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Study of Safety Aspects in Offshore Operations of Oil and Gas Industry

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Abstract: *Following the disastrous accident of 20 April 2010 in the Gulf of Mexico, where an explosion on drilling rig Deepwater strata, exploring oil and gas at the Macondo well about 60 kilometer offshore the US coast, caused the death of 11 workers and severe injuries to many others including massive sea pollution from the release of 5 million barrels of crude oil. As it has been dramatically demonstrated not only in the Macondo well accident but in a variety of cases, offshore oil rig activities entail the hazard of a major accident with potentially severe consequences to the life and health of workers, pollution of the ecosystem, direct and indirect economic losses, and deterioration of the security of energy supply. While consequences of potential accidents to life and health of the workers, environment and especially of the neighbouring coastal areas, and direct economic damage are direct effects and can easily be assessed, indirect economic loss and outcomes of the accident to security of energy supply are more difficult to be assessed accurately. After a first brief reference to the obstacles related to the exploration and production activities in oil and gas rigs, the analysis goes to the existing sources of information and their availability to the public. The primary objective of the study is to analyse the safety aspects of the offshore operations in oil and gas industry with an assessment of the resources available for accident analysis and information based communication for offshore.*

Keywords: *Accident, Crude oil, Offshore, Safety.*

1. INTRODUCTION

Energy growth is directly linked to well-being and prosperity in the current scenario across the globe. Meeting the growing demand for energy in safe and environmentally responsible manner is a key challenge for the industry. There are more than seven billion people on earth who use energy each day to make their lives richer, more productive, safer and healthier. It is perhaps the biggest driver of energy demand, the human desire to sustain and improve the well-being of our-selves, our families and our communities. It is an assessment that by the year 2040, population and economic growth will drive demand higher, but the world will use energy more efficiently and shift toward lower-carbon fuels.

Crude oil, the most important source of energy generation is a complex mixture of hydrocarbons with minor proportions of other chemicals such as compounds of sulphur, nitrogen and oxygen. The different parts of the mixture must be separated, before they can be used, and this process is called refining. Crude oil from different parts of the world, or even from different depths in the same oilfield, contains different mixtures of hydrocarbons and other compounds. This is why it varies from a light-coloured volatile liquid to thick, dark, black oil- so viscous that it is difficult to pump from the sub-surface. It is not only the appearance of crude oil that varies. Crudes from different sources must have different compositions based on various conditions. Some may have more of the valuable lighter hydrocarbons, and some may have more of the heavier hydrocarbons depending upon their source of generation. The compositions of different crudes are measured and published in assays. This information is used by the refinery in deciding which crudes to buy to make the products that its customers need at any given time. When crude oil comes out of a well it is often mixed with gases, water and sand. It forms an emulsion with water that looks a bit like caramel and the sand suspended in the emulsion produces this caramel effect. Eventually the sand settles and the water is then removed using de-emulsifying agents. Both sand and water have to be separated from the crude oil, before it can be processed ready for transportation by tanker, pipeline or any other means of transportation. The dissolved gases are removed at the well. Once the drilling shaft makes contact with the oil, it releases the pressure in the underground reservoir and the dissolved gases fizz out of

solution pushing crude oil to the surface. This is necessary as they might come out of solution and cause a build-up of pressure in a pipe or a tanker. Crude oil contains sulphur also, which has to be removed from any fractions that are going to be burnt as it forms sulphur dioxide which contributes to acid rain.

2. IMPORTANCE OF SAFETY INTO OFFSHORE OIL AND GAS INDUSTRY

Offshore, depending on size, water depth, availability of crude oil and physical conditions, a whole range of different structures are used. In the last few years, we have seen pure sea bottom installations with multi-phase piping to shore and no offshore topside structure at all. Replacing outlying wellhead towers, deviation drilling is used to reach different parts of the reservoir from a few wellhead cluster locations.

Safety was not given much importance in offshore operations until accidents started to increase tremendously. The regulatory agencies had their own standards for design and manufacturing of offshore rigs and platform. The Piper Alpha accident which changed the overall perspective about safety was the deadliest accident in the history of the offshore oil and gas industry. The Piper field is located 120 miles north-east of Aberdeen and the facility initially produced crude oil only, while in late 1980, gas conversion equipment was installed allowing the facility to produce gas as well as oil.

Health and safety is a vital part of any industry, but particularly for offshore operating companies and agencies. A number of recent disasters in various parts of the world have highlighted the increasing importance and significance of effective HSE management in the offshore field. In addition to the immediate human, environmental and financial costs, the reported accidents and negligence have a severe impact on operator's reputation also. In the wake of these high profile accidents, regulatory agencies have also taken steps to provide a strict regulatory framework along with contingency measures for all companies engaged in offshore oil and gas production and operations. The main hazards in offshore includes fire, after ignition of released hydrocarbons, explosion after gas release, formation and ignition of an explosive cloud and oil release on sea surface or subsea. The consequences of accidents should be clearly distinguished from emissions and pollution during normal operation activities, even if these activities are extended through the whole life-cycle of an offshore installation. While the later results in relatively small quantities of pollutants ending in the sea during long periods, the accidental events result in release of huge quantities of hydrocarbons and pollutants discharged uncontrolled in the sea, during relatively short periods.

3. ACCIDENT ANALYSIS IN OFFSHORE OIL AND GAS INDUSTRY

Accidents do happen, and risks are present and need to be controlled. The events that require particular attention in this context, mainly fires, explosions and blowouts, have been reported to cause severe consequences. Particular attention need to be given to low frequency-high consequences events, in other words the tail of the curve, whose frequency appears not to be negligible and uncertainly related to this estimation is very high. The spills of chemicals and crude oil need also to be monitored frequently. Landmark offshore accidents have a distinguished role in the lessons learning process. All stakeholders recognise them and are aware of their severe consequences which is the reason for characterizing them landmark. It is necessary, however, to go beyond the impressive numbers, identify the underlying causes and present the lessons in a systematic and easy way for each stakeholder to learn. It is important to present what each lesson means in the risk management chain.

Occupational related accidents and incidents are mainly notified to national level agencies. As a result in most of the cases, focus is given on accidents resulting in fatalities, injuries or serious damage of the installation or production facility. Near misses are not always reported since this is not always a legal requirement. The overall picture of accidents reporting looks like a mosaic or a puzzle; there are many pieces available but it is very difficult to put them together in order to get the full image of the problem.

Aggregation of data is absolutely necessary for effective lessons learning and dissemination of knowledge on past accidents, but also in order to obtain a clear overall picture of the risk of possible accident types. In this way, the risk management decisions related with liability provisions, financial security pooling scheme and ALARP decision would be based on more subjective and reliable data. The more worrying finding is that related with some tails of the distribution functions. The study shows that the tails of frequency distribution for some events, mainly blow-outs are not smoothly

decreasing for high severity. This requires a further investigation of the blowout events, which may not be considered as low frequency-high consequences events anymore. This must be taken into consideration in the estimation of overall risk and in the risk-based decision-making procedure. Indeed, the whole risk management process and the ALARP (As Low As Reasonably Practicable) principle are based on a pre-condition of a smooth tail of the distribution. The principle presupposes that most risks can be controlled, while only a small percentage of remaining risk needs to be tolerated and this should be managed in a cost-effective way also. If the tail of the distribution is not reduced smoothly, this means that significant amount of risk still remains uncontrolled.

4. CURRENT SCENARIO AND DISCUSSIONS ON SAFETY

One of the main sources for offshore accident information for public use is the Worldwide Offshore Accident Databank (WOAD) operated by Det Norske Veritas (DNV) which contains more than 6000 events starting from the year of 1975, including accidents, incidents and near misses as well. WOAD holds data on a number of parameters such as name, type and operation mode of the unit involved in the accident, date, geographical location, main event and chain of events, causes and consequences, as well as evacuation details. Within the WOAD database, the records are classified into 4 categories which are insignificant events, near-misses, incidents or hazardous situations, and accidents. The insignificant events represent hazardous situation, with very minor consequences and in most of the cases no damages were registered and repairs were not required. The near-misses represent events that might have or could have developed into an accidental situation. Incidents represent hazardous situation which have not developed into an accidental situation and a low degree of damage was recorded, but repairs or replacements usually were required. But the accidents represent hazardous situation which have developed into an accidental situation. In addition, for all situations or events causing fatalities and severe injuries this type of event has been used.

The survey on existing sources of information production and sharing revealed a mosaic of information, which does not allow to form a clear picture of the present situation. Accidents and incidents, especially occupational safety events are being reported to the national authorities according to national legislation. No common format is followed and even in the definition of what constitutes a reportable accident varies amongst the cases. Most authorities and industrial associations prepare overall statistical information in their annual reports. However, the descriptions of accidents, with maybe very few exceptions, seem not to be available to the public. This does not help transparency and trust to be built between all involved stakeholders, mainly between the industry on one side and NGOs and the public on the other side. Moreover, denial of accessibility to researchers, consultants and the academia, presents from more sophisticated analyses to be performed and from lessons to be learned. It is from the public scrutiny of non-confidential information that lessons can be identified and learned. The need for a common reporting format, allowing proper pooling and exchange of non-confidential information is of paramount importance for safer operations. This is an area, where co-ordination work is required. A number of attempts have been made in the past to create a common format. Therefore it is important not to re-invent the wheel, but rather to take into consideration the work already done, complement with what is needed and start implementing it. Offshore accidents are not extremely rare events. In particular, blowouts with severe consequences may not be as rare as initially thought and further investigation of these events is necessary in order to get a clear picture.

5. CONCLUSION

Given the dangerous nature of the offshore operations in oil and gas industry, the need for implementation of a smart occupational safety and health management system is valuable for improving safety and health performance. Many countries have widely involved in it by making strict and obligatory OSH standards and legislations. We also have an example of 10th June 2013 when the EU adopted a Directive on safety of offshore oil and gas operations. The new guidelines sets clear standards that cover the whole lifecycle of all exploration and production activities from design to the final removal of oil or gas based offshore installations. Safety professionals have understood for decades that to increase safety in complex industrial setups, organizations must exercise safety with the same principles of planning, organization, implementation, and study that they use to execute any other business function. It is critical that the offshore safety and health management programs be audited. The frequency of the audits can be risk based and annual audits may be necessary for very large installations, while other, non-critical installations may not require specific audits beyond

normal inspection observations. Operator liability for audits will help prevent the development of a compliance mentality. The key to an efficient audit system lies in consultations with top management and in the steps top management takes toward continuous improvement. The issues, which remain outstanding, relate to the standardisation, simplification and clarification of safety policy as well as enhanced workforce competency and increased workforce involvement in safety. Thus, it appears that there is still some way to go in advancing the right environment for most favorable safety performance in oil and gas industry.

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