



Evaluating accidents in the offshore drilling of petroleum: Regional picture and reducing impact



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ABSTRACT

This study examined several accidents over the last 56 years in the offshore drilling of petroleum. The aim is to examine the situation in relation to jack-ups, drill ships, semi-submersible and platforms and have a better awareness and understanding which may reduce the number of accidents. The materials examined were available published reports and data on exploration and production activities. From 219 accidents recorded the highest was due to blowouts with 46.1%, followed by storms and hurricanes with 15.1% and structural failures with 11.4%. High fatalities occurred at the Funiwa 5 platform in Nigeria with 230, the Piper Alpha platform in the North Sea with 167 and the Keilland semi-submersible in Norway. Other high fatalities were recorded at the Ocean Ranger fire and sinking, Java Sea sinking, Bohai 2 and Bohai 3 fire and sinking. Worker training and discipline must be maintained at a high level. The facilities must be kept sea-worthy and reliable through regular maintenance.

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1. Introduction

The petroleum industry has effective industrial and environmental safety practices. However, whenever an accident happens the impacts are so devastating that the memory lingers for decades and the event is cited time and again.

The key to good industrial and environmental safety lies from a demonstrated management commitment that treats industrial and environmental safety as having equal priority to other organizational goals. Employees are involved in, and know that they have the ownership of the industrial and environmental safety process. Realistic and achievable industrial and environmental safety targets are set for all work groups to achieve. Employees are ade-

quately trained in industrial and environmental safety skills. Incident investigations are carried out not so much as to apportion blame but to minimize and prevent future occurrences. Positive steps are taken to improve employee behaviors, attitudes and values. Ahern [1] pointed out that these include employee involvement and ownership of the industrial and environmental safety process; developing teamwork and supporting leadership within workgroups; recognizing and valuing individual contributions to industrial and environmental safety; and fostering a situation where employees genuinely care about the industrial and environmental safety of their co-workers. Monitoring techniques can be introduced to assist in assessing the general industrial and environmental safety conditions of the organization. In order to reduce risks associated with production facilities, one approach is to provide real time and risk-based accident forecasting mechanisms and tools that

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Nomenclature

Colln.	collision	P	platform
GoM	Gulf of Mexico	SS	semi-submersible
Expln.	explosion	Strut.	structure
JU	jack-up		

can enable the early understanding of process deviations and link them with possible accident scenarios. A forecasting algorithm was developed by Gabbar [2] which can identify and estimate industrial and environmental safety measures for each operation step and process model element and validated with actual process conditions.

The industrial and environmental safety management has to be aware and recognize the business hazard, and therefore be proactive to it. The attitudes throughout the organization on the application of the industrial and environmental safety management systems must be honest and sincere as shown by the commitment of senior managers, and that the actions taken are not just because of the threat of legal sanctions. The handling of commercial pressure must demonstrate knowledge that industrial and environmental safety is one of the important overall business priorities. The state of being informed and ready is also important to ensure that incidents do not escalate into worse accidents; and accident investigations and analyses do uncover the underlying factors and any managerial failings that may have led to the accidents [3]. Human factors play an important role in the completion of emergency procedures. Human factor analysis is rooted in the concept that humans make errors, and the frequency and consequences of these errors are related to work environment, work habits, and procedures [4].

An accident could have occurred repeatedly and has become of a routine nature or it can be a unique event. While there are lessons to learn from the experience of routine accidents since the impacts are somewhat similar, a once-off accident or a surprise event is more difficult to manage. Sensible responses to routine accidents can be developed, reviewed every now and again and further improved. These may include disaster warning systems, emergency management schemes, and disaster recovery programs including clean-up activities.. there are available methods to clean-up for on-land cases [5–8] but for offshore cases the recovery has to depend on natural forces. For a surprise event there is not much to draw from experience and the preparedness to face such an occurrence is usually lacking [9]. Each industry and each player in the industry has an approach towards industrial and environmental safety for that industry or that particular organization.

The petroleum industry involves activities like exploration and production (E&P), transportation [10–12], processing and refining, product distribution and storage with their own nature of incidents. Each activity is different from another with different general degree of risks involved. The focus of E&P would be drilling activities with the associated blowouts. Contributing factors include human error, equipment and control failure, weak operating systems and pro-

cedures and hazardous materials and environmental conditions. Short-comings from one or any combination of the above factors may result in an accident. Human error results from weak leadership, low levels of skills and knowledge, low reliability and poor discipline. Accidents may occur due to failure of equipment through poor state of maintenance and repair, control and emergency shut-down (ESD) system failure, materials of construction, improper design and technology utilization and operability. Technical support needs to be adequate and up-to-date. The ability to trace the drill-string by making a precise 3-dimensional underground survey is helpful. By using inertial technology an anti-disturbance and high accurate positioning can be achieved [13]. Near-bit force measurement and drill-string acoustic transmission of bottom-hole assembly (BHA) can investigate down-hole dynamic behaviors of BHA [14] and to monitor and control the forces acting on the drill assembly which would assist in preventing accidents. Application of industrial and environmental safety systems like hazard and operability (HAZOP), hazard analysis (HAZAN), technical audit and inspection, passive protection and inherent industrial and environmental safety affects the industrial and environmental safety performance. Effective procedures like operating instructions, shift change, start-up and shut-down, isolation and use of blind plates, hot-work permits, check lists, training of contractors' workers, limits of authority and lines of command can all reduce the number and impact of accidents. Escape routes, emergency response and evacuation, use of personal protective equipment (PPE), survival training, fire-fighting and First Aid are also important factors. Natural disasters contribute to the occurrence of accidents. Awareness and state of preparedness to handle the potential hazards of harsh environmental conditions from events like hurricanes, rain-storms and earth-quakes and volcanic activities can also lessen the ultimate impact of such incidents.

Accidents produce external pressures on companies leading to new regulations and renegotiation of enforcement of regulations. Structural characteristics of both the industries and the regulatory regime determine the interactions between the regulated and the regulator. In the industrial sectors where hazards and risks are visible and of public interest, it is easier to implement regulations through outside pressure [15].

Accidents drain resources. They result in loss of human lives and property. They interrupt production and negatively affect market goodwill and the environment. Effective remedial steps must be taken to reduce the frequency and consequence of accidents. The main objective of this study is to examine the situation in relation to jack-ups, drill ships, semi-submersible and platforms

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