DETERMINATION OF ENVIRONMENTAL PROBLEMS OF THE TRANSBOUNDARY PIPELINE AND APPLICABLE NATIONAL AND INTERNATIONAL LEGAL FRAMEWORK

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
THE MIDDLE EAST TECHNICAL UNIVERSITY

BY
YAMAÇ GÜNEYLİ

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE
IN
THE DEPARTMENT OF PETROLEUM AND NATURAL GAS ENGINEERING

AUGUST 2003

Approval of the Graduate School of Natural & Applied Sciences

Prof. Dr. Canan Özgen
Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science.

Prof. Dr. Birol Demiral
Head of Department

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

Prof. Dr. Turgut Turhan
Co-Supervisor

Prof. Dr. Ender Okandan
Supervisor

Examining Committee Members

Prof. Dr. Ender Okandan

Prof. Dr .Turgut Turhan

Prof. Dr. Nurkan Karahanoğlu

Prof. Dr. Birol Demiral

Prof. Dr. Fevzi Gümrah

ABSTRACT

DETERMINATION OF ENVIRONMENTAL PROBLEMS OF THE TRANSBOUNDARY PIPELINE AND APPLICABLE NATIONAL AND INTERNATIONAL LEGAL FRAMEWORK

Güneyli, Yamaç
M.Sc., Department of Petroleum and Natural Gas Engineering

Supervisor: Prof. Dr. Ender Okandan
Co-Supervisor: Prof. Dr. Turgut Turhan

August 2003, 152 pages

Regarding historical tendency and today's future estimations, the global demand of petroleum is expected to reach a huge amount and this will be supplied by fossil fuels. Turkey's geographic location will make it an optimum route for transportation between the energy-rich Caspian regions, and the energy-consuming nations of Europe. Therefore, the transboundary pipeline, the most efficient means of transporting large quantities of hydrocarbons across long distances over land, will gain importance and the decision of a route through Turkey is a logical selection. However, despite all the security measures, pipelines have caused much significant environmental pollution due to accident, intention or negligence. Law is the major applied tool for compensating this environmental pollution and for determining the liable person or organization.

According to international law, the rights and obligations of the source State and potentially affected states should be defined in such a way that all transit states can proceed with their operations. Moreover, the source state acts in compliance with its international obligations and adopts the necessary regulations in order to safeguard that the person in control of a potentially harm-causing activity has to bear the costs of additional measures to comply with those regulations. However, if the source state acts in violation of its international obligations, not the person in control of the activity but the state would be primary liable *ex delicto*. Equally significant, Turkey requires some changes in the existing laws and additional new regulations for constituting more effective Turkish Liability law and being a reference source for internationally liability law. Regarding hazardous facilities, Turkey needs some common provisions to derive new solution possibilities and to identify some criteria for cases in the future.

Keywords: Transboundary pipeline, Petroleum pollution, Liability law

ÖZ

SINIRAŞAN BORU HATLARINDAN MEYDANA GELEN ÇEVRESEL KİRLENMENİN BELİRLENMESİ VE UYGULANACAK MİLLİ VE MİLLETLERARASI HUKUK

Güneyli Yamaç
Master, Petrol ve Doğal Gaz Mühendisliği Bölümü

Tez Yöneticisi : Prof. Dr. Ender Okandan
Ortak Tez Yöneticisi : Prof Dr. Turgut Turhan

Ağustos 2003, 152 sayfa

Tarihsel sürece ve bugünkü tahminlere göre, dünya petrol ihtiyacı büyük miktarlara ulaşacak ve bu ihtiyaç fosil yakıtlarından sağlanacaktır. Türkiye'nin jeografik konumu bakımından enerji zengini Hazar bölgesi ile tüketici Avrupa arasında en optimal taşıma yolunu oluşturmaktadır. Bu da, karadan büyük miktarda petrolü uzak mesafelere verimli şekilde taşıyan, sınıraşan boru hatlarının Türkiye için büyük önem kazanacağını göstermektedir. Fakat alınan bütün önlemlere rağmen boru hatları, ihmal, kaza veya kasıt sonucu ciddi çevresel kirlenmelere yol açmaktadır. Hukuk ise, bu çevresel kirlenmelerin tazmin edilmesinde ve sorumlu kişiyi veya kuruluşu saptamada başvurulacak başlıca kaynaktır.
Uluslararası hukuka göre, bütün transit ülkelerin faaliyetlerini yürütebilecekleri şekilde, kaynak ülkenin ve etkilenebilecek ülkenin hak ve yükümlülükleri belirlenmelidir. Yapılan düzenlemelere uymak için ek önlemlerin bedeline tahammül eden potansiyel tehlikeli işletmenin kontrolörünü korumak için kaynak ülke, uluslararası yükümlülüklerine uygun davranır ve gerekli düzenlemeleri kabul eder. Fakat, eğer kaynak ülke uluslararası yükümlülüklerini ihlal ederse, işletmenin kontrolörü değil, yükümlülüklerini ihlal eden ülke birincil derecede sorumlu olur. Türk hukuku incelendiğinde, hem daha etkili bir Türk sorumluluk hukuku oluşturulması hem de hala tartışılan uluslararası hukuka bir referans kaynağı olması için Türkiye'nin mevcut kanunlarda bazı değişikliklere ve bazı ek düzenlemelere ihtiyacı vardır. Tehlikeli işletmeler ele alındığında ise, Türkiye'nin acil olarak yeni çözüm olanakları yaratacak ve gelecekte ortaya çıkabilecek olaylara uygulanabilecek kriterleri belirleyecek genel hükümlere ihtiyacı vardır.

Anahtar Kelimeler: Sınıraşan boru hattı, Petrol kirliliği, Sorumluluk hukuku

To My Family,

ACKNOWLEDGEMENTS

I wish to acknowledge the assistance and the guidance of the following: Firstly, my sincere gratitude to my family who supported me financially and morally throughout my years of all education. I am also indebted to the indefatigable Professor Ender Okandan of Middle East Technical University and Professor Turgut Turhan of Ankara University for their guidance and insight throughout the research.

I would also like to extend my gratitude to my friends, Tolga Kabaklı and Egemen Kaya, for their intellectual encouragement and motivation.

I would like to make special mention of my Angel whose skill, insight, optimism and love were outstanding.

Last but not least, I am grateful to many people who participated in and contributed to the development of my research.

TABLE OF CONTENTS

PART TWO

ENVIRONMENTAL HARMS DUE TO PETROLEUM SPILL

PART THREE

LIABILITY LAW IN GENERAL AND APPLICABLE LAWS ABOUT ENVIRONMENTAL HARM OF PETROLEUM SPILLAGE

ABBREVIATIONS

Art.	: Article
AÜHFD	: Ankara Üniversitesi Hukuk Fakültesi Dergisi
BATIDER	: Banka ve Ticaret Hukuku Dergisi
Bcm	: Billion cubic meter
Bcma	: Billion cubic meter
Bcf	: Billion cubic feet
B.K.	: Borçlar Kanunu (Obligation Code)
B.P.	: British Petroleum
BTEX	: Benzene, Toluene, Ethylbenzene and Xylene
C.	: Volume
Cc	: Code Civil
Ç.K.	: Çevre Kanunu (Environmental Act)
Dok. t.	: Doctoral thesis
EJIL	: European Journal of International Law
E.U.	: European Union
HaftpflG	:German Liability Code dated 15.08.1943 (Deutsche Haftpflichtgesetz
ICJ	: International Court of Justice
IEA	: International Energy Agency
ILC	: International Law Commission
JPT	: Journal of Petroleum Technology
LNAPLs	: Light Non-Aqueous Phase Liquids
LNG	: Liquefied Natural Gas
md.	: Article
M.K.	: Medeni Kanun (Civil Code)
MTA	: Million Tons Annually
NAPLs	: Non-Aqueous Phase Liquids
OD	: Outer Diameter
OECD	: Organisation For Economic Co-Operation and Development
OPEC	: Organisation of Petroleum Exporting Countries
PAH	: Polynuclear Aromatic Hydrocarbons
PCIJ	: Permanent Court of International Justice

P.K.	: Petrol Kanunu (Petroleum Act)
PRA	: Pipeline Risk Assessment
RLG	: Law of the Facilities of Pipeline that Transports Flammable and Explosive Substances in a Liquid or Gas Phase (BG über Rohrleitungsanlagen zur Beförderung flüssiger oder gasförmiger Brenn-oder Treib-stoffe)
RLV	: Pipeline Regulation of Swiszerland dated 11.09.1968 (Die Rohrleitungsverordnung)
S.	: Issue
Tcf	: Trillion cubic feet
UNRIAA	: United Nations Reports of International Arbitration Awards
VOC	: Volatile Organic Compound
WTO	: World Trade Organisation
YD	: Yargıtay Dergisi

PART ONE

DEVELOPMENT IN PETROLEUM INDUSTRY AND THE POSITION OF PIPELINE IN THE INDUSTRY

1. GENERAL OUTLOOK TO THE PETROLEUM INDUSTRY

A. Overview of the Petroleum Industry

The energy aspects of the biological phenomena of life that all man's needs and activities both essential and non-essential, depend on energy.[1] This dependence may be either direct as in the case of transport and heating, or indirect where energy is necessary for obtaining and converting into finished products the material resources. Energy that can be easily convertible and be changed to another form useful for us has several forms. Oil, natural gas, coal, sun are the primary energy that is found in a crude form in its natural source and petroleum products, coke oil, electricity are the secondary energy that is obtained by the process of the producing primary energy. Natural gas is the only energy resource that can be transported, stored and used just as it is for a large number of purposes. All other source of primary energy must therefore be converted into secondary energy agents distributed to the points where they are put to various users. Needless to say, in the energy market intense competition has developed among nuclear energy, petroleum, natural gas, shale oil and coal. Petroleum however has been known and used since the earliest ages of the world and most of the convertible energy comes from fossil fuels that are burned to produce heat. The word *Petroleum* – from the Latin *petra*, rock and *oleum*, oil- is properly applied to liquid hydrocarbons and is also widely used to refer to natural gas. The term “petroleum” is used in that sense throughout this study.

1. Definition of Oil and Natural Gas

Petroleum is broadly defined by a class of liquid hydrocarbon mixtures including crude oil, lease condensate, unfinished oils, and refined products obtained from the processing of crude oil and natural gas plant liquids.[2]

In point of fact, crude oil and natural gas were becoming thoroughly appreciated over all petroleum products. Crude oil that is made up essentially of carbon and hydrogen atoms exists in liquid phase in underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities. By volume, crude oil is composed of 84 to 87% carbon, 11 to 13% hydrogen, and 1 to 4% impurities consisting largely of sulfur, nitrogen, oxygen, and helium. However, natural gas is a naturally occurring mixture of hydrocarbon compounds (mainly methane) and small quantities of non-hydrocarbon gases found in porous formations beneath the earth’s surface, often in association with crude petroleum. It is composed of 70 to 90% methane, 0 to 20% ethane, propane, butane, 0-8% carbon dioxide, 0-0.2% oxygen, 0-5% nitrogen, 0-5% hydrogen sulfide and rare gases (A, He, Ne, Xe).[1, 3, 4]

According to Turkish Petroleum Act numbered 6326, it is defined in Article 2 paragraph 3/1,

- “Liquid or gas phase natural hydrocarbons which is produced or could be produced from underground reservoirs;
- Other solid hydrocarbons which is profitable to produce with liquid oil and gas;

- Products of hydrocarbon which is understood the written provisions above; is called **Petroleum**."

In a broad sense, this definition of petroleum involves the concept of natural gas. However, in a narrow sense, Petroleum expresses a hydrocarbon mixture that determines the qualitative properties of the structure in formation with other chemical elements.

2. Periods of Oil Price History and Analysis

Price is one of several elements that determine profits in the oil industry. A posted price system has been the basis today for prices of crude and refined oil products, although actual prices have been able to vary and usually have varied from posted prices in oil trading.[4] The price of oil is determined on world markets by the interaction of supply and demand. Consumers determine demand independently globally, as they respond to their needs for oil at its prevailing price. Supply is determined by a diversity of producers, who attempt to meet the world's needs in the context of prevailing prices. If more oil is demanded than supplied, the price will rise; if more is supplied than demanded, the price will drop.

a. Interwar years

To understand the importance of petroleum in world politics and economics, the review of the oil oligopoly must begin after the breakup of the Standard Oil Group in 1912.[5, 6] Between 1911 and 1915, the dissolution of the Standard Empire restored competition between the many new companies and the 'major' oil companies. Most important are Seven Sisters- Jersey (Exxon), British Petroleum, Royal Dutch-Shell, Gulf, Texaco, Socony-Vacuum (Mobil), Standard of California (Chevron). At this point, the expanded internationally and for many years, they have restricted output at the production stage and maintained accepted market shares without price discounting when they sold the oil to outsiders. With the beginning of World war-1, Russian oil had been closed off and the U.S. was to satisfy 80 percent of the allies' wartime requirement for petroleum.[7] Demand continued to exceed the supply not only because of the war but also because of the phenomenal growth in the number of automobiles in the U.S. Between 1918 and 1920; the price of crude in the U.S. jumped 50 percent from $2 to $3 per barrel.[7] In 1920s, the U.S. saw the importance of the Middle East, particularly Mesopotamia, under British Mandate and also suspected Britain of attempting to create a new empire from ex-Ottoman territory[8] as she had an invincible position in the Middle East; altogether, the U.S. oil policy started to change and Washington support to every effort of American business to expand its circle of activity in oil production throughout the world and 'Open Door' principle was appealed.

The interwar years, both Anglo-American oil dispute and oil-nationalism directed the viewpoints of consuming and producing countries to constitute and achieve their petroleum objectives. During the 1920s, Anglo-American controversy on oil centered around three distinct areas: Palestine, Mesopotamia and North Persia. The U.S. oil strategy however would be supported by technological improvement (tankers, pipeline) that helped to overcome difficulties and distances over global production. Therefore, Britain became conciliatory and signaled participation to U.S. in Mesopotamia as she thought that direct American involvement could be real plus and American capital and technology would definitely speed up the providing revenue process to British Treasury.[8]

Second, after World war-1, the seven sisters obtained concession agreements that gave them control over the production and sale of much of the world's oil in return for the payment of a small fixed royalty to their host governments. Despite the stabilization efforts of the seven, oil prices dropped.

b. After World War-2

Changes in the system began to emerge in the decade following World war-2 in the context of the political and economical significance of oil. To be a player over the huge amount of Middle Eastern resources was a primary requirement for American, British and Western Europe security.[7] It could be argued that cooperation in the postwar period depended on the prior establishment of U.S. dominance.

The price of oil rose from \$2.5 in 1948 to about \$3 in 1957 and continued exactly the same through the end of the 1960s.[9] Nevertheless, from the early 1950s to the end of the 1960s, the world oil market was extended by rapid growth. The world crude oil production was increased from 8.7 million barrel per day in 1948 to 42 million barrel per day in 1972. While U.S. production had grown 5.5 to 9.5 million barrel per day, America's share of total world production had reduced from 64 to 22% because of the huge increase in the production of Middle East from 1.1 million to 18.2 million barrel per day. Proven world oil reserves in the noncommunist world increased from 62 billion in 1948 to 534 billion barrel in 1972 while major growth occurred in the Middle East whose reserves had increased from 28 to 367 billion barrel. Out of every ten-barrel added to free world oil reserves between 1948 and 1972, more than seven were found in Middle East.[7] However, there has been a 40 % decline in purchasing power of a barrel of crude.

In these years, with the growing nationalism, the host governments succeeded in revising concession agreements negotiated before the war. The new royalties and taxes combined would yield a fifty-fifty division of profits between the companies and their respective host governments.[7, 10] As a result, profits being added to host governments increased significantly. For instance, the per-barrel payment to Saudi Arabia rose from $0.17 in 1946 to $0.8 in 1957. Nevertheless, the seven sisters continued to dominate the upstream operations by locking in concession agreements with many oil-rich areas but there was a competition in the downstream in refining, transportation and marketing.

In April 1959, the largest oil exporters, Venezuela, Saudi Arabia, Iraq, Iran and Kuwait, altogether with Egypt and Syria signed the Maadi Pact and by 1960, the Baghdad Resolutions formed the basis for the establishment of OPEC. After the mid-1960s, company-centered regime was destroyed, concession arrangements were out of favor, operating companies in the oil-producing countries were nationalized and the companies lost control of their relations with those countries.

c. Oil shocks of 1970s

Throughout the 1970s the international monetary disorders especially increasing inflation in the West and continuing devaluation of the dollar, lowered the real value of earnings from oil production, which had the effect of transforming the OPEC states into surplus countries, while seriously impoverishing many third world oil importers and temporarily throwing the OECD economies into balance of payments difficulties.[11] In 1971, the companies signed a five-year agreement that provided for an increase in the posted price of Persian Gulf oil from $1.8 to $2.29 per barrel, an annual increase in the price to offset inflation, and an increase in government royalties and taxes.[6]

Then, the fourth Arab-Israeli war had begun on October 6,1973. On December OPEC unilaterally raised the price of Persian Gulf oil to $ 11.65. During the height of the crisis, spot prices were even higher, reaching $16 to $17 per barrel. During 1973-74 the OPEC producer-state revenues expanded by some $64 billion equivalent to 1.5% of world capitalist output.[9, 11, 12] In the mid-1970s, Saudi Arabia was able to raise production to prevent the price increase desired by other OPEC members especially Iran, Iraq, Venezuela and Nigeria as they have large populations, confusing development plans and smaller reserves, and therefore, they seek to maximize their oil revenues in the short term. The supply of oil was steady and even growing. However, recession in the OECD countries, combined with conservation efforts arising from the increase in price and new sources of oil and natural gas from the North Sea, Alaska and Mexico, led to a stabilization of demand for oil.[10, 13, 14] Furthermore, as a result of the effective Saudi management, the price of oil in real terms actually dropped.

Between July 1977 and 1978, steady inflation and the sharp decline of the dollar eroded the real value of oil earnings and assets. OPEC members therefore agreed to a mutual 5 percent production cut aimed at putting a floor to OPEC price levels. However, in October 1978, as a successful revolt against the Shah in Iran oil workers cut off 5.4 million barrel of oil per day, about 17 percent of total OPEC exports. The result of this conceived shortage and rapid scrambling for stocks was again escalating prices and set off panic in the spot market for oil.[11, 12, 14]

In early 1979 spot prices rose as much as $8 above the OPEC price of $13.34 for Saudi Arabian light crude. Despite an agreement by IEA members to reduce oil consumption by 5 percent for 1979, OPEC raised the price again.

On September 22, 1980 the outbreak of war between Iraq and Iran caused a halt in oil exports from these two countries and a reduction in world supplies by an estimated 3.5 million barrel per day, roughly 10% of world oil exports. By December 1980, the price of the Saudi marker crude had been raised to $32 per barrel and spot prices reached $41 a barrel.[11, 12, 14] However, fields in Mexico, Egypt and North Sea production was increasing, they had fallen back to $35.5 by the end of the year, after which they continued to decline gradually.

These 3 crises are similar properties that all originated with 4 to 7 percent cutbacks in Middle Eastern oil production during the severe months and an explosion of spot prices inevitably triggers a subsequent response in the official price of OPEC crude.[12] Moreover, higher oil prices encouraged the energy conservation, the market share of natural gas and nuclear energy and structural adjustment, reinforced by government regulations.

d. OPEC in decline

After having continuously climbed, total oil consumption in the industrial countries fell by an estimated 10% between 1980 and 1984. As a result a long-term surplus emerged, that put sustained downward pressure on prices. Moreover, the excess supply made it difficult for OPEC to manage prices, as it had in the previous decade.

Fall in demand and higher oil prices attracted new suppliers to the international market. Therefore, OPEC's share of the world oil market fell from 63 percent in

1973 to 33 percent in 1983. New non-OPEC oil-exporters' production rose sharply from 2.8 million barrel per day in 1973 to 7.5 million barrels per day in 1983. In addition, the former Soviet Union increased its production and exports to increase its foreign exchange earnings.

Shifting supply and demand depressed oil prices. On the spot market, prices fell from $40 per barrel in 1980 to $30 per barrel at the end of 1982. The fall in demand imposed a particularly heavy burden on Saudi Arabia that acted as the swing producer. The Saudis cut its production from a peak of 9.9 million barrel per day in 1980 to below 2.5 million barrel per day in 1985 to defend OPEC's prices. Saudis oil revenues reduced from $110 billion in 1981 to $28 billion in 1985. In the late 1985s, the Saudis tired of this roll, expanding production by 2 million barrel per day to 4.5 million barrel per day and driving prices down by more than $15 per barrel in just a few week in 1986. Spot-market prices were $13 per barrel in mid-1986.[6, 9, 12]

In late 1986s, OPEC reaches an accord on new production reductions and would raise prices immediately toward a target world oil price of $18 per barrel. At the end of the Iran-Iraq war in 1988 oil prices in 'real terms' were below their 1974 level and actual OPEC production had reached to 21 million barrel per day.[13]

To sum, unlike the small group of nations' economic and political power in 1970s, it was very difficult for these nations to control world oil in the content of interdependency between states and markets.

e. After the Gulf war

Oil was this time both tool in the conflict and the source of the conflict itself. Differences among OPEC members over the price of oil and production quotas necessary to manage the price were a major factor in the invasion of Kuwait by Iraq in August 1990. In 1989 and 1990, Iraq and Kuwait were on opposite sides of a significant conflict within OPEC.

After Iraq's August invasion both crude and product prices begin to soar upward, exchange markets also pivoted on the changing situation in the Arabian Gulf. In October 1990, UN embargo, close all world oil markets to Iraqi exports affected a flow of 4.3 million barrels per day of oil to world markets, about 7% of the world total. Once the Gulf war ended on February 28, 1991, OPEC cut production and the Soviet Union announced that it would cut oil exports by 50% in March of 1991. Crude oil prices entered a steady decline until 1994.[15]

After mid-1995, the only important price increase occurred due to the U.S. missile attack on military facilities in southern Iraq in 1997. Price collapsed in 1998 because of the interaction of warm weather, an Asian recession, the devaluation of the ruble, events in Iraq, false supply estimates by the IEA that prompted higher OPEC production and perhaps some manipulation by insiders (Fig.1-1). Then, prices surged through 1999 in a staggering 300% increase, as the underlying capacity limits were breached, triggering recession. Demand fell and prices dropped. On the other hand, in 1999 'company marriages' were in agenda. First, BP announced that it would acquire Amoco for $48.2 billion in stock. Then Exxon Corporation agreed to buy Mobil for approximately $75.4 billion. Finally, French oil companies Total Fina and Elf Aquitaine agreed to merge which would form the world's fourth largest oil company.[16]

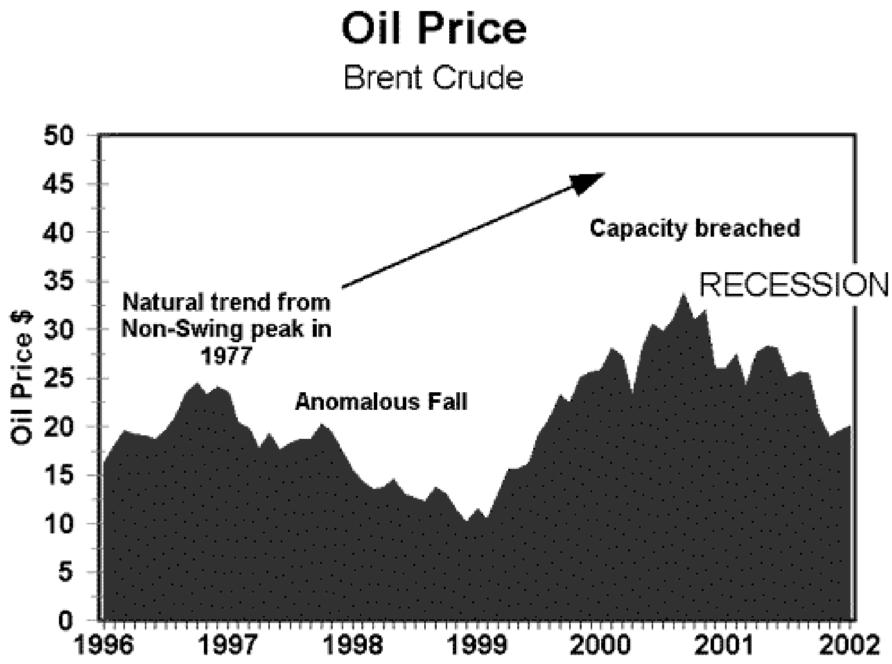

Figure 1-1 Oil Price of Brent Crude in Dollar, 1996-2002 [25]

In mid-2000, OPEC applied the 'price band' mechanism, which triggers an increase in production quotas when the price of the OPEC basket of crude oils closes over $28 per barrel for the full year 2000.[16, 17]

Oil prices remained high through 2001, averaging $24.77 a barrel- lower than the $28 seen in 2000 but still significantly up the post 1986 average of around $19. However, the average hid significant price volatility. The September 11 terrorist attacks had a severe negative impact on demand on oil prices, briefly bringing prices down to a low point of $16.54 in November and keeping them below $20 on average for the fourth quarter of the year.[16, 17] Starting with the beginning of 2002, the oil price has entered into an increasing trend nearly from $17 in January to $25 in October.

In the 1990s, the world supply of oil increased but OPEC's share decreased and the sort of price volatility caused by temporary fluctuations in demand and supply, and new oil reserves from the deep water of the Gulf of Mexico, Caspian Region and Russia.

The new century show that the rise and fall in prices depends on the changes in demand and supply, and tensions in world politics, not votes of OPEC countries.

3. World Petroleum Reserves and Production

Before starting our study, the terminology of this subject is to be examined as many different methods of calculating total recoverable hydrocarbons exist among companies and what was very much in doubt until recently was that many reported reserves and published data have a political content. Here we only focus on conventional oil that covers usually primary and secondary recovery from porous and permeable reservoirs with identified water contact and oil characteristic.

The reserve/resource system has three basic classifications of hydrocarbons: reserves (appropriated projects that are economical at today's prices), contingent resources (projects appraised or not viable with today's price and technology), and speculative potential (yet to be drilled). In this section, proved reserves defined technically as the estimated quantities of hydrocarbons and other substances that geologic and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs are required to report the global petroleum trade and market.[18] However, estimations about 2020 mentioned below are derived from an average assessment over a wide range of uncertainty for proved reserve, reserve growth and undiscovered resources.

After 1950s, a plentiful and growing supply of cheap oil has been a major player for determining all states' policies and behaviors. However, at the beginning of the industry, the U.S. has been a pioneer in petroleum exploration and production but also being a dominant power over all reserves.

In the 1950's the U.S. averaged 3 billion barrels per year in new discoveries. Then, U.S. oil reserves have been in decline since 1970 because U.S. oil production is greater than new discoveries. Worldwide in 1970, oil reserves were 530 billion barrels but U.S. production peaked at 4.123 billion barrels and reserves peaked at 38.7 billion barrels. The Middle East had reserves of 349.7 billion barrels, or 55.4% of the world's total.[4] The USSR-Eastern Europe-China complex was reported to have reserves of 103 billion barrels, or 16.3% of the world's total. Therefore, U.S. petroleum imports rose sharply until the late 1970 – 70% of U.S. petroleum imports came from OPEC countries.[19] (Fig.1-2) Nevertheless, total U.S. consumption of natural gas reached a record of 22 trillion cubic feet.

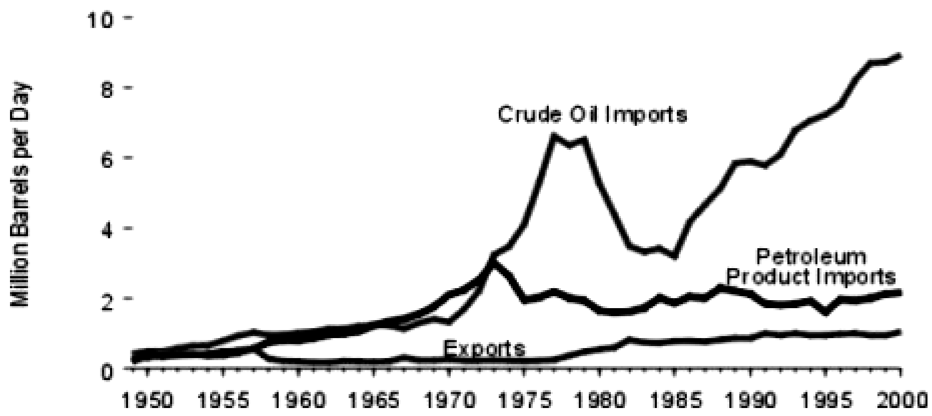

Figure 1-2 U.S. Petroleum Imports and Exports in Millions of Barrels per Day, 1950-2000 [23]

In the late 1980s, due to the OPEC quota wars, the Swing producers, Saudi Arabia, Kuwait, Iran, Iraq increased their reserves as Venezuela by more than 300 billion barrel without any new discoveries to justify these increases and as shown in Fig.1-3 that the amount have changed little despite production increases.[19, 20]

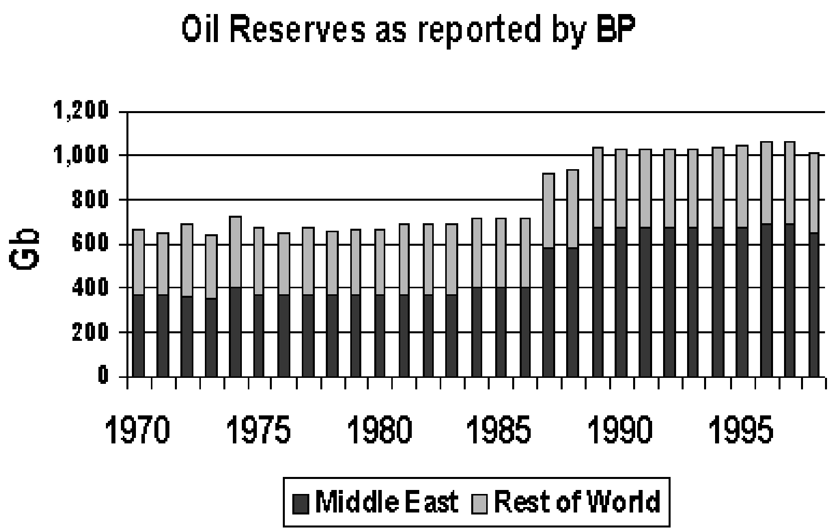

Figure 1-3 Middle East and Rest ofWorld Oil Reserves in Giga barrels, 1970-1995 [25]

Despite their swing role, the 55% share of the swing producers in 1973 had fallen to below 30% level by 1985 as new provinces in the North Sea, Alaska and elsewhere started to deliver excessive production from their giant fields. After the late 1980s, the crude oil and natural gas production in the world has entered into an increasing trend and daily production of oil was about 65 million barrels so OPEC again increased their market share to 37% and supplied 20 million barrels oil per day and after 1991, Saudi Arabia has become the largest producer. (Fig.1-4)

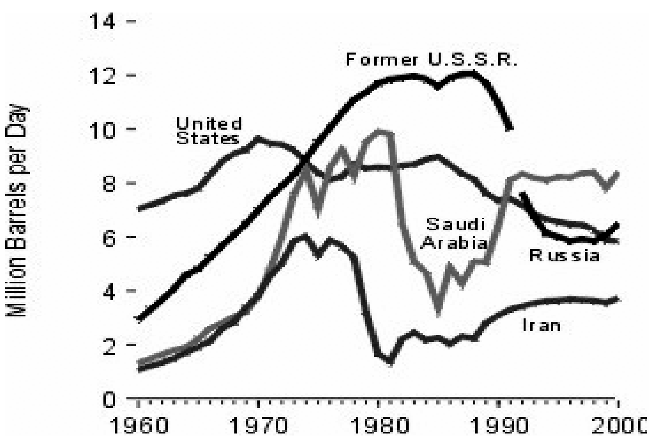

Figure 1-4 Oil Production in U.S., Russia, Saudi Arabia and Iran
in Millions of Barrels per Day, 1960-2000 [23]

During 1990s, the world crude oil production and consumption has accelerated parallelly and reached 74 million barrels daily. In the U.S., the consumption has increased sharply to 18 million barrels per day until 1998. In contrast to consumption, however, the oil production has declined steadily as U.S. oil reserves have been in decline since 1970 and total U.S. crude oil reserves were 23.2 billion barrels at the end of 1999, compared to 28.2 at the end of 1988 and 33.6 at the end of 1977.[21]

Unlike U.S., in the Former Soviet Union (FSU) despite its 6.5 billion barrels reserves, the oil production has declined from 11 million to 7.5 million barrels daily and even the consumption has dropped sharply to 3.5 mbd.[13, 22] However, despite a relatively low price environment, non-OPEC production has risen every year since 1993 adding more than 5.2 mbd between 1993 and 2000. Equally significant, after 1990, world natural gas demand and supply has risen steadily, reaching more than 2300 billion cubic meter in 1999 with all sectors increasing their use. This is because immense supplies of natural gas in the offshore areas of North Sea, in northern Africa and in FSU supply growing demand in Europe.[22]

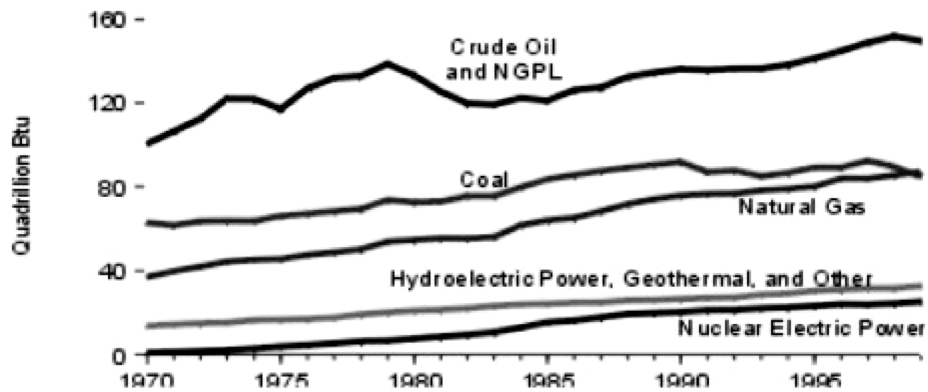

Figure 1-5 Global Demand of Crude Oil and NGPL, Coal, Natural Gas, Nuclear Electric Power, Hydroelectric Power, Geothermal and Other in Quadrillion British Thermal Unit, 1970-1995[23]

As you can see from Fig.1-5, from 1970 to 1999, world primary energy production grew by 76%. Growth occurred in all types of energy. All the while, between 1990 and 1999 total primary energy production grew in all major regions of the world except Eastern Europe and the Russian Federation where production fell by 25%.[23]

Whatever one's opinion on the work done, non-OPEC oil production would peak about now, while global production would peak around 2005-2010. Gas, less depleted than oil, will likely peak around 2020. At the end of 2000, world oil reserves were nearly 1040 billion barrels and daily production was about 74 million barrels but the historic trend of growth at about 2% could not be maintained.

However, oil continues to provide 40 % of the world's energy and gas supplies 24%. Over the past 5 years 18 countries have increased their oil production by more than 100.000 bbl/d and in the same time, 20 countries have increased their gas production by over 500 million cubic feet a day.[24, 25]

Overall, the world's energy consumption grew by only 0.3% in 2001. Boost in demand by 4.3% in China and increase by 1.2% in the FSU were the sign of the development in economy. However, N.America energy consumption fell by 2.4% and demand in entire Asia fell by 0.5% compared to a 10-year trend of 3.6% annual growth. This demand weakness was primarily caused by the global recession and was further worsened by the disruptive after-effects of the September 11 attacks. The global recession was only short-term effects on oil demand. During the war in Afghanistan, there wasn't any disruption in oil supply.

Oil prices fell sharply after the terrorist attack of September 11 but have rebounded since early 2002. In addition to oil prices, world oil demand is expected to grow by 2.2% annually, rising from 74.9 mbd in 1999 to 118.6 mbd in 2020. To take individually, helped by higher oil prices, U.S. oil production necessarily declined in 2001 and 2002, at around 5.8 mbd. For 2002, Russia oil production has averaged about 7.3 mbd, with consumption of 2.6 mbd and net exports of 4.7 mbd. In 2003, Russia is expected to produce around 8 mbd. Oil use in Western Europe is projected to increase by about 0.6% per year from 13.9 mbd in 1999 to 15.8 mbd in 2020. Equally, oil demand in industrialized Asia (Japan, Australia, N.Zealand) is projected to increase by an average of 0.9% per year, from 6.9 mbd in 1999 to more than 8.3 mbd in 2020. Conversely, in less than 10 years, China is expected to become the largest oil consumer in Asia. Oil use in China is expected to grow by 4.3% per year, from 4.3 mbd in 1999 to 10.5 mbd in 2020. Additionally, India is projected to be among the world's fastest growing economies over the forecast period and its oil consumption is projected to grow 4.6% per year on average from 1999 to 2020 to nearly 4.9 mbd.[26]

4. Natural Gas Market History

Natural gas, one of the cleanest, safest and most useful of all energy sources, is an essential player of the world's supply of energy. Beside, the technology of exploration and developments of gas fields is similar to oil; the gas industry is different economically. The high cost of transportation infrastructure (pipelines or liquefaction systems are up to 10 times the cost of transporting oil) and the related demand markets are always taken into account. This is because gas prices and contracts are often specific to a locality- country or region.[27]

Britain was first country to commercialize the use of natural gas. Around 1785, natural gas produced from coal was used for lighting. Manufactured natural gas was first used in America to illuminate the streets of Baltimore in 1816. Then, in 1821, William Hart dug the first successful American natural gas well in New York. By the 1920s, with the invention of seamless welded pipe long distance pipelines were constructed to bring natural gas from producing regions to cities. After world war-2 the market has begun to expand for residential use of clean burning natural gas.[28, 29]

During these years natural gas was an especially marginal commodity outside the U.S. In 1938, the U.S. government believed the natural gas industry to be a 'natural monopoly' so that the Natural Gas Act was passed to protect consumers by regulating the price of gas. Then, the Federal Power Commission (FPC) created a pricing system that kept wellhead prices extremely low and involved bureaucratic case procedures that delay all decisions. With low wellhead prices, new gas supplies were largely determined by exploration for petroleum. There was little exploration for natural gas.[28, 29]

In 1973, total U.S. consumption of natural gas record of 22 trillion cubic feet. Since then, gas prices raised due to deeper wells and increasing prices of other fuels. By the 1980s, lower demand resulted in a short-term surplus of deliverable gas and production curtailments in many production areas. In 1985, world natural gas consumption totaled 62 trillion cubic feet. The real wellhead price rose during the 1970s, until 1983, and then dropped by 51% from 1983 to 1994 but has risen again, with substantial fluctuations- being particularly high in the winter of 2000-2001.[30]

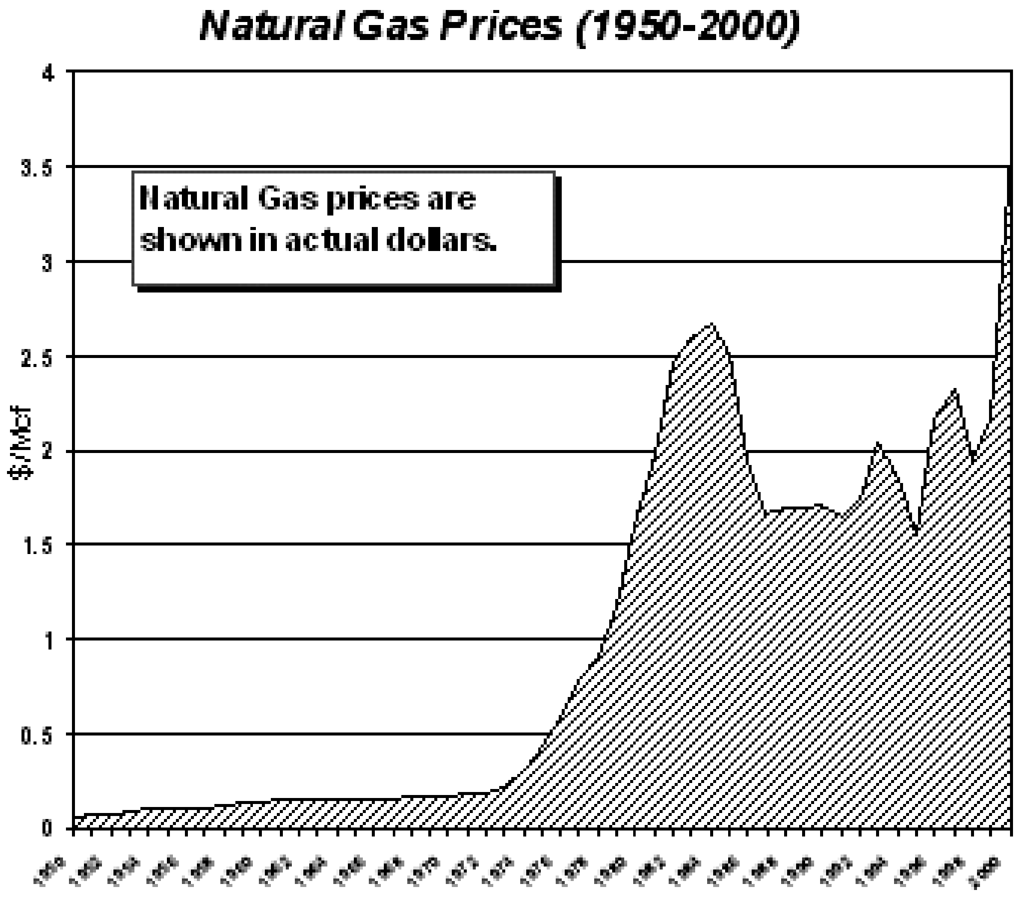

Figure 1-6 Natural Gas Prices in Dollar per Millions Cubic Feet, 1950-2000 [29]

According to BP reports, world's natural gas reserves grew by 50% from 2910 tcf to 4376 tcf between 1982 and 1992. Total world production reached 71.5 tcf daily and FSU, primary producer, has a share of 37% totally. However, until 2000 total FSU production has fallen 27%. Unlike FSU, total North American production has nearly grown 20% to 26.8 tcf in the same period.

With the help of the growing production, natural gas storage in depleted reservoirs or other subterranean features, again pioneered in the U.S., has significantly increased. These have helped to flatten out the seasonal fluctuations in price that typically marked the industry in the past, when an important cold snap might send the spot price of natural gas up by 100% or more.[5]

The use of natural gas, the fastest growing primary energy source, reached 75 trillion cubic feet in mid-1990. Many industrialized countries were and is going to use natural gas, a cleaner fossil fuel than oil or coal, to reduce greenhouse gas emissions. So worldwide gas use potentially more than doubles reaching 174 trillion cubic feet in 2020 from 82 tcf in 1996.[31] (Fig.1-7)

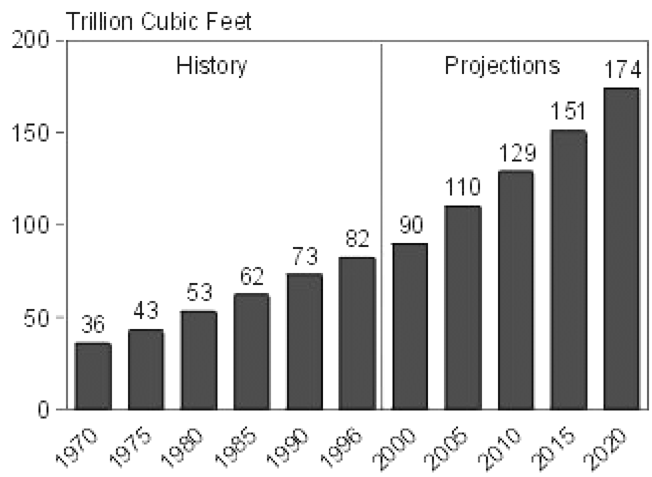

Figure 1-7 Global Natural Gas Production in Trillion Cubic Feet, 1970-2020[31]

On the other hand, unlike oil, the path for the wellhead natural gas price was less volatile between 1997 and 2000, fluctuating between a high of $2.63 per thousand cubic feet to a low of 1.76 thousand cubic feet. However, during 2000, the wellhead gas price rose from$2.26 to 3.06 and by the end of the year to $5.19 per thousand cubic feet.[32]

The EIA, conjunction with the OGJ and World Oil publications, estimates world proved natural gas reserves to be around 5278 trillion cubic feet of January 2001. It is important to note that the decrease of 12 Tcf between 1998 and 1999 in Western Europe's natural gas reserves was offset by the doubling of Australia's reserves (from 19 to 45 Tcf) in industrialized Asia. Proven reserve estimates increased by 13 Tcf for Africa, by 16 Tcf for Asia and by 24 Tcf for the Middle East.[31]

World wide, natural gas reserves are more widespread geographically than oil reserves. Most of the reserves are located in the Middle East with 1836.2 Tcf or 34% of the world total and the FSU with nearly 2000 Tcf or 38% of the world reserves. In rest of the world, reserves are fairly evenly distributed. In addition, despite an increase in gas consumption, the regional reserves to production (R/P) ratios have remained high. The R/P ratio of world is estimated at 61.9 years for natural gas and 41 years for oil. The FSU has a R/P ratio of about 86.2 years and the Middle East and Africa both more than 100 years.[28, 31]

B. GLOBAL TRADE IN PETROLEUM INDUSTRY

1. Petroleum Trade

Energy is one of the most internationally traded commodities. This trade, a positive factor in economic growth, international co-operation and globalization, now expresses the concept of mutually beneficial interdependence. The volume of internationally traded energy increased as a result of world economic growth.

a. Structural changes

After World War-2, an enormous amount of cheap oil entered into global energy market from Middle East because of its easy transport and store process, so that oil became the world's dominating fuel in many market. At the beginning of the 1960s energy demand in OECD countries grew by 90% and oil demand by 120% and oil began to replace coal nearly in all sectors but they became heavily on oil imports, mostly from OPEC countries.[31]

However, during 1970s the fast-developing oil market was irritated by the coincidence of a shortage of refining capacity in Western Europe and Japan, the closing of the Trans-Arabian pipeline and the oil shocks but there was so little change in relative consumption of energy. These divisions in consumption appear to be due more to changes in the supply of different fuels than to changes in the consumption of demand. Besides, the map of the world oil supply has changed noticeably since the mid-1970, with the important new sources of supply coming on stream from the North Sea, Brazil, Mexico, China and Alaska, all of which resulted from a competition between oil-to-oil and oil-to-other energies in the market.[11, 33]

On the other hand, for many years the U.S. was by far the main consumer of natural gas in the world but by the 1970s both environmental concerns and a desire by oil-importing countries to become less dependent on foreign oil led to an increase in use of natural gas. However, while natural gas covered about 18%-19% of the world's energy needs, the main consumers (U.S., U.S.S.R. and Western Europe) were also main producers and few of the developing countries with proven reserves have been able to find the extensive finance required to build up infrastructure for the domestic market, so that international trade was limited. About four-fifths of that trade is carried by pipeline; shipment of LNG was hampered by the extremely high cost involved.[34, 35, 36]

Since the beginning of the 1970s, the vertical structure of oil industry was disintegrated as oil producing and exporting countries started to take over ownership of crude oil production. In the core, the way of government involvement includes not only direct imports by state company but government activities that indirectly promote crude oil contracts by private companies as well.[37]

b. Environmental concerns in petroleum industry

Global climate change is one of the most challenging environmental issues the world is facing today. The petroleum industry will play a key role in our future because the burning of fossil fuels is the greatest contributor to climate change. In the last twenty years, both the high level of consumption of petroleum in the developed world as well as the insufficiency of petroleum in parts of the developing world has carely been considered throughout the world.

Since 1990s, the industry has no longer ignored the issue of climate change. As a matter of fact, the oil industry would undoubtedly suffer from new restrictions that should be the pursuit of CO_2 reduction in the Convention on Climate Change and the Kyoto Protocol that are important early steps of an effective global climate regime. As a result, developments are slow to take shape and proposed solutions tend towards flexibility mechanisms like emissions trading, a model aimed at shuffling greenhouse gases around the table at a profit for some.[38]

To sum, throughout the world, environmental awareness has given a new edge to the law as it applies to target industries such as fossil fuel suppliers and electric utilities. In some areas the environmental restrictions may be so tight that they force operations to be significantly cut back or even terminated in certain countries.[39, 40]

c. Interdependency and energy security in Millennium

Global trade competition and privatization have become major factors in the post-Cold war era as countries utterly rely on exports in context of prosperity. There is a complex structure of interdependencies among countries through international trade. Energy security is now seen as a part of “globalization” but this mutual interdependency not only enhances the security by giving greater elasticity to global economy but also only makes the relations much weaker by creating too much reliance on key logistics or infrastructure. Diversification among types of primary energy, supply routes or logistics seemed as a medicine of globalization makes the states connected uniquely.

Petroleum industry, like so many others, has been going through a major transformation. Increasing competition and liberalization of oil production helped in making the market more transparent.

Primarily, the ability of international oil companies to control the market is even more limited because of the diversification of petroleum supplies, nationalizations and entrance of new companies (state-owned and private). Moreover, the explosion of spot trading in petroleum markets further limits the market power of OPEC and the major oil companies by providing a ready source of alternative supplies or distribution channels with anonymous buyers and sellers.[41]

Equally significant, in economical point of view, the energy to GDP ratio, a traditional measure of the average amount of energy needed to produce a unit of output, has dropped dramatically. This is due both to greater efficiencies in energy usage and to a shift from energy to information technology, particularly in the industrialized countries. To put it specifically, the share of oil in the industrialized countries' energy consumption declined from 55% in 1980 to 40% today, and oil's share in world merchandise trade declined from 17% to 7% in the same period. Today, the industrialized countries need 50% less oil than they used twenty years ago to produce the equivalent unit of GDP. These changes have had an impact on the proportionate position of the oil industry in global business. For example, in 1980, there were 13 oil companies on the list of the 20 largest U.S. companies. By 1998, that number came down to only three. But, although oil's share in the industrialized countries has declined, its use in the developing countries has been on the rise. Of 20 million barrels per day increase in world oil consumption in the past two decades, 17 million barrels per day of that demand came from the developing countries. Moreover, the energy infrastructure requirements for developing countries will require trillions of dollars over the coming decades, and significant amounts of goods and services will be imported from industrialized countries.[42, 43]

Let us now turn to the politics of oil. Energy policies in many industrialized countries intended to encourage the use of alternative fuels for many reasons such as the protection of the environment, mentioned above and energy security also had an effect on oil demand and trade flows. Historically, in 1970s the energy security subject deals with several issues: Supply disruption, Supply diversity and other aspects of energy policy- conservation, efficiency, and long-term alternatives.[44, 45]

In a same way, energy security which remains a prominent issue despite the relative quietness in the market in recent years is nowadays associated with disturbances in the petroleum market, fundamentally issues of energy price changes and how these changes affect the economy. World physical supply of oil can be disrupted at any moment by events in producer regions and transit zones, especially political instability and/or war. The hazard for energy are various- physical disruptions such as a strike, a geopolitical crisis or a natural disaster, economic disruptions caused by erratic fluctuations in the price of energy products on the world markets, environmental risks such as oil slicks, methane leaks, and social risks.

Special attention will be given to supply security and the regions. The expanded oil reserves, the excess production capacity, transparent market, geology and economics should all ease the concern over supply security.

As one might expect, the world's three largest consuming regions (N. America, Europe and Asia-Pacific) are all importers. All the other regions are exporters. The Middle East still exports vastly more oil than any other region, despite the strong growth in production in other areas in recent years. This region has the largest world reserves and readily available supply. During the different supply disruptions in the past two decades, such as the Iranian Revolution, the Iran-Iraq war, the Iraqi invasion of Kuwait, the only alternative to the disrupted oil supplies came from the region itself and mostly from Saudi Arabia.[42]

In the Asia-Pacific region, oil consumption of Northeast Asia, based on the year 2000 consumption of about 13.4 mbd, accounts for 65% of Asia-Pacific and 18% of world consumption. China is the only country that produces crude oil in Northeast Asia. However, China has become a net crude oil importing country since

1996 as crude oil production stagnated and oil demand increased owing to the economic growth. Total primary energy consumption in China could grow from 916 million tons of oil equivalent (mtoe) in 1995 to 1405 mtoe to 1774 mtoe by the year 2010 and world crude oil demand is forecasted to grow 1.5 mbd annually on average during 2000-2010 of which China accounts for 12-13%.[46, 47]

Sharp growth of economy and increase of foreign trade in Northeast Asia countries increase the dependency on marine transportation route. However, as interests for to marital resources to secure energy resources have increased, the conflicts about islands dominium (Paracel isl., Senkaku isl., Spratlys isl.,) and ocean border have deepened.

In China, the central government's decreasing influence on the domestic energy sector raises serious doubts about concerns that China's rising dependence on foreign oil supplies will cause geopolitical instability in Asia and drive regional arms races. On the one hand, China will increasingly scramble for similar energy supplies with Japan, South Korea and India that will cause unavoidable tensions and dispute. Japanese elites for instance remain deeply suspicious of China's long-term intentions and worry about Chinese initiatives to disrupt free navigation in Asia sea-lanes. On the other hand, China's strategic interests about energy sources intersect to the U.S., Japan and other industrialized economies interests in Middle East. Therefore, China will also bear the same negative consequences of the threat of the energy supply balance from the States in Middle East. Moreover, a breakdown in order in Afghanistan or Central Asia will have equally terrible results for her chances of tapping Caspian energy supplies. Taking all the circumstances into account, China may continue not to contravene to mostly benefit from deep U.S. involvement in those regions.[46, 47]

The E.U., second largest energy consumer in the world and the largest energy importer, is an important actor on the international market for energy products. The E.U. imported 16% of the natural gas traded on the international market in 1999 (450 billion m^3), and a quarter of oil (9.7 out of 40.4 mbd). Moreover, community has 8 years of known oil reserves at current consumption rates and has barely 2% of world natural gas reserves or 20 years' consumption at present rates.

An analyses would indicate that in 2004 the enlarged Union will be consuming more than 20% of world oil production because of their need to catch up in their passenger and goods transport sectors. Geopolitical uncertainties and oil price volatility raise the issue of improving the organization of strategic oil stocks and co-ordinate their use. Similarity, a discussion took place as regards the need for strategic gas stocks.

So self-sufficiency and energy security have always lain at the heart of the member States' energy policies. Firstly, in the context of self-sufficiency, the E.U. must develop a new strategy on the demand side and must take into account the most effective instruments for controlling demand: taxation and legislation. Second, the best guarantee of security of energy supply is clearly to maintain a diversity of energy supplies.

Reflecting the importance of diversification, most contributors consider that political dialogues should be pursued with all the relevant partners. Russia is a key partner. E.U. common foreign policy could promote agreement among the countries bordering the Caspian Sea, the Mediterranean and also Latin America. The promotion of foreign direct investments in producer and transit countries is particularly important for E.U. security of energy supply.

Finally, special attention will be given to the WTO as the most suitable form for negotiating commercial energy issue and European Energy Charter developments, including provisions on investments, trade, transit, the environment and energy efficiency.

2. Trade Routes

a. General

There are 4 modes of transportation used in moving petroleum and refined petroleum products throughout the world. They are the railroad, tank trucks, tankers and pipelines. Two of them are used for inter-regional trade: tankers and pipelines. More than three-fifths moves by sea and less than two-fifths by pipeline.

Tankers that are low-cost, efficient and extremely flexible have made intercontinental transport of petroleum possible. Tankers are necessary for long-distance ocean transportation, but they are only a link in the gathering and distribution chain. Pipelines, on the other hand, are the made of choice for transcontinental oil movements. Pipelines are critical for landlocked crude's and also provide shortcuts to tankers at certain key locations. They are also necessary to move petroleum both from producing wells to the tanker port for shipment and to refineries for processing. So it's important to bear in mind that, both tanker and pipeline transportation are required to get these supplies to market.

b. Worldwide Activity

Before World war-2, international trade in petroleum was insignificant. Also, most petroleum exports refined at or near the source of crude. The U.S. was a significant supplier in almost all markets.

After world war-2, with the U.S. no longer an exporter, the eight majors- five Americans plus Shell, BP and CFP- were now distinctly the only suppliers. Moreover, the amount of crude oil entering international trade rose rapidly and the demand of trade in refined oil declined, because there was a distinguishable movement toward establishing refineries in consuming areas.[4]

In mid-1940, Europe was in energy crisis and the Marshall Plan made possible the change from a coal-based economy toward one based on imported oil. In 1950, the Trans-Arabian Pipeline (Tapline) began to bring oil in Lebanon, the terminal on the Mediterranean where it was picked up by tankers for the last leg of the journey to Europe.[7]

In 1957, the closure of Suez Canal, which at that time was the main route for oil shipment between the Persian Gulf and Europe, forced tanker owners back to using the much longer route around the Cape of Good and resulted in the development of Very Large Crude Carriers (VLCCs) to reduce that voyage's higher costs. In fact, the crisis may be attributed to improvements in the oil distribution system within the Soviet Union and through the East Europe countries to the construction of Friendship crude oil pipeline network.[12]

Since 1970s, the busiest routes for the crude oil trade were in the Mediterranean and the Caribbean both for North America discharge. However, in the early 1970s, Europe made it possible to bring gas from far-away Siberia by pipeline.

In addition, LNG was shipped from Algeria and Libya to West Europe market. In the mid-1970s, Norway built its first offshore pipelines to supply the U.K. and European buyers.[48]

Throughout the 1980s and 1990s, there has been an extensive pipeline grid in Europe. The major gas pipelines were built for: [49]

1. Soviet gas to Europe through the Urengay (1984) and Yambur/Progress (1988)
2. Norwegian gas through Statpipe (1986), Zeepipe1 (1993) and Europipe (1995)
3. Trans-Mediterranean pipeline system from Algeria to Italy and other areas of Europe (1983), and Bozaduc Maghreb-Europe line from Algeria to Spain (1996).

The Balkan systems linking Bulgaria to Macedonia and then to Greece were completed in 1996. Currently, the European gas market is the world' most complex gas market in terms of the number of international participants.

Significantly important, since mid-1980s, overall world LNG trade rose rapidly. Global LNG trade has been dominated by imports and exports in the Asia-Pacific region. Asian LNG exporters include Indonesia, Malaysia, Brunei and Australia. Asian importers include Japan, S. Korea and Taiwan. Algeria is the only significant producer outside of Asia. The Middle East is the most gas rich region in the world with relatively more limited projected demand for natural gas. The U.S. is the only country in the world to both import and export LNG. The U.S. exports LNG from Alaska to Japan and imports LNG on the east and gulf coasts.[50, 51]

The potential source of supply of natural gas are more diversified than those of oil with major indigenous production in North America, Europe, Latin America and Asia-Pacific adding to those of Russia and Middle East where the bulk of reserves lies.

On the other hand, the international crude trade, often correlated with oil prices, was highly volatile from its beginning. Today, the volume of international trade in oil increased as a result of world economic growth. The overall pattern for crude is to be shipped in very large tankers, then to be refined and the products shipped back around the world in small tankers. According to the statistics of BP-Amoco, Asia-Pacific region especially Japan held 58% of crude traded in the Middle East in 1999 while the U.S. held 13% and Europe 21%.

Today, over 35 million barrels of oil daily pass through the relatively narrow shipping lanes and pipelines, known as chokepoints due to their potential for closure. Oil transported by sea generally follows a fixed set of maritime routes. First, Bab el-Madab where tankers pass through Europe and the U.S. connects the Red Sea with the Gulf of Aden and the Arabian Sea. Both Bab el-Mandab and Suez Canal/Sumed pipeline complex's closure could keep Gulf tankers from reaching the Mediterranean Sea, diverting them around the Cape of Good Hope. Next, Strait of Malacca, connecting the Indian Ocean with the South China Sea and the Pacific Ocean, is the shortest sea route between three of the world's most populous countries (India, China, Indonesia). Except for the problem of piracy, it is likely to grow in strategic importance with the steady increase of Chinese oil import from the Middle East. Then, Panama Canal connects the Pacific Ocean with the Caribbean Sea and Atlantic Ocean. Around 64% of the total oil shipments went south from the Atlantic and Pacific, with oil products dominating southbound traffic. Finally, the Turkish Straits, dividing Asia from Europe and connecting the Black Sea with the Mediterranean Sea, are one of the world's busiest and most difficult-to-navigate waterways. It is the primary oil export routes of the FSU and the Russia.[52]

3. Tanker Transportation

This section attempts to analyze the tanker transportation because of its importance to the movement of petroleum and its products throughout the world. Crude, products and natural gas are moved by tanker but shipments of crude are by far the largest. Natural gas must be liquefied when moved by tanker to carry a large enough volume to be practical.

The size and pattern of tank shipping is determined entirely by ‘how much’ and ‘where’ crude oil is produced, refined and consumed. Technically, *Deadweight ton* (DWT) is a term used to rate tanker capacity indicates the amount of cargo that can be carried. A deadweight ton is equal to about 7 barrel of crude, depending on the specific gravity of the crude. According to Intertanko, the world tanker fleet as of January 2002 included approximately 3500 ships. These range greatly in size and include: “Ultra Large Crude Carriers” (ULCCs) of more than 300,000 DWT; “Very Large Crude Carriers” (VLCCs) from 200,000 to 300,000 DWT; “Suezmax” tankers between 125,000 and 180,000 DWT; “Aframax” tankers between 75,000 and 125,000 DWT; “Panamax” tankers of around 50,000 DWT; “Handymax” tankers of around 35,000 DWT; and “Handy Size” tankers of 20,000-30,000 DWT.

But what concerns us here is that each route usually has one economic size tanker based on voyage length, port and canal constraints and volume. Larger tankers are used for long voyages, smaller tankers are used for shorter hauls and for ‘lightering’ large tankers when the draft of the larger tanker is too great to enter a port facility. For example, VLCCs, typically carrying over 2 million barrels of oil on every voyage, have moved crude from producing countries in the Middle East and Africa to Europe, Japan and the U.S. However, the VLCCs are too large for all the ports in the U.S. except the one in Louisiana. Thus, they must have some or all of their cargo transferred to smaller vessels, either at sea (lightering) or at an offshore port (transshipment).[52, 53]

2. DEFINITION AND PROPERTIES OF PIPELINE

A. Overview of Pipeline Industry

1. History of Pipeline Industry

Since the beginning the industry has confronted the question of how to move crude oil from the production well to refineries and then to move the finished products to the consumer. At the beginning of the oil boom, oil in barrels or bulk was conveyed in the large flat boats. For the time being, it was understood that this method of moving oil was too expensive and hazardous and the magnitude of the oil business was huge. Railroads were the second solution to the problems of moving oil to the refiners. With the advent of railroads, the pipelines played an important role to convey oil from the wells to railway shipping. With so great in enlargement of the foreign demand and much less expense, compared with other transportation system, the pipelines became the most important transportation system in the early twentieth century.

Petroleum pipelines serve a duplicate role. First, they gather crude oil from the field and transport it to the refinery and then transport the various refined products to markets in a fast, efficient and economic way. This is called “Supplied Energy”. It seems that the supplied energy is mostly needed by industrialized and developed countries. For example the countries of central and southern Europe are generally poor in conventional energy resources. In spite of the Algerian gas conveyed under the Mediterranean sea and Russian gas, demand of Europe climbed 26% from 1989 to 1999 and it continues to increase so natural gas is the second fuel by the rate of 26%. However, though some third world countries have sufficient oil and/or natural gas reserves to satisfy domestic demand. They hardly need this type of energy and what is important is the foreign capital for financing the development and transportation of oil and natural gas. The words of other, without pipelines to move the oil and natural gas to export markets, production cannot be expanded.[54, 55]

Nowadays, in all research concerned with energy, transboundary pipelines construction activities are unavoidable for countries to meet their industrial and commercial demand.

The first pipelines to carry energy were those lines built in the U.K. and on the Continent in the early 1800s to transport gas through 2-6 in pipe from the well to towns for heating and lighting purposes.[56, 57]

The first successful crude oil line made of wrought iron pipe- 2 inches in diameter and 5 miles long- was laid by Samuel Van Syckle in 1865.[56, 58, 59] By that point, John D. Rockefeller and his Standard oil Company had strengthened his position within the U.S. oil industry and had come to dominate not only refining capacity but also transportation. To break Rockefeller’s hold, the first cross-country pipeline was laid in Pennsylvania in 1879, a 109-mi long, 6-in diameter from Bradford to Allentown.[53, 54]

2. Definition of Pipeline

Pipeline is the efficient and the convenient carrying vessel between two or more point (station) in the transportation system gathering the petroleum at the wells and carrying it rapidly to the consumers.[60]

However pipeline does not transport the petroleum by itself. Here we mention a transportation system which means the pipeline system and related facilities owned, controlled and operated by investors, comprising an integrated system necessary for the transportation of petroleum for distribution to international petroleum markets and state markets.[61]

3. Petroleum Transportation Activities in Turkey

According to BOTAŞ report, total length of the pipelines was 6298 km in 2001. The first pipeline project for transporting crude oil, Batman-Dörtyol crude oil pipeline was commissioned by TPAO on January 1967. The pipeline has an annual capacity of 3.5 million tons transports. Şelmo-Batman crude oil pipeline that transports the crude oil in the Şelmo area to the Dörtyol terminals is connected to the Batman-Dörtyol pipeline. A total of 2.8 million tons (20 million bbl) of crude oil was transported through Batman-Dörtyol crude oil pipeline in 2001.[62]

Iraq-Turkey crude oil pipeline agreement was signed on August 1973 between governments of the Republic of Turkey and the republic of Iraq for the purpose of transporting the Iraqi crude oil to the Ceyhan (Yumurtalık) Marine terminal. The 968 km. long pipeline was commissioned in 1976. The second pipeline allowed an increasing the initial annual capacity of 35 MTA to 70.9 MTA. After the suspension of the line operations in 1990, arising out of the embargo imposed on Iraq by U.N., 31 million tons (230 million bbl) of oil was transported in 2001 by Iraq-Turkey crude oil pipeline under the UN resolution. However, because of the second Gulf war and , the situation of the line is now in question.[62]

The 842 km long Russian Federation-Turkey natural gas main transmission line enters Turkey at Malkoçlar at the Bulgarian border and then reaches Ankara.

The volume of gas transported gradually increased to reach 5-6 Bcma in 1993.[62] Equally significant, Blue Stream pipeline, which connects the Russia and Turkey under the Black sea, was completed in October 2002. In 2003, Russia is expected to only about 2 Bcm (70.6 Bcf) of natural gas but it is expected to increase the capacity of 565 Bcf per year in 2009.[63]

BOTAŞ has also initiated projects to promote natural gas usage throughout the country. They are Shah Deniz natural gas pipeline project, Turkey-Greece natural gas pipeline project (South European Gas Ring) and Turkmenistan-Turkey-Europe natural gas pipeline project. The most important crude oil pipeline project that makes Turkey an energy corridor between East and West is the Baku-Tbilisi-Ceyhan crude oil pipeline. It is aimed at transporting crude oil produced in Azerbaijan via Georgia to a marine terminal in Ceyhan, Turkey, with marine access to international markets.[63]

B. Structural and Functional Properties

1. Structural Properties of the Pipeline

Until the discovery of pipeline system, oil in barrels or bulk was transported by tank cars, float boats and /or railroads. With the advent of pipeline, it is used for not only a carrying vessel but also a carrying tool and a carrying way in energy industry.[64]

a. Identicalness of Carrying Vessel, Carrying Way and Carrying Tool

aa - Carrying vessel

The diameter used in any pipeline depends primarily on the volume to be handled. Oil and gas pipeline sizes vary from 2 in. to 60 in. in diameter. Typically, flow lines in oil or gas-producing field range in size from 2 in. to 6 in. OD; gathering systems consists of pipe ranging from 4 in. to 12 in. in diameter and long distance crude trunk lines and natural gas transmission lines can range up to 56 in. in diameter or more.[53]

The wall thickness that depends on pipe materials, geographical area and carrying fluid ranges from 0.188 in to 1.25 in. For instance, a greater wall thickness may also be required in corrosive soil environments or when transporting corrosive fluids. For offshore pipelines, heavier pipe may be required to resist installation stress during lying.[53]

bb - Carrying Way

All pipelines in areas where the land is used should be buried. Aboveground lines are permissible in desert regions, wasteland and in fence-off areas.[65] After the route has been determined, right of land must be obtained throughout the length of the route before construction can begin. Width of the right of land varies according to the size line, the type of terrain, the construction method to be used, and special restrictions. Typically, the right of land width for a large-diameter, long-distance oil or natural gas pipeline is 50-ft. Of the total 50-ft right of land, 35-ft was used for operation of construction equipment and 15-ft was used for ditch spoil. Typically, the necessary depth for pipeline construction varies 43 in. to 51 in. and the width of the essential hole is 14 in. to 28 in..

The offshore pipeline is buried 36 in. below the seabed for normal excavation and 18 in. for rock excavation.[53]

cc - Carrying Tool

This is not only the structural properties but the functional properties as well. Therefore, section 2/c attempts to analyze these significant properties of the pipeline.

b. Facilities

aa- Pump and Compressor Stations

Pump stations for liquid pipelines and compressor stations for natural gas pipelines are the most significant part of the pipeline system. For the transportation in pipelines, the appropriate pressure potential has to be available to overcome the friction losses and the existing geodetic level differences (elevation losses). If this pressure potential is not naturally available, it has to be provided by the pump stations. In production fields, gathering pipelines do not need pumps or compressors. The natural pressure at the wellhead is high enough to cause fluid to flow to the gas-processing plant or lease storage tank.

The number and location of stations depend on meteorology (temperature, precipitations, atmospheric pressure…etc.), soil conditions (geology, morphology), accessibility, and possibilities for energy supply, for water supply, for sewage disposal. The longer the line, the more station may be required. The distance between two stations is typically 40 to 300 km.[53, 64, 66]

The oil trunk lines are run by main pumping stations and by relay pumping stations. The main pump stations are usually composed of a tank farm, a transfer pump house, boosters pump house, regulation units, pipes, the pigging installations and the leak oil system.[67]

bb- Pressure Reducing and Regulating Unit, and Metering Stations

Pressures are increased or decreased as the demand varies in different part of the system, via dispatching orders to pipeline companies border regulator stations. Pressure reducing system therefore is an integral part of distribution lines. Regardless of the system, low pressure is required for residential and some commercial and industrial usage. The main transmission lines picks up gas (60-250 psig) at the city gas station, where the gas is measured and reduced in pressure and carries it to the main distribution system. The main distribution lines generally carry gas in excess of 20 bar.[3]

Metering stations are able to monitor, directly or indirectly, the volumes of metered gas, the flow rates and other values associated with operating conditions with the necessary precision and reliability. The metering system consists of 2 or more metering units placed in parallel, if the particular nature of the operation (considerable seasonal changes in flow rate supplied) does not allow consumption to be kept within the metering range applicable to a single unit.[53]

cc- Valves and Fittings

Valves are used to govern the flow of fluids within a pipeline. Valves and fittings also contribute to overall system pressure loss due to friction of the flowing fluid with the walls of the pipeline. In a pumping station, for instance, where many valves exist and many changes in flow direction occur, pressure loss in valves and fittings is important. Moreover, they are used to reduce pressure and to stop fluid flow in the emergency and spill situations.[53, 68]

dd- Tanks

Storage facilities of crude oil and natural gas are an important element in all pipelines. Storage allows flexibility in pipeline and minimizes unwanted fluctuations in pipeline throughput. Tank farm or head station are special kind of storage facilities to store discharge and relocate the products.[53, 66] The oil trunk lines and product lines, which are shorter than 800 km, work on a “pump to pump” mode with no intermediate storage capacities. The lines longer than that are equipped with storage capacities at relay stations. The average distance between relay stations should not exceed 400 km.[67]

c - Monitoring

Concern about safety and environmental protection grew in the late 1980s. Traditionally, pipelines were inspected visually by traversing the route on the ground or patrolling the pipeline route in light aircraft but now developing instrumentation and monitoring equipment that will provide more rapid and precise location of leaks and potential leaks.

Pipeline monitoring programs are used to follow the effects of corrosion or mechanical damage to insure that the pipeline continues to meet safety and operating requirements.

A requirement for any successful leak detection systems accurate and repeatable pressure, temperature and flow measurement instrument. Hydrostatic pressure testing, advanced magnetic-flux leakage pigs, acoustic emission and ultrasonic leak detection tools are significant monitoring techniques. In natural gas pipelines, leaks can be inspected with surface sampling instruments using the flame-ionization principle. In pump and compressor stations, corrosion of piping and vessels must also be monitored constantly to prevent failure.[53]

2. Functional Properties of Pipeline

We mention in the preceding chapter that pipeline is not only a carrying vessel and a carrying way but also a carrying tool. With this observation in mind, pipeline as a carrying tool necessitates a huge investment at first given only one time throughout project period. As a result, an uninterrupted and one-way transportation system is constituted for conveying special kind of fluids and materials. So, this system does not easily adopt the rise or fall of the production rate and the sensitiveness of market that depends on change in demand and supply or price. If the market demand of material conveying in pipeline is reduced, low capacity pipeline is suffered loss. Therefore, pipeline works on full capacity in order to be efficient for energy transportation.[64]

a- Mass Carrying

Pipeline, as analyzed above, is much more transportation capacity than the other conveying methods. For instance, the Ceyhan-Kırıkkale crude oil pipeline, 448 km in length and 24-in diameter, has an annual capacity of 5 MTA. However, a total 3.2 MTA of crude oil was transported through pipeline in 2000.[62] Eastern Anatolia natural gas main transmission line schedule was revised to start with 3 Bcma in 2001 and reach 10 Bcma in the period in 2007.[62]

b- Carrying specific material

Today pipelines are mostly providing convenient transportation for coal, chemicals, oil, gas and products. In addition to those, there are other types of energy-related pipelines such as LNG, CO_2, coal slurry lines …etc.[53, 69]

There is another type of pipeline called commodity transporter. It is divided into two; waste commodity and raw commodity (limestone, sulphur, fertilisers…).[57]

It is important to bear in mind that the oil and natural gas pipelines are the most rapid expanded networks, which were efficient and economic way to petroleum to consumers.

c- Easy, continuous and economic way of carrying tool

After the selection of proper route and obtained rights of land and the required permits for operation, the construction of pipeline is the easiest phase of the project.

It is not necessary to build additional facilities for loading and unloading. Moreover, pipeline directly tie up the production and processing area to consumption centers. In fact, the flow of petroleum is not affected by climate condition and other factors obstruct the transportation so pipeline supplies an uninterrupted conveyance to the world market.[53, 64]

Pipelines are energy-efficient. An investigation in the 1980s concluded that crude trunk lines consume about 0.4% of the energy content of the crude transported per 1000 km. These rates compare with estimates 1.0% for oil movement by rail and 3.2% for oil trucks.[53]

To sum up, pipeline is capable of economically transporting large amounts of energy over long distances uninterruptedly without any loss.

3- Types of Pipeline

Pipelines are usually divided into two categories on account of conveyed material: petroleum pipelines and other process and utility lines. Our main study of this work is the petroleum pipelines which is divided into two subclasses with regard to carried energy; oil pipelines and gas pipelines. From legal viewpoint, the division based on the structural properties of pipelines is not significant in law and especially in liability law.[53, 64, 68]

Most of the oil and gas pipelines are divided into three groups: Gathering, Trunk or Transmission, and Distribution.

a. Oil Pipelines

Flow lines, small-diameter pipelines within an oil field, are used to move produced oil from individual wells to central point within the field for treating, storage or processing facilities. The pressure that forces oil to flow to the surface is usually sufficient to move the oil on to the central field facility. They are usually owned by the producer. As they only cause accidents within the fields, the producer company undertakes the liability of the accident.[53]

Next chain is the gathering line that transports oil from field processing to a large storage tank or tank farm. The producing capacity of the wells and the number of field storage tanks are the main criteria of the gathering systems capacity. These gathering systems are normally owned by the pipeline company that operates the main trunk line.[53]

Lastly, the crude trunk lines or transmission lines a large-diameter, long-distance lines connect the large central storage facilities to refineries or marine facilities. The crude trunk lines network comprises a wide variety of pipe sizes and capacities. Pumping stations must necessitate along the line to maintain pipeline pressure at the level required to overcome friction and changes in elevation. They operate at higher pressures than gathering lines and are also made of steel. Secondary trunk lines are easy way to convey oil to necessary point by conveying and using the main trunk line.[53] In Turkey, for instance, the crude oil produced in Batman, Diyarbakır and Sarıl regions is transported to Dörtyol through Batman-Dörtyol trunk lines by connected secondary trunk lines.[62]

b. Gas pipelines

Like crude flow lines, gas-well flow lines connect individual gas well to field processing facilities or to branches of a larger gathering system. However, many gas wells produce at high pressures that must be reduced at wellhead by a choke before gas enters the flow line. In processing facilities, water and acid gases are removed as they can cause corrosion and other problems in long-distance pipelines.[53]

Natural gas from processing facilities enters the gas transmission pipeline system for transportation to cities. Manufacture of large diameter, thin-walled, welded, and seamless steel pipe capable of withstanding high pressures facilitated the construction of long-distance lines. Controlling the deliveries of natural gas pipeline can be more complex than the operation of a crude trunk line because of the frequent and rapid changes of customer's need.[3, 53]

From the transmission pipeline gas is distributed through small, metered pipelines to individual businesses, factories and residences. For supplying natural gas to the consumers at adequate required volume and pressure, gas pressure is reduced step by step in the reducing, regulating and metering stations where gas also enters both filtering unit for separation of liquid and solid particles in suspension in the gas and preheating unit. The main distribution lines, which consist of steel pipes, convey the gas at operating pressure between 24 bar and 5 bar. Then, gas coming from the intermediary reducing and regulating station enters the distribution line at medium pressure. Plastic or polyethylene lines convey gas in front of the factories or buildings consumed. Finally, service line convey gas for customer supply from underground connection operating at working pressure less than or equal to 0.04 bar.

3. LEGAL BASIS OF INSTALLATION OF THE PIPELINE

A. Required Legal Structure of Pipelines Passing Through Immovable

1. General

A Transboundary pipeline is passed many immovable along the way between the entrance and exit points of each country. In other words, for the installation of the transboundary pipeline, right to permanent or long-term use of immovable involved in territory of each country where pipeline crosses should be obtained in pipeline operator's favor. Therefore, on the one hand certain rights of land are obtained to pipeline operators, and on the other hand tenants right of property has to be untouchable.

In a broadest sense, a tenant is one who holds or possesses lands or tenements by any kind of right or title, whether in fee, for life, for years, at will or otherwise. According to article 718 of Turkish Civil Code, a tenant is accepted to be the owner of both resources and buildings and other erections set up, on or underneath the surface of a certain piece of land. The words of other, the tenant is the owner of every integrated piece of land, which constitutes a whole (*Solo Cedit*). In this situation, the tenant has to have the position of an owner of the pipeline.

Typically, in the matter of the installation of pipeline, the problem of obtaining to get the right for the crosses of pipeline on or under the immovable is solved by an international agreement between the project operators and each of countries, where pipeline crosses. It is a kind of privilege agreement that respects obtained legal rights. The permanent or temporary rights, under which exemptions and privileges granted available, are qualified as administrative real property rights for the benefit of the one who built the 'course'. As a matter of fact that, article 7 paragraph 2/8 of the intergovernmental agreement dated 18.11.1999 between the Turkey and the Main Export Pipeline (MEP) participants stated that the State Authorities shall not characterize as or determine that this Agreement or any other Project Agreement is a special administrative contract granting a concession under Turkish Law.[71]

With regard to international public law, if the legal status of those agreements is taken into consideration, it can be seen that the agreements shall be the binding obligation of the states and shall become effective as the law of the state and prevailing over all the system of law except the Constitution.[71, 72]

Generally, the governments grant fairly extensive right and guarantee both for the selection of the pipeline corridor, and for the right to use and estate in fee simple upon and/or under the pipeline corridor and adjacent land.

For conducting all project activities, State Authorities will be liable to obtain to the project operators for the following exclusive and unrestricted legal estates other than ownership;[73]

- The right to construct and use temporary or permanent roads,
- The rights of access over other land between the public highway and the construction corridor,
- The property right to use, possess, control and construct upon and/or under the permanent land and the construction corridor,
- The permission of right to use by any other third persons chosen by the project operators.

In these type of international agreements signed by Turkey, the State primarily takes the immovable upon the pipeline corridor, from the tenants by a various ways and subsequently allocate the project operators. Moreover, the rights and privileges summarized above are warranted by the State Authorities. The State uses its authority of purchasing, expropriation, compulsory expropriation and others for providing the rights and privileges. These authorities were arranged in article 8 of the Code of Transit Passage of Petroleum within the Pipeline, numbered 4586.[74] According to the article 8, paragraph e, designated Public Association or Foundation provide the expropriation and other acquisitions by creating an easement and permanent and independent rights.

First of all, the governments provide land to pipeline operator by expropriation to be an appropriate way. However, it is an inconvenient way in respect of economy[75] because the pipeline corridor is generally an area of land within the construction corridor-8 meters wide so the expropriation of whole land is not economic. Moreover, it is impossible to expropriate every piece of land between the entrance and exit points for crossing the pipeline.

2. The Concept of Easement

In that situation, the most effective way is to create an easement. Easement is a right attaching to one piece of land (dominant tenement) entitling the owner thereof to exercise some right over adjacent land in other ownership (servient tenement) through not to take any part thereof, or to prevent the owner of the other land from utilizing his land in some particular manner. According to article 779 of Civil Code, easement is a right to direct use or title to land over dominant tenement owner who is the pipeline operator. On the other hand, this right makes the owner of the servient tenement both have the ability to avoid some authorities of right of property and tolerate the responsibilities of easement. Besides, to permanent build upon and/or under the someone's immovable is normally allowed by the right to build over another's property in articles 726 and 826 of the Civil Code.[76] Under articles 727 and 744, real right is provided by pipeline operators in means of creating an easement upon the immovable, which the pipeline passes across.[75]

In this matter, article 4 of the Expropriation Code provides that instead of expropriating the whole land, when considering the aim, it is qualified that easement is compulsory created upon, under or at a section of the immovable.

3. The Concept of Conduit

In article 727 and 774 of the Civil Code, the concept of "Conduit" is used to emphasis the facilities which are essential to transmit water, gas, electricity and like that. In the doctrine, the conduit, a technical installation, is built for transporting and distributing the forces and energies.[64, 76]

According to Charles Knapp, whatever its content, a tool that is suitable for carrying certain goods do not have to be the conduit. The conduit is an essential installation to transport fluids, gases and sliding things within the specially made canals. The act of transformation is formed by passing the fluid in a fixed pipe (body of installation) and no any part of the body moves.[75]

It is essential that to distinct each other the determination of the legal position of both the conduit and its ownership.[64, 75, 76] The 'Conduit' built on the area, which belongs to the owner, because the person's integrated part of the land under the immovable property construction in the Civil Code. Therefore, the tenant actually and legally becomes the owner of property of the conduit and also has a right to seizin over immovable. In transit conduit, the most basic way of passing the conduit through the immovables of private persons is to make an agreement with these people. Within this agreement, the easement which attribute to tolerate the obligation of the conduit, based on a long-time use, is provided to a new tenant even if the tenant immovable changes. It is important to bear in mind that this is a kind of right to build over another's property.

a. The property of conduits

It is necessary to make a huge investment to construct the conduits. For this reason, two question call for special attention to the construction companies; Who the property of the conduit belong to, and who is the possible user? Furthermore, some situations, like the getting out of the forces and energies transported within the conduit, causes significant harms that necessitate the responsibility of the owner of the conduit. According to the Turkish legal system, the conduits are both considered as the tenement and right in rem, created upon the tenement and qualified as “thing that is produced”. The owner of the conduit might therefore be liable in the respect of article 730 of the Civil Code and article 58 of the Obligation Code.

b. The structural and functional properties of conduit

The conduit must be necessarily suitable for transporting the objects, which are mentioned in articles 727 and 744 of the Civil Code.

The conduit expresses a man-made structure. Not only the expression of “... is constructed...” in article 726 of the Civil Code but also the expression of “... gas and alike pipes...” in article 744 of the Civil Code indicate that the conduits are the man-made and constructed carrying vessels. The expression of “... produce whatever it is...” in the article 58 of the Obligation Code, shows the explanation of some similar properties to the concept of ‘Conduit’.

In the doctrine, the concept of the conduit consists of water conduit, drying channel, gas and alike pipes, and electric lines and cables. Legally, it is not important to open or close-system structure. What is important is, although the conduit itself is in an inactive situation, the forces and energies are transported by flowing within fixed body of it.[64, 75] As a result, the conduit is an installation within which the things transported in an inactive situation.[64]

According to articles 727 and 744 of the Civil Code, on account of functions, the main aim of constructing the conduit is transportation; equally significant, they can transport certain things. The transportation process is provided by moving the things in certain direction and within definite boundary of the conduits but they do not directly interfere the movement of the energy of force.[64]

The movement of the energies and forces, transported by the long-distance courses, are solely provided by the additional tools and equipments. In the pipelines, for example pump stations, valve and fittings, tanks and graves are arranged in proper intervals so that they help the flow. These tools constitute an entire body all of which are defined as ‘Conduit’.[64, 75]

The expressions both of “the conduits of water, gas, electricity and like others” in article 727 of the Civil Code and of “water conduit, drying channel, gas and pipes and electric lines and cables” in article 744 of the Civil Code are used to limit the transportable things which must be qualified both as energy and force, and slippery and fluid. Hence, it is seen that crude oil and gas pipelines constitute a special branch of the conduits.

B. Danger Potential of Pipeline

The pipeline system has always been considered to be a safe and feasible way of moving the enormous quantities of petroleum we require to keep going each day. In spite of their efficiency, pipelines also have important environmental and safety risks. Obviously, a pipeline due to it’s considerable length, passes throughout a great variety of geological formations and it is characterized by a rather non-uniform and complicated failure risk distribution along its length.

If one wants to define the pollution risk due to failure, has to think of the following two components: a) the failure risk of the pipeline components and b) the degree of presence of pollutant prone geological formations at the point of failure. As far as the petroleum pollution itself is concerned, obviously this is determined by the characteristics and distribution of pollutant prone geological formations at the point of failure and the presence of environmentally sensitive natural and man made objects (lakes, forests, streams, rivers, villages, etc.).

Every year there are thousands of recorded leaks. For example, Greenpeace cites figures indicating that as much as 8-10% of the oil pumped into Russian pipelines pours out en route, with annual flows into the environment ranging from 25 to 50 million tonnes. If this information is anywhere near correct, many hundreds of square kilometres of Russian territory are rendered lifeless each year.

The two largest oil spills known to Greenpeace both occurred in Tyumen province in western Siberia. In the south of the province in 1989, around 500,000 tons poured out. In May-June 1993 in the Khanty-Mansiysky National District, an estimated 420,000 tonnes were spilled; much of this oil finished up in the Ob river, which flows into the Arctic Ocean. Neither accident was widely reported.

In the U.S. the Office of Pipeline Safety reports that from 1986 to 2000 the total of transmission and distribution incidents were 3,240 with 334 fatalities, 1,434 injuries, and $502,389,152 in property damage for the country. For instance, on January 1, 1990 an underline pipe connecting Exxon's Bayway Refinery and a nearby terminal ruptured and released over 500,000 gallons of refined oil into the

Arthur Kill, a water body separating New Jersey and New York. The spill affected several miles of shoreline and killed hundreds of birds in the area. The settlement totaled a $15 million cost to the company over a five year period. Payments included $10 million for "environmental initiatives" including the purchase of new wetlands, $4.8 million in restitution to the governments of New York and New Jersey and a $0.2 million criminal fine.

Taking all these circumstances into account, to be unaware of a little failure or defect in pipeline causes not only a significant environmental pollution and a risk of health for both animals and people, but also economical damages.

PART TWO

ENVIRONMENTAL HARMS DUE TO PETROLEUM SPILL

1. DEFINITIONS

A. Terminology

1. The Meaning of Environment

It is difficult to define the concept of environment because of no clear, exact and limited meaning. Environment generally means surroundings. However, it should not be understood 'just those things around there' but the interactive totality that comprises the planet, its biosphere, the individual species and organisms that live in it, and the human habitat and infrastructure. In the dictionary definitions, environment is 'whatever encompasses; specifically the external and internal conditions affecting the existence, growth and welfare of organisms'; 'all physical, biological and chemical factors that supply the essential things for growing and life of species', or 'the sum of biotic, abiotic and cultural factors and conditions that affect directly or indirectly long and short term facilities, life and growing of organisms and communities'. However, in the core, comprehension of the environment is still incomplete.[77, 78]

2. The Concept of Petroleum Pollution

Needless to say, a clear understanding of the terminology is necessary to avoid confusion on, and misunderstanding of the arguments written.

Technically, petroleum when spilled on land, in aquatic environments, or into atmosphere creates an environmental hazard. Thus, it is necessary to define that term. Environmental hazard is an extreme geophysical event and major technological accidents, occurred by concentrated release of energy and materials, which pose on unexpected threat to human life and can cause significant damage to goods and environment.[79]

Pollution is a word whose precise meaning in law and science is not easily discerned. ‘Pollution’ is defined as the deliberate or accidental contamination as a result of human activity, of substances, energy or noise into the air, water or land which harm the quality of the environment, destroy biogeochemical cycles, damage the health of humans and impair with amenities and other legitimate uses of environment.[80, 81, 82, 83] The reason of pollution can be described as disagreeable, noxious and toxic. Although some writers regard pollution as anthropogenic origin, natural resources can also provide enough extrinsic material to disrupt normal environmental processes.

On the other hand, for substances released without any evidence of harm, their presence in the environment is often termed ‘contamination’. According to U.K. Statute law, the contamination poses unacceptable actual or potential risks to health or the environment; and there are appropriate and cost-effective means available taking into account the actual or intended use of the site but this could not be judged to be ‘liable to cause damage or harm’. Therefore, a released substance contaminates the environment, and if it causes harm, it is *pollutant*.[78, 80, 82, 84, 85]

In a modern industrial society dependent upon petroleum as its main source of energy, it is no surprise that the pollution of the environment by petroleum is widespread and common.

In many respects, petroleum pollution is a desirable and accidental introduction of a mixture of many hydrocarbons into the environment to a degree capable of ;

- Impairing the structure and characteristics of soil and polluting indirectly the groundwater,
- Influencing the composition of water and effecting the marine and coastal ecosystem,
- Causing air pollution and threating the life of living species by inhalation.

3. Petroleum as a Pollutant

Hydrocarbon pollutants from petroleum representing normally over 75% of the constituents, are a complex mixture of alkanes, alkenes, aromatics, acids, amins ... etc. Other important components can be sulfur (0-10%), nitrogen (0-1%), and oxygen (0-5%). Heavy metals especially vanadium and nickel, found in complex compounds called *porphyrins*, can be found in the parts-per million level.

Containing variety of chemicals influence how petroleum behaves when it spills and determine the effects of the oil on living organisms in the environment.

The most important property of petroleum as a pollutant is toxicity. Factors that affect toxicity include molecular weight, hydrocarbon family, the organisms exposed to the hydrocarbon, and life-cycle stage of the organism exposed. The toxicity tends to increase with decreasing molecular weight. Smaller molecules tend to be more toxic than large molecules. Synergistic effects from the presence of other toxins can also significantly change the toxicity of specific hydrocarbons.[88] Studies suggest that the most toxic components of petroleum are aromatic hydrocarbons;

- Low-boiling point and low molecular weight aromatics, particularly Benzene, Toluene, Ethylbenzene and Xylene shortly called **BTEX**
- Polynuclear Aromatics Hydrocarbons (**PAH**) such as benzopyrene, many of which show mutagenic/carcinogenic characteristics.

Equally significant, other property of petroleum as a pollutant is solubility. Solubility in water is the measure of how much of oil will dissolve in the water column on a molecular basis. A high solubility makes a molecule more accessible for uptake by plants and animals. The most toxic hydrocarbons in fact tend to have a high solubility in water.[87, 88]

B. Preparing for Petroleum Spills

1. Risks and Hazard Assessment

Risk is the collective chance or probability of accidents and disease resulting in injury, loss or death.[89] A better quantification of risks provides a basis on which to judge whether an acceptable level of risk reduction has been achieved. The assessment of the potential risks, therefore, provides a numerical estimate of the probability of potentially adverse health effects from human exposure to environmental hazard.[88]

Estimation of risks on the ecosystem caused by the transportation of petroleum is one of the most critical concepts. Petroleum has potential dangers namely toxicity, corrosivity, flammability... etc. for flora-fauna, biota and human health. There is a 99% chance that there will be a spill of 5000 barrels or greater over the life of the pipeline and the most damaging leaks could occur at levels below detection limits over long periods. Therefore, the Pipeline Risk Assessment (PRA) provides a theoretical basis for quantifying risks associated with the pipeline. For example, in earthquake prone areas, the failure of the pipeline due to strong seismic ground motion is the main factor, which should be taken account for. When applying PRA to a situation which has not yet occurred but may occur, it is necessary to develop a hypothetical scenario somehow involving the release of petroleum into the environment so what concerns us here is that PRA attempts to take all the environmental variables and all the environmental costs into consideration. By using this scenario, a company can determine what types of preventive measures are worth pursuing depending on how much they reduce the probability or consequences of a given incident. To increase the understanding of the assessment for developing pollution scenario, PRA should consist of 4 steps:[88]

- *Hazard identification* determines the nature and amount of toxic pollutants that could potentially be emitted. It also determines the complete exposure pathways for the spread of the pollutant after a release and the adverse health effects associated with these pollutants,
- Considering that the aim of *Dose-Response Assessment* is to determine the actual toxicity of each substance identified in the hazard identification. In fact, it should involve a full description of the toxic properties of the pollutants, including acute (short-term) effects, chronic (long-term) effects, and the carcinogenic potential for different dose levels.
- *Exposure Assessment* for determining the extent of potential human exposure to any emitted pollutants includes characterizing the emissions, modelling dispersion of the emissions and quantifying the resulting exposure from each pathway.
- *Risk Characterization* that describes the nature, magnitude and uncertainty of the health risks associated with each pollutant should honestly evaluate the uncertainties of the information used in the assessment.

Even though the environmental risk assessment could be prepared, for any remaining risk, Containment plans to be added to the main plan and Contingency plans to be invoked if containment fails.

2. Spill Contingency Planning and Response

Primarily, it is important to indicate the reason of selecting the term ‘contingency’. That is because a fundamental reason for creating and supporting a plan is to prevent an out-of-course event, its impact and consequences, affects of the following disaster that is, from interrupting or stopping the process.[90]

Contingency planning has to be prepared for an event that might actually take place. It involves analyses of the material carried and the environments crossed. These plans also describe ways to eliminate the source of the release, to assess the character, amount and extent of release, to identify ways of containing the release so any impacts are minimized to recover all lost or polluted materials, and to notify relevant regulatory authorities.[88]

The development of a spill contingency plan is based on consideration and analysis of a wide variety of factors. Included are geographical elements (location of the spill, drainage characteristics, surface conditions, soil type, accessibility), environmental elements (weather conditions, hydrology) and ecological elements (sensitive and vulnerable areas, endangered species).[91]

Moreover, spill contingency planning and response necessitates both engineering elements including pumping and drainage characteristics, valve placements, monitoring equipment, operating procedures and communications, and control systems and prior knowledge of the properties of an oil to predict the behaviour of spills for the effectiveness of spill-response techniques (dispersant, in-situ burning...).[91, 92]

An effective contingency plan should aim at a situation where what-to-do actions can be made, not those based on panic reactions. Therefore, before a spill, some basic steps need to be organized: [88, 93, 94, 95]

- Identify risks and consequences, catalogue particularly sensitive areas; and determine the potential impacts of emergencies on the environment.
- Develop and implement a consolidated mapping system for rapid deployment in the event of an actual incident.
- Define the resources, capabilities and response assignments of each agency involved in response, cleanup, and removal activities in a petroleum spill.
- Define roles and responsibilities of all personnel during an emergency.
- Make a detailed response action for each potential emergency.

Detailed response plans must certainly be prepared for immediate action to be taken wherever and whenever spills occur so Immediate Response Team (IRT), the first and the most important level of the Spill Task Force, is trained and equipped to handle minor spills without additional assistance. The primary functions of the IRT are to provide for public safety, contain the spill, and exclude the spill from sensitive or vulnerable areas. For small spills, the IRT may be capable of complete control and cleanup. For larger spills, they provide stop-gap measures until greater resources can be mobilized.[91]

To sum up, the contingency plan generally describes the logical and sequential order of what-to-do actions. However, as pipelines characteristically extend considerable distances and encounter a variety of environmental conditions, an effective contingency planning and response indicates the actions to be taken, their sequence and timing on relation to other events. Furthermore, both regional contingency plans aiming to develop common procedures and policies on abatement methods and financial arrangements, and a national contingency plan providing to establish a mechanism for mutual assistance have to essentially be developed.

3. Cost-Benefit Analysis

In recent years, with an increase in environmental awareness, the pipeline industry ensures that projects it finances are environmentally sound. However, these 'environmental' investment costs are included in a project's economic analysis but corresponding benefits are not. As a result, the economic analysis is incomplete and its findings can be misleading.

In economic analysis, all environmental effects, both costs and benefits, should be identified and quantified by measuring the change in- or out-put so more comprehensive environmental cost-benefit analysis would improve the estimate of a project's development impact and provide information to managers on the benefits associated with specific environmental investments.[96]

To measure correctly the economic damage done by pollution concerns the calculation of the economic value of natural assets and resources, which are much higher than any market price. However, the lack of scientific knowledge on the subject fundamentally regards the dynamic effects of different types of pollution on various ecosystems. As a result, in the impossibility of estimating the economic value of the entire ecosystem we evaluated the damage for one of its components or specific aspects. For inland water, for instance, the damage could be estimated by measuring the cost of replacing the fish presumably destroyed by pollution and this replacement cost should be extended to obtain the total cost of dealing with habitat damage caused by pollution.[97]

In cost-benefit analysis human health benefits are a classic example of 'intangibles' not subject to economic evaluation. The problem of estimating economic damage is mainly the insufficient knowledge of the relations between the spread of illnesses and the presence and intensity of the pollution. According to research, the main economic due to the harmful effects of air and water pollution on human health are the employees' wage losses, employee's lost income, loss of domestic work by housewives, and increased expenditure for medical treatment and hospitalization.[98]

Equally significant, in a pipeline project, cost-benefit analysis have to be made for the attribution of given effects to a certain level of pollution and the placing of an economic value on these estimated effects. The analysis followed the steps described below:[96]

- Identification of all impacts caused by pollution generated by pipeline,
- Selection of impacts to be quantified and valuated on the basis of economic significance and availability of data,
- Description of non-quantifiable impacts,
- Valuation of selected impacts,
- Evaluation of the profitability of the proposed environmental investment on the basis of Net Present Value (NPV) and Economic Rate of Return (ERR).

As a result, a well-prepared cost-benefit analysis would improve the estimate of a project's development impact; enlarge the information base available to public policy makes by estimating the benefit and identifying the beneficiaries of environmental investments.

2. PETROLEUM SPILL, ITS IMPACTS AND CLEANUP TECHNIQUES

The pipeline industry has increased dramatically with the emergence of new production areas and the developments in sub-sea reserves. However, because pipelines convey a variety of hazardous and toxic materials by passing through many countries, they are always a real threat to the local population and the surrounding environment. With the improvement in design of pipelines, the main cause of leakage that can be classified into 3 categories according to the magnitude of the leakage flow: Seepage (0.1% of the maximum flow rate in the pipeline), Leakage (between 0.1 to 4.5% of the maximum flow rate) and Line break (5% or greater escape) has become errors in controlling the internal pressure, and other human factors. In this section, we attempt to analyze the behavior of spilled petroleum, its impacts to the environment and remediation facilities on land, in aquatic environment, and in atmosphere.

A. Petroleum Spills on Land

While the vast majority of oil spills come from leaks or breaks in pipelines, land spills receive less attention from the media and the public. However, transboundary pollution, for instance, is taken into account, petroleum spill on land typically causing groundwater and/or river pollution become very important not only for local people and environment but for adjacent lands as well. Therefore, this section has scientifically dealt with the movements, effects and cleanup techniques for spilled petroleum.

1. Behaviour of Oil on Land

The spreading of oil across the surface and the penetration through the deeper sections of soil are more complex on land than on water. Types of soil, moisture conditions of soil, slope of land, and level and flow rate of the groundwater are the effective factors of the movement of the oil.

Primarily, soil is both a porous material through which solutions and suspensions can move and a highly absorbent material that preferentially adsorbs molecules and particles from solution or suspension. In fact, 'permeable' soil is a filter that retards the passage of chemicals to the groundwater and a bioreactor in which many organic pollutants can be decomposed.[85, 99] Sand is the most permeable type of soil. Others such as clay, silt or shale are 'impervious' soils.

Additionally, groundwater is water present in the soil within a zone of saturation; it is generally derived from precipitation or stream infiltration. The upper surface of the saturated zone is called the water table and may be near the land surface or hundreds of feet below it. Groundwater is a fragile resource; once polluted, it is difficult to remediate.[100] The oil's ability to penetrate soils and its adhesion properties also vary importantly. Viscous oils, such as bunker fuel oil, often form a tarry mass when spilled. Non-viscous products, such as gasoline, however move in a manner similar to water. Crude oils, having immediate adhesion properties, saturate the upper 10 to 20 cm. of soil and rarely penetrate more than 60 cm. The oil generally penetrates to this depth if it has formed pools in dry depressions.[87]

2. Movement of Oil on Land

a. Movement of Oil on the Surface

When oil spilled on land, oil horizontally moves down gradient until either blocked by an impermeable barrier or all oil is absorbed by the soil. Some of the volatile compounds, the most toxic hydrocarbons, either lost to the atmosphere or can be sorbed onto the waxy cuticle of plant leaves. As the decending (higher molecular weight) oil called 'slug' moves through the soil, remaining material adhere to the soil. More of the adhered oil is carried downwards by rainwater. The movement of the oil will be greatest where the water drainage is good.[85, 87]

b. Movement of Oil in the Subsurface

Spilled oil often migrates towards excavated areas such as pipeline trenches, filled in areas around building foundations, and utility corridors. Such areas are often filled with material that is more permeable or less compacted than removed material during excavation. The bulk of oil moves downward under the influence of gravity until it reaches the groundwater or another impermeable layer. The extent of movement of oil in both the vertical and lateral directions depends on the porosity, the permeability and the resident water content of the unsaturated soil being penetrated.[99] The substrate of soil act as a proper buffer against the transport of oil to the groundwater. In the unsaturated zone, pollution may exist in 4 phases: *air phase*-vapor in the pore space, *adsorbed phase*-sorbed to subsurface solids, *aqueous phase*-dissolved in water, *liquid phase*-nonaqueous phase liquids (NAPLs).[101] Petroleum transport occurs in the vapor, aqueous and NAPL phases.

Petroleum hydrocarbons, termed light nonaqueous phase liquids (LNAPLs), less dense than water. LNAPLs will migrate vertically until residual saturation (vadose zone) depletes the liquid or until the capillary zone is reached. The capillary zone where the primary movement is lateral and a 'spreading' effect occurs has a significant influence on the movement and distribution of LNAPLs in the substrate. Lateral spreading will occur in all directions, but the predominant movement will be with the slope of the water table. As more free LNAPLs reach the capillary fringe a layer of increasing thickness begins to form on the capillary fringe under the influence of the infiltrating LNAPLs. Infiltrating water, in fact, will gradually dissolve components of LNAPLs, such as BTEX and carry the BTEX somewhat faster than other hydrocarbons to the groundwater. The BTEX compounds are of interest because these typically present the most immediate threat to groudwater.[99, 101, 102] Since LNAPLs tend to be volatile, some of the spilled material will also partition into the soil air and move through the vadose zone by molecular diffusion. That creates explosion hazards.

The characteristics shape of movement of the LNAPL in the capillary zone is called an LNAPL *pancake*. In general, the more permeable the soil, the more the petroleum will spread and the less thick the pancake will be.[99] Ultimately, the result of subsurface soil pollution is groundwater pollution, if the removal processes were not enhanced.

In a larger spill, the free product, often used when describing subsurface flow of NAPLs at concentrations above residual saturation, may reach water table. The water-soluble components of petroleum both begin to dissolve in water, polluting groundwater and may change the wetting properties of the water, causing a reduction in the residual water content and a collapse of a capillary fringe and depression of the water table.[100] If the flow from the LNAPL source is stopped, it will then not only tend to spread laterally along the top of the capillary fringe but also gradually be released by dissolution as groundwater moves through this zone.

3. The Effect of Petroleum Spills on Land

The effect of petroleum pollution varies widely according to the history of the spillage, the nature of the locality and the condition of its biota. Returning the ecosystem as much and as quickly as possible its original condition is always a high priority when cleaning up oil spills.

The first significant effect of petroleum spill across the surface of the land is any quantity is likely to be upon vegetation. During the respiration and photosynthesis the plants pores' mostly on the underside of their leaves, may be penetrated and blocked by thin oils so their leaves are darkened. While a coating of dark oil excludes the sunlight necessary to the functioning of all green plants, an individual leaf invariably dies.[103] Secondly, anaerobic conditions and restricted plant growth can also develop when oil on the surface weathers and forms an impermeable crust that reduces the air exchange.

On *agricultural land*, as oil penetrates deeper sections, the danger of groundwater pollution is greater than in other habitats. *Dry grassland* shows some similarities to agricultural land. The presence of vegetation is moreover, viewed as a symptom, not a problem. After the remediation, replanting can speed up. In the *forest*, low-lying vegetation such as shrubs and grasses much more sensitive to oiling than trees but during a serious spill, because of the affected roots, most trees will be killed and the forest will not recover fully for decades. *Wetlands*, the habitat of many species of birds and fish as well as other aquatic resources, are mostly affected by oil spills since they are at the bottom of the gravity drainage scheme. Oil from other areas flow into the system, creating anaerobic conditions that slow oil degradation. If root system of plants is damaged by the oil or the cleanup process, it takes years or decades for the plants to grow back.[87] Birds and small mammals may enter the polluted area to feed on intersects or earthworms affected by the oil, becoming oiled or intoxicated themselves.

Many cleanup practices for petroleum spilled on soil result in volatile hydrocarbons being emitted into the air and transported from the spill site. With respect to the long term adverse affect of the Volatile Organic Compounds (VOCs), only benzene is a recognized human carcinogen and haemotoxin, and little evidence of mutagenicity or teratogenicity exists for any of the other BTEX compound. The neurotoxicity of volatile hydrocarbons has some harmful effects on the central nervous system, leading to symptoms such as dizziness and amnesia.[85, 103] Moreover, benzene and toluene are lethal to fresh-water fish.

4.Cleanup and Remediation

a. Cleanup of Surface Pollution

It is very important to prevent the oil before penetrating and spreading through the subsurface by both containing it and removing the source of spill.

Firstly, *Berms or dikes* can be built to contain oil spills and prevent oil from spreading horizontally. *Sorbents* can also be used to recover some of the oil. *Shallow trenches* can be dug as a method of containment.[87]

Secondly, any excess oil that can be recovered without causing physical damage to the environment is always removed from a spill site by using suction hoses, pumps, and vacuum trucks. If not, the oil may destroy the vegetation and pollute the groundwater. Then, for extremely sensitive habitats such as wetlands, tundra ... the process of leaving the spill site to recover on its own is chosen not to damage the vegetation's root systems by cleanup operation.

Finally, to cleanup enhanced oil spill, some chemical and biological methods are used. For example, *biodegradation* by a consortium of organisms is a possible method for cleaning-up certain amount of oil. *In-situ burning*, another technique, removes oil quickly and without disturbing the area extensively although it does not only damage or kill shrubs and trees but also destroy the root systems and change the soils properties. *Hydraulic measures*, such as flooding and cold or warm water sprays, can also be used to deal with land spills although they are only effective in limited circumstances.[87]

b. Cleanup of Subsurface Pollution

Oil spills in the subsurface necessitate so complicated and expensive cleanup methods that the risk of groundwater pollution is greater.

Initially, the movement of oil must horizontally and vertically be stopped or slowed by digging an *interceptor trench* or placing 'slurry walls' (mixture of clay or cement), although this may cause physical damage to the site.

After the spill is contained, there are a number of cleanup methods that can be used. Once, *natural attenuation* is the process by which oil is naturally degraded in the subsurface and the decline in residual concentration could apparently be observed. However, in more serious situations, *bioventing* (soil-vacuum extraction), the process of supplying air or oxygen to the unsaturated zone to enhance aerobic biodegradation of oil, is used. Air can be injected through boreholes screened in the unsaturated zone or air can be extracted from boreholes, pulling air from the surface into a polluted area. *Hydraulic measures* including flooding, flushing, sumps and french drains are effectively used in permeable soil and with non-adhesive oils. Moreover, *excavation* is commonly used technique for cleaning up subsurface spills especially in urban areas where human safety is an issue and finally, *recovery wells* are preferentially used in cleanup processes. The well is drilled or dug to the depth of the water table so that oil flowing along the top of the water table will also enter the well.[87, 104]

c. Cleanup of Groundwater

Unlike rivers, groundwater moves very slowly and it has been known for long that once groundwater is polluted, it is permanently lost. Especially with older spills, significant amounts of hydrocarbons can be trapped below the water table and traditional pump and treat is ineffective because of the low solubility of trapped oily phase hydrocarbons. Therefore, the technique for treating hydrocarbons in groundwater should immediately and seriously be applied.

First, *in-situ bioremediation* is the process to treat groundwater polluted with petroleum hydrocarbons. These systems for groundwater typically consist of a combination of injection wells and one or more recovery wells. This systems supply nitrogen, phosphorus and/or oxygen to bacteria that are present in the polluted groundwater. What is important is that groundwater flow must be sufficient to deliver the required amounts of nutrients and oxygen in a reasonable time frame.[105]

Secondly, *air sparging* is the injection of air under pressure below the water table. By displacing water in the soil matrix and creating a transient air filled porosity, air sparging provides two benefits for treating VOCs and petroleum hydrocarbons in groundwater aquifers. First, air sparging enhances biodegradation by increasing oxygen transfer to the groundwater. Second, it can enhance the physical removal of organics by direct volatile extraction.[106]

Finally, once pollutant concentration is reduced belowsome defined level, natural bioremediation used to complete the cleanup. It is accomplished by biochemical degradation, evaporation, adsorption and transformation by microorganisms.

B. Petroleum Spills in Aquatic Environments

The term 'spill' is generally used for tanker spills into the oceans or seas. However, both pipeline spills on land that reaches lakes, rivers and wetlands and offshore pipeline spills is regarded as a pollutant source for aquatic environments. When petroleum spills into the aquatic environment, it can harm organisms that live on or around the water surface and those that live under water. Spilled oil can also damage parts of the food chain. The best response to offshore spills of petroleum is to minimize the amount that reaches the shoreline.

1. Behaviour of Spilled Petroleum

This section describes the behaviour of a bubble column due to a sudden release of oil and natural gas from a broken subsea pipeline.

Primarily, if oil is released from the rupture, the process during the transportation of oil includes hydrate formation and dissociation, the advective and dispersive transport of particulate oil, and an oil-slick formation on the surface. Oil released from the rupture is driven into the water column as a plume due to the momentum of the discharge. As the plume rises, it continues to entrain ambient seawater due to the velocity difference between the rising plume and the receiving water. This entrainment reduces the plume's velocity and buoyancy and increases its radius. The oil in the release is rapidly mixed by the turbulence in the rising plume causing it to break up into small droplets. Then, it can be expelled from the bubble plume. As the oil droplets move up in the water column, they are vertically and horizontally dispersed by the turbulence field and can be subsequently transported a long distance by ambient currents and wind-generated waves. In the near surface zone, plume is deflected without appreciable loss of momentum and the dispersion of droplets is enhanced. Therefore, the surface signature of the oil droplets is approximately circular in shape with a radius of about 15 km. Moreover, the surfacing zone of big droplets is directly above the release site and relatively small. However, the surfacing zone for small particles is far from the release site and much larger in size. This is because it takes much longer time (nearly 30 days) for the subsurface transport of the oil particles.[107]

Secondly, in order to predict the consequences of a sudden break of a gas pipeline, it is important to know the behaviour of gas bubbles in water. The stability of ships and equipments can be strongly influenced in the immediate vicinity of the bubble column. A bubble column may also produce subsea currents, which can be dangerous for divers who can be sucked into the bubble plume. Technically, the release gas create a turbulent plume of an upward rising mixture of gas and water. During their upward movement, the gas bubbles will entrain water from the surroundings and form a 2-phase structure denoted as a bubble plume. During the rise of the bubble in the core of the plume, the amount of entrained water increases with the height above the gas source, and thus makes the bubble plume broader. The entrained water and the gas separated when the bubble plume reaches the surface. While gas mixes with air and rises into the atmosphere, water is expelled outwards from the centerline of the bubble plume. Furthermore, for a pipe rupture located at very deep water (between 250m and 750m), the released gas may react with the surrounding water and form hydrates due to the high hydrostatic pressure. Gas hydrates constitute a class of solids in which small molecules occupy almost spherical holes in ice-like lattices made up of hydrogen-bonded water molecules. The hydrate-forming gases include light alkanes, CO_2, sulphide, nitrogen and oxygen. The hydrates will then be transported toward the sea surface due to the buoyancy of the hydrate particles and advacted by subsurface currents. When the hydrates reach water depths of about 500m, the hydrates will decompose into methane gas and water. The methane gas will continue to rise to the sea surface and be transported away by surface winds. The water released from the hydrate will mix with surrounding sea water.[108]

2. Movement of Oil on the Surface

Once oil reaches the sea surface and form an oil-slick, a number of different processes immediately begin to act on it. These include weathering, evaporation, dissolution and advection, dispersion, photochemical oxidation, emulsification, adsorption onto suspended particulate material, biodegradation and sedimentation.

Evaporation has the greatest effect on the fate of oil. Within a few hours, the light and medium-weight components of the oil begin to evaporate for example, benzene and toluene so the remaining after evaporation is usually less toxic than freshly spilled oil. The remaining oil is also denser and forms thick *sludge* and *tarballs.* Tarballs, dense-sticky black spheres, may linger in the environment, washing up on shorelines long after a spill. After weathering, the remaining oil often forms sticky, viscous water-in-oil emulsions called ‘chocolate mousse’. The formation of emulsions is an important event that it substantially increases the actual volume of spill (4 times) and often killing wildlife. Dissolution and dispersion may expose subsurface life to toxic oil.[85, 87, 109, 110] Oil remaining in the marine environment will eventually be removed by biological degradation from bacteria, fungi and yeasts.

An oil-slick does not remain in one place but spreads over the water surface and approaches the coast by the mass transport of current and winds. Therefore, extensive lengths of coastline can be affected by relatively small quantities of oil.[87, 109, 111]

In freshwater environments, because of the minimizing water movement, the impacts can be more severe. In standing water bodies, oil tends to pool and can remain in the environment for long periods of time. In flowing streams and rivers, constant and unidirectional flow restricts damage of an oil spill and soon flushes away the pollutant. Yet, oil tends to collect on plants and grasses growing on the banks.

3. Effect of Crude Oil on Aquatic Environments

Once oil spills occur it may have devastating short-term effects on marine environments including a wide variety of ecosystem, species and habitats. Likewise many freshwater biota respond to oil in a manner similar to the seas. A spill's biological impact also depends on the type and condition of the oil. Some toxic components in a spill may evaporate quickly so fresh oil is usually more harmful than weathered oil.

Both pelagic (mid-water) and demersal (bottom-dwelling) *fish* are exposed to toxicity primarily through aromatic hydrocarbons in the water column. The lethal concentrations can occur in confined waters, such as bays and estuaries. The age of a fish is very important in terms of its sensivity to hydrocarbons, with adult fish tending to be less sensitive than juveniles.[87]

Plankton are plants and animals that live in the top few centimeters of the sea and include phytoplankton and zooplankton. Planktons are important because they are exposed to the highest concentration of water-soluble constituents leaching from floating oil and are additionally at the bottom of the aquatic food chain. Thus, oil ingested or absorbed by plankton is passed higher up the food chain until it is finally ingested by fish and mammals. Plankton is killed by very low concentration of oil. Some sublethal effects of oil on zooplankton include narcosis, reduced feeding and disruption of normal responses to light.[87, 109]

Intertidal algea, an important food source for much of the fauna, *macro-algea*, and *sea grasses* can be severely affected by an oil spill. These plants are killed by intrusive cleaning techniques such as washing with hot or high-pressure water than by oil. Sublethal effects include reproduction and respiration rates and changes in color.

Spills usually do the most damage in coastal areas, which are both the habitats and breeding grounds for many biological species and home to many shallow-water bottom-dwelling organisms including the eggs and larvae of many species that are sensitive to oil. *Salt marshes* are important ecosystems. They are habitat of many birds and fish that feed on a wide variety of inventebrates including crabs, snails and worms. The effects of oil on seasonal plants living in salt marshes are different: if the plants are in bud, flowering is inhibited; if the flowers are oiled, they rarely produce seeds; and if the seed are oiled, germination is impaired. Marshes are very sensitive to physical disturbance and intrusive cleanup techniques.[87, 109, 112]

An oil spill can also harm Birds and mammals in several ways:[87, 88, 109, 112]

- Physical contact (hypothermia): When fur or feathers come into contact with oil, they get matted. A coating of oil will cause most sea birds to die from hypothermia or drown because the oil alters the insulating properties of their feathers and impairs their swimming ability.
- Toxicity of oil (emphysema): Many species inhale oil vapors causing damage to the animals' central nervous system, liver and lungs. Some are also at risk from ingesting oil causing liver and kidney failure.
- Destruction of food resources: Because the oil pollution gives fishes and other species unpleasant tastes and smells, predators will sometimes refuse to eat their prey and will begin to starve.
- Reproductive problems: Oil can be transferred from birds' plumage to the eggs they are hatching. Oil can smoother eggs by sealing pores in the eggs and preventing gas exchange.

Other water bodies, such as inland lakes, ponds and rivers are home to a variety of birds, mammals and fish. Spills in those water bodies can affect plants, grasses and mosses. The human food chain can also be affected by spill.

4. Cleanups and Remediation

Oil spills happen to behave differently from case to case. Each spill has its own set of characteristics: location, close to shore, waves, current, time of spill, time after spill ... etc. The most important factor which influence how successfully the cleanup operation will be the availability and capability of properly maintenanced equipment and products (ships, skimmer system, storage ...etc.). Theoretically, the cleanup process of marine spill divided into 2: Treatment of oil at sea, also subdivided into 2 with respect to controlling process: containment and recovery, and treatment of oil on the shoreline.

a. Treatment of Oil at Sea

To prevent an oil slick reaching the shoreline, active measures to remove the slick from the water may be required called mechanical methods.

aa. Containment on water

Containment of an oil spill refers to the method of confining the oil, either to prevent it from spreading to a particular area, to divert it to another area where it can be recovered, or to concentrate the oil so it can be recovered, burned, or otherwise treated. The most common and basic type of equipment used to control the spread of oil is floating barriers, called *booms*. Booms with a 'sail' above the water line and a 'skirt' below are used to deflect oil from environmentally sensitive areas, to enclose and concentrate oil in thicker surface layers, making recovery easier. Generally, booms will not operate properly when waves are higher than 1 m. or currents are moving faster than 1 knot/hr. However, new technologies, such as submergence plane booms and entrainment inhibitors are being developed.[87, 109, 112] In calm water such as streams, slow-moving rivers, or sheltered bays and inlets, until more complex equipment arrives, *improvihed booms*, made from wood, plastic pipe, car tires, and empty oil drums, can be effective way to deal with spills.

bb. Recovery on water

After containment, recovery including physical recovery such as boom, skimmer and sorbents and chemical recovery such as dispersants, and bioremediation is often the major step in remaining oil from the environment.

The *boom* is moored at the end points of a rigid arm extended from the vessel, forming a U or J-shaped pocket in which oil can collect then trapped oil can be pumped out to holding tanks. A *skimmer* is a device for recovery of spilled oil from the water's surface. Skimmers often use oil-wet sorbent materials like polyurethane or polypropylene to collect oil. The efficiency of skimmers depend very much on weather and sea conditions, size of spill and vessel capability. *Sorbents* are materials that soak up liquids from 3 to 15 times their weight in oil. They can be used to recover oil through the mechanisms of absorption and /or adsorption. They are most often used to remove final traces of oil, or in areas that cannot be reached by skimmers. Any oil that is removed from sorbent materials must also be properly disposed of or recycled.[87, 109, 112]

Chemical and biological treatment of oil can be used especially in areas where untreated oil may reach shorelines and sensitive habitats where a cleanup becomes environmentally damaging. *Dispersants* are chemicals that contain surfactants, lowering the interfacial tension between the oil and water, or compounds that act to break liquid substances such as oil into small droplets. Oil was dispersed from the surface into the upper 3 m. Of the water, where it quickly become diluted and lost its toxicity. Dispersants also reduce the tendency of oil to stick to solid surface (fish eggs, rocks), making any subsequent shoreline cleanup easier. Dispersants are most effective when applied immediately following a spill, before the lightest components in the oil have evaporated. *Bioremediation* refers to the act of adding materials to the environment, such as fertilizers or microorganisms, that will increase the rate at which natural biodegradation occurs. It has been proposed as a method of accelerating the dispersion of oil slicks on open water. Two bioremediation approaches have been used for oil spill cleanups: Biostimulation, method of adding nutrients to stimulate the growth of microorganisms that break down oil, and Bioaugmentation, the addition of microorganisms to the existing native oil-degrading population.[87, 88, 112]

In-situ burning of oil, an alternative treatment, involves the ignition and controlled combustion of oil. Oil-slicks will ignite if they are fresh and at least 3 mm thick. It is typically used in conjunction with mechanical recovery on open water. Fire resistant booms are often used to collect and concentrate the oil into oil-slick. Although burning keeps slicks away from shorelines, it releases sooty black smoke and combustion products to the air.[112]

b. Treatment of oil on the Shoreline

When oil is spilled on the sea, oil-slick spreads over the surface of the sea and if the remediation activities were not done, oil-slick could begin to treat a long distance of a shoreline. In fact, an adjacent states shoreline may be treated. Freshwater and marine shoreline areas are important public and ecological resources. These areas serve as homes to a variety of wildlife during all or part of the year.

Both natural processes and physical methods aid in the removal and containment of oil from shorelines. Natural processes including evaporation, oxidation and biodegradation are significant methods helping to clean the shoreline. Physical removal of oil is the time-consuming and requires much equipment and many personnel. Before physical cleaning methods starts, booms made of absorbents materials are usually set up in the water along the site to prevent oil released from returning to the water. Wiping with absorbent materials, Pressure washing and

Raking or Bulldozing are the methods that can be used to remove oil from the shorelines.[112]

C. Air Pollution Due to Spilled Petroleum Fires

It has been known for long that pipelines pollute the air medium into two ways: *Facility gas emissions* and *Petroleum fires*. The former is that the pipeline projects will contribute to global warming through emissions will occur during construction, the bulk of emissions will occur during operation. The main source are pump staions, storage tanks, the ground flares at the terminal and fugitive leaks of natural gas along the route. Emissions from pipelines contain sulphur oxides (SO_x), nitrous oxides (NO_x), carbon oxides (CO_x), methane (CH_4), and VOCs.[113, 114, 115] Currently, there are no international, national or local regulations that set numerical limits on greenhouse gas emissions. Fortunately, the impacts will be moderate, short-term, and localized. However, their repetitious nature might lead to impacts at a regional scale.

Secondly and preferentially, the burning petroleum pipelines always create a danger, degrade the region's air quality and release various potentially hazardous gases. The following sections have dealt with the causes and effects of spilled petroleum fires to the environment and human health respectively.

1. Causes of Pipeline Explosions

In recent years, there have been an increasing number of investigations about the explosions in pipeline industry. Statistics show that failures in petroleum pipeline systems originate from:[116, 117] Direct failure of the pipe itself (corrosion, accidental hits, material defects and human error), or failure due to the subsequent failure of the pipe supports. Once explosion occurred, valves quickly were closed to stop petroleum flowing through line then were allowed to vent through the rupture and burn itself out. To reduce these failures, a number of actions including improved leak detection and pipeline inspection, the increased use of corrosion resistant materials (coated steels, PVC), and automatic shut-off valves must be taken.

2. Effects of Petroleum Pipeline Fires or Explosions

Industry experience indicates that pipeline rupture-initiated fires always result in only localized damage to the vegetation and animal life, localized human health impacts and localized damage to property. Even though the environmental impacts from natural gas failure are minimal, it can be taken into account with oil as natural gas can present both an uncontrolled explosive reaction and an extreme fire hazard when mixed in appropriate concentration with air in the presence of a viable ignition source.[118] To understand the impacts of petroleum pipeline fires, it's very useful to benefit the results of Kuwait petroleum wells and infrastructure fires.

The burning petroleum created a huge widely dispersed smoke plume that degraded the region's air quality and released a mixture of heated potentially noxious gases and coated carbon particles representing combustion products. The burning crude oil produced a wide range of combustion products: carbon dioxide (CO_2) and carbon monoxide (CO), sulfur dioxide (SO_2), oxides of nitrogen (NO_x) VOCs, ozone (O_3), various polycyclic aromatic hydrocarbons (PAHs), acid aerosols and hydrogen sulfide (H_2S), a major component of natural gas. The most visible evidence of the fires were the particulate matter and carbonized particles (soot) that formed the huge smoke plumes. The pillar-like plumes would broaden and join with other smoke columns at higher attitudes. Particles smaller than 10 micrometers in aerodynamic diameter (PM_{10}) posed the greatest hazard and have the potential to settle deep in lungs. In addition to hydrocarbon combustion products, the smoke contained other components, including various heavy metals. Present in crude oil as impurities, such as metals may include nickel; small amounts of vanadium and iron; and trace quantities of aluminum, beryllium, cadmium, calcium, chromium, arsenic, silicon, zinc and lead.[119]

In general, the plumes rose to 10.000 to 12.000 feet, mixed with air and the dispersed over several thousand miles downwind over a period of several weeks. These altitudes were high enough to rapidly remove a large portions of the smoke from the living things' breathing zone but in all research concerned with petroleum fires indicated that except for particulate matter, pollutant levels were surprisingly low and because of its ability to penetrate the deepest portions of lungs and its potential to absorb other contaminants (e.g. PAHs), the major health hazard associated with petroleum fires was the particulate matter being emitted.[119] However, SO_2 and NO_x, transboundary pollutant, are converted to acids when they combine with water vapor in the air, and when mixed with VOCs, ground level ozone forms. As a result, acid rain kills lakes and forests, degrades water supplies by leaching heavy metals into drinking-water supplies affect people's homes and agricultural lands.[120]

According to researches, exposures to high levels of many above pollutants cause short- and long-term illnesses, including upper respiratory irritation and various cancers. Results indicated the prevalence of short-term symptoms (wheezing, cough and runny nose) is directly proportional to the time each group spent in proximity to the petroleum fires and the rate of short –term health problems, including irritated and burning eyes, shortness of breath, skin rashes, and respiratory irritation are very much high. The most severe exposures from petroleum fires occurred when peoples and animals were adjacent to the damaged or burning pipeline. They were subjected to short-term exposures involving unburned-oil (oil rain) and/or fall-out (soot, smoke and other combustion by products) from petroleum fires.[119, 120]

As noted previously, due to the developing industry, the amount of accidents resulting from spilled and/or burned petroleum is seen to be neglectible and unimportant. However, the impacts of the spillage of petroleum might be environmentally and economically detrimental for both regional lives and adjacent biota.

PART THREE

LIABILITY LAW IN GENERAL AND APPLICABLE LAWS ABOUT ENVIRONMENTAL HARM OF PETROLEUM SPILLAGE

1. GENERAL OUTLOOK TO THE CONCEPT OF LIABILITY

A. The Origin of Liability

1. Introduction

Nowadays, transboundary pipelines show its face through not only the transportation of vast amount of energy fast toward many States, but also the massive environmental pollution resulted from the spillage of petroleum originating from those facilities. As a result of this, two questions call for special attention: Who is held liable for these environmental catastrophes, and for which reasons the obligation to repair and obligation to compensate are applied? Hence, it is essential to identify both the concept of 'liability' and its legal characteristics for the punishment and compensation of the pollution and harm emerged from the pipelines. Therefore, at first it is beneficial to investigate the basis of the liability law in order to identify these characteristics.

2. Terminology in Doctrine

The definition of the term 'transboundary' is the identification of the origin of liability for environmental interference which originate in activities within the jurisdiction or control of a state and cause harm on the territory of another state or in an international area, i.e. an area beyond the limits of national jurisdiction.[121] The States would therefore impose an obligation upon other states to account for transboundary harm in circumstances with or without wrongful act. This kind of obligations covering the whole field of preventing, minimizing and providing reparation for the occurrence of physical transboundary harm is based on the idea that the protection of unique ecosystems and the maintenance of biological diversity.

In international relations, the invasion of the legal interest of one subject of the law by another person creates responsibility in various forms determined by the particular legal system. In international law, the term ‘state responsibility’ (Liability *ex* delicto) used to refer to the consequences of a state’s failure to comply with its international obligations. However, there is close relationship and confusion between the state responsibility and international liability so the terminology needs to be clarified. ‘State Responsibility’ is generally used to describe only the consequences arising from the breach of international obligations. ‘Liability’ means to both the obligations and consequences of a breach of the obligation, and the duty to compensate damage in the absence of a violation of international law.[121, 122] Another distinction may be done in accordance with the rules of international law. State responsibility was codified as ‘secondary’ rules (that is, the legal consequences of breach of primary rules e.g. obligation to make reparation), not ‘primary’ rules of international law (source and content of rules governing the relationship between states). Unlike responsibility, international liability involves a ‘primary’ rules whose breach will amount to the commission of a wrongful act.[72,121,122,123,124] In this sense liability precedes the imposition of state responsibility.

When the origin of liability was discussed in ILC, it was concluded that liability for internationally wrongful acts should be distinguished from liability for acts not internationally wrongful and it was decided to use the terms ‘responsibility’ only in connexion with internationally wrongful acts and the terms ‘liability’ or 'strict liability' for other forms of liability, including liability for the injurious consequences arising out of acts not prohibited by international law. From this point of view, State responsibility prohibits both the act and conduct of causing harm and the activity according to the criterion of 'wrongfulness' or 'illegality'.

3. Liability and its Functions

In a broad sense, liability that is embodied as a concept is the obligation to eliminate one's harm done by another.[125, 126] On the other hand, liability law is to all the norms that organize the following questions: to whom, of which basis, of what sort of legal reasons, and how much harm do we burden that is caused or is likely to be caused. In our legal system, liability law is narrowly examined not only to the integration of the meaning of both fault responsibility and objective responsibility, but also under the topic of the non-contractual liability.[67,125,126,127]

In the system of international law, there have been three functions of liability. The object of the reparative function is to shift the injurious consequences of conduct in whole or in part from the victim to the author of that conduct through a compensatory arrangement. The risk distributor function could provide the distribution of harmful effects emerged from the facts which are born by the community to the wide range of society again. Finally, the preventive function is understood as the duty to force the parties to avert the imposition of liability in the events *ex ante facto*.[67, 121]

B. The Basis and Sort of Liability

Generally, the maxim of '*Casus sentit dominus*' states that every person should bear the injury or loss that happen in their personality and property.[125, 128] Nowadays, according to the many legal orders, it is accepted not to arise responsibility unless the system of law, which shifts the injury from the victim to the author, has to be created. The basis of this system of law is constituted by the principle of liability that establishes the liability for harm arising someone's conduct and the obligation to compensate.[67, 128, 129] The main thought of the formation of this principle is the necessity that for why and for what condition someone undertakes this liability. The principle of *Fault*, the principle of the cause an injury, the occurrence of the contravention of law, the situation of unfulfillment of due diligence obligation, and the principle of the creation of hazard are the major elements for undertaking the liability.

In Swiss/Turkish Law, Civil liability is categorized into three main groups on account of reasons of responsibility. These are: fault responsibility, objective responsibility, and liability without a wrongful act.

1. Fault Responsibility

Fault responsibility is that a person causes an injury or loss to another for the faulty and wrongful act committed either intentionally (*Dolus*) or through negligence (*Culpa*). Fault is the constructor element of responsibility. That's why; the essential element of arising responsibility is the wrongdoer's fault together with the injury, existence of a causal link and the wrongfulness.[67, 72, 127, 130]

In the system of Swiss/Turkish Law, it is judged that fault responsibility is mentioned to be rule, other types of responsibilities, however, is qualified as exception. Fault is not described in the system, but stated that intention and negligence form the fault. Article 41 of the Turkish Obligation Code states that every wrongful act of a person arising from fault and causing injury to another person resulted from the breach of legal rule entails the obligation to indemnity.

To sum up, a person who causes injury or loss has to bear its consequences and compensate the damage.

2. Objective Responsibility (Kausalhaftung)

Since the twentieth century, with the improvement in the energy, transportation, and production sectors, it has been difficult in complex technical conditions to identify whether there is a faulty act or not, or who the wrongdoer is. Generally speaking, those sectors present remarkable risks and hazards for environment but on the assumption of hazardous, it is not possible for society to relinquish these tools and mechanisms. Therefore, in the doctrine and agreements, the principle of objective responsibility has been starting to attract attention and people who operates these risky activities had to be held responsible for causing harm because the operator has used and benefited from the activities causing significant harm.

In the core, responsibility arises from the breach of the obligation without the need to prove fault as an additional subjective element. According to the objective responsibility, one has the obligation to compensate for causing harm although there is no evidence about moral or ethical fault during operation. For the materialization of responsibility, it is necessary to have a reason-result relationship between the event causing responsibility and the harm. The responsibility derives from the following facts that have to be considered by law: Breaching of due diligence duty and being the owner of risky and hazardous material or enterprise. There are some common points in these kinds of responsibilities. The power of appeal cannot be needed for responsibility, as the fault is not required and obligatory. Besides, the objective responsibility has to involve both the harm of the assistant person's conduct whether the faulty or not, and the harm of the Act of God.[67,126,127,131]

In doctrine and practice, the objective responsibility is divided into two:

a. Relatively Objective Responsibility (Strict Responsibility)

(Gewöhnliche Kausalhaftungen)

Relatively objective responsibility based on both the person's failure to attain the appropriate standard of care and the deficiency of the thing of which he is the owner. The attribution of due diligence is nothing more than the objectification of the fault responsibility. The owner of the thing must have some care and control over the persons and the things in order to cause injury or loss.[125, 127, 132]

The responsibility of employer (BK md.55), the responsibility of the shepherd (BK md.56), the responsibility of the owner of the 'construction work' (BK md.58), and the responsibility of the head of the family (MK md.369) are the types of relatively objective responsibility. In most of them, it is possible to avoid the responsibility by proving the emergence of harm although the due diligence duties were done or even could be done.

b. Absolutely Objective Responsibility (Gefahrdungshaftungen)

Absolutely objective responsibility is the most serious type of responsibility. This responsibility derived from the special laws, applied especially to ultra-hazardous or socially harmful facility and activities. The seriousness of hazard takes its source from not only the excessive tendency of causing harm of these activity, but the serious results, qualitatively and quantitatively, of the accidents of these activity as well.[67, 130]

The main thought here is that the person who threats the social life has to compensate the injury or loss for their conduct. Absolutely objective responsibility depends on the protection of the person who is economically weak and is under risk and danger against the powerful activity and enterprises having the huge capitals and technologies. Moreover, these activity and facilities are generally permitted or licensed by authorized offices so that they have a legal character and the fact that gives harm is not a question of unlawful. In this responsibility, the abstract risk and/or dangers are allowed but the fact that gives harm is not approved. For responsibility, it is necessary to prove the causal link between the hazardous activity and facility and the harm caused. The owner of the enterprise principally cannot hold responsible for harm, for instance, caused by *force majeure* or victims fault.[67,127,132,133]

In Turkish Law system, according to article 86 (2) of the Petroleum Act numbered 6326, the responsibility arising from petroleum activities of the owner of right of petroleum is considered as the absolutely objective responsibility.

c. Liability without a wrongful act (Haftung für erlaubte griffe)

Nowadays, the Courts has to generally protect these superior or dominant interests in the presence of entities providing economic and politic advantages to the States or the community in spite of their contribution to the environmental pollution. The interference that is derived from these protected interests and causes environmental pollution, reached the excessive level and primarily influence area of the owner of neighborhood immovable.

In this type of liability, although the injury or loss originating in lawful activity is taken into consideration, the obligation of avoidance the result and/or the obligation to prevent pollution do not have to necessitate. Here, in the conflict of legal values, the lawmaker gives a priority, a privilege to dominant legal value in the presence of the less dominant legal value and thus allows to sacrifice the less dominant legal value on behalf of the dominant legal value. The words of other, it is expected that one who makes sacrifice, has to bear the injury or loss. In reply to this, the obligation to compensate comes into existence.

The major distinction of the liability without a wrongful act from the absolutely objective responsibility is that while, in the former, the act causing obligation to compensate the injury or loss is in conformity with the law, in the latter, the act of operator causing responsibility is unlawful. For this reason, the liability without a wrongful act is accepted for usual operation harm; on the other hand, the absolutely objective responsibility is used for the operation accidents.

2. THE POSITION OF THE LIABILITY OF PIPELINE OPERATOR IN THE COMPARATIVE LIABILITY LAW

A. In The Law Of Continent Europe

1. General

In the law of Continent Europe following the tradition of German law, the judge directly must oblige to search the solution in the law. In these legal orders, even if the judge is authorized to create his own law across a new liability fact, the solution of the problem is sought in the law. In other words, there has been a private principle of law to define the liability in every event and it must be applied. As a matter of fact, Germany, Austria, Japan, Switzerland and Turkey have created the liability order like this.[134]

Under the concept of "hazard of enterprise", these laws originating from the hazardous activities accept the liability of the holder of the thing, the operator of enterprise and one who facilitate from the created injury or loss. In the countries except Turkey and Japan, private provisions about the liability of the owner of pipeline that transport flammable fluids and gases were taken into account. However, according to Anglo-American law system assessing the problems through the case-to-case, the solution is entirely left to the law of the Judge (*Lex Fori*). There are some legal orders carrying the trails of both applications. In that, there has been a provision, but the judge determines the area of application of this general provision. Despite being preferred in Socialist countries, some examples of this application have been found in the Continent Europe.

2. Legal Orders Suggesting Special Provisions About Liability of the Operator of Pipeline

a. Swiss Law

aa. Legal character of liability

In Swiss law, the liability of the operator of pipeline was regulated with the administrative subjects of the construction, operation and monitoring of pipeline and the privileges given in the 'Law of the Facilities of Pipeline that Transports Flammable and Explosive Substances in a Liquid or Gas Phase.'[135] Here, the liability of the operator depends on two fundamental facts: Fact of 'being operated' and Fact of 'out of operation'.

aaa. Fact of 'being operated'

'Being operated' is being in motion and the transportation of the substances that are found in the pipeline. The harms caused by active pipeline are compensated within the frame of the absolutely objective responsibility. The mentioned hazard is originated not in the existence or structure of pipeline, but in the quality of the transported substances that are flammable, explosive, and poisonous. Therefore, the absolutely objective responsibility depending on the fact of being operated emerges from the inactive pipeline in which the hazardous substances have situated.

bbb. Fact of ‘out of operation’

The operator does not only liable for the operation of the pipeline, or for the accidents during the operation. The operator even hold liable for the harm caused by inactive pipeline or, we can say, pipeline out of operation. This liability is attached to the pipeline’s defective situation. (Construction defect)

bb. Requirements of Liability

aaa. General requirements of liability

According to Swiss law, the requirements, which form the liability of operator, are categorized into three groups. First, according to RLG 33(1), injury or loss can emerge not only in physical or moral form against the one’s body integrity, but also into the movable or immovable goods. Secondly, it is necessary to prove the causal link between the harm and the construction defect of active or inactive pipeline. Final requirement is the illegality situation. The harmful result forms a violation in the frame of legal values. For example, in the situation of pollution of above or under ground resources by pipeline, we will confront with the harm getting into the protective function of the principle.

bbb. Special requirements of liability

aaaa. Construction of a pipeline

According to Code, operation privilege is given the pipelines only used for specific aims. Therefore, it should primarily be identified what kind of substances the pipeline would be constructed to transport, and then it must be necessary to make limitations on the structural properties for pipelines identified.

With respect to transported substances, transportation of flammable gases and liquids is taken into consideration during the application of this code. In that, transportation of petroleum and its products used in industry, crude and processed gases, waste gases and liquids emerging from the petroleum processing facilities, gases and liquids used as a fuel for industry and cities are in the content of the code.[136]

From the structural viewpoint, the specification in length, diameter and operation pressure in pipeline could not only identify the application area of law, but also limit the liability of operator. Moreover, pump station, warehouses ...etc, a complementary part of the pipeline facility is also taken into consideration. If so, pipeline facility includes the facilities reaching the delivery time and point where the substances is processed or used. However, the content of liability provisions excluded the oven and heater working with natural gas, the depot laid down into the house, and the pipe, the line, and equipments used for making connection between the main carrier pipeline and the depot.

bbbb. Liable Person

Article 33 paragraph 1 of the Code says "During the operation of the pipeline facility ... will be likely to cause harm, operator of the facility will be held liable. If the operator is not the owner of the facility, the possessor will become joint liable with the operator." The words of other, the code puts the distinction itself between the operator and the possessor. However, the law-maker considers the operator as a primary person to apply the compensation of the harm for the reason being as a primary liable because of the operator's more effective position to prevent harm than to the possessor. The operator might be the possessor, but if not, both of them must be joint liable.[137]

cc. Reasons for the avoidance of liability

The code had mentioned the reasons for avoidance in a limited perspective. Extraordinary natural events (*ausserordentliche Naturvorgange*), wars and war-like events (*krigerishe Ereignisse*), and serious fault of the victims (*grosse vershulden des Geschadigten*) are qualified as the reasons for the avoidance of liability. On the other hand, although the faulty act of third person is the reason for the avoidance of general liability, this prevents the operator to avoid the liability of the pipeline.

dd. Right of Litigation

The operation of pipeline creates danger and hazard for everyone. That's why everybody who suffers harm has a right of litigation, only if the requirements of liability are provided. For example, in the situation of pollution of above or under ground resources, it is accepted that even the State has right of litigation against the operator as polluter to compensate its harm.

ee. Indemnition of harm

aaa. Compensation

RLG 34 states "the content of compensation ... is defined on account of the general rules of tort." The demand of the victim is prescribed (under prescription) within ten years that aroused from the date of any harm, and within two years from the date of the victim's was being informed about the harm of the compensator.

bbb. Obligatory liability insurance

The Code, by following the developments in the liability law as similar in the law of Highway Traffic, obliges everyone to make insurance for gases and liquids but the amount of insurance for liquids is more than the amount for gases because crude oil might cause serious environmental harm; for example, there is a possibility for polluting the water source of the city that is becoming completely useless.

b. German Law

In the German Code, pipeline, at first, was accepted as “construction work” and the operator was held liable as “possessor of construction work.” In HaftpflG §2 entering into force in 1978, the application aim of this provision was broadened. In addition, it was distinctly arranged the liability of energy distribution and transmission facilities’ holder while the fact of liability, assisted from the concept of risky and dangerous transport vehicles, be identified.

aa. Legal character of the liability

aaa. Impact liability

In HaftpflG, the liability caused by the operational accidents was primarily arranged. ‘Impact liability’ (*wirkungshaftung*) formed like the absolutely objectively responsibility has been applied the harm emerged from materialization of typical dangers of the gas, vapor or fluid substances.

bbb. Condition liability

Here, liability is created or formed by the system of pipeline not to be found in a suitable condition. The meaning of “ being found in a suitable condition” is that the facility is found in a suitable and convenient situation by technically the most recent rules and applications. This is a liability of harm emerged from the pipeline out of operation. In other words, the existence of pipeline is the only reason. Liability, formed during the construction and operation phase, will be over when pipeline is unraveled and abandoned.

bb. Requirements of liability

aaa. General requirements

In German Code, these are categorized into 3 groups. First, an injury or loss has to be emerged for creating liability and then there has been a reason-result relationship between the injury or loss and the pipeline's typical dangers. Finally, German Code has only accepted the wrongful conduct because the meaning of 'operated pipeline' is that both the official position and the code could allow the pipeline so it mustn't unlawful. Here, the main point is the connection of danger. That is, the harm is derived from the materialization of typical dangers prope to norm of liability.

bbb. Special requirements

With respect to the transported substances, the code involves not only the natural gas pipeline but also the pipeline carrying other gases (Oxygen, Nitrogen). Moreover, the concept of fluid is understood as petroleum and its products, and water, acid, wastewater. Also, in the context of hot-vapor, the application of the code was broadened by taking the system of central heating used for vapor.

With respect to the structure, the pipeline facility is considered as a whole with the pipes and additional facilities serving the main facility.

According to German Code, the 'holder of the facility' (*inhaber der anlage*) is accepted as a liable person. The holder is the person who creates the source of danger, has a control over the technical risk of the enterprise and economically benefits the facility. In that, the holder covers the concept of the operator.

cc. Reasons for the avoidance of liability

In German code, the *force majeure* (*höhere Gewalt*), valid for both of the liability facts is the only reason for the avoidance of liability.[138] The *force majeure* are the events emerged from both the acts of third persons or/and the extraordinary natural forces that is not obstructed by the careful person's diligent conduct and/or the economic vehicles. However, events like flood or earthquake that should be considered during the construction phase is not a strange things within the nature of the operation. Thus, these are not assessed as a *force majeure*. Furthermore, the holder does not make any unliability agreement for removing liability or for saving himself to compensate fully or partly the harm.[139]

dd. Right of Litigation

Everybody whose legal values were violated has a right to demand indemnity for all the harm suffered with respect to the norms of liability mentioned above. In fact, one not directly take part in the accident and therefore suffers harm indirectly has a right to demand indemnity.[140]

ee. Scope of liability

The scope of the compensation verified by the principle of the restitution in kind is subject to the general rules and provisions. Liability would be limited by the compensation amount. According to this, the operator hold liable up to 30,000 DM/year income amount for personal harms and to the maximum amount of 100,000 DM for property harms.

3. Legal Orders Suggesting Common Provisions About Liability of the Operator of Pipeline: French Law

aa. Legal Character of Liability

In French law system, there have been not only a decree of the Council of Ministers about gas pipelines dated 23.01.1964, but also a code about petroleum pipelines dated 16.05.1959. However, they do not involve any special provisions about the liability of operator of pipeline. The problems about responsibility have been solved by the five article of Code Civil dated 1804 whose application area is defined by the Judges. Like Anglo-American law, the law of the Judge (*Lex Fori*) has been dominant over the law of France.

Rarely used provision of liability, which is called 'property liability' was dealt with in Cc 1384/1. According to this, the fault of the wrongdoer is accepted as a conjecture because the guard is the only person being a dominant position over the property under care. If the control over the property is loosed and that cause an injury or loss, the guard has a fault as the breach of an legal obligation.

bb. Requirements of liability

aaa. Causation of harm by non-living thing

Every non-living material thing is accepted as a property with regard to Cc 1384(1). Therefore, things in a fluid or gas phase are assessed as a property caused harm. Cc 1384 (1) also includes the situation of malfunctioning property causing harm.

The mobility that causes a damage on property is essential requirement for emerging liability. The Guard is obliged to compensate the injury or loss that is derived from a motion (pressured gases) that is a continuation of the first movement.

According to French judicial legislation, the property must be the *causa sine qua non* of the harm (*cause geneatrice du damage*).

bbb. Protection of property

The Guard (*Gardien*) is held responsible for the property causing harm. According to the judgment of French High Court, to have a right over property is not necessary to be a guard of the property, but according to the conditions and situations, to have a authority of possession, administration and control must be essential.

cc. Reason for the avoidance of liability

The Guard’s liability is limited by the Act of God. These are *Force Majeure*, acts of third person, and fault of the person-suffered harm. On the other hand, the structural failure of property is not a reason to avoid compensating harm because the structure failure is assessed as an internal factor.

B. In the Turkish Law System

1. Liability of Operator of the Pipeline According to Petroleum Act

a. General features of Petroleum Act

The problems about petroleum, primarily, assessed and solved in the frame of mine act and then, these subjects separated from the mine act and collected within the Petroleum Act.

In Turkish Law system, provisions related to pipeline take part in the Petroleum Act[141] dated 7.03.1954, numbered 6326 (PK md.9, md.83-84, md.86), and in accordance with this act, in the decisions of the Council of Ministers which is called Petroleum Regulation[142] dated 11.05.1989 and numbered 89/14111 (PT md.2(b)).

b. Character of the Act and its application area

Petroleum Act is more public character. It regulates both the activities of petroleum and indirectly administrative, financial and economical subjects related to the management of pipeline. Moreover, provisions related to the private law are mentioned in it. The aim of the act, expressed in article 2, is "In accordance with the national interests, it provides the exploration, improvement and assessment of petroleum beds of the Republic of Turkey in a fast, efficient and continuous way."

The concept of 'petroleum activities' was expressed in article 3(8) under the topic of 'Definitions'. According to Act, petroleum activities were accepted as the activities of exploration, discovery, improvement, production, refinement, storage, wholesale trade and transportation of petroleum products, in addition to the construction of every kind of process necessary for the activity and in fact, the administrative activities relating to these.

In other words, like transportation of crude oil and gas products by road tankers, transportation by pipeline is also included in the concept of 'petroleum activities'.

aa. Pipelines with respect to the Petroleum Act

The Act divides the pipelines into two categories: Gathering and Fuel pipelines, and Transportation pipelines that is subdivided into two categories: Transmission lines and Distribution lines. Besides, national and international transmission lines are separated from each other. National pipeline is the line that transport petroleum for processing only in the facilities of Turkey from the foreign country to Turkey, and only Turkey has some interests during operation. For example, Batman-Dörtyol crude oil pipeline, and Russia- Turkey natural gas pipeline. According to P.K. 83, international pipeline is the line that is used for transporting petroleum, processed in the foreign country, to another country over Turkey. To words of other, pipelines that is used for transit transportation would be considered. For example, Kerkük-Yumurtalık crude oil pipeline, and Baku-Ceyhan crude oil pipeline. International pipelines could be excluded from the application area of the Petroleum act because the transit countries that the pipeline crosses obtain some sort of interests for the transportation process. Therefore, these types of interests are not expected any conciliation to our national Petroleum Act.

bb. General outlook to liability provisions in the Petroleum Act

The liability provisions, which are suggested in the article 9(1), 49, and 86(2) of the Petroleum Act, accepted to be a public law character. Article 9(1) indirectly mentions liability but others are the direct provisions related to liability

Article 9(1) says “The owner of the application mustn’t take any enterprise license or document … if any reasonable amount of warrant is not given to the general directory of petroleum works for compensating … injury or loss caused during the activity.”

However, article 49 of the Petroleum Act says “An Explorer must oblige to pay both the harm caused to the land and reasonable profit of which the person deprive to the owner or the possessor of the land on which the activity is done.” Furthermore, article 86(2) mentions “The owner of the right of petroleum must oblige to fully compensate not only the harm of the immovable and above facilities to which the activities lasts due to the right to use, but also the harm of the neighborhood immovable and facilities, whether there have been a fault or a possibility of any estimation about the harm or not."

c. Liability according to article 86(2) of the Petroleum Act

Two character of the liability mentioned in article 86(2) have been discussed. So, the harm caused by petroleum activity must be separated into two: Harm caused by the usual activities of the operation, and harm caused by the operational accidents. The words of other, the situation defines the type of liability that is either the absolutely objective responsibility or the liability depending on the principle of balance-of-interest. That is only identified with the happening of event.

aa. One aspect of the article 86(2) depending on the principle of Balance-of-Interest

During the activity of petroleum, some harms necessarily come into existence and these harms were known at the beginning but what concerns us here is that if the interest's of the one who interferes comes out superior, the harms of the one who sacrifices is the harm which is caused on account of these superior interests. That's why this harm should be shared between the affected people and the wrongdoer. For instance, pipeline, constructed under or above the land, decrease the market value of immovable by decreasing the yield of soil. This event is an example of the harm derived from the nature of the activity.

The harm caused by the usual activity of the operation is required to compensate according to the principle of the balance-of interest. In addition, both the activity and the harm are legal.

bb. Other aspect of the article 86(2) depending on the Absolutely Objective Responsibility

Needless to say, the operational accidents occupy an important place during the activity. Harms reaching disastrous degree come into existence in the situation of the spillage of petroleum and the start a fire with a sudden flame of spillage. These situations are only embodied in the absolutely objective responsibility.

The lawmaker also takes this responsibility into consideration by pointing out not to need the fault in act and stressing the obligation to compensate whether there have been any possibility of estimating the harm or not, and by not emphasizing the evidence of avoidance.

d. Assessment

In the core, both the public and every owner of the immovable through which the pipeline passes must necessarily bear the interest of public in the subject of the transportation of dangerous substance called petroleum by pipeline. Thus, the immovable, on which any piece of pipeline is constructed, can absolutely be appreciated to lose some value in the beginning. With respect to the absolutely objective responsibility, the harm is a suspicious event to come true and it can only be expressed as the probability of danger. The people who held liable is expected to prevent this danger. On the one hand, article 86(2) of the Petroleum Act could assess the immovable on which the petroleum activities last in frame of the principle of the balance-of-interest. On the other hand, it could mention the compensation of injury or loss together with the neighborhood immovable in the frame of the absolutely objective responsibility. After all, it can be said that the absolutely objective responsibility is more suitable for article 86(2) on account of both the fully compensation of harm and the necessity for duty to control of the pipeline transporting the dangerous substances.

2. Liability of Operator of the Pipeline According to Environment Act

a. General features of Environment Act

Some legal arrangements relating to the prevention of pollution and protection of environment (ÇK md.3 (e)), and the compensation of pollution causing injury or loss (ÇK md.28) have been found in Turkish Environment Act. The concept of 'Polluter Pays' is the main principle in these arrangements.[143, 144]

According to article 3(e) of the Environment Act, the polluter obliges to undertake the expenses of limitation and to fight against the pollution. However, the polluter can avoid these obligations by proving to take any kind of measures to prevent pollution. Moreover, article 28 mentions "one who pollutes environment and/or one who causes harm to environment is liable for causing harms that originates from the pollution and corruption.

b. Character of Environment Act and its application area

Primarily, the term of 'all activities of people' in the Article 2(c), which defines environmental pollution, and the article 2(d) of the act imply that the enterprise and facility may potentially cause pollution and the operator can be held liable for that. So, the pipeline operator, which is a corporate body for organizing as a capital company in accordance with article 6 of the Turkish Petroleum Act and article 2 of the Decree about the Use of Natural Gas, must directly or indirectly liable as a polluter for their polluting activity.[145]

The liability considered in the article 3(e) and article 28 of the Environment Act is definitely no fault or objective responsibility. Moreover, according to article 3 (e), the responsibility of the polluter actually depends on not complying with the obligation of due diligence. In that, the polluter, again according to article 3(e) and 8, must oblige to take all measures to prevent pollution.

According to the Turkish Environment Act, the polluting interferences over the standards, which is mentioned some of the regulations, should be considered as illegal. In fact, Article 13 relating to the harmful chemical substances could be characterized as illegal interferences not complying with the defined pollution standards in the regulations and according to article 28, the polluter is obliged to prevent or limit these environmental interference by taking effective measures.

As a result, the effects of the pipeline over its own immovable or neighborhood immovable are identified as the environmental pollution of pipeline and the Turkish Environment Act compromise all above-standard interferences arisen during the transportation of petroleum by pipeline.

3. Liability of Operator of the Pipeline According to Civil Code

a. Content of article 730 of the Civil Code and its application area

The article 730 of the Civil Code has searched an immovable on which the established property rights were abused as the norm of liability. The owner should use their right of property in a manner not to cause the harm to other peoples. According to this, article 730 would include an arrangement in which the compensation of harm can be requested from the owner if the third persons incurred harm when the right of property was used.

In the situations mentioned in article 730, some right of actions like ‘restitution in kind’ and/or ‘removal of danger’ will be given to the neighbor as a sanction. In addition to that, the most important sanction is the obligation to compensate for causing harm to the neighbor by excessive interferences.

The owner as an operator of the facility or activity established on any immovable should compensate all the harm caused by these in the environment. According to this, article 730 obliges to compensate, as a sanction, the harm of the excessive interference that is unbearable for the toleration limit of neighbors to each other. In addition, the person is held liable for causing harm during the acting *de facto* domination over the property. So it is not important whether there has been a contribution of the owner (fault or breach of due diligence obligation) or not when the harm is occurred.[143]

b. Liability of the operator of pipeline as a Tenant

Article 730 points out the tenant as a liable person. Since the pipeline as ‘the Conduit’ is considered as a detail of the facility on the immovable, it is also admitted as immovable. Therefore, the person who has a property right over the conduit should be liable according to article 730 of the Turkish Civil Code.

In order to apply this article, it is necessary not only to use the right of property excessively, but also to affect the legally protected things as an illegal interference. Hence, every impropriety for complying with the duties expresses the excessive use of the owner of the conduit. Excessive use of the right to seize, right to use and right to hold, all of whom form the seizing in dead, compromised in the article 730. That’s why, the operator of the pipeline is held liable for causing pollution by the effects of the substances inside the pipeline than for causing pollution by the usual activities of the pipeline.

To sum, according to the article 730, the owner of the industrial facility, has to be attributed to liable for being the owner of a right to easement over the conduit and consequently, for being the tenant of the conduit.

4. Liability of Operator of the Pipeline According to Obligation Code

a. Content of article 58 of the Obligation Code and its application area

Article 58 of the Obligation Code mentions “the owner of a building or any constructed thing must be liable for being done the thing badly and ill, or lack of care.” The owner, here, is held liable for causing harm whether he or his assistant has been a fault or not.

Article 58, which has a relatively objective responsibility character, is a provision organizing the breach of the due diligence obligation. What is important is here the creation of causing responsibility by the impropriety of the obligation to general conduct. Moreover, this responsibility must necessitate the existence of the owner of construction work, the existence of defectiveness in the construction work such as the failure during installation or fabrication and the lack of care, the causation of harm for this defectiveness, the causal link between the harm and the defective work, and the illegality of harm.

b. Pipeline as a ‘Construction Work’

In the article 58 of the Obligation Code, the building or the other construction work is the fact of the liability. ‘Other construction works’ are defined as a thing, not only created or arranged by artificially or man-made, but attached or fixed directly or indirectly to the soil as well.

The pipeline as the conduit is characterized as a manufactured construction work. Thus, both the pipeline and all the facility together with all units (depots, pumps …) comprise the ‘construction work’.

The pipeline is a conduit that ties up with industrial facility. If so, the owner of the conduit, which transports petroleum, is also regarded as the owner of the facility related to pipeline. Therefore, the owner of the conduit, being also the owner of the ‘construction work’, is a liable person.

In conclusion, with regard to the liability for harm caused by pipeline, article 58 of the Obligation Code should pointed out as a worthy and valuable rule that can definitely satisfy, in the frame of valid law, the deficiency and the gap of the article 86(2) of the Petroleum Act, which is the most suitable to apply the situation of petroleum pollution on account of both the character of liability and the liability fact.

3. LIABILITY OF THE STATE ACCORDING TO THE INTERNATIONAL LAW

A. State Responsibility For Transboundary Petroleum Pollution Causing Significant Harm

Primarily, I believe the absolute justice in which disputes are primary and rules must try to fit into them. According to Jacques Derrida, theorist of deconstruction, justice begins with a “sense of responsibility without limits.” One who has a sense of responsibility without limits takes responsibility. Taking responsibility is the province of justice. One who takes responsibility is not assigned it. Being assigned or assigning responsibility is the province of law.

It is a well-established principle of international law that states are liable for their internationally wrongful acts, also referred to as liability *ex delicto* or state responsibility.[146] The International Law Commission (ILC) draft articles on responsibility of states provide that state responsibility is the consequence of an internationally wrongful act that exists when: (a) state conduct constitutes a breach of an international obligation and (b) that conduct is attributable under international law.[147] In other words a state can only be held responsible for its acts if the violation of an obligation corresponds with the infringement of legally protected interests of another state.[148]

In the area of responsibility and, more specifically, in the area of primary rules, the new rules have taken into consideration to set limits on state sovereignty. In international law, duty to repair damage and, more generally, responsibility of transboundary petroleum pollution causing significant harm can arise only from the breach of a specific international obligations and therefore from a wrongful act.

1. Acts and Obligations of State

a. Acts of organs and agents of State

In the context of transboundary petroleum pollution causing significant harm, one of the essential condition for State responsibility, the attribution of any conduct to the State of origin under international law, needs special attention because if conduct is attributable to the State, the liability dispute should be settled in accordance with international law and, unlike internal law, international law does not permit a State to escape its international responsibilities by a mere process of internal subdivision. Thus the general rule made clear in chapter 2 of the draft article is that the only conduct attributed to the State at the international level is that of its organs of government, or of others who have acted under the direction, instigation or control of those organs, i.e., as agents of the State. … . In those, not only the conduct of an organ of a State, that is the individual and collective entities which make up the organization of the State and act on its behalf but also the conduct of a person or entity empowered to exercise elements of the governmental authority are attributable to the State under international law. Secondly, as a general principle, the conduct of private persons or entities is not attributable to the State under international law. However, circumstances may arise where such conduct is attributable to the State. Article 8 considers with two such circumstances: Private persons acting on the instructions of the State in carrying out the wrongful conduct and, more generally, private persons act under the State's direction or control. Moreover, one circumstances commonly will arise where State organs supplement their own action by recruiting or instigating private persons or groups who act as "auxiliaries" while remaining outside the official structure of the State.

In transboundary pipeline project, every State generally authorizes and appoints a state authority as a "Designated Operator" to serve as operator of pipeline and related facilities. The activities of the designated operator in respect of the pipeline and related facilities are governed by an Operating Agreement between the Operator and multinational investors. From the legal point of view, the Operator Entity initially established by the State, whether by a special law or otherwise, is not sufficient basis for the attribution to the State of the subsequent conduct of that entity. However, where there was evidence that the entity was exercising public powers or that the State was using its ownership interest in or control of a corporation specifically in order to achieve a particular result, the conduct in question has been attributable to the State. On the other, in internal pipeline project, I think that 2 circumstances should be considered: (1) the conduct of operator entity which are State-owned and controlled will be attributable to State under international law, and (2) the conduct of private operator companies will be attributable to the State only if it directed or controlled the pipeline system and the conduct complained of was an integral part of that system.

It is clear than that the State of origin may, either by specific directions or by exercising control over the entity, accept responsibility for their conduct. So now, our study is to concentrate on the determination of the principles and obligations that govern the responsibility of States for internationally wrongful acts in the context of transboundary petroleum pollution causing significant harm. Consideration of related obligations placed on States in international law may have to be treated as a necessary element in assessing the gravity of an internationally wrongful act and as a criterion for determining the consequences it should have. In the absence of binding standards, the concept of territorial sovereignty is the primary legal point in consideration of principles of State responsibility for transboundary petroleum pollution causing significant harm upon other States. This concept are also related to the general principle of law *sic utere tuo ut alienum non laedas* (the duty to exercise one's right in a way that does not harm the rights of others). Today, the maxim of *sic utere tuo* has been epitomized by the ICJ in the *Corfu Channel Case*[151] as " every State's obligation not to knowingly its territory to be used contrary to the rights of others." It is therefore affirmed that responsibility is inseparable from sovereignty. Other guided principles are the recognition that the protection of the rights and interests of other States requires the adoption of measures for the prevention of and reparation for injury and the innocent victims not being left to bear their own loss.[152,153]

After that, as far as the legal basis of delinquent State responsibility for transboundary petroleum pollution causing significant harm is concerned, some obligations and principles such as the obligation of harmless use of territory, the obligation of prevent pollution and the obligation of regulate and control are individually studied below.

b. Obligation of Harmless Use of Territory

The obligation has its origin in principle of good- neighborliness, one of the basic elements of the international law of torts. The principle was first used with regard to transboundary pollution between neighboring states. Then, it has expanded its scope of application to the protection of marine environment, including high seas, of common spaces and resources and of the environment as a whole. Finally, the principle places obligations on the States and corresponding responsibilities, not only of caretaking the States' own territory but also of controlling over activities carried outside their own territory.[152, 154, 155]

With this thoughts in mind, the *Corfu Channel Case*[156] confirms that the obligation of harmless use of territory is a due diligence obligation. The ICJ stated that Albania's responsibility with regard to Great Britain arose, among other reasons, from the obligation of every State "not to allow *knowingly* its territory to be used for acts contrary to the rights of other States." As for the exact nature of Albania's responsibility for a wrongful act, the decision must be interpreted in favor of fault responsibility, or of responsibility for breach of an objective standard of due diligence.

In my opinion, this obligation forms a basis both for other obligations, mentioned below and for State responsibility of transboundary petroleum pollution causing significant harm.

c. Obligation to Prevent Transboundary Pollution

The basic principle governing transboundary petroleum pollution is that State of origin shall prevent and abate such damaging interference that entails a risk of causing significant harm. According to Dupuy,[157] it seems possible to define this well-established rule as follows:

> "In the exercise of their sovereign rights to exploit and use, pursuant to their development policies, their natural resources, States shall take into account the impact of actual or anticipated activities in areas placed under their jurisdiction on the environment situated beyond their national frontiers. They shall take, in good faith and all due diligence, appropriate measures to prevent transboundary pollution by elaborating, in particular rules and procedures adapted to the requirements of the protection of the environment, and see to it that these are effectively applied."

The obligation to prevent transboundary pollution is supported in the classic statement in international arbitral award of the *Trail Smelter Case*[158] that reads:

> "Under the principles of international law, as well as the law of the United States, no State has the right to use or permit the use of its territory in such a manner as to cause injury to the properties or persons therein, when the case is of serious consequences and the injury is established by clear and convincing evidence."

However, the obligation to prevent transboundary pollution exists only to the extent that the risk of causing significant harm is reasonably foreseeable. In this event, international customary law has not developed sufficiently to define precisely what kind of procedures should be enforced by States to apply their obligation to prevent transboundary pollution. Environmental Impact Assessment, not be implemented on a customary basis, already constitute part of implementation of due diligence. To get any compulsory value, it must be established in an international agreement.

d. Obligation to Cooperate

I can hardly believe that the obligation to cooperate should not be separated to the obligation to prevent transboundary pollution. According to that States have the obligation to cooperate, in a spirit of solidarity, with one another as well as with competent international organs with a view to preventing, and eliminating transboundary pollution.

To discharge this obligation, State shall inform and consult one another, in all good faith, on their activities or measures, undertaken or projected that are likely to cause transboundary pollution.

The general obligation of cooperate in the field of prevention of transboundary pollution is deeply implanted in the Law of the U.N.'s as defined in particular in article 1(3) of the U.N. Charter.[159]

2. Acts of Multinational Corporations (MNCs) and Responsibility of State of Origin

Major industrial accidents, in our study transboundary pipeline accident causing significant harm have often involved MNCs using high-risk technologies in foreign countries. So, the question of distribution of responsibilities and liabilities among the actors included the MNCs, the host country, and the home country has attracted attention and discussed. Can the state of origin of the MNC be held responsible for breach of due diligence or for failure to secure a certain result when the MNCs exported technology cause significant harm to another state or to general environment?

It is true that private corporations considerably create environmental risks and they are better equipped than local industries for the task of implementing environmental assessment strategies in host countries, in view of their powerful technological support, modern plants and efficient equipments.

The MNCs are able to migrate to foreign countries without ever losing its substantial connection with the country of origin. So with such connection, the parent company subject to the home country's jurisdiction and its foreign subsidiaries could be hold *de facto* responsible.[160]

Although host countries maintain primary responsibility for the protection of their environment, a modern approach requires effective control rather than of territoriality and a broader notion of the causation link than the physical linkage between the source state and the damage abroad. Thus, the MNC is in principle capable of engaging the international responsibility of the home country that has willfully or negligently failed to exercise sufficient control over the MNC's activities that have cause significant environmental harm.[160]

Today, some modest steps have been made in its direction in certain fields such as the protection of marine environment where the UN Convention on Law of Sea provides a fairly sophisticated distribution of environmental responsibilities between coastal states, flag states, and for deep sea-bed mineral activities, the sponsoring state.

3. Violation of International Obligations

The establishment of the violation of an international obligation is relating to the secondary norms of international law. Secondary norms are the content of the primary norms that ultimately determines whether an international obligation has been violated and, thence, an internationally wrongful act has been committed. Some of them relating to the transboundary petroleum pollution causing significant harm have already been discussed above sections.

In the core, the establishment of the violation of an international obligation by a State may depend on its efforts to comply with that obligation. Such an obligation is a due diligence obligation which must be distinguished from an absolute obligation, the breach of which is independent from the efforts of a State to observe it.

A due diligence obligation requires States to take "effective measures" of a legislative, administrative, or juridical nature to prevent legally protected interests of third States from being harmed by public or private conduct.[121] Take, for instance, qualitative eco-standards that require States to take appropriate measures to prevent transboundary petroleum pollution causing significant harm.

The due diligence concept is therefore correctly described as the expression *per excellence* of the concept of *Culpa*. The term *culpa*, understood as an element of international obligation, is used to describe of consequences blameworthiness based upon reasonable foreseeability, or foresight without desire of consequences (recklessness, *culpa lata*).[161]

Moreover, the concept has proved particularly suitable to describe the degree of supervision that a State must exercise to prevent private persons within its jurisdiction or control from harming legally protected interests of third States.

It is important to bear in mind that, if an obligation calls on States to take appropriate measures, it only requires States to act diligently in order to prevent transboundary petroleum pollution causing significant harm. The simple failure of a State to prevent transboundary harm from occurring would lead to the conclusion that the obligation has been violated. The rapporteur of the Intergovernmental Working Group concluded that:

> "the draft declaration should, therefore, exclude any responsibility of the public authority based on risk and should emphasize that only the negligence of a State, imputable either to inaction or the failure to fulfill specific commitments, could engage its responsibility within the meaning of international law."[162]

To conclude, due diligence obligations are formulated to focus on the action to be taken rather than the result of such action. So it seem reasonable to maintain that States should respect of hazardous activities.[163]

4. Circumstances Precluding Wrongfulness

If the wrongfulness of an act is precluded, state responsibility (liability *ex delicto*) does not arise, as there is no breach of international law: the objective element of the internationally wrongful act is missing. The ILC's Draft Articles on State Responsibility contain a list of circumstances which preclude wrongfulness; (1) Consent (Art.20), (2) Self-defence (Art.21), (3) Countermeasures (Art.22), (4) *Force majeure* (Art.23), (5) Distress (Art.24), and (6) Necessity (Art.25). The existence of these circumstances may be invoked by States to defend themselves against accusations that they failed to observe their obligations relating to the protection of the environmental.

5. Legal Consequences of State Responsibility

a. Cessation and non-repetition

An internationally wrongful act, which extends in time must be discontinued.[164] Article 30 of the Article on State Responsibility deals with two separate but linked issues raised by the breach of an international obligation: the cessation of the wrongful conduct and the offer of assurances and guarantees of non-repetition by the responsible State if circumstances so require.

In our concerns, cessation of transboundary petroleum pollution can only be demanded if, very rare situation, the petroleum pollution has been a continual character. However, assurances and guarantees, not a necessary part of the legal consequences of an internationally wrongful act, are likely to be appropriate only where there is a real risk of repetition causing injury to the requesting state. Assurances are normally given verbally, while guarantees of non-repetition involve something more- for example, preventive measures to be taken by the responsible State designed to avoid repetition of petroleum pollution.[165]

b. Obligation to make reparation

The establishment of responsibility of State gives rise to a new obligation, the obligation to make reparation.[166] This obligation, a new legal relation, refers to all measures that the injured State may expect to be taken by the State of origin. It was recognized in article 36(2) of the Statute of the Permanent Court of International Justice.[167]

Full reparation for the injury caused by the transboundary petroleum pollution shall take the form of Restitution (Art.35), Compensation (Art.36), and Satisfaction (Art.37), either singly or in combination in accordance with the dimension of pollution. In cases where compensation has been awarded or agreed following the transboundary petroleum pollution causing significant harm, payments have been directed to rewarding the injured State for expenses reasonably incurred in preventing or remedying pollution and also providing compensation for a reduction in the value of polluted property.[168]

However, damage result in petroleum pollution generally extends beyond that which can be readily quantified in terms of clean-up costs or property devaluation. Damage to such environmental values (biodiversity, amenity) is as a matter of principle, no less real and compensable than damage to property, although it may be difficult to quantify.

B. International Liability For Transboundary Petroleum Pollution Causing Significant Harm

1. Concept of "Liability *Sine Delicto*"

Since 1950s, transportation, especially pipeline, industry has technologically been developed and created a risk of transboundary petroleum pollution causing significant harm. These hazardous technologies had created a gap in the international system because it would not be possible to hold a State responsible (liability *ex delicto*) if that State had conducted diligently to reduce the risks involved in hazardous technologies, e.g. by the prescription and enforcement of adequate safety measures but the victims of incident of hazardous technologies should not be left uncompensated.[169]

So what kind of liability do we try to mention? I actually believe the approach that it can be achieved by the abandonment of wrongfulness. The abandonment of this condition has been found to affect both the origin of liability and its consequences. Accordingly, liability may even arise without proof of an internationally wrongful act on the part of the source State. Therefore, this form of liability is described as 'liability *sine delicto*'.

Thus, the ILC decided to discuss the issue in its program of work. The Commission, at its thirtieth session (1978) included the topic "International Liability for injurious consequences arising out of acts not prohibited by international law" in its program of work and appointed Mr. Robert Q. Quentin-Baxter Special Rappourter. The topic, since its active consideration was begun in 1980, has always been understood as encompassing, both liability in the strict sense (liability *sine delicto stricto sensu*), i.e., liability to make reparation for damages caused, and prevention.[170]

2. Quentin-Baxter's View on the Topic

In his reports, Quentin-Baxter derives some rights and obligations from the maxim *sic utere tuo ut alienum non laedas* (so use your own property as not to injure another's). According to Quentin-Baxter, the study based on to secure an equitable distribution of benefits and costs warranting a balancing of all interests involved the ultimate aim being a equilibrium between the socio-economic use of an activity, on the one hand and its adverse environmental effects, on the other.

If transboundary harm has actually occurred, the aim of substitution is the procurement of an equitable distribution of costs and benefits among beneficiaries and victims of a certain activity. In the first place he imposed on the source State the obligation to negotiate and to reach an agreement *ex post facto* with the affected States to repair harm. The obligation to negotiate on reparation of the transboundary harm is triggered by the actual occurrence of harm and not by an internationally wrongful act. Quentin-Baxter held the source State liable to make reparation to the affected State in accordance with the "Shared Expectations" entertained by both of them.[121, 170]

Apparently, he has introduced the concept of shared expectations to avoid the lack of support in international law for the introduction of liability *sine delicto stricto sensu* and the gap left by liability *ex delicto*.

Equally significant, liability only arises if transboundary harm has actually occurred and the existence of a causal link between the activity and the harm can be proved. So the environmental pollution that has been proved to originate in a specific activity must be the *conditio sine qua non* and the *causa proxima* of the harm.

As a result, the State of origin is liable *sine delicto* towards the affected State if harm has actually occurred and the existence of a causal link between the activity and the harm can be proved.[171] Shared expectations should determine whether the loss should be compensated by the State of Origin, should be shared, or should lie where it falls.

In mid-1990s, the Working Group noted that the scope and the content of the topic remained under due to such factors as conceptual and theoretical difficulties, appropriateness of the title and the relation of the subject to "State Responsibility". Under the topic, "prevention" and "International liability" issues therefore have separately been dealt with by the Commission up until now. The Commission has dealt first with the issue of prevention under the subtitle of "Prevention of

Transboundary Damage from Hazardous activities." In May 2001, the Commission considered the report of the Drafting Committee and adopted the final text of a draft preamble and a set of 19 draft articles on prevention of transboundary damage from hazardous activities.

3. Prevention of Transboundary Petroleum Pollution in the Context of International Liability

a. Introduction

In many multilateral treaties, prevention of transboundary harm to the environment, persons and property has been accepted as an important principle. Duty to prevention is much more important than obligation to repair, or compensate. According to ILC, prevention should also be a preferred policy because compensation in case of harm often cannot restore the situation after the event or accident occurred.

As the title of the draft articles specifies any hazardous and ultra-hazardous activity involving a "risk of significant transboundary harm" is covered.[172] For hazardous activities, that risk emerging from an activity is primarily a function of the particular application, the specific context and the manner of operation. We clearly say that pipelines causing significant transboundary petroleum pollution are classified as hazardous activity "not prohibited by international law."

b. Basis of International Liability for Transboundary Petroleum Pollution Causing Significant Harm

It was said that: "at the very end of the day, when all the opportunities of regime-building have been set aside or, alternatively, in the nature of strict liability, to make good the loss."[171] However, both the ILC and the special rappourteurs used the devices of a “sequence of obligations”, “balance of interests” and “assessment of risks” to avoid the taint of strict liability.

aa. Balance-of-Interests

The operation of pipelines that is not prohibited by international law is normally important to the economic development of both the State of origin and adjacent States in the context of huge transboundary projects. The State of origin and the States that are likely to be affected should enter into consultations in order to agree on the measures to prevent transboundary petroleum pollution causing significant harm to minimize the risk.

During consultations, parties should seek to achieve an equitable balance of interests. With respect to factors and circumstances, the parties should compare the costs and benefits of particular cases:

- Degree of risk of significant harm,
- Importance of the activity in terms of its social, economic and technological advantages for the State of origin and the potential harm to the States.

According to draft articles on prevention, some articles[173] provide for a set of procedures essential to balancing the interests of all the States concerned by giving them a reasonable opportunity to find a way to undertake the activity with satisfactory and reasonable measure designed to prevent or mitigate transboundary harm not providing them a right of veto to project of State of origin. On the other hand, if the pipeline causes or creates a risk of causing transboundary petroleum pollution throughout the process, the State of origin is required to restore the disrupted balance of interests.

bb. Obligations to prevent significant harm

The primary obligation of the State of origin is to take all appropriate measures to prevent significant transboundary harm, one of due diligence. But, if the significant harm not be totally prevented, State of origin should exert its best efforts to minimize the risk thereof.[174] So in the situation of transboundary petroleum pollution causing significant harm, this primary role imposes the obligations of both prevention and mitigation. From this point of view, what obligations and duties does the State of origin have to prevent transboundary petroleum pollution causing significant harm?

First, States are under an obligation to take all appropriate measures of the prevention of pollution. So, states should primarily formulate some policies designed to prevent transboundary petroleum pollution causing significant harm or to mitigate the risk and then implement those policies through various enforcement mechanisms.

To summarize, the operator of the pipeline is expected to bear the costs of prevention to the extent that he is responsible for the operation. So, under the duty of prevention, the operator may needed some significant implementation which are the advance of the input of technology in the activity and the allocation of the financial and manpower resources with necessary training for the management and monitoring of the activity. Moreover, under international law the State of origin should take on the essential spending to put in place the administrative financial and monitoring mechanisms.

Secondly, co-operation is much better suited to the topic of prevention of significant pollution. Balance of interests issue gives important flexibility to the topic of co-operation. Under the draft article, State of origin concerns the co-operation in all phases of planning and of implementation and, if necessary, seeks the assistance of one or more international organizations in performing their preventive obligations.

Thirdly, State of origin diplomatically notifies the State likely to be affected by the planned activity, about activities of both State itself and private entities. In *Corfu Channel case*, the ICJ characterized the duty to warn (obligation to notify) as base on "elementary considerations of humanity." The technical information resulting from the assessment directs the State of origin to notify the States that are likely to be affected.

Finally, after an activity has been undertaken, State of origin should gather and exchange of all available information relating to the activity to prevent transboundary petroleum pollution causing significant harm either between the States that are likely to be affected or through providing the information to an international organization which makes it available to other States.[175] In other words, State of origin continues in respect of monitoring the implementation of the activity as long as the activity continues.

4. Assessment of Risks and Contingency Plans

Before the authorization of the activity, an assessment is needed to determine the extent and the nature of the risk involved in an activity and the type of preventive measures it should take.[176] If the assessment shows that the activity will cause or will create a risk of causing significant transboundary harm anytime during the process, the State of origin must notify and consult with potentially affected States and provide these States with information on that activity.[121] For the purpose of article 7, such an assessment should contain an evaluation of the possible transboundary harmful impact of the activity. The specifics of what ought to be the content of assessment is left to the domestic laws of the State conducting such assessment. However, the Convention on Environmental Impact Assessment in a Transboundary Context provides a detailed content of such assessment.[177]

Equally significant, it is suggested that the States are obliged by the duty to prevent environmental harm to enact safety measures and procedures to mitigate the likehood of major environmental accidents such as oil spills. Where necessary, States should concern specific safety or contingency measures to manage the risk of transboundary petroleum pollution causing significant harm.[178] This contingency plan is prepared in cooperation with other States likely to be affected and competent international organizations. The obligation to develop contingency plans is also found in certain bilateral and multilateral agreements concerned with environmental catastrophes.

4. A CASE STUDY: BAKU-TBLISI-CEYHAN (BTC) PROJECT

A. Introduction

The Baku-Tbilisi-Ceyhan (BTC) Project is an international transboundary pipeline project not only concerning our country with respect to its location, but also constituting an excellent example for my study with respect to its content. The BTC Project, which will enhance the Turkey’s geopolitical importance, transports crude oil from the oil fields of the Caspian Sea region via the Republic of Azerbaijan, Georgia and Turkey to a crude oil storage and export terminal to be constructed at Ceyhan on the Mediterranean coast of Turkey. What is important for our study is that the operation method of Project depends on legal and regulatory rules of each country besides the agreements between the governments and the MEP Participants. Moreover, this Project includes the agreements, which mentions the applicable procedure and the liable person on account of the given grants and warrants in the event of petroleum pollution. The following section represents the legislation, standards and policies applicable to the BTC Project in Turkey.

B. Legislation and Policy Framework

In the core, the BTC project will be operated in conformity with some legislative and regulatory rules, provisions and principles which are mentioned below:

- National legislation (including the Intergovernmental Agreement (IGA) and the Host Government Agreement (HGA) which form a prevailing legal regime under domestic law in Turkey),
- International Finance Institution (IFI) policies,
- International Conventions which bind to Turkey,
- BOTAS and BP Corporate Policies applicable to the project.

Notwithstanding the foregoing, the provisions mentioned in the IGA and the HGA bind all the parties of the BTC project whether the provisions contradict to the national legislation with the exception of the Constitution of the Turkey. In other words, the whole range of rules applicable to the BTC project in Turkey includes not only the provisions of the IGA and the HGA, but also Turkish legislation and applicable international obligations and principles to the extent that they do not contradict with the agreements.

To summarize, the BTC project is implemented in accordance with provisions and principles requiring conduct that is generally exceed national legislation and regulations.

1. National legislation

In the context of transboundary petroleum pollution causing significant harm, the sources of applicable national legislation, hierarchically arranged below, are used to find the liable party(s) with respect to the Constitution and other laws of Turkey:

- The Constitution of Turkey,
- The IGA,
- The HGA,
- The existing laws of Turkey on environmental protection, safety and emergency situations, if they do not contradict with the IGA or HGA,
- The regulatory frameworks such as Governmental Decrees, Instructions etc, to the extent they do not conflict with the IGA or HGA.

a. Constitution of Turkey

Indirectly, Section 3 of the Turkish Constitution establishes an "environment right" as one of the Social and Economical Rights and Duties. Under Article 56, *"Everyone has the right to live in a healthy and stable environment. It is the duty of the State and the citizens to develop the environment, to protect environmental health and to prevent environmental pollution."* So, the main duty of the State is to protect the environment and to prevent pollution.

b. Intergovernmental Agreement (IGA)

The Intergovernmental Agreement (IGA), comprised of the Host Government Agreements (HGA), the Lump Sum Turnkey Agreement (LSTK) and the Government Guarantee was signed within three transit countries (the Azerbaijan Republic, Georgia and the Republic of Turkey). According to IGA, each State is obliged to apply the uniform environmental, technical and safety standards while the project will be operated. Article 4 states "… environmental standards … in accordance with international standards and practices within the Petroleum pipeline industry (which shall in no event be less stringent of than those generally applied within member states of the E.U.). Moreover, article 4 indicates the obligation to cooperate between the State and the Operator. More specifically, the HGA is a contract signed between the Government of Turkey and the MEP Participants. The HGA includes following components:

- The overall legislative framework within which the BTC Project will be constructed and subsequently operated including the technical and design standards.
- The applicable international environmental standards and practices incorporated by reference into the national legislation by the HGA.
- The regulatory requirements applicable to the BTC Project and the administrative responsibilities of different government departments for the BTC Project.
- The liability of the MEP Participants to the State and to third parties for, *inter alia,* breaches of the national environmental legislation

But what concerns us here are the article 13 and article 5 of the HGA dealing with the environment, health, safety and social impacts and practices. According to article 13, if during the operation, any spillage or release of petroleum occurs which is causing or likely to cause material environmental damage or material risk to health and safety, MEP participants is firstly obliged to take all necessary action mentioned in Appendix 5. Secondly, on request by MEP Participants, the State use their best endeavors to assist them in any remedial effort in addition to any restitution obligation of the State under the Project agreements. Moreover, Appendix 5 covers the necessary procedures or obligations mentioned below in the situation of petroleum pollution.

- During the operation of the facilities, MEP Participants will use best endeavors to minimize potential disturbances to the environment and property (clause 3.1),
- Environmental Impact Assessment procedures and requirements (clause3.6),
- Spill Response Plan (SRP) procedures and requirements (clause 3.7),
- General principles to be followed in the preparation of Environmental Strategy Product including Risk Assessment, Baseline Study, EIA and SRP (clauses 3.8 to 3.11),
- In the event of dispute as to the implementation of the ESP, clause 3.12 indicate that those disputes will be resolved in accordance with the provisions of article 18 of the agreement that seeks to resolve those disputes in Arbitration.

Finally, under the topic of Limitation of Liability, article 11(1) states that MEP Participants shall be liable to the State Authorities for loss or damage arising from and breach by them of the HGA or the applicable law. Furthermore, article 11(2), the MEP Participants shall be liable to third party for loss or damage suffered by such third party as a result of breach of conduct in the agreement.

To summarize, first, the IGA and the HGA individually specify several obligations of the State and the MEP Participants any breach of whom is understood as the lack of due diligence. Second, they include some unclear provisions to guide for holding the wrongdoer party liable.

c. Existing national administrative and legal framework

The major environmental law of relevance to the BTC Project is the Environmental Law of 1983. The principal regulations[179] associated with the Environmental Law and several laws and regulations,[180] relevant to pipeline construction and operation are primary reference sources in the event of transboundary petroleum pollution causing significant harm. However, all associated law and regulations about the BTC Project will not contradict to the related provisions in the HGA.

2. International Finance Institution (IFI) Policies

IFIs, such as the International Finance Corporation, part of the World Bank Group; the European Bank for Reconstruction and Development, and export credit agencies require compliance with specified environmental and social policies during the term of any financing provided by them. To satisfy potential lending agencies, all EIA work for the BTC Project is being carried out in accordance with relevant World Bank Group polices and EC directive 85/337/EEC (as amended by EC Directive 97/1 I/EC). Moreover, all Project activities comply with good international petroleum industry standards and practices generally observed by international community.[181]

3. International Conventions and Agreements

The BTC project will also comply with the provisions and standards of some international conventions and agreements related to the BTC project to which Turkey is party.[182]

CONCLUSION

In these days, although the world energy consumption is greatly dependent on hydrocarbon fossil resources, the price of energy is a low level as there has been no problem about resource insufficiency to meet the energy demand. Over the next twenty years, world demand for energy is expected to be supplied by fossil fuels and the demand of oil and natural gas is expected to reach unprecedented levels, considering the facts of the fast growing economies except OECD, the low possibility of the usage of another resources as an alternative of petroleum, and above all increase in transportation demand.

Nowadays, the Caspian region, which is the most important new energy production center for meeting the world energy demand, will be expected to be the third after the Middle East and Russia with respect to the production levels. Considering the Azerbaijan's, Kazakhstan's and Turkmenistan's production and consumption estimates, 100-150 million tons of crude oil and nearly 100 billion m3 natural gas will be forecasted to be made ready for export in 2010. These oil and natural gas, reached the world market from the centers in the Mediterranean and Black seas, has obtained some strategic importance on account of the long-term energy demand for South and West Europe.

However, from now on Turkish authorities are pointed out that the number of tankers passing through the Turkish Straits has reached appalling levels as the transportation of huge amount of Caspian Petroleum was started to convey. The Turkish Straits, the world most dangerous and risky water ways with respect to the poor weather conditions, unexpected up and down currents and the sharp twists and turns, have run the potential risk of both environmental security and security of peoples living along the coasts. That's why; the State of Turkey should definitely and never give a permission to be used the Straits as a pipeline, transporting Caspian oil to the West, though export oil volumes exceed the ability of the Straits to accommodate the tanker traffic.

Pipelines are the most efficient and rapid way of conveying the energy, unavoidable element of the globalized world, from production areas to consumption centers. Beside, the main problem of Caspian region is that pipelines, which could be operated effectively and reliably, have been needed of transporting this petroleum to the world markets. In this point, Turkey might be the position of energy corridor or/and energy terminal between the North and South, and the East and West. Due to the geographical location and political stability, Turkey would become an ideal transit pipeline way of transporting the Caspian petroleum through international markets. Moreover, this position will be not only a vehicle for obtains some political and economical gains but also a guarantee for Turkey to supply their own required energy. In fact, Caspian-Mediterranean crude oil pipeline called Baku-Tbilisi-Ceyhan (BTC) pipeline was the first serious step of Turkey's national aims.

From the technical viewpoint, pipelines are the carrying tools that transport huge amount of energy uninterruptedly and economically between the two or more stations. Transboundary (International) pipelines, however, are the transit-carrying tools that convey extraterritorial produced petroleum to terminal country. But, despite all the security measures, pipelines have caused much significant environmental pollution due to accident, intention or negligence. These are not only the soil, river or groundwater pollutions but the air and sea pollutions as well. In that point, the environmental pollution cause by the pipeline might effect both the source State and the adjacent State. Law is the major applied tool for compensating the environmental pollution and for determining the liable person. As the transboundary pipeline involve international players such as Multinational Companies (MNCs) and transit States, three types of legal source could be emerged and considered: Law of the Affected State, Law of the Source State, and International Law.

As mentioned above, Turkey, being an energy terminal with the construction of transboundary pipelines such as the BTC or the Blue Stream, requires some changes in the existing regulations and additional new laws. The main philosophy of these arrangements is to constitute much more effective Turkish Liability Law and to be a reference source for internationally liability law that is still discussed.

In Turkish law system, the pipeline facility is legally a conduit character. Our legal system does not include any special regulation about the liability of the operator of pipeline. Thus, the solutions in the system commonly depend on the conduit characteristic of pipeline.

It can be mentioned that in the comparative law section, according to Swiss and German law, special provisions about pipeline, that depend on the principle of the hazard of operation would have been suggested. The legal character of these provisions is absolutely objective responsibility. However, in the technologically developed world, the judge searches the solution in the law even in the presence of new liability facts and does not create his own law on account of these special provisions relating to the rapidly innovated hazardous facilities. Therefore, it must be essential to make regulation or law over again for the dangerous facility and activities emerged by new technical developments. I am of the opinion that the judge should interpret the common provisions, mentioned below, regarding the principle of the absolutely objective responsibility and therefore, could take more definite and equitable decisions by harmonizing the own comments and initiative in the country like Turkey where the process of lawmaking is slow and making some specific regulation is obstructed.

The common provision is that one legal norm comprises more general topics of the subject and then legalizes them. The judge therefore would specialize the common provisions by taking a decision in each case. So, the new solution possibilities are derived and some criterion are identified to be applied to the cases emerged in the future. As a result, all the activities depending on the transportation of petroleum with high technology could be regulated by the common hazard rule that takes the energy into main consideration.

The absolutely objective responsibility will be suggested for pipelines that have a special and high hazard potential. This regulation definitely involves two major basis of the absolutely objective responsibility. These are:

- The person who causes injury or loss to somebody or something must oblige to compensate.
- If the person proves that the injury or loss is caused by the *Force Majeure* the fault of person suffered harm or the act of third person, the person must not be held liable.

Regarding this regulation, these common provisions would provide both some constant criterion and the flexibility for the solution of the problems emerged from the new facts. The identification of some common provisions for the problems of the amount of compensation, the causes of discount in compensation and the balance of harm are not essential in the absolutely objective responsibility. That's why; some ascription to the law of obligation would be sufficient. Truly, a common provision which involve the identified limits and principles considering all special and high hazard activities by not injuring the reliability of law, is placed to the obligation and civil code and these provisions will applied to the special hazard facts in all substantial events.

In conclusion, Turkey will be an energy terminal in near future. Therefore, Turkey immediately needs common provisions, used for controlling and monitoring the hazardous and high-tech facilities from the construction to operation phase and identifying effectively the liable person in the situation of injury or loss. Moreover, though the international liability law has significantly been improved by additional changes and innovations up to now, there is still not any widely accepted convention in international law. For these reasons, Turkey has a good chance for not only being effective and applicable of its domestic laws but also a reliable and experienced source of international law in the subject of liability provisions caused by the hazardous and environmentally harmful activities.

Endnotes

[1] Energy R&D, Organization For Economic Co-operation Development, Paris, 1975.
[2] 'Glossary.' (2001) <http://www.eia.doe.gov/emeu/perfpro/glossary.html>.
[3] Gas engineers handbook, Ed. By C. G. Segeler, First ed., The Industrial Press, 1966.
[4] Abdel-Aal, H.K. and Schmelzlee, R., *Petroleum Economics and Engineering*, Marcel Dekker, 1976.
[5] Gray, F., *Petroleum Production in Nontechnical Language*, 2nd ed., Pennwell, 1995.
[6] Moran, T.,'Managing an oligopoly of would-be sovereigns,' *International Organisation*, 41, 4, autumn 1987.
[7] Yergin, D., *The Prize*, Simon and Schuster, 1992, ch.9-10-21.
[8] Venn, F., *Oil Diplomacy in the Twentieth Century*, Macmillan, 1986, ch.4-10.
[9] Williams, J.L., 'Oil Price History and Analysis.' *WTRG Economics* <http://www.wtrg.com/prices.htm> (5.2.2002).
[10] Odell, P., *Oil and World Power*, 7th ed, Penguin Books, 1983, p.215.
[11] Bromley, S., *American Hegemony and World Oil*, Polity Press, 1991, ch.4.
[12] Keohane, *After Hegemony*, Priceton Uni. Press, 1984, Ch.10.
[13] *Oil Supply Security*, International Energy Agency, p.13.
[14] Turner, L., *Oil Companies in the International System*, 3rd ed., George Allen and Unwin, 1983, ch.10.
[15] Bennett, A., 'Oil: The Fuel of Global Commerce.' <http://www.usna.edu/NAFA/Papers/table10/Oil_the_Fuel_of_Global_Commerce_by_Allison_Bennett.doc>.
[16] Energy Information Administration, "World Oil Market and Oil Price Chronologies: 1970-2001." <http://www.eia.doe.gov/emeu/cabs/chron.html> (29.January.2002).
[17] Kumins, L., "Oil Prices: Overview of Current World Market Dynamics." <http://shelby.senate.gov/legislation/leg_pdf/oil1.pdf> (26.10.2001).
[18] Patricelli, J.A. and McMicheal, C.L. "An Integrated Deterministic/Probabilistic Approach to Reserves Estimates", *JPT*, Jan 95, pp.49-53.
[19] 'Energy Perspectives: Trends and Milestones 1949-2000.' <http://www.eia.doe.gov/emev/aer/ep/inter.html>.
[20] Laherrere, J., "Estimates of Oil Reserves." <http://www.oilcrisis.com/laherrere/iiasa_reserves.pdf>.
[21] 'Statistical Review of World Energy 2001.' <http://www.bp.com/downloads/702/Bpwebglobal.pdf>.
[22] *BP Statistical Reviews*, <http://www.bp.com/downloads/index.asp>.
[23] "Petroleum Trade." <http://www.eia.doe.gov/emeu/aer/ep/inter.html>.
[24] "Tough year but the Oil and Gas Kept Flowing." (2002) <http://www.bp.com/centres/press/p-r_detail.asp?id= 904>.
[25] Campbell, C.J., 'Peak Oil: an Outlook an Crude Oil Depletion.' <http://www.mbendi.co.za/indy/oilg/ p0070.htm>.
[26] Energy Information Administration, *International Energy Outlook 2002*, online version <http://www.eia.doe.gov/oiaf/ieo/index.html>.
[27] "World Market Overview." <http://www.tradepartners.gov.uk/oilandgas/profile/index/worldmarket.shtml>.
[28] "Overview of Natural Gas." <http://www.naturalgas.org/naturalga/transport>
[29] "Natural Gas Production: Where Price Controls Failed, The Market Succeeded." <http://www.ipaa.org/govtrelations/factsheets/NaturalGasBackground.asp>.
[30] "A Brief History of the Natural Gas Industry." <http://www.flogas.com/natgashistory/history_of_natural_gas.htm>.
[31] "Natural Gas." EIA, <http://www.eia.doe.gov/oiaf/archieve/ieo01/nat_gas.html> (march.2002).
[32] "Energy Price Impacts on the US Economy." <http://www.eia.doe.gov/oiaf/economy/energy_price.html>.
[33] "9 Million b/d from New Areas", *The Petroleum Economist*, Vol 42, No 2, Feb 75, pp.44-45.
[34] "LNG Prospects and Problems", *The Petroleum Economist*, Vol.42, No.12, Dec.75, pp.447-49.
[35] "World Trade in Fuels Forecast", *The Petroleum Economist*, Vol 47, No 7, July 80, p.293.
[36] "World Bank Energy Report" *The Petroleum Economist*, Vol 47, No 9, Oct 80, p.429.
[37] Mohnfeld, J.H., "Changing Patterns of Trade", *Petroleum Economists*, Vol 47, No 8, Aug 1980, pp.329-30.

[38] Steensnæs, Einar., “The World Summit on Sustainable Development” <http://odin.dep.no/oed/norsk/aktuelt/taler/statsraad_a/026031-090052/index-dok000-n-f-a.html>.
[39] “Acting on Green Laws”, *Petroleum Economist*, Vol.59, No.2, Feb 92, p.19.
[40] “Earth Shaking Summit”, *Petroleum Economist*, Vol.59, No.4, April 92, p.29.
[41] Toman, M.A., “What Do We Know About Energy Security”, <http://www.cato.org/pubs/regulation/reg14n1i.html>.
[42] Al-Naimi, A., “Geopolitics of Energy and Saudi Oil Policy.” <http://www.csis.org/sei/event991208sAlNaimi. htm>.
[43] “Energy Outlook.” <http://www.fe.doe.gov/strategic_plan/festrategy_outlook.html>.
[44] Al-Moneef, A.M., “Petroleum and The WTO.” (29 Jan 2001) <http://www.mees.com/news/a44n05d01.htm>.
[45] Coburn, L.L., “Energy Security: Is The Past Prologue.” <http://www.usaee.org/pdf/v02coburn.pdf>.
[46] Moon, Yeong-Seok and Lee, Dal-Sok., “Energy Cooperation in Northeast Asia.” <http://www.neasiaenergy. net>.
[47] Baker, A.J., “China and Long-Range Asia Energy Securities.” <http://www.rice.edu/projects/baker/Pubs/workingpapers/efac/executive_summary.html>.
[48] Hamid, H. Emanul., “International Transportation of Natural Gas by Pipeline: Prospects of Bangladesh.”<http://www.duncanchowdhury.com/belavista/economy/international_trans_of_nat_gas.htm>.
[49] Zhao, Jimin., “Diffusion, Costs and Learning in the Development of International Gas Transmission Lines.” <http://www.iiasa.ac.at>.
[50] Conaway, F. Charles. *The Petroleum Industry*, p.229.
[51] Dyke, V.K., *Fundamentals of Petroleum*, fourth ed., p.319.
[52] “World Oil Transit Chokepoints.” (Nov 2002) <http://www.eia.doe.gov/emeu/cabs/choke.html>.
[53] Kennedy, *Oil and Gas Pipeline Fundamentals*, second ed., Penwell, 1993,pp.19-25.
[54] Ebel, E.R., *CSIS Report Energy Choices in the Near Abroad*, The Center For Strategic and International Studies, 1997, p.9.
[55] Foley and Lönnroth, ‘Mapping the Landscape’, *The European Transition From Oil*,Academic Press, 1981, p.23.
[56] Henry, J. T., *History of Petroleum*, Burt Franklin, New York, 1965, p.283.
[57] Lester, C.P., *Pipeline Construction in the Seventies.*
[58] Oates, J.A., *Pipes and Pipelines Manual*, fourth ed., England, 1972.
[59] Wagner, R.L., ‘Petroleum Products Pipeline Transportation’, *Petroleum Marketing and Transportation*, Gulf Publ., 1964.
[60] Giddens, H.P., *The Birth of Oil Industry*,Arno Press, 1972, p.xxxii.
[61] ‘Host Government Agreement of Baku-Tbilisi-Ceyhan’, *Official Gazette*, numbered 24166, dated 10. 09. 2000.
[62] ‘Activities.’ BOTAS On-line, < http://www.botas.gov.tr/eng/activities/activities.html >.
[63] “Russia: Oil and Natural Gas Export Pipelines”, (Nov 2002) <http://www.eia.doe.gov/emeu/cabs /russpip.html>.
[64] Erişgin, N., *Boru Hattı İşletenin Hukuki Sorumluluğu*, Dok. t., Ankara, 1996.
[65] *Petroleum pipelines safety codes*, Third ed., Applied Science Publ., 1967.
[66] Feizlmayr, A. H., *Design and Construction of Stations for Oil Pipelines*, ILF Consulting Engineers, 1975.
[67] *CIS pipeline system*, Petroconsultants, June 1995, p.6.
[68] Littleton, T.C., *Industrial Piping*, 2^{nd} ed., Mc-Graw Hill, p.152.
[69] Mendel, Otto., *Practical Piping Handbook*, Pennwell Books, p.1.
[70] Article 684 of the Turkish Civil Code.
[71] See text of Host Government Agreement between the Turkey and the MEP Participants *Official Gazette* dated 10.9.2000 and numbered 24166.
[72] Pazarcı, H., *Uluslararası Hukuk Dersleri*, Turhan Kitabevi, Sixth ed., Ankara, 1997.
[73] Host Government Agreement, article 4 Grant of rights; article 5 Government guaranties; article 6 Representations and warranties; article 7 certain covenants and consents of the government.
[74] For the text of the Code, see *Official Gazette* dated 29.06.2000 and numbered 24094.
[75] Tandoğan, Haluk. “Türk Hukukunda Mecralar,” *AÜHFD*, c.9, s.3-4, 1952, p.142-43.
[76] Ertaş, Şeref. “İrtifak Hakları,” *Eşya Hukuku*, 9 Eylül ünv. Yayınları, n.74, 1997, p.428.
[77] Caldwell, L.K., *International Environmental Policy*, Duke Uni. Press, 3^{rd} ed., 1996, pp. 13-14.
[78] Turgut, N., *Çevre Hukuku*, Savaş Yayınevi, 1^{st} ed., Ankara, 1998, p.66, 342.

[79] Smith, K., *Environmental Hazards*, Routledge, London, 1992, p.16.
[80] Farmer, A., *Managing Environmental Pollution*, Routledge, London, 1997, p.3.
[81] Lowe and Thompson, ‘Pollution and Development’, *Environmental Issues in 1990s*, Wiley & sons, 1992, p.197.
[82] Porteous, A., *Dictionary of Environmental Science and Technology*, Wiley & sons, 2000, p.126, 474
[83] 1974 OECD Principles Concerning Transfrontier Pollution, Title A.
[84] Cairney, T. and Hobson, D.M., *Contaminated Land*, E&FN Span, 2nd ed., 1998, p.11.
[85] Harrison, R.M., *Pollution*, Royal society of chemistry, 3rd ed., 1996, p.1, 318-19, 375.
[86] Alloway, B.J., ‘Soil Pollution and Land Contamination’, *Pollution*, p.321;
[87] Fingas, M., *The Basics of Oil Spill Cleanup*, Lewis pub., 2001, p.31; Johnston, p.36, 66, 121-34, 177-86;
[88] Reis, J.C., *Environmental Control in Petroleum Engineering*, Gulf pub., 1996, p.78, 85, 128-131, 163, 265-68.
[89] Inhaber, H., *Energy Risk Assessment*, Gordon&Breach science pub.,1982, p.1.
[90] Levitt, A.M., *Disaster Planning and Recovery*, Wiley&Sons, 1997, p.265.
[91] Sartor, J.D. and Castle, R.W., ‘How to plan for oil pipeline spills’, *Pipeline Rules of Thumb Handbook*, 3rd ed., Gulf pub., 1993, p.467, 470.
[92] ‘Oil Testing and Spill Modeling.’
< http://www.slross.com/modeling/modelingmain.htm> (20.06.2002).
[93] Bellinger, E.G., et al., ‘Oil Spill Contingency Plans for Cyprus’, *Oil Spills in the Mediterranean and Black Sea Regions*, Boğaziçi Uni. Press, İstanbul, pp.167-176.
[94] ‘State Approves Trans-Alaska Pipeline Oil Contingency Plan.’ <http://www.state.ak.us/local/akpages/ENV.CONSERV/press/rel_116.htm>;
[95] ‘Comments on the Trans-Alaska Pipeline 2001 Draft Oil Spill Contingency Plan.’ <http://www.alaskaforum.org>.
[96] Karmokolias, Y., ‘Cost-Benefit Analysis of Private Sector Environmental Investments’, *IFC Discussion Paper*, no.30.
[97] Muraro, G., ‘Estimate of the Economic Damage Caused by Pollution; the Italian Experience’, *Environmental Damage Costs*, OECD, pp.136-148.
[98] Economic Costs and Benefits of a Antipollution Project in Italy’, *Report of ENI*, Stockholm Conference, June 1972.
[99] Yong, R.N. et al., *Principles of Contaminant Transport in Soils*, Elsevier pub., 1992, ch. 1-5-9.
[100] Riser-Roberts, E., *Bioremediation of Petroleum Contaminated Sites*, Smoley, 1992, p.4.
[101] Kerr, R.S., *Handbook of Bioremediation*, Lewis press, 1994, p.13.
[102] Palmer C.M., *Principles of Contaminant Hydrogeology*, Lewis pub., 2nd ed., 1996, p.46.
[103] Smith, A.N., ‘The effect of oil spill on land and water’, *The Prevention of Oil Pollution*, Graham&Trotman, 1979, p.18, 231.
[104] Hichee, R.E.,’Bioventing of Petroleum Hydrocarbons’, *Handbook of Bioremediation*, 1994, pp.39-56.
[105] Norris, R.D., ‘In-situ Bioremediation of Soils and Groundwater Contaminated with Petroleum Hydrocarbons’, *Handbook of Bioremediation*, 1994, pp.17-34.
[106] Brown, R., ‘Treatment of Petroleum Hydrocarbons in Groundwater by Air Sparging’, *Handbook of Bioremediation*, 1994, pp.61-83.
[107] Spaulding, M. L., P.R. Bishnoi, E. Anderson , and T. Isaji, 2000. An integrated model for prediction of oil transport from a deep water blowout, 23 rd Arctic and Marine Oil Spill Program (AMOP) Technical Seminar, June 14-16, 2000, Vancouver, British Columbia, Canada, p. 611-636.
[108] *Prediction of the Behaviour of a Bubble Column Produced by a Broken Subsea Gas Pipeline*, IFE, 1994.
[109] Clark, R.B., *Marine Pollution*, 4th ed.,Oxford Press, 1997, p.45, 52-53.
[110] ‘Oil Spills.’ <http://www.epa.gov/oilspill/does/pdfbook.htm>.
[111] Gilberrt, R.J., *The Environment of Oil*, Kluwer pub., 1993, p.194.
[112] EPA Oil Spill Guide.
[113] Mustafaev, I., ‘Environmental Impact of Magistral Oil Pipelines’,*Energy and the Environment*, ed. by İbrahim Dincer and Teoman Ayhan, Begell House Inc., 1999, p.297.
[114] Jones and Stokes, ‘Final Supplemental Environmental Impact Statement.’ (May 2002) <http://www.efsec.wa.gov/Sumas2/fseis.html>.

[115]'BTC Project EIA Turkey.' (June 2002) <http://www.caspiandevelopmentandexport.com/BTC/eng/docs.asp> (10.08.2002).
[116] Hallgarth, A., 'Mechanical Response of Pipeline Structures to Transient Explosion Loads.' <Http://neumann.dph.aber.ac.uk/research/mechresp/mechresp.html> (August 2002);
[117] 'ASME General Position Statement on the Role of Voluntary Consensus Codes and Standards in Ensuring the Integrity of Gas Transmission and Hazardous Liquid Pipelines.' (June 2000) <http://www.asme.org/gric/ps/2000/00-22.html> (August 2002).
[118] 'Material Safety Data Sheet.' <http://www.hess.com/about/msds/Natural_Gas_8010_clr.pdf> (13.8.2002).
[119] 'Air Pollutants from Oil Fires.' (2000) <http://www.gulflink.osd.mil/owf_ii/index.html>.
[120] 'Immediate Effects of Pollution.' <http://www.essentialaction.org/shell/report/section1.html>; <http://arnica.csustan.edu/Biol1010/human_impact/human_impact.htm>.
[121] Lefeber, R., *Transboundary Environmental Interference and the Origin of State Liability*, Kluwer Law Int., The Hague, 1996, ch.1.
[122] Taylor, P., *An Ecological Approach to International Law*, Routledge, London, 1998, ch.4.
[123] Nanda, P.V., *International Environmental Law and Policy*, Transnational Publis., 1995, pp.141-42;
[124] See also Zemanek, 'Causes and Forms of International Liability', *Contemporary Problems of International Law*, Cheng and Brown (eds.), 1988, p.319.
[125] Deschenaux/Tercier, *Sorumluluk Hukuku*, Kadıoğlu matb.,translated by Özdemir, S., 1983, p.2.
[126] Tiftik, M., *Akid Dışı Sorumlulukta Maddi Tazminatın Kapsamı*, Yetkin yayınevi, Ankara, 1994.
[127] Eren, F., *Borçlar Hukuku*, Genel Dağıtım, c.2, 4th ed.,İstanbul, 1991, p.2, 8, 13.
[128] Ozansoy, C., *Tarihsel ve Kuramsal Açıdan İdarenin Kusurdan Doğan Sorumluluğu*, Doktora Tezi, Ankara, 1989, p.166-67.
[129] Ulusan, İ., 'Çevre Kirlenmesinden Doğan Sorumlulukta Fedakarlığın Denkleştirilmesi İlkesi', YD, 1986, C.12, S.1-2, pp. 57-76.
[130] Erten, A., *Bina ve İnşa Eseri Sahiplerinin Sorumluluğu*, Sözkesen matb., Ankara, 2000, p.7, 20.
[131] Karahasan, M.R., *Sorumluluk Hukuku*, Beta Basım, İstanbul, 1995, p.78.
[132] Tandoğan, H., 'Tehlike Sorumluluğu Kavramı ve Türk Hukukunda Tehlike Sorumluluklarının Düzenlenmesi Sorunu', BATIDER, C.10, 1979, pp.292-313.
[133] Tiftik, M., *Tehlike Sorumluluğunun Ayırıcı Özellikleri ve Türk Hukukunda Tehlike Sorumluluklarının Genel Kural ile Düzenlenmesi Sorunu*, Atatürk Üniversitesi Basımevi, Erzurum, 1997, ch.1.
[134] See e.g. for German Law. Larenz/Canaris, p.601; See e.g. for Swiss Law. Oftinger/Stark 2/1; See e.g. for Turkish Law. Tandoğan, p.29, Eren Ibid. p.18.
[135] RLG, art.33-40.
[136] RLG 1(1); RLV 1(1).
[137] RLG 33(1) c.2.
[138] HaftpflG § 2(3) c.3.
[139] HaftpflG §7 c.1.
[140] HaftpflG §5.
[141] *Official Gazette* dated 16.03.1954 and numbered 8659.
[142] *Official Gazette* dated 17.07.1989 and numbered 20224.
[143] Sirmen, L., 'Taşınmaz Mülkiyetinin Kullanılmasında Çevre Etkileri Yaratan Müdahalelerden Dolayı Malikin Sorumluluğu', *AÜHFD*, C. 40, 88, S. 1-4, p.285.
[144] Tandoğan, H., '2872 Sayılı Çevre Kanununa Göre Çevrenin Kirletilmesinden Doğan Sorumluluk', *YD*, C. 12, S. 1-2, Ocak-Nisan 1986, pp.42-43.
[145] Abacıoğlu, M., *Çevre Kanunu ve Çevre Sağlığı Mevzuatı*, Seçkin Yayınevi, 1995, pp.30-52.
[146] See esp. The Factory at Chorzow (Claim for Indemnity, Merits), Judgement No. 13, PCIJ Series A, No. 17 (1928), at 29; British Claims in the Spanish Zone of Morocco, 2 UNRIAA 615, at 641(para. 1).
[147] See 2001 Draft articles on Responsibility of States for Internationally Wrongful Acts adopted by ILC of the fifty-third session. A/CN.4/L.602/Rev.1, Article 2.
[148] International Law Commission 1973, at 182 (para.9).
[149] The para-statal entities may include public corporations, semi-public entities, public agencies of various kinds and even, in special cases, private companies, provided that in cases the company is empowered by the law of the State to exercise functions of a public character normally exercised by State organs.
[150] Article 8 – Conduct Directed or Controlled by a State

"The conduct of a person or group of persons shall be considered an act of a State under international law if the person or group of persons is in fact acting on the instructions of, or under the direction or control of, that State in carrying out the conduct."

[151] Corfu Channel Case (U.K. vs. Alb.) 1949, I.C.J. 4 (Judgement of 9 April 1949).

[152] *Transboundary Pollution*, <http://anthonydamato.law.northwestern.edu/IELA/Intech08-2001-edited.pdf>, hereinafter cited as Transboundary Pollution.

[153] Nanda, P. Ved., *International Environmental Law and Policy,* Transnational Publ., 1995, p.140.

[154] Riccardo-Pisillo-Mazzeschi, 'Forms of Responsibility for Environmental Harm', *International Responsibility For Environmental Harm*, (ed. by Francioni and Scovazzi), Graham and Trotman, 1991.

[155] In this sense, the formula used by Principle 21 of the Stockholm Declaration is also instructive; It refers not only to "jurisdiction" but also to the "control" of the States.

[156] ICJ, Reports (1949), 3 ff.

[157] Dupuy, Pierre-Marie. « Overview of the Existing Customary Legal Regime Regarding International Pollution », *International Law and Pollution*, ed. By Daniel Magraw, University of Pennsylvania Press, 1991, p.63.

[158] Trail Smelter Arbitration (US vs. Can.) 1941, 11 Mar. 1941, 3 R.I.A.A. 1905 (1949); See e.g. 1972 UN Declaration of Human Environment (Principle 21); Resolution 3129 of December 1973 on Cooperation in the Field of Environment Concerning Natural Resources Shared by Two or More States; 1978 UNED Draft Principles of Conduct on Shared Natural Resources (Principle 3); 1960 Frontier Treaty between Germany and Netherlands (Art 58(2)(e)); 1982 UN Convention on the Law of Sea (Art 192(2)).

[159] UN CHARTER (Art 1(3)); See e.g. 1972 UN Conference on the Human Environment (Principle 24); Lake Lanoux Arbitration (Spain vs. France) 1957- I.L.R. 101 (1957); 1979 ECE Convention on Long-Range Transboundary Air Pollution; 1982 UN Convention on the Law of Sea (Art 63, 66-67, 197 and following arts.).

[160] Francioni, Francesco., "Exporting Environmental Hazard Through Multinational Enterprises: Can The State of Origin be Held Responsible", *International Responsibility for Environmental Harm*, Graham&Trotman, 1991, p.283.

[161] Brownlie, Ian., *Principles of Public International Law*, Claredon Press, fourth ed., 1990, p.440.

[162] UN Doc. A/CONF.48/PC.12, Annex 2, at 15 (para.66).

[163] 1992 UN/ECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Art. 3(2)); 1992 OsPar Convention for the Protection of the Marine Environment of the North-East Atlantic (Art. 2(3) b).

[164] Rainbow Warrior 2 (New Zealand vs. France), 82 ILR 499, at 570-573 (paras.111-114).

[165] Crawford, J. et al. "The ILC' Article on Responsibility on States for Internationally Wrongful Acts: Completion of the Second Reading", *EJIL*, Vol 12, No 5, Nov 2001, pp.985-87.

[166] In a report on the Spanish Zone of Morocco claims Judge Huber said: "Responsibility is the necessary collar of right. All rights of an international character involve international responsibility if the obligation in question is not met, responsibility entails the duty to make reparation."

In its judgment in the Chorzow Factory proceedings, the Permanent Court stated that: "It's a principle of international law that the breach of an engagement involves an obligation to make reparation in an adequate form. Reparation therefore is the indispensable complement of a failure to apply a convention and there is no necessity for this to be stated in the convention itself." *Factory of Chorzow*, Merits, 1928, P.C.I.J., Series A, No.17.

[167] Article 36 (2)

"(c) the existence of any fact which, if established, would constitute a breach of an international obligation,

(d) the nature or extent of the reparation to be made for the breach of an international obligation."

[168] See the decision of the arbitral tribunal in the Trail Smelter Arbitration, which provided compensation to the U.S. for damage to land and property caused by sulphur dioxide emissions from a smelter across the border in Canada. Compensation was assessed on the basis of the reduction in value of affected land. *Trail Smelter Arbitration*, UNRIAA, vol.3, p.1907 (1938, 1941).

[169] … attempts to interpret international law solely in terms of breaches of imprecise or disputed rules, engaging State responsibility for a wrongful act or omission, are bound to be inadequate …" (YB ILC 1983 2 (part 1) 2013 (Document A/CN.4/373), 219, para.60, (Quentin-Baxter's fourth report); YB ILC 1970 2 177 (Document A/CN.4/233), 178, paras.5-6.

[170] Tomuschat, C., "International Liability for Injurious Consequences Arising Out of Acts not Prohibited by International Law: The Work of ILC", *International Responsibility for Environmental Harm*, p.46.
[171] Quentin-Baxter 1982, at 60 (para.41); Quentin-Baxter 1981, at 123 (para.92): "at the end of the journey the monster of strict liability should be domesticated."
[172] Article 1 of the draft article on prevention.
[173] Article 8, article 9, article 11, article 12 and article 13.
[174] Article 3 of the draft article.
[175] Draft articles on Prevention Transboundary Damage from Hazardous Activities (art.12); 1982 UN Law of Sea (art.200); Convention on Long-Range Transboundary Air Pollution (art.4 (1)); Convention on the Protection and Use of Transboundary Water Courses and International Lakes (art.13); Convention on Environmental Impact Assessment (art.3); Rio Declaration on Environment and Development (prin.19); Convention on the Transboundary Effect of Industrial Accidents (arts.3 and 10).
[176] 1982 UN Law of Sea (arts. 205 and 206); Convention on the Transboundary Effect of Industrial Accidents (art.4); Convention on Biological Diversity (art.14 (1)(a) and (b)).
[177] Article 4 of the convention provides that the environmental impact assessment of a State party should contain, at a minimum, the information described in appendix 2 to the Convention.
[178] Safety measures could include: (a) adoption of safety standards for the location and operation of pipeline, (b) monitoring of facilities, (c) maintenance of equipment and facilities to ensure ongoing compliance with safety measures.
[179] Environmental Pollution Fund Regulation (17 May 1985); Water Pollution Control Regulation (4 September 1988); Hazardous Chemicals Regulation (11 July 1993); Environmental Inspection Regulation (5 January 2002); Environmental Impact Assessment Regulation (23 June 1997).
[180] Petroleum Law (16 March 1954); Law on Transit Passage of Petroleum by Pipelines (29 June 2000); Natural Gas Market Law (2 May 2001); National Parks Law (11 August 1983); Shore (coastal) Law (4 April 1990); Decree with the Force of Law on the Establishment of the Special Environment Protection Authority (13 November 1989).
[181] EIA of the BTC Project, Appendix 5 sect. 2.1(1).
[182] Montreal Protocol on Substances That Deplete the Ozone Layer (and sub. Amendments) (acceded by Law no. 4118 published in the Official Gazette dated 12 July 1995 and no. 22341); Vienna Convention on the Protection of the Ozone Layer (acceded by Law no. 3655 published in the Official Gazette dated 20 June 1990 and no. 20554); Barcelona Convention on the Protection of the Mediterranean Sea from Pollution (acceded by Law no. 2328 and published in the Official Gazette dated 12 June 1981 and no. 17368); Protocol for Combat and Cooperation in Cases of Pollution of the Mediterranean Sea by Petroleum and Other Hazardous Substances; Protocol on the Protection of the Mediterranean Sea from Earth-Based Pollutants (acceded by the Decision of the Council of Ministers dated 18 February 1987 and published in the Official Gazette dated 8 March 1987 and no. 19404); International Convention on the Prevention of Pollution of Seas by Ships (MARPOL-73 CONVENTION) (acceded by the Decision of the Council of Ministers dated 3 May 1990 and published in the Official Gazette dated 24 June 1990 and no. 20558); Geneva Convention on Long-Range Transboundary Air Pollution (acceded by the Decision of the Council of Ministers dated 21 January 1983 and published in the Official Gazette dated 23 March 1983 and no. 17996); Ramsar Convention on Wetlands of International Importance Especially as Wildfowl Habitat (acceded by the Decision of the Council of Ministers dated 15 March 1994 and published in the Official Gazette dated 17 May 1994 and no. 21937); Bern Convention on Protection of Europe's Wild Life and Living Environment (acceded by the Decision of the Council of Ministers dated 9 January 1984 and published in the Official Gazette dated 20 February 1984 and no. 18318); Convention on International Trade in Endangered Species of Wild Flora and Fauna (acceded by Law no. 4041 and published in the Official Gazette dated 20 June 1996 and no. 22672); Basel Protocol on Transboundary Movements of Hazardous Wastes and Their Disposal (published in the Official Gazette dated 15 May 1994 and no. 21935).

BIBLIOGRAPHY

‘A Brief History of the Natural Gas Industry’, <http://www.flogas.com/natgashistory/history_of_natural_gas.htm>.

Abacıoğlu, Muhittin, Çevre Kanunu ve Çevre Sağlığı Mevzuatı, Seçkin Yayınevi, 1995.

Abdel-Aal, K. Hussein and Schmelzlee, Robert, Petroleum Economics and Engineering, Marcel Dekker Inc, 1976.

‘Acting on Green Laws’, *Petroleum Economist*, vol. 59, no. 2, February 1992.

Al-Naimi, Ali, ‘Geopolitics of Energy and Saudi Oil Policy’, <http://www.csis.org/sei/event991208/sAlNaimi.htm>.

Al-Moneof, A. Majid, ‘Petroleum and The World Trade Organisation’, vol. 44, no. 5, (29 January 2001), <http://www.mees.com/news/a44n05d01.htm>.

‘ASME General Position Statement on the Role of Voluntary Consensus Codes and Standards in Ensuring the Integrity of Gas Transmission and Hazardous Liquid Pipelines’, (June 2000), <http://www.asme.org/gric/ps/2000/00-22.html>.

Alloway, B.J., ‘Soil Pollution and Land Contamination’, Pollution, (ed. By Harrison), 1996.

Baker, A. James, ‘China and Long-Range Asia Energy Securities’, <http://www.rice.edu/projects/baker/Pubs/workingpapers/efac/executive_summary.html>.

Bellinger, E.G. *et al,* ‘Oil Spill Contingency Plans for Cyprus’, Oil Spills in the Mediterranean and Black Sea Regions, Boğaziçi University Press.

Bennett, Allison, ‘Oil: The Fuel of Global Commerce’, <http://www.usna.edu/NAFA/Papers/table10/Oil_the_Fuel_of_Global_Commerce_by_Allison_Bennett.doc>.

Brown, R., ‘Treatment of Petroleum Hydrocarbons in Groundwater by Air Sparging’, Handbook of Bioremediation, (ed.by Kerr), 1994.

Brownlie, Ian, Principles of Public International Law, fourth ed., Claredon Press, 1990.

‘Bp Statistical Review’, <http://www.bp.com/downloads/index.asp>.

Bromley, S., American Hegemony and World Oil, Polity Press, 1991.

‘BTC Project EIA Turkey’, (June 2002), <http://www.caspiandvelopmentandexport.com/BTC/eng/docs.asp>.

Caldwell, K. Lynton, International Environmental Policy, third ed., Duke University Press, 1996.

Campbell, C.J., ‘Peak Oil: an Outlook on Crude Oil Depletion’, World: Oil and Gas Industry, revised February 2002, <http://www.mbendi.co.za/indy/oilg/p0070.htm>.

Chairney, T. And Hobson, D.M., Contaminated Land, second ed., E&FN Span, 1998.

CIS Pipelines, Petroconsultants, May 1995.

Clark, R.B., Marine Pollution, fouth ed., Oxford University Press, 1997.

Coburn, L.L., ‘Energy Security:Is The Past Prologue’, <http://www. usaee.org/pdf/v02coburn.pdf>

‘Comments on the Trans-Alaska Pipeline 2001 Draft Oil Spill Contingency Plan’, (October 2001), <http://www.alaskaforum.org>.

Conaway, F. Charles, The Petroleum Industry, Penwell, 1999.

‘Cost/Benefit Analysis’, <http://www.Icra.org/about/news/lhpl/letter.html>.

Crawford, J. *et al.*, ‘The ILC’s Article on Responsibility on States for Internationally Wrongful Acts: Completion of the Second Reading’, *EJIL*, vol. 12, no. 5, November 2001.

Deschenaux, Henri and Tercier, Pierre, Sorumluluk Hukuku, Kadıoğlu matbaası, 1983.

Dupuy, Pierre-Marie, ‘Overview of the Existing Customary Legal Regime Regarding International Pollution’, International Law and Pollution, (ed. By Magraw), University of Pennsylvania Press, 1991.

Dyke, V. Kate, Fundamentals of Petroleum, fourth ed., 1997.

‘Earth Shaking Summit’, *Petroleum Economist*, vol. 59, no. 4, April 1992.

Ebel, E. Robert, CSIS Report Energy Choices in the Near Abroad, The Center For Strategic and International Studies, 1997.

‘Economic Costs and Benefits of a Antipollution Project in Italy’, Report of ENI, Stockholm Conference, June 1972.

Energy Information Administration, ‘International Energy Outlook 2002’, <http:// www.eia.doe.gov/oiaf/ieo/index.html>.

Energy Information Administration, ‘Natural Gas’, (March 2002) <http://www.eia.doe.gov/oiaf/ archieve/ieo01/nat_gas.html>.

Energy Information Administration, ‘World Oil Market and Oil Price Chronologies: 1970-2001’, <http://www.eia doe.gov/emeu/cabs/chron.html>.

‘Energy Outlook’, <http://www.fe.doe.gov/strategic_plan/festrategy_outlook.html>.

Energy R&D, Organisation for Economic Co-operation and Development, Paris, 1975.

‘Energy Perspectives: Trends and Milestones 1949-2000’, <http://www.eia.doe.gov. /emeu/aer/ep/inter.html>.

‘Energy Pirce Impacts on the U.S. Economy’, <http://www. eia.doe.gov/oiaf/economy /energy_price.html>.

EPA Oil Spill Guide.

Eren, Fikret, Borçlar Hukuku, Genel Dağıtım, c. 2, fourth ed., 1991.

Erişgin, Nuri, Boru Hattı İşletenin Hukuki Sorumluluğu, Dok. T., Ankara, 1996.

Ertaş, Şeref, Eşya Hukuku, third ed., 9 Eylül Üniversitesi yayınları, no. 74, 1997.

Erten, Ali, Bina ve İnşa Eseri Sahiplerinin Sorumluluğu, Sözkesen matb., 2000.

Farmer, Andrew, Managing Environmental Pollution, Routledge, 1997.

Feizlmayr, A.H., Design and Construction of Stations For Oil Pipelines, I.L.F. Consulting Engineers, 1975.

Fingas, Merv, The Basics of Oil Spill Cleanup, Lewis publ., (ed. by Charles, J.), 2001.

Foley, G. And Lönnroth, M., ‘Mapping The Landscape’, The European Transition From Oil, Academic press, 1981.

Francioni, Francesco, ‘Exporting Environmental Hazard Through Multinational Enterprises: Can The State of Origin be Held Responsible’, International Responsibility for Environmental Harm, (ed. by Francioni and Scovazzi), 1991.

Gas Engineers Handbook, first ed., The Industrial Press, 1966.

Giddens, H. Paul, The Birth of Oil Industry, Arno Press, 1972.

‘Glossary’, <http://www.eia.doe.gov/emev/perfpro/glossary.html>.

Gray, Forest, Petroleum Production in Non-technical Language, second ed., Penwell, 1995.

Gilbert, R.J., The Environment of Oil, Kluwer publ., 1993.

Hallgart, A., ‘Mechanical Reponse of Pipeline Structures to Transient Explosion Loads’, <http://neumann.dph.aber.ac.uk/research/mechresp/mechresp.html>.

Hamid, H. Emanul, ‘International Transportation of Natural Gas by Pipeline: Prospects of Bangladesh’, <http://www.duncanchowdhury.com/belavista/economy/ int_trans_of_nat_gas.htm>.

Harrison, M. Roy, Pollution, third ed., The Royal Society of Chemistry, 1996.

Henry, J.T., History of Petroleum, Burt Franklin, 1965.

Hichee, R.E., 'Bioventing of Petroleum Hydrocarbons', Handbook of Bioremediation, (ed. by Kerr), 1994.

'Human Impact on the Environment', (2000), <http://arnica.csustan.edu/Biol1010/human_impact/human_impact.htm>

Inhaber, Herbert, Energy Risk Assessment, Gordon&Breach Science publ., 1982.

'Immediate Effects of Pollution', <http://www.essentialaction.org/shell/report/section 1.htm>.

Jones and Stokes, 'Final Supplemental Environmental Impact Statement', (May 2002), <http://www.efsec.wa.gov/Sumas2/fseis.html>.

Karahasan, R. Mustafa, Sorumluluk Hukuku, Beta Basım, 1995.

Karmokolias, Y., 'Cost-Benefit Analysis of Private Sector Environmental Investments', IFC Discussion Paper, no. 30.

Kennedy, J.L., Oil and Gas Pipeline Fundamentals, second ed., Pennwell Books, 1993.

Keohane, Robert, 'After Hegemony: Cooperation and Discord in the World Political Economy, Princeton University Press, 1984.

Kerr, S.Robert, Handbook of Bioremediation, Environmental Research Laboratory, Lewis publ., 1994.

Kumis, Lawrence, 'Oil Prices: Overview of Current World Market Dynamics', <http://shelby.senate.gov/legislation/leg_pdf/oil1.pdf>.

Laherrere, H. Jean, 'Estimates of Oil Reserves', <http://www.oilcrisis.com/laherrere/iiasa_reserves.pdf>.

Lefeber, Rene, Transboundary Environmental Interference and the Origin of State Liability, Kluwer Law International, 1996.

Lester, C.B., Pipeline Construction in the Seventies, 1982.

Levitt, A.M., Disaster Planning and Recovery, Wiley and Sons Inc., 1997

Littleton, T. Charles, Industrial Piping, second ed., McGraw-Hill Book Company, 1962.

'LNG Prospects and Problems', *Petroleum Economist*, vol. 42, no. 12, December 1975.

Lowe and Thompson, 'Pollution and Development', Environmental Issues in the 1990s, (ed. by Mannion, A.M. *et al.*), Wiley and Sons Inc., 1992.

Lyle, Don, 'Demand Triggers Pipeline Rush', *Hart's E&P*, December 2001.

'Material Safety Data Sheet', <http://www.hess.com/about/msds/Natural_Gas_8010_clr.pdf>.

Mendel, Otto, Practical Piping Handbook, Penwell Books, 1981.

Moco, Yeong-Seok and Lee, Dal-Sok, ‘Energy Cooperation in Northeast Asia’, (May 2002), <http://www.neasiaenergy.net>.

Mohnfeld, H. Jochen, ‘Changing Patterns of Trade’, *Petroleum Economists*, vol. 47, no. 8, August 1980.

Muraro, G., ‘Estimate of the Economic Damage Caused by Pollution: The Italian Experience’, Environmental Damage Costs, OECD, Paris, 1974.

Mustafaev, I., ‘Environmental Impact of Magistral Oil Pipelines’, Energy and the Environment, ed. by Dincer, I. And Ayhan, T., Begell house inc., 1999.

Nanda, P.V., International Environmental Law and Policy, Transnational Publ., 1995.

NATO/CCMS Short Term Ad-Hoc Project, Report no. 252, March 2002.

‘Natural Gas Production: Where Price Controls Failed, The Market Succeeded’, <http://www.ipaa.org/govtrelations/factsheets/NaturalGasBackground.asp>.

Norris, R.D., ‘In-situ Bioremediation of Soil and Groundwater Contaminated With Petroleum Hydrocarbons’, Handbook of Remediation, (ed. by Kerr), 1994.

Oates, J.A., Pipes and Pipeline Manual, fourth ed., England, 1972.

Odell, P., Oil and World Power, seventh ed., Penguin Books, 1983.

‘Oil Spills’, <http://www.epa.gov/oilspill/does/pdfbook.htm>.

Oil Supply Security, International Energy Agency.

‘Oil Testing and Spill Modelling’, <http://www.slross.com/modeling/modelingmain.htm>.

‘Overview of Natural Gas’, <http://www.naturalgas.org/naturalgas/transport.htm>.

Ozansoy, Cüneyt, ‘Tarihsel ve Kuramsal Açıdan İdarenin Kusurdan Doğan Sorumluluğu’, dok. t., 1989.

Palmer, M. Christopher, Principles of Contaminant Hydrogeology, second ed., Lewis publ., 1996.

Patricelli, J.A., and McMicheal, C.L., ‘An Integrated Deterministic/Probabilistic Approach to Reserves Estimates’, *JPT*, January 1995.

Pazarcı, Hüseyin, Uluslararası Hukuk Dersleri, Turhan Kitabevi, second ed., c. 3, 1997.

Petroleum Pipelines Safety Codes, third ed., Applied Science Publ., 1967.

‘Petroleum Trade’, <http://www.eia.doe.gov/emeu/aer/ep/inter.html>.

Porteous, Andrew, Dictionary of Environmental Science and Technology, third ed., Wiley&Sons Inc., 2000.

‘Prediction of the Behavior of a Bubble Column Produced by a Broken Subsea Gas Pipeline’, IFE, 1994.

Reis, C. John, Environmental Control in Petroleum Engineering, Gulf Publ., 1996.

Riccardo-Pisillo-Mazzeschi, ‘Forms of Responsibility for Environmental Harm’, International Responsibility For Environmental Harm, (ed. by Francioni and Scovazzi), Graham and Trotman, 1991.

Riser-Roberts, Eve, Bioremediation of Petroleum Contaminated Sites, Smoley, 1992.

Rostker, Bernard, ‘Environmental Exposure Report’, (August 2000), <http://www.gulflink.osd.mil/owf_ii/index.htm>.

‘Russia: Oil and Natural Gas Export Pipelines’, (November 2002), <http://www.eia.doe.gov/emeu/cabs/russpip.html>.

Sartor, J. D. and Castle, R.W., ‘How to Plan for Oil Pipeline Spills’, Pipeline Rules of Thumb Handbook, (ed. by McAllister, E.W.), third ed., Gulf Publ., 1993.

Shamout, M.N., ‘On Leakage Detection in Pipelines’, Oil Spills in the Mediterranean and Black Sea Regions, Bogaziçi University Press, İstanbul, 2000.

Sirmen, Lale, ‘Taşınmaz Mülkiyetinin Kullanılmasında Çevre etkileri Yaratan Müdahalelerden Dolayı Malikin Sorumluluğu’, *AÜHFD*, c. 40, 88, s. 1-4.

Smith, A.N., ‘The Effect of Oil Spill on Land and Water’, The Prevention of Oil Pollution, Graham&Trotman, 1979.

Smith, Keith, Environmental Hazards, Routledge, 1992.

Spaulding, M. L., P.R. Bishnoi, E. Anderson , and T. Isaji, 2000. An integrated model for prediction of oil transport from a deep water blowout, 23 rd Arctic and Marine Oil Spill Program (AMOP) Technical Seminar, June 14-16, 2000, Vancouver, British Columbia, Canada, p. 611-636.

‘State Approves Trans-Alaska Pipeline Oil Contingency Plan’, (November 1998), <http://www.state.ak.us/local/akpages/ENV.CONSERV/press/rel_116.htm>.

‘Statistical Review of World Energy 2001’, Full Report, <http://www.bp.com/downloads/702/Bpwebglobal.pdf>.

Steensnæs, Einar, ‘The World Summit on Sustainable Development’, <http://odin.dep.No/oed/norsk/aktuelt/taler/statsroad_a/026031:090052/index-dok000-n-f-a.html>.

Tandoğan, Haluk, ‘Tehlike Sorumluluğu Kavramı ve Türk Hukukunda Tehlike Sorumluluklarının Düzenlenmesi Sorunu’, *BATIDER*, C. 10, 1979.

Tandoğan, Haluk, ‘Türk Hukukunda Mecralar’, *AÜHFD*, C. 9, S. 3-4, 1952.

Tandoğan, Haluk, ‘2872 Sayılı Çevre Kanununa Göre Çevrenin Kirletilmesinden Doğan Sorumluluk’, *YD*, C. 12, S. 1-2, Ocak-Nisan 1986.

Taylor, P., Ecological Approach to International Law, Routledge, 1998.

Theodore, H. Moran, ‘Managing an Oligopoly of Would-be Sovereigns: The Dynamics of Joint Control and Self-Control in the International Oil Industry Past, Present and Future’, International Organization, 41, 4, Autumn 1987.

Tiftik, Mustafa, Tehlike Sorumluluğunun Ayırıcı Özellikleri ve Türk Hukukunda Tehlike Sorumluluklarının Genel Kural ile Düzenlenmesi Sorunu, Atatürk Üniversitesi Basımevi, 1997.

Tiftik, Mustafa, Akid Dışı Sorumlulukta Maddi Tazminatın Kapsamı, Yetkin Yatınevi, 1994.

Toman, A. Micheal, ‘What Do We Know About Energy Security’, <http://www.cato.org/pubs/regulation/reg14n1i.html>.

Tomuschat, C., ‘International Liability For Injurious Consequences Arising Out of Acts Not Prohibited by International Law: The Work of ILC’, International Responsibility For Environmental Harm, (ed. by Francioni and Scovazzi), Graham and Trotman, 1991.

‘Tough Year but the Oil and Gas Kept Flowing’, <http://www.bp.com/centres/press/p_r_detail.asp?id=904>.

Transboundary Pollution, <http://anthonydamato.law.northwestern.edu/IELA/Intech08-2001-edited.pdf>.

Turgut, Nükhet, Çevre Hukuku, first ed., Savaş Yayınevi, 1996.

Turner, L., Oil Companies in the International System, third ed., George Allen and Unwin, 1983.

Ulusan, İ., ‘Çevre Kirlenmesinden Doğan Sorumlulukta Fedakarlığın Denkleştirilmesi İlkesi’, *YD*, c. 12, s. 1-2, 1986.

Venn, Fiona, Oil Diplomacy in the Twentieth Century, Macmillan, London, 1986.

Wagner, R.L., ‘Petroleum Products Pipeline Transportation’, Petroleum Marketing and Transportation, Gulf Publ., 1964.

Williams, J.L., ‘Oil Price History and Analysis’, WRTG Economics, <http://www.wrtg.com/prices.htm>.

‘World Bank Energy Report’, *Petroleum Economist*, vol. 47, no. 9, October 1980.

‘World Market Overview’, <http://www.tradepartners.gov.uk/oilandgas/profile/index/worldmarket.shtml>.

‘World Oil Transit Chokepoints’, (November 2002), <http://www.eia.doe.gov/emeu/cabs/choke.html>.

‘World Trade in Fuels Forecast’, *Petroleum Economist*, vol. 47, no. 7, July 1980.

Yergin, Daniel, The Prize: The Epic Quest for Oil, Money and Power, Simon and Schuster, 1992.

Yong, R.N., Mohamed, A.M.O. and Warkentin, B.P., Principles of Contaminant Transport in Soils, Elsevier Publ., 1992.

Zemanek, 'Causes and Forms of International Liability', Contemporary Problems of International Law, Cheng and Brown, 1988.

Zhao, Jimin, 'Diffusion, Costs and Learning in the Development of International Gas Transmission Lines', <http://www.iiasa.ac.at>.

1974 OECD Principles Concerning Transfrontier Pollution.