

Common Health, Safety and Environmental Concerns in Upstream Oil and Gas Sector: Implications for HSE Management in Ghana

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Abstract

This paper explores the literature to identify common occupational injuries, diseases, and psychological wellbeing on oil rigs as well as the negative environmental impacts of the upstream oil and gas sector. It ends by making recommendations for effective health, safety, and environmental (HSE) management. Review of the literature showed that contusion (bruise), cuts, and laceration are the commonest occupational injuries that workers on the oil rig suffer and that the injuries mostly affect the hand and finger, leg, and eyes of the offshore workers. These injuries were found to be caused mostly by direct stroke, jamming and overstrain. Similarly, accidental poisoning, musculoskeletal disorders, respiratory disorders and diseases of the digestive system were also documented as the commonest occupational diseases among offshore workers. The literature also shows that working offshore is associated with poorer psychological wellbeing or health; this is to say that offshore workers tend to experience higher levels of stress, burnout, anxiety, depression, low job satisfaction (particularly with the environmental conditions associated with their work), and sleep disorders. Finally, the literature review indicated that land-use problems, air pollution, acid rain, climate change, habitat disruption, environmental degradation, oil spills and leakages are some of environmental impacts of upstream oil production. This review was concluded by recommending some measures for the management of the HSE hazards associated with the oil and gas sector.

Keywords: Oil and Gas; Ghana; Occupational injuries; Psychological wellbeing; Environmental Impact; HSE

Introduction

The discovery oil in Ghana has resulted in anticipation among Ghanaians of the prospects of massive makeover of the economy and a remarkable rise in the living standards. According to the Center for Democratic Development (2008), Ghana's discovery of oil has raised high hopes and expectation that Ghana's long delayed dream of "accelerated development" might soon become a reality. In 2007, Ghana discovered a significant quantity of crude oil when Kosmos Energy Ghana HC (KOSMOS) drilled the first well that unlocked the potential off Ghana's western shores, nicknamed the

Jubilee Field. The field is estimated to potentially hold 1.8 billion barrels and that production of oil is expected to commence in the last quarter of 2010 with a first flow of 120,000 barrels per day output during the first quarter with the potential to increase to 200,000 barrels per day (Cook, 2010). Indeed, on December 15, 2010, the president of the Republic of Ghana launched the commercial production of oil in Ghana.

Analyses of seismic data have further estimated an upward potential of 4 billion barrels in the basin that comprises West Cape Three Points, Tano Shallow and Deepwater Tano (Cook, 2010). A second company to Ghana's oil exploration is Tullow Ghana Limited (Tullow). At the end of 2008, a new discovery of oil and natural gas deposits with an expected 800 million barrels of oil was also announced. It is further reported that the value of services to be demanded by the oil industry when production begins is estimated to be around US \$ 5 billion (Oppong, 2011).

There is a greater emphasis on the management of the oil revenue than any other likely outcome of the extraction industry. There is very little discussion about the environmental and human safety of the industry and how prepared Ghana is to manage these likely occurrences. However, occupational safety has been identified as one of the key operational risks in the oil and gas industry (Powell, 2004). According to Powell (2004), the prevention of fatal accidents is a significant risk for the industry to deal with. These fatal accidents are frequently associated with lifting incidents, either on decks or associated with drilling activity and explosions. He added that installation integrity (mainly structural integrity and particularly hydrocarbon containment) constitutes the second key risk for the oil and gas industry.

Several accidents have been documented in oil and gas industry since its inception as an industry. Schouwenaars (2008) recorded a number of fatal accidents that occurred in the oil and gas industry between 1970 and 2008. He identified the following (note that the figures in the parenthesis represent the year in which the accident occurred): Fixborough (1974), Seveso (1976), Bhopal (1984), Norco, Louisiana (1988), Henderson, Nevada (1988), Pasadena, Texas (1989), Piper Alpha (1988), Longford (1998), Grangemouth (2000), Humber Oil Refinery (2001), P36 (2001), Toulouse (2001), Skikda (2004), Buncefield, UK (2005), Texas City (2005), and Alon (2008). The most recent case is that of the British Petroleum (BP) deepwater disaster in 2010 (National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, January 2011). All these major accidents resulted in death and damage to equipment and property of the companies concerned. The rest of this paper draws on the extant literature to discuss the common occupational injuries, diseases, and psychological health problems faced by workers on the offshore oil rigs. The discussion continues with how countries and oil organizations manage these occupational health issues. This paper, therefore, draws on what is known already in the literature about occupational

health and safety issues and draws lessons on it for how developing countries such as Ghana should respond to the gargantuan challenges in such business.

In economic terms, ILO (2009, 2006, 2005) estimates that roughly 4% of the annual global Gross Domestic Product (GDP), or US\$1.25 trillion, is siphoned off by direct and indirect costs associated with occupational accidents and diseases such as lost working time, workers' compensation, the interruption of production and medical expenses. Similarly, Schouwenaars (2008: 3), in analysis of refinery losses due to 123 refinery fires over a 15 year period from 1965 to 2000, demonstrated a trend of rising losses over the period. He added that between 1998 and 2000 alone, the total loss from refinery and petrochemical incidents around the world exceeded \$900 million. In fact, Adei and Kunfaa (2007: 164) have reported that the cost of accident as a percentage of the GDP for developing countries like Ghana is estimated to be around 7%. The UK's Health and Safety Executive (1997) also estimates that, on an annualised basis, accident costs the oil platform 14.2% of its potential output.

Occupational Injuries on Oil Rigs

Occupational injuries are definitely a common occurrence among workers on oil rigs. Based on the analysis of data from 518 workers on an American oil rig in the Mediterranean Sea between May 1998 and May 1999, Valentic, Stojanovic, Micovic and Vukelic (2005) identified a number of occupational injuries and diseases among the workers. These data were the result of medical examinations of injured workers many of whom were Americans, British, Scots, Italians, Croatians, Bosnians, Albanians, Malteses and Indians. Of the 518 workers examined, occupational injuries were most frequent among the oil drillers (223), their assistants and manual workers at the drilling floor, rotating drill under the tower and around drilling tubes. Then followed injuries in deck hands and engineers (192) and auxiliary personnel (41), catering (36) and specialized services staff (26). However, no injuries were recorded among the management personnel. They also found that nearly 80% (414) of ill and injured workers were those engaged in the direct work process. This means that only those Ghanaians who will be directly involved in the extraction of the crude oil and gas will suffer most of the injuries.

Valentic et al (2005) found that the workers suffered injuries ranging from contusion (bruise), cuts, laceration, alien body, chemical injury, thermal injury, luxation (joint dislocation), bone fracture, and amputation of phalanges of fingers or whole hand. Among the 138 injuries recorded by the medical officers at the oil rig hospitals, the top three occurring injuries among the workers were contusion, cuts, and laceration (wounds with irregular edges) respectively with luxation, fracture, and amputation rarely occurring. Valentic et al (2005) also classified the injuries according to the part of the body involved in the injuries. They recorded hand and finger injuries, leg

(without foot), and eye injuries. Others were head and neck, arm (without hand), foot and trunk injuries. The most occurring injuries in terms of this classification were the hand and finger injuries, leg injuries and eye injuries while foot and trunk injuries rarely occurred. They also recorded the causes of these injuries and found to include struck-by (direct stroke), jamming, overstrain/stretch, fall-to-below (slipping from different levels), foot-level-fall (slipping on one level), contact with chemicals and hazardous substances, electrical shocks, flame, and vapour. Among these causes they found that most of the injuries were caused by direct stroke, jamming and overstrain while injuries hardly resulted from contact with chemicals and hazardous substances and electrical shocks, flames and vapour. Jensen et al (2005) found similar types of injuries affecting the same body parts among merchant seafarers across the globe.

In a like manner, data collected by Ghana Health Service and Ministry of Health (2002) show that in the manufacturing sector including petroleum and plastics, workers suffer injuries such as slips and falls, burns, and electrical shocks. Similarly, General Reinsurance Africa Ltd. (2005), an insurance company, has catalogued various safety hazards workers in the oil and gas industry often encounter. According to them, explosions are a common safety risk oil workers face frequently. This is because the presence of large amount of oil and gas on a production platform at any given time exposes workers to potential explosions within the production area. Platform explosions are often overwhelming and usually kill any workers within the immediate blast area. The entire facility is likely to be affected by an explosion because production platforms are designed compactly. Other safety risks identified by General Reinsurance Africa Ltd. (2005) include the exposure to drowning, driving risk, physical risk and accident, aviation risk, and unfavourable weather condition.

Occupational Diseases on Oil Rigs

Using the 10th revision of International Classification of Diseases and Related Health Problems (ICD), Valentic et al (2005) also classified the occupational diseases suffered by the offshore workers. They found that many of the workers suffered the following diseases: accidental poisoning, musculoskeletal disorders, respiratory disorders, diseases of digestive system, mental disorders, diseases of nervous system, skin disorders (such as skin cancer), diseases of genitor-urinary system, and diseases of circulatory system. They found accidental poisoning, musculoskeletal disorders, respiratory disorders and diseases of the digestive system to be the most occurring health problems for the workers on the oil rig. However, they reported that diseases of the circulatory system hardly occurred among the workers. Valentic et al (2005) attributed the low occurrence of cardiovascular diseases among workers on the oil rig to the relatively young age of the workers who were examined; their age ranged mostly from 20-50 years, and the majority of them were 25-35 years old. Those in

older age were not many, and they were mostly employed in the management and were assigned to easier work. Parkes (2010) also reported that the frequently reported psychosomatic problems among Norwegian offshore workers include headaches, stomach problems, and muscular tensions.

Again, General Reinsurance Africa Ltd. (2005) also found that there is also the risk of exposure to toxic gases. For instance, hydrogen sulfide is said to be a toxic gas usually found in petroleum deposits. It is also believed that it is not detected easily, and drilling crews may release the trapped gas by accident. Exposure to the gas may cause irritation of eyes, nose and throat, headaches, dizziness, nausea and vomiting, disorientation, convulsions and coma. Breathing high concentrations of such gas can lead to sudden death (General Reinsurance Africa Ltd., 2005).

Similarly, data collected by Ghana Health Service and Ministry of Health (2002) show that in the manufacturing sector including petroleum and plastics, workers suffer diseases including noise-induced hearing loss, asthmatic attacks, skin diseases and irritation, cancers, musculoskeletal disorders (general body pains, back and joint pains), and respiratory diseases. Put together, this means that Ghanaians who are going to work on the oil rigs are more likely to suffer food poisoning due to handling of crude oil, musculoskeletal disorders, respiratory disorders (such as and digestive system disorders such as ulcers. The musculoskeletal disorders are known to be the result of awkward work posture, vibration, cold temperatures, repetitions, and quick motions which are all common occurrences in the work process of oil drilling.

Psychological Wellbeing of Workers on Oil Rigs

Psychological wellbeing is a simple phrase without a simple definition. We need to understand that psychological wellbeing is not simply the absence of ill-health. According to Luthans (2005), many organizational psychologists use it interchangeably with happiness or subjective wellbeing. Alwater (1990:122) defined psychological wellbeing as a “general term denoting feelings of high self-esteem, life satisfaction, and lack of negative symptoms “such as loneliness, depression, stress, and related conditions. Recent efforts to define wellbeing have led to the identification of three components; satisfaction with life as a whole and with different aspects of life (e.g., work, family, community, health), the presence of positive affect (the experience of pleasant emotions such as joy, contentment, happiness, pride) and the relative absence of negative affect (the experience of unpleasant emotions such as guilt, sadness, anxiety and depression) (Diener, Sub, Lucas, & Smith, 1999, by Diener (2000; cited in Luthans, 2005: 278). Though the absence of ill-health is not indicative of good psychological wellbeing, psychologists tend to use measures of stress, burnout, anxiety, depression (mood swings), job satisfaction, and sleep as indicators of psychological wellbeing (Parkes, 2002; Spurgeon & Cooper, 2000).

In the review of literature on offshore workers published prior to 1996, Parkes (2002: 3–4) reported, among the key findings, that offshore workers tend to display higher levels of generalized anxiety disorders than comparable onshore employees. She reported that the offshore environment was associated with poorer psychological wellbeing. For instance, she found that installation characteristics (such as age, location, size, and type), physical environment (such as noise, ventilation, and illumination), and psychosocial factors (such as time pressures, workload, job insecurity, and perceived risks) all affected the psychological wellbeing of the offshore workers, with unfavourable conditions being associated with lower levels of psychological wellbeing. She also reported that circadian changes inherent in day/night shift rotation have adverse implications for sleep, performance and health. In short, Parkes (2002) found that offshore workers tend to suffer stress, burnout, anxiety, depression, low job satisfaction, and sleep disorders. Similarly, Bresic et al (2007) found in a study of 125 workers in a Croatian oil company that the workers find many aspects of their work stressful. For instance, compared with the laboratory workers and office workers, oil field workers found the work overload, overtime work, shift-work, night shifts, time on duty, working without co-workers, unpredictable conditions at sea, presence of fire and chemical hazards to be stressful. The conditions at sea represent a threat which is a common cause of stress, particularly the risk of harm caused by working in unsafe conditions.

The importance of psychological wellbeing in the oil and gas sector and in any other organization setting lies in its linkage with employee performance, accidents, and diseases. For instance, there is empirical evidence that many disorders and diseases are stress-related; these diseases and disorders range from musculoskeletal, cardiovascular, and endocrinological diseases, psychological and emotional disorders, a series of psychosomatic diseases, infectious diseases, and finally carcinoma (cancer affecting the tissue the lines the skin and the internal organs) (van Dijk & Swaen, 2003; Griffin, Fuhrer, Stansfeld, & Marmot, 2002; Bosmal et al, 1997). Chen, Yu and Wong (2005) have also documented evidence about the association between psychosocial stressors and musculoskeletal pains among Chinese offshore oil installation workers; they found that stress from safety, physical environment, and ergonomics were important predictors of musculoskeletal pains. In addition, Chen et al (2002) reported that stress at work can impact safety negatively and increase chances for occupational injury among workers working on oil platforms. This is because mood affects risk perceptions by workers. The link between risk perception and occupational injury and diseases is such that faulty risk perception leads to error which in turn leads to risk exposure. The risk exposure can lead to the accident or incident with or without unsafe acts. In a more recent review of the literature, Parkes (2010) reported that work-related stressors (including odd working hours) offshore are shown to be associated with physical and psychological health problems among offshore workers.

Sound psychological health should also be pursued in the oil and gas sector as an end itself because data on psychiatric and psychological health suggest that psychological ill-health is increasingly becoming a problem in Ghana. For instance, the 2002 data on admissions to psychiatric hospitals in Ghana indicate that substance abuse (1,101 cases), depression (736 cases), manic-depressive psychosis (343 cases), and alcohol dependency syndrome (215 cases) ranked as the second, third, sixth and eighth among the top ten cases of admission (Asare, 2010). Remember that these figures represent only those who seek help from psychiatrists and clinical psychologists and therefore grossly underestimate prevalence and incidence of these psychological problems; there are numerous others who seek help through religious healing practices. Partly, the increasing incidence of psychological ill-health in Ghana may be due to maladjustment by many individuals to the demands of the modern life in the 21st century. We need to also note that such psychological or psychiatric profile may be linked to crimes of all kinds (spouse abuse, robbery, thuggery, assaults, and violation of traffic regulations resulting in fatal road accidents). Because we already know that the offshore environment is associated with poorer psychological wellbeing, we must not compound the existing psychological ill-health by de-emphasizing or ignoring provision of psychological services in the HSE management in the oil and gas sector. Currently, Factories, Offices, and Shops, Act 1970 (Act 328) and Workmen's Compensation Law 1987 (P.N.D.C.L. 187) do not provide for the prevention and/or treatment of psychological ill-health in the workplace despite the obvious link between psychological ill-health and organizational outcomes such as productivity, revenue, job satisfaction, organizational citizenship behaviour, and workplace safety.

Environmental Impacts

At Harvard Medical School's Center for Health and the Global Environment, Epstein and Selber (March 2002) have identified a number of environmental impacts associated with the various technical activities of the entire lifecycle of the oil and gas industry (exploration, drilling and extraction, transport, refining, and combustion/use). Table 1 summarizes the environmental impacts that occur during exploration, drilling and extraction, transport and combustion. This is because these activities constitute the major technical operations in the upstream sector.

In effect, Epstein and Selber (March 2002) suggested that upstream operations results in deforestation and disturbance of aquatic ecosystem, environmental degradation, physical fouling, habitat disruption, livestock destruction, and oil spills. For instance, in October of 1998, a pipeline in the Nigerian Delta town of Warri burst and caught fire, resulting in over 700 deaths (500 deaths immediately and an additional 200 within the next week (Anon, 1998, cited in Epstein & Selber, March 2002). The British Petroleum (BP) deepwater disaster in 2010 offers examples of environmental impacts

of operations in the upstream oil and gas sector (National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, January 2011).

In 1997, The Exploration & Production (E & P) Forum and UNEP jointly identified some potential environmental impacts of oil production.

Stage	Effect	Subcategory
Exploration	Deforestation and disturbance of aquatic ecosystems	Infectious diseases
Drilling and extraction	Chronic environmental degradation	<ul style="list-style-type: none"> • Discharges of hydrocarbons, water and mud • Increased concentrations of naturally occurring radioactive materials increasing the chances of occurrence of cancer
	Physical Fouling	<ul style="list-style-type: none"> • Reduction of fisheries • Reduced air quality resulting from flaring and evaporation • Soils contamination • Morbidity and mortality of seabirds, marine mammals and sea turtles
	Habitat Disruption	<ul style="list-style-type: none"> • Noise effects on animals • Pipeline channeling through estuaries • Artificial islands
	Livestock Destruction	
Transport	Oil spills	<ul style="list-style-type: none"> • Destruction of farmland, terrestrial and coastal marine communities • Contamination of groundwater • Death of vegetation • Disruption of food chain
Combustion	Air pollution	<ul style="list-style-type: none"> • Particulates • Ground level ozone
	Acid rain	<ul style="list-style-type: none"> • NO_x, SO_x • Acidification of soil • Eutrophication; aquatic and coastal marine
	Climate change	<ul style="list-style-type: none"> • Global warming and extreme weather events, with associated impacts on agriculture, infrastructure, and human health

Table 1: Environmental Impacts of Operations in Upstream Oil and Gas Sector

Particularly, their technical publication categorized the environmental impacts as follows: human, social, and cultural impacts (such as changing land-use patterns, etc.), atmospheric impacts resulting from flaring, venting, and purging gas as well as combustion processes (such as air pollution, acid rain, and climate change), aquatic impacts resulting from disposal of drilling fluids, cuttings, and well treatment chemicals as well as spills and leakages, terrestrial impacts resulting from physical disturbance as a result of construction, contamination resulting from spillage and leakage or solid waste disposal, and ecosystem impacts resulting in habitat disruption.

HSE Management

The nature and prevalence of injuries, diseases, psychological ill-health and environmental impacts discussed above signify that there is an urgent need by stakeholders in the oil and gas sector to institute measures to manage these imminent hazards. The government of Ghana should enact laws that require the oil companies to carry out safety audits internally and also train external auditors to assess compliance with safety regulations. With regards to the safety audits, the current Petroleum Model Agreement requires the investor to carry out HSE audits with assistance and/or supervision of EPA. Again, there is a need for Ghana to prepare herself in terms of strengthening the archaic Factories, Offices, and Shops, Act 1970 (Act 328) and Workmen's Compensation Law 1987 (P.N.D.C.L. 187) and resourcing the National Occupational Health Unit to provide the needed occupational health services.

With regards to the environmental impacts management, E&P Forum and UNEP (1997) have suggested that while host governments seek to understand the environmental impacts of the industry and put in place environmental laws to regulate the activities of the oil companies, the management of the oil companies must also do their part to institute an HSE management system. Tullow Ghana deserves a special mention here. This company has developed its own comprehensive HSE policy manual.

E&P Forum and UNEP (1997) also suggested that the following conditions are typically required for effective application of environmental legislations by governments:

- appropriate international and national laws, regulations and guidelines,
- coherent procedures for decisions on projects/activities,
- legislation with clearly defined responsibilities and appropriate liabilities,
- enforceable standards for operations,
- appropriate monitoring procedures and protocols,
- performance reporting,
- adequately funded and motivated enforcement authorities,
- existence of adequate consultation and appeal procedures,
- appropriate sanctions and political will for their enforcement.

Equally importantly, E&P Forum and UNEP (1997) identified examples of infrastructure needed for environmental protection and these include the following:

- Policy formulation and regulations,
- Baseline environmental surveys,
- Assessment and approvals,
- Inspection, monitoring, enforcement,
- Services—water, power, waste disposal,

- Emergency response,
- Logistics and transportation,
- External supplies/services—construction, materials, engineering, consultants, etc.
- Technical services—laboratories, laboratory supplies, and equipments,
- Training institutions, standards associations.

In addition to risk assessment and risk management, provision of health insurance, occupational health services (in the form of medical care and rehabilitation), workplace counseling for accident victims, safety training, and relevant employee assistance programmes are all needed. Similarly, the EPA, Factories Inspectorate, and the Free Zone Board together with the National Fire Service and National Occupational Health Unit should develop a Health and Safety Performance Framework for periodic workplace safety audits and inspections. This also means Ghana Investment Promotion Centre (GIPC) should include health and safety performance as one of the performance metrics they use to assess companies who make it to the Ghana Club 100.

Based on the common HSE concerns in oil production and suggestions by international bodies (E&P Forum and UNEP) reviewed above, Ghana needs to pay attention to the following critical areas in order to effectively manage the HSE hazards in the upstream oil and gas sector:

- Enactment of appropriate national laws, regulations and guidelines with clearly defined responsibilities and appropriate liabilities,
- Development of appropriate monitoring procedures and protocols,
- Requirement for periodic HSE performance reporting,
- Capacity building efforts to resource the existing enforcement authorities such as EPA, Factories Inspectorate, and National Occupational Health Unit,
- Instituting appropriate sanctions and having the political will for their enforcement,
- Establishment of educational institutions or centers for training interested individuals in HSE management,
- Development of HSE management systems by individual oil companies with top management commitment,
- Establishment of association of HSE practitioners and researchers,
- Involvement of applied psychologists (both occupational health psychologists and industrial psychologists) and provision of psychological trauma management services to accident victims who may suffer post-traumatic stress disorder resulting from fatal and sometimes nonfatal accidents. Because the current paradigm for safety management is cast within safety culture and climate, it is important that applied psychologists get and are involved in HSE management

in Ghana. For instance, U. S. National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling (January 2011) that was set up in the wake of BP disaster, after its investigations, concluded that the *“immediate causes of the Macondo well blowout can be traced to a series of identifiable mistakes made by BP, Halliburton, and Transocean that reveal such systematic failures in risk management that they place in doubt the safety culture of the entire industry”* (pp. vii).

Conclusion

The above discussion has indicated that workers on oil rigs elsewhere have suffered and continues to suffer numerous occupational injuries, occupational diseases, and psychological problems as well as environmental effects. This call to action stems from the low priority that Ghanaian entrepreneurs currently give to workplace health and safety issues (Oppong, 2010). Studies of SMEs in Ghana show that finance, credit services, and skill development are their priorities and occupational health and safety training nowhere near their priority; again, (Arthur, 2007). This lack of priority to safety is contrary to research findings that management commitment to safety is one of the most important determinants of safety climate and/or culture in an organization (Cooper, 2006; Cooper & Phillips, 2004). Apart from the measures recommended for the management of the HSE hazards, there is a need for attitudinal change among the government officials representing Ghana’s interest in the oil and gas sector, corporate leadership of the oil companies themselves, and the employees who will work on the oil rigs. With regards to the proposition that applied psychologists should be involved in HSE management in Ghana, I pose this question: *Who other the applied psychologist is better equipped to deal with risk perceptions, safety climate, safety motivation, safety intentions, behaviour-based safety interventions and accident-prone personality factors that determine the degree of compliance with safety regulations?*

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