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Floating Storage Object/Off-loading (FSO) as alternative on logistics for the Mexican petroleum company (PEMEX) : analysis after one year of its implementation

Alfredo Parroquin Ohlson
WMU

WORLD MARITIME UNIVERSITY

Malmö, Sweden

FLOATING STORAGE OBJECT / OFF-LOADING (FSO) AS ALTERNATIVE ON LOGISTICS FOR THE MEXICAN PETROLEUM COMPANY (PEMEX) ANALYSIS AFTER ONE YEAR OF ITS IMPLEMENTATION

By

Alfredo Parroquín Ohlson

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DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views and are not necessarily endorsed by the University.

_____

Alfredo Parroquín Ohlson SM 99

Supervised by: _____

Patrick Donner
Associate Professor, Shipping Management
World Maritime University

Assessed by: _____

Rajendra. Prasad
Lecturer
World Maritime University

Co-assessed by: _____

Erik Ranheim
Manager research
INTERTANKO

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ABSTRACT

PEMEX, the Mexican State owned Oil Company has during the last years been facing severe problems on storage and distribution. Bad weather and non-stop production are the main reasons for those problems. Export programs are directly affected increasing the total cost of the operations for PEMEX and its customers.

After extensive research, PEMEX decided to implement a Floating Storage Off-loading system (FSO) in order to increase its storage capability and at the same time install two new loading positions from the same system.

The practice of the international oil players has shown that the FSO system itself is a good choice to prevent and minimise losses arising from distribution activities and to improve the management of oil storage as well. The company believes that the FSO system has been the best choice taken to improve logistics into the organisation's activities.

Nevertheless, in all kinds of industries, external factors always affect the strategies adopted by any company, oil could not be an exemption. Demand and supply fluctuations lead to uncertainty for oil exports. These are linked to prices, which are the most important cause of an oil crisis.

In the case of PEMEX the expected results of the FSO project are not being fully realised yet, which is the result of the current critical situation of the oil industry all around the world. Thus, alternative actions have to be taken in order to take maximum advantage of the implemented project. Any such actions / decisions should take the international trends for the oil market into consideration.

This dissertation is an analysis "one year after implementation" of the FSO system, which has been taken by PEMEX to solve its immediate needs in crude oil storage and distribution. The analysis is linked to the present export activities of the company. This study also focuses on why this kind of project was chosen, what the expectations were and how the project has been affected by external factors. Some commercial and technical alternatives for the short-term future are also analysed from the point of view of the author.

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LIST OF ABBREVIATIONS

Bbls	Barrels
BPD	Barrels per Day
BPH	Barrels per hour
dwt	Dead-weight
EEZ	Exclusive Economic Zone
FSO	Floating Storage Off-loading
	Floating Storage Object = Naval Artifact (legal terms)
GNP	Gross National Product
Km	Kilometres
LT	Long Tons 1,000 = 1,016 MT
MB	Millions of Barrels.
MBD	Millions of Barrels per Day
MT	Metric Tons
NM	Nautical Miles
OPEC	Organisation of Petroleum Exporting Countries
PEMEX	Mexican Petroleum Company
SBM	Sea Buoy Mooring
SPM	Single Point Mooring
ULCC	Ultra Large Crude Carrier
UN	United Nations
USD	United States Dollar
VLCC	Very Large Crude Carrier

CHAPTER ONE

INTRODUCTION

1.1 Background

With more than 80,000 employees Petroleos Mexicanos (PEMEX) is the biggest company in Mexico. Looking at its activities and profits, PEMEX is listed among the "top-ten" organisations of its kind in the world. Based on its extracting and refinery capabilities, it holds a position among the five most important petroleum companies in the world.

i) The company´s organisation

The following bodies make up PEMEX:

- General Directorate: One General Director, he/she is appointed by the state. Also a small team of experienced executive persons is in charge of the development of the whole company. This team headed by the General Director, is responsible for reporting the financial and operational status of the company to the state (as owner of the company).

- Corporate Division: is in charge of administrating the whole company, its activities and economic matters; budgetary allocation to each section of the company. This division also compiles the reports of activities from each body of the organisation.

- Exploration and Production Division: crude oil exploration and production activities are specifically the tasks of this important division. This body is in

charge of the operations related to platforms, supply vessels, helicopters and all personnel involved in such activities.

- Refinery: This body is in charge of managing the activities of the group of refineries for "clean products" such as gasoline, diesel, jet fuel, lubricants, additives, naphtas and pentanes oil products. Also the domestic distribution and marketing of the mentioned products are part of the duties of PEMEX Refinery.

- Gas and Petrochemicals Basic Division: This part of PEMEX has the gas exploitation and petrochemicals production as its main tasks. It includes administration of the plants of production and its activities. With regard to Gas products, this body is appointed to deal with the marketing in the domestic market.

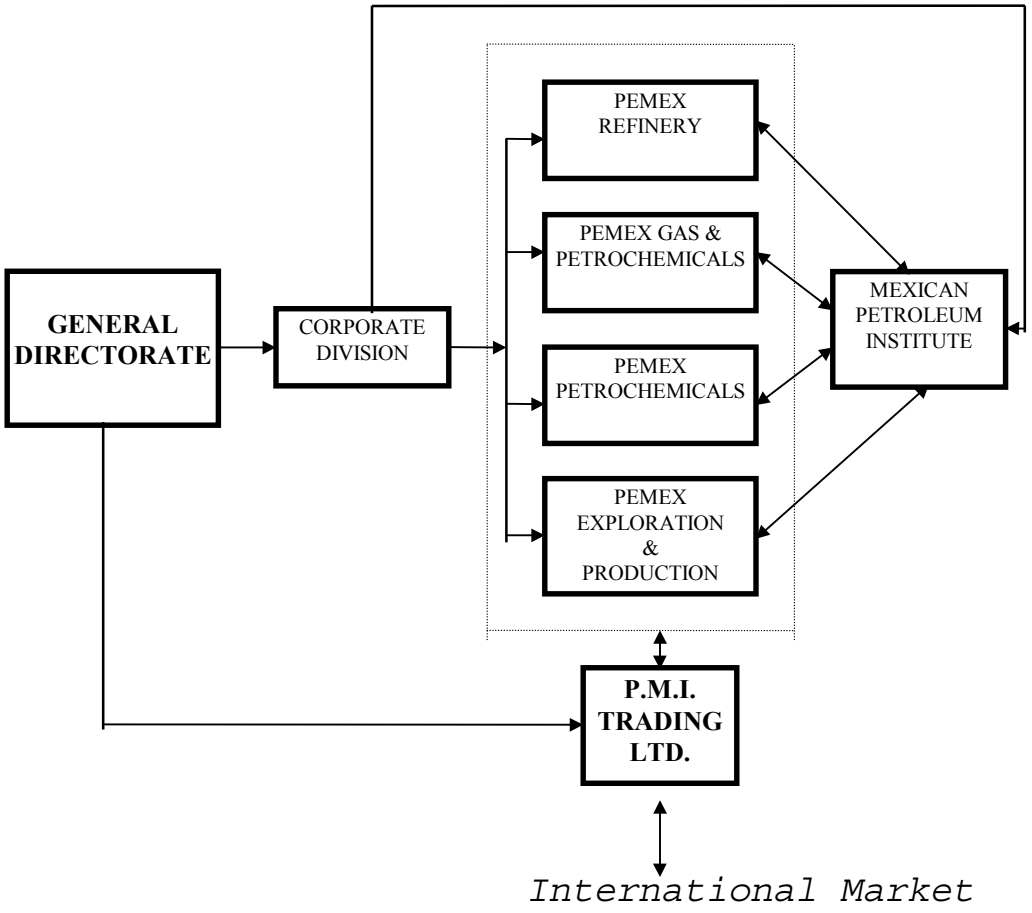
- Petrochemicals Division: The duty of this body is to commercialise and supply produced petrochemical substances of the domestic market.

- Mexican Petroleum Institute: This institute provides to all PEMEX´s bodies technical support on maintenance, research and development of new technologies for exploitation, production and refinery.

- P.M.I. Trading Ltd. (PEMEX International Commerce division): is an affiliated enterprise, created to act as the official trader for the export of crude oil and export / import of petroleum and petrochemical products with foreign countries. P.M.I is managed as a private enterprise, its staff is composed of 250 persons working in different areas such as trading, operations, market risk analysis, chartering, loss control (actual position of the author as analyst), legal,

finance and insurance. The headquarters are located in Mexico City, with subsidiary offices in London, Madrid, Tokyo and Houston.

Figure 1.1: Organisational Chart of PEMEX



ii) Activities

Generally speaking, PEMEX´s activities cover exploration and exploitation of hydrocarbons, as well as storage, trading and distribution for domestic or foreign markets. According to the Mexican national legislation after the national petroleum expropriation in 1938, these kinds of activities can only be carried out

by the state; therefore, by PEMEX, the decentralised public organisation, which was created to deal with such matters. (Mexican Legislation, 1997)

In the first trimester in 1999, the average rate of crude oil production reached 3,132,000 BPD. Almost half of the total daily production 1,484,000 Bbls is destined for refinery, then to domestic distribution and uses, while the remaining 1,648,000 Bbls are exported for international trade via PMI Trading Ltd. In Mexico, crude oil exports alone represent 33 per cent of Gross National Product (GNP).(P.M.I. annual report, 1998)

iii) Strength (reserves)

In relation to the earnings from exports, the most important strength of PEMEX is the quantity of hydrocarbons (oil reserves) it has and their value. The national oil reserves in December 1998 were estimated at: 34,200 MB *proven*; 12,100 MB *probable* and 11,400 MB *possible*, totaling **57,700 MB** of crude oil in a total of 621 oil fields.(PEMEX Press Bulletin, 1999)

The terms *"proven, probable and possible"* are classification categories based on the percentage of certainty in relation to time and technology used to obtain the total quantity of oil found. These calculations should be applied in every oil field and that "certainty" is related to the natural physical characteristics of each oil pool. The numbers shown above come from calculations which were carried out at the end of 1998 according to the "French Petroleum Institute" (IFP) methods, which are used by serious oil companies involved in this practice.

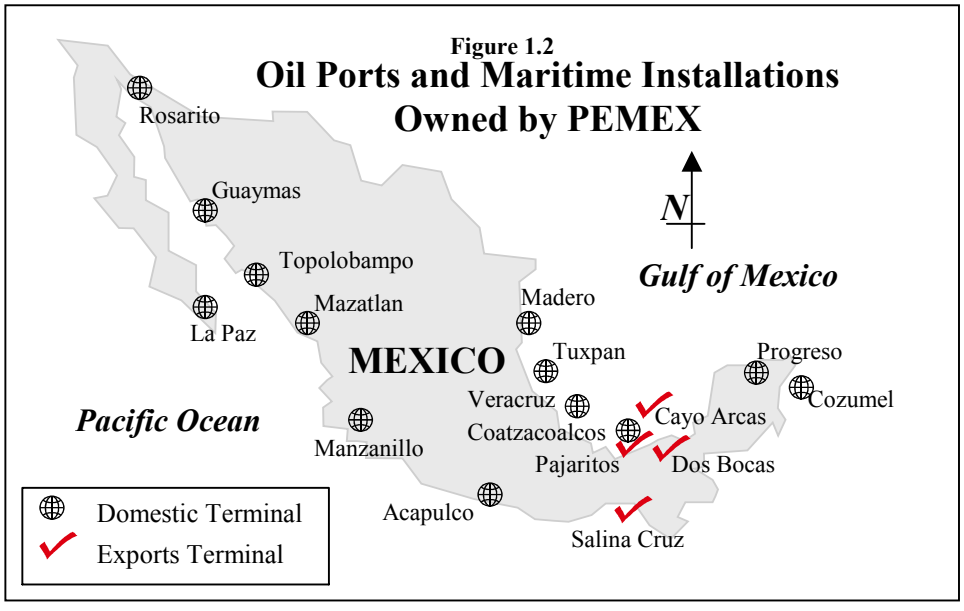
iv) Export facilities

Among the facilities PEMEX holds, the net of maritime terminals is the greatest support for distribution of the production. Those terminals are mainly ports and offshore facilities. The interest of this study involves only the analysis of those terminals classified as "crude oil export points".

PEMEX counts eighteen (18) oil ports and maritime installations along the country´s coastline, but only four are exportation doors, which are along the south coast of the Gulf of Mexico: Cayo Arcas, Dos Bocas and Pajaritos, and Salina Cruz on the Pacific Ocean side. Those four exportation terminals count a total of eight (8) loading positions integrated mainly by Sea Buoy Mooring (SBMs) and some berth facilities. SBM is as known as off-shore terminals as well; it is a "floating mooring point" fixed to the sea bottom. This point / station is capable of receiving a vessel "made fast" to load oil products through the submarine pipelines which link the SBM with the shore.

Those positions for exports serve about 150 tanker vessels per month, which are scheduled for the exportation programs. Production and exports can, therefore, be considered as the main non-stop activities in the day to day development of the country and the major source of national earnings.

Figure 1.2



v) Recent problems

In 1997 PEMEX started facing problems regarding crude oil storage and distribution. The major reason was due to the increasing production of the previous years to sustain the domestic demand, which had increased as a result of the population growth and the country's development. On the other hand, continuous new basins of oil found in the actual fields had led to the development of oil wells in the national Exclusive Economic Zone (EEZ). Therefore, the rate of crude oil production in Mexico has increased during the last two years from 3,022,000 BD in 1997 to 3,132,000 BD in 1999.

Moreover, since the rise in the rates of production has required huge capital investments, reducing production is not an intelligent solution to face storage and distribution problems, due first of all to the domestic demand. Secondly, the closure of oil wells, or a reduction of the extraction pressure due to the lack of storage facilities, is a very sensitive decision to be taken and most of the time considered as the last alternative to avoid losses. The pressure, with which the oil is extracted, has been achieved maybe over several years. To recover it from a fall could take a long time and huge extra costs, causing consecutive losses, could create an economic chaos for the entire organisation.

Another very sensitive reason for PEMEX to reach a solution in storage and distribution logistics is the constant threat of bad weather in the exploitation fields and in the export terminal zones. On many occasions such problems have resulted in losses of millions of US dollars due to the suspension of the exportation program and the necessity of minimum reductions in extraction pressure on the oil pools/platforms for more than 130 hours in order to avoid any personal or environmental disaster through spills.

In order to improve the results of the activities mentioned before, PEMEX decided to implement its first FSO system in 1998 and a second one in September 2000 as an immediate project solution to those problems of logistics, which directly affect the production and export programs. Generally speaking, it is necessary to face the obligation the company has to the country in continuing under development and competitiveness at the same time.

During 1998 PEMEX faced changes in its exports markets. The volume of exports had been reduced; therefore, the number of liftings too. This has affected directly the reliability of the implemented FSO project.

1.2 Objectives

The intention of this document is to do a research on the results achieved after one year of implementation of the first FSO system implemented in Mexico, which has been chosen to solve problems of crude oil storage and distribution activities as an important part of the logistics of PEMEX. Since the author agreed that the FSO system is a good project to improve the logistics in the company, this study intends to of recommend parallel activities to minimise losses, if any and at the same time to demonstrate that the implementation of a second FSO system in the year 2000 is far too early to provide better results, but an unnecessary investment.

The specific objectives of this study are:

- To asses the current procedures and activities for crude oil exportation, taking into account the FSO system already as a part of the infrastructure facilities.

- To study the present exportation programs and to find related alternative activities in order to implement a second project stage holding as a mission to take full advantage of the first FSO project in the future.

- To focus on present external factors from the commercial market, which are affecting the project, and consider the future expectations before a possible solution could be decided.

1.3 Scope and Limitations

This study is limited to assessing the Floating Storage Off-loading system (FSO) as a project solution and what advantages it provides to the crude oil storage and distribution problems in Mexico, what the importance of these problems is, the causes and analysis of what the external factors affecting this project are after one year of implementation. Also a comparison of results with or without the FSO system during the last year is made.

To provide a logical sequence to this study, the structure and activities of the company in mention will be described. Also, why the FSO system was chosen as the best alternative solution is analysed and what a FSO, technically speaking is and its advantages as a project are explained.

Chapter one makes an introduction to the Mexican petroleum company structure, its activities and the role it plays for the national economy. Next, a brief description of the storage and distribution problem PEMEX faced, before undertaking the FSO as a logistics solution, will be mentioned.

Chapter two highlights the management of crude oil production, storage and distribution. It involves rates and quantities of production, tank capacities and

availability of loading positions. All of these focus on the important link of those matters to the performance of PEMEX´s exports program.

Chapter three looks into technical and economic aspects of the FSO project as the immediate solution. What are the advantages, looking for logistics, and how do advantages/disadvantages of the FSO system compared against other studied alternative solutions

Chapter four reviews external factors, which create sensitive inconveniences preventing the company from taking full advantage of the project.

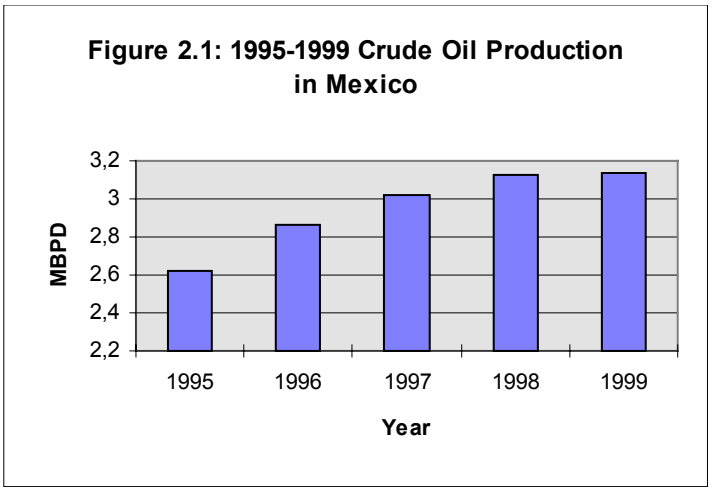
In chapter five, some alternative solutions to take more advantage of the FSO project will be exposed through the conclusions. Also a short analysis and some reflections about the implementation of a second FSO system in the year 2000 will be presented.

CHAPTER TWO

2.1 Production Records and Increases of Production

Despite the present critical situation of the crude oil sales due to the low prices in the world market during the last years, PEMEX keeps its goal to increment the crude oil production at the end of 1999 up to 3,200,000 BPD. That decision was taken even when the main oil export countries including Mexico (OPEP and no-members too) have signed some international agreements on export reductions, as strategy to increase the prices.

The last years facts on crude oil production in Mexico reveal the following figures: 3,022,000 BPD were produced in 1997, 5.7 % more than the 2,858,000 BPD produced in 1996. 1997 was the first year in the history of the company that the production exeeded 3,000,000 BPD. In 1998 the crude oil production grew to 3,127,000 BPD, and lately, during the first trimester of 1999, it reached 3,132,000 BPD (P.M.I. annual report, 1998)



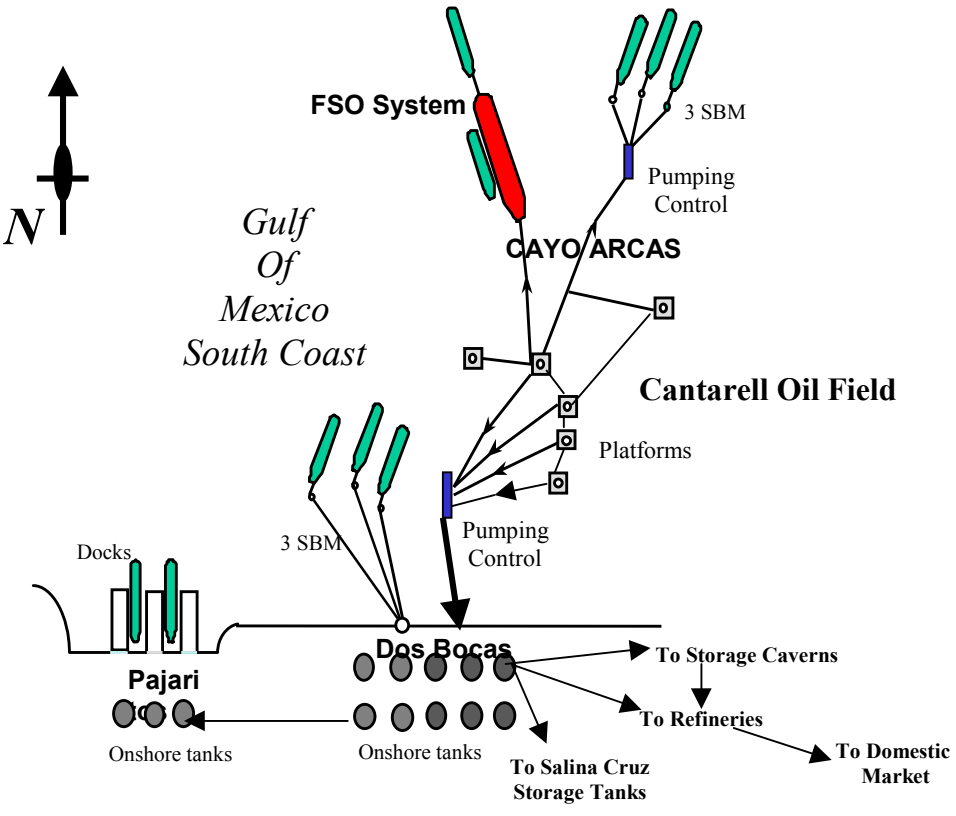
Source: Petroleo Internacional / Julio- Agosto 1999

2.2 Production and Storage Process

In order to better understand the following sections in this chapter, the production and storage process has to be briefly explained. This process means the route the product travels from the platforms to its final destinations.

The major part of the reserves PEMEX can count on, lies on the south coast of the Gulf of Mexico and it is named the "Cantarell" field. This field counts twenty-three (23) production platforms extracting the oil from the basins, which are located under the sea bottom. Six main platforms are directly connected by submarine pipelines to Cayo Arcas, specifically to its pumping station. Individual lines then connect each of the three SBMs and another independent line leads to the FSO system.

Figure 2.2: Production and Storage Process



Also, submarine pipelines link those six platforms to the Dos Bocas onshore storage tanks. An intermediate pumping station is located to control the oil passing through the pipelines. Moreover, the crude oil stored in Dos Bocas is used to serve its three export SBM positions and it is also used to serve the Pajaritos and Salina Cruz storage tanks and the underground storage caverns. Another activity of Dos Bocas is to pump crude oil to the refineries, which are going to distribute the refined products to the domestic market.

2.3 Needs for Storage before FSO system implementation.

In addition to the increase of production explained in the section 2.1, bad weather interfering with the cargo operations was another main reason to expand the availability of storage facilities. The closures of loading terminals due to bad weather became more frequent during the last two years and the time they remained closed has increased dramatically.

Once the product is extracted by each platform, a part is sent straight to Cayo Arcas to serve its three SBMs. Before the FSO system in Cayo Arcas, this offshore terminal did not have storage capabilities. Then, every time the terminal had to be closed due to bad weather, the product was deviated to Dos Bocas, then to the rest of the storage facilities available. As a result of the increase in closure times mainly in Cayo Arcas and Dos Bocas, the practice of deviating the product was not enough to contain the daily production leading to a reduction of the extraction pressure of the oil from the platforms.

Oil cargo operations have to be suspended due to bad weather, but on the other hand the production from platforms do not stop. To diminish the extraction pressure on the oil pools, as has been done in the past, costs huge amounts of money and time to recover the normal rhythm of production.

The pressure with which the oil is extracted is got through the injection of gas or water into the pool / basin. This operation is extremely difficult, long and expensive, but unavoidable. When the injection of water or gas is carried out, it tends to push the oil through pipelines (perforations) straight to the platforms. The platforms are in charge of directing the extracted oil (production) to the designated storage tanks, loading positions or refineries (it depends on whether the oil is for exportation or the domestic market). The pressure of the extracted oil, which was achieved through a long and previous injection process, can be controlled (only reduced) directly on the platforms from a single hydraulic valve.

The longest time a port terminal remained closed in 1997 was 3.2 days (75 hrs), but this time has risen to 5.5 days (132 hrs) in 1998. This fact creates critical situations, which prevent complying with monthly-programmed schedules on crude oil lifting for export, resulting in long losses of time and, therefore money. At the same time that problem means high risk for the company in creating a personal or environmental catastrophe if the oil was spilt due to the lack of storage.

The following table shows PEMEX´s terminal closure records in 1998. It has to be mentioned that the table contents do not consider times of closure due to hurricanes or maintenance from unexpected events, since the number of those phenomenons is not accurate.

In order to get a better idea of the problem, the next page presents the table 2.1: "Terminal Closures", 1998 annual report. Source: P.M.I. Trading Ltd. Loss Control Division annual report 1998.

Gulf of Mexico Terminal Closures Annual Report

1998

Port Terminal	CLOSURES				REOPENING				TIME	
	month	day	hr	min	month	day	hrs	min	hrs	min
Cayo Arcas	Feb	2	7	34	Feb	4	7	30	47	56
	Mar	8	14	30	Mar	9	7	40	17	10
	Aug	31	4	30	Sep	1	7	0	26	30
	Oct	27	9	45	Oct	30	5	30	67	45
	Dec	12	21	18	Dec	14	6	0	32	42
Dos Bocas	Jan	7	15	35	Jan	10	7	0	63	25
	Jan	15	17	5	Jan	17	14	30	45	25
	Jan	20	7	16	Jan	20	14	0	6	44
	Jan	22	23	20	Jan	25	16	0	64	40
	Jan	27	8	35	Jan	28	6	25	21	50
	Feb	2	7	0	Feb	4	7	0	48	0
	Feb	5	14	0	Feb	6	8	25	18	25
	Feb	6	8	25	Feb	7	19	35	35	10
	Feb	20	7	0	Feb	21	6	40	23	40
	Feb	22	9	10	Feb	23	7	10	22	0
	Mar	3	6	0	Mar	4	11	30	29	30
	Mar	8	1	15	Mar	13	13	24	132	9
	Mar	22	10	45	Mar	23	7	0	20	15
	Mar	26	7	0	Mar	26	19	5	12	5
	Mar	31	15	0	Apr	2	7	0	40	0
	Apr	10	9	10	Apr	12	7	30	46	20
	Apr	13	6	25	Apr	14	9	50	27	25
	Aug	30	14	14	Sep	1	22	0	55	46
	Sep	8	6	30	Sep	10	8	50	50	20
	Oct	8	15	40	Oct	11	9	0	65	20
	Oct	21	6	15	Oct	26	9	30	123	15
	Oct	27	18	0	Oct	30	13	15	67	15
	Dec	9	15	0	Dec	10	11	30	20	30
	Dec	11	18	30	Dec	15	12	30	90	0
	Dec	24	23	59	Dec	27	11	50	59	51
Pajaritos	Jan	2	16	0	Jan	3	7	0	15	0
	Jan	15	17	0	Jan	16	10	0	17	0
	Jan	22	21	55	Jan	25	7	0	57	5
	Jan	27	8	0	Jan	28	7	0	23	0
	Feb	2	0	30	Feb	3	7	0	30	30
	Feb	6	12	35	Feb	7	7	0	18	25
	Feb	22	7	45	Feb	23	7	0	23	15
	Mar	8	13	30	Mar	9	12	0	22	30
	Mar	31	15	45	Apr	1	12	0	20	15
	Oct	8	6	0	Oct	10	7	30	49	30
	Oct	21	19	15	Oct	26	7	0	107	45
	Oct	27	20	5	Oct	28	7	0	10	55
	Nov	2	19	15	Nov	3	7	0	11	45
	Dec	9	12	50	Dec	10	7	15	18	25
	Dec	12	5	0	Dec	15	7	15	74	15
	Dec	24	16	0	Dec	27	8	0	64	0

From the previous table we get the following results:

1776 hrs and 33 minutes = 74 days a year of loading operations suspended due to bad weather.

To get a better idea of the main losses of money just due to demurrages arisen from port terminal closures, it is easy to make an approximation of the longest individual closure knowing that US$ 15,000 per day (prorate) is the cost of demurrage for a standard tanker vessel.

Then:

US$ 15,000 x 5.5 days = US$ 82,500.00

US$ 82,500 x 3 positions in one terminal / 3 vessels = **US$ 247,500.00 per day**

To that amount of lost money has to be added also consecutive demurrages (about the same amount), that is during the suspension of loading operations for the first three vessels due to bad weather, another group of three vessels arrived complying with the programmed lay-can. Therefore, they have to wait to be served until the first group of vessels continue and finish their loading operations. In addition to the loss of money, abnormal last minute schedule changes had to be organised.

The continuous production led to the need of storage, if bad weather affected the export terminals. The lack of storage is a serious risk. On the other hand, delays on scheduled sales led to the increase of the final cost of the export operations, which will be reflected in the economic statements of the company parties involved in that trade.

Storage capacities before the FSO system implementation:

Table 2.2: Crude Oil Storage Capacities in PEMEX

Port Terminal	Bbls
Dos Bocas	5,148,000
Pajaritos	1,354,000
Salina Cruz	3,012,000
Domes / Caverns	4,500,000
	Total 14,014,000

After FSO implementation

Cayo Arcas = FSO system	2,300,000
	Total **16,314,000**

Table 2.3: Storage required in case of bad weather

Port Terminal	days of closure	Receiveing Bbls	Required Storage Bbls
Dos Bocas	5.5	330,000	1,800,000
Pajaritos	4.5	350,000	1,600,000
Cayo Arcas	2.4	1,000,000	2,400,000
		Total 1,650,000	**Total** 5,800,000

As was mentioned in the last section, after implementation of FSO in Cayo Arcas, an additional independent submarine line has been built connecting the oil field straight trough the platform to the FSO storage tanks. It minimises the need to reduce the pressure of the production activity. (see Figure 2.2)

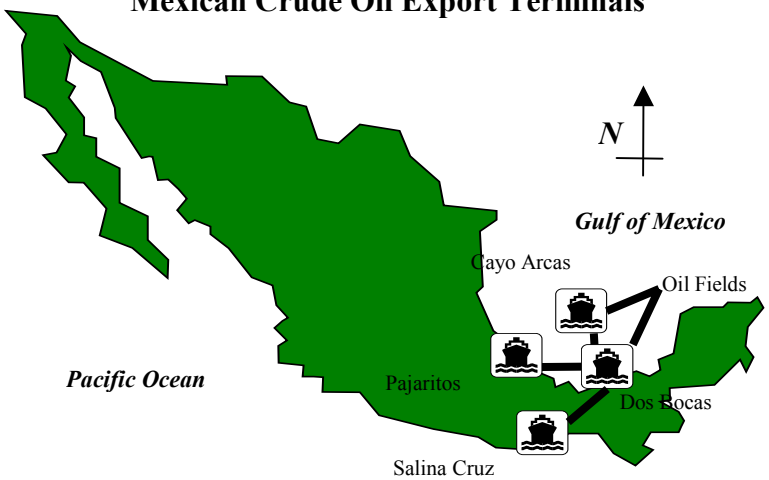
2.4 Net of Loading Positions and Distribution

Loading positions for crude oil lifting play a very important role in the schedule and management of export operations for PEMEX. The net of PEMEX´s export terminals and their positions after implementation of the FSO system are as follows:

Table 2.4: Loading positions availability per maritime terminal.

Terminal	**Positions**	**Liftings per Month**
Cayo Arcas	3 - SBM **2 - FSO system**	46 38
Dos Bocas	3 - SBM	27
Pajaritos	2 - Berths	27
Salina Cruz (Pacific Ocean)	1 - SBM	8
Total	**11 Positions**	**146 tanker vessels**

Figure 2.3
Mexican Crude Oil Export Terminals



The exportation program should consider the number of maritime terminals and the availability of positions, that is docks or SBMs, in order to schedule each lifting, port terminal and quantity of product to be lifted. Tanker size is also considered to determine the loading port/position when the monthly schedule is organised. This is carried out by a crude oil operations department in PMI International Commerce division of PEMEX.

Since bad weather is the most frequent threat to this division, usually on those occasions last minute changes arise, and vessels have to be deviated to other terminals. Deviating a vessel to another terminal is a practice, which has been done as a strategy to avoid losses because of bad weather. It is relatively cheaper than the wasted time, which could be paid due to demurrages.

Deviation costs are usually handled and paid as a common claim. The "Loss Control" department in P.M.I., in co-operation with the Operations Department, calculates this activity. The cost of a vessel deviation will be the difference resulting from the additional distance (if any) to be sailed by the tanker to reach her new destination, in relation to the extra bunkers spent (if any), and the cost based on the daily market price for bunkers. The original distance and costs agreed at the vessel´s nomination, which is accepted by the operations department must be compared. Adjustments of lay-can also have to be considered in order to avoid cosequencial or overlapping charges of demurrage as the case could be. The percentages of the total crude oil export volumes handled per terminal in 1997 and 1998 were as follows:

Table 2.5: Percentage of crude oil handled per terminal.

TERMINAL	1997	1998
Cayo Arcas	43.0 %	44.0%
Dos Bocas	29.3%	32.1%
Pajaritos	22.7%	20.7%
Salina Cruz	05.0%	03.2%
	100%	**100%**

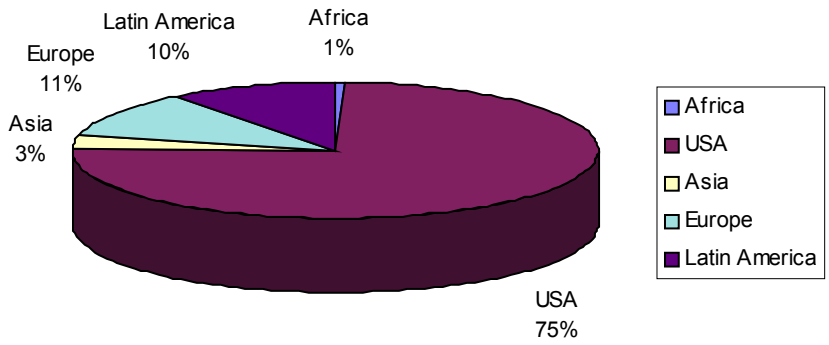
Source: P.M.I. crude oil activities annual report 1997,1998

After FSO implementation the last minute rescheduling is more comfortable due to the existence of the new positions in the FSO and major storage capacity available in each port terminal as an alternative to deviating any ship from terminal to terminal.

2.5 Importance of Exportation Programs

Regarding GNP, exports and the source of energy for the country´s needs, PEMEX is definitively the main strength of Mexico. Focussing on exports, the international trade is linked to at least 30 countries around the world. Moreover, as was mentioned in the introduction of this study, the crude oil exportation alone represents 33 % of the GNP of Mexico. It becomes enough reason to invest efforts and money in order to comply with the export contracts and programs.

Figure 2.4: Crude Oil Export Destinations

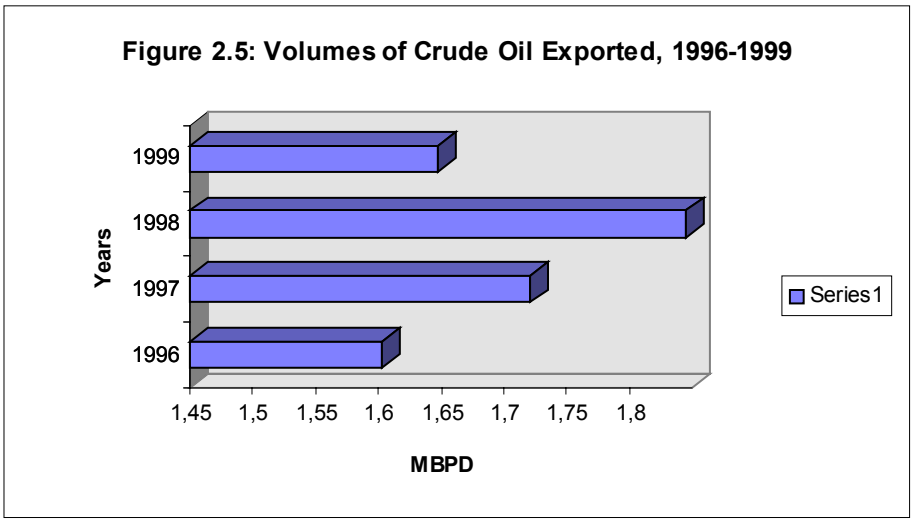


Source: P.M.I. customer files, 1998.

Most of the sales contracts signed between Mexico (through P.M.I.) as "the seller" and the most important customer companies/countries as "the buyer", are based on complying with agreed quantities of crude oil per month, during long periods of time (more than 15 years in some cases).

Those kinds of contracts are called "Forward Contracts", that is, a producing company (PEMEX) will sell today some or all of its future entitlements. The oil may be the production from a specified field, or a certain quality. The volume and basis for changing the volume (if any) are specified, and the period of the contract must be defined. Additional clauses to define responsibilities along the contract period may also be stated. (P.M.I sales policy, 1991)

The development in the market of Mexican crude oil exports in 1997 reached 1,721,000 BPD, which is 11,5 % more than in 1996. In 1998 the production rose again up to 1,844,000 BPD. The first trimester of 1999 the exports were 1,648,000 BPD.



Source: P.M.I. annual reports, 1996-1999

From 1997 to 1998 exports from Mexico were reduced by 325,000 BPD as was agreed by oil producing export countries (OPEC and non-members), who try to control the international supply. That is a collective strategy to increase the prices of the product and minimise losses, in other words "give less for a higher price rather than give more for lower prices". This leads to more earnings.

The decision taken by PEMEX to increase its production against the circumstances explained before, corresponds to the increase of the domestic demand of about 5% from 1997 to 1999. This is easy to understand since the country has shown a 2.2 % average population growth during the same period. Mexico counted to the end of 1997 with above 100 millions inhabitants, this market also means an important income for the company.

CHAPTER THREE

3.0 What FSO is (Origin)

Due to the second closure of the Suez Canal during seven years from 1967 to 1975, world shipping struggled when costs rose to 50% (70% Mediterranean Sea). Regarding the oil market an immediate need of reducing costs of oil transportation via "the Cape" (South Africa) to connect the Indian Ocean to the North Atlantic Ocean, where the main oil markets exist, was the heavy reason to find a solution for this problem.

Looking for economy of scales in cost advantages, much larger vessels suddenly appeared. It gave birth to the first Very/Ultra Large Crude Carriers (VLCCs / ULCCs). The super tanker had arrived. Early in 1967 there was just one ship of over 200,000 dwt in existence, one year later there were 14 (fourteen) and by the year 1973 the number of these vessels had increased to 288 (two hundred and eighty-eight). The increase continued until the oil crisis resulted in a tanker surplus in 1974, that is higher supply than demand for transportation on that kind of vessels.

In addition to the problems mentioned above, the expenses of building and operating those super tankers increased steeply and their cost advantage dwindled as a result.

After an estimated total additional investment of US$ 2,600 millions in about 24 million dwt in oil tanker capacity, some of those giant vessels were moth-balled and may never sail again. Some even made only one voyage; they sailed straight

from the builder's yard into lay-up or were leased as Floating Storage Objects (FSO).

Twenty-five years later, consolidation in the highly fragmented ULCC/VLCC sector is a pipe dream. Nowadays, it is estimated that about 80 companies operate 430 ULCC/VLCCs in the world fleet as carriers. (Fairplay, 1999).

In order to get a better understanding of the main difference that is capacity of ULCCs against other crude oil carriers, the different types of tankers are listed below with dead-weight in descending order:

Table 3.1: Tankers type subdivision per sizes. (Source: PMI tankers data base).

Tanker Type	**Capacity / Sub Division**
ULCC / VLCC	All tankers > 199,999 dead-weight **(LT)**
Suezmax tankers	120,000 to 199,999 dead-weight
Aframax tankers	80,000 to 119,999 dead-weight
Panamax tankers	60,000 to 79,999 dead-weight
Handysize tankers	40,000 to 59,999 dead-weight
Handysize tankers	10,000 to 39,999 dead-weight
Double Hull	Subdivided into tankers with: -Double hull (sides and bottom) -Double Bottom only -Double Sides only
Ore / Oil	All Ore / Oil combined Carriers > 9,999 dead-weight (long tons)
Bulk / Oil	All Bulk / Oil combination Carriers > 9,999 dead-weight (long tons)

3.1 FSO Technical Aspects

The intention of this section is to provide a summary of details in the form of principal technical characteristics of the FSO system.

i) Legal requirements

To comply with the Mexican maritime legislation, in order to integrate and install the FSO system in Mexican territorial waters, it has to be done as a Naval Artifact. Thus, the propeller of the vessel was removed during the conversion works at the shipyard to complete those formalities.

According to the Mexican maritime legislation definition, a Naval Artifact is: *"All floating or fixed structures/objects not destined for navigation, but as a support for maritime activities including exploration and/or exploitation of hydrocarbons*". (MML, 1997)

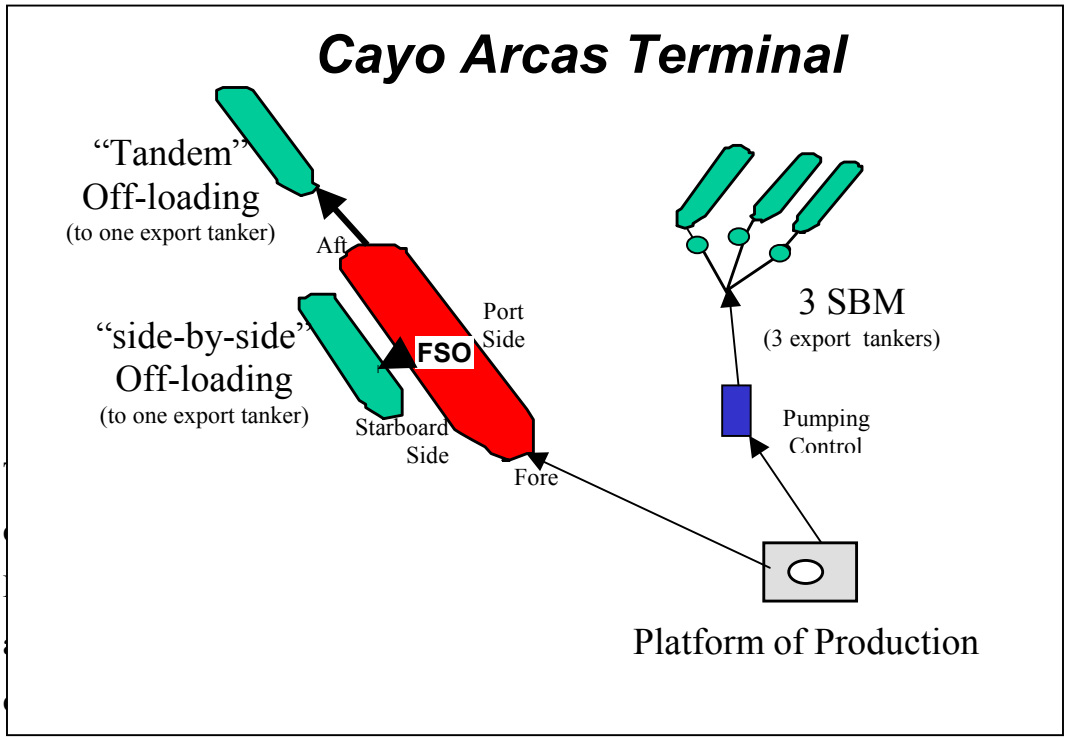
From now on, the converted ULCC, which is integrated as one of the main parts of the FSO system, will be referred to in this study as a Naval Artifact.

ii) Technical Overview

In the case of PEMEX as most of the others, its FSO system consisted of the conversion of a super tanker vessel (350,000 dwt ULCC), the new building of a Single Point Mooring (SPM) system and two 16-inches Flexible Risers connecting the SPM cargo piping system to a Pipeline End Manifold (PLEM) on the seabed and off-loading system. The off-loading system will allow off-loading crude to

export tankers when moored in “tandem” and “side-by-side” to the Naval Artifact (FSO system) both individually and simultaneously.

Figure 3.1: FSO system off-loading on “Tandem” and “Side-By-side”

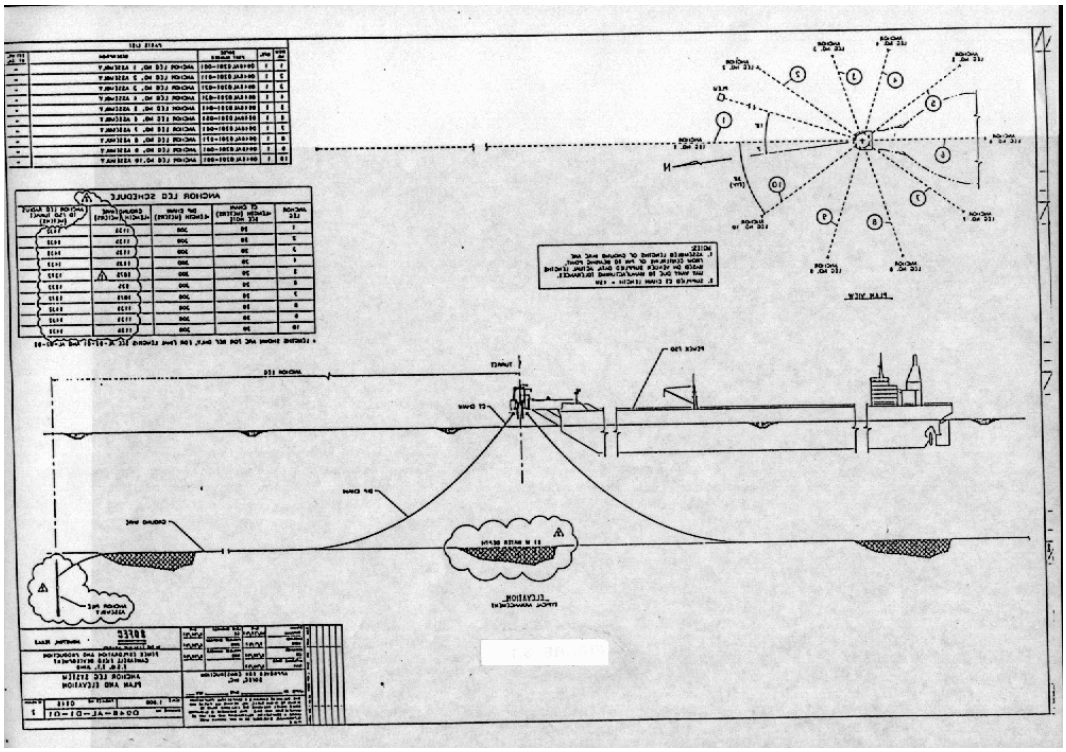


(10) anchors distributed symmetrically every 36 degrees. The Naval Artifact is capable of allowing 2.32 million barrels storage capacity in segregated tanks for crude oil and ballast.

Simplifying the explanation above, the FSO system is mainly integrated by:

FSO system = Naval Artefact (before ULCC) + SPM + two Flexible Risers

Figure 3.2: FSO / SBM positioning system

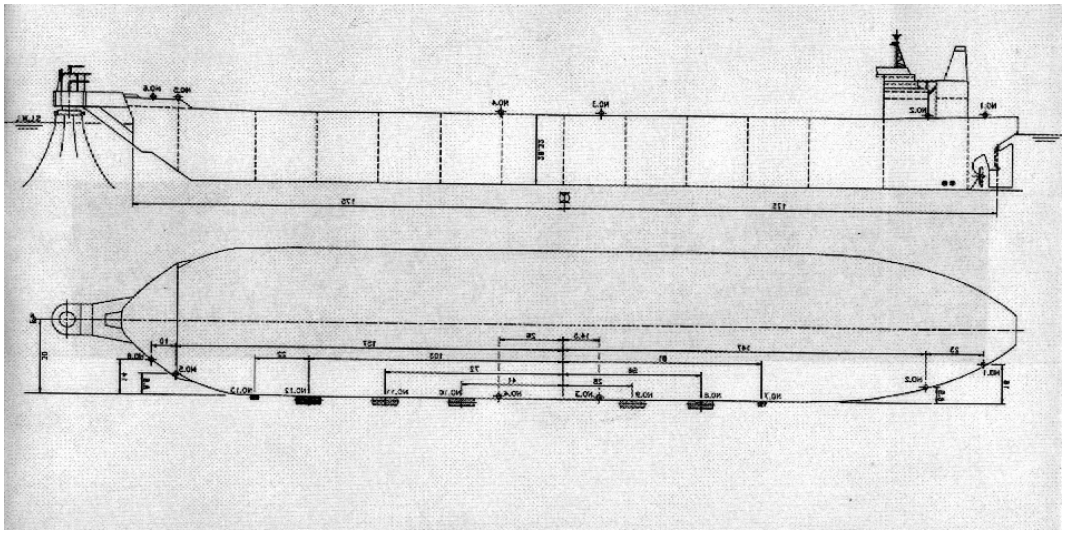


iii) Main Dimensions

The main dimensions of the Naval Artifact are shown in the following Table 3.2:

Length overall	391.60 m
Length between perpendiculars	350.00 m
Breadth	60.00 m
Depth	28.32 m
Distance Bow-Midship	214.22 m
Distance Stern-Midship	177.38 m
Max Draft S	22.35 m
Height from keel to top mast	64.70 m
Dead-weight	349,592 ton
Storage Capacity	2,300,000 Bbls

Figure 3.3: transversal and over view of FSO system.



v) Extreme Design Environment

The extreme environmental condition taken for design of the FSO system is the data associated with a 100-year hurricane storm, that is, the most severe storm observed over a 100-year period is used as a design criterion. The typical data required to properly adapt the system to the location requested are:

- water depth
- tides
- storm tides
- maximum wave height
- period of the waves
- water currents
- 24 hrs mean wind velocity
- gusts duration and velocity

The SPM system was also designed to survive that environment even when the FSO is connected. Under those circumstances, off-loading operations can be carried out simultaneously to one tanker in "tandem" and another in a "side-by-side" positions. In case of heavy bad weather, off-loading operations will be ceased and the export tankers in "tandem" or "side-by-side" released at lower environmental conditions. As was mentioned before, due to legal matters the propeller and steering gear of the ULCC were removed. Nevertheless, considered as a safety matter, two aft lateral propulsors (stern thrusters) remained to help the Naval Artifact in keeping its position and heading even in heavy weather.

v) Export Tanker Criteria

Export tanker sizes are assumed to be accepted due to the FSO system design and purposes:

Export Tanker (tandem mooring):	50,000 to 350,000 dwt
Export Tanker (side-by-side mooring):	50,000 to 250,000 dtw

vi) Production Data

The abilities of the FSO system to receive crude oil from the production fields and to serve it for export tankers are:

- The flow rate and pressure under which the FSO system can receive crude oil from the production field and to store it in its tanks are:

Crude Oil Receiving Rate (maximum):	800,000 BPD
Crude Oil Receiving Rate (normal):	350,000 BPD

- Off-loading Rate to a Single Export Tanker:

  Side-by-side: 80,000 BPH

  Tandem: 55,000 BPH

- Off-loading Rate Simultaneously to Two Export Tankers:

  Side-by-side: 80,000 BPH

  Tandem: 40,000 BPH

  Total pressure under these circumstances 120,000 BPH

- Minimum crude oil storage capacity in order to preserve optimal off-loading operation with the pumps onboard is:

  crude oil minimum storage capacity: 1,750,000 Bbls

vii) Service and Design Life

The service life of the FSO on station can be up to fifteen (15) years from the date of positioning. No planned disconnection for overhaul or dry-docking is required during this period, considering its suitability for the receipt of cargo at all times whilst on station.

Naval Artifact:	15 years
SPM Structure:	20 years
Flexible Risers:	15 years

To assure the life extension a safehull fatigue analysis was carried out and a detailed condition survey of the ULCC´s structure. All other components such as pumps, valves, swivel and hoses. have been designed with enough redundancy to allow replacement or repair without shutting down crude oil receiving, storing or off-loading operations.

3.2 FSO as project solution

Resulting from the last 1997 analysis of the scenarios on the increment of crude oil production and distribution for export programs as well as the increase of lost time and money during port closures due to bad weather, two key questions were discussed:

- Does PMI have enough loading positions to handle the export lifting programs and avoid losses, which have been monitored during the last years because of bad weather?

- Does PEMEX have enough storage capacity to handle the intended increase of crude oil production in normal or bad weather conditions?

Therefore, PEMEX found out that it was necessary to choose an immediate solution approached to the control inventories and increment storage capacities for the coming years, according to the problems mentioned before.

Finally in September 1998, under classification of the American Bureau of Shipping PEMEX incorporated a FSO system permanently moored near the field facilities to increase the storage capacity. At the same time they intended to minimise losses on the exportation programs resulting from bad weather.

The location of the FSO system was decided to be in the offshore terminal Cayo Arcas, one of the three terminals in the Gulf of Mexico. Apart from the fact that Cayo Arcas is a key maritime terminal for export traffic, it is a very important place where the production fields are located. Among other benefits, geographical advantages were also present on that site, since the FSO system is physically protected from bad weather by an island better called Arcas Cay (Cayo Arcas) considered as a "World Natural Reserve" by UNESCO due to the existence of marine birds under threat of extinction.

Geographically, Cayo Arcas is located between Dos Bocas and Pajaritos. This resulted in an attractive idea for possible last minute changes on loading operation. Schedules among the three terminals when any of them could be affected and closed due to bad weather.

3.3 Advantages of the FSO system as a project (logistic point of view)

Generally speaking, after the FSO system implementation the loading positions destined to export crude oil were increased by 40 %. At the same time the storage capacity grew by 75 % (for more details refer to sections 2.3 and 2.4 of this document).

Savings on demurrage payments due to bad weather have been achieved during the first months of the implementation of the new system. The average cost of demurrage per day for tanker vessels lies about US$ 15,000.00. Even when it is related to an "Act of God", 50 % of the time lost will be paid by the terminal and the other half by the owner/charterer; therefore, it means losses for both parties involved.

In this section the main immediate advantages after implementation of the FSO system will be explained.

i) Economic benefits

The acquisition of the FSO system is being made through "Leasing" (Bareboat Charter Basis). The whole project investment was US$ 150 millions. This amount will be remunerated by PEMEX cover the next 10 (ten) years with a charterer´s option for an extension of a further five years. Furthermore PEMEX holds the opportunity to buy the equipment at the end of the agreed charter period.

The contracts identified as a "Lease" intend to ensure that the shipowner´s liabilities are retained by the shipping company instead of the lessee. This brings advantages, for PEMEX as the lessee it means that the project is "off balance sheet" financing. The operator company, PEMEX, did not need capital imput; the company was funded for 100% of the equipment; in addition, the rentals are fully tax deductible as operating expenses.

Focusing on economics, the decision to implement the FSO system was based on a comparison against other possible alternatives, such as to build 6 shore tanks of 500,000 Bbls each on the shore side at the Dos Bocas terminal.

As per the shore tank selection criteria, according to the kind of heavy crude oil to be stored (API Classification), it was found that the type of tanks appropriate to PEMEX´s needs were floating cone roof tanks API Spec 650, with a vapour recovery system. The idea was discarded immediately when the research showed that the costs of construction of those tanks were three times more expensive than the FSO system. The most expensive part of that project was due to the land characteristics designated to allow those new constructions. Further the minimum

life span of shore tanks was found up to 30 or 40 years, which incremented the price of this alternative.

Another advantage of FSO against shore tanks, was that the latter require an additional 250 km of submarine pipelines to connect the loading terminal to those storage tanks ashore and the production platforms on the other side. In addition, three pumps with enough power to serve a pipeline of that length were required for that alternative. The pipeline and pumps mentioned above would have meant additional costs to the six 500,000 Bbls shore tank constructions.

ii) Commercial benefits

Even if the commercial advantages in the oil market will always depend on the international oil prices, the main idea of PEMEX to implement a FSO system for crude oil storage capacity and inventory was the result of a study of a list of situations which represented considerable losses for the company. The following issues are the commercial advantages achieved after the implementation of the FSO system:

- To handle larger and more continuous shipments
- To accumulate volume in anticipation of the export tanker´s arrival
- To meet seasonal peaks in demand
- To handle unavoidable but anticipated events, some of which are emergencies and others that provoke quick and "last minute" changes of schedules on the exportation programs.
- To accumulate crude oil before and during planned maintenance periods
- To meet safety and environmental restrictions as a first class seller.

Another advantage of FSO which reflects attractive commercially speaking, is that an FSO can carry out simultaneous operations, such as receive crude oil from the

production fields to be stored in its tanks; discharge to an export tanker up to 250,000 dwt “side-by-side” and an other export tanker up to 350,000 dwt in “tandem”. For simultaneous off-loading operations the FSO system rate of discharge becomes 120,000 BPH (for further details, of rates of off-loading, please refer to the section 3.1 / vi of this document)

Each loading position provided by the FSO system offers independent measuring and sampling systems in order to quantify the product received or/and delivered at every time during the storage or/and off-loading operation.

According to international practice, the quality of the product for export must be analysed on site by a third party inspector, i.e. Inspectorate, SGS or Saybolt. The samples taken can be verified in the laboratory on board, which is equipped with the most advanced technology to verify any kind of quality analysis related to the product managed.

Under normal practice, three quality inspections must be make: “pre-loading, intermediate and final”, each inspection and analysis usually takes 60 minutes. In this time the time for transportation of samples to the nearest laboratory is included. Time used for those procedures on tankers loading at offshore terminals is often subject of complaints from crews through the better known “Letter of Protest”. The laboratory of analysis facility on board the Naval Atrtifact leads to timesavings for the operations, which is also attractive for customers, commercially speaking.

iii) Speed up cargo flow

Before the FSO system implementation, the exportation program had some limitation to comply with the programmed schedules due to the reasons already explained in the previous chapter. Those main limitations were:

- Diverting whole production to Dos Bocas due to bad weather
- Tanker Congestion at Dos Bocas
- BPD maximum rate at Cayo Arcas
- Lack of storage at Dos Bocas and Pajaritos due to Cayo Arcas lifting programs
- Closure of Dos Bocas due to bad weather resulting in vessel congestion.

Off-loading operations can now be carried out quicker since the number of positions has been increased. On the other hand, the pressure of the FSO pumps permits off-loading in an independent way, providing a larger range of pressure from the shore side to Dos Bocas and Pajaritos. The speed of cargo flow also provides commercial advantages.

The speed of cargo flow advantages due to the FSO system are:

- Increase the pumping rates in Cayo Arcas for lifting programs.
- More flexible lifting program at Dos Bocas
- In case of closure of Dos Bocas terminal, or delays due to unexpected events, vessels can be deviated to Cayo Arcas (two new loading positions) preventing loading delays.
- Increased storage capacity at Pajaritos by not being affected anymore by Cayo Arcas transit.

The speed of cargo flow helps minimising the risk of port congestion, which benefits the net of terminals in the Gulf of Mexico.

iv) Reduce port congestion

The two new loading points available from the FSO system implemented, help to reduce the time of the loading operations and to reduce port congestion, not only in Cayo Arcas where the FSO system is located, but also because additional combinations of loading schedules can be managed by the operations department in PMI, taking in account the two other available terminals, Pajaritos and Dos Bocas, both in the Gulf of Mexico.

Last minute changes of destination for export tankers calling PEMEX terminals are a normal practice within export programs. Since three terminals of similar capabilities are located very near to each other in the Gulf of Mexico, deviating the vessels to load the same product at another terminal becomes a comfortable alternative. This practice is carried out when the closure of one of these terminals is unavoidable because of bad weather. As was explained in Chapter 2 of this study, deviation costs are cheaper than demurrages.

Two new loading positions with availability of storage of products benefit the export program schedules when they are threatened by bad weather.

v) Reduce cost of operation

PEMEX found two alternative solutions to its present needs and problems mentioned before (storage capacity and distribution). Both alternatives, shore tanks and an FSO system were analysed deeply taking into consideration all costs involved which could vary during the service life of the project, they are:

- Forecasts of oil prices and the production records throughout the first years of service of the alternatives.
- Inflation, assuming that the oil price and the costs follow the same trend as inflation.
- The rate of exchange between the Mexican peso and the US dollar
- The production downtime
- The high season demand
- Group corporation taxes and allowances for the alternatives
- Wages of extra personnel required
- Insurance
- Safety installations and the cost of this national certification and licence costs
- Harbour charges or land taxes
- Logistics (helicopters, supply vessels or pumps and submarine pipelines)

The result of the analysis showed that the operation cost of an FSO was more convenient and attractive for the decision-makers in charge of the project. Moreover, the operational costs and taxes of a FSO system through leasing were the lowest against other alternatives. At the same time it was found that leasing reduces costs for maintenance and risks for casualty liabilities.

Talking about shore tanks, their life cycle is from 30 to 40 years, which increases dramatically the costs for maintenance. Moreover, that long period of lifetime did not justify the immediate intensive capital investment required to solve the problems PEMEX was facing.

All those costs are considered apart from the costs of design, material, fabrication, installation and commissioning costs required first for the implementation of any alternative.

vi) Improve competitiveness

Commercially speaking, the two new loading positions for export mean a good advantage for the exportation programs organised by PMI, and for customers as well due to the reasons explained herein below.

Mexico, as many other crude oil seller countries dealing with the United States as a buyer, prefers to manage its sales under international commercial terms and conditions "Free On Board" (Incoterms, 1990). This is to avoid risks over U.S. regulations relating to petroleum product transportation into their territory. In other words, PMI as a particular policy for crude oil exportations, does not charter any vessel to carry crude oil into any port of that country. Therefore, crude oil sales are based on FOB (P.M.I. crude oil sales policy, 1997)

FBO Incoterms 1990 terms and conditions protect the seller in many matters specifying each party´s obligations, generally speaking, licences, authorisations and formalities at the port of discharge/import (U.S. in most of the cases, see section 2.5 of this document). The vessel has to be chartered by the buyer and the transfer of risk of loss or damage of the product pass to the buyer at the time the product has passed the ship's rail at the loading port. Definitively all these matters increase the total costs of the trade for the customer. (Incoterms, 1990).

On the other hand, following the laytime clauses stated in the sales contracts of PEMEX, the time allowed for loading up to 350,000 Bbls is 36 hrs. Laytime for tankers according to Asbatankvoy 1977 starts to count six (6) hrs after "Notice of

Readiness" or when "All Fast" whichever occurs first. Vessels loading crude oil from the FSO system reduce the time used for loading operations by about 8 hrs, avoiding in many cases to fall on the expensive demurrage costs increasing the trade cost as well.

Since the customer's main interest is focused on satisfying its needs with minimum cost, more loading position availability and reduced time for loading operations can be considered as an optimisation or aim to better organise the related activities. It attracts the customer´s attention focused on minimising costs through avoiding waiting time in anchorage positions due to port congestion and also avoids demurrages due to higher pumping rates from the FSO system. In logistics this is called "improvement of level of the service provided". It will place the company at a competitive advantage, providing speed to the customers, reliability and availability. All this is important in the international oil market.

Iossif Voutsinos, Chief Deck Officer of M/T "SKIROPOULA" stated that they (crew) were often calling the Mexican oil terminals of Pajaritos, Dos Bocas and Cayo Arcas and compared to other terminals in South America we found in Mexico very quick pumping rates and reduced time of loading operations. The only disadvantage those terminals have is the geographical location. Off-shore terminals are situated in a "very open sea" then very high intensity winds in combination with medium size swells provoke serious problems for the loading operations. If implementation of FSO system in Cayo Arcas is able to avoid that inconvenience, I think the loading terminals of PEMEX would be the most competent and competitive in the area.

vii) Reduced time for implementation

The decision to implement a project for immediate solution, was in PEMEX´s view to solve its present problems. Since there was no specific focus on a future strategy, the short time for implementations of the FSO system was the most attractive to the company according to those immediate needs.

The conversion of the ULCC into a Naval Artefact took about eleven (11) months in ship yard work and on site installation (mooring work) against the minimum two (2) years the shore tanks project should take for their construction.

viii) Improve stable surplus schedules

The new storage capacity helps PEMEX to link demand, supply and requirements with production capabilities. Storage inventory is required for any company of this size to balance its supply capability and market demand. The demand of crude oil used to be very volatile; unfortunately, crude oil can not be produced just in time in order to serve any level of market demand.

Clear examples are the costs of increasing production capacity at peak periods, which is very expensive. The new storage capacity available from the FSO system allows PEMEX to fully comply and improve its stable supply as well as meet the demand changes due to seasonal peaks.

Even when the oil market changes all the time in volume, quality and price, more storage capacity will always help PEMEX to protect itself by holding inventory of supplied products. Another reason for inventory is previous sales, which are

scheduled in terms of the number of export tankers with the programmed quantity to be exported.

In the past, during seasonal peak demand periods, such as the additional winter demand of North America, the lack of storage required additional money and time investments to be made in order to increase the production capability. Those costs are expected to be reduced due to the larger storage capacity now in service.

Now, it is possible for PEMEX to maintain a relatively stable work force and produce at a constant level throughout a short period of time creating a significant inventory, which becomes useful at various times during the year.

The possibility to hold inventory in key points for instance in the export terminals, gives a very wide margin to PEMEX in the efficient organisation of export programs, and a higher percentage of certainty in their competition. Complying with schedules brings benefits of time and money savings.

ix) Improved management through investment

The investment appraisal of PEMEX in this project was not looking for a "pay-back time" of the capital invested through more sales of oil. It is clear that the main intention was focused on minimising losses by taking advantage of the project.

The advantages that the FSO system provide to PEMEX are:

- Allowing the company to improve the actual management of its sales
- Cost benefits implementing new facilities, which provide cost savings.

- Possibility of expansion of the business (in oil industry this possibility will always depend of the international market behaviour)

CHAPTER FOUR

4.1 External Factors Affecting the Project

In the previous chapter it has been shown why the FSO system is a very good alternative as a project. Unfortunately, in every kind of market external factors affect the reliability of any industry, the companies involved and their implemented projects. The oil industry is not an exception.

After considering the FSO system as the best choice, PEMEX should choose to solve its problems; the external market environment affecting it could not be will forgotten. In this section events which have been the key to the oil market uncertainty through the years, will be mentioned as main threats the FSO project in Mexico.

i) Background to the present critical situation of the oil market

For the oil industry things have not been easy for a long time. Different events in the world led demand and supply to change dramatically due to price fluctuations, which have affected the oil industry directly.

The oil industry in the world has experienced enormous changes in the last decades. This started when in 1970 the oil producing countries (through OPEC) managed to establish a system of consensus for collective actions. The prices of oil went upward and the revenues per barrel of the involved countries increased substantially.

In late 1973, the oil producing countries began to exercise control over the quantity of oil output. This production control adversely affected the world energy

consumption rate, thus leading to the first oil crisis that resulted in tremendous changes to the world's international oil market system. The effect of those actions has remained as a pain for the oil industry up till now. OPEC played a very important role in these events, when after 10 years of its inception, it started to control the output of oil of member countries in 1970.

The prices of oil had risen by 400% between 1973 and 1974 when the first oil crisis arose, while in the years between 1979 and 1981, due to the second oil crisis, it reached another peak of 161% increment.

The formation of OPEC has adversely affected the crude oil prices as the organisation began putting restrictions on crude oil trade. In 1960, the oil producing countries decided to form an organisation of petroleum exporting countries (OPEC). Today this organisation is comprised of Saudi Arabia, Kuwait, Iran, Iraq, United Arab Emirates, Libya, Nigeria, Venezuela, Indonesia, Algeria and Qatar. The aim of the organisation is to protect their own interests in the oil revenues. This prevented oil companies from manipulating the posted prices of oil at their own free will.

OPEC participation in the oil market has made history; it can be seen in some of the actions taken by this organisation for almost twenty years:

- February 1971. - OPEC posted a price 30 cents per barrel under competitor´s prices.
- January 1973.- OPEC increased the posted price of oil by 70 % (due to the member governments request of 25 % interest in the producing properties)
- January 1974. - OPEC more than double the new posted price. (Member governments requested 60 % interest in production properties, tax rates rose to 85% and royalty raised to 20 %.)
- October 1975. - OPEC increased the price per barrel by10%.

- July 1977. - OPEC members selling prices reunified at US$ 12.70 per barrel.
- December 1978. - OPEC states its intention to raise the price by 14.5% in 1979 by quarterly adjustments.
- March 1979. - OPEC telescoped a total 1979 increase of 14.5% into the first quarter raising selling the price to US$ 14.55 per barrel.
- December 1979. - Saudi Arabia raised the price to US$ 24.00 per barrel, retroactive from Nov 1st, after breakdown of OPEC price unity and a series of individual members increases.
- May 1980. – S. Arabia set prices at US$ 28.00 Bbl retroactively from April.
- August 1980. - Saudi Arabia raised prices to US$ 30.00 per barrel.
- November1980. - Saudi Arabia raised prices again to US$ 32.00 per barrel.
- October 1981. - OPEC agreed to set crude oil prices with the market at US$ 34.00 per barrel.
- March 1982. - OPEC agreed for the first time to establish a production ceiling, fixing the total at 17.5 million barrels per day.
- March 1983. -OPEC agreed the first reduction in prices fixing crude at US$ 29.00 per barrel and reducing production for 1983 from 18.5 million barrels per day set in December, to 17.5 million barrels per day.
- September 1985.- OPEC presided over the destruction of official prices and the promise of an unparalleled decrease in revenues.
- January 1991. - “Desert Storm” military operation liberated Kuwait and with the concomitant selling of emergency oil stocks in the USA and Europe oil prices fell to pre-crisis level. (Exxon, 1998 and BP, 1992)

Apart from the OPEC conflicts related to the uncertain ways to calculate the cuts of production and the lack of trust among its members on the production agreements, other aspects have helped to keep up till now the crisis situation for the oil market:

- The return of Iraq in 1997 to the group of OPEC with 600,000 BPD
- The fall of the oil prices in the world due to over production
- Manipulation of oil market from big refinery players
- False estimations (speculators) on supply and demand
- The factor of the Ex-Soviet Union as an essential key for the oil market.

Some situations shown before could appoint OPEC as "the blame" of the actual crisis. Globally speaking the point now is that even if inflation rates never have been low, this time inflation has turned into a worse world-wide phenomenon that seems to stay forever. Current views about the oil market in 1999 offer little joy to oil companies. The only development that would be good for those companies would be a strong revival of demand.

ii) Reflections of the current oil market situation on PEMEX and its FSO system project.

The FSO system, which was implemented in late 1998 for PEMEX, is being affected directly due to the international agreements to control supply by cutting production and exportation. The main intention of PEMEX with the FSO project was to provide better management of the distribution and storage operations involved with the export programs. The addition of the FSO system to the company's net of export terminals, provided PEMEX with two new loading positions and a larger storage capacity of 2.3 millions of barrels. These new facilities could be considered to be "in addition" when the number of liftings and volumes has been cut.

The last revisions of the world demand of oil have dropped the demand by a further 600,000 BPD. On the other hand, prices of oil fell dramatically once again in 1998. Regarding the Mexican grades, they were receiving US$ 15.70 per barrel

in 1995, US$ 18.94 per barrel in 1996, US$ 16.46 per barrel in 1997, but only US$ 10.75 per barrel in 1998.

Followed by those prices, the earnings received by PEMEX through crude oil exports were US$ 7,500 millions in 1995, US$ 10,700 millions in 1996, US$ 10,300 millions in 1997, but only US$ 1,800 millions during the first trimester in 1998. Nevertheless, the Mexican oil is placing its prices at about US$ 16.00 for the second trimester in 1999. (P.M.I. crude oil sales report, 1995-1998)

There have been several meetings between the governments involved regarding the day to day running of the industry and petroleum price changes depending on the market forces of demand and supply, whenever the governments of the main oil producing countries want to change the prices of oil in order to increase their revenues.

Thus, having reviewed the present situation of the oil market, OPEC agreed to make reductions in oil production of member countries (excluding Iraq). Mexico is not a member of that organisation. Nevertheless, like other non-members countries (Norway, Oman, Russia, Egypt, Yemen and China) Mexico is also interested in the oil market situation and decided to participate in making reductions, not to its production, but to its exports.

There were three earlier agreements organised by OPEC and interested countries. The first agreement was reached in March of 1998 where Mexico agreed to reduce its exports by 100,000 Bbls per day, the second in June of the same year with an additional reduction of 100,000 Bbls per day. The third and last agreement was made in March 1999 through the 107th Meeting of the OPEC Conference in Vienna, Austria, states:

OPEC Press releases No.2/1999 March 23. – "Hailing the new spirit of co-operation prevailing within OPEC and between OPEC and non-OPEC producers, the Conference also recorded its deepest appreciation to the co-operation extended by the esteemed Governments of Mexico, Norway, the Sultanate of Oman and Russia in pledging additional cuts of 125,000 BPD, 100,000 BPD, 63,000 BPD and 100,000 BPD, respectively, being these countries contributions to the steps being taken to restore prices to acceptable levels". (OPEC press release, 1999).

The following table shows the total cuts agreed by OPEC members as well as the participation of non-members countries, which was effective from 1 April 1999 and valid for one (1) year. Mexican participation in the OPEC agreements is based on reduction of exportation:

Table 4.1: Final numbers after OPEC 3rd agreement on cuts of production

OPEC	**Production to Feb 1999**	**Agreed Cuts**	**% of the participation**
Saudi Arabia	8.760	1.310	15.0
Algeria	0.868	0.138	15.9
U Arab Emirates	2.382	0.382	16.0
Indonesia	1.380	0.193	14.0
Iran	3.925	0.569	14.5
Qatar	0.700	0.107	15.3
Kuwait	2.205	0.369	16.7
Libya	1.453	0.226	15.6
Nigeria	2.258	0.373	16.5
Venezuela	3.370	0.650	19.3
Subtotal	**27,301**	**4,317**	**15.8**

No OPEC

Mexico	1.84	0.325	17.6
Norway	3.26	0.200	6.1
Oman	0.90	0.111	12.3
Russia	6.14	0.100	1.6
Egypt	0.84	0.030	3.6
Yemen	0.37	0.010	2.7
China	3.10	0.150	4.8
Subtotal	**16.45**	**0.926**	**5.6**

TOTAL	**5,243**

Source: OPEC Bulletin, June 1999

According to Lloyd's Shipping Economist: "Supply has been vanishing, non-OPEC supply in 1998 declined by 1.8 millions BPD in the 12 months from December 1997. Only 10% of this can be attributed to the participation of Mexico and one or two others in the co-ordinated production/exportation cuts, while under 20% can be attributed to low prices. The rest is result of disruptions or start-up delays, for which there was no advance provision". (Lloyd's Shipping Economist January, 1999)

Considering the current situation of the market and its perspectives to April 2000 it can clearly can be seen that PEMEX is not taking proper advantage of the project and the investment put in it.

CHAPTER FIVE

5.0 Conclusions

Since the fluctuation of the oil demand and supply can not be avoided, it makes the evaluation of the FSO project over its life time difficult, that is 10 to 15 years. the main interest of the author concerns only short term future conclusions and recommendations.

5.1 One Year after FSO system Implementation (intentions against results)

Investing in the FSO system made PEMEX feel confident in getting successful results of the investments. The first result achieved after the project implementation was the reduction of demurrage costs per annum. After one year of implementation of the projects the results have shown that costs of demurrage paid by the company were reduced by about 15 percent in relation to 1997 and two trimesters in 1998 when more than US$ 1,200,000 were paid to oil buyers for delays.

If demurrage expenses were reduced in one year by almost US$ 200,000, the waste of resources due to unutilised space became more expensive. It is clear that spending money to save time was not the best solution at this time under the present situation of the market.

After FSO implementation, PEMEX drew up future scenarios involving the number of liftings, which could be served, considering the two new positions and

the availability of products by increased storage capacity. However, as a result of the international oil market behaviour, the reality dropped other results.

The following series of tables show the utilisation of the export facilities PEMEX holds. The standard volume loaded per any export vessel is calculated on 350,000 Bbls

Table 5.1: Utilisation of loading positions in 1997.

Year	Monthly Export BPD	Vessels Served per Month	Positions Available	Vessels Served per Day	Unutilised Positions per day
1997	53,351,000	152	8	5	3

In 1997 a huge amount of money was paid due to demurrages even when 3 unutilised positions were available to load. This is because the lack of storage capacity PEMEX was facing. The vessels had to wait for the right position where the crude oil was located.

It should be mentioned that one of the unutilised positions is in Salina Cruz, the export terminal on the Pacific Ocean side. This terminal is specifically used for sales to Asia and its sales have been reduced by 1.8% since the Asiatic crisis. The only SBM available in this terminal remains serving occasional liftings for sales to that region.

In the period of September 1998 to June 1999, after FSO system implementation two new positions are available. The program of lifting has been as follows:

Table 5.2: Utilisation of loading positions after FSO implementation.

Year	Monthly Export BPD	Vessels Served per Month	Positions Available	Vessels Served per Day	Unutilised Positions per Day
1998 to 1999	51,100,000	146	10	5	5

During this period after FSO implementation, the money paid due to demurrage was reduced by 15%; but on the other hand, it can be noticed how the number of unutilised positions increased from 3 to 5 per day.

The contract of payment for FSO leasing has not changed. The system is complying with its functions of providing storage capacity and two new loading positions to the network of export terminals of PEMEX. Unfortunately, it is clear that the expected advantage is not being taken due to the market situation.

This situation will remain at least until April 2000, when the validity of Mexico´s compromise with OPEC to reduce its exports will end. If the market situation continues at least as now (to September 1999), Mexico will increase its exports by 325,000 BPD for the first trimester in 2000. The probable situation under those conditions could be as follows:

Table 5.3: Minimum utilisation of loading positions for April 2000

Year	Monthly Export BPD	Vessels Served per Month	Positions Available	Vessels Served per Day	Unutilised Positions per day
2000	61,163,000	176	10	6	4

This is the best of the scenarios, which could be expected in the near future. The rest will depend on the change in demand. In this last table it can be observed that the results in the two last columns are quite similar to the results shown in Table 5.1 for 1997, but the difference is 2.3 millions more of stored oil available. It gives the flexible opportunity for export programs to be managed as was expected when the FSO system was planned.

In addition to the new storage capacity in Cayo Arcas, the availability of 3 empty positions a day (not including Salina Cruz) in different locations in the Gulf of Mexico terminals is something in the range of what PEMEX expected after implementation of FSO in 1998. These two advantages combined led to a more reliable management of loading operations and losses because bad weather could be avoided.

5.2 Alternatives for the future

The range of positive alternatives to achieve the advantages of the FSO system in the future is very limited. Nevertheless, some situations should be considered. They are going to be briefly explained herein below.

i) Changes in the market

As was mentioned at the end of the previous chapter one of the solutions which could lead PEMEX to take full advantage of its FSO project, could be a strong revival of the demand. Nevertheless, the oil market is synonymous with uncertainty. It is not possible to forecast when the diminishing demand and the vanished supply will turn in the producers favour.

Looking into recent market reviews, Asia has been a driving force behind the world´s demand during this decade. After its recent crisis, the player´s expectations do not predict Asia to recover its economical normality soon; therefore the normality for the whole market. According to some researchers although there is now some faint light at the end of the tunnel regarding Asia´s financial crisis, it is premature to expect this to translate to a return to pre-crisis growth rates and most other regions still have economic storm clouds hanging over them. (Lloyd´s Shipping Economist, January, 1999)

As a result of the OPEC cuts, this second trimester of this year the crude oil market has shown a short recuperation in the balance of supply and demand. Even though the expectations for the next trimester are that crude oil prices will continue to rise, it does not solve the situation of the FSO profitability.

To wait for a change in the market to find increased operational activities for the FSO system and to take more advantage of it, is not an intelligent decision.

ii) Short term future

Being more realistic in the short run, from now on there are seven months ahead to finish the agreement Mexico has on reducing its exports; so, the worst of the scenarios could be the one explained above in Table 5.3 for the year 2000. In April of next year, Mexico will add 325,000 BPD to its daily exports. Then, automatically the number of liftings will increase from 146 to 176 per month, which could provide utilisation for the wasted positions.

iii) Commercial parallel activities.

Waste of resources or lack of operation for available loading positions is taking place after the FSO implementation. Parallel commercial activities could be an alternative to be taken in order to utilise the loading positions available.

Mexico used to import large amounts of gasoline. In 1998 PEMEX spent US$ 2,600 millions on gasoline imports. Since the country, which is selling that product to Mexico, is also a potential buyer of crude oil from PEMEX, the proposal of the author is to pay part of the invoice due to gasoline imports through volumes of crude oil, that is "Crude oil for Gasoline".

The volumes of crude oil used to pay for other products coming to Mexico would not be included in the export rates. Under this practice the number of crude oil liftings would increase, reducing waste of capital to PEMEX on its FSO system due to unutilised facilities.

This proposal could sound as an abnormal activity, but the reality of the world trade suggests that this practice has been done successfully by some of the players in the market to solve their needs. An example of this, is the agreement reached by USA and Iraq, when despite repeated intransigence over the UN arms inspection programme and consequent US military brinkmanship, the "oil-for-food" deal was swiftly renewed for a second time at the end of 1998. (Lloyd´s Shipping Economist, January, 1999)

The division in charge of those activities could be P.M.I., the PEMEX´s divison in charge of the trading of its products. This division is also in charge of importing gasoline to the country, so it will be easy to settle those payments, "invoice against invoice".

Since gasoline prices are much more higher than crude oil, it would led PEMEX to having a wide marging of activities of extra crude oil liftings in order to pay the imports of gasoline.

Commercial activities like this explained above could tend to minimise the waste of investment that the FSO means for PEMEX at present.

iv) A second FSO system implementation

According to PEMEX´s General Director semestral report, the company would soon release a tender for a second FSO system to be implemented also at Cayo Arcas in September 2000. The plan is to get it under the same contractual conditions as the first one. The characteristics would be the same, that is about 2.5 million of barrels new storage capacity for crude oil, plus two more loading positions. (PEMEX Press Bulletin, 1999)

Regarding the intention on the number of liftings and barrels to be exported to April 2000, this could carry more losses to PEMEX due to more unutilised facilities through new agreement compromises, like another 10 year leasing period.

Table 5.4: Utilisation of loading position in case a second FSO system were implemented.

Year	Monthly Export BPD	Vessels Served per Month	Positions Available	Vessels Served per Day	Unutilised Positions per day
2000	61,163,000	176	12	6	6

Table 5.4 shows results on "waste of facilities" if a second FSO system were implemented. The number of positions would increase to 12, while under the best of the market scenarios the rate of oil for export in April 2000 will not be higher than 1,973,000 BPD, so the number of empty loading positions will increase to 6 per day.

Clearly, it can be understood that the implementation of a second FSO system is not justified at all. The criteria is based on the comparison of the range of activities PEMEX is able to hold in relation to the investment requested for a new project of that magnitude.

5.3 Recommendations

It have been seen that not only PEMEX is undertaking this kind of project as a part of logistics to solve problems on storage and distribution. Industry sources say there are much more than 300 million barrels of oil being held off-shore in tankers (FSO) The physical cost is steep: about 20 cents/Bbl/month. In addition, more and more tankers are being chartered for storage. Faced with brimming onshore storage facilities, the oil industry has increasingly turned to this option.

The option to choose an FSO project was good. The project itself guaranties good management and reliability of the investment in many aspects such as logistics, commercially speaking, low operating costs, and short time for its implementation. Unfortunately, "when" the decisions were taken had a great influence on the success of the project. In the oil market it is, not possible to know what is going to happen. Since the conditions of the market can change at any given moment, any decision taken, whatever it is, for instance a project or trading game strategies, it could become an "early or premature" decision and give the opposite results to those expected.

Regarding PEMEX´s case in the FSO implementation, a lot of efforts, time and huge investments were required for this project. Finally, in relation to the amount of money saved or generated, the project can be labelled as a very premature decision taken.

The idea to implement at a second FSO system in the next year should be discarded completely or at least postponed. It is not a good idea when intending to justify the investment through its activities and new implementation could bring serious economic problems.

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