Noise Evaluation in oil and gas Fields and associated risk assessment

Wahid Salem Alzmzam (✉ wahid12258@gmail.com)

University of Tripoli <https://orcid.org/0000-0002-1370-9655>

Walid Bashir Alfaghi

Baker Hughes a GE Co LLC

Conference Paper

Keywords: Noise, risk assessment, sulfur recovery unit, cause and effect analysis, OSHA

Posted Date: February 9th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-161975/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Version of Record: A version of this preprint was published at Euro-Mediterranean Journal for Environmental Integration on December 1st, 2021. See the published version at <https://doi.org/10.1007/s41207-021-00249-4>.

Noise Evaluation in Oil and Gas Fields and Associated Risk Assessment

ABSTRACT

This work investigates the level of noise in oil and gas fields and its impact on the health of the operators, visitors, and trainees, as well as controlling noise within acceptable levels in the workplace by proper measurement. Risk assessment is done to identify the associated hazards of particular activities or tasks in the fields. Sulfur recovery unit (SRU) at a gas processing complex is the case study which consists of three production plants.

Many master points were randomly selected, where workers are present. Therefore, in order to sufficiently measure the level of noise, the measurement of the noise level was performed in different periods of time within the years 2014-2017 and was compared with OSHA limits. Results show that most of the gathered noise field data were beyond the permissive limits of OSHA (85 dB). Ishikawa Diagram depicts the analysis of cause and effect of over limits readings which are rotating machines, maintenance activities, steam leakages, fluid flow, and gas flaring.

Finally, the risk assessment presents that such workplaces may present a high noise risk score that could harm the workers.

Keywords: Noise, risk assessment, sulfur recovery unit, cause and effect analysis, OSHA

INTRODUCTION

Noise is defined as unwanted sound (Wright SE et al, 2001). Noise pollution is one of the important pollutant issues in workplaces and is almost one of the harmful agents for workers (Arefian S. et al, 2008). Most particularly, it can result in damage to the audio sensory mechanism and lead to premature and permanent loss of hearing (Aluclu I. et al, 2008).

The general effect of noise on the hearing of workers has been a topic of debate among scientists for a number of years (Jansen G., 1992). Regulations limiting noise exposure of industrial workers have been instituted in many places. For example, OSHA (Occupational Safety and Health Administration) provided the Occupational Noise Exposure Regulation which states that industrial employers must limit noise exposure of their employees to 85 dB (decibels) (USEPA 1973).

Exposure to continuous and extensive noise at a level higher than 85 dB may lead to hearing loss. Continuous hearing loss differs from person to person with the level, frequency and duration of the noise exposed (USEPA 1974).

In the lawn care industry, a lot of equipment produces noise levels louder than the recommended 85 decibels (dB). For example, the noise level of a lawn mower is 101 dB, a leaf blower is 110 dB, and a chainsaw is 120 dB (Common, 2013).

Occupational hearing loss is the damage to the inner ear from noise or vibrations due to certain types of jobs or entertainment (Zieve, 2010).

Negative effects of noise to human beings are generally of a physiological and psychological nature. Hearing losses are the most common effects among the physiological ones. It is possible to classify the effects of noise on ears in three groups: acoustic trauma, temporary hearing loss, and permanent hearing loss (Melamed et al, 2001). Blood pressure increases, heart beat accelerations, appearance of muscle reflexes have been observed as well. A great majority of people working in an industrial setting are exposed to noise (Cheung C., 2004).

In this study, the level of noise on human beings has been investigated with respect to the level of noise that is permissive limit of OSHA. In this context, measurement of noise is done at different period of time called discrete field data, the reason Behind the harmful phenomena was analyzed according to Ishikawa Diagram (cause and effect Analysis), risk assessment will be done to know how risky this phenomenon is to workers.

MATERIAL AND METHOD

Study Area

The Western Libyan Gas Project is the case study which is a joint venture between the Libyan National Oil Cooperation and the ENI Gas Company. In 2005, The Libyan Ministry of Energy reported that the project to be the Libyan's most ambitious non-associated gas project and it have expected that the project's first flow in 2005 will mark a significant change in the Mediterranean Sea as this landmark \$6.4 billion for both fields development supplied about 2 billion barrels. Bouri Oil field has held "pride of

place” since 1980s as the premier producing development off the coast of Libya.

The project is the contribution of two offshore fields named “Bahr Essalam and Sabratha Platform” and the onshore fields named as “Wafa Field and Mellitah Complex.” Both fields produce approximately 30 million Sm³/day of gas, 60,000 barrels of oil/condensate daily, along with 15,000 b/d of liquid propane and butane and some 500 t/d of sulphur, brief descriptions of project’s fields are mentioned as follows:

Mellitah Complex consists of three gas plants; all are connected with three sulphur recovery units (SRU) via a common acid gas header. The main function of the SRUs is to treat sour gas from the gas plant, which contains CO₂, H₂S, and water in some cases hydrocarbons (HC) (Mellitah Oil and Gas B.V., 2006). The sour gas is fed to the H₂S enrichment unit to increase the H₂S concentration, and then the Amine Acid Gas (AAG) is fed to Claus unit where the H₂S is converted into sulphur.

Fig .1, Mellitah complex overview.

Field Work

Sound is measured in decibels (dB) using sound level meters. These meters measure the pressure of the sound waves. The noise-measuring meter used in this survey was sound level meter RION NL 52, sound level meter with a range of 30 to 130 dB, It is also compliant with the Occupational Safety and Health Act of 1970 (OSHA). Noise standards used in this survey is OSHA standard as shown in table (1):

Table (1): OSHA Noise Permissible Limits

Daily Exposure (hrs)	Sound Level (dB)
16	85
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
½	110
¼ or less	115

Risk Assessment

The likelihood of an occurrence means the probability of an event happened. It ranges from "very likely" to "very unlikely" and according to measured field data in this study, Table (2) shows the likelihood rating with its description. The

severity divided into five groups, ranges from "Very Low" to "Extreme" and given the rate of 1 to 5.

Table (2) Noise Probability for Field Data

Definition	Noise level	Probability %	Probability Rating
Very unlikely	0-10	0	1
Unlikely	10-50	0	1
Possible	50-85	14	2
Likely	Over 100	24	3
Very likely	85-100	62	4

Table (3) shows the severity level with its description, and according to noise effect, the impact rating in this study was based on the degree of danger of noise level.

Table (3): Noise Level Vs Impact for Field Data

Decibel	EFFECT	Impact rating	
0-10	Hearing threshold	1	Very low
10-50	,Quiet	2	low
50- 85	Annoying, intrusive, interferes with phone use Possible hearing damage	3	Medium

85-100	Damage if over 1 minute	4	high
More 100	Human pain threshold, Eardrum rupture	5	Extreme

Risk matrix is the outcome of study result based on likelihood and severity method, relative risk is the product of likelihood and severity. The risk score with respective action needed to be taken is shown in Table (4). The higher score obtained from the multiplication of likelihood and severity rating the higher risk level.

Table (4): Risk Description (DOSH 2008)

Risk score	Description	Action
1-4	Low	Acceptable, further reduction
5-12	Medium	Temporary measures
13-25	High	Immediate action

RESULT AND DISCUSION

According to gathered field data for sulfur recovery units (Plant1, Plant2 and Plant3) and Gas Plant4 and Steam Turbine Plant5, noise surveys were done and figures below represent master points and noise level (dB), Fig.2, shows that noise levels at different master points in Plant1 area, they are almost over range (85 decibel), which harms operators hearings, and must not allow longer exposure in accordance with OSHA standards for exposure time to protect people.

Fig. 3 presents that noise levels at different master points in Plant2 area, they behave the same manner as Plant1 and almost over range on what as OSHA recommended (85 decibel).

Fig. 4 shows that noise levels at different master point in Plant3, the noise levels almost over range according to OSHA limit (85 decibel). The risk assessment of noise field data demonstrated that the high level of noise due to gas processing operations may cause risks for workers as a result of high probability and impact.

Fig. 5 and 6 depict that noise levels at different master points in Plant4 and Plant5 respectively, are almost over range according to OSHA limit (85 decibel). Therefore, this might cause risks for workers as a result of high probability and impact.

Fig .2 Plant 1 Noise level VS OSHA

Fig 3 Plant 2 Noise level VS OSHA

Fig .4 Plant 3 Noise level VS OSHA

Fig.5 Plant4 Noise level VS OSHA

Fig.6 Plant5 Noise level VS OSHA

Fig. 8 Cause and Effect Diagram for Noise in Industrial Plants

Table (5): Risk Registry

ID	Description	Area	EFFECT	who may be harmed	p	I	S	Response strategy	Risk Response Action Plan
1	noise level (0-10) decibel	Plants(1,2 and 3)	Hearing threshold,	operators, contractors, and visitors	1	1	2	Accept	Ear protection zones in Applied Unit, Warning signs
2	noise level (10-50) decibel		Quiet		1	2	2	Accept	Ear protection zones in Applied Unit, Warning signs
3	noise level (50-85) decibel		Annoying, intrusive, interferes with phone use,		2	3	6	reduce	PPE, Limited work times in vicinity of high noise exposure
4	noise level (85-100) decibel		Possible hearing damage		4	4	16	avoid	Reengineering, awareness, mitigates.
5	noise level (over 100) decibel		Damage if over 1 minute, Human pain threshold		3	5	15	avoid	.

S: Risk Score, I: Impact, P: Probability

Conclusion and Recommendation

Result shows that the noise survey for sulfur recovery unit has high noise level, which is almost exceeds the lower exposure level of 85 dB. The Ishikawa diagram shows the main reasons of high level of noise inside sulfur recovery plants are steam leakages, pressure safety valves, vibration of fluids flow, flares, and rotating machine such as compressor, pumps and fan cooler. Also this high

noise level due to maintenance activity like hammering and welding, this high level can harm people working in such oil and gas facility, and cause disease such as possible hearing damage, Human pain threshold, and eardrum rupture. Finally the oil and gas facilities are a source of high level noise and this phenomenon has high risk value, because it may Increase the likelihood of accidents and high health impact on human

body. So the control action of high noise level is to reduce exposure time, using PPE (personal protective equipment) modify the process, reengineering practices, and reduce noise from the source.

ACKNOWLEDGMENT

The authors would like to thank Mellitah oil and Gas Company, especially operation department coordinator, Superintend and complex manger whom always support us and the scientific research.

On behalf of all authors, the corresponding author states that there is no conflict of interest.

REFERENCE:

- WrightSE, Atmoko H (2001). Active control of environmental noise, V: the effect of environmental change on the stability of free field sound canceling system. J of Sound and Vibration 28: 107-122.
- Golmohammadi R, Atari SQ, Arefian S et al, (2008).A rapid method for estimating of noise exposure in work-places. J Research Health Sciences (JRHS) 2008; 8(2): 21-27.
- Aluclu I, Dalgic A, Toprak ZF (2008).A Fuzzy logic-based model for noise control at industrial workplaces, Applied Ergonomics 2008; 39: 368–378.
- JANSEN G (1992), Effects of noise on human beings,VGB (German) 72 (1), 60.
- USEPA (United States Environmental Protection Agency)(1973).Public health and welfare criteria for noise. United States Environmental Protection Agency, Washington (DC), July.
- ELEFTHERIOU, P. C(2002).Industrial noise and its effects on human hearing, Applied Acoustics, 63, 35.
- USEPA (United States Environmental Protection Agency)(1974).Information on levels of environmental noise requisite to protect public health and welfare with adequate margin of safety, (EPA/ONAC Rep. No. 550/9-74-004)
- MELAMED, S, FRIED, Y., FROOM, P (2001). The interactive effect of chronic exposure to noise and job complexity on changes in blood pressure and job satisfaction: A longitudinal study of industrial employees, Journal of Occupational Health Psychology, 6, 182.
- CHEUNG,C,K (2004).Organizational influence on working people's occupational noise protection in Hong Kong, Journal of Safety Research, 35, 465.
- Department of Occupational Safety and health (2008).Guidelines for Hazard Identification, Risk Assessment and Risk Control (HIRARC), Ministry of Human Resources of Malaysia.

Common environmental noise levels (2013), Retrieved from Center for Hearing and Communication.

Zieve,D.(2010).Occupational hearing loss-overview. University of Maryland Medical Center, Retrieved on 2012.

BIOGRAPHIES

¹Wahid S. Azmzam, (Msc Chemical Engineering), Senior Control Room Operator (Sulfur Recovery Unit), Mellitah Complex – Mellitah Oil and Gas B.V.

²Walid B. Alfoghi, (Msc Chemical Engineering), Senior Control Room operator, (Gas Plant), Mellitah Complex – Mellitah Oil and Gas B.V.

Noise Evaluation in oil and gas Fields and associated risk assessment

Wahid Salem Alzamzam¹, Walid Bashir Alfaghi²

^{1,2} Mellitah Oil Gas Company, ^{1,2}Enginnering Management Department,
Tripoli University. Libya.

²Email wahid12258@gmail.com, [Tel:00218916736514](tel:00218916736514)

Cover letter for submission of a paper to Springer journal

[Wahid Salem Alzamzam¹&Walid Bashir Alfaghi²]

[^{1,2}Mellitah Oil Gas Company. Libya]

[Tripoli-Libya]

[8/31/2018]

Dear Editor,

I/We wish to submit a new manuscript entitled “[**Noise Evaluation in oil and gas Fields and associated risk assessment**]” for consideration by the [Springer].

I/We confirm that this work is original and has not been published elsewhere nor is it currently under consideration for publication elsewhere.

In this paper, I/we report on Noise evaluation in oil and gas facility. This is significant because of human health and protection workers in such places. The paper should be of interest to readers in the areas of where there is a source of up normal noise.

[protecting humans and environment is highly significant and required to create a well life surrounding that is the novelty in this work which was done to raise an awareness to our colleagues and work mates who are with us exposed to the same level of high noise risk, so that as the springer is well known journal and is being read all over the world and concerns of environment and oil and gas safe working surround.

Thatexplains the significance of publishing our work at your paper.

Please address all correspondence concerning this manuscript to me at [\[wahid1258@gmail.com&walzmzam@yahoo.com\]](mailto:wahid1258@gmail.com&walzmzam@yahoo.com).

Thank you for your consideration of this manuscript.

Sincerely,

[wahidalzmzam&walidalfaghi]

Figures

Figure 1

Mellitah complex overview.

Figure 2

Plant 1 Noise level VS OSHA

Figure 3

Plant 2 Noise level VS OSHA

Figure 4

Plant 3 Noise level VS OSHA

Figure 5

Plant4 Noise level VS OSHA

Figure 6

Plant5 Noise level VS OSHA

Figure 7

Cause and Effect Diagram for Noise in Industrial Plants