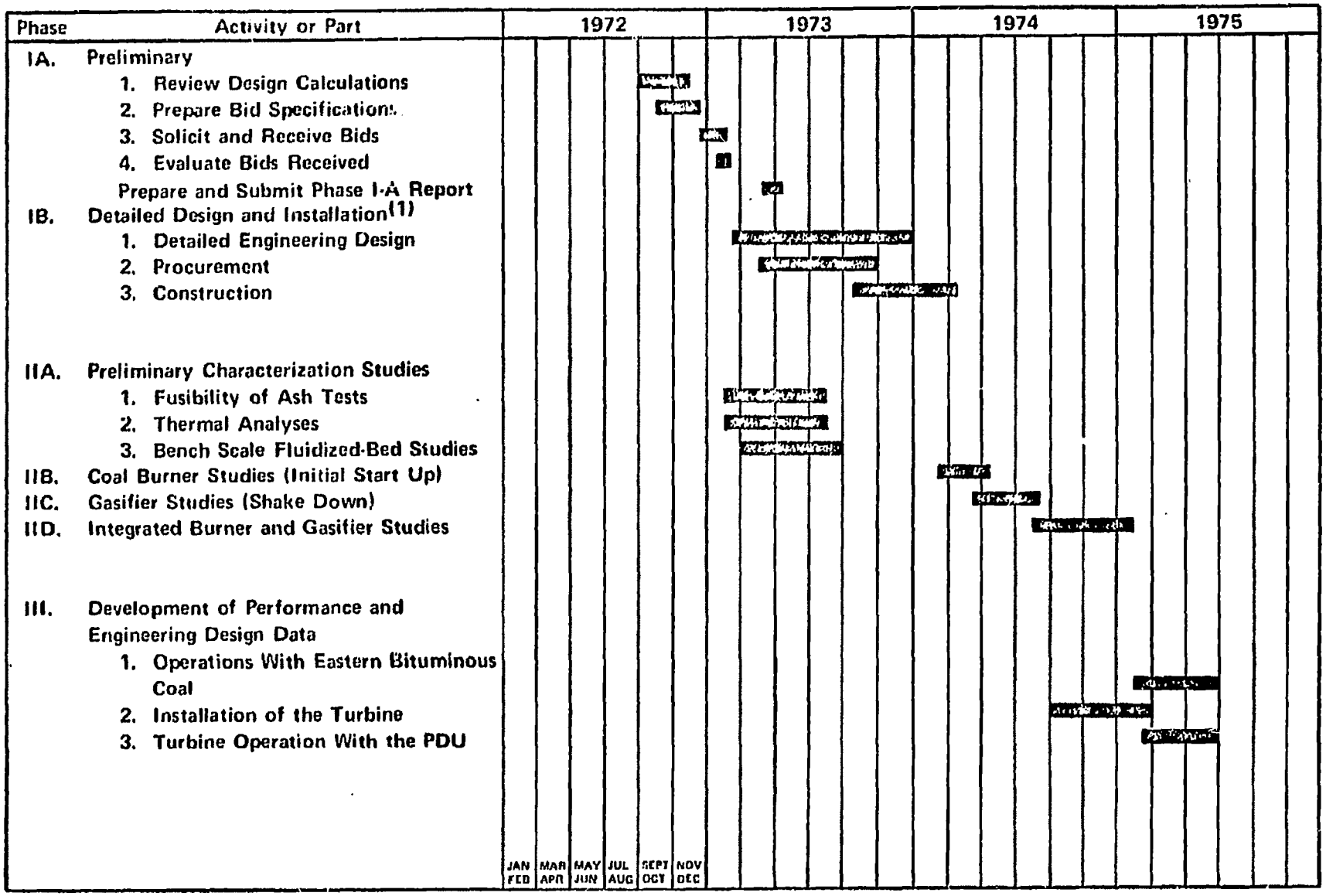
The schedule shown in Table 1 was presented by Chemico to Battelle as a revision on June 26 with the information that it was realistic and that it could be met. Based on current review with Chemico, it appears that this revised schedule may suffer further delay by as much as 6 weeks.

As was noted in our sixth progress report, any delay beyond that anticipated in the present (June 26) schedule of Chemico, will make it very unlikely that the overall program can be completed by June 30, 1975. Chemico has advised us that additional manpower has been assigned to the program to avoid or minimize such delay.

WORK PLAN AND SCHEDULE

We are still proceeding on the basis that the overall schedule presented in Table 4 can be met. Work will be continued on the characterization studies of Phase IIA at a nominal level during the forthcoming reporting period. Major emphasis will be given to the expediting of Chemico's requisitions and preparation of bid analyses and recommendations for purchase to recoup time lost in this segment of the schedule. Regarding other work on the program at Battelle, major effort will be directed at preparing the site to accept the PDU prior to the onset of inclement weather.

TABLE 4.
OVERALL PROGRAM SCHEDULE
BATTELLE PROCESS DEVELOPMENT UNIT
FOR
SELF-AGGLOMERATING GASIFICATION PROCESS



(1) Under subcontract with Chemical Construction Corporation.

FINANCIAL SECTION

of

PROGRESS REPORT NO. 8

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

September 14, 1973

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

FINANCIAL SECTION

of

PROGRESS REPORT NO. 8

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

from

BATTELLE
Columbus Laboratories

September 14, 1973

Included in this section as Table A-1 is the Task Cost and Manpower Projection form for the month ending August 31, 1973. During this reporting period we received a billing of $30,926.70 from Chemico which covers their engineering expenses and fee from July 16, 1973, to August 15, 1973. The billing was received too late to make payment during this reporting period, consequently, total actual disbursements to Chemico remain at $123,315.87.

Assuming Chemico's expenditures for the period August 15 to September 14 are $30,000, or about the same as in previous periods of this length of time, the total expenditures of Chemico to date on the program are estimated to be $184,000. This does not include approved purchase order commitments of $295,635.05*.

The cumulative expenditures of Battelle, including payments to Chemico to date are, as shown in Table A-2 and drawn on Table A-1, about $349,000. The total amount either spent or committed is about $705,000 or 17.2 percent of the encumbered funds.

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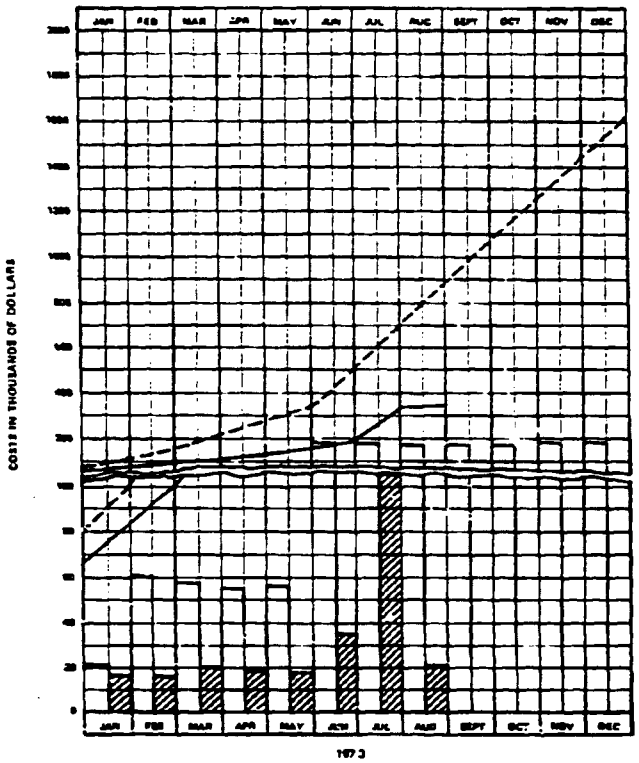
* We were advised by Chemico on September 6 that they anticipate commitment of additional funds for equipment purchase and their own engineering costs to exceed $900,000 by the end of September (letter and attachment to Mr. Paul J. McNeill from Mr. Roger L. Evans, dated September 10, 1973).

TABLE A-1.

BATTELLE PDU
TASK COST AND MANPOWER PROJECTIONS
MONTH ENDING AUGUST 31, 1973



MANPOWER (MAN-MONTHS)

Proj.	4.4	5.8	5.5	4.2	4.6	5.1	5.1	4.1	4.2	4.7	4.2	5.3
Act.	5.3	4.4	5.3	5.0	4.2	5.3	5.7	5.8				

DIRECT LABOR & OVERHEAD COSTS (THOUSANDS OF DOLLARS)

Proj.	18.6	21.4	20	18.2	14.4	17.9	17.9	16.8	17.2	17.2	17.2	19.8
Act.	16.6	14.3	17.8	17.6	15.9	18.3	18.8	18.2				

SUBCONTRACT AND CONSULTANT COSTS (THOUSANDS OF DOLLARS)[1]

Proj.	0	36.8	36.7	36.8	36.7	164	164.2	164	164.2	164	164.2	164
Act.	0	0.7	0.3	0	0	12.8	110.5	0				

NON-EXPENDABLE EQUIPMENT (THOUSANDS OF DOLLARS)[2]

Proj.	0	0	0	0	0	0	0	0				
Act.	0	0	0	0	0	0	0	.15				

MATERIALS, SUPPLIES, TRAVEL AND ODC (THOUSANDS OF DOLLARS)[3]

Proj.	2.9	2.2	2	2.2	3.4	3.1	3.8	3	2.3	2.3	4.4	2.1
Act.	1.2	2.1	3.1	2.1	3.2	4.1	2.2	3.3				

TOTAL (THOUSANDS OF DOLLARS)[4]

Proj.	21.5	60.4	58.7	55.2	57	185	185.9	183.8	183.7	183.5	185.8	185.9
Act.	17.8	17.1	21.2	19.7	19.1	35.2	131.8	21.7				

. . . . . .

KEY TO GRAPH:

PROJECTED TOTAL COSTS — ACTUAL TOTAL COSTS

PROJECTED CUMULATIVE — ACTUAL CUMULATIVE

NOTES

(1) OUTSIDE CONSULTANTS

(2) NON-EXPENDABLE EQUIPMENT TO BE PURCHASED BY SUBCONTRACTORS INCLUDED IN SUBCONTRACT CATEGORY

(3) COST OF BATTELLE RESIDENT CONSULTANTS INCLUDED IN THIS CATEGORY

(4) DOES NOT INCLUDE BATTELLE FEE

TABLE A-2. SUMMARY OF APPROXIMATE COSTS[a]

Expenditures on Program Through August 1	$327,110
Battelle Internal Expenditure on Program During August	21,655
Total Cumulative Expenditures as of September 1	$348,765
Unpaid Billing Received from Chemico	31,000
Estimated Expenditures of Chemico in August	30,000
Purchase Order Commitments	295,635
Expended or Committed	$705,400

(a) Costs do not include the Battelle fee.

It was noted in the previous monthly progress report that, on August 9, we were informed by Chemico of a projected cost increase. Some details of the new cost estimate were received from Chemico on August 22. On September 4 and 5, Battelle and Chemico met in Columbus to review their projected increase in costs. A document prepared by Chemico outlining their major reasons for the projected cost increase was received by Battelle on September 13. We currently are examining this document and expect to forward it, along with our comments, to OCR and AGA before September 20.

BATTELLE-COLUMBUS LABORATORIES PERSONNEL ASSIGNED TO PROJECT*

(1) W. M. Goldberger
(2) W. C. Corder
(3) R. R. Adams
(4) T. L. Tewksbury
(5) H. C. Meeks
(6) J. A. Lowman
(7) B. J. Shankle
(8) E. A. Wasto
(9) H. R. Batchelder (Staff Consultant)

CHEMICAL CONSTRUCTION CORPORATION PERSONNEL ASSIGNED TO PROJECT*

(1) F. W. Peterson
(2) E. M. Ezcurra
(3) E. Coles
(4) J. Fisher
(5) H. Osborne

* Only staff who devote significant portions of their time to the program are listed. Various others have temporary assignments.

BCL-MPR--9

TECHNICAL SECTION

of

PROGRESS REPORT NO. 9

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

October 15, 1973

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

TECHNICAL SECTION

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PROGRESS REPORT NO. 9

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CONTRACT NO. 14-32-0001-1513

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OFFICE OF COAL RESEARCH

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BATTELLE
Columbus Laboratories

October 15, 1973

INTRODUCTION AND PROJECT OBJECTIVE

This progress report describes work completed by Battelle on the Coal Gasification Program during the period September 15-October 15. The section that follows is the technical section. The administrative and financial section is appended.

The general objective of the current contract is development of a two-stage fluidized-bed process utilizing a self-agglomerating fluidized-bed burner as part of a practical and economical method for producing synthesis gas by steam gasification of coal. The developed process is to be useful as a part of a system for producing synthetic pipeline gas or for other purposes.

Pursuant to the general objective, a 25-ton-a-day-of-coal Process Development Unit (PDU) is to be erected and operated and the following aspects of the process explored:

- The operability of a self-agglomerating fluidized-bed coal burner operating on an Eastern bituminous coal under pressure and using air for combustion.
- The mechanical feasibility of continuously circulating a burden of hot-ash agglomerates between fluidized-bed burner and fluidized-bed gasifier vessels at 100 psig of pressure

and the rates and temperatures required for effective heat transfer.

- The operability of integrated fluidized-bed burner and gasifier vessels both fed by Eastern bituminous coal (or char in the case of the burner) and operating at 100 psig of pressure. The gasifier is to be fluidized by steam and the endothermic heat of gasification is to be provided by the circulating burden of hot-ash agglomerates.
- The operability over extended time periods of a power-recovery turbine using hot, fluidized-bed burner effluent gases as the turbine working fluid.
- The factors that influence the long-term operability of the process. Included is to be the gathering of data on all key process variables and their effect on the characteristics of the process.

Concurrent with operation of the PDU, sufficient process data and information will be acquired to permit scale-up of the process to its next logical stage of development.

SUMMARY

During this reporting period, work was continued by Chemico on the detailed design and procurement of equipment for the Battelle Coal Gasification PDU. Details of the new cost estimate for the design and installation of the PDU developed by Chemico were discussed with the OCR Operating Committee and a disposition of the problem is being awaited.

Activities previously initiated by Battelle not directly related to the PDU installation were continued at a reduced level of effort. The most substantial activity on the program in this reporting period by Battelle has been in working with the subcontractor both on technical and administrative matters. A nominal amount of coal characterization work was continued. Other activity by Battelle has been that related to site preparation and obtaining permits. Also an increased amount of attention has been given to specifying and making arrangements for acquisition of the turbine.

WORK COMPLETED

Contractual

The subcontract between Battelle and Chemico for the detailed design, construction, and installation of the PDU is being negotiated on the basis of subcontract modifications requested by AGA. Chemico is continuing work authorized by a written purchase order of June 26 from Battelle.

Detailed Engineering Design of the PDU

Chemico Activity

We have no current schedule from Chemico. The Chemico schedule presented in our previous monthly reports is no longer valid. We understand from Chemico that a new schedule is being prepared.

Chemico has concentrated on preparation of an updated process P and I's and flowsheets, equipment requisitions, summaries of bids for equipment received, and recommendations for purchase. Items which are early on any schedule and which have received attention from Chemico to our knowledge* during this reporting period are as follows.

- Process Flow Diagrams and Data Sheets. Updated process flow diagrams have been prepared at Chemico to reflect modifications to the PDU design made since June. These have been reviewed at Battelle and with Chemico and basic approval has been given to the flowsheets as they currently exist.

We received preliminary copies of certain of the flow diagrams for utility sections of the PDU including those for the cooling water, inert gas, and natural gas distribution systems. Formal versions of these have not yet been issued by Chemico.

---

*We have not received weekly or monthly reports from Chemico recently.

• Requisitions and Purchases. A listing of the items of equipment for the PDU which are in some stage of the procurement cycle is shown in Table 1. Battelle's estimate of the current status of each item is as indicated.

The listing shown represents about 65 percent of the expected PDU requisitions. Items not listed but shown on the process flowsheets are still at the engineering-design stage and specifications for the requisitions have not been developed yet.

• Process P&I Diagrams. We have reviewed an updated version of the process P and I's at Battelle and then with Chemico. Another review was also made by Battelle with C. F. Braun. Work is proceeding with the engineering of final P and I's and we understand the preliminaries are being continually updated.

• Structural Steel Design and Civil Engineering. A supplier for the structural steel has been approved. The structural steel and foundation drawings were reported by Chemico to have been started the week of October 8.

• Electrical Drawings. We have been informed by Chemico that a one-line electrical drawing for the PDU will be available the week of October 15.

Battelle Activity Directly Related to Detailed Design of the PDU

Time has been devoted to reviewing the specifications in the requisitions issued by Chemico. Procedures have been developed by Battelle for orderly shutdown of the PDU in emergency situations. We have held discussions related to this technical matter as well as on administrative matters with Chemico. Other technical points concerning the PDU have been examined at Battelle. Our monitoring function has continued at Chemico through residency of R. R. Adams at the subcontractor's site. Frank Crowe, the Sponsor's Representative for Engineering Design has joined Mr. Adams during much of this time.

TABLE 1. STATUS OF PDU EQUIPMENT PROCUREMENT

1. Purchase orders have been authorized for the following items:

Section 100

G-101	Coal Pulverizer Surge Hopper	(OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 2)

Section 200

D-201	Inert Gas Generator	OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 3
K-201	Main Fan	
K-202	Auxiliary Fan	
K-203	Combustion Air Blower	
O-201	Coal Pulverizer	
P-201	Cyclone Separator	
P-203	Bag Filter	

Section 400

G-401A	Combustor Feed Bin	OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 2
G-401B	Gasifier Feed Bin	
G-402	Combustor Feed Pressure Hopper	
G-403	Combustor Feed Injection Hopper	
G-404	Pretreated Coal Receiving Bin	
G-405	Gasifier Feed Pressure Hopper	
G-406	Gasifier Feed Injection Hopper	

Section 500

H-501	Combustor Vessel	(OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 6)
H-502	Gasifier Vessel	

Section 600

E-604	Recycle Make Gas Cooler	("Information Only" - OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 5)

Section 700

G-701A&B	Process Air Receivers	(OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 1)
K-701A&B	Process Air Compressors	

General

Panel Instruments (OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 4)

Unit Price Structural Steel (OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 7)

TABLE 1. (Cont.)

2. Bids have been received by Chemico on the following items. These bids have been reviewed by Chemico, their recommendations have been made to Battelle and requests for authority to purchase have been submitted to OCR/AGA after Battelle's review.

General

- Weigh Systems (OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 8)
- Gas Analyzers (OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 10)

Section 300

O-301 Screw Conveyor Cooler (OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 11)
P-301 Coal Pretreater Cyclone (OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 9)

Section 500

O-502 Ash and Char Conveyor Cooler (OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 11)
P-501 Combustor Cyclone (OCR/AGA Purchase Quotation and Authorization Sheet Serial No. 9)
P-502 Gasifier Cyclone

3. Initial bids or revised bids have been received on the following items by Chemico. They are currently evaluating the bids and will transmit their recommendations to us very soon.

Section 800

D-802 Package Steam Boiler
D-803 Steam Superheater

4. The following items are out for bids:

Section 300

J-301 Oil-Solids Pump

Section 400

P-401A&B Bag Filters

Section 500

D-501 Start-up Heater
H-501 Combustor Refractories
H-502 Gasifier Refractories

TABLE 1. (Cont.)

G-501	Combustor Cyclone Receiving Hopper
G-502	Combustor Cyclone Letdown Hopper
G-503	Gasifier Cyclone Receiving Hopper
G-504	Gasifier Cyclone Letdown Hopper
G-505	Char Receiving Hopper
G-506	Char Letdown Hopper
G-509	Gasifier Ash Letdown Hopper
G-510	Combustor Ash Letdown Hopper
G-511	Cooler Conveyor Receiving Hopper

Section 600

J-601A&B	Venturi Circulating Pumps
J-602A&B	Venturi Circulating Pumps

Section 700

D-702	Inert Gas Generator
G-702	Inert Gas Receiver

General

A-190	Reinforcing Bars (Unit Price)
A-191	Anchor Bolts (Unit Price)

5. Requisitions have been drafted on the following items and are currently being reviewed or revised:

Section 100

G-102	Coal Receiving Hopper

Section 600

K-603	Recycle Make Gas Booster

Section 700

G-703	Instrument Air Receiver
K-702	Emergency Instrument Air Compressor
K-703A&B	Natural Gas Boosters

Section 800

R-803	Water Cooling Tower
R-804	Water Treatment System

General

V-020	Transformer Substations

A portion of the area adjacent to Building JS-2 at our West Jefferson site has been cleared and graded by Battelle in preparation for receipt of the PDU equipment. An additional primary electrical transformer to supply the PDU is presently being installed. Battelle's Plant Facilities Department has completed a preliminary design on an additional enclosure to be built by Battelle at the West Jefferson site to enclose compressors and other PDU auxiliaries. It is anticipated that work on this structure as well as new required access roads can begin immediately. Currently our Plant Facilities Department is in a "holding pattern" awaiting final disposition of the cost problem incurred by Chemico's new estimate.

- Work Related to Environmental Impact of the PDU. In the previous monthly progress report, we noted that the State of Ohio EPA had requested we submit two "permit to construct" applications. These applications were submitted and are under review by the State authorities. We have been asked for additional specific information regarding the construction and start-up and await a new schedule from Chemico to provide this.

- Determination of Electrical Area Classifications for the PDU. This subject has been reviewed at Battelle and, in conjunction with Chemico, a determination was made to assign the following classifications to areas of the PDU: To the Burner-Gasifier Area - Class I, Division 2, Group B; and to the Coal Preparation Areas - Class II, Division 2, Group F. These are classifications according to the National Electrical Code.

- Turbine Specification. More attention was given to obtaining a turbine for the PDU during this reporting period. Mr. R. D. Fischer of Battelle-Columbus' Thermal and Mechanical Energy Systems Section has been assisting in this work.

Based on contacts with the specialists at C. F. Braun, a preliminary design review of the turbine requirements and our previous contact with Elliott Company, Mr. Fischer plans to meet with Elliott this month to explore the feasibility of their providing a turbine for the PDU.

Other Work Related Indirectly to PDU Design

Reports

Reports on experimental work conducted in the scale model of the Burner-Gasifier System and on the mathematical model of the Gasification process have not yet been completed. Completion of these reports has been subordinated to work more directly related to design and construction of the PDU.

Coal Characterization and Bench-Scale Fluidized-Bed Studies

In the previous monthly it was noted that additional experiments directed at examining the self-agglomerating behavior of candidate coals were in progress. Another fluidized-bed vessel with a different type of gas distributor is being used for these experiments. Inasmuch as we are sharing the vessel with another program, only about three additional experiments have been made during this reporting period. This work in no way influences the overall program schedule.

PROBLEMS AND RECOMMENDATIONS

The problems of present concern are, as noted in previous monthly progress reports, related to the increase in subcontract costs and the PDU installation schedule.

At their last verbal estimate Chemico was as much as 6 weeks behind in the schedule which we have been reporting. This was the revised schedule presented to us in June. We are increasingly concerned about winter construction and the necessity of Batteile's making required modifications to the site, particularly access roads, prior to inclement weather.

Chemico has applied additional manpower to the program in the hope that further delay can be minimized. Until the new schedule promised

by Chemico is forthcoming, we cannot evaluate how effective this increased manpower emphasis will be on the future schedule or in making up lost time.

Our recommendations regarding these problems are well documented elsewhere.

WORK PLAN AND SCHEDULE

We are still proceeding on the basis that an overall schedule which will result in completion of all experimental work by June 30, 1975, can be met. Work will be continued on the characterization studies of Phase IIA at a nominal level during the forthcoming reporting period. Major emphasis will be given to our activities associated with installation of the PDU.

FINANCIAL SECTION

of

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OFFICE OF COAL RESEARCH

October 15, 1973

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

FINANCIAL SECTION

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from

BATTELLE
Columbus Laboratories

October 15, 1973

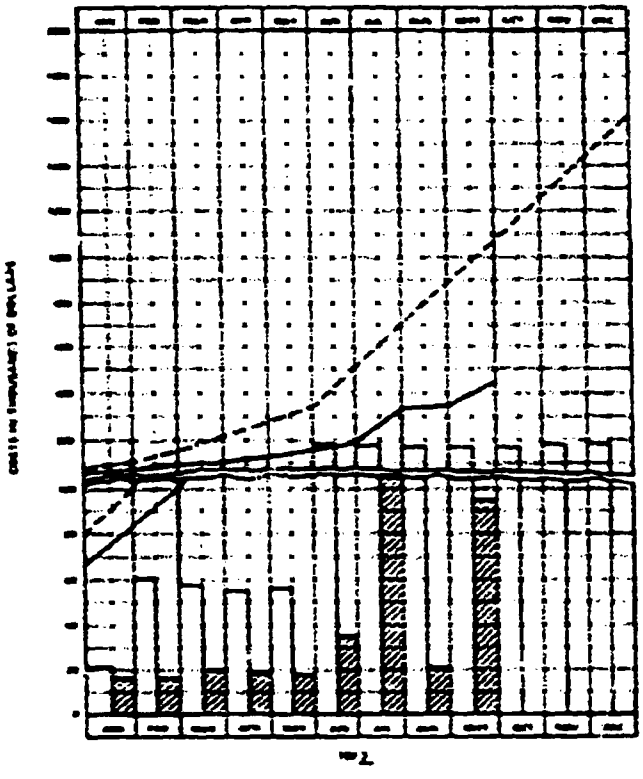
Table A-1 presents the Task Cost and Manpower Projection form for the month ending September 30, 1973. All billings received by Battelle from Chemico to date have been paid. The most recent Chemico billing was for New York Office costs for the month of August and their fee for the period mid-August to mid-September. Total disbursements to Chemico are $193,796.22.

Chemico estimates their New York Office costs through September 30 to be $45,000. Because no billing for September costs has been received from Chemico, yet, these are not included in Table A-1. Consequently, it is estimated by Battelle that a total of $238,796.32 has been spent by Chemico on engineering, procurement, and other activities related to their current phase of work. Chemico has been authorized to commit an additional $436,675.05 to suppliers of equipment for the PDU.

The cumulative expenditures of Battelle, including payments to Chemico to date are, as shown in Table A-2 and drawn on Table A-1, about $445,000. The total amount either spent or committed as of October 1 is about $926,440 or 22.6 percent of the encumbered funds.

TABLE A-1

BATTELLE [illegible]
TASK COST AND MANPOWER PROJECTIONS
MONTH ENDING SEPTEMBER 30, 1973



Proj.	4.4	5.0	5.5	6.7	4.6	5.1	5.1	4.1	4.2	4.7	4.2	5.3
Act.	5.3	4.4	5.3	5.0	4.2	5.3	6.7	5.0	6.2			

DIRECT LABOR & OVERHEAD COSTS (THOUSANDS OF DOLLARS)

Proj.	16.6	21.4	20	16.7	14.4	17.9	17.9	16.8	17.2	17.2	17.2	19.8
Act.	16.6	14.3	17.8	17.8	15.9	18.3	16.6	16.7	22.3			

SUBCONTRACT AND CONSULTANT COSTS (THOUSANDS OF DOLLARS)[1b]

Proj.	0	35.8	35.7	35.8	35.7	104	104.7	104	104.2	104	104.2	104
Act.	0	0.7	0.3	0	0	12.8	118.5	0	78.5			

NON-EXPENDABLE EQUIPMENT (THOUSANDS OF DOLLARS)[1c]

Proj.	0	0	0	0	0	0	0	0	0			
Act.	0	0	0	0	0	0	0	15	0			

MATERIALS, SUPPLIES, TRAVEL AND OSC (THOUSANDS OF DOLLARS)[1d]

Proj.	2.9	2.2	2	2.2	3.4	3.1	3.8	3	2.3	2.3	4.4	2.1
Act.	1.7	2.1	3.1	2.1	3.2	4.1	2.2	2.3	3.2			

TOTAL (THOUSANDS OF DOLLARS)[1e]

Proj.	21.5	63.4	62.7	55.2	57	125	125.9	123.8	123.7	123.5	125.8	126.9
Act.	17.8	17.1	21.2	15.3	19.1	35.2	121.3	21.7	98.0			

KEY TO GRAPH

[illegible] PREDICTED TOTAL COSTS — ACTUAL TOTAL COSTS

PREDICTED CUMULATIVE — ACTUAL CUMULATIVE

NOTES

(1) [illegible]

(2) [illegible]

(3) [illegible]

(4) [illegible]

TABLE A-2. SUMMARY OF APPROXIMATE COSTS[a]

Expenditures on Program Through September 1	$348,765
Battelle Internal Expenditure on Program During September	25,500
Chemico Billings Paid During September	70,500
Total Cumulative Expenditures as of October 1	$444,765
Estimated Expenditures of Chemico in September	45,000
Purchase Order Commitments	436,675
Expended or Committed	$926,440

(a) Costs do not include the Battelle fee.

In the last monthly progress report we explained that a document outlining Chemico's major reasons for a projected cost increase was to be prepared by them and transmitted along with Battelle's comments to OCR and AGA. This information was sent on September 18.

On September 21 a meeting was held in Washington with the OCR Operating Committee, Battelle-Columbus, and Chemico participating. The cost problem was discussed at that time but no resolution of the problem resulted from the meeting. As of this reporting date, the problem is still unresolved.

BATTELLE-COLUMBUS LABORATORIES
PERSONNEL ASSIGNED TO PROJECT*

(1) W. M. Goldberger
(2) W. C. Corder
(3) R. R. Adams
(4) T. L. Tewksbury
(5) H. C. Meeks
(6) H. R. Batchelder (Staff Consultant)
(7) J. A. Lowman
(8) B. J. Shankle
(9) E. A. Wasto
(10) R. E. King
(11) R. D. Fischer

CHEMICAL CONSTRUCTION CORPORATION
PERSONNEL ASSIGNED TO PROJECT*

(1) F. W. Peterson
(2) E. M. Ezcurra
(3) E. Coles
(4) L. LaPadula
(5) H. Osborne

---

*Only staff who devote significant portions of their time to the program are listed. Various others have temporary assignments.

BCL-MPR-10

TECHNICAL SECTION

of

PROGRESS REPORT NO. 10

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

November 15, 1973

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

TECHNICAL SECTION

of

PROGRESS REPORT NO. 10

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

from

BATTELLE
Columbus Laboratories

November 15, 1973

INTRODUCTION AND PROJECT OBJECTIVE

This progress report describes work completed by Battelle on the Coal Gasification Program during the period October 15-November 14. The section that follows is the technical section. The administrative and financial section is appended.

The general objective of the current contract is development of a two-stage fluidized-bed process utilizing a self-agglomerating fluidized-bed burner as part of a practical and economical method for producing synthesis gas by steam gasification of coal. The developed process is to be useful as a part of a system for producing synthetic pipeline gas or for other purposes.

Pursuant to the general objective, a 25-ton-a-day-of-coal Process Development Unit (PDU) is to be erected and operated and the following aspects of the process explored:

- The operability of a self-agglomerating fluidized-bed coal burner operating on an Eastern bituminous coal under pressure and using air for combustion.
- The mechanical feasibility of continuously circulating a burden of hot-ash agglomerates between fluidized-bed burner and fluidized-bed gasifier vessels at 100 psig of pressure and the rates and temperatures required for effective heat transfer.

- The operability of integrated fluidized-bed burner and gasifier vessels both fed by Eastern bituminous coal (or char in the case of the burner) and operating at 100 psig of pressure. The gasifier is to be fluidized by steam and the endothermic heat of gasification is to be provided by the circulating burden of hot-ash agglomerates.
- The operability over extended time periods of a power-recovery turbine using hot, fluidized-bed burner effluent gases as the turbine working fluid.
- The factors that influence the long-term operability of the process. Included is to be the gathering of data on all key process variables and their effect on the characteristics of the process.

Concurrent with operation of the PDU, sufficient process data and information will be acquired to permit scale-up of the process to its next logical stage of development.

SUMMARY

During this reporting period, work was continued by Chemico on the detailed design and procurement of equipment for the Battelle Coal Gasification PDU.

Activities previously initiated by Battelle not directly related to the PDU installation were also continued. The major activity on the program in this reporting period by Battelle has been in working with the subcontractor on the acquisition of PDU equipment. A nominal amount of coal characterization work was continued. Other nominal activity by Battelle has been on obtaining permits. An increased amount of attention has been given to specifying and making arrangements for acquisition of the turbine.

WORK COMPLETED

Contractual

The subcontract between Battelle and Chemico for the detailed design, construction, and installation of the PDU was approved by OCR during this reporting period. The subcontract was signed by Battelle and Chemico during this period.

Detailed Engineering Design of the PDU

Chemico Activity

A detailed schedule has not as yet been submitted by Chemico. Chemico has projected a February 1 construction start date and a July 15 date for PDU completion.

Chemico has concentrated on preparation of updated P and I's and flowsheets, equipment requisitions, summaries of bids for equipment received, and recommendations for purchase. A synthesis of information provided by Chemico's status report to us of November 2 and information obtained by our resident Project Engineer, R. R. Adams, provides the following status of scheduled activities.

- Flow Diagrams and Data Sheets. The process flow diagrams are now firm and are ready for final issue by Chemico. The heat and material balance calculations have also been completed by Chemico.

We received preliminary copies of certain of the flow diagrams for utility sections of the PDU, including those for the cooling water, inert gas, and natural gas distribution systems. We understand that updated versions of these are in drafting at Chemico.

• Requisitions and Purchases. Table 1 provides Battelle's summary of the status of procurement of items of process equipment. This is in general agreement with information provided by Chemico's November 2 status report. A more detailed listing of the items of equipment for the PDU which are in some stage of the procurement cycle is appended as Table A-1. An estimate of the current status of each item is also indicated.

Table I and the listing of Table A-1 represents about 75 percent of the expected PDU requisitions. Chemico estimates that approximately an additional 20 percent of the requisitions are either being prepared or are under review by them. Less than 5 percent have not been started.

• P&I Diagrams. We have discussed versions of the process P&I diagrams with Chemico regarding start-up, operation, and shutdown. Work is proceeding with the engineering of final process P&I's and we understand the preliminaries are being continually updated. The utility P&I's are in drafting at Chemico.

• Structural Steel Design and Civil Engineering. Calculations for the "outer structure" (the one supporting the coal feed hoppers, etc) were completed. These calculation sheets were transmitted to the structural steel fabricator to permit take-offs and detailing. Calculations for the other, "inner structure", will be completed when some revisions currently in progress on the plot plan and elevation are concluded. The inner structure supports the Gasification Section of the PDU.

Chemico informs us that drawings for the outer structure will be finished by mid-November.

A supplier for the anchor bolts has been selected, however, to date, one for the reinforcing bars has not. Although the "unit price" requisition for reinforcing bars has been out for a considerable period of time, vendors appear to be slow in responding.

TABLE 1. PROCESS EQUIPMENT STATUS SUMMARY

Process Area[a]	Total Items	Not Requisitioned	Requisitions Out	Purchase Approved
100	5	1	3	1
200	11	3	1	7
300	8	3	3	2
400	9	0	2	7
500	19	14	0	5
600	13	3	9	1
700	10	2	4	4
800	12	7	4	1
Misc[b]	9	2	3	4
	96	35	29	32

(a) The section numbers and corresponding description section names are:

Section	Name
100	Coal Receiving and Storage
200	Coal Preparation and Grinding
300	Coal Pretreatment
400	Coal Feed System
500	Coal Gasification
600	Gas Treatment
700	Air, Inert Gas, and Natural Gas Utilities
800	Steam and Water Utilities

(b) Structural steel, anchor bolts, reinforcing bars, etc.

• Electrical. A one-line drawing for the high voltage electrical distribution system was completed by Chemico. Consideration has also been given to the PDU lighting and low voltage, incidental electrical power systems.

• Piping. Piping analytical work is in progress at Chemico. They expect to begin stress calculations for the hot piping as soon as the inner structure plot plan and elevation is firm.

• Expediting. Chemico's personnel visited the coal pulverizing mill vendor's shop to assure proper maintenance of the mill schedule.

Battelle Activity Directly Related to Detailed Design of the PDU

Substantial activity has concerned the examination of bids and bid analyses transmitted by Chemico to Battelle. In addition to R. R. Adams' technical liaison activity with Chemico, meetings have been held between Battelle and Chemico engineers to discuss special technical points.

Work by Battelle's Plant Facilities Department, previously reported in progress at the West Jefferson site, is currently suspended while we await disposition of contractual matters noted in the financial section of this report.

• Turbine Specification. A letter was sent to 12 candidate companies to determine interest in supplying the gas turbine for the PDU. Some replies have been received to our letter and we are currently examining them.

• Work Related to Environmental Impact of the PDU. As requested by the State of Ohio EPA, we have provided them with the anticipated start of construction and start-up dates for the PDU.

Other Work Related Indirectly to PDU Design

Reports

Reports on experimental work conducted in the scale model of the Burner-Gasifier System and on the mathematical model of the gasification process have not yet been completed. Completion of these reports has been subordinated to work more directly related to design and construction of the PDU.

Coal Characterization and Bench-Scale Fluidized-Bed Studies

In the previous monthly it was noted that additional experiments directed at examining the self-agglomerating behavior of candidate coals were in progress. Another fluidized-bed vessel with a different type of gas distributor was used for these experiments which are now concluded. We presently are doing analytical work on various samples from the experiments.

PROBLEMS AND RECOMMENDATIONS

The problems of present concerns are, as noted in previous monthly progress reports, related to the increase in subcontract costs and the PDU installation schedule.

With the construction start and PDU completion dates now estimated by Chemico, we can no longer complete the original program scope within the allotted time. When the new detailed schedule promised by Chemico is forthcoming, we can reevaluate the overall program schedule.

Battelle recommendations have been provided previously.

WORK PLAN AND SCHEDULE

Major emphasis will be given to our activities associated with installation of the PDU. Work will also be continued on analysis of the data acquired in the characterization studies of Phase II-A.

APPENDIX

DETAILED STATUS OF EQUIPMENT PROCUREMENT

TABLE A-1. STATUS OF PDU EQUIPMENT PROCUREMENT

1. Purchase orders have been authorized for the following items:

Equipment Item Number	Name	OCR/AGA Authorization Sheet Serial Number
G-101	Coal Pulverizer Surge Hopper	2
D-201	Inert Gas Generator	3
K-201	Main Fan	3
K-202	Auxiliary Fan	3
K-203	Combustion Air Blower	3
O-201	Coal Pulverizer	3
P-201	Cyclone Separator	3
P-203	Bag Filter	3
O-301	Screw Conveyor Cooler	11 Rev. 1
P-301	Coal Pretreater Cyclone	9
P-401A/B	Bag Filters	14
G-401A	Combustor Feed Bin	2
G-401B	Gasifier Feed Bin	2
G-402	Combustor Feed Pressure Hopper	2
G-403	Combustor Feed Injection Hopper	2
G-404	Pretreated Coal Receiving Bin	2
G-405	Gasifier Feed Pressure Hopper	2
G-406	Gasifier Feed Injection Hopper	2
H-501	Combustor Vessel	6
H-502	Gasifier Vessel	6
O-502	Ash and Char Conveyor Cooler	11 Rev. 1
P-501	Combustor Cyclone	9
P-502	Gasifier Cyclone	9
G-603	Sludge Settler Tank	13
E-604	Recycle Make Gas Cooler	5
G-701A&B	Process Air Receivers	1
K-701A&B	Process Air Compressors	1
G-802	High Pressure Water Storage Tank	13
D-803	Steam Superheater	12
	• Panel Instruments	4
	• Unit Price Structural Steel	7
	• Weigh Systems	8
	• Gas Analyzers	10
	• Anchor Bolts (unit price)	None Required

TABLE A-1. (Cont)

2. Bids have been received by Chemico on the following items. These bids have been reviewed by Chemico, their recommendations have been made to Battelle and requests for authority to purchase will be submitted to OCR/AGA after Battelle's review.

D-702	Inert Gas Generator Package
G-702	Inert Gas Receiver

3. Initial bids or revised bids have been received on the following items by Chemico. They are currently evaluating the bids and will transmit their recommendations to us very soon.

None currently.

4. The following items are out for bids

G-102	Coal Receiving Hopper
R-101	Grizzly
K-204	Screened Coal Blower
P-204	Vibrating Screen
O-205	Coarse Coal Conveyor-Elevator
J-301	Oil-Solids Pump
P-302	Pretreated Coal Bag Filter
K-303	Pretreated Coal Blower
J-601A&B	Venturi Circulating Pumps
J-602A&B	Venturi Circulating Pumps
D-602	Combustor Furnace with Stack
D-802	Package Steam Boiler
R-803	Cooling Tower and Erection
R-804	Water Treatment System

- Reinforcing Bars
- Multipoint Temperature Indicators and Recorders
- Annunciators

V-020	Transformer Substations

5. Requisitions have been drafted on the following items and are currently being reviewed or revised at Chemico:

V-050	Instrument Control Panel

TABLE A-1. (Cont)

D-501	Start-Up Heater
H-501	Combustor Refractories
H-502	Gasifier Refractories
G-501	Combustor Cyclone Receiving Hopper
G-502	Combustor Cyclone Letdown Hopper
G-503	Gasifier Cyclone Receiving Hopper
G-504	Gasifier Cyclone Letdown Hopper
G-505	Char Receiving Hopper
G-506	Char Letdown Hopper
G-5C9	Gasifier Ash Letdown Hopper
G-510	Combustor Ash Letdown Hopper
G-511	Cooler Conveyor Receiving Hopper
K-603	Recycle Make Gas Booster
G-703	Instrument Air Receiver
K-703A&B	Natural Gas Boosters
V-801	Emergency Electrical Generator

6. Among the items upon which no specifications for requisition have been written by Chemico yet are the following:

H-301	Coal Pretreater
R-301	Pretreater Venturi Scrubber
P-503	Vibrating Screen
E-601	Semple Gas Cooler
R-601	Flue Gas Venturi
R-602	Make Gas Venturi
R-701	Instrument Air Dryer Package
J-801A&B	Boiler Feedwater Pumps
R-801	Boiler Feedwater Treatment System

FINANCIAL AND ADMINISTRATIVE SECTION

of

PROGRESS REPORT NO. 10

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

November 15, 1973

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

FINANCIAL AND ADMINISTRATIVE SECTION

of

PROGRESS REPORT NO. 10

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CONTRACT NO. 14-32-0001-1513

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from

BATTELLE
Columbus Laboratories

November 15, 1973

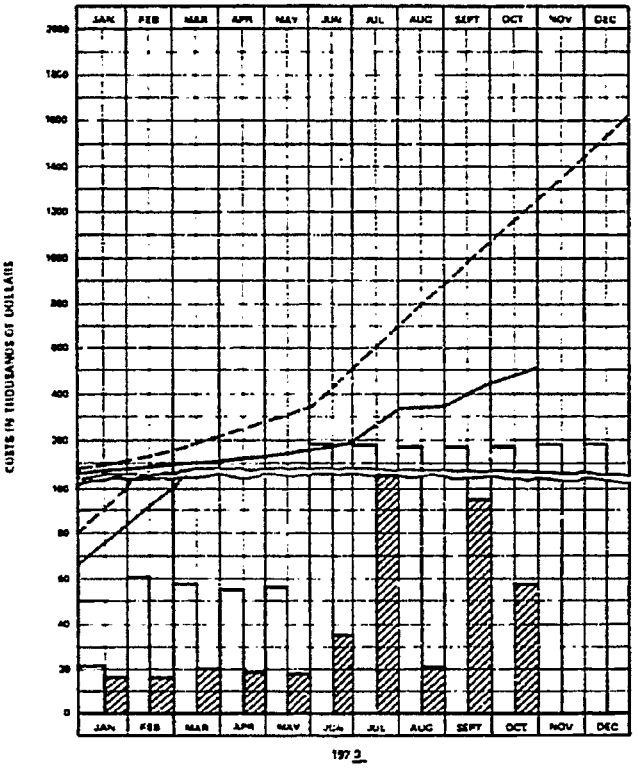
Table B-1 presents the Task Cost and Manpower Projection form for the month ending October 31, 1973. All billings received by Battelle from Chemico to date have been paid. The most recent Chemico billing was for New York office costs for the month of September and their fee for the period mid-September to mid-October. Total disbursements to Chemico are $224,899.97.

Chemico estimates their New York office costs and fee through October 31 to be about $51,000. Because no billing for October costs has been received from Chemico yet, these are not included in Table B-1. Consequently, it is estimated by Battelle that a total of about $276,000 has been spent by Chemico on engineering, procurement, and other activities related to their current phase of work. Chemico has been authorized to commit an additional $566,033.55 to suppliers of equipment for the PDU.

The cumulative expenditures of Battelle, including payments to Chemico to date are, as shown in Table B-2 and drawn on Table B-1, about $502,000. The total amount either spent or committed as of November 1 is about $1,120,000 or 27.4 percent of the 4.1 million dollar contract funding. The percentage of the presently encumbered 2.4 million dollars spent or committed is about 46.7 percent.

TABLE B-1.

BATTELLE PDU
TASK COST AND MANPOWER PROJECTIONS
MONTH ENDING OCTOBER 31, 1973



MANPOWER (MAN-MONTHS)

Pred	4.4	5.8	5.5	4.2	4.6	5.1	5.1	4.1	4.2	4.7	4.2	5.3
Act.	5.3	4.4	5.3	5.0	4.2	5.3	5.7	5.8	6.2	6.2		

DIRECT LABOR & OVERHEAD COSTS (THOUSANDS OF DOLLARS)

Pred	18.6	21.4	20	16.2	14.4	17.9	17.9	16.8	17.2	17.2	17.2	19.8
Act.	16.6	14.3	17.8	17.6	15.9	18.3	18.6	18.2	22.3	23.5		

SUBCONTRACT AND CONSULTANT COSTS (THOUSANDS OF DOLLARS)[1]

Pred.	0	36.8	36.7	36.8	36.7	164	164.2	164	164.2	164	164.2	164
Act.	0	0.7	0.3	0	0	12.8	110.5	0	70.5	31.1		

NON-EXPENDABLE EQUIPMENT (THOUSANDS OF DOLLARS)[2]

Pred.	0	0	0	0	0	0	0	0	0	0		
Act.	0	0	0	0	0	0	0	.15	0	0		

MATERIALS, SUPPLIES, TRAVEL AND ODC (THOUSANDS OF DOLLARS)[3]

Pred.	2.9	2.2	2	2.2	3.4	3.1	3.8	3	2.3	2.3	4.4	2.1
Act.	1.2	2.1	3.1	2.1	3.2	4.1	2.2	3.3	3.2	2.9		

TOTAL (THOUSANDS OF DOLLARS)[4]

Pred.	21.5	60.4	58.7	55.2	57	186	185.9	183.8	183.7	183.5	185.8	185.9
Act.	17.6	17.1	21.2	19.7	19.1	35.2	131.8	21.7	96.0	57.5		

KEY TO GRAPH:

- PREDICTED TOTAL COSTS
- ACTUAL TOTAL COSTS
- PREDICTED CUMULATIVE
- ACTUAL CUMULATIVE

NOTES

(1) OUTSIDE CONSULTANTS

(2) NON EXPENDABLE EQUIPMENT TO BE PURCHASED BY SUBCONTRACTOR IS INCLUDED IN SUBCONTRACT CATEGORY

(3) COST OF BATTELLE RESIDENT CONSULTANTS INCLUDED IN THIS CATEGORY

(4) DOES NOT INCLUDE BATTELLE FEE

TABLE B-2. SUMMARY OF APPROXIMATE COSTS[a]

Expenditures on program through October 1	$ 444,765
Battelle internal expenditure on program during October	26,381
Chemico billings paid during October	31,074
Total cumulative expenditures as of November 1	502,220
Estimated expenditures of Chemico in October	51,000
Purchase order commitments	566,034
	$1,119,254

(a) Costs do not include the Battelle fee.

On September 21, a meeting was held in Washington with the OCR Operating Committee, Battelle-Columbus, and Chemico participating. The projected cost increase for the Chemico subcontract from $1,870,000 to $3,143,000 was discussed at that time but no resolution of this problem resulted from the meeting.

Along with informing us of an anticipated construction start date of February 1, Chemico has indicated that they must have the contract price extended prior to preconstruction activity. This preconstruction activity involves a prejob conference with the applicable local trade unions and should be initiated in December. Based on this Chemico information, Battelle has formulated the milestone table shown as Table B-3. We believe it is essential that these milestones be met if further serious delay of the schedule is to be avoided.

In our letter of September 18 to OCR, with which the Chemico cost proposal revision statement was transmitted, we advised that the original scope of the Battelle program could not be completed within the $4.1 MM appropriation established by our OCR contract for this project. Because of the delay in the PDU installation schedule, we now also believe it is unrealistic to expect to fully complete the operating phase of the program by mid-1975.

TABLE B-3. MILESTONE DATES REQUIRED TO MEET THE PDU CONSTRCUTION SCHEDULE[a]

December 3	Battelle to have approval to increase subcontract price to $3.143 MM
December 10	Chemico to start setup of trade union meetings
January 7	Hold trade union meetings
January 21	Start construction (layout foundations)
February 4	Begin concrete pouring
February 18	Arrival of steel for first structure
February 25	Begin steel erection

(a) Compiled by Battelle based on information provided by Chemico.

We offer the following as possible alternatives to pursuing the project.

(1) Propose extension of the deadline for performance of all work within the original scope of the program for a higher than anticipated cost.

(2) Continue the PDU installation under the present $4.1 MM appropriation but modify the scope of PDU operation to commit more funds to the subcontractor and to demonstrate operability of the process to the maximum extent possible with the remaining funds.

These alternatives are essentially the same as noted in our September 18 letter.

BATTELLE-COLUMBUS LABORATORIES
PERSONNEL ASSIGNED TO PROJECT*

(1) W. M. Goldberger
(2) W. C. Corder
(3) R. R. Adams
(4) T. L. Tewksbury
(5) H. C. Meeks
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(11) R. D. Fischer

CHEMICAL CONSTRUCTION CORPORATION
PERSONNEL ASSIGNED TO PROJECT*

(1) F. W. Peterson
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(3) E. Coles
(4) L. LaPadula
(5) H. Osborne

*Only staff who devote significant portions of their time to the program are listed. Various others have temporary assignments.

BCL-mPR--11

TECHNICAL SECTION

of

PROGRESS REPORT NO. 11

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

December 14, 1973

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

TECHNICAL SECTION

of

PROGRESS REPORT NO. 11

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

from

BATTELLE
Columbus Laboratories

December 14, 1973

INTRODUCTION AND PROJECT OBJECTIVE

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The general objective of the current contract is development of a two-stage fluidized-bed process utilizing a self-agglomerating fluidized-bed burner as part of a practical and economical method for producing synthesis gas by steam gasification of coal. The developed process is to be useful as a part of a system for producing synthetic pipeline gas or for other purposes.

Pursuant to the general objective, a 25-ton-a-day-of-coal Process Development Unit (PDU) is to be erected and operated and the following aspects of the process explored:

- The operability of a self-agglomerating fluidized-bed coal burner operating on an Eastern bituminous coal under pressure and using air for combustion.
- The mechanical feasibility of continuously circulating a burden of hot-ash agglomerates between fluidized-bed burner and fluidized-bed gasifier vessels at 100 psig of pressure and the rates and temperatures required for effective heat transfer.

- The operability of integrated fluidized-bed burner and gasifier vessels both fed by Eastern bituminous coal (or char in the case of the burner) and operating at 100 psig of pressure. The gasifier is to be fluidized by steam and the endothermic heat of gasification is to be provided by the circulating burden of hot-ash agglomerates.
- The operability over extended time periods of a power-recovery turbine using hot, fluidized-bed burner effluent gases as the turbine working fluid.
- The factors that influence the long-term operability of the process. Included is to be the gathering of data on all key process variables and their effect on the characteristics of the process.

Concurrent with operation of the PDU, sufficient process data and information will be acquired to permit scale-up of the process to its next logical stage of development.

SUMMARY

During this reporting period, work was continued by Chemico on the detailed design and procurement of equipment for the Battelle Coal Gasification PDU.

Activities previously initiated by Battelle not directly related to the PDU installation were also continued. The major activity on the program in this reporting period by Battelle has been in working with the subcontractor on the acquisition of PDU equipment. A nominal amount of coal characterization work was continued. Other nominal activity by Battelle has been on obtaining permits. An increased amount of attention has been given to specifying and making arrangements for acquisition of the turbine.

WORK COMPLETED

Contractual

The subcontract between Battelle and Chemico has now been fully negotiated and signed by all parties. Chemico work on the detailed design, procurement, construction and installation of the PDU is progressing under this subcontract.

Detailed Engineering Design of the PDU

Chemico Activity

Although promised the week of December 10, a detailed schedule was not available from Chemico in time to include it in this monthly report. Chemico has most recently projected a February 1 construction-start date and a July 15 date for PDU completion.

Chemico has continued their work on the detailed design and procurement of PDU components during this reporting period. A synthesis of information provided by Chemico's weekly reports of November 16, November 30, and December 7, their monthly report of December 10, and information obtained by our resident Project Engineer, R. R. Adams, provides the following status of scheduled activities.

- Flow Diagrams and Data Sheets. The process flow diagrams have remained reasonably fixed since their last issue. The minor changes to the flowsheets since the last issue do not at this time amount to enough to justify a reissue in Chemico's opinion.

- Requisitions and Purchases. Table 1 provides Battelle's summary of the status of procurement of the major items of process equipment. We estimate that 41 percent of the major items of process equipment have been fully approved for purchase and that 30 percent of the equipment has not been requisitioned yet. Chemico's estimate contained in their monthly for November is somewhat higher in the first category and somewhat

TABLE 1. MAJOR PROCESS EQUIPMENT ITEMS STATUS SUMMARY

Process Area[a]	Total Items	Not Requisitioned	Requisitions Out	Purchase Approved
100	5	1	3	1
200	11	0	4	7
300	8	3	3	2
400	8	0	0	8
500	19	11	3	5
600	10	5	3	2
700	7	2	1	4
800	10	4	4	2
Misc[b]	12	1	5	6
	90	27	26	37

(a) The section numbers and corresponding descriptive section names are:

Section	Name
100	Coal Receiving and Storage
200	Coal Preparation and Grinding
300	Coal Pretreatment
400	Coal Feed System
500	Coal Gasification
600	Gas Treatment
700	Air, Inert Gas, and Natural Gas Utilities
800	Steam and Water Utilities.

(b) Structural steel, anchor bolts, reinforcing bars, etc.

lower in the second category. This difference may be due to interpretation of terminology.

A detailed listing of the items of equipment for the PDU which are in some stage of the procurement cycle is appended as Table A-1. An estimate of the current status of each item is also shown in Table A-1.

Table 1 and the listing of Table A-1 represent about 75 percent of the expected PDU requisitions.

- Process P and I Diagrams. Updated versions of the process piping and instrumentation diagrams were reviewed with Chemico. The most recent version is under continuing examination at Battelle particularly with regard to the location of control-board mounted instruments on the panel. This review is being conducted primarily by Battelle's Supervisor of Operations, T. L. Tewksbury, with particular attention to operability of the controls specified.

In the absence of a detailed schedule from Chemico we do not know their planned date for issuance of final P and I's. The version we are currently reviewing appears to incorporate Battelle and Braun comments to date.

- Utility P and I Diagrams. Partially completed P and I diagrams for the cooling water and inert gas utility sections of the PDU have been provided to us by Chemico. We are presently examining these.

Because Chemico does not plan to issue utility section flowsheets, we have requested that the stream flows and conditions be tabulated on the P and I's. We assume Chemico is doing this.

- Structural Steel Design and Civil Engineering. We understand that Chemico is in the process of checking the drawings made for the outer steel structure against final equipment drawings. The "outer structure" is the one which supports the coal feed hoppers and other equipment ancillary to the gasification section of the PDU. The calculations for the outer structure have been provided to the Gremp Steel Company (the fabricator) so it is assumed they are involved in this Chemico review.

We are informed that preliminary calculations for the "inner steel structure" (which supports the gasification section of the PDU) have been concluded. We know that the inner structure design is undergoing some modifications based on these calculations. To assist in formulating the final design of the inner structure, Chemico is building a scale model of the burner and gasifier vessels and associated piping. This model will eventually be used as a part of the overall scale model of the PDU provided by Chemico.

On December 7, Chemico informed us that foundation drawings for the outside structure had been started.

We understand that Chemico has not received bids on reinforcing bars yet. Because of the tightness in the local area for "rebars" we are suggesting that Chemico expedite obtaining one or more quotes.

- Electrical. In addition to the one-line drawing for the high-voltage electrical distribution system reported as completed by Chemico in our October monthly, agreement has now been reached on what incidental electrical power will be provided by Battelle and what Chemico is responsible for.

A request for authorization to purchase electrical substations has been submitted for OCR/AGA approval. The delivery on these items is very long (30 weeks); consequently, Battelle has agreed to make the final transformer connections in place of Chemico if Chemico believes this delay will hinder their completion of PDU construction by mid-July. Chemico in that case will "stub in" for the transformers.

- Piping. Piping analytical work is proceeding at a nominal pace at Chemico. We have been informed that stress calculations on hot piping await the firming up of the structural steel design of the inner structure.

The process P and I's we have received indicate that much of the cold piping has been sized and recommended materials of construction have been specified.

• Equipment Deliveries. Chemico has been informed by the Williams Patent Crusher and Pulverizer Company that the mill for the PDU will be ready for inspection at the end of January. Presumably it will be shipped shortly after that.

During this reporting period the first equipment was received at the West Jefferson site. Several items of process air compressor equipment arrived from Ingersoll-Rand.

• Construction. Chemico has not started construction at the site. They still estimate the start of Construction as February 1.

Battelle Activity Directly Related to Detailed Design of the PDU

Major activity by Battelle related to the PDU design has concerned examination of bids and bid analyses transmitted by Chemico to Battelle, analysis of Chemico's equipment specifications contained in their requisitions, and review of process P and I's and other technical information received from Chemico.

Administratively, Bob Adams has continued in residence at Chemico's offices for purposes of expediting approvals, expediting interchange of technical information and generally monitoring the subcontractor's activities. He has been joined by F. Crowe and L. Carau, the sponsor's representatives, for much of this time.

Site modification activities initiated by Battelle's Plant Facilities Department which were reported to be suspended in last month's report have been reinitiated at a nominal level. The design for an auxiliary building to be provided at the site by Battelle to house compressors and other equipment is being completed. It is planned that this design will be submitted for bidding prior to January 1. The piping runs that must be added to provide Chemico utilities at the battery limits of the PDU site in and adjacent to building JS-2 are also being determined. It is expected that these modifications will be handled by local contractors and arrangements will be made with them within the next month.

The time has passed when road improvements planned at the site can be made before spring. However, it is believed that the present roads at the site are adequate to support the Chemico construction activity. In summary, we are told by the Plant Facilities Department that nothing related to Battelle's activities at the site should prevent or delay Chemico's stated construction start date of February 1.

- Turbine Specification. The last monthly explained that a letter was sent to 12 candidate companies to determine interest in supplying the gas turbine for the PDU. In general, initial response to our inquiry has been very good. Airesearch, Boeing (Boeing turbine now manufactured by Steward-Davis Incorporated), Elliott, United Aircraft, and General Electric expressed some interest. No-bid letters were received from International Harvester-Solar, Teledyne-CAE, and Ingersoll-Rand. The reasons for the no-bids were that these organizations do not make a turbine small enough for use in the PDU. A lack of interest in developing such small hardware was expressed in some cases. We still await responses from Detroit Diesel-Allison, Alco Engine Division of White Industrial Power, Inc., Westinghouse, and Worthington. Brown-Boveri has directed our inquiry to their engineering offices in Switzerland.

  Some of the responses received appear to be promising enough to pursue further. It is thought that a substantial lead time may be required by the supplier ultimately selected to provide the turbine. Consequently, we are anxious to proceed. The speed with which we are able to proceed with the turbine procurement is highly dependent upon the resolution of contractual matters discussed in the financial and administrative section of this report.

- Work Related to Environmental Impact of the PDU. A meeting is to be held between Battelle representatives and Ohio EPA representatives the week of December 17. While the meeting will not be solely on the subject of the Coal Gasification PDU, we hope to determine at that time what action is being taken by the EPA on our permit requests.

Other Work Related Indirectly to PDU Design

Coal Characterization and Bench-Scale Fluidized-Bed Studies

The activity during this reporting period was concerned with analysis and correlation of data from self-agglomerating combustion experiments made with several coals in bench-scale fluidized beds.

PROBLEMS AND RECOMMENDATIONS

The primary problems are those related to increased subcontract costs and the PDU installation schedule. Battelle recommendations on the former problem have been provided previously.

At present we do not have a detailed schedule from Chemico. Without their schedule it is not possible to meaningfully reevaluate the overall program schedule. We are extremely hopeful of having in hand a detailed engineering, procurement and construction schedule from Chemico immediately. Our recommendations, should we fail to receive Chemico's schedule immediately, are contained in the financial and administrative section of this report.

WORK PLAN AND SCHEDULE

Major emphasis will be given to our activities associated with installation of the PDU. Work will also be continued on analysis of the data acquired in the characterization studies of Phase II-A.

APPENDIX

DETAILED STATUS OF EQUIPMENT PROCUREMENT

TABLE A-1. STATUS OF PDU EQUIPMENT PROCUREMENT

1. Purchase orders have been authorized for the following items:

Equipment Item Number	Name	OCR/AGA Authorization Sheet Serial Number
G-101	Coal Pulverizer Surge Hopper	2
D-201	Inert Gas Generator (for Coal Pulverizer)	3
K-201	Main Fan	3
K-202	Auxiliary Fan	3
K-203	Combustion Air Blower	3
O-201	Coal Pulverizer	3
P-201	Cyclone Separator	3
P-203	Bag Filter	3
O-301	Screw Conveyor Cooler	11 Rev. 1
P-301	Coal Pretreater Cyclone	9
P-401A/B	Bag Filters and Bin Vents	14
G-401A	Combustor Feed Bin	2
G-401B	Gasifier Feed Bin	2
G-402	Combustor Feed Pressure Hopper	2
G-403	Combustor Feed Injection Hopper	2
G-404	Pretreated Coal Receiving Bin	2
G-405	Gasifier Feed Pressure Bin	2
G-406	Gasifier Feed Injection Bin	2
H-501	Combustor Vessel	6
H-502	Gasifier Vessel	6
O-502	Ash and Char Conveyor Cooler	11 Rev. 1
P-501	Combustor Cyclone	9
P-502	Gasifier Cyclone	9
G-603	Sludge Settler Tank	13
E-604	Recycle Make Gas Cooler	5
G-701A&B	Process Air Receivers	1
K-701A&B	Process Air Compressors	1
D-702	Inert Gas Generator	16
G-702	Inert Gas Receiver Tank	16
G-802	High Pressure Water Storage Tank	13
D-803	Steam Superheater	12
	• Panel Instruments	4
	• Unit Price Structural Steel	7
	• Weigh Systems	8
	• Gas Analyzers	10
	Anchor Bolts (unit price)	None Required
V-050	Instrument Control Panel	15

TABLE A-1. (Cont)

2. Bids have been received by Chemico on the following items. These bids have been reviewed by Chemico, their recommendations have been made to Battelle and requests for authority to purchase have been submitted to OCR/AGA after Battelle's review.

R-701	Instrument Air Dryer Package (Serial No. 18)
V-020	Transformer Substations (Serial No. 17)

3. Initial bids or revised bids have been received on the following items by Chemico. They are currently evaluating the bids and will transmit their recommendations to us very soon.

P-204	Vibrating Screen

4. The following items are out for bids

G-102	Coal Receiving Hopper
R-101	Grizzly
O-101	Coarse Coal En Masse Conveyor/Elevator
K-204	Screened Coal Blower
O-205	Ground Coal Conveyor/Elevator
P-205	Screened Coal Cyclone
J-301A&B	Oil-Solids Pumps
P-302	Pretreated Coal Bag Filter
K-303	Pretreated Coal Blower
D-501	Start-Up Heater
H-501	Combustor Refractories
H-502	Gasifier Refractories
J-601A&B	Venturi Circulating Pumps
J-602A&B	Venturi Circulating Pumps
D-602	Combustor Furnace with Stack
G-801	Deaerator
D-802	Package Steam Boiler
R-803	Cooling Tower and Erection
R-804	Water Treatment System (Cooling Tower)
	• Reinforcing Bars
U-030	Multipoint Temperature Indicators and Recorders
U-030	Annunciators
V-100	Motor Control Centers

TABLE A-1. (Cont)

5. Requisitions have been drafted on the following items and are currently being reviewed or revised at Chemico.

G-501	Combustor Cyclone Receiving Hopper
G-502	Combustor Cyclone Letdown Hopper
G-503	Gasifier Cyclone Receiving Hopper
G-504	Gasifier Cyclone Letdown Hopper
G-505	Char Receiving Hopper
G-506	Char Letdown Hopper
G-509	Gasifier Ash Letdown Hopper
G-510	Combustor Ash Letdown Hopper
G-511	Cooler Conveyor Receiving Hopper
K-603	Recycle Make Gas Booster Compressor
G-703	Instrument Air Receiver
K-703A&B	Natural Gas Booster Compressors

6. Among the items upon which no specifications for requisition have been written by Chemico yet are the following:

H-301	Coal Pretreater
R-301	Pretreater Venturi Scrubber
K-501	Start-Up Recycle Blower
P-503	Vibrating Screen
E-601	Sample Gas Cooler
R-601	Flue Gas Venturi
R-602	Make Gas Venturi
J-603	Transfer Pump
J-801A&B	Boiler Feedwater Pumps
R-801	Boiler Feedwater Treatment System
J-802	High-Pressure Water Storage Tank Pump
J-803A&B	Cooling Tower Water Pumps
V-801	Emergency Electrical Generator

FINANCIAL AND ADMINISTRATIVE SECTION

of

PROGRESS REPORT NO. 11

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

December 14, 1973

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

FINANCIAL AND ADMINISTRATIVE SECTION

of

PROGRESS REPORT NO. 11

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

from

BATTELLE
Columbus Laboratories

December 14, 1973

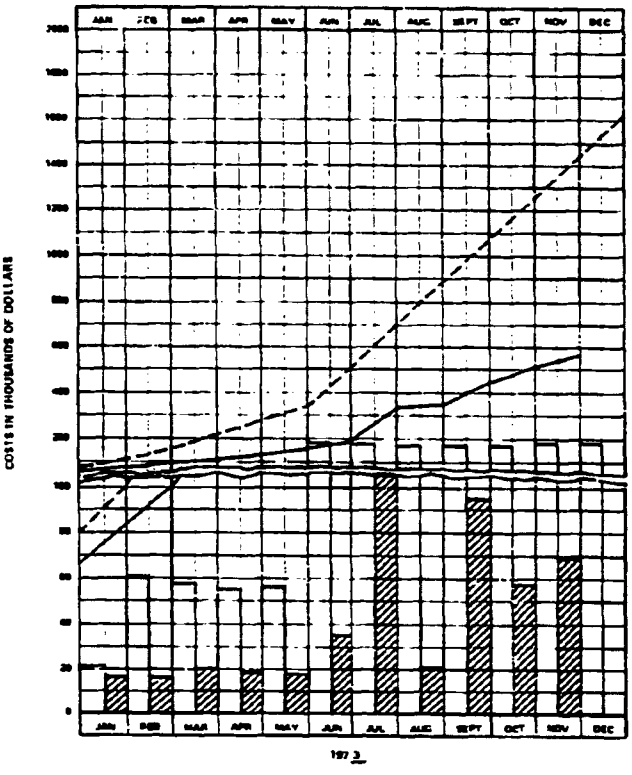
Table B-1 presents the Task Cost and Manpower Projection form for the month ending November 30, 1973. All billings received by Battelle from Chemico to date have been paid. The most recent Chemico billing was for New York office costs for the month of October and their fee for the period mid-October to mid-November. Total disbursements to Chemico are $276,097.15.

As shown in the attached monthly report of Chemico, they estimate their costs through November to be about $60,000. Because no billing for November costs has been received from Chemico yet, these are not included in Table B-1. Consequently, it is estimated by Battelle that a total of about 336,097 has been spent by Chemico on engineering, procurement, and other activities related to their current phase of work. Chemico has been authorized to commit an additional $700,000 (approximately) to suppliers of equipment for the PDU.

The cumulative expenditures of Battelle, including payments to Chemico to date are, as shown in Table B-2 and drawn on Table B-1, about $571,000. The total amount either spent or committed as of November 1 is about $1,331,000 or 32.5 percent of the 4.1 million dollar contract funding. The percentage of the presently encumbered 2.4 million dollars spent or committed is about 55.5 percent.

TABLE B-1.

BATTELLE PDU
TASK COST AND MANPOWER PROJECTIONS
MONTH ENDING NOVEMBER 30 1973



MANPOWER (MAN-MONTHS)

Pred.	4.6	5.8	5.5	4.2	4.6	5.1	5.1	4.1	4.2	4.7	4.2	5.3
Act.	5.3	4.4	5.3	5.0	4.2	5.3	5.7	5.8	6.2	6.2	2.6	

DIRECT LABOR & OVERHEAD COSTS (THOUSANDS OF DOLLARS)

Pred.	18.6	21.4	20	16.2	14.4	17.9	17.9	16.8	17.2	17.2	17.2	18.8
Act.	16.6	14.3	17.8	17.6	15.9	18.3	18.6	18.2	22.3	23.5	15.1	

SUBCONTRACT AND CONSULTANT COSTS (THOUSANDS OF DOLLARS)[1]

Pred.	0	36.8	36.7	36.8	36.7	164	184.2	164	164.2	164	164.2	164
Act.	0	0.7	0.3	0	0	12.8	110.5	0	70.5	31.1	51.3	

NON-EXPENDABLE EQUIPMENT (THOUSANDS OF DOLLARS)[2]

Pred.	0	0	0	0	0	0	0	0	0	0	0	
Act.	0	0	0	0	0	0	0	.15	0	0	0	

MATERIALS, SUPPLIES, TRAVEL AND ODC (THOUSANDS OF DOLLARS)[3]

Pred.	2.9	2.2	2	2.2	3.4	3.1	3.8	3	2.3	2.3	4.4	2.1
Act.	1.2	2.1	3.1	2.1	3.2	4.1	2.2	3.3	3.2	2.9	2.6	

TOTAL (THOUSANDS OF DOLLARS)[4]

Pred.	21.5	60.4	58.7	55.2	57	186	186.9	183.8	183.7	183.5	185.8	185.9
Act.	17.8	17.1	21.2	19.7	19.1	35.2	131.8	21.7	96.0	57.5	69.0	

KEY TO GRAPH:

PREDICTED TOTAL COSTS — ACTUAL TOTAL COSTS

PREDICTED CUMULATIVE — ACTUAL CUMULATIVE

NOTES

TABLE B-2. SUMMARY OF APPROXIMATE COSTS(a)

Expenditures on program through November 1	$ 502,000
Battelle internal expenditure on program during November	17,000
Chemico billings paid during November	51,300
Total cumulative expenditures as of December 1	571,000
Estimated expenditures of Chemico in November	60,000
Equipment commitments	700,000
	$1,331,000

(a) Costs do not include the Battelle fee.

On September 21, a meeting was held in Washington with the OCR Operating Committee, Battelle-Columbus, and Chemico participating. The projected cost increase for the Chemico subcontract from $1,870,000 to $3,143,000 was discussed at that time, however, to date there is no resolution of this problem.

When Chemico informed us in late October of an anticipated construction start date of February 1, they said that they must have the contract price extended prior to preconstruction activity which was to be started in December. This preconstruction activity involves a prejob conference with the applicable local trade unions. Based on this Chemico information, Battelle formulated the milestone table shown as Table B-3 and presented this in our last monthly. The first two milestone dates have passed and the actions indicated as required have not been accomplished.

Cost Problem

In the attached Chemico monthly report to Battelle, Chemico has made an analysis to determine the least amount of money they will have to commit in Engineering and Purchasing activities in order to permit field activity to proceed. This analysis indicates that within

TABLE B-3. MILESTONE DATES REQUIRED TO MEET THE PDU CONSTRUCTION SCHEDULE[a]

December 3	Battelle to have approval to increase subcontract price to $3.143 MM
December 10	Chemico to start setup of trade union meetings
January 7	Hold trade union meetings
January 21	Start construction (layout foundations)
February 4	Begin concrete pouring
February 18	Arrival of steel for first structure
February 25	Begin steel erection

the present authorized subcontract appropriation, Chemico cannot proceed with field activity at a steady rate.

From the Chemico monthly and conversations with them, we gather that their recommendation is to not begin field work at all unless they are authorized to commit the additional $1,273,000 above their currently authorized $1,870,000.

Chemico has indicated that they could begin field work if they had authorization to commit approximately $700,000 more than the $1,918,200 shown as "least amount to be spent" in their monthly. This is not their recommended method of proceeding.

Lacking guidance from OCR and AGA, Battelle is not in a position to authorize either course of action offered by Chemico. Our suggested alternatives to resolve the immediate problem were provided in the last monthly report.

Schedule Problem

We have repeatedly asked for a project schedule from Chemico, particularly since September. We have been told on almost a daily basis that the schedule would be forthcoming almost immediately. At the date of this writing a schedule has still not been provided but is again promised almost immediately.

The schedule is urgently needed by Battelle in order that our overall program schedule can be suitably evaluated.

We are fully aware of our obligation to OCR/AGA to provide them an updated schedule of activities. We have pointed this out to our subcontractor, both formally and informally, on numerous occasions and most recently, formally in a letter from our Mr. Evans to Chemico's Mr. Clarke on November 12.

We have been unable to determine why the Chemico schedule cannot be produced and we have no official statement from them on this matter. It is our presumption that the lack of a schedule is related to two things: (1) Chemico has not known whether to schedule for continuation of the program or for an orderly termination, or (2) the

assignment of manpower at Chemico has not permitted simultaneous production of a schedule and the other design and procurement activities they are engaged in.

Consideration of what alternatives are available to us if the promised schedule is not forthcoming and if it is not kept updated as contractually required, leaves us with few options. One obvious option appears to be to withhold payment of billings until we obtain compliance. We plan to do this. Other options are being considered.

BATTELLE-COLUMBUS LABORATORIES
PERSONNEL ASSIGNED TO PROJECT*

(1) W. M. Goldberger

(2) W. C. Corder

(3) R. R. Adams

(4) T. L. Tewksbury

(5) H. R. Batchelder (Staff Consultant)

(6) R. D. Fischer

CHEMICAL CONSTRUCTION CORPORATION
PERSONNEL ASSIGNED TO PROJECT*

(1) F. W. Peterson

(2) E. M. Ezcurra

(3) E. T. Coles

(4) J. B. Perrone

(5) H. Osborne

(6) P. S. Schlaff

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* Only staff who devote significant portions of their time to the program are listed. Various others have temporary assignments.

CHEMICO

Chemical Construction Corporation

ONE PENN PLAZA • NEW YORK, N. Y. 10001
(34th Street between 7th & 8th Avenues)
Telephone: (212) 239-3100 • Telex: 234110 • Cable: CHEMICONST, N. Y.

December 10, 1973

Mr. W. C. Corder
Minerals and Metallurgical Processing
Division
Battelle Memorial Institute
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

Letter No. CB-95
Contract 1947J
Re: Battelle's Columbus Laboratories
Coal Gasification
Process Development Unit

Monthly Report

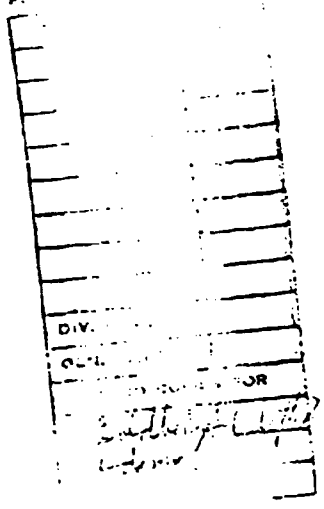
Dear Bill:

Attached is the Monthly Status Report as of December 3, 1973.

Very truly yours,

Fritz W. Peterson
Assistant Manager Operations

FWP:d
w/att.



JOB 1947

BATTELLE'S COLUMBUS LABORATORY
COAL GASIFICATION PDU
STATUS AS OF DECEMBER 3, 1973

A). Overall Status

The overall status is on a reasonably firm basis for a development type project and since Battelle has signed the subcontract we will be able to work without monetary restrictions for the immediate future. However, to maintain the momentum it is necessary that the price of the contract be extended from $1,270,000 to $3,143,000. This is illustrated by the analysis made below, using figures from the August 9, 1973 Estimate that was submitted to Battelle. These were incorporated in the Cost Control Estimate dated October 1, 1973. These figures show two columns.

The first column is the amount of money in the Estimate.

The second column is an estimate of the least amount of money that we will have to commit in Engineering and Purchasing activities so that Field Activities can be continued at a reasonably steady basis. This assumes that at some later date we can buy the remainder of the equipment and materials without affecting costs or schedule.

	Estimate 8/9/73	Least Amount To Be Spent
New York Office Salaries To maintain engineering almost all will have to be spent.	$ 247,000	$ 200,000
New York Office Expenses	50,000	25,000
Overhead	247,000	200,000

(continued)		Estimate 8/9/73	Least Amount To Be Spent
A-C	Foundations and Structural Material Since this is the first field work, we have to spend all of it.	$ 138,000	$ 138,000
D-R	Numbered Equipment We need this equipment not only for delivery purposes but, also, we need drawings for engineering. We will have to spend all of it.	843,000	843,000
S	Insulation	Sub.	Sub.
T	Piping To maintain continuity in construction we have to purchase almost all piping except drips and drains.	210,000	200,000
U	Instrumentation To maintain piping work we have to buy control valves and relief valves Panel Board (ordered) Load Cells (ordered) Analyzers (ordered) Nuclear Switches	290,000	130,700 17,000 11,000 26,500 6,000 191,200
V	Electrical Transformer and Substation	93,000	56,000
X	Painting	Sub.	Sub.

(continued)		Estimate 8/9/73	Least Amount To Be Spent
Y	Site Development	0	0
Subcontracts		$ 242,000	$ 18,000
	We have to install the refractory insulation and can delay the commitments for painting and electrical.		
Total Home Office, Material and Subcontracts		2,360,000	1,871,200
	Fee	47,000	47,000
	Total	$ 2,407,000	$ 1,918,200

The Labor Costs are:

Direct Labor	367,000
Total Field Expense	339,000
Remainder of Subcontracts	224,000
Total Labor and Expenses	930,000

NOTES:

1). The above figures have been reviewed with various people at Chemico. All say that the estimate of $1,918,200 is low, that for example: if you purchase equipment and materials then you are committed to receive the material in the field and/or pay storage charges. Neither are included in the $1,918,200. Field receiving costs are in the Total Field Cost Estimate of $930,000.

2). Usual sequence is engineering, purchasing and construction. The $2,360,000 represents the estimated costs of engineering and purchasing activities for the project. By decreasing the engineering and purchasing activities to $1,871,200, it is the same as saying that we can decrease these activities by 20.7% and not affect the schedule or costs in construction, which is very doubtful.

Chemico has a subcontract suthorizing Chemico to spend $1,870,000 and Chemico has made a request to extend this cost to $3,143,000.

The purpose of the above analysis is to see if it is possible to decrease the engineering and purchasing activities sufficiently so that meaningful construction activities could be undertaken within Chemico's present authorization of $1,870,000.

The study above shows that the lowest that engineering and purchasing activities can be lowered to, and still maintain project momentum, is $1,918,200. Since this is above the present authorization of $1,870,000, it appears that construction activities can only be started if additional monies are made available during the first half of December.

B. Financial Status

Purchase Orders and Letters of Intent placed	$ 627,275.30
Purchase Orders authorized	77,400.00
Billings up to November 7, 1973	276,097.15
Estimated Billing for November	60,000.00
Sub-total	$1,040,772.45
Estimated Billing for December	70,000.00
Total	$ 1,110,772.45

Engineering Change Orders Nos. 1, 2 and 3 are being completed in the Estim ating Department and will be forwarded to Battelle shortly. The cost will be in the range of $30,000 to $40,000.

B. Financial Status (continued)

The Comparative Cost Report is being prepared and will be issued to Battelle shortly.

We have had savings in some of our recent purchase orders that may offset the increased cost of E.C.O.s.

C. Material Status

(% Based on Estimated Cost)

1. D to R Equipment

		%
a.	Requisitions not started	2.8
b.	Requisitions being prepared	0.9
c.	Requisitions being reviewed or revised	7.1
d.	Requisitions being typed	2.2
e.	Requisitions out for bids	29.6
f.	Quotes being evaluated by Engineering	3.2
g.	Evaluations under Project review	
h.	Recommendations submitted to BCL	0.6
i.	Approved for purchase or letter of intent	8.1
j.	Equipment committed but not purchased	14.3
k.	Equipment purchased	31.2

2. A to C

a. Purchase requisition has been placed for structural steel on a unit price basis.

b. Rebars are being quoted on a unit price basis.

3. S to Z Equipment

a. Purchase orders were placed for Control Panel, Analizer Systems and Weigh Systems.

3. S to Z Equipment (continued)

b. Motor Control Centers are out for bids and quotes for substations were received.

c. Electrical bids were received, tabulated and sent to Battelle for approval.

d. Motor Control Centers requisition approved and being typed.
Same for Annunciators and Multi-Temp indicators and recorders.

D). Process Engineering

Heat and Material Balances and Flows are complete, including Inert Gas and Steam Purge Connections.

Process Flow Diagrams are being checked for consistency with P&Is.

E). Flow Sheets

P&Is for process and utilities have been issued to Drafting and are being reviewed by Analytical for formal issue.

F). Plot Plans and Elevations

1. Plot Plans and Elevations for the two structures are being revised as per latest equipment drawings. This is necessary so as to be able to finalize the structural drawings.

2. Model of Combustor, Gasifier and associated piping and equipment is being made.

G. Structural Steel

1. Calculations for the outer structure have been made. Drawings have been made and are now being checked against final equipment drawings.

G. Structural Steel (continued)

2. Preliminary calculations are being made for the inner structure. Final design awaits finishing the model for the Combustor-Gasifier.

H. Piping

1. Stress calculations for the hot piping will be started as soon as the model studies are finished.

I. Instrumentation

1. P&Is have been issued and discussed with the Client as to start-up, operation and shut-down.

J. Electrical

1. One line for high voltage has been done.

2. Quotations for substation have been received.

K. Construction

1. Construction has not started.

2. We estimate start of construction as February 1, 1974.

F. W. Peterson

FWP:d

U.S. DEPARTMENT OF COMMERCE
Technology Administration
National Technical Information Service
Springfield, VA 22161 (703) 605-6000