DOE/PC/90543--T10

COMMERCIAL-SCALE DEMONSTRATION OF THE LIQUID PHASE METHANOL (LPMEOH™) PROCESS

TECHNICAL PROGRESS REPORT NO. 2

For The Period

July 1, 1994 to September 30, 1994

Prepared by

Air Products and Chemicals, Inc.
Allentown, Pennsylvania

Prepared for the United States Department of Energy
Pittsburgh Energy Technology Center
Under Cooperative Agreement No. DE-FC22-92PC90543

Patents cleared by Chicago on 5/30/97

REPORT2.DOC

DISCLAIMER

ACRONYMS AND DEFINITIONS

Acurex	-	Acurex Environmental Corporation
Air Products	-	Air Products and Chemicals, Inc.
AFDU	-	Alternative Fuels Development Unit - The "LaPorte PDU."
Balanced Gas	-	A syngas with a composition of hydrogen (H_2), carbon monoxide (CO), and carbon dioxide (CO_2) in stoichiometric balance for the production of methanol
Carbon Monoxide Gas	-	A syngas containing primarily carbon monoxide (CO); also called CO Gas
DME	-	dimethyl ether
DOE	-	United States Department of Energy
DOE-PETC	-	The DOE's Pittsburgh Energy Technology Center (Project Team)
DOE-HQ	-	The DOE's Headquarters - Clean Coal Technology (Project Team)
DTP	-	Demonstration Test Plan - The four year Operating Plan for Phase 3, Task 2 Operation
DVT	-	Design Verification Testing
Eastman	-	Eastman Chemical Company
EIV	-	Environmental Information Volume
EMP	-	Environmental Monitoring Plan
EPRI	-	Electric Power Research Institute
HAPs	-	Hazardous Air Pollutants
Hydrogen Gas	-	A syngas containing an excess of hydrogen (H_2) over the stoichiometric balance for the production of methanol; also called H_2 Gas
IGCC	-	Integrated Gasification Combined Cycle, a type of electric power generation plant
IGCC/OTM	-	An IGCC plant with a "Once-Thru Methanol" plant (the LPMEOH™ Process) added-on.
KSCFH	-	Thousand Standard Cubic Feet per Hour
LaPorte PDU	-	The DOE-owned experimental unit (PDU) located adjacent to Air Product's industrial gas facility at LaPorte, Texas, where the LPMEOH™ process was successfully piloted.
LPDME	-	Liquid Phase DME process, for the production of DME as a mixed coproduct with methanol
LPMEOH™	-	Liquid Phase Methanol (the technology to be demonstrated)
MTBE	-	methyl tertiary butyl ether
NEPA	-	National Environmental Policy Act
OSHA	-	Occupational Safety and Health Administration
Partnership	-	Air Products Liquid Phase Conversion Company, L.P.
PDU	-	Process Development Unit
PFD	-	Process Flow Diagram(s)
ppb	-	parts per billion
Project	-	Production of Methanol/DME Using the LPMEOH™ Process at an Integrated Coal Gasification Facility
psia	-	Pounds per Square Inch (Absolute)
psig	-	Pounds per Square Inch (gauge)
P&ID	-	Piping and Instrumentation Diagram(s)
SCFH	-	Standard Cubic Feet per Hour
Sl/hr-kg	-	Standard Liter(s) per Hour per Kilogram of Catalyst
Syngas	-	Abbreviation for Synthesis Gas
Synthesis Gas	-	A gas containing primarily hydrogen (H_2) and carbon monoxide (CO), or mixtures of H_2 and CO; intended for "synthesis" in a reactor to form methanol and/or other hydrocarbons (synthesis gas may also contain CO_2, water, and other gases)
Tie-in(s)	-	the interconnection(s) between the LPMEOH™ Process Demonstration Facility and the Eastman Facility
TPD	-	Ton(s) per Day
WBS	-	Work Breakdown Structure
wt	-	weight

Executive Summary

The Liquid Phase Methanol (LPMEOH™) Demonstration Project at Kingsport, Tennessee is a $213.7 million cooperative agreement between the U.S. Department of Energy (DOE) and Air Products and Chemicals, Inc. (Air Products). The demonstration is sited at the Eastman Chemical Company (Eastman) complex in Kingsport. Air Products and Eastman are working on a partnership agreement which will form the Air Products Liquid Phase Conversion Company, L.P. As a limited partner in the venture, Eastman will own and operate the demonstration unit.

The project involves the construction of a 260 tons-per-day (TPD) or 80,000 gallon per day methanol demonstration unit utilizing an existing coal-derived synthesis gas from Eastman. The new equipment consists of synthesis gas feed preparation and compression, liquid phase reactor and auxiliaries, product distillation, and utilities.

The technology to be demonstrated was developed by Air Products in a DOE sponsored program that started in 1981. Originally tested at a small, DOE-owned experimental facility in LaPorte, Texas, the LPMEOH™ process offers several advantages over current methods of making methanol. This liquid phase process suspends fine catalyst particles in an inert liquid, forming a slurry. The liquid dissipates heat from the chemical reaction away from the catalyst surface, protecting the catalyst and allowing the gas-to-methanol reaction to proceed at higher rates. The process is ideally suited to the type of gas produced by modern coal gasifiers. At the Eastman Chemical complex, the technology will be integrated with existing coal gasifiers to demonstrate the commercially important aspects of the operation of the LPMEOH™ Process to produce methanol.

A four-year demonstration will prove the commercial applicability of the process. An off-site product-use test program will prove the suitability of the methanol as a transportation fuel and as a fuel for stationary applications in the power industry. In future commercial facilities, advanced coal-to-methanol processes may be a cost-enhancing option for coal gasification-based power plants. Future facilities using "integrated gasification-combined-cycle technology" will produce methanol as a co-product during times of low electricity demand, allowing the gasifiers to operate at steady, peak performance.

This project may also demonstrate the production of dimethyl ether (DME) as a mixed coproduct with methanol if laboratory- and pilot-scale research and market verification studies show promising results. If implemented, the DME would be produced during the last six months of the four-year demonstration period. DME has several commercial uses. In a storable blend with methanol, the mixture can be used as a peaking fuel in gasification-based electric power generating facilities. Blends of methanol and DME can be used as chemical feedstocks for synthesizing chemicals, including new oxygenated fuel additives.

The project was reinitiated in October of 1993, when DOE approved a site change to the Kingsport location. Since that time project definition activities have been on-going. During this last quarter the project transitioned to the design phase. The project requires review under the National Environmental Policy Act (NEPA) to move to the construction phase, which is scheduled to begin in August of 1995. DOE is moving forward with the preparation of an Environmental Assessment (EA) and Finding of No Significant Impact (FONSI), which are necessary to complete this review process. The facility is scheduled to be mechanically complete in November of 1996. The Continuation Application is expected to be submitted to the DOE in early October of 1994. When approved this will move the project into the Design and Construction Phase.

A. Introduction

The Liquid Phase Methanol (LPMEOH™) demonstration project at Kingsport, Tennessee is a $213.7 million cooperative agreement between the U.S. Department of Energy (DOE) and Air Products and Chemicals, Inc. (Air Products). A facility producing 80,000 gallons per day of methanol will be located at the Eastman Chemical (Eastman) facility in Kingsport, Tennessee. Under a proposed partnership agreement, Eastman will be a limited partner in the venture, which will own and operate the demonstration unit for the four-year operating period. This project is sponsored under the DOE's Clean Coal Technology Program and its objective is to "demonstrate, at a commercial scale, the production of methanol from coal-derived synthesis gas using the LPMEOH™ process. The project will also determine the suitability of the methanol produced for use as a chemical feedstock or as a low-sulfur dioxide, low-nitrogen oxides alternative fuel in stationary and transportation applications."

The Kingsport project may also demonstrate the production of dimethyl ether (DME) as a mixed coproduct with methanol if laboratory- and pilot-scale research shows promising results. If implemented, the DME would be produced during the last six months of the four-year demonstration period.

The LPMEOH™ process was developed by Air Products in a DOE-sponsored program that started in 1981. It was successfully piloted at a 10 TPD (3,200 gallons per day) rate in the DOE-owned facility at Air Products' LaPorte, Texas site. This demonstration project is the culmination of this extensive effort.

B. Project Description

Existing Site

The site for this demonstration is the Eastman complex located in Kingsport, Tennessee. This major chemical complex is spread over almost 4,000 acres and employs approximately 12,000 people. In 1983 Eastman constructed a coal gasification facility utilizing Texaco technology. The synthesis gas generated by this gasification facility is used to produce carbon monoxide and methanol. Both of these products are used to produce methyl acetate and ultimately cellulose acetate and acetic acid. The availability of this highly reliable coal gasification facility was the major factor in selecting this location for the LPMEOH™ Process Demonstration. The existing methanol unit (gas phase Lurgi technology) will be operated at turndown since some of the feed gas will be diverted to the LPMEOH™ demonstration unit.

The proposed project includes these four major process areas with their associated equipment:

- Reaction Area
- Purification Area
- Catalyst Preparation Area
- Storage/Utility Area

The physical appearance of this facility will closely resemble the adjacent Eastman process units, including process equipment in steel structures.

Reaction Area

The reaction area will include feed gas compression and catalyst guard beds, the reactor, a steam drum, separators, heat exchangers, and pumps. The equipment will be supported by a matrix of structural steel. The most salient feature will be the reactor, since with supports, it will be approximately 84-feet tall.

Purification Area

The purification area will feature two distillation columns with supports; one will be approximately 82-feet tall, and the other 97-feet tall. These vessels will resemble the columns of the surrounding process areas. In addition to the columns, this area will include the associated reboilers, condensers, air coolers, separators, and pumps.

Storage/Utility Area

The storage/utility area will include two diked lot-tanks for methanol, two tanks for oil storage, a slurry holdup tank, trailer loading/unloading area, and a buried oil/water separator.

Catalyst Preparation Area

The catalyst preparation area will be housed in a building with a roof and partial walls, in which the catalyst preparation vessels, slurry handling equipment, and spent slurry disposal equipment will be located. In addition, a hot oil utility system is included in the area.

C. Process Description

The LPMEOH™ demonstration unit will be integrated with Eastman's coal gasification process train and operated in parallel with an existing Lurgi technology methanol unit. A simplified Process flow diagram is included in Appendix A. When the LPMEOH™ plant is operating, the Lurgi unit will be turned down. Synthesis gas will be introduced into the slurry reactor, which contains liquid mineral oil with suspended solid particles of catalyst. The synthesis gas dissolves through the oil, contacts the catalyst, and reacts to form methanol. The heat of reaction is absorbed by the mineral oil and is removed from the oil by steam coils. The methanol vapor leaves the reactor and is condensed to a liquid, sent to the distillation columns for removal of higher alcohols, water, and other impurities, and is then stored in the day tanks for sampling before being sent to Eastman's methanol storage. Most of the unreacted synthesis gas is recycled back to the reactor with the synthesis gas recycle compressor, improving cycle efficiency. The methanol will be used for downstream feedstocks and in off-site fuel testing to determine its suitability as a transportation fuel and as a fuel for stationary applications in the power industry.

D. Project Status

Major accomplishments during this July 1, 1994, to September 30, 1994, period are as follows:

1. Project Management Plan

Reviews

- A Project Review meeting was held at DOE's Pittsburgh Energy Technology Center (PETC) offices on September 29, 1994. A copy of the meeting minutes is attached as Appendix B.

Agreements

- The Continuation Application was prepared and is expected to be submitted to the DOE in early October of 1994.
- The following project management guides were prepared:

Updated Project Management Plan	(September 7, 1994)
Updated Statement of Work	(September 9, 1994)
Project Evaluation Report for Budget Period No. 1	(September 28, 1994)

Safety

- A meeting was held July 28, 1994, with Air Products and Eastman to review Occupational Safety and Health Administration (OSHA) Process Safety Management (PSM) requirements and to ensure that the required PSM documentation will be developed as part of the project.

2. Technology Baseline

Process Design

- The Air Products Process Engineering Group continues to develop equipment specifications. The specifications for the following equipment items were released for mechanical design:

C-20	Methanol Rectifier Column (Rev. 1)
C-10	Methanol Stabilizer Column (Rev. 1)
C-30	Catalyst Reduction Vessel (Rev. 0)
C-32	Utility Oil Surge Tank (Rev. 0)
E-02	Syngas Feed/Product Economizer (Rev. 0)

E-10 Methanol Stabilizer Reboiler (Rev. 0)

E-11 Methanol Stabilizer Column Condenser (Rev. 0)

C-02 Steam Drum (Rev. 0)

E-01 Syngas Compressor Cooler (Rev. 0)

E-32 Utility Oil Heater (Rev. 0)

E-33 Utility Oil Cooler (Rev. 0)

G-32 Utility Oil Circulating Pump (Rev. 0)

V-01 Utility Oil Skid (Rev. 0)

Process specifications have been completed for about 25% of the equipment items.

Design Engineering

- The following mechanical specifications were released to Air Products' Purchasing Department to obtain quotations from vendors:

  -- LPMEOH™ Reactor

  -- Synthesis Gas Feed/Product Economizer

- The plot plan and equipment arrangements continue to be revised as information becomes available.

- Work has started on the Piping and Instrument Diagrams (P&ID's). This is a combined effort of Air Products' Process Engineering, Operations, Systems Engineering, and Eastman Engineering personnel. The P&ID has to be developed to a certain level for an operational review to be conducted. The operational review is followed by the Design Hazards Review (DHR). Following the Design Hazards Review (which is a level above the Preliminary Hazards Review) the P&ID is revised and detailed piping, instrument, and civil/structural design can commence.

- The Control System Design Objectives (CSDO) document was issued on September 22, 1994. This document outlines the factors to be considered in the design of the process control system. A meeting was held between systems/operations/instrument engineers from Eastman and Air Products to review this design basis document.

Construction

No activity to report at this time. Eastman has begun making plans to perform the piping tie-ins in the Spring of 1995.

3. *Schedule Baseline*

- The milestone schedule, dated September 16, 1996 (see Appendix C), has the following key dates:

• Complete NEPA Review/Issue FONSI	May 31, 1995
• Begin Construction	October 17, 1994
• Complete Construction	November 15, 1996
• Begin Start-up	October 31, 1996
• Begin Operation	December 16, 1996
• Complete Operation	December 28, 2001

4. *Cost Baseline*

A current Cost Management Report is included in Appendix D.

Procurement

- Demag was selected as the vendor for the Synthesis Gas Recycle Compressor and an order was placed on August 25, 1994. Delivery is scheduled for October of 1995. The value of the award was approximately $787,000 (including G&A).

5. *Financial Commitment*

- Final business agreements between Air Products and Eastman have been prepared and are expected to be executed in early October of 1994. These agreements provide for the necessary financial commitments, the site, and management of the Project.

6. National Environmental Policy Act

- Air Products and Eastman continue to answer questions to support the PETC NEPA Review Team.
- A draft of the dimethyl ether (DME) write-up for the Environmental Information Volume (EIV) (new Section 9) was submitted for PETC review.
- A revised draft of the off-site test program for the EIV (Section 8) was submitted. Based on DOE's comments, Acurex Environmental Corporation will prepare the draft final section for inclusion in the updated EIV. This update is expected to be issued in mid-November of 1995.

E. Planned Activities

During the next quarter (October through December of 1995):

- The Continuation Application to Budget Period No. 2 will be submitted to DOE. Approval is expected by the end of November of 1994. This Budget Period transition will allow the initiation of detailed design and construction.
- Process specifications are expected to reach the 90+% completion level by the end of the next quarter.
- The reactor is expected to be purchased in November of 1994. The distillation columns and some major heat exchangers should also be purchased.
- The P&ID will be at a level allowing the Operational Review to be started in the subsequent quarter (January through March of 1995).
- A design engineering schedule will be issued.

F. Summary

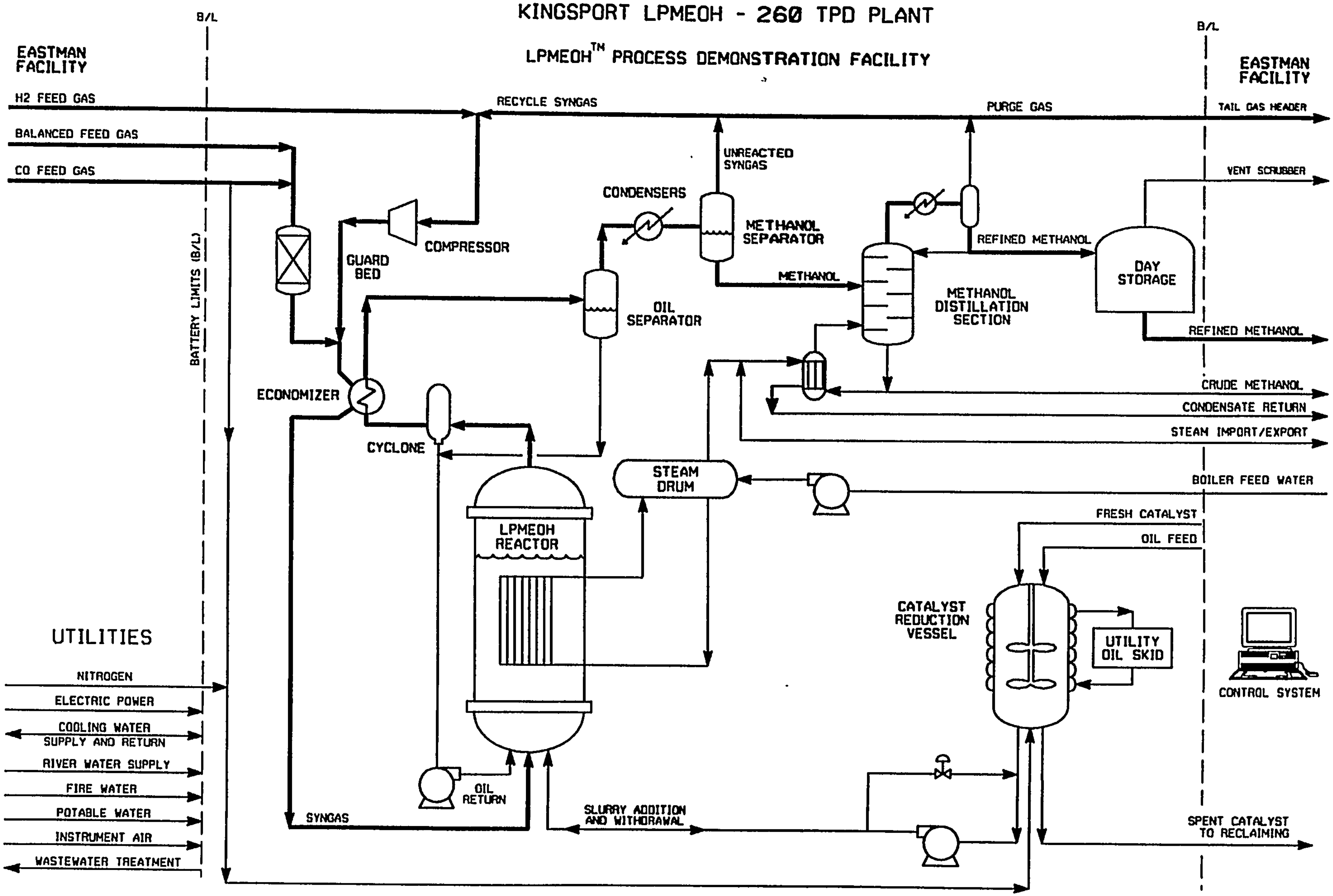
Project definition activities have been completed and the project design has started. Partnership arrangements between Air Products and Eastman are near final as is the draft Continuation Application.

Good progress is being made in the mechanical designs. The team is functioning well and is confident that the projected schedule can be met. The revised draft Environmental Information Volume is in preparation with no major roadblocks anticipated. All project related issues continue to be resolved. The project continues on track.

APPENDIX A SIMPLIFIED PROCESS DIAGRAM 1 Page

SIMPLIFIED PROCESS DIAGRAM
KINGSPORT LPMEOH - 260 TPD PLANT

LPMEOH™ PROCESS DEMONSTRATION FACILITY



APPENDIX B   PROJECT REVIEW MEETING 9/29/94   37 Pages

Air Products and Chemicals, Inc.
7201 Hamilton Boulevard
Allentown, PA 18195-1501

Telephone (610) 481-4911
Telex: 847416

AIR PRODUCTS

14 November 1994

Mr. Robert M. Kornosky
U.S. Department of Energy
Cochran Mill Road
Building 920
Pittsburgh, Pennsylvania 15236-0940

Subject: Cooperative Agreement DE-FC22-92P90548
Kingsport Liquid Phase Methanol Demonstration
29 September 1994 Project Review Meeting

Dear Bob:

Attached are the revised minutes from our meeting of 29 September in your offices. They are marked "FINAL". The attachments are unchanged.

Sincerely,

Frank S. Frenduto

Frank S. Frenduto
Project Engineer

cc: D. Brown
W. Brown
L. Daniels - EMN
D. Drown
E. Heydorn
W. Jones - EMN
R. Moore
E. Schaub
S. Unnasch - Acurex
R. Vannice - EMN

w/o Attachments

FSF\Let 13
11/14/94

KINGSPORT LPMEOH PROJECT
MEETING NOTES
SEPTEMBER 29, 1994 (FINAL)

These meeting notes highlight the discussion and action items from the 29 September meeting at PETC.

The attendance list and agenda are attached.

1. After introductions, D. Drown presented a brief overview of the Project Status (Attachment 1).

2. We then discussed the EIV 'open question list' (Attachment 2).

   Ques.#4 For competitive reasons, Eastman does not want to divulge the amount of methanol they presently haul into Kingsport. Ryan Vannice referred to published data in the Eastman 1993 "Health Safety and Environmental Performance Report", which is in the Appendix of the EIV. This data on page 4 shows that 5400 tons/day of coal alone are brought to the site. This places the 30 T/D incremental methanol required at approximately 0.5% of the coal traffic alone. The PETC team said they would try to work with the data they had and could do without additional methanol data.

   Ques.#6 PETC and Air Products agree that there does not appear to be any literature that would indicate that there is a problem with peroxide formation from DME alone. Rick Noceti made the point that there is uncertainty on how mixtures of DME/methanol and water stored under normal conditions (exposed to air at normal temperature and pressure) might act over time. He suggested some lab tests might be warranted. Air Products agrees and we will define a test program. Bob Kornosky suggested this be the subject for a topical report.

   Ques.#8 A few clarifying comments were made.

   Ques.#12 PETC had questions about the local noise ordinance and the nature of resident complaints. Ryan Vannice agreed to provide a copy of the ordinance and some details of the complaints.

   Ques.#13 PETC said they would like to have artist rendering of the LPMEOH plant at Kingsport by 1 December. Air Products agreed to have a 3-D CAD drawing of the facility in October followed by the artist rendering by 1 December.

3. Acurex was not able to attend the meeting. Rick Noceti reported that he had reviewed their revised document and that they had done a reasonable job in assessing the impacts given the nature of the reference material available. Air Products will ask Acurex to complete their analysis based on the examples they have provided.

4. Regarding the status of the EA.

   - The Letter of Determination for the LPMEOH project has not been written yet. Based upon advance review within PETC, it was agreed that this project would likely require an EA.

   - PETC is two weeks behind their original schedule.

   - PETC expects to have the first draft of the EA done in two weeks. They expect to issue a draft of the EA to Washington before the end of December 1994.

   - Even with this delay PETC expects that a FONSI will be signed-off by 7 April 1995.

   - Agreed that a redraft of the EIV is not required in the near future. PETC will continue to work on the EA with Air Products/Eastman providing answers to any questions as they come-up.

   - APCI and Eastman will be preparing the state air permit for the LPMEOH plant within the next month or two. A copy will be sent to PETC when it is submitted to the state.

5. The PETC team will review the material presented regarding DME addition to EIV (Attachment 3).

6. Other questions:

   - Mara Dean said that the Capital Cost information provided by Air Products was great but she was having trouble understanding the operating cost breakdowns (catalyst cost, fixed vs. variable costs, operating and maintenance labor). Bill Brown agreed that the material was confusing in some places and he would ask Bob Moore to provide clarification. (Information sent 30 September.)

   - Ryan Vannice provided the name and phone number of the state of Tennessee representative who is in contact with the National Park Service. PETC will follow through and contact the National Park Service for any input they might have.

   - Eastman/Air Products have no plans to do any soil testing of the site except what is required to design the equipment and building foundations. There is no indication from previous land use to show the need to perform soil contamination studies (refer to Chapter 5 of the EIV). PETC has some concerns about their potential liabilities without testing for pre-existing conditions. PETC will seek additional advice from L. Lorenzi and T. Russial on this matter.

7. Plans for Air Toxics Monitoring.

- Dave Drown went through a handout on this subject (Attachment 4).

- Regarding the Syngas sampling at Kingsport, Rich Hargis asked for our analytical techniques since our detection limits seemed an order of magnitude higher than what he believes wt. % numbers should be. (The concentration units are ppb by volume.)

- Rich Hargis also suggested for the offsite stationary testing that we analyze the boiler flue gas using Volatile Organics Sampling Train (VOST). He also suggested that we analyze the fuel methanol for metals.

Action Items

- Air Products to provide a stability testing plan for the atmospheric storage of DME/water/methanol. - F. Frenduto

- Eastman to provide local noise ordinance and details of residence complaints. - R. Vannice

- Air Products to provide 3-D CADD drawing of the facility by end of October and artist rendering by 1 December. - D. Drown

- Have Acurex complete off-site fuel test write-up. - F. Frenduto

- PETC to review DME write-up and provide comments. - K. Khonsari

- Air Products to provide clarification for operating costs. - B. Brown/ R. Moore (done - see letter R. Moore to M. Dean dated 30 September 1994.)

- Eastman to provide name and phone number of state of Tennessee contact. - R. Vannice (done - the Contact is John Walton, 615-532-0554)

- PETC to seek advice from L. Lorenzi and T. Russial regarding DOE's liability for pre-existing site conditions and the need for establishing an environmental baseline (done - see e-mail R. Kornosky to L. Lorenzi and T. Russial dated 30 September 1994 and T. Russial's e-mail reply dated 3 October 1994.)

- Air Products to provide analytical technique basis for Syngas analysis. - D. Drown

- What components should we look for in the offsite stationary testing VOST? - R. Hargis

ATTENDEE LIST

LIQUID PHASE METHANOL PROJECT REVIEW MEETING

29 SEPTEMBER 1994

Name	Company	Phone No.
Bob Kornosky	DOE/PETC	(412) 892-4521
R. P. Noceti	DOE/PETC	(412) 892-5955
Michael F. Zarochak	DOE/PETC	(412) 892-5960
Joseph B. Renk III	DOE/PETC	(412) 892-6249
Frank Frenduto	Air Products	(610) 481-7857
Mike Dahlberg	DOE/PETC	(412) 892-6248
Gary J. Stiegel	DOE/PETC	(412) 892-4499
Bill Brown	Air Products	(610) 481-7584
Ryan Vannice	Eastman	(615) 229-2885
Mara Dean	DOE/PETC	(412) 892-4520
Karen Khonsari	DOE/PETC	(412) 892-6106
Robert B. Webster	DOE/PETC	(412) 892-4475
David Drown	Air Products	(610) 481-6143
Rich Hargis	DOE/PETC	(412) 892-6065

LPMEOH DEMONSTRATION PROJECT
PROJECT REVIEW WITH PETC
29 SEPTEMBER 1994

	PRESENTER	TIME
A. Status of LPMEOH Project	W. Brown	8:30 AM
B. Review Status of EIV		8:45 AM
1. Open Items for APCI/EMN to Answer	F. Frenduto	
2. Acurex Offsite Demonstration Submittal	D. Lowell	
3. Status of EIV Review/EA Development @ PETC	K. Khonsari	
4. DME Addition to the EIV Document	F. Frenduto	
5. Questions	All	
C. Lunch		12:00 PM
D. Plans for Toxics Air Monitoring	D. Drown	1:00 PM
E. Status of Continuation Application	R. Kornosky	2:00 PM

Visiting Attendees:

Air Products	Eastman	Acurex
W. Brown	R. Vannice	D. Lowell
D. Drown		
F. Frenduto		

T020
9/21/94

LIQUID PHASE METHANOL DEMONSTRATION PROJECT
PROJECT STATUS

PROCESS

Syngas Sampling for Catalyst Poisons Nearly Complete

Process Specifications Issued for 11 Equipment Items

Working on Remaining 59 Equipment Specifications

DESIGN

Compressor Purchased

Reactor Bids Due 30 September 1994

Syngas Feed/Product Economizer Bids Due 14 October 1994

Distillation Columns & 2 Exchanger Mechanical Specifications Complete

Working on 3 Equipment Mechanical Specifications

Developing Equipment Bidders List

Started P&ID Development

Issued Control System Design Objectives

PROJECT

Updating EIV (Including DME Plans)

Issued Budget Period 2 Milestone Plan and Cost Plan

Completing Detail Project Design Schedule

Working on CADD Plan (Compatibility of APCI Files with EMN)

Setting Up Project Control Budget for Phase 1 & 2

S020
9/26/94

Update on Open Questions for 29 September 1994 Meeting at PETC

Ref. 1. "Issues/concerns identified at 18 August 1994 LPMNT meeting."

2. Letter F. Frenduto to K. Khonsari/M. Dean dated 9 September 1994.

Ques.# 4. Regarding methanol presently being purchased.

R. Vannice to give a verbal update at this meeting.

Ques.# 6. Regarding organic peroxide formation.

We are still looking for a good explicit technical reference. Attached is a DME Gas Data book from Matheson and a DME Technical Manual from Air Products, both of whom manufacture and store DME; there are no references to a peroxide problem.

Ques.# 8. Regarding the guard bed on the PFD.

The guard bed 29C-40 is now shown on Sheet 1 of the PFD. There was also a suggestion that the major process line be shown bold; this has also been done.

Attached are copies of the revised PFD.

Ques.# 12. Regarding noise levels.

As was mentioned in the EIV, the dominant contribution to noise levels from LPMEOH is the recycle syngas compressor. Noise levels due to the compressor are estimated below.

Distance from compressor, ft.	Noise level, dBA
100	67
250	61
500	57
1000	53

The nearest resident is 260 ft. from the plant site, which means the noise level would be roughly 60 dBA at the residence. Eastman is also making efforts to purchase the property in which case the nearest residence would be 1000 ft. from the plant site. The noise level at this distance from the compressor would be equivalent to background noise levels.

As far as existing noise levels, there is not enough noise data to establish a baseline noise level. The studies that have been done are "snapshots" of noise levels and may not be representative of the actual levels. In addition, only one of these studies has been done at site #16.

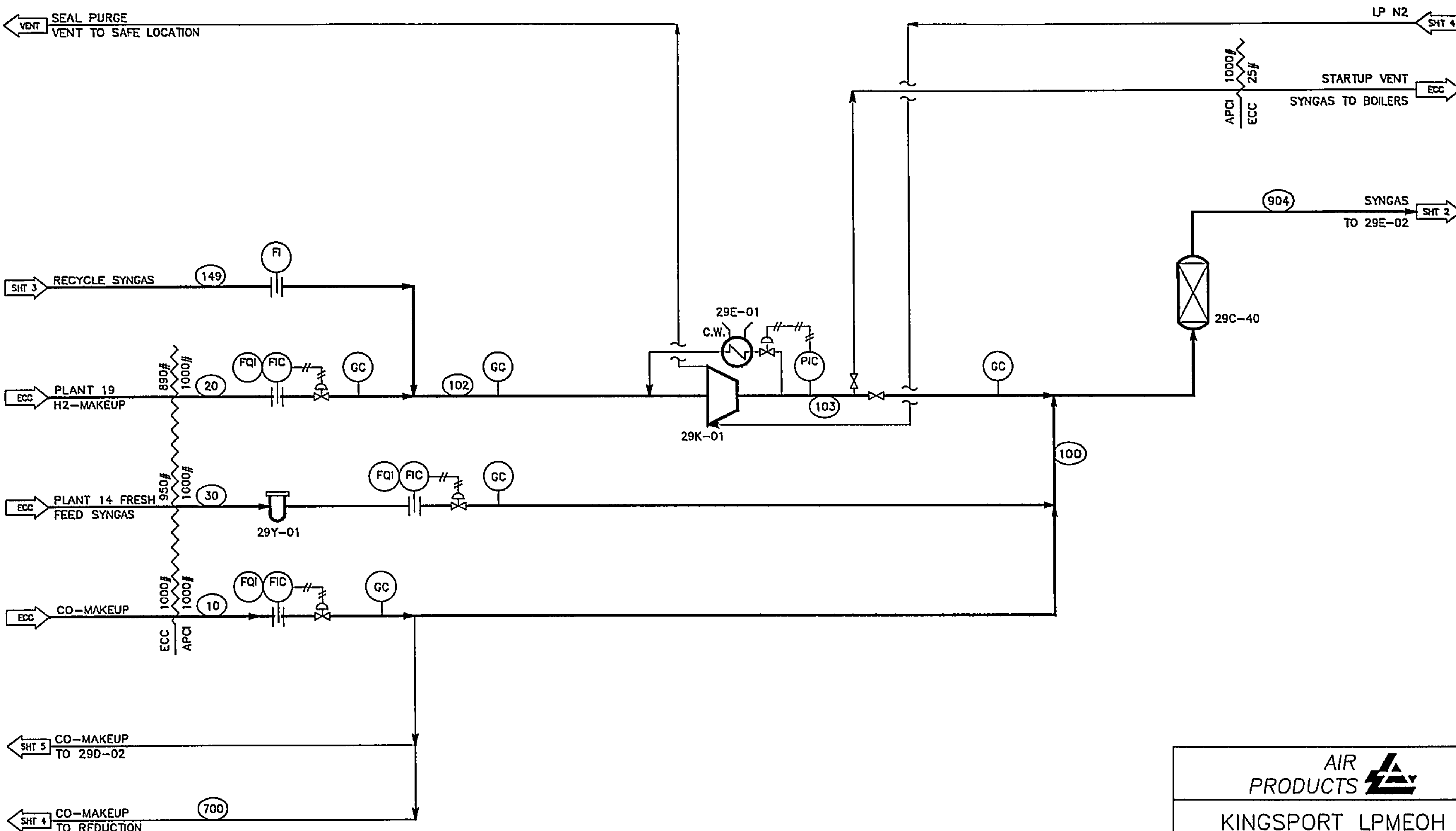
Ques.# 13. Regarding artist rendering.

We are still working on this. When do you need it?

III. Solids Table
Regarding Incinerator Ash

Some additional information to put this project into perspective.

For the years 1988 to 1993 (6 points), the average ash generated at TED was 4.9 MMlb/yr, but this number is variable. For instance, as of August of this year, this average has already been surpassed. The proposed action will add approximately 41,000 lb/yr (the amount of dry catalyst), so the total ash generated would still be 4.9 MMlb/yr.



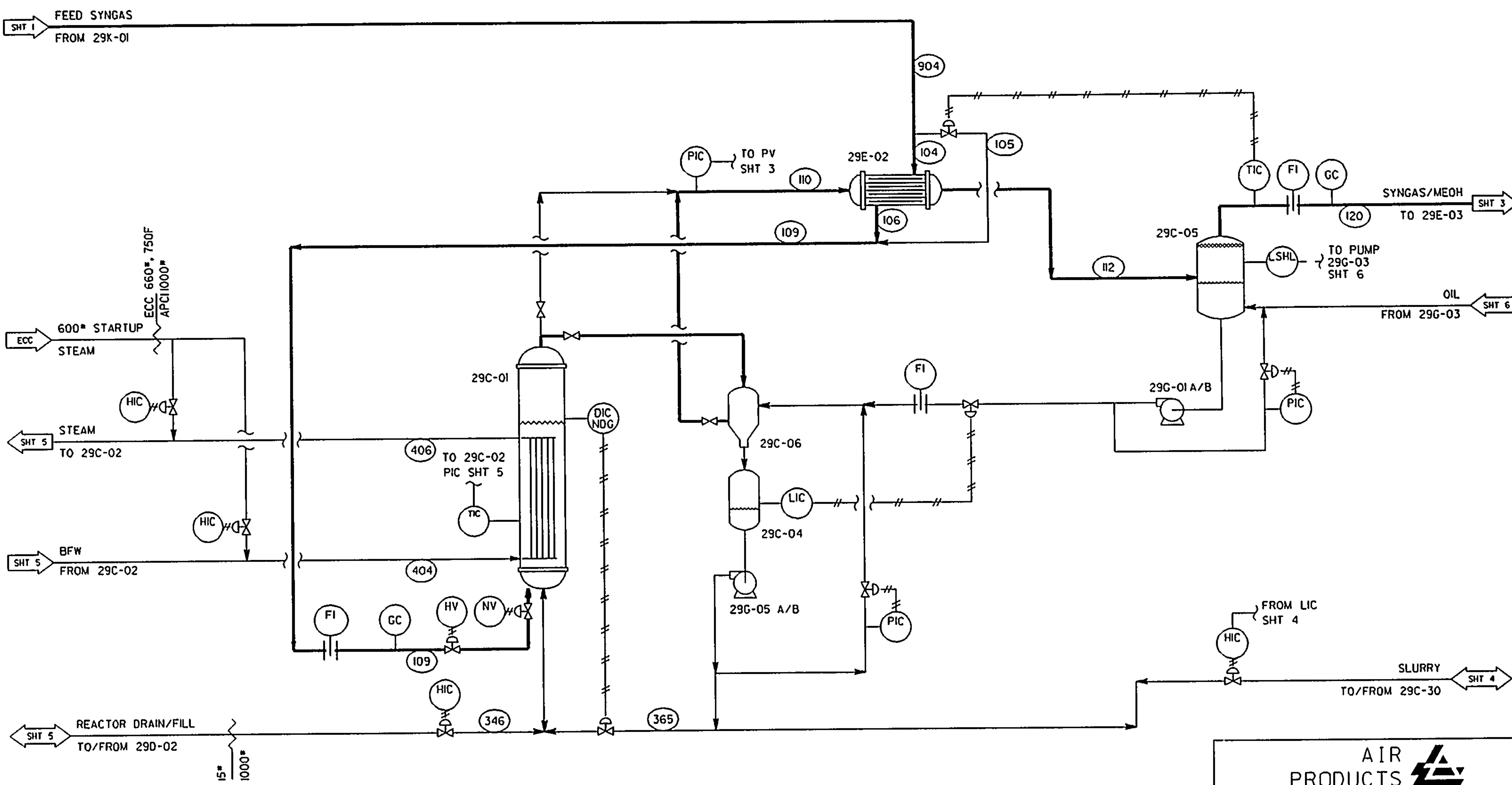
NOTE: LOCATION OF 29C-40 GUARD BED IS SUBJECT TO CHANGE PENDING FINAL RESULTS OF FEED STREAM ANALYSIS

9/27/94	JMR/CMC	VES	WRB	TEC	ADB	DPD	GAM	DPB	ECH	JLD
DWG DATE	PROCESS ENGINEER	PROCESS APPROVAL	BUSINESS AREA REPRESENTATIVE	SYSTEMS ENGINEER	PSG TECHNOLOGY	PROJECT ENGINEER	PROCESS CONTROLS	ENGINEERING SAFETY	PRODUCTION & DELIVERY	MACHINERY

AIR PRODUCTS

KINGSPORT LPMEOH FEED SECTION

DRG. NO.	LPM1	SHEET NO. 1
	00-3-8215	REV. NO. 0*

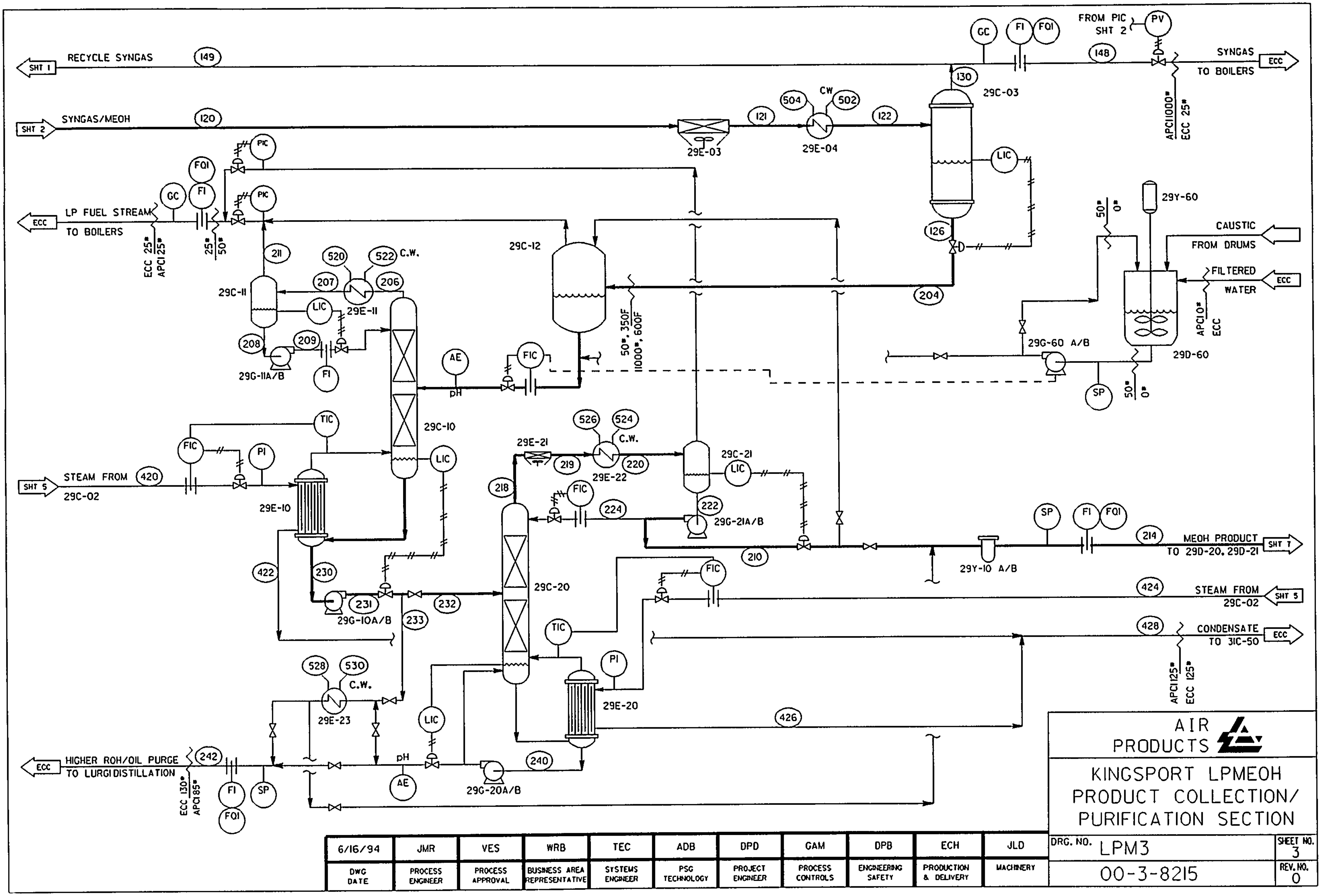


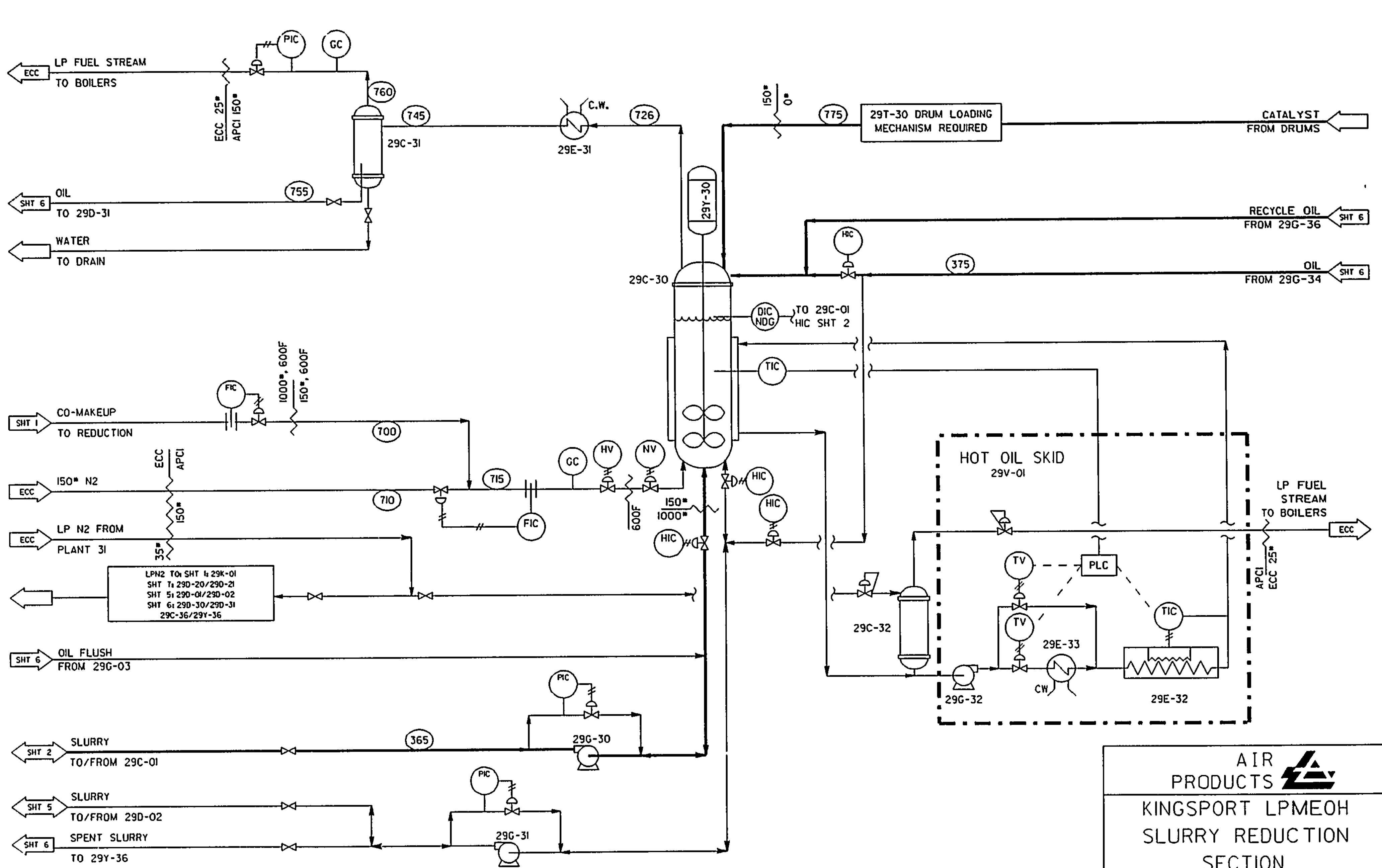
AIR PRODUCTS

KINGSPORT LPMEOH
SYNTHESIS SECTION

6/16/94	JMR	VES	WRB	TEC	ADB	DPD	GAM	DPB	ECH	JLD
DWG DATE	PROCESS ENGINEER	PROCESS APPROVAL	BUSINESS AREA REPRESENTATIVE	SYSTEMS ENGINEER	PSG TECHNOLOGY	PROJECT ENGINEER	PROCESS CONTROLS	ENGINEERING SAFETY	PRODUCTION & DELIVERY	MACHINERY

DRG. NO.	SHEET NO.
LPM2	2
00-3-8215	REV. NO. 0


RECYCLE SYNGAS
SHT 1
149
SYNGAS/MEOH
SHT 2
120
LP FUEL STREAM
TO BOILERS
ECC
ECC 25#
APCI 25#
25#
50#
GC
FI
FQI
PIC
PIC
211
29C-11
208
209
29G-11A/B
FI
LIC
207
520
522
C.W.
206
29E-11
29C-10
AE
pH
FIC
29C-12
50#, 350F
1000#, 600F
204
29E-03
121
504
CW
502
29E-04
122
29C-03
130
126
LIC
GC
FI
FQI
148
FROM PIC
SHT 2
PV
SYNGAS
TO BOILERS
ECC
APCI1000#
ECC 25#
29Y-60
CAUSTIC
FROM DRUMS
FILTERED
WATER
ECC
APCI0#
ECC
29D-60
29G-60 A/B
SP
50#
0#
TIC
FIC
PI
STEAM FROM
29C-02
SHT 5
420
29E-10
LIC
422
230
231
29G-10A/B
233
232
29E-21
219
526
524
C.W.
29E-22
220
218
29C-21
LIC
FIC
224
222
29G-21A/B
210
29C-20
SP
FI
FQI
214
MEOH PRODUCT
TO 29D-20, 29D-21
SHT 7
29Y-10 A/B
FIC
424
STEAM FROM
29C-02
SHT 5
TIC
PI
428
CONDENSATE
TO 31C-50
ECC
APCI125#
ECC 125#
29E-20
426
528
530
C.W.
29E-23
LIC
pH
AE
240
29G-20A/B
HIGHER ROH/OIL PURGE
TO LURGI DISTILLATION
ECC
242
ECC 130#
APCI85#
FI
FQI
SP
AIR PRODUCTS
KINGSPORT LPMEOH
PRODUCT COLLECTION/
PURIFICATION SECTION
DRG. NO. LPM3
SHEET NO. 3
00-3-8215
REV. NO. 0
6/16/94
DWG DATE
JMR
PROCESS ENGINEER
VES
PROCESS APPROVAL
WRB
BUSINESS AREA REPRESENTATIVE
TEC
SYSTEMS ENGINEER
ADB
PSG TECHNOLOGY
DPD
PROJECT ENGINEER
GAM
PROCESS CONTROLS
DPB
ENGINEERING SAFETY
ECH
PRODUCTION & DELIVERY
JLD
MACHINERY

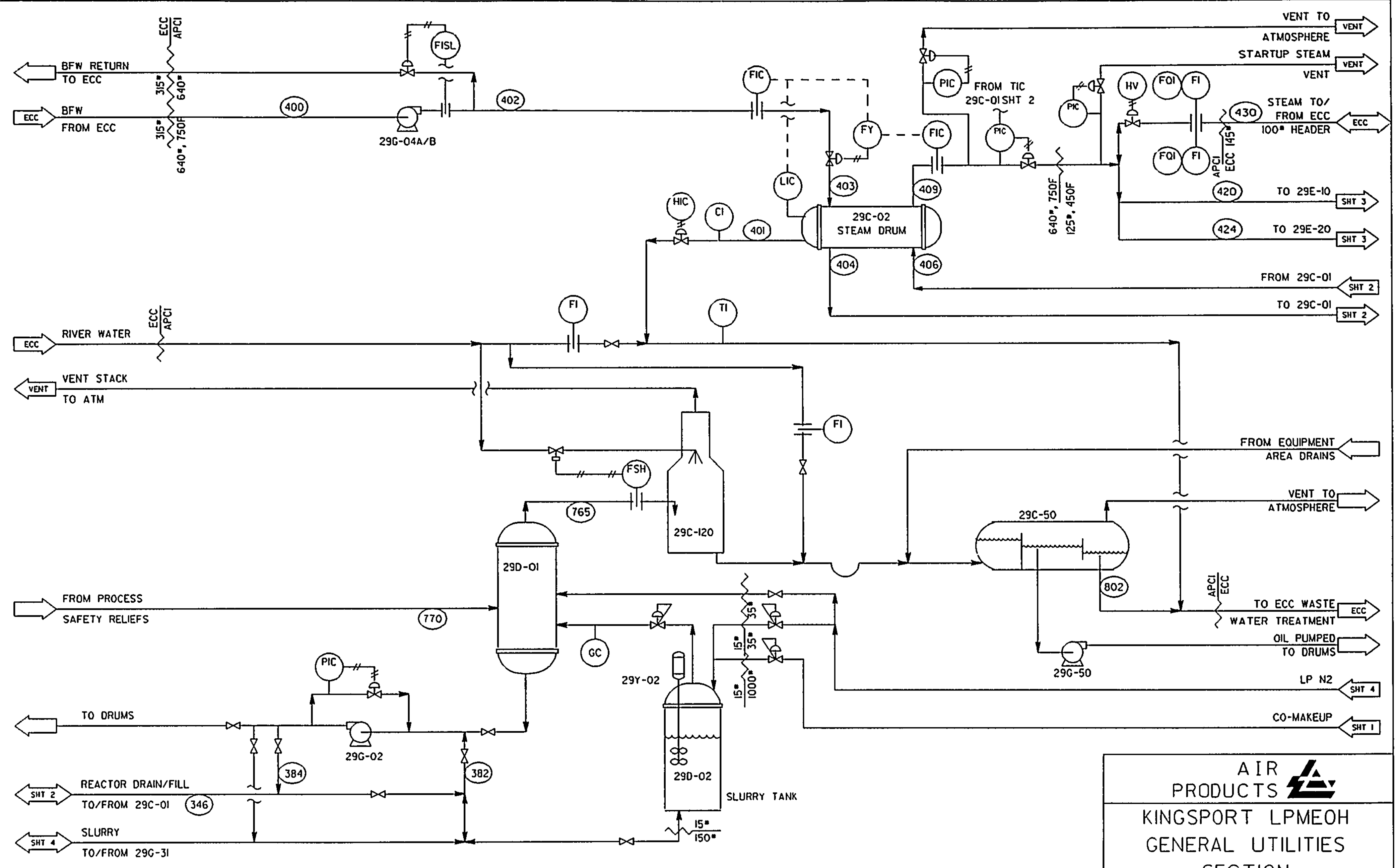


AIR PRODUCTS

KINGSPORT LPMEOH
SLURRY REDUCTION
SECTION

DRG. NO. LPM4 | SHEET NO. 4
00-3-8215 | REV. NO. 0

6/16/94	JMR	VES	WRB	TEC	ADB	DPD	GAM	DPB	ECH	JLD
DWG DATE	PROCESS ENGINEER	PROCESS APPROVAL	BUSINESS AREA REPRESENTATIVE	SYSTEMS ENGINEER	PSG TECHNOLOGY	PROJECT ENGINEER	PROCESS CONTROLS	ENGINEERING SAFETY	PRODUCTION & DELIVERY	MACHINERY



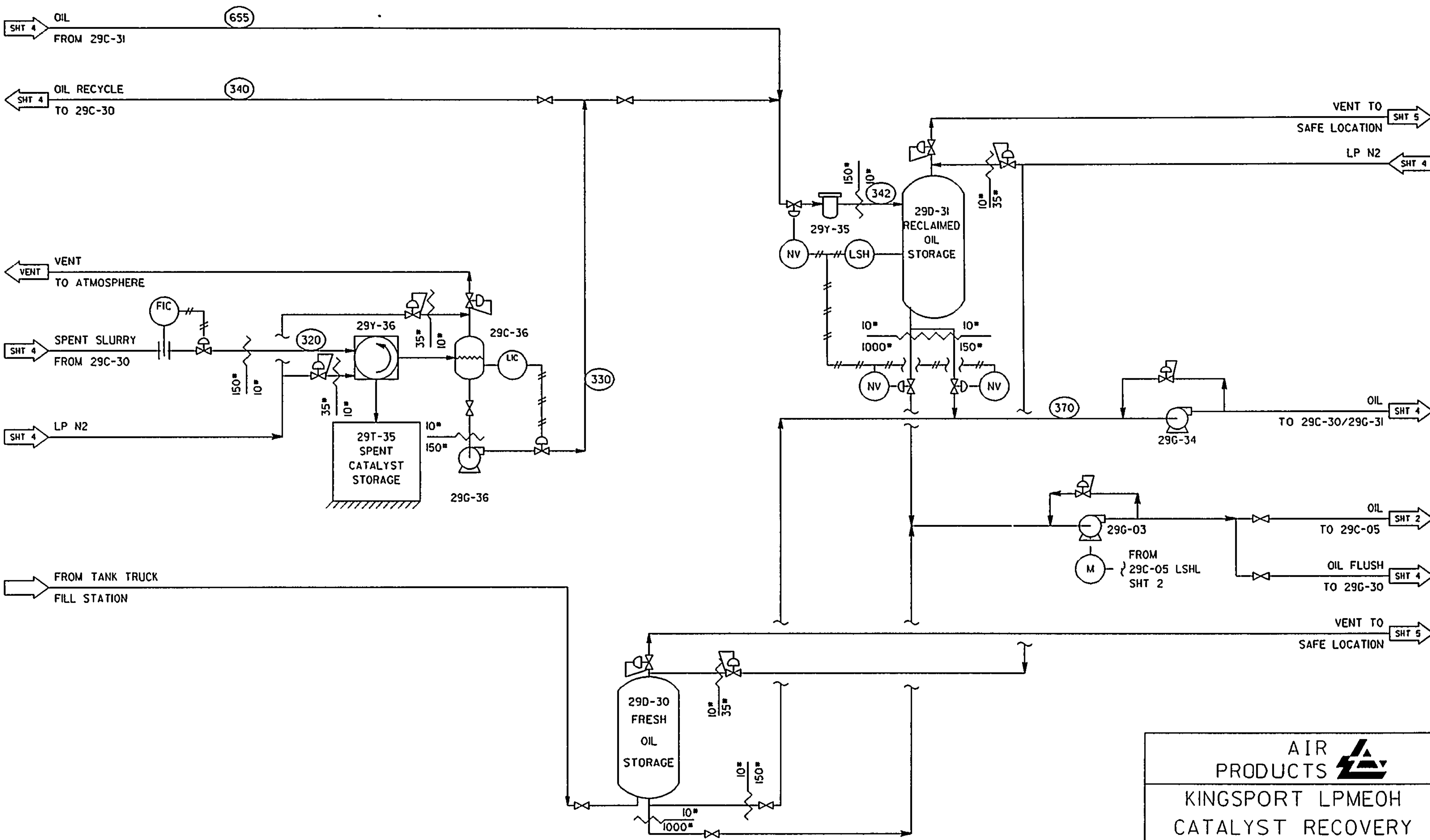
AIR PRODUCTS

KINGSPORT LPMEOH
GENERAL UTILITIES
SECTION

6/16/94	JMR	VES	WRB	TEC	ADB	DPD	GAM	DPB	ECH	JLD
DWG DATE	PROCESS ENGINEER	PROCESS APPROVAL	BUSINESS AREA REPRESENTATIVE	SYSTEMS ENGINEER	PSG TECHNOLOGY	PROJECT ENGINEER	PROCESS CONTROLS	ENGINEERING SAFETY	PRODUCTION & DELIVERY	MACHINERY

DRG. NO. LPM5 — SHEET NO. 5

00-3-8215 — REV. NO. 0

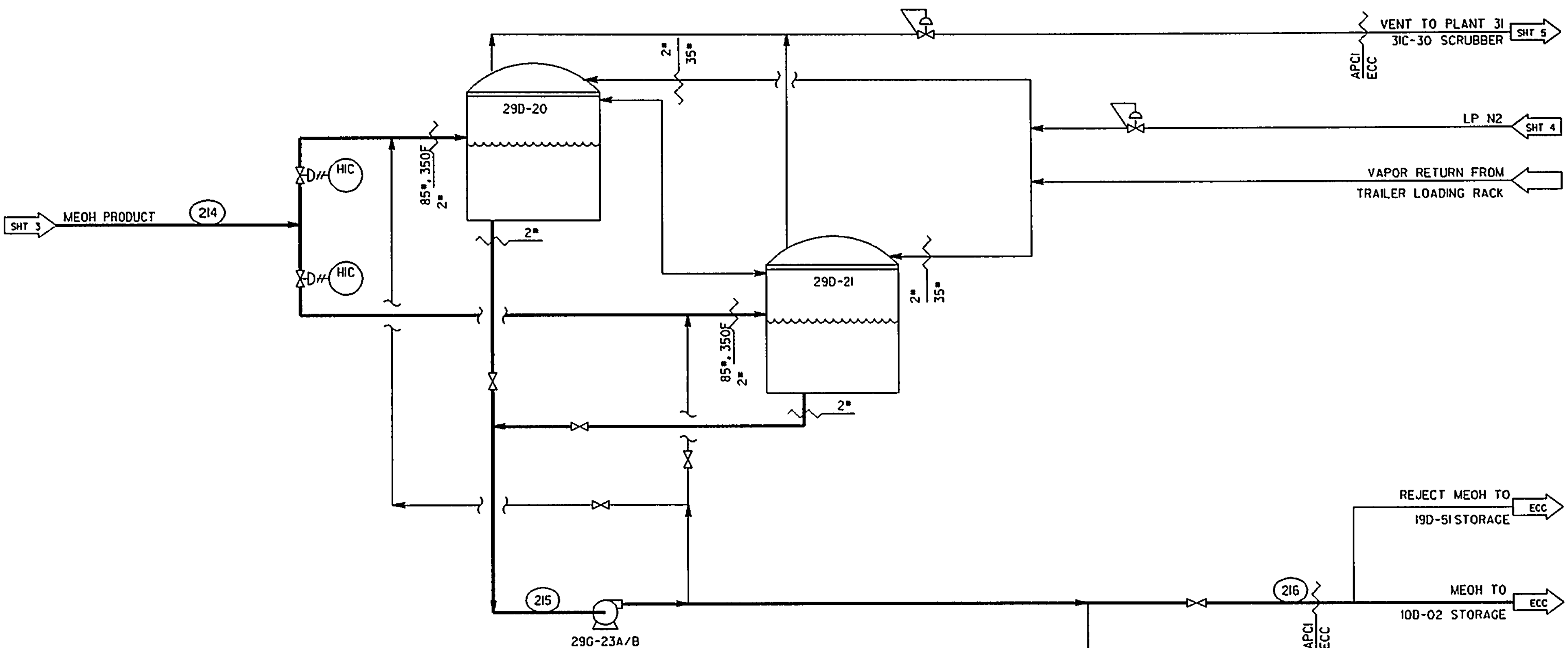


AIR PRODUCTS

KINGSPORT LPMEOH
CATALYST RECOVERY
SECTION

6/16/94	JMR	VES	WRB	TEC	ADB	DPD	GAM	DPB	ECH	JLD
DWG DATE	PROCESS ENGINEER	PROCESS APPROVAL	BUSINESS AREA REPRESENTATIVE	SYSTEMS ENGINEER	PSG TECHNOLOGY	PROJECT ENGINEER	PROCESS CONTROLS	ENGINEERING SAFETY	PRODUCTION & DELIVERY	MACHINERY

DRG. NO. LPM6	00-3-8215	SHEET NO. 6 / REV. NO. 0



AIR PRODUCTS

KINGSPORT LPMEOH
PRODUCT STORAGE
SECTION

6/16/94	JMR	VES	WRB	TEC	ADB	DPD	GAM	DPB	ECH	JLD
DWG DATE	PROCESS ENGINEER	PROCESS APPROVAL	BUSINESS AREA REPRESENTATIVE	SYSTEMS ENGINEER	PSG TECHNOLOGY	PROJECT ENGINEER	PROCESS CONTROLS	ENGINEERING SAFETY	PRODUCTION & DELIVERY	MACHINERY

DRG. NO. LPM7	SHEET NO. 7
00-3-8215	REV. NO. 0

9.0 PROVISIONAL PROCESS PLANT ADDITION FOR THE PRODUCTION OF DIMETHYL ETHER (DME)

9.1 BACKGROUND

A part of the stated technical objectives of the proposed LPMEOH™ demonstration is to install equipment in order to produce a dimethyl ether (DME) and methanol co-product. Although the final design for this equipment will not be done until Air Products has sufficient data on the reactor/catalyst system, and after market studies have been conducted, we have prepared a 'best guess' process design case for this EIV.

DME is a gas at ambient conditions with properties similar to propane. It is currently manufactured by the catalytic dehydration of methanol. The production of DME from synthesis gas is a natural extension of the LPMEOH™ process in that three reactions occur concurrently in a single liquid phase reactor; these reactions are methanol synthesis, methanol dehydration, and water-gas shift. This can significantly improve the overall conversion of coal derived synthesis gas to a storable blend of methanol and DME.

DME has several potential commercial uses. In a storable blend with methanol the mixture can be used as a peaking fuel in IGCC electric power generating facilities. A small amount of DME can also be used to increase the vapor pressure of methanol being used as a diesel engine fuel. The resulting higher volatility is expected to provide beneficial "cold-start" properties to the methanol fuel. Blends of methanol and DME can also be used as a chemical feedstock for the synthesis of chemicals or new, oxygenate fuel additives.

For this project Air Products proposes to demonstrate the slurry reactor's capability to produce DME as a mixed co-product with methanol in a commercial size reactor.

Design Verification Testing (DVT) is required to provide additional data for the engineering design and to understand the economics of DME production. The DVT plan will be coordinated with and utilize the resources of the DOE's Liquid Fuels Program as technology experts. The essential DVT steps required for project decision making regarding the methanol/DME enhancement are:

1. Confirm catalyst activity and stability in the lab. This step will be funded by DOE Alternative Fuels I contract. A DME program decision point will follow this work to be completed in July 1996.

2a. Develop Engineering data in the lab. This data will be needed to proceed with designs to developing process economics.

2b. Confirm markets and economics. This includes tests as a replacement for M100 in diesel engines and marketplace acceptance, IGCC energy storage economics, and chemical feedstock process economics.

The above activities will be funded by the CCT LPMEOH Process Demonstration Program.

Based on the technology status determined in Step 1 and the market and economic data from the above, a decision on the continuation of the DME Program will be made. This decision will be made by December 1996.

3. Run Proof of Concept tests in the LaPorte AFDU. This work will be done in late 1996 and in 1997; it will be funded by the CCT LPMEOH Process Demonstration Program. Following this work and assimulation of the data, a final decision will be made by March 1998 on whether we should proceed with implementing the Kingsport DME Demonstration.

The decisions shown above will be made jointly by the Partnership and the DOE. The go/no-go implementation decision must be made in time such that the necessary design, procurement, construction and commissioning of the additional equipment can be completed in time for (Phase 3, Task 2) operation at the end of the primary LPMEOH Process demonstration period.

9.2 PROCESS DESCRIPTION

The Simplified Process Flow Diagram, Fig. 9.2-1 shows the major equipment in the synthesis loop and product separation train. Fig. 9.2-2 shows the composition and flowrates for both the Design Methanol Production Case as well as the anticipated DME Case. For the DME Case selected, the reactor feed rate (Stream 1) is 93% of the Design Methanol Case; methanol in the Raw Methanol Stream (Stream 3) drops from 266 T/D to 198 T/D and a net 27 T/D of DME (Stream 2-Stream 1) is produced in the reactor.

By adding up to 5 wt% alumina (dehydration catalyst) to the methanol catalyst already in the reactor, we will produce an outlet stream which is approximately 0.4 DME/methanol on the molar basis. When this stream is cooled the liquid which condenses (Stream 3) contains 8.8# DME/91.2# methanol; or 8.8 wt% DME on a DME and methanol basis. This approximates the 8 wt% target that was set in the joint objectives.

Most of the unreacted synthesis gas, now containing most of the DME, will be recycled back to the reactor while a purge gas (Stream 4) containing approximately 7 T/D of DME will be sent to the boilers as fuel.

The reactor loop will be operated in a very similar manner as in the LPMEOH demonstration period. Additional equipment, probably an additional stripping column, will need to be added to the crude methanol purification; this equipment will be needed to separate the DME from the methanol product. Some modifications to the analytical equipment will be needed to record the Liquid Phase DME (LPDME) Process performance.

9.3 ENVIRONMENTAL IMPACTS

9.3.1 Air Pollution Emissions and Controls

9.3.1.1 Waste Gas Flows

Since we are burning the net DME product produced, the gas streams to the boilers have increased compared to the base methanol case from a total of 48 MMBTU/hr (HHV) to 66 MMBTU/hr. These streams are the sum of streams 4 and 6 shown in Fig. 9.2-2. These streams will be going to Boiler #30 or #31 which have design input heat duties of 780 MMBTU/hr and 880 MMBTU/hr, respectively. The net effect here will be to reduce coal firing compared to the base methanol case by an additional 21 MMBTU/hr (approximately 21 T/D of coal).

Total air emissions should decrease with the cleaner fuel.

9.3.1.2 Storage Tank Emissions

These are shown in Table 6.1-2 and remain unchanged for the DME Demonstration.

9.3.1.3 Equipment Leak Emissions

These emissions are calculated based on the number of valves, flanges, etc. in the process. These in turn are estimated based on the number of pieces process equipment. Our estimate for the DME case for these emissions is based on using ratio of the reactor feed compositions (Fig. 9.3-1). An MSDS for DME is found at the end of this section. DME is nontoxic.

The DME production case is expected to be run for up to six months at the very end of the four year demonstration period as a substitution for the base methanol operation (Phase 3, Task 2.1).

9.3.1.4 Fugitive Dust

The DME equipment construction will involve no major excavation work and no dust emissions are expected.

9.3.2 Operational Impacts

Storm water will remain unchanged from the base methanol case described in Paragraph 6.32.

The process stream described in Paragraph 6.3.2 as the under flow from Eastman's distillation will be further increased from the base methanol case. The increase adds an additional 0.4 gpm to the 0.8 gpm increase of the base methanol case and an additional 2100 lb/day of BOD compared to the 4180 lb/day increase in the base methanol case.

The oil waste stream will remain the same as described in Paragraph 6.4.2. The existing (prior to the LPMEOH Process Demonstration) liquid waste stream also referred to in Paragraph 6.4.2 will decrease compared to the base methanol case. Our estimate for this decrease is 84,000 lb/year. The DME case would produce 240,000 lb/yr of additional waste for energy recovery in the onsite boilers compared to 324,000 lb/yr additional waste for the base methanol case.

The solid waste streams generated will remain unchanged from those shown in Paragraph 6.4.2.

9.3.3 Ecology

Remains the same as described in Paragraph 6.5

9.3.4 Community Resources

Remains the same as described in Paragraph 6.6.

9.3.5 Energy Resources

Remains the same as described in Paragraph 6.7.

9.3.6 Bidiversity

Remains the same as described in Paragraph 6.8.

9.3.7 Pollution Prevention

Remains the same as described in Paragraph 6.9.

9.3.8 Other Impacts

During the DME Process Demonstration, Eastman will have to import additional methanol onto the site. In the base methanol case there was also an increase required, this was 30 T/D. For DME this will increase by 68 T/D bringing the total to 98 T/D.

9.3.9 Cumulative Impacts

Remains the same as described in Paragraph 6.10.

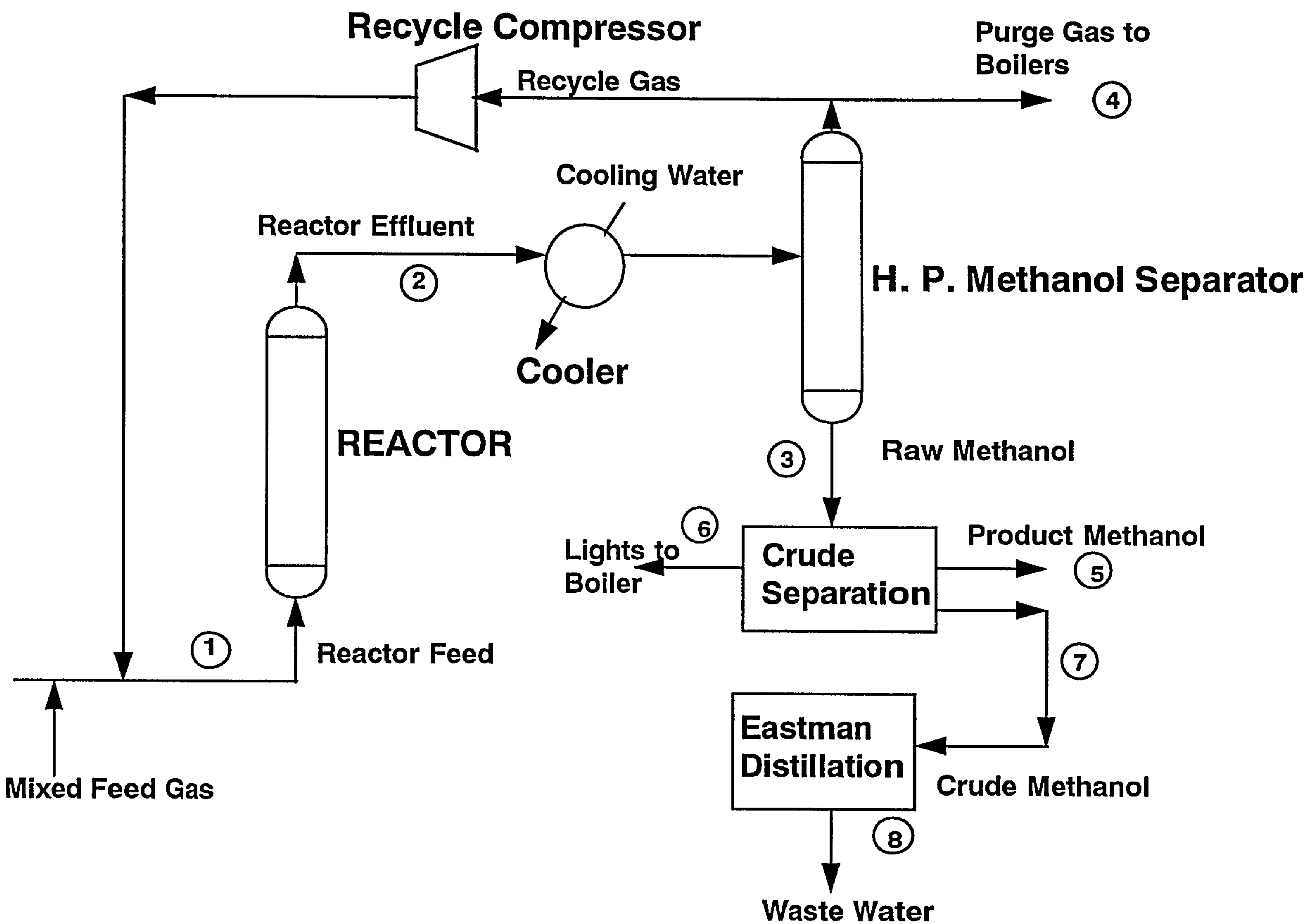


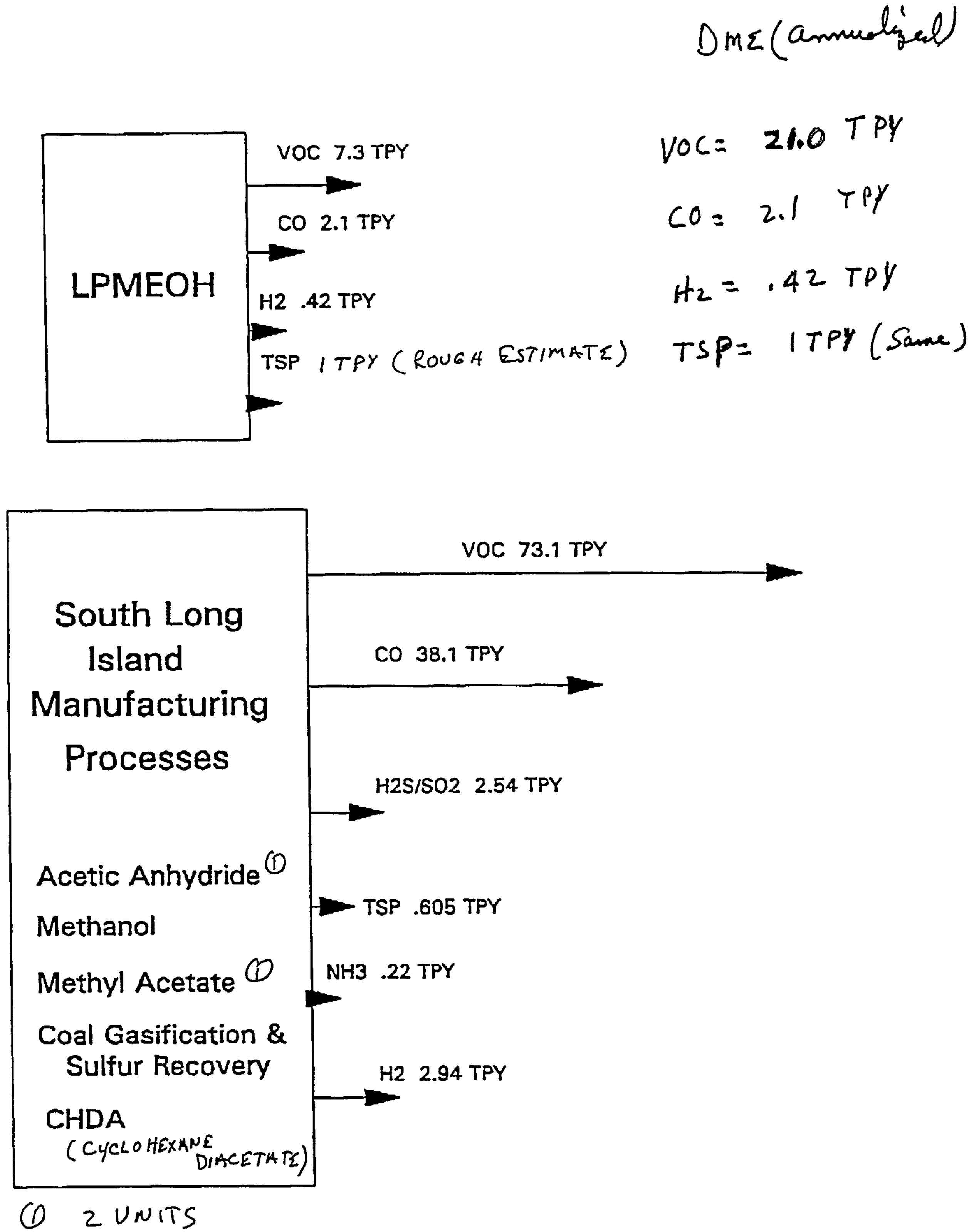
Fig. 9.2-1 Simplified Flow Diagram

Comparison of DME Case With Design Methanol Case

Stream Number	1	1	2	2	3	3	4	4
Stream	Reactor Feed	Reactor Feed	Reactor Effluent	Reactor Effluent	Raw Methanol	Raw Methanol	Purge Gas to Boilers	Purge Gas to Boilers
Case	**DME**	**MEOH**	**DME**	**MEOH**	**DME**	**MEOH**	**DME**	**MEOH**
(volume %)								
H2 %	61	60	52	50	0	0	59	58
CO %	19	25	12	20	0	0	14	22
CO2%	12	9	15	11	4	4	16	13
DME %	2	0	4	0	6	0	3	0
MEOH %	0	1	10	13	83	92	0	1
Water %	0	0	1	<1	7	3	0	<1
Moles/Hr	6729	7235	5494	5829	625	753	383	438
DME T/D	80		107		20	0	7	0
MEOH T/D					198	266	1	2
MMBTU(HHV)/Hr							42	45
Stream Number	5	5	6	6	7	7	8	8
Stream	Product Methanol	Product Methanol	Lights to Boiler	Lights to Boiler	Crude Methanol	Crude Methanol	Waste Water	Waste Water
Case	**DME**	**MEOH**	**DME**	**MEOH**	**DME**	**MEOH**	**DME**	**MEOH**
(volume %)								
H2 %	0	0	3	8	0	0		
CO %	0	0	3	7	0	0		
CO2%	0	0	34	63	0	0		
DME %	0	0	56	0	0	0		
MEOH %	99.9	99.9	2	12	73	89		
Water %	0	0	0	0	27	11		
MeAc %	0	0	<1	1	0	0		
MeFormate %	0	0	2	4	0	0		
Moles/hr	388	520	66	42	171	190		
DME T/D	0	0	20	0	0	0		
MEOH T/D	149	200	0	0	48	65		
MMBTU(HHV)/Hr			24	3				

FIG. 9.2-2

9/23/94 FSF



Equipment Leak and Other Fugitive Emissions Manufacturing Processes - South Long Island

FIG 9.3-1

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
P.O. BOX 1436, SCHENECTADY, NY 12301 USA
(518) 385-2577

NO 342

DIMETHYL ETHER
Revision B

DATE April 1983

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: - DIMETHYL ETHER
DESCRIPTION: Supplied in cylinder as liquefied gas under its own vapor pressure (62.3 psig at 20 C)
OTHER DESIGNATIONS: DME, Methyl ether, Methyl oxide, Wood ether, Methoxymethane, $(CH_3)_2O$, CAS # 000 115 106
MANUFACTURER: Available from several suppliers.

SECTION II. INGREDIENTS AND HAZARDS

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Dimethyl Ether -- (Impurities can include methanol and methyl formate) CH_3-O-CH_3	>99.0	No TLV Established Mouse, Inhalation LC_{50} 386 ppm/15M

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg C ---	-24.8	Specific gravity liquid (20/4 C)	0.66
Vapor pressure, 20 C, mm Hg ---	3.982	Freezing point, deg C ----------	-141.5
Vapor density (Air=1) ---------	1.56	Evap. rate (Butyl Ether=1) ----	209
Water solubility, 18 C, wt. % -	7	Molecular weight --------------	46.07

Appearance & Odor: Colorless gas or liquid (pressurized) with a slight etheral odor. (Odor warning not adequate)

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
-42F (-41C) TCC	662F (350C)	% by Volume	3.45	26.7

Dimethyl ether is an extremely flammable gas, a dangerous fire and explosion hazard. Use water spray from a safe distance to cool fire-exposed cylinders and surroundings. If feasible, remove cylinders from fire area. If gas is burning, control but do not extinguish flame until gas flow is controlled. Use abundant water spray to disperse vapors and to protect those working to shut off gas.
Gas can flow to distant ignition source and flash back.
Firefighters should use protective clothing and self-contained respirators.

SECTION V. REACTIVITY DATA

Dimethyl ether is stable in pressurized cylinders at room temperature. It does not polymerize. It readily forms complexes with inorganic materials.
It is incompatible with oxidizing agents. Peroxides can form when in contact with oxygen at room temperature in sunlight or for long periods.
Keep away from heat and ignition sources and hot surfaces.
Thermal-oxidative decomposition products can include carbon monoxide and formaldehyde.

NO. 342

SECTION VI. HEALTH HAZARD INFORMATION

TLV None Established

Methyl ether can enter the body by inhalation and by skin absorption. Its principal physiological effect is acute narcosis. Inhalation at about 7.5% in air causes mild intoxication in about 12 minutes. Longer exposures and higher levels produce incoordination, blurring of vision, headache, dizziness and unconsciousness; 20% produces unconsciousness in 17 minutes. In heavy exposures death can occur by respiratory failure. Vapors can be irritating to the eyes and mucous membranes. Contact with liquid can cause frostbite.

FIRST AID:

Eye contact: Flush well with running water, including under eyelids.

Skin contact: Remove from contact. Warm affected areas with tepid water about (42 C or 108 F). Do not apply direct heat. Treat area as a burn.

Inhalation: Remove to fresh air. Restore and/or support breathing as needed. Have trained person administer oxygen if breathing is difficult.

After first aid, seek medical help for further treatment, observation and support.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Institute predetermined plan. Notify safety personnel. Remove sources of ignition. Provide optimum explosion-proof exhaust ventilation; allow to evaporate. Isolate area until vapors dispersed. Personnel need protection against inhalation of vapors or contact with the liquid. Use cold water spray to dissolve and flush liquid (not to sewer or enclosed area), to disperse vapors and to protect men attempting to stop leak. Detect small gas leaks by bubble formation using a soap solution.

DISPOSAL: Remove leaking containers to exhaust hood or isolated outdoor area and allow gas to discharge at a moderate rate. Tag defective cylinder, close valve and return to supplier.

Follow Federal, State, and Local regulations.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide explosion-proof general and local exhaust ventilation (floor level and sumps included) to keep at as low a level as feasible in workplace.* Control enclosed area concentrations at <25% of LEL. (Consider use of gas level monitors.) Self-contained breathing apparatus should be available for non-routine and emergency use.

Workers should use approved gloves and other body protection as conditions require to prevent skin contact. Prevent eye contact by wearing chemical safety goggles and/or full faceshield. Safety shoes and safety glasses are recommended when handling cylinders of compressed gas.

Eyewash station and washing facilities should be accessible to areas of use and handling.

*Use of ventilated hood recommended. Use care to avoid mixing with noncompatible gas (oxidizing or corrosive)

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers (cylinders, tanks) in a cool, dry, well-ventilated, low fire-risk area away from oxidizing agents, combustibles, and sources of heat and ignition. Ground equipment to avoid static sparks. Protect containers from physical damage. Outside or detached storage preferred.

Purge air from systems with nitrogen (do not use CO_2) and test for leaks before transferring dimethyl ether. Handle gas cylinders properly. Avoid breathing gas. Prevent skin and eye contact. No smoking where this gas is stored or used.

DOT Classification: FLAMMABLE GAS I.D. NO. UN1033 Label: FLAMMABLE GAS

DATA SOURCE(S) CODE: 4-11,14,17,37,45

APPROVALS: MIS/CRD J. M. Nixon

INDUST. HYGIENE/SAFETY 4-6-83

MEDICAL REVIEW: 12 April 1983

LIQUID PHASE METHANOL DEMONSTRATION PROJECT

AIR TOXICS MONITORING

Definition of Air Toxics:

Table 1: Specific Air Toxics to be Monitored, Letter from R. Kornosky to W. Brown, dated 27 March 1992, on Environmental Monitoring Plan.

The LPMEOH plant is not a combustion process. The plant does have some waste streams which will be combusted.

Air Toxics Not Entering LPMEOH™ Plant

- Eastman's syngas cleanup section and reactor guard bed remove metals and inorganics below detectable levels. See attached Table 2.
- APCI will install reactor guard bed (activated carbon) on one or three of the gas streams to the reactor to protect the reactor catalyst from possible upstream process upsets.

LIQUID PHASE METHANOL DEMONSTRATION PROJECT

REGULATED WASTE STREAMS

	Waste Stream	Discharge To	Regulation
AIR			
	Distillation Purge Gas	Boiler 30 or 31	NSPS
	Reactor Purge Gas	Boiler 30 or 31	NSPS
	Product Storage Vent	Plant 31 Scrubber	NSPS & TN Dept. of Envir. & Conserv.
	Fugitive Emissions	---	NSPS & TN Dept. of Envir. & Conserv.
	Tank Truck Transfers	Storage Tanks	HON
WATER			
	Process Waste Water	EMN Wastewater Treatment Plant	NPDES
	Storm Water Runoff	EMN Wastewater Treatment Plant	NPDES
	Cooling Water Blowdown	EMN Outfall	NPDES
	Boiler Feed Water Blowdown	EMN Wastewater Treatment Plant	NPDES
SOLID & LIQUID			
	Waste Oils	Boilers 23, 24 or 30	RCRA
	Spent Catalyst	EMN Incinerator & Hazardous Waste Landfill	RCRA
	Spent Catalyst Guard Bed Absorbent	EMN Incinerator	RCRA
	Construction Debris	Non-hazardous Waste Landfill	State of TN

HON - Hazardous Organic NESHAPS
NPDES - National Pollutant Discharge Elimination System
NSPS - New Source Performance Standards in EPA Regulation 40 CFR Part 60
RCRA - Resource and Conservation Recovery Act

S021
9/26/94

LIQUID PHASE METHANOL DEMONSTRATION PROJECT

MAJOR AIR & SOLID WASTE STREAMS FROM LPMEOH™ PROCESS

- Purge gas streams from the LPMEOH™ plant will be combined with other purge streams from other Eastman processes and burned in a coal fired boiler.

- Spent catalyst has two options for disposal:

  a. Send to metals reclaimer.
  b. Incinerate along with other materials in Eastman's onsite incinerator. The ash would be sent to an onsite landfill.

- Disposal of the guard bed activated carbon has two options:

  a. Investigate possible recycle with manufacturer.
  b. Incinerate or landfill.

LIQUID PHASE METHANOL DEMONSTRATION PROJECT

OFFSITE DEMONSTRATIONS

Emissions Monitoring

Demonstration	Where	What
Bus Test	Engine Exhaust*	NO_X, HC, CO, MeOH, Formaldehyde, Particulates
√an Tests	Engine Exhaust*	NO_X, HC, CO, MeOH, Formaldehyde
Stationary Tests (Boilers, Generators, etc.)	Flue Stack	NO_X, HC, CO, SO_X, MeOH, Formaldehyde

* Tests on chassis dynamonitor.

S017
9/26/94

LIQUID PHASE METHANOL DEMONSTRATION PROJECT

AIR TOXICS DATA TO BE COLLECTED

1. Catalyst Poisons Data (Nearly Complete)*

2. Fugitive Emissions

3. Offsite Demonstrations Emissions*

4. Solid and Liquid Waste Streams to EMN Incinerators will be Periodically Analyzed for As, Be, Cd, Cr, Sb, Ba, Pb, Hg, Ag, Tl, ash, Cl_2, & Heating Value

5. Landfill Materials will be Subject to Toxicity Characteristic Leachate Procedure (TCLP)

*Supplemental Monitoring

S018
9/26/94

LIQUID PHASE METHANOL DEMONSTRATION PROJECT

ENVIRONMENTAL MONITORING PLAN

Air Products, Eastman, and Acurex will create an Environmental Monitoring Plan (EMP) during phase 2 to identify what streams and pollutants will be monitored during the project. This document will address both compliance and supplemental monitoring.

S019
9/26/94

TABLE 2
LIQUID PHASE METHANOL DEMONSTRATION PROJECT
SYNGAS SAMPLING AT KINGSPORT

Air Toxic	Syngas Sampling Prelim. Results	Notes
Antimony	<25 ppb	bdl*
Arsenic	27 ppb AsH_3	EMN will modify existing reactor guard bed to reduce AsH_3 level in syngas**
Barium	---	***
Beryllium	<25 ppb	bdl
Cadmium	--- +	
Chromium	<25 ppb	bdl
Cobalt	---	***
Lead	--- +	
Manganese	--- +	
Mercury	<25 ppb	bdl
Nickel	<2 ppb $Ni(CO)_4$	
Selenium	<150 ppb	bdl, ***
Vanadium	--- +	
Cl_2/HCl		***
Cyanide Compounds	<1 ppm	bdl
F_2/HF	---	***
Phosphorus/Phosphates	--- +	
Radionuclides	--- +	
Sulfur	Nominal 30 ppb H_2S	Downstream of EMN guard bed

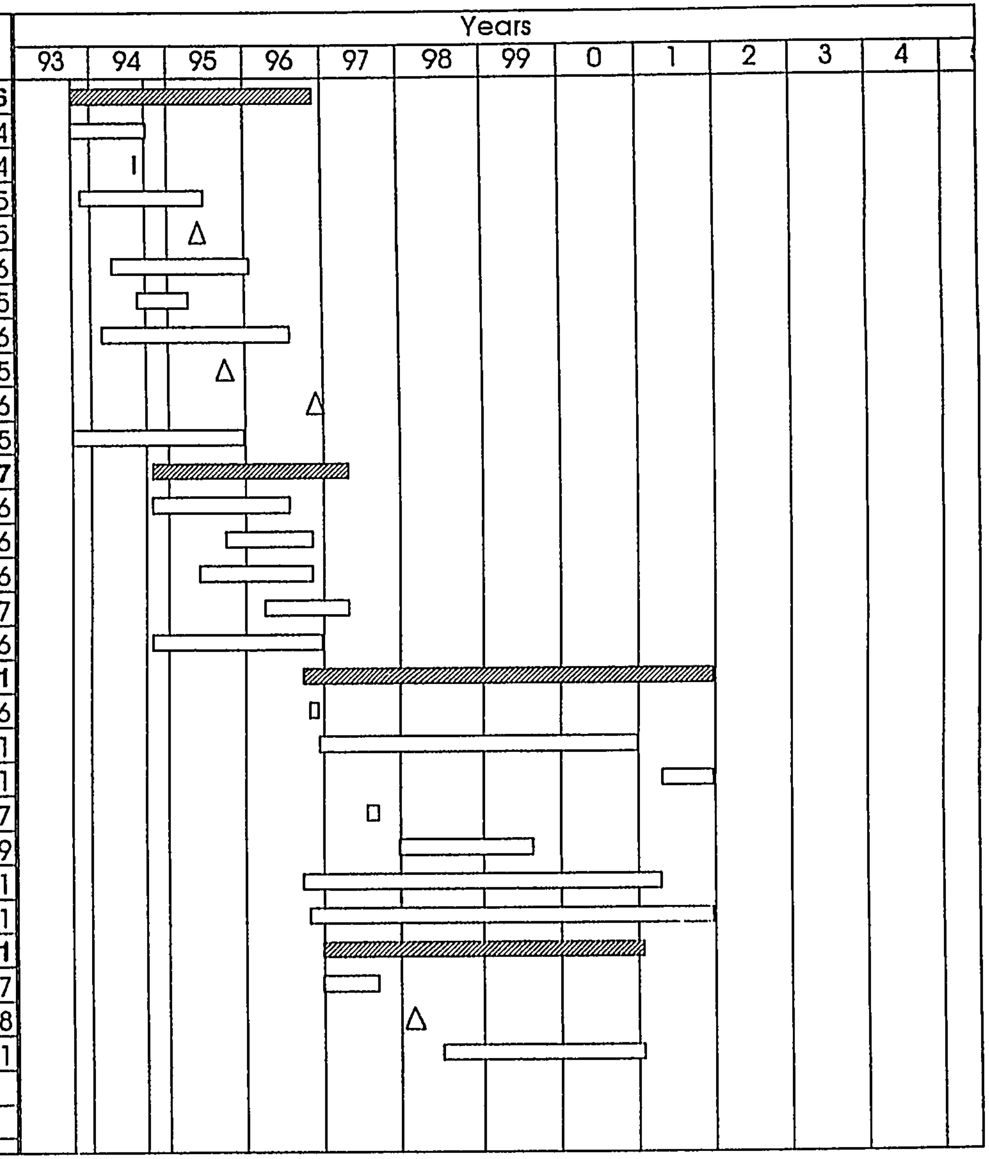
* bdl - below detection limit
** not part of LPMEOH project
*** no additional amount detected on EMN spent vs. fresh methanol catalyst
\+ no analysis

T021
9/23/94

APPENDIX C MILESTONE SCHEDULE 9/16/94 1Page

MILESTONE SCHEDULE STATUS REPORT
LIQUID PHASE METHANOL DEMONSTRATION
DE-FC22-92PC90543

Task Name	Duration	Start	End
PHASE 1: DESIGN	**38.17 m**	**Oct/01/93**	**Dec/01/96**
PROJECT DEFINITION(TASK1)	12.04 m	Oct/01/93	Sep/30/94
CONTINUATION APPLICATION	9.00 d	Aug/02/94	Aug/10/94
PERMITTING(TASK 2)	19.50 m	Nov/17/93	Jun/30/95
NEPA FONSI APPROVAL	0.00 d	May/31/95	May/31/95
DESIGN ENGINEERING(TASK 3)	21.64 m	Apr/15/94	Jan/30/96
VENDOR ENGINEERING	8.21 m	Aug/10/94	Apr/15/95
OFF-SITE TESTING(TASK 4)	29.56 m	Feb/25/94	Aug/08/96
UPDATED FUEL TEST PLAN APPROVAL	0.00 d	Oct/01/95	Oct/01/95
DECISION TO CONTINUE DME TESTING	0.00 d	Dec/01/96	Dec/01/96
PLANNING, ADMIN & DME DVT(TASK	27.05 m	Oct/01/93	Dec/29/95
PHASE 2: CONSTRUCTION	**30.75 m**	**Oct/17/94**	**May/05/97**
PROCUREMENT(TASK1)	21.61 m	Oct/17/94	Aug/01/96
TRAINING & COMMISSIONING(TASK 3)	13.53 m	Oct/03/95	Nov/15/96
CONSTRUCTION(TASK2)	17.65 m	May/31/95	Nov/15/96
OFF-SITE TESTING(TASK 4)	13.20 m	Apr/01/96	May/05/97
PLANNING & ADMINISTRATION(TASK 5)	26.62 m	Oct/17/94	Dec/31/96
PHASE 3: OPERATION	**63.18 m**	**Oct/01/96**	**Dec/28/01**
START-UP(TASK 1)	1.45 m	Oct/31/96	Dec/13/96
METHANOL OPERATION(TASK 2.1)	48.86 m	Dec/16/96	Jan/04/01
DISMANTLE PLANT(TASK 2.3)	7.98 m	May/01/01	Dec/28/01
ON-SITE PRODUCT USE DEMO(TASK 3)	2.08 m	Aug/01/97	Oct/02/97
OFF-SITE PRODUCT USE DEMO(TASK 4)	20.00 m	Jan/02/98	Aug/31/99
DATA ANALYSIS/REPORTS(TASK 5)	55.09 m	Oct/01/96	Apr/27/01
PLANNING & ADMINISTRATIVE(TASK 6)	62.19 m	Oct/31/96	Dec/28/01
PROVISIONAL DME IMPLEMENTATION	**49.25 m**	**Jan/02/97**	**Feb/02/01**
DME DVT(PDU TESTS)(TASK 3.6)	8.97 m	Jan/02/97	Sep/30/97
DECISION TO IMPLEMENT	0.00 d	Mar/01/98	Mar/01/98
DESIGN, MODIFY & OPERATE(TASK 3.2.2)	31.27 m	Jul/01/98	Feb/02/01



Milestone Δ Summary

Printed: Sep/16/94

APPENDIX D COST MANAGEMENT REPORT 8/94 1Page

DOE F 1332.9
(11-84)

U.S. DEPARTMENT OF ENERGY
COST MANAGEMENT REPORT

FORM APPROVED
OMB 1910-1400

1. TITLE Liquid Phase Methanol Demonstration	2. REPORTING PERIOD August 01, 1994 through August 31, 1994	3. IDENTIFICATION NUMBER DE-FC22-92PC90543
2. PARTICIPANT NAME AND ADDRESS Air Products and Chemicals, Inc. 7201 Hamilton Boulevard Allentown, PA 18195-4911	5. COST PLAN DATE February 23, 1994	6. START DATE January 1, 1990 7. COMPLETION DATE December 30, 2001

8. ELEMENT	9. REPORTING ELEMENT	10. ACCRUED COSTS Reporting Period a. Actual **	10. Reporting Period b. Plan	10. Cumulative to Date c. Actual	10. Cumulative to Date d. Plan	11. ESTIMATED ACCRUED COSTS a. Subsequent Reporting Period	11. b. Balance of Fiscal Year	11. c. (1)	11. c. (2)	11. c. (3)	11. d. Fiscal Years to Completion	11. e. Total	12. Total Contract Value	13. Variance
	Prior to Mod 2			15,906	15,906							15,906	15,906	0
1.1.1	Project Definition	141	65	853	1,763	43	0	910				1,806	1,806	0
1.1.2	Permitting	77	20	143	254	20	0	160	0			323	323	0
1.1.3	Design Engr.	91	326	123	711	344	0	7,548	1,769			9,784	9,784	0
1.1.4	Off-site Testing	0	0	0	0	0	0	0	0			0	0	0
1.1.5	Planning, Admin, & DME Verif. Testing	246	37	421	393	35	0	440	158			1,054	1,054	0
1.2.1	Procurement	1	370	1	670	420	0	8,857	5,800			15,078	15,078	0
1.2.2	Construction	0	0	0	0	0	0	4,909	9,819			14,728	14,728	0
1.2.3	Proj. Mgmt.	0	10	0	20	20	0	318	297			635	635	0
1.3.1	Startup	0	0	0	0	0	0		922	264		1,186	1,186	0
1.3.2	Operations	0	0	0	0	0	0		5,110	36,309	100,790	142,209	142,209	0
1.3.3	On-Site Demo.	0	0	0	0	0	0			98		98	98	0
1.3.4	Off-Site Demo.	0	0	0	0	0	0			1,533	2,090	3,623	3,623	0
1.3.5	Data Collection	0	0	0	0	0	0		56	336	1,094	1,486	1,486	0
1.3.6	Proj. Mgmt.	0	0	0	0	0	0		321	1,285	4,178	5,784	5,784	0
														0
14. TOTAL		555	828	17,447	19,717	882	0	23,142	24,252	39,825	108,152	213,700	213,700	0

15. DOLLARS EXPRESSED IN: Thousands

16. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE
D. P. Drown — 9/21/94 — DATE

17. SIGNATURE OF PARTICIPANTS AUTHORIZED FINANCIAL REPRESENTATIVE AND DATE
J. R. Hopps — 9/21/94 — DATE

** NOTE: Excludes spending by Acurex not yet invoiced. Includes Eastman Chemical costs of $320M incurred through July 31, 1994.