



(REVIEW ARTICLE)



Long term and short-term occupational health risks associated with petroleum industry in India

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Abstract

The present informative article is intended to focus on the occupational diseases being faced by oil and gas company's employees, its effects on their health, family life and some remedies have been discussed to overcome the problems related to their health. Occupational hazards are always been a prominent issue in industries especially hazardous industries like Petroleum Industry. In this review paper, we have tried to mention and identify most of the long term and short-term health risks associated with Petroleum Industry in India. Also, it covers Ergonomics/ mechanical hazards and Psychological Hazards in Oil & Gas Industry in India. This review article outlines the health hazards and risks present in petroleum industry and it mentions preventive measures to minimize the health risks by analyzing the root cause. We have tried to mention primary causes of Occupational Diseases associated with petroleum Industry and its prevention. The health hazards that are present in oil and gas industries are classified as long term and short term depending on primarily on the duration of Exposure. It was felt that there is a need to do work on safety of human capital resulting in the culmination of this review article paper.

Keywords: Occupational Health Hazards in petroleum industry; Noise induced hearing loss (NIHL); Whole Body Vibration; Ionizing Radiation; Ergonomics

1. Introduction

The oil and gas industry is a truly difficult enterprise to work for—for example, in the India the oil industry is second only to the military (Army, Navy, Airforce & BSF) in terms of having personnel in remote locations. Among the most demanding of these remote work- places, for both technology and the workforce, is the offshore sector. Offshore oil and gas exploration and production can be found in environmental conditions ranging from Arctic to tropical considering operations of ONGC & OVL; and in situations ranging from inshore shallow waters to remote deep- water locations (1).

During the industrial history, there are several drastic industrial accidents that happened and resulted in loss in workers' life and workplaces. Bhopal Gas Plant disaster (1984), Chernobyl Nuclear Power Plant disaster (1986) Piper Alpha disaster (1988), and BP Deepwater Horizon Oil Spill disaster (2010) are examples of these accidents. As a result, health & safety revealed as a building block of any industrial policy to protect workers against sickness, disease and injury related to the working environment (2).

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1.1. About Petroleum Industry in General

The petroleum industry, also known as the oil industry includes the global processes of exploration, extraction, refining, transporting and marketing of petroleum products.

The industry is usually divided into three major components: upstream midstream and downstream Upstream regards exploration and extraction of crude oil midstream encompasses transportation and storage of crude, and downstream concerns refining crude oil into various end products.

Drilling operations” means the penetration of ground below the setting depth of structural or conductor casing, using a drilling rig capable of performing the permitted well work, and for purposes other than setting structural or conductor casing; “drilling operations” includes the running of casing, cementing, and other down hole work performed ancillary to formation evaluation, and operations necessary to complete and equip the well so that formation fluids can be safely brought to the surface.

Engineers in the drilling operation are exposed to chemical hazards including hydrogen sulphide (H₂S), drilling fluids, silica, diesel exhaust, and mercury and physical agents such as radioactive sources, drilling mud and petroleum products.

Govt. of India started encouraging upstream hydrocarbon industry to surge the domestic oil and gas production to shrink import encumbrance. Due to handling of these petroleum products and oil field chemicals, they are affected by various diseases. Noise and vibrations also can cause adverse health effects such as hearing impairment and hypertension. Other dangers include confined spaces, in which untrained workers have been seriously injured or killed.

1.2. What is Occupational disease?

An occupational diseases or health disorders are caused by the nature of work or working conditions. An “occupational disease” is any disease contracted primarily as a result of an exposure to risk factors arising from work activity. Occupational diseases usually develop over an extended periods of time. They are slow and generally develop over an extended period of time. They are slow and generally cumulative in their effects, are irreversible and often complicated by non-occupational factors. Generally, the occupational diseases are the effects of frequent exposure to the influence of toxic substances, of microorganism, or air borne contaminants, and stress producing factors [3].

1.3. How Bigger problem it is?

As per the World Health Organization (WHO), one-third of adult life is spent at the workplace where risky exposures are often several times greater than in any other environment. The International Labour Organization (ILO) estimates that every day a 1,000 people die globally from accidents at the workplace and 6,500 from occupational diseases while about 65% of this global work-related mortality is reported annually in Asia.

Hazard is the potential to cause harm; risk on the other hand is the likelihood of harm (in defined circumstances, and usually qualified by some statement of the severity of the harm)(3).

1.4. Occupational Health & Safety (OHS) at Workplace and Non-Communicable Diseases (NCDs)

Work-related safety and health hazards are major public health concerns worldwide. The occurrence of workplace hazards, occupational diseases, and deaths contribute significantly to the increase in the global burden of (NCDs). NCDs, injuries, and infectious diseases contribute 70% 22%, and 8%, respectively, to the total disease burden from the occupational health risks according to the WHO. This should not be overlooked as many workers are persistently challenged by occupational safety and health risks.

1.5. Occupational Health Hazards

Workplace health hazards generally differ from those found in the general environment. Furthermore, because workers are often exposed in confined spaces, exposure levels to workplace hazards are often much higher than exposures to hazards in the general environment. In developing countries, workers may be exposed simultaneously to workplace hazards, to an unsafe housing environment, and a polluted general environment.

Occupational Health Hazards are broadly divided into Physical, Chemical, Biological, Behavioural/ Psychosocial, and Mechanical/Ergonomics as included in ILO List.

1.5.1 Physical Hazards

Physical hazards are often said to be less important than chemical hazards but this is not so. They can and do cause several health problems, injuries or even death. The nature of physical agents is wide and should not be underrated but the main ones capable of causing occupational disorders and injuries are:

- Noise
- Illumination
- Vibration
- Radiation (ionizing and non-ionizing)
- Microclimatic conditions in the case of extreme heat and cold.

1.5.2 Biological Hazards

Exposure to some 200 biological agents, viruses, bacteria, parasites, fungi and organic dusts occurs in selected occupational environments. Petroleum Sector employees work in far flung remote places where for provided at common canteens can cause Bacterial Dysentery, Typhoid, Food poisoning due to contamination of Food. Or by poor housekeeping exposure to rodents, parasites. Diseases like Malaria, Dengue, rare forest fevers, Japanese encephalitis etc are common due to endemic vector borne diseases. Blood-borne diseases such as HIV/AIDS and hepatitis B are now major health hazards in employees with high risk promiscuous sexual behavior.

1.5.3 Chemical Hazards

About 100 000 different chemical products are in use in modern work environments and the number is growing. High exposures to chemical hazards are most prevalent in industries that process chemicals and metals, in the manufacture of certain consumer goods, in the production of textiles and artificial fibres, and in the construction industry. Chemical hazards could be classified into:

- Particles, fibres, fumes and mist: Carbon Black, Welding Fume, Oil Mist
- Metals and metalloids: Arsenic, Cadmium, Chromium, Mercury, Zinc
- Organic, solvents and compounds: Acetone, hydrocarbons, Benzene
- Inorganic gases: Carbon monoxide, Hydrogen sulphide, Sulphur dioxide Chemicals are also increasingly used in virtually all types of work, including non-industrial activities such as hospital and office work, cleaning, and provision of cosmetic and beauty services.

Exposure varies widely. Health effects include metal poisoning, damage to the central nervous system and liver (caused by exposure to solvents), pesticide poisoning, dermal and respiratory allergies, dermatoses, cancers and reproductive disorders.

In some developing countries, more than half of the workers exposed to dust-containing silica in certain high-risk industries (such as mining and metallurgy) are reported to show clinical signs of silicosis or other types of pneumoconiosis.

About 300–350 substances have been identified as occupational carcinogens. They include chemical substances such as benzene, chromium, nitrosamines and asbestos, physical hazards such as ultraviolet radiation (UVR) and ionizing radiation, and biological hazards such as viruses. In the European Union alone, approximately 16 million people are exposed to carcinogenic agents at work. The most common cancers resulting from these exposures are cancers of the lung, bladder, skin, mesothelium, liver, haematopoietic tissue, bone and soft connective tissue.

Among certain occupational groups, such as asbestos sprayers, occupational cancer may be the leading factor in ill-health and mortality. Due to the random character of effect, the only effective control strategy is primary prevention that eliminates exposure completely, or that effectively isolates the worker from carcinogenic exposure.

1.5.4 Psychosocial Hazards

Psychosocial hazards comprises of the psychological and social hazards. Psychological hazards are caused when time and a work pressure has become more prevalent during the past decade. Monotonous work, work that requires constant concentration, irregular working hours, shift-work, and work carried out at risk of violence (for example, police or prison work), isolated work or excessive responsibility for human or economic concerns, can also have adverse

psychological effects. Psychological stress and overload have been associated with sleep disturbances, burn-out syndromes and depression.

Epidemiological evidence exists of an elevated risk of cardiovascular disorders, particularly coronary heart disease and hypertension in association with work stress. Severe psychological conditions (psycho-traumas) have been observed among workers involved in serious catastrophes or major accidents during which human lives have been threatened or lost. Social conditions of work such as gender distribution and segregation of jobs and equality (or lack of) in the workplace, and relationships between managers and employees, raise concerns about stress in the workplace. Many service and public employees experience social pressure from customers, clients or the public, which can increase the psychological workload. Measures for improving the social aspects of work mainly involve promotion of open and positive contacts in the workplace, support of the individual's role and identity at work, and encouragement of teamwork.

Organizational Psychosocial factors following:

- Violence and aggression
- Lone working
- Shift and night work
- Long working hours
- Time zone changes

1.5.5 Ergonomic Hazards

Table 1 Depending on the duration of exposures the health risks can be classified as Long Term & Short Term Health risks

| Sr | Long Term Health Risk | Short Term Health Risk |
|----|--|--|
| 1 | Occupational exposure to Noise | Fires and Accidents at work |
| 2 | Occupational exposure to Ionizing Radiation | Toxic Radiation Syndrome |
| 3 | Exposure to Natural Optical Radiation- Sunlight Exposure to Artificial Optical Radiation- Light in all its forms such as visible, ultraviolet, infra-red and lasers, but excluding sunlight. | Exposure to Work Environment Heat- leading to Heat Exhaustion, Heat Hyperpyrexia, Heat Stroke Exposure to Extreme cold- Frost Bite, Emersion Syndrome etc |
| 4 | Occupational exposure to Vibration- Whole Body Vibrations (WBVs) or Hand & Arm Vibration (HAVs) | Biological Agents Exposure- Food Borne Shigela, Salmonella, COVID 19 Virus, Other contagious diseases |
| 5 | Ergonomics Risks - Work Related Musculoskeletal Disorders (WRMSDs) leading Cervical Spondylitis, Lumbar Spondylitis, Carpal tunnel syndrome, tendonitis, thoracic outlet syndrome, and tension neck syndrome etc | Chemical Agents exposure- Chemicals, gases & toxic substances |
| 6 | Work related Stress leads to Hypertension, DM, CVAs, Loss of Focus/ concentration leading to accidents, poor work efficiency etc. Dysthymia/ Chronic Stress leads obesity, memory loss, and erectile dysfunction. | Work related Stress- leading to acute symptoms of Anxiety, Insomnia, panic attacks, adjustment disorders due frequent transfers, PTSD (Post Traumatic Stress Disorder) - Aversion to go to work due to fatal accident at Work, after surviving a major accident etc. |
| | Non Communicable Diseases (NCD) Diabetes, Hypertension, Obesity etc | Stressors arising out of personal life- loss of near & dear ones, financial loss, divorce etc leads to poor focus at work- poor work efficiency, can contribute to accident at work. |

Ergonomic hazards include awkward postures, static postures, large forces, repetitive motion, or short intervals between activities. The risk of Musculoskeletal Disorders (MSD) is often magnified when multiple factors are present. Factors such as whole-body or hand/arm vibration, poor lighting, poorly designed tools, equipment, or workstations all contribute to negative interactions with the worker/user. Ergonomic hazards occur in both occupational and non-occupational settings such as in workshops, building sites, offices, home, school, or public spaces and facilities (4).

1.6. Classification of Occupational Diseases Occupational diseases can be classified in different forms

- Occupational diseases of the respiratory system
- Occupational diseases of the liver
- Occupational diseases of the cardiovascular system
- Occupational diseases of the Gastro-intestinal system
- Occupational diseases of the Genito-urinary system
- Occupational diseases of the skin or dermatologic system
- Occupational diseases of the musculoskeletal system
- Occupational diseases of the haemopoietic system
- Occupational diseases of the physical agent.

Table 2 The following table shows the diseases from the various processes included in upstream, midstream and downstream segments of activities in Oil & Gas Industry

| Sr | Segment | Processes | Diseases. |
|----|-------------------------------|---|--|
| 1. | Upstream Activities Processes | Seismic survey and evaluation, Exploration and drilling, development, production, decommissioning | Infectious and parasitic diseases such as Hepatitis A, Cholera, Typhoid fever, cumulative trauma disorders, chronic obstructive pulmonary diseases, Gastrointestinal disorders, Dermal and eye issues, spinal disorders, neoplasm cancer, heat strike, stress, sleep deficits, noise induced hearing loss, drug and alcohol abuse. |
| 2. | Midstream Activities | Pipeline maintenance, transport, storage and marketing etc. | Dermal and eye problems, Gastrointestinal disorders, neoplasm/ cancer. |
| 3. | Downstream Activities | Product refining and petro chemicals | Dermal and eye problems, Gastrointestinal disorders, neoplasm/ cancer, loss of hearing due to noise |

Table 3 Factors of Work Related-Illness and Diseases.

| Sr. | Workers susceptibility factors | Workplace factors |
|-----|--------------------------------|--------------------------|
| 1. | Genetic | Multiplicity of Exposure |
| 2. | lifestyle | Duration of Exposure |
| 3. | Age | Physical Properties |
| 4. | Race | Magnitude of Exposure |
| 5. | Gender | Timing of Exposure |
| 6. | Medical History | Threshold Limit |

The oil and natural gas sector has a significant place in the world's economy. This sector is expanding rapidly and providing many new job opportunities; but at the same time there is an increasing risk of work related fatality, injury and diseases. New exposures hazards are some of the challenges being faced by the employees to maintain a safe and

healthy work environment. Employees exposed to chemicals, gases produced and used in the oil and Gas Company may develop occupational diseases of lungs, skin, and other organs. Therefore, to overcome the problems of occupational diseases, some remedies have been suggested in this information article.

However, work related-illnesses and diseases could be caused by two major factors: workers' susceptibility and the workplace environment and conditions as mentioned in Table 3 below.

1.7. Recommendations mitigate OH hazards in workplace setting

Three main strategies are used to achieve Occupational Health & Safety at Workplace (OHS) which are Health Promotion, Protection and Rehabilitation in the workplace.

1.7.1 Health Promotion includes

- Health Risk Assessment which is a management tool that allows the workplace comply with her occupational policy, helps the workers do their jobs without damage to their health, enables the workplace meet her legal responsibilities, enables the workplace show due diligence in the protection and promotion of the health of the workers, provides an auditable platform and involves the work force in protecting the health of the workers.
- Biological Monitoring/Medical Surveillance that involves periodic medical examination including pre-employment medical examination, health assessment and biological test. Sickness absence monitoring, reporting of occupational diseases and illnesses and ethical and legal issues.
- Training
- Physical Activities: Yoga, Walkathons, Health & Wellness Promotion Activities.
- Strict enforcement and implementation of the Organizational Occupational Health and Safety Policies with strategic planning should be put in place to imbibe Behavioural Occupational Health and Safety culture in the staff of the Refinery.
- Management Commitment and Resources through advocacy.

1.7.2 Health Protection

Elimination

Using a hazardous material from use in the workplace so that no further exposure is possible.

Substitution

Replacing a very hazardous material with a less hazardous one.

Modification

Changing a process or procedure to eliminate or reduce emissions.

Containment

Using physical barrier or containment to separate materials or environment from work areas.

Ventilation

Removing or diluting hazardous materials in the air by removing the contaminated air and replacing it with outside air.

Workplace Practice

Work practices are procedures that limit worker exposure by reducing exposure times or keeping workers away from contaminants. The following are some common work practices; Scheduling, Good Housekeeping and Personal Hygiene Practices, Policies and Procedures.

Personal Protective Equipment (PPE)

Equipment such as gloves and goggles are used to protect workers from hazards. PPE is less effective because the hazard is still present and workers are not protected if the PPE fails. PPE should only be used if necessary after other control measures are implemented or if other controls are not practicable.

1.8. Health Rehabilitation

- Immediate Support and Initial Administrative Processes
- Duty of Care - Safe Return Home After Injury
- Book Keeping and Reporting Injuries/Illnesses
- Effective Early Communication

2. Conclusion

The most common Occupational Health Hazards that could affect the health and well-being of people who are working in oil & gas industry are:

- Physical Health Hazard – Noise, Vibrations, Ionizing Radiation, Illumination etc
- Chemical Health Hazards – O₂, CO, NH₃, C₂H₄ and H₂S.
- Mechanical/Ergonomic Health Hazards – obsolete machines and equipment's.
- Biological Health Hazard – Organic dust (carbon black).

Identification of these Occupational Health Hazards, the awareness of the workers on the health hazards, the risk associated with them and the effectiveness of the Occupational Health Practices is crucial in the promotion, protection and rehabilitation of the health and well-being of people working in the Oil & Gas industry. Occupational Health and Safety should be an integral part of production processes of an organization should not be toyed with by the Staff and Management of the any industrial and production organization & should not be seen lacking in this area.

Currently only 15% of workers worldwide have access to specialized occupational health services. They mostly carry out prevention of occupational risks, health surveillance, training in safe working methods, first aid and advising employers on aspects related to occupational health and safety.

In India, constitutional provisions form the basis of workplace safety and health laws. It is the duty of the state to implement policies that encourage workplace safety and health of workers. The major occupational diseases/morbidity of concern in India are silicosis, musculoskeletal injuries, coal workers' pneumoconiosis, chronic obstructive lung diseases, asbestosis, byssinosis, pesticide poisoning and noise induced hearing loss. The Directorate General of Factory Advisory Services & Labour Institutes (DGFASLI) is an attached office of the Ministry of Labour & Employment, Government of India. It serves as a technical arm of the ministry and assists in formulating national policies on occupational safety and health in factories and docks. It also advises factories on problems concerning safety, health, efficiency and well-being of every employee.

The present informative article is intended to focus on the occupational diseases being faced by oil and gas company's employees, its effects on their health, family life and some remedies have been discussed to overcome the problems related to their health. This review paper is an attempt to impart awareness & knowledge about the Occupational Diseases as these are silent killers & no permanent treatment is available for most of them. So prevention is the only cure.

This paper also identifies primary causes of Occupational Diseases associated with oil & gas Industry and its prevention. The health hazards that are present in oil and gas industries are classified as long term and short term depending on primarily on the duration of Exposure. It was felt that there is a need to do work on safety of human capital resulting in the culmination of this review article paper.

3. Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interest.

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