ENG 384 REPORT

ON

ENGINEERING LAW AND HAZARD ASSESSMENT OF HEALTH WORKERS FOR ENHANCED OCCUPATIONAL SAFETY IN NIGERIA

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ABSTRACT

A quick look at engineering law and how it relates to the topic. In Engineering, it’s important to be familiar with some of the laws that might affect technical work. Generally speaking, members of the engineering team won’t be subject matter experts in this area – but the more that engineers are aware of key legal requirements, the less likely costly rework will be required, and the easier it will be to avoid any liability that might arise. Some of the basis of the engineering laws: intellectual property, fraud, regulatory compliance, liability. The common types of hazards usually seen in the oil industry which includes: physical, ergonomic, biological, chemical and psychological hazards.

A method of hazard assessment is shown and how hazards are ranked as well as measures taken to avoid hazards, There are several types of control measures that fall into three main categories (in order of priority and effectiveness): Elimination Engineering, Administrative, Personal Protective Equipment. Health Safety Environment (HSE)’s role in these measures. Which is to evaluate, manage safety culture among the employees of an oil &gas sector. Improving safety, not only psychological and personal factors, organization and environmental factors should carefully be investigated, the actual problem be identified, appropriate solving methodologies be implemented, ultimately incidents rates will reduce. Individual unsafe behaviors, pervasive organization defects lie behind the majority causes of the hazards.

The current and recent historical situation with regard to health hazards in the offshore oil and gas industries can be summarized in three key points. • Exposures to health hazards inherent to the raw product have been relatively stable over recent decades. • After nearly a century of experience, and with relatively stable and mature processes, chemicals, and engineering facilities, the health risks offshore are relatively well understood and can be considered in the five categories forming the basis of the health risk assessment (HRA) process.

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**CHAPTER 1**

INTRODUCTION

In Engineering, it’s important to be familiar with some of the laws that might affect technical work. Generally speaking, members of the engineering team won’t be subject matter experts in this area – but the more that engineers are aware of key legal requirements, the less likely costly rework will be required, and the easier it will be to avoid any liability that might arise. Some of the basis of the engineering laws is given below:

**Intellectual Property: A Major Issue for Software Engineers**

Intellectual property can be a thorny issue for engineering teams to navigate. Businesses vigorously defend their intellectual property because so much future revenue and competitive advantage might depend on it. IP issues can arise in any area of engineering, but they are especially prominent in software development, where features and methodologies can infringe on intellectual properties that the developers themselves might not be aware of.

In large enterprises, legal risks are assessed well before a project is undertaken. The engineering manager should be briefed on these issues and may choose to disseminate high-level information to the team. Whatever the case, the manager should work to be familiar with the legal “footprint” of similar and competing products. Most issues arise not from intentionally using others’ intellectual property, but from substantially reproducing their work independently.

In addition to avoiding unintentional legal entanglements with other companies, engineers also typically take pains to safeguard their own employer’s IP. On sensitive projects, engineers are often subject to non-disclosure and confidentiality agreements. These require them to be cautious about how they communicate technical details that are valuable to their employer. It also requires them to safeguard that technical information even when they are using it in lawful ways. Acting negligently in a way that causes data to be hacked or stolen, or even lost, can have legal repercussions.

**Fraud: Sales Engineers Beware**

All enterprises that produce tangible products of any kind need to be aware of the risk of fraud. The basic definition of fraud is “a false representation of a matter of fact” that deprives another of legal rights and induces the victim to act in a way that advantages the party committing fraud. In many ways, fraud can be understood as lying – by omission or commission – in a way that causes legal harm to another person. “Harm” in this case can mean physical injury, damage to reputation, loss of earnings, or simply the loss of money an individual spent on a product based on false claims.

A victim of fraud can also be entitled to “punitive damages,” an amount of money that is awarded by a court to punish an individual or enterprise for misconduct in the hopes it won’t happen again. How does an engineering organization fit into avoiding fraud liability? Engineers should be careful of any claims they make that might be taken to indicate the presence of a feature or advantage that doesn’t exist or the absence of a potential risk or hazard that does exist.

Such misrepresentations can take place in internal communication, end-user documentation, press statements, and a variety of other contexts. Sales engineers must be especially careful about the presentations and other collateral used to persuade potential clients to purchase a product or service. Such materials are usually kept on file by major clients throughout the duration of a contract and even afterwards – and liability can extend far into the future.

**Regulatory Compliance: Especially Important in Sensitive Industries**

Engineering managers working in sensitive areas such as medical devices will often need to have detailed knowledge of the compliance issues that apply to them. While virtually all products have certain legal safety standards, those that represent an especially high risk to the public often go through several rounds of compliance checks before they are ever presented to the government agency responsible for verifying their suitability for sale.

In compliance-focused industries such as finance and healthcare, every team in the enterprise has a role in ensuring compliance. As regulations change, updated training and resources should become available well in advance of any changes taking effect. To protect their interests, engineers should also be proactive in tapping resources like professional conferences that can help them adjust to any changes efficiently.

Lack of regulatory compliance can lead to millions of dollars in fines, and in very serious cases, it may result in criminal charges for the responsible party. For engineers, however, the risk of an accident or mistake that leads to regulatory issues can often be low – simply because so many people are involved in the vetting process. This advantage, however, needs to be maintained. If a technical issue arises that seems to have compliance implications, it is important to communicate it to others in the organization that can help resolve it effectively.

**When it comes to Engineering Law & Liability, Everyone Has a Role to Play**

Virtually everyone who works with the public in any capacity has to minimize their legal liability in some form or fashion. Engineers may have higher stakes – in the sense that issues may have serious repercussions – but they also have the benefit of others in the enterprise bringing legal knowledge to the table. Doing background research before each project can reveal some of the major legal risks attached to it. Engineering managers shouldn’t hesitate to tap their company’s resources to learn more in the early stages of work. Taking a course in Engineering Law and Engineering Management is also a major step toward building the engineer’s effectiveness.

THEORY

Health and safety laws can be especially important in the engineering field. There are also laws preventing discrimination in the workplace, laws governing medical leave and laws protecting workers’ rights. In discussing the above topic, I feel it would be beneficial  
to identify some of the hazards inherent to the Oil and Gas industry.  Some of these hazards include:

Hazards associated with temperature and flammable materials,  
taking special note of terminologies such as Flash point (lowest temperature at  
which vapour above a volatile liquid form a combustible mixture with air); Flammability  
and flammability limits (i.e. the proportion of combustible gases in a mixture  
with air.   This is usually categorised  
into Upper flammable limit and Lower flammable limit.  Other hazards worth mentioning include  
Toxicity (which is the degree to which a substance is able to damage an exposed  
organism). Toxic entities can be chemical, biological or physical.  There are Skin Irritants which are stimuli or  
agents which induce a state of irritation.   
Irritants are usually thought of as chemical agents but mechanical,  
thermal and radioactive stimuli (such as ultraviolet light or ionising  
radiation) can also be irritants.  Also  
substances with Carcinogenic properties such as asbestos, certain dioxins and   
tobacco smoke are hazards which act as agents directly involved in causing  
cancer.

The common types of hazards are:

1. **Physical hazards**

Noise and vibration can both independently pose significant health risks (e.g. from drill floors, shakers, sack rooms, generators, compressors and mixers). The typical approach, where noise cannot be mitigated at source or via engineering controls, has been to establish noise control zones requiring the use of hearing protection, based on area noise measurements [1]. Some regulators require area measurements to be used for comparison between installations [3]. Design guides on noise levels have been area based, as part of asset integrity maintenance (machines get noisier as they age, proactive maintenance can contribute significantly to lowering area noise). The use of hand-held vibrating tools is widespread on offshore installations (e.g. grinders, needle guns, impact wrenches, air drills and chipping hammers). This creates the possibility for hand–arm vibration syndrome in workers who use these tools routinely. Various forms of radiation and thermal extremes are also relatively common on offshore platforms. Exposure to extreme heat and direct sunlight in tropical areas and to extreme cold in high latitudes can become significant sources of health risk dependent on the geographical region.

1. **Chemical hazards**

Chemical hazards Published exposure data from systematic sampling of hazardous agents on upstream operations are limited or published some years ago. Since benzene is a natural component of crude oil and natural gas, a few studies have reported data on benzene exposure. Substances, such as hydrogen sulphide (H2S), are usually well controlled through sealed systems, permit to work systems, gas purging, area and personal monitoring, training, emergency plans, etc. In the past, the composition of drilling ‘mud’ had considerable toxicity for both the humans and the environment. However, the composition has changed over the years, with a general trend to materials of lower toxicity [1]. Other potential toxic and suspected carcinogenic agents or mixtures exist, such as mineral oil mist and vapour, asbestos fibres, formaldehyde, tetrachloroethylene, welding/cutting fumes, acids, coatings, etc. Many epidemiological studies of workers in the petroleum industry have been conducted to help address whether there is an excess of mortality from cancers. The vast majority of these have been limited to oil refinery workers (i.e. ‘downstream’). Upstream petroleum workers exposure levels to benzene, toluene, xylene and ethyl benzene, based on personal air monitoring data, are generally regarded as low during regular activities. Higher exposures, usually less than a full shift duration, may be encountered during maintenance tasks (e.g. when containment is broken or vessels need to be entered for cleaning). There has also been speculation that dermal exposures during early years of operations could be high, but such exposure has not been routinely assessed.

1. **Biological hazards**

Food-poisoning outbreaks are typical manifestations of biological hazards in the offshore workplace. They tend to occur more commonly in less developed areas, often related to poor hygiene associated with water dispensers, ice makers and ice cream machines. Also galley space can be limited, so cold storage can be deficient. Airborne diseases can spread rapidly through ventilation systems on offshore installations because accommodation is pressurized and living space is usually at a premium. Robust health risk management is required to control health risk from potential Legionella contamination of water pipes, particularly in showers of accommodation blocks and air-conditioning plants.

1. **Ergonomic hazards**

‘Ergonomic hazards’ generally refers to health problems due to the interaction between the following: (i) the postures people are forced to adopt to reach, act on or operate the objects and equipment they work with and (ii) the nature and time history of the application of force on those objects. The critical factor that identifies a health issue as being ‘ergonomic’ is that the injury arises because the way the environment and equipment are arranged requires people to adopt postures, movements, apply force and read material in conditions that are potentially damaging to health in order to complete what is expected of them in the normal course of their work.

1. **Psychological hazards**

Psychological hazards are different from other occupational hazards (e.g. noise and chemicals) because • The level of stress within an organization varies both rapidly and significantly over time; • Stress occurs in hot spots in an organization and is rarely uniform; • The effort required to conduct a full objective assessment of stress and controls is high and should not be undertaken lightly; • Comprehensive stress and control assessments actually impact on stress; • There is some evidence that stress in an organization or population is normal and often transient and • Currently available data does not directly measure stress while interpretation is difficult and often counterproductive.

**CHAPTER 2**

**Methodology**

Hazard assessment Hazards identification was conducted by 2 complementary assessment methods and the outputs of both methods were used in LOPA and ETA risk analysis. In an attempt to identify hazards, the results of the what if method was considered as input data for the HAZOP process using the standard hazard identification (HAZID) procedure. Data obtained from the HAZOP analysis was used to assess risks using the LOPA technique).

Based on the results of HAZOP analysis, 4 hazards from node 2, 3, and 4 were selected for determining scenarios. The levels of risks were determined according to the risk matrix. More likely scenarios with significant consequences were selected. The purpose of this step was to reduce the number of scenarios in order to manage their study. Generally, 4 scenarios in the first and 4 scenarios in the second gas sweetening unit with the same hazards were selected. For each scenario, an analysis of root causes and consequences and the assessment of frequency and level of risk were conducted. Then, the levels of risks associated with each scenario were determined using the LOPA method considering the IPLs, SILs, and their associated probability of failure on demand (PFD). SILs were defined as :

SIL 1: The probability of failure per hour ≥ 10-5 to <10-6, and PFD ≥ 10-1 to <10-2.

SIL 2: The probability of failure per hour ≥ 10-6 to <10-7, and PFD ≥ 10-2 to <10-3.

SIL 3: The probability of failure per hour ≥ 10-7 to <10-8, and PFD ≥ 10-3 to <10-4.

SIL 4: The probability of failure per hour ≥ 10-8 to <10-9, and PFD ≥ 10-4 to <10-5.

The starting point of the analysis was determining the piping and instrumentation diagrams (P&IDs) for each studied plant. On completion of analysis, the data were analyzed using the LOPA standard template (PHA-Pro6 software)

The likelihood of the scenarios and their consequences were determined using the ETA method. The probabilities of initial events in the event tree were determined by fault tree analysis (FTA) method and other branches were developed using the reliability block diagram (RBD). The initiating cause frequencies were estimated according to the approach of the center for chemical process safety (CCPS) (2001). In any part of the event tree, when one branch is divided to 2 branches, the sum of their probabilities is equal to 1. It is suggested that the events were complementary. For comparing the results of ETA in 2 gas sweetening units, the initial events with different protection layers were considered.

A control measure was needed. Think of a control measure as an action aimed to eliminate a hazard completely. If the hazard you've identified can't be eliminated, follow the hierarchy of controls to select the next-best control to mitigate the risk of an accident, incident, injury, or near-miss in the laboratory.

The hazard assessment may reveal that you will need a temporary control measure until you can put a better and more permanent control in place.

Selecting your controls is a key part of the process of identifying and evaluating hazards in your lab. According to several studies hazard controls are usually placed:

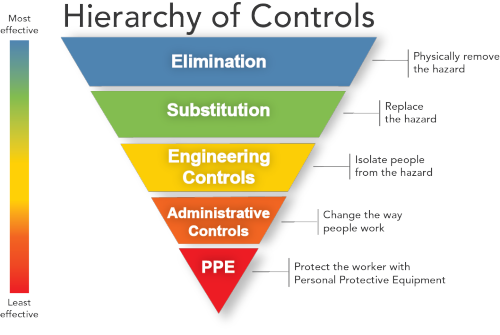
* At the source (where the hazard comes from)
* Along the path (where the hazard travels)
* With/on the worker

There are several types of control measures that fall into three main categories (in order of priority and effectiveness):

1. Elimination
2. Engineering
3. Administrative
4. Personal Protective Equipment

**The Hierarchy of Controls**

The National Institute for Occupational Safety and Health (NIOSH) in the US depicts the hierarchy of controls as “an inverted pyramid with the most effective types of control measure (elimination) at the top and the least effective (personal protective equipment) at the bottom”.

[[](http://www.cdc.gov/niosh/topics/hierarchy/)](http://www.cdc.gov/niosh/topics/hierarchy/)

* 1. **Elimination (and Substitution)**

Elimination and substitution are considered the most effective control measures. They are easiest to achieve for brand new processes. They can be more difficult to implement for existing processes, because new and/or more expensive equipment and materials may be required.

**Elimination**

Completely get rid of chemicals, materials, processes, and equipment that are unnecessary to your specific experiment. This is especially done in labs where various tests are carried out.

Check if your equipment is well-worn, check dates, and refer to manufacturer's recommendations.

**Substitution**

Switch out processes, equipment, material, or other components, where applicable.

Think about the amount of chemicals or potentially hazardous materials you are using. Can you reduce the amount and still achieve the desired result?

* 1. **Engineering Controls**

Although elimination and substitution are separate controls in the hierarchy of control measures, they are also considered engineering controls because they are designed to remove the hazardous source before the worker makes contact. Other forms of engineering controls include:

* **Isolation**  
  Reduce or remove hazards by separation in time or space. (May be particularly helpful in a shared lab space where different types of chemicals are being used.)
* **Enclosure**  
  Place the material or process in a closed system.
* **Transportation**  
  Move hazardous materials where fewer workers are present.
* **Guarding and shielding**  
  Install guards to provide protection from moving parts or electrical connections.  
  Shielding provides protection from potential explosions
* **Ventilation**  
  Use fume hoods, fans, air ducts and air filters.

* 1. **Administrative Controls**

While engineering controls seek to eliminate hazards, administrative controls aim to minimize a lab worker's exposure. Administrative controls are the existing safety rules and protocols put in place for workers in the lab to follow. Following are examples of administrative controls:

* Standard operating procedures and checklists;
* Training;
* Conducting a Job hazard Analysis prior to the start of an experiment;
* Limiting the time a person works with a certain material;
* Mandating that no one should work in the lab alone.

**Personal Protective Equipment (PPE)**

Even though the hierarchy of control measures indicates PPE is the least effective of control measure, it should absolutely be used, in case other control measures fail. The success of PPE depends in part on whether or not lab workers actually use it.

Eye goggles, hearing protection, and protective clothing (e.g., lab coats and gloves) are the most recognizable and most used PPE in the lab.

PPE is always essential, and especially critical in the following circumstances:

* When engineering controls are not feasible or they do not totally eliminate a hazard;
* As a temporary control while engineering controls are being developed;
* In emergency situations.

**Result Analysis**

The stated above can never be 100% efficient due to human error but can provide a means of preserving the health of several workers. Long term exposure however in small quantities could have a future damaging effect on former employees: some of which include cancer. The oil companies should ready their finances ensuring that pension fees are paid to appease for these future occurrence as the case may be. The HSE has been pivotal in the implementation of this methods of preventing health risks. HSE)as an alternative approach is of great importance. The aim of Health Safety Environment (HSE) is to evaluate, manage safety culture among the employees of an oil &gas sector. Improving safety, not only psychological and personal factors, organization and environmental factors should carefully be investigated, the actual problem be identified, appropriate solving methodologies be implemented, ultimately incidents rates will reduce. Individual unsafe behaviors, pervasive organization defects lie behind the majority causes of the hazards. Though many DOES and DON’TS have been anticipated in HSE policy, people have negative belief. This determines the system of multiple defenses that an organization makes and maintains to guard against injuries to its employees and damage to its property through HSE. The HSE management system is a social system, based on the staff operating it; its success depends on three items: Its scope, whether employees are informed about it and whether they are well disposed. HSE culture is number one priority in oil and gas sector as the way of formulating and addressing and contribute to the reasonable applicable reduction of related accidents, fatalities ,losses( both time and property), and occupational health. Successful implementation of HSE best practice policy takes time and commitment from the entire oil and gas organization, can significantly improve environmental performance and minimize the environmental destruction that occur as a result of oil and gas exploration and production thus sustainable development and Effective running of an HSE will provide ongoing environmental benefits, cost savings and contribute to building an attractive work place culture.

**CHAPTER 3**

**CONCLUSION &DISCUSSION**

The current and recent historical situation with regard to health hazards in the offshore oil and gas industries can be summarized in three key points. • Exposures to health hazards inherent to the raw product have been relatively stable over recent decades. • After nearly a century of experience, and with relatively stable and mature processes, chemicals, and engineering facilities, the health risks offshore are relatively well understood and can be considered in the five categories forming the basis of the health risk assessment (HRA) process; • There are few published studies presenting accurate and reliable data on health issues compared with the ‘downstream’ (refining, etc.) petroleum industry. This is probably partly due to commercial sensitivities, as well as to the rapid and often relatively short-time scale of many upstream operations. The data that are available also tend to be western-centric, with very little information on health issues in the developing world. The upstream petroleum industry is facing major changes in the future macroeconomic climate in many ways. Two of these are particularly important for health: • The move to difficult oil; • The continuation of the long-term trend for societies globally to be less willing to accept risk arising from commercial activities. Across the industry, the health function in major companies is responding to these changes in a number of ways, including the following: • by improving the ability to predict and model potential health risks (in ways similar to how explosion and noise modelling are currently conducted). • By seeking to develop health functions that are capable of integrating with project development processes to ensure barriers against health risks are effectively strengthened as each layer of defense is developed (engineering, procedures, training and personal protective engineering)

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