Journal of Vocational Health Studies

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NOISE MAPPING IN THE TURBINE AREA AT PT POMI

PEMETAAN KEBISINGAN PADA AREA TURBIN DI PT POMI

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Research Report
Penelitian

A B S T R A C T

Background: *One of the problems faced by industrial companies that use large machines and work equipment is noise. Steam power plant companies will certainly face noise problems in their work areas. PT. Paiton Operation and Maintenance Indonesia is one of the private power generation companies in East Java which manages three units of PLTU (Steam-Electric Power Plant) which in the process operates using a turbo generator. In addition, this company uses machines and equipment that produce noise that can potentially interfere with the health of the workers.* ***Purpose:*** *To map the noise with Golden Surfer software and to analyze the control efforts that had been carried out.* ***Method:*** *This research used an observational method and the analysis was done using Golden Surfer software.* ***Result:*** *The results of this study indicated that in general the noise that occurred in the turbine area exceeded the threshold value which was >85 dB. Furthermore, the results of the mapping showed the distribution pattern of noise levels that occurred in the turbine area starting from the first floor to the fifth floor. Noise control efforts were also carried out by the company, including noise measurements, scheduled preventive maintenance for machine repairs, safety sign, audiometric checks, work procedures, and PPE.* ***Conclusion:*** *In addition to this noise mapping, noise control efforts that have been carried out by the company will reduce the risk of health problems for workers. Thus, noise mapping can be used as a basic reference for companies to be able to determine additional noise control as an effort to prevent and control noise.*

A R T I C L E I N F O

Received 09 July 2022
Revised 12 July 2022
Accepted 23 December 2022
Available online 30 March 2023

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Keywords:
Mapping, Noise, PLTU, Turbine

A B S T R A K

Latar belakang: Salah satu masalah yang dihadapi oleh perusahaan industri yang menggunakan mesin dan peralatan kerja berukuran besar adalah adanya kebisingan. Perusahaan pembangkit listrik tenaga uap tentunya akan menghadapi permasalahan kebisingan di area kerjanya. PT. Paiton Operation and Maintenance Indonesia merupakan salah satu perusahaan pembangkit listrik swasta di Jawa Timur yang mengelola 3 unit PLTU, pada proses beroperasi menggunakan turbo generator. Selain itu, perusahaan ini juga menggunakan mesin dan peralatan yang menghasilkan kebisingan yang berpotensi dapat mengganggu kesehatan tenaga kerja. **Tujuan:** Untuk memetakan kebisingan dengan *software Golden Surfer* dan menganalisis upaya pengendalian yang telah dilakukan. **Metode:** Penelitian ini menggunakan metode observasional dan analisis yang dilakukan menggunakan *software Golden Surfer*. **Hasil:** Secara umum kebisingan yang terjadi di area turbin melebihi nilai ambang batas yaitu >85 dB. Selain itu, hasil pemetaan yang dilakukan juga menunjukkan pola persebaran tingkat kebisingan yang terjadi di area turbin mulai dari lantai 1 sampai dengan lantai 5. Upaya pencegahan dan pengendalian kebisingan juga dilakukan oleh perusahaan yang diantaranya pengukuran kebisingan, pemeliharaan preventif terjadwal untuk perbaikan mesin, rambu K3, pemeriksaan audiometri, dan prosedur kerja, APD. **Kesimpulan:** Disamping adanya pemetaan kebisingan ini, upaya pencegahan dan pengendalian kebisingan telah dilakukan oleh perusahaan sehingga akan mengurangi risiko timbulnya gangguan kesehatan pada tenaga kerja. Dengan demikian, pemetaan kebisingan dapat digunakan sebagai acuan dasar bagi perusahaan untuk bisa menentukan upaya pengendalian kebisingan tambahan sebagai upaya pencegahan dan pengendalian kebisingan.

Kata kunci:
Pemetaan, Kebisingan, PLTU, Turbin

Journal of Vocational Health Studies p-ISSN: 2580–7161; e-ISSN: 2580–717x
DOI: 10.20473/jvhs.V6.I3.2023.209-214

INTRODUCTION

According to the Minister of Manpower of the Republic of Indonesia, noise is unwanted sounds that come from a process or work equipment with a certain intensity that can potentially cause health problems for the workers (Minister of Manpower Regulation, 2018). According to Nasution (2019), noise is a disturbing sound caused by a vibrating sound source which causes the surrounding air molecules to vibrate. Sounds that exceed the threshold will interfere with human activities that are taking place in the environment. According to Harahap (2016), noise is one of the physical hazards that is found in the work environment that can cause occupational health problems, especially hearing problems. Noise with high intensity is a potential hazard that can interfere with the health of workers.

Noise causes not only disturbance to the sense of hearing, but also other health problems. According to Sujoso (2012), exposure to noise can cause two types of effects, namely auditory effects and non-auditory effects. Auditory effect is an effect that arises on the auditory system due to exposure to noise. The most serious hearing loss is deafness. Based on a study conducted by Minggarsari and Sahuri (2019), high intensity noise is a risk factor for auditory complaints in the workforce. The higher the noise exposure received by the workers, the greater the risk of auditory complaints that can occur. Meanwhile, non-auditory effects are effects that arise from exposure to noise in addition to effects on hearing such as physiological disorders, psychological disorders, and communication disorders. In line with Rimantho and Cahyadi (2015) noise can also cause physiological disorders, psychological disorders, communication disorders, and balance disorders. Physiological disorders can include increased blood pressure, increased pulse rate, sensory disorders, and sleep disturbances. Based another study conducted by Enggar and Zulfian (2018) noise can cause physiological disorders where noise can affect the blood pressure of workers. Psychological disorders can be in the form of anxiety, stress, and mood changes. Yusmardiansyah and Zhara (2020) also indicate that noise is a factor that can cause work stress, and workers who are exposed to noise are at greater risk of experiencing work stress. Besides, according to research conducted by Khalik and Hermawanto (2019), noise can also cause work fatigue in the workforce. This is in accordance with Suma'mur (2013) who states that fatigue occurring in the workforce can increase due to noise in the workplace. Further, disturbances that can be experienced by workers are communication disorders. Communication disorders due to noise happen because workers cannot hear clearly what is being said, which can lead to misunderstandings. In addition, disturbance of balance due to noise can give the impression that the workers is walking in space.

In the process of operating an industrial company, the use of machines and work equipment results in the emergence of noise. Workers doing daily work for eight hours can receive a noise intensity of 85 dBA without experiencing health problems (Minister of Manpower Regulation, 2018). Problems due to noise exposure can usually occur in large industries.

One of the industries that often experience this kind of problem is the power generation industry. PT. Paiton Operation and Maintenance Indonesia is a private power generation company located in East Java. The main task of this company is to provide electricity for Java and Bali islands. This company manages three units of electric steam power plant that use a turbo generator with coal as its fuel in its operation. The company also uses large work machines and equipment such as turbines, generators, condensers, and other work equipment. These machines and work equipment will certainly produce noise that has the potential to cause health problems for the workforce.

In order to see the distribution of noise levels, noise mapping needs to be done. According to Silviana *et al*. (2021), noise mapping describes the pattern of noise levels in a scope of work area. Besides Alam *et al*. (2020) assert that noise mapping is a graphical representation of the distribution of noise levels in certain areas and environmental conditions. Noise mapping provides a clear detail regarding the fine noise level around the machine. Based on Casas *et al*. (2014) noise mapping can be used to evaluate noise generated by industry and identify the main sources of noise in the industry. Marfuah and Handayani (2022) elaborate that noise mapping can be used to analyze and assess a noise risk in an industry. Further, Bozkurt and Demirkale (2017) add that noise mapping is carried out to obtain information for noise reduction planning. The noise intensity in the area under study or research should be determined and areas of the workplace exposed to high-intensity noise should also be identified. According to Baffoe *et al*. (2022), noise mapping also can be used as an important tool to assess noise intensity levels for planning, policy-setting and mitigation purposes.

Based on the above reasons, the researchers are interested in conducting a study on noise assessment based on noise mapping along with noise prevention and control efforts against noise intensity carried out by the turbine building area at PT POMI in Paiton, East Java. The purpose of this study was to describe and map the noise that occurred in the turbine building area starting from the 1st floor to the 5th floor with Golden Surfer software, as well as to analyze the control efforts that had been carried out in the turbine building area at PT POMI in Paiton, East Java.

MATERIAL AND METHOD

This research was conducted in the turbine building area at a steam power plant company, namely PT POMI in Paiton, East Java in March 2022. The method in this study was observational where the observation was conducted without intervening on the research subjects. The variables used in this study included

the results of measuring noise intensity in the turbine area using a sound level meter, noise mapping, and control efforts against noise exposure. The study took the object of research in the turbine building area at PT POMI in Paiton, East Java. The turbine building area was divided into five measurement points, namely the 1st floor turbine area, the 2nd floor turbine area, the 3rd floor turbine area, the 4th floor turbine area, and the 5th floor turbine area.

Sources of data used in this study are primary data and secondary data. The primary data in this research were obtained through measurements of noise intensity, interviews with safety personnel, and direct observation of the identification of noise sources and existing noise control efforts. The secondary data in this research were obtained from company records and documents related to noise at PT POMI. The results of the measurement of noise intensity were compared with the noise threshold value based on the Regulation of the Minister of Manpower of the Republic of Indonesia Number 5 of 2018.

This present study measured the intensity of noise that occurred in the turbine area using the Lutron SL-4012 Sound Level Meter for one measurement. In this case, the noise measurement procedure in this study followed the steps in SNI 7231:2009. The results of these measurements were analyzed using the Golden Surfer software which produced a colored contour map. This contour map would show the distribution pattern of noise levels that occurred in the turbine area. This study passed the ethical requirements at the Faculty of Public Health, Airlangga University with the number: 50/EA/KEPK/2022.

RESULT

Based on the results of noise measurements made in the turbine area, the noise source came from the machines and work equipment in the turbine area which were used to convert heat energy into mechanical energy that drove the generator. The results of the noise measurement in the turbine area showed that the noise was more than 85 dB. The multiple color category represented how much noise level was at that point. The distribution pattern of the noise level is categorized as follows (a) Noise levels between 73 dB to 78 dB are shown in purple – dark green, (b) Noise levels between 79 dB to 85 dB are shown in dark green – green, (c) Noise levels between 86 dB to 89 dB are shown in light green – yellow, (d) Noise levels between 90 dB to 94 dB are shown in light orange – dark orange, and (e) Noise levels >94 dB are shown in red. The following is a mapping of the noise level in the turbine area (Figure 1-5).

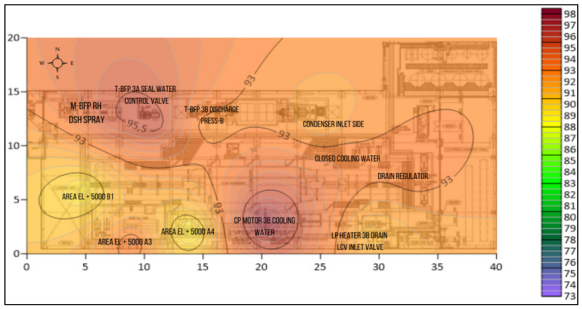

Figure 1. Noise contour map of 1st floor turbine area

Based on the results of noise mapping in Figure 1, it shows that the color tends to be close to red. This color indicates that the noise level is >94 dB.

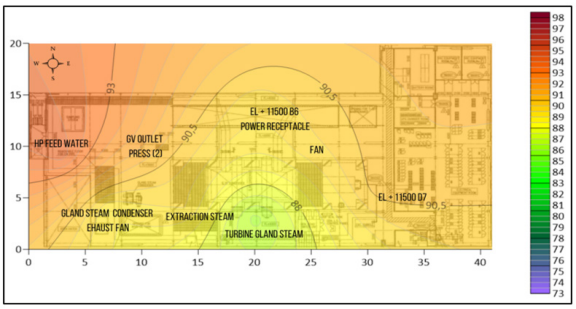

Figure 2. Noise contour map of 2nd floor turbine area

Based on the results of noise mapping in Figure 2, it shows that the color tends to be close to dark orange. This color indicates that the noise level is between 90 dB to 94 dB.

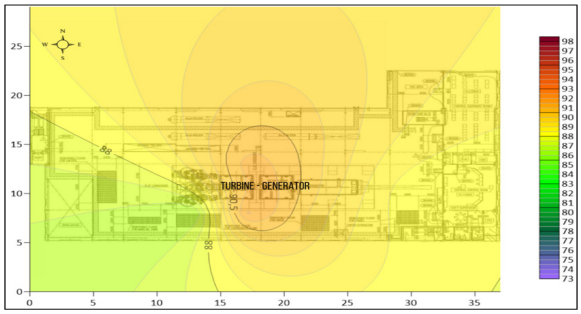

Figure 3. Noise contour map of 3rd floor turbine area

Based on the results of noise mapping in Figure 3, it shows that the color tends to be close to dark orange. This color also indicates that the noise level is between 90 dB to 94 dB.

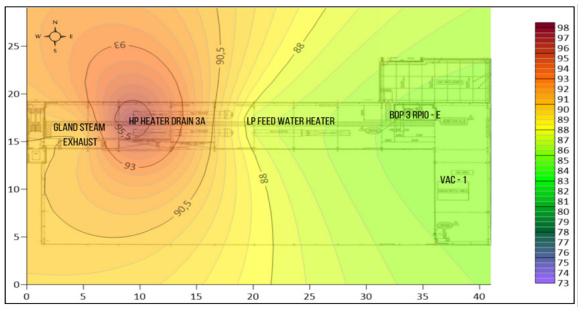

Figure 4. Noise contour map of 4th floor turbine area

Based on the results of noise mapping in Figure 4, it shows that the color tends to be closer to red. This color indicates that the noise level is >94 dB.

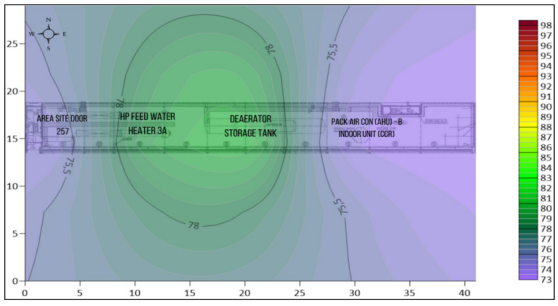

Figure 5. Noise contour map of 5th floor turbine area

Based on the results of noise mapping in Figure 5, it shows that the color tends to be close to green. This color indicates that the noise level is between 79 dB to 85 dB.

DISCUSSION

In the results of the noise mapping of the turbine area, there are several different color indicators that indicate the noise level in the area. In the turbine area on the first floor (Figure 1), the color of the contour map tends to be red, indicating that in that area there are machines in the form of T-BFP seal water control valve and CP motor cooling water. In the turbine area on the second floor (Figure 2), the color of the contour map tends to be close to orange, indicating that in that area there is a machine in the form of HP feed water. On the third floor turbine area (Figure 3), the color of the contour map tends to be close to orange indicating that in that area there is a turbine-generator. One of the important components in the operation of an electric steam power plant. The turbine serves to convert heat energy into kinetic energy where the blades on the turbine are designed to be able to accept water vapor pressure and produce mechanical energy. Furthermore, the generator functions to convert mechanical energy into electrical energy (Yuniarti and Aji, 2019). On the fourth floor turbine area (Figure 4), the color tends to be close to red, indicating that in that area there is a machine in the form of an HP heater drain. The turbine area on the fifth floor (Figure 5) shows that the noise is below the threshold value which is different from the turbine area from the first floor to the fourth floor. The turbine area from the first to fourth floor is in the room. Meanwhile, the fifth floor turbine area is located on the top floor and is outdoors. This noise mapping can represent the noise distribution pattern that occurs in the turbine area, so that it can support noise prevention and control efforts carried out by the company in the turbine area.

Based on the results of noise mapping, the highest noise intensity is on the first floor. Noise prevention and control efforts that have been carried out by the company on the first floor are providing a safety sign on the first floor area, providing earplug dispensers in front of the door before entering the turbine area on the first floor, and limiting access to enter the turbine area. In addition, the company has also made various noise prevention and control efforts in the turbine area. Every equipment and machinery used in the turbine area has a fixed reference regarding the noise level of the equipment and machinery. The company, in this case, the safety department, has re-checked the noise level produced with a fixed reference from the proper noise level for equipment and machinery. Noise in the turbine area is also measured and checked annually. This is in accordance with the Regulation of the Minister of Manpower of the Republic of Indonesia No. 5 of 2018 Article 10 Paragraph (1), which states that noise measurement and control must be carried out in workplaces that have a source of noise hazard from operating work equipment (Minister of Manpower Regulation, 2018). Based on a study conducted by Atina and Safitri (2020), measurements of noise levels need to be carried out to provide inputs in making policies in the work areas. Scheduled preventive maintenance for machine repairs is also one of the noise control efforts carried out by the company. It is in line with research conducted by Fanny (2015), routine machine maintenance is one of the efforts that companies can take to control noise. In addition, safety signs for the use of personal hearing protective equipment in the form of earplugs are installed in front of the turbine area door. The installment is intentional, so that before workers enter the turbine area, they can use personal hearing protection equipment in the form of earplugs that are already available in the earplug dispenser which is right next to the turbine area door. Properly fitted earplugs can reduce noise by 15 to 30 dB. According to a study conducted by Sulaiman *et al*. (2019), safety sign is one of the factors related to safety culture in the company. The better the communication between workers and the company through safety signs, the better the behavior of workers to avoid the risk of work accidents and occupational diseases.

The company has also established procedures for the use of personal hearing protective equipment; hence, workers can use it properly when working in areas with noise. Based on research conducted by Ayu *et al*. (2019), standard operating procedures or work procedures are one of the factors related to hearing loss. Workers who do not apply work procedures can be at risk of having hearing loss. The company also limits the access of workers who can enter the turbine area. Besides, the company conducts initial examination for new workers to collect the workers' initial health data that can later be compared with the results of health checks after they have worked for a certain period of time. This program will also provide an easier way for the company to see the potential for occupational diseases that may arise. This is in accordance with the Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia No. Per. 02/MEN/1980 Article 2

Paragraph (2) concerning workforce health examination and Implementation of occupational safety, which states that all companies must conduct a pre-employment health examination (Minister of Manpower and Transmigration of the Republic of Indonesia, 1980). According to Ridwan and Kamariah (2019), an initial health examination is very important. This examination is also the initial medical data of the worker that can be used to resolve occupational disease problems if it is found in the future.

Noise prevention efforts that are also carried out for its workers are audiometric examination that is carried out once a year. This is in accordance with the Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia No. Per. 02/MEN/1980 Article 5 Paragraph (1) concerning workforce health examination and implementation of occupational safety, which states that a special health examination is intended to assess the influence of certain jobs on the workforce (Minister of Manpower and Transmigration of the Republic of Indonesia, 1980). A special room for operators operating machinery and equipment in the turbine area is also available. Also, the company provides training to workers regarding compliance with the use of PPE once a year. According to Sasmita *et al*., (2021), workers' awareness of the importance of using hearing protection equipment in the workplace can be increased by providing training to the workers. Based on research conducted by Ayu *et al*. (2019), occupational safety and health training is one of the factors associated with workplace accidents. Workers who have never attended this training can be at risk of having work accidents. The training can serve to deepen the knowledge of the worker about PPE, the ability to use PPE, the regulations governing PPE, and change the behavior of the worker regarding the use of PPE. The company has also provided earplugs as hearing protection devices that can be taken from the earplug dispenser before workers enter the turbine area. This is in accordance with the Regulation of the Minister of Manpower of the Republic of Indonesia No. 5 of 2018 Article 10 Paragraph (4), which states that one of the controls to prevent hearing loss is to use appropriate personal protective equipment (Minister of Manpower Regulation, 2018). Based on research conducted by Ramadhani *et al*. (2017), the use of personal protective equipment for hearing with noise-induced hearing loss. Workers who do not use personal protective equipment for hearing are at greater risk of hearing loss. Noise prevention and control efforts carried out by the company also minimize the risk of hearing health problems in the workforce. In addition to several control measures that have been carried out by the company, the company needs to conduct a regular hearing conservation program for workers who are exposed to noise and encourage partners to routinely carry out audiometric checks on their workers.

CONCLUSION

Noise is a problem that cannot be avoided by industrial companies, especially companies engaged in power generation. Power generation companies use large-sized and large-capacity work machines and equipment during the operating process. This will surely cause noise that can interfere with the health of the workforce over time. Noise measurements carried out in the turbine area of PT POMI showed that the noise level of most of the turbine areas exceeded the threshold value. Furthermore, the mapping showed the distribution pattern of different noise levels on each floor of the turbine area. The results of the noise mapping of the turbine area on the first and fourth floors tended to be red that indicated that the noise level in the area was >94 dB. Meanwhile, the results of noise mapping were different in the turbine area on the fifth floor that showed that there was a green trend which indicated the noise level in that area was between 79 dB to 85 dB. Besides, the company has made various noise prevention and control efforts to minimize the occurrence of health problems due to noise. The existence of this noise mapping can function as an additional control effort that can help the company to determine further prevention and control efforts. In addition, companies are advised to increase workforce's awareness of the dangers of noise and encourage partners to regularly conduct audiometric checks on their workforce.

ACKNOWLEDGMENTS

The researcher would like to express gratitude to PT. Paiton Operation and Maintenance Indonesia that has allowed this research to take place and has assisted during the research. The authors state there is no conflict of interest with the parties involved in this study.

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