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HEALTH, SAFETY AND ENVIRONMENT IN OIL AND GAS INDUSTRY

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Abstract - Oil and gas exploration, drilling, production, transportation, processing and handling are associated with hazards, which pose threats to life, health, and wellbeing of employees, as well as the public and environment. There is concern for health, safety and environment in the oil and gas industry. An integrated approach to management of health, safety and environment can provide a quality management system for managing risks in the industry to ensure the protection of workers, assets, reputation, and the operational environment. Hazards can be reduced by the development and application of improved technology in oil and gas operations.

Keywords: Health, Safety, Environment, Hazards, Risks, Equipment

I. INTRODUCTION

The concern for safety and health in industry dates back to the 18th century; the era of 'Industrial Revolution', when machines were invented and manufactured, and were installed in factories. Production of goods shifted from homes and farms to factories. The machines were in their crudest form, with exposed cutting blades, gear wheels, and moving shafts, and conditions in the factories were squalid, with poor lighting and inadequate ventilation. Serious injuries and deaths resulted from the poor environment and health conditions prevailing in the factories [1].

Legislation required an employer to provide a safe and healthful place of employment, and also medical care for employees who were ill as a result of the job they performed. Where death or disability occurred, the employer was under obligation to pay compensation.

There was concern for accidents and the need for their prevention. Industries became concerned because of the obligation to comply with legislation, and desire to avoid the cost of medical care and compensation. Besides, accidents at work lower the morale of employees, and this reduces production, whilst having accidents frequently impacts adversely on the reputation of the employer. Both factors have economic consequences.

II. OIL AND GAS INDUSTRY IN PERSPECTIVE.

Crude oil and natural gas will continue to play an important role in the future world energy balance for decades to come. The Nigeria economy is supported by oil which is the major non-renewable energy source [2]. The importance of oil and gas cannot be overemphasized. However, their recovery, transportation, processing and use, are all fraught with hazards to human health and earth's ecology. Exploration, drilling and production use poisonous chemicals that can pollute the environment and endanger the health of workers [3]. Processing produces products that are not only toxic and noxious [4-6], and affect the health of workers, but risk fire, explosion, more pollution and other hazards. Accidents do occur from time to time [7].

2.1 Accidents - Causes and Prevention

Research showed that accidents are caused by unsafe acts and unsafe conditions, and could thus be prevented through Engineering, Education, Enforcement and Encouragement [1]. The Oil and Gas industry is a leader in the development and application of advanced technology [3]. Engineering would ensure proper and safe physical structures, equipment, materials, and maintenance. Education would provide training and instruction. Enforcement, through effective supervision, would ensure compliance of employees with set procedures and standards, and Encouragement would boost morale and bring about ready compliance and willingness of employees.

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In the Oil and Gas industry, these tasks are performed by the Health, Safety and Environment unit. This review was aimed at highlighting the concept and relevance of health, safety and environment management in the oil and gas industry.

III. HEALTH, SAFETY AND ENVIRONMENT (HSE) MANAGEMENT IN OIL AND GAS INDUSTRY

The HSE management system integrates the management of Health, Safety and Environment into the management of the business, and is defined as a quality management system for managing risks within the company, to ensure the protection of employees, assets, and reputation The HSE – Management System (HSE-MS) has the following elements:

- Management Leadership and Commitment.
- Policy and Strategic Objectives.
- Organization, Responsibility, Resources.
- Hazards and Effects Management Process.
- Implementation.
- Audit
- Management Review

The important element in the HSE-MS is the hazards and effects management process (HEMP)
HEMP is a process for identifying the hazards in an HSE critical activity and the effect, with a view to eliminating or controlling them - to reduce them to as low as reasonably practicable. It is central to the effective implementation of the HSE-MS. Risk is a function of the occurrence of an undesired event together with a measure of its adverse consequence.

Hazards: Hazard is the potential to cause harm, ill health or injury, damage to property, plant, products or the environment, production losses or increased liabilities. Examples of hazards in the oil and gas industry include hydrocarbons under pressure, objects at height, electricity, toxic substances, noise, radiation, and working at heights.

Effects: This is defined as either the consequence of not managing hazards, for example; loss of control, or the consequence of an unintended release. An effect is usually an adverse effect either on the health or safety of employees or the public. The basis of HEMP is the key principles of Identify, Assess, Control and Recover. (IACR).

The steps in the process are:
(i) Identify the Hazards, the threats, and potential hazards, events and effects that may affect, or arise from a company's operation throughout the life cycle of the operation. Since process technology passes through discrete phases of development and implementation, this offers unique opportunities for detection of potential hazards. The industry utilizes these for selection of process routes, reduction in inventories of hazardous materials, and incorporation of suitable safety devices or systems [8].
(ii) Evaluate (Assess) the risks from the identified hazards against accepted screening criteria, taking into account the likelihood of occurrence and the severity of any consequences to employees, assets, the environment and the public. Risk assessment is critical to HEMP and has the Risk Assessment Criteria to aid assessment.
(iii) Record the hazards and effects identified as significant in relation to the screening criteria. Compare the evaluated risk against the detailed HSE objectives and targets for the project or installation. For all cases, these targets must be maintained and be consistent with the company policy and strategic objectives. Performance standards at all levels must meet the criteria set, and comply with the company's HSE-MS.
(iv) Establish Risk Reduction Measures. Select, evaluate and implement appropriate measures to reduce or eliminate risks. Risk reduction measures include those to prevent and control incidence (that is, reducing the probability of occurrence) and those to mitigate effects (that is, reducing the consequences). Mitigation measures include steps to prevent escalation of, or developing abnormal situation, and to lessen adverse effects on health, safety and the environment. Risk Reduction Measures also include recovery preparedness measures, which address emergency procedures as well as restoration and compensation procedures to recover.

Application: HEMP can be implemented at any point in the life cycle of a facility or operation. When planning the development of new facilities, or reviewing existing ones, the focus is on identification and assessment of hazards and effects that may be avoided, reduced or eliminated. In Operational and maintenance phase, the focus is on control of hazard and effects by procedures and the development and implementation of effective recovery preparedness measures.

3.1 GOOD HOUSEKEEPING

Housekeeping is essentially the orderly placement of tools and equipment, disposal of items not in use, and maintenance of a tidy environment. Good housekeeping is an essential part of eliminating hazards which could cause incidents/accidents [9]. Shamble environment can lead to lack of pride and promote accident in the work environment. Slippery floors, platforms and other walking surfaces can cause slips. Trips can result from tools, objects and materials that are not in use and are left in walkways and work areas. Good housekeeping should be

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practical to ensure an incident and accident free/safe working environment. Ensuring good housekeeping is one of the responsibilities of HSE. A good housekeeping program must include: careful planning, a cleanup schedule policy, effective inspection and continuous supervision, and enforcement of housekeeping rules. These can be summarized by the five (5) steps to good housekeeping:

- Sort – Get rid of unnecessary items
- Store – A place for everything and everything in its place
- Shine – Clean your workplace and equipment
- Standardize – Set standards for housekeeping and continuously look for ways to improve standard.

3.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

PPE are pieces of equipment, gadgets and / or apparels used or worn by worker/workers to protect him/her against the hazard(s) existing in his/her work situation/environment. This is a statutory requirement ideally designed to protect or minimize the impact of accident(s) on a worker in a work site [10]. Note that where a hazard is found to exist in a work place, every effort should be made to eliminate it by Engineering review, Change in material, and Education. PPE becomes necessary when all other efforts at eliminating the hazard(s) have proved abortive [11]. The functions of HSE management amongst others include; analyzing, specifying, selecting, and recommending PPE, training of workers to use PPE, and educating them on the risk of not using the PPE.

Types of PPE

i. Helmet/Hard Hats: These are equipment used to protect the head against falling and flying objects, snapped ropes, slings, sparks and metal droplets from overhead welding, and liquid leaking from overhead facilities. They are made of metal, plastic, glass and some non-metallic materials.

ii. Eye Goggles: They are mainly for the protection of the eyes against liquid and splashes from chemicals, corrosive liquid, flying particles, dusts, and harmful radiation. They are of various types and styles. Examples include; cup goggles, protection goggle and spectacles with side shield.

iii. Foot protection: consist of safety shoes/boots, job master, and swamp shoes. These are worn in all operation, maintenance and construction areas.

iv. Face Shield: They are used for the protection of faces and necks against light impact, flying particles, hazardous chemicals, heat, and radiation.

v. Hand Gloves: They are used for the protection of fingers, palms, and hands from burns, cuts, bruises and scratches. Hand gloves are used when performing general purpose work. This includes tools use, handling materials or equipment, climbing an equipment or ladder.

vi. Ear protection: Assorted types and styles designed for protection of ear from high damaging sound. They are ear muffs and ear plugs.

vii. Respiratory protection: For the protection against substances such as, dusts, fumes and tiny air particles. Examples are: Air supplying Respirator – Self contained breathing apparatus (SCBA), and Air purifying Respirator – Gas masks.

viii. Overalls/Aprons: Protect the body from contact with heat, corrosive and/or toxic substances.

ix. Belts/Harnesses: Are used when working at an elevated place, for securing, suspending, and retrieving a worker.

x. Fire Suit: for fire fighting

The prototype of one with complete PPE is shown in Fig. 1.

3.3 HSE COMMUNICATION

Good communication is very essential in HSE management. HSE policies, plans, procedures, strategies and goals are made known to different levels of the organization through effective communication. The methods of communication in HSE include among others; signs and symbols, written instructions or orders, HSE meetings, report writing, posters and bill boards.

3.3.1 Safety Signs and Symbols.

As a way of preventing accidents and eliminating hazards, safety symbols and signs are placed in some areas to inform, alert and warn personnel, and restrict movement in certain places considered ‘Unsafe’ [12]. Some safety symbols and their meanings are presented in Figs. 2a and 2b.

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3.3.2 Permit to Work System

A permit to work (PTW) system is a formal written document used to control certain types of work/job that are potentially hazardous. It specifies the work to be done and the precautionary measures to be taken [9]. PTW is a means of communication between site management, plant supervisors, operators and those who carry out the job. A permit to work is not simply permission to carry out a dangerous job; it is an essential part of the system which determines how the job can be carried out safely. The main objectives of PTW are to ensure proper authorization of a designed work; to make clear to people carrying out the work the exact identity, nature and extent of the job and hazards involved; and specify safety precaution to be followed.

Works that require PTW include; hot work, electrical and excavation work, handling hazardous and radioactive substances, entering a confined space, and any other job assessed to be potentially hazardous.

3.3.3 Confined Space

A confined space is a space not originally designed for human occupancy. It is characterized by unfavourable natural ventilation, limited openings for entry and exit, and potential hazards. Confined spaces exist in many settings in the oil and gas industry, but are especially common in storage and transportation facilities. Examples of confined spaces are; pipelines, tunnels, storage tanks, vessels sub-cellars, cold storage lockers and hoppers. The hazards associated with such spaces include; flammable and toxic atmosphere, slip and falls, noise and heat stress. Before entering a confined space there are safety procedures to be followed. The area must be first and foremost evaluated and then a confined space checklist completed – which includes but not limited to; permit to work, risk assessment, job hazard analysis, risk identification and control. Above all, essential PPE's must be worn before entering a confined space such as respirator, safety harness and life lines, goggles and face shield, boots, hand gloves and coveralls.

Fig 1: Prototype of one with complete PPE

Fig 2a: Safety symbols

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Fig 2b: Safety symbols

IV. CONCLUSION

There are risks associated with every workplace. Oil and Gas extraction, transportation, processing and handling are associated with hazards which pose threats to the life, health, and well being of workers as well as the public and environment. Hazards can be reduced by the application of improved technology. Industrial accidents create not only personal grief and distress but also huge financial costs and unwelcome negative publicity for the organization and industry concerned. A well articulated HSE management system can reduce risks, hazards and accidents to the barest minimum in the oil and gas Industry. When assets, employees and work environments are properly secured and operations are not unduly disrupted, then objectives and targets can be achieved.

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