Comparative Studies and Impact Analysis of Environmental Noise Modeling from Malaysian Industrial Projects

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Abstract: - This paper presents the results obtained in a study on environmental noise pollution due to industrial project proposals at four different places in Malaysia. The different projects included in this case study are Petronas refinery extension project MG-3, Janamanjung power station in Perak, RCC plant in Semenyih and Co-generation plant in Melaka. Noise level measurements and analysis for the projects were categorized in three different stages namely, existing environmental noise level, noise scenario during construction stage and noise contours predicted during operation stage. This paper presents typical environmental noise scenarios and impact analysis due to industrial project activities in Malaysia.

Key-Words: - noise, modeling, legislation, discomfort

1 Introduction

Noise, a universal environmental pollutant, is fast-becoming one of the major public-health issues in Malaysia today, which could lead to human annoyance, reduce life quality, and might affect health and physiological well-being. Noise pollution is by now recognized worldwide as a major problem for the quality of life in any urban area [1]. In most developed countries, standards for air pollution and noise exposures are an important part of environmental policy to improve local environmental quality. Often these standards are based on expert judgments and do not take into account people's preferences. Numerous noise surveys treating the problem of noise pollution in many cities throughout the world have been conducted [3-15]. In some surveys, noise impact was treated as a stress indicator, and in consequence the role of noise as a risk factor for human health was discussed. Noise effect includes various impacts on mental and physical health and disturbance of daily activities which may affect sleep, conversation, lead to perception of annoyance, cause hearing loss, instigate cardiovascular problems as well as affect human judgment and performance [16-18].

Traditionally, quality of life measures include environmental features. For instance, the questionnaire developed within this framework by the World Health Organization, the WHOQOL includes the relationship to salient aspects of the subject's environment such as: home environment, physical environment (pollution, noise, traffic and climate), transport and recreational opportunities [2, WHO1997]. Looking at the impact of environmental conditions would naturally leads to analysis scheme for the quantification and expression of annoyance level. Discomfort and stress, which involve complex inter-relation of life space dimension, may have long-term effects on human health.

Compared to previous research on noise level where surveys was taken from the factory workers or the residents of surrounding areas [19-20], this research was measured using noise measurement equipment. Furthermore, previous recorded researches was done in a situation comparing the noise level output before and after a refinery was build. This particular research was done not only on a new or existing refinery but also predicted an increase of noise level after an extension of its building was made.

The objective of this paper is to highlight some noise pollution scenarios at selected industrial project sites in Malaysia such as Petronas refinery extension project MG-3, Janamanjung power station in Perak, RCC plant in Semenyih, Selangor and Co-generation plant in Melaka. Measured noise levels were classified according to the environmental legislation at the effected surrounding areas.

2 Methodology

Equipment utilized to measure existing background noise levels subscribes to the International Electro-technical Commissioning (IEC) specifications. The instrument was placed at a height of about 1.2 meter above the ground. Steps were also taken to ensure that no reflections took place near the instrument. ISO 1996/1 standard suggests that the monitoring time should be at

least 15 minutes, and the noise instrument should be placed at least 1 meter away from any reflective surface.

The sound level meter was calibrated on site before the first measurement was taken and after the final measurement was completed. The dBA scale was selected for the measurements of the environmental noise as recommended by ISO 1996/1 standard. The 'A'-weighted measurement, are more reliable when associated with people's reaction for many applications.

2.1 Noise descriptors

Noise descriptors such as LAeq, Lmax, Lmin, LA10, LA50 and LA90 were recorded. Baseline sound levels were monitored for two different periods of the day, namely: day-time and night-time readings. Definition for the noise descriptors are presented as follows:

LAeq: The equivalent continuous dBA level which has the same energy as the original fluctuating noise for the same given period of time.

LAmax: Maximum noise level measured.

LAmin: Minimum noise level measured.

LA10: A specified dBA levels which is exceeded ten percent of the time during the whole period of measurement.

LA50: A specified dBA levels which is exceeded fifty percent of the time during the whole period of measurement.

LA90: A specified dBA levels which is exceeded ninety percent of the time during the whole period of measurement.

2.2 Equipment

The equipments used in this study consist of sound level meter including with calibrator while Cadna software has been utilized to analysis the sound propagations and exposure. The brief information of equipment used was briefly described in Table 1.

Table 1 Equipment used for noise study

ORIGIN	QUEST Technologies USA
MODEL	QUEST 2900 Integrating and Logging Sound Level Meter
CALIBRATION	NML/2082/E/03National Metrology Lab.SIRIM Berhad. (Date 18/11/2003)
SOUND CALIBRATORS	QC-10 114dB - 1000Hz

3 Results

3.1 Project: MG-3

Table 2 is the summary of the existing baseline noise level taken during the MG-3 Project.

Stations	Descriptions	Existing Leq (dBA)	Future Leq (dBA)	Increase in noise level
N1 (R7)	Inside commando-based	52.4	56.9	4.5
N2 (R12)	Taman Peruna	52.6	59.1	6.5
N3 (R1)	Near Madrasah Al-Nuriah	51.6	50.7	-0.9
N4 (R19)	Kg. Tangga Batu	49.6	53.0	3.4
N5 (R16)	Near Hualon Factory	60.2	51.4	-8.8
N6 (R15)	Near Kg. Pantai Kundor	61.8	47.1	-14.4
N8 (R18)	Near Kg. Sungai Udang	47.4	56.8	9.4
N9 (R17)	Near Kg. Tangga Batu	50.7	50.8	0.1
N10 (R20)	Sek. Keb. Pantai Kundor	57.5	50.6	-6.9

Table 2 Increase in noise level at selected locations surrounding the plant area.

Figure 1 shows the predicted noise contours of 50, 55, 60, 65, 70, 75 and 80dBA near the surrounding area of the proposed plant during operation stage. The 60dBA noise contour line is encroaching the boundary of Taman Peruna as shown in the figure.

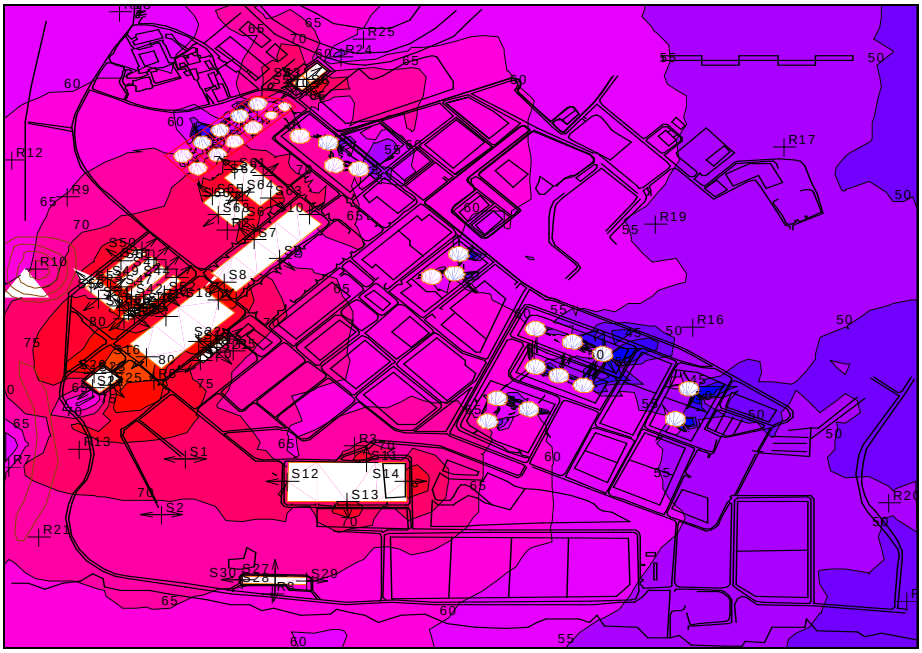

Figure 1 Predicted future noise contours during operation stage of the proposed MG-3 project.

3.2 Project: Janamanjung

Noise measurements were carried out to establish the existing background noise level around the Janamanjung Coal Fired Power Plant. Noise measurements were carried out on 16th – 17th April 2003. The main purpose of this survey is to establish the existing background noise levels and also to identify all the significant noise sources caused by the existing power plant facilities. Table 3 is the summary of the existing baseline noise level at Janamanjung Project.

Table 3 Summary of the existing baseline noise level

STATIONS	Leq dBA	Lmax dBA	Lmin dBA	Remarks (One unit running with 700MW day-time loading and 600MW night-time loading)
N1 : Near Aeration Pump (30m)				
Day (9.37am)	65.2	79.4	62.6	Aeration pump, motorcycle & lorries passing by
Night (10.25pm)	65.9	71.3	63.6	Aeration pump & flue gas ducting
N2 : Near Silo (50-60 m)				
Day (10.05am)	70.1	78.5	66.5	Boiler, coal mill & alarm system
Night (10.48pm)	70.2	75.5	66.7	Boiler, steam release & coal mill
N3 : Near Chemical Lab				
Day (10.24am)	75.5	96.7	68.3	Boiler, coal mill, motorcycle and jeep passing by
Night (11.06pm)	73.1	80.2	68.1	Boiler, steam release, coal mill, motorcycle.
N4 : Near Ash Disposal Conveyor (150m)				
Day (10.48am)	62.6	75.3	55.3	Boiler, coal mill & motorcycle passing by
Night (11.28pm)	64.3	72.4	56.4	Boiler & coal mill
N5 : Near Switch yard				
Day (11.36am)	63.0	74.2	58.7	Boiler, coal mill & lorry passing by
Night (12.00am)	64.8	74.6	59.4	Boiler, coal mill, motorcycle & jeep passing by
N6 : Near Guard House				
Day (12.24pm)	56.5	72.1	42.7	Traffics (Vehicles coming in and out from the station)

Night (12.34am)	46.0	61.9	38.2	Motorcycle passing by
N7 : Kg. Permatang				
Day (2.18pm)	57.5	77.6	39.6	Motorcycle, car & lorry passing by
Night (12.55am)	58.1	79.9	44.8	Motorcycle passing by
N8 : Seri Manjung Fasa 3				
Day (1.27pm)	46.8	65.0	35.3	Motorcycle passing by
Night (1.44am)	36.6	56.2	-	

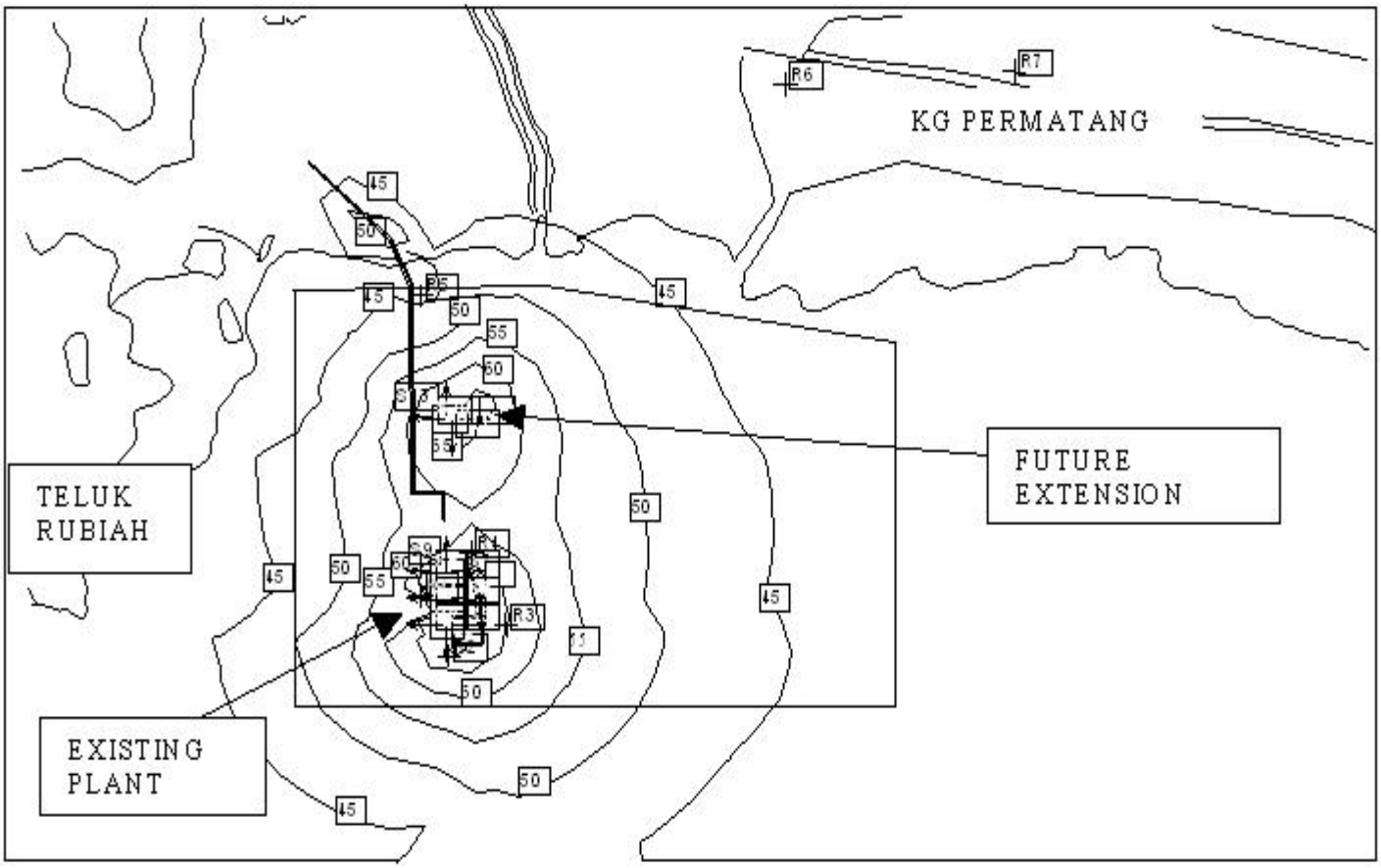

Figure 2 Location of the measurement station and predicted noise contours during operation of the proposed extension project.

3.3 Project: RCC Plant Semenyih

Noise measurements were carried out to establish the existing background noise level around the proposed power project areas including Kg. Pasir Baru, Kg. Sg. Lalang Lama, Kg. Sg. Machang and Taman Sri Tanjung. Noise measurements were carried out on 8th and 9th September 2004. The main purpose of this survey is to establish the existing background noise level and also to identify all the significant noise sources caused by the existing environment.

Table 4 tabulates the measured noise levels and the corresponding sources at the selected monitoring stations. Dominant noise sources at the area are mainly due to industrial activities from the nearby factories and also vehicle noise from the nearby road. The fifteen-minute LAeq noise levels at these monitoring stations varied from 45.2dBA to 76.2dBA during day-time and 42.8dBA to 56.0dBA during night-time. The levels are representative of the existing baseline noise levels at the proposed project area.

In general, night-time noise measurements are lower than the day-time readings. It is mainly due to local noise sources such as the nocturnal insects, animals and some contributions from the nearby traffic.

Table 4 Summary of the existing baseline noise measurements at RCC project area.

Stations	Leq dBA	Lmax dBA	Lmin dBA	Remarks
R1 : Near Master Plaster Cement Factory – Kg. Pasir Baru.				
Day (2.00pm)	51.9	79.6	33.4	Human Activities, Cement Factory
Night (10.00pm)	52.2	82.1	40.4	Frogs, Dog Barking, Cement Factory, Human Activities.
R2 : Near Proposed Site Boundary along Existing Road.				
Day (2.30pm)	52.5	71.6	33.6	Human Activities, Car passing by.
Night (10.25pm)	52.3	74.5	45.8	Frogs, Insects, Distance Traffics.
R3 : Near Proposed Site boundary beside Fishing Pond.				
Day (2.55pm)	45.2	72.7	38.7	Human Activities, Birds.
Night (10.55pm)	51.4	70.8	46.3	Frogs, Insects, Human Activities.
R4 : Near Proposed Site boundary beside Swamp Area.				
Day (3.15pm)	55.4	78.7	37.3	Human Activities, Distance Traffics, Birds
Night (11.05pm)	47.8	56.6	46.2	Frogs, Insects, Distance Traffics.
R5 : Near Proposed Site beside existing pond at Existing Road.				
Day (3.50pm)	50.2	72.5	36.1	Human Activities, Distance traffics, Birds.
Night (11.35pm)	50.6	72.1	46.4	Frogs, Dog Barking, Insects.
R6 : Near Kg. Orang Asli.				
Day (4.20pm)	56.0	76.3	41.6	Human Activities Dog barking, Distance traffics.
Night (12.05am)	53.1	82.4	40.0	Frogs, Dog barking, Insects, Human activities.
R7 : Near Jalan Sg. Lalang 25m from road & 100m from Semenyih - Kajang road.				
Day (4.50pm)	54.6	68.0	41.5	Human activities, Traffics.
Night (12.40am)	51.5	77.5	35.8	Frogs, Dog Barking, Human Activities, Distance traffics.
R8 : Near Ostrich Farm and Residential area at Kg. Sg. Lalang Lama.				
Day (5.30pm)	54.7	73.8	40.1	Human Activities, Car passing by. Ostriches
Night (01.10am)	50.4	77.2	43.3	Frogs, Insects, Ostriches.
R9 : Near Kg. Sg. Lalang Lama.				
Day (6.25pm)	60.0	80.1	40.4	Human activities, Distance traffics.
Night (01.35am)	42.8	64.0	37.2	Frogs, Insects, Human Activities.
R10 : Near Kg. Pasir Baru Bt. 25 main entrance junction.				
Day (10.00am)	49.3	71.0	33.7	Human Activities, Distance Traffics, Birds
Night (02.10am)	45.4	68.5	38.1	Insects, Distance Traffics.
R11: Near Sek. Keb. Ulu Semenyih, KM 41 Jln. Sg. Lalang.				
Day (10.35am)	65.1	82.0	45.4	Human Activities, Traffics.
Night (02.40am)	56.0	75.9	42.3	Frogs, Insects, Radio. Human activities...
R12 : Near Industrial Area (Sg. Lalang Villaraya).				
Day (11.00am)	76.2	77.9	74.2	Human Activities Dog barking, Traffics (Vehicles going in & out near main road

				junction.).
Night (03.05am)	53.3	73.1	48.2	Frogs, Dog barking, Insects, Human activities, Jeep passing by.
R13 : Near Kg. Sg. Machang BT. 23 about 25m from main road.				
Day (11.30am)	62.4	77.8	43.6	Human activities, Traffics, Birds
Night (03.30am)	55.8	78.2	45.7	Insects, Distance Traffics, nearby factory
R14:. Near Kg. Sg. Machang BT. 21 about 20m from main road.				
Day (12.00pm)	62.1	78.7	41.3	Human Activities, Traffics,
				Helicopter passing by
Night (4.00am)	43.0	60.6	35.5	Frogs, Insects, Human activities.
R15 : Near Taman Sri Tanjung about 40m from main road.				
Day (12.30pm)	60.2	84.3	36.8	Human Activities, Traffics (car & motorcycle passing by).
Night (04.30am)	43.0	63.3	35.9	Frogs, Insects, Human activities,

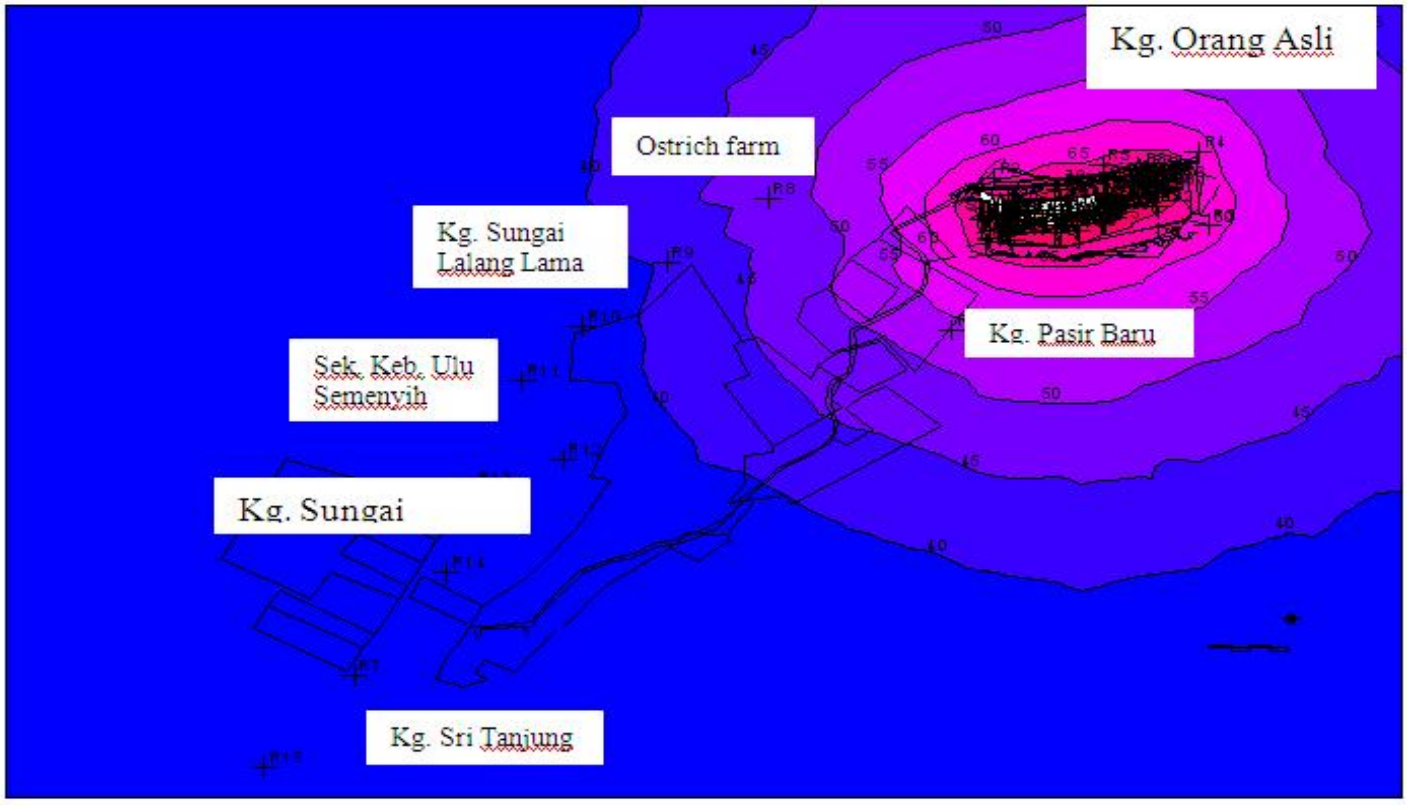

Figure 3 Predicted noise contours during operation stage of the proposed RCC plant.

The typical operating condition of the proposed plant will inevitably increase the existing environmental noise levels in the surrounding area. However, the impact is predicted to be localized within the plant area.

Figure 3 presents the results from computer simulation to predict noise contours generated by the proposed RCC plant operation. Where the operation of the proposed RCC plant is predicted not to cause

significant noise impact to the surrounding residential areas, appropriate mitigating measures is required to control and reduce the overall noise level emitted by the proposed RCC plant.

3.4 Project: Co-Gen Melaka

Noise measurements were carried out to establish the existing background noise levels around the plant area. Noise measurements were carried out on 19th – 20th February 2003. The main purpose of this survey is to establish the existing background noise levels and also to identify all the significant noise sources caused by the existing plant facilities.

A summary of the existing noise level from the process plant area is presented in Table 5a and Table 5b. Day-time and night-time noise levels recorded showed that they were above the limit imposed by DOE regulations. Predicted noise contours for the proposed co-gen extension project is shown in Figure 4.

Table 5a Noise level at various sampling stations inside the Plant Area.

Location of Monitoring Station	Date and hours	Noise sources	L_{eq} dBA	L_{max} dBA	L_{min} dBA
S1	11:00 - 11:15	Blower fan from fume ventilator	**57.0**	61.2	51.5
S2	11:20 - 11:35	Compressor unit.	**69.2**	75.9	67.6
S3	11:55 - 12:10	Delayed Cooker Unit, Stack Flare. .	**69.9**	76.9	68.5
S4	12:25 - 12:40	Incerator unit.	**73.8**	77.2	71.6
S5	12:45 - 13:00	Boiler & Incinerator unit.	**68.9**	81.6	67.2
S6	14:40 - 14:55	Cooling Water unit.	**84.2**	87.5	82.1
S7	15:10 - 15:25	Stack Flare PRS2.	**72.3**	78.0	68.4
S8	15:35 - 15:50	Sea water intake, stack flare.	**67.1**	80.6	64.3
S9	16:15 - 16:30	Stack flare, incinerator unit.	**52.4**	64.1	52.4
S10	16:35 - 16:50	Stack flare, incinerator unit.	**58.9**	63.4	56.6

Table 5b Day-time Noise Level at Various Sampling Stations outside the Plant area.

Location of Monitoring Station	Date and hours	Noise sources	L_{eq} dBA	L_{max} dBA	L_{min} dBA
P1	13:45 - 14:00	Human activities, Stack Flare	**56.4**	69.3	48.0
P2	14:15 - 14:30	Human activities, Distance Traffics. Stack Flare	**53.4**	78.4	43.9
P3	15:00 - 15:15	Human activities, Distance traffics, Air quality sampling pump.	**58.3**	79.5	45.7
P4	16:50 - 17:10	Human activities, Distance Traffics, birds	**47.4**	69.1	39.7
P5	16:10 - 16:25	Distance traffics, Human activities, birds, plant operation from Taiko Drums sdn. bhd.	**57.1**	81.1	49.7
P6	15:45 - 16:00	Human activities, traffics, birds.	**63.2**	81.3	43.3

Table 5c Night-time Noise Level at Various Sampling Stations outside the Plant Area.

Location of Monitoring Station	Date, Hours and	Noise sources	L_{eq} dBA	L_{max} dBA	L_{min} dBA

P1	22:30 - 22:45	Human activities, Stack flare, Windy	**54.1**	64.8	48.6
P2	23:00 - 23:15	Stack Flare, Distance traffics, Human activities.	**51.3**	65.3	46.5
P3	23;30 - 23:45	Stack Flare Distance traffics, Air sampling pump.	**56.1**	64.3	51.6
P4	00:05 - 00:20	Human activities, Insects. Frogs, Distance Traffics, windy.	**48.9**	74.2	42.9
P5	00:40 - 00:55	Windy, plant operation from Taiko Drum sdn. bhd. insects.	**56.0**	69.7	53.6
P6	01:00 - 01:15	Traffics passing by : motorbikes (7), Cars (12), Lories (2), Human activities.	**64.8**	84.0	46.4

Figure 4 Existing noise contours around the plant area.

3.5 Noise Impact During Construction

3.5.1 Earthworks and Construction Stage Noise

The earthwork and construction activities may contribute to noise problems at the proposed industrial project area such as site clearing, earthworks, reclamation, piling activities and constructions:

3.5.2 Construction of the Proposed Industrial Project

Noise due to engines, construction equipment and movement of heavy vehicles and machinery within the construction site can be a nuisance to residents living nearby the proposed project site.

The calculation of noise level from different types of equipment at any time is only an estimate of the actual noise scenario. Table 6 shows the noise levels of 52.6 –70.4dBA predicted at a distance of 300m away from the construction site of the project. Using the prediction methodology discussed above, the noise level at a distance of 300m from the proposed project site can reach between 52.6 to 70.4dBA.

Table 6 Noise Levels for Typical Equipment Used During Construction phase

Equipment Involved	Sound Power Level (dBA)	Facade Sound Pressure Level			
		50m	300m	1000m	2500m
		Sound Pressure Level (dBA)			
Concrete Mixer	112	70.2	54.6	44.2	36.3
Concrete Truck	120	78.2	62.6	52.2	44.3
Crane (Boring, Placing Precast Concrete & Concrete Pouring)	123	81.2	65.6	55.2	47.3
Generator Set for Welding	110	68.2	52.6	42.2	34.3
Generator Set for Power (250kVA)	120	78.2	62.6	52.2	44.3
Hammer Drill	112	70.2	54.6	44.2	36.3
Chipping Hammer	119	77.2	61.6	51.2	43.3
Air Compressor	119	77.2	61.6	51.2	43.3
Range of Noise Level From Combination of Equipment		68.2-86.1	52.6-70.4	42.2-60.1	34.3-52.2

4 Conclusion

Several noise pollution analysis and scenarios were presented to represent typical noise impact from industrial development projects in Malaysia. Background noise levels were measured for each case and contributing factors from the existing source includes traffic noise, human activities and animals were noted in this paper. Computer simulation was carried out using established software which complies with the ISO and other European standards. The simulation results were used to produce noise contours predicted during operation stage of the projects. Typical equipment which represents the dominant noise sources during construction stage are also presented in this paper. Discussion on noise pollution scenario presented in this paper will benefit the researchers and consultants who are working in this field, espescially for those who are directly involve with the study of noise pollution for environmental impact assessment (EIA) for the Department of Environment (DOE) in Malaysia.

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