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The Economic Impact of Vapor Control Regulations on the Bulk Storage Industry

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The Economic Impact of Vapor Control Regulations on the Bulk Storage Industry

by

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I. EXECUTIVE SUMMARY

A. INTRODUCTION

The U.S. Environmental Protection Agency (EPA) is considering regulations which would control total benzene emissions on a national basis. A significant portion of these benzene emissions is contained in the gasoline vapors released during the normal gasoline transfer operations of petroleum bulk terminals and bulk plants. Possible strategies for controlling benzene in the bulk storage industry include the on-site collection and disposal of gasoline vapors and the collection and transportation of these vapors to a common or central point within the gasoline marketing network for ultimate disposal. This study represents only one approach to the benzene problem.

The EPA has requested Arthur D. Little, Inc. (ADL) to assess the economic impacts of several vapor control strategies which would reduce the benzene emissions of the bulk storage industry. Specifically, Arthur D. Little has been asked to:

- Identify and characterize the bulk storage industry
- Determine the number of facility closures expected to occur because of the proposed vapor control regulations
- Estimate the employment levels displaced by these closures, and
- Calculate the national cost of installing and operating vapor control systems in the remaining bulk storage population.

In this chapter, we will present an overview of the methodological approach used in performing this analysis and a summary of our results.

B. MARKET AUDIT

Because no comprehensive data base exists on the bulk storage industry, a detailed market audit of all bulk terminals and bulk plants was conducted. The purpose of this task was to profile the physical (e.g. number, size and location) and operational (e.g. product mix, gasoline throughput and employment) characteristics of the industry. Additionally, the competitive environment within which these facilities operate and all significant industry trends were identified. Arthur D. Little compiled the data necessary to conduct this audit from government, industry and trade association reports, industry and trade association interviews, and in-house sources. The principal findings of the market audit follow.

1. Historical Market Environment

The conditions which induced the petroleum companies to overbuild their marketing networks in the 1950's and early 1960's disappeared by the end of the 1960's. The integrated oil companies began to view their marketing and/or refining operations as separate profit centers to be judged on "stand alone" economics. Marketing activities, including bulk storage operations, could no longer be subsidized by upstream profits and were now expected to recover all operating expenses as well as to provide an acceptable return on capital. "Stand alone" economics caused gasoline marketers, both majors and independents, to review their marketing strengths and to re-evaluate their overall corporate marketing strategies. Many of the integrated petroleum companies shifted their marketing philosophy from volume maximization to profit maximization. Investment in new marketing facilities declined and older, marginal terminals, bulk plants and service stations were sold, consolidated or closed as market conditions rendered them uneconomic. Through this "market rationalization" process, some companies scaled down their marketing activities or withdrew entirely from selected areas where they had over-extended their supply or marketing capabilities. The trend of "market rationalization," which was well underway by the early 1970's, was accelerated by the market conditions resulting from the OAPEC Embargo of 1973-1974.

2. Bulk Terminals

In 1978, there were an estimated 1,751 petroleum bulk terminals[1] in the U.S. (Table I.1). This figure represents a decline of 9% from the 1,925 terminals identified by the Department of Commerce in 1972.[2] Approximately 55% of these facilities are marine terminals receiving petroleum product by tanker or barge, while the remaining 45% are pipeline terminals. Of the 1978 bulk terminal population, an estimated 1,511 terminals or 86% store gasoline. While the total number of bulk terminals declined between 1972 and 1978, total product storage increased approximately 30% from 593 million barrels to 771 million barrels. Total gasoline storage capacity in 1978 was estimated to be 296 million barrels or 38% of total product storage.

Almost three-quarters, or 72%, of the gasoline bulk terminals in the U.S. are owned by the major and semi-major oil companies[3] (Table I.2). Independents, including regional refiners, marketers/wholesalers, jobbers[4] and bulk liquid warehousers,[5] own the remaining 28%. Majors own a proportionately greater number of the larger terminals than do the independents. While majors on average own approximately 72% of the gasoline terminals, they own over 84% of the terminals having a total

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[1] This figure does not include crude or LPG terminals which were excluded from consideration in this study.
[2] Bureau of Census, 1972 Census of Wholesale Trade.
[3] The largest 22 gasoline marketers based on total assets, hereafter referred to as simply majors. For a listing of the individual companies comprising these two groups, see Appendix B.
[4] A jobber is a petroleum distributor who purchases refined product from a refiner or terminal operator for the purpose of reselling to retail outlets, commercial and agricultural accounts, or through his own retail outlets.
[5] Bulk liquid warehousers only store petroleum products at their terminals for a fee and do not market the product themselves.

TABLE I.1

1978 BULK TERMINAL POPULATION

PADD	ALL PETROLEUM TERMINALS: Number of Terminals	Percent of Total	Total Storage Capacity: Thousand Barrels	Total Storage Capacity: Thousand Cu. Meters	Percent of Total	TERMINALS STORING GASOLINE: Number of Terminals	Percent of Total	Gasoline Storage Capacity: Thousand Barrels	Gasoline Storage Capacity: Thousand Cu. Meters	Percent of Total
I	745	43%	403,633	64,172	52%	657	43%	149,792	23,815	51%
II	429	24%	158,219	25,155	21%	343	23%	62,115	9,875	21%
III	276	16%	126,223	20,068	16%	234	15%	51,753	8,228	17%
IV	39	2%	7,238	1,151	1%	39	3%	4,240	674	1%
V	262	15%	75,403	11,988	10%	238	16%	28,408	4,517	10%
Total	1,751	100%	770,716	122,534	100%	1,511	100%	296,308	47,109	100%

Source: Bureau of Census, 1972 Census of Wholesale Trade; U.S. Army Corps of Engineers, Port Series; National Petroleum News, Factbook (1972-1978); Independent Liquid Terminals Association, 1978 Directory - Bulk Liquid Terminals and Storage Facilities; Industry contacts; Arthur D. Little, Inc.

TABLE I.2

GASOLINE TERMINAL DISTRIBUTION
BY SIZE AND OWNERSHIP
PERCENT OF TERMINALS STORING GASOLINE

Total Storage Capacity: Thousand Barrels	Total Storage Capacity: Thousand Cu. Meters	Majors and Semi-Majors	Independents	Percent of Total	Total Number of Terminals Storing Gasoline
< 200	< 30	30%	21%	50%	764
200-600	30-95	25%	3%	28%	423
600-1,000	95-160	10%	3%	13%	192
> 1,000	> 160	7%	2%	9%	132
Percent Total		72%	28%	100%	
Total Number of Gasoline Terminals		1,086	425		1,511

Source: Bureau of Census, 1972 Census of Wholesale Trade; U.S. Army Corps of Engineers, Port Series; National Petroleum News, Factbook (1972-1978); Independent Liquid Terminals Association, 1978 Directory - Bulk Liquid Terminals and Storage Facilities; Industry contacts; Arthur D. Little, Inc.

storage capacity greater than 200,000 barrels, but only 59% of the gasoline terminals having less than 200,000 barrels of total storage. A shift in ownership from majors to independents is expected to continue, particularly regarding the smaller terminals, as some majors either reduce their marketing activities or withdraw entirely from selected regions as part of a market rationalization process.

"Stand alone"economics and the market rationalization of petroleum companies are expected to continue exerting closure pressure on marginally profitable facilities. Although most closures and consolidations in the bulk terminal industry have already occurred, approximately 20 small marine terminals, or 3% of the terminals having an average daily gasoline throughput less than 200,000 gallons, are expected to close or to consolidate their operations between 1978 and 1983 (Figure I.1).

3. Bulk Plants

In 1978, there were approximately 18,640 petroleum bulk plants in the U.S. (Table I.3). This figure represents a decline of 20% from the 23,370 bulk plants reported by the Department of Commerce in 1972. Of the total 1978 bulk plant population, 96% or 17,850 bulk plants store gasoline. Total product storage capacity at bulk plants in 1978 was estimated at 1.8 billion gallons of which 1.1 billion gallons, or 60%, was gasoline capacity.

Jobbers own the greatest number of gasoline bulk plants with 76% of the estimated 1978 population (Table I.4). Majors own approximately 20%, while the independent marketer/wholesalers own less than 5%. The jobbers' share of the market has been increasing steadily in recent years as the majors have pulled out of secondary storage operations as part of their overall marketing strategy. Jobbers tend to own a proportionately greater number of small gasoline bulk plants, and proportionately fewer large bulk plants than either the majors or the independent marketer/wholesalers. Jobbers, who own 76% of all gasoline bulk plants, own over 82% of the smallest bulk plants having less than

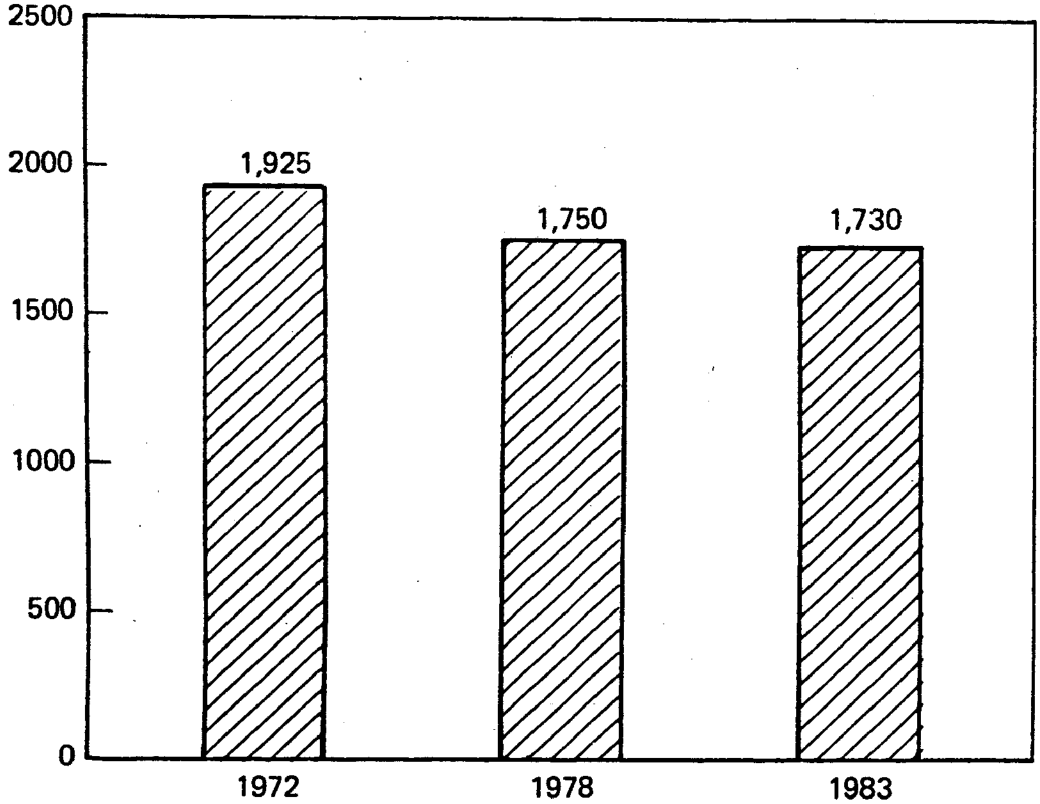

FIGURE I.1 ESTIMATED 1983 BULK TERMINAL POPULATION BEFORE VAPOR CONTROL IMPACTS

TABLE I.3

1978 BULK PLANT POPULATION

PADD	ALL PETROLEUM BULK PLANTS: Number of Bulk Plants	Percent of Total	Total Storage Capacity: Thousand Gallons	Total Storage Capacity: Thousand Cu. Meters	Percent of Total	BULK PLANTS STORING GASOLINE: Number of Bulk Plants	Percent of Total	Gasoline Storage Capacity: Thousand Gallons	Gasoline Storage Capacity: Thousand Cu. Meters	Percent of Total
I	3,510	19%	433,290	1,641	24%	3,190	18%	250,270	947	24%
II	8,850	47%	710,670	2,691	40%	8,540	48%	401,830	1,521	38%
III	3,320	18%	253,380	958	14%	3,320	19%	187,190	709	18%
IV	990	5%	85,490	323	5%	990	5%	58,490	221	5%
V	1,970	11%	302,270	1,144	17%	1,810	10%	164,600	623	15%
Total	18,640	100%	1,785,100	6,757	100%	17,850	100%	1,062,380	4,021	100%

Source: Bureau of Census, 1972 Census of Wholesale Trade; National Oil Jobbers Council; National Petroleum News, Factbook, (1972-1978); Industry contacts; Arthur D. Little, Inc.

TABLE I.4

GASOLINE BULK PLANT DISTRIBUTION BY SIZE AND OWNERSHIP

Total Storage Capacity: Thousand Gallons	Total Storage Capacity: Cubic Meters	Majors & Semi-Majors	Independent Marketers/ Wholesalers	Jobbers	Percent of Total	Total Number of Bulk Plants Storing Gasoline
		— PERCENT OF BULK PLANTS STORING GASOLINE —				
<40	<150	2.0	0.4	11.0	13.4	2,380
40-150	150-570	16.2	3.5	59.3	79.0	14,100
150-300	570-1,140	1.2	0.3	4.7	6.2	1,110
>300	>1,140	0.8	0.1	0.5	1.4	260
Percent of Total		20.2	4.3	75.5	100.0	
Total Number of Bulk Plants Storing Gasoline		3,610	770	13,470		17,850

Source: Bureau of Census, 1972 Census of Wholesale Trade; National Oil Jobbers Council; National Petroleum News, Factbook (1972-1978); Industry contacts; Arthur D. Little, Inc.

40,000 gallons of storage capacity, but only 36% of the largest bulk plants having storage greater than 300,000 gallons. By contrast, the majors, who own 20% of the gasoline bulk plants, own over 75% of the largest facilities, but only 18% of the smallest bulk plants.

Additional bulk plant closures are expected because of increasing market competition and the ongoing rationalization process of petroleum marketers which will continue to favor larger, more efficient bulk plant operations. Many bulk plants can no longer operate profitably because of shrinking margins caused by increasing operating costs. Based upon industry discussions with majors, independents and jobbers, an estimated 3,480 gasoline bulk plants are expected to close or be consolidated over the next 5 years, thereby reducing the bulk plant population to about 15,100 (Figure I.2). A large portion of this decline results from a more accelerated exodus from the bulk plant industry on the part of the majors and independents. As much as 42% of the majors' 1978 bulk plant population will be either sold or closed over the next 5 years. Most of these facilities are expected to be purchased by jobbers who will consolidate them with their existing operations. The jobbers' share of the bulk plant population is expected to increase from 76% to 81% by 1983. The ongoing shift of bulk plant ownership will continue to be a major consideration within the industry. All 3,480 closures are expected to be bulk plants having less then 8,000 gallons of average daily gasoline throughput.

C. CONTROL STRATEGIES

The EPA is considering three control options which would reduce the nationwide emission of benzene during normal bulk storage operations. These options address the following three major sources of gasoline vapor in the industry:

- The loading of truck transports at bulk terminals (dispatch of product)
- The filling of gasoline storage tanks at bulk plants (receipt of product)

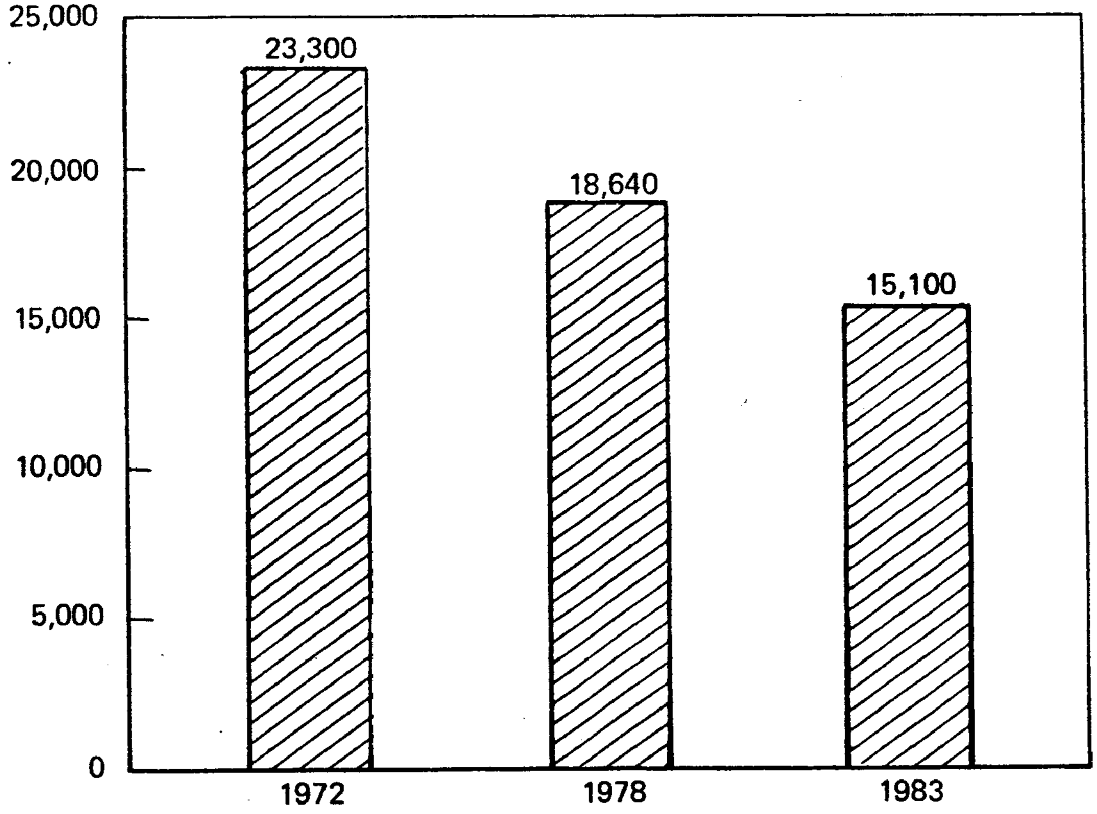

FIGURE I.2 ESTIMATED 1983 BULK PLANT POPULATION BEFORE VAPOR CONTROL IMPACTS

- The loading of tank wagons at bulk plants (dispatch of product)

These sources of gasoline vapor are controlled to varying degrees by the three proposed options outlined below.

1. Option 1

Option 1 provides the least amount of benzene reduction of the three control options. Under this option, all terminals must install control systems to collect and dispose of gasoline vapors resulting from truck transport loading. All truck transports loading at the terminal would also have to install equipment to receive gasoline vapors from customers' storage tanks and direct this vapor to the terminal's vapor control system. These systems may either reliquify the gasoline vapors, returning the liquid to the storage tanks, or oxidize the collected vapors. Bulk plants would be required to use either a top-loading or bottom-loading submerged fill method when loading their tank wagons. Additionally, vapors displaced from the storage tanks by the rising gasoline level during tank filling would no longer be allowed to escape into the air. These vapors would be captured and "balanced" (or sent) to the truck transport making the gasoline delivery. Vapors would then accumulate in the emptying tank compartments of the truck and be returned by the transport to the bulk terminal for eventual collection and disposal during the transport's next loading. Accounts serviced by bulk plants would be exempted from vapor balancing as the tank wagons would not be equipped to handle those vapors. However, these accounts would be required to install submerged fill systems for their storage tanks.

2. Option 2

Option 2 is a more effective control strategy than Option 1. Bulk terminals would be required to employ the same degree of vapor control under this option as Option 1. However, bulk plants would now be required to install a balance system on all tank wagons in addition to the balance system on storage tanks required by Option 1. Tank wagons would then be modified in order to receive gasoline vapors while filling tanks at retail outlets and to transport these vapors back to the bulk plant. During subsequent tank wagon loading, the gasoline vapors, which would have escaped through the hatch opening in Option 1, would now be collected and sent to the emptying storage tank. These vapors, which are "balanced to storage," will eventually be "balanced to transport" during the next transport delivery and be returned to the bulk terminal for ultimate disposal. Bulk plants would still load their tank wagons using a submerged fill method.

3. Option 3

Option 3 provides the greatest reduction in benzene emissions of the three control options. Again, the control requirements of bulk terminals are exactly the same as they were in Option 1 and Option 2. Bulk plants, however, would now be required to install vapor collection and disposal systems similar to those required at bulk terminals. These control systems would be of a smaller scale than those at terminals, but all vapors would be collected and disposed of on-site. No vapors would be "balanced to transport" and returned to the bulk terminal. All retail outlets serviced by bulk plants would be required to install vapor balance systems. A brief summary of the base case assumptions and the proposed vapor control regulations is presented in Table I.5.

4. Stand-by Systems

It is the intention of the EPA that no gasoline loading be performed at bulk terminals or bulk plants if the continuous and efficient operation of the vapor control systems cannot be assured. A bulk storage facility would have three alternatives should its vapor control system become temporarily inoperative:

- switch to a stand-by system,
- utilize a gasoline vapor holder to collect vapors until the control system is operational, or
- shut down gasoline loading operations until the control system is operational.

TABLE I.5

VAPOR CONTROL OPTIONS AT GASOLINE BULK STORAGE FACILITIES

SOURCE	CONTROL SCENARIO: BASE CASE[a]	OPTION 1[b]	OPTION 2[c]	OPTION 3[c]
Terminals				
Filling Truck Transports At The Loading Rack	Top Submerged Fill	Vapor Recovery or Incineration	Vapor Recovery or Incineration	Vapor Recovery or Incineration
Bulk Plants				
Filling Gasoline Storage Tanks	Bottom Fill	Balance to Transport	Balance to Transport	Vapor Recovery or Incineration
Filling Tank Wagons At The Loading Rack	Splash Fill	Submerged Fill	Balance to Storage	Vapor Recovery or Incineration

[a] Most common current industry practice.

[b] Vapors from all gasoline stations supplied from terminals will be balanced to the truck transport. Vapors from gasoline stations supplied from bulk plants will not be balanced to the tank wagons.

[c] Vapors from all gasoline stations will be balanced to the supplying vehicles. Service station tanks will be loaded via submerged fill.

Source: U.S. Environmental Protection Agency

The EPA has provided Arthur D. Little with cost data for the first two alternatives shown above. Based on estimated capital requirements, a stand-by system was selected as the less expensive alternative that would assure that gasoline vapors were continuously controlled. Because both the decision to shut down gasoline loading operations and the costs incurred from such a decision would vary considerably from one installation to another, evaluating this alternative was considered to be outside the scope of this study. It may, however, be a viable alternative for some facilities having very small gasoline throughputs.

5. Model Vapor Control Systems

The EPA has developed and provided to Arthur D. Little cost estimates for model vapor control systems which would bring bulk terminals and bulk plants into compliance with the above control options. One set of costs was prepared for the various control systems which could be installed at bulk terminals. However, for bulk plants, three sets of costs for the possible control systems were prepared for each of the three options. Since it was outside the scope of this study to select a "most appropriate" set of vapor control costs for bulk plants, we evaluated the economic impacts of each of these three cost scenarios. The three cost scenarios in descending order of installed capital costs are NOJC[1], Houston-Galveston[2], and Colorado APCD[3]. The EPA has assumed that all of the above systems are equally efficient in controlling gasoline vapors for each one of the three control options. Since it may also be necessary for bulk terminals and bulk plants installing vapor recovery systems to also install a stand-by unit, the costs of primary control systems with an appropriate back-up unit were

[1]NOJC - the most expensive control system described by McCormack and Schuster of the California Independent Oil Marketers Association (National Oil Jobbers Council, a jobber trade association).

[2]Houston-Galveston - a top loading version of the Wiggins System.

[3]Colorado APCD - the least expensive control system reported by the Colorado Air Pollution Control Division (APCD).

also provided.

D. CLOSURE ANALYSIS

1. Bulk Storage Models

Because it would be impossible to assess the economic impacts of each of the proposed vapor control options for the bulk storage industry on an individual basis, Arthur D. Little has developed six bulk storage models, each representative of segments of the bulk storage industry, to be used as illustrative analytical tools. By using these bulk storage models in conjunction with the model vapor control systems developed by the EPA, economic and financial parameters, e.g. profitability, debt capacity, and tariff rates, were tested under base case conditions and then for each of the proposed regulations. The changes in these variables provided valuable insight in conducting the economic impact analysis by indicating how and to what degree the bulk storage industry might actually be affected by the vapor control options.

2. Cost Pass Through Assumptions

Although 100% of the costs associated with vapor control may be passed through to buyers, we have assumed that the incremental costs of vapor control may be absorbed by the bulk storage models to varying degrees. The price setter or market leader of each type of storage facility in an area was assumed to be the most efficient facility and, presumably, the largest. This facility, because of its unique market position, will be able to pass through the full cost of vapor control by increasing its tariff to where it covers all of its incremental vapor control costs and hence, does not experience any decline in margin. A less efficient facility, however, competing with the market leader, will be constrained to only passing through, at most, the same unit cost as the market leader, thereby absorbing some of the cost and causing a decrease in margin. Only the small marine terminal and small bulk plant models are assumed to be constrained in the amount of vapor control costs they can pass through in the form of tariff increases. The cost pass through of these facilities is assumed to be limited to the same cost per gallon increases as the larger, more efficient marine terminal and bulk plant models with which these smaller facilities are assumed to be in competition. All of the other models are assumed to be able to pass through the full cost of vapor control. A summary of these pass through assumptions appears in Table I.6.

3. Facilities Subject to the Proposed Control Options

Bulk storage facilities which are not subject to this closure analysis include bulk terminals and bulk plants which would close anyway due to reasons other than vapor control, non-gasoline terminals and bulk plants, and facilities which already have installed the necessary vapor control equipment. All other facilities would be subject to possible closure as a consequence of the vapor control strategies outlined earlier.

4. Bulk Storage Closures

Bulk terminals and bulk plants subject to vapor control regulations are assumed to close because of either of the following two reasons:

- Operators are unable to obtain the capital necessary to install vapor control equipment, or
- Storage facilities would operate below a minimum acceptable level of profitability if vapor control equipment were installed.

a. Availability of Capital

For this analysis, each bulk storage facility is treated as a separate profit center in determining its ability to secure the capital necessary to install vapor control equipment. Because an in-depth financial examination of each and every facility was impractical as well as infeasible, the bulk storage models developed by Arthur D. Little will act as surrogates for the bulk terminal industry. In our analysis, if the model's anticipated after-tax cash flow, i.e. net

TABLE I.6

COMPETITIVE PASS THROUGH ASSUMPTIONS

FACILITY PROTOTYPE	LOW THROUGHPUT[1]	HIGH THROUGHPUT[2]
Marine Terminal	Partial Pass Through	Full Pass Through
Pipeline Terminal	Full Pass Through	Full Pass Through
Bulk Plant	Partial Pass Through	Full Pass Through

[1]Gasoline throughput is 250,000 gallons/day for bulk terminals and 4,000 gallons/day for bulk plants.

[2]Gasoline throughput is 500,000 gallons/day for bulk terminals and 20,000 gallons/day for bulk plants.

profit plus depreciation, covers its total debt obligation, i.e. principal of pre-vapor control and vapor control related debt,[1] the necessary capital will most likely be made available.

Because the projected after-tax cash flow of all the bulk terminal models was sufficient to meet all debt obligations, both pre- and post-vapor control, it was concluded that no bulk terminal closures were likely because of an inability to obtain capital. However, depending upon the control option and the cost scenario chosen in the bulk plant analysis, post-vapor control cash flow was often not sufficient to obtain the capital required to install vapor control equipment. Even after considering non-standard financing almost 9,000 bulk plants, or 48% of the estimated 1978 bulk plant population, would still not be able to obtain financing for some of the Option 3 control systems. No bulk plant closures are expected to occur because of Option 1, which has the smallest capital requirement of the three control options Table I.7). Option 2 is expected to cause approximately 1,690 facilities, or 12% of all gasoline bulk plants, to close if the NOJC, or most expensive, cost scenario is assumed. No closures are expected for Option 2 for the other two cost scenarios. Because Option 3 compliance requires the greatest amount of capital, it is the option expected to cause the largest number of bulk plant closures. The number of likely bulk plant closures as the result of Option 3 ranges from 1,060 for a Colorado APCD incineration unit to 8,990 for a NOJC refrigeration/incineration system.

b. Insufficient Profitability

Many of the bulk storage facilities having access to adequate amounts of capital may still close because of vapor control economics. Those failing to achieve a minimum level of profitability after vapor control equipment is installed are assumed to close. Facilities will remain open as long as their operators can meet all current liabilities, i.e., operating expenses (including salaries) and debt obligations (principal and interest). Bulk storage facilities would continue to

[1] Interest payments are included in the cash flow figure.

TABLE I.7

BULK PLANT CLOSURES BECAUSE OF INACCESSIBILITY OF CAPITAL

	CONTROL STRATEGY					
	OPTION 1	OPTION 2	OPTION 3			
			Primary Control System		Primary System With Stand-By	
	Balance Incoming Trucks Only	Balance In-Coming & Outgoing Trucks	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
NOJC Cost Scenario	0	1,690	8,930	6,080	8,990	8,880
Houston-Galveston Cost Scenario	0	0	8,890	4,370	8,960	8,820
Coloardo APCD Cost Scenario	0	0	8,870	1,060	8,950	8,820

Source: Arthur D. Little, Inc.

operate under these conditions, even if no return on equity investment was realized, if operators have limited business alternatives for their equity investment or believe that profitability will increase in the future as other facilities close.

In order to generate a revenue stream sufficient to continue operations, i.e. to break even, a minimum product throughput at all bulk terminals must be sustained. After netting out the revenue contribution of the non-gasoline products, the revenue necessary to meet the remaining current liabilities must be generated through gasoline volumes. The gasoline volume necessary for the model facilities to remain open was then calculated.

Bulk storage facilities unable to pass through the full cost of vapor control would be forced to absorb the remaining control costs and their minimum required gasoline volumes would increase as a result.[1] This increase could cause some facilities, which are now just breaking even or marginally profitable, to operate at a loss. Using a distribution of storage facilities by gasoline throughput, and the increase in gasoline throughput necessary to offset the absorbed vapor control costs, the number of terminals and bulk plants which would now operate below their gasoline breakeven throughput as a result of vapor control economics, and presumably close, was calculated.

From the above analysis, between 23 and 51 bulk terminals, or 2% to 5% of the gasoline terminals subject to vapor control regulations, are likely to close because they would be operating at less than a breakeven level. Depending upon the specific control option and cost scenario, bulk plant closures are expected to range from zero to 1,300. Closures resulting from Option 1 are estimated to be 130 for the NOJC and Houston-Galveston cost scenarios and zero for the Colorado APCD cost scenario (Table I.8). Closures resulting from Option 2 range from

[1]The throughputs of the non-gasoline products, and hence, their revenue contribution are assumed to remain the same.

TABLE I.8

BULK PLANT CLOSURES BECAUSE OF INSUFFICIENT PROFITABILITY

	CONTROL STRATEGY					
	OPTION 1	OPTION 2	OPTION 3			
			Primary Control System		Primary System With Stand-By	
	Balance Incoming Trucks Only	Balance In-Coming & Outgoing Trucks	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
NOJC Cost Scenario	130	530	1,040	900	1,300	800
Houston-Galveston Cost Scenario	130	240	920	890	1,180	690
Colorado APCD Cost Scenario	0	50	840	1,010	1,100	610

Source: Arthur D. Little, Inc.

50 to 530 facilities, while Option 3 compliance is expected to cause between 600 and 1,300 bulk plants to close. It should be noted, however, that while bulk plant closures due to insufficient profitability appear far less significant than closures due to inaccessibility of capital, this phenomenon is the result of the arbitrary ordering of the above two analytical steps and not the inherent significance of either factor. Before conducting the profitability analysis, the expected capital-related closures were netted out of the potentially impacted population and their gasoline throughput redistributed among the remaining storage facilities. A summary of the closure impacts on the bulk storage industry due to the three vapor control options, both high and low estimates, is presented in Table I.9.

E. EMPLOYMENT AND COST IMPACTS

a. Employment

The employment impacted or displaced is directly proportional, as would be expected, to the facility closures caused by vapor control. Between 300 and 700 workers employed at gasoline bulk terminals and up to 43,730 workers employed at bulk plants would be displaced by the vapor control induced closures. A summary of these employment impacts is presented for the three proposed vapor control options in Table I.10.

b. Cost

The nationwide cost of installing, financing and operating vapor control systems varies significantly by control option, control technology and cost scenario. High and low estimates for each control option appear in Table I.11. The total costs of compliance under Option 1 range from $281 million to $719 million. The vapor control costs required to comply with Option 2 range from $297 million to $1.1 billion, while Option 3 costs vary from $832 million to $1.4 billion. These costs represent a substantial portion of the petroleum industry's $1.2 billion 1977 environmental budget for the control of air pollution. Additionally, in 1977 the major oil companies' total budget for

TABLE I.9

CLOSURE IMPACT OF THE PROPOSED VAPOR CONTROL OPTIONS

	CONTROL STRATEGY					
	Option 1		Option 2		Option 3	
	High	Low	High	Low	High	Low
Primary Vapor Control System						
Bulk Terminal[1]	32	23	32	23	32	23
Bulk Plant[2]	130	0	2,220	50	9,970	1,900
Primary Vapor Control System With a Stand-By Unit						
Bulk Terminal[3]	51	46	51	46	51	46
Bulk Plant[2]	130	0	2,220	50	10,290	9,430

[1] The High and Low estimates result from using the incineration system and the refrigeration system, respectively, as the cost basis.

[2] The High estimate results from using the NOJC cost scenario, while the Low estimate results from using the Colorado APCD cost scenario. The closure impact of the Houston-Galveston cost scenario falls between these two estimates.

[3] The High and Low estimates result from using the incineration system with incineration stand-by and the refrigeration system with incineration stand-by, respectively.

TABLE I.10

EMPLOYMENT IMPACT OF THE PROPOSED VAPOR CONTROL OPTIONS

	CONTROL STRATEGY					
	Option 1		Option 2		Option 3	
	High	Low	High	Low	High	Low
Primary Vapor Control System						
Bulk Terminal[1]	450	320	450	320	450	320
Bulk Plant[2]	550	0	9,440	210	42,370	8,800
Total Employment	1,000	320	9,890	530	42,820	9,120
Primary Vapor Control System With a Stand-By Unit						
Bulk Terminal[3]	710	640	710	640	710	640
Bulk Plant[2]	550	0	9,440	210	43,730	40,080
Total Employment	1,260	640	10,150	850	44,440	40,720

[1] The High and Low estimates result from using the incineration system and the refrigeration system, respectively, as the cost basis.

[2] The High estimate results from using the NOJC cost scenario, while the Low estimate results from using the Colorado APCD cost scenario. The employment impact of the Houston-Galveston cost scenario falls between these two estimates.

[3] The High and Low estimates result from using the incineration system with incineration stand-by and the refrigeration system with incineration stand-by, respectively.

TABLE 1.11
TOTAL COST[1] OF THE PROPOSED VAPOR CONTROL OPTIONS
(Million 1978 Dollars)

	CONTROL STRATEGY					
	Option 1		Option 2		Option 3	
	High	Low	High	Low	High	Low
Single Vapor Control System						
Bulk Terminal Cost[2]	329.0	201.9	329.0	201.9	329.0	201.9
Conversion of the Tank Trailer Fleet	101.4	101.4	101.4	101.4	101.4	101.4
Bulk Plant Cost[3]	36.9	(22.7)[5]	375.5	(6.5)	651.3	528.6
Total Cost	467.3	280.6	805.9	296.8	1,081.7	831.9
Vapor Control System With Stand-By Unit						
Bulk Terminal Cost[4]	580.4	473.2	580.4	473.2	580.4	473.2
Conversion of the Tank Trailer Fleet	101.4	101.4	101.4	101.4	101.4	101.4
Bulk Plant Cost[3]	36.9	(22.7)	375.5	(6.5)	747.3	465.2
Total Cost	718.7	551.9	1,057.3	568.1	1,429.1	1,039.8

[1] Total cost includes capital charge, financing cost and operating expense less any applicable recovery credit. All future expenses and credits have been discounted to present value using a discount rate of 10%.

[2] The High and Low estimates result from using the incineration system and the refrigeration system, respectively, as the cost basis.

[3] The High estimate results from using the NOJC cost scenario, while the Low estimate results from using the Colorado APCD cost scenario. The cost impact of the Houston-Galveston cost scenario falls between these two estimates.

[4] The High and Low estimates result from using the incineration system with incineration stand-by and the refrigeration system with incineration stand-by, respectively.

[5] Indicates a net savings because the present value of the recovery credit exceeds the estimated 1978 vapor control expenses.

environmental effluent abatement was estimated to be only $803 million, of which marketing's share was approximately $120 million.

II. MARKET AUDIT OF BULK TERMINALS

A. INTRODUCTION

1. Definition and Operational Profile

Although a bulk terminal is significantly larger than a bulk plant, having a total storage capacity typically in excess of 50,000 barrels,[1] there is no well-defined and universally-accepted set of physical characteristics which uniquely defines a bulk terminal. Rather, the definition of a terminal is more often derived from its function within the petroleum marketing network. Therefore, within the scope of this study, we will assert that a bulk terminal operates as a primary storage facility receiving petroleum products directly from domestic or offshore refineries for eventual market distribution. Because the primary economic impacts of the proposed vapor control regulations, e.g. incremental investment requirements or possible terminal closures, will only occur at facilities which store and distribute gasoline, the bulk terminals comprising the gasoline distribution network will be the principal focus of the following operational profile.

Pipelines, tankers and barges transport U.S. gasoline throughput, both domestic production and imports, from refinery storage tanks to bulk terminal storage (Figure II.1). Because pipeline transportation is significantly less expensive than waterborne shipment (Figure II.2), most of the gasoline throughput in the U.S. is handled by pipeline terminals. However, since most product pipelines in the U.S. are currently operating at full capacity, the marginal or incremental barrel of product in many regions moves by water through marine terminals. Additionally, almost all gasoline imports, primarily originating in the Caribbean, are received at marine terminals for domestic distribution.

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[1] Part of the definition used by the Department of Commerce when conducting its Census of Wholesale Trade.

FIGURE II.1

GASOLINE DISTRIBUTION NETWORK

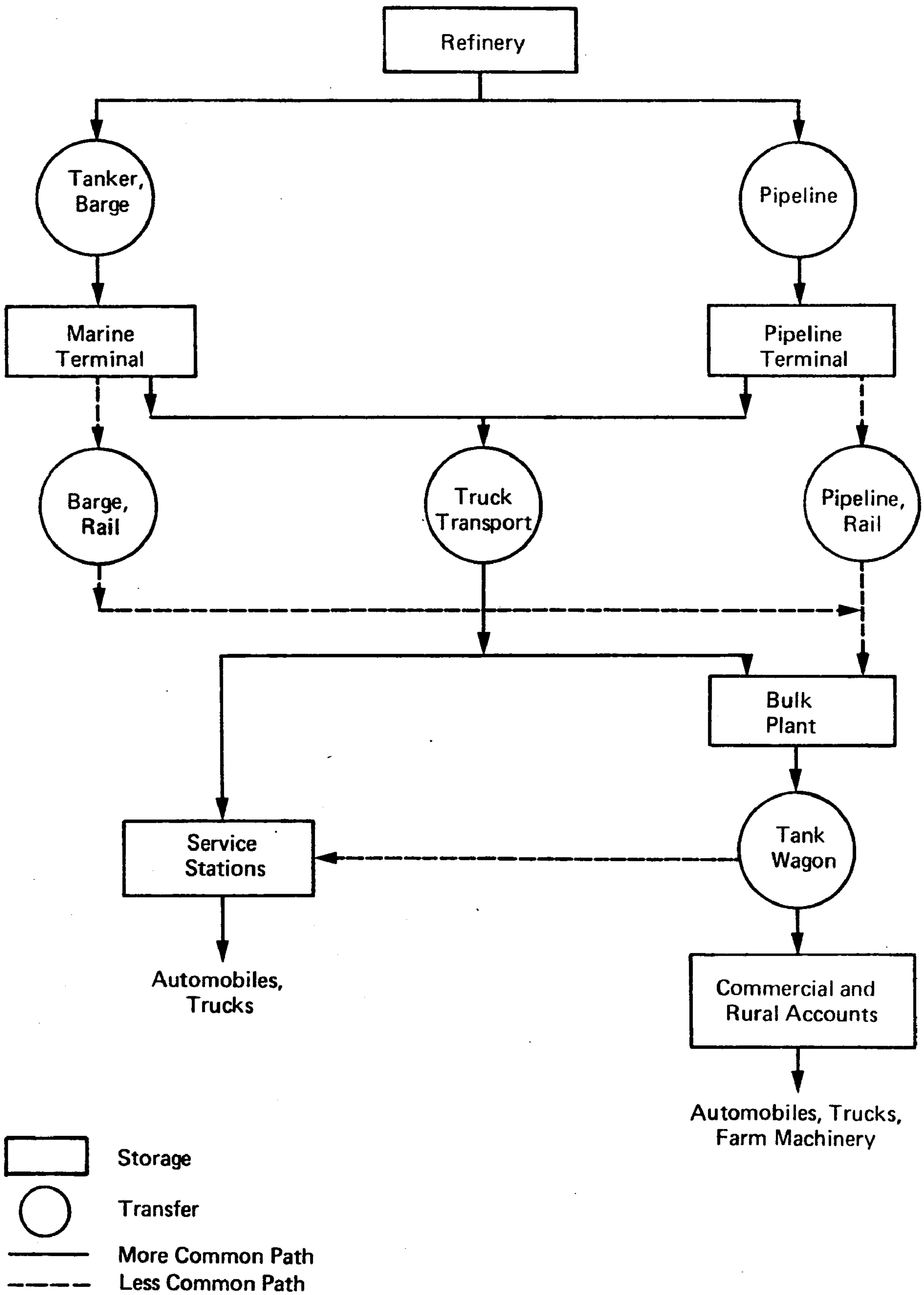
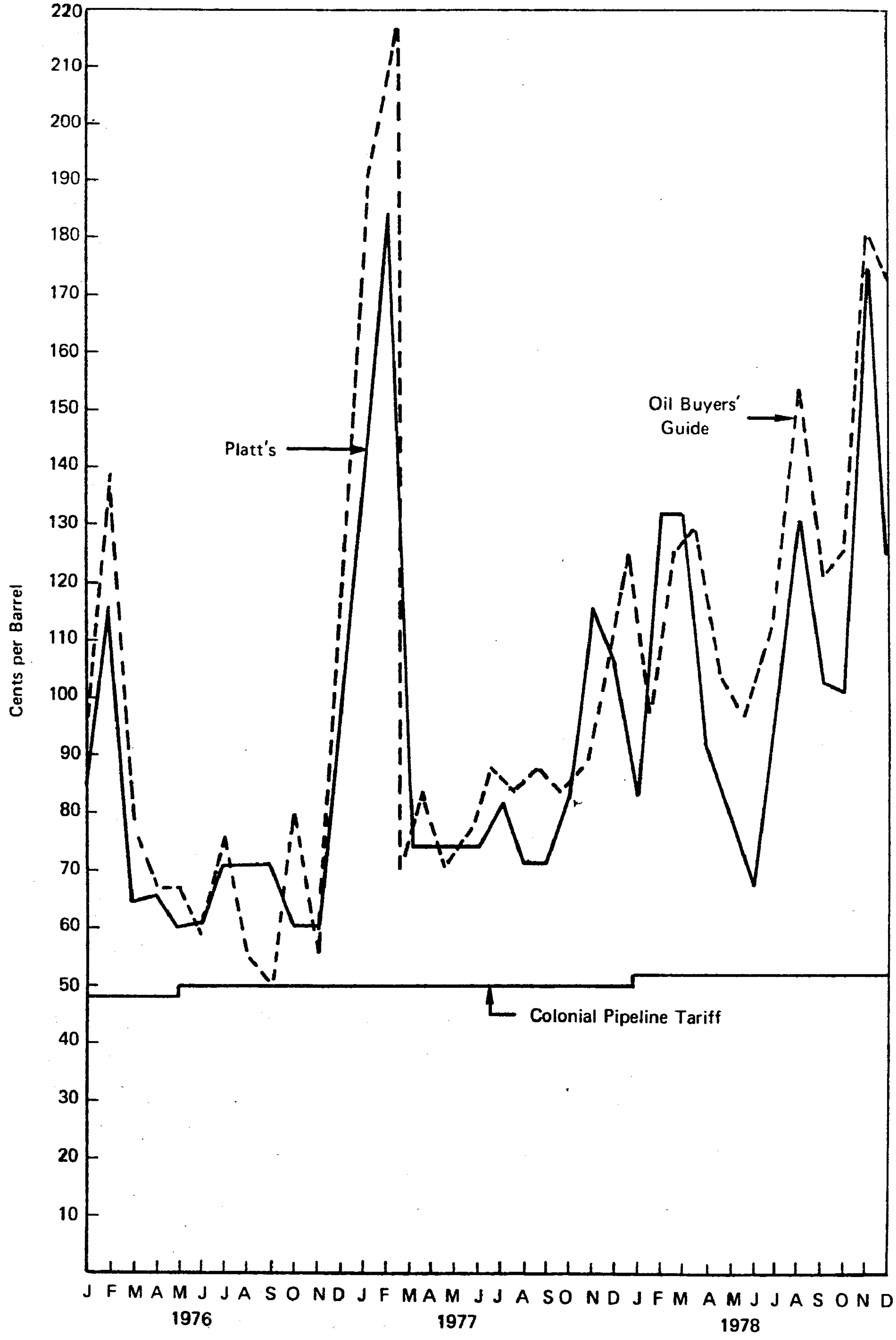


FIGURE II.2

GASOLINE TRANSPORTATION COSTS GULF COAST TO NEW YORK
SPOT TANKER RATES VS. COLONIAL PIPELINE



A typical bulk terminal distributes all of the gasoline which it receives through its loading racks into truck transports. These transports usually have tank capacities between 8,000 and 9,500 gallons and deliver gasoline directly to service stations or deliver to bulk plants for further distribution. Most of the transports delivering gasoline are owned by common carriers with the bulk terminal operators owning the majority of the remaining fleet. Shipments of gasoline from terminals by pipeline, barge or rail car occur infrequently and only in areas having unusual logistical constraints or opportunities.

2. Historical Market Environment

For more than a quarter of a century until about 1970, the marketing philosophy of the integrated oil companies was to maximize the flow of petroleum products through their marketing networks. This philosophy evolved from the fact that the production of both domestic and foreign crudes contributed the most significant portion of the total corporate profits of these companies. In order to "draw" more barrels of crude oil out of the ground, and hence, more profits, an aggressive construction program of downstream marketing facilities, including terminals, bulk plants and service stations, was conducted. The construction and operation of many of these marketing facilities was justified and supported, not by the individual facility's profitability outlook or performance, but by the upstream profits of crude production.

The conditions which induced the petroleum companies to overbuild their marketing networks in the 1950's and early 1960's disappeared by the end of the 1960's. The integrated oil companies began to view their marketing and/or refining operations as separate profit centers to be judged on "stand alone" economics. Marketing activities, including bulk storage operations, could no longer be subsidized by upstream profits and were now expected to recover all operating expenses as well as to provide an acceptable return on capital. "Stand alone" economics caused gasoline marketers, both majors and independents, to review their marketing strengths and to re-evaluate their overall corporate marketing strategies. Many of the integrated petroleum companies shifted their marketing philosophy from volume maximization to profit maximization. Investment in new marketing facilities declined and older, marginal terminals, bulk plants and service stations were sold, consolidated or closed as market conditions rendered them uneconomic. Through this "market rationalization" process, some companies scaled down their marketing activities or withdrew entirely from selected areas where they had over-extended their supply or marketing capabilities. The trend of "market rationalization," which was well underway by the early 1970's, was accelerated by the market conditions resulting from the OAPEC Embargo of 1973-1974.

B. AUDIT SUMMARY

This discussion of the bulk terminal industry will focus on five of its primary characteristics:

- Population
- Storage Capacity
- Size Distribution
- Ownership, and
- Employment.

The section on size distribution includes a discussion of both shell storage capacity and average daily throughput. Also, when appropriate, regional differences or trends pertinent to an understanding of the nature of the bulk terminal industry are identified. The information that comprised the basis of this audit was compiled from government, industry and trade association reports, field interviews, and in-house Arthur D. Little sources. The data obtained from the above sources was then verified and cross-checked to assure a high level of confidence in the audit results.

1. Population

In 1978, there were an estimated 1,751 petroleum bulk terminals[1] in the U.S. (Table II.1). This figure represents a 9% decline from the 1,925 bulk terminals identified by the Department of Commerce in 1972.[2] This attrition has been the result of the rationalization process of the petroleum marketers largely affecting the less efficient facilities. Of the 1,751 terminals identified in 1978, approximately 86% or 1,511 store gasoline. Terminals not storing gasoline may specialize in distillate, residual or bunker fuel sales. Most bulk terminals are located in PADD's I and II (Figure II.3) which together account for two-thirds of the bulk terminal population. PADD I has 43% of all petroleum bulk plants and 43% of those storing gasoline, while PADD II has 24% and 23%, respectively. The large number of bulk terminals in these two PADD's reflects the regions' lack of refining self-sufficiency and their reliance on shipments from other PADD's and from foreign sources in order to meet their total product (Table II.2) and gasoline (Table II.3) demand.

2. Storage Capacity

While the total number of terminals declined between 1972 and 1978, total storage increased by approximately 30% from 593 million barrels to 771 million barrels as larger terminals expanded via new construction or consolidated smaller, less efficient facilities into their operations. Gasoline storage capacity increased to an estimated 296 million barrels of shell capacity or 38% of total product storage. Because most of the bulk terminal population is located in PADD's I and II, these two regions account for most of the storage capacity with 73% of total product storage and 72% of the gasoline storage.

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[1] This figure does not include crude or LPG terminals which were excluded from consideration in this study.

[2] Bureau of Census, 1972 Census of Wholesale Trade.

TABLE II.1

1978 BULK TERMINAL POPULATION

PADD	ALL PETROLEUM TERMINALS: Number of Terminals	Percent of Total	Total Storage Capacity: Thousand Barrels	Total Storage Capacity: Thousand Cu. Meters	Percent of Total	TERMINALS STORING GASOLINE: Number of Terminals	Percent of Total	Gasoline Storage Capacity: Thousand Barrels	Gasoline Storage Capacity: Thousand Cu. Meters	Percent of Total
I	745	43%	403,633	64,172	52%	657	43%	149,792	23,815	51%
II	429	24%	158,219	25,155	21%	343	23%	62,115	9,875	21%
III	276	16%	126,223	20,068	16%	234	15%	51,753	8,228	17%
IV	39	2%	7,238	1,151	1%	39	3%	4,240	674	1%
V	262	15%	75,403	11,988	10%	238	16%	28,408	4,517	10%
Total	1,751	100%	770,716	122,534	100%	1,511	100%	296,308	47,109	100%

Source: Bureau of Census, 1972 Census of Wholesale Trade; U.S. Army Corps of Engineers, Port Series; National Petroleum News, Factbook (1972-1978); Independent Liquid Terminals Association, 1978 Directory - Bulk Liquid Terminals and Storage Facilities; Industry contacts; Arthur D. Little, Inc.

FIGURE II.3 PETROLEUM ADMINISTRATION FOR DEFENSE DISTRICTS

TABLE II.2

1978 REGIONAL PRODUCT SUPPLY/DEMAND BALANCE

(Thousand Barrels/Day)

			INTER PADD SHIPMENTS						
PADD	Regional Demand	Refinery Output	From PADD I	From PADD II	From PADD III	From PADD IV	From PADD V	Imports	Other
I	6,498	1,815	--	66	3,100	--	--	1,671	66
II	5,219	3,950	220	--	791	42	--	129	347
III	3,942	6,602	--	126	--	--	3	22	1,163
IV	547	498	--	68	--	--	14	13	67
V	2,621	2,392	--	--	83	71	--	120	(28)
Total	18,827	15,257						1,955	1,615

[1] Includes stock changes

Source: U.S. Department of Energy, Supply, Demand and Stock of All Oils By PAD Districts and Imports into the United States, by Country.

TABLE II.3

1978 REGIONAL GASOLINE SUPPLY/DEMAND BALANCE
(Thousand Barrels/Day)

PADD	Regional Demand	Refinery Output	INTER PADD SHIPMENTS From PADD I	From PADD II	From PADD III	From PADD IV	From PADD V	Imports	Other[1]
I	2,521	733	--	27	1,703	--	--	160	19
II	2,516	1,962	161	--	281	17	--	7	211
III	1,026	2,529	--	53	--	--	1	3	471
IV	252	220	--	43	--	--	7	1	32
V	1,139	989	--	--	47	34	--	25	52
Total	7,454	6,473						196	785

[1]Includes stock changes

Source: U.S. Department of Energy, *Supply, Demand and Stock of All Oils By PAD Districts and Imports into the United States, by Country*.

3. Size Distribution

a. Storage Capacity

Small facilities comprise the largest portion of the bulk terminal population. Almost half, 48%, of all product terminals have a total storage capacity that is less than 200,000 barrels, while approximately another third, 30%, have a total storage capacity between 200,000 and 600,000 barrels (Table II.4). Similarly, half of the terminals storing gasoline have total storage capacities that are less than 200,000 barrels and of these, more than a quarter, 28%, are between 200,000 and 600,000 barrels. A more detailed presentation of product and gasoline capacities appears in Appendix A.

b. Average Daily Throughput

Another measure of a bulk terminal's size is its average daily throughput of petroleum products, particularly gasoline. Almost two-thirds, 63%, of all bulk terminals have a daily product throughput that is less than 680,000 gallons and over a third of these, 36%, are less than 170,000 gallons (Table II.5). Of the bulk terminals storing gasoline, three-quarters have an average gasoline throughput that is less than 400,000 gallons/day of which almost half, 48%, are less than 200,000 gallons/day.

4. Ownership

Major and semi-major oil companies[1] own the majority of the product bulk terminals and the gasoline terminals with 67% and 72%, respectively (Table II.6). Independents, including regional refiners, marketer/wholesalers, jobbers[2] and bulk liquid warehousers,[3] own the remaining 33% and 28%. Majors also own a proportionately greater

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[1] Hereafter referred to as simply majors. For a listing of the individual companies comprising these two groups, see Appendix B.

[2] A jobber is a petroleum distributor who purchases refined product from a refiner or terminal operator for the purpose of reselling to retail outlets, commercial and agricultural accounts, or through his own retail outlets.

[3] Bulk liquid warehousers only store petroleum products at their terminals for a fee and do not market the product themselves.

TABLE II.4

BULK TERMINAL STORAGE DISTRIBUTION

Total Storage Capacity		ALL PETROLEUM TERMINALS		TERMINALS STORING GASOLINE	
Thousand Barrels	Thousand Cu. Meters	Number of Terminals	Percent of Total	Number of Terminals	Percent of Total
>200	>30	834	48%	764	50%
200-600	30-95	534	30%	423	28%
600-1,000	95-160	215	12%	192	13%
<1,000	<160	168	10%	132	9%
TOTAL		1,751	100%	1,511	100%

Source: Bureau of Census, 1972 Census of Wholesale Trade; U.S. Army Corps of Engineers, Port Series; National Petroleum News, Factbook (1972-1978); Independent Liquid Terminals Association, 1978 Directory - Bulk Liquid Terminals and Storage Facilities; Industry contacts; Arthur D. Little, Inc.

TABLE II.5

BULK TERMINAL THROUGHPUT DISTRIBUTION

ALL PETROLEUM TERMINALS				TERMINALS STORING GASOLINE			
Average Product Throughput		Number of Terminals	Percent of Total	Average Gasoline Throughput		Number of Terminals	Percent of Total
Thousand Gallons/Day	Cubic Meters/Day			Thousand Gallons/Day	Cubic Meters/Day		
<170	<640	626	36%	<200	<750	728	48%
170-670	640-2,540	475	27%	200-400	750-1,510	401	27%
670-1,850	2,540-7,000	375	21%	400-600	1,510-2,270	312	21%
>1,850	>7,000	275	16%	>600	>2,270	70	4%
Total		1,751	100%			1,511	100%

Source: Bureau of Census, 1972 Census of Wholesale Trade; Industry Contacts; Arthur D. Little, Inc.

TABLE II.6

1978 BULK TERMINAL OWNERSHIP

Ownership Segment	ALL PETROLEUM TERMINALS: Number of Terminals	ALL PETROLEUM TERMINALS: Percent of Total	TERMINALS STORING GASOLINE: Number of Terminals	TERMINALS STORING GASOLINE: Percent of Total
Majors & Semi-Majors	1,170	67%	1,086	72%
Independents	581	33%	425	28%
Total	1,751	100%	1,511	100%

Source: U.S. Army Corps of Engineers, Port Series; National Petroleum News, Factbook (1972-1978); Independent Liquid Terminals Association, 1978 Directory - Bulk Liquid Terminals and Storage Facilities; Industry contacts; Arthur D. Little, Inc.

number of the larger terminals than do the independents. While majors own approximately 72% of all gasoline terminals, they own over 84% of those facilities having a total storage capacity greater than 200,000 barrels, but only 59% of the gasoline terminals having a total storage less than 200,000 barrels (Table II.7). This disparity is expected to grow as majors shift a larger portion of their operations from smaller to larger terminals due to the greater efficiencies of the larger facilities.

5. Employment

The number of employees in the bulk terminal industry in 1978 was approximately 35,700 (Table II.8). This figure represents a decline of 11% from the 40,220 employees reported in 1972 by the Department of Commerce. The employment level at gasoline bulk terminals in 1978 was estimated at 30,830, or 86% of total terminal employment. Employment levels have fallen over this period because of bulk terminal closures and consolidations, and because of the industry's trend towards greater automation as a means of increasing efficiencies and reducing labor costs. Since most of the bulk terminals are located in PADD's I and II, these regions account for over three-quarters of the industry's employment.

C. BULK TERMINAL TRENDS

1. New Construction

Recent gasoline demand forecasts have indicated that only a modest increase in consumption is likely through 1980 and that a demand downturn will occur by the early 1980's and continue through 1990 (Table II.9). It is, therefore, reasonable to conclude that the construction of new bulk terminals to handle significant additional quantities of gasoline throughput will not be necessary, although gasoline storage at existing facilities in selected growth areas will probably increase. This conclusion is supported by discussions with industry sources which indicated that few, if any, new gasoline terminals are expected to be built in the foreseeable future.

TABLE II.7

GASOLINE TERMINAL DISTRIBUTION BY SIZE AND OWNERSHIP

— PERCENT OF TERMINALS STORING GASOLINE —

Total Storage Capacity		Majors and Semi-Majors	Independents	Percent of Total	Total Number of Terminals Storing Gasoline
Thousand Barrels	Thousand Cu. Meters				
< 200	< 30	30%	21%	50%	764
200-600	30-95	25%	3%	28%	423
600-1,000	95-160	10%	3%	13%	192
> 1,000	> 160	7%	2%	9%	132
Percent Total		72%	28%	100%	
Total Number of Gasoline Terminals		1,086	425		1,511

Source: Bureau of Census, 1972 Census of Wholesale Trade; U.S. Army Corps of Engineers, Port Series; National Petroleum News, Factbook (1972-1978); Independent Liquid Terminals Association, 1978 Directory - Bulk Liquid Terminals and Storage Facilities; Industry contacts; Arthur D. Little, Inc.

TABLE II.8

1978 BULK TERMINAL EMPLOYMENT

PADD	ALL PETROLEUM TERMINALS Employment	ALL PETROLEUM TERMINALS Percent of Total	TERMINALS STORING GASOLINE Employment	TERMINALS STORING GASOLINE Percent of Total
I	19,280	55%	17,000	56%
II	7,850	22%	6,280	20%
III	4,460	12%	3,770	12%
IV	440	1%	440	1%
V	3,670	10%	3,340	11%
Total	35,700	100%	30,830	100%

Source: Bureau of Census, 1972 Census of Wholesale Trade; U.S. Army Corp of Engineers; Port Series; National Petroleum News, Factbook, (1972-1978); Industry contacts; Arthur D. Little, Inc.

TABLE II.9

A COMPARISON OF RECENT FORECASTS OF U.S. GASOLINE CONSUMPTION

(Millions of Barrels/Day)

	1980	1985	1990
Study for DOE by Energy and Environmental Analysis (January 1979)[1]	6,769	6,175	5,673
PIRINC (March 1979)	7,561	--	--
Shell (July 1978)[2]	7,050	6,773	6,709
Bankers' Trust (October 1978)[3]			
Passenger Car Use	5,400	4,900	4,300
Other Vehicles & Off-Highway (ADL)	2,264	2,368	2,316
	7,664	7,268	6,616
Sun Petroleum (August 1978)	7,567	7,175	6,784
Arthur D. Little (May 1979)			
Low Case	7,384	6,790	6,151
High Case	7,384	6,797	6,464

[1] Excludes off-highway use, but includes all gasoline-powered vehicles.

[2] Shell forecast stated in crude oil equivalent. Conversion to barrels of gasoline assumes crude @ 5.6 MM Btu/Bbl and gasoline @ 5.25 MM Btu/Bbl.

[3] Bankers' Trust projections included only passenger car consumption. Arthur D. Little estimates for trucks, vessels, and off-highway have been added.

2. Existing Bulk Terminals

"Stand alone" economics and the market rationalization of petroleum companies are expected to continue exerting closure pressure on marginally profitable facilities. Although most closures and consolidations in the bulk terminal industry have already occurred, approximately 20 small marine terminals, or 3% of the terminals having an average daily gasoline throughput less than 200,000 gallons, are expected to close or to consolidate their operations between 1978 and 1983 (Figure II.4). The approximate magnitude of these closures, which represents less than 1% of the bulk terminal population, was also confirmed through industry discussions.

As marginal bulk terminals close, the average daily gasoline throughput at other nearby terminals will increase to compensate for the loss of those facilities. This phenomenon, however, will be more than offset by the long-term overall decline in gasoline consumption. A shift in ownership from majors to independents is also expected to occur as some majors either reduce their marketing activities or withdraw entirely from selected regions. Throughout the 1978-1983 period, bulk terminal employment is expected to decline as unprofitable facilities close. Employment will also decline as more bulk terminals install automated equipment in order to reduce labor costs and to increase marketing efficiencies.

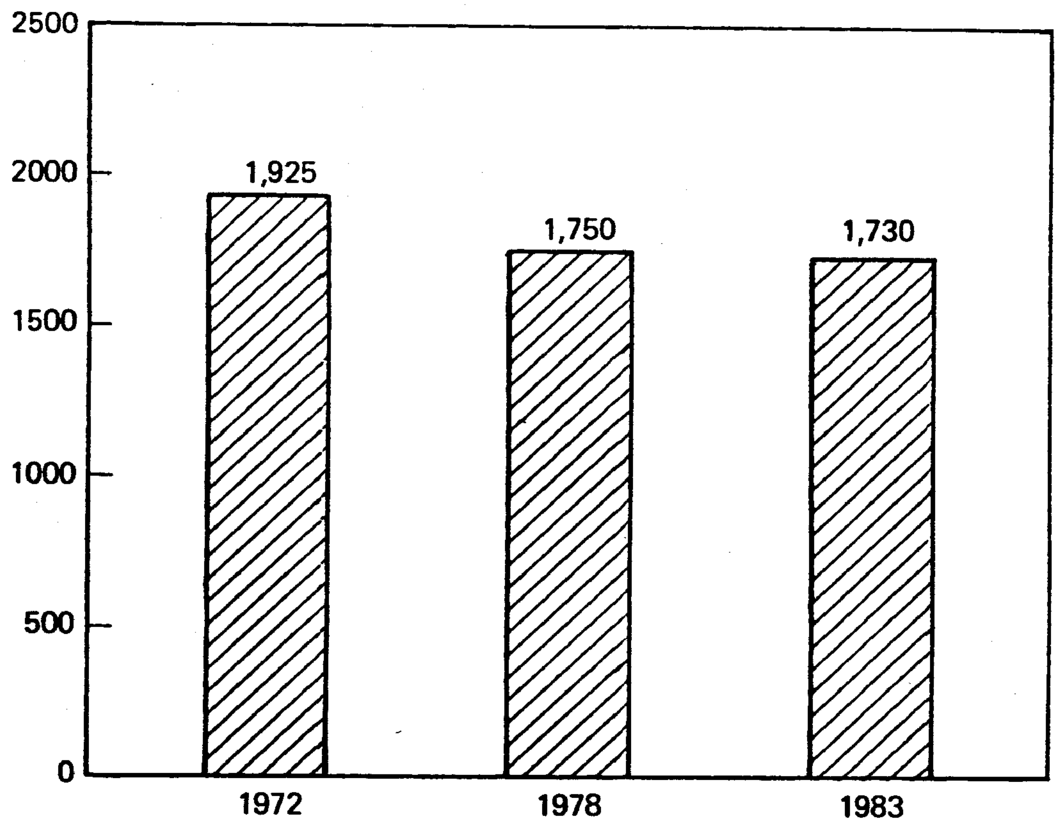


FIGURE II.4 ESTIMATED 1983 BULK TERMINAL POPULATION BEFORE VAPOR CONTROL IMPACTS

III. MARKET AUDIT OF BULK PLANTS

A. INTRODUCTION

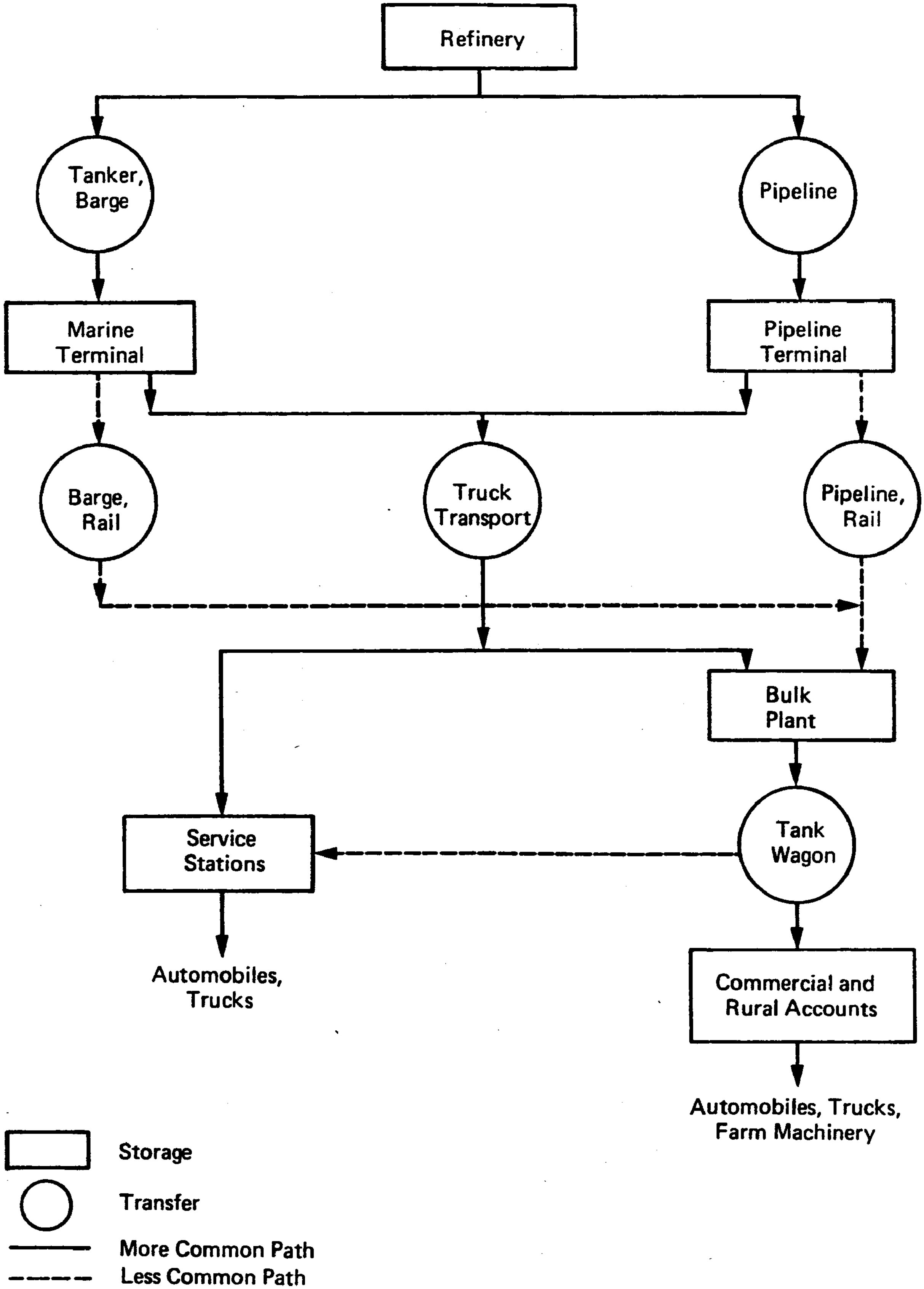
1. Definition and Operational Profile

As in the case of bulk terminals, the definition of petroleum bulk plants is more often derived from its function within the petroleum marketing network than from a well-defined set of physical characteristics. Therefore, within the scope of this study, we will define bulk plants as secondary bulk storage facilities which operate as satellite distribution centers of primary bulk terminals and which receive petroleum products from terminals by truck transport (Figure III.1). Some minor regional variations regarding the mode of delivery, however, do exist. Bulk plants supplied by rail are most common in the Rocky Mountain states and along the West Coast, pipeline deliveries occur in parts of the Northwest and Midwest, while barge transportation occurs along the coasts, particularly around the New York Harbor area. Since the proposed vapor control regulations will only impact those facilities storing and distributing gasoline, the following operational profile will focus on those bulk plants which are a part of the gasoline distribution network.

Bulk plants typically serve agricultural and commercial accounts in addition to retail outlets, and therefore, handle a variety of petroleum products, e.g., gasoline, kerosene, diesel fuel and distillates. Many of the bulk plants in the Northeast, however, tend to specialize in either gasoline or distillate sales. While most of the U.S. gasoline throughput moves directly from bulk terminals to service stations and large end-users by truck transport, bulk plants distribute gasoline via smaller tank wagons to accounts requiring small and infrequent deliveries, to customers whose storage capacities are insufficient to permit transport-sized drops, or to large-end users if the access roads are impassable to transport traffic. Tank wagons usually have tank capacities between 2,000 and 4,000 gallons and are owned by the bulk plant operator. Bulk plant operators, however, may also supply a number

FIGURE III.1

GASOLINE DISTRIBUTION NETWORK



of high volume accounts. Deliveries to these customers are made by truck transports directly from the bulk terminal, thereby bypassing storage at the bulk plant because of the costs associated with product handling. Only about 20% of the total U.S. gasoline throughput actually moves through bulk plant storage. This figure is expected to decline as increasing volumes of gasoline move directly from bulk terminals to retail outlets and end-users thus avoiding bulk plant storage.

2. Historical Market Environment

Bulk plants have experienced the same historical market conditions as bulk terminals and are subject to the same "stand alone" economics and rationalization process. A substantial number of bulk plants have already closed because of their poor profitability, and more closures are expected. However, some rural and semi-rural bulk plants will be more secure than their urban counterparts because their operations, and hence profitability, are partially shielded from competitive market forces by transportation economics.

B. AUDIT SUMMARY

The following discussion of the bulk plant industry will focus on five of its primary characteristics:

- Population
- Storage Capacity
- Size Distribution
- Ownership, and
- Employment

As in the case of the bulk terminal audit, the discussion of size distribution treats both shell storage capacity and average daily throughput. Additionally, regional differences or trends are identified whenever appropriate. Much of the information used in assembling this audit was obtained from the national and regional offices of the National

Oil Jobbers Council.[1] This data was supplemented and cross-checked with government and industry reports, field interviews, and in-house Arthur D. Little information in producing the final audit results.

1. Population

In 1978, there were approximately 18,640 petroleum bulk plants in the U.S. (Table III.1) representing a 20% decline from the 23,370 bulk plants reported by the Department of Commerce in 1972.[2] These closures have primarily been the result of adverse market conditions characterized by shrinking margins. Also, the withdrawal of the integrated oil companies from bulk plant operations removed the necessary financial subsidy required by marginal operations. Furthermore, the rationalization process of many gasoline marketers has resulted in the sale, closing or consolidation of bulk plant operations in certain areas.

Of the total 1978 bulk plant population, 96% or 17,850 bulk plants store gasoline. Bulk plants not storing gasoline may specialize in distillate fuels, lubes or specialty oils and are primarily located in the Northeast and Midwest (Table III.2). PADD's I and II together account for two-thirds of all bulk plants and two-thirds of those storing gasoline. Almost half, 47%, of all bulk plants and half, 48%, of the gasoline bulk plants are located in PADD II where distribution logistics and a high concentration of rural accounts warrant secondary petroleum storage.

2. Storage Capacity

Storage capacity at bulk plants has been declining as an increasing number of marginal facilities close. The total storage capacity of all bulk plants in 1978 was estimated at 1.8 billion gallons with gasoline storage capacity accounting for 1.1 billion gallons, or 60% of this

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[1] A jobber trade association

[2] Bureau of Census, 1972 Census of Wholesale Trade

TABLE III.1

1978 BULK PLANT POPULATION

PADD	ALL PETROLEUM BULK PLANTS: Number of Bulk Plants	Percent of Total	Total Storage Capacity: Thousand Gallons	Total Storage Capacity: Thousand Cu. Meters	Percent of Total	BULK PLANTS STORING GASOLINE: Number of Bulk Plants	Percent of Total	Gasoline Storage Capacity: Thousand Gallons	Gasoline Storage Capacity: Thousand Cu. Meters	Percent of Total
I	3,510	19%	433,290	1,641	24%	3,190	18%	250,270	947	24%
II	8,850	47%	710,670	2,691	40%	8,540	48%	401,830	1,521	38%
III	3,320	18%	253,380	958	14%	3,320	19%	187,190	709	18%
IV	990	5%	85,490	323	5%	990	5%	58,490	221	5%
V	1,970	11%	302,270	1,144	17%	1,810	10%	164,600	623	15%
Total	18,640	100%	1,785,100	6,757	100%	17,850	100%	1,062,380	4,021	100%

Source: Bureau of Census, 1972 Census of Wholesale Trade; National Oil Jobbers Council; National Petroleum News, Factbook, (1972-1978); Industry contacts; Arthur D. Little, Inc.

TABLE III.2

NON-GASOLINE BULK PLANT DISTRIBUTION BY REGION AND OWNERSHIP

PADD	Majors & Semi-Majors	Jobbers	Total	Percent of Total
I	200	120	320	41%
II	170	140	310	39%
III	-	-	-	-
IV	-	-	-	-
V	130	30	160	20%
Total	500	290	790	100%
Percent of Total	63%	37%	100%	

Source: National Oil Jobbers Council; Miscellaneous Trade Associations; Industry contacts; Arthur D. Little, Inc.

total. Gasoline storage has been declining not only because of the number of bulk plant closures, but also because of the increasing amount gasoline throughput which is bypassing bulk plant storage and being delivered directly to service stations and end users. Because most of the bulk plant population is located in PADD's I and II, almost two-thirds of the total storage capacity, 64%, and gasoline capacity, 62%, is located in these two regions with PADD II accounting for 40% and 38%, respectively.

3. Size Distributions

a. Storage Capacity

Because bulk plant economics and operations are based upon a large number of annual tank turnovers, most facilities tend to be small. Over 90% of both petroleum and gasoline bulk plants have total storage capacities less than 150,000 gallons. Of this number, 79% are between 40,000 and 150,000 gallons (Table III.3). A more detailed presentation of bulk plant storage capacity appears in Appendix A.

b. Average Daily Throughput

Bulk plant operators will avoid storing petroleum products at bulk plants whenever possible. This will continue to exert downward pressure on all average product throughputs at bulk plants, gasoline in particular. Over 80% of all bulk plants have an average daily product throughput that is less than 8,000 gallons (Table III.4). Similarly, over 90% of the gasoline bulk plants have an average daily gasoline throughput less than 8,000 gallons. Most bulk plants have product or gasoline throughputs that are between 3,000 and 8,000 gallons/day.

4. Ownership

Jobbers[1] own the greatest number of bulk plants with 74% of all

[1] A jobber is a petroleum distributor who purchases product from a refiner or terminal operator for the purpose of reselling to retail outlets, commercial accounts or reselling through his own retail outlets.

TABLE III.3

BULK PLANT STORAGE DISTRIBUTION

Total Storage Capacity: Thousand Gallons	Total Storage Capacity: Cubic Meters	All Petroleum Bulk Plants: Number of Bulk Plants	All Petroleum Bulk Plants: Percent of Total	Bulk Plants Storing Gasoline: Number of Bulk Plants	Bulk Plants Storing Gasoline: Percent of Total
<40	<150	2,380	13%	2,380	13%
40-150	150-570	14,800	79%	14,100	79%
150-300	570-1,140	1,180	6%	1,100	6%
>300	>1,140	280	2%	260	2%
Total		18,640	100%	17,850	100%

Source: Bureau of Census, 1972 Census of Wholesale Trade; National Oil Jobbers Council; National Petroleum News, Factbook (1972-1978); Industry contacts; Arthur D. Little, Inc.

TABLE III.4

BULK PLANT THROUGHPUT DISTRIBUTION

ALL PETROLEUM BULK PLANTS				BULK PLANTS STORING GASOLINE			
Average Product Throughput		Number of Plants	Percent of Total	Average Gasoline Throughput		Number of Plants	Percent of Total
Thousand Gallons/Day	Cubic Meters/Day			Thousand Gallons/Day	Cubic Meters/Day		
<3	<10	4,400	24%	<3	<10	5,210	29%
3-8	10-30	10,760	58%	3-8	10-30	11,210	63%
8-17	30-65	2,650	14%	8-17	30-65	1,170	7%
>17	>65	830	4%	>17	>65	260	1%
Total		18,640	100%	Total		17,850	100%

Source: Bureau of Census, 1972 Census of Wholesale Trade; National Oil Jobbers Council; National Petroleum News, Factbook, (1972-1978); Industry contacts; Arthur D. Little, Inc.

bulk plants and 76% of all gasoline bulk plants (Table III.5). The majors own almost a quarter, 22%, of all bulk plants and a fifth of the gasoline bulk plants, while the independent marketers/wholesalers own less than 5% of either type. The jobbers' share of the market has been increasing steadily in recent years as the majors have pulled out of secondary storage operations as part of their overall marketing strategy. Jobbers also tend to own a proportionately greater number of small gasoline bulk plants, and proportionately fewer large bulk plants than either the majors or the independent marketers/wholesalers. Jobbers, who own 76% of all gasoline bulk plants, own over 82% of the smallest bulk plants having less than 40,000 gallons of storage capacity, but only 36% of the largest bulk plants having storage greater than 300,000 gallons (Table III.6). By contrast, the majors, who own 20% of the gasoline bulk plants, own over 75% of the largest facilities, but only 18% of the smallest bulk plants.

5. Employment

Bulk plant employment fell from 105,520 reported by the Department of Commerce in 1972 to an estimated 75,010 in 1978, a decline of 29% (Table III.7). The employment level at gasoline bulk plants was estimated at 72,130 or 96% of the total bulk plant employment. Because most of the bulk plants are located in PADD's I and II, almost three-quarters of the employment is also located in these two regions.

C. BULK PLANT TRENDS

1. New Construction

Because gasoline demand is not expected to increase substantially from present levels and because more gasoline volume will bypass storage at bulk plants, no new bulk plants or gasoline storage are expected to be built.

2. Existing Bulk Plants

Additional bulk plant closures are expected because of increasing market competition and the ongoing rationalization process of petroleum marketers which will continue to favor the larger, more efficient bulk

TABLE III.5

1978 BULK PLANT OWNERSHIP

Ownership Segment	ALL PETROLEUM BULK PLANTS: Number of Bulk Plants	ALL PETROLEUM BULK PLANTS: Percent of Total	BULK PLANTS STORING GASOLINE: Number of Bulk Plants	BULK PLANTS STORING GASOLINE: Percent of Total
Majors & Semi-Majors	4,110	22%	3,610	20%
Independent Marketers/ Wholesalers	770	4%	770	4%
Jobbers	13,760	74%	13,470	76%
Total	18,640	100%	17,850	100%

Source: National Oil Jobbers Council; National Petroleum News, Factbook (1972-1978); Industry contacts; Arthur D. Little, Inc.

TABLE III.6

GASOLINE BULK PLANT DISTRIBUTION BY SIZE AND OWNERSHIP

Total Storage Capacity: Thousand Gallons	Total Storage Capacity: Cubic Meters	Percent of Bulk Plants Storing Gasoline: Majors & Semi-Majors	Percent of Bulk Plants Storing Gasoline: Independent Marketers/ Wholesalers	Percent of Bulk Plants Storing Gasoline: Jobbers	Percent of Bulk Plants Storing Gasoline: Percent of Total	Total Number of Bulk Plants Storing Gasoline
<40	<150	2.0	0.4	11.0	13.4	2,380
40-150	150-570	16.2	3.5	59.3	79.0	14,100
150-300	570-1,140	1.2	0.3	4.7	6.2	1,110
>300	>1,140	0.8	0.1	0.5	1.4	260
Percent of Total		20.2	4.3	75.5	100.0	
Total Number of Bulk Plants Storing Gasoline		3,610	770	13,470		17,850

Source: Bureau of Census, 1972 Census of Wholesale Trade; National Oil Jobbers Council; National Petroleum News, Factbook (1972-1978); Industry contacts; Arthur D. Little, Inc.

TABLE III.7

1978 BULK PLANT EMPLOYMENT

PADD	ALL PETROLEUM BULK PLANTS		BULK PLANTS STORING GASOLINE	
	Employment	Percent of Total	Employment	Percent of Total
I	24,210	32%	22,850	32%
II	31,220	42%	30,180	42%
III	9,780	13%	9,780	13%
IV	3,520	5%	3,520	5%
V	6,280	8%	5,800	8%
Total	75,010	100%	72,130	100%

Source: Bureau of Census, 1972 Census of Wholesale Trade; National Oil Jobbers Council; National Petroleum News, Factbook (1972-1978); Industry contacts; Arthur D. Little, Inc.

plant operations. Based upon industry discussions with majors, independents and jobbers, an estimated 3,480 gasoline bulk plants are expected to close or be consolidated over the next 5 years, thereby reducing the bulk plant population to about 15,100 (Figure III.2). This decrease represents an average annual reduction in the bulk plant population of 4.2%, which is greater than the 1972-1978 average rate of decline of 3.7%. The increase in the rate of closures results from a more accelerated exodus from the bulk plant industry on the part of the majors and independents. The average annual decline in existing jobber operations was assumed to be only 2.5% in the above calculation. All 3,480 closures are expected to be bulk plants having less than 8,000 gallons of average daily gasoline throughput.

The ongoing shift of bulk plant ownership will continue to be a major consideration within the industry. Major oil companies are expected to continue to withdraw from bulk plant operations in most markets by attempting to sell their facilities. Between 1978 and 1983, 1,540 bulk plants are expected to be offered for sale by the majors with most of these facilities, i.e. 75%, being purchased by jobbers who will consolidate them with their existing operations (Table III.8). Some attrition, i.e. 25%, however, is expected to result from this ownership transfer as market conditions preclude total absorption of these facilities by the jobber network.

As bulk plants close, their gasoline throughput will be redistributed among other facilities. By 1983, the average annual gasoline throughput of the remaining bulk terminal population could increase by as much as 1,000 gallons/day. However, the actual incremental throughput will most likely be less than this figure for the following three reasons. First, overall gasoline demand is expected to decline from its current levels. Second, an increasing portion of bulk plants' gasoline sales will be delivered directly from the bulk terminal, thereby bypassing actual storage at the bulk plant. Third, the expanding marketing sphere

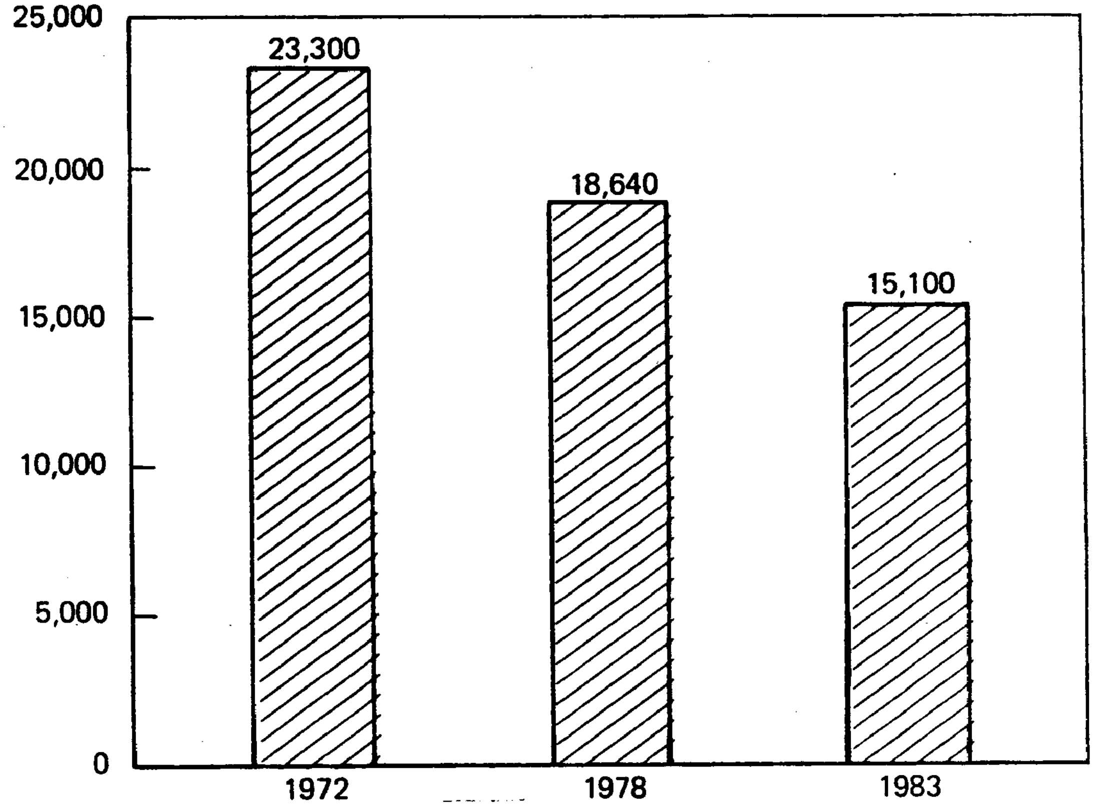


FIGURE III.2 ESTIMATED 1983 BULK PLANT POPULATION BEFORE VAPOR CONTROL IMPACTS

TABLE III.8

MARKET RATIONALIZATION OF
GASOLINE BULK PLANTS, 1978-1983

	Majors & Semi-Majors	Independent Marketers/ Wholesalers	Jobbers	Total
1978 Bulk Plant Population	3,610	770	13,470	17,850
Ownership Transfer	(1,150)	0	1,150	0
Closures Due To Market Rationalization	(390)	(170)	(2,920)	(3,480)
1983 Bulk Plant Population (Pre-Vapor Control)	2,070	600	11,700	14,370
Percent Decline 1978-1983	42.7%	22.1%	13.2%	19.5%

Source: Bureau of Census, 1972 Census of Wholesale Trade; National Oil Jobbers Council; National Petroleum News, Factbook, (1972-1978); Industry contacts; Arthur D. Little, Inc.

of bulk terminals will increase the competition between terminals and bulk plants and, through greater efficiencies and economies of scale, capture a portion of the bulk plants' existing gasoline throughput.

IV. VAPOR CONTROL STRATEGIES AND SYSTEM COSTS

A. INTRODUCTION

Gasoline vapors containing benzene and other hydrocarbons routinely escape into the atmosphere during normal bulk storage operations, e.g., whenever gasoline storage tanks are filled or delivery vehicles are loaded. The U.S. Environmental Protection Agency has defined three control strategies or options which would reduce the amount of benzene released into the atmosphere by controlling the resulting hydrocarbon vapors whenever gasoline is moved into or out of bulk storage. The darkened lines of Figure IV-1 indicate those segments of the gasoline distribution network addressed in this study by the three vapor control options. The EPA has requested that Arthur D. Little evaluate the economic impact of each option and has provided us with cost data for model vapor control systems, representing various technologies, which would comply with the proposed vapor control regulations. A discussion of each of the control options, as well as the costs of the model vapor control systems, is presented in this chapter.

B. VAPOR CONTROL OPTIONS

Before discussing the specific options to control gasoline vapor emissions at bulk storage facilities, it is first necessary to define an operational base case for the bulk storage industry. Then, each of the three control options, which will be measured relative to this base case, will be discussed.

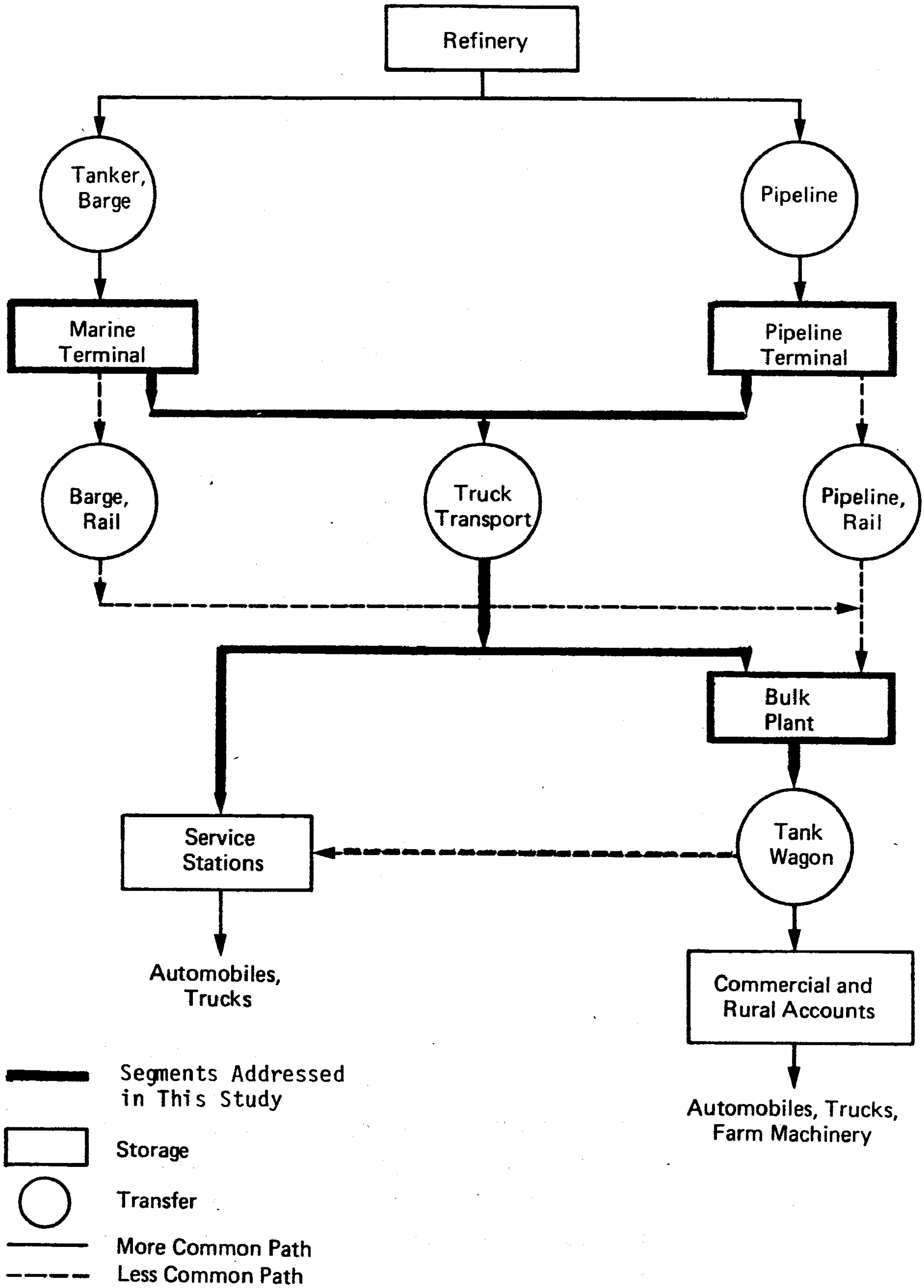
1. Base Case

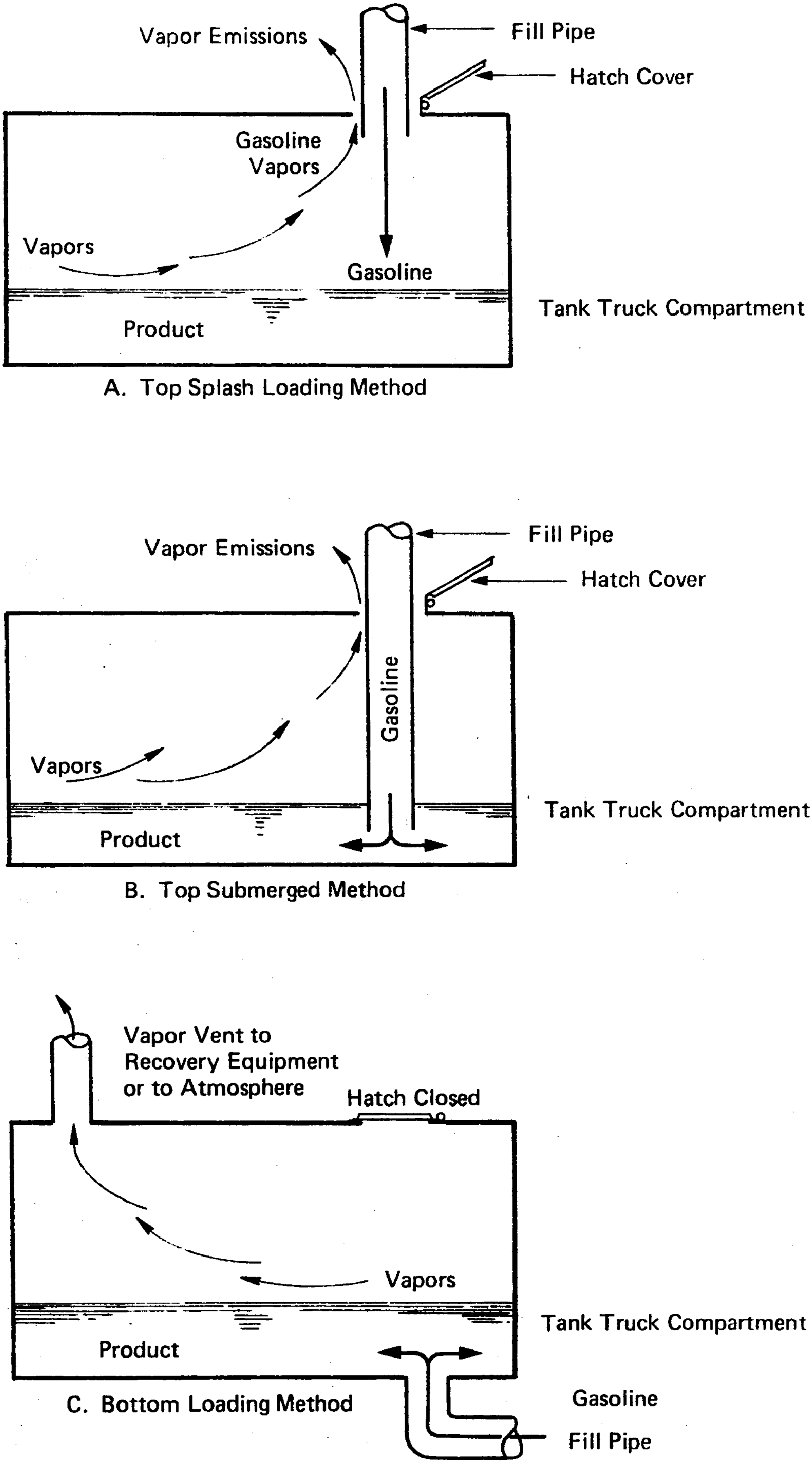
a. Bulk Terminals

In the base case, bulk terminals, which have not already installed vapor control systems required by the three control options, are assumed to load transports using the top-loading, submerged fill method. With this method, the loading arm of the gasoline rack enters the tank compartment and extends to within 6 inches of the bottom of the tank (Figure IV.2). This method reduces the amount of vapors that might form

FIGURE IV.1

GASOLINE DISTRIBUTION NETWORK





A. Top Splash Loading Method

B. Top Submerged Method

C. Bottom Loading Method

FIGURE IV.2 GASOLINE TANK TRUCK LOADING METHODS

within the tank compartment during the loading operation by reducing the turbulence of the gasoline as it fills the compartment. However, because the fill pipe entering the tank has a smaller diameter than the opening of the hatch cover, the space surrounding the fill pipe will still permit gasoline vapors to escape into the atmosphere as the liquid level rises. No control of these escaping vapors has been assumed in the base case. Approximately 1,980 metric tons of benzene would be released into the air annually by the bulk terminal industry if all terminals used this method of loading (Table IV.1).

b. Bulk Plants

Filling storage tanks accounts for over 30% of the annual benzene emissions at bulk plants. When a truck transport delivers gasoline to a bulk plant, gasoline is usually pumped into the storage tank through a pipe at the bottom of the tank. As the gasoline level in the storage tank rises, gasoline-saturated vapors are displaced and vented through a pressure-relief valve on the top of the tank. No control of these filling losses is assumed in the base case.

Almost 40% of total benzene emissions at bulk plants occurs during truck loading. In the base case, tank wagons are assumed to be loaded using the splash fill method. Splash fill, as its name implies, allows the gasoline to fall from the top of the tank compartment (Figure IV.2). This method of loading is considerably more turbulent than the submerged fill method and, hence, allows more gasoline vapors to form and subsequently escape. These vapors will be forced through the space between the hatch opening of the truck and the fill pipe of the loading rack by the rising gasoline level in the tank compartment. Storage tank filling and tank wagon loading together account for over 70% of the benzene emissions originating at bulk plants in the base case.

The remaining 30% of the benzene emissions results from storage tank emptying and breathing. As the gasoline storage tanks are emptied, the partial vacuum created within the tank draws in fresh air through the pressure-relief valve. The fresh air becomes saturated with gasoline

TABLE IV.1

BASE CASE EMISSIONS AT BULK STORAGE FACILITIES

Source	Hydrocarbon Emissions (mg/l)	Benzene Emissions (mg/l)	Annual Gasoline Throughput (l/yr)	National Benzene Emissions (metric tons/yr)
Bulk Terminal				
- Loading Trucks (top submerged)	600	4.8	413×10^9	1980
Bulk Plant				
- Tank Breathing	600	4.8		792
- Tank Emptying	460	3.7	165×10^9	607
- Tank Filling	1150	9.2		1518
- Truck Loading (splash fill)	1400	11.2	165×10^9	1848
Total				6745

Source: U.S. Environmental Protection Agency

vapors and expands, thus forcing a portion of the gasoline-saturated air back into the atmosphere through the pressure-relief valve. Similarly, breathing losses occur because temperature changes within the tank, cause the gasoline vapor to expand and to contract. As the tank is warmed, the gasoline vapor expands and a portion is vented through the pressure-relief valve. As the tank cools, the gasoline vapor within the tank contracts and draws in fresh air, which will eventually become saturated with gasoline vapors. In addition to ambient temperature, breathing losses are affected by a number of factors, including the color and the condition of the storage tanks.

2. Option 1

Option 1 provides the least amount of benzene reduction of the three control options. This option only reduces the benzene emissions by about 64% from the base case level. Under this option, all terminals must install control systems to collect and dispose of gasoline vapors resulting from truck transport loading. Truck transports delivering gasoline would also have to be equipped to handle vapor control. These systems may either capture and reliquify gasoline vapors, returning the liquid to the storage tanks, or oxidize the collected vapors. Examples of vapor control systems which reliquify gasoline vapors include refrigeration (RF), compression-refrigeration-absorption (CRA), and adsorption-absorption (AA). An incineration system (OX) will oxidize the collected vapors. All of these technologies are currently in use by the bulk storage industry, although the refrigeration system is the most common. These systems are considered to be the most effective vapor control methods at bulk terminals, capable of reducing benzene emissions by 95%.

Bulk plants would be required to stop splash loading tank wagons and to balance storage tanks to incoming truck transports during storage tank loading. Operators would now have to use either a top-loading or bottom-loading submerged fill method when loading their tank wagons (Figure IV.2). Most bulk plants now employing splash fill will most likely switch to the top-loading, submerged fill method because its conversion costs are significantly less than the conversion costs associated with a bottom-loading system. Vapors displaced from the storage tanks by the rising liquid level during tank filling would no longer be allowed to escape into the air. These vapors would be captured at the pressure-relief valve and "balanced" or sent to the truck transport making the gasoline delivery. Vapors would then accumulate in the emptying tank compartments of the truck and be returned by the transport to the bulk terminal for eventual collection and disposal during the transport's next loading (Figure IV.3). Accounts serviced by bulk plants would be exempted from vapor balancing as the tank wagons would not be equipped to handle those vapors. However, retail accounts would be required to install submerged fill systems for their storage tanks.

3. Option 2

Option 2 is a more effective control strategy than Option 1, with a level of benzene emission that is 82% lower than the base case (Table IV.2). Bulk terminals would be required to employ the same degree of vapor control under this option as in Option 1, i.e., refrigeration, compression-refrigeration-absorption, adsorption-absorption, oxidation or the equivalent. Benzene emissions from bulk terminals in this option would also be the same as in Option 1.

Bulk plants would still load their tank wagons using a submerged fill method. However, they would also be required to install a balance system on all tank wagons in addition to the balance system on storage tanks required by Option 1. Tank wagons would then be modified in order to receive gasoline vapors while filling tanks at retail outlets and to transport these vapors back to the bulk plant. During subsequent tank wagon loading, the gasoline vapors, which would have escaped through the hatch opening in Option 1, will now be collected and sent to the emptying storage tank (Figure IV.4). These vapors, which are "balanced to storage," will eventually be "balanced to transport" during the next transport delivery and be returned to the bulk terminal for ultimate disposal. With

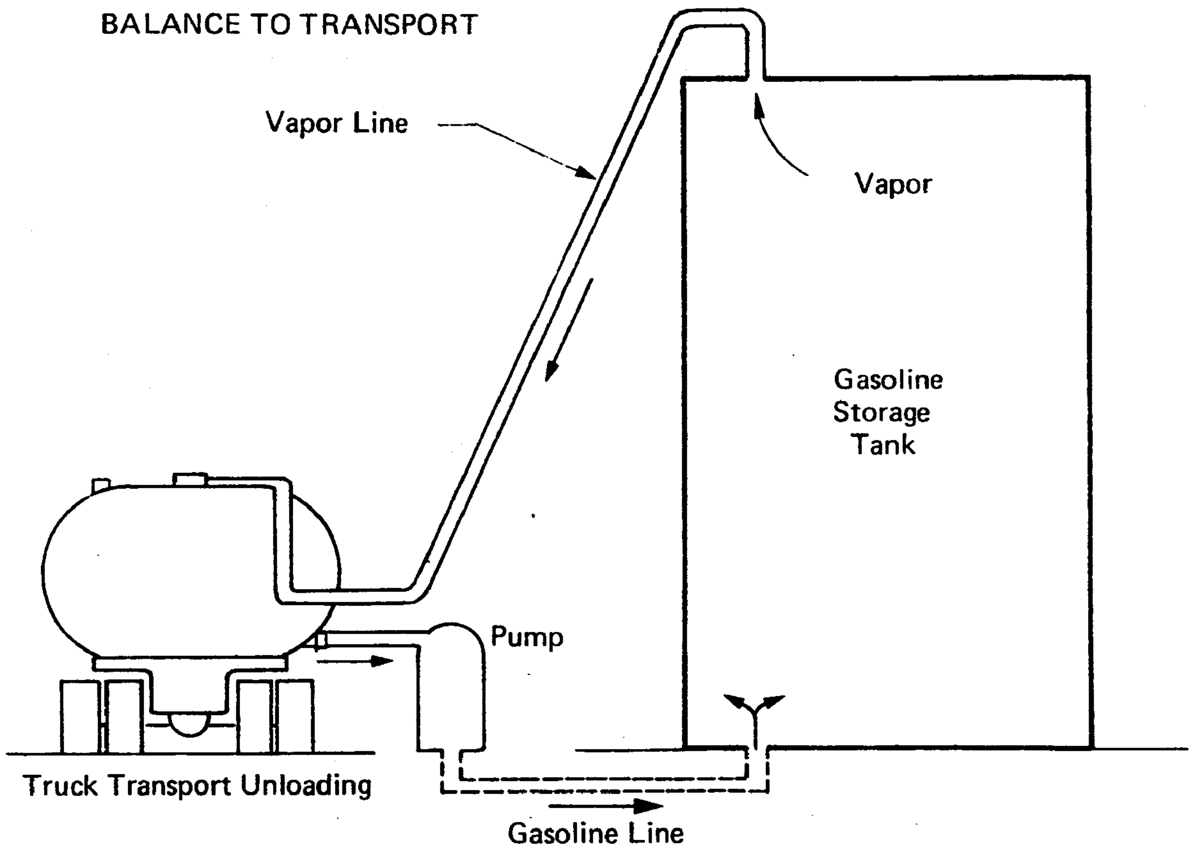


FIGURE IV.3 VAPOR BALANCED TO TRUCK TRANSPORT DURING STORAGE TANK LOADING

TABLE IV.2

NATIONAL BENZENE EMISSIONS UNDER VAPOR CONTROL OPTIONS

(Metric tons/year)

	CONTROL SCENARIO			
Source	Base Case	Option 1	Option 2	Option 3
Bulk Terminal				
- Loading Trucks	1980	100	100	100
Bulk Plants				
- Tank Breathing	792	792	792	792
- Tank Emptying	607	607	0	60
- Tank Filling	1518	152	152	152
- Truck Loading	1848	792	185	185
Total	6745	2443	1229	576
Percent Reduction from Base Case		64%	82%	91%

Source: U.S. Environmental Protection Agency

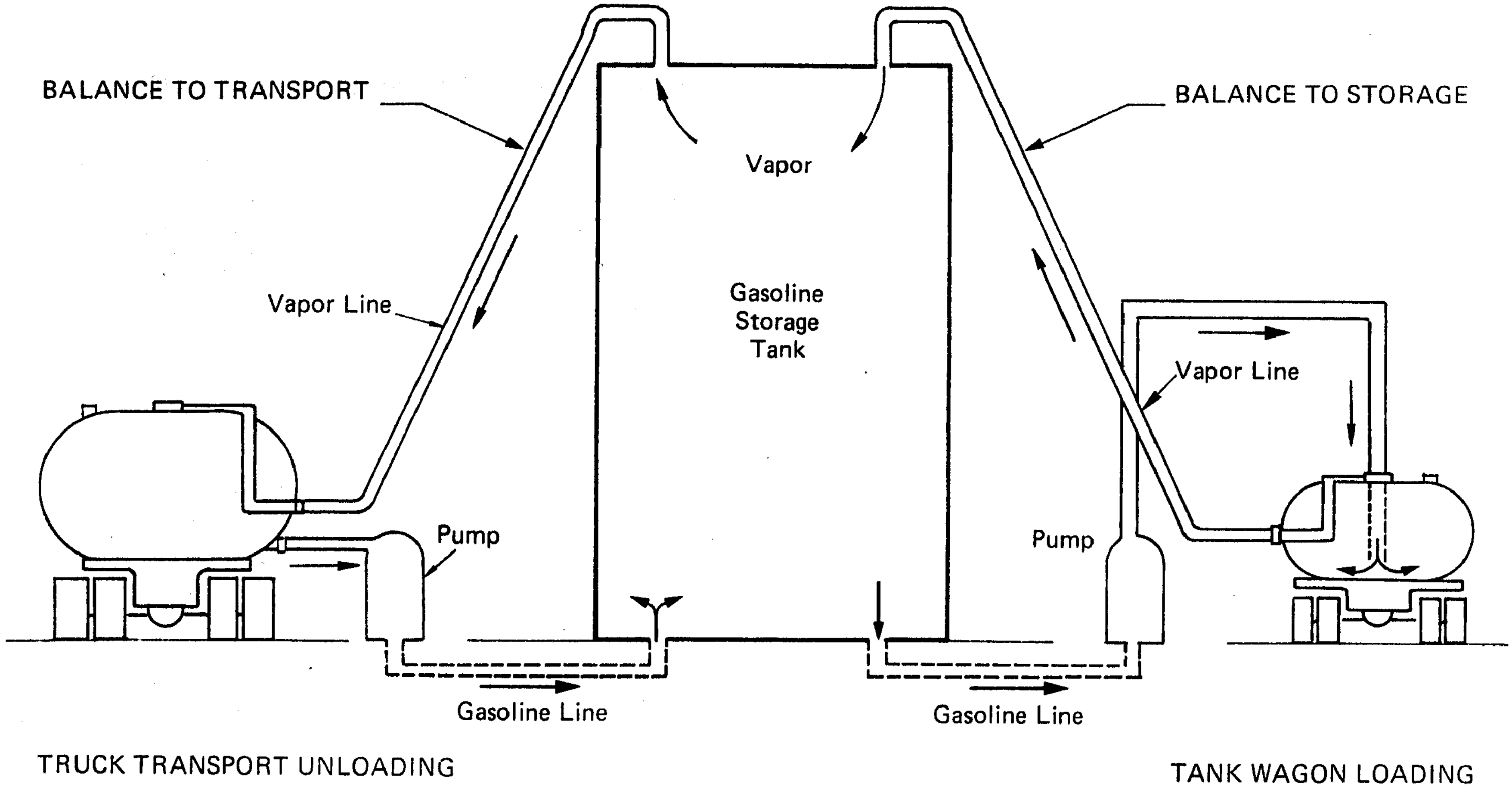


FIGURE IV.4 VAPOR BALANCE SYSTEMS AT BULK STORAGE PLANTS a full balance system, bulk plant benzene emissions are reduced by almost 50% over Option 1. This decline occurs not only because gasoline vapor emissions during tank wagon loading are substantially reduced, but also because the emptying storage tank is now being filled with gasoline-saturated vapor instead of fresh air drawn in through the pressure-relief valve.

4. Option 3

Option 3 provides the greatest reduction in benzene emissions of the three control options with an annual benzene level 91% below the base case. Again, the control requirements and the benzene levels at bulk terminals are exactly the same as they were in Option 1. Bulk plants, however, would not be required to install vapor collection and disposal systems similar to those required at bulk terminals, e.g. refrigeration, compression-refrigeration-absorption, adsorption-absorption, oxidation or the equivalent. These control systems would be of a smaller scale than those at terminals, but all vapors would be collected and disposed of on-site. No vapors would be "balanced to transport" and returned to the bulk terminal. All retail outlets serviced by bulk plants would be required to install vapor balance systems. A brief summary of the base case assumptions and the proposed vapor control regulations is presented in Table IV.3.

5. Stand-By Systems

It is the intention of the EPA that no gasoline loading be performed at bulk terminals or bulk plants if the continuous and efficient operation of the vapor control systems cannot be assured. A bulk storage facility would have three alternatives should its vapor control system become temporarily inoperative:

- switch to a stand-by system,
- utilize a gasoline vapor holder to collect vapors until the control system is operational, or
- shut down gasoline loading operations until the control system is operational.

TABLE IV.3

VAPOR CONTROL OPTIONS AT GASOLINE BULK STORAGE FACILITIES

	CONTROL SCENARIO			
Source	Base Case[a]	Option 1[b]	Option 2[c]	Option 3[c]
Terminals				
Filling Truck Transports At The Loading Rack	Top Submerged Fill	Vapor Recovery or Incineration	Vapor Recovery or Incineration	Vapor Recovery or Incineration
Bulk Plants				
Filling Gasoline Storage Tanks	Bottom Fill	Balance to Transport	Balance to Transport	Vapor Recovery or Incineration
Filling Tank Wagons At The Loading Rack	Splash Fill	Submerged Fill	Balance to Storage	Vapor Recovery or Incineration

[a]Most common current industry practice.

[b]Vapors from all gasoline stations supplied from terminals will be balanced to the truck transport. Vapors from gasoline stations supplied from bulk plants will not be balanced to the tank wagons.

[c]Vapors from all gasoline stations will be balanced to the supplying vehicles. Service station tanks will be loaded via submerged fill.

Source: U.S. Environmental Protection Agency

These alternatives will not significantly affect the vapor balance systems since they are not as susceptible to mechanical failure as the collection and disposal systems, e.g., refrigeration, CRA, incineration, etc.

The EPA has provided Arthur D. Little with cost data for the first two alternatives shown above. Based on estimated capital requirements, a stand-by system was selected as the less expensive alternative that would assure that gasoline vapors were continuously controlled. The stand-by system selected for use in both terminals and bulk plants was the incineration system. This stand-by system had the least capital requirement of any of the technologies evaluated. Because both the decision to shut down gasoline loading operations and the costs incurred from such a decision would vary considerably from one installation to another, evaluating this alternative was considered to be outside the scope of this study. It may, however, be a viable alternative for some facilities having very small gasoline throughputs.

C. VAPOR CONTROL SYSTEM COSTS

1. Bulk Terminals

Because the level of vapor control at terminals is the same for each of the three options discussed in the previous section, the EPA provided Arthur D. Little with one set of costs for the various primary control systems currently available to terminal operations. Cost information was also provided for an incineration stand-by system should such a system be required. This cost data was prepared for two bulk terminal models: 250,000 gallons/day and 500,000 gallons/day of gasoline throughput.

Representative costs of primary control systems, i.e., no stand-by system, are shown in Table IV.4. Installed capital costs range from $144,000 for an incineration unit in a terminal having 250,000 gallons of daily gasoline throughput to $328,000 for a CRA unit in a terminal having 500,000 gallons of throughput. All of the capital costs presented in this report exclude the cost of monitoring equipment which has been

TABLE IV.4

ESTIMATED 1978 CONTROL COSTS FOR PRIMARY VAPOR CONTROL SYSTEMS AT MODEL TERMINALS
(Thousand Dollars)

Gasoline Loading Rate:	250,000 Gallons/Day				500,000 Gallons/Day			
Vapor Control System:	ADSORPTION/ ABSORPTION	COMPRESSION/ REFRIGERATION ABSORPTION	INCINERATION	REFRIGERATION	ADSORPTION/ ABSORPTION	COMPRESSION/ REFRIGERATION ABSORPTION	INCINERATION	REFRIGERATI
Installed Capital Cost	240.0	256.0	144.0	204.0	310.0	328.0	190.0	306.0
Annual Operating Costs								
Electricity	3.9	5.1	2.9	9.9	7.8	8.3	5.8	19.8
Propane (Pilot)	--	--	1.0	--	--	--	1.0	--
Maintenance	4.8	5.1	2.9	6.1	6.2	6.6	3.8	9.2
Operating Labor	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Carbon Replacement	2.4	--	--	--	4.7	--	--	--
Taxes, Insurance, G & A	9.6	10.2	5.8	8.2	12.4	13.1	7.6	12.2
TOTAL OPERATING COSTS	22.2	21.9	14.1	25.7	32.6	29.5	19.7	42.7
GASOLINE RECOVERY CREDIT	39.2	39.2	--	39.2	78.4	78.4	--	78.4

Source: U. S. Environmental Protection Agency estimated at an additional $20,000. Operating costs are least expensive for the incineration systems and most expensive for the refrigeration systems. The gasoline recovery credit shown in Table IV.4 and in subsequent tables is the value to the terminal or bulk plant operator of the recovered gasoline volumes that would have otherwise been lost into the atmosphere. These credits were calculated by the EPA using $.40 per gallon times the terminal's annual throughput assuming that 100% of the available gasoline vapor is collected at the loading rack. All of the recovery system, i.e., refrigeration, CRA and adsorption-absorption, have been assumed to be equally efficient and, hence, realize the same recovery credit. Because the refrigeration and incineration units have the least capital cost and are the most common control systems in operation today, they were selected for use in our analysis, i.e., to determine the number of potential bulk terminal closures and the costs of nationwide compliance.

The costs of an incineration stand-by unit and the costs of combined primary/stand-by systems, e.g., refrigeration/incineration and incineration/incineration, are shown in Table IV.5. The total capital cost of these systems ranges from $239,000 for a 250,000 gallon/day incineration/incineration system to $436,000 for a 500,000 gallon/day refrigeration/incineration system. Operating costs of these dual systems are the sum of the operating expenses of the primary and the stand-by units. The gasoline recovery credit for the refrigeration/incineration system is 5% less than the recovery credit of the single refrigeration unit because of losses resulting from system testing and the periodic overhaul of the combined control unit. Refrigeration and incineration systems with incineration stand-by were also selected for the closure and cost analysis. Additional cost data and assumptions used in calculating the model control system costs are presented in Appendix D.

TABLE IV.5

ESTIMATED 1978 CONTROL COSTS FOR STAND-BY VAPOR CONTROL SYSTEM AT MODEL TERMINALS

(Thousand Dollars)

Gasoline Loading Rate:	250,000 Gallons/Day			500,000 Gallons/Day		
	STAND-BY INCINERATION	REFRIGERATION/ INCINERATION	INCINERATION/ INCINERATION	STAND-BY INCINERATION	REFRIGERATION/ INCINERATION	INCINERATION/ INCINERATION
Installed Capital Cost	95.0	299.0	239.0	126.0	436.0	316.0
Annual Operating Costs						
Utility	--	9.9	3.9	--	17.8	6.8
Maintenance, Labor & Materials	2.9	10.5	7.3	3.8	16.2	9.1
Taxes, Insurance, G & A	3.8	12.0	9.6	5.0	17.4	12.6
TOTAL OPERATING COSTS	6.7	32.4	20.8	8.8	51.4	28.5
GASOLINE RECOVERY CREDIT	--	37.2	--	--	74.5	--

Source: U.S. Environmental Protection Agency

2. Conversion of the Truck Transport Fleet

The cost of modifying the truck transport fleet is not included in the bulk terminal costs discussed above. These expenses will be incurred by common carriers and terminal operators who own almost all of the gasoline transports. The EPA has estimated that the installed capital cost of the vapor control equipment for a four-compartment tank trailer to be $2,100, if retrofitting, and $1,900, if ordering vapor control equipment on a new trailer (Table IV.6). These costs include co-axial elbows and hoses, vents and gaskets. Annual maintenance and miscellaneous operating expenses are estimated to total $350.

3. Bulk Plants

The EPA has compiled control system costs for each of the three control options discussed above. Vapor control system costs were calculated for two bulk plant models: 4,000 gallons/day and 20,000 gallons/day of gasoline throughput. However, for each control option and bulk plant model, there are three distinct and possible control systems:

- NOJC[1] - the most expensive control system described by McCormack and Schuster of the California Independent Oil Marketers Association.
- Houston-Galveston - a top-loading version of the Wiggins System.
- Colorado APCD - the least expensive control system reported by the Colorado Air Pollution Control Division (APCD).

The EPA has assumed that all of the above systems are equally efficient in controlling gasoline vapors for each one of the three control options.

For the purpose of our analysis, it was assumed that bulk plant operators would choose a top-loading system in order to comply with the three vapor control options. The top-loading method was selected because it is generally a less expensive modification than a conversion to bottom-loading. Some bulk plants, however, may choose a bottom-loading system for reasons of efficiency and safety. However, because

[1]National Oil Jobbers Council, a jobber trade association.

TABLE IV.6

ESTIMATED 1978 COST OF VAPOR
CONTROL IN GASOLINE TANK TRAILERS
(Thousand Dollars Per Trailer[1])

	Retrofit Market	New Market
Installed Capital Cost	2.10	1.90
Annual Operating Costs		
Maintenance & Labor	0.27	0.27
Taxes, Insurance, G & A	0.08	0.08
Total Operating Costs	0.35	0.35

[1] Assuming four compartments per trailer

Source: U.S. Environmental Protection Agency

the bulk plants that might decide upon a bottom-loading system would be facilities in a stronger financial position relative to the rest of the industry, their decision to go with a bottom-loading system would not significantly affect the results of our closure analysis.

The costs of the three control systems, i.e., NOJC, Houston-Galveston, and Colorado APCD, for each of the three control options are presented in Tables IV.7 through IV.12. Estimated capital costs for Option 1 range from $2,000 to $4,000 (Table IV.7). The capital requirement necessary to comply with Option 2 regulations is $24,000 for the NOJC system, six times the capital requirement of the Colorado APCD system to achieve the same level of vapor control (Table IV.8). Four alternative system configurations are presented for Option 3. The costs for the primary refrigeration and incineration units are shown in Tables IV.9 and IV.10, respectively. Because neither of these includes a stand-by unit, costs were also calculated for a refrigeration/incineration system and an incineration/incineration system (Tables IV.11 and IV.12). Installed capital costs required to comply with Option 3's vapor regulations range from $30,000 for a primary unit to over $120,000 for a primary/stand-by system.

TABLE IV.7

OPTION 1

ESTIMATED 1978 COSTS TO INSTALL A VAPOR BALANCE SYSTEM AT BULK PLANTS FOR INCOMING TRUCK TRANSPORTS[1]
(Thousand Dollars)

	COST SCENARIO					
	NOJC COSTS		HOUSTON-GALVESTON COSTS		COLORADO APCD COSTS	
Daily Gasoline Throughput:	4,000 Gal/Day	20,000 Gal/Day	4,000 Gal/Day	20,000 Gal/Day	4,000 Gal/Day	20,000 Gal/Day
Installed Capital Cost	4.25	4.25	4.25	4.25	1.70	1.70
Annual Operating Cost						
Labor	--	--	--	--	--	--
Utilities	--	--	--	--	--	--
Maintenance	0.13	0.13	0.13	0.13	0.05	0.05
Taxes, Insurance, G&A	0.17	0.17	0.17	0.17	0.07	0.07
Total Operating Cost	0.30	0.30	0.30	0.30	0.12	0.12
Gasoline Recovery Credit	0.51	2.59	0.51	2.59	0.51	2.59

[1]Assumes top submerged loading of tank wagons at bulk plants.

Source: U.S. Environmental Protection Agency

TABLE IV.8

OPTION 2

ESTIMATED 1978 COSTS TO INSTALL A VAPOR BALANCE SYSTEM AT BULK PLANTS FOR INCOMING AND OUTGOING TRUCKS[1]
(Thousand Dollars)

	COST SCENARIO					
	NOJC COSTS		HOUSTON-GALVESTON COSTS		COLORADO APCD COSTS	
Daily Gasoline Throughput:	4,000 Gal/Day	20,000 Gal/Day	4,000 Gal/Day	20,000 Gal/Day	4,000 Gal/Day	20,000 Gal/Day
Installed Capital Cost	23.03	25.73	10.70	12.98	3.84	4.88
Annual Operating Cost						
Labor	--	--	--	--	--	--
Utilities	--	--	--	--	--	--
Maintenance	0.69	0.77	0.32	0.39	0.12	0.15
Taxes, Insurance, G&A	0.92	1.03	0.43	0.52	0.15	0.20
Total Operating Cost	1.61	1.80	0.75	0.91	0.27	0.35
Gasoline Recovery Credit	0.81	4.08	0.81	4.08	0.81	4.08

[1]Assumes top sumberged loading of tank wagons at bulk plants.

Source: U.S. Environmental Protection Agency

TABLE IV.9

OPTION 3

ESTIMATED 1978 COSTS TO INSTALL A SINGLE PRIMARY VAPOR REFRIGERATION SYSTEM AT BULK PLANTS[1]
(Thousand Dollars)

	COST SCENARIO					
	NOJC COSTS		HOUSTON-GALVESTON COSTS		COLORADO APCD COSTS	
Daily Gasoline Throughput:	4,000 Gal/Day	20,000 Gal/Day	4,000 Gal/Day	20,000 Gal/Day	4,000 Gal/Day	20,000 Gal/Day
Installed Capital Cost	92.18	94.88	79.85	82.13	72.99	74.03
Annual Operating Cost						
Labor	1.43	1.43	1.43	1.43	1.43	1.43
Utilities	2.17	2.17	2.17	2.17	2.17	2.17
Maintenance	3.28	3.36	2.91	2.98	2.71	2.74
Taxes, Insurance, G&A	3.69	3.80	3.19	3.29	2.92	2.96
Total Operating Cost	10.57	10.76	9.70	9.87	9.23	9.30
Gasoline Recovery Credit	2.19	11.11	2.19	11.11	2.19	11.11

[1]Assumes top submerged loading of tank wagons at bulk plants

Source: U.S. Environmental Protection Agency

TABLE IV.10

OPTION 3

ESTIMATED 1978 COSTS TO INSTALL A PRIMARY VAPOR INCINERATION SYSTEM AT BULK PLANTS[1]
(Thousand Dollars)

	COST SCENARIO					
	NOJC COSTS		HOUSTON-GALVESTON COSTS		COLORADO APCD COSTS	
Daily Gasoline Throughput:	4,000 Gal/Day	20,000 Gal/Day	4,000 Gal/Day	20,000 Gal/Day	4,000 Gal/Day	20,000 Gal/Day
Installed Capital Cost	48.32	50.99	35.96	38.24	29.10	30.14
Annual Operating Cost						
Labor	1.43	1.43	1.43	1.43	1.43	1.43
Utilities	0.16	0.16	0.16	0.16	0.16	0.16
Maintenance	1.31	1.39	0.94	1.01	0.74	0.77
Taxes, Insurance, G&A	1.93	2.04	1.44	1.53	1.16	1.21
Total Operating Cost	4.83	5.02	3.97	4.13	3.49	3.57
Gasoline Recovery Credit[2]	--	--	--	--	--	--

[1] Assumes top submerged loading of tank wagons at bulk plants
[2] No gasoline recovery credit when using an incineration system

Source: U.S. Environmental Protection Agency

TABLE IV.11

OPTION 3

ESTIMATED 1978 COSTS TO INSTALL A PRIMARY REFRIGERATION AND A STAND-BY INCINERATION SYSTEM AT BULK PLANTS[1]
(Thousand Dollars)

	COST SCENARIO					
	NOJC COSTS		HOUSTON-GALVESTON COSTS		COLORADO APCD COSTS	
Daily Gasoline Throughput:	4,000 Gal/Day	20,000 Gal/Day	4,000 Gal/Day	20,000 Gal/Day	4,000 Gal/Day	20,000 Gal/Day
Installed Capital Cost	117.42	120.12	105.09	107.37	98.23	99.27
Annual Operating Cost						
Labor	1.43	1.43	1.43	1.43	1.43	1.43
Utilities	2.17	2.17	2.17	2.17	2.17	2.17
Maintenance	3.59	3.67	3.22	3.29	3.02	3.05
Taxes, Insurance, G&A	4.70	4.80	4.20	4.29	3.93	3.97
Total Operating Cost	11.89	12.07	11.40	11.18	10.55	10.62
Gasoline Recovery Credit[2]	2.08	10.55	2.08	10.55	2.08	10.55

[1]Assumes top submerged loading of tank wagons at bulk plants.

[2]The gasoline recovery credit has been adjusted to reflect that no credit will be realized when the stand-by system is operating.

Source: U.S. Environmental Protection Agency

TABLE IV.12

OPTION 3

ESTIMATED 1978 COSTS TO INSTALL A PRIMARY INCINERATION AND A STAND-BY INCINERATION SYSTEM AT BULK PLANTS[1]

(Thousand Dollars)

	COST SCENARIO					
	NOJC COSTS		HOUSTON-GALVESTON COSTS		COLORADO APCD COSTS	
Daily Gasoline Throughput:	4,000 Gal/Day	20,000 Gal/Day	4,000 Gal/Day	20,000 Gal/Day	4,000 Gal/Day	20,000 Gal/Day
Installed Capital Cost	73.55	76.25	61.22	63.50	54.36	55.40
Annual Operating Cost						
Labor	1.43	1.43	1.43	1.43	1.43	1.43
Utilities	0.16	0.16	0.16	0.16	0.16	0.16
Maintenance	1.62	1.70	1.25	1.32	1.05	1.08
Taxes, Insurance, G&A	2.94	3.05	2.45	2.54	2.17	2.22
Total Operating Cost	6.15	6.34	5.29	5.45	4.81	4.89
Gasoline Recovery Credit[2]	--	--	--	--	--	--

[1] Assumes top submerged loading of tank wagons at bulk plants.

[2] No gasoline recovery credit when using either incineration system.

Source: U.S. Environmental Protection Agency

V. BULK STORAGE MODELS

A. INTRODUCTION

Because it would be impossible to assess the economic impacts of each of the proposed vapor control options for the bulk storage industry on an individual basis, Arthur D. Little has developed six bulk storage models to be used as illustrative analytical tools. The six bulk storage model are: large and small marine terminal, large and small pipeline terminal, and large and small bulk plant. Bulk terminals were distinguished according to mode of gasoline receipt because the financial and operational profiles of marine and pipeline terminals having identical gasoline throughput would be substantially different. No differentiation regarding the mode of gasoline receipt was made in the case of the bulk plant models where both were assumed to receive product from bulk terminals by truck transport. The sizing of the bulk storage models is based on average daily gasoline throughput and corresponds exactly with the throughput parameters of the model vapor control systems supplied by the EPA, i.e. 500,000 gallons/day for the large marine and pipeline terminals, 20,000 gallons/day for the large bulk plant, 250,000 gallons/day for the small marine and pipeline terminals, and 4,000 gallons/day for the small bulk plant. By using the bulk storage models in conjunction with the model vapor control systems, economic and financial parameters, e.g. profitability, debt capacity, and tariff rates, were tested under base case conditions and then for each of the proposed regulations. The changes in these variables provided valuable insight in conducting the economic impact analysis indicating how and to what degree the bulk storage industry might actually be affected by the vapor control options. In this chapter, the bulk storage models and the cost pass through assumptions applying to each are discussed. The model of the large marine terminal is presented below only as an example of the type of data which comprises each of the models. A complete presentation of all six bulk storage models appears in Appendix C.

B. BULK STORAGE MODELS

Beginning with one of the specific daily gasoline throughputs discussed above, other pertinent operational and facility parameters, e.g. non-gasoline throughput, storage capacity and physical plant, were calculated for each of the bulk storage models (Table V.1). These and subsequent model calculations were made using industry information and in-house Arthur D. Little knowledge.

Gross and net investment profiles were developed for the terminal and bulk plant models assuming that terminals and bulk plants were built 10 and 25 years ago, respectively. The investment profiles only include bulk storage operations; ancillary marketing operations, e.g. service stations, and inventory allocated to class of trade profit centers were excluded. The net investment or book value of these facilities was calculated by adjusting the original gross investment to take into account depreciation and equipment replacement (Table V.2). The current net investment of the six bulk storage models is shown in Table V.3. The gross replacement cost, i.e., capital required to build new storage facilities, is not presented since very few new terminals or bulk plants are expected to be built in the near future.

Operating expenses include labor costs, maintenance and repair, utilities, taxes and insurance (Table V.4). As would be expected, total unit operating expenses, i.e. dollars/gallon, of the larger terminal and bulk plant models are less than those of the smaller models because of their economies of scale (Table V.5). Labor is the largest component of total operating expense in all models, but its unit cost, or percent of total operating costs, is less in the larger models. The number of supervisors and workers at each bulk storage facility was based on the average number of employees at actual facilities having similar operating characteristics.

The target tariffs of the bulk plant models were assumed to be the same for all products. In reality, each product delivered to a

TABLE V.1

LARGE MARINE TERMINAL PROTOTYPE

OPERATIONS

	PRODUCT GROUP		
	Gasoline	Distillate	Total
Storage (Thousand Barrels)	217	424	641
Annual Tank Turnovers	20	9	13
Annual Throughput (Million Gallons).	182.5	160.2	342.7
Daily Throughput (Thousand Gallons)	500	439	939

FACILITIES

No. of Tanks - 10

Land (Acres) - 25

No. of Employees - 21

Method of Receipt - Marine Tanker (35,000 DWT)

Source: Arthur D. Little, Inc.

TABLE V.2

ESTIMATED INVESTMENT PROFILE OF
LARGE MARINE TERMINAL PROTOTYPE
(Thousand Dollars)

INVESTMENT	GROSS INVESTMENT	NET INVESTMENT[1]	NET COST ($/Shell Barrel)
A. Depreciable Fixed Assets			
Tanks	1,921.5	960.8	1.50
Building	35.0	17.0	
Dock	650.0	100.0	
Meters, Piping, Pumps	200.0	175.0	
Loading Racks, etc.	1,000.0	940.0	
Miscellaneous Equipment	365.0	183.6	
Total Depreciable Assets	4,171.5	2,376.4	3.71
B. Other Fixed Assets			
Land		760.0	
Engineering		350.0	
Capitalized Interest		400.0	
		1,510.0	2.36
C. Working Capital[2]		40.0	.06
TOTAL INVESTMENT		3,926.4	6.13

[1]Book value of 10 year old facility.

[2]Excluding inventory allocated to class of trade sales profit centers.

Source: Arthur D. Little, Inc.

TABLE V.3

ESTIMATED 1978
NET INVESTMENT OF BULK STORAGE PROTOTYPES
(Thousand Dollars)

STORAGE FACILITY	LOW THROUGHPUT[1]	HIGH THROUGHPUT[2]
Marine Terminal	1,952	3,926
Pipeline Terminal	990	2,473
Bulk Plant	57	143

[1]Daily gasoline throughput is 250,000 gallons for terminals and 4,000 gallons for bulk plants.

[2]Daily gasoline throughput is 500,000 gallons for terminals and 20,000 gallons for bulk plants.

Source: Appendix C

TABLE V.4

ESTIMATED 1978 OPERATING EXPENSES OF LARGE MARINE TERMINAL PROTOTYPE

(Thousand Dollars)

Labor	Annual Expense	$/Annual Throughput Gallon	Percent of Total Expenses
Straight Time 15 men X 52 X $320/wk ($8.00/hr)	249.6		
3 Supervisors	75.0		
Plant Manager	35.0		
Plant Secretary/Clerk	27.0		
a) Straight Time (S&W)	386.6		
b) Overtime 15 men X 47 X $48/wk (4 hr @ $12.00/hr)	33.8		
c) Benefits (25% of a)	96.7		
d) FICA (6.13% of a+b)	23.2		
e) Employee expenses	17.6		
Total Labor Expense	557.9		
1. Total Labor Expense	557.9	.00163	56%
2. Miscellaneous Services	11.2	.00003	1%
3. Maintenance & Repairs	28.1	.00008	3%
4. Utilities & Misc. Operating Expenses	65.0	.00019	7%
5. Local Taxes	150.0	.00044	15%
6. Insurance/Misc. Fixed Costs	175.0	.00051	18%
Total Expenses	987.2	.00288	100%

Source: Arthur D. Little, Inc.

TABLE V.5

ESTIMATED 1978 OPERATING EXPENSE
OF BULK STORAGE PROTOTYPES

Storage Facility	Low Throughput[1]			High Throughput[2]		
	Thousand Dollars	Dollars Per Annual Through-Put Gallon	Percent Labor	Thousand Dollars	Dollars Per Annual Through-Put Gallon	Percent Labor
Marine Terminal	502.9	.00394	61%	987.2	.00288	57%
Pipeline Terminal	423.5	.00305	59%	732.3	.00243	48%
Bulk Plant	54.9	.02670	71%	162.5	.01486	48%

[1]Daily gasoline throughput is 250,000 gallons for terminals and 4,000 gallons for bulk plants.

[2]Daily gasoline throughput is 500,000 gallons for terminals and 20,000 gallons for bulk plants.

Source: Appendix C

different class of trade would have its own tariff rate. However, a facility-wide tariff can be assumed for our analysis without loss of generality. Bulk storage models were treated as individual profit centers and the tariffs were calculated so as to cover all operating expenses and to return 20% before federal income tax (BFIT) on a discounted cash flow (DCF) basis over a 20-year investment horizon (Table V.6). The target tariffs for each of the bulk storage models appear in Table V.7.

C. COST PASS THROUGH ASSUMPTIONS

Although 100% of the costs associated with vapor control may be passed through to buyers, we have assumed that the incremental costs of vapor control may be absorbed by the bulk storage models to varying degrees. The price setter or market leader of each type of storage facility in an area was assumed to be the most efficient facility and, presumably, the largest. This facility, because of its unique market position, will be able to pass through the full cost of vapor control by increasing its tariff to where it covers all of its incremental vapor control costs and hence, does not experience any decline in margin. A less efficient facility, however, competing with the market leader, will be constrained to only passing through, at most, the same unit cost as the market leader. This "competitive" pass through maintains the same tariff differential between the two facilities after vapor control costs are considered as before (Table V.8). An attempt by the less efficient model to pass through a greater portion of the vapor control costs would further weaken its competitive position relative to the market leader. By not passing through the full cost of vapor control, the less efficient facility will have to absorb some of the cost, thereby causing a decrease in margin, and hence, profitability.

Because pipelines are the most attractive method of transporting petroleum products and because most are currently operating at full capacity, we have assumed for our analysis that both the small and large pipeline

TABLE V.6

REQUIRED 1978 TARIFF (PRE-VAPOR CONTROL) OF LARGE MARINE TERMINAL PROTOTYPE

	Net Investment (Thousand Dollars)
Total Investment	3926.4
X Annual Capital Recovery Factor (20% BFIT, 20 Years)	.2054
	806.5

	Annual Cost (Thousand Dollars)	Required Tariff (Dollars Per Annual Throughput Gallon)
Operating Expenses	987.2	.00288
Capital Recovery	806.5	.00235
Total	1,793.7	.00523

Source: Arthur D. Little, Inc.

TABLE V.7

REQUIRED TARIFF OF BULK STORAGE PROTOTYPES
TO COVER ESTIMATED 1978 COSTS
(Dollars/Gallon)

Storage Facility	Low Throughput[1]	High Throughput[2]
Marine Terminal	.00708	.00523
Pipeline Terminal	.00451	.00412
Bulk Plant	.03238	.01754

[1]Daily gasoline throughput is 250,000 gallons for terminals and 4,000 gallons for bulk plants.

[2]Daily gasoline throughput is 500,000 gallons for terminals and 20,000 gallons for bulk plants.

Source: Appendix C

TABLE V.8

EXAMPLE OF COMPETITIVE ECONOMICS OF TWO BULK STORAGE FACILITIES
(Dollars/Gallon)

	Most Efficient Facility	Less Efficient Facility
Pre-Vapor Control Tariff	.0050	.0080
Tariff Differential	.0030	
Vapor Control Cost	.0010	.0020
Cost Pass Through	.0010	.0010
Post-Vapor Control Tariff	.0060	.0090
Tariff Differential	.0030	
Absorbed Vapor Control Cost		.0010

terminal models will pass through the full cost of vapor control. In the case of marine terminals, which usually handle the marginal barrel of product, full cost pass through is only permitted for the larger model. The small marine terminal model will only pass through the same unit cost as the larger facility in order to maintain the same competitive position. Similarly, the large bulk plant model is permitted to pass through the full cost of vapor control while the small bulk plant model cannot. However, we estimate that 30% of the small bulk plant population, because they operate in areas partially shielded from external competitive forces by transportation economics, would in reality be able to pass through all costs associated with vapor control. This estimate is based on our discussions with the petroleum industry, particularly with regional jobber and petroleum marketer associations. Although the actual percentage varies geographically between 20% and 50%, the nationwide average is believed to be roughly 30%.

VI. BULK TERMINAL IMPACTS

A. INTRODUCTION

The purpose of this chapter is to identify all bulk terminals that are subject to the proposed vapor control regulations and to estimate the economic impacts of those regulations on the bulk terminal industry. These economic impacts are expressed as the number of potential bulk terminal closures expected to occur because of the various vapor control options, the employment displaced by these closures, and the nationwide cost of installing, financing and operating vapor control equipment at all remaining facilities. No attempt, however, has been made to express the costs of bulk terminal closures and the displaced work force in monetary terms. Also, the nationwide cost of installing vapor control equipment in the gasoline truck transport fleet, which was calculated separately from the bulk terminal impacts, is presented in this chapter.

B. BULK TERMINAL POPULATION SUBJECT TO VAPOR CONTROL

Not all of the terminals identified by the market audit are subject to the vapor control options discussed in Chapter IV. The exceptions include those gasoline terminals which are expected to close within the next five years because of competitive economics and market rationalization, terminals not handling gasoline, and terminals already in compliance with the proposed options. From our discussions with the bulk terminal industry, an estimated 20 gasoline terminals, or 3% of the smallest marine terminals, are expected to close by 1983 because of reasons other than vapor control. While the mandatory installation of vapor control equipment may accelerate the decision to close these facilities, their closure cannot be attributed solely to the imposition of vapor control economics, and therefore, are excluded from the following closure analysis. Similarly, the 240 bulk terminals identified by the market audit as having no gasoline throughput are not included in the closure analysis as they would not be subject to the vapor control regulations (Table VI.1).

TABLE VI.1

PETROLEUM BULK TERMINALS HAVING NO GASOLINE THROUGHPUT

PADD	NUMBER OF TERMINALS	PERCENT OF TOTAL
I	88	37%
II	86	36%
III	42	18%
IV	--	--
V	24	10%
Total	240	100%

Source: Arthur D. Little, Inc.

Finally, the estimated 360 bulk terminals which have already installed vapor control systems are not assumed to be subject to the proposed regulations. However, because the EPA is expected to require the continuous and efficient operation of all vapor control systems, these facilities may have to install a stand-by unit, vapor holder, or be prepared to shut down gasoline loading operations should the primary control system become inoperative.

After adjusting the 1978 market audit total for the above three factors, approximately 1,131 bulk terminals, or 65% of the total terminal population, are subject to the vapor control options presented in Chapter IV (Table VI.2 and Figure VI.1). A distribution of these facilities by gasoline throughput indicates that almost half of the terminals have less than 200,000 gallons/day of gasoline throughput (Table VI.3). For the following closure analysis, the small bulk terminal models having "low" throughputs of 250,000 gallons/day act as surrogates for the bulk terminal population having less than 400,000 gallons/day of gasoline throughput. Similarly, the larger terminal models having "high" throughputs of 500,000 gallons/day act as surrogates for the terminal population having greater than 400,000 gallons/day of gasoline throughput.

C. CLOSURE ANALYSIS

Bulk terminals subject to vapor control regulations are assumed to close because of either of the following two reasons:

- Terminal operators are unable to obtain the capital necessary to install vapor control equipment, or
- Terminals would operate below a minimum acceptable level of profitability if vapor control equipment were installed.

TABLE VI.2

PETROLEUM BULK TERMINALS SUBJECT TO THE PROPOSED VAPOR CONTROL OPTIONS

1978 Bulk Terminal Audit	1,751
Terminal Closures Between 1978 and 1983 Because of Market Rationalization	(20)
Bulk Terminals Having No Gasoline Throughput	(240)
Gasoline Terminals Already Having Vapor Control Systems	(360)
Total Number of Terminals Subject to the Proposed Vapor Control Options	1,131

Source: Arthur D. Little, Inc.

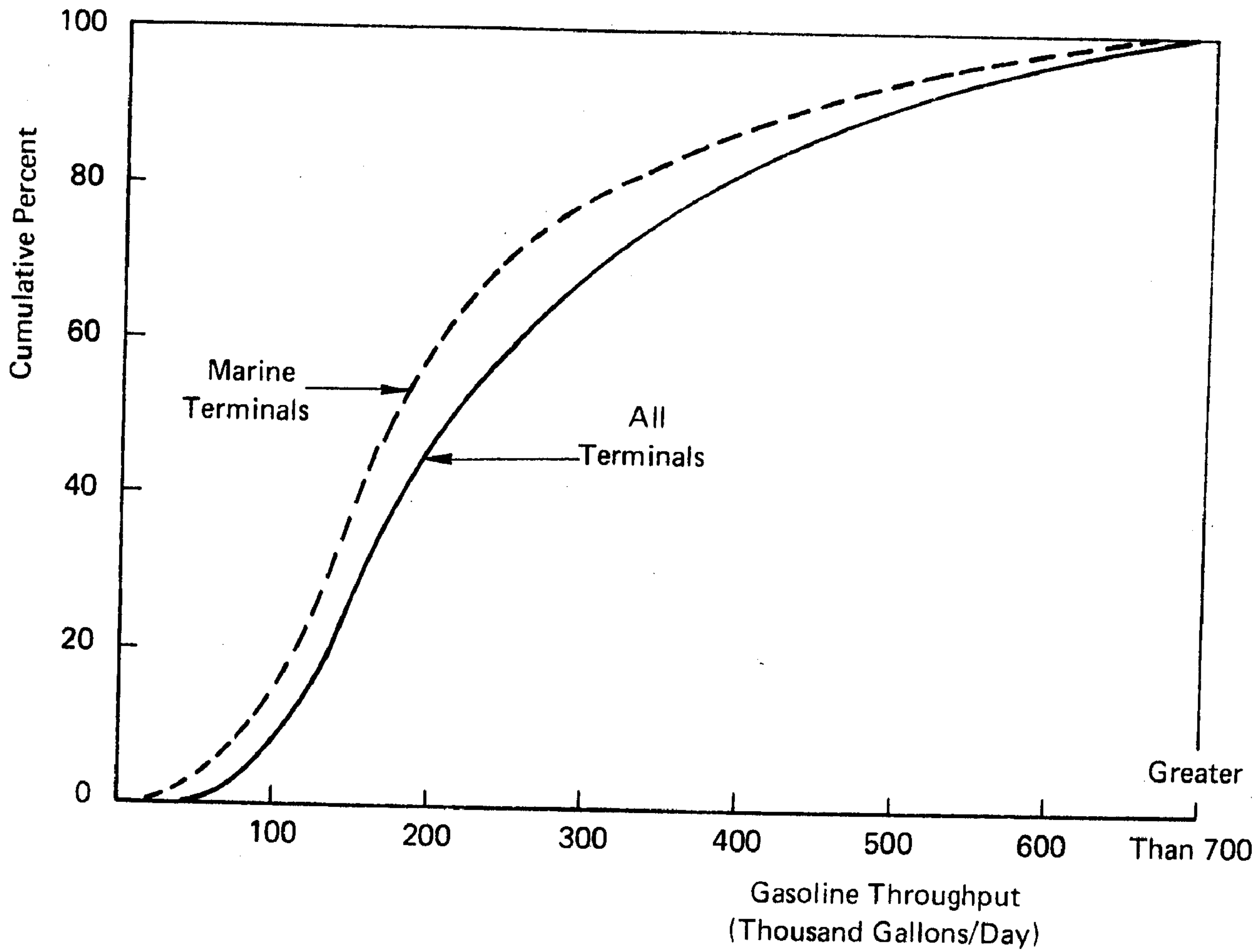


FIGURE VI.1 DISTRIBUTION OF BULK TERMINALS SUBJECT TO VAPOR CONTROL

TABLE VI.3

DISTRIBUTION OF GASOLINE TERMINALS
SUBJECT TO THE PROPOSED VAPOR CONTROL OPTIONS

DAILY GASOLINE THROUGHPUT		NUMBER OF TERMINALS	PERCENT OF TOTAL
Thousand Gallons	Cubic Meters		
< 200	< 760	535	47%
200 - 400	760 - 1,510	305	27%
400 - 600	1,510 - 2,270	238	21%
> 600	> 2,270	53	5%
Total		1,131	100%

Source: Arthur D. Little, Inc.

1. Availability of Capital

While over two-thirds of the bulk terminals are owned by the major and semi-major oil companies having very good access to capital markets, for this analysis each bulk terminal is treated as a separate profit center in determining its ability to secure the capital necessary to install vapor control equipment. Because an in-depth financial examination of each and every terminal is impractical and infeasible, the bulk terminal models presented in Chapter V will act as surrogates for the bulk terminal industry. The inability of these models to incur and to service the incremental debt required to comply with the vapor control regulations was translated into potential closures in the actual bulk terminal population. This approach represents "stand alone" economics without any cross-subsidies and is generally the way the petroleum companies would view these economics, although there may be some exceptions.

a. Capital Requirement

The capital required to install any of the various vapor control systems which are under consideration generally represents less than 15% of the existing net investment at the marine and large pipeline terminal models (Table VI.4). Vapor control investment is most significant, up to 30% of net investment, for the small pipeline model since its asset base is not as extensive as that of the other terminal models. However, this model's substantial throughput volumes and the ability to pass through the entire cost of vapor control counter balance this apparent weakness.

b. Approach

Since we stated that no cross-subsidy will come from either the parent corporation or ancillary marketing operations, the terminal operators have been assumed to seek capital from commercial lenders. Therefore, within this analysis an attempt is made to simulate the lending criteria employed by commercial loan officers. A lender considering an applicant's request for funds is primarily interested

TABLE VI.4

ESTIMATED 1978 VAPOR CONTROL CAPITAL REQUIREMENTS OF BULK TERMINALS

(Thousand Dollars)

	LOW THROUGHPUT MODEL				HIGH THROUGHPUT MODEL			
	Primary Control System		Primary System With Stand-By		Primary Control System		Primary System With Stand-By	
	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
MARINE TERMINAL								
Pre-Vapor Control Net Plant Investment	1951.6	1951.6	1951.6	1951.6	3926.4	3926.4	3926.4	3926.4
Vapor Control Investment	204.0	144.0	299.0	239.0	306.0	190.0	432.0	316.0
Vapor Control Investment as a Percent of Pre-Control Net Investment	10%	7%	15%	12%	8%	5%	11%	8%
PIPELINE TERMINAL								
Pre-Vapor Control Net Plant Investment	989.9	989.9	989.9	989.9	2473.1	2473.1	2473.1	2473.1
Vapor Control Investment	204.0	144.0	299.0	239.0	306.0	190.0	432.0	316.0
Vapor Control Investment as a Percent of Pre-Control Net Investment	21%	15%	30%	24%	12%	8%	17%	13%

Source: Appendix C and EPA cost estimates in the borrower's ability to repay the full amount of the loan, i.e. principal as well as interest. If a lender is confident that the loan can be easily repayed under normal business conditions, the loan will probably be made. If, however, the prospective borrower is already so leveraged that repayment would be difficult if an unexpected business downturn occurred, a lender then would have to rely more heavily upon subjective factors such as the borrower's past relationship with the lender, his credit history, the quality of the collateral pledged, and the future outlook of the borrower's business. Under these circumstances, a borrower may in theory have the resources necessary to repay the debt, but the lender may feel that he would be undertaking too much risk in making the loan. A decision to extend funds in this case would widely vary among lenders according to each lender's risk threshold. Lastly, if it would be difficult for the borrower to repay the lender even under normal business conditions, there would be no hesitation on a lender's part to refuse the loan. Many financial tools, e.g. quick ratio, current ratio and debt-to-equity ratio, could be used to measure a terminal's ability to incur and service debt. However, the analytic tool used in this analysis is total term debt as a percent of after-tax cash flow, or put another way, the ratio of the terminal's projected after-tax cash flow to its total debt obligation.

In the commercial lending model used for our analysis, as long as the borrower's anticipated after-tax cash flow, i.e. net profit plus depreciation, is at least twice as large as his total debt obligation, i.e. principal of pre-vapor control and vapor control related debt,[1] it is assumed that the loan will be made (Table VI.5). If, however, projected cash flow exceeds the total debt obligation, but not by a factor of 2, then the lender will become more cautious when considering this loan relative to his overall risk portfolio and downside exposure.

[1]This figure does not include interest payments as they have already been taken into account when calculating the after-tax cash flow. See Appendix F for the cash flow worksheets used in this analysis.

TABLE VI.5

BORROWING CRITERIA USED IN ANALYSIS

Debt as a Percent of After-Tax Cash Flow	Ratio of After-Tax Cash Flow to Debt	Lender's Decision
0 - 50%	Greater than 2:1	Loan is adequately covered. Loan will be made.
50 - 100%	2:1 to 1:1	Loan is covered but lender assumes increasing risk. Probability of refusal increases proportionately as the debt percentage increases (Figure VI.2).
Greater than 100%	Less than 1:1	Loan is not covered. Loan will not be made.

Source: Arthur D. Little, Inc.

Within this range, the probability that the loan will be rejected is assumed to be directly proportional to the calculation of term debt as a percentage of cash flow (Figure VI.2). In reality, however, this relationship would be non-linear, particularly at the endpoints, although this simple linear model will suffice for our purposes. Finally, if the borrower's cash flow cannot fully meet his total debt obligation, the loan would clearly be rejected as the incremental debt obligation of the vapor control loan would render the borrower insolvent. This financial tool is certainly not the only criteria employed in the commercial lender's calculus when he is evaluating a loan candidate. As stated above, many other financial tools and subjective factors will also come to bear on the loan decision. Moreover, the decision thresholds described above would not always be as clear-cut. However, this lending model is useful in our analysis because it is reasonable, straightforward, and easy to apply.

Discussions with independent marketers and terminal operators indicate that 25-40% of the net plant investment of many terminals is currently mortgaged. Therefore, debt as a percent of cash flow was calculated for the bulk terminal models thereby establishing a base case, by assuming that 30% of the net plant investment was mortgaged for 20 years at an 8% annual interest rate. In this base case, the existing debt principal of the bulk terminal models was approximately 11-12% of projected annual after-tax cash flow (Table IV.6). Cash flow, therefore, covered debt obligations by a ratio of 9:1. This percentage was again calculated assuming that 100% of the required vapor control investment was financed for 8 years at a 9% annual interest rate.[1] After the costs of the model vapor control systems had been folded into the calculation, the models' total debt obligation was between 16% and 28% of cash flow, still well below the 50% threshold established by the lending model presented in Table VI.5. These percentages

[1]Terms quoted by a sample of commercial lenders.

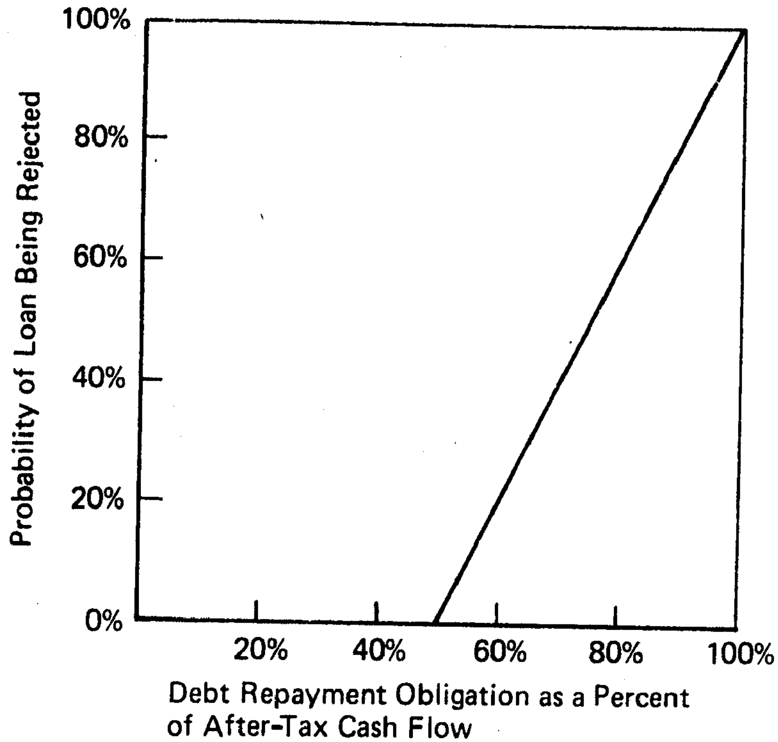


FIGURE VI.2 AFTER TAX CASH FLOW AS A DETERMINANT FOR SECURING A COMMERCIAL LOAN FOR VAPOR CONTROL EQUIPMENT

TABLE VI.6

TERM DEBT AS A PERCENT OF AFTER-TAX CASH FLOW AT BULK TERMINALS

	LOW THROUGHPUT MODEL				HIGH THROUGHPUT MODEL			
	Primary Control System		Primary System With Stand-By		Primary Control System		Primary System With Stand-By	
	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
MARINE TERMINAL								
Pre-Vapor Control	12%	12%	12%	12%	11%	11%	11%	11%
Post-Vapor Control	19%	17%	22%	20%	17%	15%	19%	17%
PIPELINE TERMINAL								
Pre-Vapor Control	11%	11%	11%	11%	11%	11%	11%	11%
Post-Vapor Control	24%	21%	28%	26%	19%	16%	21%	19%

Source: Appendix F

indicate that the models have 3 to 4 times the annual cash flow necessary to meet both their base case and their vapor control debt obligations. For bulk terminals with less than 30% of net plant investment mortgaged, the amount of coverage would be even greater.

c. Closure Summary

From the results of the preceding analysis, it is concluded that no bulk terminal closures are likely because of an inability to obtain the necessary capital.

2. Insufficient Profitability

The bulk terminals having access to adequate capital may still close as the result of the vapor control regulations if, after installing and operating vapor control equipment, they could no longer attain a minimum acceptable level of profitability. Bulk terminals are assumed to continue operating as long as they can meet all current liabilities, i.e. operating expenses (including salaries) and debt obligations (principal and interest payments). Under this condition, terminals are assumed to remain open even though they are not earning any return on equity investment. This is a valid argument if the terminal operator has limited business alternatives in which to redeploy his equity investment, or if he expects business to improve in the near future.

a. Approach

In order to generate a revenue stream sufficient to continue operations, i.e. to breakeven, a minimum product throughput at all bulk terminals must be sustained. After netting out the revenue contribution of the non-gasoline products, all revenue necessary to meet the remaining current liabilities must be generated through gasoline volumes. The gasoline volume necessary for a terminal to remain open is referred to here as the "gasoline breakeven throughput." Bulk terminals that operate below this breakeven volume are assumed to close, while those that operate above it are assumed to remain open.

Vapor control regulations, however, will in effect raise this breakeven point and require a larger gasoline throughput[1] in order to cover the incremental operating expenses and debt obligation (Table VI.7). In this analysis, attention is focused on the number of terminals which may operate above this breakeven volume in the pre-vapor control case, but below its new breakeven volume when the economics of vapor control are considered.

Most terminals are not expected to experience any change in gasoline breakeven throughput since they will pass through the full cost of vapor control by way of tariff increases. The additional revenue resulting from this tariff increase is assumed to exactly offset all incremental expenses caused by vapor control. Only some small marine terminals, which do not pass through their entire vapor control costs, will perceive a change in their minimum gasoline throughput requirement. Because of competitive economics, these facilities will be limited to the same per gallon tariff increase as the larger terminals. Therefore, some marine terminals will have to absorb portion of the cost of vapor control themselves, thereby falling below the adjusted breakeven throughput. An example as to how this analysis was conducted is shown in Figure VI.3. Presumably, the affected facilities would realize this consequence and close without actually installing vapor control equipment. The changes in profitability and gasoline tariffs of the bulk terminal models caused by the proposed vapor control regulations are summarized in Table VI.8.

b. Closure Summary

Our analysis indicates that 23 to 51 terminals, or 2-5% of all gasoline terminals subject to the vapor control regulations, are likely to close because they would now operate below their gasoline

[1]The throughputs of the non-gasoline products and hence, their revenue contribution, are assumed to remain the same as they were in the pre-vapor control case.

TABLE VI.7

CHANGE IN DAILY GASOLINE BREAKEVEN THROUGHPUT AT BULK TERMINALS BECAUSE OF VAPOR CONTROL COSTS[1]

	LOW THROUGHPUT MODEL				HIGH THROUGHPUT MODEL			
	Primary Control System		Primary System With Stand-By		Primary Control System		Primary System With Stand-By	
	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
MARINE TERMINAL								
Gasoline Breakeven Throughput (Pre-Vapor Control)	117.2	117.2	117.2	117.2	213.8	213.8	213.8	213.8
Incremental Gasoline Throughput Required Due to Vapor Control Capital and Operating Costs	13.3	17.9	24.4	28.0	0.0	0.0	0.0	0.0
Gasoline Breakeven Throughput (Post-Vapor Control)	130.5	135.1	141.6	145.2	213.8	213.8	213.8	213.8
Percent Increase Over Pre-Control Throughput	11%	15%	21%	24%	0%	0%	0%	0%
PIPELINE TERMINAL								
Gasoline Breakeven Throughput (Pre-Vapor Control)	145.7	145.7	145.7	145.7	212.5	212.5	212.5	212.5
Incremental Gasoline Throughput Required Due to Vapor Control Capital and Operating Costs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gasoline Breakeven Throughput (Post-Vapor Control)	145.7	145.7	145.7	145.7	212.5	212.5	212.5	212.5
Percent Increase Over Pre-Control Throughput	0%	0%	0%	0%	0%	0%	0%	0%

[1] Assuming competitive pass through.

Source: Arthur D. Little, Inc.

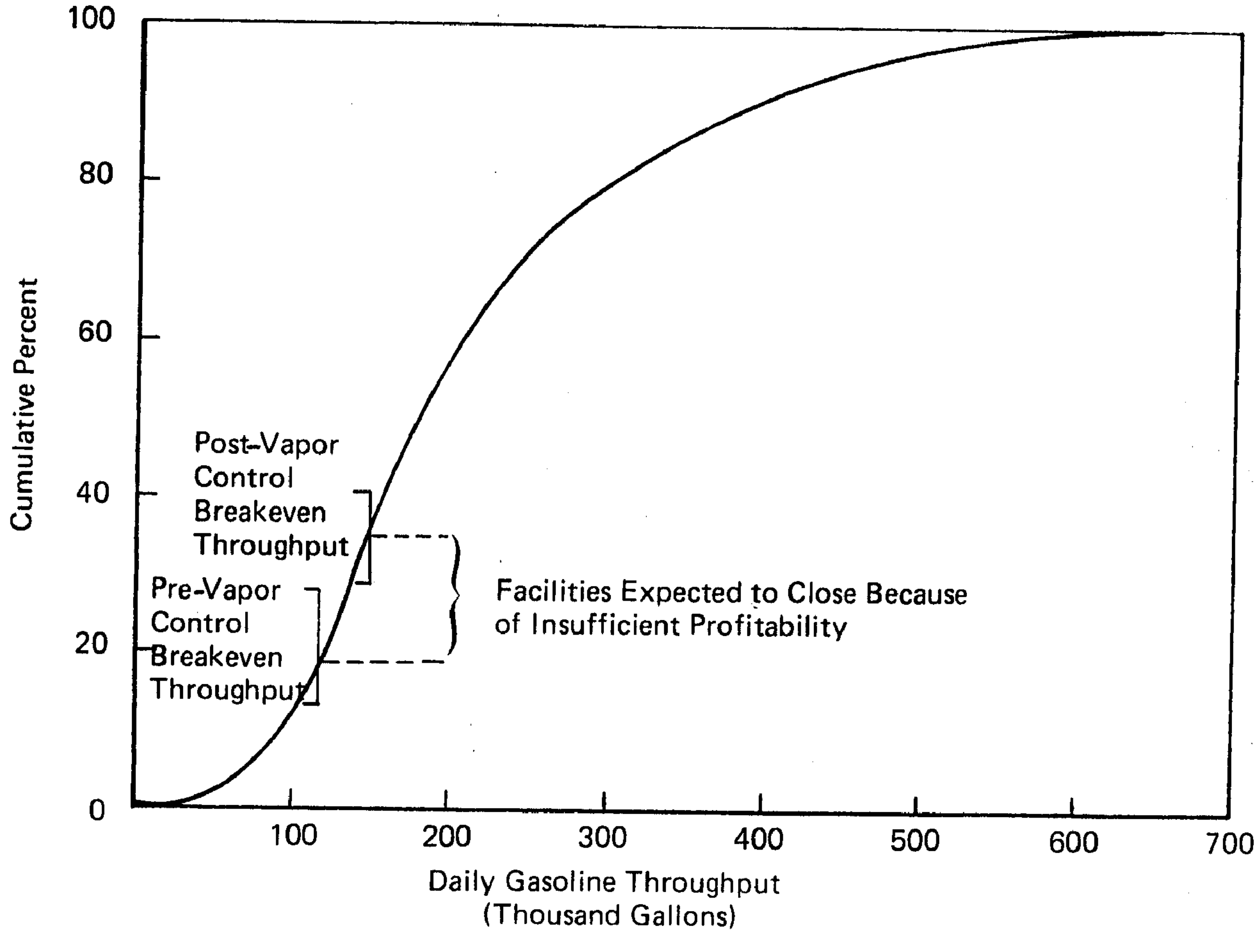


FIGURE VI.3 BREAKEVEN ANALYSIS OF THE MARINE TERMINAL POPULATION

TABLE VI.8

BULK TERMINALS ROI AND GASOLINE TARIFF IMPACTS[1]

	LOW THROUGHPUT MODEL				HIGH THROUGHPUT MODEL			
	Primary Control System		Primary System With Stand-By		Primary Control System		Primary System With Stand-By	
	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
MARINE TERMINAL								
Post-Vapor Control ROI	18.4%	18.9%	17.5%	17.8%	20.5%	20.5%	20.5%	20.5%
Percent Increase/Decrease over Pre-Control ROI[2]	(10.2%)	(8.2%)	(14.9%)	(13.1%)	NC[3]	NC	NC	NC
Post-Vapor Control Gasoline Tariff ($/Gal)	.0072	.0074	.0075	.0076	.0054	.0056	.0057	.0058
Percent Increase/Decrease over Pre-Control Gasoline Tariff	2.8%	5.1%	6.1%	8.1%	3.8%	6.9%	8.2%	10.9%
PIPELINE TERMINAL								
Post-Vapor Control ROI	20.5%	20.5%	20.5%	20.5%	20.5%	20.5%	20.5%	20.5%
Percent Increase/Decrease over Pre-Control ROI[2]	NC	NC	NC	NC	NC	NC	NC	NC
Post-Vapor Control Gasoline Tariff ($/Gal)	.0048	.0049	.0050	.0051	.0043	.0045	.0046	.0047
Percent Increase/Decrease over Pre-Control Gasoline Tariff	6.0%	8.4%	11.5%	13.5%	4.9%	8.7%	10.4%	13.8%

[1] Assuming competitive cost pass through

[2] Pre-Control ROI is 20.5%. ROI is simple before-tax return on net plant investment.

[3] No Change - assumes full pass through of costs for this model.

Source: Appendix G

breakeven throughputs after installing vapor control equipment (Table VI.9). The redistribution of product volume from these closures would slightly increase the volumes of some other terminals, thereby helping them meet post-vapor control throughput levels. However, in this case, the impact is so small that it can be disregarded. These closures are based on the refrigeration and the incineration systems. If more expensive technologies were considered, e.g., CRA or adsorption-absorption, the number of closures would be somewhat greater. All of the above closures are expected to be small marine terminals having less than 150,000 gallons of daily gasoline throughput. No closures are expected to occur in either the large marine or the pipeline terminal populations.

D. TERMINAL IMPACTS

In addition to terminal closures, the economic impacts of vapor control in the bulk terminal industry are expressed in terms of the employment displaced by these closures and the monetary cost of installing, financing and operating vapor control systems at all remaining terminals subject to the vapor control regulations. While some terminal operators may simply discontinue their gasoline throughput rather than installing vapor control equipment, most operators are not likely to be in a strong enough financial position to choose this as a viable alternative. Therefore, this option has been excluded from our discussion of potential terminal impacts.

1. Employment Impact

Between 300 and 700 workers, representing 1-2% of the estimated employment at all gasoline terminals, are employed at the bulk terminals expected to close because of vapor control economics (Table VI.10). These employment figures were calculated by multiplying the average number of workers at a small marine terminal by the estimated number of closures.

TABLE VI.9

BULK TERMINAL CLOSURES BECAUSE OF VAPOR CONTROL ECONOMICS[1]

	Primary Control System		Primary System With Stand-By	
	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
Petroleum Bulk Terminals Subject to Vapor Control	1131	1131	1131	1131
Terminal Closures Because of Inaccessibility of Capital	0	0	0	0
Terminal Closures Because of Insufficient Profitability	23	32	46	51
Remaining Terminals Installing Vapor Control	1108	1099	1085	1080

[1]Assuming competitive cost pass through.

Source: Arthur D. Little, Inc.

TABLE VI.10

VAPOR CONTROL EMPLOYMENT AND COST IMPACTS AT BULK TERMINALS

	PRIMARY CONTROL SYSTEM		PRIMARY SYSTEM WITH STAND-BY	
	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
Small Marine Terminals Closed Due to Vapor Control Economics	23	32	46	51
Estimated Employment at Closed Terminals	320	450	640	710
Remaining Terminals Installing Vapor Control Systems	1,108	1,099	1,085	1,080
Total Cost of Installing Vapor Control (Million 1978 Dollars)	201.9	329.0	473.2	580.4

Source: Arthur D. Little, Inc., and Table VI.11

2. National Cost of Compliance

The total cost of vapor control, i.e. installed capital costs, financing and operating expenses, less appropriate recovery credits over the expected 10-year useful life of the vapor control equipment, ranges from $200 million, if only primary vapor control systems are required, to almost $600 million, if primary/stand-by systems are necessary (Table VI.10). Larger costs would result if more expensive technologies were considered, e.g. CRA and adsorption-absorption. The installed capital costs of national compliance range from $170 million for a primary incineration unit to $365 million for a refrigeration unit with incineration stand-by (Table VI.11). These capital costs represent a substantial portion of the petroleum industry's $1.2 billion 1977 budget for the control or air pollution, ranging from 15% to 26%.[1] Furthermore, in 1977 the major oil companies spent $803 million for environmental effluent abatement, of which the marketing portion was approximately $120 million.[2] Table VI.12 shows the magnitude of these capital costs relative to the majors' estimated marketing budget for environmental effluent abatement. These costs range from 140% to 300% of the estimated environmental control budgets.

E. TANK TRAILER COSTS

Because the installation of vapor control equipment in the truck transport fleet is essential to the control of gasoline vapors at bulk terminals, the nationwide costs of installing such equipment are considered in this chapter. This cost could not be incorporated in the model control system costs of the terminals because most gasoline transports are owned by common carriers and not by terminal operators.

[1] Oil and Gas Journal, March 20, 1978.

[2] API Publication No. 4259, Environmental Expenditures of the U.S. Petroleum Industry.

TABLE VI.11
COST OF VAPOR CONTROL AT BULK TERMINALS[1]
(Million 1978 Dollars)

	Primary Control System		Primary System With Stand-By	
	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
Capital Investment	255.7	171.6	364.3	280.5
Financing Cost[2]	77.8	52.2	110.8	85.3
Operating Expense[3]	205.4	105.2	250.0	151.8
Recovery Credit[3]	(337.0)[4]	--	(314.7)	--
Capital Investment[5]	--	--	37.0	37.0
Financing Cost	--	--	9.8	9.8
Operating Expense	--	--	16.0	16.0
Total Vapor Control Cost at Bulk Terminals	201.9	329.0	473.2	580.4

[1]All future cash streams discounted to present value using a discount rate of 10%.

[2]Interest charges associated with vapor control debt are incurred over an 8-year period and discounted to 1978 value.

[3]Operating expenses and recovery credits are realized over the 10-year useful life of the vapor control system and discounted to present value.

[4]Represents a negative cost or a savings equivalent to the present value of the gasoline vapor which otherwise would have been discharged into the atmosphere if a vapor recovery system was not utilized.

[5]Cost of incineration stand-by units for bulk terminals already having a primary vapor control system.

Source: Arthur D. Little, Inc. estimates based on EPA cost data

TABLE VI.12

CAPITAL COST OF THE PROPOSED VAPOR CONTROL OPTIONS AS A PERCENT OF THE PETROLEUM INDUSTRY'S 1977 ENVIRONMENTAL EXPENDITURES

	Primary Control System		Primary System With Stand-By	
	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
Capital Cost of National Vapor Control Compliance at Bulk Terminals (Million 1978 Dollars)	256	172	364	280
Percent of Major Oil Companies' 1977 Marketing Budget for Effluent Abatement	213%	143%	303%	233%
Percent of Total 1977 Industry Expenditures to Control Air Pollution	22%	15%	26%	24%

Source: API Publication No. 4259, Environmental Expenditures of the U.S. Petroleum Industry, Oil & Gas Journal, Nov. 20, 1978. and Table VI.11.

Therefore, while this cost calculation is being treated separately, it is still a fundamental part of the vapor control options addressing bulk terminal operations.

In 1978, there were an estimated 29,200 gasoline tank trailers in operation in the U.S., of which about 7,300 or 25% had already installed vapor control equipment. Of the remaining trailers, 12,800 probably would be retrofitted with vapor control because they are less than 5 years old, while the other 9,100 would have vapor control equipment installed in their eventual replacements. Because gasoline demand is not expected to increase significantly during the next 5 years, no additional gasoline tank trailers are expected to be built other than those needed to replace the existing fleet. The new and retrofit segments of the gasoline trailer fleet are summarized in Table VI.13. Based on these estimates of the trailer population and the equipment costs presented in Chapter V, the total cost of installing and operating vapor control equipment on the gasoline trailer fleet is $101.4 million over the useful 12-year life of the trailers (Table VI.14).

TABLE VI.13

ESTIMATED 1978 GASOLINE TRAILER POPULATION

MC-306 Trailers Built Between 1966 and 1978	36,900
Estimated 1978 Gasoline Tank Trailer Fleet	29,200
Trailers Already Equipped with Vapor Control	(7,300)
Trailers to be Replaced within the next 5 years[1]	(9,100)
Retrofit Trailer Market	12,800
New Trailers Built to Replace Existing Fleet within the next 5 years	9,100
New Trailers Required Because of an Increase in Gasoline Demand	0
New Trailer Market	9,100
Total Number of Trailers Installing Vapor Control Equipment	21,900

[1]Estimated trailer lifetime of 12 years.

Source: Department of Commerce and Arthur D. Little, Inc.

TABLE VI.14

TOTAL COST OF INSTALLING VAPOR CONTROL EQUIPMENT ON THE GASOLINE TANK TRAILER FLEET

(Million 1978 Dollars[1])

Capital Investment - Retrofit Market	26.9
- New Market	17.3
Financial Cost[2]	5.0
Operating Expense[3]	52.2
TOTAL CONVERSION COST	101.4

[1] All future cash streams discounted to present value, using a discount rate of 10%.

[2] 100% debt financing for 3 years @ 9%.

[3] Incurred over estimated trailer lifetime of 12.3 years.

Source: Arthur D. Little, Inc., and U.S. Environmental Protection Agency cost estimates

VII. BULK PLANT IMPACTS

A. INTRODUCTION

The purpose of this chapter is to identify all bulk plants that are subject to the proposed vapor control regulations and to estimate the economic impacts of those regulations on the bulk plant industry. The analytic approach used in this chapter to calculate these economic impacts is the same as that used in the preceding chapter on bulk terminal impacts. An important addition to this analysis, however, is the calculation of economic impacts for the three control options using three distinct cost or control system scenarios. Because it is beyond the scope of this study to select a "most likely" scenario, all potential impacts resulting from each are discussed below.

B. BULK PLANT POPULATION SUBJECT TO VAPOR CONTROL

As was the case in the bulk terminal analysis, not all of the bulk plants identified by the market audit are subject to the vapor control options discussed in Chapter IV. From the market audit results presented in Chapter VI, approximately 3,480 bulk plants are expected to close during the next five years because of competitive economics and market rationalization. The economics of vapor control may accelerate their closing, but it cannot be held as the principal reason for their closure. Similarly, the 790 non-gasoline bulk plants and the estimated 120 bulk plants already having vapor control systems are not subject to the proposed vapor control regulations and, therefore, are excluded from our closure analysis. Most of the bulk plants already having vapor control systems would have to modify or augment their control capability under the various regulations. However, because these facilities represent less than 1% of all gasoline bulk plants, these bulk plants are not considered further in the closure analysis with regard to possible stand-by systems. Therefore, approximately 14,250 bulk plants, or 76% of the total 1978 bulk plant population, are subject to potential closure caused by vapor control economics (Table VII.1 and Figure VII.1). A distribution of these facilities by gasoline throughput appears in

TABLE VII.1

PETROLEUM BULK PLANTS SUBJECT TO THE PROPOSED VAPOR CONTROL OPTIONS

1978 Bulk Plant Audit	18,640
Bulk Plant Closures Between 1978 and 1983 Because of Market Rationalization	(3,480)
Bulk Plants Having No Gasoline Throughput	(790)
Gasoline Bulk Plants Already Having Vapor Control Systems	(120)
Total Number of Bulk Plants Subject to the Proposed Vapor Control Options	14,250

Source: Arthur D. Little, Inc.

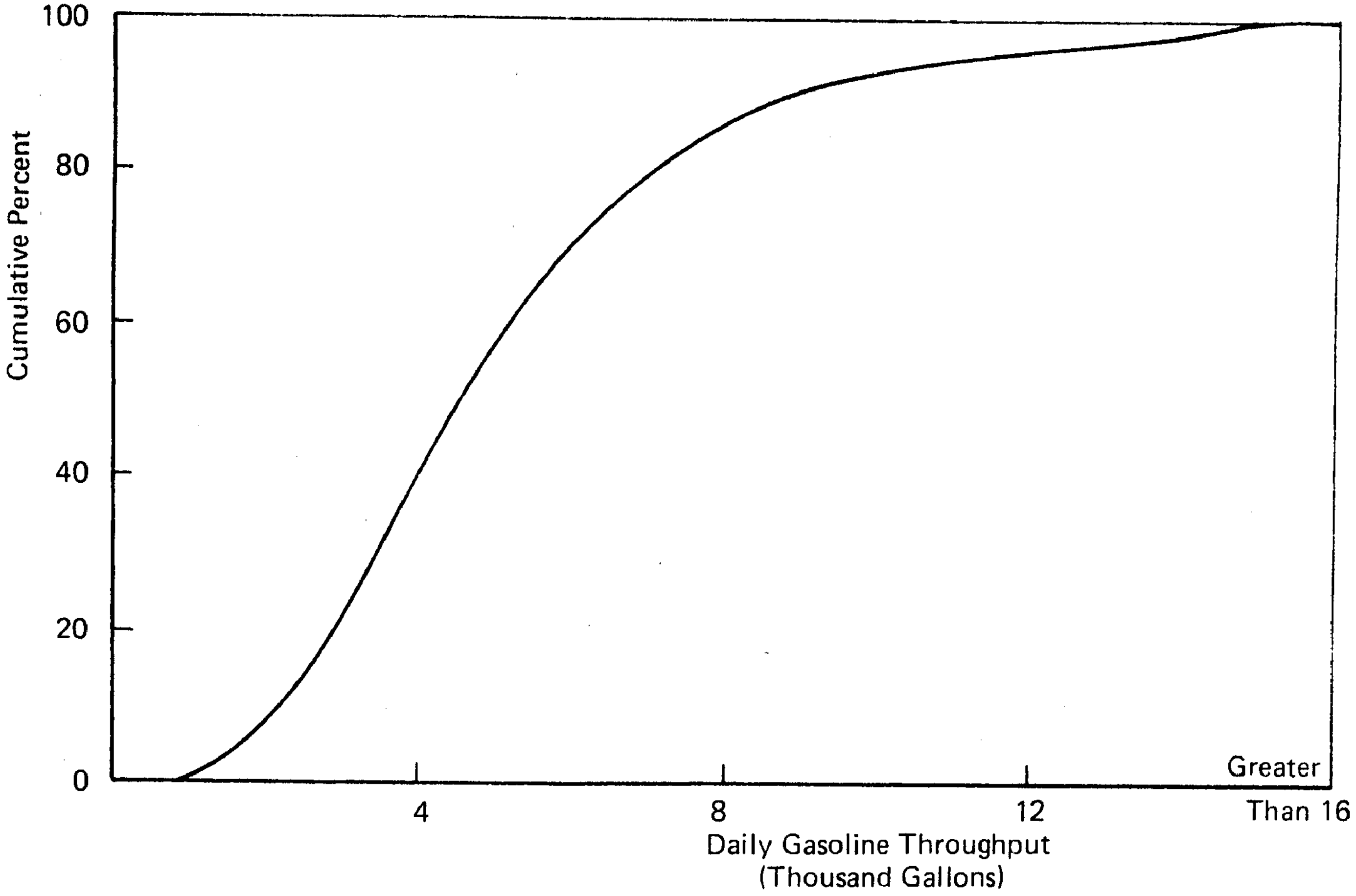


FIGURE VII.1 DISTRIBUTION OF BULK PLANTS SUBJECT TO VAPOR CONTROL

Table VII.2. For the following closure analysis, the small or low gasoline throughput model, i.e., average 4,000 gallons/day, will act as a surrogate for all bulk plants having less than 8,000 gallons/day of gasoline throughput. Similarly, the larger or high throughput model, i.e., average 20,000 gallons/day, will act as a surrogate for the bulk plant population having more than 8,000 gallons/day of gasoline throughput.

C. CLOSURE ANALYSIS

Bulk plants subject to vapor control regulations are assumed to close because of the same reasons as bulk terminals:

- Bulk plant operators are unable to obtain the capital necessary to install vapor control equipment, or
- Bulk plants would operate below a minimum acceptable level of profitability if vapor control equipment were installed.

Plant closures resulting because of the above factors are calculated for each of the three cost scenarios discussed in Chapter IV and are presented below.

1. Availability of Capital

In this analysis, bulk plants are considered as separate profit centers subject to "stand alone" economics in order to determine their ability to secure the capital necessary to install vapor control equipment. To assist the analysis, the bulk plant models and the model vapor control systems are used to estimate the number of bulk plant closures likely under each of the three control options for each of the three cost scenarios. As was the case for bulk terminals, the inability of these model facilities to incur and to service the incremental debt associated with vapor control was translated into potential closures in the actual bulk plant population.

a. Capital Requirement

The capital required to comply with the vapor control regulations can represent a substantial part of existing net investment of the bulk

TABLE VII.2

DISTRIBUTION OF GASOLINE BULK PLANTS SUBJECT TO THE PROPOSED VAPOR CONTROL OPTIONS

Daily Gasoline Throughput: Thousand Gallons	Daily Gasoline Throughput: Cubic Meters	Number of Bulk Plants	Percent of Total
>3	>10	4,080	29%
3-8	10-30	8,750	61%
8-17	30-65	1,160	8%
<17	<65	260	2%
Total		14,250	100%

Source: Arthur D. Little, Inc.

plant models. In order to comply with Option 1 regulations, vapor control investment could equal 3%-7% of the current net investment of the small bulk plant model and 1%-3% of the net investment of the larger model (Table VII.3). Compliance with Option 2, which requires stricter vapor control than Option 1, requires a capital outlay of as much as 40% of the net plant investment of the small bulk plant model and 18% of the larger facility. Option 3, which requires the greatest amount of gasoline vapor reduction, requires the greatest amount of additional capital. Vapor control investment under this option can exceed 100% of the net investment at the small model and equal 20% to 85% of the net investment of the larger facility. The substantial capital investment required for Option 3 compliance will make it very difficult for bulk plant operators to service this incremental debt, even if the necessary funds can be secured.

b. Approach

The methodology used for calculating the number of expected bulk plant closures resulting from an inability to obtain capital is the same as that used in the bulk terminal analysis. The commercial lending rules used in this analysis are the same as those presented in Table VI.5 and Figure VI.2. However, because the bulk plant industry has historically been more leveraged than the bulk terminal industry, has frequently used non-conventional financing methods, and is largely comprised of jobbers—many of whose personal finances are virtually indistinguishable from those of their bulk plants, we have assumed that 20% of the bulk plant operators failing to secure commercial loans because their total debt obligation exceeds 50% of after-tax cash flow, but is less than 100%, are able to obtain non-standard commercial loans through established banking ties or by pledging personal assets. Another 20% of these prospective borrowers are assumed to obtain non-commercial financing, e.g., using personal funds, liquidating personal assets, or borrowing from relatives and friends. However, if the proposed debt obligation exceeds 100% of the projected cash flow, no commercial loans of any sort will be made. Non-commercial loans would

TABLE VII.3

ESTIMATED 1978 VAPOR CONTROL CAPITAL REQUIREMENT OF BULK PLANTS
(Thousand Dollars)

	LOW THROUGHPUT MODEL						HIGH THROUGHPUT MODEL					
			Primary Control System		Primary System With Stand-By				Primary Control System		Primary System With Stand-By	
	Balance Incoming Trucks Only	Balance Incoming & Outgoing Trucks	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration	Balance Incoming Trucks Only	Balance Incoming & Outgoing Trucks	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
BULK PLANT[1]												
Pre-Vapor Control Net Plant Investment	57.0	57.0	57.0	57.0	57.0	57.0	143.0	143.0	143.0	143.0	143.0	143.0
Vapor Control Investment	4.2	23.0	92.2	48.3	117.4	73.6	4.2	25.7	94.9	51.0	120.1	76.2
Vapor Control Investment as a Percent of Pre-Control Net Investment	7%	40%	162%	85%	206%	129%	3%	18%	66%	36%	84%	53%
BULK PLANT[2]												
Pre-Vapor Control Net Plant Investment	57.0	57.0	57.0	57.0	57.0	57.0	143.0	143.0	143.0	143.0	143.0	143.0
Vapor Control Investment	4.2	10.7	79.8	36.0	105.1	61.2	4.2	13.0	82.1	38.2	107.4	63.5
Vapor Control Investment as a Percent of Pre-Control Net Investment	7%	19%	140%	63%	184%	107%	3%	9%	57%	27%	75%	44%
BULK PLANT[3]												
Pre-Vapor Control Net Plant Investment	57.0	57.0	57.0	57.0	57.0	57.0	143.0	143.0	143.0	143.0	143.0	143.0
Vapor Control Investment	1.7	3.8	73.0	29.1	98.2	54.4	1.7	4.9	74.0	30.1	99.3	55.4
Vapor Control Investment as a Percent of Pre-Control Net Investment	3%	7%	128%	51%	172%	95%	1%	3%	52%	21%	69%	39%

[1]NOJC costs for top loading. [2]Houston-Galveston costs for top loading. [3]Colorado APCD costs for top loading.

Source: Appendix C and Environmental Protection Agency cost estimates still be possible for up to 20% of these applicants failing the lending criteria if personal, relatives', or friends' funds were available at very low interest rates or if an operator accepted a smaller take-home pay. Admittedly, these percentages probably have leakage and they, in effect, represent a form of cross-subsidy. However, this modification to the lending model is necessary in order to recognize the nature of the bulk plant industry where many facilities are very small—being only one- or two-man operations.

Discussions with the National Oil Jobbers Council (NOJC) and local jobber and petroleum marketer associations indicated that many bulk plants currently have 50% to 75% of their current plant investment under mortgage. This roughly corresponds to a debt-to-equity ratio of between 1:1 and 3:1. Pre-control debt obligation as a percent of cash flow was calculated for the bulk plant models assuming that 60% of net plant investment was mortgaged for 20 years at a 9% annual interest rate.[1] The result of this calculation was that debt obligations equalled 21% to 23% of cash flow, or that cash flow covered debt obligations by a ratio of about 4:1 (Table VII.4). Total debt as a percent of cash flow was then calculated assuming that 100% of the incremental vapor control investment, required for each cost scenario and for each control option, was borrowed for 5 years at an 11% annual interest rate.[2] Under this condition, the total debt obligation ranged from 25% to over 100% of cash flow for the small bulk plant model and from 22% to 60% of cash flow for the larger model. Because small bulk plants, which comprise the majority of the 1978 bulk plan population, are the most

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[1]Borrowing terms currently available if financing a bulk plant prototype at its book value.

[2]Bulk plant operators are not financially strong enough to obtain the same borrowing terms, both in duration and interest rate, as the bulk terminal operators.

TABLE VII.4

TERM DEBT AS A PERCENT OF AFTER-TAX CASH FLOW AT BULK PLANTS

	LOW THROUGHPUT MODEL						HIGH THROUGHPUT MODEL					
	Balance Incoming Trucks Only	Balance Incoming & Outgoing Trucks	Primary Control System		Primary System With Stand-By		Balance Incoming Trucks Only	Balance Incoming & Outgoing Trucks	Primary Control System		Primary System With Stand-By	
			Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration			Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
BULK PLANT[1]												
Pre-Vapor Control	21%	21%	21%	21%	21%	21%	23%	23%	23%	23%	23%	23%
Post-Vapor Control	31%	61%	> 100%	96%	> 100%	> 100%	24%	36%	58%	46%	62%	54%
BULK PLANT[2]												
Pre-Vapor Control	21%	21%	21%	21%	21%	21%	23%	23%	23%	23%	23%	23%
Post-Vapor Control	31%	42%	> 100%	83%	> 100%	> 100%	24%	29%	55%	41%	60%	50%
BULK PLANT[3]												
Pre-Vapor Control	21%	21%	21%	21%	21%	21%	23%	23%	23%	23%	23%	23%
Post-Vapor Control	24%	29%	> 100%	58%	> 100%	> 100%	22%	24%	53%	25%	59%	48%

[1]NOJC costs

[2]Houston-Galveston costs

[3]Colorado APCD costs

Source: Appendix F

severely impacted according to the above analysis, a substantial number of closures are expected.

c. Closure Summary

The number of bulk plant closures expected to result from an inability to secure capital varies significantly by control option and cost scenario. No bulk plant closures are likely to occur because of Option 1, which has the smallest capital requirement of the three control options (Table VII.5). Option 2 is expected to cause approximately 1,690 facilities, or 12% of all gasoline bulk plants, to close if the NOJC, or most expensive, cost scenario is assumed. No closures are expected for Option 2 for the other two cost scenarios. Because Option 3 compliance requires the greatest amount of capital, it is the option expected to cause the largest number of bulk plant closures. The number of bulk plant closures expected as a result of Option 3 ranges from 1,060 for a Colorado APCD incineration unit to 8,990 for a NOJC refrigeration/incineration system. The bulk plant closures identified here will be subtracted from the total number of bulk plants subject to possible closure to avoid possible double-counting. Only those facilities having adequate access to capital are subject to possible closure resulting from insufficient profitability.

2. Insufficient Profitability

Many of the bulk plants having access to adequate capital may still close because of vapor control economics. Bulk plants failing to achieve a minimum level of profitability after vapor control equipment is installed are assumed to close. Bulk plants will continue operating as long as the bulk plant operators can meet current liabilities, i.e., operating expenses (including salaries) and debt obligations (principal and interest). Bulk plants would continue to operate under these conditions even if no return on equity investment was earned. Bulk plant operators having limited business alternatives for their equity investment or believing that profitability would increase in the future as other facilities close would remain in business.

TABLE VII.5

BULK PLANT CLOSURES BECAUSE OF INACCESSIBILITY OF CAPITAL

	CONTROL STRATEGY					
	OPTION 1	OPTION 2	OPTION 3			
			Primary Control System		Primary System With Stand-By	
	Balance Incoming Trucks Only	Balance Incoming & Outgoing Trucks	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
NOJC Cost Scenario	0	1,690	8,930	6,080	8,990	8,880
Houston-Galveston Cost Scenario	0	0	8,890	4,370	8,960	8,820
Colorado APCD Cost Scenario	0	0	8,870	1,060	8,950	8,820

Source: Arthur D. Little, Inc.

a. Approach

The methodology employed to calculate bulk plant closures is the same as that used in analyzing bulk terminals. Gasoline breakeven throughputs were calculated for the bulk plant models under base case conditions (Table VII.6). Facilities operating below this breakeven volume are assumed to close due to reasons other than the vapor control options. All bulk plants operating above this throughput would remain in operation. If the bulk plant models must cover higher operating expenses or larger loan payments because of vapor control, the gasoline breakeven throughput will increase. Some bulk plants, once operating above breakeven volumes, would now operate below these adjusted breakeven volumes. The example of this methodology shown in Figure VI.3 for bulk terminals is also appropriate here for bulk plants.

The incremental gasoline throughput necessary to cover all vapor control costs is shown in Table VII.6. A summary of the changes in profitability and gasoline tariff of the bulk plant models under the various control options and cost scenarios is presented in Table VII.7. In addition to the larger bulk plants, an estimated 30% of the small bulk plants will be able to pass through the entire cost of vapor control. These facilities are partially shielded from the full force of competitive pressure due to transportation economics, i.e., the incremental cost per gallon of full vapor control pass through is less than the transportation cost of a marginal gallon of gasoline moved into the bulk plant's service area. Other small bulk plants, however, will realize an increase in their breakeven throughput as a result of partially absorbing the costs of vapor control. Their gasoline tariff increase is limited to the same per gallon increase as the larger facilities and they will, therefore, experience a decline in margin and an increase in breakeven throughput.

The product volumes of the bulk plants which closed because they lacked the capital necessary to install vapor control equipment will be redistributed across the remaining bulk plant population. This

TABLE VII.6

CHANGE IN DAILY GASOLINE BREAKEVEN THROUGHPUT AT BULK PLANTS BECAUSE OF VAPOR CONTROL COSTS[1]
(Thousand Gallons)

	LOW THROUGHPUT MODEL						HIGH THROUGHPUT MODEL					
									Primary Control System		Primary System With Stand-By	
BULK PLANT[2]	Balance Incoming Trucks Only	Balance Incoming & Outgoing Trucks	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration	Balance Incoming Trucks Only	Balance Incoming & Outgoing Trucks	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
Gasoline Breakeven Throughput (Pre-Vapor Control)	3.2	3.2	3.2	3.2	3.2	3.2	16.1	16.1	16.1	16.1	16.1	16.1
Incremental Gasoline Throughput Required Due to Vapor Control Capital and Operating Costs	0.1	0.5	2.7	1.4	3.4	2.1	0.0	0.0	0.0	0.0	0.0	0.0
Gasoline Breakeven Throughput (Post-Vapor Control)	3.3	3.7	5.9	4.6	6.6	5.3	16.1	16.1	16.1	16.1	16.1	16.1
Percent Increase Over Pre-Control Throughput	3%	15%	84%	44%	> 100%	66%	0%	0%	0%	0%	0%	0%
BULK PLANT[3]												
Gasoline Breakeven Throughput (Pre-Vapor Control)	3.2	3.2	3.2	3.2	3.2	3.2	16.1	16.1	16.1	16.1	16.1	16.1
Incremental Gasoline Throughput Required Due to Vapor Control Capital and Operating Costs	0.1	0.2	2.4	1.1	3.1	1.8	0.0	0.0	0.0	0.0	0.0	0.0
Gasoline Breakeven Throughput (Post-Vapor Control)	3.3	3.4	5.6	4.3	6.3	5.0	16.1	16.1	16.1	16.1	16.1	16.1
Percent Increase Over Pre-Control Throughput	3%	6%	75%	34%	97%	56%	0%	0%	0%	0%	0%	0%
BULK PLANT[4]												
Gasoline Breakeven Throughput (Pre-Vapor Control)	3.2	3.2	3.2	3.2	3.2	3.2	16.1	16.1	16.1	16.1	16.1	16.1
Incremental Gasoline Throughput Required Due to Vapor Control Capital and Operating Costs	0.0	0.04	2.2	0.9	2.9	1.6	0.0	0.0	0.0	0.0	0.0	0.0
Gasoline Breakeven Throughput (Post-Vapor Control)	3.2	3.24	5.4	4.1	6.1	4.8	16.1	16.1	16.1	16.1	16.1	16.1
Percent Increase Over Pre-Control Throughput	0%	1%	69%	28%	91%	50%	0%	0%	0%	0%	0%	0%

[1] Assuming competitive cost pass through. [2] NOJC costs. [3] Houston-Galveston costs. [4] Colorado APCD costs.

Source: Arthur D. Little, Inc.

TABLE VII.7

BULK PLANT ROI AND GASOLINE TARIFF IMPACTS

	LOW THROUGHPUT MODEL						HIGH THROUGHPUT MODEL					
	Balance Incoming Trucks Only	Balance Incoming & Outgoing Trucks	Primary Control System		Primary System With Stand-By		Balance Incoming Trucks Only	Balance Incoming & Outgoing Trucks	Primary Control System		Primary System With Stand-By	
			Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration			Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
BULK PLANT[1]												
Post-Vapor Control ROI	17.3%	7.8%	Negative	Negative	Negative	Negative	20.5%	20.5%	20.5%	20.5%	20.5%	20.5%
Percent Increase/ (Decrease) Over Pre-Control ROI[2]	(15.7%)	(62.1%)	--	--	--	--	NC[3]	NC	NC	NC	NC	NC
Post-Vapor Control Gasoline Tariff ($/Gal)	.0322	.0328	.0353	.0347	.0364	.0357	.0174	.0180	.0205	.0198	.0216	.0208
Percent Increase/ (Decrease) Over Pre-Control Gasoline Tariff	(0.6%)	1.4%	9.1%	7.0%	12.5%	10.1%	(1.0%)	2.6%	16.9%	13.0%	23.1%	18.7%
BULK PLANT[4]												
Post-Vapor Control ROI	17.3%	13.2%	Negative	1.2%	Negative	Negative	20.5%	20.5%	20.5%	20.5%	20.5%	20.5%
Percent Increase/ (Decrease) Over Pre-Control ROI[2]	(15.7%)	(35.8%)	--	(94.3%)	--	--	NC	NC	NC	NC	NC	NC
Post-Vapor Control Gasoline Tariff ($/Gal)	.0322	.0323	.0349	.0342	.0360	.0352	.0174	.0175	.0200	.0194	.0211	.0204
Percent Increase/ (Decrease) Over Pre-Control Gasoline Tariff	(0.6%)	(0.1%)	7.8%	5.6%	11.1%	8.7%	(1.0%)	(0.2%)	14.3%	10.4%	20.5%	16.1%
BULK PLANT[5]												
Post-Vapor Control ROI	19.2%	17.7%	Negative	10.1%	Negative	Negative	20.5%	20.5%	20.5%	20.5%	20.5%	20.5%
Percent Increase/ (Decrease) Over Pre-Control ROI[2]	(6.8%)	(14.1%)	--	(50.7%)	--	--	NC	NC	NC	NC	NC	NC
Post-Vapor Control Gasoline Tariff ($/Gal)	.0321	.0320	.0346	.0379	.0356	.0349	.0173	.0172	.0197	.0190	.0208	.0200
Percent Increase/ (Decrease) Over Pre-Control Gasoline Tariff	(0.9%	(1.1%)	1.7%	17.0%	10.0%	7.7%	(1.6%)	(2.0%)	12.4%	8.4%	18.5%	14.1%

[1]NOJC costs. [2]Pre-control ROI is 20.5%. ROI is a simple before-tax return on net plant investment.

[3]No Change - assumes full pass through of costs for this model. [4]Houston-Galveston costs. [5]Colorado APCD costs

Source: Appendix G

increase in product throughput will assist the facilities under consideration here to achieve their new breakeven volumes. However, the amounts of this redistribution for Options 1 and 2 are rather insignificant since the incremental throughput of only one of the six cost scenarios is greater than zero and even that is less than 700 gallons/day. The additional product volumes for Option 3 range from under 500 gallons/day to over 10,000 gallons/day. As was the case for Options 1 and 2, the incremental volumes resulting from the low end of this range can be regarded as insignificant. Volume adjustments caused by the high end of this range, however, are quite significant. The redistribution of this product will greatly reduce the number of expected bulk plant closures caused by insufficient profitability, but it also is expected to alter many of the basic attributes which have historically characterized the bulk plant industry. Considering the magnitude of the closures and the redistributed volumes described above, a substantially new and different secondary storage industry is likely to emerge.

b. Closure Summary

The number of bulk plants able to obtain capital but having to close because of insufficient profitability is shown in Table VII.8. The number of closures varies by control option and cost scenario. Closures resulting from Option 1 are estimated to be 130 for the NOJC and Houston-Galveston cost scenarios and zero for the Colorado APCD cost scenario. Closures resulting from Option 2 range from 50 to 530 facilities, while Option 3 compliance is expected to cause between 600 and 1,300 bulk plants to close. A summary of all bulk plant closures caused by vapor control economics, as well as the number of remaining bulk plants installing vapor control equipment, is shown in Tables VII.9 through VII.11.

TABLE VII.8

BULK PLANT CLOSURES BECAUSE OF INSUFFICIENT PROFITABILITY

	CONTROL STRATEGY					
	OPTION 1	OPTION 2	OPTION 3			
			Primary Control System		Primary System with Stand-By	
	Balance Incoming Trucks Only	Balance Incoming & Outgoing Trucks	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
NOJC Cost Scenario	130	530	1,040	900	1,300	800
Houston-Galveston Cost Scenario	130	240	920	890	1,180	690
Colorado APCD Cost Scenario	0	50	840	1,010	1,100	610

Source: Arthur D. Little, Inc.

TABLE VII.9

BULK PLANT CLOSURES BECAUSE OF VAPOR CONTROL ECONOMICS[1] RESULTING FROM THE NOJC COST SCENARIO

	CONTROL STRATEGY					
	OPTION 1	OPTION 2	OPTION 3			
			Primary Control System		Primary System with Stand-By	
	Balance Incoming Trucks Only	Balance Incoming & Outgoing Trucks	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
Petroleum Bulk Plants Subject to Vapor Control	14,250	14,250	14,250	14,250	14,250	14,250
Bulk Plant Closures Because of Inaccessibility of Capital	0	1,690	8,930	6,080	8,990	8,880
Bulk Plant Closures Because of Insufficient Profitability	130	530	1,040	900	1,300	800
Remaining Bulk Plants Installing Vapor Control	14,120	12,030	4,280	7,270	3,960	4,570

[1] Assuming competitive cost pass through.

Source: Table VII.5 and VII.8

TABLE VII.10

BULK PLANT CLOSURES BECAUSE OF VAPOR CONTROL ECONOMICS[1] RESULTING FROM THE HOUSTON-GALVESTON COST SCENARIO

	CONTROL STRATEGY					
	OPTION 1	OPTION 2	OPTION 3			
			Primary Control System		Primary System With Stand-By	
	Balance Incoming Trucks Only	Balance Incoming & Outgoing Trucks	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
Petroleum Bulk Plants Subject to Vapor Control	14,250	14,250	14,250	14,250	14,250	14,250
Bulk Plant Closures Because of Inaccessibility of Capital	0	0	8,890	4,370	8,960	8,820
Bulk Plant Closures Because of Insufficient Profitability	130	240	920	890	1,180	690
Remaining Bulk Plants Installing Vapor Control	14,120	14,010	4,440	8,990	4,110	4,740

[1]Assuming competitive cost pass through.

Source: Table VII.5 and VII.8

TABLE VII.11

BULK PLANT CLOSURES BECAUSE OF VAPOR CONTROL ECONOMICS[1] RESULTING FROM THE COLORADO APCD COST SCENARIO

	CONTROL STRATEGY					
	OPTION 1	OPTION 2	OPTION 3			
			Primary Control System		Primary System With Stand-By	
	Balance Incoming Trucks Only	Balance Incoming & Outgoing Trucks	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
Petroleum Bulk Plants Subject to Vapor Control	14,250	14,250	14,250	14,250	14,250	14,250
Bulk Plant Closures Because of Inaccessibility of Capital	0	0	8,870	1,060	8,950	8,820
Bulk Plant Closures Because of Insufficient Profitability	0	50	840	1,010	1,100	610
Remaining Bulk Plants Installing Vapor Control	14,250	14,200	4,540	12,180	4,190	4,820

[1] Assuming competitive cost pass through.

Source: Table VII.5 and VII.8

D. BULK PLANT IMPACTS

In addition to bulk plant closures, the economic impacts of vapor control on the bulk plant industry are expressed in terms of the employment displaced by these closures and the monetary cost of installing, financing, and operating vapor control systems at all the remaining bulk plants.

1. Employment Impact

At bulk plants, the number of employees displaced by the proposed vapor control options ranges from zero to 43,700 (Table VII.12). These numbers were calculated by multiplying the average number of employees per large and small bulk plant times the number of expected closures of each type. Approximately 550 workers, or less than 1% of the total employment at gasoline bulk plants, are displaced by closures caused by Option 1. Up to 9,400 workers, or 13% of the worker population, are displaced by closures caused by Option 2 compliance, while as many as 43,700 workers, or 61% of those employed at gasoline bulk plants, are likely to be displaced by Option 3.

2. National Cost of Compliance

The installation and operation of vapor control systems at bulk plants over the estimated 10-year useful life of the equipment may cost as much as $750 million or produce a savings of up to $23 million, depending upon the control option and the cost scenario selected (Table VII.13). A cost savings is possible because the Colorado cost scenario requires less than half the capital investment of the other systems but still produces the same recovery credit as the more expensive systems. Depending on the set of costs examined, Option 1 compliance ranges from a $23 million savings to a cost of $37 million; Option 2 compliance ranges from a savings of $6 million to a cost of $376 million; and Option 3 compliance costs between $465 and $750 million. A more detailed breakdown of all control system costs is presented in Tables VII.14 through VII.16.

TABLE VII.12

EMPLOYMENT IMPACT AT BULK PLANTS BECAUSE OF VAPOR CONTROL ECONOMICS

	CONTROL STRATEGY					
	OPTION 1	OPTION 2	OPTION 3			
			Primary Control System		Primary System With Stand-By	
	Balance Incoming Trucks Only	Balance Incoming & Outgoing Trucks	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
NOJC COST SCENARIO						
Bulk Plants Closed Because of Vapor Control Economics	130	2,220	9,970	6,980	10,290	9,680
Estimated Employment At Closed Bulk Plants	550	9,440	42,370	29,660	43,730	41,140
HOUSTON-GALVESTON COST SCENARIO						
Bulk Plants Closed Because of Vapor Control Economics	130	240	9,810	5,260	10,140	9,510
Estimated Employment At Closed Bulk Plants	550	1,020	41,690	22,360	43,100	40,420
COLORADO APCD COST SCENARIO						
Bulk Plants Closed Because of Vapor Control Economics	0	50	9,710	2,070	10,050	9,430
Estimated Employment At Closed Bulk Plants	0	210	41,270	8,800	42,710	40,080

Source: Arthur D. Little, Inc.

TABLE VII.13

TOTAL COST OF VAPOR CONTROL AT BULK PLANTS
(Million 1978 Dollars)

	CONTROL STRATEGY					
	OPTION 1	OPTION 2	OPTION 3			
			Primary Control System		Primary System With Stand-By	
	Balance Incoming Trucks Only	Balance Incoming & Outgoing Trucks	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
NOJC COST SCENARIO						
Bulk Plants Installing Vapor Control Equipment	14,120	12,030	4,280	7,270	3,960	4,570
Total Vapor Control Cost[1]	36.9	375.5	636.9	651.3	747.3	589.5
HOUSTON-GALVESTON COST SCENARIO						
Bulk Plants Installing Vapor Control Equipment	14,120	14,010	4,440	8,990	4,110	4,740
Total Vapor Control Cost	36.9	154.8	569.3	619.7	698.3	514.0
COLORADO APCD COST SCENARIO						
Bulk Plants Installing Vapor Control Equipment	14,250	14,200	4,540	12,180	4,190	4,820
Total Vapor Control Cost	(22.7)[2]	(6.5)[2]	528.6	696.8	656.0	465.2

[1] Vapor control costs include capital charges, financing cost and operating expenses over the useful life of the equipment. All future cash streams have been discounted to present value using a discount rate of 10%.

[2] Negative cost or net savings because the net present value of the gasoline recovery credit exceeds the net present value of the capital, financing and operating expenses.

Source: Tables VII.14 and VII.16

TABLE VII.14

COST OF VAPOR CONTROL AT BULK PLANTS RESULTING FROM THE NOJC COST SCENARIO[1]
(Million 1978 Dollars)

	CONTROL STRATEGY					
	OPTION 1	OPTION 2	OPTION 3			
			Primary Control System		Primary System With Stand-By	
	Balance Incoming Trucks Only	Balance Incoming & Outgoing Trucks	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
Capital Investment	60.0	280.9	398.0	355.1	468.4	339.8
Financing[2]	13.3	62.3	88.3	78.8	103.9	75.4
Operating Expense[3]	26.0	120.7	279.5	217.4	290.7	174.3
Recovery Credit[3]	(62.4)[4]	(88.4)	(128.9)	--	(115.7)	--
Total Vapor Control Costs	36.9	375.5	636.9	651.3	747.3	589.5

[1] All future cash streams discounted to present value using a discount rate of 10%.

[2] Interest charges associated with vapor control debt are incurred over a 5-year period and discounted to present value.

[3] Operating expenses and recovery credits are realized over the 10-year useful life of the vapor control system and discounted to present value.

[4] Represents a negative cost or a savings equivalent to the present value of the gasoline vapor which otherwise would have been discharged into the atmosphere if a vapor recovery system was not utilized.

Source: Arthur D. Little, Inc. estimates based upon EPA cost data.

TABLE VII.15

COST OF VAPOR CONTROL AT BULK PLANTS RESULTING FROM THE HOUSTON-GALVESTON COST SCENARIO[1]
(Million 1978 Dollars)

	CONTROL STRATEGY					
	OPTION 1	OPTION 2	OPTION 3			
			Primary Control System		Primary System With Stand-By	
	Balance Incoming Trucks Only	Balance Incoming & Outgoing Trucks	Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
Capital Investment	60.0	153.1	357.6	326.5	434.8	293.4
Financing[2]	13.3	34.0	79.4	72.5	96.5	65.1
Operating Expense[3]	26.0	66.0	266.1	220.7	286.2	155.5
Recovery Credit[3]	(62.4)[4]	(98.3)	(133.8)	--	(119.2)	--
Total Vapor Control Costs	36.9	154.8	569.3	619.7	698.3	514.0

[1] All future cash streams discounted to present value using a discount rate of 10%.

[2] Interest charges associated with vapor control debt are incurred over a 5-year period and discounted to present value.

[3] Operating expenses and recovery credits are realized over the 10-year useful life of the vapor control system and discounted to present value.

[4] Represents a negative cost or a savings equivalent to the present value of the gasoline vapor which otherwise would have been discharged into the atmosphere if a vapor recovery system was not utilized.

Source: Arthur D. Little,Inc. estimates based upon EPA cost data

TABLE VII.16

COST OF VAPOR CONTROL AT BULK PLANTS RESULTING FROM THE COLORADO APCD COST SCENARIO[1]

	CONTROL STRATEGY					
	OPTION 1	OPTION 2	OPTION 3			
	Balance Incoming Trucks Only	Balance Incoming & Outgoing Trucks	Primary Control System		Primary System With Stand-By	
			Refrigeration	Incineration	Refrigeration/ Incineration	Incineration/ Incineration
Capital Investment	24.2	56.0	332.8	355.9	412.9	263.5
Financing[2]	5.4	12.4	73.9	79.0	91.6	58.5
Operating Expense[3]	10.5	24.3	258.1	261.9	272.2	143.2
Recovery Credit[3]	(62.8)[4]	(99.2)	(136.2)	--	(120.7)	--
Total Vapor Control Costs	(22.7)	(6.5)	528.6	696.8	656.0	465.2

[1]All future cash streams discounted to present value using a discount rate of 10%.

[2]Interest charges associated with vapor control debt are incurred voer a 5-year period and discounted to present value.

[3]Operating expenses and recovery credits are realized over the 10-year useful life of the vapor control system and discounted to present value.

[4]Represents a negative cost or a savings equivalent to the present value of the gasoline vapor which otherwise would have been discharged into the atmosphere if a vapor recovery system was not utilized.

Source: Arthur D. Little, Inc. estimates based upon EPA cost data

APPENDIX A

MARKET AUDIT OF BULK STORAGE FACILITIES

TABLE A.1

BULK TERMINALS AND STORAGE CAPACITY IN THE U.S. - 1978[1]

	RANGE OF STORAGE CAPACITY											
Thousand Cu. Meters	< 32	32-95	95-159	> 159								
Thousand Barrels	<200	201-600	601-1000	>1000	TOTAL	PERCENT OF TOTAL	TOTAL CAPACITY		PERCENT OF TOTAL CAPACITY	TOTAL GASOLINE CAPACITY		GASOLINE AS A PERCENT TOTAL CAPACITY
							Thousand Cu. Meters	Thousand Barrels		Thousand Cu. Meters	Thousand Barrels	
MARINE TERMINALS												
Majors & Semi-Majors	232	199	78	78	587	33%	54,417	342,273	43%	22,739	143,367	42%
Independents	231	60	33	48	372	22%	28,026	181,502	28%	6,992	43,979	25%
PIPELINE TERMINALS												
Majors & Semi-Majors	253	213	84	33	583	33%	28,261	177,758	23%	13,438	84,522	48%
Independents	118	62	20	9	209	12%	10,999	69,183	9%	3,886	24,440	35%
TOTAL	834	534	215	168	1,751	100%	122,534	770,716	100%	47,109	296,308	38%
% Total	48%	30%	12%	10%	100%							

[1] Excludes crude and product storage at refineries

Source: Bureau of Census, 1972 Census of Wholesale Trade; U.S. Army Corps of Engineers, Port Series; National Petroleum News, Factbook (1972-1978); Independent Liquid Terminals Association, 1978 Directory - Bulk Liquid Terminals and Storage Facilities; Industry contacts; Arthur D. Little, Inc.

TABLE A.2

BULK TERMINALS AND STORAGE CAPACITY IN PADD I - 1978[1]

	RANGE OF STORAGE CAPACITY											
Thousand Cu. Meters	< 32	32-95	95-159	> 159								
Thousand Barrels	< 200	201-600	601-1000	> 1000	TOTAL	PERCENT OF TOTAL	TOTAL CAPACITY		PERCENT OF TOTAL CAPACITY	TOTAL GASOLINE CAPACITY		GASOLINE AS A PERCENT TOTAL CAPACITY
							Thousand Cu. Meters	Thousand Barrels		Thousand Cu. Meters	Thousand Barrels	
MARINE TERMINALS												
Majors & Semi-Majors	97	118	46	50	311	42%	38,702	243,432	61%	15,094	94,939	39%
Independents	138	48	13	23	222	30%	13,990	87,996	21%	2,845	17,895	20%
PIPELINE TERMINALS												
Majors & Semi-Majors	82	51	36	10	179	24%	10,192	64,107	16%	5,606	35,259	55%
Independents	19	14	--	--	33	4%	1,287	8,098	2%	270	1,701	21%
TOTAL	336	231	95	83	745	100%	64,172	403,633	100%	23,815	149,792	37%
% Total	45%	31%	13%	11%	100%							
% U.S.	40%	43%	44%	49%	43%		52%			51%		

[1]Excludes crude and product storage at refineries

Source: Bureau of Census, 1972 Census of Wholesale Trade; U.S. Army Corps of Engineers, Port Series; National Petroleum News, Factbook (1972-1978); Independent Liquid Terminals Association, 1978 Directory - Bulk Liquid Terminals and Storage Facilities; Industry contacts; Arthur D. Little, Inc.

TABLE A.3

BULK TERMINALS AND STORAGE CAPACITY IN PADD II - 1978[1]

	RANGE OF STORAGE CAPACITY											
Thousand Cu. Meters	< 32	32-95	95-159	> 159								
Thousand Barrels	<200	201-600	601-1000	>1000	TOTAL	PERCENT OF TOTAL	TOTAL CAPACITY Thousand Cu. Meters	TOTAL CAPACITY Thousand Barrels	PERCENT OF TOTAL CAPACITY	TOTAL GASOLINE CAPACITY Thousand Cu. Meters	TOTAL GASOLINE CAPACITY Thousand Barrels	GASOLINE AS A PERCENT TOTAL CAPACITY
MARINE TERMINALS												
Majors & Semi-Majors	12	34	11	5	62	14%	3,725	23,431	15%	1,788	11,247	48%
Independents	20	17	5	2	44	10%	2,636	16,580	10%	538	3,386	20%
PIPELINE TERMINALS												
Majors & Semi-Majors	97	95	23	11	226	53%	13,056	82,121	52%	5,484	34,491	42%
Independents	64	20	7	6	97	23%	5,738	36,088	23%	2,066	12,992	23%
TOTAL	193	166	46	24	429	100%	25,155	158,219	100%	9,875	62,115	39%
% Total	45%	39%	11%	6%	100%							
% U.S.	23%	31%	21%	14%	25%		21%			21%		

[1]Excludes crude and product storage at refineries

Source: Bureau of Census, 1972 Census of Wholesale Trade; U.S. Army Corps of Engineers, Port Series; National Petroleum News, Factbook (1972-1978); Independent Liquid Terminals Association, 1978 Directory - Bulk Liquid Terminals and Storage Facilities; Industry contacts; Arthur D. Little, Inc.

BULK TERMINALS AND STORAGE CAPACITY IN PADD III - 1978[1]

	RANGE OF STORAGE CAPACITY											
Thousand Cu. Meters	< 32	32-95	95-159	> 159			TOTAL CAPACITY		PERCENT OF TOTAL CAPACITY	TOTAL GASOLINE CAPACITY		GASOLINE AS A PERCENT TOTAL CAPACITY
Thousand Barrels	<200	201-600	601-1000	>1000	TOTAL	PERCENT OF TOTAL	Thousand Cu. Meters	Thousand Barrels		Thousand Cu. Meters	Thousand Barrels	
MARINE TERMINALS												
Majors & Semi-Majors	39	19	10	13	81	29%	6,455	40,600	32%	3,808	23,954	59%
Independents	38	11	10	17	76	28%	9,218	57,982	46%	2,756	17,332	30%
PIPELINE TERMINALS												
Majors & Semi-Majors	60	16	11	7	94	34%	2,881	18,118	14%	1,210	7,610	42%
Independents	12	6	3	4	25	9%	1,514	9,522	8%	454	2,857	30%
TOTAL	149	52	34	41	276	100%	20,068	126,223	100%	8,228	51,753	41%
% Total	54%	19%	12%	15%	100%							
% U.S.	18%	10%	16%	24%	16%		16%			17%		

[1]Excludes crude and product storage at refineries

Source: Bureau of Census, 1972 Census of Wholesale Trade; U.S. Army Corps of Engineers, Port Series; National Petroleum News, Factbook (1972-1978); Independent Liquid Terminals Association, 1978 Directory - Bulk Liquid Terminals and Storage Facilities; Industry contacts; Arthur D. Little, Inc.

TABLE A.5

BULK TERMINALS AND STORAGE CAPACITY IN PADD IV - 1978[1]

	RANGE OF STORAGE CAPACITY											
Thousand Cu. Meters	< 32	32-95	95-159	> 159								
Thousand Barrels	<200	201-600	601-1000	>1000	TOTAL	PERCENT OF TOTAL	TOTAL CAPACITY Thousand Cu. Meters	TOTAL CAPACITY Thousand Barrels	PERCENT OF TOTAL CAPACITY	TOTAL GASOLINE CAPACITY Thousand Cu. Meters	TOTAL GASOLINE CAPACITY Thousand Barrels	GASOLINE AS A PERCENT TOTAL CAPACITY
PIPELINE TERMINALS												
Majors & Semi-Majors	19	10	2	--	31	79%	987	6,210	86%	612	3,850	62%
Independents	6	2	--	--	8	21%	164	1,029	14%	62	390	38%
TOTAL	25	12	2	--	39	100%	1,151	7,239	100%	674	4,240	59%
% Total	64%	31%	5%	--	100%							
% U.S.	3%	2%	1%	--	2%		1%			1%		

[1]Excludes crude and product storage at refineries

Source: Bureau of Census, 1972 Census of Wholesale Trade; U.S. Army Corps of Engineers, Port Series; National Petroleum News, Factbook (1972-1978); Independent Liquid Terminals Association, 1978 Directory - Bulk Liquid Terminals and Storage Facilities; Industry contacts, Arthur D. Little, Inc.

BULK TERMINALS AND STORAGE CAPACITY IN PADD V - 1978[1]

	RANGE OF STORAGE CAPACITY											
Thousand Cu. Meters	< 32	32-95	95-159	> 159								
Thousand Barrels	< 200	201-600	601-1000	> 1000	TOTAL	PERCENT OF TOTAL	TOTAL CAPACITY Thousand Cu. Meters	TOTAL CAPACITY Thousand Barrels	PERCENT OF TOTAL CAPACITY	TOTAL GASOLINE CAPACITY Thousand Cu. Meters	TOTAL GASOLINE CAPACITY Thousand Barrels	GASOLINE AS A PERCENT TOTAL CAPACITY
MARINE TERMINALS												
Majors & Semi-Majors	84	26	12	11	133	51%	5,534	34,810	46%	2,103	13,228	38%
Independents	35	14	5	6	60	23%	3,012	18,945	25%	853	5,366	28%
PIPELINE TERMINALS												
Majors & Semi-Majors	11	8	4	--	23	9%	1,145	7,202	10%	527	3,313	46%
Independents	20	21	5	--	46	18%	2,297	14,447	19%	1,034	6,501	45%
TOTAL	150	69	26	17	262	100%	11,988	75,403	100%	4,517	28,408	38%
% Total	57%	26%	10%	6%	100%							
% U.S.	18%	13%	12%	10%	15%		10%			10%		

[1]Excludes crude and product storage at refineries

Source: Bureau of Census; 1972 Census of Wholesale Trade; U.S. Army Corps of Engineers, Port Series; National Petroleum News, Factbook (1972-1978); Independent Liquid Terminal Association, 1978 Directory - Bulk Liquid Terminals and Storage Facilities; Industry contacts; Arthur D. Little, Inc.

TABLE A.7

BULK PLANTS AND STORAGE CAPACITY - U.S. TOTAL - 1978

	RANGE OF STORAGE CAPACITY											
Cubic Meters	<151	152-568	569-1136	>1136								
Thousand Gallons	<40	41-150	151-300	>300	TOTAL	PERCENT OF TOTAL	TOTAL CAPACITY Thousand Cu. Meters	TOTAL CAPACITY Thousand Gallons	PERCENT OF TOTAL CAPACITY	TOTAL GASOLINE CAPACITY Thousand Cu. Meters	TOTAL GASOLINE CAPACITY Thousand Gallons	GASOLINE AS A PERCENT TOTAL CAPACITY
Majors & Semi-Majors	350	3,330	260	170	4,110	22%	1,901	502,250	28%	1,097	289,920	58%
Independent Marketer/Wholesalers	70	620	60	20	770	4%	279	73,650	4%	176	46,540	63%
Jobbers	1,960	10,850	860	90	13,760	74%	4,577	1,209,200	68%	2,748	725,920	60%
TOTAL	2,380	14,800	1,180	280	18,640	100%	6,757	1,785,100	100%	4,021	1,062,380	59%
% Total	13%	79%	6%	2%	100%							

Source: Bureau of Census; 1972 Census of Wholesale Trade; National Oil Jobbers Council; National Petroleum News, Factbook (1972-1978); Industry contacts; Arthur D. Little, Inc.

TABLE A.8

BULK PLANTS AND STORAGE CAPACITY - PADD I - 1978

	RANGE OF STORAGE CAPACITY											
Cubic Meters	<151	152-568	569-1136	<1136								
Thousand Gallons	<40	41-150	151-300	<300	TOTAL	PERCENT OF TOTAL	TOTAL CAPACITY		PERCENT OF TOTAL CAPACITY	TOTAL GASOLINE CAPACITY		GASOLINE AS A PERCENT TOTAL CAPACITY
							Thousand Cu. Meters	Thousand Gallons		Thousand Cu. Meters	Thousand Gallons	
Majors & Semi-Majors	20	450	50	30	550	16%	299	78,890	18%	187	49,450	63%
Independent Marketer/Wholesalers	20	170	20	10	220	6%	91	24,000	6%	60	15,800	66%
Jobbers	380	2,020	320	20	2,740	78%	1,251	330,400	74%	700	185,020	56%
TOTAL	420	2,640	390	60	3,510	100%	1,641	433,290	100%	947	250,270	58%
% Total	12%	75%	11%	2%	100%							
% U.S.	18%	18%	33%	21%	19%		24%			24%		

Source: Bureau of Census, 1972 Census of Wholesale Trade; National Oil Jobbers Council; National Petroleum News, Factbook (1972-1978); Industry contacts; Arthur D. Little, Inc.

TABLE A.9

BULK PLANTS AND STORAGE CAPACITY - PADD II - 1978

	RANGE OF STORAGE CAPACITY											
Cubic Meters	<151	152-568	569-1136	>1136								
Thousand Gallons	< 40	41-150	151-300	>300	TOTAL	PERCENT OF TOTAL	TOTAL CAPACITY Thousand Cu. Meters	TOTAL CAPACITY Thousand Gallons	PERCENT OF TOTAL CAPACITY	TOTAL GASOLINE CAPACITY Thousand Cu. Meters	TOTAL GASOLINE CAPACITY Thousand Gallons	GASOLINE AS A PERCENT TOTAL CAPACITY
Majors & Semi-Majors	130	1,310	90	30	1,560	17%	533	140,720	20%	292	77,240	55%
Independent Marketer/Wholesalers	30	340	40	10	420	5%	149	39,250	5%	89	23,550	60%
Jobbers	860	5,870	120	20	6,870	78%	2,009	530,700	75%	1,140	301,040	56%
TOTAL	1,020	7,520	250	60	8,850	100%	2,691	710,670	100%	1,521	401,830	57%
% Total	11%	85%	3%	1%	100%							
% U.S.	43%	51%	21%	21%	47%		40%			38%		

Source: Bureau of Census; 1972 Census of Wholesale Trade; National Oil Jobbers Council; National Petroleum News, Factbook (1972-1978); Industry contacts; Arthur D. Little, Inc.

TABLE A.10

BULK PLANTS AND STORAGE CAPACITY - PADD III - 1978

	RANGE OF STORAGE CAPACITY											
Cubic Meters	<151	152-568	569-1136	>1136								
Thousand Gallons	< 40	41-150	151-300	>300	TOTAL	PERCENT OF TOTAL	TOTAL CAPACITY		PERCENT OF TOTAL CAPACITY	TOTAL GASOLINE CAPACITY		GASOLINE AS A PERCENT TOTAL CAPACITY
							Thousand Cu. Meters	Thousand Gallons		Thousand Cu. Meters	Thousand Gallons	
Majors & Semi-Majors	110	690	40	20	860	26%	321	84,890	33%	243	64,090	75%
Independent Marketer/Wholesalers	10	50	--	--	60	2%	16	4,350	2%	12	3,280	75%
Jobbers	540	1,630	230	--	2,400	72%	621	164,140	65%	454	119,820	73%
TOTAL	660	2,370	270	20	3,320	100%	958	253,380	100%	709	187,190	74%
% Total	20%	71%	8%	10%	100%							
% U.S.	28%	16%	22%	7%	18%		14%			18%		

Source: Bureau of Census, 1972 Census of Wholesale Trade; National Oil Jobbers Council; National Petroleum News, Factbook (1972-1978); Industry contacts; Arthur D. Little, Inc.

TABLE A.11

BULK PLANTS AND STORAGE CAPACITY - PADD IV - 1978

	RANGE OF STORAGE CAPACITY												
Cubic Meters	<151	152-568	569-1136	>1136									
Thousand Gallons	< 40	41-150	151-300	>300	TOTAL	PERCENT OF TOTAL	TOTAL CAPACITY		PERCENT OF TOTAL CAPACITY	TOTAL GASOLINE CAPACITY		GASOLINE AS A PERCENT TOTAL CAPACITY
							Thousand Cu. Meters	Thousand Gallons		Thousand Cu. Meters	Thousand Gallons	
Majors & Semi-Majors	30	260	20	10	320	32%	141	37,190	44%	100	26,430	71%
Independent Marketer/Wholesalers	--	20	--	--	20	2%	6	1,700	2%	5	1,300	75%
Jobbers	80	560	10	--	650	66%	176	46,600	54%	116	30,760	66%
TOTAL	110	840	30	10	990	100%	323	85,490	100%	221	58,490	68%
% Total	11%	85%	3%	1%	100%							
% U.S.	4%	5%	3%	4%	5%		5%			5%		

Source: Bureau of Census, 1972 Census of Wholesale Trade; National Oil Jobbers Council; National Petroleum News, Factbook (1972-1978); Industry contracts; Arthur D. Little, Inc.

TABLE A.12

BULK PLANTS AND STORAGE CAPACITY - PADD V - 1978

Cubic Meters / Thousand Gallons	RANGE OF STORAGE CAPACITY: <151 / < 40	152-568 / 41-150	569-1136 / 151-300	>1136 / >300	TOTAL	PERCENT OF TOTAL	TOTAL CAPACITY: Thousand Cu. Meters	TOTAL CAPACITY: Thousand Gallons	PERCENT OF TOTAL CAPACITY	TOTAL GASOLINE CAPACITY: Thousand Cu. Meters	TOTAL GASOLINE CAPACITY: Thousand Gallons	GASOLINE AS A PERCENT TOTAL CAPACITY
Majors & Semi-Majors	60	620	60	80	820	42%	608	160,560	53%	275	72,710	45%
Independent Marketer/Wholesalers	10	40	--	--	50	3%	16	4,350	2%	10	2,610	60%
Jobbers	100	770	180	50	1,100	55%	520	137,360	45%	338	89,280	65%
TOTAL †	170	1,430	240	130	1,970	100%	1,144	302,270	100%	623	164,600	54%
% Total	9%	73%	12%	6%	100%							
% U.S.	7%	10%	21%	47%	11%		17%			15%		

Source: Bureau of Census, 1972 Census of Wholesale Trade; National Oil Jobbers Council; National Petroleum News, Factbook (1972-1978); Industry contacts; Arthur D. Little, Inc.

A P P E N D I X   B

LIST OF MAJOR AND SEMI-MAJOR OIL COMPANIES

TABLE B.1

MAJORS AND SEMI MAJORS[1]

MAJORS

Amoco Oil Co.
Atlantic Richfield Co.
Chevron U.S.A., Inc.
Exxon Co., U.S.A.
Gulf Oil Co.
Mobil Oil Corp.
Shell Oil Co.
Texaco, Inc.

SEMI-MAJORS

Amerada Hess Corp.
Ashland Oil Co.
Cities Service Oil Co.
Continental Oil Co.
Diamond Shamrock Oil & Gas Co.
Getty Refining & Marketing Co.
Kerr-McGee Corp.
Marathon Oil Co.
Murphy Oil Corp.
Phillips Petroleum Co.
Standard Oil Co. (Ohio)
Sunmark Industries
Tenneco Oil Co.
Union Oil Co. of California

[1]Largest 22 gasoline marketers based on total company assets in 1977.

Source: National Petroleum News Factbook

APPENDIX C

OPERATIONAL AND FINANCIAL PRO FORMAS OF PROTOTYPICAL BULK STORAGE FACILITIES

TABLE C.1

LARGE MARINE TERMINAL PROTOTYPE

OPERATIONS

	PRODUCT GROUP		
	Gasoline	Distillate	Total
Storage (Thousand Barrels)	217	424	641
Annual Tank Turnovers	20	9	13
Annual Throughput (Million Gallons)	182.5	160.2	342.7
Daily Throughput (Thousand Gallons)	500	439	939

FACILITIES

No. of Tanks - 10

Land (Acres) - 25

No. of Employees - 21

Method of Receipt - Marine Tanker (35,000 DWT)

Source: Arthur D. Little, Inc.

TABLE C.2

ESTIMATED INVESTMENT PROFILE OF
LARGE MARINE TERMINAL PROTOTYPE
(Thousands of Dollars)

INVESTMENT	GROSS INVESTMENT	NET INVESTMENT*	NET COST ($/Shell Barrel)
A. Depreciable Fixed Assets			
Tanks	1,921.5	960.8	1.50
Building	35.0	17.0	
Dock	650.0	100.0	
Meters, Piping, Pumps	200.0	175.0	
Loading Racks, etc.	1,000.0	940.0	
Miscellaneous Equipment	365.0	183.6	
Total Depreciable Assets	4,171.5	2,376.4	3.71
B. Other Fixed Assets			
Land		760.0	
Engineering		350.0	
Capitalized Interest		400.0	
		1,510.0	2.36
C. Working Capital**		40.0	.06
TOTAL INVESTMENT		3,926.4	6.13

*Book value of 10 year old facility.
**Excluding inventory allocated to class of trade sales profit centers.

Source: Arthur D. Little, Inc.

TABLE C.3

ESTIMATED OPERATING EXPENSES OF LARGE MARINE TERMINAL PROTOTYPE

(Thousands of Dollars)

LABOR	ANNUAL EXPENSE	$/ANNUAL THROUGHPUT GALLON	PERCENT OF TOTAL EXPENSES
Straight Time 15 men X 52 X $320/wk ($8.00/hr)	249.6		
3 Supervisors	75.0		
Plant Manager	35.0		
Plant Secretary/Clerk	27.0		
a) Straight Time (S&W)	386.6		
b) Overtime 15 men X 47 X $48/wk (4 hr @ $12.00/hr)	33.8		
c) Benefits (25% of a)	96.7		
d) FICA (6.13% of a+b)	23.2		
e) Employee expenses	17.6		
Total Labor Expense	557.9		
1. Total Labor Expense	557.9	.00163	56%
2. Miscellaneous Services	11.2	.00003	1%
3. Maintenance & Repairs	28.1	.00008	3%
4. Utilities & Misc. Operating Expenses	65.0	.00019	7%
5. Local Taxes	150.0	.00044	15%
6. Insurance/Misc. Fixed Costs	175.0	.00051	18%
Total Expenses	987.2	.00288	100%

Source: Arthur D. Little, Inc.

TABLE C.4

REQUIRED TARIFF (PRE-VAPOR CONTROL) OF LARGE MARINE TERMINAL PROTOTYPE

	Net Investment (Thousand Dollars)
Total Investment	3926.4
x Annual Capital Recovery Factor (20% BFIT, 20 Years)	.2054
	806.5

	Annual Cost (Thousand Dollars)	Required Tariff ($/Annual Throughput Gallon)
Operating Expenses	987.2	.00288
Capital Recovery	806.5	.00235
Total	1,793.7	.00523

Source: Arthur D. Little, Inc.

TABLE C.5

SMALL MARINE TERMINAL PROTOTYPE

OPERATIONS

	PRODUCT GROUP		
	Gasoline	Distillate	Total
Storage (Thousand Barrels)	150	124	274
Annual Tank Turnovers	15	7	10
Annual Throughput (Million Gallons)	91.3	36.5	127.8
Daily Throughput (Thousand Gallons)	250	100	350

FACILITIES

No. of Tanks - 8

Land (Acres) - 20

No. of Employees - 13

Method of Receipt - Marine Tanker (20-35,000 DWT)

Source: Arthur D. Little, Inc.

TABLE C.6

ESTIMATED INVESTMENT PROFILE OF SMALL MARINE TERMINAL PROTOTYPE

(Thousands of Dollars)

INVESTMENT	GROSS INVESTMENT	NET INVESTMENT*	NET COST ($/Shell Barrel)
A. Depreciable Fixed Assets			
Tanks	904.0	452.1	1.65
Building	10.0	5.5	
Dock	450.0	70.0	
Meters, Piping, Pumps	100.0	90.0	
Loading Racks, etc.	400.0	375.0	
Miscellaneous Equipment	200.0	100.0	
Total Depreciable Assets	2,064.0	1,092.6	3.99
B. Other Fixed Assets			
Land		500.0	
Engineering		164.0	
Capitalized Interest		170.0	
		834.0	3.04
C. Working Capital**		25.0	0.09
TOTAL INVESTMENT		1,951.6	7.12

*Book value of 10 year old facility

**Excluding inventory allocated to class of trade sales profit centers.

Source: Arthur D. Little, Inc.

TABLE C.7

ESTIMATED OPERATING EXPENSES OF
SMALL MARINE TERMINAL PROTOTYPE
(Thousands of Dollars)

LABOR	ANNUAL EXPENSE	$/ANNUAL THROUGHPUT GALLON	PERCENT OF TOTAL EXPENSES
Straight Time 10 men X 52 X $320/wk ($8.00/hr)	166.4		
1 Supervisor	20.0		
Plant Manager	30.0		
Plant Secretary/Clerk	12.0		
a) Straight Time (S&W)	207.6		
b) Overtime 10 men X 47 X $48/wk (4 hr @ $12.00/hr)	22.6		
c) Benefits (25% of a)	51.9		
d) FICA (6.13% of a+b)	15.0		
d) Employee Expenses	11.7		
Total Labor Expense	308.8		
1. Total Labor Expense	308.8	.00242	61%
2. Miscellaneous Services	4.2	.00003	1%
3. Maintenance & Repairs	20.5	.00016	4%
4. Utilities & Misc. Operating Expenses	24.2	.00019	5%
5. Local Taxes	80.0	.00063	16%
6. Insurance/Misc. Fixed Costs	65.2	.00051	13%
Total Expenses	502.9	.00394	100%

Source: Arthur D. Little, Inc.

TABLE C.8

REQUIRED TARIFF (PRE-VAPOR CONTROL)
OF SMALL MARINE TERMINAL PROTOTYPE

	Net Investment (Thousand Dollars)
Total Investment	1,951.6
x Annual Capital Recovery Factor (20% BFIT, 20 Years)	.2054
	400.9

	Annual Cost (Thousand Dollars)	Required Tariff ($/Annual Throughput Gallon)
Operating Expenses	502.9	.00394
Capital Recovery	400.9	.00314
Total	903.8	.00708

Source: Arthur D. Little, Inc.

TABLE C.9

LARGE PIPELINE TERMINAL PROTOTYPE

OPERATIONS

	PRODUCT GROUP		
	Gasoline	Distillate	Total
Storage (Thousand Barrels)	145	141	286
Annual Tank Turnovers	30	20	23
Annual Throughput (Million Gallons)	182.5	118.6	301.1
Daily Throughput (Thousand Gallons)	500	325	750

FACILITIES

No. of Tanks - 8

Land (Acres) - 15

No. of Employees - 16

Method of Receipt - Colonial Pipeline

Source: Arthur D. Little, Inc.

TABLE C.10

ESTIMATED INVESTMENT PROFILE OF
LARGE PIPELINE TERMINAL PROTOTYPE
(Thousands of Dollars)

INVESTMENT	GROSS INVESTMENT	NET INVESTMENT*	NET COST ($/Shell Barrel)
A. Depreciable Fixed Assets			
Tanks	858.0	429.0	1.50
Building	30.0	16.0	
Meters, Piping, Pumps	175.0	153.1	
Loading Racks, etc.	1,000.0	940.0	
Miscellaneous Equipment	300.0	150.0	
Total Depreciable Assets	2,363.0	1,688.1	5.90
B. Other Fixed Assets			
Land		275.0	
Engineering		250.0	
Capitalized Interest		225.0	
		750.0	2.62
C. Working Capital**		35.0	0.12
TOTAL INVESTMENT		2,473.1	8.64

*Book value of 10 year old facility
**Excluding inventory allocated to class of trade sales profit centers.

Source: Arthur D. Little, Inc.

TABLE C.11

ESTIMATED OPERATING EXPENSES OF
LARGE PIPELINE TERMINAL PROTOTYPE
(Thousands of Dollars)

LABOR		ANNUAL EXPENSE	$/ANNUAL THROUGHPUT GALLON	PERCENT OF TOTAL EXPENSES
	Straight Time 12 men X 52 X $280/wk ($7.00/hr)	174.7		
	2 Supervisors	40.0		
	Plant Manager	30.0		
	Plant Secretary/Clerk	12.0		
a)	Straight Time (S&W)	236.7		
b)	Overtime 12 men X 47 X $42/wk (4 hr @ $10.50/hr)	23.7		
c)	Benefits (25% of a)	59.2		
d)	FICA (6.13% of a+b)	16.8		
e)	Employee Expenses	14.1		
	Total Labor Expense	350.5		
1.	Total Labor Expense	350.5	.00117	49%
2.	Miscellaneous Services	9.8	.00003	1%
3.	Maintenance & Repairs	32.9	.00011	4%
4.	Utilities & Misc. Operating Expenses	57.1	.00019	8%
5.	Local Taxes	133.0	.00044	18%
6.	Insurance/Misc. Fixed Costs	149.0	.00049	20%
	Total Expenses	732.3	.00243	100%

Source: Arthur D. Little, Inc.

TABLE C.12

REQUIRED TARIFF (PRE-VAPOR CONTROL)
OF LARGE PIPELINE TERMINAL PROTOTYPE

	Net Investment (Thousand Dollars)
Total Investment	2,473.1
x Annual Capital Recovery Factor (20% BFIT, 20 Years)	.2054
	508.0

	Annual Cost (Thousand Dollars)	Required Tariff ($/Annual Throughput Gallon)
Operating Expenses	732.3	.00243
Capital Recovery	508.0	.00169
Total	1,240.3	.00412

Source: Arthur D. Little, Inc.

TABLE C.13

SMALL PIPELINE TERMINAL PROTOTYPE

OPERATIONS

	PRODUCT GROUP		
	Gasoline	Distillate	Total
Storage (Thousand Barrels)	72.5	56.5	129
Annual Tank Turnovers	30	20	25
Annual Throughput (Million Gallons)	91.3	47.5	138.8
Daily Throughput (Thousand Gallons)	250	130	380

FACILITIES

No. of Tanks - 6

Land (Acres) - 10

No. of Employees - 11

Method of Receipt - Colonial Pipeline

Source: Arthur D. Little, Inc.

TABLE C.14

ESTIMATED INVESTMENT PROFILE OF SMALL PIPELINE TERMINAL PROTOTYPE
(Thousands of Dollars)

INVESTMENT	GROSS INVESTMENT	NET INVESTMENT*	NET COST ($/Shell Barrel)
A. Depreciable Fixed Assets			
Tank	444.7	222.4	1.72
Building	7.0	3.4	
Meters, Piping, Pumps	40.2	35.2	
Loading Racks, etc.	364.5	342.6	
Miscellaneous Equipment	73.5	37.0	
Total Depreciable Assets	929.9	640.6	4.97
B. Other Fixed Assets			
Land		182.4	
Engineering		94.3	
Capitalized Interest		107.8	
		384.5	2.98
C. Working Capital**		16.0	.12
TOTAL INVESTMENT		989.9	8.07

*Book value of 10 year old facility
**Excluding inventory allocated to class of trade sales profit centers.

Source: Arthur D. Little, Inc.

TABLE C.15

ESTIMATED OPERATING EXPENSES OF
SMALL PIPELINE TERMINAL PROTOTYPE
(Thousands of Dollars)

LABOR	ANNUAL EXPENSE	$/ANNUAL THROUGHPUT GALLON	PERCENT OF TOTAL EXPENSE
Straight Time 8 men X 52 X $280/wk ($7.00/hr)	116.5		
1 Supervisor	20.0		
Plant Manager	30.0		
Plant Secretary/Clerk	12.0		
a) Straight Time (S&W)	178.5		
b) Overtime 8 men X 47 X $42/wk (4 hr @ $10.50/hr)	15.8		
c) Benefits (25% of a)	44.6		
d) FICA (6.13% of a+b)	11.5		
e) Employee Expenses	9.4		
Total Labor Expense	250.4		
1. Total Labor Expense	250.4	.00182	59%
2. Miscellaneous Services	4.5	.00003	1%
3. Maintenance & Repairs	11.4	.00008	3%
4. Utilities & Misc. Operating Expenses	26.3	.00019	6%
5. Local Taxes	60.0	.00043	14%
6. Insurance/Misc. Fixed Costs	70.9	.00052	17%
Total Expenses	423.5	.00305	100%

Source: Arthur D. Little, Inc.

TABLE C.16

REQUIRED TARIFF (PRE-VAPOR CONTROL)
OF SMALL PIPELINE TERMINAL PROTOTYPE

	Net Investment (Thousand Dollars)
Total Investment	989.9
x Annual Capital Recovery Factor (20% BFIT, 20 Years)	.2054
	203.3

	Annual Cost (Thousand Dollars)	Required Tariff ($/Annual Throughput Gallon)
Operating Expenses	423.5	.00305
Capital Recovery	203.3	.00146
Total	627.8	.00451

Source: Arthur D. Little, Inc.

TABLE C.17

LARGE BULK PLANT PROTOTYPE

OPERATIONS

	PRODUCT GROUP		
	Gasoline	Distillate	Total
Storage (Thousand Gallons)	183	182	365
Annual Tank Turnovers	40	20	30
Annual Throughput (Thousand Gallons)	7,300	3,650	10,950
Daily Throughput (Thousand Gallons)	20	10	30

FACILITIES

No. of Tanks - 4

Land (Acres) - 5

No. of Bulk Plant Employees - 4

Method of Receipt - Tank transport from a primary terminal

Source: Arthur D. Little, Inc.

TABLE C.18

ESTIMATED INVESTMENT PROFILE OF
LARGE BULK PLANT PROTOTYPE
(Thousands of Dollars)

INVESTMENT (Bulk Plant Only)	GROSS INVESTMENT	NET INVESTMENT*	NET COST ($/Shell Gallon)
A. Depreciable Fixed Assets			
Tanks	48.0	31.0	0.08
Building	20.0	12.0	
Meters, Piping, Pumps	26.0	16.0	
Loading Racks, Tankwagons (4)	79.0	51.0	
Miscellaneous Equipment	18.0	13.0	
Total Depreciable Assets	214.0	123.0	0.34
B. Other Fixed Assets			
Land		10.0	0.13
C. Working Capital**		10.0	0.03
TOTAL INVESTMENT	234.0	143.0	0.50

*Book value of 25 year old facility

**Bulk plant operations only. Excludes inventory allocated to class of trade profit centers.

Source: Arthur D. Little, Inc.

TABLE C.19

ESTIMATED OPERATING EXPENSES OF
LARGE BULK PLANT PROTOTYPE
(Thousands of Dollars)

LABOR	ANNUAL EXPENSE	$/ANNUAL THROUGHPUT GALLON	PERCENT OF TOTAL EXPENSE
a) Straight Time 4 men X 52 X $260/wk ($6.50/hr)	54.1		
b) Overtime 4 men X 47 wks X $39/wk (4 hr @ $9.75/hr)	7.3		
c) Benefits (20% of a)	10.8		
d) FICA (6.13% of a+b)	3.8		
e) Employee Expenses	2.0		
Total Labor Expense	78.0		
1. Total Labor Expense	78.0	0.00714	48%
2. Maintenance & Repairs	10.1	0.00092	6%
3. Utilities & Misc. Operating Expenses & Services	17.5	0.00160	11%
4. Local Taxes	31.9	0.00291	20%
5. Insurance/Misc. Fixed Costs	25.0	0.00228	15%
Total Expenses	162.5	0.01486	100%

Source: Arthur D. Little, Inc.

TABLE C.20

REQUIRED TARIFF (PRE-VAPOR CONTROL)
OF LARGE BULK PLANT PROTOTYPE

	Net Investment (Thousand Dollars)
Total Investment	143.0
x Annual Capital Recovery Factor (20% BFIT, 20 Years)	.2054
	29.4

	Annual Cost (Thousand Dollars)	Required Tariff ($/Annual Throughput Gallon)
Operating Expenses	162.5	0.01486
Capital Recovery	29.4	0.00268
Total	191.9	0.01754

Source: Arthur D. Little, Inc.

TABLE C.21

SMALL BULK PLANT PROTOTYPE

OPERATIONS

	PRODUCT GROUP		
	Gasoline	Distillate	Total
Storage (Thousand Gallons)	45	30	75
Annual Tank Turnovers	32	20	27
Annual Throughput (Thousand Gallons)	1,460	600	2,060
Daily Throughput (Thousand Gallons)	4.0	1.6	5.6

FACILITIES

No. of Tanks - 4

Land (Acres) - 5

No. of Bulk Plant Employees - 2

Method of Receipt - Tank transport from a primary terminal

Source: Arthur D. Little, Inc.

TABLE C.22

ESTIMATED INVESTMENT PROFILE OF SMALL BULK PLANT PROTOTYPE
(Thousands of Dollars)

INVESTMENT (Bulk Plant Only)	GROSS INVESTMENT	NET INVESTMENT*	NET COST ($/Shell Gallon)
A. Depreciable Fixed Assets			
Tanks	14	9	0.12
Building	14	8	
Meters, Piping, Pumps	7	4	
Loading Racks, Tankwagons (2)	30	22	
Miscellaneous Equipment	5	3	
Total Depreciable Assets	71	45	0.60
B. Other Fixed Assets			
Land		10	0.13
C. Working Capital**		2	0.03
TOTAL INVESTMENT	83	57	0.76

*Book value of 25 year old facility

**Bulk plant operations only. Excludes inventory allocated to class of trade profit centers.

Source: Arthur D. Little, Inc.

TABLE C.23

ESTIMATED OPERATING EXPENSES OF
SMALL BULK PLANT PROTOTYPE
(Thousands of Dollars)

LABOR	ANNUAL EXPENSE	$/ANNUAL THROUGHPUT GALLON	PERCENT OF TOTAL EXPENSE
a) Straight Time 2 men X 52 X $260/wk ($6.50/hr)	27.0		
b) Overtime 2 men X 47 wks X $39/wk (4 hrs @ $9.75/hr)	3.7		
c) Benefits (20% of a)	5.4		
d) FICA (6.13% of a+b)	1.9		
e) Employee Expenses	1.0		
Total Labor Expense	39.0		
1. Total Labor Expense	39.0	0.01898	71%
2. Maintenance & Repairs	1.9	0.00092	3%
3. Utilities & Misc. Operating Expenses & Services	3.3	0.00160	6%
4. Local Taxes	6.0	0.00291	11%
5. Insurance/Misc. Fixed Costs	4.7	0.00228	9%
Total Expenses	54.9	0.02670	100%

Source: Arthur D. Little, Inc.

TABLE C.24

REQUIRED TARIFF (PRE-VAPOR CONTROL) OF SMALL BULK PLANT PROTOTYPE

	Net Investment (Thousand Dollars)
Total Investment	57.0
x Annual Capital Recovery Factor (20% BFIT, 20 Years)	.2054
	11.7

	Annual Cost (Thousand Dollars)	Required Tariff ($/Annual Throughput Gallons)
Operating Expenses	54.9	0.02670
Capital Recovery	11.7	0.00568
Total	66.6	0.03238

Source: Arthur D. Little, Inc.

APPENDIX D

VAPOR CONTROL COSTS PROVIDED BY EPA

TABLE D.1

MODEL TERMINAL PARAMETERS

Average Daily Loading Rate:		
m^3/day	950	1,900
gallons/day	250,000	500,000
DESIGN FACTORS		
(a) Number of rack positions	2	4
(b) Number of loading arms per position	3	3
(c) Method of loading	Submerged (top or bottom)	Submerged (top or bottom)
(d) Pumps (each)	1.9 m^3/min (500 gpm)	1.9 m^3/min (500 gpm)
(e) Tank truck capacities	30 m^3 (8,000 gallons)	30 m^3 (8,000 gallons)
(f) Tank truck loading time (total)	20 minutes/truck	20 minutes/truck
(g) Peak hour loading (e) ÷ (f) x 60 x (a)	180 m^3/hr (48,000 gph)	360 m^3/hr (96,000 gph)
(h) Maximum instantaneous loading (a) x (b) x (d)	11 m^3/min (3,000 gpm)	22 m^3/min (6,000 gpm)
EMISSION FACTORS		
Uncontrolled:		
Total hydrocarbon	960 mg/liter	960 mg/liter
Benzene	8 mg/liter	8 mg/liter
Controlled[a]:		
Total hydrocarbon	80 mg/liter	80 mg/liter
Benzene (95% reduction)	0.4 mg/liter	0.4 mg/liter
TERMINAL OPERATING SCHEDULE	300 days/year	300 days/year)

[a]Assumes 100 percent vapor collection ar rack during loading and no losses in vapor collection system

Source: U.S. Environmental Protection Agency

TABLE D.2

COST FACTORS USED IN DEVELOPING
ANNUALIZED COST ESTIMATES FOR MODEL TERMINALS

Utilities:	
- Electricity	$.017/10^6 joules ($.06/Kw-hr)[1]
- Propane	$.10/liter ($.40/gallon)
Operating Labor	$10/man-hour
Maintenance (percent of equipment cost)	
- Refrigeration (RF) Vapor Recovery	6 percent
- Compression-Refrigeration-Absorption (CRA) Vapor Recovery	4 percent[2]
- Adsorption-Absorption (AA) Vapor Recovery	4 percent[3] (carbon replacement is additional)
- Oxidizer (OX)	4 percent[1]
Capital Charges (percent of capital cost):	
- Interest and depreciation, plus	16 percent[4]
- Property taxes, insurance and administrative overhead	4 percent
Gasoline Value (recovered) FOB Terminal Before Tax:	$.10/liter ($.40/gallon)[5]
Carbon for AA unit (replacement cost)	$21/Kg ($.90/lb)

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[1]Industry data reported to EPA

[2]Based upon actual maintenance costs reported to EPA

[3]Assumed to be comparable to CRA

[4]Calculated using capital recovery factor formula assuming 10 year equipment life and 10 percent interest rate.

[5]Oil Daily - March 1978.

Source: U.S. Environmental Protection Agency

TABLE D.3

ESTIMATED CONTROL COSTS FOR MODEL EXISTING TERMINALS
SINGLE VAPOR CONTROL SYSTEM ALTERNATIVES
(Thousands of January 1978 Dollars)

Gasoline Loaded:	950 m^3/day (250,000 gallons/day)				1900 m^3/day (500,000 gallons/day)			
Vapor Control System:	AA	CRA	OX	RF	AA	CRA	OX	RF
Investment								
Purchase Cost (FOB factory)[a]	120	128[b]	72	102	155	164[b]	95	153
Total Installed Cost	240	256	144	204	310	328	190	306
Annualized Cost(credit)								
Electricity[c]	3.9	5.1	2.9	9.9	7.8	8.3	5.8	19.8
Propane(pilot)[d]	--	--	1.0	--	--	--	1.0	--
Maintenance	4.8	5.1	2.9	6.1	6.2	6.6	3.8	9.2
Operating labor[e]	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Carbon Replacement[f]	2.4	--	--	--	4.7	--	--	--
Subtotal (Direct operating costs)	12.6	11.7	8.3	17.5	20.2	16.4	12.1	30.5
Capital Charges	48.0	51.2	28.8	40.8	62.0	65.6	38.0	61.2
Gasoline Recovery(credit)[g]	(39.2)	(39.2)	--	(39.2)	(78.4)	(78.4)	--	(78.4)
Net Annualized Cost(credit)	21.4	23.7	37.1	19.1	3.8	3.6	50.1	13.3

[a] Vendor quotes

[b] Includes vapor holder

[c] All systems except CRA calculated at 12 hours/day of vendor estimated nominal Kw draw - CRA hours based upon design flow rate.

[d] Estimated at .72 gal/hour operation

[e] Inspections at .5 man-hr/day.

[f] Estimated based upon three year carbon life

[g] Calculated at 16°C (60°F) and 100% vapor collection at rack.

Source: U. S. Environmental Protection Agency

TABLE D.4

ESTIMATED CONTROL COSTS FOR MODEL EXISTING TERMINALS
STAND-BY CONTROL SYSTEM ALTERNATIVES
(Thousands of January 1978 Dollars)

Gasoline Loaded:	950 m^3/day (250,000 gallons/day)			1900 m^3/day (500,000 gallons/day)		
	Stand-by System Only (OX)[a]	Primary/Stand-by System		Stand-by System Only (OX)[a]	Primary/Stand-by System	
		(RF/OX)	(OX/OX)		(AA/OX)	(OX/OX)
Total Installed Capital Cost	95	299	239	126	436	316
Direct Operating Costs						
Utilities	Footnote b	9.9	3.9	Footnote b	17.8	6.8
Maintenance and Labor and materials	2.9	10.5	7.3	3.8	16.2	9.1
Capital Charges	19.0	59.8	47.8	25.2	87.2	63.2
Gasoline (credit)	--	(37.2)[c]	--	--	(74.5)[c]	--
Net Annualized Cost(credit)	21.9	43	59.0	29.0	36.7	79.1

[a]Stand-by system costs are shown separately for those terminals that have already installed vapor controls to comply with existing SIP requirements for hydrocarbons.

[b]These will vary but should not significantly effect net operating costs of the primary/stand-by combination.

[c]Recovery reductions will vary but are estimated at 5 percent or 15 days down time on primary system.

Source: U.S. Environmental Protection Agency

TABLE D.5

MODEL BULK PLANT PARAMETERS

		Small Model	Large Model
1.	Throughput, (liters/day)	15,000 (4,000 gallons/day)	76,000 (20,000 gallons/day)
2.	Loading Racks	1	1
3.	Loading Arms per Rack	3	3
4.	Storage Tanks (above-ground)	3	3
5.	Account Trucks (Tank Wagons)	2	4
6.	Account Trucks Converted to Vapor Control	1	2
7.	Compartments per Account Truck	4	4
8.	Density of Gasoline (lb/gallon)		
9.	Emissions of HC Prevented (mg/liter)		
	Option 1	800	800
	Option 3	1260	1260
	Option 4	3429	3429
10.	Working Days per Year	286	286
11.	Working Hours per Day	8	8
12.	Peak Loading Rate (liters per minute)	490 (130 gallons/minute)	490 (130 gallons/minute)
13.	Liquid to Vapor Ratio	7.5	7.5
14.	Operating Labor Cost ($/hour)	10.0	10.0
15.	Propane for Oxidizer (gallons/hour)	0.72	0.72
16.	Price of Propane ($/gallon)	0.40	0.40
17.	Price of Electricity ($/KWH)	0.05	0.05
18.	Capital Recovery Factors (interest)		
	a. Vapor Balance Equipment at 20-year life, 10% interest	0.118	0.118
	b. Refrigeration or oxidation equipment at 10-year life, 10% interest	0.163	0.163
	c. Taxes, insurance, administration on capital (all equipment)	0.04	0.04

Source: U.S. Environmental Protection Agency

TABLE D.6

OPTIONS 1 AND 2 COST ESTIMATES (NOJC COSTS)
(Thousands of January 1978 Dollars)

	Option 1				Option 2			
	Bottom or Top-Submerged Loading with Incoming Vapor Balance				Bottom or Top-Submerged Loading With Incoming and Outgoing Vapor Balance			
	Bottom Loading		Top-Submerged		Bottom Loading		Top-Submerged	
	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd
1. Truck (Tank Wagon) Conversion, including Labor	6.27	12.54	N/A	N/A	7.02	14.05	2.38	4.76
2. Rack Conversion, including labor	35.45	35.45	3.54	3.54	35.45	35.45	18.30	18.30
3. Installation, excluding labor	5.31	5.82	0.71	0.71	5.52	6.22	2.35	2.67
4. TOTAL INSTALLED CAPITAL	47.03	53.81	4.25	4.25	47.99	55.72	23.03	25.73
5. Operating Labor	NONE		NONE		NONE		NONE	
6. Utilities	NONE		NONE		NONE		NONE	
7. Maintenance Labor and Materials	1.41	1.61	0.13	0.13	1.43	1.67	0.69	0.77
8. Capital Charges	7.41	8.48	0.67	0.67	7.56	8.76	3.63	4.05
9. TOTAL ANNUALIZED COST	8.82	10.09	0.80	0.80	8.99	10.43	4.32	4.82
10. Less Recovery Credit	0.51	2.59	0.51	2.59	0.81	4.08	0.81	4.08
11. NET ANNUALIZED COST	8.31	7.50	0.29	(1.79)	8.18	6.35	3.51	0.74

Source: U.S. Environmental Protection Agency

TABLE D.7

OPTION 3 COST ESTIMATE (NOJC COSTS)
(Thousands of January 1978 Dollars)

SINGLE SYSTEMS

	Refrigeration				Oxidation			
	Bottom Loading		Top Submerged		Bottom Loading		Top Submerged	
	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd
Recovery Equipment	42.47	49.50	20.68	23.06	42.47	49.50	20.68	23.06
Processing Equipment	43.22	43.22	43.22	43.22	15.50	15.50	15.50	15.50
Recovery Installation	5.52	6.22	2.35	2.67	5.52	6.22	2.35	2.67
Processing INstallation	25.93	25.93	25.93	25.93	9.76	9.76	9.76	9.76
TOTAL INSTALLED CAPITAL	117.14	124.87	92.18	94.88	73.25	80.98	48.32	50.99
Recovery Operating Labor	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Processing Operating Labor	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43
Recovery Utilities	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Processing Utilities	2.17	2.17	2.17	2.17	0.16	0.16	0.16	0.16
Recovery Maintenance	1.43	1.67	0.69	0.77	1.43	1.67	0.69	0.77
Processing Maintenance	2.59	2.59	2.59	2.59	0.62	0.62	0.62	0.62
Recovery Capital Charges	7.56	8.76	3.63	4.05	7.56	8.76	3.63	4.05
Processing Capital Charges	14.02	14.02	14.02	14.02	5.12	5.12	5.12	5.12
TOTAL ANNUALIZED COST	29.20	30.64	24.53	25.03	16.32	17.76	11.65	12.15
Less: Processing Recovery Credit	2.19	11.11	2.19	11.11	NONE	NONE	NONE	NONE
NET ANNUALIZED COST	27.01	19.53	22.34	13.92	16.32	17.76	11.65	12.15

TABLE D.7
continued

OPTION 3 COST ESTIMATE (NOJC COSTS)
(Thousands of January 1978 Dollars)

	DUAL SYSTEMS							
	Refrigeration Plus Oxidation				Oxidation Plus Oxidation			
	Bottom Loading		Top Submerged		Bottom Loading		Top Submerged	
	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd
Recovery Equipment[1]	42.47	49.50	20.68	22.06	42.47	49.50	20.68	23.06
Processing Equipment	58.70	58.70	58.70	58.70	31.00	31.00	31.00	31.00
Recovery Installation	5.52	5.52	2.35	2.67	5.52	5.52	2.35	2.67
Processing Installation	35.69	35.69	35.69	35.69	19.52	19.52	19.52	19.52
TOTAL INSTALLED CAPITAL	142.38	149.41	117.42	120.12	98.51	105.54	73.55	76.25
Recovery Operating Labor	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Processing Operating Labor	1.42	1.43	1.43	1.43	1.43	1.43	1.43	1.43
Recovery Utilities	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Processing Utilities	2.17	2.17	2.17	2.17	0.16	0.16	0.16	0.16
Recovery Maintenance	1.43	1.67	0.69	0.77	1.43	1.67	0.69	0.77
Processing Maintenance	2.90	2.90	2.90	2.90	0.93	0.93	0.93	0.93
Recovery Capital Charge	7.56	8.76	3.63	4.05	7.66	8.76	3.63	4.05
Processing Capital Charges	19.54	19.54	19.54	19.54	10.24	10.24	10.24	10.24
TOTAL ANNUALIZED COST	35.03	36.47	30.36	30.86	21.75	23.19	17.08	17.58
Less: Processing Recovery Credit	2.19	11.11	2.19	11.11	NONE	NONE	NONE	NONE
NET ANNUALIZED COST	32.84	25.36	28.17	19.75	21.75	23.19	17.08	17.58

TABLE D.8

OPTIONS 1 AND 2 COST ESTIMATES (WIGGINS AND HOUSTON-GALVESTON COSTS)
(Thousands of January 1978 Dollars)

	Option 1: Bottom or Top-Submerged Loading with Incoming Vapor Balance				Option 2: Bottom or Top-Submerged Loading With Incoming and Outgoing Vapor Balance			
	Bottom Loading		Top-Submerged		Bottom Loading		Top-Submerged	
	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd
Truck (tank wagon) conversion, including labor	0.97	1.95	N/A	N/A	1.95	3.90	2.16	4.33
Rack conversion, including labor	7.47	7.47	3.54	3.54	7.47	7.47	6.71	6.71
Piping rack to storage, including labor	1.58	1.58	N/A	N/A	1.58	1.58	N/A	N/A
Installation, excluding labor	2.29	2.34	0.71	0.71	2.34	2.45	1.83	1.94
TOTAL INSTALLED CAPITAL	12.31	13.34	4.25	4.25	13.34	15.40	10.70	12.98
Operating Labor	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Utilities	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Maintenance Labor and Material	0.37	0.40	0.13	0.13	0.40	0.46	0.32	0.39
Capital charges	1.94	2.10	0.67	0.67	2.10	2.43	1.69	2.04
TOTAL ANNUALIZED COST	2.31	2.50	0.80	0.80	2.50	2.89	2.01	2.43
Less Recovery Credit	0.51	2.59	0.51	2.59	0.81	4.08	0.81	4.08
NET ANNUALIZED COST (credit)	1.70	(0.09)	0.29	(1.79)	1.69	(1.19)	1.20	(1.85)

TABLE D.9

OPTION 3 COST ESTIMATES (WIGGINS AND HOUSTON-GALVESTON COSTS)
(Thousands of January 1978 Dollars)

	Refrigeration				Oxidation			
	Bottom Loading		Top Submerged		Bottom Loading		Top Submerged	
	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd
Recovery Equipment	11.00	12.95	8.87	11.04	11.00	12.95	8.87	11.04
Processing Equipment	43.22	43.22	43.22	43.22	15.50	15.50	15.50	15.50
Recovery Installation	2.34	2.45	1.83	1.94	2.34	2.45	1.83	1.94
Processing Installation	25.93	25.93	25.93	25.93	9.76	9.76	9.76	9.76
TOTAL INSTALLED CAPITAL	82.49	84.55	79.85	82.13	38.60	40.66	35.96	38.24
Recovery Operating Labor	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Processing Operating Labor	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43
Recovery Utilities	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Processing Utilities	2.17	2.17	2.17	2.17	0.16	0.16	0.16	0.16
Recovery Maintenance	0.40	0.46	0.32	0.39	0.40	0.46	0.32	0.39
Processing Maintenance	2.59	2.59	2.59	2.59	0.62	0.62	0.62	0.62
Recovery Capital Charges	2.10	2.43	1.69	2.04	2.10	2.43	1.69	2.04
Processing Capital Charges	14.02	14.02	14.02	14.02	5.12	5.12	5.12	5.12
TOTAL ANNUALIZED COST	22.71	23.10	22.22	22.64	9.83	10.22	9.34	9.76
Less: Processing Recovery Credit	2.19	11.11	2.19	11.11	NONE	NONE	NONE	NONE
NET ANNUALIZED COST	20.52	11.99	20.03	11.53	9.83	10.22	9.34	9.76

TABLE D.9
continued

OPTION 3 COST ESTIMATES (WIGGINS AND HOUSTON-GALVESTON COSTS)
(Thousands of January 1978 Dollars)

	Refrigeration Plus Oxidation				Oxidation Plus Oxidation			
	Bottom Loading		Top Submerged		Bottom Loading		Top Submerged	
	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd
Recovery Equipment	4.00	12.95	8.87	11.04	11.00	12.95	8.87	11.04
Processing Equipment	58.70	58.70	58.70	58.70	31.00	31.00	31.00	31.00
Recovery Installation	2.34	2.45	1.83	1.94	2.34	2.45	1.83	1.94
Processing Installation	35.69	35.69	35.69	35.69	19.52	19.52	19.52	19.52
TOTAL INSTALLED CAPITAL	107.73	109.79	105.09	107.37	63.86	65.92	61.22	63.50
Recovery Operating Labor	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Processing Operating Labor	1.42	1.43	1.43	1.43	1.43	1.43	1.43	1.43
Recovery Utilities	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Processing Utilities	2.17	2.17	2.17	2.17	0.16	0.16	0.16	0.16
Recovery Maintenance	0.40	0.46	0.32	0.39	0.40	0.46	0.32	0.39
Processing Maintenance	2.90	2.90	2.90	2.90	0.93	0.93	0.93	0.93
Recovery Capital Charge	2.10	2.43	1.69	2.04	2.10	2.43	1.69	2.04
Processing Capital Charges	19.54	19.54	19.54	19.54	10.24	10.24	10.24	10.24
TOTAL ANNUALIZED COST	28.53	28.93	22.05	28.47	15.26	15.65	14.77	15.19
Less: Processing Recovery Credit	2.19	11.11	2.19	11.11	NONE	NONE	NONE	NONE
NET ANNUALIZED COST	26.34	17.82	25.86	17.36	15.26	15.65	14.77	15.19

TABLE D.10

OPTIONS 1 AND 2 COST ESTIMATES (COLORADO APCD COSTS)
(Thousands of January 1978 Dollars)

	Option 1: Bottom or Top-Submerged Loading with Incoming Vapor Balance				Option 2: Bottom or Top-Submerged Loading With Incoming and Outgoing Vapor Balance			
	Bottom Loading		Top-Submerged		Bottom Loading		Top-Submerged	
	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd
1. Truck (Tank Wagon) Conversion, including labor[b]	0.97	1.94	0.75	0.75	1.61	3.23	1.69	2.15
2. Rack Conversion, including labor[c]	1.08	1.08	0.75	0.75	1.08	1.08	1.69	2.15
3. Installation, excluding labor[d]	0.28	0.41	0.20	0.20	0.36	0.58	0.46	0.58
4. TOTAL INSTALLED CAPITAL	2.33	3.43	1.70	1.70	3.05	4.89	3.84	4.88
5. Operating Labor	NONE		NONE		NONE		NONE	
6. Utilities	NONE		NONE		NONE		NONE	
7. Maintenance Labor and Materials	0.07	0.10	0.05	0.05	0.09	0.15	0.12	0.15
8. Capital Charges[5]	0.37	0.54	0.27	0.27	0.48	0.77	0.60	0.77
9. TOTAL ANNUALIZED COST	0.44	0.64	0.32	0.32	0.57	0.92	0.72	0.92
10. Less Recovery Credit	0.51	2.59	0.51	2.59	0.81	4.08	0.81	4.08
11. NET ANNUALIZED COST	(0.07)	(1.95)	(0.19)	(2.27)	(0.24)	(3.16)	(0.09)	(3.16)

TABLE D.11

OPTION 3 COST ESTIMATES (COLORADO APCD COSTS)
(Thousands of January 1978 Dollars)

	Refrigeration				Oxidation			
	Bottom Loading		Top-Submerged		Bottom Loading		Top Submerged	
	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd
Recovery Equipment	2.69	4.31	3.38	4.30	2.69	4.31	3.38	4.30
Processing Equipment	43.22	43.22	43.22	43.22	15.50	15.50	15.50	15.50
Recovery Installation	0.36	0.58	0.46	0.58	0.36	0.58	0.46	0.58
Processing Installation	25.93	25.93	25.93	25.93	9.76	9.76	9.76	9.76
TOTAL INSTALLED CAPITAL	72.20	74.04	72.99	74.03	28.31	30.15	29.10	30.14
Recovery Operating Labor	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Processing Operating Labor	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43
Recovery Utilities	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Processing Utilities	2.17	2.17	2.17	2.17	0.16	0.16	0.16	0.16
Recovery Maintenance	0.09	0.15	0.12	0.15	0.09	0.15	0.12	0.15
Processing Maintenance	2.59	2.59	2.59	2.59	0.62	0.62	0.62	0.62
Recovery Capital Charges	0.48	0.77	0.60	0.77	0.48	0.77	0.60	0.77
Processing Capital Charges	14.02	14.02	14.02	14.02	5.12	5.12	5.12	5.12
TOTAL ANNUALIZED COST	20.78	21.13	20.93	21.13	7.90	8.25	8.05	8.25
Less: Processing Recovery Credit	2.19	11.11	2.19	11.11	NONE	NONE	NONE	NONE
NET ANNUALIZED COST	18.59	10.02	18.74	10.02	7.90	8.25	8.05	8.25

TABLE D.11
Continued

OPTION 3 COST ESTIMATES (COLORADO APCD COSTS)
(Thousands of January 1978 Dollars)

	Refrigeration Plus Oxidation				Oxidation Plus Oxidation			
	Bottom Loading		Top-Submerged		Bottom Loading		Top Submerged	
	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd	15,000 lpd	76,000 lpd
Recovery Equipment	2.69	4.31	3.38	4.30	2.69	4.31	3.38	4.30
Processing Equipment	58.70	58.70	58.70	58.70	31.00	31.00	31.00	31.00
Recovery Installation	0.36	0.58	0.46	0.58	0.36	0.58	0.46	0.58
Processing Installation	35.69	35.69	35.69	35.69	19.52	19.52	19.52	19.52
TOTAL INSTALLED CAPITAL	97.68	99.28	98.23	99.27	53.57	55.41	54.36	55.40
Recovery Operating Labor	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Processing Operating Labor	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43
Recovery Utilities	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Processing Utilities	2.17	2.17	2.17	2.17	0.16	0.16	0.16	0.16
Recovery Maintenance	0.09	0.15	0.12	0.15	0.09	0.15	0.12	0.15
Processing Maintenance	2.90	2.90	2.90	2.90	0.93	0.93	0.93	0.93
Recovery Capital Charge	0.48	0.77	0.60	0.77	0.48	0.77	0.60	0.77
Processing Capital Charges	19.54	19.54	19.54	19.54	10.24	10.24	10.24	10.24
TOTAL ANNUALIZED COST	26.61	26.96	26.76	26.96	13.33	13.68	13.36	13.58
Less: Processing Recovery Credit	2.19	11.11	2.19	11.11	NONE	NONE	NONE	NONE
NET ANNUALIZED COST	24.42	15.85	24.57	15.85	13.33	13.68	13.36	13.58

A P P E N D I X E

EXISTING STATE AND LOCAL VAPOR CONTROL REGULATIONS FOR GASOLINE MARKETING

TABLE E.1

STATE AND LOCAL REGULATION OF HYDROCARBONS

State	Terminal	Bulk Plant		Service Stations
	Loading Rack	Storage Tank Loading	Loading Rack	Underground Storage Tank Loading
Alabama	Submerged Fill	Submerged Fill	None	Submerged Fill
Alaska	None	None	None	None
Arkansas	None	None	None	None
Arizona	Submerged Fill	Submerged Fill	Submerged Fill	Submerged Fill
California*				
Bay Area	Vapor Recovery 90%	Balance & Submerged Fill	Balance & Submerged Fill	90% Collection
San Diego	Vapor Recovery	Submerged Fill/ Balance	Submerged Fill/ Balance	90% Collection
South Coast	Vapor Recovery	Submerged Fill/ Balance	Submerged Fill/ Balance	90% Collection
Colorado	Vapor Collection & Disposal = 90%	Submerged Fill & Collection = 1.15 lb/ 1000 gal	Vapor Collection & Disposal = 90%	Submerged Fill & Collection Equivalent to 1.15 lb/1000 gal
Connecticut	Vapor Collection & Disposal	Submerged Fill	<10,000 gal/day exempted	Submerged Fill
Washington, DC	Vapor Collection & Disposal = 90%	Submerged Fill & 90% Collection	Submerged Fill & 90% Collection	Submerged Fill & 90% Collection
Delaware	None	None	None	None
Florida	None	None	None	None

* Regulated by Regional Agencies

TABLE E.1 (continued)

STATE AND LOCAL REGULATION OF HYDROCARBONS

	Terminal	Bulk Plant		Service Stations
State	Loading Rack	Storage Tank Loading	Loading Rack	Underground Storage Tank Loading
Georgia	None	None	None	None
Hawaii	None	Submerged Fill	None	Submerged Fill
Idaho	None	None	None	None
Illinois	Submerged Fill	Submerged Fill	None	Submerged Fill
Indiana	Submerged Fill	Submerged Fill	None	Submerged Fill
Iowa	None	None	None	None
Kansas	None	None	None	None
Kentucky	90% Control	Submerged Fill	None	Submerged Fill
Louisiana	Submerged Fill	Submerged Fill	None	Submerged Fill
Maine	None	None	None	None
Maryland	None	None	None	None
Massachusetts	None	None	None	None
Michigan	None	None	None	None
Minnesota	None	Submerged Fill	None	Submerged Fill
Mississippi	None	None	None	None
Missouri	None	None	None	None
Montana	None	None	None	None

TABLE E.1 (continued)

STATE AND LOCAL REGULATION OF HYDROCARBONS

State	Terminal Loading Rack	Bulk Plant: Storage Tank Loading	Bulk Plant: Loading Rack	Service Stations Underground Storage Tank Loading
Nebraska	None	None	None	None
Nevada	Submerged Fill	Submerged Fill	Submerged Fill	Submerged Fill
New Hampshire	None	None	None	None
New Jersey	Submerged Fill (Region requires 90% control)	Submerged Fill	Submerged Fill	90% Collection
New Mexico	None	None	None	None
New York	None	None	None	None
North Carolina	Submerged Fill	None	None	None
North Dakota	Submerged Fill	Submerged Fill	None	Submerged Fill
Ohio	Vapor Collection & Recovery	Submerged Fill	None	Submerged Fill
Oklahoma	Bottom Loading	Submerged Fill	Submerged Fill	Submerged Fill
Oregon	None	None	None	None
Pennsylvania	Vapor Collection	Submerged Fill	None	Submerged Fill
Rhode Island	Submerged Fill	Submerged Fill	None	Submerged Fill
South Carolina	None	None	None	None
South Dakota	None	None	None	None

TABLE E.1 (continued)

STATE AND LOCAL REGULATION OF HYDROCARBONS

State	Terminal Loading Rack	Bulk Plant Storage Tank Loading	Bulk Plant Loading Rack	Service Stations Underground Storage Tank Loading
Tennessee	None	None	None	None
Texas	Vapor Recovery	Submerged Fill	None	Submerged Fill
Utah	None	None	None	None
Virginia	Vapor Control	None	None	None
Vermont	None	None	None	None
Washington	None	None	None	None
West Virginia	None	None	None	None
Wisconsin	None	None	None	None
Wyoming	None	Submerged Fill	None	Submerged Fill

Source: U.S. Environmental Protection Agency

APPENDIX F

CASH FLOW WORKSHEETS

TABLE F.1

CASH FLOW WORKSHEET

FOR LARGE MARINE TERMINAL[1]
(Thousand dollars/year)

	PRIMARY SYSTEM		PRIMARY SYSTEM WITH STANDBY	
	REFRIGERATION	INCINERATION	REFRIGERATION/ INCINERATION	INCINERATION/ INCINERATION
Present Term Debt[2]	58.9	58.9	58.9	58.9
New Term Debt[3]	38.3	23.8	54.0	39.5
Total Debt	97.2	82.7	112.9	98.4
Pre-Tax Profit[4]	840.0	869.2	882.0	907.5
Interest Expense[5]	(8.2)	(6.9)	(9.6)	(8.3)
Vapor Control Operating Expense[6]	35.7	(19.7)	22.9	(28.5)
Adjusted Net Profit (BFIT)	867.5	842.6	895.3	870.7
Tax @ 50%	(433.8)	(421.3)	(447.7)	(435.4)
Adjusted Net Profit (AFT)	433.8	421.3	447.7	435.4
Present Depreciation	118.8	118.8	118.8	118.8
Vapor Control Equipment Depreciation	30.6	19.0	43.2	31.6
Total Depreciation	149.4	137.8	162.0	150.4
Estimated Cash Flow	583.2	559.1	609.7	585.8
Debt as % of Cash Flow (Pre Control)	11%	11%	11%	11%
Debt as % of Cash Flow (Post Control)	17%	15%	19%	17%

[1] Assumes competitive pass through
[2] 30% of net plant investment
[3] 100% debt financing of vapor control equipment
[4] Annual throughput times adjusted tariffs less pre-vapor control operating expense
[5] Plant investment mortgaged for 20 years @ 8%; vapor control equipment mortgaged for 8 years @ 9%
[6] Adjusted to include recovery credit
[7] 10 year operating life

CASH FLOW WORKSHEET

FOR SMALL MARINE TERMINAL[1]
(Thousand dollars/year)

	PRIMARY SYSTEM		PRIMARY SYSTEM WITH STAND-BY	
	REFRIGERATION	INCINERATION	REFRIGERATION/ INCINERATION	INCINERATION/ INCINERATION
Present Term Debt[2]	29.3	29.3	29.3	29.3
New Term Debt[3]	25.5	18.0	37.4	29.9
Total Debt	54.8	47.3	66.7	59.2
Pre-Tax Profit[4]	426.0	436.0	448.8	457.0
Interest Expense[5]	(4.6)	(4.0)	(5.7)	(5.0)
Vapor Control Operating Expense[6]	13.5	(14.1)	4.8	(20.8)
Adjusted Net Profit (BFIT)	434.9	417.9	447.9	431.2
Tax @ 50%	(217.5)	(209.0)	(224.0)	(215.6)
Adjusted Net Profit (AFT)	217.5	209.0	224.0	215.6
Present Depreciation	54.6	54.6	54.6	54.6
Vapor Control Equipment Depreciation[7]	20.4	14.4	29.9	23.9
Total Depreciation	75.0	69.0	84.5	78.5
Estimated Cash Flow	292.5	278.0	308.5	294.1
Debt as % of Cash Flow (Pre Control)	12%	12%	12%	12%
Debt as % of Cash Flow (Post Control)	19%	17%	22%	20%

[1] Assumes competitive pass through
[2] 30% of net plant investment
[3] 100% debt financing of vapor control equipment
[4] Annual throughput times adjusted tariffs less pre-vapor control operating expense
[5] Plant investment mortgaged for 20 years @ 8%; vapor control equipment mortgaged for 8 years @ 9%
[6] Adjusted to include recovery credit
[7] 10 year operating life

TABLE F.3

CASH FLOW WORKSHEET

FOR LARGE PIPELINE TERMINAL[1]
(Thousand dollars/year)

	PRIMARY SYSTEM		PRIMARY SYSTEM WITH STAND-BY	
	REFRIGERATION	INCINERATION	REFRIGERATION/ INCINERATION	INCINERATION/ INCINERATION
Present Term Debt[2]	37.1	37.1	37.1	37.1
New Term Debt[3]	38.3	23.8	54.0	39.5
Total Debt	75.4	60.9	91.1	76.6
Pre-Tax Profit[4]	544.4	573.6	586.9	612.0
Interest Expense[5]	(6.4)	(5.1)	(7.8)	(6.5)
Vapor Control Operating Expense[6]	35.7	(19.7)	22.9	(28.5)
Adjusted Net Profit (BFIT)	573.7	548.8	602.0	577.0
Tax @ 50%	286.9	274.4	301.0	288.5
Adjusted Net Profit (AFT)	286.9	274.4	301.0	288.5
Present Depreciation	84.4	84.4	84.4	84.4
Vapor Control Equipment Depreciation[7]	30.6	19.0	43.2	31.6
Total Depreciation	115.0	103.4	127.6	116.0
Estimated Cash Flow	401.9	377.8	428.6	404.5
Debt as % of Cash Flow (Pre Control)	11%	11%	11%	11%
Debt as % of Cash Flow (Post Control)	19%	16%	21%	19%

[1] Assumes competitive pass through
[2] 30% of net plant investment
[3] 100% debt financing of vapor control equipment
[4] Annual throughput times adjusted tariffs less pre-vapor control operating expense
[5] Plant investment mortgaged for 20 years @ 8%; vapor control equipment mortgaged for 8 years @ 9%
[6] Adjusted to include recovery credit
[7] 10 year operating life

TABLE F.4

CASH FLOW WORKSHEET

FOR SMALL PIPELINE TERMINAL[1]

(Thousand dollars/year)

	PRIMARY SYSTEM		PRIMARY SYSTEM WITH STAND-BY	
	REFRIGERATION	**INCINERATION**	**REFRIGERATION/ INCINERATION**	**INCINERATION/ INCINERATION**
Present Term Debt[2]	14.8	14.8	14.8	14.8
New Term Debt[3]	25.5	18.0	37.4	29.9
Total Debt	40.3	32.8	52.2	44.7
Pre-Tax Profit[4]	226.9	237.0	249.8	258.0
Interest Expense[5]	(3.5)	(2.8)	(4.6)	(3.9)
Vapor Control Operating Expense[6]	13.5	(14.1)	4.8	(20.8)
Adjusted Net Profit (BFIT)	236.9	220.1	250.0	233.3
Tax @ 50%	(118.5)	(110.1)	(125.0)	(116.7)
Adjusted Net Profit (AFT)	118.5	110.1	125.0	116.7
Present Depreciation	32.0	32.0	32.0	32.0
Vapor Control Equipment Depreciation[7]	20.4	14.4	29.9	23.9
Total Depreciation	52.4	46.4	61.9	55.9
Estimated Cash Flow	170.6	156.5	186.9	172.6
Debt as % of Cash Flow (Pre Control)	11%	11%	11%	11%
Debt as % of Cash Flow (Post Control)	24%	21%	28%	26%

[1] Assumes competitive pass through
[2] 30% of net plant investment
[3] 100% debt financing of vapor control equipment
[4] Annual throughput times adjusted tariffs less pre-vapor control operating expense
[5] Plant investment mortgaged for 20 years @ 8%; vapor control equipment mortgaged for 8 years @ 9%
[6] Adjusted to include recovery credit
[7] 10 year operating life

TABLE F.5

CASH FLOW WORKSHEET

FOR LARGE BULK PLANT (NOJC COSTS)[1]
(Thousand dollars/year)

	BALANCE INCOMING ONLY	BALANCE INCOMING & OUTGOING	PRIMARY SYSTEM		PRIMARY SYSTEM WITH STAND-BY	
			REFRIGERATION	INCINERATION	REFRIGERATION/ INCINERATION	INCINERATION/ INCINERATION
Present Term Debt[2]	4.3	4.3	4.3	4.3	4.3	4.3
New Term Debt[3]	0.9	5.1	19.0	10.2	24.0	15.3
Total Debt	5.2	9.4	23.3	14.5	28.3	19.6
Pre-Tax Profit[4]	28.0	32.6	51.0	46.0	58.9	53.3
Interest Expense[5]	(0.4)	(0.9)	(2.4)	(1.5)	(3.0)	(2.0)
Vapor Control Operating Expense[6]	2.4	2.9	1.0	(4.4)	(0.9)	(5.7)
Adjusted Net Profit (BFIT)	30.0	34.6	49.6	40.1	55.0	45.6
Tax @ 50%	(15.0)	(17.3)	(24.8)	(20.1)	(27.5)	(22.8)
Adjusted Net Profit (AFT)	15.0	17.3	24.8	20.1	27.5	22.8
Present Depreciation	6.2	6.2	6.2	6.2	6.2	6.2
Vapor Control Equipment Depreciation[7]	0.4	2.6	9.5	5.1	12.0	7.6
Total Depreciation	6.6	8.8	15.7	11.3	18.2	13.8
Estimated Cash Flow	21.6	26.1	40.5	31.4	45.7	36.6
Debt as % of Cash Flow (Pre Control)	23%	23%	23%	23%	23%	23%
Debt as % of Cash Flow (Post Control)	24%	36%	58%	46%	62%	54%

[1]Assumes competitive pass through
[2]60% of net plant investment
[3]100% debt financing of vapor control equipment
[4]Annual throughput times adjusted tariffs less pre-vapor control operating expense
[5]Plant investment mortgaged for 20 years @ 9%; vapor control equipment mortgaged fo4 5 years @ 11%
[6]Adjusted to include recovery credit
[7]10 year operating life.

TABLE F.6

CASH FLOW WORKSHEET

FOR LARGE BULK PLANT (HOUSTON-GALVESTON COSTS)[1]
(Thousand dollars/year)

	BALANCE INCOMING ONLY	BALANCE INCOMING & OUTGOING	PRIMARY SYSTEM		PRIMARY SYSTEM WITH STAND-BY	
			REFRIGERATION	INCINERATION	REFRIGERATION/ INCINERATION	INCINERATION/ INCINERATION
Present Term Debt[2]	4.3	4.3	4.3	4.3	4.3	4.3
New Term Debt[3]	0.9	2.6	16.4	7.6	21.5	12.7
Total Debt	5.2	6.9	20.7	11.9	25.8	17.0
Pre-Tax Profit[4]	28.0	29.1	47.7	42.6	55.6	49.9
Interest Expense[5]	(0.5)	(0.7)	(2.2)	(1.2)	(2.8)	(1.8)
Vapor Control Operating Expense[6]	2.4	3.4	1.2	(4.1)	(0.6)	(5.4)
Adjusted Net Profit (BFIT)	29.9	31.8	46.7	37.3	52.2	42.7
Tax @ 50%	(15.0)	(15.9)	(23.4)	(18.7)	(26.1)	(21.4)
Adjusted Net Profit (AFT)	15.0	15.9	23.4	18.7	26.1	21.4
Present Depreciation	6.2	6.2	6.2	6.2	6.2	6.2
Vapor Control Equipment Depreciation[7]	0.4	1.3	8.2	3.8	10.7	6.4
Total Depreciation	6.6	7.5	14.4	10.0	16.9	12.6
Estimated Cash Flow	21.6	23.4	37.8	28.7	43.0	34.0
Debt as % of Cash Flow (Pre Control)	23%	23%	23%	23%	23%	23%
Debt as % of Cash Flow (Post Control)	24%	29%	55%	41%	60%	50%

1 Assumes competitive pass through
2 60% of net plant investment
3 100% debt financing of vapor control equipment
4 Annual throughput times adjusted tariffs less pre-vapor control operating expense
5 Plant investment mortgaged for 20 years @ 9%; vapor control equipment mortgaged for 5 years @ 11%
6 Adjusted to include recovery credit
7 10 year operating life

TABLE F.7

CASH FLOW WORKSHEET

FOR LARGE BULK PLANT (COLORADO APCD COSTS)[1]
(Thousand dollars/year)

	BALANCE INCOMING ONLY	BALANCE INCOMING & OUTGOING	PRIMARY SYSTEM		PRIMARY SYSTEM WITH STAND-BY	
			REFRIGERATION	INCINERATION	REFRIGERATION/ INCINERATION	INCINERATION/ INCINERATION
Present Term Debt[2]	4.3	4.3	4.3	4.3	4.3	4.3
New Term Debt[3]	0.3	1.0	14.8	6.0	19.9	11.1
Total Debt	4.6	5.3	19.1	10.3	24.2	15.4
Pre-Tax Profit[4]	27.3	26.8	45.2	69.5	53.1	47.5
Interest Expense[5]	(0.4)	(0.5)	(2.0)	(1.0)	(2.6)	(1.6)
Vapor Control Operating Expense[6]	2.5	3.7	1.8	(3.6)	(0.1)	(4.9)
Adjusted Net Profit (BFIT)	29.4	30.0	45.0	64.9	50.4	41.0
Tax @ 50%	(14.7)	(15.0)	(22.5)	(32.5)	(25.2)	(20.5)
Adjusted Net Profit (AFT)	14.7	15.0	22.5	32.5	25.2	20.5
Present Depreciation	6.2	6.2	6.2	6.2	6.2	6.2
Vapor Control Equipment Depreciation[7]	0.2	0.5	7.4	3.0	9.9	5.5
Total Depreciation	6.9	6.7	13.6	9.2	16.1	11.7
Estimated Cash Flow	21.1	21.7	36.1	41.7	41.3	32.2
Debt as % of Cash Flow (Pre Control)	23%	23%	23%	23%	23%	23%
Debt as % of Cash Flow (Post Control)	22%	24%	53%	25%	59%	48%

1 Assumes competitive pass through
2 60% of net plant investment
3 100% debt financing of vapor control equipment
4 Annual throughput times adjusted tariffs less pre-vapor control operating expense
5 Plant investment mortgaged for 20 years @ 9%; vapor control equipment mortgaged for 5 years @ 11%
6 Adjusted to include recovery credit
7 10 year operating life

TABLE F.8

CASH FLOW WORKSHEET

FOR SMALL BULK PLANT (NOJC COSTS)[1]
(Thousand dollars/year)

	BALANCE INCOMING ONLY	BALANCE INCOMING & OUTGOING	PRIMARY SYSTEM		PRIMARY SYSTEM WITH STAND-BY	
			REFRIGERATION	INCINERATION	REFRIGERATION/ INCINERATION	INCINERATION/ INCINERATION
Present Term Debt[2]	1.7	1.7	1.7	1.7	1.7	1.7
New Term Debt[3]	0.9	4.6	18.4	9.7	23.5	14.7
Total Debt	2.6	6.3	20.1	11.4	25.2	16.4
Pre-Tax Profit[4]	11.4	12.4	16.0	15.0	17.6	16.5
Interest Expense[5]	(0.3)	(0.7)	(2.2)	(1.2)	(2.7)	(1.8)
Vapor Control Operating Expense[6]	0.3	(0.2)	(7.8)	(4.3)	(9.3)	(5.6)
Adjusted Net Profit (BFIT)	11.4	11.5	6.0	9.5	5.6	9.1
Tax @ 50%	(5.7)	(5.8)	(3.0)	(4.8)	(2.8)	(4.6)
Adjusted Net Profit (AFT)	5.7	5.8	3.0	4.8	2.8	4.6
Present Depreciation	2.3	2.3	2.3	2.3	2.3	2.3
Vapor Control Equipment Depreciation[7]	0.4	2.3	9.2	4.8	11.7	7.4
Total Depreciation	2.7	4.6	11.5	7.1	14.0	9.7
Estimated Cash Flow	8.4	10.4	14.5	11.9	16.8	14.3
Debt as % of Cash Flow (Pre Control)	21%	21%	21%	21%	21%	21%
Debt as % of Cash Flow (Post Control)	31%	61%	139%	96%	150%	115%

1 Assumes competitive pass through
2 60% of net plant investment
3 100% debt financing of vapor control equipment
4 Annual throughput times adjusted tariffs less pre-vapor control operating expense
5 Plant investment mortgaged for 20 years @ 9%; vapor control equipment mortgaged for 5 years @ 11%
6 Adjusted to include recovery credit
7 10 year operating life

TABLE F.9

CASH FLOW WORKSHEET

FOR SMALL BULK PLANT (HOUSTON-GLAVESTON COSTS)[1]

(Thousand dollars/year)

	BALANCE INCOMING ONLY	BALANCE INCOMING & OUTGOING	PRIMARY SYSTEM		PRIMARY SYSTEM WITH STAND-BY	
			REFRIGERATION	INCINERATION	REFRIGERATION/ INCINERATION	INCINERATION/ INCINERATION
Present Term Debt[2]	1.7	1.7	1.7	1.7	1.7	1.7
New Term Debt[3]	0.9	2.1	16.0	7.2	21.0	12.2
Total Debt	2.6	3.8	17.7	8.9	22.7	13.9
Pre-Tax Profit[4]	11.4	11.6	15.4	14.4	17.0	15.8
Interest Expense[5]	(0.3)	(0.4)	(1.9)	(0.9)	(2.5)	(1.5)
Vapor Control Operating Expense[6]	0.3	0.1	(7.5)	(4.0)	(8.9)	(5.3)
Adjusted Net Profit (BFIT)	11.4	11.3	6.0	9.5	5.6	9.0
Tax @ 50%	(5.7)	(5.7)	(3.0)	(4.8)	(2.8)	(4.5)
Adjusted Net Profit (AFT)	5.7	5.7	3.0	4.8	2.8	4.5
Present Depreciation	2.3	2.3	2.3	2.3	2.3	2.3
Vapor Control Equipment Depreciation[7]	0.4	1.1	8.0	3.6	10.5	6.1
Total Depreciation	2.7	3.4	10.3	5.9	12.8	8.4
Estimated Cash Flow	8.4	9.1	13.3	10.7	15.6	12.9
Debt as % of Cash Flow (Pre Control)	21%	21%	21%	21%	21%	21%
Debt as % of Cash Flow (Post Control)	31%	42%	133%	83%	146%	108%

[1] Assumes competitive pass through
[2] 60% of net plant investment
[3] 100% debt financing of vapor control equipment
[4] Annual throughput times adjusted tariffs less pre-vapor control operating expense
[5] Plant investment mortgaged for 20 years @ 9%; vapor control equipment mortgaged for 5 years @ 11%
[6] Adjusted to include recovery credit
[7] 10 year operating life

CASH FLOW WORKSHEET

FOR SMALL BULK PLANT (COLORADO APCD COSTS)[1]
(Thousand dollars/year)

	BALANCE INCOMING TT ONLY	BALANCE INCOMING & OUTGOING TT	PRIMARY SYSTEM		PRIMARY SYSTEM WITH STAND-BY	
			REFRIGERATION	INCINERATION	REFRIGERATION/ INCINERATION	INCINERATION/ INCINERATION
Present Term Debt[2]	1.7	1.7	1.7	1.7	1.7	1.7
New Term Debt[3]	0.3	0.8	14.6	5.8	19.6	10.9
Total Debt	2.0	2.5	16.3	7.5	21.3	12.6
Pre-Tax Profit[4]	11.3	11.2	14.9	19.7	16.4	15.3
Interest Expense[5]	(0.2)	(0.2)	(1.8)	(0.8)	(2.3)	(1.4)
Vapor Control Operating Expense[6]	0.4	0.5	(7.0)	(3.5)	(8.5)	(4.8)
Adjusted Net Profit (BFIT)	11.5	11.5	6.1	15.4	5.6	9.1
Tax @ 50%	(5.8)	(5.8)	(3.1)	(7.7)	(2.8)	(4.6)
Adjusted Net Profit (AFT)	5.8	5.8	3.1	7.7	2.8	4.6
Present Depreciation	2.3	2.3	2.3	2.3	2.3	2.3
Vapor Control Equipment Depreciation[7]	0.2	0.4	7.3	2.9	9.8	5.4
Total Depreciation	2.5	2.7	9.6	5.2	12.1	7.7
Estimated Cash Flow	8.3	8.5	12.7	12.9	14.9	12.3
Debt as % of Cash Flow (Pre Control)	21%	21%	21%	21%	21%	21%
Debt as % of Cash Flow (Post Control)	24%	29%	128%	58%	143%	102%

[1] Assumes competitive pass through
[2] 60% of net plant investment
[3] 100% debt financing of vapor control equipment
[4] Annual throughput times adjusted tariffs less pre-vapor control opearting expense
[5] Plant investment mortgaged for 20 years @ 9%; vapor control equipment mortgaged for 4 years @ 11%
[6] Adjusted to include recovery credit
[7] 10 year operating life

APPENDIX G

VAPOR CONTROL IMPACTS ON PROTOTYPICAL BULK STORAGE FACILITIES

TABLE G.1

VAPOR CONTROL COSTS AT LARGE MARINE TERMINALS[1]
(Thousand dollars)

TYPE PRIME SYSTEM	REFRIGERATION VAPOR RECOVERY	INCENERATION	REFRIGERATION VAPOR RECOVERY	INCINERATION
Back-up System	NO	NO	YES	YES
Current Investment	3926.4	3926.4	3926.4	3926.4
Added Vapor Control Investment	306.0	190.0	432.0	316.0
Total Investment-Post Vapor Control	4232.4	4116.4	4358.4	4242.4
Vapor Control Operating Expenses				
Utilities	19.8	6.8	19.8	6.8
M & R	10.7	5.3	14.5	9.1
Taxes, Insurance, G & A	12.2	7.6	17.3	12.6
Recovery Credit	(78.4)	--	(74.5)	--
Net Expenses	(35.7)	19.7	(22.9)	28.5
Unit Operating Expenses ($/Gal) - Gasoline Only				
Pre Control	.00288	.00288	.00288	.00288
Post Control	.00268	.00299	.00275	.00304
Tariff Increase/(Decrease)	(.00020)	.00011	(.00013)	.00016
NO PASS THROUGH CASE (Thousand dollars)				
ROI Impact				
Total Terminal Revenue[2]	1795.3	1795.3	1795.3	1795.3
Expenses-Pre Control	(987.2)	(987.2)	(987.2)	(987.2)
Expenses-Vapor Control[3]	(17.7)	(52.9)	(52.5)	(83.6)
Net Income-Post Control	787.2	752.0	752.4	721.3
ROI	18.64%	18.31%	17.30%	17.04%
% Increase/(Decrease) over Pre Control Case	(9.3%)	(10.9%)	(15.8%)	(17.0%)

1 Gasoline Throughput - 500,000 gallons/day
2 Target Tariff = $.00523/Gal.
3 Includes principle and interest payments for vapor control equipment.

TABLE G.1 (continued)

VAPOR CONTROL COSTS AT LARGE MARINE TERMINALS
(Thousand dollars)

TYPE PRIME SYSTEM	REFRIGERATION VAPOR RECOVERY	INCINERATION	REFRIGERATION VAPOR RECOVERY	INCINERATION
Back-up System	NO	NO	YES	YES
Capital Recovery Requirement				
Pre Control[1]	806.5	806.5	806.5	806.5
Vapor Control[2]	73.0	45.3	103.0	75.4
Total Capital Recovery	879.5	851.3	909.5	881.9
Operating Expenses				
Pre Control	987.2	987.2	987.2	987.2
Vapor Control	(35.7)	19.7	(22.4)	28.5
Total Expenses-Post Control	954.7	1010.1	968.0	1018.9
FULL PASS THROUGH CASE (Thousand dollars)				
Gasoline Tariff Required ($/Gal)				
Pre Control	.00523	.00523	.00523	.00523
Vapor Control Capital Recovery	.00040	.00025	.00056	.00041
Vapor Control Operating Expenses	(.00020)	.00011	(.00013)	.00016
Gasoline Tariff Required-Post Control	.00543	.00559	.00566	.00580
% Increase/(Decrease) over Pre Control Case	3.8%	6.9%	8.2%	10.9%

[1]20% BFIT, 20 years

[2]20% BFIT, 10 years

TABLE G.2

VAPOR CONTROL COSTS AT SMALL MARINE TERMINAL[1]
(Thousand dollars)

TYPE PRIME SYSTEM	REFRIGERATION VAPOR RECOVERY	INCINERATION	REFRIGERATION VAPOR RECOVERY	INCINERATION
Back-up System	NO	NO	YES	YES
Current Investment	1951.6	1951.6	1951.6	1951.6
Added Vapor Control Investment	204.0	144.0	299.0	239.0
Total Investment-Post Vapor Control	2155.6	2095.6	2250.6	2190.6
Vapor Control Operating Expenses				
Utilities	9.9	3.9	9.9	3.9
M & R	7.6	4.4	10.5	7.3
Taxes, Insurance, G & A	8.2	5.8	12.0	9.6
Recovery Credit	(39.2)	--	(37.2)	--
Net Expenses	(13.5)	14.1	(4.8)	20.8
Unit Operating Expenses ($/Gal) - Gasoline Only				
Pre Control	.00394	.00394	.00394	.00394
Post Control	.00379	.00401	.00386	.00406
Tariff Increase/(Decrease)	(.00011)	.00011	(.00004)	.00016

NO PASS THROUGH CASE
(Thousand dollars)

ROI Impact				
Total Terminal Revenue[2]	904.8	904.8	904.8	904.8
Expenses-Pre Control	(502.9)	(502.9)	(502.9)	(502.9)
Expenses-Vapor Control[3]	(22.1)	(39.2)	(47.4)	(62.5)
Net Income-Post Control	377.8	360.7	352.5	337.4
ROI	17.53%	17.21%	15.66%	15.40%
% Increase/(Decrease) over Pre Control Case	(14.8%)	(16.2%)	(23.7%)	(25.0%)

[1] Gasoline Throughput - 250,000 gallons/day
[2] Target Tariff = $.00708/gallon
[3] Includes principle and interest payments for vapor control equipment

TABLE G.2 (continued)

VAPOR CONTROL COSTS AT SMALL MARINE TERMINAL
(Thousand dollars)

TYPE PRIME SYSTEM	REFRIGERATION VAPOR RECOVERY	INCINERATION	REFRIGERATION VAPOR RECOVERY	INCINERATION
Back-up System	NO	NO	YES	YES
Capital Recovery Requirement				
Pre Control[1]	400.9	400.9	400.9	400.9
Vapor Control[2]	48.7	34.3	71.3	57.0
Total Capital Recovery	449.6	435.2	472.2	457.9
Operating Expenses				
Pre Control	502.9	502.9	502.9	502.9
Vapor Control	(13.5)	14.1	(4.8)	20.8
Total Expenses-Post Control	489.4	517.0	498.1	523.7
FULL PASS THROUGH CASE (Thousand dollars)				
Gasoline Tariff Required ($/Gal)				
Pre Control	.00708	.00708	.00708	.00708
Vapor Control Capital Recovery	.00038	.00027	.00056	.00045
Vapor Control Operating Expenses	(.00011)	.00011	(.00004)	.00016
Gasoline Tariff Required-Post Control	.00735	.00746	.00760	.00769
% Increase/(Decrease) over Pre Control Case	3.8%	5.4%	7.4%	8.7%

[1] 20% BFIT, 20 years
[2] 20% BFIT, 10 years

TABLE G.2 (continued)

VAPOR CONTROL COSTS AT SMALL MARINE TERMINAL
(Thousand dollars)

COMPETITIVE PASS-THROUGH CASE

TYPE PRIME SYSTEM	REFRIGERATION VAPOR RECOVERY	INCINERATION	REFRIGERATION VAPOR RECOVERY	INCINERATION
Gasoline Tariff ($/Gal)				
Pre-control	.00708	.00708	.00708	.00708
Full Pass-through of most efficient unit	.00020	.00036	.00043	.00057
Gasoline Tariff - Post Control	.00728	.00744	.00751	.00765
% Increase/(Decrease) over Pre-control Case	2.8%	5.1%	6.1%	8.1%
ROI Impact				
Total Terminal Revenue[1]	923.1	937.7	944.1	956.9
Expenses - Pre-Control	(02.9)	(502.9)	(502.9)	(502.9)
Expenses - Vapor Control[2]	(22.1)	(39.2)	(47.4)	(62.5)
Net Income - Post Control	398.1	395.6	393.8	391.5
ROI	18.44%	18.85%	17.47%	17.84%
% Increase/(Decrease) over Pre-Control Case	(10.2%)	(8.2%)	(14.9%)	(13.1%)

[1] Based on above gasoline tariffs
[2] Includes principle and interest payments for vapor control equipment

TABLE G.3

VAPOR CONTROL COSTS AT LARGE PIPELINE TERMINAL[1]
(Thousand dollars)

TYPE PRIME SYSTEM	REFRIGERATION VAPOR RECOVERY	INCENERATION	REFRIGERATION VAPOR RECOVERY	INCINERATION
Back-up System	NO	NO	YES	YES
Current Investment	2473.1	2473.1	2473.1	2473.1
Added Vapor Control Investment	306.0	190.0	432.0	316.0
Total Investment-Post Vapor Control	2779.1	2663.1	2905.1	2789.1
Vapor Control Operating Expenses				
Utilities	19.8	6.8	19.8	6.8
M & R	10.7	5.3	14.5	9.1
Taxes, Insurance, G & A	12.2	7.6	17.3	12.6
Recovery Credit	(78.4)	--	(74.5)	--
Net Expenses	(35.7)	19.7	(22.9)	28.5
Unit Operating Expenses ($/Gal) - Gasoline Only				
Pre Control	.00243	.00243	.00243	.00243
Post Control	.00223	.00254	.00230	.00259
Tariff Increase/(Decrease)	(.00020)	.00011	(.00013)	.00016

NO PASS THROUGH CASE
(Thousand dollars)

ROI Impact				
Total Terminal Revenue[2]	1240.6	1240.6	1240.6	1240.6
Expenses-Pre Control	(732.3)	(732.3)	(732.3)	(732.3)
Expenses-Vapor Control[3]	(17.7)	(52.9)	(52.5)	(83.6)
Net Income-Post Control	490.0	454.8	455.2	424.1
ROI	17.64%	17.09%	15.68%	15.22%
% Increase/(Decrease) over Pre Control Case	(14.1%)	(16.8%)	(23.7%)	(25.9%)

[1] Gasoline Throughput - 500,000 gallons/day
[2] Target Tariff = $.00412/gallon
[3] Includes principle and interest payments for vapor control equipment

TABLE G.3 (continued)

VAPOR CONTROL COSTS AT LARGE PIPELINE TERMINAL
(Thousand dollars)

TYPE PRIME SYSTEM	REFRIGERATION VAPOR RECOVERY	INCINERATION	REFRIGERATION VAPOR RECOVERY	INCINERATION
Back-up System	NO	NO	YES	YES
Capital Recovery Requirement				
Pre Control [1]	508.0	508.0	508.0	508.0
Vapor Control [2]	73.0	45.3	103.0	75.4
Total Capital Recovery	581.0	553.0	611.0	583.4
Operating Expenses				
Pre Control	732.3	732.3	732.3	732.3
Vapor Control	(35.7)	19.7	(22.9)	28.5
Total Expenses-Post Control	696.4	752.0	709.4	760.8

FULL PASS THROUGH CASE
(Thousand dollars)

Gasoline Tariff Required ($/Gal)				
Pre Control	.00412	.00412	.00412	.00412
Vapor Control Capital Recovery	.00040	.00025	.00056	.00041
Vapor Control Operating Expenses	(.00020)	.00011	(.00013)	.00016
Gasoline Tariff Required-Post Control	.00432	.00448	.00455	.00469
% Increase/(Decrease) over Pre Control Case	4.9%	8.7%	10.4%	13.8%

[1] 20% BFIT, 20 years
[2] 20% BFIT, 10 years

TABLE G.4

VAPOR CONTROL COSTS AT SMALL PIPELINE TERMINAL[1]
(Thousand dollars)

TYPE PRIME SYSTEM	REFRIGERATION VAPOR RECOVERY	INCENERATION	REFRIGERATION VAPOR RECOVERY	INCINERATION
Back-up System	NO	NO	YES	YES
Current Investment	989.9	989.9	989.9	989.9
Added Vapor Control Investment	204.0	144.0	299.0	239.0
Total Investment-Post Vapor Control	1193.9	1133.9	1288.9	1228.9
Vapor Control Operating Expenses				
Utilities	9.9	3.9	9.9	3.9
M & R	7.6	4.4	10.5	7.3
Taxes, Insurance, G & A	8.2	5.8	12.0	9.6
Recovery Credit	(39.2)	--	(37.2)	--
Net Expenses	(13.5)	14.1	(4.8)	20.8
Unit Operating Expenses ($/Gal) - Gasoline Only				
Pre Control	.00305	.00305	.00305	.00305
Post Control	.00294	.00316	.00296	.00321
Tariff Increase/(Decrease)	(.00011)	.00011	(.00004)	.00016

NO PASS THROUGH CASE
(Thousand dollars)

ROI Impact				
Total Terminal Revenue[2]	627.0	627.0	627.0	627.0
Expenses-Pre Control	(423.5)	(423.5)	(423.5)	(423.5)
Expenses-Vapor Control[3]	(22.1)	(39.2)	(47.4)	(62.5)
Net Income-Post Control	181.0	164.9	155.7	140.6
ROI	15.18%	14.47%	12.10%	11.46%
% Increase/(Decrease) over Pre Control Case	(26.1%)	(29.5%)	(41.1%)	(44.2%)

[1] Gasoline Throughput - 250,000 gallons/day
[2] Target Tariff = $.00451/gallon
[3] Includes principle and interest payments for vapor control equipment

TABLE G.4 (continued)

VAPOR CONTROL COSTS AT SMALL PIPELINE TERMINAL
(Thousand dollars)

TYPE PRIME SYSTEM	REFRIGERATION VAPOR RECOVERY	INCINERATION	REFRIGERATION VAPOR RECOVERY	INCINERATION
Back-up System	NO	NO	YES	YES
Capital Recovery Requirement				
Pre Control[1]	203.3	203.3	203.3	203.3
Vapor Control[2]	48.7	34.3	71.3	57.0
Total Capital Recovery	252.0	237.6	274.6	260.3
Operating Expenses				
Pre Control	423.5	423.5	423.5	423.5
Vapor Control	(13.5)	14.1	(4.8)	20.8
Total Expenses-Post Control	410.0	437.6	418.7	444.3

FULL PASS THROUGH CASE
(Thousand dollars)

Gasoline Tariff Required ($/Gal)				
Pre Control	.00451	.00451	.00451	.00451
Vapor Control Capital Recovery	.00038	.00027	.00056	.00045
Vapor Control Operating Expenses	(.00011)	.00011	(.00004)	.00016
Gasoline Tariff Required-Post Control	.00478	.00489	.00503	.00512
% Increase/(Decrease) over Pre Control Case	6.0%	8.4%	11.5%	13.5%

[1] 20% BFIT, 20 years
[2] 20% BFIT, 10 years

TABLE G.5

VAPOR CONTROL COSTS (NOJC) AT LARGE BULK PLANTS[1]
(Thousand dollars)

OPTION	1	3	4	4	4	4
TYPE PRIMARY SYSTEM	BALANCE Incoming TT Only	BALANCE Incoming & Outgoing Trucks	REFRIGERATION VAPOR CONTROL	INCINERATION	REFRIGERATION VAPOR CONTROL	INCINERATION
TYPE LOADING	TOP	TOP	TOP	TOP	TOP	TOP
BACK-UP SYSTEM	NO	NO	NO	NO	YES	YES
Current Investment	143.00	143.00	143.00	143.00	143.00	143.00
Added Vapor Control Investment	4.25	25.73	94.88	50.99	120.12	76.25
Total Investment-Post Control	147.25	168.73	237.88	193.99	263.12	219.25
Vapor Control Operating Expenses						
Utilities	--	--	2.17	0.16	2.17	0.16
Labor	--	--	1.43	1.43	1.43	1.43
M & R	0.07	0.17	2.76	0.79	3.07	1.10
Mis., Taxes, Ins., G & A	0.17	1.03	3.80	2.04	4.80	3.05
Recovery Credit	(2.59)	(4.08)	(11.11)	--	(10.55)	--
Net Expenses	(2.35)	(2.88)	(1.00)	4.42	0.92	5.74
Unit Operating Expenses ($/Gal) - Gasoline Only						
Pre Control	.01486	.01486	.01486	.01486	.01486	.01486
Post Control	.01454	.01447	.01472	.01547	.01499	.01565
Increase/(Decrease)	(.00032)	(.00039)	(.00014)	.00061	.00013	.00079

NO PASS THROUGH CASE
(Thousand dollars)

ROI Impact	1	3	4	4	4	4
Bulk Plant Revenue[2]	192.10	192.10	192.10	192.10	192.10	192.10
Expenses-Pre Control	(162.50)	(162.50)	(162.50)	(162.50)	(162.50)	(162.50)
Expenses-Vapor Control[3]	1.25	(3.77)	(23.53)	(8.76)	(31.98)	(25.45)
Net Income-Post Control	30.45	25.43	5.67	20.44	(2.38)	3.75
ROI/ROE	20.81%	15.19%	2.47%	10.64%	--	1.80%
% Increase/(Decrease) over Pre Control Case	1.3%	26.0%	88.0%	(48.2%)	--	(91.2%)

[1] Gasoline Throughput - 20,000 gallons/day
[2] Target Tariff = $.01754/gallon
[3] Includes principle and interest payments for vapor control equipment

TABLE G.5 (continued)

VAPOR CONTROL COSTS (NOJC) AT LARGE BULK PLANTS
(Thousands dollars)

FULL PASS THROUGH CASE

OPTION	1	3	4	4	4	4
TYPE PRIMARY SYSTEM	BALANCE Incoming TT Only	BALANCE Incoming & Outgoing Trucks	REFRIG-ERATION VAPOR CONTROL	INCIN-ERATION	REFRIG-ERATION VAPOR CONTROL	INCIN-ERATION
TYPE LOADING	TOP	TOP	TOP	TOP	TOP	TOP
BACK-UP SYSTEM	NO	NO	NO	NO	YES	YES
Capital Recovery Requirement						
Pre Control[1]	29.40	29.40	29.40	29.40	29.40	29.40
Vapor Control[2]	1.01	6.14	22.63	12.16	28.65	18.19
Total Capital Recovery	30.41	35.54	52.03	41.56	58.05	47.59
Operating Expenses						
Pre Control	162.50	162.50	162.50	162.50	162.50	162.50
Vapor Control	(2.35)	(2.88)	(1.00)	4.42	0.92	5.74
Total Expenses-Post Control	160.15	159.62	161.50	166.92	163.42	168.24
Gasoline Tariff ($/Gal)						
Pre Control	.01754	.01754	.01754	.01754	.01754	.01754
Vapor Control Capital Recovery	.00014	.00084	.00310	.00167	.00392	.00249
Vapor Control Operating Expenses	(.00032)	(.00039)	(.00014)	.00061	.00013	.00079
Gasoline Tariff-Post Control	.01736	.01799	.02050	.01982	.02159	.02082
% Increase/(Decrease) over Pre Control Case	(1.0%)	2.6%	16.9%	13.0%	23.1%	18.7%

[1] 20% BFIT, 20 years

[2] 20% BFIT, 10 years

TABLE G.6

VAPOR CONTROL COSTS (HOUSTON-GALVESTON) AT LARGE BULK PLANTS[1]
(Thousand dollars)

OPTION	1	3	4	4	4	4
TYPE PRIMARY SYSTEM	BALANCE Incoming TT Only	BALANCE Incoming & Outgoing Trucks	REFRIGERATION VAPOR CONTROL	INCINERATION	REFRIGERATION VAPOR CONTROL	INCINERATION
TYPE LOADING	TOP	TOP	TOP	TOP	TOP	TOP
BACK-UP SYSTEM	NO	NO	NO	NO	YES	YES
Current Investment	143.00	143.00	143.00	143.00	143.00	143.00
Added Vapor Control Investment	4.25	12.98	82.13	38.24	107.37	63.50
Total Investment-Post Control	147.25	155.98	225.13	181.24	250.37	206.50
Vapor Control Operating Expenses						
Utilities	--	--	2.17	0.16	2.17	0.16
Labor	--	--	1.43	1.43	1.43	1.43
M & R	0.07	0.39	2.98	1.01	3.29	1.32
Mis., Taxes, Ins., G & A	0.17	0.52	3.29	1.53	4.29	2.54
Recovery Credit	(2.59)	(4.08)	(11.11)	--	(10.55)	--
Net Expenses	(2.35)	(3.17)	(1.24)	4.13	0.63	5.45
Unit Operating Expenses ($/Gal) - Gasoline Only						
Pre Control	.01486	.01486	.01486	.01486	.01486	.01486
Post Control	.01454	.01440	.01469	.01543	.01495	.01561
Increase/(Decrease)	(.00032)	(.00046)	(.00017)	.00057	.00009	.00075

NO PASS THROUGH CASE
(Thousand dollars)

ROI Impact	1	3	4	4	4	4
Bulk Plant Revenue[2]	192.10	192.10	192.10	192.10	192.10	192.10
Expenses-Pre Control	(162.50)	(162.50)	(162.50)	(162.50)	(162.50)	(162.50)
Expenses-Vapor Control[3]	1.25	0.01	(19.99)	(14.02)	(28.39)	(21.87)
Net Income-Post Control	30.45	29.21	9.21	15.18	.81	7.33
ROI	20.81%	18.85%	4.18%	8.49%	0.4%	3.56%
% Increase/(Decrease) over Pre Control Case	1.3%	(8.20%)	(79.7%)	(58.7%)	(98.0%)	(82.2%)

[1] Gasoline Throughput - 20,000 gallons/day
[2] Target Tariff = $.01754/gallon
[3] Includes principle and interest payments for vapor control equipment

TABLE G.6 (continued)

VAPOR CONTROL COSTS (HOUSTON-GALVESTON) AT LARGE BULK PLANTS
(Thousand dollars)

OPTION	1	3	4	4	4	4
	FULL PASS THROUGH CASE					
TYPE PRIMARY SYSTEM	BALANCE Incoming TT Only	BALANCE Incoming & Outgoing Trucks	REFRIG-ERATION VAPOR CONTROL	INCIN-ERATION	REFRIG-ERATION VAPOR CONTROL	INCIN-ERATION
TYPE LOADING	TOP	TOP	TOP	TOP	TOP	TOP
BACK-UP SYSTEM	NO	NO	NO	NO	YES	YES
Capital Recovery Requirement						
Pre Control[1]	29.40	29.40	29.40	29.40	29.40	29.40
Vapor Control[2]	1.01	3.10	19.59	9.12	25.61	15.14
Total Capital Recovery	29.41	31.50	47.99	37.52	54.01	43.54
Operating Expenses						
Pre Control	162.50	162.50	162.50	162.50	162.50	162.50
Vapor Control	(2.35)	(3.17)	(1.24)	4.13	0.63	5.45
Total Expenses-Post Control	160.15	158.93	161.26	166.63	163.13	167.95
Gasoline Tariff ($/Gal)						
Pre Control	.01754	.01754	.01754	.01754	.01754	.01754
Vapor Control Capital Recovery	.00014	.00042	.00268	.00125	.00351	.00207
Vapor Control Operating Expenses	(.00032)	(.00046)	(.00017)	.00057	.00009	.00075
Gasoline Tariff-Post Control	.01736	.01750	.02005	.01936	.02114	.02036
% Increase/(Decrease) over Pre Control Case	(1.0%)	(0.2%)	14.3%	10.4%	20.5%	16.1%

[1] 20% BFIT, 20 years

[2] 10% BFIT, 10 years

TABLE G.7

VAPOR CONTROL COSTS (COLORADO APCD) AT LARGE BULK PLANTS[1]
(Thousand dollars)

OPTION	1	3	4	4	4	4
TYPE PRIMARY SYSTEM	BALANCE	BALANCE	REFRIG-ERATION	INCIN-ERATION	REFRIG-ERATION	INCIN-ERATION
	Incoming TT Only	Incoming & Outgo-ing Trucks	VAPOR CONTROL		VAPOR CONTROL	
TYPE LOADING	TOP	TOP	TOP	TOP	TOP	TOP
BACK-UP SYSTEM	NO	NO	NO	NO	YES	YES
Current Investment	143.00	143.00	143.00	143.00	143.00	143.00
Added Vapor Control Investment	1.70	4.88	74.03	30.14	99.27	55.40
Total Investment-Post Control	144.70	147.88	217.03	173.14	242.27	198.40
Vapor Control Operating Expenses						
Utilities	--	--	2.17	0.16	2.17	0.16
Labor	--	--	1.43	1.43	1.43	1.43
M & R	0.05	0.15	2.74	0.77	3.05	1.08
Mis., Taxes, Ins., G & A	0.07	0.20	2.96	1.21	3.97	2.22
Recovery Credit	(2.59)	(4.08)	(11.11)	--	(10.55)	--
Net Expenses	(2.47)	(3.73)	(1.81)	3.57	0.07	4.89
Unit Operating Expenses ($/Gal) - Gasoline Only						
Pre Control	.01486	.01486	.01486	.01486	.01486	.01486
Post Control	.01452	.01435	.01461	.01535	.01487	.01553
Increase/(Decrease)	(.00034)	(.00051)	(.00025)	.00049	.00001	.00067

NO PASS THROUGH CASE
(Thousand dollars)

ROI Impact						
Bulk Plant Revenue[2]	192.10	192.10	192.10	192.10	192.10	192.10
Expenses-Pre Control	(162.50)	(162.50)	(162.50)	(162.50)	(162.50)	(162.50)
Expenses-Vapor Control[3]	2.03	2.47	(17.33)	(11.36)	(25.74)	(19.21)
Net Income-Post Control	31.23	31.67	11.87	17.84	3.46	9.99
ROI	21.72%	21.55%	5.56%	10.42%	1.51%	5.14%
% Increase/(Decrease) over Pre Control Case	5.7%	4.9%	(72.9%)	(49.3%)	(92.6%)	(75.0%)

[1]Gasoline Throughput - 20,000 gallons/day
[2]Target Tariff = $.01754/gallon
[3]Includes principle and interest payments for vapor control equipment

TABLE G.7 (continued)

VAPOR CONTROL COSTS (COLORADO APCD) AT LARGE BULK PLANTS
(Thousand dollars)

FULL PASS THROUGH CASE

OPTION	1	3	4	4	4	4
TYPE PRIMARY SYSTEM	BALANCE Incoming TT Only	BALANCE Incoming & Outgoing Trucks	REFRIG-ERATION VAPOR CONTROL	INCIN-ERATION	REFRIG-ERATION VAPOR CONTROL	INCIN-ERATION
TYPE LOADING	TOP	TOP	TOP	TOP	TOP	TOP
BACK-UP SYSTEM	NO	NO	NO	NO	YES	YES
Capital Recovery Requirement						
Pre Control[1]	29.40	29.40	29.40	29.40	29.40	29.40
Vapor Control[2]	0.41	1.16	17.66	7.19	23.68	13.21
Total Capital Recovery	29.81	30.56	47.06	36.59	53.08	42.61
Operating Expenses						
Pre Control	162.50	162.50	162.50	162.50	162.50	162.50
Vapor Control	(2.47)	(3.73)	(1.81)	3.57	0.07	4.89
Total Expenses-Post Control	164.97	166.23	164.31	166.07	162.57	167.39
Gasoline Tariff ($/Gal)						
Pre Control	.01754	.01754	.01754	.01754	.01754	.01754
Vapor Control Capital Recovery	.00006	.00016	.00242	.00098	.00324	.00181
Vapor Control Operating Expenses	(.00034)	(.00051)	(.00025)	.00049	.00001	.00067
Gasoline Tariff-Post Control	.01726	.01719	.01971	.01901	.02079	.02002
% Increase/(Decrease) over Pre Control Case	(1.6%)	(2.0%)	12.4%	8.4%	18.5%	14.1%

[1] 20% BFIT, 20 years

[2] 10% BFIT, 10 years

TABLE G.8

VAPOR CONTROL COSTS (NOJC) AT SMALL BULK PLANTS[1]
(Thousand dollars)

OPTION	1	3	4	4	4	4
TYPE PRIMARY SYSTEM	BALANCE Incoming TT Only	BALANCE Incoming & Outgoing Trucks	REFRIGERATION VAPOR CONTROL	INCINERATION	REFRIGERATION VAPOR CONTROL	INCINERATION
TYPE LOADING	TOP	TOP	TOP	TOP	TOP	TOP
BACK-UP SYSTEM	NO	NO	NO	NO	YES	YES
Current Investment	57.00	57.00	57.00	57.00	57.00	57.00
Added Vapor Control Investment	4.25	23.03	92.18	48.32	117.42	73.55
Total Investment-Post Control	61.25	80.03	149.18	105.32	174.42	130.55
Vapor Control Operating Expenses						
Utilities	--	--	2.17	0.16	2.17	0.16
Labor	--	--	1.43	1.43	1.43	1.43
M & R	0.07	0.07	2.75	0.78	3.06	1.09
Mis., Taxes, Ins., G & A	0.17	0.92	3.69	1.93	4.70	2.94
Recovery Credit	(0.51)	(0.81)	(2.19)	--	(2.08)	--
Net Expenses	(0.27)	0.18	7.85	4.30	9.28	5.62
Unit Operating Expenses ($/Gal) - Gasoline Only						
Pre Control	.02670	.02670	.02670	.02670	.02670	.02670
Post Control	.02652	.02682	.03208	.02965	.03306	.03055
Increase/(Decrease)	(.00018)	.00012	.00538	.00295	.00636	.00385

NO PASS THROUGH CASE
(Thousand dollars)

ROI Impact						
Bulk Plant Revenue[2]	66.70	66.70	66.70	66.70	66.70	66.70
Expenses-Pre Control	(54.90)	(54.90)	(54.90)	(54.90)	(54.90)	(54.90)
Expenses-Vapor Control[3]	(0.83)	(6.13)	(31.68)	(16.79)	(39.64)	(24.64)
Net Income-Post Control	10.77	5.47	(19.88)	(4.99)	(27.84)	(12.84)
ROI /ROE	17.75%	6.96%	---	---	---	---
% Increase/(Decrease) over Pre Control Case	(13.6%)	(66.1%)	---	---	---	---

[1] Gasoline Throughput - 4,000 gallons/day
[2] Target Tariff = $.03238/gallon
[3] Includes principle and interest payments for vapor control equipment

TABLE G.8 (continued)

VAPOR CONTROL COSTS (NOJC) AT SMALL BULK PLANTS
(Thousand dollars)

FULL PASS THROUGH CASE

OPTION	1	3	4	4	4	4
TYPE PRIMARY SYSTEM	BALANCE Incoming TT Only	BALANCE Incoming & Outgoing Trucks	REFRIGERATION VAPOR CONTROL	INCINERATION	REFRIGERATION VAPOR CONTROL	INCINERATION
TYPE LOADING	TOP	TOP	TOP	TOP	TOP	TOP
BACK-UP SYSTEM	NO	NO	NO	NO	YES	YES
Capital Recovery Requirement						
Pre Control[1]	11.70	11.70	11.70	11.70	11.70	11.70
Vapor Control[2]	1.01	5.49	21.98	11.52	28.00	17.54
Total Capital Recovery	12.71	17.19	33.68	23.22	39.70	29.24
Operating Expenses						
Pre Control	54.90	54.90	54.90	54.90	54.90	54.90
Vapor Control	(0.27)	0.18	7.85	4.30	9.28	5.62
Total Expenses-Post Control	54.63	55.08	62.75	59.20	64.18	60.52
Gasoline Tariff ($/Gal)						
Pre Control	.03238	.03238	.03238	.03238	.03238	.03238
Vapor Control Capital Recovery	.00069	.00376	.01505	.00789	.01918	.01201
Vapor Control Operating Expenses	(.00018)	.00012	.00538	.00295	.00636	.00385
Gasoline Tariff-Post Control	.03289	.03626	.05281	.04322	.05792	.04824
% Increase/(Decrease) over Pre Control Case	1.6%	12.0%	63.1%	33.5%	78.9%	49.0%

[1] 20% BFIT, 20 years

[2] 10% BFIT, 10 years

TABLE G.8 (continued)

VAPOR CONTROL COSTS (NOJC) AT SMALL BULK PLANTS
(Thousand dollars)

COMPETITIVE PASS THROUGH CASE

OPTION	1	3	4	4	4	4
TYPE PRIMARY SYSTEM	BALANCE Incoming TT Only	BALANCE Incoming & Outgoing Trucks	REFRIGERATION VAPOR CONTROL	INCINERATION	REFRIGERATION VAPOR CONTROL	INCINERATION
TYPE LOADING	TOP	TOP	TOP	TOP	TOP	TOP
BACK-UP SYSTEM	NO	NO	NO	NO	YES	YES
Gasoline Tariff ($/Gal)						
Pre Control	.03238	.03238	.03238	.03238	.03238	.03238
Capital Recovery-Most Efficient Unit	.00014	.00084	.00310	.00167	.00392	.00249
Operating Expense-Most Efficient Unit	(.00032)	(.00039)	(.00014)	.00061	.00013	.00079
Gasoline Tariff-Post Control	.03220	..03283	.03534	.03466	.03643	.03566
% Increase/(Decrease) over Pre Control Case	(0.6%)	1.4%	9.1%	7.0%	12.5%	10.1%
ROI Impact						
Bulk Plant Revenue[1]	66.44	67.36	71.02	70.03	72.62	71.49
Expenses-Pre Control	(54.90)	(54.90)	(54.90)	(54.90)	(54.90)	(54.90)
Expenses-Vapor Control[2]	(0.83)	(6.13)	(31.68)	(16.79)	(39.64)	(24.64)
Net Income-Post Control	10.51	6.13	(15.56)	(1.66)	(21.92)	(8.05)
ROI/ROE	17.32%	7.78%	---	---	---	---
% Increase/(Decrease) over Pre Control Case	(15.7%)	(62.1%)	---	---	---	---

[1]Based on above gasoline tariffs

[2]Includes principle and interest payments for vapor control equipment

TABLE G.9

VAPOR CONTROL COSTS (HOUSTON-GALVESTON) AT SMALL BULK PLANTS[1]
(Thousand dollars)

OPTION	1	3	4	4	4	4
TYPE PRIMARY SYSTEM	BALANCE Incoming TT Only	BALANCE Incoming & Outgo-ing Trucks	REFRIG-ERATION VAPOR CONTROL	INCIN-ERATION	REFRIG-ERATION VAPOR CONTROL	INCIN-ERATION
TYPE LOADING	TOP	TOP	TOP	TOP	TOP	TOP
BACK-UP SYSTEM	NO	NO	NO	NO	YES	YES
Current Investment	57.00	57.00	57.00	57.00	57.00	57.00
Added Vapor Control Investment	4.25	10.70	79.85	35.96	105.09	61.22
Total Investment-Post Control	61.25	67.70	136.85	92.96	162.09	118.22
Vapor Control Operating Expenses						
Utilities	--	--	2.17	0.16	2.17	0.16
Labor	--	--	1.43	1.43	1.43	1.43
M & R	0.07	0.32	2.91	0.94	3.22	1.25
Mis., Taxes, Ins., G & A	0.17	0.43	3.19	1.44	4.20	2.45
Recovery Credit	(0.51)	(0.81)	(2.19)	--	(2.08)	--
Net Expenses	(0.27)	(0.06)	7.51	3.97	8.94	5.29
Unit Operating Expenses ($/Gal) - Gasoline Only						
Pre Control	.02670	.02670	.02670	.02670	.02670	.02670
Post Control	.02652	.02666	.03184	.02942	.03282	.03032
Increase/(Decrease)	(.00018)	(.00004)	.00514	.00272	.00612	.00362

NO PASS THROUGH CASE
(Thousand dollars)

ROI Impact						
Bulk Plant Revenue[2]	66.70	66.70	66.70	66.70	66.70	66.70
Expenses-Pre Control	(54.90)	(54.90)	(54.90)	(54.90)	(54.90)	(54.90)
Expenses-Vapor Control[3]	(0.83)	(2.71)	(28.15)	(13.27)	(36.11)	(21.12)
Net Income-Post Control	10.77	8.89	(16.35)	(1.47)	(24.31)	(9.32)
ROI	17.75%	13.28%	---	---	---	---
% Increase/(Decrease) over Pre Control Case	(13.6%)	(35.3%)	---	---	---	---

[1] Gasoline Throughput - 4,000 gallons/day
[2] Target Tariff = $.03238/gallon
[3] Includes principle and interest payments for vapor control equipment

TABLE G.9 (continued)

VAPOR CONTROL COSTS (HOUSTON-GALVESTON) AT SMALL BULK PLANTS
(Thousand dollars)

FULL PASS THROUGH CASE

OPTION	1	3	4	4	4	4
TYPE PRIMARY SYSTEM	BALANCE Incoming TT Only	BALANCE Incoming & Outgoing Trucks	REFRIG-ERATION VAPOR CONTROL	INCIN-ERATION	REFRIG-ERATION VAPOR CONTROL	INCIN-ERATION
TYPE LOADING	TOP	TOP	TOP	TOP	TOP	TOP
BACK-UP SYSTEM	NO	NO	NO	NO	YES	YES
Capital Recovery Requirement						
Pre Control[1]	11.70	11.70	11.70	11.70	11.70	11.70
Vapor Control[2]	1.01	2.55	19.04	8.58	25.06	14.60
Total Capital Recovery	12.71	14.25	30.74	20.28	36.76	26.30
Operating Expenses						
Pre Control	54.90	54.90	54.90	54.90	54.90	54.90
Vapor Control	(0.27)	(0.06)	7.51	3.97	8.94	5.29
Total Expenses-Post Control	54.63	54.84	62.41	58.87	63.84	60.19
Gasoline Tariff ($/Gal)						
Pre Control	.03238	.03238	.03238	.03238	.03238	.03238
Vapor Control Capital Recovery	.00069	.00175	.01304	.00588	.01716	.01000
Vapor Control Operating Expenses	(.00018)	(.00004)	.00514	.00272	.00612	.00362
Gasoline Tariff-Post Control	.03289	.03409	.05056	.04098	.05566	.04600
% Increase/(Decrease) over Pre Control Case	1.6%	5.3%	56.1%	26.6%	71.9%	42.1%

[1] 20% BFIT, 20 years
[2] 10% BFIT, 10 years

TABLE G.9 (continued)

VAPOR CONTROL COSTS (HOUSTON-GALVESTON) AT SMALL BULK PLANTS
(Thousand dollars)

COMPETITIVE PASS THROUGH CASE

OPTION	1	3	4	4	4	4
TYPE PRIMARY SYSTEM	BALANCE Incoming TT Only	BALANCE Incoming & Outgoing Trucks	REFRIGERATION VAPOR CONTROL	INCINERATION	REFRIGERATION VAPOR CONTROL	INCINERATION
TYPE LOADING	TOP	TOP	TOP	TOP	TOP	TOP
BACK-UP SYSTEM	NO	NO	NO	NO	YES	YES
Gasoline Tariff ($/Gal)						
Pre Control	.03238	.03238	.03238	.03238	.03238	.03238
Capital Recovery-Most Efficient Unit	.00014	.00042	.00268	.00125	.00351	.00207
Operating Expense-Most Efficient Unit	(.00032)	(.00046)	(.00017)	.00057	.00009	.00075
Gasoline Tariff-Post Control	.03220	.03234	.03489	.03420	.03598	.03520
% Increase/(Decrease) over Pre Control Case	(0.6%)	(0.1%)	7.8%	5.6%	11.1%	8.7%
ROI Impact						
Bulk Plant Revenue[1]	66.44	66.44	66.44	66.44	66.44	66.44
Expenses-Pre Control	(54.90)	(54.90)	(54.90)	(54.90)	(54.90)	(54.90)
Expenses-Vapor Control[2]	(0.83)	(2.71)	(28.15)	(13.27)	(36.11)	(21.12)
Net Income-Post Control	10.51	8.83	(12.68)	.99	(19.05)	(5.20)
ROI	17.32%	13.19%	---	1.17%	---	---
% Increase/(Decrease) over Pre Control Case	(15.7%)	(35.8%)	---	(94.3%)	---	---

[1] Based on above gasoline tariffs
[2] Includes principle and interest payments for vapor control equipment

TABLE G.10

VAPOR CONTROL COSTS (COLORADO APCD) AT SMALL BULK PLANTS[1]
(Thousand dollars)

OPTION	1	3	4	4	4	4
TYPE PRIMARY SYSTEM	BALANCE Incoming TT Only	BALANCE Incoming & Outgo-ing Trucks	REFRIG-ERATION VAPOR CONTROL	INCIN-ERATION	REFRIG-ERATION VAPOR CONTROL	INCIN-ERATION
TYPE LOADING	TOP	TOP	TOP	TOP	TOP	TOP
BACK-UP SYSTEM	NO	NO	NO	NO	YES	YES
Current Investment	57.00	57.00	57.00	57.00	57.00	57.00
Added Vapor Control Investment	1.70	3.84	72.99	29.10	98.23	54.36
Total Investment-Post Control	58.70	60.84	129.99	86.10	155.23	109.36
Vapor Control Operating Expenses						
Utilities	--	--	2.17	0.16	2.17	0.16
Labor	--	--	1.43	1.43	1.43	1.43
M & R	0.05	0.12	2.71	0.74	3.02	3.05
Mis., Taxes, Ins., G & A	0.07	0.15	2.92	1.16	3.93	2.17
Recovery Credit	(0.51)	(0.81)	(2.19)	--	(2.08)	--
Net Expenses	(0.39)	(0.54)	7.04	3.49	8.47	4.81
Unit Operating Expenses ($/Gal) - Gasoline Only						
Pre Control	.02670	.02670	.02670	.02670	.02670	.02670
Post Control	.02643	.02633	.03152	.02909	.03250	.02999
Increase/(Decrease)	(.00027)	(.00037)	.00482	.00239	.00580	.00329

NO PASS THROUGH CASE
(Thousand dollars)

ROI Impact						
Bulk Plant Revenue[2]	66.70	66.70	66.70	66.70	66.70	66.70
Expenses-Pre Control	(54.90)	(54.90)	(54.90)	(54.90)	(54.90)	(54.90)
Expenses-Vapor Control[3]	(0.05)	(0.45)	(25.91)	(11.01)	(33.87)	(18.86)
Net Income-Post Control	11.55	11.15	(14.11)	0.59	(22.07)	(7.06)
ROI	19.85%	18.49%	---	0.8%	---	---
% Increase/(Decrease) over Pre Control Case	(3.4%)	(10.0%)	---	(96.1%)	---	---

[1] Gasoline Throughput - 4,000 gallons/day
[2] Target Tariff = $.03238/gallon
[3] Includes principle and interest payments for vapor control equipment

TABLE G.10 (continued)

VAPOR CONTROL COSTS (COLORADO APCD) AT SMALL BULK PLANTS
(Thousand dollars)

FULL PASS THROUGH CASE

OPTION	1	3	4	4	4	4
TYPE PRIMARY SYSTEM	BALANCE Incoming TT Only	BALANCE Incoming & Outgoing Trucks	REFRIG-ERATION VAPOR CONTROL	INCIN-ERATION	REFRIG-ERATION VAPOR CONTROL	INCIN-ERATION
TYPE LOADING	TOP	TOP	TOP	TOP	TOP	TOP
BACK-UP SYSTEM	NO	NO	NO	NO	YES	YES
Capital Recovery Requirement						
Pre Control[1]	11.70	11.70	11.70	11.70	11.70	11.70
Vapor Control[2]	0.41	0.92	17.41	6.94	23.43	12.96
Total Capital Recovery	12.11	12.62	29.11	18.64	35.13	24.66
Operating Expenses						
Pre Control	54.90	54.90	54.90	54.90	54.90	54.90
Vapor Control	(0.39)	(0.54)	7.04	3.49	8.47	4.81
Total Expenses-Post Control	54.51	54.36	61.94	58.39	63.37	59.71
Gasoline Tariff ($/Gal)						
Pre Control	.03238	.03238	.03238	.03238	.03238	.03238
Vapor Control Capital Recovery	.00028	.00063	.01192	.00475	.01605	.00888
Vapor Control Operating Expenses	(.00027)	(.00037)	.00482	.00239	.00580	.00329
Gasoline Tariff-Post Control	.03239	.03264	.04912	.03952	.04523	.04455
% Increase/(Decrease) over Pre Control Case	0.0%	0.8%	51.7%	22.1%	67.5%	37.6%

[1] 20% BFIT, 20 years

[2] 20% BFIT, 10 years

TABLE G.10 (continued)

VAPOR CONTROL COSTS (COLORADO APCD) AT SMALL BULK PLANTS
(Thousand dollars)

COMPETITIVE PASS THROUGH CASE

OPTION	1	3	4	4	4	4
TYPE PRIMARY SYSTEM	BALANCE Incoming TT Only	BALANCE Incoming & Outgoing Trucks	REFRIGERATION VAPOR CONTROL	INCINERATION	REFRIGERATION VAPOR CONTROL	INCINERATION
TYPE LOADING	TOP	TOP	TOP	TOP	TOP	TOP
BACK-UP SYSTEM	NO	NO	NO	NO	YES	YES
Gasoline Tariff ($/Gal)						
Pre Control	.03238	.03238	.03238	.03238	.03238	.03238
Capital Recovery-Most Efficient Unit	.00006	.00016	.00242	.00501	.00324	.00181
Operating Expense-Most Efficient Unit	(.00034)	(.00051)	(.00025)	.00049	.00001	.00067
Gasoline Tariff-Post Control	.03210	.03203	.03455	.03788	.03563	.03486
% Increase/(Decrease) over Pre Control Case	(0.9%)	(1.1%)	6.7%	17.0%	10.0%	7.7%
ROI Impact						
Bulk Plant Revenue[1]	66.29	66.19	69.87	74.73	71.45	70.32
Expenses-Pre Control	(54.90)	(54.90)	(54.90)	(54.90)	(54.90)	(54.90)
Expenses-Vapor Control[2]	(0.05)	(0.45)	(25.91)	(11.01)	(33.87)	(18.86)
Net Income-Post Control	11.14	10.64	(10.94)	8.62	(17.32)	(3.44)
ROI	19.15%	17.65%	---	10.13	---	---
% Increase/(Decrease) over Pre Control Case	(6.8%)	(14.1%)	---	(50.7%)	---	---

[1] Based on above gasoline tariffs
[2] Includes principle and interest payments for vapor control equipment

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16. ABSTRACT

This report assesses economic impacts of several vapor control strategies which would reduce the benzene emissions of the bulk storage industry. The report seeks to:

- o Identify and characterize the bulk storage industry
- o Determine the number of facility closures expected to occur because of the proposed vapor control regulations
- o Estimate the employment levels displaced by these closures, and
- o Calculate the national cost of installing and operating vapor control systems in the remaining bulk storage population.

The U.S. Environmental Protection Agency (EPA) has analyzed alternative regulations which would control total benzene emissions on a national basis. A significant portion of these benzene emissions is contained in the gasoline vapors released during the normal gasoline transfer operations of petroleum bulk terminals and bulk plants. Possible strategies for controlling benzene in the bulk storage industry include the on-site collection and disposal of gasoline vapors and the collection and transportation of these vapors to a common or central point within the gasoline marketing network for ultimate disposal.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Benzene Emissions Gasoline Bulk Terminals Gasoline Bulk Plants Marine Terminals Service Stations Vapor Recovery Systems Gasoline Marketing	Socio-Economic Factors National VOC Emissions Economic Impacts Tank Trailer Vehicles	Vapor Control Regulations, bulk Gasoline Storage/ Marketing Network	

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