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Comparison of Perspective and Performance-Based Regulatory Regimes in the U.S.A and the U.K.

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Abstract:

Every major industrial accident such as Piper Alpha disaster, Exxon Valdez Oil Spill, BP Texas City Refinery led to the development of new regulations. After the BP Deepwater Horizon accident, several investigation committees recommended to reexamine the United States' existing regulatory approaches by integrating more sophisticated risk assessment and risk management practices. It has been observed that this type of reactive changes in regulation sometimes give more focus on the causes of a particular accident rather than considering possible future hazards unrelated to that particular accident. There are primarily two approaches of the offshore oil/gas industry's regulatory regime; while the United States' regulatory system is the more prescriptive-based, the United Kingdom's approach is performance-based. The National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling Accident recommended changing U.S. regulatory regime to a proactive, risk-based approach which could be similar to the "Safety Case" approach of the North Sea. The "Safety Case" approach of the U.K. is considered successful in minimizing accidents in the North Sea region. The objective of this study is to perform an evaluation and comparison between the United States' prescriptive-based regulatory approaches and the United Kingdom's performance-based regulatory approaches to understand their advantages and disadvantages. Then, this study presents an analysis of major accident histories under both regulatory regimes and discusses their effectiveness in reducing accidents. The study has found that there are both advantages and disadvantages in both the regulatory regimes and with available data, it is difficult to conclude with certainty that one regulatory regime is better than the other.

1. Introduction:

The offshore oil and gas drilling, exploration and production in different parts of the world has fueled the growth of world economies. The North Sea in Europe and the Gulf of Mexico in the Americas are two main locations for offshore oil and gas activities. In the United States, offshore oil and gas activities contribute for about 16% of the crude oil and 5% of natural gas (Muskal, 2015). Offshore drilling involves hazards and risks due to exposure of flammable and combustible substances, harsh weather conditions, human error, etc., and therefore safety is one of the major concerns. There are numbers of catastrophic accidents from offshore drilling and exploration activities which had significant impact on people, environment and society, and financial loss. The North Sea experienced 123 fatalities in the Norwegian side when a drilling rig overturned by a bad storm in 1980. In 1988, the Piper Alpha oil production platform in the U.K. side of the North Sea was destroyed due to an explosion resulting in 167 fatalities. This is considered as the 'worst' accident in the history of offshore oil/gas activities and changed the fundamentals of the regulatory regime in the North Sea region. The United States experienced significant oil spill incident in 1969 from the Santa Barbara Oil Spill, which is recorded as third largest oil spill incident in the drilling history of the U.S.A. There were about 509 recorded fire incidents in the Gulf of Mexico platform from 2006 to 2010 that caused fatalities and injuries of the workers (Olsen and Langford, 2010). The Deepwater Horizon accident, described as the worst environment disaster, occurred in 2010 at the Gulf of Mexico resulting into 11 deaths and 17 serious injuries followed by approximately 5 mm barrels of oil spills in 87 days (U.S. CSB, 2012). The oil spilled from the accident reached several hundred miles of the shorelines and had a disastrous impact on the marine and wildlife habitats. In Canada, 84 personnel were killed in an accident in the Coast of Newfoundland, Canada. In Australia, about 2,000 barrels of oil was spilled per day for continuous 74 days at the Timor Sea from the Montara oil spill incident in 2009. Other major oil and gas producing nations, such as Nigeria, Mexico and Brazil, also experienced blowout and spill incidents during offshore oil and gas activities which also involved numbers of fatalities and serious injuries. Oil and gas is the major source of energy and offshore drilling, exploration and production activities are vital part of it globally. Therefore, it is important to manage the hazards and risks in these activities to ensure safety of the public, property and environment.

It has been observed that after any major accidents, either in offshore or onshore, there were significant changes in regulatory regimes and regulations such as the Piper Alpha accident, THE Valdez Oil spill accident, the Texas City Refinery accidents etc. Specially, the Piper Alpha accident and the Deepwater Horizon accidents are very important from the regulatory regime point of view. Prior to the Piper Alpha accident, the U.K. regulatory regime was prescriptive. In 1990, the Cullen report (1990) on the Piper Alpha accident recommended to introduce Safety Case (Turner, 2013). Implementation of this recommendation transformed the U.K.'s regulatory regime into performance based regulatory regime and required the operators to identify potential hazards and risks, and design hazard management and control system to keep risk 'As Low As Reasonably Practicable'. In the United States, offshore regulations are mainly prescriptive. The National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling (2011) recommended developing a proactive and risk-based performance-based approach similar to the "safety case" approach in the North Sea. The United States Chemical Safety and Hazard Investigation Board (U.S. CSB) recommended requiring the regulated entity to ensure effective operation and management of safety critical elements for minimizing risk to 'As Low As Reasonably Practicable (ALARP)', similar to the U.K.'s performance based regulatory regime requirement (2014). The National Academy of Engineering (NAE) recommended implementing a hybrid regulatory system combining limited number of prescriptive element with the goal-oriented risk management system (2011). After the Deepwater Horizon accident until now, significant changes were brought in the regulations and regulatory organizations, but the character of the U.S. regulatory regime is still prescriptive.

Det Norske Veritas (DNV, 2010) performed a study on identifying key differences between the offshore regulatory regime of the United States and Norway. DNV (2010) published a position paper on an effective U.S. regulatory regime. Dagg *et al.* (2011) conducted a comparison study on the regulatory regimes of Canada arctic, the U.S., the U.K., Greenland and Norway. These studies mainly focused on qualitative comparison of the regulatory regimes and regulatory authorities. The present study is intended to review the prescriptive and performance based regulatory regimes in the U.S.A. and the U.K. respectively. The objective is to conduct a quantitative comparison between these two regimes to verify their effectiveness in improving process safety of the offshore oil and gas industry. The article briefly describes the key characteristics of these regulatory regimes. Then, an analysis of available offshore incident data in these two countries is performed.

2. Regulatory Regime in the U.S.A. and the U.K.

Offshore regulatory regime can be categorized into two types:

- Prescriptive regulatory regime.
- Performance-based regulatory regime.

In the prescriptive regulatory regime, the regulated entity has to comply with certain technical and procedural requirements set by the regulator. Under the prescriptive regulatory regime, the regulator's function is to ensure that regulated entities comply with specified requirements. This regulatory regime limits regulated entities' commitment to take proactive actions to increase the safety beyond compliance (Det Norske Veritas, 2010). Prescriptive regulation might be more useful where setting mandatory specification on safety equipment design or procedures or technical standards is required. Also, it would be appropriate where requirements should not differ depending on circumstances or the location. Dagg *et al.* (2011) stated that the prescriptive regulatory regime is particularly applicable where the best practices can be clearly defined, there is little need for innovation and where a discrepancy with requirements could generate huge risks to the environment or human health. Prescriptive regulations are driven by consequences based approach which may restrict application of new technology, practice and reduce responsiveness to unique or changing circumstances.

In the performance-based regime, regulated entity has the flexibility in determining the technical and procedural approach to control hazards. In this approach regulators responsibility is to ensure the regulated entity has identified hazards properly and adequate measures have been planned or taken to reduce the risk. There is a steady increase in the use of this regulatory regime because the regulated entity can consider credible risk scenarios for design and can adopt required program and procedures, and use new technology to minimize risk exposure to public, property and environment. It allows cost-effective design in comparison to the prescriptive requirements. It advocates innovation which can contribute to safer systems and a more proactive approach by companies to identify the issues. The regulated entity also assumes more accountability. One disadvantage of performance-based approach is that the explanation and interpretation of the desired performance levels in the regulation can be complex and challenging.

The regulatory regime in the U.S.A. is primarily prescriptive. The regulations have specified requirements to equipment, operations, pollution prevention, training, audit and inspection, exclusion zones, personnel safety and health, workplace safety, hazard and fire control equipment, etc. The regulatory regime in the U.K. is primarily performance-based. The operator has to demonstrate the risk is reduced to 'As Low As Reasonably Practicable' during project life-cycle instead of complying with certain requirements.

In the U.S.A., prior to the Deepwater Horizon accident, Mineral Management Service (MMS) was responsible for the offshore mineral exploration and development under the primary legislation, the *Outer Continental Shelf Lands Act* (OCSLA). After the Deepwater Horizon accident in April 2010, the MMS was renamed to the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE). Then, Natural Resource Revenues (ONRR) was separated from the BOEMRE and then BOEMRE was divided into the Bureau of Ocean Energy Management (BOEM) and the Bureau of Safety and Environmental Enforcement (BSEE). The US Environmental Protection Agency (U.S. EPA) and US Coast Guard (UCCG) also have jurisdiction on the offshore oil/gas activities specifically on environmental aspects and safety of life, property and navigation respectively on the outer continental shelf facilities.

In the U.K., the Health and Safety Executive (U.K. HSE) is the regulatory authority that responsible to manage the health, safety and environmental risks from offshore oil and gas activities and the Department of Energy and Climate Change (DECC) is responsible for oil spill planning along with licensing, exploration and development of oil and gas activities in the U.K. offshore under the *Petroleum Act 1998*.

Before the Deepwater Horizon accident, the U.S.A. regulations did not require establishing a management program for managing safety and environment aspects of offshore operations. The participation to the *Safety and Environment Management Program* (SEMP), based on *API RP 75: Recommended Practice for Development of a Safety and Environmental Management Program (SEMP) for Offshore Operations and Facilities*, was voluntary and there was no mandatory requirement to systematically identify and manage the risks. The regulatory requirements are mainly based or worst-case scenario or consequence, not risk based. After the Deepwater Horizon accident, U.S.A. first enacted Workplace Safety rule in 2010. With the new regulations, the SEMP was made mandatory which requires establishing a safety management program. Regulators and regulated entity share the responsibility, where regulated entity is required to comply with set criteria or requirements and regulators are required to review and approve. The U.K. regulatory regime was shifted from prescriptive to performance based regulations following the implementation of the Lord Cullen report (1990) recommendation. Therefore, the approach is risk based, different from the U.S.A. approach.

Under the prescriptive regulation, it is difficult to cope with technological advances and to incorporate new technologies or techniques for ensuring better safety and risk management. Also, in some cases, it becomes very expensive to comply with prescriptive regulation since it is based on worst-case scenario. It allows the companies to employ new techniques and technologies for offshore oil/gas activity by demonstrating how risk is managed to practicably achievable low level. As it is risk based, the companies have to consider only credible scenarios and therefore it could be less expensive to achieve target risk level.

In the U.K. operator has to submit an argument, 'Safety Case', describing identified hazards and risks, setting practicably achievable goals in risk reduction and illustrating the mitigation technique in reducing risk "As Low As Reasonable Practicable" continuously throughout life-cycle of the project. The companies also have the flexibility to adopt international standards or recommended practice and demonstrate the design of the safety critical elements can achieve the required performance standard.

3. Comparison of Regulatory Regimes in the U.K. and the U.S.A.

Company under the U.K. regulatory regime has to report injuries, diseases and dangerous occurrences to the U.K. Health and Safety Executive under the *Reporting of Injuries, Diseases, and Dangerous Occurrences Regulations 2013* (Blakstad, 2011). The U.K. HSE publishes offshore workplace incident data every year. The definitions of major accidents, dangerous occurrences and reportable gas incidents are specified in the *Reporting of Injuries, Diseases, and Dangerous Occurrences Regulations 2013* (U.K. HSE, 2013a).

One of the main successes of the U.K. regulatory regime is to keep the fatality rate very low in the U.K. offshore oil and gas drilling and operation activities. From 2008-2014, there was no fatality from 2008-2011 and in 2013. There were 2 fatalities in 2012 and 1 in 2014. Fatality data in U.K. offshore oil/gas activities is presented in Figure 1.

Figure 1: The Number of Fatalities in the U.K. Offshore Oil/Gas Activities from 2008-2014

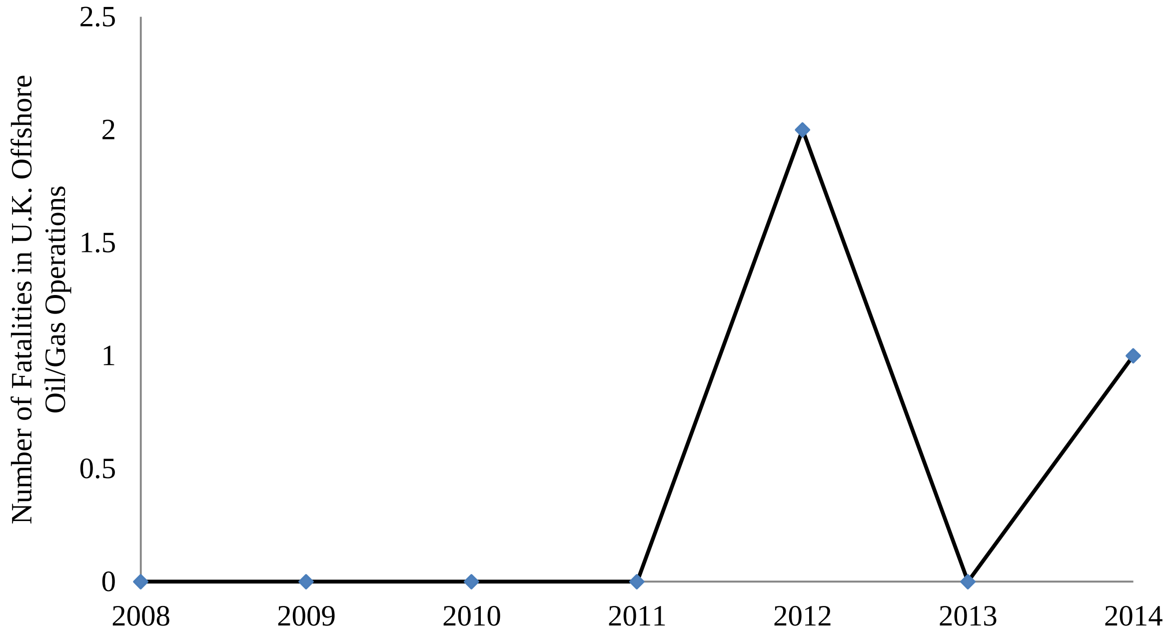
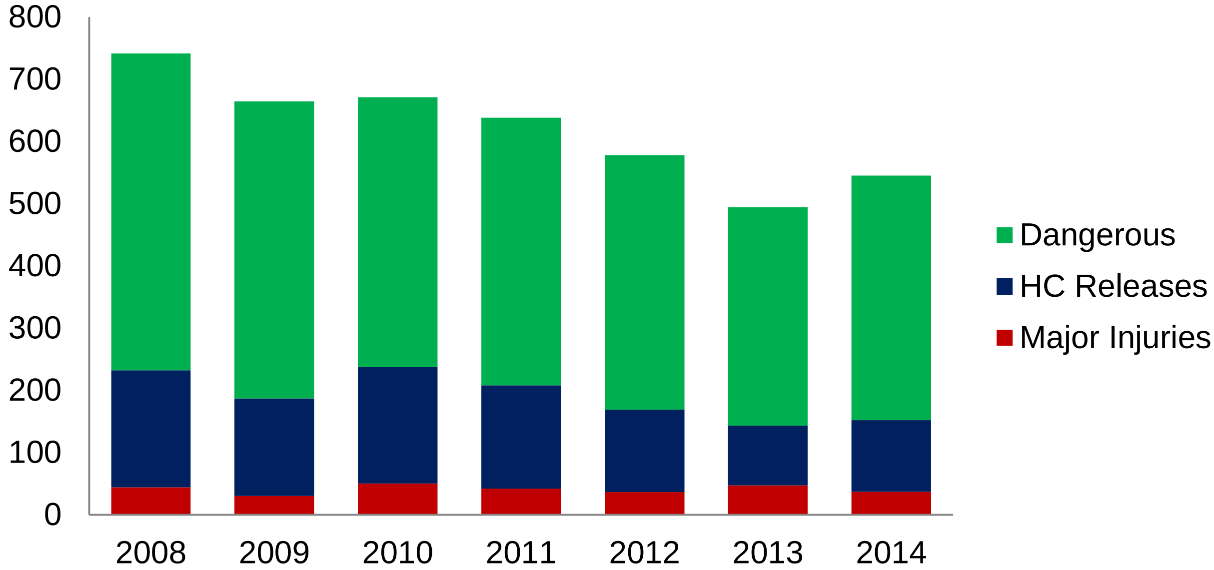


Figure 2 presents number of incidents resulting in major injury, hydrocarbon release and dangerous occurrences in the U.K. offshore oil/gas activities. The U.K. has seen improvement in total number of recordable incidents from 2008-2014. But the number of incidents resulting in major injury and hydrocarbon release are fairly constant in this period. The dangerous occurrences, such as well blowout, failure of blow-out preventer, failure of over-pressure system, damage of pipeline or failure of pipeline isolation device, electrical incidents, unintentional fire, explosion or ignition, release of biological agents, malfunction of radiation generators, malfunction of breathing apparatus, failure of lifting equipment, or structural collapse etc. as defined in the *Reporting on Injuries, Diseases and Dangerous Occurrences Regulations 2013* (U.K. HSE, 2013a) has been reduced in the last three years.

Figure 2: The Total Number of Incidents in U.K. Offshore Oil/Gas Activities Except Fatality from 2008-2014



The U.K. HSE took Key Program 1: Hydrocarbon Release Campaign which resulted in the significant reduction in the number of major and significant hydrocarbon release incidents (U.K. HSE, 2001). From 2004-2007, the U.K. HSE ran Key Program 3 (KP3) project in which it reviewed maintenance management of safety-critical elements (SCEs) of 100 offshore installations and found that the condition of at least 50% of the installations was ‘poor’. In 2008, the U.K. HSE undertook a project to review the progress by the industry on the issues reported in KP3 findings and figured that good progress was made by the industry, but there was scope for continued effort and improvement.

From figure 1 and 2, it can be concluded that though fatality rate is low, incidents happen regularly in the U.K. offshore oil and gas activities. Also, there was no major accident happened after the Piper Alpha accident in 1988. Therefore, apparently it can be concluded the U.K. offshore regulatory regime is successful in minimizing and preventing fatality but less successful in controlling the other types of incidents.

In the U.S.A., the regulated entity submits recordable Outer Continental Shelf (OCS) incidents to the Bureau of Safety and Environmental Enforcement (BSEE). Figure 3 presents number of facilities in the U.S. Outer Continental Shelf from 2008-2015 (until 3rd August 2015) (BSEE, 2015). There was a large number of fatalities occurred in 2008 and 2010. The large number of fatalities in 2010 is mainly due to the Deepwater Horizon accident. The rate of fatalities continuously decreased after 2010. The average number of fatalities in offshore petroleum activity in the U.S.A. was 4.63 from 2008 to 2015. The average number of fatalities from 2008 to 2010 was 8.7 which decreased to 2.2 during 2011 to 2015 after the new regulation became effective in November 2010 on the aftermath of the Deepwater Horizon accident. Mendes *et al.* (2014) reported that the U.S.A. had the highest fatality records from 2010 to 2012 while Norway only had 1 fatality.

Figure 3: The Number of Fatalities in U.S.A. Outer Continental Shelf from 2008 to 2015 (3rd August 2015)

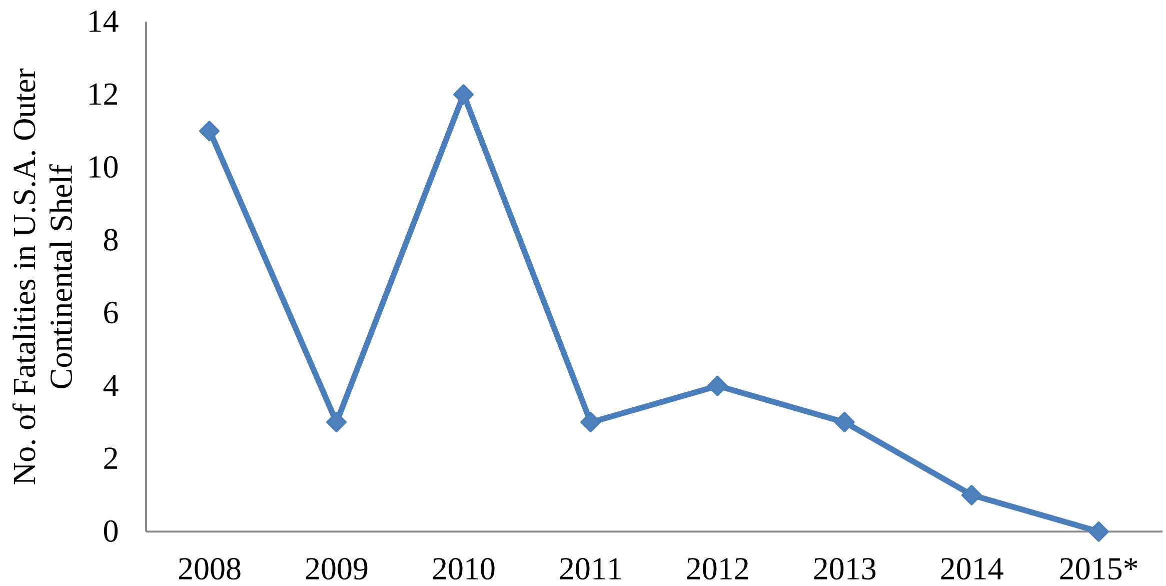
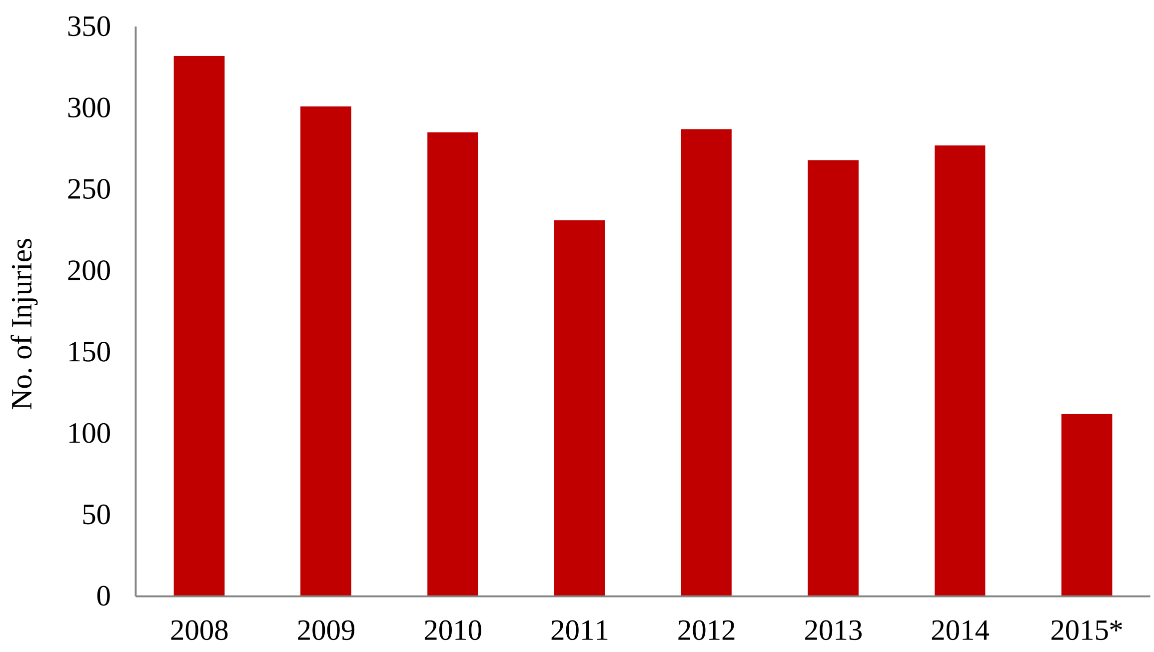


Figure 4: The Number of Injuries in U.S.A. Outer Continental Shelf from 2008-2015 (3rd August 2015)



From figure 4, it is observed that the number of injuries has been decreased from 2008-2015 (until 3rd August 2015). The average number of injury incident in the U.S.A. was 261.63 and there was no significant change in the average injury data after the change in the regulations until 2015. In 2015, injury incident is still lower in comparison to that of the previous years.

Comparing with the U.K., the overall rate of injury in the U.S.A. (in Figure 4) is higher than that of the U.K. (in Figure 2). But, the available data in the U.S.A. provides the total number of injury incidents and does not distinguish between major and minor injuries.

Figure 5: The Number of Incidents of LOWC, Fire & Explosion and Spills of equal or more than 50 barrels in the U.S.A.

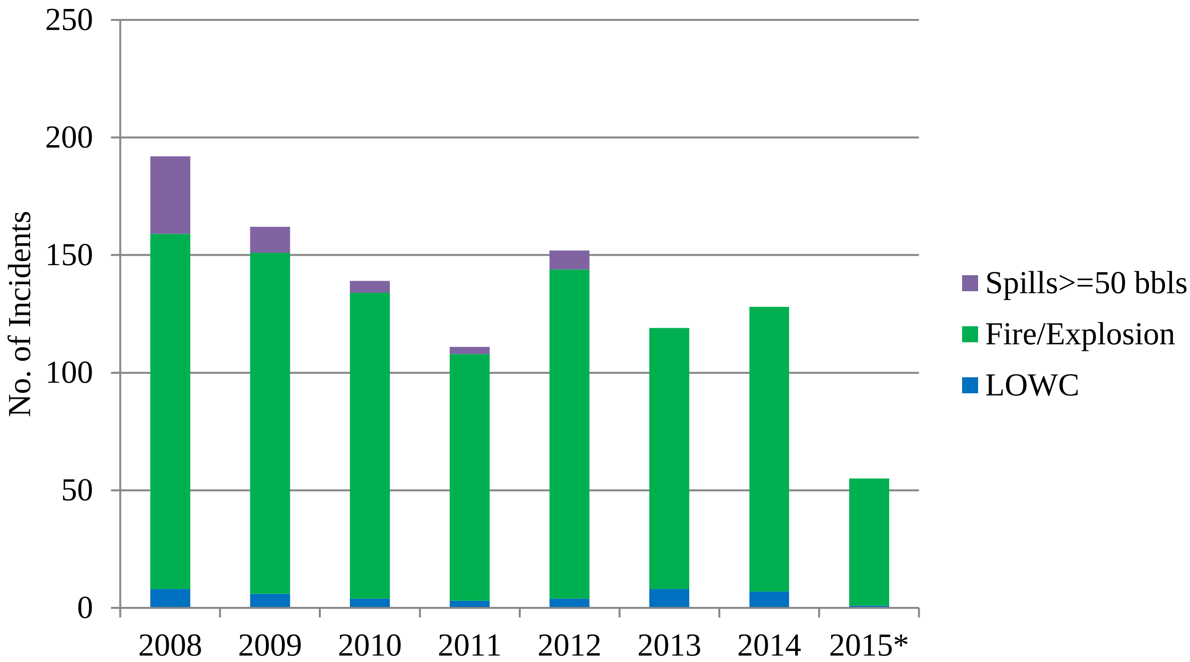


Figure 5 presents the number of incidents related to Loss of Well Control (LOWC), Fire and Explosion, and spill of equal or more than 50 barrels. No. of Loss of Well Control (LOWC) is nearly constant every year until 2014. There is an improvement both in the number of fire and explosion and spills of equal or more than 50 barrels incidents.

Mannan (2014) stated that there has been 50% improvement in no. of fire and explosion incidents during 2008-12 in the U.S.A. Mannan (2014) also reported that blowout incidents in the U.S.A. have decreased during 2008-12 while it increased in the U.K. at the same period.

International Regulators' Forum (IRF) Performance Measure Data (2010, 2011 and 2012) has shown that the U.S.A. had the highest major injury incidents in 2010 in comparison with that of the U.K., Norway and Brazil. Table 1 presents IRF data on fatalities and injuries in the offshore incidents in the U.S.A. and the U.K. It is to note that the total worked hours in the U.S.A. was higher than that of the U.K. Also, the major injury rate is higher in the U.K. than that of the U.S.A. The U.K. did not have any fatality in 2010 and 2012, but the U.S.A. had fatalities every year during the period of 2010-2012.

Table 1: Fatalities and Injuries Statistics in the U.S.A. and the U.K. Offshore from 2010-2012

Fatality and Injury Incidents		**Fatalities**			**Major Injuries**		
		2010	**2011**	**2012**	**2010**	**2011**	**2012**
	USA	12	3	4	78	38	49
	UK	0	2	0	44	32	46
Total Hours Worked	**USA**	194,487,878	129,620,501	122,656,035	194,487,878	129,620,501	122,656,035
	UK	54,531,528	56,501,520	62,848,188	54,531,528	56,501,520	62,848,188
Derived Rates (per million hours worked)	**USA**	0.06	0.02	0.03	0.40	0.29	0.40
	UK	0.00	0.04	0.00	0.81	0.57	0.73

Table 2: The Loss of Well Control Incidents in U.S.A. and U.K. from 2010-2012

Well Control Incidents		**Major Loss of Well Control**			**Less than Major Loss of Well Control**		
		2010	**2011**	**2012**	**2010**	**2011**	**2012**
	USA	1	1	1	3	3	3
	UK	0	0	1	1	0	1
No. of Well Related Activities	**USA**	1781	1733	1625	1781	1733	1625
	UK	192	164	175	192	164	175
Derived Rates (per 100 Well Related Activities)	**USA**	0.06	0.06	0.06	0.17	0.17	0.18
	UK	0.00	0.00	0.57	0.52	0.00	0.57

Table 2 presents loss of well control incidents in offshore of the U.S.A. and the U.K. from 2010-2012. The U.K. did not have any major loss of well control in 2010 and 2011, but there was an incident in 2012 while the U.S.A. had one major loss of well control every year in that period. Also, the rate of loss of well control is higher in the U.K. than that of the U.S.A. since the number of well related activities was much higher in the U.S.A. than that of the U.K.

4. Conclusion

The objective of this study was to review the prescriptive and performance-based regulatory regime of the United States of America and the United Kingdom and to analyze their effectiveness in minimizing process safety related incidents in the offshore oil and gas drilling, exploration and production. The study briefly discusses the distinguishing characteristics of the two regulatory regimes. Then the study analyzed different statistics available from the U.K. HSE, the BSEE and the IRF to understand which regulatory regime is more effective. From the available data, it is found that the total number of incidents is very low in the U.K., but the rate of incident occurrence is lower in the U.S.A. The amount of activity in the U.S.A. offshore is much higher than that of the U.K. Also, the incident rate in the U.S.A. has also been decreased after the Deepwater Horizon accident when new regulations were enacted. Therefore, it is difficult to conclude whether the prescriptive or performance-based regulatory regime is better than the other. Other countries such as Canada has adopted the hybrid approach for offshore safety management and Norway has adopted the performance based approach with non-essential guidelines and recommended practices. Also, the safety record of Norway offshore oil and gas activities are considered very well. In future, process safety indicators related to offshore oil and gas activities can be developed. Dagg *et al.* (2011) already conducted a qualitative comparison of regulatory regimes of the Canadian arctic, the U.S., the U.K., Greenland and Norway. A quantitative comparison of these regulatory regimes can be performed to understand their effectiveness.

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