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A critical analysis of safety and marine environmental protection regulations for oil and gas development in the high seas

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A CRITICAL ANALYSIS OF SAFETY AND MARINE ENVIRONMENTAL PROTECTION REGULATIONS FOR OIL AND GAS DEVELOPMENT IN THE HIGH SEAS

By

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DECLARATION

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

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

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ABSTRACT

Title of Dissertation : A Critical Analysis of Safety and Marine Environmental Protection Regulations for Oil and Gas Development in the High Seas

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This dissertation examines international regulations for the prevention of incidents/accidents at oil and gas (O&G) development platforms in the high seas, analyzing current situations regarding accident trends and measures conducted by various institutions against accidents.

The need for enacting new legislations that ensure maximum safe operation on the platforms has been increasing under the circumstance of expanded development underneath the seabed in not only territorial seas but also Exclusive Economic Zones or continental shelves. A further motivating factor was the aftermath of the BP oil disaster in the Gulf of Mexico in 2010 that resulted in the loss of lives of workers and severe damage to the marine environment.

This is because the disasters, occurring at the platforms, raised awareness of the risks involved in O&G development activities and evidenced the lack of adequate regulations for emergencies. Moreover, the development area is currently enlarging to the high seas that are beyond national jurisdiction.

Therefore, for safe operation based on functional equipment and appropriate procedures, an international organization should take the initiative to establish effective and pragmatic instructions on behalf of the players engaged in O&G development business.

For analysis of the thesis, this paper shows the accident trends related to O&G development to demonstrate the importance of discussion around the accidents by IHS World Casualty Statistics and DNV WOAD; and, current regulations, standards and guidance are introduced for the purpose of comparing the roles of each instrument and identifying an insufficiency of effective and reasonable legislation to ensure the safety of the platform, such as the IMO conventions, UNCLOS, ISA Code, EU Directive, and API, ISO and DNV standards.

Eventually, after concluding the lack of regulations for safe O&G development in the high seas, some recommendations regarding the development of new regulations are given to achieve the prevention of accidents.

Keywords: Oil and Gas Platform, Safety, Accident, the High Seas, International Laws

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LIST OF ABBREVIATIONS

ABS	American Bureau of Shipping
API	American Petroleum Institute
DNV	Det Norske Veritas
DWT	Deadweight Tonnage
EEZ	Exclusive Economic Zone
EPCI	Engineering, Procurement, Construction and Installation
EU	European Union
FPSO	Floating Production Storage Offloading Facility
FSO	Floating Storage and Offloading Facility
GMEP	Global Marine Environment Protection
GT	Gross Tonnage, as per ITC-69
IMO	International Maritime Organization
ISA	International Seabed Authority
ISO	International Organization for Standardization
JOGMEC	Japan Oil, Gas and Metals National Corporation
MARPOL	International Convention for the Prevention of Pollution from Ships
MODU	Mobile Offshore Drilling Units
MSC	Maritime Safety Committee

N/A	Not applicable
OECD	Organization for Economic Co-operation and Development
OGP	International Association of Oil & Gas producers
O&G	Oil and Gas
SOLAS	International Convention for the Safety of Life at Sea
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
UK	United Kingdom
UN	United Nations
UNCLOS	1982 United Nations Convention on the Law of the Sea
USA	United States of America
WOAD	Worldwide Offshore Accident Databank
WOC	World Ocean Council

Chapter 1 INTRODUCTION

1.1. Back ground

For a few decades, demands for energy such as oil and gas have been expanded on a global scale, in particular in developing countries like China, India and Brazil, i.e. "the world is highly dependent on oil" (Kloff and Wicks, 2004). According to the U.S Energy Information Administration (2014), the world's petroleum consumption increased from 63,119 thousand barrels per day in 1980 to 90,325 in 2013. Similar to petroleum consumption, gas is focused on as clean and alternative energy; and, the gas demand has been increasing year by year.

The rapid growth of energy demands contributes to the increasing development and exploitation of these resources from under both land-based ground and seabed, in other words, onshore and offshore[1]. In particular, the area for drilling and mining natural resource has been expanding to be huge and broad, thanks to developing technology, especially to the offshore area. Offshore development, thus, has been increasing in

[1] According to the Europe Directive (2013), offshore means "situated in the territorial sea, the Exclusive Economic Zone (EEZ) or the continental shelf of a Member State within the meaning of the United Nations Convention on the Law of the Sea (UNCLOS)".

Brazil and West Africa where oil and gas were found at sea several years ago. In the future, it will extend wider and deeper into the high seas, beyond the territorial sea, EEZ and continental shelf. The high seas are the next stage to be developed to supply global demand for energy, and a project[2] to develop in the high seas has already started in Japan for the reason that minerals and other important natural resources such as oil and gas that can be mined from the seabed are spurring industrial and technological development. By this trigger, the countries which have huge EEZs or do not have offshore areas will try to start searching, exploring and developing the seabed in the high seas to acquire new natural resources.

In order to explore and develop the natural resources from the seabed, special and particular facilities and equipment are needed for drilling, producing, processing, storage and transfer. For example, fixed platform, jack-up rig platform, compliant tower, semi-submersible facility and floating production storage offloading facility (FPSO) are parts of special facilities[3]. A Jack-up rig platform is a mobile drilling rig currently being used in a production capacity and an FPSO has many functions for

[2] Japan Oil, Gas and Metals National Corporation (JOGMEC), which is a state entity which implements national policies on natural resources and energy as an agency of the Government of Japan, will prospect and explore for cobalt-rich ferromanganese crusts based on the a 15-year contract with the International Seabed Authority (ISA) that signed at Tokyo in 2014 (ISA, 2014). Under the contract, JOGMEC will have exclusive rights for exploration for cobalt-rich ferromanganese crusts over 3,000 square kilometres of the seabed in the Western Pacific.

[3] See **APPENDIX 1** about other types of platforms

producing, processing and storing oil. These facilities can be divided into two types: floating and fixed platform, which is fixed to the seabed directly. While semi-submersible facility and FPSO are floating platforms, jack-up rig platform and compliant tower are fixed platforms. A Jack-up rig platform[4] is built on steel or concrete legs anchored directly to the sea floor in shallow water; a semi-submersible facility on floating pontoons that can be filled with ballast to adjust their position in the water, and which are anchored by chains and cables to the sea floor, can be operated in depths of 60 to 3000 meters; an FPSO can be positioned over wells to extract oil and fill storage tanks in the hull of a ship in deep water, approaching 4000 meters (AGI, 2014). Fixed platforms, which have the advantage of stability and easy installation, access and operation due to being near the coastline and shallow water, are located in the Middle East and the North Sea. On the other hand, floating types can be installed at deep water like pre-salt area in Brazil and Angola thanks to developing technology.

Offshore oil and gas (O&G) development, however, causes unpredictable offshore incidents like spoiled pipelines and helicopter accidents which result in terrible oil pollution and loss of workers' lives, for example, the BP oil disaster in the USA Gulf of Mexico in 2010. The number of offshore incidents is around 100 per year (Christou and Konstantinidou, 2012). Such environmental disasters have raised awareness of the

[4] The deck contains the drilling and production facilities and the living quarters. Because they cannot be moved, they are long term structures and installed at depths of up to 550 meters. In deeper waters, platforms are mounted on flexible towers that can withstand the motions of water that is between 400 - 950 meters deep.

risks involved in O&G development activities and evidenced the lack of adequate regulations in the case of an accident, triggering the development of new legislation that ensures maximum safety (Gómez and Green, 2013). Since the number of offshore accidents will go up in the near future due to increasing O&G development, incidents should be prevented by regulating the unsafe operation and substandard technologies in advance for safe development.

Until now, there are various regulations, guidance, standards and best practices which are enacted by many institutions. While the importance of the safe development and the necessity of some guidance or instruments related to protection from marine pollution are well recognized, there are no international instruments for effective protection from accidents. For instance, as the body which is responsible for safety of life at sea and marine environmental protection, the International Maritime Organization (IMO) has attempted to develop some instruments: the International Convention for the Safety of Life at Sea (SOLAS), the International Convention for the Prevention of Pollution from Ships (MARPOL) and the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW). They were adopted to keep vessels safe, prevent the oil pollution and educate seafarers. However, these conventions were exclusively designed only for maritime traffic, i.e. they do not apply to O&G development platforms such as FPSOs and Floating Storage and Offloading Facilities (FSOs) (Kloff and Wicks, 2004). But, since the oil spills caused by offshore incidents influence many countries beyond boundaries and might

occur in any other countries, international regulations are essential to ensure the recovery of the incidents by polluters, not taxpayers in neighboring countries (Östman, 2012).

On the other hand, other associations have conducted studies and enacted standards or regulations for avoiding offshore accidents. For example, American Petroleum Institute (API), which is a non-governmental community that shares the information about O&G development, drafted standards themselves as main players or stakeholders to prevent high risk situations; another guidance were issued by DNV, which is a third party and has high quality knowledge and experience, by request of stakeholders. While these regulations, standards and guidance are useful for the members who are related to the O&G business and they are high standards, they cannot cover all O&G activities and some of them are not mandatory. That is why there are still accidents happening recently due to technical failure and other reasons at O&G platforms.

Therefore, new regulations need to be developed to avoid all accidents in the future. Regulations which can cover all O&G activities should meet the requirements of being user-friendly for all stakeholders and having perfect coverage of areas and facilities. In order to regulate the O&G development activities practically, the large burden placed on oil companies by the regulations should be taken into account.

1.2. Purpose

As stated above, while O&G development and exploitation have been focused on covering increased energy demands, international standards to prevent incidents are thought to be insufficient. Notably, there are not enough discussions regarding O&G development in the IMO because the scope of the IMO is safety and environmental protection related to shipping. However, this new category also makes a strong contribution to both shipping safety and marine environmental protection. Moreover, even if many best practices and standards for O&G development already exist in various organizations, the multiple information and instructions makes the situation complex and complicated for users. Besides, these instruments cannot cover all areas that are developed at this moment and will be explored in the future, especially in the high seas. In order to maintain safety and prevent environmental damage, proactive actions for O&G development are needed through international cooperation because of common issues like shipping. And information for the safety of operation and installations should be shared by all stakeholders. That is why effective and pragmatic regulations which secure the highest safety standards and protect the environment based on best regulatory practices are necessary to be delivered to all stakeholders. Therefore, the importance of thinking about O&G development activities is expressed and the necessity of considering new regulations for O&G development in the high seas is suggested throughout the dissertation.

1.3. Methodology

In order to demonstrate the insufficiency of regulations for safe O&G development in the high seas for the achievement of marine pollution prevention and to recommend the enactment of new regulations for O&G development in the high seas, this research paper introduces actual situations about offshore accidents and current regulations for protection against offshore accidents including other standards and guidance such as the API and ISO.

For showing the actual situations, the importance of discussion about offshore accidents and the severity of offshore accidents are explained by comparison between offshore and shipping accidents in terms of the number, trends and types of accident based on statistical research, IHS World Casualty Statistics and Worldwide Offshore Accident Databank (WOAD) produced by Det Norske Veritas (DNV).

On the other hand, a literature review of regulations enacted by the IMO and some standards developed by other institutions is conducted in order to identify the coverage area of these instruments and insufficiency of establishing international regulations for O&G development in the high seas. Moreover, an interview of the DNV is implemented to confirm the DNV activities and collect information about current regulations. The interview was conducted with Mr. Ikuo Hamanaka of the DNV official by the author at Oslo, Norway on 8th August 2014.

This dissertation does not describe all regulations, standards and guidance related to O&G development activities, domestic laws and the contents of regulations and instructions in detail, but brief and essential ideas which are, at least, relevant to the issues discussed here.

1.4. Structure

This dissertation mainly comprises four parts from Chapter 2 to Chapter 5 regarding the follow questions:

Chapter 2

1. Why do offshore accidents have to be considered? (Section 2.2)
2. What is the difference between shipping accidents and offshore accidents? (Section 2.3.2 and 2.3.3)
3. How severe are offshore accidents? (Section 2.3.2 and 2.3.3)

Chapter 3

1. Does the IMO have responsibility for offshore accidents resulting from O&G development and exploitation? (Section 3.1)
2. What kinds of efforts has the IMO made for preventing offshore accidents? (Section 3.1, 3.2 and 3.3)

3. What is the problem about regulating O&G development issues in the IMO? (Section 3.4)

Chapter 4

1. Other than the IMO, what kinds of actions have organizations or stakeholders made for safe O&G development? (Section 4.1, 4.2, 4.3 and 4.4)
2. What is the difference among these approaches (advantages and disadvantages)? (Section 4.5)
3. What is the problem about regulating the offshore sector with them? (Section 4.5)

Chapter 5

1. In terms of vessels, floating platform and fixed platform, which instruments apply to territorial seas, EEZ and the high seas? (Section 5.1 and 5.2)
2. Is there any lack of coverage for safety of O&G development? (Section 5.2)
3. What is the best approach to manage the accelerated development of the high seas for safety and marine environmental protection? (Section 5.3)

At the end of the paper, conclusion and recommendation are given in Chapter 6 based on the discussions in Chapters 2 - 5.

Chapter 2 ANALYSIS OF OFFSHORE ACCIDENTS

In this chapter, an analysis of offshore accidents[5] is conducted in order to identify trends in offshore accidents, and compare the characteristics of accidents from shipping activities with ones from O&G development activities. The difference between shipping and offshore accidents is examined based on the comparison to know the severity of offshore accidents, which can show the importance of discussion of safety for O&G development.

2.1. Current situation of O&G development

The offshore O&G market has been increasing dramatically for supplying the demands of energy. With regard to the consumption of oil as a nonrenewable resource, 87.8 million barrels per day were used in 2011 as global demand and, 107.3 million barrels per day will be used in 2035 ("World", 2012). In particular, there is outstanding movement in Africa, which produced 376.4 million tons of oil per year in 2004 as

[5] In this dissertation, offshore accidents are defined as the accidents by O&G development within national jurisdiction.

10.6 % of world oil production in comparison with 10 million tons of oil per year in 1960 (Kloff and Wicks, 2004).

In order to supply increasing oil demands, oil development has been expanding not only from onshore but also from offshore, including the territorial sea, EEZ or continental shelf. Offshore development has increased in Brazil and West African nations such as Nigeria and Angola where fossil fuels were found recently due to precise undersea surveys. Advanced technologies, which enable the development of deeper and further areas from coastlines, also contribute to the discovery of natural resources at sea and their rapid exploitation. With regard to the technologies, an FPSO for instance, has developed over the last 40 years to become an increasingly popular solution for development of new offshore fields. FPSOs can extract oil further from the coastline and from the deep and ultra-deep undersea layers which contain the crude oil and other valuable resources. FPSOs, which have the function of refineries, can also produce crude oil from the mixture as soon as the oil is pumped onto the vessel. Besides, FPSOs can store the produced oil until delivery by shuttle crude oil tankers. These functions contribute to an efficient operation and, finally, rapid oil production with low capital expenditure. The new technologies, including FPSOs, have practical advantages compared to more traditional types of offshore installations, rig platforms (Colby, Matos and Mony, 2007, p.1).

2.2. Offshore accidents/incidents

However, O&G development by utilizing FPSOs sometimes induces offshore accidents/incidents like ruptured pipelines and helicopter accidents which result in terrible oil pollution and lost lives. For example, a catastrophic accident happened on 20 April 2010 in the USA Gulf of Mexico, where an explosion occurred on the drilling rig, Deepwater Horizon, exploring oil and gas at the Macondo well about 60 km off the US coast. This incident had three results: the death of 11 workers, severe injuries to many others and massive sea pollution from the release of 5 million barrels of crude oil (Christou and Konstantinidou, 2012). Other than big incidents, O&G development has general impacts on environmental circumstances, such as disturbance of sea bed areas, avoidance of the area by marine wildlife like fish and marine mammals and possible invasion of non-indigenous species. These impacts come from vibration and noise from facility operation, solid and liquid production wastes, increased water column turbidity from dredging and ballast water carried by offshore support vessels and oil tankers (Kloff and Wicks, 2004). The environmental effects possibly damage human lives.

The incidents which result in terrible oil pollution and other impacts can be caused by many different factors. Blowouts of wells or pipelines are the best known-example; one of the other factors is loss of a well. These factors can take place when a drilling rig encounters a pocket of sub sea oil under excessive geological pressure or when

human errors or technical failures are made. Technologies to reduce blowouts and support human operation have been improved over the past years, but these incidents still do occur. These incidents can also take place not only at tankers which carry oil to shore but at rig platforms like FPSOs as well. The hull of an FPSO may be broken after a collision with another vessel (Kloff and Wicks, 2004). Therefore, it is important to consider offshore accidents as a common issue because they affect human lives and marine environmental pollution, which is the answer of the question No.1 of Chapter 2 given in Section 1.4. While FPSOs are built appropriately based on stricter regulations which came from best practices and comprehensive research, judging from the actual situation, it is doubtful that these regulations are enough to ensure the safety of platforms and their adequate operation.

2.3. Analysis of shipping and offshore accidents

2.3.1. Data source for analysis

In order to know the current situation in detail and severity of offshore accidents, the trend of offshore accidents and causes of the accidents is analyzed in this section, by utilizing WOAD issued by DNV. WOAD, which is a web based tool, located at http://woad.dnv.com, is a databank of global and reported offshore accidents in the energy industry from January 1970 to December 2013 amounting to over 6000 records. These accident records contain the name of the operating unit, type of operating unit,

function of unit, classification society, owner, contractor, operator, geographical area in which the accident occurred and field/block of specific location (DNV, 2010; DNV, 2014).

As well as WOAD, IHS Maritime World Casualty Statistics issued by IHS are used for comparison between accidents related to shipping and offshore activities to know the difference between them. The statistics, which were originally published by Lloyd's Register about the annual statistical summary of reported total losses and disposal of propelled sea-going merchant ships of not less than 100 GT before 2009, are annual electronic databases, covering the previous year's statistics; and, it is issued every May. The statistics include ship name, flag state, GT, built year and location (IHS, 2014).

2.3.2. **Trend of accidents**

Before looking at offshore accidents/incidents, accidents related to shipping are observed to know the trend of these accidents. Figure 1 shows the number of total losses by shipping accidents such as collision, fire and grounding in each year. Over 11 years, the average number of total losses per year is approximately 170. While some international conventions like SOLAS and MARPOL that are introduced in Chapter 3 have been developed to regulate shipping activities in order to ensure ship safety and preserve the marine environment based on lessons from past incidents and accidents, there was a peak of 228 accidents in 2009 and the number of total losses has fluctuated. Because of the growth of the world fleet (UNCTAD, 2013), it was estimated that the rate of total losses per the world fleet was generally decreasing year by year. Thus,

these conventions have had some effect on the prevention of accidents/incidents related to shipping activities.

On the other hand, the number of total losses by O&G development activities has fluctuated as shown in Figure 2, similar to the trend of total losses by shipping activities. The difference is that the number of total losses by shipping activities is larger than the number by O&G development activities, which is one of the answers of the question No. 2 of Chapter 2 in Section 1.4. Total losses by O&G development activities were rare cases, fewer than 10 instances because there is a small number of existing platforms in the world compared to vessels and most platforms are fixed, not for transfer except for offshore support vessels. Moreover, as shown in Table 1, most of the number of total losses by O&G development activities came from helicopter accidents, not from platforms. Therefore, with regard to total losses, it was assumed that O&G development platforms are relatively robust enough to prevent total losses. Besides, according to this Table, a diminishment of helicopter accidents was found recently.

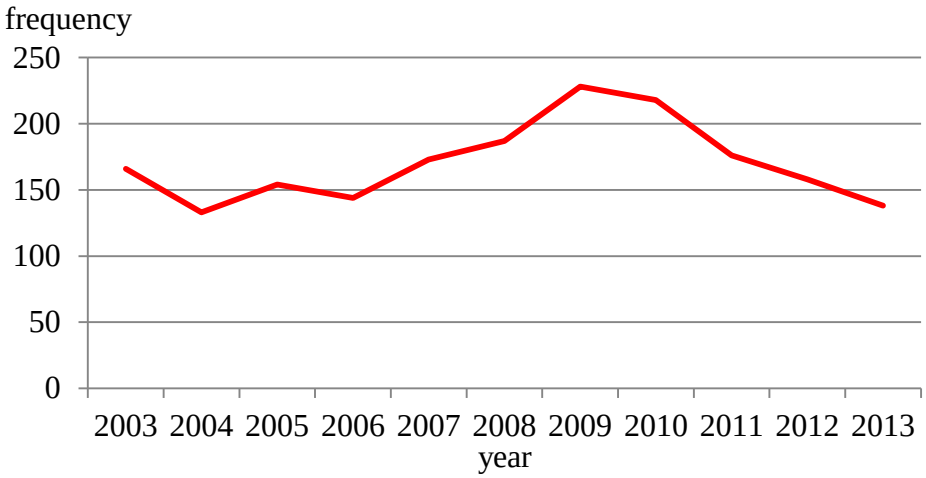

FIGURE 1 THE TREND OF TOTAL LOSSES BY ACCIDENTS RELATED TO SHIPPING ACTIVITIES BETWEEN 2003 AND 2013

(Data from Lloyd's Register Fairplay, 2009; IHS, 2014)

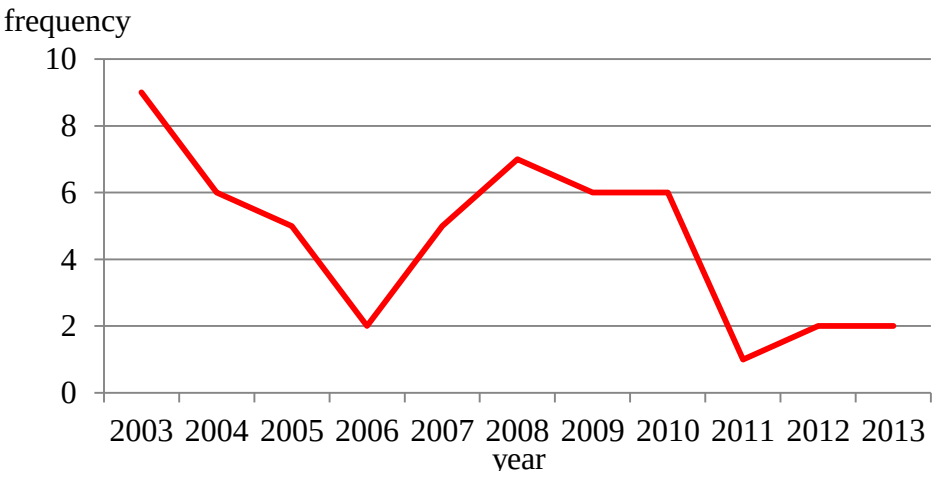

FIGURE 2 THE TREND OF TOTAL LOSSES BY O&G DEVELOPMENT ACTIVITIES BETWEEN 2003 AND 2013

(Data from DNV, 2014)

TABLE 1 THE TOTAL LOSSES DERIVED FROM SHIPPING AND O&G DEVELOPMENT ACTIVITIES.

Year	By shipping activities		By O&G development activities	
	Number	**m GT**	**Number**	**Helicopter**
2003	166	0.58	9	9
2004	133	0.46	6	5
2005	154	0.47	5	3
2006	144	0.76	2	2
2007	173	0.64	5	4
2008	187	0.55	7	4
2009	228	1.23	6	4
2010	218	1.10	6	2
2011	176	1.17	1	0
2012	158	0.84	2	0
2013	138	0.86	2	0

(Data from Lloyd's Register Fairplay, 2009; IHS, 2014; DNV, 2014)

When looking at the trend of lives lost related to shipping as shown in Figure 3, the number of total lives lost has fluctuated quickly and dramatically because of passenger ship accidents. Some years, there were accidents involving passenger ships that resulted in numerous lives lost. The number of lives lost by passenger ships affected the number of total lives lost directly. When focusing on the number of lives lost excluding passenger ships, it was stable with 270 persons per year as an average number. It was found that the trend of number of total losses was similar to that of lives lost excluding passenger ships. On the other hand, during 2003 and 2013, the average lives lost by O&G development activities was 34 persons per year according to the calculations in Table 2, less than the average lives lost by shipping, which is the other answer of the question No.2 of Chapter 2 in Section 1.4.

In order to check the severity of offshore accidents, the lives lost rate is calculated based on the number of lives lost and total losses. It is difficult to collect the total number of accidents because all incidents and accidents that happen in the world are not reported; therefore, the number of total losses is used for calculation of the lives lost rate and the lives lost rate is defined by the number of lives lost are divided by the number of total losses. From the calculation based on Tables 1 and 2, the lives lost rate of shipping accidents is about 1.6 times (270 persons / 170 instances) and the rate of offshore accidents is 6.8 times (34 persons / 5 instances). Average number of lives lost can be calculated from Table 2, which shows the trend of lives lost by shipping and offshore accidents between 2003 and 2013. From the rate, offshore accidents caused a

higher rate of lives lost than shipping accidents and a higher severity of offshore accidents compared to shipping accidents was found in terms of lives lost, which is the answer of the question No. 3 of Chapter 2 in Section 1.4.

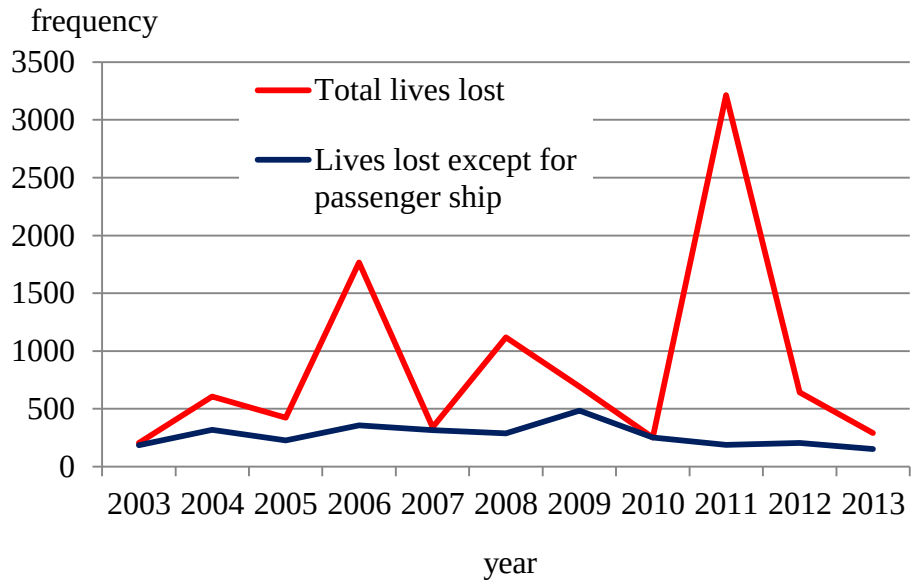

FIGURE 3 THE TREND OF LIVES LOST RELATED TO SHIPPING BETWEEN 2003 AND 2013

(Data from Lloyd's Register Fairplay, 2009; IHS, 2014)

TABLE 2 THE TREND OF LIVES LOST BY SHIPPING AND OFFSHORE ACCIDENTS BETWEEN 2003 AND 2013

Year	Shipping accidents			Offshore accidents
	Passenger ship	Other ships	Total	
2003	22	184	206	57
2004	289	317	606	27
2005	196	228	424	24
2006	1,411	356	1,767	16
2007	26	315	341	34
2008	831	287	1,118	67
2009	210	483	693	58
2010	0	253	253	17
2011	3,025	189	3,214	60
2012	436	205	641	11
2013	137	153	290	3

(Data from Lloyd's Register Fairplay, 2009; IHS, 2014; DNV, 2014)

2.3.3. **Cause of accidents or initial incidents types**

The severity of offshore accidents was realized based on the number of lives lost and total lost; therefore, considering offshore accidents is crucial for saving human lives. For preventing such accidents by regulating some instruments, the causes of offshore accidents are analyzed in this section.

The typical causes of shipping accidents are normally collision, fire, foundering and stranding, as shown in Table 3. Similar to shipping accidents, collision of offshore units, fire, capsizing and overturning are frequent in offshore accidents, as shown in Table 4. On the other hand, in offshore accidents, there are different and frequent causes: blowout, breakage or fatigue, toppling, falling load and dropped object, which is the other answer of question No.2 of Chapter 2 in Section 1.4. This is because the characteristics of O&G development are different from shipping activities. At O&G development platforms, mining, producing and storage are conducted and other operations like construction and loading to build the platforms and facilities for such activities are carried out; therefore, particular causes of accidents tend to occur.

TABLE 3 INITIAL INCIDENTS TYPES OF SHIPPING ACCIDENTS IN 2013

Initial incidents types	**Number**
Foundering	52
Fire / Explosion	34
Wrecking / Stranding	25
Collision	15
Hull / Machinery	11
Missing	1

(Data from IHS, 2014)

TABLE 4 THE CAUSES OF OFFSHORE ACCIDENTS BETWEEN 1970 AND 2013

Initial incidents	Number of accidents	Number of lives lost	Lives lost rate
Anchor / mooring failure	7	11	1.57
Blowout	230	35	0.152
Breakage or fatigue	260	2	0.008
Capsizing/overturning/toppling	270	590	2.19
Collision, not offshore units	159	43	0.270
Collision, offshore units	229	74	0.323
Crane accident	9	3	0.333
Explosion	92	87	0.946
Falling load / Dropped object	237	126	0.532
Fire	441	397	0.900
Grounding	59	6	0.102
Helicopter accident	23	100	4.35
Leakage into hull	31	1	0.032
List, uncontrolled inclination	56	7	0.125
Loss of buoyancy or sinking	111	322	2.90
Machinery/propulsion failure	2	1	0.5
Out of position, adrift	17	1	0.059
Release of fluid or gas	139	6	0.043
Towline failure/rupture	8	0	0
Well problem, no blowout	8	1	0.125
Other	173	454	2.62

(Data from DNV, 2014)

When looking at causes of offshore accidents in terms of lives lost, three causes: capsizing/overturning/toppling, fire and loss of buoyancy or sinking, can be seen as the most severe reasons, as shown in Table 4. Moreover, by comparing the lives lost rate whereby the number of lives lost is divided by the number of accidents; helicopter accident, loss of buoyancy or sinking, and capsizing/overturning/toppling have a higher rate than other initial incidents. This result shows many human lives are lost at the time when facilities including O&G development platforms or vessels lose balance and are going to sink or capsize in the end. Significantly, helicopter accidents are a special cause compared to shipping activities and result in the highest rate of lives lost, which is the answer of the question No. 2 of Chapter 2 in Section 1.4. As shown in Table 1 regarding total losses of helicopters, it can be said that most dangerous stage and work involves helicopters for carrying small cargoes and workers to the platforms. Therefore, training for escaping from a helicopter under water, which is described in detail in the next section, is necessary for workers at the platforms to eliminate the risk of lives lost.

As shown in Table 4, O&G development has a different risk from shipping activities, which is not a high rate of lives lost but can cause marine environmental pollution from blowouts and explosions; therefore, these causes of offshore accidents are also not acceptable even if the lives lost rate is lower, and they have to be addressed. Generally, it could be considered that most accidental events often occur by individual accidents. An unexpected oil blowout in a production well, for instance, can be caused

by a fire, an explosion, or a spillage. If the response of recovery, or search and rescue is late and inadequate, the collapse of the entire structure may happen as the worst case scenario. The consequences of individual accidents, thus, depend on a combination of circumstances and environmental factors. As the typical causes of offshore accidents, blowout and explosion are described below:

Blowout

Blowout is an unexpected flow of oil and gas that occurs during drilling wells caused by equipment failure, personnel mistakes or extreme natural impacts. Blowouts are more frequent during the initial phases of well construction, when preventative measures are not in place, but may also occur during production. While preliminary blowouts are controllable by safety valves or by changing the density of the drilling fluid, uncontrollable blowouts may lead to large oil or gas spills if recovery methods are not appropriate and immediate (Gómez and Green, 2013).

Explosion

The explosion of an oil or gas well is the most dangerous accident, posing risk of catastrophe with human casualties. An explosion may occur directly linked to a blowout or spillage of oil. In the case of partial or complete destruction of the offshore installation, an additional risk exists of a high volume of hydrocarbon spill. In this case, the volume of leakage is difficult to quantify, and the well could be spilling for a long period until depletion or until it is brought under control (Gómez and Green, 2013).

In order to avoid such kinds of accidents derived from initial incidents, operation and installation of platforms should be regulated by proper instruments based on appropriate and best practice, and workers should be educated to enhance their competence at the same time.

2.4. Preparedness for accidents

For training the personnel or engineers who work at O&G development platforms, the Offshore Petroleum Industry Training Organization (OPITO), which is a non-profit organization owned by members of the O&G industry to support the industry to build a sustainable, competent and safe O&G workforce, provides industry standards and best practice guidance as the O&G industry benchmarks, and develops technical and safety training standards. OPITO standards are driven by the needs of employers to help creating a safe and competent workforce (OPITO, 2013).

As described in the previous section, there are many accidents, especially helicopter accidents. Therefore, in order to reduce the potential risk of helicopter accidents and prevent helicopter casualties, workers at the platforms need to have licenses based on the training conducted by education facilities or other institutions according to the OPITO standards. Thanks to this training, it was assumed that the number of casualties by helicopter accidents has been going down, as shown in Figure 4, which shows the number of helicopter casualties is decreasing except for the two years, 2008 and 2009.

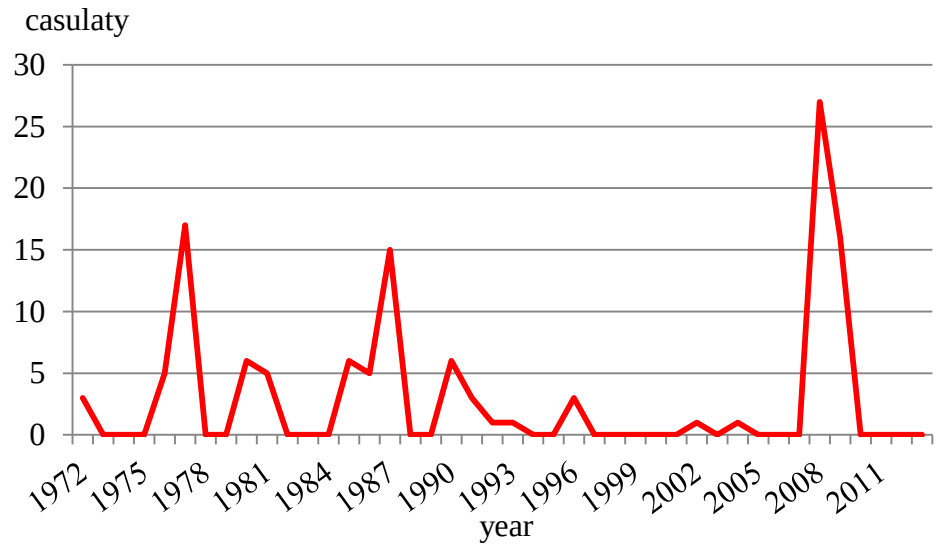

FIGURE 4 THE TREND OF CASUALTY BY HELICOPTER ACCIDENTS BETWEEN 1972 AND 2013

(Data from DNV, 2014)

However, as shown in Figure 4, there are still helicopter accidents and the accidents are strongly connected to technical failure and weather conditions. More training for workers could have been done, and this training should be conducted for all workers based on further effective regulations or standards for the future. Therefore, it is difficult to prepare for helicopter accidents perfectly. Besides, there are other types of offshore accidents like fire and collision; thus, even though there are training courses

based on the practical standards, all accidents cannot be avoided whilst some results have been achieved by these standards.

2.5. Difficulty of regulating O&G development activities

In case of O&G development, there are probably a few difficulties of regulating these accidents. One of them is that there are different stakeholders in O&G development business unlike shipping. Regarding the shipping business, ship owners, ship machinery companies, ship building companies and ship operators are the main stakeholders other than trading companies, and insurance companies. It is relatively easy and effective to regulate accidents through the IMO conventions because of the particular players. However, in the case of O&G development business, not only shipping business, which carries oil and gas, but also the companies for drilling, production, and operation of oil and gas such as oil companies, drilling companies and EPCI (Engineering, Procurement, Construction and Installation) contractors are the main stakeholders. Many stakeholders that have different considerations make the situation complicated and it is very difficult to manage the safety of O&G development. Therefore, the relationship from upstream companies to downstream companies contributes to toughness for making compromises.

Moreover, the areas of operation and installation of O&G development platforms are particular, not global. Therefore, it is difficult to make international compromises

because it is not clear for other stakeholders to know the real situation regarding the O&G business. As a consequence, they are sometimes not interested in such issues even if there are terrible accidents and they have a potential risk of marine pollution from offshore accidents.

Furthermore, as various types of causes are shown, there are plenty of factors to be taken into consideration to avoid accidents. In order to check the safety of installation and operation, detailed and specific rules are needed with regard to the procedures for all steps of the process and technical criteria depending on the sea and weather conditions.

In addition to this, technologies for O&G exploitation have been rapidly and drastically advanced, making the players who are in charge of governance behind in knowledge and late to respond against the progress of technologies.

For the above reasons, it is assumed that there is difficulty regulating O&G development activities, especially through international organizations. What safety regulations for O&G development need is flexibility depending on the progress of technology, best collaboration between the regulations and best practice and rapid implementation of regulations under consensus of all stakeholders.

2.6. Summary and remarks

In this chapter, an analysis of offshore accidents was conducted to show the severity of offshore accidents compared to shipping accidents by checking the trend of lives lost and total loss regarding both types of accidents. While the number of offshore accidents is smaller than shipping accidents, the rate of lives lost by offshore accidents is higher than that by shipping accidents. This is because special causes such as helicopter accidents while carrying workers and cargoes, loss of buoyancy or sinking, and capsizing/overturning/toppling affected the increased rate of lives lost. Besides, there are other potential risks pertaining to blowouts at oil wells and explosions at O&G development platforms. These accidents lead to both numerous human lives lost and marine environmental pollution derived from oil spills. Therefore, offshore accidents should be prevented to save human lives and preserve marine resources. It was found that discussion of the safety of O&G development was important.

In order to avoid accidents, especially helicopter accidents, some standards for training workers at O&G development platforms like OPITO standards have been established and implemented. However, more training should be conducted for all workers because there are still accidents like the Deepwater Horizon even if these standards can contribute to a decreased number of lives lost to some extent. Besides, to prevent such accidents through regulations, the regulations for O&G development have to be

flexible, well-collaborated and rapidly implemented through the cooperation of all stakeholders based on best practices.

Chapter 3 EXISTING IMO INSTRUMENTS TO REGULATE O&G DEVELOPMENT ACTIVITIES

The current situation regarding accidents connected to O&G development was checked and thereby the importance of considering offshore accidents was recognized precisely through a quantitative approach. In Chapters 3 and 4, the current regulations, standards and guidance are introduced in order to examine the responsibility of each institution by comparison of their actions with regard to regulating O&G development activities and avoiding offshore accidents. In this chapter, past and current IMO activities are the focus because the IMO is in charge of maritime issues. Based on IMO's actions, limitations in terms of regulating O&G development activities appropriately through IMO conventions and guidelines are discussed at the end.

3.1. The IMO's responsibility

First of all, the responsibility of the IMO needs to be discussed to consider the role of regulating the issue of safety and marine environmental protection regarding O&G development. The IMO is responsible for safety of life at sea related to shipping and the protection of the marine environment from vessels; these targets are the scope of

the IMO to be considered and discussed within member states. The IMO, thus, has attempted to develop some instruments for safer shipping according to its scope. While its scope is currently becoming wider since air pollution from vessels has been added to protect the environment for the purpose of reserving limited resources and achieving sustainable global environmental protection, the IMO always focuses on vessels and units that have the purpose of transport at sea.

For example, SOLAS, MARPOL and STCW, which are the main conventions issued by the IMO were adopted to keep vessels safe, to prevent the oil, chemical and air pollution and to educate seafarers to be competent. Therefore, these conventions were exclusively designed only for maritime traffic. This means that parts of functions like hull structure, propulsion systems and stability of O&G development platforms are covered by IMO conventions. When looking at the platforms, in so far as mobile offshore drilling units are in transit and are to be considered as ships, they, even fixed platforms, are subject to international maritime conventions, in particular, SOLAS, MARPOL or the equivalent standards of the applicable version of the Code for the construction and equipment of mobile offshore drilling units (MODU Code), generally speaking. This is the answer of the question No. 1 of Chapter 3 in Section 1.4.

However, the installation and operation of O&G development at fixed platforms are, in many cases, exempt and out of the IMO's scope; therefore, it is difficult to discuss them in the IMO. For approaching O&G development issues, the IMO has been

discussing measures to avoid accidents and ensure safety at sea and marine environmental protection as the IMO's efforts.

Recommendation on safety zones and safety of navigation around offshore installations and structures (A.671 (16)) and Guidelines for the transport and handling of limited amounts of hazardous and noxious liquid substances in bulk on offshore support vessels (A. 673(16)) are examples of instructions given to vessels against O&G development activities for the safety of vessels. Neither of them is mandatory and installation or operation at O&G development platforms is not covered by these instructions.

Moreover, besides developing or amending the international conventions that the IMO has enacted, the Marine Environment Protection Committee in 2009 and the Maritime Safety Committee in 2010 approved the Guidance[6], in accordance with recognizing that there is a need to provide guidance to Member States such that they may develop regulations on safety, pollution prevention and security of FPSOs and FSUs, to provide member states with clearer and specific information on them (IMO, 2010). While it is useful to apply the safety, security and environmental protection provisions to FPSOs and FSUs, it is on a voluntary basis, not mandatory. At this moment, the IMO has not developed international legally binding laws related directly to O&G development activities, which is the answer of the question No. 2 of Chapter 3 in Section 1.4.

[6] MSC-MEPC.2/Circ.9

In the following sections, each main convention related to O&G development activities in terms of safety and marine environmental protection is introduced independently: SOLAS, MARPOL and the MODU Code, for checking the practical application to O&G development platforms.

3.2. SOLAS and MARPOL for O&G development activities

The International Convention for the Safety of Life at Sea (SOLAS) was established in 1974 under awareness of the importance of setting up minimum standards for the construction, equipment and operation of ships after the Titanic disaster and was amended many times to add supplementary themes, new codes and public issues of concern. The current SOLAS contains Articles setting out general obligations, amendment procedures and so on, followed by an Annex divided into 12 chapters.

According to the application in Regulation 1 of chapter I of SOLAS, SOLAS targets only ships engaged on international voyages and the different application is described in each chapter. It is clear that SOLAS applies only to vessels, which can include offshore support vessels and the O&G development platforms engaged on international voyages. Therefore, if the O&G development platforms are installed within national waters or the platforms, like the fixed platforms that are carried and installed by offshore support vessels, are not on a single voyage, the platforms are out of SOLAS's

application. Since most platforms are installed within the territorial sea, it is assumed that SOLAS does not work for O&G development activities in practice.

On the other hand, the International Convention for the Prevention of Pollution from Ships, known as MARPOL, addresses pollution from ships by oil and other substances. It applies to 99% of the world's merchant tonnage and has contributed to a significant decrease in pollution from international shipping (Gómez and Green, 2013).

According to Article 3 of MARPOL, MARPOL applies to "Ship" that means "a vessel of any type whatsoever operating in the marine environment and includes hydrofoil boats, air-cushion vehicles, submersibles, floating craft and fixed or floating platforms" and that is engaged on both international and national voyages. Thus, O&G development platforms are generally subject to MARPOL. However, since "nothing in the present Article shall be construed as derogating from or extending the sovereign rights of the Parties under international law over the seabed and subsoil thereof adjacent to their coasts for the purposes of exploration and exploitation of their natural resources" as described in MARPOL, it is difficult for MARPOL to regulate all activities within national jurisdiction. Moreover, with regard to Regulations for the Prevention of Pollution by Oil in Annex I, FPSOs and FSUs are not oil tankers and are not to be used for the transport of oil except that produced oil may be transported to port in abnormal and rare circumstances; thus, they are not covered by the procedures in Annex I. Besides, regarding other Annexes, there are no special requirements for

FPSOs and FSOs in MARPOL except for Annex V that shows the discharge into the sea of any garbage is prohibited from fixed or floating platforms. While there is a higher severity of offshore accidents than those from shipping and other causes, regulations for O&G development are not stricter than those for shipping.

3.3. MODU Code

As shown in the previous chapter, SOLAS and MARPOL cannot apply to O&G development platforms effectively and appropriately. Therefore, to approach the issues in a different way, the IMO adopted a code for the construction and equipment of mobile offshore drilling units (MODU Code[7]) in 1989 to recommend design criteria, construction standards and other safety measures for MODUs so as to minimize the risk to such units, to the personnel on board and to the environment.

According to the Code, MODU or unit is a vessel capable of engaging in drilling operations for the exploration for or exploitation of resources beneath the seabed such as liquid or gaseous hydrocarbons, sulphur or salt. Thus, the MODU Code applies to FPSOs and FSOs. These units need to be issued a certificate called a Mobile Offshore Drilling Unit Safety Certificate after an initial or renewal survey to a unit which complies with the provisions of the Code. The Certificate should be issued or endorsed

[7] Resolution A.649 (16)

either by the Administration or by any person or organization recognized by it. In every case, that Administration assumes full responsibility for the Certificate. The Certificate should be issued for a period specified by the Administration, which should not exceed five years.

For ensuring the safety of MODUs in terms of construction and equipment, the Code provides instructions for strength and materials, stability, machinery and electrical installations for units, fire safety, life-saving appliances and equipment, radio communication and navigation, lifting devices, helicopter facilities, and operation in each chapter. Yet, there are five points to be considered regarding the MODU Code.

While the Code was developed for facilitating the international movement and operation of MODUs, to ensure a level of safety for such units, and for personnel on board, equivalent to that required by SOLAS, it is not intended that the Code gives additional requirements for Special Purpose Ships. However, the activities at O&G development platforms are severer and more dangerous than shipping activities; therefore, the requirements for MODUs should be stricter than those for conventional merchant vessels.

Moreover, as the Code states, the Code should be reviewed according to both experience and future development because the technology of MODUs is not only complex but continually evolving.

Besides, an insufficient point of the Code is that existing units are not covered by the Code. That is because many existing MODUs have operated successfully and safely for extended periods of time according to the MODU Code. The Code says that their operating history should be considered in evaluating their suitability to conduct international operations; however, offshore accidents have occurred at existing platforms. The MODU Code should take into account the accidents.

Fundamentally, the MODU Code is not mandatory. Therefore, the MODU Code allows the coastal states to permit any unit designed to lower standards than the requirements of the Code to engage in O&G development, having taken into account the local conditions. Nevertheless, the MODU Code does not give any instructions to the coastal states for the intended operation and to ensure the overall safety of the unit and the personnel on board, while the responsibility of enacting the standards is transferred to the coastal states by the MODU Code and it requests the costal states to make adequate standards.

Lastly, the Code does not include requirements for the drilling of subsea wells or procedures for their control. The Code states that drilling operations are subject to control by the coastal state. As described in Chapter 2 of this dissertation, there are special accidents like blowouts to be avoided. Therefore, the Code should include these devices even though they are not vessels.

3.4. Limitation in the IMO conventions and guidelines

The IMO's scope focuses on shipping currently, but the IMO needs to protect the marine environment. Therefore, as being in charge of marine pollution, the IMO can have responsibility for offshore accidents/incidents derived from O&G development and exploitation as well as from maritime traffic. While some member states of the IMO claim the IMO's scope should be largely restricted to shipping issues, other groups including the European Commission expect the IMO to advance the development of a global regime to cover liability and compensation for damage arising from offshore drilling accidents (Östman, 2012). In practice, the IMO is struggling with on-going discussions regarding definition of platforms, which are divided into two types: Offshore Service Craft (OSC) and Offshore Construction Vessels (OCV). These ideas have to be clarified in the future. However, there are limitations to IMO's approach to O&G issues and development of mandatory regulations for ensuring the safety of MODUs as considerable problems, which are given as the question No.3 of Chapter 3 in Section 1.4, in the following.

Firstly, many instruments and standards, which are described in detail in the next chapter, have already existed and they are advanced and stricter than the IMO's conventions. Most stakeholders believe that these standards can ensure the safety of installation and operation at O&G development platforms. Therefore, it is difficult for the IMO to enact new regulations for O&G development activities on behalf of other

international institutions. Besides, if there are other standards developed by the IMO, upstream stakeholders like oil companies that need to reduce the cost of equipment could experience a significant burden and confusion.

Secondly, the stakeholders related to O&G development activities are different from those in shipping activities. In the IMO, there are representatives of each country and other stakeholders related to shipping activities like the International Association of Classification Societies (IACS) and International Chamber of Shipping (ICS), not major oil companies and upstream players. Therefore, the opinions of O&G business players cannot influence the discussions in the IMO.

Moreover, it is difficult to enter into force a new convention because of the requirements that are normally set up like ratification by one third of the parties to the Convention representing at least 50% of the world merchant ship tonnage (Spackman, 2002). In practice, six nations namely Panama, Liberia, Greece, Malta, Bahamas, and Cyprus are the main countries that hold a large percentage of ship tonnage as flags of convenience as shown in Table 5. These countries have almost no O&G development infrastructure; therefore, they may disagree with the new conventions related to O&G development or understate the issues regarding the safety of MODUs if they do not have any interests in the topic or face serious problems like marine pollution derived from O&G development activities. Thus, reaching a compromise between involved

and uninvolved players and dealing with this issue become very arduous and challenging.

The above reasons make the situation for development of new regulations difficult whilst the IMO recognizes its importance for the safe installation and operation of the O&G development platforms that affect the marine environment directly.

TABLE 5 RANKING OF REGISTERED FLEETS BY COUNTRIES

Country	**Number of Vessels**	**DWT**	
		m DWT	**%**
Panama	8,580	350,506	21.52
Liberia	3,144	198,032	12.16
Marshall Islands	2,064	140,016	8.60
Hong Kong (China)	2,221	129,806	7.97
Singapore	3,339	89,697	5.51
Greece	1,551	75,424	4.63
Bahamas	1,446	73,702	4.52
Malta	1,794	68,831	4.24
Cyprus	1,030	31,706	1.95
Isle of Man	422	22,629	1.39
Total	86,942	1,628,783	100

*As of 1 January 2013, propelled seagoing merchant vessels of 100 GT and above; ranked by deadweight tonnage (DWT). (Data from UNCTAD, 2013)

3.5. Summary and remarks

Since oil spills caused by offshore incidents influences many countries beyond boundaries and could occur in any other countries, international regulations are essential to ensure the safety of O&G development activities. However, the IMO does not have any mandatory instruments that are stricter than those standards issued by other institutions. Until now, SOLAS and MARPOL are the mandatory instruments related to vessels in terms of the safety of vessels and marine environmental protection. While they apply to O&G development platforms even fixed platforms generally, there are exemptions of application and similar requirements to shipping activities in spite of the high severity of offshore accidents that contribute to catastrophic accidents.

It is clear that O&G development activities should be regulated by appropriate measures and effective and stricter regulations than before to prepare for increased O&G development in the future. Being in charge of the issue of marine pollution, the IMO can have responsibility not only for maritime traffic but also for offshore incidents derived from O&G development and exploitation. However, there are difficulties which have caused the IMO to struggle to develop new regulations for O&G development as follows:

- Other standards that are stricter than the IMO Conventions exist.
- The companies related to O&G development cannot join the IMO discussion directly.

- Main flag states do not have strong interests in new regulations having no O&G development infrastructure.

Normally, the IMO has taken actions after big disasters as a passive and reactive stance; however, in terms of offshore disasters, it is assumed that the IMO has not conducted outstanding actions. On the other hand, other organizations have tried to make guidelines or guidance to ensure the safety of O&G development activities, which are introduced in next chapter.

Chapter 4 PAST ACTIONS BY VARIOUS INSTITUTIONS FOR SAFE O&G DEVELOPMENT

In the previous chapter, IMO's activities aimed at avoiding offshore accidents were focused on and the insufficient development of new instruments for regulating O&G development activities and difficulty of enacting rules in the IMO were found by checking the application of SOLAS, MARPOL and the MODU Code. While the IMO is struggling to develop new regulations for the safety of O&G development activities, other institutions have also discussed the importance of thinking about offshore accidents, shared information for reducing the risk of the activities and established their own rules, standards or regulations at domestic, regional and industrial levels in terms of technology and operational procedure. Thus, in this chapter, the main activities by each organization are introduced to show their contributions to the safety of O&G development, and to compare the differences among them for the purpose of understanding the gap and lack of regulations that is described in the next chapter. UNCLOS, the ISA Code, best practices of OECD, API, ISO and DNV standards, European Directive, WOC actions and OGP activities are introduced, as the answer of the question No. 1 of Chapter 4 in Section 1.4, in 3 sections: actions by international

organizations, global technical standards, classification society's actions, and domestic laws and regional activities, which are described in each section.

4.1. Actions by international organizations

4.1.1. **UNCLOS**

Firstly, as a fundamental instrument, the 1982 United Nations Convention on the Law of the Sea (UNCLOS) should be stated in this section. UNCLOS, which was developed by the United Nations and came into force in 1994, is an international treaty that provides a regulatory framework for the use of the world's oceans to ensure the conservation equal usage of resources and protection of the marine environment. UNCLOS also addresses such other matters as sovereignty, rights of usage in maritime zones, and navigational rights. As of January 10 2014, 166 States have ratified, acceded to, or succeeded to, UNCLOS (Permanent Court of Arbitration, 2009).

According to UNCLOS, the ocean is divided into six major maritime zones: the territorial sea, the contiguous zone, the exclusive economic zone (EEZ), the continental shelf, the high seas and the areas of the seabed beyond the continental shelf, as shown in Figure 5. While four of these zones, the territorial sea, the contiguous zone, the EEZ and the continental shelf, are under coastal state jurisdiction, the two remaining, called as 'the Area', are beyond national jurisdiction (Ribeiro, 2013). Therefore, coastal states have a fundamental right to regulate O&G development activities within the

continental shelf based on the principle of UNCLOS if private companies try to develop the area; and, international organizations cannot interfere with the actions of the coastal states in terms of specific procedures and operation at O&G development platforms for ensuring the safety of the activities and avoiding accidents. For approaching the Area beyond national jurisdiction, the IMO or other international organizations like the International Seabed Authority (ISA) have enacted instruments to practically implement the principles and procedures that are written in UNCLOS.

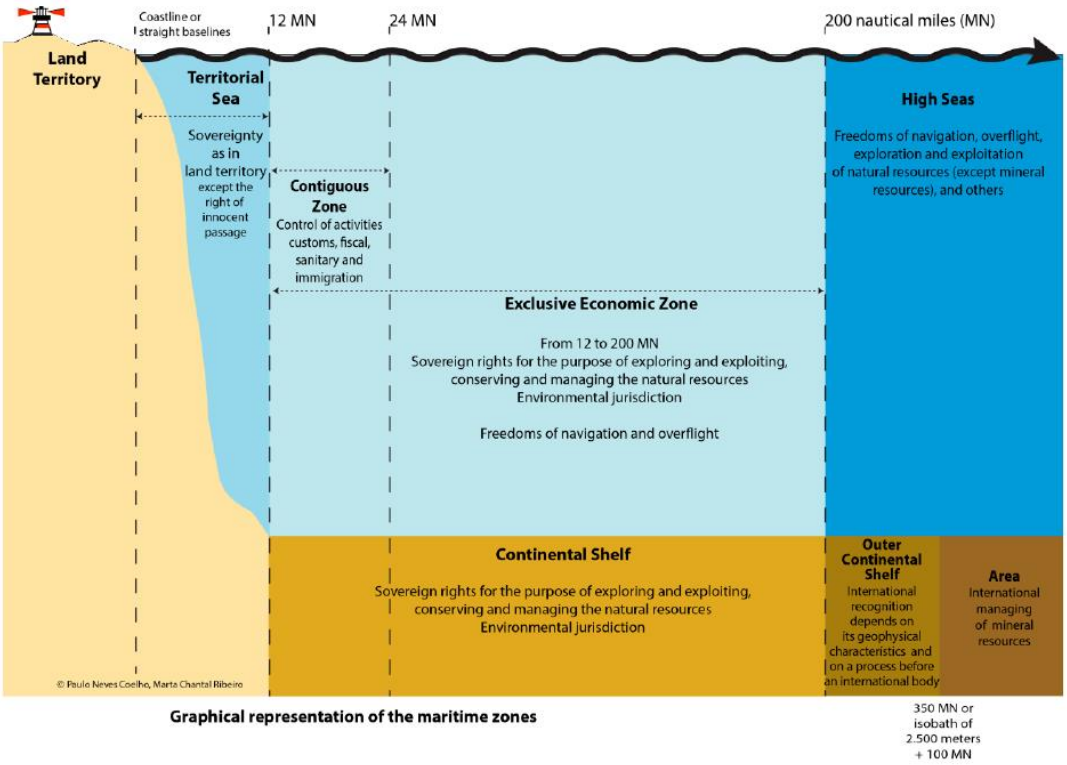

FIGURE 5 THE ZONES OF OCEAN

(Source from Ribeiro, 2013)

In UNCLOS, Part XI and XII, there are important parts to be examined since these parts describe the Area and principle for managing the Area properly.

Part XI of UNCLOS defines “the Area”. It shows that Activities in the Area shall be governed by the provisions of this Part XI. According to Article 136 and 137 of UNCLOS, the Area which has mineral resources that may be solid, liquid or gaseous has the status of ‘common heritage of mankind’ (Ribeiro, 2013). “No State can claim or exercise sovereignty or sovereign rights over any part of the Area, nor can any State or natural or juridical person appropriate any part thereof. No such claim or exercise of sovereignty or sovereign rights nor such appropriation can be recognized.” Thus, the ISA is the body entitled to act on behalf of the mankind as a whole and to give concrete content to the principle of the common heritage of mankind. The ISA’s activities and its Code are described in next section.

To implement Part XI, Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 was adopted in 1994 and entered into force in 1996, apart from UNCLOS. The Agreement consists of 10 articles dealing mainly with procedural aspects such as signature, entry into force and provisional application, and nine annexes dealing with the various issues that were identified as problem areas during the informal consultations. Its Article 2 shows the relationship between the Agreement and Part XI of the Convention and it provides that the two shall be interpreted and applied together as a single instrument. In the event of

an inconsistency between the Agreement and Part XI, however, the provisions of the Agreement shall prevail (Division, 2010).

As the second significant part, Article 211 of UNCLOS is about protection and preservation of the marine environment in Part XII; and, paragraph 5 of Article 211 addresses the EEZ regarding prevention of pollution, which leads to the need to keep ships and offshore platforms safe within the EEZ. For enforcement of this principle, UNCLOS requests coastal states to adopt laws and regulations for the prevention, reduction and control of pollution from vessels conforming to and giving effect to generally accepted international rules and standards established through the competent international organization or general diplomatic conference.

According to UNCLOS, it is clear that coastal states have a right to develop national jurisdictions based on international rules for marine environmental protection that is relevant to the safety of O&G development activities whilst the Areas are common heritage of mankind and should not be governed by States instead of the ISA.

4.1.2. **Mining code by the ISA**

The International Seabed Authority (ISA), which is an autonomous international organization established under the 1982 United Nations Convention on the Law of the Sea and the 1994 Agreement relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea, work together with member states that

shall organize and control activities in ‘the Area’ which is beyond the limits of national jurisdiction established in Part XI and the Agreement (ISA, 2013).

The ISA has issued the Mining Code which refers to the whole of the comprehensive set of rules, regulations and procedures to regulate prospecting, exploration and exploitation of marine minerals in the Area. To date, the Authority has issued:

- Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area;
- Regulations on Prospecting and Exploration for Polymetallic Sulphides in the Area; and,
- Regulations on Prospecting and Exploration for Cobalt-Rich Crusts.

These regulations contain the forms necessary to apply for exploration rights and form part of the Mining Code together with recommendations for the guidance of contractors on the assessment of the environmental impacts of exploration for polymetallic nodules (ISA, 2013).

For the development of the Area by states, it is necessary to get permission from ISA in terms of marine environmental protection and preservation of natural resources underneath the seabed in the Area. Therefore, it is assumed that ISA is the safety net and last barrier for protection from illegal development. However, there are no detailed measures or instructions to develop the Area, in other words unclear criteria. The ISA should show the criteria and requirements for development of the Area clearly and specifically for securing of liability to the public, which is definitely helpful for States

and players related to O&G development to know how to manage the operation at the platforms.

4.1.3. **Best practices by OECD**

As international organizations other than the UN and the ISA, the Organization for Economic Co-operation and Development (OECD), which consists of 34 countries, has been developing "best practices" to protect the marine environment and to prevent accidents related to O&G exploration and development in the Global Marine Environment Protection Working Group (GMEP) of G20 after the accident in the Gulf of Mexico. The mandates[8] on GMEP are the following:

> *"Following the recent oil spill in the Gulf of Mexico we recognize the need to share best practices to protect the marine environment, prevent accidents related to offshore exploration and development, as well as transportation, and deal with their consequences"*
>
> *"We welcome the progress achieved by the Global Marine Environment Protection (GMEP) initiative toward the goal of sharing best practices to protect the marine environment, to prevent accidents related to offshore exploration and development, as well as marine transportation, and to deal with their consequences. We recognize*

[8] Toronto Summit in 2009; Seoul Summit in 2010

the work done by the GMEP Experts Sub-Group and take note of the progress made on reviewing international regulation of offshore oil and gas exploration, production and transport with respect to marine environmental protection as a first step to implement the Toronto mandate. Future work on the GMEP initiative should benefit from relevant findings, as they become available, from the National Commission on the BP Deepwater Horizon Oil Spill in the United States and the Montara Commission of Inquiry in Australia. We ask the GMEP Experts SubGroup to provide a further report, with the support of the IMO, OECD, IEA, OPEC, International Regulators Forum, and International Association of Drilling Contractors and, in consultation with relevant stakeholders, to continue work on the effective sharing of best practices at the 2011 Summit in France." (Sorokin, 2011)

Eventually, the best practices were published in 2012 on the website of G20 ("The global", 2013). But it is simply useful information for maritime stakeholders, not a mandatory regulation. While it is important for stakeholders to share best practice for the purpose of learning lessons from past events as shown in mandates on GMEP, the best practices are not regulations to be followed by related players; and, they cannot focus on future accidents which will happen in the high seas beyond national jurisdictions. Therefore, non-compulsory information may sometimes become a dead letter. Moreover, among international organizations, it is difficult to decide which institutions should take the initiative to develop compulsory instructions. Collaboration and cooperation among them, thus, are needed to enact effective and practical

regulations to avoid future accidents. Taking into account the scale of OECD, OECD cannot be the main body for the establishment of new regulations but a collector of best practices from major oil companies that belong to OECD member states.

4.2. Global technical standards

4.2.1. American Petroleum Institute standards

Other than regulations developed by international organizations, industrial standards have been established for ensuring the safety of O&G development by some associations which are organized by related private companies or representatives of each country in terms of technical aspects and operational procedures. As an example of standards, API is introduced firstly as follows.

The American Petroleum Institute (API) is the only national trade association that represents all aspects of America's oil and natural gas industry. More than 550 corporate members, from the largest major oil company to the smallest of independents, come from all segments of the industry. They are producers, refiners, suppliers, pipeline operators and marine transporters, as well as service and supply companies that support all segments of the industry. Although API's focus is primarily domestic, in recent years its work has expanded to include a growing international dimension, and today the API is recognized around the world for its broad range of programs. The API can influence public policy in support of a strong, viable USA O&G industry.

Their advocacy contributes to the O&G industry by negotiating with the public, Congress and the Executive Branch, state governments and the media (API, 2014).

For more than 85 years, the API has led the development of petroleum and petrochemical equipment and operating standards. The API has more than 500 standards that apply to many segments of the O&G industry from drill bits to environmental protection, and recommended practice. Many have been incorporated into USA domestic regulations; and increasingly, they are also being adopted by the International Organization for Standardization (ISO) (API, 2014).

Each day, the equipment on which the O&G industry depends to produce, refine and distribute its products is some of the most technologically advanced available in the search for O&G and allows the industry to operate in an environmentally safe manner. Designed for manufacturers of production, drilling, and refinery equipment, the API Monogram Program verifies that manufacturers are operating in compliance with industry standards. API also provides quality, environmental, and occupational health and safety management systems certification through APIQR[9]. The API also certifies inspectors of industry equipment through their Individual Certification Programs, designed to recognize working professionals who are knowledgeable of industry inspection codes and are performing their jobs in accordance with those codes. Further, the API's Training Provider Certification Program provides third-party certification for

[9] American Petroleum Institute Quality Registrar is the service that is accredited by the ANAB (ANSI-ASQ National Accreditation Board) for ISO 9001 and ISO 14001.

a variety of O&G industry training courses to ensure that any training provided meets industry needs (API, 2014).

In addition to established standards, certification and education of personnel and O&G development companies are also provided through seminars, workshops, conferences and symposia organized by the API. The activities of the API including API standards are currently becoming the most well-known and reliable among O&G stakeholders and the players have to comply with the API standards to participate in the market. It is assumed that the API standards are the most important rules since they can cover all activities at O&G development platforms practically and specifically on behalf of international regulations.

4.2.2. **ISO standards**

The International Organization for Standardization (ISO) is an independent, non-governmental membership organization and the world's largest developer of voluntary International Standards. The members are the national standards bodies of 163 member countries around the world. International Standards give world-class specifications for products, services and systems, to ensure quality, safety and efficiency. They are instrumental in facilitating international trade. ISO has published more than 19,500 International Standards covering almost every industry, from technology, to food safety, to agriculture and healthcare (ISO, n. d.).

For O&G development activities, there are so many standards[10] to be required for equipment, facilities and operation in ISO (ISO and OGP, 2014). One of them is ISO 19900:2013, Petroleum and natural gas industries -General requirements for offshore structures. ISO 19900:2013 specifies general principles for the design and assessment of offshore structures subjected to known or foreseeable types of actions. These general principles are applicable worldwide to all types of offshore structures, including, bottom-founded structures as well as floating structures, and to all types of materials used including steel, concrete and aluminum. ISO 19900:2013 specifies design principles that are applicable to: the successive stages in the construction of the structure (i.e. fabrication, transportation and installation); use during its intended life; and its decommissioning. The principles are also generally applicable to the assessment or modification of existing structures. Aspects related to quality control are also addressed. ISO 19900:2013 is applicable to the design of complete structures, including substructures, topsides structures, vessel hulls, foundations and mooring systems (ISO, n. d.). The comprehensive ISO standards, therefore, contribute to the safety of O&G development.

The ISO and API have already become global standards to be followed for safety of O&G development activities. These are really pragmatic to apply to all facilities because of practical research and specific measures based on scientific approach to the

[10] See **APPENDIX 2** about ISO standards related to O&G activities

structures, and they can prevent parts of offshore accidents. However, since they are voluntary and the API and ISO's activities are business, there is no linkage between responsibilities in emergency situations and compensation. Besides, the process of making standards may be influenced by the intentions of particular countries. In practice, the standards related to O&G development have been developed by the technical committee 67 (TC67) that deals with materials, equipment and offshore structure for petroleum, petrochemical and natural gas industries (JCI, 2010). The TC67's secretariat is the API on behalf of the American National Standards Institute (ANSI); thus, the ISO standards are relevant to the API standards. Because each country has its own national strategy for facilitating its industry, the ISO standards may be non-neutral and are not under the world's consensus. Therefore, these standards should become international regulations in order to be reliable instructions through discussion at international organizations.

4.3. Classification Society's actions

Classification Societies like Det Norske Veritas (DNV) and American Bureau of Shipping (ABS) are the organizations which develop technical standards to the design, construction and assessment of ships and other marine facilities and which carry out survey on ships on behalf of each competent authority of flag state as a recognized organization. For assessing quality, DNV and ABS have advanced standards not only

for shipping but also for O&G development to ensure the safety of equipment, structure of platforms and operation. This is because the USA and Norway have developed O&G in their territorial seas and the DNV and ABS need to establish standards to provide reliable instructions in terms of technical and procedural aspects on behalf of each competent authority.

For example, the DNV has been active in developing standards, specifications and recommended practices for the drilling and well segment. Both DNV standards and recommended practices are for technical elements; and, DNV service specifications are for procedural elements. Regarding O&G development activities, the DNV has the Offshore Service Specification DNV-OSS. For instance, current publications regarding drilling and well include:

- DNV Offshore Standard DNV-OS-E10 (Drilling plant)
- DNV Offshore Service Specification DNV-OSS-201 (Verification for Compliance with Norwegian Shelf Regulations)
- DNV Offshore Service Specification DNV-OSS-202 (Verification for Compliance with UK Shelf Regulations)
- DNV Recommended Practice DNV-RP-E101 (Recertification of Well Control Equipment)
- DNV Recommended Practice DNV-RP-E102 (Recertification of Blowout Preventers and Well Control Equipment for the US Outer Continental Shelf)

- CO_2WELLS guideline (This guideline describes a risk management framework for existing wells at potential CO_2 storage sites, both onshore and offshore.)

The DNV standards can cover most of O&G development activities because the standards are detailed and specific. This is because the demand from the European O&G industry for development of standards is high. According to the interview[11] of the DNV, European perspective and American one on regulations for avoiding the accidents in terms of the safety and marine environment protection are different respectively. For example, while European governments require companies which participate in O&G development business to establish their own rules for ensuring safety and marine environmental protection and to obtain authorization by a third party like DNV for clarification of reliability, the American government requests companies to follow national legislations that come from the API standards as high standards for O&G development. The European style is similar to self-insurance, which is shown in the European Directive issued in 2013 for creating unity and sharing a concept idea within European stakeholders. The detail of the Directive is shown in next section.

While the DNV standards are effective and meaningful for the safe development of O&G, its characteristics are similar to the API standards. The DNV standards are neither mandatory to all players related to O&G development nor global; therefore,

[11] On 8th August 2014, the interview was conducted with Mr. Ikuo Hamanaka of the DNV official by the author at Oslo, Norway.

different requirements and criteria from other standards, such as the ABS standards, exist. Like the IMO conventions for shipping, basic and minimum requirements for O&G development activities should be developed by international organizations.

4.4. Domestic laws and regional activities

As described in Chapter 1, particular sea beds like the North Sea and the territorial sea in the USA have rich resources of oil and gas. Therefore, such countries have made some progress in regulating O&G development activities and enacting instruments. The North Sea, for instance, was divided into five sectors, corresponding to the UK, Norway, Denmark, Netherlands and Germany (Gómez and Green, 2013). And, each country has different legislations. National legislation is diverse between EU states and the O&G industry operates to different environmental, health and safety standards in different EU member states. This situation causes confusion for the players regarding the development; therefore, it is necessary to unify the standards between them or make a fundamental principle that can cover all aspects of the O&G industry for fairness of treatment and user-friendliness.

Within Europe, to solve the problem of diverse national legislations and to share the information to secure their own territorial seas appropriately in terms of safety and marine environmental protection and to regulate O&G development activities to avoid frequent offshore accidents, the European council developed Directive 2013/30, Safety

of offshore oil and gas operations, which came into force in July 2013, amending prior Directive 2004/35. This regulation is addressed to all member states but its effect and requirements of transposition to national legislation differ for countries that have offshore waters and those that are landlocked. According to the Directive, the objective of this Directive is to reduce as far as possible the occurrence of major accidents relating to offshore O&G operations and to limit their consequences, thus increasing the protection of the marine environment and coastal economies against pollution, establishing minimum conditions for safe offshore exploration and exploitation of oil and gas and limiting possible disruptions to Union indigenous energy production, and to improve the response mechanisms in case of an accident (Directive, 2013).

The EU Directive establishes rules covering the entire lifecycle of exploration and production activities, from design to final removal of installations. Additionally, it aims to improve the response in the event of an incident and where prevention is not achieved, to assure clean up and mitigation is carried out, minimizing consequences. As above stated in the interview of the DNV, the principle of risk management includes the requirement for ‘operators’ to take all suitable measures to prevent major accidents in offshore O&G operations and to limit consequences for human health and the environment in the event of a major accident. The Directive shows that operators would not be relieved of their duties if an accident occurred as a consequence of an action or omission of their contractors. The Directive offers rules for transparency and

sharing of information, cooperation between member states, emergency response plans, and trans-boundary emergency preparedness and response (Gómez and Green, 2013).

In order to comply with this Directive, member states shall bring into force the laws, regulations, and administrative provisions necessary by 19 July 2015 (Directive, 2013). The following is the complementary procedure to follow the Directive.

- Information to be included in documents submitted to the competent authority (Article 11)
- Reports of well operations to be submitted (Article 15(4))
- Provisions relating to the appointment and functioning of the competent authority (Articles 8 and 9)
- Provisions by operators and owners for prevention of major accidents (Article 19)
- Selection of the independent verifier and the design of schemes for independent verification (Article 17(3))
- Information relating to priorities for cooperation between operators and owners and competent authorities (Article 19(7))
- Information to be provided in external emergency response plans (Article 29)
- Particulars to be included in the preparation of external emergency response plans (Article 29)
- Sharing of information and transparency

Even if the Directive provides new, sufficient and comprehensive regulation at the regional level, there are some problems in the Directive as stated by the commission as follows.

1. The Commission regrets that some Member States are partially exempted from the obligation to transpose the Directive and considers that such derogations shall not be regarded as a precedent in order not to affect the integrity of EU law.
2. The Commission notes that Member States may use the option not to transpose and apply Article 20[12] of the Directive because of the current absence of any company registered in their jurisdiction which has offshore activities outside the territory of the Union.

In order to ensure effective enforcement of this Directive, the Commission needs to take all necessary measures against any circumvention which may be brought to its attention (Directive, 2013). However, this action by the EU is advanced and is expected to be effective regulation for the avoidance of offshore accidents.

Other than the EU action, there are well-organized institutions for sharing useful information and affecting the discussion of international organizations: WOC and OGP are introduced in the following.

[12] The Directive says that Member States shall require companies registered in their territory and conducting, themselves or through subsidiaries, offshore oil and gas operations outside the Union as licence holders or operators to report to them, on request, the circumstances of any major accident in which they have been involved.

WOC

The World Ocean Council (WOC), which is an international, cross-sectoral industry alliance, brings together the diverse ocean business community to collaborate on stewardship of the seas. The purpose of the WOC is to improve ocean science in support of safe and sustainable operations, educate the public and stakeholders about the role of responsible companies in addressing environmental concerns, more effectively engage in ocean policy and planning, and develop science-based solutions to cross-cutting environmental challenges that cannot be solved by one company or industry, such as invasive species, and ocean noise. The WOC is engaging a wide range of ocean industries including shipping, oil and gas, fisheries, aquaculture, tourism, renewable energy, dredging, cables and pipelines as well as the maritime legal, financial and insurance communities for assisting private companies to improve environmental performance through best practice and standards, for developing relationships among industries and for exchanging information (WOC, 2014)

OGP

The International Association of Oil & Gas producers (OGP), which encompasses most of the world's leading publicly-traded, private and state-owned oil & gas companies, industry associations and major upstream service companies and of which members produce more than half the world's oil and about one third of its gas, is a unique global forum in which members identify and share best practices to achieve

improvements in every aspect of health, safety, the environment, security, social responsibility, engineering and operations. Currently, the representatives of associate members are BP plc, Chevron Corporation, ConocoPhillips, ExxonMobil, PetróleoBrasileiro SA, Shell International Exploration & Production BV, Statoil, Total and Baker Hughes (OGP, 2014). The purpose of the OGP is to develop effective communications between the upstream industry and an increasingly complex network of international regulators. An essential part of the OGP's mission is to represent the interests of the upstream industry before international regulators and legislators in the IMO. The OGP also works with the World Bank and with the ISO. It is also accredited to a range of regional bodies that include OSPAR[13], the Helsinki Commission[14] and the Barcelona Convention[15]. The OGP provides an essential conduit for advocacy and debate between the upstream industry and the EU.

The OGP developed guideline for managing marine risks associated with FPSO ("Guideline for managing", 2006). This guideline introduces hazards that include potential pollution associated with frequent transfers of crude oil and potential collision with tankers and offshore support vessels ("Guideline for managing", 2006).

[13] OSPAR is the mechanism by which fifteen Governments of the western coasts and catchments of Europe, together with the EU, cooperate to protect the marine environment of the North-East Atlantic.

[14] Baltic Marine Environment Protection Commission

[15] Convention for the Protection Of The Mediterranean Sea Against Pollution

The WOC and OGP play an important role in contributing to safe O&G development by sharing information and by representing the O&G industry in international organizations.

4.5. Comparison of each function among organizations

In order to know the function of each organization, the differences among various organizations including the IMO are shown in Table 6. From that, overlapping and insufficient conditions as well as pros and cons of the activities of these institutions can be analyzed to answer the questions No. 2 and 3 of Chapter 4 in Section 1.4.

There exist many types of instruments and they have different approaches to O&G development activities. As superior of laws, UNCLOS clearly defines which body has to manage a particular area. Following this, the ISA and national legislations govern the area. To know the importance of public issues and limit human activities based on the principle of UNCLOS for the purpose of avoiding disasters and achieving sustainable uses of natural resources, some regulations have been developed at regional and international levels. Moreover, for the end-user, there are business basis standards that probably became global standards to show detailed criteria concerning equipment and operation of O&G development.

TABLE 6 COMPARISON OF ROLE OF EACH INSTITUTION

Institution	Found year	Number of Member	Measures related to O&G activities	Scope	Coverage area
IMO	1948	170 states IADC[16] IPIECA[17] OCIMF[18] ISO, OGP	***SOLAS*** ***MARPOL*** MODU Code	All Ships MODU	Territorial sea EEZ The High seas
UN	1945	193 states	***UNCLOS***	Resource	Ocean
ISA	1994	166 states	***Mining Code***	Seabed	The Area
OECD	1948	34 States	Best practices	Equipment Operation	Ocean
DNV	1864	No member	DNV standard	Equipment Operation	Ocean
ISO	1946	163 states	ISO standards	Equipment Operation	Ocean
API	1919	Over 600 Companies	API standards	Equipment Operation	Ocean
EU	1951	28 states	***EU Directive***	Equipment Operation	Territorial sea
WOC	Not available	74 Co. (incl. DNV)	Developing relationship and sharing information		
OGP	1974	82 Co. and associations (incl. API)	Providing drafts for ISO ballot /publication in cooperation with ISO/TC67		

****Italics*** denote mandatory regulations. (Data from the websites of each institution)

[16] International Association of Drilling Contractors

[17] International Petroleum Industry Environmental Conservation Association

[18] Oil Companies International Marine Forum

With regard to various instruments that overlap and are insufficient, it is assumed that there are advantages and disadvantages as follows.

Advantage

- Dissemination of information to new comers

  Like DNV, WOC and OGP, these institutions work as international consultants to give practical information to users.

- Segmentalization

  Detailed procedures can be established within a particular area by several instructions, depending on the environmental conditions, such as weather, sea conditions and geographical environment.

- Double check

  Comparing multiple instructions optimizes user activities with regard to protection from failure, especially human error.

- Flexibility

  Various options bear flexible construction of the platform and operation according to the economic situation, which leads to extra benefits for O&G development companies.

Disadvantage

- Complex

  Multiple instructions confuse users when O&G development companies check the criteria before their project starts.

- Double standards

  Like the difference between the API standards and the IMO conventions, one side may become dead letter if the others become popular and most reliable.

- Market occupation

  New participation to the O&G market is difficult for new comers due to the occupation based on high standards like the API standards that are influenced by particular stakeholders.

As shown in Table 6, even if various institutions develop the exact guidelines standards and guidance that have pros and cons, most of them are just information for O&G development stakeholders such as ship owners, ship manufacturers, EPCI contractors, plant engineers and oil companies. Mandatory regulations are normally developed by the international organizations like the IMO, UN, ISA and EU under consensus of member states and non-mandatory standards are business based. Thus, no one has responsibility for accidents resulting from O&G development activities except for national jurisdictions. This is because "the international recommendation is that

plans for oil and gas exploitation and plans to protect the marine environment should be developed within the context of National sustainability strategies based on the results of World Summits on Sustainable Development (WSSD[19]).” (Kloff and Wicks, 2004) Not international but national instruments can regulate these incidents and the oil pollution. However, in order to widely ensure the safety of O&G development in more extensive areas of the high seas for the future, new international regulations should be established instead of non-mandatory standards, guidelines and guidance which cannot reliably and fairly cover global O&G activities.

The key to be considered is the international body that should take the initiative to develop new regulations. Establishing a new international organization for O&G development issues specially requires extra costs and much time; therefore, the current organizations should be utilized. As found in Table 6, the IMO has already enacted mandatory regulations regarding all ships and MODU for all coverage areas. Thus, it is thought that the body should be the IMO. Taking into account its history and past discussion, the IMO can have responsibility for O&G development activities in cooperation with the ISA, which has a strong right to manage the Area. The IMO can create a general principle for procedural measures and equipment for safety and marine environmental protection.

[19] The WSSD, held in Johannesburg in August 2002 reinforced the Rio agenda and urged in its Plan of Implementation that: "States should: Take immediate steps to make progress in the formulation and elaboration of national strategies for sustainable development and begin their implementation by 2005"

4.6. Summary and remarks

Not only the IMO but also other institutions have discussed O&G development issues for avoiding offshore accidents, such as the UN, ISA, EU, API, ISO, DNV, WOC and OGP. By sharing information and establishing their own rules, standards or regulations at domestic, regional and industrial levels in terms of technology and operational procedure, some offshore accidents can be prevented based on their advantages. However, these instructions also have disadvantages, which are complex, double standards and market occupation, which lead to disproportionation among O&G industries or between new comers and existing players. Since all players should be treated equally under general consensus based on the discussion at international organizations, new regulations are needed for O&G development activities, taking into account the advantages of current instructions.

For achieving new regulations, the IMO can have responsibility for O&G development issues rather than the other institutions because of its past activities through cooperation with other parties. Especially cooperation with the ISA makes the IMO powerful in the high seas where the players will develop the seabed in the future.

Chapter 5 COVERAGE OF EACH INSTRUMENT IN TERMS OF TERRITORIAL SEA, EEZ AND THE HIGH SEAS

In Chapter 3 and 4, the activities by the main institutions for regulating O&G development activities were shown. In this chapter, based on Chapter 3 and 4, in order to understand insufficient or lack of regulations for ensuring safety and marine environmental protection, the difference among these activities implemented by various organizations including the IMO are analyzed in terms of coverage areas: the territorial sea, EEZ and the high seas. This analysis is conducted separately depending on the platforms: vessels, floating platforms and fixed platforms, to answer the question No. 1 of Chapter 5 in Section 1.4. Moreover, matching between the O&G development issues and current regulations is examined at the end.

5.1. Instruments regarding O&G development activities for vessels

Firstly, it should be stated that there are domestic laws in each country where O&G development is conducted within the territorial sea and EEZ. Therefore, the activities need to be conducted following domestic regulations in terms of safety and marine environmental protection. And the domestic laws are enacted based on the principles

of international regulations; some of them, for example, the American regulations that are affected by the API standards are stricter than the international regulations.

TABLE 7 LEGISLATIONS FOR VESSELS IN TERMS OF THE AREA

	Territorial sea	**EEZ**	**The high seas**
Mining right	UNCLOS Domestic law	UNCLOS Domestic law	UNCLOS ISA
Safety	EU Directive Domestic law	EU Directive Domestic law	SOLAS
Marine environmental protection	MARPOL Domestic law	MARPOL Domestic law	MARPOL

When focusing on the instruments for the vessels like offshore support vessels, there are three steps to regulate O&G development activities as shown in Table 7: mining right, safety, and marine environmental protection. As a first step, UNCLOS regulates all areas that are territorial sea, EEZ and the high seas, and gives the right of managing the area to coastal states except for the high seas, which are public heritage. The high seas are managed by the ISA under UNCLOS. Secondly, SOLAS and MARPOL are the main mandatory international instruments. SOLAS can apply to all ships that engage in international voyages; therefore, the high seas can be covered by SOLAS in terms of safety. On the other hand, MARPOL can apply to both domestic and

international voyages as a third step that indirectly affects the safety aspect. These conventions, therefore, become a safety net as a minimum requirement for the high seas to ensure safety and marine environmental protection. Moreover, there are non-mandatory codes and various instruments that are supportive and provide specific instructions for special purpose vessels to achieve further accomplishment of reliability.

Thus, if new projects wherein the high seas are developed for natural resources start, these legislations can work for vessels, similar to shipping activities.

5.2. Instruments regarding O&G development activities for floating and fixed platforms

On the other hand, the circumstance for fixed and floating platforms is a bit different from the one for vessels as shown in Table 8, which shows legislations for fixed platforms. In case of mining right and marine environmental protection, the application for fixed platforms is similar to that for vessels. However, as shown in Table 8, it is clear that the high seas cannot be covered by any international laws in the case of safety even if there are some standards for fixed platforms, which is the answer of the question No. 2 of Chapter 5 in Section 1.4. It means that safety needs to be ensured by each company that develops the high seas based on instructions issued by various institutions like the API and ISO. In that case, if accidents happen, the companies have to compensate for victims by themselves.

TABLE 8 LEGISLATIONS FOR FIXED PLATFORM IN TERMS OF THE AREA

	Territorial sea	**EEZ**	**The high seas**
Mining right	UNCLOS Domestic law	UNCLOS Domestic law	UNCLOS ISA
Safety	EU Directive Domestic law	EU Directive Domestic law	
Marine environmental protection	MARPOL Domestic law	MARPOL Domestic law	MARPOL

Unlike fixed platforms, floating platforms have two aspects: transfer phase and operation phase. Transfer phase involves transfer of platforms to the development area, which should be covered by the IMO conventions regardless of the area if the voyage is international and the platforms like FPSOs or FSOs are not carried by other vessels. If not, they are not covered by the IMO conventions and just follow standards such as the API or ISO on a voluntary basis. On the other hand, in the operation phase, the platforms are not on voyage and are located at a particular position; therefore, since they behave as fixed platforms, they are not covered by the IMO conventions.

However, the high seas cannot be governed by national legislations; enacting new regulations for floating and fixed platforms in the high seas is necessary to prevent accidents in the future.

5.3. Matching between the O&G development issues and current regulations

In Chapter 2, it was found that the rate of lives lost in offshore accidents is higher than that in shipping accidents because there are special causes such as helicopter accidents that occur when carrying workers and cargoes, loss of buoyancy or sinking, and capsizing, overturning and toppling. Besides, there are other potential risks related to blowouts at oil wells and explosions at O&G development platforms. These accidents lead to numerous human lives lost and marine environmental pollution derived from oil spills. Nevertheless, the coverage area by current regulations that define mandatory and minimum requirements for ensuring safety and marine environmental protection is not complete as shown in the previous section. It was found that there is a lack of international safety regulations about minimum requirements for equipment and procedural measures for floating and fixed platforms in terms of safety, especially in the high seas.

Under this condition, if O&G development in the high seas is increasing, the structure of the platforms for safety must be different to use in special conditions. Therefore, unifying the standards issued by the API or ISO and transferring the standards to the status of international laws should be done by one international organization through the cooperation of related players. It can be useful for new investors or newcomers into O&G business to start new businesses; and, it can be easy for each country to manage the activities by the measure based on international laws; further, it can lead to fewer

accidents by improving the regulations based on the best practice. This is an ideal process for enacting appropriate and effective laws, and it will probably contribute to fair trade under one regulation.

Besides, the most important benefit from new regulations for development in the high seas is that preservation of natural resources can be achieved by fair criteria of one standard. Moreover, education of personnel like OPITO is defined easily. Otherwise, plenty of regulations and standards will be developed by various institutions and the situation will remain complicated; significantly, no one will take any responsibility for accidents derived from the development in the high seas. Thus, as soon as possible, consideration of these issues and drafting of new regulations should be conducted, contrary to the IMO's current response, which is creating non-mandatory instruments. Various standards confuse players and impose heavy burdens on them.

For achieving this goal, the best approach is that the IMO takes responsibility for enacting new regulations in cooperation with the ISA that manages the high seas, which is the answer of the question No. 3 of Chapter 5 in Section 1.4. The IMO has considerable experiences with maritime issues and has already controlled vessels by the IMO conventions on behalf of the UN. The advantages of the IMO are that:

- IMO can relatively easily cooperate with other international organizations;
- IMO's knowledge of shipping can apply to O&G platforms;
- IMO can deal with navigation between vessels and fixed platforms; and,

- Other relevant IMO conventions like STCW, SAR and CLC can be useful for the offshore accidents.

As stated in Chapter 3, the difficult point is the contribution from other stakeholders like oil companies. But if the IMO collaborates with the ISA, new regulations for the high seas can be achieved by the strong right of the ISA.

5.4. Summary and remarks

The existing legislations governing safe O&G development activities can be divided into 3 steps: mining right, safety, and marine environmental protection. As a first step, UNCLOS ensures the sovereign right of nations that is managing their territorial seas and EEZ except for the high seas, which are managed by the ISA under UNCLOS. Secondly, SOLAS and MARPOL as mandatory international instruments set up criteria for regulating shipping activities and O&G development activities generally. However, fixed and floating platforms in the high seas are out of SOLAS's application. On the other hand, though MARPOL can apply to the fixed and floating platforms in high seas as a third step to ensure marine environmental protection, the requirement for the platforms is similar to that for vessels despite the high risk for offshore accidents. That is why the API is stricter than the IMO conventions.

In conclusion, to fulfill the lack of regulations for the high seas, enacting new regulations for floating and fixed platforms in the high seas is necessary to prevent accidents in the future. For achieving this action, the IMO can take responsibility for enacting new regulations in cooperation with the ISA based on the IMO's advantages for approaching maritime issues.

In the next chapter, this dissertation is concluded; further, recommendations are given.

Chapter 6 CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

Oil and gas development and exploitation have been expanding to supply the increasing demand for the energy based on rapid population growth. The recent advanced technologies, which enable the development of deeper and further areas from coastlines, also contribute to an expanding development area; in the future, the area will enlarge to the high seas. In order to ensure maximum safe operation of O&G development platforms that will be installed at sea, research [20] into international regulations for preventing from incidents/accidents at platforms was conducted for this dissertation by analyzing current situations regarding accident trends and measures conducted by various institutions for the prevention of accidents.

From the analysis of offshore accidents, the greater severity of offshore accidents compared to shipping accidents was found by the higher rate of lives lost in offshore accidents than in shipping accidents. This is because special causes such as helicopter accidents when carrying workers and cargoes, loss of buoyancy or sinking, and

[20] The results of research are shown in **APPENDIX 3** in the form of answering the questions described in Section 1.4.

capsizing/overturning/toppling affected the increased rate of lives lost. Besides, there are other potential risks related to blowouts at oil wells and explosions at O&G development platforms. These accidents have led to both numerous human lives lost and marine environmental pollution derived from oil spills.

For preventing such accidents that effect many countries beyond boundaries and that could occur in any other countries, it was clearly found that international regulations were essential to ensure the safety of O&G development activities; therefore, the existing regulations and standards by various institutions were examined.

According to the examination, in terms of offshore disasters, it was assumed that the IMO has not conducted sufficient actions. This is because there are exemptions of application and similar requirements to shipping activities in SOLAS and MARPOL, which are mandatory regulations and ensure the safety of vessels and marine environmental protection. This is despite the greater severity of offshore accidents, which have contributed to catastrophic accidents while they apply to O&G development platforms, even fixed platforms generally.

Moreover, it was pointed out that not only the IMO but also other institutions, such as the UN, ISA, EU, API, ISO, DNV, WOC and OGP, have discussed O&G development issues by sharing information and establishing their own rules, standards or regulations at domestic, regional and industrial levels in terms of technology and operational procedure. It was found that these instructions may complicate issues for the

stakeholders and bear double standards and market occupation, which lead to disproportionation among O&G industries, while they are effective for avoiding offshore accidents. All players should be treated equally under general consensus based on the discussion at international organizations.

From the detailed analysis of the existing legislations, it can be assumed that there are 3 steps: mining right, safety, and marine environmental protection for safe O&G development activities. UNCLOS, SOLAS and MARPOL have an important role in each step; however, appropriate criteria for fixed and floating platforms in the high seas are not set up by them. Besides, MARPOL cannot provide stricter requirements for the platforms according to the high risk of offshore accidents.

In conclusion, to fulfill the lack of regulations for the high seas, enacting new regulations for floating and fixed platforms in the high seas is necessary to prevent accidents in the future.

6.2. Recommendations

Proactive actions are expected to prevent offshore accidents happening in the future as common issues like shipping accidents. For safe operation based on functional equipment and appropriate procedures, an international organization should take the initiative to establish effective and pragmatic instructions on behalf of the players that

engage in O&G development business. From the discussion in this dissertation, it was recommended that the IMO should have responsibility for O&G development issues rather than other institutions. This is because of IMO's past activities through the cooperation with the others. Especially cooperation with the ISA makes the IMO powerful in the high seas where the players will develop the seabed in the future.

In brief, the following agenda items are recommended as the way forward.

- Collaboration between the IMO and the ISA
- Consideration of the steps and criteria for development of 'the Area'
- Verification of the structure of various current instruments and unification for user friendliness
- Development of supplementary regulations to cover insufficient areas including the high seas

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APPENDICES

APPENDIX 1 TYPES OF PLATFORMS

- Semi-Submersible: A floating production facility
- Guyed: A piled platform with additional tethers
- Jack-up: A mobile drilling rig currently being used in a production capacity
- Piled: A single jacket
- Compliant Tower (CPT): Deepwater piled platform built in two sections
- TLP: Tension Leg platform
- Gravity: Large platform held in place by ballast rather than piled into the seabed
- Mobile: Special purpose ship-shaped platform that can move from field to field
- Caisson: Simple cylindrical steel platform
- Ship-Shaped: Ship-shaped platform such as a FPSO (Floating Production Storage Offloading Facility), FSO (Floating Storage Offloading Facility)
- Skirt Plate: Jacket held to the seabed by suction
- Suction Pile
- Conductor Supported
- Buoy-Shaped
- SPAR: Deep draft caisson vessel

(Source from Infield, 2014)

APPENDIX 2 ISO STANDARDS RELATED TO O&G DEVELOPMENT ACTIVITIES

- ISO 10418 Basic surface safety systems
- ISO 10423 Wellhead & christmas tree equipment
- ISO/TR 12489 Reliability modeling/safety systems (New)
- ISO 13354 Shallow gas diverter equipment (New)
- ISO 13533 Drill-through equipment (BOPs)
- ISO 13534 Hoisting equipment - care/maint
- ISO 13535 Hoisting equipment – specification
- ISO 13626 Drilling and well-servicing structures
- ISO 13702 Control & mitigation of fires & explosions (Rev)
- ISO 13703 Offshore piping systems
- ISO 14224 Reliability/maintenance data
- ISO 14692 GRP piping, Parts 1-4
- ISO 14693 Drilling equipment
- ISO 15156-1 Selection of cracking resistant materials for use in H_2S envrironments
- ISO 15156-2 Cracking-resistant steels and cast irons for use in H_2S environments
- ISO 15156-3 Cracking-resistant alloys for use in H_2S environments
- ISO 15138 HVAC
- ISO 15544 Emergency response
- ISO 15663 Life cycle costing, Parts 1-3
- ISO 17776 Assessment of hazardous situations
- ISO/TS 17969 Guidelines on competency for personnel (New)
- ISO 20815 Production assurance and reliability management
- ISO 21457 Materials selection
- ISO 23936-1,2 Thermoplastics, Elastomers (New)
- ISO/TS 27469 Method of test for offshore fire dampers
- ISO/TS 29001 Sector-specific quality management systems

- ISO 13624-1 Marine drilling riser systems
- ISO/TR 13624-2 Marine drilling riser system analysis
- ISO 13625 Marine drilling riser couplings
- ISO 19901-7 Station-keeping systems for floating offshore structures (New)
- ISO 19904-1 Floating offshore structures
- ISO 13628-1 Subsea production systems (Amd)
- ISO 13628-2 Subsea flexible pipe systems
- ISO 13628-3 Subsea TFL pumpdown systems
- ISO 13628-4 Subsea wellhead and tree equipment
- ISO 13628-5 Subsea control umbilicals
- ISO 13628-6 Subsea production controls
- ISO 13628-7 Completion/workover riser system
- ISO 13628-8 ROT and interfaces
- ISO 13628-9 ROT intervention systems
- ISO 13628-10 Bonded flexible pipe
- ISO 13628-11 Flexible pipe systems for subsea and marine applications
- ISO 13628-15 Subsea structures and manifolds
- ISO/TR 10400 Calculations for OCTG performance properties
- ISO 10405 Care/use of casing/tubing
- ISO 10407-1 Drill stem design
- ISO 10407-2 Inspection and classification of drill stem elements
- ISO 10414-1 Field testing of water-based fluids
- ISO 10414-2 Field testing of oil-based drilling fluids
- ISO 10416 Drilling fluids - lab testing
- ISO 10417 Subsurface safety valve systems
- ISO 10424-1 Rotary drill stem elements
- ISO 10424-2 Threading and gauging of connections
- ISO 10426-1 Well cementing
- ISO 10426-2 Testing of well cements
- ISO 10426-3 Testing of deepwater well cement

- ISO 10426-4 Preparation and testing of atmospheric foamed cement slurries
- ISO 10426-5 Shrinkage and expansion of well cement
- ISO 10426-6 Static gel strength of cement formulations
- ISO 10427-1 Bow spring casing centralizers
- ISO 10427-2 Centralizer placement and stop-collar testing
- ISO 10427-3 Performance testing of cement float equipment
- ISO 10432 Subsurface safety valves
- ISO 11960 Casing and tubing for wells (Rev)
- ISO 11961 Drill pipe
- ISO 12835 Qualification of casing connections for thermal wells (New)
- ISO 13085 Tubing aluminium alloy pipes (New)
- ISO 13500 Drilling fluids (Amd)
- ISO 13501 Drilling fluids - processing systems evaluation
- ISO 13503-1 Measurement of viscous properties of completion fluids
- ISO 13503-2 Measurement of properties of proppants
- ISO 13503-3 Testing of heavy brines
- ISO 13503-4 Measurement of stimulation & gravelpack fluid leakoff
- ISO 13503-5 Measurement of long term conductivity of proppants
- ISO 13503-6 Measuring leak-off of completion fluids under dynamic conditions (New)
- ISO 13678 Thread compounds
- ISO 13679 Casing and tubing connections testing
- ISO 13680 CRA seamless tubes for casing & tubing
- ISO 14310 Packers and bridge plugs
- ISO 14998 Accessory completion equipment (New)
- ISO 15136-1 Progressing cavity pump systems
- ISO 15136-2 Progressing cavity pump systems - drive heads
- ISO 15463 Field inspection of new casing, tubing and plain end drill pipe
- ISO 15464 Gauging and inspection of threads
- ISO 15546 Aluminium alloy drill pipe

- ISO 16070 Lock mandrels and landing nipples
- ISO/TS 16530-2 Well integrity operational phase (New)
- ISO 17078-1 Side-pocket mandrels (Amd)
- ISO 17078-2 Flow control devices for side-pocket mandrels
- ISO 17078-3 Latches & seals for side-pocket mandrels & flow control devices
- ISO 17078-4 Side-pocket mandrels and related equipment
- ISO 17824 Sand control screens
- ISO 20312 Design of aluminium drill string
- ISO 27627 Aluminium alloy drill pipe thread gauging (New)
- ISO 28781 Subsurface tubing mounted formation barriers
- ISO 19900 General requirements for offshore structures (Rev)
- ISO 19901-1 Metocean design and operating considerations (Rev)
- ISO 19901-2 Seismic design procedures and criteria (Rev)
- ISO 19901-3 Topsides structure
- ISO 19901-4 Geotechnical and foundation design (Rev)
- ISO 19901-5 Weight control
- ISO 19901-6 Marine operations
- ISO 19901-8 Marine soil investigations (New)
- ISO 19902 Amd 1 Fixed steel offshore structures (Amd)
- ISO 19903 Fixed concrete offshore structures
- ISO 19905-1 Jack-ups
- ISO/TR 19905-2 Jack-ups commentary (New)
- ISO 19906 Arctic offshore structures
- ISO 3977-5 Gas turbines – procurement
- ISO 10428 Sucker rods
- ISO 10431 Pumping unites
- ISO 10434 Bolted bonnet steel gate valves
- ISO 10437 Special-purpose steam turbines (Rev)
- ISO 10438 Lubrication, shaft-sealing and control-oil systems, Parts 1-4
- ISO 10439 Centrifugal compressors

- ISO 10440-1 Rotary-type positive-displacement process compressors (oil-free)
- ISO 10440-2 Rotary PD packaged air compressors
- ISO 10441 Flexible couplings – special
- ISO 10442 Integrally geared air compressors
- ISO 12211 Spiral plate heat exchangers
- ISO 12212 Hairpin heat exchangers
- ISO 13631 Reciprocating gas compressors
- ISO 13691 High speed enclosed gear units
- ISO 13704 Calculation of heater tube thickness
- ISO 13705 Fired heaters for general service
- ISO 13706 Air-cooled heat exchangers
- ISO 13707 Reciprocating compressors
- ISO 13709 Centrifugal pumps
- ISO 13710 Reciprocating positive displacement pump
- ISO 14691 Flexible couplings – general
- ISO 15547-1 Plate & frame type heat exchangers
- ISO 15547-2 Brazed aluminium platefin type heat exchangers
- ISO 15649 Piping
- ISO 15761 Steel valves DN 100 and smaller
- ISO 16812 Shell & tube heat exchangers (Rev)
- ISO/TS 16901 Risk assessment of onshore LNG installations
- ISO 16961 Coating of above-ground steel storage tanks (New)
- ISO 17177 Unconventional LNG transfer systems (New)
- ISO 17292 Metal ball valves
- ISO 21049 Centrifugal and rotary pumps shaft sealing
- ISO 23251 Pressure-relieving and depressuring systems
- ISO 24817 Composite repair of pipework (Rev)
- ISO 25457 Flares details
- ISO 27509 Compact flanged connections
- ISO 28300 Venting of storage tanks

- ISO 28460 LNG - Ship to shore interface
- ISO 3183 Steel pipe for pipeline transportation systems
- ISO 12490 Actuation, mechanical integrity and sizing for pipeline valves
- ISO 12736 Wet thermal insulation coatings (New)
- ISO/TS 12747 Pipeline life extension
- ISO 13623 Pipeline transportation systems
- ISO 13847 Welding of pipelines (Rev)
- ISO 14313 Pipeline valves
- ISO 14723 Subsea pipeline valves
- ISO 15589-1 Cathodic protection for on-land pipelines (Rev)
- ISO 15589-2 Cathodic protection for offshore pipelines
- ISO 15590-1,2,3 Pipeline induction bends, Pipeline fittings, Pipeline flanges
- ISO 16440 Steel-cased pipelines (New)
- ISO 16708 Pipeline reliability-based limit state design
- ISO 21329 Test procedures for pipeline mechanical connectors
- ISO 21809-1,2,3,4,5 Polyolefin coatings (3-layer PE and 3-layer PP), Fusion-bonded epoxy coatings (Rev), Field joint coatings, Polyethylene coatings (2-layer PE), External concrete coatings

(Source from ISO and OGP, 2014)

APPENDIX 3 ANSWERS OF THE QUESTIONS IN SECTION 1.4

Chapter 2

1. Why do offshore accidents have to be considered? (Section 2.2)

It is important to consider offshore accidents as a common issue because they affect human lives and marine environmental pollution.

2. What is the difference between shipping accidents and offshore accidents? (Section 2.3.2 and 2.3.3)

The difference is that the number of total losses by shipping activities is larger than the number by O&G development activities during 2003 and 2013. Besides, the average lives lost by O&G development activities was less than the average lives lost by shipping. Moreover, in offshore accidents, there are different and frequent causes: blowout, breakage or fatigue, toppling, falling load, dropped object and helicopter accidents that are a special cause compared to shipping activities and result in the highest rate of lives lost.

3. How severe are offshore accidents? (Section 2.3.2 and 2.3.3)

In terms of the lives lost rate, the severity of offshore accidents is higher compared to shipping accidents. (The rate of shipping accidents: 1.6 times, the rate of offshore accidents: 6.8 times)

Chapter 3

1. Does the IMO have responsibility for offshore accidents resulting from O&G development and exploitation? (Section 3.1)

The IMO is responsible for safety of life at sea related to shipping and the protection of the marine environment from vessels. When looking at the platforms related to O&G development, in so far as mobile offshore drilling units are in transit and are to be considered as ships, they, even fixed platforms, are subject to international maritime conventions, in particular, SOLAS, MARPOL or the equivalent standards of the applicable version of the MODU Code.

2. What kinds of efforts has the IMO made for preventing offshore accidents? (Section 3.1, 3.2 and 3.3)

SOLAS, MARPOL and the MODU Code are relevant to O&G development activities in terms of safety and marine environmental protection, but the IMO has not developed international legally binding laws related directly to O&G development activities.

3. What is the problem about regulating O&G development issues in the IMO? (Section 3.4)

There are difficulties which have caused the IMO to struggle to develop new regulations for O&G development as follows:

- Other standards that are stricter than the IMO Conventions exist.
- The companies related to O&G development cannot join the IMO discussion directly.
- Main flag states do not have strong interests in new regulations having no O&G development infrastructure.

Chapter 4

1. Other than the IMO, what kinds of actions have organizations or stakeholders made for safe O&G development? (Section 4.1, 4.2, 4.3 and 4.4)

The UN, ISA, EU, API, ISO, DNV, WOC and OGP, for example, have discussed O&G development issues for avoiding offshore accidents. By sharing information and establishing their own rules, standards or regulations at domestic, regional and industrial levels in terms of technology and operational procedure, some offshore accidents can be prevented based on their advantages.

2. What is the difference among these approaches (advantages and disadvantages)? (Section 4.5)

Advantages are dissemination of information to new comers, segmentalization, double check and flexibility; disadvantages are complex, double standards and market occupation.

3. What is the problem about regulating the offshore sector with them? (Section 4.5)

Most of them are just information for O&G development stakeholders. While mandatory regulations are normally developed by the international organizations under consensus of member states, non-mandatory standards are business based. Thus, no one has responsibility for accidents resulting from O&G development activities except for national jurisdictions.

Chapter 5

1. In terms of vessels, floating platform and fixed platform, which instruments apply to territorial seas, EEZ and the high seas? (Section 5.1 and 5.2)

UNCLOS, SOLAS and MARPOL apply to each area in terms of vessels. As a first step, UNCLOS ensures the sovereign right of nations that is managing their territorial seas and EEZ except for the high seas, which are managed by the ISA. Secondly, SOLAS and MARPOL as mandatory international instruments set up criteria for regulating shipping activities and O&G development activities generally. On the other hand, fixed and floating platforms in the high seas are out of SOLAS's application.

2. Is there any lack of coverage for safety of O&G development? (Section 5.2)

The high seas cannot be covered by any international laws in the case of safety even if there are some standards for fixed platforms.

3. What is the best approach to manage the accelerated development of the high seas for safety and marine environmental protection? (Section 5.3)

The best approach is that the IMO takes responsibility for enacting new regulations in cooperation with the ISA that manages the high seas. Under the IMO's initiative, consideration of the steps and criteria for development of 'the Area', verification of the structure of various current instruments, unification for user friendliness and development of supplementary regulations to cover insufficient areas including the high seas are recommended.