

Sustainable Development and Health, Safety and Environmental Management in Offshore Oil and gas Drilling and Production Industry

O Aboul Dahab^{1*}

Faculty of Science, University of Alexandria, Alexandria, Egypt



Abstract

This work presents the main elements of health, safety, and environmental management programs in offshore oil and gas drilling and production industry. These elements are:

- i. management commitment,
- ii. accountability,
- iii. employee involvement,
- iv. hazard identification and control,
- v. incident/accident analysis, vi. training, and
- vi. program evaluation and continual feedback and health, safety, and environmental performance improvement.

The present work is an attempt to answer the difficult question, "how to achieve sustainable development while drilling and producing oil and gas from offshore areas?" It summarizes the importance and benefits of the development and implementation of health, safety and environmental management systems (HSEMS) for offshore oil and gas drilling and production companies. It focuses on hazards and effects management process (HEMP) as a tool for preparing of simple, measurable, achievable, realistic, dynamic and time based HSEMS. HEMP steps are

- i. identify hazards,
- ii. assess the risk,
- iii. control the threats,
- iv. recover the consequences if needed, and. document and communicate the results. It delineates the components of an effective HSEMS and explains how to simply use and implement the system by the company employees especially with regard to the hazards and effects register and the HSEMS activities catalogues. The present work also highlights the potential use of HSEMS and its integration with health, safety, and environmental impact assessment studies (HSEIA), asset integrity management systems (AIMS), health, safety, and environmental monitoring and auditing, and environmental management systems (EMS) in achieving business continuity, continual health, safety and environmental performance improvement, and sustainable development in offshore oil drilling and production industry.

Keywords: Hazards and effects management process (HEMP); Health; Safety and environmental management system (HSEMS); Offshore oil and gas industry; Sustainable development

Introduction

The coastal and marine environments represent an important resource which can provide the current and new generations with considerable amount of their demands of water, food, energy, raw materials for several industries, oil, gas. and recreation, in addition to uses of sea water for industrial and transport activities. Appropriate use and management of the coastal and marine resources represent an essential requirement for the protection and continual use by the new generations. Damage to the coastal and marine environments has three potential costs to present to future human welfare. Human health may be harmed. Economic productivity may be reduced. The pleasure or satisfaction obtained from an unspoiled environment, often referred to as its "amenity" value, may be lost [1], Sustainable development is development that lasts. The drilling and production of oil and gas from coastal and marine reservoirs and the associated industries have high potential to produce negative environmental impacts

***Corresponding author:** O Aboul Dahab, Oceanography Department, Faculty of Science, University of Alexandria, Alexandria, Egypt

Submission:  September 09, 2020

Published:  November 13, 2020

Volume 5 - Issue 2

How to cite this article: O Aboul Dahab. Sustainable Development and Health, Safety and Environmental Management in Offshore Oil and gas Drilling and Production Industry. Nov Res Sci. 5(2). NRS.000609. 2020. DOI: [10.31031/NRS.2020.5.000609](https://doi.org/10.31031/NRS.2020.5.000609)

Copyright@ O Aboul Dahab, This article is distributed under the terms of the Creative Commons Attribution 4.0 International License, which permits unrestricted use and redistribution provided that the original author and source are credited.

and omit the numbers 1,5 mpacts and hamper the achievement of sustainable development [2]. Therefore, offshore oil and gas companies voluntarily or in compliance with legislation or code of practice of their regulating authorities develop and implement several practices to manage health, safety and environmental issues such as:

- i. health, safety and environmental impact assessment studies (HSEIA),
- ii. Health, safety and environmental management systems (HSEMS),
- iii. Health, safety, and environmental monitoring and auditing,
- iv. Environmental management systems (EMS),
- v. asset integrity management systems (AIMS) [3]. To achieve better health, safety and environmental protection and management in offshore oil and gas drilling and production industry companies can integrate between the above-mentioned practices [1,4,5].

Health, safety and environment is crucial for any oil and gas business because this industry, in most cases, produce its revenue from hazardous plants, hence, any incident or accident at those plants can lead to injuries, production loss and in some cases to fatalities and asset damage. Furthermore, pollution and environmental concerns are huge in oil and gas industry due to the type of products, gases, and material handled, produced or generated as waste [2]. In view of the hazardous nature of oil and gas industry, health, safety and environmental issues and their effective management becomes a key to any oil and gas business and can be considered as a tool for achieving sustainable development in this highly important industry. Health, Safety and Environmental Management System (HSEMS) provides a framework for managing health, safety and environmental issues [5,6]. It helps in achieving continuous occupational health, safety and environmental protection and improvement. The present work highlights the importance of having and implementing Health, Safety, and Environment Management System (HSEMS) for offshore oil and gas companies. It delineates the main components of an effective HSEMS and how to use and implement them in an effective way. It also focuses on Hazards Effects Management Process (HEMP) as a tool for preparing simple, measurable, achievable, realistic, dynamic, and time-based HSEMS [5,7].

The present work main objective is to articulate HSEMS as a potential means of ensuring continual health, safety and environmental protection from offshore upstream oil and gas industry. It also demonstrates how HSEMS when adequately implemented and integrated with other health, safety, and environmental management practices, it should help reduce negative health, safety and environmental impacts and help in achieving sustainable development in the offshore oil and gas highly important economic sector. Generally speaking, this work is an attempt to answer the difficult question "How to practice

the offshore oil and gas industry with minimal health, safety, and environmental negative impacts?". In other words, "How to achieve sustainable development while drilling and production of oil and gas from offshore areas?"

Methodology

This work is prepared using descriptive approach in addition to the writer knowledge and experience and the information gained during conducting health, safety and environmental management training courses and providing environmental protection consultancy services to several offshore oil and gas companies working in the Arabian Gulf area during the period from 2002 to 2010.

Results and Discussion

Health, safety and environmental management in offshore oil drilling and production industry usually implies on organizational structure, inputs, processes and outputs. Inputs include tools, machinery, facilities, time, equipment, materials, people, and money [8]. The company management commitment is measured, in part, by the quality of inputs to the health, safety and environmental management processes. The health, safety and environmental management program processes may imply on

- i. commitment: leading, managing, planning and funding,
- ii. accountability: responsibility and discipline,
- iii. involvement: health, safety and environmental department and committees and suggestions, hazard identification and control: inspection and observation,
- iv. incident/accident analysis: determine root causes,
- v. Training, and vii. program evaluation: processes design and performance.

Outputs may include safe/unsafe conditions and behaviors, number of incidents and accidents, accidents costs and high/low productivity, morale and trust [8]. Generally speaking, every management system is designed perfectly to produce what it produces. Safety, health, and environmental protections require the continual commitment of all company employees, contractors and suppliers.

i. Top management commitment means that every employer shall furnish employment and a place of employment which are safe and healthful for employees therein, and shall furnish and use such devices and safeguards, and adopt and use such practices, means, methods, operations and processes as are reasonably necessary to render such employment and place of employment safe and healthful, and do every other thing reasonably necessary to protect the life, environment, safety and health of such employees.

ii. Accountability means the duty to comply with environment, safety and health orders, decisions, and rules. Every employer, owner, employee, contractor and supplier shall obey and

comply with every requirement of every order, decision, direction, standard, rule and regulation, and do everything necessary or proper in order to secure compliance with and observance of every such order, decision, direction, standard, rule or regulation.

iii. Employee involvement simply means the direct participation of employees to help the company to fulfill its health, safety and environmental policy and mission and meet its objectives by applying their own ideas, expertise, and efforts towards solving problems and making decisions [9]. To facilitate the implementation of the company HSEMS, the employee health, safety and environmental responsibilities can be incorporated in his job description sheet with cross references to the associated parts of the company HSEMS.

Hazard identification and control process includes:

- i. identification of the potentially health, safety and environmental harmful hazards, measurements to estimate the consequences of the hazards,
- ii. estimation of the probability of the occurrence of each hazard consequence,
- iii. quantitative calculation of risks and comparison with potentially acceptable hazard levels, characterization of the hazard risks to be managed, along with the assumptions and uncertainties, and
- iv. ranking of the risk hazards for management decision making [10]. The hazard control process includes hazard identification, risk assessment, administrative controls, engineering controls, emergency response planning, operation and emergency training, accident and incident investigation, near-miss review, internal and external audits, and feedback and iteration.

The main categories of hazards in offshore oil drilling and production industry may be hydrocarbons, chemical reactions, pressure, hazardous equipment, hazardous jobs, differences in height, flammability/fire, heat/temperature, electricity, acceleration, vibration/noise, explosives, toxic substances, corrosive substances, maritime transport, on land transport, in air transport, dangerous goods transport, biological agents/pathogens, medical hazards, ergonomic hazards, confined spaces, maintenance jobs, radiation, use of natural resources, stress & psychological hazards, general & miscellaneous hazards such as objects under tension or compression, drugs, alcohols & weapons, contractors & visitors, defective/incorrect tools, poor housekeeping. environment hazards, stress, and workplace violence. v. Incident/accident analysis: the term incident refers to all accidents and near-miss events that did or could cause injury or death, property damage or loss, or environmental harm. By determining what went wrong, and why it went wrong, we can greatly reduce or eliminate their recurrence. Potential benefits of incident/accident investigations may be: all incidents will be reported and investigated. Root causes

of incidents will be determined, appropriate preventive measures and corrective actions will be identified, operations knowledge, techniques, and facilities will be improved, process and equipment safety will be enhanced, safety awareness of employees will be increased, overall health, safety and environmental program will be improved, operations will achieve greater compliance with authorities regulations, detailed records will be available to support litigation, and incident losses will be better controlled. vi. Training: The process of change begins with the individual consciousness. Training is needed to raise understanding of the "what, why, when, where, who and how" of the health, safety and environmental management program. Different employees need different training methods and activities. Types of health, safety and environmental training may include: awareness of health, safety and environmental {HSE} issues, company HSE policy, HSE skills enhancement, HSE compliance and HSE management. HSE awareness training should be presented differently at levels of the company, depending on responsibilities, proximity in high risk activities and it should start with the most senior management [8]. Training methods and activities may include seminars, workshops for senior managers and lectures, videos, on -the-job training by peers, supervisors or managers for operators, informal lunch-time chats and presentations, in-house newsletters and magazines, poster displays, external courses, conferences, and seminars, in addition to any general, on-going communication of the HSE messages. Effective training allows audience to benefit from shared experiences, needs, concerns, and pressures. vii. HSE management program evaluation: The successful HSE management requires effective design and implementation with continual feedback as follows: Plan: plan and develop improvements, then Do: implement improvements, Study: monitor process, then Act: adopt, abandon, or revise program as needed and feed the results to the planning step [5].

Health, Safety and Environmental Management System (HSEMS) is the company structure, responsibilities, practices, procedures, processes and resources for implementing health, safety and environmental management [1]. The effective HSEMS requires strict commitment for its implementation at all company levels from the senior management to the operators, in addition to continuous introduction of improvement corrective actions. It may include

- i. company health, safety and environmental (HSE) policy and strategic objectives,
- ii. organization, resources and competence,
- iii. risk evaluation and management,
- iv. planning, standards and procedures,
- v. implementation and monitoring,
- vi. audit,

- vii. management review [5,6,8,9],
HSEMS is important to
 - i. fulfill the concerned authorities' requirements,
 - ii. protect employees, contractors and the public,
 - iii. reduce negative environmental impacts,
 - iv. help to keep on the facilities and equipment integrity,
 - v. maintain company image,
 - vi. Safeguard local community,
 - vii. achieve better safe and financial results,
- viii. enhance efficiencies of facilities and equipment, machineries and employees,
- ix. Manage health, safety and environmental risks,
- x. support and integrate with other management systems especially those for quality, asset integrity and environmental management [4,12].

The HSEMS typical components are usually manual and case [5,6,8]. The manual includes

- i. company HSEMS elements,
- ii. HSEMS activity catalogue,
- iii. references, documents, codes and standards,
- iv. shortfalls and remedial action plan, and
- v. HSE hazards, effects and aspects,

while the HSE case implies on

- i. introduction and management summary for facility or operation,
- ii. company HSEMS
- iii. safety case activity catalogue,
- iv. description of operation and assets,
- v. hazards and effects register,
- vi. shortfalls, and
- vii. statement of fitness.

The main goal of any company HSEMS is to control threats and escalation factors in such a way that the likelihood of the hazard being released and the potential consequences thereof are reduced to be as low as reasonably practicable (ALARP). The hazards and effects management process (HEMP) represents the heart of the HSEMS and is carried out within a structured framework which include i. identification of hazards and their potential threats, ii. evaluation of risks, iii. recording of hazards and effects, iv. comparison with objectives and performance criteria, and v. establishment and

implementation of risk reduction measures. HEMP results are required for the preparation of the company HSEMS hazards and effects register and also for activities catalogues for both the HSEMS manual and case [5]. The hazards and effects register is required for carrying out the company health, safety and environmental impact assessment, especially when control of major accident hazards (COMAH) report is required. It is also interdependent and integrated with the company asset integrity management system (AIMS) and health, safety and environmental studies (HSEIA) [1,12]. Activities such as seismic surveys, exploration drilling, production operations, field development, pipeline construction, waste treatment, handling, storage and disposal operations usually need HSEIA studies which depend and integrate with the company hazards and effects register and HSE critical activity catalogues. HSEIA is a systematic process of identifying the impact of existing, new or substantially altered projects related to health, safety and the environment. One of the main objectives of the HSEIA report is to demonstrate that environmental impacts have been systematically identified, assessed and mitigated.

Asset integrity simply means that the asset is operated and maintained so that the combination of the probability of failure and the negative consequences of failure makes the risk to people, to the environment and to the company assets as low as reasonably practicable (ALARP) [13]. Asset integrity management (AIM) is a strategy directed towards optimizing asset performance against target criteria such as total cost, environmental and safety concerns for the full life cycle and thus maximizing the profit and return for the asset owner. AIMS can be defined as the continuous assessment process to assure facilities integrity is measured and maintained on a permanent basis [13]. In simple words AIMS objectives are to use your assets per the designer intention in safe way for its life span or more. Oil and gas offshore drilling and production industry is not an exception from other industries in its bad need for AIMS. It is suffering from several environmental problems such as high level of humidity, tight designs, working outdoor, salty atmosphere, etc. Due to the close resemblance, seamless integration and smooth interaction between AIMS and HSEMS is of paramount importance to the success of both systems. Both systems to be integrated into the company management framework (CMF) in the same fashion. The intention behind this approach is to make AIMS a slave of HSEMS, which will serve:

- i. capitalize on the commitment and drive towards the health, safety and environmental (HSE) management within the company,
- ii. eliminate duplication of efforts as much as possible, and
- iii. drill in the fact that integrity management and HSE management are inseparable, However, AIMS covers both HSE-critical and business-critical equipment, systems, tasks, and activities [5,13]. The HSEIA report has a static nature and serves as basis for post-project monitoring and reference for performance evaluation within an HSEMS. It details significant HSE impacts,

mitigation, compensation and continual improvement actions as identified by HSEIA. To achieve better HSE protection and management in offshore oil and gas industry, the companies may consider the integration between HSEIA and HSEMS. Achieving integration is possible through a system that ensures negative impacts are predicted and mitigated as part of HSEIA, and that any residual impacts are managed through a continuous improvement process, which is a major feature in HSEMS.

The company employee before carrying out his designated activity he has to read the relevant hazard register sheet which usually shows the results of the Bowtie risk evaluation method, and

- i. understand (threats, consequences and risk assessment, exposure and escalation factors),
- ii. determine (appropriate control measures, recovery and preparedness measures, deficiencies and remedial actions,
- iii. check (availability of control and recovery measures and resources, and his competency to control and recover the effects of hazards at his workplace), and then iv. carry out his activity [5].

HSE critical activity technical meaning is the one which is related to HEMP steps and components. The HSEMS activity catalogue is a quality record for all HSE critical activities of the company. It consists of several specification sheets or activity records (one sheet for each HSE critical activity). The HSEMS manual critical activities catalogue is based on company level processes information (company managers), whereas for the HSE case we need facility/operation level information (supervisors, operators and technicians). The HSEMS activities catalogues will help the company employees to

- i. identify and assess hazards (HEMP),
- ii. arrange to control risks to ALARP level,
- iii. arrange to deal with emergencies,
- iv. better conduct audit and training,
- v. identifies areas for HSE improvements,
- vi. define the requirements and responsibilities of HSE management to all levels of the company [7,9].

The company employee has to read the HSEMS activities catalogues specification sheet related to job description and i. understand (the hazard management objectives, the methods to be used to achieve objectives, HSE critical inputs and outputs of the activity, form of recording activity, methods of verifying activity, and deficiencies), ii. determine (the tasks, accountable party, and competency requirements), iii. check his performance against the mentioned performance indicators).

Conclusion

The elements of offshore oil and gas companies' health, safety and environmental management program are management

commitment, accountability, employee involvement, hazard identification & control, incident/accident analysis, training, and program evaluation & continual feedback. HSEMS is a specific, measurable, achievable, realistic and time-based system, in addition, it is a dynamic system which is constantly subject to regular and irregular revisions for continuous health, safety and environmental performance improvement. Business continuity, sustainability and continual improvement in the company Health, safety and environmental performance can be ensured through the adequate implementation of the HSEMS which usually depends on the Deming model (Plan-Do-Check-Improve). The HSEMS components and structure may vary from one company to another but it always depends mainly on the results of the hazards and effects management process (HEMP). Critical HSE activities are those related and associated to HEMP steps and they are usually presented in the HSEMS activity catalogues. The company HSEMS can help in achieving sustainable development through the company commitment for i. using the best available environmental technology and practices, progressively reduce emissions, discharges and wastes, improve the efficient use of energy and conserve natural resources and ii. Identifying operational hazards and environmental aspects to manage HSE risks to level that ensures safety of people, protection of the environment and integrity of operation, and iii. hold all levels of management, supervision, and employees, in line function accountable for health, safety, and environmental performance. HSEMS can be considered as an essential requirement for the preparation and implementation of the company quality management system, HSEIA studies together with COMAH reports, and AIMS, which are all tools to achieve sustainable development and business continuity in offshore oil drilling and production industry.

References

1. Aboul DO, Shaaban N (2017) Environmental protection and management in coastal and maritime industries. *Oceanography and Fisheries Open Access Journal* 5(3): 1-2.
2. Onwukwe SI, Nwakaudu MS (2012) Drilling wastes generation and management approach. *International Journal of Environmental Science and Development* 3(3): 253-257.
3. Alexandra SW (2002) Adoption of international standard by transnational oil companies: Reducing the impact of oil operations in emerging economies. *Journal of Energy and Natural Resources* 20(4): 402-434.
4. Aboul DO, Shaaban N (2020) Importance of environmental management systems in ensuring environmental protection in offshore oil and gas industry. *Examines in Marine Biology and Oceanography* 3(2): 1-4.
5. Aboul DO (2019) Health, safety and environmental management in sustainable development of the offshore oil and gas industry. *Journal of Aquatic Research and Marine Sciences* 2(4): 1-3.
6. OHSAS 18001 (2007) Management system of occupational health and safety requirements.
7. E&P Forum (1994) Guidelines for the development and application of health, safety and environmental management systems. 6.36/210, London, UK pp. 1-45.

8. Margaret R (1997) Managing worker safety and health for excellence. Van Nostrand Reinhold, International Thomson Publishing Inc. edition, New York, USA, pp. 382.
9. Kochetkova OP, Glyzina TS, Vazim AA, Tugutova SS (2016) Ecological policy in oil-gas complexes, HSE MS implementation in oil and gas company. Earth Environ Sci 43: 012044.
10. ISO 19011 (2018) Guidelines for auditing management systems.
11. Charles WA (1999) Safety, health and environmental protection. McGraw-Hill ed., international editions US 40-66.
12. ISO 14001 (2015) Environmental management systems-requirements with guidance for use. Edn 3.
13. ISO 55000 (2014) Asset management – Overview, principles and terminology.

For possible submissions Click below:

[Submit Article](#)