

- o Established Special Bank Account for DOE drawdowns
- o Miscellaneous weekly and monthly report maintenance

2.1.3 Major Accomplishments/Milestones

See Exhibit VII-C

2.1.4 Major Problems

2.1.4.1 Fluor

EXHIBIT VII-D

CONSULTANT/CONTRACTOR REVIEW

<u>Firm:</u>	<u>Fluor</u>	<u>Pilko &amp; Associates</u>
<u>Individuals/Positions:</u>	M. Norman - Deputy Director of Project Controls	R. Smullen-Principal
<u>Statement of Scope:</u>	Responsible for cost, scheduling & estimating	Develop plan/schedule CPM for environmental activities and review Radian change orders.
<u>Dates of Service:</u>	February, 82 through June, 82	February, 82 through May, 82
<u>Reports Prepared (dates):</u>	Fluor: Cost Reports CPM Reports Budget Estimates	Environmental CPM and Radian Change Order review. April, 1982
<u>Decisions Impacted:</u>	Completion date and cost of project	Completion date of environmental activities, partic- ularly the EIS.
Budgeted \$ to date:		
Actual \$ to date:		
Future Budget/Estimate		
<u>Performance appraisal:</u>		
 <u>Future Recommendations:</u>		

2.1.4.3 Lurgi

2.1.4.4 Tri-State Synfuels Company

2.2 CURRENT STATUS

2.2.1 Current Work Activities

- o Establishing revised budget for Phase I to include:
  - Fluor - complete
  - Radian - in progress
  - Lurgi - in progress
  - Texas Eastern - in progress

Texas Gas - in progress

- o Establishing new plan/schedule on CPM. Logic diagrams have been developed for: (see appendix 4.4.13)

Fluor - computer inputted on FAST  
Radian - computer inputted on MSCS  
Lurgi - computer inputted on FAST  
Texas Eastern - logic diagrams only

- o Updating Monthly Reports for:  
DOE  
CARS Cost Report
- o Review and analysis of subcontractor reports
- o Review and make recommendations on all outstanding subcontractor change orders.
- o The work activities of Accounting; that of monitoring project expenditures and reporting these expenditures to management for decision making, has remained constant throughout the project and will continue for the life of the project.

#### 2.2.2 Key Decisions Pending

- o Total cost of revised Phase I work program has not been completed.
- o Integration of Tri-State Synfuels Company activities into the environmental and engineering schedule has not been completed.
- o Revised Fluor budget estimate has been submitted, but not approved by Tri-State Synfuels Company.

#### 2.2.3 Major Strengths/Weaknesses

##### 2.2.3.1 Project Controls

- o Strengths
  - The ability to analyze the cost data on a macro and micro basis.
  - The integration of all subcontractor schedules into one schedule with the ability to analyze the effect of one subcontractor on another.
  - Written project controls procedures.

EXHIBIT VII-E

FUTURE MILESTONES/MASTER SCHEDULE

Description

- . Review and approve revised Fluor Budget Estimate
- . Complete and approve revised CPM Project Schedules
- . Develop and approve Phase II Equipment Factored Estimate
- . Monthly maintenance of: CARS Cost Reports  
Financial Statements  
CPM Schedules  
DOE Progress Report  
Invoice Processing  
Subcontractor's Progress Reports
- . Develop Phase II Project Control Procedures

- o Weaknesses

- Fluor's CPM software. (for detail see 3.5.1.1)
- Houston's inability to interact with Fluor directly.
- Inability of the cost system to forecast effectively.

#### 2.2.3.2 General Accounting

The major strengths of the accounting system is that of internal accounting controls represented by:

- o competent personnel assigned to the accounting functions.
- o separation of duties among personnel as well as departments.
- o an adequate system of checks and balances.
- o formulized written procedures which govern activities. These accounting controls played a large role in assuring that the assets of Tri-State were safeguarded, that transactions were recorded in a consistent manner, and that the operations of Tri-State were reported to management in a meaningful manner.

#### 2.2.4 Demobilization

- o Demobilization plan and budget was developed.
- o Weekly reports were issued to update status of demobilization.

### 2.3 FUTURE

#### 2.3.1 Milestones/Master Schedule

See Exhibit VII-E

#### 2.3.2 Work Program

##### 2.3.2.1 Accounting

The "minimal effort" accounting work program will essentially be the same as the previous work program except on a much smaller scale. These functions consist of the following:

- o Process invoices
- o Record transactions
- o Prepare financial statements
- o Prepare cash calls

#### 2.3.2.2 Project Controls

The recommended project control work activities for the "minimal effort" program should consist of the following:

- o Revise quarterly the Total Project Summary Schedule
- o Revise quarterly the Phase I Summary Schedule
- o Periodically escalate to present value, the cost estimates for Phase I and total project

#### 2.3.3 State of Readiness

The accounting records are maintained in a fashion that facilitates ease of retrieval and Accounting will continue to report expenditures to management for the life of the project. Therefore, if at any time a decision is made to resume accelerated spending levels, accounting will have virtually no extra tasks but will only have an increased volume of the existing tasks. The CPM diagrams and cost estimates are in the files and would only have to be updated to the present status of the project.

#### 2.3.4 List of Tasks for Project Reactivation

- o Set up new job numbers
- o Establish special Bank Account (if DOE is involved to fund the project in this manner)
- o Initiate and revise CARS cost program
- o Revise and input data for CPM schedules
- o Revise Phase I budget estimates
- o Develop standardized project control procedures for all subcontractors

#### 2.3.5 Staffing

In the future, if the project were to be reactivated, it is recommended that:

- o there is direct line authority from project control personnel working in subcontractor offices to the project control department in Houston.

- o more personnel with project oriented experience be utilized.
- o project control personnel, in subcontractor offices, should be totally devoted to project control activities and administrative personnel be assigned for miscellaneous administrative duties.



### 3.0 DETAILED REVIEW OF WORK PLAN

#### 3.1 ORIGINAL MILESTONE SCHEDULE, MANPOWER PLAN, & COST PLAN

The original Milestone Schedule, Manpower Plans and Cost Plans for Phase I, were issued March 13, 1981 (in project files). The start date of the project was February 6, 1981 with a scheduled completion of February 22, 1983. There were two cost plans initiated in which one was for the DOE cooperative agreement costs and the other was for total partnership costs. The budgets established for these two cost plans were as follows:

	<u>Cooperative Agreement Costs</u>	<u>(\$000's)</u>	<u>Partnership Costs</u>
TSSC			
Subcontractor- Fluor			
Subcontractor- Radian			
Subcontractor- Lurgi			
Subcontractor- Consultants			
Coal Test			
TOTAL			

#### Note:

There was one manpower plan developed for the cooperative agreement period. The additional partnership costs, as shown above, were not manhour related. Therefore, no additional manhours were indicated.

The following represents the manhour distribution:

#### Manhours

Texas Eastern  
Texas Gas  
Fluor  
Radian  
L

### 3.2 CARS (CONTROL AND REPORTING SYSTEM)

Upon completion of the cost and manpower plans, TSSC instituted its CARS computer software program. This was an internally developed computer program designed to rollover Texas Eastern accounting and payroll data into TSSC CARS accounting and control program. Budgets were inputted from the cost and manpower plans by month and actuals were compared with these budgets. It was an effective reporting device, but it was felt that it was ineffective as a control document. Texas Eastern's accounting codes had to be followed, which are not set-up to be project oriented. As an example; Texas Eastern engineering expenditures were all charged into one account number and not broken out by location. Therefore, it was impossible to indentify the Irvine costs from the Houston costs. Another weakness in the program was the way forecasts were calculated. The program was set-up to automatically forecast manhours and dollars based on variances between planned and actual expenditures. Therefore, if the schedules slipped and the manpower level didn't increase as planned, the program would calculate this as an underrun and would forecast an inaccurate smaller expenditure. It is suggested that forecasting should be a manual input based on an analysis that is accepted for that work activity. It is noted that CARS was updated and issued monthly, and a users guide was prepared and is in the project files.

### 3.3 BUDGET DEVELOPMENT

#### 3.3.1 February 1981 Budget Development - Phase I

This budget was the instrument used in developing the Manpower and Cost Plans mentioned in section 3.1. The personnel responsible for this budget were not involved in the project at the time of this writing. Therefore, only secondhand knowledge can be discussed.

##### 3.3.1.1 Texas Eastern and Texas Gas

The initial development of the Texas Eastern/Texas Gas budget was completed in January, 1981. (A notebook in the files includes all the back-up for this budget) It was considered to be realistic and well-founded, and was prepared based on the February 1981 - February 1983 timing schedule. It was used as the control document until December, 1981.

##### 3.3.1.2 Fluor

#### 3.3.1.3 Radian

A scope of work was developed for the environmental program and was then issued for competitive bidding. Radian was subsequently awarded the contract and their bid estimate was used as their budget. Again, no detailed estimate back-up was provided. Therefore, an analysis of the budget estimate was difficult. This budget was used for their entire program to date, but in March they presented a number of change orders totalling \$ . These were discussed with Radian and rejected as unneeded.

#### 3.3.1.4 Lurgi

The budget for Lurgi was prepared by Lurgi. There were no back-up documents or a formal estimate for their scope of work. Lurgi was never released to work full-time on their work activities, but was used on spot occasions and on the coal tests. A better estimate and scope of work was needed to control Lurgi's work activities.

#### 3.3.2 Reevaluation Budget - December, 1981

In December, 1981, new budgets were developed to control a new direction in the project which was to last for 6 months. This was a reevaluation of the project to reflect a change in the process configuration. A budget was established with an average expenditure rate of \$ . (See appendix 4.4.14) This budget was controlled manually and was discontinued at the end of March after the decision to cancel the cooperative agreement. The budget was developed initially by manpower distribution and expenses associated with the work program. This budget was underrun 15% at the end of 3 months.

As part of the reevaluation program, a new overall project budget was developed which included the reevaluation work activities and assumed the project took the configuration of case 7R of the alternative studies. This budget is indicated below and when compared to the original budget in section 3.1, it is approximately an \$ ; primarily due to TSSC costs associated with the continuation of Phase I from February 1983 to March 1984.

	Cooperative Agreement Costs (\$000'S)	Partnership Costs (\$000'S)
TSSC		
Subcontractor - Flour		
Subcontractor - Radian		
Subcontractor - Lurgi		
Subcontractor - Consultants		
Coal Test		
Total		

Note:

### 3.3.3 Demobilization Budget - April 15, 1982 - June 15, 1982

When the cooperative agreement was cancelled, a demobilization budget was developed. (See appendix 4.4.15). The monitoring and controlling of this budget was carried out manually by reporting against manhours. Total budget was established at \$ million, with actual expenditures estimated at \$ thousand.

### 3.3.4 Termination Budget - June 1982 - April 15, 1982

After discussions with the DOE, it was determined that another budget was needed to close-out the cooperative agreement. The work activities for this budget were generally; auditing activities and negotiations with subcontractors for final settlement. This budget was established at \$ with a final termination date of April 15, 1983.

## 3.4 COST REPORTING AND CONTROLLING

### 3.4.1 Texas Eastern and Texas Gas

It was described earlier how CARS was used for reporting and controlling Texas Eastern. It was felt that the existing cost reporting was inefficient due to the inflexibility of the Texas Eastern accounting codes and system, and the two month lag in reporting actual expenditures. Texas Gas

expenditures were minimal, so they weren't a major factor in the overall system. A system was set-up in November, 1981 for controlling Texas Eastern support services. The CARS program was not definitive enough to control the part-time participants of Texas Eastern. A manual system was initiated, whereby, activities were identified and given task numbers. Timesheets were collected semi-monthly with these activities identified. These hours were then recorded in a log and summarized monthly.

#### 3.4.2 Fluor

Fluor used their monthly progress report for reporting expenditures and manhours as their only reporting document until December, 1981.

#### 3.4.3 Radian

Until October, 1981, Radian was issuing a monthly progress report that indicated actual expenditures per month and cumulative to date.

#### 3.4.4 Lurgi

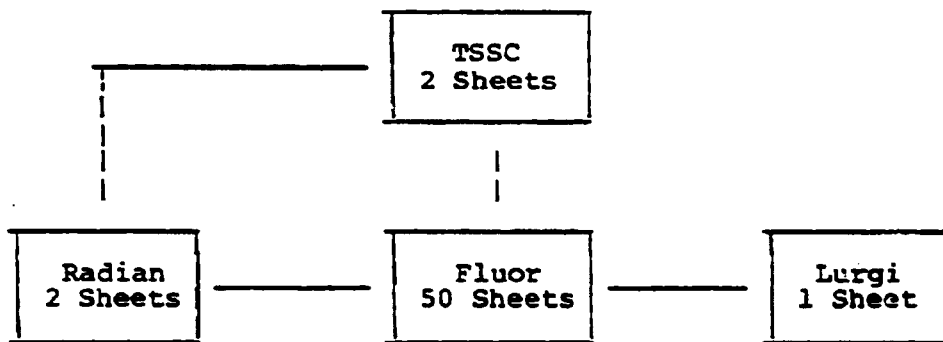
Lurgi did not issue cost reports, but would telex their monthly expenditures at the end of the month. They were to start issuing cost reports in July when the bulk of their work was to start.

### 3.5 SCHEDULES - CPM & SUMMARY

#### 3.5.1 CPM Schedules - Phase I

##### 3.5.1.1 Original CPM Schedule - REV.08 (7-16-81)

On July 16, 1981, the first issue of the project CPM was issued as REV.08. This was updated as of June 21, 1981. The CPM schedules were developed as an integral schedule as depicted below:



#### CPM Development & Interfacing

Each work group developed logic diagrams for their work activities and upon completion interfaced their work activities to the other work groups. There were approximately 4,000 activities, all included. The CPM was developed and maintained on Fluor's "FAST" system. This was considered a hindrance for the following reasons:

1. Limited to 4000 activities, no room for expansion.
2. Was not an interactive system, no if/what games could be played.
3. Turn-around time was dependent on priority basis which was expensive.
4. Resource (Manpower) allocation and levelling was not available. Resources were controlled through a separate system called MADAP.
5. Reports were issued for total project which tended to reemphasize Fluor's activities, which did not have as much negative float as Radian.

6. Fluor's unnecessary knowledge of TSSC activities and their progress.

The first update report showed a June 22, 1983 completion date which was 83 days past the original scheduled completion date of February 24, 1983. The critical path was traced starting with the Ranney Well Study and continuing through the environmental program. A copy of the initial logic diagrams and status reports are referenced in appendix 4.3.

3.5.1.2 Revised CPM Schedule - REV.09 (3-31-82)

As discussed previously in this report, there was a project reevaluation period in which there were some major process changes. It was after these process changes were identified, that Fluor was requested to re-estimate and re-schedule their work activities for Phase I. (See appendix 4.4.17) This was started in January, 1982 and issued on March 26, 1982. The approach taken by TSSC on this reorganization of the CPM schedule, was to separate the monitoring and maintenance functions of the Fluor, Radian, and TSSC activities. The Fluor schedule included their activities and Lurgi activities. The Radian schedule was comprised of all remaining environmental activities including permitting, which was not detailed in the previous schedule. The TSSC schedule was detailed three-fold from the previous CPM and was to include all outstanding work activities. As stated above, all three CPM's were independent of each other and were to be maintained on separate systems. Fluor's activities were to be kept on their FAST system, Radian's was inputted on McAuto's MSCS program, and TSSC's was also to be inputted on MSCS. All ties between the three schedules were to be identified on each schedule and manually inputted on each. As of this writing, the Radian and Fluor schedule were up and operating 100%. The logic had been developed for TSSC activities, but had not been inputted in MSCS. The new completion date for Fluor's activities was February 16, 1984, or a one year extension from the original date. This was due to the reduced manpower levels originally planned and the reevaluation period that was not in the original schedule. The critical path for Fluor began with the Topography Report and continued through the site preparation drawings. Radian's activities were scheduled to complete December 13, 1983 with the issuing of the final Environmental Impact Statement by the EPA. The critical path for this schedule was through the design of the non-hazardous waste area. A copy of the computer generated CPM for the environmental program is included in the appendices of this report. The TSSC work activities were not directly on the critical path of the Phase I schedule, but served more as a supportive function of the overall schedule. There were certain goals that were to be attained before the start of Phase II, and these are identified on the logic diagrams included in appendix 4.4.13 of this report.

### 3.5.2 Phase I - Summary Schedules

Included in the appendix 4.4.3 are copies of the Phase I summary schedules depicting the project on a summary level. There were four schedules developed throughout the project. These are listed as follows:

- o February 1983 Completion (issued July, 1981)
- o June, 1983 Completion (issued October, 1981)
- o February, 1984 Completion (issued December, 1981)
- o February, 1984 Completion (REV.1) (issued May, 1982)

### 3.6 PHASE II - SCHEDULES

Included in appendix 4.4.2 are a copy of the two Master Schedules, prepared by Fluor, for the entire project depicting process design through start-up of the plant. These are included as follows:

- o Construction Completion December, 1987 (issued July, 1981)
- o Construction Completion February, 1988 (issued March, 1982)

### 3.7 GENERAL ACCOUNTING

#### 3.7.1 Journal Entry Preparation

Texas Eastern's Accounting Department prepares journal entries to record all transactions which relate to Tri-State. The entries were compiled for use in preparing financial statements.

#### 3.7.2 Financial Statements

Financial Statements for Tri-State Synfuels Company were prepared monthly and distributed to the managements of Texas Eastern Corporation and Texas Gas Corporation. The financial statements incorporated the following individual statements:

- o Balance Sheet
- o Statement of Partners Income
- o Statement of Partners Capital
- o Statement of Changes in Financial Position



o Analysis of Financial Status

These statements were prepared primarily to help the partners (Texas Eastern and Texas Gas) assess the financial position of Tri-State. (See sample in appendix 4.4.16)

3.7.3 Invoice Processing

Invoices were received during the month from the various firms and vendors which performed work for Tri-State. These invoices were proofed for validity and accuracy and then processed for payment.

3.7.4 United States Department of Energy Drawdowns

The procedure by which the United States Department of Energy Funded the Tri-State Project was via a Modified Letter of Credit on the account of the United States Treasury. This Letter of Credit was established at a designated Federal Reserve Bank or Branch.

Drawdowns under the Modified Letter of Credit were effected by checks drawn on a Special Bank Account at Chemical Bank, New York. The operation of the Special Bank Account was as follows:

- o Upon accumulating DOE reimbursable expenditures of at least \$5,000 but not greater than \$5,000,000, Tri-State prepared a check payable to itself, and drawn on the Special Bank Account. This check was then forwarded to Chemical Bank, New York. Upon receipt, Chemical Bank prepared a payment voucher and forwarded such to the designated Federal Reserve Bank or Branch which had the Modified Letter of Credit. At the time funds were received by Chemical Bank from the Federal Reserve Bank, Chemical Bank gave credit to the Special Bank Account. At the same time, they would honor the check drawn on the Special Bank Account, which was payable to Tri-State Synfuels Company. Thus, upon payment of this check, funds in the Special Bank Account were transferred to Tri-State Synfuels Company.

In consideration of Chemical Bank's performance of its obligations in connection with the Special Bank Account, a non-interest-bearing time deposit was initiated in a separate account at Chemical Bank. The interest earned on this deposit was intended to compensate Chemical Bank for expenses incurred in administering the Special Bank Account.

### 3.7.5 Kentucky Department of Energy Invoice

Pursuant to Agreement between the Commonwealth of Kentucky and Tri-State Synfuels Company dated May 18, 1981, Commonwealth of Kentucky agreed to reimburse Tri-State for costs incurred in connection with the large scale coal test conducted at Sasol One (Proprietary) Limited.

In consideration of the above agreement, Tri-State prepared monthly invoices to bill Kentucky Department of Energy for costs which were related to the Sasol cost test, as these costs were incurred by Tri-State. The approximate total cost of the coal test was \$            million.

### 3.7.6 Cash calls

At the beginning of each month, an analysis of estimated cash receipts and disbursements was prepared. The result of which, indicated a cash surplus or cash deficiency. Upon analyzing the current cash position of Tri-State, a cash request or refund to the partners was made in proportions which would satisfy the cash needs of the partnership and also keep the partners' capital accounts in balance.

### 3.7.7 Monthly Department of Energy Progress Reports

On the 20th day of each month, Tri-State was required to submit progress reports for the preceding month's activities to the United States Department of Energy. This report is divided into the following sections: Milestone Schedule and Status Report, Contract Management Summary Report, Project Status Report, Monthly Cost and Manpower Management Report, and Technical Progress Report. (See appendix 4.4.18)

#### 3.7.7.1 Milestone Schedule and Status Report

This report lists significant events of the Project by work discipline and the estimated date each milestone is to be attained. It also shows progress for each discipline.

#### 3.7.7.2 Contract Management Summary Report

This report depicts, in graphic format, the deviations of actual cost and manpower from the planned cost and manpower. It also gives estimates of cost and manpower for subsequent periods.

#### 3.7.7.3 Project Status Report

This report, prepared in outline form, highlights the activities and accomplishments occurring during the month.

#### 3.7.7.4 Monthly Cost and Manpower Management Report

This report, separated by work discipline, compares the actual cost and manpower expended over a given period to the planned cost and manpower and reveals the variance between the two. It also indicates estimated expenditures of cost and manpower for subsequent periods and the total project.

#### 3.7.7.5 Technical Progress Report

This report, prepared in outline form, is a summary of the technical activities and accomplishments occurring during the month.

#### 3.7.8 General Bank Account Maintenance and Reconciliation

Texas Eastern (a partner in the Tri-State Project) Treasury and Auditing Departments performed all necessary duties to maintain Tri-State's General Bank Account.

Treasury's function was to prepare all checks for the payment of current obligations and keep records of all deposits and disbursements pertaining to Tri-State's bank account. Auditing's function was to reconcile the General Bank Account balance per Treasury's records with Chemical Bank's records and maintain all bank statements received from Chemical Bank.

#### 4.0 APPENDIX

- 4.1 Major contacts (See Exhibit VII-F)
- 4.2 File Listings (See Exhibit VII-G-1 through VII-G-4)
- 4.3 Major Reference Documents (See Exhibit VII-H)
- 4.4.1 CARS Report
- 4.4.2 Total Project Master Summary Schedules (7/81 & 3/82)
- 4.4.3 Phase I Master Schedules (7/81, 10/81, 12/81, 5/82)
- 4.4.4 January 82 - June 82 Fluor Work Schedules
- 4.4.5 Meeting notes for DOE review of Fluor Project Controls
- 4.4.6 Critique of Fluor's 5-B Modified Estimate
- 4.4.7 Fluor Productivity Analysis
- 4.4.8 Radian Monthly Status Report
- 4.4.9 Radian Cost Report
- 4.4.10 Radian Revised Reporting System
- 4.4.11 Fluor Phase I Revised Budget Estimate
- 4.4.12 Fluor CPM Reports (March 31, 1982)
- 4.4.13 Fluor, Radian, Lurgi, TSSC CPM logic diagrams (March 31, 1982)
- 4.4.14 TSSC Control Budget (January 82 - June 82)
- 4.4.15 Demobilization Control Budget
- 4.4.16 TSSC Financial Statements
- 4.4.17 Correspondence for revising Fluor Budget Estimate
- 4.4.18 DOE Monthly Report - February 82

EXHIBIT VII-F

MAJOR CONTACTS

<u>Company &amp; Address</u>	<u>Individual</u>	<u>Title/Position</u>	<u>Telephone</u>
Chemical Bank New York 20 Pine Street, 3rd Floor New York, New York 10005	*Albert P. Nesi, Jr.	Assistant Vice President	(212) 770-2502
Chemical Bank, New York Energy & Minerals 5th Floor, 277 Park Avenue New York, New York 10172	Sherry Amanpour	Service Assistant	(212) 310-6375

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\*KEY CONTACT

EXHIBIT VII-G-1

T.E. Synfuels Central Files  
Critical/Important Items

<u>File Number</u>	<u>Item/Description</u>	<u>Date</u>	<u>Proprietary/Confidential If yes, by whom</u>
2020	Invoices - Preagreement cost General Project Management		
2038	Invoices - Preagreement cost Project Control		
2039	Invoices - Preagreement cost Environmental		
2040	Invoices - Preagreement costs Legal		
2046	Invoices - Preagreement costs Market Analysis		
2047	Invoices - Preagreements costs Coal Resources		
2048	Invoices - Preagreement costs Public Relations		
2049	Invoices - Preagreement costs Economics		
2050	Invoices - Preagreement costs Engineering		
N/A	Tri-State Synfuels Company Working Trial Balance		
N/A	Tri-State Synfuels Company Financial Statements		
N/A	Tri-State Synfuels Company Cash Reports		
N/A	Tri-State Synfuels Company U.S. DOE Drawdown Schedules		

EXHIBIT VII-G-2

<u>File Number</u>	<u>Item/Description</u>	<u>Date</u>	<u>Proprietary/Confidential If yes, by whom</u>
4901	Invoices - Texas Eastern General Project Management		
4902	Invoices - Texas Eastern Project Controls		
4903	Invoices - Texas Eastern Environmental		
4904	Invoices - Texas Eastern Legal		
4905	Invoices - Texas Eastern Market Analysis		
4906	Invoices - Texas Eastern Coal Resources		
4907	Invoices - Texas Eastern Public Relations		
4908	Invoices - Texas Eastern Economics		
4909	Invoices - Texas Eastern Project Engineering		
4910	Invoices - Texas Gas Synfuels Corp.		
4911	Invoices - Radian Corp.		
4912	Invoices - Fluor Engineers and Consultants, Inc.		
4913	Invoices - Sasol One (Pty.) Ltd.		
4914	Invoices - Lurgi Kohle and Mineraloltechnik GmbH		
4915	Invoices - Consultants		
4916	Invoices - Coal Test		
4917	Invoices - Texas Eastern Project Development		
4918	Invoices - Texas Eastern Project ment		

EXHIBIT VII-G-3

<u>File Number</u>	<u>Item/Description</u>	<u>Date</u>	<u>Proprietary/Confidential If yes, by whom</u>
N/A	Tri-State Synfuels Company General Bank Account		
N/A	Tri-State Synfuels Company Special Bank Account		
N/A	United States Department of Energy Monthly Progress Report		
N/A	Tri-State Synfuels Company Cost and Reporting Systems Reports (CARS)		
N/A	Tri-State Synfuels Company KDOE Invoices		
N/A	Tri-State Synfuels Company Job Runs		
N/A	Texas Eastern Synfuels Inc. Job Runs		
N/A	Tri-State Synfuels Company U.S. DOE Monthly Reports		
N/A	Tri-State Synfuels Cash Calls		
N/A	Tri-State Synfuels Company Computer Service Charges		
N/A	Tri-State Synfuels Company Airline Tickets		
N/A	Texas Eastern Corporation Employee Number Listings		
N/A	Tri-State Synfuels Company Cash Voucher Register		
N/A	Texas Eastern Synfuels Inc. Manpower Schedules		
N/A	Tri-State Synfuels Company U.S. DOE Reports Support		
N/A	Tri-State Synfuels Company CARS Users Guide		



EXHIBIT VII-G-4

<u>File Number</u>	<u>Item/Description</u>	<u>Date</u>	<u>Proprietary/Confidential If yes, by whom</u>
N/A	Texas Eastern Engineering Services Division Timesheets		
N/A	Fluor Home Office Progresss Reports		
N/A	Radian Progress Reports		
N/A	Lurgi Monthly Expenditures		
N/A	Tri-State General Bank Account		
N/A	Tri-State Special Bank Account		
N/A	Fluor Cost Reports		

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# EXHIBIT VII-H

## MAJOR REFERENCE DOCUMENTS\*

<u>Description</u>	<u>Author</u>	<u>Date</u>	<u>Location</u>	<u>Utility**</u>
1. Fluor Cost Reports (Oct. 81-Feb. 82)	Fluor	Feb. 82	Project Control File	2
2. T.E./T.G. Phase I Budget Estimate (Rev. 1) - Back-Up Data	TSSC	Jan. 81	Project Control File	1
3. -Project Procedures	TSSC	Mar. 81		2
-Milestone Schedule, Manpower Plan, & Cost Plan	TSSC	Mar. 81	Notebook in project control file	3
-Management Plan	TSSC	Feb. 81		2
-Phase I - Budget Estimates (Rev. 1) including Fluor's 5B Modified estimate and Job Bulletin #1	TSSC, Fluor	Feb. 81		2
4. Fluor CPM logic diagrams (Rev. 8) and initial reports for status as of June 81	Fluor	Jul. 81	Project Control Files	2
5. Environmental CPM Activity Master File	Pilko	Mar. 82	Project Control Files	3
6. 1982 Budget Estimate with Back-Up	TSSC	Jan. 82	Project Control Files	2
7. TSSC Project Controls Procedures	TSSC	Jul. 80	Project Control Files	2

\*Reports: maps, papers, reference/research groups, schedules

\*\*Utility: 3-very important; 2-useful; 1-questionable value

## VIII

### ENVIRONMENTAL PROGRAM

Prepared by: Jay S. Christopher - Environmental Coordinator

#### 1.0 INTRODUCTION

##### 1.1 SCOPE OF WORK

The environmental program scope of work was developed to prepare baseline environmental data to be used in the preparation of the project's future environmental documentation, conduct a basic health and safety program, prepare a comprehensive Regulatory Compliance Management plan, and prepare a comprehensive environmental assessment report. The detailed scope of work is in the Tri-State/Radian contract located in the project files.

The internal environmental support program was designed to manage Radian Corporation's work effort and prepare environmental documentation necessary to carry out the project. The internal environmental program was focused around the project's Environmental Coordinator, who was assisted by various support personnel.

##### 1.2 OBJECTIVES AND GOALS

The overall work program was to complete all activities necessary to make a decision whether to construct the Tri-State Synfuels Project. For the environmental program, this objective was to be met by the successful completion of an environmental impact statement, the receipt (or planned receipt) of all environmental permits necessary to commence construction, and the development of a comprehensive health and safety management program which would ensure that the plant would be operated in a safe manner.

##### 1.3 WORK EFFORTS

Internal project personnel are shown in Exhibit VIII-A. The focus of the environmental effort was the project's Environmental Coordinator. This person was a full-time member of the Tri-State ESD Project Team located in Houston. Full-time support was provided by an environmental engineer during the last five months of the project. Outside support services were provided by Texas Eastern's Engineering Services Division, Environmental Protection Department on an as needed basis. The project team personnel were necessary

Exhibit VIII-A

PROJECT PERSONNEL

Tri-State

<u>Name</u>	<u>Title</u>	<u>Service</u>	<u>Area Of Responsibility</u>
Jay Christopher	Environmental Coordinator	1/81 - 5/82	Overall environmental program, EIS activities
Ed Tschupp	Environmental Engineer	11/81 - 4/82	Air and water activities

Texas Eastern Support

<u>Name</u>	<u>Title</u>	<u>Area/Type Assistance</u>	<u>Role</u>
Pat Shevlin	Engineer	Wastewater	2
Tom Bolli**	Engineer	Wastewater	2
Anita Cuevas	Engineer	Solid Waste	1
Tommy Law	Engineer	Air quality modeling	1
Michael Terraso	Supervisor	Wastewater (analytical)	1

Texas Gas Support

<u>Name</u>	<u>Title</u>	<u>Area/Type Assistance</u>	<u>Role</u>
Charles Brown	Director Codes and Procedures	Texas Gas environmental liason	1

\*3-Key

2-Impact but on "as required basis"

1-Occasional use

\*\*No longer with Texas Eastern

Exhibit VIII-B

ESTIMATED EXPENDITURES FOR WORK AREA

<u>Major Areas</u>	<u>Expenditures 2/6/81-6/15/82</u>		<u>To Complete Phase I</u>
	<u>Budget</u>	<u>Actual</u>	<u>Estimate</u>
Environmental health, safety and socioeconomic program			
Wastewater Treatability Study			
Toxic work program and Sasol site tour			
Analysis of coal test samples (export sample program)			

to the proper day-to-day functioning of the environmental program. For special studies or specific research it was necessary to utilize the more specialized ESD support, as the project team personnel lacked some of these specialized capabilities.

#### 1.4 ESTIMATED COSTS AND MANPOWER

Comparisons of actual versus budgeted expenditures are given in Exhibit VIII-B. In general, it is estimated that approximately \$        in external expenditures are required to complete all Phase I activities.

In addition, the manpower levels utilized for the environmental program appeared to be too low. At least three full-time environmental people may be necessary to meet all project management and technical requirements. Outside technical support will also be necessary, with the level of effort dependent upon specific project matters.

## 2.0 SUMMARY AND HIGHLIGHTS

### 2.1 HISTORY

#### 2.1.1 Phase 1 Work Plan

The original work plan developed for Phase 1 was intended to provide all environmental support necessary for the development of the Tri-State Synfuels Project. A multi-task work program was developed by Radian Corporation (Austin, Texas) to meet the Tri-State objectives. The program involved environmental and socioeconomic analyses, analyses of health and safety risks, and the development of a detailed regulatory compliance plan, and preparation of a comprehensive environmental report. This program evolved to include Radian's participation in a public participation program, the modification of the environmental report to form the basis of an environmental impact statement, and the development, by Radian, of the Prevention of Significant Deterioration (air quality) and hazardous and non-hazardous solid waste disposal permits.

#### 2.1.2 Work Completed

- o Public acceptance of the project was recognized early in the program as crucial to the project's success. A major component of Tri-State's program to generate public support for the project was the public participation program with the Citizen's Advisory Committee. This program was well received by the public and the regulatory agencies.

The principal accomplishment of the environmental work program was the virtual completion of the baseline environmental monitoring and studies, and the completion of the Regulatory Compliance Plan. Essentially no work has been accomplished to assess environmental impacts, and the health and safety program had accomplished little more than developing a literature base.

Although the vast majority of the environmental baseline inventory was complete, further work is still necessary. For example, detailed ecological studies are still necessary immediately surrounding the barge dock and water intake locations. These studies have not been performed because the exact locations of these facilities have not been finalized. Other activities, such as ground-truthing aerial maps for vegetation, and groundwater monitoring at the solid waste disposal area, must also be performed.

The wastewater treatability study was an added program started in April, 1982. The study is being performed by

Engineering-Science in their Houston laboratory. The results of the study are not available at this time and will be published as a separate report by September 1982.

#### 2.1.3 Key Decisions Reached

Decisions reached during the cooperative agreement which significantly affect the environmental program are shown in Exhibit VIII-C. This table also shows the rank (importance) of the decision, when the decision was reached, alternatives considered, and the rationale for the decision.

#### 2.1.4 Major Accomplishments and Milestones

Major accomplishments and milestones completed during the cooperative agreement are shown in Exhibit VIII-D.

#### 2.1.5 Major Problems

A detailed analysis of major problem areas and recommended improvements may be found in a confidential report titled "Tri-State Environmental Management Review", located in the project file room. The following highlights some of the problems and provides general suggestions to overcome the problem at a later date.



Exhibit VIII-C

KEY DECISIONS REACHED

<u>Decision</u>	<u>Rank*</u>	<u>Date</u>	<u>Alternatives</u>	<u>Rational for Decision</u>
EPA as lead agency	3	9/81	Other Potential lead agencies are the U.S. Department of Energy and the U.S. Army Corps of Engineers	The U.S. Department of Energy determined that they had no "major federal action" which would allow them to be lead agency. Tri-State redefined the project to allow the U.S. EPA to assume this role, in light of the EPA's technical expertise with synfuels and the public's negative perception of the Corp's environmental attitudes.
Plant size decrease to a normal quarter size	3	1/82	Full range of size alternatives	See other reports. This decision had the effect of delaying the environmental program (due to delay in engineering work), but increasing the ease of permitting the plant
Process change to methanol	3	1/82	Fischer-Tropsch process	See other reports. Same affect as down-sizing.
Process wastewater discharge	2	11/81	Zero discharge	Consensus opinion was that a zero discharge of process wastewater is not technically or economically viable in western Kentucky. It was also felt that conventional biological treatment could produce a wastewater suitable for discharge at a lower capital cost with fewer environmental side effects

Exhibit VIII-C (continued)

<u>Decision</u>	<u>Rank*</u>	<u>Date</u>	<u>Alternatives</u>	<u>Rational for Decision</u>
Natural draft cooling towers	2	3/82	1. Forced draft cooling towers 2. Cooling ponds	See Engineering Report, Volume 11-C. Forced-draft cooling towers appear environmentally acceptable, natural draft cooling towers appear to be less costly overall.
Covered Coal Storage	3	1/82	Uncovered coal storage	In a downsized plant, covered coal storage is economically superior to uncovered storage. Significant benefits to air quality due to reduced fugitive dust.
Offsite Hazardous Waste Disposal	2	3/82	On-site hazardous waste disposal	Reduction in plant size and certain process changes (particularly the incinerator in the wastewater system) reduces volume of hazardous waste produced. It appears feasible to use a commercial hazardous waste disposer, eliminating necessity of permitting and constructing a hazardous waste landfill.

Exhibit VIII-C (continued)

<u>Decision</u>	<u>Rank*</u>	<u>Date</u>	<u>Alternatives</u>	<u>Rational for Decision</u>
Stratford Sulfur Recovery and Sales	1	3/82	Remove sulfur and dispose by-product. (FGD System)	See Engineering Report, Volume II. Recovery of elemental sulfur is preferable to land-filling additional sludge from FGD system.  NOTE: Stratford experiencing significant operational problems at Sasol. Alternative process most likely required.
Wastewater treatability study	3	4/82	No action	Study is being performed to supply necessary support for future permitting activities.
Conventional EIS Approach w/EPA	3	10/81	Third Party EIS Approach w/EPA	Conventional approach appeared to be: 1) More manageable 2) Less Costly 3) Same time requirement a EIS  Third party approach presented significant problems with Radian as contractor and flow of confidential/proprietary information of Lurgi & SASOL.

\*3-Absolute

2-Preliminary (pending additional input/information)

1-Operational (little to no support)

Exhibit VIII-D

MAJOR ACCOMPLISHMENTS/MILESTONES COMPLETED

<u>Description</u>	<u>DATE</u>	
	<u>Initiated</u>	<u>Completed</u>
EPA as Lead Agency	9/81	12/81
EIS Procedures	7/81	12/81
Scoping Meeting	-	1/82
Environmental Baseline Studies	2/81	5/82
Regulatory Compliance Plan	3/81	1/82
Detailed Permit Acquisition Schedule	1/82	3/82
Archaeological Report	2/82	5/82
Air Quality Monitoring Plan	5/80	6/80
Air Quality Monitoring	7/80	7/81

#### 2.1.6 Changes in Early Assumptions

Problems associated with public health impacts were a much greater concern than was first anticipated. Carcinogenic impacts of synfuel facilities has become a major issue, and much more emphasis should be placed on resolving public concerns.

Regulatory uncertainty has also caused more problems than anticipated. Simple problems, such as determining the proper fugitive particulate emission factor or determining the proper application format for the non-hazardous waste disposal facility, were never resolved and caused significant scheduling uncertainty.

The speed with which decisions are made is slower than anticipated. In the early stages of the program many decisions were taken as given and not reflected in the project CPM. However, even minor decisions may impact environmental activities and should be shown in the project's CPM.

#### 2.1.7 Contractor Reviews

A detailed review of contractor performance may be found in a confidential report titled "Tri-State Environmental Management Review" located in the project file room. Overall, the performance of the Environmental Contractor (Radian) was

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VIII - 5

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quite adequate in light of project modifications, delays, etc. If and when the project is reactivated, it is recommended that Radian be returned as the Environmental Contractor.

## 2.2 CURRENT STATUS

### 2.2.1 Current Focus of Work Activities

At the time of project demobilization, the emphasis in the environmental program was to file for major permits necessary for construction before December 31, 1982 (see Jay Christopher's March 12, 1982 memo Exhibit VIII-E. By meeting this filing date and certain other requirements the project would qualify for a 10 percent energy investment tax credit. An extremely tight schedule, based upon a high level of coordination between the contractors and with the regulatory agencies, was developed and is reflected in the final CPM located in the project files. Whether all of the permits deemed necessary for the tax credit could be determined administratively complete by the regulatory agencies prior to December 31, 1982 could not be determined with any degree of confidence.

Activities necessary to develop the environmental impact statement were given lower priority than the permits, but no significant delays or problems were anticipated. The final environmental impact statement may have been issued before the project was ready to construct.

### 2.2.2 Pending Decisions

Most of the decisions remaining to be made are associated with the finalization of plant size, process configuration, or offsite facility requirements. For example, neither the coal handling facilities or the barge dock have been defined sufficiently to be properly addressed from an environmental standpoint. These decisions are more effectively addressed in the Engineering reports.

The decision as to whether the coal mine should be included in the EIS is also pending.

### 2.2.3 Major Strengths/Weaknesses

Two major concerns were evident at project demobilization. First, the extremely tight time frame for permit filing left no flexibility. Even slight delays at any point in the program would mean missing the December 31, 1982 deadline. A second concern was whether an adequate environmental program could be performed within the original budget. Various delays, project changes, and revised regulations required significant changes in the environmental program. Whether

EXHIBIT VIII-E-1

TEXAS   
EASTERN

INTEROFFICE CORRESPONDENCE

TO: DISTRIBUTION  
FROM: J. S. Christopher  
SUBJECT: Permits *JSC*

CO/DIV: Synfuels  
DATE: March 12, 1982

To alleviate any confusion, I have prepared to attached tables showing which permits are required during Phase I and which permits are required during Phase 2. The Phase 1 list has been further broken down to show the nine (9) permits which, in my estimation, must be applied for by December 31, 1982. Please note that the IRS guidelines for the tax credit are very vague, but I believe that this is a reasonable listing and the permit program will be so oriented.

With respect to the Phase 2 permits, it should be realized that just because a permit is shown in the period does not obviate the need to coordinate preliminary plans, etc. with the appropriate agencies during Phase 1.

Please let me know if you have any questions.

JSC/glp

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EXHIBIT VIII-E-2

PERMITS NECESSARY DURING PHASE 1

Certificate of Environmental Compatibility (KYPSC)<sup>2</sup>  
Certificate of Convenience and Necessity (KYPSC)<sup>2</sup>  
Prevention of Significant Deterioration (KDNREP)<sup>1</sup>  
National Pollutant Discharge Elimination System (EPA)<sup>1</sup>  
Wastewater Discharge Permit (KDNREP)<sup>1</sup>  
Section 404, Dredge and Fill Permit (COE)<sup>1</sup>  
Section 10, Rivers and Harbors Act Permit (COE)<sup>1</sup>  
Floodway Construction Permit (KDNREP)  
New Water Supply Source-Preliminary Approval (KDNREP)  
Water Withdrawal Permit (KDNREP)<sup>1</sup>  
Hazardous Waste Disposal (EPA)<sup>1</sup>  
Hazardous Waste Landfill (KDNREP)<sup>1</sup>  
Solid Waste Landfill (KDNREP)<sup>1</sup>  
Right-of-Way Encroachment (KDOT)  
Stack Height Approval (FAA & KAZC)  
Zoning Amendments (Henderson Co.)  
County Roads (Henderson Co.)

<sup>1</sup>Submittal Required by December 31, 1982

<sup>2</sup>Probably not required

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EXHIBIT VIII-E-3

PERMITS NECESSARY DURING PHASE 2

New Water Supply Source - Final Approval (KDNREP)  
TSCA Premanufacturing Notification (EPA)  
Social Security (IRS)  
Federal Withholding Tax (IRS)  
Plant Radio (FCC)  
Business Income Tax (IRS)  
Transportation by Company Owned Vehicles (ICC)  
SPCC Plan (EPA)  
Registration with Secretary of State (KY)  
Building Permits (KDHBC)  
Plumbing Permit (KDHBC)  
Boiler Permit (KDHBC)  
Vehicle License (KDOT)  
Elevator Installation (KDOL)  
Workmen's Compensation (KDOL)  
Radioactive Materials (KDHR)  
Unemployment Insurance (KDHR)  
Withholding Tax (KDOR)  
Business Tax (KDOR)  
Air Pollution Source Operating Permit (KDNREP)  
Sales and Use Tax (KDOR)  
Tank Vehicle Permit (KDHBC)  
Elevator Inspection (KDOL)  
Industrial Hauling (KDOT)  
Vehicle Identification (KDOT)  
Highway Motor Fuel Users Tax/Bond (KDOT)  
Injury and Liability Certificate (KDOT)  
Commercial Vehicle Sticker (KDOI)  
Intent to Conduct Business (Henderson Co.)  
Property Assessment (Henderson Co.)  
Building Permit (Henderson Co.)  
Plumbing Permit (Henderson Co.)  
Withholding Tax (Henderson Co.)  
Business Tax (Henderson Co.)  
Fire/Marshall's Approval

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Exhibit VIII-F

FUTURE MILESTONE/MASTER SCHEDULE

Phase 1

<u>Description</u>	<u>DATE*</u>	
	<u>Initiate</u>	<u>Deadline</u>
Complete and file various permit applications	5/82	12/82
Complete environmental assessment report	-	4/83
EPA issue of Draft Environmental Impact Statement	4/83	6/83
EPA issue of Final Environmental Impact Statement	6/83	12/83
Receive All Permits	12/82	1/84
Health and Safety Management Plan	-	3/83
Solid Waste Disposal Facility Conceptual Plan	3/82	11/82

\*Date assumes project continued towards "start of construction" of mid 1984.

these changes could be made in accordance with management's desire to hold costs to the original budget was questionable.

#### 2.2.4 Demobilization Program

The environmental demobilization program was developed to package the work accomplished to date by Radian, discuss the permitting and EIS program developed to date, and discuss management oriented areas such as performance and recommendations for future improvements. The actual demobilization reports are appended to this environmental report.

### 2.3 FUTURE ACTIVITIES

#### 2.3.1 Future Milestones

Exhibit VIII-F provides a listing of future milestones and schedules as of project demobilization. The final version of the environmental CPM, located in the project files, should also be consulted.

#### 2.3.2 Recommended Future Work Program

Although a minimal continued environmental effort appears appropriate, site specific environmental activities should be discontinued. The most appropriate environmental program for the future should be aimed at tracking state and federal regulatory activities, various research programs, and keeping abreast of the environmental programs associated with other projects.

#### 2.3.3 Startup Priorities

Exhibit VIII-G provides a list of priority activities which should be undertaken upon project reactivation.

#### 2.3.4 Long Lead Activities

The following activities require long lead times and must be specifically tracked in any new schedule.

- o Environmental Impact Statement
- o Prevention of Significant Deterioration Permit
- o Solid waste disposal facility design and permitting

All permitting time frames should also be carefully reviewed to determine whether changes have occurred which may modify the previously planned durations. If the future work program

EXHIBIT VIII-G

TASKS FOR PROJECT STARTUP

1. Determine status of NPDES delegation to Kentucky (necessary to determine whether EPA can function lead agency for EIS)
2. Contact likely EIS lead agency and start determine revised procedures to obtain EIS
3. Reinitiate contacts with all regulatory agencies
4. Reinitiate contact with Citizen's Advisory Committee
5. Determine appropriate scope of work for remaining environmental studies.
6. Reactivate environmental contractor, develop detailed cost plan
7. Redevelop environmental schedule (CPM)
8. Research changes in all appropriate environmental regulations which have occurred since demobilization
9. Develop "information needs" list to obtain all information necessary to complete environmental studies
10. Review project files

involves regulatory tracking, it should not be a significant problem to complete this review.

#### 2.3.5 Organizational Recommendations

The environmental activities should occur at the project team level, as has occurred previously. At the time of project demobilization, approximately three people were working full time on the environmental program. Two (environmental coordinator and environmental engineer) were on the project team and one (environmental engineer) was in ESD-Environmental. Although this format was functional, placing the third person on the project team would allow greater project control and is recommended.

The Environmental Coordinator technically reported to the Project Engineering Manager and functionally reported to the Deputy Project Director. Due to the importance of the environmental program, it appears more appropriate to coordinate environmental activities at a manager's level, reporting directly to the Deputy Project Director.

### 3.0 DETAILED REVIEW OF ENVIRONMENTAL WORK PROGRAM

A comprehensive, in-depth, and detailed review of the environmental work program is presented in Volumes 6 and 7 of the published PROJECT REVIEW REPORTS:

#### VOLUME 6 - ENVIRONMENTAL, HEALTH, SAFETY, AND SOCIOECONOMIC REVIEW

This volume provides the environmental information developed by Radian Corporation during the project. Included are detailed information on the natural and man-made environment, a detailed Health/Safety Management Plan outline, a conceptual plan for the development of a non-hazardous waste disposal site, the general strategy to be utilized to obtain air permits, and a site selection analysis describing the process used to select the Geneva site. Little environmental impact analysis was performed prior to project demobilization, hence the impacts sections are not as thoroughly developed. The table of contents of this report is presented in Exhibit VIII-H

#### VOLUME 7 - PERMITS, ENVIRONMENTAL IMPACT STATEMENT, AND RELATED ENVIRONMENTAL INFORMATION

This volume prepared by Tri-State summarizes permit and environmental impact statement (EIS) status prior to project demobilization. A brief discussion regarding each major environmental permit is provided, together with appropriate supporting documentation. The status of the EIS is addressed, along with the agencies involved and the comments received regarding the scope of the EIS. Offsite transportation corridors are also addressed in this volume.

The table of contents of this report is presented in Exhibit VIII-I, and the report is summarized in the following section.

EXHIBIT VIII-H  
TRI-STATE SYNFUELS PROJECT REVIEW  
VOLUME 6  
ENVIRONMENTAL, HEALTH, SAFETY, AND SOCIOECONOMIC REVIEW

TABLE OF CONTENTS

1.0 Summary and Report Preparation

- 1.1 Climate
- 1.2 Topography and Geology
- 1.3 Soils
- 1.4 Surface-Water Hydrology
- 1.5 Ground-Water Hydrology
- 1.6 Ecology
- 1.7 Air Quality
- 1.8 Noise and Odor
- 1.9 Man-Made Environment
- 1.10 Socioeconomics
  - 1.10.1 Demographic Characteristics
  - 1.10.2 Labor Force, Employment, and Income
  - 1.10.3 Housing
  - 1.10.4 Transportation
  - 1.10.5 Public Education
  - 1.10.6 Health Facilities and Services
  - 1.10.7 Utilities
  - 1.10.8 Public Safety
  - 1.10.9 Parks and Recreational Facilities
  - 1.10.10 City and County Planning Responsibilities and Fiscal Analysis
- 1.11 Land Use
  - 1.11.1 Regional Land Use
  - 1.11.2 Site Area Land Use
  - 1.11.3 Pipeline Corridors
  - 1.11.4 Land Use Controls and Growth Management Ability
- 1.12 Health and Safety Management
- 1.13 Solid Waste Management
  - 1.13.1 Identification and Evaluation of Candidate Disposal Sites
  - 1.13.2 Waste Disposal Strategy
  - 1.13.3 Conceptual Layout of the Solid Waste (Nonhazardous) Disposal Site
  - 1.13.4 Permitting Strategy
- 1.14 Air Quality Analysis Strategy
- 1.15 Site Selection Analysis

## TABLE OF CONTENTS (Continued)

### 2.0 Natural Environment

#### 2.1 Climate

- 2.1.1 Temperature and Humidity
- 2.1.2 Precipitation and Extreme Rainfall Events
- 2.1.3 Thunderstorms, Hailstorms, and Tornadoes
- 2.1.4 Wind Patterns
- 2.1.5 Visibility and Fog
- 2.1.6 Dispersion Conditions and Inversion Frequencies
- 2.1.7 Topographic Influences
- 2.1.8 Climatic Impacts
- 2.1.9 References for Section 2.1

#### 2.2 Topography and Geology

- 2.2.1 Introduction
- 2.2.2 Physiography and Topography
  - 2.2.2.1 Regional Physiographic Setting
  - 2.2.2.2 Site Topographic Conditions
- 2.2.3 Regional Geology
  - 2.2.3.1 Stratigraphy and Lithology
  - 2.2.3.2 Structural Setting
- 2.2.4 Seismicity
- 2.2.5 Site Geology
  - 2.2.5.1 Stratigraphy and Lithology
  - 2.2.5.2 Local Structure
  - 2.2.5.3 Mineral Resources
- 2.2.6 Issues Requiring Further Assessment
- 2.2.7 References for Section 2.2

#### 2.3 Soils

- 2.3.1 Existing Soils Environment
  - 2.3.1.1 Soil Map and Regional Distribution of Soils
  - 2.3.1.2 Description of Major Mapping Units
    - 2.3.1.2.1 Wheeling Soils
    - 2.3.1.2.2 Dekoven Soils
    - 2.3.1.2.3 Wakeland Soils
    - 2.3.1.2.4 Uniontown Soils
    - 2.3.1.2.5 Henshaw Soils
    - 2.3.1.2.6 Loring Soils
    - 2.3.1.2.7 Grenada Soils
    - 2.3.1.2.8 Memphis Soils

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NOTICE PAGE AT THE FRONT OF THIS REPORT



TABLE OF CONTENTS (Continued)

- 2.3.1.3 Description of Soil Properties
  - 2.3.1.3.1 Estimated Properties
  - 2.3.1.3.2 Results of Field Measurement and Laboratory Analysis
- 2.3.1.4 Prime Farmlands
- 2.3.1.5 Land Use Suitability and Productivity Potential of Existing Soils
- 2.3.2 Environmental Impacts
- 2.3.3 Mitigating Measures
- 2.3.4 References for Section 2.3
- 2.4 Surface-Water Hydrology
  - 2.4.1 Description of Local Watersheds
  - 2.4.2 Water Quantity
    - 2.4.2.1 Local Streams
    - 2.4.2.2 Ohio River
  - 2.4.3 Water Quality
    - 2.4.3.1 Local Streams
    - 2.4.3.2 Ohio River
  - 2.4.4 Water Use
    - 2.4.4.1 Local Streams
    - 2.4.4.2 Ohio River
  - 2.4.5 Flood Flow and Floodplains
  - 2.4.6 Impacts
    - 2.4.6.1 Primary Impacts
      - 2.4.6.1.1 Construction Phase
      - 2.4.6.1.2 Operational Phase
    - 2.4.6.2 Secondary Impacts
  - 2.4.7 References for Section 2.4
- 2.5 Ground-Water Hydrology
  - 2.5.1 Existing Environment
    - 2.5.1.1 Ground-Water Occurrence
    - 2.5.1.2 Ground-Water Recharge
    - 2.5.1.3 Ground-Water Levels, Pressures, and Movement

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IS SUBJECT TO THE RESTRICTION ON THE  
NOTICE PAGE AT THE FRONT OF THIS REPORT

TABLE OF CONTENTS (Continued)

- 2.5.1.4 Ground-Water Quality
- 2.5.1.5 Ground-Water Discharge and Uses
- 2.5.2 Ground-Water Hydrology Issues
  - 2.5.2.1 Project Ground-Water Withdrawal
  - 2.5.2.2 Potential Water Quality Impacts Related to Solid Waste and Liquid Storage/Transfer Facilities
  - 2.5.2.3 Other Potential Impacts
- 2.5.3 References for Section 2.5
- 2.6 Ecology
  - 2.6.1 Terrestrial Vegetation
    - 2.6.1.1 Methods for Quantitative Analysis
    - 2.6.1.2 Quantitative Description of Bottomland Hardwood Forests
      - 2.6.1.2.1 Stand 1--Trigg-Turner Forest
      - 2.6.1.2.2 Stand 2--Pond Bayou Forest
      - 2.6.1.2.3 Stand 3--Streamside Forest at Sauerheber Sloughs
      - 2.6.1.2.4 Stand 4--Cypress Swamp at Jenny Hole
    - 2.6.1.3 Quantitative Description of Upland Hardwood Forest
      - 2.6.1.3.1 Stand 6--Martin-Martin Road Forest
      - 2.6.1.3.2 Stand 7--Fence-Line Forest
      - 2.6.1.3.3 Stand 8--Sugar Tree Ridge Forest
      - 2.6.1.3.4 Stand 9--Bench Forest at Sauerheber Sloughs
      - 2.6.1.3.5 Stand 10--Sauerheber Sloughs Upland Forest
      - 2.6.1.3.6 Stand 11--Grazed Forest, Crenshaw Farm
    - 2.6.1.4 Quantitative Description of Miscellaneous Vegetation Types
      - 2.6.1.4.1 Stand 12--Successional Old Field
      - 2.6.1.4.2 Stand 13--Emergent Vegetation
      - 2.6.1.4.3 Stand 14--Sugar Tree Ridge Hay Meadow
      - 2.6.1.4.4 Stand 15--Jarboe Lane Hillside
    - 2.6.1.5 Vegetation Map and Floristic Summary

## TABLE OF CONTENTS (Continued)

- 2.6.2 Terrestrial Wildlife
  - 2.6.2.1 Methodologies
  - 2.6.2.2 Observations
- 2.6.3 Aquatic Ecology
  - 2.6.3.1 Sampling Stations
  - 2.6.3.2 Materials and Methods
  - 2.6.3.3 Results: Fish
  - 2.6.3.4 Results: Benthic Macroinvertebrates
  - 2.6.3.5 Results: Phytoplankton
- 2.6.4 Threatened and Endangered Species
- 2.6.5 Wetlands
- 2.6.6 Ecological Impacts of the Proposed Project
  - 2.6.6.1 Impacts of Construction and Mitigation Procedures
  - 2.6.6.2 Impacts of the Project and Mitigation Measures
  - 2.6.6.3 Conclusions
- 2.6.7 References for Section 2.6
- 2.7 Air Quality
  - 2.7.1 Existing Environment
  - 2.7.2 Air Quality Impacts
- 2.8 Noise and Odor
  - 2.8.1 Noise
    - 2.8.1.1 Qualitative Description of Noise Environment
    - 2.8.1.2 Quantitative Measures of Existing Noise
    - 2.8.1.3 Potential Noise Impacts and Mitigation Strategies
  - 2.8.2 Odor
    - 2.8.2.1 Introduction
    - 2.8.2.2 Existing Odor Environment
    - 2.8.2.3 Rules and Regulations Governing Odorous Emissions
  - 2.8.3 References for Section 2.8

TABLE OF CONTENTS (Continued)

3.0 Man-Made Environment

3.1 Socioeconomics and Land Use

3.2 Socioeconomic Baseline Description

3.2.1 Demographic Characteristics

3.2.2 Labor Force, Employment, and Income

3.2.2.1 Labor Force

3.2.2.2 Employment Characteristics

3.2.2.3 Income Characteristics

3.2.3 Housing

3.2.3.1 Supply and Availability

3.2.3.2 Mobile Homes

3.2.4 Transportation

3.2.4.1 Highways

3.2.4.2 Railroads

3.2.4.3 Ohio River Transportation

3.2.4.4 Air Transportation

3.2.4.5 Public Transportation

3.2.4.6 Pipelines

3.2.5 Public Education

3.2.6 Health Facilities and Services

3.2.7 Utilities

3.2.7.1 Electricity

3.2.7.2 Natural Gas

3.2.7.3 Water Supply

3.2.7.3.1 Henderson County

3.2.7.3.2 Daviess County

3.2.7.3.3 Vanderburgh County

3.2.7.4 Wastewater Treatment

3.2.7.4.1 Henderson County

3.2.7.4.2 Daviess County

3.2.7.4.3 Vanderburgh County

3.2.7.5 Solid Waste Services

3.2.7.5.1 Henderson County

3.2.7.5.2 Daviess County

3.2.7.5.3 Vanderburgh County

USE OR DISCLOSURE OF REPORT DATA  
IS SUBJECT TO THE RESTRICTION ON THE  
NOTICE PAGE AT THE FRONT OF THIS REPORT

TABLE OF CONTENTS (Continued)

- 3.2.8 Public Safety
- 3.2.9 Parks and Recreational Facilities
- 3.2.10 City and County Planning Responsibilities  
and Fiscal Analysis
  - 3.2.10.1 Form of Government
    - 3.2.10.1.1 Henderson County and the City of  
Henderson
    - 3.2.10.1.2 Daviess County and the City of  
Owensboro
    - 3.2.10.1.3 Vanderburgh County and the City of  
Evansville
  - 3.2.10.2 Planning Responsibilities
    - 3.2.10.2.1 Henderson County
    - 3.2.10.2.2 Daviess County
    - 3.2.10.2.3 Vanderburgh County
  - 3.2.10.3 Fiscal Analysis
    - 3.2.10.3.1 Revenues and Expenditures
    - 3.2.10.3.2 Property Values and Indebtedness
    - 3.2.10.3.3 Property Tax Limitations
- 3.3 Land Use
  - 3.3.1 Regional Land Use
  - 3.3.2 Site Area Land Use
  - 3.3.3 Pipeline Corridors
  - 3.3.4 Land Use Controls and Growth Management Ability
- 3.4 References for Section 3.0
- 4.0 Health and Safety Management
  - 4.1 Proposed Outline: Occupational Health and Safety  
Assessment for the Tri-State Synfuels Project
  - 4.2 Summary
    - 4.2.1 Objectives and Technical Approach
    - 4.2.2 Work Accomplished
    - 4.2.3 Data Gaps Identified
  - 4.3 References for Section 4.0

## TABLE OF CONTENTS (Continued)

### 5.0 Solid Waste Management

#### 5.1 Technical Evaluations

- 5.1.1 Evaluation of Candidate Disposal Sites
- 5.1.2 Cost Estimate for Solid Waste Disposal
- 5.1.3 Plan to Conduct Leaching Studies
  - 5.1.3.1 Batch Leaching and Attenuation Studies
  - 5.1.3.2 Soil Liner Compatibility
  - 5.1.3.3 Column Leaching and Attenuation Study
- 5.1.4 Summary of Site Geology and Planned Hydrogeological Studies for Residual Landfill

#### 5.2 Waste Disposal Strategy

- 5.2.1 Characterization and Classification of Potential Waste Streams
  - 5.2.1.1 Sample Sources
  - 5.2.1.2 Expected Solid Waste Streams and Their Potential Classification
  - 5.2.1.3 Characterization of Wastes Based on Available Samples
    - 5.2.1.3.1 Ash From Gasification
    - 5.2.1.3.2 Boiler Bottom Ash
    - 5.2.1.3.3 Boiler Precipitator Ash
    - 5.2.1.3.4 FGD Sludge
    - 5.2.1.3.5 Spent Filter Media
  - 5.2.1.4 Characterization of Wastes Based on the Literature
    - 5.2.1.4.1 Boiler Cleaning Wastes
    - 5.2.1.4.2 Spent Catalysts from Product Synthesis
    - 5.2.1.4.3 Wastes from Raw Water and Wastewater Treatment
    - 5.2.1.4.4 Wastes from Auxiliary Systems
- 5.2.2 Solid Waste Management Approach
  - 5.2.2.1 Initial Screening of Solid Waste Management Options
    - 5.2.2.1.1 Suggested Management Option for High Volume Nonhazardous Wastes
    - 5.2.2.1.2 Suggested Management Option for Hazardous Wastes

USE OR DISCLOSURE OF REPORT DATA  
IS SUBJECT TO THE RESTRICTIONS ON THE  
NOTICE PAGE AT THE FRONT OF THIS REPORT

TABLE OF CONTENTS (Continued)

- 5.2.2.1.3 Suggested Management Option for Construction
- 5.2.2.2 Summary of Anticipated Solid Waste Management Methods
- 5.2.3 Regulatory Review
  - 5.2.3.1 Review of EPA/RCRA Rules
    - 5.2.3.1.1 Nonhazardous Waste
    - 5.2.3.1.2 Hazardous Waste
  - 5.2.3.2 Status of RCRA Authorization to the Commonwealth of Kentucky
  - 5.2.3.3 Review of State Rules
  - 5.2.3.4 Summary
- 5.2.4 Conceptual Design of the Nonhazardous Waste Landfill
  - 5.2.4.1 Surface-Water Hydrology
  - 5.2.4.2 Floodplains
  - 5.2.4.3 Ground-Water Hydrologic Characteristics
  - 5.2.4.4 Climatic Conditions
  - 5.2.4.5 Air Quality
  - 5.2.4.6 Safety and Gas Mitigation Control
  - 5.2.4.7 Endangered Species
  - 5.2.4.8 Application to Land Used for Food-Chain Crops
  - 5.2.4.9 Disease Vectors
  - 5.2.4.10 Conceptual Layout of the Solid Waste (Nonhazardous) Disposal Site
  - 5.2.4.11 Inspection Plan
  - 5.2.4.12 Closure Plan
  - 5.2.4.13 Postclosure Maintenance
- 5.3 Permitting Strategy
  - 5.3.1 Permitting Strategy for Disposal of Nonhazardous Waste
  - 5.3.2 Permitting Strategy for Disposal of Hazardous Waste Landfill
  - 5.3.3 Permitting Strategy for Hazardous Waste Incinerator
- 5.4 References for Section 5.0

## TABLE OF CONTENTS (Continued)

### 6.0 Air Quality Analysis Strategy

#### 6.1 Environmental Impact Statement 6.2 Prevention of Significant Deterioration Permit

- 6.2.1 Emissions Inventory
- 6.2.2 Meteorological Data
- 6.2.3 BACT Analysis
- 6.2.4 Air Quality Impacts
- 6.2.5 Other Air Quality Related Impacts

#### 6.3 Modeling Plan - Criteria Pollutants

- 6.3.1 Determination of Worst-Case Meteorology
- 6.3.2 Air Quality Impacts
- 6.3.3 Area of Influence
- 6.3.4 Increment Consumption
- 6.3.5 NAAQS Compliance

#### 6.4 Modeling Plan - Non-Criteria Pollutants

#### 6.5 Modeling Plan - Cooling Towers

#### 6.6 Permitting Strategy

- 6.6.1 Preliminary Analysis
- 6.6.2 Pre-Application Meeting
- 6.6.3 Midpoint Progress Meeting
- 6.6.4 PSD Permit Application Submitted
- 6.6.5 Agency Interactions

#### 6.7 References for Section 6.0

### 7.0 Site Selection Analysis

#### 7.1 Phase I--National Screening 7.2 Phase II--Regional Screening 7.3 Subregional Screening 7.4 Environmental Comparison of the Alternative Sites

- 7.4.1 Air Quality
- 7.4.2 Hydrology
- 7.4.3 Geologic Conditions
- 7.4.4 Ecology
- 7.4.5 Socioeconomics
  - 7.4.5.1 Population
  - 7.4.5.2 Economic Structure
  - 7.4.5.3 Community Services and Facilities

- 7.4.6 Land Use
- 7.4.7 Aesthetics
- 7.4.8 Solid Waste Disposal

USE OR DISCLOSURE OF REPORT DATA  
IS SUBJECT TO THE RESTRICTION ON THE  
NOTICE PAGE AT THE FRONT OF THIS REPORT



TABLE OF CONTENTS (Continued)

- 7.5 Geneva Site Suitability
- 7.6 References for Section 7.0

APPENDICES

- Appendix A - Laboratory Reports for Surface-Water Quality Analysis
- Appendix B - Kentucky Surface-Water Standards
- Appendix C - Preliminary Sediment Delivery Calculations
- Appendix D - Results of Stream Bottom Sediment Analysis
- Appendix E - Summary of Methodologies Using Point-Center Quarter (PCQ) and the Quadrat Method To Describe Vegetation of Two Stands
- Appendix F - Threatened and Endangered Species
- Appendix G - Identification and Environmental Evaluation of Candidate Solid Waste Disposal Sites for Tri-State Synfuels Project
- Appendix H - Preliminary Cost Estimate for Solid Waste Disposal for the Tri-State Synfuels Project
- Appendix I - Technical Note on Summary of Site Geology and Planned Hydrogeological Studies for Residual Landfill, Henderson County, Kentucky
- Appendix J - Meteorological Data for Modeling

EXHIBIT VIII-I

TRI-STATE SYNFUELS PROJECT REVIEW  
VOLUME 7  
PERMITS, ENVIRONMENTAL IMPACT STATEMENT  
and  
RELATED ENVIRONMENTAL INFORMATION

1.0 Summary

- 1.1 Permits
- 1.2 Environmental Impact Statement
- 1.3 Offside Transportation Corridors
- 1.4 Treatability Study

2.0 Permit Review (Phase 1 Permits)

- 2.1 Certificate of Environmental Compatibility (KYPSC)
- 2.2 Certificate of Convenience and Necessity (KYPSC)
- 2.3 Prevention of Significant Deterioration (KDNREP)
- 2.4 National Pollutant Discharge Elimination System (EPA)
- 2.5 Wastewater Discharge Permit (KDNREP)
- 2.6 Section 404, Dredge and Fill Permit (COE)
- 2.7 Section 10, Rivers and Harbors Act Permit (COE)
- 2.8 Floodway Construction Permit (KDNREP)
- 2.9 New Water Supply Source-Preliminary Approval (KDNREP)
- 2.10 Water Withdrawal Permit (KDNREP)
- 2.11 Hazardous Waste Disposal (EPA)
- 2.12 Hazardous Waste Landfill (KDNREP)
- 2.13 Solid Waste Landfill (KDNREP)
- 2.14 Right-of-Way Encroachment (KDOT)
- 2.15 Stack Height Approval (FAA & KAZC)
- 2.16 Zoning Amendments (HENDERSON COUNTY)
- 2.17 County Roads (HENDERSON COUNTY)

3.0 Environmental Impact Statement

3.1 Federal Agencies

- 3.1.1 EPA (Region IV)
- 3.1.2 U. S. Army Corps of Engineers
- 3.1.3 Others

EXHIBIT VIII-I (cont)

- 3.2 State Agencies
  - 3.2.1 KDNREP
  - 3.2.2 KDOE
  - 3.2.3 Others
- 3.3 Local Agencies
  - 3.3.1 Henderson Planning Commission
  - 3.3.2 Henderson Zoning Commission
  - 3.3.3 Henderson County Fiscal Court
  - 3.3.4 Green River Area Development District
  - 3.3.5 Evansville Department of Metropolitan Development
  - 3.3.6 Evansville Environmental Protection Agency
- 3.4 General EIS Procedures
  - 3.4.1 Conventional vs. Third Party EIS
  - 3.4.2 Selected Approach
    - 3.4.2.1 EFA/Tri-State/Radian Procedures
    - 3.4.2.2 Document Exchange
    - 3.4.2.3 Interface with other agencies
- 3.5 EIS Contents
  - 3.5.1 Outline
- 3.6 EIS Scope
  - 3.6.1 Interagency Scoping Session
    - 3.6.1.1 EPA official record
    - 3.6.1.2 Other notes, etc.
  - 3.6.2 Public Scoping Session
    - 3.6.2.1 EPA Official Record
    - 3.6.2.2 Written Comments
    - 3.6.2.3 Other notes, etc.
  - 3.6.3 Incorporation of Coal Mine Impact Analysis
- 3.7 Tri-State's EIS Schedule

**EXHIBIT VIII-I (cont)**

**4.0 Offsite Transportation Corridors**

- 4.1 Pipelines**
- 4.2 Conveyors**
- 4.3 Barge Facility**

**5.0 Treatability Study**

#### 4.0 PERMITS, ENVIRONMENTAL IMPACT STATEMENT, AND RELATED INFORMATION

##### 4.1 PERMITS

A fairly detailed framework to develop and apply for all permits associated with the Tri-State Synfuels Project was prepared prior to project demobilization. This plan is shown on the final Pilko-developed CPM located in the Project Controls Report, and is felt to be extremely tight with respect to accomplishing all permit filings prior to December 31, 1982. Integral to this plan is the Regulatory Compliance Plan developed by Radian. The program timing was contingent upon timely receipt of engineering data from Fluor and close coordination with the regulatory agencies.

Tri-State would be responsible for the preparation and filing of all permits except for the Prevention of Significant Deterioration and solid waste disposal permits, which would be prepared by Radian. The permitting program contained significant uncertainty due to undeveloped regulations and/or ill-defined requirements. These are noted for each permit in the detailed report, Volume 7.

Future regulatory changes may also cause significant modifications to the planned program. Major revisions are currently planned for the Clean Air Act and the Clean Water Act. Ongoing changes to various regulatory programs will also impact planning. For example, delegation of NPDES authority to Kentucky would eliminate the major federal action necessary for the EPA to be the lead agency for the project's EIS.

##### 4.2 ENVIRONMENTAL IMPACT STATEMENT

The EPA formally became the lead federal agency for the Tri-State Synfuels Project EIS in December, 1981 following a fairly lengthy series of discussions between Tri-State and the EPA. A somewhat unusual strategy was developed whereby Radian and Tri-State would develop the majority of the EIS in a conventional manner, and EPA would maintain review privileges over the document in much the same fashion as a third-party EIS. This format was chosen to alleviate Tri-State's concerns with confidentiality to non-U.S. contractors and to develop an EIS in the most timely fashion. Although this method would most likely increase Tri-State's costs to prepare the EIS, the time savings would accrue significant benefits to the project.

An interagency and public scoping session was held in January, 1982. No surprises came out of these meetings which are fully documented in Volume 7 Section 3.0.

#### 4.3 OFFSITE TRANSPORTATION CORRIDORS

Pipeline routes were developed in coordination with Texas Eastern Transmission Corporation and Texas Gas Transmission Corporation. However, the configuration (and the basic route) cannot be selected until final plant size, product slate, and product distribution are determined. The actual routes would not be surveyed until plant construction was actually underway. The pipelines would not be permitted until that time, although the pipeline's impacts would be addressed in the Tri-State EIS.

The conveyor routes had not been determined. The conveyors would be addressed in much the same fashion as the pipelines, although they would have to be permitted at the same time as the plant, as the conveyors would be owned by Tri-State.

The barge facility was to be located along the Ohio River west of the Henderson Riverport. The configuration of the facility had not been determined as this is dependent upon plant size, product distribution, and coal resources. This facility, as planned, would be owned by Tri-State and require permit filings at the same time as the rest of the plant.

#### 4.4 TREATABILITY STUDY

Following extensive discussions, it was determined to perform a wastewater treatability study using gas liquor obtained during the coal test at Sasolburg. Engineering-Science was selected following competitive bidding to perform the study.

It was agreed by all parties that the study was necessary to permit the plant. The study is based upon the assumption of a Lurgi-based plant located in western Kentucky. The importance of the study was increased when KDNREP (Division of Water) noted their objections to direct discharge of process wastewater, but felt that a successful treatability study would alleviate their concerns.

The results of the study were not available prior to demobilization, and will be placed in the project files at a later date.

#### 5.0 ENVIRONMENTAL MANAGEMENT REPORTS

Documents reviewing the management of the environmental work program from Tri-State's, Radian's, and Pilko & Associate's perspective were prepared and are available in Tri-State's central files. Tables of contents of each of the Tri-State and Radian reports are presented in Exhibits VIII-J and VIII-K.

EXHIBIT VIII-J

TRI-STATE ENVIRONMENTAL MANAGEMENT REPORT

1.0 Summary

2.0 Tri-State - Management

2.1 Performance

2.1.1 Positive

2.1.2 Negative

2.2 Communications

2.3 Recommended Improvements

3.0 Tri-State - Environmental

3.1 Performance

3.1.1 Positive

3.1.2 Negative

3.2 Communications

3.3 Recommended Improvements

4.0 Engineering Services Division - Environmental Protection Department

4.1 Performance

4.1.1 Positive

4.1.2 Negative

4.2 Communications

4.3 Recommended Improvements

5.0 Radian

5.1 Performance

5.1.1 Positive

5.1.2 Negative

5.2 Communications

5.3 Recommended Improvements

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NOTICE PAGE AT THE FRONT OF THIS REPORT



- 6.0 Pilko and Associates
  - 6.1 Performance
    - 6.1.1 Positive
    - 6.1.2 Negative
  - 6.2 Communications
  - 6.3 Recommended Improvements
- 7.0 Fluor
  - 7.1 Performance
    - 7.1.1 Positive
    - 7.1.2 Negative
  - 7.2 Communications
  - 7.3 Recommended Improvements
- 8.0 Coordination with Federal/State Agencies
  - 8.1 Performance
    - 8.1.1 Positive
    - 8.1.2 Negative
  - 8.2 Communications
  - 8.3 Recommended Improvements
- 9.0 Public Participation/Community Relations
  - 9.1 Performance
    - 9.1.1 Positive
    - 9.1.2 Negative
  - 9.2 Communications
  - 9.3 Recommended Improvements

## **10.0 Impact of Program/Plant Configuration Changes**

### **10.1 Downsizing To 70%, 50%, 25%**

**10.1.1 Impacts on: Costs, Coordination of Environmental Program**

**10.1.2 Recommendations For Remobilization**

### **10.2 Product Mix/Process Changes**

**10.2.1 Impact on Environmental Alternatives**

**1) Number of Permits Required**

**2) Number and Type of Control and Abatement Approaches**

**10.2.2 Impact on Costs of Environmental Program**

**10.2.3 Recommendations For Remobilization**

### **10.3 Environmental Configuration Changes**

**(i.e. Zero Discharge vs. Discharge, Onsite vs. Off Site Hazardous Waste Disposal, Cooling technologies, etc.)**

**10.3.1 Impact on Permits Required**

**10.3.2 Recommendations For Remobilization**

EXHIBIT VIII-K  
RADIAN ENVIRONMENTAL REPORT

TABLE OF CONTENTS

- 1.0 Summary
  - 1.1 Project Team Structure
  - 1.2 Cost Controls
  - 1.3 Schedule Controls
  - 1.4 Progress Reporting
  - 1.5 Management Consultant
  - 1.6 Tri-State Decisions
- 2.0 Project Team Structure
  - 2.1 Assessment of Overall Utility
  - 2.2 Lines of Communication
    - 2.2.1 Radian Internal
    - 2.2.2 Radian - Tri-State
  - 2.3 How Would A Future Project Team Be Organized?
- 3.0 Cost Controls
  - 3.1 Radian Internal Controls
    - 3.1.1 Controls from Radian's Perspective
    - 3.1.2 Cost Controls from TSSC Viewpoint
  - 3.2 Change Orders
    - 3.2.1 Level of Detail
    - 3.2.2 Timing
  - 3.3 Recommended Changes to Cost Controls for Future Project
- 4.0 Schedule Controls
  - 4.1 Radian Internal Controls
    - 4.1.1 How Well Did Controls Work from Radian's Perspective?
    - 4.1.2 Control as Perceived by Tri-State
  - 4.2 CPM Control
    - 4.2.1 Fluor's F.A.S.T. System
    - 4.2.2 Proposed Controls
    - 4.2.3 Pilko CPM

## **TABLE OF CONTENTS (Continued)**

- 4.3 How Would Schedule Controls Be Changed for a Future Project?**
  - 5.0 Progress Reporting**
    - 5.1 Review of Progress Reporting Formats**
      - 5.1.1 February and March 1981
      - 5.1.2 April 1981
      - 5.1.3 May 1981
      - 5.1.4 June 1981
      - 5.1.5 July 1981
      - 5.1.6 August 1981
      - 5.1.7 September 1981
      - 5.1.8 October 1981
      - 5.1.9 November 1981
      - 5.1.10 December 1981
      - 5.1.11 January 1982
      - 5.1.12 February 1982
    - 5.2 Discussion of Progress Reporting**
  - 6.0 Management Consultant**
    - 6.1 Radian's View of Independent Management Consultants
    - 6.2 Radian's Perceived View of Pilko and Associates
  - 7.0 Tri-State Decisions**
    - 7.1 Effects of Project Changes on Radian's Program**
      - 7.1.1 Changing Plant Capacity
      - 7.1.2 Changing From F-T to MTG Processes
      - 7.1.3 Changing Facility Locations and Functions
      - 7.1.4 Other Sources of Project Delay
    - 7.2 Radian's Role in Future Decisions**
- APPENDIX A - RATH-0134 Alternate Management and Reporting**

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EXHIBIT VIII-L

MAJOR CONTACTS

<u>Company (Location)</u>	<u>Individual</u>	<u>Title/Position</u>	<u>Telephone</u>
U.S. EPA (Atlanta)	Robert Howard	Chief, EIS Branch	404/881-7458
Corps of Engineers (Louisville)	Terry Siemsen	Environmental Analysis Branch	502/582-6475
KY. Audubon Council (Henderson)	Ron Dodson	President	502/827-5467
Henderson Planning Commission (Henderson)	Don Bryant	Director	502/827-4232
KY. DNREP (Frankfort)	Rose Marie Carr	Office of Special Projects	502/564-7320
KY. DNREP (Frankfort)	Valerie Wickstrom	Permits Coordinator	502/564-2150
KY. DOE (Lexington)	Dr. Harry Enoch	Dr., Technology & Assessment	606/252-5535
Radian Corp. (Austin)	Kirk Holland	Sr. Program Manager	512/454-4797
Radian Corp. (Salt Lake City)	Bob Vandervort	Program Manager (Health and Safety)	801/487-4901
Vinson and Elkins (Houston)	Jeff Cevens	Attorney at Law	713/651-2294
Engineering-Science (Austin)	Dr. Davis Ford	Group Vice-President	512/477-9901
Toosin	Dr. Charles Shaw	President	713/748-1280
Pilko & Associates	George Pilko	President	713/680-1885

EXHIBIT VIII-M

MAJOR REFERENCE DOCUMENTS\*

<u>Description</u>	<u>Author</u>	<u>Date</u>	<u>Location</u>	<u>Utility**</u>
Environmental Compliance Handbook-Kentucky	Oak Ridge National Laboratory	September, 1980	T.E. Library	2
Regulatory Compliance Plan	Radian	January, 1982	Tri-State File	3
Compilation of Environmental Information for Tri-State Synfuels Project	Radian	September, 1981	Tri-State File	3
Coal Ash Disposal Manual	EPRI	October, 1981	T.E. Library	2

\*Reports, maps, papers, reference/research groups, schedules

\*\*Utility 3 - very important, 2 - useful, 1 - questionable value

IX  
COAL TEST PROGRAM

Prepared by: Anton Roger, III - Technical Manager, Texas Eastern Synfuels

Comprehensive, in-depth, and detailed reports of all aspects of the Tri-State coal testing programs are presented in Volume 13 - Coal Sampling and Testing and Volume 14 - Commercial Scale Coal Test of the Tri-State Synfuels Project Review Program. A summary of each of these reports is presented in sections IX-A and IX-B of this report.

IX-A COAL SAMPLING AND TESTING PROGRAM

1.0 INTRODUCTION

This report focuses on the sampling and testing program for run-of-mine Illinois Basin coals which was conducted for the supply and design program of the Tri-State Synfuels Project. The program is reported in detail in Coal Sampling and Testing, Volumes 1 and 2.

Ten mines representative of future coal production were examined. The mines represented a mix of underground--both continuous and conventional mining--and strip mining. The two predominant seams in each of three states were sampled. The technical data on these run-of-mine coals were judged to be representative of the coal to be mined from potentially available reserves by the various operators.

The overall program was conducted to identify coals suitable for Lurgi gasification which would supplement the data from the Camp 1 coal being used as the design coal for the Tri-State Synfuels Project.

The Camp 1 coal had been selected for the commercial scale gasification test at Sasolburg on the basis of its proximity to the Towhead Island Reserves, plant site and similarity of coal quality. The sampling and testing program for Camp 1 coal has been reviewed in the Tri-State Synfuels Project Review Report, Volume 14, Commercial Scale Coal Test, June 1982.

1.1 Scope of Work

The scope of work for the program consisted of:

- o Evaluating on a preliminary basis seven coals from Kentucky and Illinois which were especially collected

EXHIBIT IX-A  
PROJECT PERSONNEL

Tri-State

<u>Name</u>	<u>Title</u>	<u>Dates of Service</u>	<u>Area of Responsibility</u>
Anton Roeger, III	Technical Manager Synfuels Division	June 1980	Planning and Coordinating Sampling and Testing Program for Illinois Basin Mines
Linda S. Rathbun	Manager, Project Development	July 1981 - June 1982	Coal Supply Contracts
William M. Scriber	Coordinator, Project Develop- ment	January 1981 - June 1982	Acquisition of Mineral Resources
William N. Shoff	Analyst, Project Development	January 1982 - June 1982	Statistical Analysis of Coal Resource Data

Texas Eastern Support

<u>Name</u>	<u>Title</u>	<u>Area/Type Assistance</u>	<u>Role</u>
Jack T. Wooten	Consulting Engineer, Synfuels Division	Technical Advice on Gasification and Coal	Technical Advisor



EXHIBIT IX-B

ESTIMATED/ACTUAL EXPENDITURES  
TRI-STATE SYNFUELS PROJECT  
COAL SAMPLING AND TESTING

<u>ITEM</u>	<u>BUDGET COSTS</u>	<u>ACTUAL COSTS*</u>
1. Supervision of collection, sample preparation, analytical testing and reporting (Paul Weir)		
2. Collection, preparation, analytical testing and reporting (CT&E)		
3. Analytical testing of six samples and report (Lurgi)		
GRAND TOTAL		

\* Phase I work is complete as of June 15, 1982.

and analytically tested during the selection of coal for the commercial scale gasification test. Lurgi commented on the acceptability of these coals for gasification.

- o Conducting an expanded program of sampling and testing on ten mines in Kentucky, Illinois and Indiana which were judged to be representative of coal to be mined from potentially available reserves:
  - Selecting, collecting, preparing and analyzing samples from underground and strip mines.
  - Furnishing Lurgi these coals for testing and evaluation.
  - Requesting Lurgi to rank Illinois Basin coals for their gasification suitability for coal selection.
  - Requesting Paul Weir Company to examine the coals sampled for expected size consists and physical and chemical properties and compare them with the Camp 1 sample selected for the design basis.
  - Providing representative splits of the ten mine samples to the University of Kentucky - Institute for Mining and Minerals Research for analytical testing.

## 1.2 Objectives and Goals

The objectives and goals of the program were to:

- o Establish an estimate of the size consist and coal quality ranges to be expected from run-of-mine Illinois Basin coals and compare the data with the Camp 1 sample used for design basis.
- o Establish a sensitivity range for the Lurgi design which used the Camp 1 coal for heat and material balances. The maximum heat rates and flow rates are used to specify requirements for major equipment.
- o Establish environmental design criteria in the areas of wastewater treatment and solids disposal.
- o Provide technical guidance to assess reserves potentially available for the project during supply negotiations.

### 1.3 Work Effort by Organizations and Individuals

The organizations and individuals involved in the program number in the dozens. Only the major organizations can be covered here while detailed lists of the readily identifiable individuals are reported in Exhibits IX-A and IX-F.

- o Paul Weir Company was responsible for conducting the program of collecting, preparing, analyzing and providing recommendations on the mine samples.
- o Commercial Testing & Engineering Co. performed the work under the direction of Paul Weir. Laboratories at Henderson, Kentucky; South Holland, Illinois and Golden, Colorado were used.
- o Tennessee Valley Authority provided a mine sample and operating data.
- o Peabody Coal Company provided several mine samples and operating data.
- o Island Creek Coal Company provided several mine samples and operating data.
- o Old Ben Coal Company provided several mine samples and operating data.
- o Amax Coal Company provided several mine samples and operating data.
- o Lurgi Kohle und Mineraloeltechnik GmbH analyzed mine samples, prepared heat and material balances around the gasification area and provided recommendations on coal selection.
- o University of Kentucky - Institute for Mining and Minerals Research analyzed mine samples.
- o Sasol Technology (Proprietary) Limited provided technical advice on coal selection criteria.
- o Texas Eastern Corporation managed the program and provided technical assistance.

### 1.4 Estimated Costs

The estimated and actual costs for the sampling and testing for the overall project are shown in Exhibit IX-2. The

actual costs of

The United States Department of Energy and Tri-State Synfuels Company shared these costs including project management costs which are covered elsewhere. Lurgi costs in preparing and interpreting heat and material balances and relative ranking of coals are included in the engineering costs.

The sampling and United States testing costs exceeded estimates due primarily to the inability to forecast field costs with any accuracy.

The Phase I work effort is complete.

## 2.0 SUMMARY

### 2.1 History

#### 2.1.1 Work Plan

The Phase I work plan for the Tri-State Synfuels Project involved:

- o Selecting ten candidate mines in the Illinois Basin, representative of potentially available coal supplies.
- o Collecting, preparing and analyzing ten samples of run-of-mine (2 inch x 0) coal. Instructions for this selection and preparation work would be developed by Paul Weir and analytical requirements would be furnished by Tri-State.
- o Providing University of Kentucky - Institute for Mining and Minerals Research representative splits of all ten 2 inch x 0 samples for analysis.
- o Providing Lurgi representative splits of all ten 2 inch x 0 samples. Six samples would be selected by Tri-State for analysis and comments on gasification acceptability. Further, Lurgi would develop heat and material balances using six samples.
- o Providing Commercial Testing & Engineering Co. representative splits of all ten 2 inch x 0 samples for screening into 2 inch x 1/4 inch (coarse) and 1/4 inch x 0 (fine) fractions for analytical work as defined.
- o Developing statistical comparisons of the ten coals sampled for quality and size data with the Camp 1 coal selected for design.
- o Requesting Lurgi to rank all coals tested by Lurgi and/or CT&E and also include Illinois 6 data from American Gas Association - Office of Coal Research Trials since this coal formed the basis of the April 1980 feasibility study.
- o Providing project development personnel a technical data base to assist in identification of coal supply sources.
- o Establishing a range of selected coal properties of the most likely candidate coals to enable Lurgi to develop maximum flow and heat rate cases relative to the Camp 1 design for equipment sizing.

## 2.1.2 Work Completed

2.1.2.1 Preliminary Evaluation - In early 1981, after the Camp 1 coal had been selected as the design base case, a preliminary evaluation of coals was initiated. A detailed list of the properties of seven coals being produced in Kentucky and Illinois, including Camp 1, was sent to Lurgi for comments on the acceptability of these coals for the Tri-State plant. Also, a statistical analysis based on 485 quality control samples from Camp 1 mine was forwarded to give an indication of variations to be expected in quality from one mine.

Lurgi responded by stating that none of the coals appear totally unacceptable and classified them into three groups according to their acceptability. Coals in the acceptable range included Camp 1, Camp 11, River Queen, Ken and Baldwin. No. 9 mine coal was of lesser acceptability while Providence mine coal was least acceptable.

2.1.2.2 Supply and Design - A new list of candidate coal samples was developed to expand our technical knowledge of physical and chemical characteristics, provide good state representation, demonstrate adequate supplier balance and illustrate type of mining (conventional and continuous underground and strip mining) as it affects coal size consist and quality.

Tri-State Synfuels provided Paul Weir with contacts at Peabody Coal, Island Creek, Amax, and Old Ben coal companies who identified the mines to be sampled and with whom to coordinate the sampling.

Instructions for sampling, preparation and testing of the mine samples were prepared by Paul Weir. Analytical requirements were furnished by Tri-State Synfuels and modified by Paul Weir.

The start of the sampling program was delayed beyond the initial deadline due to prolongation of the United Mine Workers of America strike. An intensive campaign to collect the samples was undertaken as soon as it became apparent that the strike had been settled.

The necessity for preparing sized test samples for Lurgi and University of Kentucky - Institute for Mining and Minerals Research in order to meet the deadline, controlled the initial efforts at the laboratories. The work priority was to size and prepare, as necessary, a simulated crushed run-of-mine 2 inch x 0 (total), 2 inch x 1/4 inch (coarse) and 1/4 inch x 0 (fine) sized products for each of the mines.

1

EXHIBIT IX-C

KEY DECISIONS REACHED

<u>Decision</u>	<u>Rank*</u>	<u>Date</u>	<u>Alternatives</u>	<u>Rationale for Decision</u>
Confirmation of acceptable range of coals	3	October 1981	None	Laboratory tests by Lurgi
Recommendations on size consist	3	October 1981	None	Mine screening tests by Paul Weir
Recommendations on quality	3	October 1981	None	Laboratory tests by Paul Weir
Establish ranges of expected coal size and quality	3	February 1982	None	Recommendations cited Previously
Establish maximum flow and heat rates around gasification unit through syngas preparation	3	February 1982	None	Design calculations by Lurgi

\*3 Absolute

2-Preliminary (pending additional input/information)

1-Operational (little to no support)

Lurgi was furnished ten coals in early July for their analytical testing and evaluation. Tri-State instructed Lurgi to analyze six of these coals. Lurgi analyzed the coals from Camp 11, Old Ben, Wabash, Lynnville, Delta and Hamilton for proximate analysis, ultimate analysis, Fischer assay, ash melting behavior, reactivity and heating value.

Lurgi considered these six samples as suitable for gasifier feed coal and expressed preferences as follows (most preferable first): Wabash, Old Ben, Lynnville, Camp 11, Hamilton and Delta.

Since the coal quality knowledge had been expanded since the preliminary evaluation, Lurgi was requested to provide a comprehensive list of the ranking of coal candidates examined during the preliminary program and current sampling program.

Sasol was requested to provide technical advice on critical items to select coal.

Paul Weir compared the physical and chemical properties with Camp 1 coal and estimated an expected fines content from the Illinois Basin mines to provide a technical data base.

Lurgi developed material and heat balances for the six coals and provided maximum flow and heat rate parameters relative to the Camp 1 design coal.

### 2.1.3 Key Decisions

The key decisions reached in the overall program are shown in Exhibit IX-C and summarized below:

- o Confirmation of the acceptability for gasification of a wide range of Illinois Basin coals--the basis for the technical, economic and environmental aspects of the project.
- o Recommendations on expected coal size consist-- criterion for coal supply negotiations.
- o Recommendations on expected coal quality--criterion for design sensitivity to Camp 1 coal to establish maximum flow and heat rates for equipment selection.
- o Establishment of maximum flow and heat rates around gasification through syngas units for equipment sizes relative to design coal basis.

### 2.1.4 Major Accomplishments

The major accomplishments and their milestones are tabulated in Exhibit IX-D. They range from the sampling and testing of



EXHIBIT IX-D

MAJOR ACCOMPLISHMENTS/MILESTONES COMPLETED

<u>Description</u>	<u>Date</u>	
	<u>Initiated</u>	<u>Completed</u>
Selection of ten Illinois Basin mines for sampling and testing	April 3, 1981	April 30, 1981
Collection of samples	June 15, 1981	June 24, 1981
Preparation of preliminary gasification balances on Illinois Basin coals		
o TG-10, IC-11, PB-7 (LFTH-0024)	June 1981	July 16, 1981
o TG-13, PB-19, IC-14 (LFTH-0025)	June 1981	July 20, 1981
o AX-1, OB-1, PB-31, TG-19, AX-4, IC-35 (LFTH-0033 and 0050)	July 1981	September 8 and October 28, 1981
Preparation of coal quality and size analysis data on Illinois Basin Coals (WChEB-0023)	June 2, 1981	October 20, 1981 draft Feb. 26, 1982 final
Lurgi laboratory report (LFTH-0047)	July 10, 1981	October 27, 1981
Lurgi ranking of coals (LFTH-0048)	October 7, 1981	October 27, 1981
Development of ranges of expected coal quality and sizes to initiate supply negotiations	January 28, 1982	February 4, 1982
Development of ranges of expected maximum flow and heat rates around gasification unit for Illinois Basin coals (THLF-0080 and LFTH-0089)	February 4, 1982	February 18, 1982

the coal to development by Lurgi of the ranking of all coals tested to development of heat and material balances. These activities occurred from June 1981 through February 1982.

The results of these activities were used to provide the range of expected quality and size consist data available for potential plant supply and predict the maximum flow and heat rates for equipment sizes relative to the Camp 1 design coal.

The specific supply and design recommendations, findings and observations are listed in this section.

A preliminary evaluation of coals collected for the selection of the coal for the commercial scale gasification test provided certain preferences on coal acceptability:

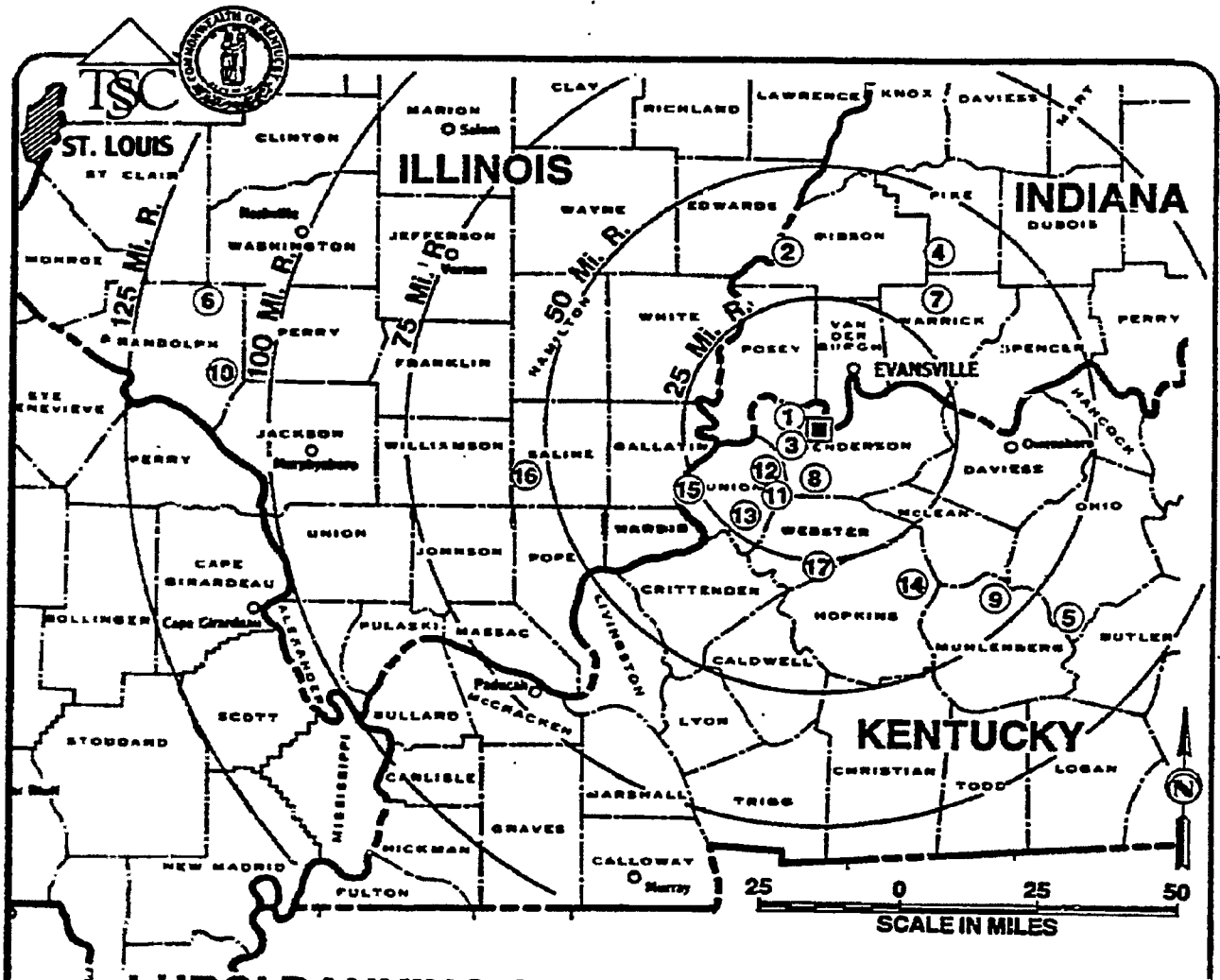
- o Lurgi concluded that Camp 1, Camp 11, River Queen, Ken and Baldwin mine samples qualify as acceptable coals for gasification. Of lower acceptability were No. 9 mine and Providence mine samples due to the high free swelling index.

In order to expand the range of coal technology knowledge, the new sampling program covered ten mines representative of the Illinois Basin and the data used to supplement the preliminary evaluation. The mines were operated by Peabody, Island Creek, Amax and Old Ben coal companies.

From this program, the following recommendations resulted:

- o Lurgi considered the six samples analyzed as suitable for gasifier feed coal and expressed preferences as follows (most preferable first): Wabash, Old Ben, Lynnville, Camp 11, Hamilton and Delta.
- o Lurgi ranked all coals developed into an overall list based primarily in terms of steam and oxygen consumption figures, thermal efficiencies, etc. rather than strictly in terms of gasifiability. Thus, the fact that, for example, Kentucky 9 core and Camp 1 are rather far apart doesn't mean that the latter gasifies a lot worse than the former. Instead, Lurgi preferred it for the main criteria.

# EXHIBIT IX-E



## LURGI RANKING OF ILLINOIS BASIN COALS

### INFORMATION DEVELOPED FROM SEVERAL SOURCES

### IN ADDITION TO SUPPLY/DESIGN PROGRAM

RANK	MINE	SEAM	COUNTY	RANK	MINE	SEAM	COUNTY
1	Core	KY 9	Henderson	10**	Streamline	IL 6	Randolph
2	Wabash	IL 5	Wabash	11	Camp 11	KY 11	Union
3	Core	KY 7	Henderson	12*	Camp 1	KY 9	Union
4	Old Ben	IN 5	Pike	13	Camp 11	KY 11	Union
5	Ken	KY 9	Ohio	14	No. 9	KY 9	Hopkins
6	Baldwin	IL 6	Randolph	15	Hamilton	KY 9	Union
7	Lynnville 1	IN 6	Warrick	16	Delta	IL 6	Saline
8	Core	KY 11	Henderson	17	Providence	KY 9	Webster
9	River Queen	KY 9	Muhlenberg				

■ TRI-STATE SYNFUELS PLANT SITE - HENDERSON

\* TRI-STATE DESIGN COAL

\*\* AGA/OCR TRIALS AT WESTFIELD

USE OR DISCLOSURE OF REPORT DATA  
IS SUBJECT TO THE RESTRICTION ON THE  
INSIDE PAGE AT THE FRONT OF THIS REPORT

The coal ranking is:

<u>RANKING</u>	<u>MINE</u>	<u>SEAM</u>	<u>SAMPLE</u>
1.	Core*	Kentucky 9	Towhead Island
2.	Wabash	Illinois 5	AX 1
3.	Core*	Kentucky 7	--
4.	Old Ben	Indiana 5	OB 1
5.	Ken	Kentucky 9	PB 13
6.	Baldwin	Illinois 6	PB 19/PB 25
7.	Lynnville	Indiana 6	PB 31
8.	Core*	Kentucky 11	Towhead Island
9.	River Queen	Kentucky 9	PB 7
10.	Streamline	Illinois 6	Westfield Trials
11.	Camp 11	Kentucky 11	TG 19
12.	Camp 1	Kentucky 9	TG 10/TG 16
13.	Camp 11	Kentucky 11	TG 13
14.	No. 9	Kentucky 9	IC 14/IC 41
15.	Hamilton	Kentucky 9	IC 35
16.	Delta	Illinois 6	AX 4
17.	Providence	Kentucky 9	IC 11/IC 38

\*Core Sample - not an operating mine

This technical and economic ranking of coals, (Exhibit IX-E) representative of supplies available for the project was used as guidance for the supply program to establish likely candidate suppliers considering distance of reserves from the plant site and other economic and business matters.

- o Paul Weir concluded that the coals sampled in close proximity to the Camp 1 coal have similar crushing characteristics. Paul Weir recommended that an average design fines content at the mine loadout facility for the supplemental coals be 37.7% + 4.6% by weight (one standard deviation). Nonetheless, there is a 95% probability (two standard deviations) that the maximum fines content could be 47% by weight at the mine loadout facility, unless measures are taken contractually to limit the fines fraction.
- o Paul Weir concluded that the physical and chemical properties of the coals are quite uniform (on a moisture and ash-free basis) except for swelling and caking properties and are within the variations to be expected from the Camp 1 mine output used for design. The concentration of trace metals varies considerably among coal sources and would have to be judged on specific impacts on the environmental design. Therefore, the quality range of supplies available to the project is quite broad and suitable for gasification. The design basis for Camp 1 can accommodate a large population of coals from the southern part of the Illinois Basin.

- o Lurgi developed heat and material balances around the gasification section for the six coal samples to supplement heat and material balances for six previous samples.
- o Tri-State provided Lurgi a range of expected coal quality parameters based on discussions with the candidate suppliers. Lurgi then established the range of maximum flow and heat rates around the gasification and auxiliary units through syngas generation for equipment sizing purposes and provided the data to the engineering group.
- o The analytical and screen analysis work on the ten special mine samples was reported by Paul Weir as probably the most detailed known to have been carried out on Illinois Basin coals. The analytical work covered three categories: (1) ASTM analyses, (2) Fischer assay, and (3) trace elements including fluorine and mercury. Comparisons between these mean analytical values with the corresponding values from the Camp 1 mine samples have been tabulated. The screen analysis work is also compared with the data for the Camp 1 sample.

#### 2.1.5 Major Problems

No major problems have been identified in this program.

#### 2.1.6 Assumptions Challenged

The sampling and testing of run-of-mine Illinois Basin coals program did not challenge the major assumption that all Illinois Basin coals can be gasified. The program did identify particular coals that are preferred for the first plant operation as well as a sensitivity range of operating parameters that would be required to satisfactorily process a wider range of coals relative to the design coal.

#### 2.1.7 Consultant/Contractor Review

The several consultants and contractors used during this program were chosen because of their considerable experience and expertise and their excellent work on the Camp 1 sampling and testing program. They were competent and responsive to the schedule. The reviews are presented in Exhibits IX-F-1 through IX-F-3.

### 2.2 CURRENT STATUS

#### 2.2.1 Current Work Activities

There are no work activities being conducted.

EXHIBIT IX-F-1

CONSULTANT/CONTRACTOR REVIEW

Firm: Paul Weir Company

Individuals/Positions:

Martial P. Corriveau, Senior Engineer and Vice President  
Melvin J. Laurila, Coal Preparation Engineer  
Roy Byrom, Senior Engineer and Vice President

Statement of Scope:

Collect, prepare and analyze coal samples from ten Illinois Basin mines and compare with Camp 1 mine sample for screen analysis and physical and chemical properties.

Dates of Service:

April 1981 through May 1982

Reports Prepared (Dates):

- o Instructions for Sampling and Testing Program, May 21, 1981
- o Addendum to Instructions, May 29, 1981
- o Mine Sampling Memoranda (for ten mines), June/July 1981
- o Size Analysis Details, 1981-1982
- o Coal and Coal Ash Analysis Details, 1981-1982
- o Special Coal Sampling Program, WChEH-0023, October 20, 1981 (draft), February 20, 1982 (final)

Decisions Impacted:

- o Technical guidance input to coal supply negotiations.
- o Technical guidance input to design coal sensitivity.
- o Technical guidance input to environmental design for wastewater and solids disposal.

Budgeted \$ to date:

Actual \$ to date:

Future Budget/Estimate: None

Performance Appraisal: Competent and Responsive to Schedule

Future Recommendations: Use when needed

EXHIBIT IX-F-2

CONSULTANT/CONTRACTOR REVIEW

Firm: Commercial Testing & Engineering Co.

Individuals/Positions:

Lloyd W. Taylor, III, Manager, Central Division (Henderson, KY)  
R. A. Bouser, Manager, Midwest Division (South Holland, IL)  
M. L. Jacobs, Manager, Instrumental Analysis Division (Golden, CO)

Statement of Scope:

Collect, prepare and analyze coal samples from ten Illinois Basin mines under direction and supervision of Paul Weir Company.

Dates of Service:

April 1981 through June 1982

Reports Prepared (Dates):

o Ten sets of screen analysis and analytical reports, 1981-1982

Decisions Impacted:

- o Technical guidance input to coal supply negotiations.
- o Technical guidance input to design coal sensitivity.
- o Technical guidance input to environmental design for wastewater and solids disposal.

Budgeted \$ to date:

Actual \$ to date:

Future Budget/Estimate: None

Performance Appraisal: Competent and Responsive to Schedule

Future Recommendations: Use when needed

EXHIBIT IX-F-3

CONSULTANT/CONTRACTOR REVIEW

Firm: Lurgi Kohle und Mineraloeltechnik GmbH

Individuals/Positions:

Peter K. Herbert, Manager of Gasification  
Karl Cleve, Project Manager

Statement of Scope:

- o Develop gasification balances on Illinois Basin coal samples.
- o Analyze six coal samples from Illinois Basin mines and provide recommendations.
- o Rank all Illinois Basin coal mine samples.

Dates of Service:

July 1981 through February 1982

Reports Prepared (Dates):

- o Preliminary gasification balances on Illinois Basin coals, LFTB-0024, July 16, 1981; LFTB-0026, July 20, 1981; LFTB-0033, September 8, 1981; LFTB-0050, October 28, 1981
- o Specific testing of six coal samples - Design Coal Evaluation, LFTB-0047, October 27, 1981
- o Coal ranking, LFTB-0048, October 27, 1981
- o Lurgi design for maximum case gasification, LFTB-0089, Feb. 18, 1982

Decisions Impacted:

- o Technical guidance input to coal supply negotiations.
- o Technical guidance input to design coal sensitivity.
- o Technical guidance input to environmental design for wastewater and solids disposal.

Budgeted \$ to date:

Actual \$ to date:

Future Budget/Estimate: None

Performance Appraisal: Competent and responsive to schedule

Future Recommendations: Use when needed



#### 2.2.2 Key Decisions Pending

There are no key decisions pending.

#### 2.2.3 Major Strengths/Weaknesses

The technical guidance information developed from this program provides a comprehensive study of the physical, chemical and gasification characteristics for Illinois Basin coals relative to the Camp 1 design coal.

#### 2.2.4 Demobilization

All work documentation, results and technology transfer activities have been completed concurrently with the demobilization activities.

### 2.3 FUTURE

#### 2.3.1 Milestone/Master Schedule

Since all phases of the work program are complete, no experimental work is planned.

#### 2.3.2 Work Program

At a minimum, certain activities will be conducted to maintain awareness of technology developments in the following areas:

- o Gasification and synthesis process advances.
- o Mining techniques to minimize fines generation.
- o Environmental processes and regulations.
- o Coal blending so as to provide acceptable free swelling and caking criteria.
- o Disposition of trace metals in the Lurgi process.
- o Fines utilization methods including briquetting and extruding.

#### 2.3.3 State of Readiness

A state of readiness and awareness will be maintained by assessing emerging technologies, changing regulations, and availability of key personnel organizations.

#### 2.3.4 List of Tasks

No specific program oriented tasks can be defined at the present time as being first priority, if the project is reactivated. There is a high probability that technological questions will arise and will have to be answered on an individual need basis which cannot now be readily identified. Depending on the schedule of the resource development activities, an experimental coal quality review program will have to be implemented when the final coal supply candidates have been identified.

#### 2.3.5 Long Lead Activities

No long lead activities have been identified.

#### 2.3.6 Staffing

If the project is reactivated, technical support will be required on the same level as the current program activities.

## IX-B COMMERCIAL SCALE COAL TEST PROGRAM

### 4.0 INTRODUCTION

This report focuses on the overall program consisting of planning, implementing and supervising the activities surrounding the commercial scale gasification test of Camp 1 coal in the Lurgi Mark IV gasifier at the Sasol One plant in Sasolburg, Republic of South Africa.

The overall program was conducted to provide the design and environmental criteria bases for the Tri-State Synfuels Project, a venture of Tri-State Synfuels Company.

The work involved the following individual programs:

- o Selection of Camp 1 Coal
- o Collection and Shipment
- o Gasification Test at Sasolburg
- o Coal Fines Utilization in Furnace Boilers
- o Kentucky Stockpile Tests
- o Export Sample Program
- o Wastewater Treatability Study

Each individual program is reported in detail in Commercial Scale Test of Kentucky 9 Coal in a Lurgi Mark IV Gasifier, Volumes 1 through 7.

Supplementary work on the sampling and testing program for run-of-mine Illinois Basin coals has been reviewed in the Tri-State Synfuels Project Review Report, Volume 13, Coal Sampling & Testing, June 1982.

### 4.1 SCOPE OF WORK

The scope of work for the overall project consisted of:

- o Generating an Illinois Basin coal quality information base and selecting from technical and availability viewpoints likely candidates for the commercial scale test, plant design basis, and potential feedstock suppliers. The information base was developed from several sources: potential suppliers, university data and a preliminary sample program.

- o Collecting 22,500 tons of the selected coal--Camp 1 mine--in Morganfield, Kentucky, loading the barges at Uniontown on the Ohio River, transloading the barges to a bulk carrier on the Mississippi River, offloading the carrier on to rail cars at Port Elizabeth, unloading the rail cars at Sasolburg and trucking the coal to storage at the Sigma Mine until the gasification test could start. The collection and shipment included inspection, sampling, preparation and analytical testwork on coal size and quality during each of the transfer points. It also involved supplying coal for construction of a test stockpile near Uniontown.
- o Testing of Camp 1 coal on the Lurgi Mark IV gasifier by Sasol Technology Limited at the Sasol One plant in Sasolburg, Republic of South Africa. Each type of coal has its own particular characteristics requiring specific adaptations of plant and equipment, and modifications and design base ranges derived from Lurgi laboratory test work can best be narrowed down by an actual gasification run on the specific coal. An extensive set of operating and analytical data were collected around the coal preparation and gasification units during mass balance conditions. High load tests were conducted to determine maximum raw gas throughput and set the number of gasifiers.

Testing of stripped gas liquor from the Camp 1 coal test in a cooling tower over a three-month period. A set of operating, analytical and corrosion data were obtained. If proven feasible, certain advantages would accrue:

- Reducing raw water intake
- Utilizing a by-product advantageously
- Reducing volume of subsequent treatment facilities
- Using cooling water system as a biological treatment facility
- Eliminating chemical additives as normally done in cooling water systems

Exporting liquid and solid samples for further testing in the United States for engineering, marketing and environmental purposes.

- o Testing on a laboratory scale a representative sample of the fines from the Camp 1 coal shipment to Sasolburg to assess the fines utilization potential in existing boilers and provide design information. Fine coal was tested on a raw and washed basis and the results compared with specifications for both pulverized fuel and cyclone furnace boilers.

- o Constructing, monitoring and analytical testing of a 200-ton compacted stockpile of representative coal collected during the shipment to Sasolburg for the gasification test to determine weatherability and leaching effects.

#### 4.2 OBJECTIVES AND GOALS

The major objectives and goals of the overall program were to:

- o Select an Illinois Basin coal to be used for the commercial scale gasification test and for the design and environmental criteria bases.
- o Ensure quality control of the sample during collection and shipment.
- o Provide design recommendations on fines generation as determined during coal collection and shipment from the mine to Sasolburg.
- o Characterize thoroughly the physical and chemical properties of the Coal for the design basis.
- o Conduct a commercial scale test on the Lurgi Mark IV gasifier, modified with a distributor-stirrer to:
  - Confirm the operability of Illinois Basin coal.
  - Confirm and modify, if necessary, the preliminary design basis used by Lurgi and Sasol in preparation of the April 1980 feasibility study.
  - Optimize design parameters of both the coal preparation, gasification and associated units.
- o Conduct a small scale cooling tower test program over a three-month period to examine the feasibility of direct use of stripped gas liquor from the test coal as cooling water makeup.
- o Characterize the fines from the coal to:
  - Provide criteria to the engineering contractor to develop the design heat and material balances for steam and power generation.
  - Determine applicability in existing pulverized fuel and cyclone furnaces.

EXHIBIT IX-G  
PROJECT PERSONNEL

TRI-STATE

<u>Name</u>	<u>Title</u>	<u>Dates of Service</u>	<u>Area of Responsibility</u>
A. Roeger, III	Technical Manager	June 1980	Planning, Coordinating, Managing the Commercial Scale Coal Gasification Test
O. D. Adams	Manager, Project Engineering	April-July 1981	Camp 1 Coal Loading Technical Observer at Test
R. A. Jones	Resident Manager Project Engineering	November 1981	Technical Observer at Test
D. C. Longshore	Asst. Resident Mgr. Project Engineering	March-April 1981 July-Sept. 1981	Camp 1 Coal Shipment Technical Observer at Test

TEXAS EASTERN SUPPORT

<u>Name</u>	<u>Title</u>	<u>Area/Type Assistance</u>	<u>Role</u>
R. G. Ackerley	Environmental Engr. Corporate Engineering	Environmental Sampling	Environmental Observer at Test
H. C. Shaw	Engineering Manager Synfuels Division	Technical Advice	Environmental Observer at Test
P. J. Shevlin	Environmental Engr. Water Section, Gas Engineering	Environmental Sampling	Technical Observer at Test
J. T. Wooten	Consulting Engr. Synfuels Division	Technical Advice	Technical Observer at Test

TEXAS GAS SUPPORT

M. N. Kelley	Project Manager	Technical Advice	Technical Observer at Test
P. A. Pedde	Vice President Research and Development	Technical Advice	Sampling/Conceptual Screening/Technical Observer at Test
H. D. Jones, II	Manager, Gas Process Studies	Technical Advice and Supervision	Camp 1 Coal Loading and Shipment/Technical Observer at Test
W. E. Meacham	Superintendent of Engineering Research	Technical Advice and Supervision	Observations at Kentucky Stockpile
M. D. Falk	Project Engineer TSSC Design Team	Technical Advice	Technical Observer at Test

Use or disclosure of data is subject to the restriction on the notice page of this document.

- o Obtain data on the quality of coal in a compacted stockpile over an properties and gasification characteristics.
- o Obtain chemical composition of rain water leachate from a compacted stockpile to assist in establishing design criteria for the water runoff system.
- o Demonstrate construction of a stockpile which is safe from spontaneous ignition.
- o Characterize export samples of various liquids and solids from the coal gasification test to:
  - Develop environmental design information and support permits especially in areas of wastewater treatment and ash disposal.
  - Support market development efforts, especially of crude phenols.
  - Develop engineering design data for naphtha hydrotreating and creosote/cresol upgrading, possibly leading to pilot plant tests.
- o Conduct wastewater treatability study on the stripped gas liquor from the Illinois Basin coal to:
  - Optimize environmental design parameters on biological treatment with emphasis on organic removal and nitrification, post filtration using multimedia filters, and effluent polishing with activated carbon.
  - Obtain data to support permit application.
- o Supply liquid and solid samples to the University of Kentucky - Institute for Mining and Minerals Research for chemical characterization and corrosion testing.

#### 4.3 WORK EFFORTS BY ORGANIZATIONS AND INDIVIDUALS

The organizations and individuals involved in all the programs number into the several hundreds. Only the major organizations can be covered here while detailed lists of readily identifiable individuals are reported in Exhibits IX-G and IX-Q.

In the coal selection phase of the program:

- o Peabody Coal Company provided existing data and several samples and funded the analyses for Illinois and western Kentucky mines.

- o Island Creek Coal Company provided existing data and several mine samples funded the analyses for western Kentucky mines.
- o The Pennsylvania State University - College of Earth and Mineral Sciences provided data on coals from Illinois, western Kentucky and Indiana mines.
- o Texas Gas Transmission Corporation provided assistance in sample collection.
- o Commercial Testing & Engineering Co. - Henderson, Kentucky, provided laboratory analytical services.
- o Lurgi Kohle und Mineraloeltechnik GmbH provided recommendations on coal selection.
- o Sasol Technology (Proprietary) Limited provided recommendations on coal selection.
- o Paul Weir Company provided recommendations on coal selection.
- o Texas Eastern Corporation, Synfuels Division, managed the overall program and funded the program.

In the collection and shipment phase of the program:

- o Paul Weir Company was responsible for instructing and supervising sampling and testing personnel at all locations except Sasolburg.
- o Commercial Testing & Engineering Co. - Henderson, Kentucky, conducted quality control sampling through the transloading at Darrow, Louisiana, and analytical testwork on the representative sample of the barge shipment.
- o McLachlan & Lazar (Pty) Ltd. performed the sampling and testing work at Port Elizabeth.
- o Lurgi conducted analytical testwork and provided recommendations on the representative sample of the barge shipment.
- o Sasol conducted analytical testwork on the representative sample of the barge shipment.
- o University of Kentucky - Institute for Mining and Minerals Research conducted analytical testwork on the representative sample of the barge shipment.



- o The Pennsylvania State University conducted analytical testwork on the representative sample of the barge shipment.
- o Kentucky Department of Energy purchased the coal sample and committed to funding the collection and shipment. Tri-State has been reimbursed for only a portion of these costs to date.
- o Tennessee Valley Authority owns the Camp 1 Mine.
- o Peabody Coal Company operates the Camp 1 Mine.
- o Texas Gas Transmission Corporation supervised the coal loading in Kentucky and coordinated the transportation arrangements and services with Peabody Coal Company, Overland Coal Conveyor Company, and American Commercial Barge Line Company, in Kentucky and up to transloading in Darrow, Louisiana. Texas Gas also provided technical assistance at all locations.
- o Overland Coal Conveyor Company provided the belt transportation service to the loading dock.
- o American Commercial Barge Line Company provided barge transportation to Darrow, Louisiana.
- o Fluor Engineers & Constructors, Inc. coordinated the bulk carrier shipment harterarrangements with Americanized Welsh Coal Charter from Darrow to Port Elizabeth.
- o Tickflaw Marine, Inc. provided inspection services.
- o Darrow Fleeting & Switching, Inc. provided barge services.
- o Cooper Stevedoring Company, Inc. provided bulk carrier loading services at Darrow.
- o Ugland Shipping Company provided ocean transportation to Port Elizabeth.
- o Sasol One Limited made arrangements to conduct South African unloading and rail transportation to Sasolburg rail head.
- o South African Railways and Harbours provided berthing, unloading cranes and transportation services to Sasolburg.

- o Freight Services and Freight Marine Shipping Limited provided unloading and custom clearances in South Africa.
- o L & M Trucking transported the coal from the Sasolburg rail head to Sigma Mine.
- o Texas Eastern provided management and technical assistance at all locations.

In the commercial scale test phase of the program:

- o Sasol Technology (Proprietary) Limited provided direction, coordination and operation of the test as assisted with operating personnel from Sasol One and Sasol Three plants.
- o L & M Trucking provided coal trucking services to the plant from Sigma Mine.
- o Kentucky Department of Energy observed and committed to funding each phase of the test. Tri-State has been reimbursed for only a portion of these costs to date.
- o Lurgi provided consulting engineering services to Sasol and Tri-State during the test.
- o Air Imports & Exports (Proprietary) Limited was the agent handling transportation services for the export samples to the United States.
- o Freight Services Forwarding Limited provided handling services for the export samples to the United States.
- o World Trade Air Freight Services, Inc. was the agent handling transportation services for the export samples in the United States.
- o Texas Eastern Corporation provided management and technical assistance during each phase of the test.
- o Texas Gas Development Corporation provided technical assistance and observed each phase of the test.

In the technological assessment of fines utilization:

- o Paul Weir Company was responsible for sample preparation and analytical testing and supervised the laboratory.
- o Commercial Testing & Engineering Co. provided analytical testing services.

EXHIBIT IX H

ESTIMATED/ACTUAL EXPENDITURES  
TRI-STATE SYNFUELS PROJECT  
COMMERCIAL SCALE GASIFICATION TEST OF  
KENTUCKY 9 COAL IN A LURGI GASIFIER

<u>ITEM</u>	<u>BUDGET COSTS</u>	<u>ACTUAL COSTS*</u>
1. Raw Coal (22, 600 ton @\$29.32/ton		
2. Coal Transport		
a. Conveying from mine to barges (@\$1.02/ton)		
b. Barging from Uniontown, KY to Darrow, LA (@\$8.50/ton)		
c. Transfer barge to ocean vessel at Darrow, LA (@\$3.75/ton)		
d. Unloading 3 fines barges		
e. Barge demurrage (10 days over 5 days)		
f. Ocean freight (@\$37.50/MT)		
g. Unloading bulk carrier at Port Elizabeth		
h. Bulk carrier demurrage (5 days @\$9,250)		
i. Railroad shipment to Sasolburg		
j. Inspection		
k. Disposal		
SUBTOTAL	\$	
3. Transit Insurance (0.25% of items 1. and 2.)		
4. Coordination and Assessment of Transportation - Fluor		
5. Supervision of Collection, Loading, Transloading, Inspection, Sampling, Testing and Analytical Instructions		
6. Analytical Testing and Shipping of Samples		
7. Gasification Test		
a. Mark IV modification and test fee		
8. Cooling Tower Test		
a. Test cost and fee		
9. Technical Assistance - Lurgi		
10. Sample Transportation & Storage		
GRAND TOTAL		

\* Phase I work is complete as of June 15, 1982, except for export sample program and wastewater treatability study costs which are covered in Project Review, Volume 6.

- o Texas Eastern provided management and technical assistance.

In the Kentucky stockpile test program:

- o Texas Gas Transmission Corporation was responsible for technical assistance in constructing the stockpile and maintaining, collecting and interpreting site data.
- o Paul Weir Company was responsible for directing the core sampling, preparation, screening, analytical testing and the leaching tests for the stockpile.
- o Commercial Testing & Engineering Co. assisted Paul Weir in sampling and analytical testing.
- o Lurgi analyzed core samples for gasification reactivity, and other properties to identify any influence of weathering.
- o Texas Eastern provided management and technical assistance.

#### 4.4 ESTIMATED COSTS

The estimated and actual costs for the overall project are shown in Exhibit IX-H. On balance, the actual costs of were essentially on target with the estimated amount. Major funding for the overall project was committed by the Kentucky Department of Energy under Memorandum of Agreement No. 3687. Tri-State has been reimbursed for only a portion of these costs to date. United States Department of Energy and Tri-State Synfuels Company shared project management costs which are covered elsewhere.

The raw coal purchase and transportation expenses accounted for the major cost element--in excess of 63% of the costs of the project. Items which exceeded estimates were in the areas of supervision, sampling and analytical testing of the coal at all locations. These were due to inadequate scoping of the project during the early phases and a greatly expanded export sample program, especially in the environmental area. In addition, the Lurgi expenses were higher because the technical assistance involved two additional phases of the test which incurred extensive time and travel expenses from West Germany for at least six Lurgi personnel.

Savings which were achieved were primarily in the Sasol expenses which were contractually specified in rands but due to the rapid improvement in the value of the dollar during 1981 to early 1982 resulted in a greatly reduced dollar outlay thus offsetting dollar increases elsewhere.