Study of the Noise Level During the Construction of the Tanjung Jati Steam Power Plant

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Authors’ contributions

This work was carried out in collaboration among all authors. Author SI designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SF and PSO managed the analyses of the study. Author PSO managed the literature searches. All authors read and approved the final manuscript.

ABSTRACT

The impact of noise due to the construction of a Steam Power Plant can have a negative impact on the surrounding environment. This study aims to assess the initial baseline condition of environmental noise before the existence of development activities, predictions after activities, and actions to manage/monitor the impact of noise that occurs. The research method is evaluative descriptive using the integrating sound level meter. The research data are the equivalent noise level (Leq), daytime noise level (LS), night noise level (LM), and day-night noise level (L-SM) from 9 sampling locations. The results of the noise analysis are categorized based on scale and compared with the Decree of the Minister of Environment of the Republic of Indonesia No. Kep-48 / MENLH / 11/1996 and IFC - EHS guidelines. Noise level data The initial environmental baseline of the laydown area utilization stage at scale 2, land clearing stage at scale 1, the construction phase of the main building, and supporting facilities at scale 1. The value of the scale of the noise level is assessed based on the difference in impact components that is smaller than the difference in the

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average environmental scale, so that the impact category is a manageable impact. The direction for controlling the impact of noise is to install a project guardrail, activities are carried out at 07.00-19.00 WIB and and tree planting. Environmental management and monitoring have been carried out well, the evaluation trend shows a decline.

Keywords: Environmental management and monitoring; noise equivalent (Leq); daytime noise level (LS); night noise level (LM); day-night noise level (L-SM); noise level scale.

1. INTRODUCTION

The concept of sustainable development in Indonesia has been regulated based on Law of the Republic of Indonesia Number 32 of 2009 concerning environmental protection and management, including in this case the obligation of environmental permits through the preparation of an environmental impact analysis document. This aims to protect and regulate the use of natural resources so that there is an ecological balance. The growth of the Indonesian national economy demands an increase in the supply of electrical energy in its production process. Therefore, a cheap source of electrical energy that is possible to be applied in Indonesian territory is needed, one of which is a source of electric energy based on steam power plants. Presidential Regulation of the Republic of Indonesia Number 71 of 2006 State electricity companies has the right to establish a consortium with the private sector to invest in the construction of steam power plants in Indonesian territory. This causes the steam power plant to be one of the types of power plants that supply the largest electricity needs in Indonesia [1].

The Tanjung Jati B Units 5 & 6 Steam Power Plant is one of the investments in steam power plants in Indonesia. The construction of the Tanjung Jati B Units 5 & 6 Steam Power Plant was carried out in Tubanan Village, Kembang District, Jepara Regency. The plan to build Steam Power Plant Tanjungjati B Units 5 & 6 has a gross capacity of 2 x 1,070 MW or a net capacity of 2 x 1,000 MW. The Tanjung Jati B Unit 5 & 6 steam power plant uses Ultra Supercritical Technology (USC) which has advantages in fuel consumption efficiency, lower exhaust emission reduction, and better noise level reduction compared to Subcritical Technology. [2,3].

The prediction of noise sources in the construction of a Steam Power Plant is an increase in noise levels due to the land clearing stage, the stages of land clearing activities, the construction of supporting facilities, the use of Laydown activities [4]. These stages of activity can increase noise disturbance for workers and the community around the project site [5]. The noise level must not exceed the quality standards established by the noise level standards in the IFC (International Finance Corporation) and EHS guidelines [6]. Noise quality standard is a value or noise that is allowed to occur in environmental media. In the Decree of the State Minister for the Environment No. 48 of 1996 concerning the Noise Level Standard, stipulates that the maximum noise level for residential area designation is the noise level threshold value of 55 dB (A) [7].

The Environmental management directives based on initial baseline noise levels at the development stage can be determined based on the environmental scale. If the scale value of the impact component is smaller (<) than the difference in the average environmental scale, then the impact due to the activity is included in the category can be managed. The Fisher & Davies method can be used to predict, interpret, and evaluate the impact of development in an area where conditions change very rapidly. This method is suitable to be applied in the study of the impact of increasing noise in an area where there has been a lot of development, such as in the Kanji and the impact of increasing the noise level of the Tanjung Jati B Units 5 & 6 steam power plant, wherein existing conditions there are operations Units 1 & 2 and Unit 3. & 4 [8] Therefore, this study aims to examine the environmental impact noise level at the construction stage of the Tanjung Jati B Steam Power Plant Unit 5 & 6, Central Java based on the initial environmental baseline and to obtain environmental management directions.

2. METHODOLOGY

The research method is evaluative descriptive using the integrating sound level meter. The research data are the equivalent noise level (Leq), daytime noise level (LS), night noise level (LM), and day-night noise level (L-SM) from 9 sampling locations [9].
The construction of the Tanjung Jati B Units 5 & 6 Steam Power Plant was carried out in Tubanan Village, Kembang District, Jepara Regency. The power plant is located in a coastal area with a distance of 1 km to the east of the mouth of the Banjaran river, and a distance of 0.5 km to the west of the mouth of the Ngarengan river. The selection of this location has considered the need for sea depth and the stability of ocean currents to support the transportation of fuel by sea as well as the need for seawater for the cooling process. The project location is located at coordinates 6 ° 27'00 “Latitude and 110° 44'32” East Longitude (Fig. 1).

The data collected is the noise level due to heavy equipment operation, namely the equivalent noise level (Leq), the day noise level (LS), the night noise level (LM), and the daytime noise level. -night (L-SM) [10].

2.1 Location of Sampling
Noise samples were taken as many as 9 location points representing residential locations, public facilities, and trade and service locations (Table 1).

2.2 Data Collection Methods
Noise level measurement uses an integrated sound level meter (Extech 407780A) which has an LTM5 measurement facility. Noise sampling is carried out during 24-hour activities (LSM) divided into night time intervals, namely 22.00-06.00 WIB (LM) and day time intervals namely 06.00-22.00 WIB (LS)24.00 - 03.00, g) L7 is taken at 04.00, representing the interval from 03.00 - 06.00.

![Fig. 1. Location of activities and noise sampling](image)

Table 1. Location of noise level measurement

| Code  | Longitude    | Latitude    | Location                                      |
|-------|--------------|-------------|-----------------------------------------------|
| BIS-01| 110° 44'48.7"| 06° 27'09.8"| Hamlet Sekuping, ±100 m south of Ash Yard     |
| BIS-02| 110° 45'24.9"| 06° 26'57.5"| Hamlet Selencir, Tubanan Village              |
| BIS-03| 110° 45'36.4"| 06° 26'25.7"| Hamlet Bayuran, Tubanan Village               |
| BIS-04| 110° 44'34.2"| 06° 27'01.5"| Hamlet Sekuping, ±200 m from Main gate        |
| BIS-05| 110° 44'18.5"| 06° 27'01.9"| Hamlet Sekuping, ±280 m west of Main gate     |
| BIS-06| 110° 45'00.0"| 06° 28'25.8"| Kaliaman Village                               |
| BIS-07| 110° 46'57.2"| 06° 30'53.5"| Wedelan Village                                |
| BIS-08| 110° 46'00.6"| 06° 27'25.1"| Hamlet Duren, Tubanan Village                  |
| BIS-09| 110° 43'43.3"| 06° 27'06.0"| Hamlet Margokerto, Bondo Village               |
2.3 Data Analysis Method

2.3.1 Equivalent noise level (Leq)

The equivalent noise level (Leq) is calculated as follows:

\[ Leq = 10 \log \left( \sum_{i=1}^{n} f_i 10^{L_i/10} \right) \text{dB(A)} \]

where \( f_i \) is the fraction of the time the noise level occurs at a certain measurement time interval, \( L_i \) is the middle value of the noise level at a certain measurement time interval (dBA) [11].

2.3.2 Daytime noise level (Ls)

Daytime noise level is the equivalent noise level used to express the noise level at daytime intervals (06.00 - 22.00), calculated as follows [12].

\[ Ls = 10 \log \left( \frac{1}{16} \left\{ T_1 \cdot 10^{0.1L_5} + \ldots + T_4 \cdot 10^{0.1L_4} \right\} \right) \text{dB(A)} \]

2.3.3 Night noise level (Lm)

The night noise level is the equivalent noise level used to express the noise level at night time intervals (22.00 - 06.00) calculated as follows [13].

\[ Lm = 10 \log \left( \frac{1}{8} \left\{ T_5 \cdot 10^{0.1L_7} + \ldots + T_7 \cdot 10^{0.1L_5} \right\} \right) \text{dB(A)} \]

2.3.4 Day-night noise level (Lsm)

To find out whether the noise level has exceeded the standard noise level, it is necessary to look for the day-night noise level (Lsm) value which is calculated as follows [14].

\[ Lsm = 10 \log \left( \frac{1}{24} \left\{ T_1 \cdot 10^{0.1L_5} + \ldots + T_7 \cdot 10^{0.1L_5} \right\} \right) \text{dB(A)} \]

The results of the noise data analysis are compared with the quality standards for environmental noise levels according to Kep-48 / MENLH / 11/1996 as presented in Tables 2 and 3.

### Table 2. Area noise level quality standards [15]

| Area designation | Noise level (dBA) |
|------------------|------------------|
| A. Area designation |                  |
| 1. Housing and settlements | 55 |
| 2. Trade and services | 70 |
| 3. Office and trade | 65 |
| 4. Green open space | 50 |
| 5. Industrial + portable compressors | 70.85 |
| 6. Government and public facilities | 60 |
| 7. Recreation | 70 |
| 8. Special |                  |
| - Airport * |                  |
| - Railway station ** |                  |
| - Seaports | 70 |
| - Cultural heritage | 60 |
| B. Activity environment |                  |
| 1. Hospital and the like | 55 |
| 2. School or the like | 55 |
| 3. Place of worship or the like | 55 |

### Table 3. Ambient air quality standards in respect of Noise [15]

| Area Code | Category of Area | Limits in dB(A) Leq* |
|-----------|------------------|----------------------|
|           |                  | Day Time | Night Time |
| A         | Industrial area  | 75       | 70        |
| B         | Commercial area  | 65       | 55        |
| C         | Residential area | 55       | 45        |
| D         | Silence Zone     | 50       | 40        |

Note: a) Daytime sampling is 6.00 to 22.00 and night sampling is 10.00 pm to 06.00 am.
b) Silent Zone is an area of at least 100 meters around hospitals, educational institutions, courts, places of worship, or other areas declared or determined by authorized agencies.
c) Leq is the average noise level for a certain period
The noise levels of the Tanjung Jati B Units 5 & 6 steam power plant during operation are designed to meet the noise level standards set out in the IFC (International Finance Corporation) / WB (World Bank) EHS guidelines (Table 4).

Table 4. International Finance Corporation guidelines for noise levels [16]

| Parameter                        | Guidelines IFC /WB EHS** |
|----------------------------------|--------------------------|
| Residential Area                 | 55 (07:00-22:00), 45 (22:00-07:00) |
| Service and Commercial Areas     | 70 (07:00-22:00), 70 (22:00-07:00) |
| Industrial Area                  | 70 (07:00-22:00), 70 (22:00-07:00) |
| Medical facility                 | 55 (07:00-22:00), 45 (22:00-07:00) |
| Educational Facilities           | 55 (07:00-22:00), 45 (22:00-07:00) |

The study was carried out by analyzing differences in environmental quality conditions with activities and without activities. The method used in this study is the Fisher and Davies method. The impact forecast begins with presenting the parameter values of the initial environmental baseline which are converted to a scale of environmental quality, the scale of environmental quality at the initial environmental baseline and at each stage of the activity is displayed on a numerical scale (scale 1, 2, 3, 4, 5) (Table 5) [17].

Table 5. Environmental quality scale

| Scale | Environmental quality |
|-------|-----------------------|
| 1     | Very bad              |
| 2     | Bad                   |
| 3     | Moderate              |
| 4     | Good                  |
| 5     | Very good             |

If in determining the environmental quality scale, both in the initial environmental baseline and the results of the impact forecast and several different environmental quality scales are found, then in determining the environmental quality scale that is the worst selected. The difference in the value of the environmental quality scale above is used to determine the magnitude of the impact. The difference in the scale of the impact magnitude is presented in Table 6 [18].

Table 6. The difference in the scale of impact magnitude

| Difference of scales | Impact magnitude |
|----------------------|------------------|
| 4                    | Very large       |
| 3                    | Large            |
| 2                    | Moderate         |
| 1                    | Small            |
| 0                    | Very small       |

If the scale determination is not in accordance with the conditions of the surrounding environment and existing literature, then the determination of the rating scale is based on professional judgment, then the results of the team’s brainstorming indicate that the determination of whether an impact is managed or not, as follows: [19].

If the difference between each impact component is smaller than the average scale difference the environment then the impact is managed,

1. If point a) is not met, if the scale is sensitive to environmental management each impact component is smaller than 3 then the impact is managed,
2. If point b) is not met, if there are predictive results in the form of a large impact and permanent impact on the respective impact components, then the impact is managed,
3. If point c) is not fulfilled, but based on professional judgment needs to be managed then the impact is managed
4. If point d) is not met, then the impact is not managed.

3. RESULTS AND DISCUSSION

The stages of development activities for the Tanjung Jati B Units 5 & 6 Steam Power Plant that have the potential to cause noise impacts are as follows:

3.1 Utilization of the LayDown Area

The activity of utilizing the laydown area is an activity in the form of assembly welding. The laydown location is surrounded by community settlements, so it is estimated that it will increase the noise level in these settlements. The results of measuring noise level conditions in settlements around the Laydown Area Utilization as environmental baseline data are presented in Table 7.
Table 7. Noise level in settlements around the utilization laydown area

| No   | Sampling location                                                                 | Environmental baseline Lm | Ls | Lsm | Scale |
|------|-----------------------------------------------------------------------------------|----------------------------|----|-----|-------|
| BIS 01 | Sekuping hamlets S= 06°27'09,8" E= 110°44'48,7".                               | 52                         | 53 | 52,7 | 3     |
| BIS 02 | Selencir hamlets, Tubanan village S= 06°26'57,5" LS E= 110°45'24,9" BT.          | 48                         | 54 | 52,8 | 3     |
| BIS 03 | Bayuran hamlets, Tubanan village S= 06°26'25,7" LS E= 110°45'36,4" BT.            | 54                         | 60 | 58,8 | 2     |
| BIS 04 | Sekuping hamlets ± 250 m east of main gate, S= 06°27'01,5" LS E= 110°44'34,2" BT. | 51                         | 55 | 54,0 | 3     |
| BIS 05 | Sekuping hamlets ± 280 m West Main E= 110°44'18,5" BT Gate, S= 06°27'01,9" LS.   | 50                         | 58 | 56,6 | 2     |
| BIS 08 | Duren hamlets, RT1 RW 5, S= 06°27'25,1" LS E= 110°46'00,6" BT.                 | 53                         | 57 | 56   | 3     |

All noise survey locations around the access road have a noise level above the quality standard, namely 55 + 3 dB. The reason is, this location is the main road from the Wedelan area to the Tubanan area. Only in Sekuping Hamlet, the noise level is below the quality standard, because the road access in Dukuh is not the main road. Based on the description above, this initial environmental baseline condition is categorized as bad (scale 2). The future environmental conditions without the project are assumed to be the same as the initial baseline conditions. This is because the increase in noise only occurs when a power plant project or construction has started.

Prediction of future environmental conditions with the Tanjung Jati B Units 5 & 6 Steam Power Plant Development project, there will be an increase in noise levels due to welding activities and the resistance of noise to the surrounding community, this is due to the laydown location that is close to community settlements (Table 8).

Noise level Assumed with a Li value (welding activity) using FCAW (Flux-cored arc welding) of 50 - 86 dB [20]. So that at a distance of 26 m it reaches 57.70 dB. In full, the noise level forecast at a certain distance is presented in Table 9:

The noise level forecast at the survey location around the Lay Down area is presented in Table 10.

Based on the description above, the conditions with this project are categorized as poor (scale 2). The magnitude of the impact of increased noise at the laydown area utilization stage is as follows:

a) Initial environmental quality = scale 2
b) Environmental quality that will come without project = scale 2
c) Environmental quality that will come with the project = scale 2
d) Magnitude of impact = (2) - (2) = 0

3.2 Land Clearing Activities

The increase in noise based on the estimated magnitude of the impact on land clearing activities will be carried out at the power block location, coal yard, non-technical buildings, and the ash stockpile area which is expected to result in increased noise in settlements around the land clearing plan location. Based on the results of measurements of the initial environmental baseline, the noise level conditions in the settlements around land clearing are presented in Table 11.

Table 8. The level of noise generated in welding work [21]

| Activity                                         | Noise level |
|--------------------------------------------------|-------------|
| Welding with Gas Tungsten Arc Welding (GTAW)      | 50 – 60 dB  |
| Welding with Shielded Metal Arc Welding (SMAW)    | 62 – 82 dB  |
| Welding with Flux Core Arc Welding (FCAW)         | 50 – 86 dB  |
| Welding with Gas Metal Arc Welding (GMAW)         | 70 – 82 dB  |
| Welding with Oxy-fuel welding and cutting         | < 70 dB     |
Table 9. Estimated noise level at the Lay Down area utilization stage at a certain distance [22]

| No | Distance (R2)/m | Noise level (L2) dBA |
|----|-----------------|---------------------|
| 1  | 10              | 66,00               |
| 2  | 15              | 62,48               |
| 3  | 20              | 59,98               |
| 4  | 26              | 57,70               |
| 5  | 50              | 52,02               |
| 6  | 75              | 48,50               |

Table 10. Estimates for utilization of the lay down area

| Location code | Lsm | Distance (m) | L2 (dB) | Lsm total (dBA) | Scale |
|---------------|-----|--------------|---------|-----------------|-------|
| BIS01         | 52,7| 970,76       | 26,26   | 54,78           | 3     |
| BIS02         | 52,8| 332,05       | 35,58   | 53,74           | 3     |
| BIS03         | 58,8| 875,36       | 27,16   | 59,69           | 2     |
| BIS04         | 54,0| 950,04       | 26,45   | 55,36           | 2     |
| BIS05         | 56,6| 1,240,89     | 24,13   | 57,21           | 2     |
| BIS08         | 56,0| 1,127,79     | 24,96   | 57,36           | 2     |

Table 11. Noise level conditions in settlements around land clearing activities

| No | Location                                                                 | Location code | L_m | L_s | L_sm | Noise standards | Scale |
|----|--------------------------------------------------------------------------|---------------|-----|-----|------|-----------------|-------|
| BIS01 | Sekuping Hamlet ± 100 m south of the ash yard area of Jepara Regency, sampling was carried out on 21-22 September 2015. The monitoring coordinate points are S = 06 ° 27'09.8" and E = 110 ° 44'48.7". | 52 | 53 | 52,7 | 55+3 | 3 |
| BIS02 | Dusun Selencir, Desa Tubanan, Kabupaten Jepara. Pengambilan sampel dilakukan pada tanggal 27 September 2015. Titik koordinat pemantauan adalah S = 06 ° 26'57.5" dan E = 110 ° 45'24.9". | 48 | 54 | 52,8 | 55+3 | 3 |
| BIS04 | Sekuping Hamlet ± 250 m east of the main gate of Jepara Regency. Sampling was conducted on 21 - 22 September 2015. The monitoring coordinates are S = 06 ° 27'01.5" and E = 110 ° 44'34.2". | 51 | 55 | 54,0 | 55+3 | 3 |
| BIS05 | Sekuping Hamlet ± 280 m west of the Main Gate of Jepara Regency. The side was held on September 21-22, 2015. The monitoring coordinates were S = 06 ° 27'01.9" and E = 110 ° 44'18.5". | 50 | 58 | 56,6 | 55+3 | 2 |
| BIS09 | Sampling was carried out around the settlements of Margokerto Hamlet, Bondo Village, Bangsri District, Jepara Regency on 6 October 2015. Monitoring coordinate points = 06 ° 27'06, S-and E = 110 ° 43'43,3 | 49 | 50 | 49,7 | 55+3 | 4 |

All noise survey locations around the land clearing location still meet the noise level quality standard, namely 55 + 3 dB. Based on the description above, the initial environmental baseline conditions are included in the medium category (scale 3). The future environmental conditions without the project are assumed to be the same as the baseline environmental conditions. Because of the increase in noise only occurs when there is a project. Based on the description above, the condition without the project is classified as moderate (scale 3). Conditions of changes in noise levels in land clearing activities due to heavy equipment use. Heavy equipment that will be used for the land maturation process is presented in Table 12.
Table 12. Heavy equipment to be used in land clearing activities

| No | Area                  | Dump Truck (76* dBA) | Bulldozer (82* dBA) | Excavator (81* dBA) |
|----|-----------------------|----------------------|----------------------|---------------------|
| 1  | Power Block           | 45                   | 3                    | 20                  |
| 2  | Non-technical building| 8                    | 1                    | 2                   |
| 3  | Coal Yard             | 25                   | 2                    | 2                   |
| 4  | Ash Disposal Area     | 8                    | 0                    | 2                   |

Note: (*) at a distance of 15.24 m from the noise source. The Federal Highway Administration [23]

Noise distribution modeling can be described at Fig 2.

The noise level forecast at the survey locations around the land clearing site is presented in Table 13.

Based on the description above, the noise level conditions can be categorized as scale 1. The magnitude of the impact of increased noise at the land clearing stage is as follows:

- a. Initial environmental quality = scale 3
- b. Quality of the environment that will come without a project = scale 3
- c. Environmental quality that will come with the project = scale 1
- d. Magnitude of impact = (1) - (3) = -2

Fig 2. Noise distribution modeling during land clearing

Table 13. Estimated noise level for land clearing activities

| Location Code | Lsm | L2 (dB) | Final Lsm (dBA) | Scale |
|---------------|-----|---------|-----------------|-------|
| BIS01         | 52,7| 66,60   | 65,25           | 1     |
| BIS02         | 52,8| 66,52   | 64,86           | 1     |
| BIS04         | 54,0| 62,23   | 60,96           | 1     |
| BIS05         | 56,6| 64,53   | 63,00           | 1     |
| BIS09         | 49,7| 58,92   | 58,26           | 2     |
3.3 Main Building Construction Activities and Supporting Facilities

The estimated source of noise in the main building construction activities and supporting facilities is the use of heavy equipment, especially the use of hammer piles. The noise impact is expected to have an impact on settlements around the construction site. Based on the measurement results, the noise level conditions in the settlements around the main building and its supporting facilities are presented in Table 14.

All noise survey locations around the Tanjung Jati B Units 5 & 6 Steam Power Plant construction site still have a noise level that meets the noise level standards in settlements, namely 55 + 3 dB. Based on the description above, this initial environmental baseline condition is categorized as bad (scale 2). The future environmental conditions without the project are assumed to be the same as the initial baseline conditions. Because of the increase in noise only occurs when there is a project. Based on the description above, the condition without this project is categorized as scale 2. Prediction of future environmental conditions with the construction of the main building project and its supporting facilities in this case the construction of the Power Block area and the Coal Yard area which will use a lot of heavy equipment which can increase the surrounding noise level. The heavy equipment used is presented in Table 15.

The noise distribution based on the results of the noise level prediction is shown in Fig. 3.

The estimated noise level at the survey location in the vicinity of the main building construction activities for the steam power plant and its supporting facilities is presented in Table 16.

Based on the description above, the environmental conditions in this project are categorized as very bad (scale 1). The magnitude of the impact of increased noise at the construction stage of the main building and its supporting facilities is as follows:

| Table 14. Noise level conditions in settlements around the main building and supporting facilities |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| No | Location | Noise level (dBA) | Noise standards | Scale |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| BIS 01 | Sekuping hamlets ± 100 m south of ash yard area , Jepara Regency was held on 21 - 22 September 2015. Monitoring coordinate points S = 06 ° 27'09.8" and E = 110 ° 44'48.9". | 52 53 52.7 | 55+3 | 4 |
| BIS 02 | Selencir hamlet, Tubanan village, Jepara regency was held on September 27 2015. Monitoring coordinates points S = 06 ° 26'57.5" and E = 110 ° 45'24.9". | 48 54 52.8 | 55+3 | 4 |
| BIS 04 | Sekuping hamlet ± 250 m east of main gate, Jepara Regency was held on September 21 - 22 2015. Monitoring coordinate point S = 06 ° 27'01.5" and E = 110 ° 44'34.2". | 51 55 54.0 | 55+3 | 3 |
| BIS 05 | Sekuping hamlet ± 280 m west of main gate, Jepara Regency was held on September 21 - 22 2015. Coordinating points for monitoring S = 06 ° 27'01.9" and E = 110 ° 44'18.5". | 50 58 56.6 | 55+3 | 2 |
| BIS 09 | Sampling was carried out around the settlements of Margokerto hamlet, Bondo village, Bangsri Jepara sub-district on October 6, 2015. Monitoring coordinate points = 06 ° 27'06, S-and E = 110 ° 43'43.3". | 49 50 49.7 | 55+3 | 4 |
Table 15. Heavy equipment used in the construction of the power block area and the coal yard

| No | Area                     | Power block | Coal yard |
|----|--------------------------|-------------|-----------|
| 1  | Crawler Crane (81* dBA)  | 3           | -         |
| 2  | Truck Crane (81* dBA)    | 5           | -         |
| 3  | Mixer Truck (76* dBA)    | 45          | 25        |
| 4  | Pile Driver (101* dBA)   | 5           | -         |
| 5  | Forklift (89.4** dBA)    | 3           | -         |

Fig. 3. Noise distribution during the construction of the main building and its supporting facilities

Table 16. Estimates for the construction of steam power plants main buildings and supporting facilities

| Location code | Lsm  | Distance (m) | L2 (dBA) | Lsm final (dBA) | Scale |
|---------------|------|--------------|----------|-----------------|-------|
| BIS01         | 52.7 | 830.39       | 66.60    | 65.25           | 1     |
| BIS02         | 52.8 | 509.13       | 66.27    | 64.86           | 1     |
| BIS04         | 54.0 | 566.59       | 61.32    | 60.96           | 1     |
| BIS05         | 56.6 | 138.94       | 63.43    | 63.00           | 1     |
| BIS09         | 49.7 | 690.52       | 58.92    | 58.26           | 2     |

a) Initial environmental quality = scale 2  
b) Quality of environment that will come without project = scale 2  
c) Environmental quality that will come with project = scale 1  
d) Magnitude of impact = (1) - (2) = -1

Management direction Noise increase based on future conditions with the project. If the difference between each impact component is smaller (<) than the average environmental scale difference, the noise impact caused by the construction of the Tanjungjati Power Plant is categorized as a manageable impact, as follows:

1) Utilization of the Laydown Area. Initial environmental quality = scale 2 with magnitude of impact = 0  
2) Land clearing activities Initial environmental quality = scale 3 with magnitude of impact = -2  
3) Construction activities of main building and supporting facilities. Initial environmental quality = scale 2 with magnitude of impact = -1

3.4 Environmental Management and Monitoring

Monitoring of the laydown area utilization activities, land preparation and construction of
main buildings and supporting facilities with the progress of work up to June 2019 amounting to 47.41%.

The Construction activities include, among others, the use of lay down areas, land clearing activities, and main building construction activities and supporting facilities (Fig. 4).

Noise management measures in laydown area utilization activities, land clearing and construction of main buildings and supporting facilities activities are:

1. Install a fence covering the project at the land clearing site adjacent to residential areas. Activities that have the potential to cause noise, especially the use of heavy equipment, need to be managed by arranging activities to be carried out at 07:00-19:00 WIB. If an activity is needed above 19:00, the initiator will coordinate with the surrounding community. The fences that are built are in the form of concrete fences, wire fences, and barbed wire fences. For areas adjacent to residential areas, a concrete fence is built. From the results of visual monitoring, the fence that was built was still in good condition and no damage was found. (Fig. 5)

2. Limiting the speed of the transport vehicle to a maximum of 40 km / hour and the presence of traffic signs for a maximum of 40 km / hour (Fig 5).

3. The tree planting program to reduce noise was carried out by planting 500 trees of sea pine, Sengon / Australian pine tree and Chinese Albizia, 100 cm high and 1 cm in diameter. planting locations are in the Power Block area and the Low Shrub area. The tree planting program is included in the green program plan of the management of steam power plants.

Fig. 4. Land clearing activities in the form of filling and compaction of landfill

Fig. 5. Cover fence at construction site
Benchmark Noise level management must meet the noise level standard in residential areas according to the Decree of the State Minister for the Environment No. 48/1996 at 55+ 3 dBA with the management period during the construction phase [24].

Evaluation of the trend of noise levels has been monitored since the construction period until the October 2019 period, so that the evaluation trend of noise levels can be seen in the research location, and is used for monitoring and control of the Tanjung Jati B Units 5 & 6 Steam Power Plant (Fig. 9). The monitored environmental parameter is the day-night noise level (Lsm) in the settlement. Evaluation Methods Monitoring noise level is direct observation of the speed limit of transport vehicles of a maximum of 40 km/hour and the presence of traffic signs for a maximum of 40 km/hour, direct observation of...
the function and presence of a cover fence, timing of activities that cause noise and measuring noise. Noise measurement is based on the measurement of day-night noise levels in settlements in accordance with the Decree of the Minister of Environment Number 48 of 1996 concerning Noise Level Standards.

Based on Fig. 9, the noise level is still fluctuating, but in the 2019 October 2019 period, it has shown a significant reduction, the evaluation trend shows a negative value this is due to environmental management is the installation of noise dampening walls and tree planting have been implemented. When the management is implemented, the progress of the contraction has been running 40%-47.41%.

Based on the figure above (Fig. 10), it can be seen that the noise level is based on the evaluation trend of the monitoring period, it can be seen that there has been a decrease in the noise level starting from the monitoring period of October 2018, July 2019 and October 2019, shown in the linear modeling trend with a negative value $LS = y = -2.9994x + 87778$, $LM = -0.5556x + 56.074$ and $LSM = -2.5556x + 82.963$. The management of daytime noise levels (LS) has the best reduction because, then the daytime noise level (LSM) and the day-night noise level (LM), this indicates that noise management is carried out by the manager of the Tanjung Jati Steam Power Plant that has been implemented properly. The image below shows the process of maintaining a noise reduction tree.
4. CONCLUSION

The environmental baseline before and after the activity shows an average scale of 2. If the scale value based on the difference of each impact component is smaller than the difference between the average environmental scale, then the impact can be managed. The impact of the noise level due to the construction of a steam power plant is in the manageable category. The direction for noise control in construction activities is to install a project boundary fence at the Lay Down Area location associated with residential areas, activities are carried out at 07.00-19.00 WIB. If activities are required above 19.00 WIB, the Initiator will coordinate with the surrounding community.

DATA AVAILABILITY

All relevant data is included in the working paper and supporting information files. This research will help researchers to reveal critical area of the Tanjung Jati B Unit 5-6 steam power plant development plan, so that predictive impact of noise levels is monitored and managed.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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