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ANALYSIS OF NOISE INTENSITY AND ITS CONTROL EFFORTS IN WORK IN THE FABRICATION SHOP AREA OF PT. X BATAM IN 2025

Arimbi Julida Husna[1, a)] Ice Irawati[1, b)] Agung Sundaru[1, c)]

Author Affiliations
[1]*Occupational Health and Safety Study Program, Universitas Ibnu Sina, Batam, Indonesia*

Author Emails
[a)] Corresponding author: arimbijulidahusna@gmail.com
[b)]ice.irawati@uis.ac.id
[c)]agungsundaru@hotmail.com

Abstract. Noise in the Fabrication Shop area is one of the occupational risk factors that can endanger workers' health and safety. This study aims to analyze noise intensity and control efforts at PT. X in Batam City, a company engaged in offshore facility fabrication. Initial measurements showed noise levels ranging from 80.7 to 92.0 dBA, exceeding the Threshold Limit Value (TLV) of 85 dBA. This research used a case study descriptive qualitative approach. Data were collected through direct measurements using a Sound Level Meter (SLM), observations, interviews with workers and HSE officers, and document analysis. The findings indicate that grinding, welding, flame cutting, and gouging are the main sources of noise. Control efforts have included the use of personal protective equipment (PPE) such as earplugs and earmuffs, job rotation, and technical modifications. However, some areas still exceed the TLV. Further action is needed, including the use of low-noise equipment and improving workers' awareness of PPE usage to create a safer and healthier work environment.

Keywords: Noise, fabrication shop, control measures, occupational health and safety (OHS).

1. INTRODUCTION

One of the challenges faced in construction projects is the noise problem that arises during the project. Noise is defined as an undesirable sound that comes from the production process or work equipment that has the potential to cause a decrease in productivity at a certain level. A workplace hazard that can cause hearing loss at certain levels. The most common problem associated with noise is hearing damage that results from overexposure. Almost all workers are exposed to noise on a regular basis without experiencing hearing loss or losing the ability to understand normal speech. This condition is represented by the noise threshold value, which indicates the average noise pressure or noise level based on the duration of noise exposure for 8 working days. the noise limit is 85 dBA. If the noise level above the threshold is not monitored at each construction project site, problems will arise, and construction management must be carried out effectively [1].

According to Word Health Organization (WHO) research findings on hearing loss and deafness from 2018, up to 1.1 billion people between the ages of 12 and 35 are at risk of hearing loss due to noise exposure. According to WHO 018 data, more than 14% of industrial workers are exposed to noise levels higher than 90 dB at work, and about 20 million Americans are also exposed to noise levels higher than the 85 dB threshold. In 2018, Indonesia's Riskesdas reported that 2.6% of the Indonesian population had hearing loss. Indonesia has the largest number of hearing loss cases in Southeast Asia, with 3.6 million people, or 16.8% of the total population, experiencing hearing loss, based on data from the National Committee for Hearing Loss and Deafness in 2014 [2].

According to research results (Wibisono & Jawwad, 2024), the increased use of machinery in the production process can have a negative impact on the physical aspects of the work environment, such as increased temperature, unstable air pressure, radiation, vibration, inadequate lighting, and especially noise. Production machinery alone

produces three levels of noise: low, medium, and high. As production capacity increases, so does the level of noise generated by the machine. This noise not only disturbs the comfort of the work environment, but also spreads through the air and can affect the physical condition and concentration of workers. When these conditions no longer meet the required standards, the quality of work and comfort in the workplace decrease

Based on the results of the initial noise survey conducted on Monday, December 30, 2024, the noise level in the Fabrication Shop area was recorded in the range of 80.7 dBA to 92.0 dBA. These measurements were taken during ongoing activities that produce high noise. when grinding activities are carried out, the noise level increases significantly to reach 92.0 dBA. Given the high frequency and routine of hot work activities such as grinding, welding, cutting, and gouging that occur daily in the area, noise exposure in this work environment has a high potential health hazard for workers. In addition, the longer the duration of noise exposure, the higher the average noise received by workers, potentially increasing the risk of hearing loss.

Based on this explanation, a research on "Analysis of Noise Intensity and its Control Efforts at Work in Fabrication Shop Area of PT X Batam City in 2025" was conducted. This research focuses on measuring the noise level in various work activities, evaluating the measurement results, and identifying control measures that can be applied to ensure the noise level remains within the permissible limits.

2. LITERATURE REVIEW

2.1 Noise

Noise is an unwanted sound that comes from production process equipment or work tools, which at a certain level can interfere with hearing. The impact of noise disturbance depends on the intensity and frequency of the sound [3]. Noise is also one form of environmental pollution that cannot be eliminated, especially in the industrial sector. The use of machines in the production process has the potential to cause noise. If the noise level exceeds the standard limit set, it can reduce the quality of health, especially causing hearing loss to deafness. Continuous exposure to noise in humans can cause discomfort, physiological disorders, difficulties in communication, and the risk of hearing loss [4].

Noise is a significant problem, especially in relation to comfort. Noise levels that are too high can cause various negative impacts, both on health, psychological, and technical aspects. In terms of health, noise can cause damage to the hearing device. Psychologically, noise has the potential to cause emotional disturbances. Meanwhile, from a technical perspective, noise can be a sign of problems with the equipment used [5].

2.2 Types of Noise

According to Siswanto [6] and Suma'mur in [7] noise generated comes from various sources and can be categorized into the following types:

1. Continuous Noise (Steady State Noise) Continuous noise is a type of noise with intensity fluctuations that do not exceed 6 dB. For example, when measuring noise using a Sound Level Meter, only a slight difference is detected when the response button is changed from "fast" to "slow" mode.
2. Impact/Impulse Noise Impulsive noise is a type of noise that reaches its peak intensity in no more than 25 milliseconds, with a decrease in intensity to 20 dB below its peak in no more than 500 milliseconds. Examples of this noise include firearm explosions, cannon blasts, and hammer blows.
3. Intermittent/Interrupted Noise Intermittent noise is a type of noise that changes in intensity and is not continuous, where the sound appears and then disappears slowly. Examples of this noise include the sound of traffic and airplanes during takeoff. The sound level fluctuation in this type of noise is more than ±4 dB (A)/lin.

2.3 Noise Source

Noise is generated by the activity of machines operating in various industries. A noise source is a sound that is considered to interfere with hearing, whether it comes from a moving or stationary source. In general, noise sources can be found in industrial activities, trade, construction, power generation equipment, transportation equipment, and household activities. In an industrial environment, noise sources are categorized into three main types, namely [8]:

1. Machinery, noise generated comes from the activities of industrial machines and factories.
2. Grinding, the grinding process causes noise due to friction between the grinding stone and the metal surface being scraped. The high rotation of the grinding tool produces strong vibrations as well as sharp friction sounds. In addition, the electric motor that drives the tool also creates a constant humming sound.
3. Flame Cutting, cutting processes using gases, such as oxygen-acetylene or plasma cutting, can cause considerable noise. The high-pressure gas coming out of the nozzle at high speed produces a loud hissing sound. In addition, when the gas comes into contact with the metal surface, an oxidation and melting reaction occurs that causes a small boom or strong vibration.
4. Welding, the welding process produces less noise than grinding and flame cutting, but still has the potential to be annoying. The main noise source in welding comes from the hiss of gas or the electric spark that occurs when the electrode comes into contact with the metal surface.

2.4 NAB Noise

The safe noise limit for most workers is 85 dB, with a maximum duration of 8 hours per day or 40 hours per week. The threshold value of noise in the workplace refers to the highest intensity that can still be accepted by workers without causing permanent damage to hearing. Continuous exposure to noise for more than 8 hours a day or 40 hours per week risks causing permanent hearing loss [9]. The Threshold Value (NAB) of noise is considered safe for most workers, but does not guarantee full protection for all workers exposed to sound intensity of 85 dBA. Individual sensitivity to noise varies, so safety standards cannot protect all workers absolutely. Based on the Regulation of the Minister of Manpower of the Republic of Indonesia Number 5 of 2018 concerning Occupational Safety and Health in the Work Environment, noise limits in the workplace have been set in accordance with applicable regulations.

2.5 Noise Control Measures

Before noise is addressed, the company must formulate a countermeasure plan based on the results of the assessment of the noise level and its impact [10]. The hierarchy of noise-induced hearing loss risk control is organized by level of protection and reliability, from the most effective to the least. There are five main methods of controlling noise, namely:

1. Elimination, changes to processes, machinery, or equipment are implemented so that workers experience less noise exposure.
2. Substitution, the Replacement of high noise-producing machines with better alternatives, is done to protect workers from noise exposure.
3. Isolation, noise sources are isolated by the installation of silencers, barriers, or barriers to reduce disturbance to workers.
4. Administrative Controls, worker noise exposure is reduced by limiting the duration of exposure or the number of workers exposed to noise.
5. Personal Protective Equipment (PPE), in accordance with the opinion of Sri Redjeki (2016), the use of PPE is mandatory when working to protect workers and other people in the work environment from noise risks (Safe Work Australia, 2015) in (Isliko et al,.2022).

3. RESEARCH METHODOLOGY

This research uses a descriptive qualitative approach with a case study strategy to analyze noise intensity and its control effort in the fabrication shop area of PT X Batam. The research location is in Batu Ampar Sub-district, Batam City, and was conducted from April to May 2025. The selection of informants was done by purposive sampling, consisting of five informants, including an HSE officer, supervisor, and three production operators (cutting, grinding, dan welding).

Figure 1. Fabrication Shop

Data were collected through direct observation, in-depth interviews, noise measurement using a Sound Level Meter (SLM), and analysis of company documents. Noise measurement followed the procedure of Indonesian National Standard (SNI) 7231:2009.

Figure 2. Sound Level Meter

All data were analyzed using the (Miles and Huberman 2014) interactive model, which includes the stages of data reduction, data presentation, and conclusion drawing systematically to obtain a complete picture of noise conditions and the effectiveness of its control.

4. RESULTS

Measurement of noise intensity in the fabrication shop area of PT X Batam shows that all main activities produce high noise levels. Grinding activity was recorded as the highest noise source with intensity reaching 92 dBA, followed by gouging at 91.3 dBA, flame cutting at 90.8 dBA, and welding at 89.2 dBA. All of these values exceed the Threshold Value (NAB) of 85 dBA for an 8-hour work exposure. A comparison between the measurement results in December 2024 and May 2025 shows that most of the measurement points did not experience a significant decrease in noise intensity. In fact, at some points, there is an increase in noise values, especially in areas with high work frequency, such as grinding and cutting.

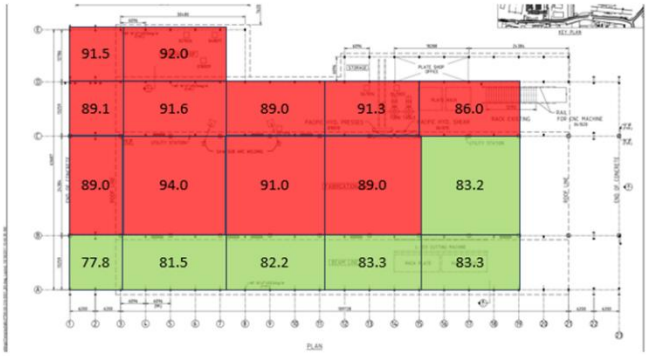

Figure 3. Map Fabrication Shop

Observations in the field revealed that most workers work in close proximity to noise sources. The use of personal protective equipment (PPE) is not optimal; many workers do not use earplugs or earmuffs consistently during work activities. In addition, there are signs related to mandatory PPE scattered in the fabrication shop area.

Interviews with several workers showed that they experienced complaints such as ringing in the ears and difficulty communicating during work due to noise exposure in the work area. However, workers stated that the rest periods provided were sufficient, and that the personal protective equipment (PPE) provided by the company was comfortable and never out of stock. Before starting work, the company also routinely holds briefings that emphasize the importance of using PPE. In addition, workers said that signs or signs of mandatory use of PPE in the fabrication shop area were very clear and easy to understand. The HSE stated that adequate PPE has been provided and regular appeals are made, but worker compliance remains a challenge. Elimination of noise sources has not been done significantly, while substitution through the use of new types of low-noise technology grinders is not continuing because it is considered less effective by workers. However, the mandatory PPE signs in the fabrication shop area are clear and easy to understand. This finding reinforces the observation and measurement results that noise exposure is still the dominant risk at the worksite.

5. DISCUSSION

PT X Indonesia is a major contractor in the oil and gas sector. The company operates in various fields, including engineering, fabrication, installation, procurement, research, manufacturing, environmental systems, and project management. PT X is located in Batu Ampar Sub-district, Batam City, Riau Islands.

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A comparison between the measurement results in December 2024 and May 2025 shows that most of the measurement points did not experience a significant decrease in noise intensity. In fact, at some points, there is an increase in noise values, especially in areas with high work frequency, such as grinding and cutting.

Based on the measurement results, all work activities in the fabrication shop area of PT X show noise levels above the NAB of 85 dBA. Grinding activities produce the highest intensity, which has the potential to cause hearing loss and reduce work concentration. This high noise exposure reflects the importance of implementing comprehensive controls in accordance with the noise risk control hierarchy.

At the elimination level, there are no significant efforts to totally eliminate noise sources, for example, by redesigning work processes or changing production methods. This is understandable considering that processes such as grinding and cutting are crucial parts of production. Similar findings were also recorded in Anas et al.'s research [1] in PLTD Rema, which stated that diesel engines, as the main source of noise, cannot be eliminated because their function is very important in the work system. Eliminating the engine or sound source will actually have an impact on the disruption of the overall production process.

Meanwhile, substitution efforts, such as replacing work tools with low-noise technology machines, have been attempted through the use of new types of grinders. However, replacement tools are considered less technically effective by workers, especially in terms of speed and working power, so their use has not been sustainable.

At the engineering level, the company has not implemented silencers, machine enclosures or acoustic screens in the work area. The unavailability of physical isolation from noise sources causes direct exposure to remain high. These findings are in line with the results of Yudisha et al. [10], who noted that high noise levels in several work areas of the Fatty Acid Plant Phase 2 unit of PT Permata Hijau Palm Oleo KIM II were influenced by the presence of compressor and cooling tower machines.

More dominant controls are carried out at the administrative control level, such as work rotation and exposure time restrictions. Although rotations have been implemented, the system is not uniform and lacks integration with the production schedule. Supervision has also not been fully effective due to the lack of direct monitoring in the field. This step is in line with the recommendations of (Syukri, et al., 2024), which emphasizes the importance of having warning signs at work sites with high noise levels. Research conducted by Isliko et al. (2022) revealed that in work areas with noise levels exceeding 89 dB(A), the implementation of administrative controls such as job rotation and regulation of exposure duration are very important steps.

The use of personal protective equipment (PPE) such as earplugs and earmuffs has become the most common effort in the field. However, its effectiveness is still low because workers' awareness of its use is uneven. Some workers claim to feel uncomfortable or distracted when using PPE, while the quality of the equipment also varies. In fact, based on Permenaker No. 5/2018, the use of PPE is only a last resort if technical and administrative controls are insufficient. This research is in line with [6] routine supervision should be carried out to ensure the condition of the PPE used is still in good condition. If damage or decreased function is found, the company will replace the tool. In addition, training on the use of APT has also been provided to all workers, which is carried out through briefing activities before they start working.

Overall, noise control at PT X still focuses on the lowest level of the hierarchy, which is PPE and partly administrative. In fact, to achieve sustainable effectiveness, it needs to be improved at the level of elimination, substitution, and engineering as the top priority as mandated by work safety regulations.

6. CONCLUSION

Noise levels in the Fabrication Shop area showed variations between 80.7 dBA and 94.0 dBA. A number of measurement points even recorded figures above the threshold set in Permenaker No. 5/2018, which is 85 dBA for an 8-hour work duration. Some of the activities that contribute most to the noise include grinding, welding, and flame cutting, with the highest sound intensity reaching 92.0 dBA.

The results show that noise control efforts in the Fabrication Shop area of PT X Batam City are still dominated by administrative control and the use of personal protective equipment (PPE), while implementation at the elimination, substitution and engineering levels is still very limited. There is no total elimination of noise sources because activities such as grinding and cutting are an essential part of the production process. Substitution efforts through the use of low-noise machines have not been sustainable due to limited technical effectiveness in the field. In addition, the absence of engineering applications such as soundproofing or acoustic insulation causes noise exposure to remain high. Administrative controls such as work rotation and setting the duration of exposure have been carried out, but their implementation has not been optimal and has not been fully integrated with the work system. The use of PPE is the main strategy implemented, but its effectiveness is still constrained by low worker compliance and variations in equipment quality. Therefore, it is necessary to strengthen the technical and administrative engineering aspects more systematically and increase workers' awareness of the importance of using PPE to create a safe and healthy working environment from noise exposure.

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