

especially in conditions where traditional methods of cleanup are economically unfeasible or environmentally hazardous.

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Vasyliiv Nataliia

Assistant of Department of Environmental
Protection Technology

Ivano-Frankivsk National Technical University of Oil and Gas

RISK MANAGEMENT AND ENVIRONMENTAL MONITORING AS COMPONENTS OF OIL AND GAS INDUSTRY FACILITIES SAFETY OPERATION

Safety is a paramount requirement in oil and gas facilities. Numerous risks in such facilities are typically having high hazard potentials for major accidents. Our ongoing research aims at: (a) establishing linkages between common set of leading and lagging indicators of oil and gas facilities and (b) benchmarking the safety management system (SMS) components to the effectiveness of safety

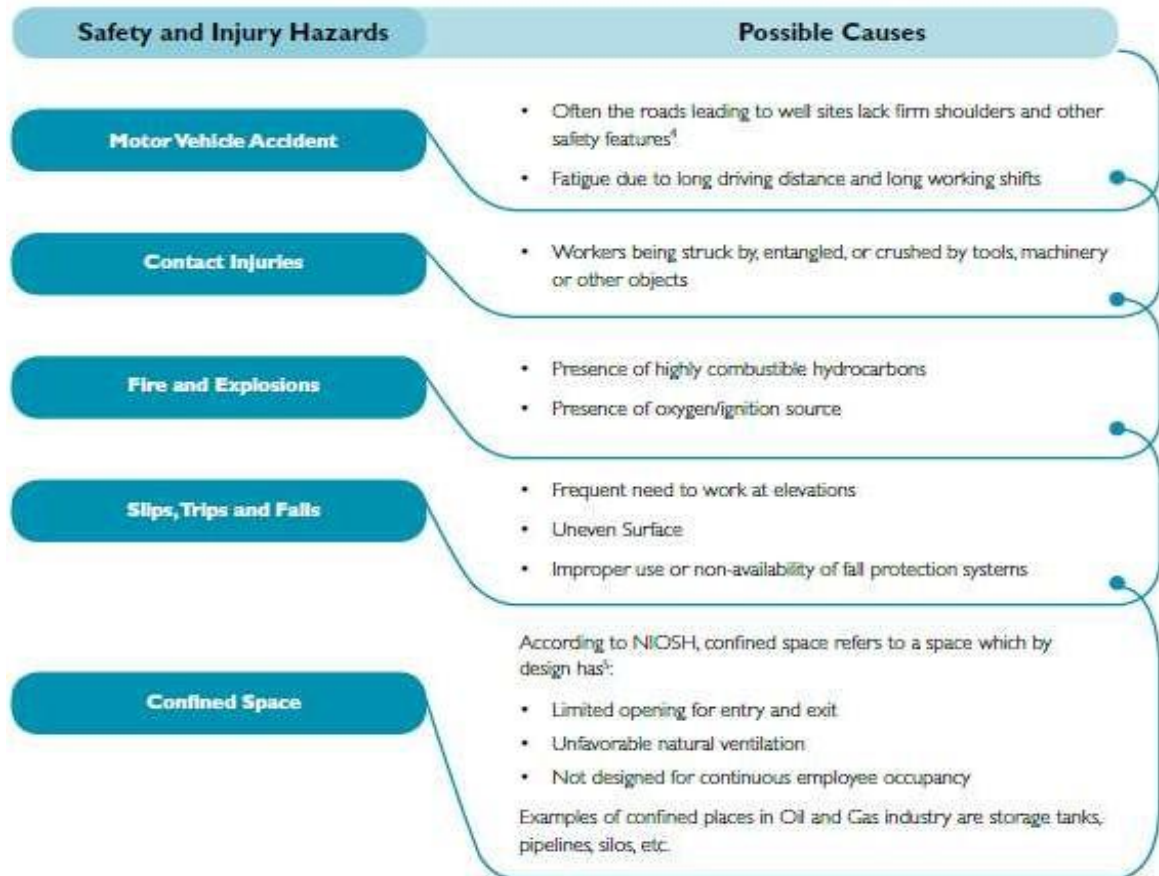
performance outcomes in a sample set of operators. The research methods include focused knowledge mining through literature review and case studies as well as benchmarking and risk analysis explorations. This paper presents a consolidation of interim findings from this on-going research, which includes (i) a comparison of safety management system components, (ii) a snapshot summary of potential linkages from recent case-studies in upstream of oil and gas industry.

Safety and health management is one of the vital constituents of Oil and Gas industry activities because most of the operational conditions, chemicals and end products (hydrocarbons and other compounds) associated with Oil and Gas production are well-known to pose serious safety and health threats to the workers.

Hazards Related to Oil and Gas Industry. Hazards in Oil and Gas industry can be divided into two broad categories:

- Safety and Injury Hazards
- Health and Illnesses Hazards

Safety and Injury Hazards. Workers in Oil and Gas industry are generally susceptible to the following safety and injury hazards:



Health and Illnesses Hazards. Workers in Oil and Gas industry are generally susceptible to following agents which lead to various health and Illnesses hazards: chemical hazards (toxic, corrosive, carcinogens, asphyxiates, irritant and sensitizing substances); physical hazards (noise, vibration, radiations, extreme temperature); biological hazards (virus, parasites, bacteria); ergonomic hazards (manual handling activities, repetitive motions, awkward postures); and psychosocial hazards (overwork, odd working hours, isolated sites, violence).

The aim of occupational safety and health risk management is to identify and assess safety and health hazards existing at the workplace and to define appropriate control and retrieval steps.

Business processes in Oil and Gas industry are very complex. Hence it is essential that a systematized approach should be used for managing occupational safety and health hazards. Its solution model can be based on the PDCA Cycle:

The following table identifies the potential health effects from key processes in Oil and Gas industry:

Segments	Key Processes	Agents	Possible Health Effects
Upstream	• Seismic Survey and evaluation • Exploration and drilling • Development and production • Decommissioning	• Pathogenic microorganisms • Infection transmitting vectors • Drilling mud • Petroleum products (Hydrocarbons) • Radioactive sources • Chemicals and additives • Metals (Pb, Cd, Mn, etc.) • Extreme temperatures • Silica/Asbestos • Noise/Vibration • Mechanical • Ergonomic • Psychosocial	• Infectious and parasitic diseases (e.g., Hepatitis A, Cholera, Typhoid fever) • Cumulative trauma disorders • Chronic obstructive pulmonary disease • Gastrointestinal disorders • Dermal and eye issues • Spinal disorders • Neoplasms/Cancer • Heat Stroke • Stress • Sleep deficits • Noise induced hearing loss • Drug and alcohol abuse
Midstream	• Pipelines • Transport and storage • Marketing	• Petroleum products (Hydrocarbons) • Dust from filing and scaling (from cleaning of pipes and tanks)	• Dermal and eye issues • Pulmonary disorders • Gastrointestinal disorders • Neoplasms/Cancer
Downstream	• Product Refining • Petro chemicals • Sales and Distribution	• Petroleum products (Hydrocarbons) • Treatment chemicals • Metals (Pb, Cd, Mn, etc.) • Silica/Asbestos • Solvents • Noise/Vibration	• Dermal and eye issues • Gastrointestinal disorders • Neoplasms/Cancer • Noise induced hearing loss

Managing Occupational Safety and Health Risks. The aim of occupational safety and health risk management is to identify and assess safety and health hazards existing at the workplace and to define appropriate control and retrieval steps. Business processes in Oil and Gas industry are very complex. Hence it is essential that a systematized approach should be used for managing occupational safety and health hazards. Its solution model can be based on the PDCA Cycle:



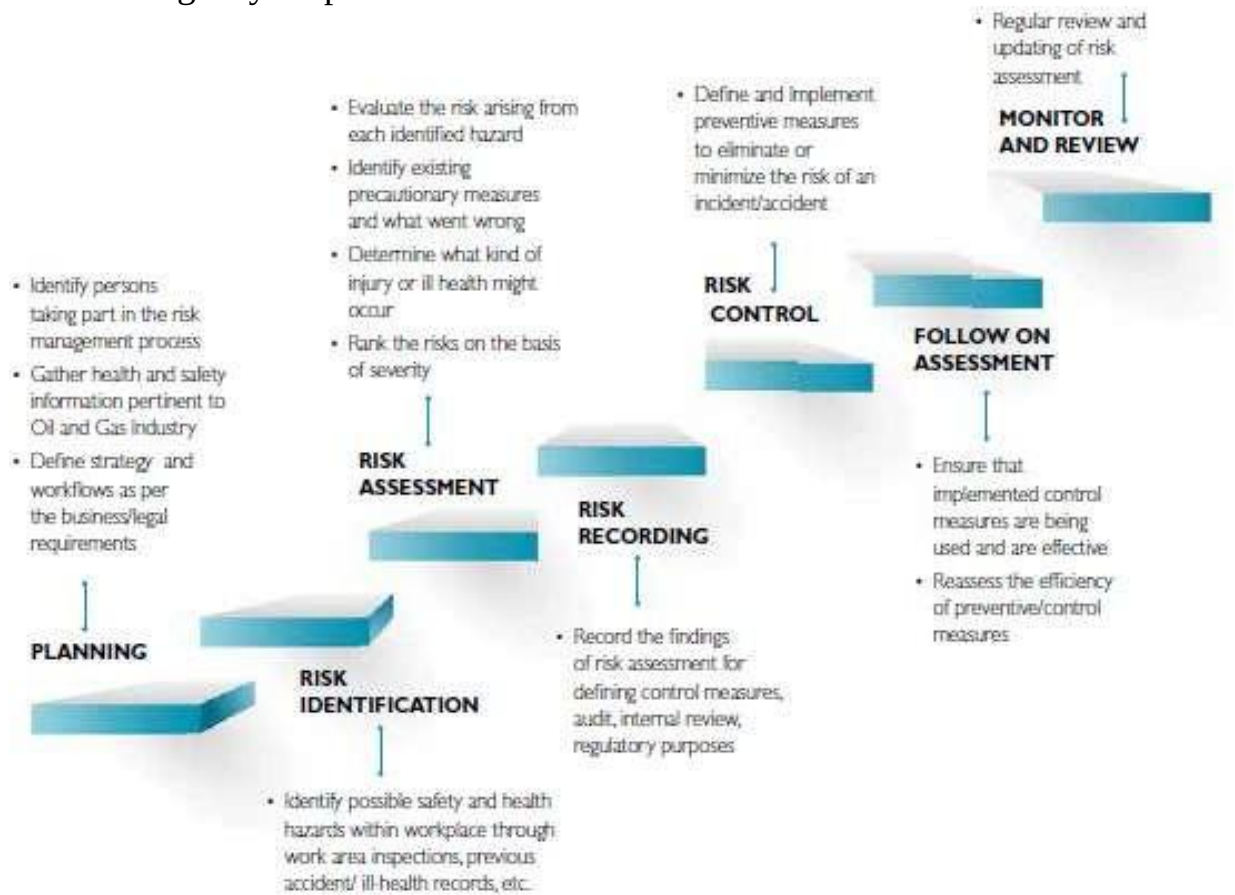
Risk Management Process. As stated earlier, risk management is crucial for preventing work related injury and illness. It includes:

- Identifying the risks
- Evaluating and prioritizing the risks
- Implementing preventive/protective measures to control the risk

There are a number of circumstances in the Oil and Gas industry where a proper risk management process is essential. For example:

- Job safety analysis: It is a process of systematically evaluating certain jobs, tasks, processes or procedures and eliminating or reducing the risks or hazards to As Low As Reasonably Practical (ALARP) in order to protect workers from injury or illness
- Workplace inspections and audits
- Change management - identification of new hazards, introduction of new equipment/process, or regulatory needs.

Generally Risk Management Process in the Oil and Gas Industry Involves the Following Key Steps:



Components of an Effective Occupational Safety and Health Management System. Occupational Safety and Health Management System is one of the critical factors whose successful execution confirms operational safety in upstream, midstream and downstream segments of Oil and Gas industry. Following key components should be encompassed in an active occupational Safety and Health Management System:

Benefits of Occupational Safety and Health Management System:

- It enables Oil and Gas industry in performing hazard identification, risk assessment and implementing various control methods
- It ensures well-being of all the employees and thus contributes to a more inspired, and performance driven workforce
- Regular risk assessment process helps in frequent tracking and monitoring of health and safety indicators (both leading and lagging).
- Reduced costs associated with accidents and incidents
- Improved regulatory compliance
- Implementation of OSH management system gives competitive edge and improves relationships between stakeholders, such as clients, contractors, subcontractors, consultants, suppliers, employees and unions

SL No	OSHMS Components	Requirements
1	Health and Safety Plan	Oil and Gas Company's vision and approach towards Health and Safety
2	Administration	Organizational hierarchy Key details of persons responsible for managing health and safety plans
3	Work Area Management	Proper demarcation and management of workplace according to processes, activities, design, etc. Worksite inspections Implementation of best practices and lessons learned from the past experiences at workplace
4	H&S Risk Management	Set of systems and processes for managing Health & Safety risks Job Hazard analysis Hazard ranking/risk matrix Corrective action plans Risk control levels analysis
5	Inventory Management	Maintenance of hazardous substance database
6	Task and Workflow Management	Calendar management Role assignments - Involving and informing workers, safety officers and others about their roles and responsibilities, allocated tasks, etc. Automated notifications
7	H&S Maintenance Systems	Performance and monitoring of H&S activities and corrective action as needed
8	Incident Management	Recording, processing, investigation, reporting and root cause analysis of any reported incident/accident/near miss/safety observations

9	Occupational Health Management	Health protocols Medical appointments Injury/Illness management Drug, alcohol and other medical testing
10	Management of Change	Identification of new hazards Introduction of new equipment Process change New regulatory requirements
11	Emergency Response Plan	Disaster management/Emergency response plan for all the potential predicaments based on predictive risk analysis Alarm system
12	Compliance Management	Comply with the obligations under pertinent local/national/global H&S regulations
13	Competency Management	Track capabilities/skills of workforce Trainings for employees, contractors and visitors Assessments
14	Content Management	Management of SOP/SDS, Health and safety documents
15	Contractor Management	Managing and coordinating activities of contractors
16	Rehabilitation Management	Tracks number of compensation days, rehabilitation information of workers
17	Statistics, Reporting and Dashboard	Relevant report generation from health and safety data Interactive dashboards for higher management view and decision making
18	Audit and Review	Audit and review programs to check and improve the effectiveness of implemented Safety and Health Management System

Given the perilous nature of the Oil and Gas industry, the need for implementation of an efficient Occupational Safety and Health Management System (OSHMS) is important for improving safety and health performance. Many countries have extensively participated in it by making strict and obligatory Occupational Safety and Health (OSH) standards and legislations. For example, on 10th June 2013, the EU adopted a Directive on safety of offshore oil and gas operations. The new directive sets clear rules that cover the whole lifecycle of all exploration and production activities from design to the final removal of an oil or gas installation. Because of the regulatory compliance pressure, the principal responsibility of ensuring operational safety and sustainability is placed on the Oil and Gas industry. OSHMS not only provides a systematic and synchronized proactive approach to managing occupational health and safety risks, but also helps in defining strategies for implementing control actions, performance substantiation, resource mapping and competency management. Moreover it also helps in enhancing organization's brand image in today's competitive scenario.

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Vasyliv Nataliia

Assistant of Department of Environmental Protection Technology
Ivano-Frankivsk National Technical University of Oil and Gas

AIR EMISSIONS IN OIL AND GAS DEVELOPMENT SECTOR

Toxic air monitoring is essential in the oil and gas industry for ensuring worker safety, environmental protection, and operational efficiency.

By detecting harmful airborne contaminants, toxic air monitors play a critical role in maintaining safe working conditions and preventing health hazards.

This paper explores the types of toxic air monitors used, common contaminants detected, their applications, and the benefits they provide.

Occupational safety in the context of air pollution from the oil and gas industry is a critical concern due to the presence of hazardous airborne substances that can significantly affect worker health and safety. Here's an overview of key aspects:

1. Sources of Air Pollution in Oil and Gas Industry:
 - ✓ Volatile Organic Compounds (VOCs): Emitted during drilling, storage, and transportation (e.g., benzene, toluene).
 - ✓ Hydrogen Sulfide (H₂S): A toxic gas often found in natural gas and crude oil.
 - ✓ Particulate Matter (PM): Released during flaring, combustion, and equipment operation.