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Fluor MPR-77-05

COAL LIQUEFACTION PILOT PLANT

CRESAP, WEST VIRGINIA

MONTHLY TECHNICAL PROGRESS REPORT

MAY, 1977

Fluor Engineers and Constructors, Inc.

3333 Michelson Drive

Irvine, California 92711

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PREPARED FOR THE UNITED STATES

ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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NOTIFICATION OF TRIPS

Name	Duration	Destination	Purpose
R. H. Pulliam	5/18-5/20	Cresap, West Va.	ERDA Meeting
	5/23-5/27	Cresap, West Va.	ERDA Meeting
G. O. Fredrickson	5/9-5/27	Cresap, West Va.	ERDA Meeting & LCDC Support
A. A. Keens	5/23-5/26	Cresap, West Va.	CCDC Meeting &
		Library, Pa.	Process Checkout
L. C. Lewton	5/23-5/27	Cresap, West Va.	Filter Systems Checkout
M. Llanos	5/23-5/27	Cresap, West Va.	Develop Startup Schedules
P. A. Linam	5/2-5/6	Cresap, West Va.	Process Checkout
F. U. Leonard	5/9-5/10	Washington, D.C.	ERDA Meeting
	5/10-5/13	Cresap, West Va.	ERDA Meeting
	5/19-5/27	Cresap, West Va.	ERDA Meeting
D. B. McCaughey	5/17-5/20	Cresap, West Va.	Fired Heater Checkout
D. Barlow	5/23-6/17	Cresap, West Va.	Develop Startup Schedules
K. Bujnowski	5/23-6/17	Cresap, West Va.	Develop Startup Schedules
P. R. Young	5/9-5/20	Cresap, West Va.	Vessels Checkout
J. Mykita	5/2-5/27	Cresap, West Va.	Control Systems Checkout
P. Michalko	4/29-5/27	Cresap, West Va.	LCDC Support
M. Dobbs	5/19-6/3	Cresap, West Va.	LCDC Support
C. Moore	5/23-6/3	Cresap, West Va.	OSHA Piping Checkout

I. OPERATIONS (INCLUDING CONSTRUCTION CLEANUP)

A. Summary

During this period, Section 200 - Extraction was operated for a brief time circulating startup solvent hot. The run was terminated prematurely by failure of the extractor seals. In Section 300 - Solids Separation, refractory in the third fired heater was cured. Other efforts were minimal pending completion of the construction effort. Section 700 - Product Fractionation, was also operated in closed-loop, using Number 2 fuel oil and gasoline as startup fluid. Startup solvent has been introduced into Section 800 - Low Temperature Carbonization. Cold operation of gas recirculation and the quench loops has taken place.

On May 16, all operations efforts were halted and a total plant shutdown taken to allow Construction to complete critical items in the front-end (Sections 100, 200, 300, 500 and 800) in preparation for integrated front-end startup planned for June 1. This activity will begin with closed-loop operations on startup solvent and move toward fully integrated operation on solvent and coal.

Preoperational analyses have been prepared for Sections 100 and 500.

Followup on test requirements is continuing.

B. Progress by Plant Sections

Section 100 - Coal Preparation

High ash raw coal has been removed from the receiving hopper. The removed coal was disposed of at a neighboring power plant with appropriate credit.

The new sprockets are on hand to modify the rotary feeder, L-A103A, for an increased coal feed rate to the roller mill and to ensure a size consist within the desired range (30 to 200 mesh). Installation is scheduled for early June.

Work is in progress to install the external lubrication system on the roller mill to provide longer operating intervals (greater than 4 hours). An internal inspection of the mill indicated the main shaft was scored on the top bearing surfaces; outside repairs (chrome plating and regrinding) will complete in early June.

Changes to improve the control of inert gas supply and reduce consumption are under review. A change request will cover necessary modifications.

The preoperation performance summary report was prepared. It identifies operating parameters for further consideration in future coal-grinding operations.

I. OPERATIONS (INCLUDING CONSTRUCTION CLEANUP)

B. Progress by Plant Sections (Continued)

Section 200 - Extraction

Number 2 fuel oil was circulated cold through the startup recirculation loop to evaluate equipment and instrumentation operability. Problems were resolved as identified.

The Number 2 fuel oil was then drained and the system refilled with Sure-Sol 180 startup solvent. After recirculation of the Sure-Sol 180 cold, the startup solvent was heated by the slurry preheater. Minor leaks which developed during heatup were repaired. However, mechanical damage to the seals on the extractor agitator required shutdown of the section.

Following installation of the throttle bushings on the seals during the week of April 18, initial tests indicated leakage from the bottom seal at the shaft packing. After repair, the seals tested satisfactorily at 500 psig.

Following the solvent heatup operation and unit shutdown on May 13, the extractor agitator was disassembled for inspection and the following problems were identified:

a. Blasting grit was found in the lower seal cavity and in the bottom of the vessel. No foreign matter was found in the top seal. Also, the seal flush system was found to be clean which indicated that the grit entered the lower seal from the vessel and through the throttle bushing.

b. The lower seal bellows were at least partially jammed while the upper seal stationary member was found to be cocked due to a bent antirotation pin (wrong type pin installed at factory).

c. Both upper and lower throttle bushings and shaft sleeves were scored, indicating insufficient clearance.

d. Lower seal leakage was between the shaft and the sleeve due to insufficient packing. Further, the auxiliary packing outboard of the quench cavity had extruded and developed leakage on both seals.

Seal repairs by Sealol in Rhode Island were completed and parts returned on May 26. The failure mechanisms and possible corrective actions have been reviewed with Sealol engineering personnel and SCD. As a result, a flushing "cup" will be installed on the top seal to ensure face lubrication. The bottom seal will be reinstalled under present design to operate prior to coal introduction while permanent corrective actions are being evaluated.

I. OPERATIONS (INCLUDING CONSTRUCTION CLEANUP)

B. Progress by Plant Sections (Continued)

Section 200 - Extraction (Continued)

Repairs were made to the extractor charge pump, J-A202A, to correct an internal knock that was found caused by a 0.004-inch end play in the journal bearing which was found scored and therefore replaced. Internal cleaning also was required as the oil ports to the journals and the crankcase were found plugged with blasting material. Similar problems were identified with J-A202B.

Several design problems with temperature control loops identified during preoperational checkouts were corrected and the loops were made operational.

The weigh cells on the slurry mix tanks, F-A203A/B, were calibrated; however, a defective load cell was identified on F-A203B. The replacement cell is scheduled for a June 7 delivery.

Several deficiencies were identified with the level transmitter, LT-201:

a. Defective internal components.

b. Over-designed purge rate.

c. Incorrect piping and valving design.

A change request (Number 388) was issued to implement correction, although a temporary repair was made.

A leak in the thrermocouple connection on the spray solvent heater, C-A204, was identified during fuel oil circulation. The inlet and outlet connections to the heater were found to be reversed. Corrections are being defined in conjunction with the Vendor (General Electric).

Repairs were made to correct a malfunctioning of the solenoid valves, VS-220 and 221, on the inlet and outlet of J-A202B, extractor charge pump, caused by crossed electrical wiring.

Flow calibrations of the extractor charge pumps, J-A202A/B, were made. The pressure drop between the pumps and the top of the extractor was determined to be 400 psi at a flow rate of 12.8 gpm of clean, cold solvent. The burner orifice size in the slurry preheater was found to be too small (Number 72 MTD vs. Number 56 MTD required) to allow maximum design heat output.

I. OPERATIONS (INCLUDING CONSTRUCTION CLEANUP)

B. Progress by Plant Sections (Continued)

Section 300 - Solids Separation

Instrument tagging is being carried out and is nearly complete. Close attention is being given to following construction and maintenance work on items related to hydroclone operation.

Plans and schedules for pre-startup and startup activities are being prepared.

Significant efforts were expended toward the recalibration of instruments to conform to the latest specifications. Both level and pressure instruments, as well as alarm systems throughout the unit, have been reset.

Temperature control loop problems previously identified during preoperational checkouts were corrected. Some of the outstanding material items identified by RFA Number 21 were received and installation by Construction is scheduled for the week of May 30.

The hard-coated pump parts that needed repair were sent to Daman Industries, near Pittsburgh, for recoating. The two pump cases, J-A313B and 208, and the impeller for J-A208 are expected back on June 1; plungers for J-A202A/B will follow.

Proper installation of dip-tube-type level instruments was verified at all vessel locations except for F-A301 (hydroclone feed tank) and F-B345 (slurry tank). The tube was found missing in F-A301 and a new one was installed by Construction. In addition, the tube in F-B345 was found to be approximately three feet shorter than the design length. Corrective action is under review.

Section 500 - Solvent Recovery

Instrument tagging is nearly complete. Support for construction activities is being provided as needed. Startup plans are being prepared.

A report summarizing the preoperation efforts was prepared. The location of the skin thermocouples on the flash still heater tube was checked.

As in Section 300, significant efforts were expended to recalibrate instruments to conform to the latest specifications.

Repairs to the out-of-round bore diameters on several flow orifices were completed. Misaligned controllers and leaky control valve packing were identified and corrected.

I. OPERATIONS (INCLUDING CONSTRUCTION CLEANUP)

B. Progress by Plant Sections (Continued)

Section 500 - Solvent Recovery (Continued)

Replacement of low temperature wiring with high temperature rated wiring for the vacuum column reboiler, B-A502, is in progress via change request Number 386.

The vacuum condensers, JV-A501A/B/C were hydro-blasted and reassembly of the shell heads is complete.

Section 600 - Extract Hydrogenation

Instrument tagging is nearly complete. A list of items requiring attention by Construction has been submitted to Maintenance and Engineering.

Reversed stroking on numerous control valves was resolved.

Electrical preoperational checks are 80 percent complete; mechanical checkout of equipment is 20 percent complete. Suction piping to JC-A601A/B was acid-cleaned.

The level control valve, LV-6006, on the inlet to the letdown tank, F-A612, was found to have a stellite trim instead of tungsten carbide. Corrective action was resolved with SCD and the valve is ready for reinstallation. A series of technical, operational and maintenance meetings were held among personnel from Lummus, SCD and LCDC. The contingency operation procedures are being reviewed and modified as a result of comments from these meetings. Demonstrations of ebullation characteristics were conducted for the operations personnel using the glass model of the hydrotreating reactors.

Section 700 - Fractionation

Instrument tagging is nearly complete. Support for construction activity is being provided as needed.

The preoperating performance summary report is being prepared. A list of instrument set points was drawn up; instrument calibrations are being updated.

Incorrect, low-temperature rated wiring was found in the feed preheater, B-A701, stabilizer reboiler, B-A702, fractionator reboiler, B-A703, and the vacuum reboiler, B-A704. This caused a deterioration of wire insulation due to overheating and eventual shorting. The installation of high-temperature wiring is complete.

I. OPERATIONS (INCLUDING CONSTRUCTION CLEANUP)

B. Progress by Plant Sections (Continued)

Section 800 - Low Temperature Carbonization

Instrument tagging is nearly complete. Startup plans and schedules are being developed. Support for construction activity is being provided as needed.

A status report summarizing the preoperating efforts to date was prepared. The inability to get adequate heat into the carbonizer was determined to be caused by a restrictive piping run in the recycle gas line near the startup heater. Work continues with the glass model to predict operating data.

The recycle compressor, J-C804A, was found to have an improperly-sized circuit breaker that does not permit compressor operation under full load. The replacement breaker is scheduled for a June 7 delivery.

The work to slope the carbonizer overhead line to prevent back-splashing from the primary venturi, L-A807, is in progress.

Electrical problems related to the startup heater, B-A801, are still unresolved. A change request is in progress.

Section 900C - Hydrogen Compression

Instrument tagging is nearly complete in this area.

An acceptance inspection report covering electrical and instrument punchlist items was issued on May 10. Numerous deficiencies related to equipment not meeting the area electrical classification were identified.

The suction piping to JC-A900A/B hydrogen compressors was acid-cleaned. The interstage piping on JC-A900B was also acid-cleaned and the pulsation dampeners were slushed with kerosene.

The JC-A900B compressor has been reassembled following replacement of the cast iron piston rings on the first, second and third stages with filled TFE rings and the fourth stage with bronze rings.

Series 1000 Units - Utilities

Most utility units were shut down for the period of concentrated construction effort. All PSV's have been removed, calibrated and reinstalled by Construction.

I. OPERATIONS (INCLUDING CONSTRUCTION CLEANUP)

B. Progress by Plant Sections (Continued)

Series 1000 Units - Utilities (Continued)

The motor for the combustion air blower on the inert gas generator presently draws approximately 160 percent of full load current. Proposed changes are under review.

Numerous instruments were reset to conform to the latest design specifications.

Series 1200 Units - Environmental

The environmental units proceed to full activation.

Testing of the Stretford sour gas scrubber will proceed early next month with artificial sour gas feed. Test procedures have been prepared. Operators have received special safety training to prepare them for full activation of this unit.

Installation of the new resin retaining screens inside the primary, secondary and carbon absorber columns was completed. The tube side of the methanol reboiler, L-A1230M, was found severely scaled and was chemically-cleaned successfully with inhibited sulfamic acid.

A phenol adsorption test confirmed that the unit has acceptable performance. There still remains an instrument/control problem on automatic regeneration but the unit is operational.

C. Test Programs

Test Program 1100 - Pumps

The underflow pump, J-C303, was inspected and photographed. A calibration of J-A252A/B with fuel oil was completed.

Test Program 1300 - Fired Heaters

The skin thermocouple locations for the slurry preheater, B-A201, were remeasured; the data confirmed earlier measurements. The revised lengths will be incorporated into the heat exchange programs by SCD. The skin thermocouples for the flash still heater, B-A501, were reinstalled with the proper size pads. The location and identity of each thermocouple was confirmed and reported to SCD.

Firing of B-A201 during the Section 200 hot solvent test was limited to an outlet temperature of 325°F. This limitation resulted from undersized orifices in the burners. These orifices were enlarged to allow full gas flow.

I. OPERATIONS (INCLUDING CONSTRUCTION CLEANUP)

C. Test Programs (Continued)

Test Program 1300 - Fired Heaters (Continued)

The SCD test coordinating engineer inspected both furnaces and reviewed the test program with Cresap personnel.

Test Program 1500 - Filtration

MFD checkout of the filtration equipment in Section 300 was completed. The SCD test coordinating engineer toured the test area with Krauss-Maffei representatives.

Test Program 1600 - Valves and Piping

Inspection of the Rockwell plug valve, Test Plan 1608, was completed.

Test Program 1800 - Extractor

Initial operation of the extractor agitator, L-B205, was limited due to problems in the sealing areas (described under Section 200 above). Installation of vibration probes is scheduled for the week of May 31. Complete checkout of the Modime Surveillance System (MSS) is also scheduled for the week of May 31.

Test Program 1900 - Corrosion/Erosion

A bench test was conducted to evaluate the relative abrasivity of the coal and char under consideration for slurry testing in Sections 200 and 300. Against carbon steel, the char slurry exhibited the higher erosion rate of 1.1 mpy at 7-1/2 fps velocity.

The plant-wide ultrasonic NDE program was initiated; approximately 70 percent of the base-line measurements have been completed.

D. Environmental

Due to the plant shutdown, no water has been discharged from the holding pond over the past week; therefore, no analyses were performed. Results of the weekly effluent analyses performed during May are attached. Although all the analyses are within the daily discharge limits specified by state and federal permits, the monthly averages for both oil and grease, and phenol were high.

E. Laboratory

With the installation of the laboratory benches, expected early next month, construction of the laboratory extension will be complete. Refurbishment activities will be concluded with the reactivation of the bakeout oven and the connection of the cylinder gas supplies.

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I. OPERATIONS (INCLUDING CONSTRUCTION CLEANUP)

G. Departments (Continued)

Technical (Continued)

In Data Processing, troubleshooting of the data acquisition system continues. Two replacement circuit boards and a replacement control board from recording devices were installed; system checkout is underway. Grounding connections and cable shielding have been inspected. Possible problem areas were corrected as encountered. Monitoring of power sources for voltage stability is underway.

An electrical fire in the IBM keypunch-verifier resulted in the unit being down for three days. A power surge is thought to be the probable cause. A proposed fire detection alarm system for the computer trailer is under local review.

The system is now being preserved on tape biweekly due to increased activity on work order process systems. The software problems which have appeared in both systems are being reviewed by the program authors at SCD and Morgantown.

Maintenance and Engineering

Several failure prevention report forms were completed for equipment in Section 600, which has continued to receive current emphasis. There are approximately 31 items remaining in the program for an overall completion of 91 percent.

The lubrication data for equipment in Sections 300 and 800 have been entered into the computer system.

In general, a large effort was expended to verify correct orifice installations and recalibrate instruments to conform to the latest design specifications.

The bus bars and clamps on the main transformer yard were successfully cleaned by Wheeling Electric Company during the total plant power outage on May 28.

The revised work schedule to provide instrument technician coverage on the 4-12 shift remains in effect.

A master list of electrical and instrument pre-startup work that included all known LCDC and E&C work was completed on May 13. A similar list that relates to mechanical items remaining to be done by LCDC Maintenance was completed May 27.

Rolf Henriks joined the E&I group on May 23 to assist in field troubleshooting and resolve heat tracing problems.

I. OPERATIONS (INCLUDING CONSTRUCTION CLEANUP)

G. Departments (Continued)

Maintenance and Engineering (Continued)

The transfer of radioactive sources for plant nuclear level instruments from Library, PA to the plantsite is scheduled for the first week in June; installation by Robertshaw's subcontractor will follow.

The preparation work for the plant-wide ultrasonic NDE program was completed. Pittsburgh Testing Laboratory is approximately 50 percent complete with measurements.

Work order activities over the past four weeks are as follows:

	Mech.	E&I	Total
Work Orders Opened	111	283	394
Bills of Material Issued	23	0	23
Work Orders Completed	87	150	237
Histories Entered	66	52	118

Administrative

Staffing: In Technical, a laboratory analyst has resigned and a qualified candidate was interviewed and hired. A resignation occurred in the data clerk group and the vacancy has been filled. An offer is outstanding for a test engineer. In Maintenance and Engineering, a mechanical engineer was at the plant on May 13 for an interview. Telephone screening continues for additional candidates.

Personnel: The revamp of the plant hygienic facility is near completion. The hygienic program has been activated for full compliance with existing procedures.

Purchasing and Accounting

The building maintenance subcontract will be activated on June 1.

The plant sign has been ordered and should be received shortly.

II. TEST PROGRAM

A. General

1.0 General test plan definition continued this past month, but at a low level of activity as many of the test engineers were assisting in the plant checkout and startup. See Part II, Section C for additional details.

B. Tasks

1.0 Solvent Deashing

1.1 Objective:

To determine the process design for solids-liquids separation using the solvent deashing concept developed by CCDC, with verification of the design on both the bench scale and pilot plant scale bases.

1.2 Work Accomplished for the Month:

A progress meeting was held with Conoco Coal Development Company (CCDC) on May 26. Also attending were representatives from EPRI and from the Ft. Lewis and Wilsonville pilot plants. A similar milestone meeting had been arranged last year to present the results of the CSF program. This month, the data from the SRC program were reviewed.

The SRC batch autoclave work was first discussed. Feeds were Ft. Lewis filter feed and light oils used as antisolvent. Only one commercial antisolvent, Phillips Soltrol 130, was used. In addition to providing some information for the continuous SRC program, the batch results indicated that Kauri-Butanol valves could be used to predict antisolvent quality.

The SRC work on the 30 lb/hr continuous unit was then reviewed. The feeds were Wilsonville coal (Kentucky 9 and 14) and Ft. Lewis liquefaction solvent. The antisolvent was Soltrol 130. One run was made using Ft. Lewis filter feed. The sensitivity of the process to antisolvent ratio was well demonstrated. As shown by failure of 4 inch and 6 inch diameter settlers to produce low ash extract, the need for low upflow velocities was shown. All specification runs were made with an 8 inch settler, corresponding to about 0.4 inch/minute upflow velocity. The run with Ft. Lewis filter feed gave high ash content using the 0.3 antisolvent to liquefaction solvent ratio which had provided low ash (0.1 wt%) on freshly produced material.

II. TEST PROGRAM

B. Tasks (Continued)

1.2 (Continued)

Conoco will present the results of both the CSF and SRC programs to the Technical Advisory Committee of the H-Coal Project at Catlettsburg, Kentucky.

2.0 Liquid-Solids Mechanical Separation

2.1 Objectives - The overall objectives are:

2.1.1 To determine maximum filtration rates with various attractive candidate filtration equipment.

2.1.2 To evaluate mechanical design, configuration and reliability.

2.1.3 To analyze the operation economics of the various filtration schemes with various coal liquefaction process streams.

2.2 Work Accomplished for the Month:

2.2.1 Purchase Orders have been completed for startup assistance for the K-M filter and Chemapec Funda Filter.

2.2.2 Completed third review of the 1500 filtration area. The 1500 is almost complete except for insulation. The missing items are a control valve on the Funda Filter and a weather-hood on the dust collecting system.

2.3 Problems Encountered and Solutions:

2.3.1 As stated in the April progress report, some of the vessel welds do not meet the requirements of the ASME Code Figure UW 16.1(d). After the deduction of 1/4 inch is made for the corrosion allowance, the throats are only 0.144 inch thick, which is less than the minimum of 1/4 inch for fillet welds. Reduction of the 1/4 inch corrosion allowance to 1/8 inch is being considered. This would alleviate the problem.

2.3.2 The other current problems concerning the 1500 area are completion of some of the outstanding change requests, i.e., decking in the third level platform, widening the west side access door, changing out pipe unions for flanges on the overhead breakout piping on the K-M filter and rerouting a flare vent line.

2.4 Work Forecast for the Coming Month:

2.4.1 Final approval of K-M vessel for conformance to the ASME Code.

II. TEST PROGRAM

B. Tasks (Continued)

2.4.2 Completion of Mechanical Checkout Procedures L-B341 Rotary Drum Filter.

3.0 Pumps

3.1 Objective:

To develop pump and seal design configuration and material for coal liquefaction process application with emphasis on durability in slurry service.

3.2 Work Accomplished for the Month:

3.2.1 Pump J-A502A/B - Mechanical seal changed from Sealol to Dura Double Seal per change request 316-500.

3.2.2 Reviewed seal oil system for possibility of replacing existing pumps, J-A1130A/B, with new pumps per RFA 35-1130-0.

3.2.3 Checked drawings of pump J-A203.

3.2.4 Prepared test spare parts list for LCDC.

3.3 Problems Encountered and Solutions:

None.

3.4 Work Forecast for the Coming Month:

Continue to follow up on design requirements for the test program.

4.0 CSF Process Extractor Improvement

4.1 Objectives:

4.1.1 Evaluate process variables inherent to the CSF Process Extractor Mixer.

4.1.2 Determine the performance capabilities of Mixer mechanical components.

4.1.3 Evaluate mechanical and nonmechanical extractor design configuration with respect to mechanical reliability, process acceptability and scale-up potential.

II. TEST PROGRAM

B. Tasks (Continued)

4.2 Work Accomplished for the Month:

4.2.1 Final inspection of the mechanical vibration probes was completed and the units were prepared for shipment.

4.2.2 All remaining manuals and instructions were incorporated into the Test 1800 General Manual.

4.2.3 Assisted and coordinated the field during the preoperational checkout and operation of the Extractor on water. (See Problems and Solutions)

4.2.4 Reviewed results of preliminary operation of Extractor on water and assisted in the operation of the unit on hot startup solvent. (See Problems and Solutions)

4.2.5 Initiated discussions with Sealol (mechanical seal Vendor) concerning the development and modification of seals for more reliable service. (See Problems and Solutions)

4.2.6 Circulated the Test 1800 Test Procedures for preliminary review.

4.3 Problems Encountered and Solutions:

4.3.1 Initial operation of the Extractor at 40 rpm, while filled with water, was interrupted due to a 0.125 inch diameter stream of water leaking past the bottom single mechanical seal. The water leakage emanated from the steam quench inlet and outlet lines in the seal. (No other leaks were observed in the bottom seal or elsewhere on the Extractor.) Due to the leak, operation of the Extractor was discontinued in order to perform a maintenance check on the bottom seal. Preliminary suspicions were confirmed upon seal removal and disassembly when it was noticed that an insufficient amount (1 ring instead of the required 2) of auxiliary packing was installed. In addition, the auxiliary packing gland in the seal was not adequately tightened to ensure proper seating of the auxiliary packing.

The solution to this problem was to reinstall the bottom mechanical seal with the proper amount of auxiliary packing correctly installed and seated. This was accomplished and the Extractor was again prepared for operation.

II. TEST PROGRAM

B. Tasks (Continued)

4.3.2 After successful preliminary operation of the Extractor, while filled with cold solvent and with heat up of solvent underway, the bottom mechanical seal showed signs of minor solvent leakage along the L-B205 shaft in the area of the bottom bearing.

The rate of leakage was approximately one drop per second. In addition, water was observed dripping out of the bottom seal housing which then mixed with the bearing grease. Also, some solvent in the top seal steam quench outlet line was suspected, but not confirmed. No other leaks or pressure venting was observed or recorded. This occurred after approximately seven hours of operation at 40 rpm and while the Extractor was filled with startup solvent at 310°F and 350 psi. Operation of the unit was discontinued in order to prevent damage to the bottom bearing since the bearing grease was being washed out by the leaking solvent. Disassembly and inspection of both mechanical seals was ordered in order to determine the cause of the difficulty.

Disassembly of the bottom single mechanical seal revealed the following:

a. The convolutes of the bellows of the seal and the stuffing box were completely packed with sandblasting material and small pieces of wire and weld slag. Some material was found on the underside of the bellows inside the seal. The material apparently came from other areas in the vessel. Original deposition of the material apparently occurred during construction in the area.

b. The bottom carbon throttle bushing was scored and galled with the inside diameter of the bushing measuring approximately 0.060 inch over original.

c. The bottom seal sleeve in the region of the throttle bushing was also scored and ground undersize. The scoring or galling was observed as spiral serrations in the metal.

d. The sleeve/shaft auxiliary packing had extruded out of the gland.

Disassembly of the top seal revealed the following:

a. No sandblasting or other foreign material was found. However, the seal had been damaged.

II. TEST PROGRAM

B. Tasks (Continued)

4.3.2 (Continued)

b. The stationary seal face hollow locking pin was bent flat (90° from original position) and a slot was worn in the stationary seal ring when the ring subsequently began to rotate. (The stationary and rotating seal faces were cocked to one side and rotating together.) Evidence shows this may have been a manufacturer's assembly error.

c. The seal sleeve showed excessive wear in the carbon throttle bushing area.

d. The carbon throttle bushing was scoured on the inside diameter.

e. The sleeve/shaft auxiliary packing had extruded out of the gland. Pieces of packing were found in the stuffing box area.

Additional disassembly of the bottom vessel flange and stationary and rotating cones revealed heavy deposits of sandblasting material, wire, weld rod, weld splatter and slag.

Systematic and thorough analysis of the above resulted in the following changes, modifications and developments after photographs and recording of data was completed:

a. A Sealol-Chempro (seal manufacturer) service representative was ordered on the site to witness the seal disassembly. Conversations between the representative and LCDC personnel resulted in expediting the rebuilding of the seal faces and check out of both seal rotating bellows assemblies and stationary faces by the manufacturer in Providence, Rhode Island. Checkout by the manufacturer revealed a crack in the top tungsten carbide rotating seal face believed to have been caused by inadequate solvent seal flush of the seal faces. In addition, the top rotating seal face exhibited microscopic leaching or corrosion. However, this was not apparent on the other seal faces and could not be confirmed.

Further discussions with the manufacturer resulted in the following manufacturer modifications to ensure reliable seal service:

1. The top seal rotating face material was changed to carbon instead of the previously used tungsten

II. TEST PROGRAM

B. Tasks (Continued)

4.3.2 (Continued)

a. 1. (Continued)

carbide. This was done to guard against further dry running conditions and to provide a greater pressure to velocity ratio for this application.

2. Both seals were reassembled using solid locking pins to secure stationary seal faces.

3. All seal faces were inspected and lapped prior to reassembly.

4. A review of the compatibility of Sure Sol 180 (startup solvent) and the binder used for seal faces showed that no leaching or other deleterious effects should occur.

5. Proper installation procedures of the sleeve/shaft auxiliary packing was reviewed.

6. Upon recommendation from Sealol, a solvent retaining cup was fabricated and shrunk fit over the top rotary seal head to ensure positive retention of seal flush solvent around the seal face area. A minor modification to the seal flush inlet port on the seal flange was also completed.

b. The carbon throttle bushing and seal sleeve clearances were recalculated by Sealol-Chempro and found to be inadequate to accommodate thermal expansion at the higher temperatures. This apparently was the cause of sleeve and bushing scoring. Consequently, the carbon throttle bushing inside diameters were machined to the required size.

c. The seal sleeves were machined and chrome plated to obtain original dimensions.

In addition, the following Extractor configuration changes were made towards the end of the month prior to reassembly:

a. Present design and construction of the rotating and stationary cones is ineffectual in keeping particles out of the bottom mechanical seal stuffing box. In reality,

II. TEST PROGRAM

B. Tasks (Continued)

4.3.2 a. (Continued)

the cones appear to retain particles in the stuffing box once located in the area. For this reason, both cones were removed and the first L-B205 shaft impeller was inverted and placed close to the bottom vessel flange to increase agitation and prevent particles from settling in the stuffing box area. An alternate cone and stuffing box arrangement is presently being developed and evaluated.

b. Piping for the seal flush solvent to both seals was modified and instrumented in order to allow monitoring of seal flush injection.

c. Steam quench inlet and outlet piping to both seals was modified to ensure monitoring of steam purge to seals. Additionally, a change in operation procedure was instituted to prevent steam condensate collection in the mechanical seals. (The water leak observed near the bottom bearing during hot solvent operation apparently came from steam condensate collected in the bottom mechanical seal near the auxiliary packing.)

d. The Extractor vessel and shaft was thoroughly swept down and washed with fire hose to remove any remaining materials that may be hazardous to successful Extractor operation.

The above developmental changes and modifications are expected to increase reliability of the Extractor in future operations.

4.4 Work Forecast for the Coming Month:

4.4.1 Coordinate and advise field during Extractor reassembly.

4.4.2 Travel to field to discuss future rotating cone modifications and stuffing box arrangements. Coordinate installation of mechanical and electrical vibration probes.

4.4.3 Supervise on-site Machine Surveillance System (MSS) electrical checkout by Vendor representative.

4.4.4 Train Test Engineer in operation of the MSS and data collection methods.

4.4.5 Submit Test 1800 Test Procedures for final review and distribution.

II. TEST PROGRAM

B. Tasks (Continued)

4.4.6 Review startup procedures with LCDC prior to Extractor operation.

4.4.7 Review and schedule Test 1821 and Test 1822 with LCDC personnel.

5.0 Flow Meters

5.1 Objective:

Development of flow meters for hot slurry service and high viscosity low Reynolds numbers streams and devices that will meet the requirements of mechanical reliability, process acceptability, and scale-up potential.

5.2 Work Accomplished for the Month:

5.2.1 Test engineer involved in plant startup assistance; no progress for test accomplished.

5.3 Problems Encountered and Solutions:

None.

5.4 Work Forecast for the Coming Month:

5.4.1 Continue to provide instrumentation support to other test elements.

5.4.2 To continue the preparation of test procedures for plant test runs, Numbers 3, 4, 5, 6 and 7.

6.0 Control, Letdown Valves and Expansion Chambers

6.1 Objective:

Development of control, letdown and expansion chamber configuration and trim materials that will maintain their dimensional integrity and design performance in coal liquefaction service.

6.2 Work Accomplished for the Month:

6.2.1 Test engineer involved in plant startup assistance; no progress for test accomplished.

6.3 Problems Encountered and Solutions:

None.

II. TEST PROGRAM

B. Tasks (Continued)

6.4 Work Forecast for the Coming Month:

6.4.1 To continue the preparation of test procedures for plant test runs, Numbers 3, 4, 5, 6 and 7.

7.0 Valves and Piping

7.1 Objectives:

7.1.1 Performance evaluation of pipeline valves used in coal liquefaction slurry service. Body material and trim selection that will minimize changes in the internal configuration which will give superior flow characteristics and minimal solids buildup.

7.1.2 Design modifications of high-pressure pipe connectors to investigate their reliability when exposed to thermal shock.

7.2 Work Accomplished for the Month:

7.2.1 No further work in the Home Office is planned in this area until field test operations begin.

8.0 Corrosion and Erosion

8.1 Objective:

To determine the corrosion and erosion rates of various materials in coal liquefaction service.

8.2 Work Accomplished for the Month:

8.2.1 Test procedures are still in the review stage by Client.

8.2.2 Field has completed the review of test procedures.

8.2.3 Completed the spare parts checkout at Cresap.

8.3 Problems Encountered and Solutions:

Test Number 1941 may have to be relocated, because the way it is currently set up could result in the polymerization of the line.

II. TEST PROGRAM

B. Tasks (Continued)

8.4 Work Forecast for the Coming Month:

8.4.1 Continue the effort with LCDC to install the test elements, and review the test procedures, data collection and data transmittals.

9.0 Pipe System Erosion/Hydraulics

9.1 Objective:

To test the erosive quality of some of the slurry streams which are characteristic of coal liquefaction plants.

9.2 Work Accomplished for the Month:

No further work in the Home Office is planned in this area until field test and operations begin.

10.0 High-Pressure Closures

10.1 Objectives:

10.1.1 Confirm the existing high-pressure reactor closure and flange assemblies for 5000 psi, 900°F operation.

10.1.2 Evaluate the performance of two additional 4-inch flanges in the aforementioned high-pressure temperature environmental under cyclic operation and external pipe-imposed load.

10.2 Work Accomplished for the Month:

No further work in the Home Office is planned in this area until field test and operations begin.

11.0 Vessels

11.1 Objective:

Develop information for improved vessel design.

11.2 Work Accomplished for the Month:

No further work in the Home Office is planned in this area until field test and operations begin.

II. TEST PROGRAM

B. Tasks (Continued)

12.0 Heaters

12.1 Objective:

To obtain quantitative data on heater design parameters including:

12.1.1 Tube fouling caused by coke laydown.

12.1.2 Pressure drop characteristics.

12.1.3 Heat transfer characteristics.

12.2 Work Accomplished for the Month:

12.2.1 Resolved discrepancies concerning tubeskin thermocouple locations in both test heaters. Computer data reduction programs are being revised to incorporate results.

12.2.2 Inspected the test heaters and associated test equipment. Several minor problem areas were identified for correction.

12.2.3 Continued refinement of test planning.

12.3 Problems Encountered and Solutions:

No problems are anticipated at this time.

12.4 Work Forecast for the Coming Month:

12.4.1 Provide field assistance as required.

12.4.2 Review and refine computer data reduction program.

13.0 Heat Exchangers

13.1 Objective:

To obtain quantitative data on heat exchanger design parameters, including:

13.1.1 Heat transfer coefficients of coal derived fluids.

13.1.2 Fouling characteristics of coal derived fluids.

13.1.3 Erosion and corrosion studies of coal derived fluids.

II. TEST PROGRAM

B. Tasks (Continued)

13.1.4 Viscosity studies for coal derived fluids.

13.2 Work Accomplished for the Month:

13.2.1 Continued definition of data reduction program.

13.3 Problems Encountered and Solutions:

No problems at this time.

13.4 Work Forecast for the Coming Month:

13.4.1 Continue definition of data evaluation program.

14.0 Process Definition and Development

14.1 Objective:

Development of process information required to improve the knowledge of the CSF process including data useful for commercial design.

14.2 Work Accomplished for the Month:

14.2.1 Reviews of the detailed test procedures to incorporate process information continue.

14.3 Problems Encountered and Solutions:

None.

14.4 Work Planned for the Coming Month:

14.4.1 Continue to work with all aspects of the test program and laboratory scope to incorporate process definition comments as appropriate.

INDUSTRIAL WASTEWATER EFFLUENT

			MONITORING DATA FOR MONTH OF May, 1977				
PARAMETER	VALUE REPORTED	DATE / STANDARD	5/1/77	5/8/77	5/15/77	5/22/77	
FLOW (gal/day)	Daily Flow	Monitor					
TSS (mg/l)	Measurement	60 mg/l	18	11	15		
	Av. to Date	30 mg/l	18	14	15		
TDS (mg/l)	Measurement	Monitor	4925		4000		
	Av. to Date	Monitor	4925	4925	4462		
COD (mg/l)	Measurement	Monitor	257		404		
OIL & GREASE (mg/l)	Measurement	15 mg/l	16	14	11		
	Av. to Date	10 mg/l	16	15	14		
PHENOL (mg/l)	Measurement	1.0 mg/l	0.25	0.8	0.5		
	Av. to Date	0.05 mg/l	0.25	0.52	0.5		
NH_3 (mg/l)	Measurement	30 mg/l	<1	<1	0	NO DISCHARGE	
	Av. to Date	15 mg/l	<1	<1	<1		
CYANIDE (mg/l)	Measurement	0.2 mg/l	0	0	0		
	Av. to Date	Monitor	0	0	0		
PHOSPHATES (mg/l)	Measurement	Monitor	0				
pH	Measurement	6.0≤ pH≤9.0	8.1	8.3	8.5		
TOT. RES. Cl (mg/l)	Measurement	Monitor	0				
	Av. to Date	Monitor	0	0	0		
ARSENIC (mg/l)	Measurement	Monitor	0	0			
LEAD (mg/l)	Measurement	Monitor	0.092	0.679			
CADMIUM (mg/l)	Measurement	Monitor	0.022	0.001			
MERCURY (mg/l)	Measurement	Monitor	0.00005	0.0135			
TOTAL IRON (mg/l)	Measurement	Monitor	0.016				
TOTAL COPPER (mg/l)	Measurement	Monitor	0.020				
ALUMINUM (mg/l)	Measurement	Monitor	0.377				
HEX. CHROMIUM (mg/l)	Measurement	0.05 mg/l	0				
ZINC							

SANITARY WASTEWATER EFFLUENT

PARAMETER	VALUE REPORTED	DATE / STANDARD	MONITORING DATA FOR MONTH OF May, 1977 5/1/77	5/8/77	5/15/77	5/22/77
FLOW (gal/day)	Daily Flow	Monitor				
TSS (mg/l)	Measurement	45 mg/l	19	27	12	37
	Av. to Date	30 mg/l	19	23	19	24
BOD_5 (mg/l)	Measurement	45 mg/l				5 (5/19/77)
	Av. to Date	30 mg/l				5
CAL COLIFORM (No./100 ml)	Measurement	400		<9 (5/4/77)		
	Av. to Date	200		<9	<9	<9
pH	Measurement	$6.0 \leq pH \leq 8.5$	8.0	7.9	7.5	7.9
Resid Cl	Measurement	>0.5 mg/l	49	5.3	9.1	11.9

POTABLE WATER

PARAMETER	VALUE REPORTED	DATE / STANDARD	MONITORING DATA FOR MONTH OF May, 1977 5/1/77	5/8/77	5/15/77	5/22/77
E Cl RESIDUAL (mg/l)	Measurement	0.35	0.15	0.09	0.06	0.06