

TECHNICAL SECTION

Box. MPR--24

of

PROGRESS REPORT NO. 24

ON

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

January 17, 1975

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

SUMMARY

During this reporting period Chemico continued expediting material deliveries to the site, continued field construction, and completed and delivered to the field the scale model of the PDU. The substantial portion of Chemico's work has definitely shifted from their New York offices to the field.

Battelle continued to monitor the work of Chemico, assisted them in expediting, studied alternatives to the use of natural gas in some of our operations to free gas for PDU use, submitted paperwork required for the Ohio EPA Permit to Operate, and completed some building additions and site modifications required for the PDU.

TECHNICAL SECTION
of
PROGRESS REPORT NO. 24
on
CONTRACT NO. 14-32-0001-1513
to
OFFICE OF COAL RESEARCH
from
BATTELLE
Columbus Laboratories
January 17, 1975

INTRODUCTION AND PROJECT OBJECTIVE

This progress report describes work completed by Battelle on the Coal Gasification Program during the period December 21, 1974, to January 20, 1975. The work completed during this period was nonexperimental and was associated with the installation of the 25-ton-a-day coal gasification process development unit by Chemico for Battelle. Nothing of a patentable nature is disclosed within this report.

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 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.

WORK COMPLETED

Detailed Engineering Design and Procurement of the PDU

Chemico provided Battelle with an overall project schedule for the PDU installation on April 4, 1974. This schedule was first presented in Progress Report Number 15. Since then Chemico has been noting the work completed on the schedule and reissuing it. On December 6 Battelle was presented with a new construction schedule by Chemico. A mechanical completion date for the PDU of June is now projected by Chemico.

Chemico has continued the expediting of equipment and materials to the site by their New York office staff during this reporting period.

A scale model of the PDU was completed in New York during this period and was delivered to the field. Chemico's major activity has definitely shifted from New York to the field. A nominal amount of engineering design and procurement activity did continue in New York; however, this activity will be essentially phased out in the forthcoming reporting period.

Drawings

Virtually all of the Chemico drawings for the PDU have been "issued for construction". Modifications are being made to drawings as required.

Requisitions and Purchases

Change orders on some of the commodity items are being issued almost daily by Chemico. Very few change orders for noncommodity items are being made. The nature of the change orders is normally that of increasing or decreasing quantities, splitting orders, cancellations, etc.

Expediting and Inspection

Expediting and inspection of equipment and materials prior to delivery continue to be important activities required for orderly progress of the PDU construction.

Mr. Thomas Dillon, Chemico's project engineer on our job, is coordinating visitation activity. Most of the items requiring expediting are commodity or bulk items (e.g., fittings, wire, switches, piping, etc.). The Chemico staff involved in expediting is being reduced for this reason. Battelle continues to supplement the Chemico expediting and inspection activity by making our own trips to vendor's shops and following up on the trips with phone calls.

Equipment and Materials Received at the Site

About 80 percent of the major items of process equipment have arrived at the site; in addition about 49 percent of the instruments are at the site. The percentages last month were 65 percent and 40 percent, respectively. The equipment and the materials, for the most part, are being used as they are received. Equipment and materials which have arrived to date are as follows:

FLWSHEET EQUIPMENT ITEMS

<u>Description</u>	
U-100	Control Cabinets
B-180	Equipment Shelter
G-101	Coal Mill Surge Hopper
G-102	Coal Receiving Hopper
R-101	Grizzly
K-201	Main Fan
P-205	Screened Coal Cyclone
D-201	Inert Gas Generator (for Coal Pulverizer)
K-203	Combustion Air Blower
K-202	Auxiliary Fan
K-204	Screened Coal Blower
O-201	Coal Pulverizer
P-201	Cyclone Separator & Support Ring
L-202	Spinner Separator
P-203	Bag Filter
O-205	Ground Coal En Masse Conveyor/Elevator
P-204	Vibrating Screen
J-301-A&B	Oil-Solids Pumps
O-301	Screw Conveyor Cooler
O-303	Rotary Valves
P-301	Pretreater Cyclone
K-303	Pretreated Coal Blower
P-302	Pretreated Coal Bag Filter
P-301	Gas Separator
R-301	Teflon-Lined Separator
P-401-A&B	Bag Filters and Bin Vents
G-401-A	Combustor Feed Bin
G-401-B	Gasifier Feed Bin
G-402	Combustor Feed Pressurizing Bin
G-403	Combustor Feed Injection Bin
G-404	Pretreated Coal Receiving Bin
G-405	Gasifier Feed Pressurizing Bin
G-406	Gasifier Feed Injection Bin

FLWSHEET EQUIPMENT ITEMS (Continued)

<u>Description</u>	
G-501	Cyclone Hopper
G-502	Cyclone Hopper
G-503	Cyclone Hopper
G-505	Char Hopper
G-511	Conveyer Hopper
P-501	Combustor Cyclone
P-502	Gasifier Cyclone
H-502	Gasifier Vessel and Spare Head
H-501	Combustor Vessel and Spare Head
K-501	Heater Recycle Blower
O-502	Char and Sinter Cooler-Conveyor
O-505	Dump Hoppers
O-506	Dump Hoppers
O-507	Dump Hoppers
O-508	Dump Hoppers
O-509	Dump Hoppers
O-510	Dump Hoppers
O-511	Dump Hoppers
O-512	Dump Hoppers
U-050	Instrument Panel
R-601	Teflon-Lined Separator
R-602	Teflon-Lined Separator
P-601	Gas Separator
G-603	Sludge Settler
J-602-A&B	Venturi Circulating Pumps
J-601-A&B	Venturi Circulating Pumps
E-604	Recycle Make Gas Cooler
K-603	Recycle Make Gas Compressor
E-605	Recycle Make Gas Aftercooler
P-602	Separator
E-604-B	Gas Cooler
E-605-B	Gas Aftercooler
D-702	Inert Gas Generator
G-703	Instrument Air Receiver
E-703	Instrument Air Aftercooler
K-701-A&B	Process Air Compressors
G-701-A&B	Process Air Receivers
R-701	Instrument Air Dryer Package
K-703	Natural Gas Booster Compressor
G-702	Inert Gas Receiver
G-801	Deaerator
D-802	Steam Generator
R-804	Cooling Tower Water Treatment System
D-803	Steam Superheater
J-804-A&B	Valve Cooling Water Pumps

FLWSHEET EQUIPMENT ITEMS (Continued)

<u>Description</u>	
V-802	Emergency Electrical Generator
G-802	H. P. Water Surge Tank
J-803-A&B	Cooling Tower Water Pumps
R-803	Cooling Tower
J-801-A&B	Boiler Feedwater Pumps
R-801-A&B	Boiler Feedwater Treating System
U-801	Motor Control Panel

BULK ITEMS

<u>Chemico Cost Code Number</u>	<u>Description</u>
A-190	Anchor Bolts
T-600 & T-605	TFE-Lined Valves
R-301-2, R-601-2, R-602-2	Raschig Rings for Scrubbers
--	Needle Glove Valve
--	Flow Switches
T-626	Miscellaneous Valves
T-450	Tubing
--	Strainers
--	Tube Fittings
--	Gaskets
T-620 & T-621	Miscellaneous Valves
T-615	Miscellaneous Valve
U-060	Pressure Regulators
R-450	Filter Regulators
T-450	Miscellaneous Valves
U-030	Annunciators
V-020	Transformer Substation (1)
A-190	Reinforcing Bars
U-030 & U-041	Weigh Systems (load cells)
T-31A2	Copper Tubing
P-145	Seamless Pipe
UGA-42	Gate Valves
6-COS	Expansion Joints
--	Ulukepe Cable
T-550	Miscellaneous Valves
U-060	Miscellaneous Valves
R-301-2, R-602-2, R-602-2	Gaskets
U-041	Pneumatic Pressure Transmitters
--	Teflon-Lined Pipe Fittings
U-020	Instruments
U-060	Fabri Valves
--	Gaskets
V-032	Miscellaneous Electrical Supplies
U-060	Control Valves
U-020	Pressure Gauges

BULK ITEMS (Continued)

<u>Chemico Cost Code Number</u>	<u>Description</u>
B-101	Small Bore Pipe (partial)
U-030	AIT 10-22 Gas Analyzers
"	AIT 30-39 Gas Analyzers
"	AIT 50-11 Gas Analyzers
80-V	Unistur
80-V	Lighting Fixtures
80-T-022	Pipe Fittings
U-100	Lab Panel
U-041	d/p Transmitters
80-T-040	S.S. Pipe
U-060	Valves
80-T-615	Valves
T-450	Swagelock Fittings
V-020	Substation No. 2
80-V	Conduit Fittings
80-V-100	Terminators
U-041	Level Transmitter
V-060	Cable
T-450	Tubing
80-V	Electrical Fittings
80-T-022	Pipe Fittings
T-450	S.S. Pipe
V-100	Motor Control Center
80-V	Conduit Fittings
V-060	Wire
80-T	Shop Fabricated Pipe (partial)
T-450	Valve Manifold-Gauge Siphon
U-050	Main Control Panel
80-T-615	Pipe Fittings
U-020	Thermocouples
U-030	Nuclear Density & Level Gauges

In addition to the above listing, partial shipment of various orders for bulk items has been received. These items will be reported as received when the orders are completed.

All structural steel for both the coal feed and the burner-gasifier structure has been received.

Construction of the PDU

Chemico issued their first construction schedule on May 23, 1974 (Issue P-1). This schedule and its refinements indicated a mechanical

completion date for the PDU of mid-February, 1975. On December 6, 1974, Chemico advised Battelle that the February completion date could not be met and issued a new schedule showing mechanical completion by mid-June of 1975. Copies of Chemico's Construction Schedule, Issue 3₁ dated December 13, 1974, were sent to Dr. R. E. Vener of OCR, Dr. Ab Flowers of A.G.A., and Dr. R. Detman of C. F. Braun on January 6, 1975. This is a refined version of the schedule received by Battelle from Chemico on December 6 and shows a mechanical completion date of mid-June and all work by Chemico completed by mid-July.

Construction was initiated formally on June 10, 1974. Work done prior to mid-January has been reported in our previous monthly reports to OCR. Battelle's field office is in daily contact with the Chemico construction personnel.

Figure 1 shows the gasifier vessel about to be hoisted into the burner-gasifier structure. The people in the figure give an idea of the scale of the vessel. The vessel will be lined with refractory in place. The smaller nozzles shown on the vessel's vertical sides are instrument taps; those on the inclined transition section are supplemental steam injectors. The medium-sized nozzles on the lower vertical sides are nozzles for the mounting of nuclear sources and detectors to be used as an alternate means of density and level measurement. The large nozzles are, starting at the top left and going clockwise, the alternate agglomerated ash feed, the char overflow, the coal feed, and the primary agglomerated ash feed. The large nozzle immediately behind the person on the right is an alternate one for feeding coal. The head and bottom sections of the gasifier are at the site but will not be installed until the refractory lining work is in progress.

Figure 2 is a photograph of the PDU Site made from the south on December 20, 1974. The essentially completed coal feed structure is at the right in the background. At the left in the background is the partially completed coal feed structure with the gasifier being placed. In the foreground is the auxiliary building or compressor shed which has been erected by a local contractor as a portion of Battelle's financial contribution to the program. The compressor shed houses the process air compressors, the inert gas generating equipment (including compressor),

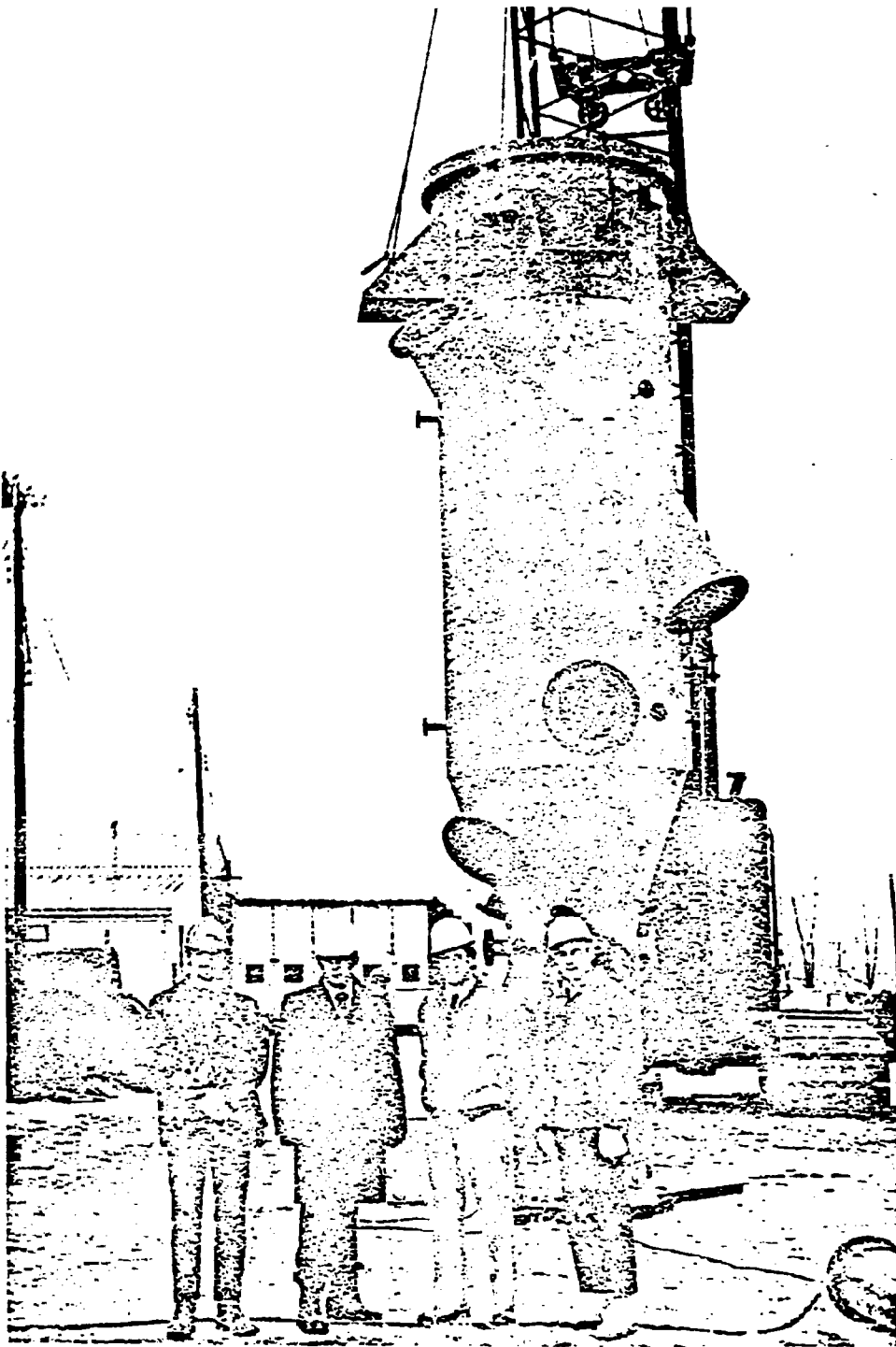
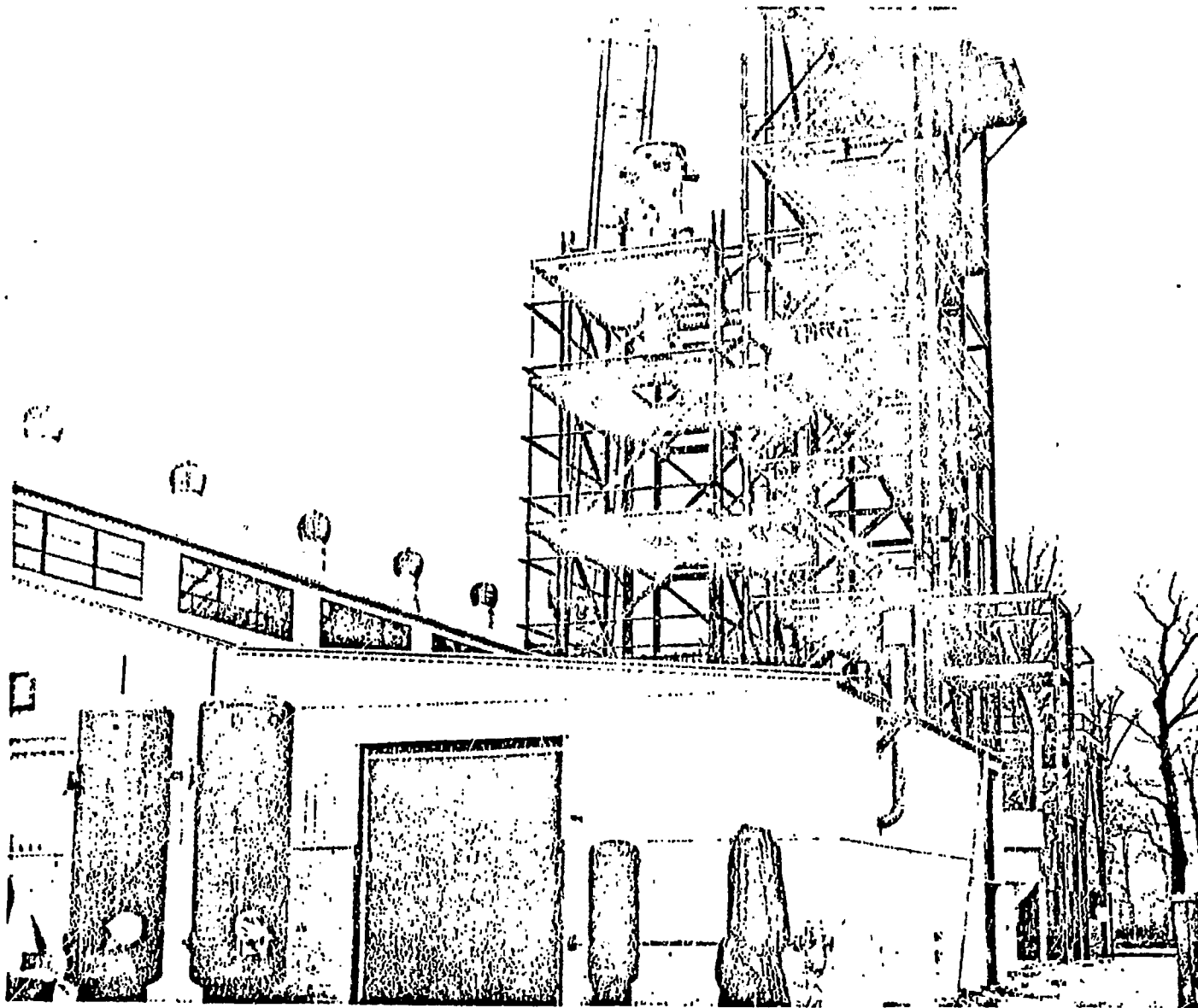


FIGURE 1. GASIFIER VESSEL READY FOR HOISTING INTO PLACE



10

FIGURE 2. VIEW OF THE COAL-GASIFICATION PDU SITE DECEMBER 20, 1974

the emergency electrical generator, the steam boiler, the natural gas booster compressor, and boiler feedwater treatment equipment. Although it cannot be seen in the photograph, all of this auxiliary equipment is in place except for the natural gas booster compressor. The two large tanks at the left foreground, in front of the building, are process air storage tanks. The smaller tank to the right of the air storage tanks and the tarpaulin-covered item are the storage tank and dryer for compressed recycle product gas.

Considerable construction progress has been made during this reporting period in spite of the holidays and predominately inclement weather. All of the structural steel has now been received. The gasifier vessel was installed in position, and the burner-gasifier structure has been continued to the 97-foot level. As soon as a small amount of additional bracing is put in place, the combustor vessel can be installed.

Battelle has completed the compressor shed enclosure, and the floor for the shed has been poured. Chemico has now set all of the equipment in this area, and work is proceeding on the interconnecting piping.

Significant progress has been made on the installation of the coal grinding and conveying systems. The coal feed surge hopper, the vibrating screen, and the recycle blower have been set in place, and most of the interconnecting duct work and conveyors have been installed. The pretreated-coal conveyor-cooler has been installed. The pretreated-coal conveyor-cooler has also been connected with the duct work of the conveying system.

General work has continued on the field fabrication and installation of small-bore piping, and on the installation of prefabricated pipe, instrument hangers and trays, field panels, and low-voltage and lighting conduit.

The field labor force averaged about 40 during this reporting period. There were no lost-time accidents.

Battelle Activity Directly Related to Detailed
Design and Installation of the PDU

In addition to the Battelle activity related to monitoring Chemico's design and construction work and assisting them in expediting, the Battelle staff have been participating in other areas directly related to the PDU design and installation.

Problems have arisen regarding the refractory installation subcontractor of Chemico's and also the supply of some special valves for the PDU. The Battelle Project staff is assisting Chemico in resolving the problems with their refractory subcontractor. The Project staff as well as members of Battelle's Metallurgy and Ceramics Departments are working with the valve supplier to develop a workable, deliverable valve.

No significant efforts were expended on the turbine procurement during this reporting period.

As a result of the hearing held before the Ohio Public Utilities Commission on December 12, Battelle was instructed to further investigate alternate fuels which might lend themselves to substitution for natural gas we now use in various Battelle facilities and thus free an equivalent portion of natural gas for use in the PDU. We were also to continue our dialogue with Columbia Gas and report back to the commission in 30 to 45 days. We have been doing as directed and expect that we will be reporting back to the commission by the end of January with the results of our studies and some proposals.

Battelle presently has a permit from the State of Ohio Environmental Protection Agency to construct the PDU. The forms necessary to obtain the Operating Permit have been completed by Battelle's environmental coordinator and have been transmitted to the Ohio EPA. We await action of the Agency.

PROBLEMS AND RECOMMENDATIONS

Technically related problems at present continue to be due to the slower-than-desired delivery of materials to the field and inclement weather. In addition a problem arose related to design of the solids

flow control valves for use in the loops between the burner and gasifier. Continued expediting by Chemico and by Battelle is required to improve the materials delivery situation. We believe we have achieved a technically acceptable solution to the valve problem.

WORK PLAN AND SCHEDULE

Major emphasis will be placed on continuing the field construction during the forthcoming reporting period. It is also expected that Battelle will place an order for the personnel hoist to be used in the PDU during the forthcoming reporting period and that its installation may begin.

It is expected that the PDU construction will continue in accordance with Chemico's construction schedule, Issue 3₁. As the items of auxiliary equipment (compressors, inert gas generator, etc.) are fully piped and wired in preliminary check out operations will begin.

Battelle plans to review drafts of the facilities and operating manuals prepared by Chemico to date. Mr. Tewksbury (Battelle's supervisor of operations for the PDU) will work with the Chemico start-up staff in this. An addition to the PDU operating staff was made during the current reporting period and other additions may be made in the period which is forthcoming. Mr. James L. Stickel, long-time Battelle staff member and licensed nuclear reactor operator has joined us to be responsible for PDU maintenance. Initially he is following the equipment installation work of Chemico's and assuring that adequate protection is provided for the more sensitive equipment.

As a result of the recently approved prime contract modification, Battelle is committed to completion of all experimental work on the program by June 30, 1977.

FINANCIAL AND ADMINISTRATIVE SECTION

of

PROGRESS REPORT NO. 24

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

January 17, 1975

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

FINANCIAL AND ADMINISTRATIVE SECTION

of

PROGRESS REPORT NO. 24

on

CONTRACT NO. 14-32-0001-1513

to

OFFICE OF COAL RESEARCH

from

BATTELLE
Columbus Laboratories

January 17, 1975

FINANCIAL

Table B-1 presents the Task Cost and Manpower Projection form for the month ending December 31, 1974. Billings have been paid to Chemico for New York operating costs through October and all of their fee except for the final payment which by contract is withheld. In addition, Chemico has been reimbursed \$1,514,508 for equipment invoices paid by them. Total actual disbursements to Chemico are \$2,919,555.

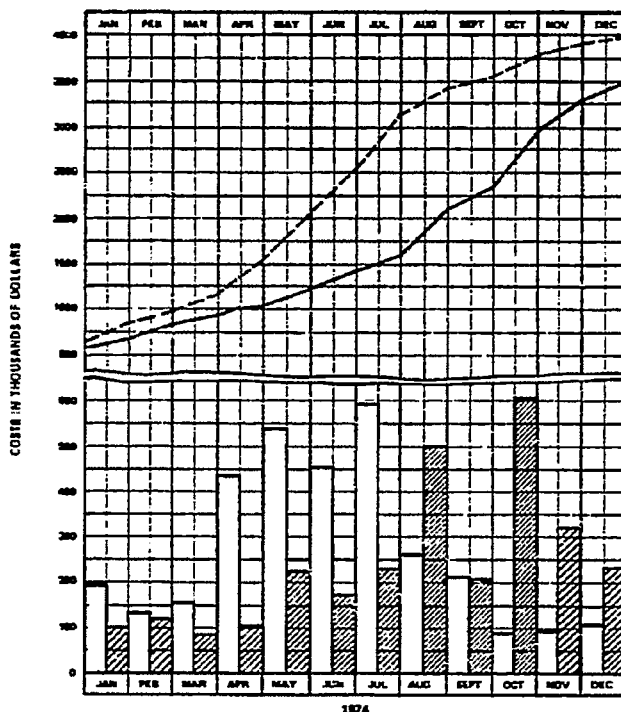
We have received additional vouchers from Chemico for equipment purchases amounting to about \$274,887 and for services for the month of November amounting to about \$118,231. These billings were received too late by Battelle's accounting group for them to be processed yet.

The cumulative money actually expended by Battelle, including actual payments to Chemico but exclusive of the Battelle fee, to date is about \$3,490,400 as shown in Table B-1. If the Battelle fee and received-but-not-paid vouchers of Chemico are included, the "expended" by Battelle is about \$3,982,300. This is about 45.0 percent of the total encumbered funds* for the project.

On December 6 Chemico estimated, informally, that their costs might increase from 5.7 million dollars to 6.3 million dollars for completion of the PDU. Battelle asked Chemico to thoroughly reappraise

* Letter from Mr. G. Edward Larson (OCR) to Battelle dated December 11, 1974, shows authorized funding of \$8,850,000.

TABLE B-1
 BATTELLE PDU
 TASK COST AND MANPOWER PROJECTIONS
 MONTH ENDING DECEMBER 31, 1974



MANPOWER (MAN-MONTHS)

Prd.	6.0	6.0	6.0	6.0	6.5	6.5	8.0	8.0	11	11	13	15
Act.	4.3	4.0	4.4	3.7	4.0	4.8	4.2	4.3	3.8	5.0	3.8	3.1

DIRECT LABOR & OVERHEAD COSTS (THOUSANDS OF DOLLARS)

Prd.	21.8	19.8	22.8	25	25	25	32.5	36	60.8	65	77	96.5
Act.	19.6	18.2	18.4	17.8	17.9	21.6	18.3	18.9	17.3	22.6	17.6	14.3

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

Prd.	168	115	128	404	504	422	556	221	145	7	0	0
Act.	77.9	103	64.9	87.8	207	142	208	478	191	580	2.93	212

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

Prd.	0	0	0	0	0	0	0.5	1.0	1.2	10.0	4.0	1.5
Act.	0	0	0	0	0	0	0	0	0	0	0	.28

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

Prd.	3.2	3.2	5.2	5.0	5.0	5.0	2.0	3.0	6.0	8.0	12.0	12.0
Act.	3.2	1.4	2.3	2.2	4.8	4.3	3.7	4.3	1.8	5.1	2.5	2.6

TOTAL (THOUSANDS OF DOLLARS)⁽⁴⁾

Prd.	184	133	156	434	534	452	591	281	213	80	93	110
Act.	100.7	123	86.6	107.8	228.6	188	230	501.2	210	608	313	229

KEY TO GRAPH:



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 PFC

their cost estimate. They are still in the process of doing this and have not yet formally notified us of any estimated requirement for job completion beyond the 5.7 million dollars which was contained in our formal proposal to OCR for a contract modification (submitted in August, 1974).

One factor which is contributing to a projected cost increase is the cost of a subcontract Chemico has with Babcock and Wilcox (B&W) for the supply and installation of most of the refractories required for the PDU. In earlier negotiations with B&W, in May of 1974, they quoted a lump sum price for the refractory job of \$106,914 and this was the subcontract amount authorized by OCR and A.G.A. Since May, the amount of piping to be refractory lined has increased, B&W has been asked to line two cyclones which they were not asked to quote originally, and B&W has been asked to line about 11 expansion joints which they were not asked to quote originally. These requested changes are made necessary by two factors: (1) a much more complete design by Chemico now over what they had in May and (2) oversights in Chemico's solicitation sent to B&W and other refractory suppliers prior to the May quotation. Babcock and Wilcox now projects the materials cost at about \$89,216 (up from \$51,454), installation by a subcontractor to them at \$102,730 (up from \$55,460), and dry-out at \$60,000 for a total proposed subcontract price of about \$252,000. Babcock and Wilcox did not previously include dry-out costs in their quotation.

Chemico and Battelle are examining the correctness of the new materials cost, renegotiating the installation costs and looking for alternate ways of accomplishing the dry-out at lower cost. Until these matters are fully resolved the refractory subcontract cost is an unknown in any new cost projection by Chemico.

Another factor contributing to a projected cost increase is, of course, the delay of mechanical completion of the PDU from mid-February to mid-June now projected by Chemico.

Another factor which is typical is the inability of one of Chemico's subcontractors to obtain parts of special valves from one of his vendors within the cost and schedule he originally projected. Chemico and Battelle have worked out a technically acceptable means to sidestep Chemico's subcontractor's vendor which should result in an acceptable schedule for delivery of the valves at close to the budgeted costs.

It is expected that as soon as these matters and other lesser ones are resolved, Chemico will formally notify Battelle of any projected cost increase.

BATTELLE'S COLUMBUS LABORATORIES'
PERSONNEL ASSIGNED TO PROJECT*

- | | |
|----------------------|--|
| (1) W. M. Goldberger | (4) H. R. Batchelder (Staff
Consultant) |
| (2) W. C. Corder | (5) J. L. Stickel |
| (3) T. L. Tewksbury | |

CHEMICAL CONSTRUCTION CORPORATION
PERSONNEL ASSIGNED TO PROJECT**

- | | |
|--------------------|----------------------|
| (1) T. Dillon | (6) E. A. Postrk |
| (2) M. J. Dicianni | (7) J. P. Regan |
| (3) G. G. Elsis | (8) F. W. Shirley |
| (4) H. J. Rubchen | (9) L. Van Amerongen |
| (5) F. Matherne | (10) N. Vario |
| | (11) M. Young |

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

** Identified by Chemico as "key" staff on project.