

Research article

Risk Assessment and HAZOP Study of Oil and Gas Sector

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Abstract

The Environmental Risk Assessment and HAZOP study covers hazard management, record keeping and variety of Health, Safety and environment problems. The main objectives of the study are to evaluate existing risk management plan and HAZOP effectiveness in Oil and Gas sector. The results shows, that the average noise level was found within the range of 78.6 dB (A) during the study against the National Environmental Quality standard 85dB (A), waste water parameters (pH, BOD, COD, TSS, TDS, Grease and oil, Chromium, Lead, Silver, Barium) were measured against the standards, some of the parameters like BOD (510 mg/L) and COD (1159 mg/L) were exceeding the range of standards. Air emission parameters (CO, NO_x and SO₂) were measured but at some places like gas generator for power generation and heat medium skid NO_x was (567 mg/Nm³) which was exceeding the National Environmental Quality Standards. In result, the data reveals that the workplace conditions are good and low permissible hazards were found because industry has proper management system and control over risks and hazards. **Copyright © AJEPR, all rights reserved.**

Key Words: Environment Risk Assessment, HAZOP Analysis, Health & Safety, Oil & Gas Sector, Workplace, Hazards, Operability Study.

Introduction

In general environment includes air, water and land; all layers of the atmosphere; all organic and inorganic matter and living organisms; the ecosystem and ecological relationships; buildings, structures, roads, facilities and works all social and economic conditions affecting community life; and the inter-relationships between any of the

factors which are described above (PEPA, 1997).

Risk is defined as the probability and severity that a certain event will occur. The event which has occurred or going to occur has some unwanted outcomes which can be positive or may be negative. The events which are going to be occur has some ranges which vary from minor to disastrous, which mainly depends upon the condition (Martha Grabowski, 2006).

Therefore risk is defined as the result of frequency with which event is predicted to occur and the outcomes of that event.

Risk = Frequency x Occurrence

The frequency of that unwanted event is described as events per unit time, the frequency can be calculated by previous data, if it is easily available, or there are certain events happened in the past. Usually risk analysis centers on events which has more severe results and low frequency for which the data is established (Martha Grabowski, 2006).

The Hazard and Operability Study (HAZOP) form part of the Department's requirements for identifying and addressing hazards, and is a component of the integrated approval process The HAZOP process is used to identify potential hazards and operational problems in terms of plant design and human error. The technique should be applied to a plant during final design before construction commences, and there is some advantage in carrying out a preliminary HAZOP at an earlier stage to facilitate the design process (Avelino., I. Mondlane., 2003) .

This research identifies possible deviations from normal operating conditions which could lead to hazardous situations. The consequences and likelihood of such deviations are examined qualitatively. The adequacy and relevance of available safeguards to detect such deviations and prevent and/or protect against their resultant effects are also considered. This process enables a comprehensive evaluation of hazard control systems and produces recommendations for any necessary modifications. The overall result is a reduction in both hazards and potential operational problems, and the possibility of reduced down-time and smoother commissioning (Mubin., 2008).

Now a day's humans are living in the era of increasing frequency of environmental hazards, as population is continuously increasing , living standards are getting more improved and in same way the value of human property is decreasing, so by viewing this situation the environmental situation getting more worse and costly. Human's negligence can cause such hazards that cannot be fully rectified. There should be an estimate about the loss of human as well as property so that authorities can allocate such resources to alleviate the effected people miseries, hence preparedness and awareness is provided so that impacts can be reduced (Korean. H. & Bisesi, M., 2004).

The major concern of the industries of developing countries to focus on the occupational health and safety (OHS) and improving worker's productivity. Some common problems like improper work design, ill structured jobs, mismatch between worker abilities and job which worker demands, severe environment, poor human and machine system and inappropriate management. These factors lead to workplace hazards, poor workers health, injuries and increase cost. Ergonomics or human factor can reduce or improve worker's productivity, OHS and satisfaction. All these have direct or indirect effect on overall performance. It would very difficult for any company to attain its objectives unless it has attained the proper consideration for ergonomics (Ashraf et al., 2004).

MATERIAL & METHODS

Study Area

The group presently produces Oil & Gas from TAL Block as the operator of the concession. It also holds concessions for Margala and Margala North Blocks and has recently acquired significant shares in the Karak block as non-operating partner which is considered as another promising prospect for the future discoveries. The first ever hydrocarbon discovery in NWFP province named manzali in 2002 by the same company under study on kohat plateau, new focus area for exploration is under study. The company has made yet another gas/ condensate discovery namely makori (2005) which has reinforced the belief of many geologist that this

region can host large hydrocarbon reserves with upside touching tens of trillion cubic feet of natural gas. Nine blocks have been recently awarded in this province. The discoveries of Bhit, Badhra Sawan, Zamzama, Miano, Chanda, Manzalai and Rehmat have been developed, adding around 1.4 BCF per day of new gas into the system and enhanced recoverable gas reserves by 6.8 trillion cubic feet.

Main Focus

- The potential hazards related to workers health safety in oil and gas industry
- To carry HAZOP study in different sections of the company/ facility
- To mitigate these hazards by providing different types of controls
- Feasible to reach there.

Materials:

Table 1: Materials & instrument used for Waste Water measurement and Comparison

Sr. no	Parameter	Unit	NEQs	Method
1	pH	mg/L	6-9	HACH method 8156
2	BOD	mg/L	80	HACH method 8043
3	COD	mg/L	150	HACH method 8000
4	TSS	mg/L	200	HACH method 8006
5	TDS	mg/L	3500	HACH method 8163
6	Grease & Oil	mg/L	10	HACH method 8041
7	Chromium	mg/L	1	HACH method 8024
8	Lead	mg/L	0.5	HACH method 1.09717
9	Silver	mg/L	1.0	HACH method 8120
10	Barium	mg/L	1.5	HACH method 8014
11	Sodium	mg/L	-	Flame photometer
12	Magnesium	mg/L	-	Digital titration

Table 2: Material & instruments used for Gaseous emissions

Sr.No	Parameter	Unit	NEQs	method
1	CO	mg/Nm ³	800	Lancom series 2
2	Nox	mg/Nm ³	400	Lancom series 2
3	SO ₂	mg/Nm ³	1700	Lancom series 2

Methodology

Desk Study

Desk study was also modified by available documents, manuals and drawings, etc. related to site facility, QHSE policy and procedures of the company. Before the field visit detailed study of the documents was commenced.

Efforts were made to understand the salient features of the company's policy and procedure with regard to the HSE aspects so that a detailed evaluation of the compliance can be made. The major emphasis was placed on the review of company's policy, Emergency Response Plans (ERP), Evacuation Plan (EP), Firefighting Procedures and Standard Operating Procedures (SOP's).

Field Study

Field visits were carried out to investigate all risks, occupational hazards and other site hazards which are directly or indirectly related to worker's Health, Safety and Environment.

Identification of Hazards

In oil and gas facilities potential and actual hazards exist that must be recognized, evaluated and controlled in the working environment. The recognition, nature and severity of these hazards are based on many factors but we used the following points for carrying out hazard identification.

Process Analysis

The transformations of raw material into products and by products may result in the release of chemicals in the form of energy and this could affect the work environment at certain point. Analysis of all processes of these transformations were carried out to study the dangers and to provide awareness about these work dangers.

Interview and Questionnaire

The information provided by workers and management, regarding health symptoms, tasks and changes in conditions, that can provide essential details regarding process analysis. Health impacts, other stressors on the job that may be chemical, ergonomic or biological.

Walk - Through Survey

The Walk through Survey is also called the initial survey or inspection. Its purpose is to scrutinizing the operations and work practices, with the goal of identifying (Recognition) potential Occupational Stressor, their evaluation exposure, ranking the potential for exposure, identifying the routes of exposures, estimating the duration and frequency of exposures. So walk- through survey was also done.

Results & Discussion:

The gaseous emissions in below Fig 1 were checked at the glycol showering tower, the main fuel used was natural gas, the results are CO 111 Mg/Nm³, NOx 13 Mg/Nm³ and SO₂ 0 Mg/Nm³, these values were within the NEQS and cause no impact on the environment .

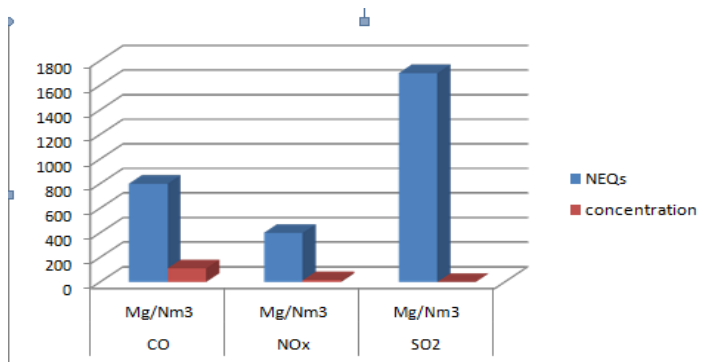


Figure 1: Gaseous Emissions at Glycol Emissions at Glycol Showering

Gaseous emissions at condensate heater in below Fig.2 were noted which are given CO 591 Mg/Nm³, NOx 567 Mg/Nm³ and SO₂ was 0 Mg/Nm³. The fuel used was natural gas the reading of CO and SO₂ are in range but the value of NOx is increased.

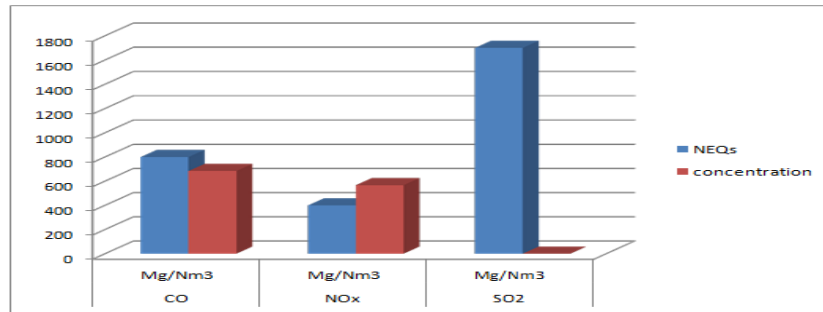


Figure 2: Gaseous Emissions at Condensate Heater

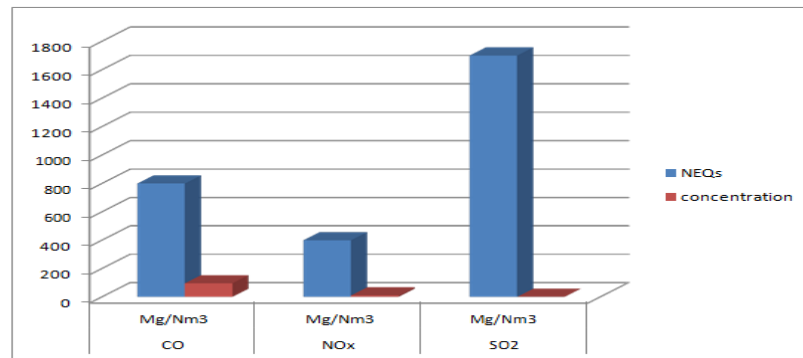


Figure 3: Gaseous Emissions at Power Generation Generator

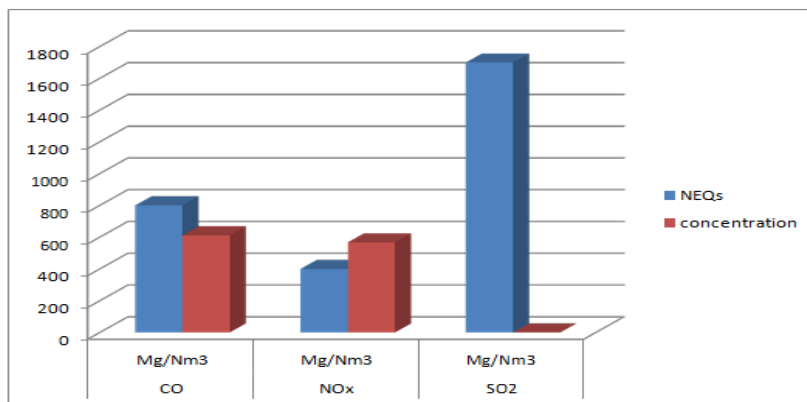


Figure 4: Gaseous Emissions at oil Heate

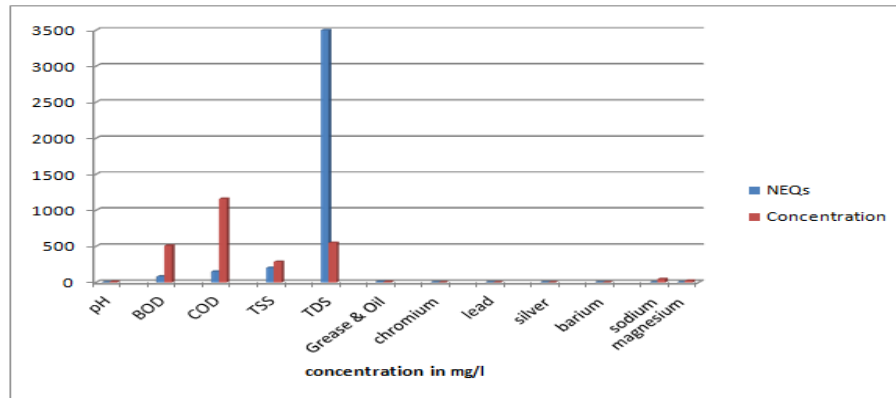


Figure 5: Wastewater Measurement for Grab Sample

Gaseous emissions at gas generator for power generation in Fig.3 below were noted which are given CO 684 mg/Nm³, NOx 567 mg/Nm³ and SO₂ was 0 mg/Nm³, The fuel used was natural gas the reading of CO and SO₂ are in range but the value of NOx is Gaseous emissions in below Fig 4 at heat medium skid were noted which are given CO 96 mg/Nm³, NOx 10 mg/Nm³ and SO₂ was 0 mg/Nm³. The fuel used was natural gas; all the parameters were in limit of NEQS.

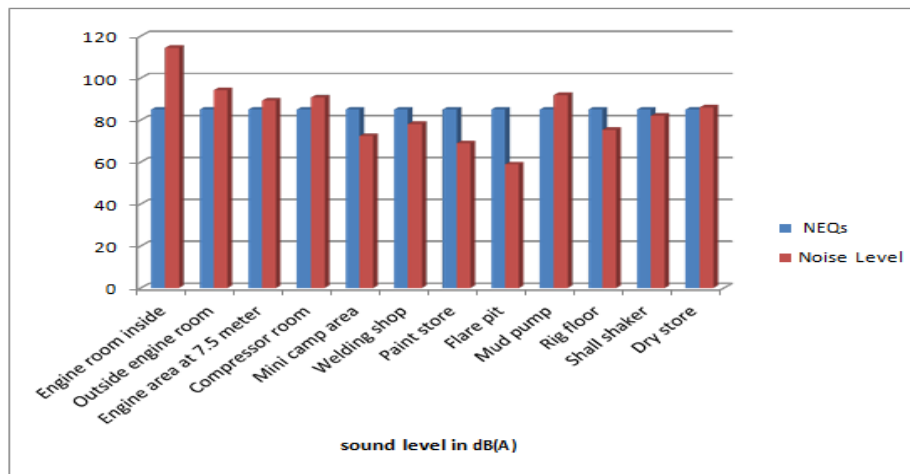


Figure 6: Noise Level Measurement

Grab waste water sample in above Fig 5 was collected from the facility, following parameters were and compared with the NEQS which are given pH, BOD, COD, TSS, TDS, Grease and oils, Chromium, Lead, Silver, Barium, Sodium and Magnesium. Most of the parameters were in the range of NEQS while TSS, COD, Sodium and Magnesium exceed the limit. These can have impact on the human body temporary as well as permanent. Noise level reading were in above Fig 6 noted from different locations in the facility, most of the readings were in the range of the NEQS, while there were some areas like the engine room 114.4 dB(A), compressor room 96.3 dB(A) and mud pump area 91.9 dB(A), these areas have noise level exceeded from the NEQS, these should be in limit but if not then it can cause temporary or permanent hearing loss, headache and fatigue.

Conclusion

The nature of the product and the hostile locations in which it is found means that oil companies must place the uppermost emphasis and priority on health and safety. Yet despite this, there have been some high profile incidents in the oil and gas industry which cause a great injuries and loss of life. In oil and gas sector, there are various health and safety issues present, which include thermal stress, noise level, and direct injuries from workplace. Other types of hazard are physical hazards (slips and fall), ergonomic hazards (vibration and uncomfortable working posture), chemical hazards (exposure to acids, solvents, hydrocarbon etc.)

To conclude that overall safety conditions in oil and gas sector are not up to mark and management need to be addressed the safety issues arising from the workplace. However administration is striving to facilitate its workers to ensure their safety so that hazards can be controlled in time before they turn into disaster.

Recommendations

After the recognition and evaluation, the most important part is to determine the specific type of hazard present in the workplace. For these hazards control methods are followed which fall under three categories:

1. Engineering control
2. Administrative control
3. Personal protective control

Following are here mentioned some of the recommendations regarding the control and prevention of the hazards at the work place.

- High level noise was found to be a major hazard in the working area, especially in the compressor unit, pumps and condenser. PPE like Ear muffs and ear plugs must be mandatory while on field.
- Temperature should be controlled in all sections where the temperature is very high especially in field area.
- Safety overall, shoes and gloves should be used.
- The workers should have the proper knowledge about the safety issues and the safety signs displayed in the workplace.
- All the workers should have the proper knowledge about the emergency exit planes and routes.
- All the workers should be aware of the work place hazards and the ways to reduce or eliminate them.
- Safety helmets and shoes must be worn during welding and related works.
- Sheds should be provided especially for those who work in high temperature work stations.
- Storage lockers and cabinets should be provided for the placement of chemical containers in all storage areas within the relevant sections to reduce the passage way spills and accidents.
- Static charge can lead to explosion at sampling points. Care must be taken while sampling and cotton overalls must be used.
- Oil spillage leads to assets and financial loss. Proper removal of spilled oil must be ensured to avoid any injury i.e. slips and trips
- Inappropriate placement of objects i.e. pipes; buckets and iron scrappers in walkways can lead to trips and consequently injury. Proper placement can reduce the rate of injuries.
- Emissions like NO_x and other flue gases can cause respiratory problems and cause air pollution. Proper supply of O₂ and maintenance of turbines may reduce the emissions.
- There should be proper lubrication of machines to avoid noise and manage the spilled lube oil properly for the safety of workers.
- Whereas, if it's not possible to reduce noise through lubrication, then that particular machine part should be isolated from the rest, or if isolation is not possible, the job rotation phenomenon should be adopted.
- All the workers should be trained how to respond the emergency and they should have appropriate understanding of emergency evacuation plan.

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