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**U.S. DEPARTMENT OF ENERGY
PITTSBURGH ENERGY TECHNOLOGY CENTER**

**DIRECT COAL LIQUEFACTION
BASELINE DESIGN
AND
SYSTEM ANALYSIS**

CONTRACT NO. DEAC22 90PC89857

**QUARTERLY REPORT
OCTOBER - DECEMBER 19__**

We have no objection from a patent
standpoint to the publication or
dissemination of this material
Mark P. Dvorscak
Date 12-7-95
Mark Dvorscak
Intellectual Property Law Dept.
DOE Chicago Operations Office

**FEBRUARY, 1993
PITTSBURGH, PENNSYLVANIA**

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Bechtel

3000 Post Oak Boulevard
Houston, Texas 77056-6503

Mailing address: P.O. Box 2166
Houston, Texas 77252-2166

February 19, 1993

U. S. Department of Energy
Pittsburgh Energy Technology Center
Mail Stop 922-H
P. O. Box 10940
Pittsburgh, PA 15236

Attention: Mr. Swenam Lee
Project Manager

Subject: D.O.E. Coal Liquefaction
Base Line Design and System Analysis
Contract No. DE-AC22 90PC89857
Bechtel Job No. 20952
Quarterly Status Report
Letter No. BLD-131

Dear Mr. Lee:

Attached for your information are three copies of the subject Quarterly Status Report covering the September 14, 1992 through December 20, 1992 reporting period. Copies to other members, as required by the contract are separately and directly transmitted.

Please note that all information contained herein should be considered preliminary pending issue of the final tasks reports.

If you have any questions or comments on this Quarterly Status Report please contact me.

Sincerely yours,

Syamal K. Poddar
Project Manager

Attachment

cc: Martin Byrnes, DOE/PETC
Robert Hamilton, DOE/PETC
A. B. Schachtschneider, AMOCO
File

Gilbert V. McGurl, DOE/PETC
Joanne Wastek, DOE/PETC

Bechtel Corporation

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1. INTRODUCTION

Effective May 16, 1990, Bechtel with Amoco as subcontractor, initiated a study to develop a computer model for a base line direct coal liquefaction design for the U.S. Department of Energy's (DOE) Pittsburgh Energy Technology Center (PETC). The project was initially for a duration of 18 months with an approved budget of \$2 MM. Later, the project was extended in two steps to mid-December 1992. During this reporting period a proposal to relax the design basis for baseline by including higher space velocity for coal liquefaction reactor design basis has been granted by DOE/PETC. This is referred to as the improved baseline case and is scheduled to be completed by mid-December 1992. The study is under DOE contract No. DE-AC22 90PC89857.

The primary objective of the study is to develop a computer model for a base line direct coal liquefaction design based on two stage direct coupled catalytic reactors. This primary objective is to be accomplished by completing the following:

- A base line design based on previous DOE/PETC results from Wilsonville pilot plant and other engineering evaluations
- A cost estimate and economic analysis
- A computer model incorporating the above two steps over a wide range of capacities and selected process alternatives
- A comprehensive training program for DOE/PETC Staff to understand and use the computer model
- A thorough documentation of all underlying assumptions for baseline economics, and
- A user manual and training material which will facilitate updating of the model in the future

With the inclusion of the improved baseline case, the above primary objective is extended to include the impact of higher space velocity through liquefaction reactor.

The progress made during any particular quarter is published in a quarterly report following the duration of the quarter. The report consists of the following four sections:

- Introduction
- Summary
- Technical Progress Report (By Tasks)
- Key Personnel Staffing Report.

Introduction (Continued)

Any confidential information will be presented in the quarterly report as a separate section under the heading "confidential". As agreed upon by DOE/PETC, information included in the confidential section will be treated confidential by DOE/PETC and its contractors.

This report is Bechtel's tenth quarterly progress report and covers the period of September 14, 1992 through December 20, 1992.

2. SUMMARY

Effective May 16, 1990, Bechtel initiated this study, with Amoco as subcontractor, as an assignment from the U.S. Department of Energy (DOE)'s Pittsburgh Energy Technology Center (PETC). The objective of the study is to develop a computer model for a baseline direct coal liquefaction design based on two stage direct coupled catalytic reactors. The study was for a period of 18 months which was extended later to mid-December 1992.

This is Bechtel's tenth quarterly progress report and covers the period (as requested and approved by DOE/PETC) of September 14, 1992 through December 20, 1992. This reporting period was previously covered by three already published monthly status reports.

The report contains accomplishments made during this time period in all the Tasks scheduled for the period i.e., Tasks I through VI. As per schedule, the major focus, however, was on Task II, III, IV and V. Therefore, the accomplishments included in this report are predominantly for these four tasks.

The accomplishments are presented in the report on Task by Task basis for all the Tasks covered during this reporting period.

Task I

- In Task I (which defines the project) the Project Management Plan Draft Report was completed and subsequently updated incorporating the comments and suggestions of DOE/PETC and their contractors. The final version was sent to DOE/PETC for their approval and subsequently published in August, 1990. The approved copy was the deliverable for the Task.
- Project Management Plan report covers the overall scope of work, the methodology of managing the cost and schedule of the project (configuration management), program administration, the deliverables during various phases of work and the definition of the baseline configuration.
- For the baseline case, Task I was completed on schedule during the September, 1990 monthly reporting period. The design basis for the improved baseline case has been established utilizing Wilsonville pilot plant runs 257J, 261B and 261D. The improved baseline case is for a higher space velocity in the liquefaction reactors.
- The number of liquefaction reactor trains and the coal feed rate through each of the reactor trains have been finalized with the help of Amoco's kinetic model.

Task II

- Task II concerns the development of the baseline design as well as improved baseline design of the liquefaction complex. This task, with reference to baseline design, has been completed and the results have been published in three volumes during the quarterly progress reporting period, December 23, 1991 through June 21, 1992. Any update and results reflecting fine tuning with modeling effort will be included in the corresponding portions of the final project report.
- The design effort for the improved baseline as well as improved baseline with the best option has been completed. The best option refers to the case where steam reforming of natural gas plus FBC unit for hydrogen production is utilized. This includes designing primarily the coal liquefaction plant (Plant 2), gas plant (Plant 3), naphtha hydrotreater (Plant 4), gas oil hydrotreater (Plant 5) and hydrogen purification plant (Plant 6).
- The overall hydrogen flow and water flow distribution for the critical ISBL plants for the improved baseline case have also been completed. During this reporting period similar information for the best option (steam reforming of natural gas plus FBC unit for hydrogen production) has also been developed.

Task III

Task III concerns the development of the cost estimate and economics for the baseline design and options for the coal liquefaction facility.

- The final versions of volumes I and II of the Topical/Task III reports were published in September 1992. The remaining volume (Volume III) of this report containing economics will be completed and issued after the improved baseline case is completed.
- The capital cost estimate for the improved baseline case has been completed.
- Assessment of the economics (preliminary) of the improved baseline has also been completed.

Task IV

- Task IV which concerns the development of the mathematical algorithms and models was completed. The final task report was issued the first week in October, 1991.

Task V

Task V involves developing the ASPEN process simulation model of the baseline and improved baseline design.

- The Task V Topical Report covering the Process Simulation Model for the baseline and options was issued during this reporting period. Also a restricted addendum to the Task V Topical Report covering the Lotus Spreadsheet Economics Model was issued in December 1992.
- The final listings of the ASPEN/SP Fortran source code for the various block models that will appear in the Appendices to the Task V Topical Report is being prepared (including the improved baseline design case) and is scheduled to be published by the end of January 1993.
- The ASPEN/SP process simulation model, which previously was tuned to match the material and utility balances for the improved baseline (higher space velocity) cases, was tuned to match the plant cost information. The documentation of the modeling is in progress.
- The ASPEN/SP kinetic model was tuned so that it also will simulate the improved baseline case. Documentation is in preparation.

Task VI

- The revised draft Topical Report for Task VI (training) was split into two volumes; a main volume and a restricted addendum discussing the LOTUS spreadsheet economics model. The report was published during this quarterly reporting period.

3. TECHNICAL PROGRESS (BY TASKS)

In order to carry out this Study efficiently, the Study has been divided in seven major tasks. Task I defines the project. Task II develops the Baseline design. Task III develops the capital, operating and maintenance costs. Task IV develops the mathematical model necessary for the process computer simulation model. Task V develops and verifies the process simulation model. Task VI documents the process simulation model and training. Task VII is a level of effort task for project management, technical coordination and other miscellaneous support functions.

During this reporting period (September 14, 1992 through December 20, 1992) several accomplishments were made in Tasks II, III, IV, V and VI. These accomplishments are included in this report task by task.

Task I was completed during the first quarterly reporting period. The accomplishment of Task I was documented in the Project Management Plan published in August, 1990. It was also presented in the first quarterly report, covering the period of May 16, 1990 through August 19, 1990).

3.1 TASK I

Task I defines the scope and the methodology of accomplishing the project. It sets the objectives of the project and defines the paths to accomplish those objectives.

As mentioned earlier in Section 3, Task I was completed during the first quarterly reporting period and accomplishments were documented in the Project Management Plan issued in August, 1990.

The Project Management Plan report is comprised of the following 9 sections:

- Executive Summary
- Background/Introduction
- Study Objective
- Overall Scope Of Work
- Configurational Management
- Program Administration
- Deliverables
- Baseline Configuration
- Appendix/Project Procedure Booklet
List Of Contents

The report completing Task 1 was published on time schedule. Detailed accomplishments of Task I were included in the first quarterly report (May 16, 1990 through August 19, 1990) of the project.

3.2 TASK II

Task II concerns the development of the Baseline design of the liquefaction facility. This part of the study includes the acquisition of process licensors information, incorporation of various processing options into the design, and developing the design of the on-site processing units and offsite facilities (including storage and loading, utilities, and waste handling).

In this task certain plants are handled as packaged plants (or blocks) with an overall heat and material balance only.

3.2.1 STATUS UPDATE

- The final Topical/Task report for task II is divided into three volumes. Volumes I and II contain the information on the Baseline design while volume III covers the options (alternates). Volumes I and II of the report were published during the quarter of September 16, 1991 through December 22, 1991 reporting period, whereas Volume III of the report, both draft and the final version were published During December 23, 1991 through March 15, 1992 quarterly reporting period.
- The design effort for the improved baseline as well as improved baseline with the best option has been completed. The best option refers to the case where steam reforming of natural gas plus FBC unit for hydrogen production is utilized. This includes designing primarily the coal liquefaction plant (Plant 2), gas plant (Plant 3), naphtha hydrotreater (Plant 4), gas oil hydrotreater (Plant 5) and hydrogen purification plant (Plant 6).
- The overall hydrogen flow and water flow distribution for the critical ISBL plants for improved baseline case have also been completed. During this reporting period similar information for the best option (steam reforming of natural gas plus FBC unit for hydrogen production) has also been developed.
- Important results of the improved baseline design have been included in the ninth quarterly progress report (June 22, 1992 through September 13, 1992). The key results of the improved baseline with Option 6 (hydrogen production by natural gas reforming plus a FBC unit) are summarized in this section of the report.

3.2.1 STATUS UPDATE - continued

Material Balance for the Directly Affected Plant

The overall material balance for the Steam Methane Reformer (Plant 9-01) and Fluid Bed Combustion unit (Plant 31.9) are shown in Table 3.1 and Table 3.2 respectively. In addition, the overall material balance for the liquefaction plant, Plant 2 is shown in Figure 3.1.

Table 3.1 Improved Baseline Plus Option 6 Overall Material Balance for Plant 9.01				
Stream No.	Plant Input			
	9.1	9.2		
Components	Natural Gas Lbs/hr	Steam Lbs/hr	Total Input Lbs/hr	
H2			116824	
H2O		981149	464106	
CO			26957	
CO2			610761	
C1	348853		111354	
TOTAL	348853	981149	1330002	
Stream No.	Plant Output			
	9.3	9.4	9.5	
Components	Hydrogen Lbs/hr	Offgas Lbs/hr	Sour Water Lbs/hr	Total Output Lbs/hr
H2	103578	13266		116824
H2O		34777	429329	464106
CO		26957		26957
CO2		610761		610761
C1	827	110527		111354
TOTAL	104405	796268	429329	1330002

Table 3.2
Improved Baseline Plus Option 6
Overall Material Balance for Plant 31.1 & 31.4

Plant Input				
Components	Ash Conc Lbs/hr	Limestone 3/hr	Air Lbs/hr	Total Input Lbs/hr
N2			2994826	2994826
O2			903924	903924
H2O				
CO2				
850-1000	7884			7884
1000+	93888			93888
CaCO3		47663		47663
CaSO4				
UC Coal	110016			110016
Ash	178224			178224
TOTAL	390012	47663	3898750	4336525
Plant Output				
Components	Flue as Lbs/hr	Total Solid Lbs/hr	Total Output Lbs/hr	
N2	2999328		2999328	
O2	319708		319708	
H2O	87370		87370	
CO2	688816	2305	691121	
850-1000				
1000+				
CaCO3				
CaSO4		60774	60774	
UC Coal				
Ash		178224	178224	
TOTAL	4095222	241303	4336525	

Figure 3.1
MATERIAL BALANCE PER TRAIN
IMPROVED BASELINE PLUS
HYDROGEN BY NATURAL GAS REFORMING OPTION

NOTES: . Flow rate in lbs/hr

. Number in parenthesis is due to input stream (1). Therefore, to calculate the % yield subtract out the corresponding number in parenthesis.

. The HC's in sour water are shown in net reactor effluent.

H2REFOP.DRW

3.2.1 STATUS UPDATE - continued

Utility Summary for the Directly Affected Plant

The utility requirement for the directly affected plant (Plant 9-01) is shown in Table 3.3.

TABLE 3.3

Improved Baseline Plus Option 6

Utility Requirement for Plant 9-01

Steam, 600 psig saturated, lbs/hr	-1,285,006
Cooling water, gpm	10,709
Electricity, KW	6,961
Fuel Gas, MMBtu/hr	1,750

Overall Impact

The overall impact on the entire complex due to the change in hydrogen production method from coal gasification, Plant 9 (in the baseline design) to steam methane reforming (Plant 9-01) has been quantified based on the throughput adjustments to all the indirectly affected plants. Such effects are included in this report as: overall plant configuration and overall material balance, overall utility summary, overall water flow distribution and overall hydrogen flow distribution.

Overall Plant Configuration and Material Balance

The overall plant configuration and overall material balance for this option are shown in the same figure, Figure 3.2.

Overall Utility Summary

The overall utility summary for this option is shown in Table 3.4.

Overall Water Flow Distribution

The overall water flow distribution for the entire complex is shown in Figure 3.3.

Overall Hydrogen Flow Distribution

The overall hydrogen flow distribution for the entire complex is shown in Figure 3.4.

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FIGURE 3.2

DOE / PETC
COAL LIQUEFACTION
IMPROVED BASELINE CASE
HYDROGEN BY NATURAL GAS
REFORMING OPTION
OVERALL PLANT CONFIGURATION
AND
OVERALL MATERIAL BALANCE

TABLE 3.4

OVERALL UTILITY BALANCE FOR IMPROVED BASELINE
H2 BY NATURAL GAS REFORMING OPTION

12-Feb-93

Plant No.	PLANT NAME	Fuel Gas MMbtu/hr	Electric Power KW	Steam Psig, Lb/hr				Cond/BFW Net Cons lb/hr	Cooling Water gpm	Sour Water gpm	Waste Water gpm	Makeup Water gpm	Air scfm	Nitrogen scfm
				600 & 2620 Sup	600 @489 F	150 @386 F	50 @298 F							
	PROCESSING UNITS													
1	Coal Cleaning and Handling		6,651								629			
1.4	Coal Grinding and Drying	530	13,204						262				6,492	81,819
2	Coal Liquefaction	1,129	59,162	6,068	(162,508)	(98,203)	176,362	462,939	8,824	(2,871)				779
3	Gas Plant	(1,522)	502		279,468		15,096	(294,564)	9,784	(2)				
4	Naphtha Hydrotreater	71	1,198		90,386			(90,386)	7,080	(38)		(37)		
5	Gas Oil Hydrotreater	335	2,147		62,030	(104,578)		47,548	330	(99)		(81)		
6	Hydrogen Purification		28,859			71,944	2,483	(74,427)	6,438	(101)		(84)		
8	Critical Solvent Deashing	208	4,286			24,969				(50)				
9-01	H2 Prod by Nat'l Gas Reforming	1,750	6,961		(1,285,006)			2,266,155	10,709	(859)				
11	By-product Sulfur Recovery	43	1,897		37,145	(115,570)	33,745	44,680	5,034	(54)				
ALL	Common Users			73000		40000	90000	(193,000)				(532)	8,508	
	Sub Total (Process)	2,544	124,867	79,068	(978,485)	(181,438)	317,686	2,168,945	48,461	(4,074)	629	(734)	15,000	82,598
	OFFSITES													
19	Relief and Blowdown		19											
20	Tankage		6,758			22,000	3,300	(25,300)	100					
30	Electrical Distribution													
31	Steam and Power Generation	917		(79,068)			(305,169)	(851,199)	0		(338)	(3,149)		
31.1	Steam Turbine Generation		(229,183)	2,434,297				(2,604,636)	177,565			(341)		
31.4	Fluid Bed Combustion		18,852	(2,434,297)				2,434,297			(97)	(97)		
32	Raw, Cooling and Potable Water Systems		16,927						(316,833)		(235)	13,745		
33	Fire Protection		44											
34	Sewage & Effluent Treatment		7,313				3,000	(3,000)				(235)		
35	Instrument & Plant Air Systems		2,894										(15,000)	
36	Purge and Flush Oil System		258											
37	Solid Waste Disposal		48											
38	Ammonia Recovery		1,673		356,183	634,985		(991,169)	83,920	4,074	90			
39	Phenol Recovery		1,236			34,482	93,456	(127,938)	6,787		(2,264)			
Other	Bldg 41,42, Light, Etc.		4835											
	Natural Gas Imported	(3,461)												
	Off Site BL and Evaporation										2,215	(9,189)		
	Sub Total (Offsite)	(2,544)	(168,326)	(79,068)	356,183	691,467	(205,413)	(2,168,945)	(48,461)	4,074	(629)	734	(15,000)	0
	GRAND TOTAL	0	(43,459)	0	(622,302)	510,029	112,273	0	0	0	0	0	0	82,598

FIGURE 3.4

OVERALL HYDROGEN FLOW DISTRIBUTION HYDROGEN BY NATURAL GAS REFORMING OPTION

NOTES:

Hydrogen flow rates are in MMSCFD (Pure H₂)

3.3 TASK III

Task III concerns the development of the cost estimate and economics for the base-line design and the alternates for the coal liquefaction facility. This part of the study includes the compilation of equipment and utilities summaries, development of scaling factors for equipment sizes and plant costs, and development of the estimates for capital cost, working capital, and owner's costs. Work to perform the economic analyses includes the workup of the manpower requirements and operating costs for the Baseline design and for the options and the completion of sensitivity studies.

In this task plants are handled as packaged plants or blocks for the purpose of capital investment, and operating costs as well as overall capacity scale-up.

3.3.1 Capital Cost Estimates for the Improved Baseline

The methodology to 1) develop the capital cost for each inside battery limit (ISBL) plant and each out side battery limit (OSBL) plant and 2) ultimately calculate the installed capital costs for the entire complex are discussed below:

- Capital cost for each ISBL plant as well as OSBL plant was calculated by summing up the estimated costs of five components (i.e. major equipment, bulk material, sub contracts, direct labor and distributables).
- Allocate capital costs for OSBL plants to each ISBL plant capital costs.
- Include the prorated portion of the home office, fee and contingency to the adjusted costs as obtained in step above to calculate the installed capital costs for each ISBL plant.
- Sum up the installed capital cost for each ISBL plant to obtain the installed capital cost for the entire liquefaction complex.

Capital cost estimates for the improved baseline case were obtained for the "Nth Plant" concept. The "Nth Plant" concept had been discussed in the quarterly progress report covering the period March 16, 1992 through June 21, 1992. Results are presented in Tables 3.5.

Table 3.5
Installed Plant Costs

CAPITAL COST SUMMARY FOR THE COMPLEX IMPROVED BASELINE (NTH PLANT)					
Plant #	No. of Oper Tr.	Total No. of Tr.	ISBL Plant Field Costs 1000\$	ISBL Plant Cost Adjusted With OSBL Costs 1000\$	Installed Plant Costs 1000\$
1	6	6	104900	151700	186200
1.4	12	12	96800	140000	171800
2	4	4	854800	1236400	1517000
3	1	1	23600	34100	41900
4	1	1	13600	19700	24100
5	1	1	82900	119900	147100
6	1	1	130000	188000	230700
8	1	1	41700	60300	74000
9	6	6	303300	438700	538200
10	6	6	222500	321800	394800
11	5	5	55100	79700	97800
38	1	1	45000	65100	79900
39	1	1	16000	23100	28400
TOTAL			1990200	2878500	3531900

3.3.2 Capital Cost Estimates (Nth Plants)

The total installed cost for the option was re-estimated from the baseline estimates by replacing the cost of the directly affected baseline plant with the cost of the optional plant. All other cost modifications impacting the indirectly affected plants were done using the cost vs capacity correlations.

Thus the installed costs reported in the last column of Table 3.6 for the Nth plant scenario are those for the entire complex operating in the option six mode.

For this option the directly affected plants are hydrogen production by coal gasification (Plant 9), air separation plant (Plant 10), and the additional fluid bed combustion (FBC) plant in Plant 31.4-01 for the ROSE-SR bottoms. For this option, the air separation plant (Plant 10) is not a part of this complex.

Table 3.6

Installed Plant Costs (Option 6)

CAPITAL COST SUMMARY FOR THE COMPLEX IMPROVED BASELINE OPTION 6 (NTH PLANT)					
Plant #	No. of Oper Tr.	Total No. of Tr.	ISBL Plant Field Costs 1000\$	ISBL Plant Cost Adjusted With OSBL Costs 1000\$	Installed Plant Costs 1000\$
1	6	6	86000	115800	142100
1.4	12	12	96800	130400	160000
2	4	4	854800	1151300	1412600
3	1	1	23600	31700	38900
4	1	1	13600	18300	22500
5	1	1	82900	111700	137000
6	1	1	129900	174900	214700
8	1	1	41700	56200	68900
9-01	3	3	224700	302600	371300
11	5	5	33700	45400	55700
38	1	1	42500	57300	70300
39	1	1	18500	24900	30500
TOTAL			1648700	2220500	2724500

3.4 TASK IV

Task IV concerns the development of the mathematical algorithms and models for equipment sizing, scale-up, costing, and train duplication for incorporation into the ASPEN/SP process simulation model being developed in Task V.

3.4.1 Status of Task IV

The final topical/task report for Task IV was published in October 1991.

3.5 TASK V

Task V concerns the development of the ASPEN process simulation model of the baseline design and improved baseline design cases. The model will produce complete heat and material balances, elemental balances around each plant and the entire process complex, a major equipment list and outline specifications for Plant 2, utility requirements, capital cost for all plants, and a discounted cash flow economic model for the total complex. The model will be suitable for studying technology advances and options in a case study approach. The model will not include optimization capabilities.

During this reporting period several accomplishments were made in this task. These accomplishments are listed below.

- The Task V Topical Report covering the Process Simulation Model for the baseline and options was issued during this reporting period. Also a restricted addendum to the Task V Topical Report covering the Lotus Spreadsheet Economics Model was issued in December 1992.
- The final listings of the ASPEN/SP Fortran source code for the various block models that will appear in the Appendices to the Task V Topical Report is being prepared (including the improved baseline design case) and is scheduled to be published by the end of January 1993.
- The ASPEN/SP process simulation model, which previously was tuned to match the material and utility balances for the improved baseline (higher space velocity) cases, was tuned to match the plant cost information. The documentation of the modeling is in progress.
- The ASPEN/SP kinetic model was tuned so that it also will simulate the improved baseline case. Documentation is in preparation.

3.6 TASK VI

Task 6 concerns the development of a training manual and a training course for the process simulation model. The training course will include an overview of the system, modification of the reporting system, interfacing user models, modification of chemical properties, use of the cost and economics modules, specifying flowsheets, streams, components, properties, and convergence. Trainees will be instructed through the use of case study example problems.

- The revised draft Topical Report for Task VI (training) was split into two volumes; a main volume and a restricted addendum discussing the LOTUS spreadsheet economics model. The report was published during this quarterly reporting period.

4. KEY PERSONNEL STAFFING REPORT

Key Personnel staffing report for this reporting period (March 16, 1992 through June 21, 1992) as required by DOE/PETC is included in Table 4-1 shown below.

Table 4-1
Key Personnel Staffing Report

Duration of Quarter		From September 14, 1992 to December 20, 1992
<u>Name of Key Person</u>	<u>Function</u>	<u>% Time Spent*</u>
<u>Bechtel:</u>		
S. K. Poddar	Project Manager	35
S. K. Poddar	Process Manager	35
T. J. Reynolds	Project Secretary	44
<u>Amoco:</u>		
A. B. Schachtschneider	Project Manager	10
A. Basu	Principal Investigator	10
S. J. Kramer	Principal Investigator	25

* (Number of hours spent/total available working hours for September 14, 1992 through December 20, 1992) x 100.