

## 10 NOISE AND VIBRATION

### 10.1 INTRODUCTION

This *Chapter* presents an assessment of the potential noise impacts arising from the construction and operational phases of the Project. Noise sensitive receivers (NSRs) and potential sources of noise generation were identified and an assessment of the potential impacts from the latter was carried out. Mitigation and management measures are recommended where necessary.

### 10.2 ASSUMPTIONS AND LIMITATIONS

The noise impact assessment was carried out based on an assumed plant inventory for the construction and operational phases of the Sembcorp Myingyan Combined Cycle Gas Turbine (CCGT, hereafter referred to as 'the Project'). These will be confirmed by the Engineering, Procurement and Construction (EPC) contractor prior to commencement of each phase. Should there be significant differences between the assumed plant inventory and that used on site, additional assessments may be needed and the proposed noise mitigation measures should be updated and implemented accordingly.

### 10.3 SCOPE OF THE ASSESSMENT

Scoping of potential noise impacts has been undertaken in two stages:

- First, potential interactions between project activities and NSRs have been identified; and
- Second, taking into consideration the information gathered on the extent and nature of project activities, and the existing conditions / sensitivities of the baseline, these potential interactions have been prioritised in terms of their potential to cause significant impacts.
- The potentially significant noise impacts arising from the activities during the construction and operational phases of the Project have been identified as:
  - Construction activities, mainly from trucks, cranes, pilling rig and generators during site preparation, foundation, construction of buildings and infrastructures such as internal roads; and
  - Noise generation due to operation of fixed plant and machinery.

### 10.4 LEGISLATION REQUIREMENTS

The noise impact assessment was conducted with reference to relevant international guidelines and local legislation, regulations, standards where available. Further detail is summarised here for reference.

#### 10.4.1 Myanmar Legislation

##### **Construction and Operational Phases**

The Government of Myanmar has not yet established numerical standards for noise impact arising from construction noise and operational noise. In the absence of national standards, the Ministry of Environmental Conservation and Forestry (MOECAF) typically recommends that internationally accepted numerical

environmental standards, such as International Finance Corporation (IFC) to be adopted for any noise assessment.

#### 10.4.2 IFC Guidelines

The IFC EHS Guidelines - Thermal Power Plants <sup>(1)</sup>, the IFC General EHS Guidelines: Environmental – Noise Management <sup>(2)</sup> and the IFC General EHS Guidelines: Construction and Decommissioning <sup>(3)</sup> are relevant to the Project.

**Table 10.1** outlines the IFC’s day time and night time noise level limits for different types of receptors. Given that the identified NSRs for the Project are the villages, monastery and a worker camp, the noise guideline values for residential, institutional and educational receptors are adopted for this assessment. The applicable standards are 55 dB(A)  $L_{Aeq,1}$  hour for daytime and 45 dB(A)  $L_{Aeq,1}$  hour for night-time (as presented in **Table 10.1**) or a maximum increase in background levels of not more than 3 dB(A) at the nearest NSR. Since baseline monitoring was conducted, noise criterion of a maximum increase in background levels of not more than 3 dB(A) was adopted as the assessment criterion. Details of measured noise levels and proposed noise criteria are given in **Section 10.6**.

**Table 10.1 Noise Level Guidelines (2007)**

Receptor	One Hour $L_{Aeq}$ (dBA)	
	Daytime (07:00 - 22:00)	Nighttime (22:00 - 07:00)
Residential; institutional; educational	55	45
Industrial; commercial	70	70

**Note:** Guidelines values are for noise levels measured outdoors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.

#### 10.5 NOISE SENSITIVE RECEIVERS

The nearest representative NSRs that may potentially experience noise impacts from the work sites of the Project during construction and operational phases are identified and described below:

- NSR1, a permanent steel mill construction worker (EPC) accommodation in Taung Tha Township located approximately 1920 m to the south of the notional noise source.
- NSR2, a monastery and pagoda in Taung Tha Township located approximately 2670 m to the south of the notional noise source.
- NSR3, a Hnan Ywa Village in Taung Tha Township located approximately 1810 m to the south-east of the notional noise source.

(1) IFC EH&S Guidelines for Thermal Power Plants (December 2008), Available from: [http://www.ifc.org/wps/wcm/connect/dfb6a60048855a21852cd76a6515bb18/FINAL\\_Thermal%2BPower.pdf?MOD=AJPERES&id=1323162579734](http://www.ifc.org/wps/wcm/connect/dfb6a60048855a21852cd76a6515bb18/FINAL_Thermal%2BPower.pdf?MOD=AJPERES&id=1323162579734)

(2) IFC EH&S Guidelines: Noise Management (April 2007), Available from: <http://www.ifc.org/wps/wcm/connect/06e3b50048865838b4c6f66a6515bb18/1-7%2BNoise.pdf?MOD=AJPERES>

(3) IFC EH&S Guidelines: Construction and Decommissioning (April 2007), Available from: <http://www.ifc.org/wps/wcm/connect/3aa0bc8048855992837cd36a6515bb18/4%2BConstruction%2Band%2BDecommissioning.pdf?MOD=AJPERES>

- NSR4, Sa Ka Village in Myingyan Township located approximately 1060 m to the north-east of the notional noise source.
- NSR5, a temporary Steel Mill Worker Housing in Myingyan Township located approximately 170m to the east of the notional noise source. As all workers are on-site during daytime, there is no people present at NSR5 during daytime. Based on this, NSR5 will not be affected by the daytime construction noise from the Project. This temporary Steel Mill Worker Housing will be relocated to the area of NSR1 by the start of operation of the Project. Based on this, NSR5 will also not be affected by the operation of the Project.
- NSR6, a Government Technical High School in Taung That Township located approximately 1560m to the south-east of the notional noise source.

The locations of representative NSRs are summarised in **Table 10.2** and shown in **Figure 10.1**

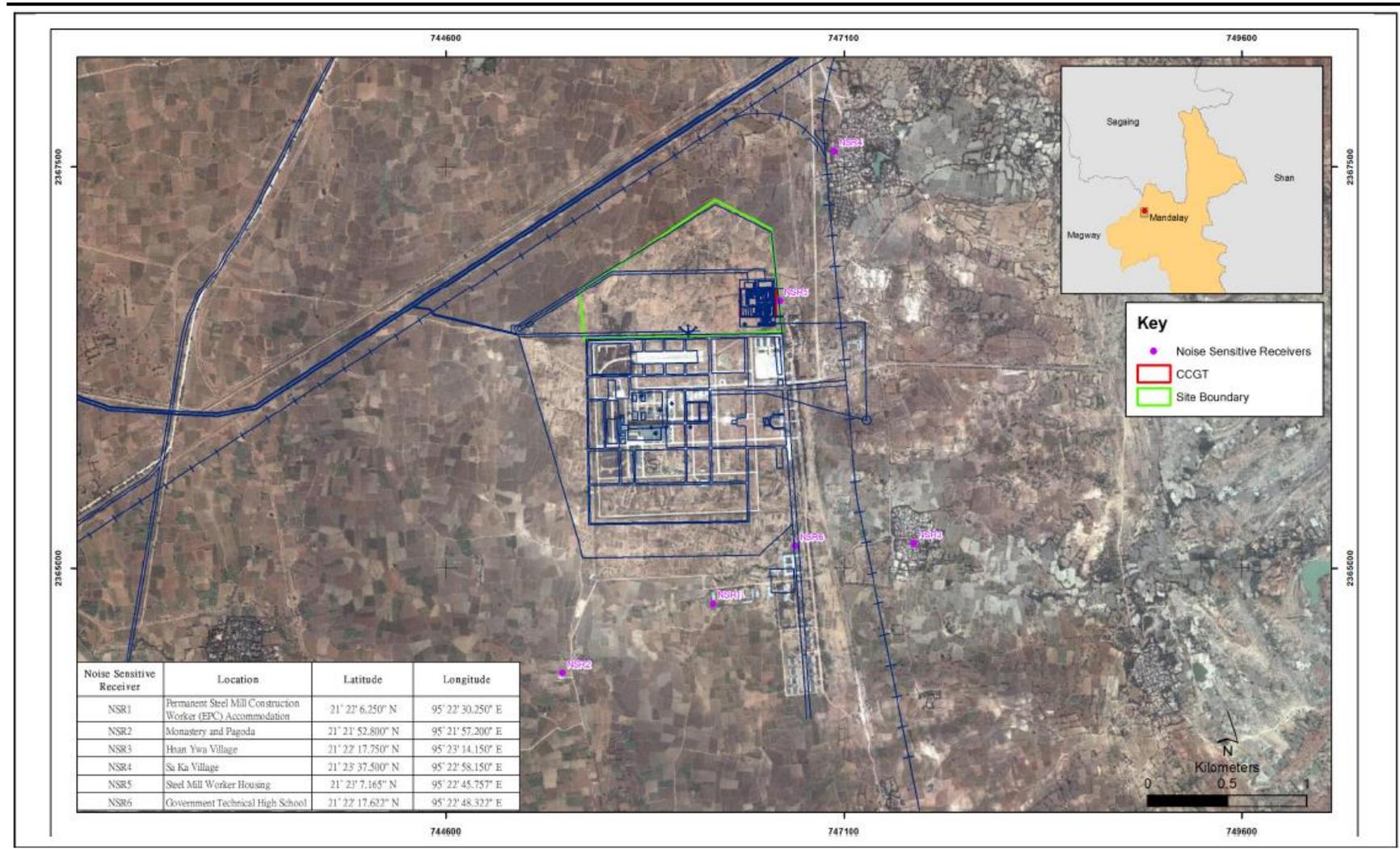
**Table 10.2 Representative Noise Sensitive Receivers**

NSR	Location	Type of Uses	Approximate Nearest Distance to the Notional Noise Source
NSR1	Permanent Steel Mill Construction Worker (EPC) Accommodation	Existing Residential	Approx. 1920 m to the south of the notional noise source.
NSR2	Monastery and Pagoda	Existing Institutional	Approx. 2670 m to the south of the notional noise source.
NSR3	Hnan Ywa Village	Existing Residential	Approx. 1810 m to the south-east of the notional noise source.
NSR4	Sa Ka Village	Existing Residential	Approx. 1060 m to the north-east of the notional noise source.
NSR5 <sup>(a)</sup>	Steel Mill Worker Housing	Temporary Residential	Approx. 170 m to the east of the notional noise source.
NSR6	Government Technical High School	Existing Institutional	Approx. 1560 m to the south-east of the notional noise source.

Note:

- (a) As no people present at NSR5 during daytime, NSR5 will not be affected by the daytime construction noise from the Project. And, this temporary Steel Mill Worker Housing will be relocated to the area of NSR1 by the start of operation of the Project, NSR5 will also not be affected by the operation of the Project. Based on these, noise prediction has not been conducted for NSR5 due to the construction works during daytime and operation of the Project.

Figure 10.1 Locations of Representative Noise Sensitive Receivers



## 10.6

### BASELINE CONDITIONS

Baseline noise monitoring was conducted continuously at the four NSRs from July to September 2014 and from February to June 2015. Hourly A-weighted equivalent continuous sound pressure levels ( $L_{Aeq}$ , 1 hour) were recorded continuously over 24 hours at each location during both weekday and weekend. At each location, daytime and night-time  $L_{Aeq}$  were calculated by averaging the hourly sound pressure levels measured between 0700 and 2200 hours and between 2200 to 0700 hours, respectively.

Results of the background noise measurement are presented in **Table 10.3**.

**Table 10.3 Results of Background Noise Measurement**

NSR	Type of Uses	Averaged Background Noise Levels, dB(A) <sup>(a)</sup>		IFC Operational Noise Level Guidelines, dB(A)	
		Daytime	Night-time	Daytime	Night-time
NSR1	Existing Residential	54	50	55	45
NSR2	Existing Institutional	56	53	55	45
NSR3	Existing Residential	59	55	55	45
NSR4	Existing Residential	55	51	55	45
NSR5 <sup>(c)</sup>	Existing Residential	-	-	55	45
NSR6 <sup>(c)</sup>	Existing Institutional	-	-	55	45

**Notes:**

- (a) Noise Levels are averaged over 8 months period from July to September 2014 and from February to June 2015.
- (b) Daytime refers to the hours from 0700 hrs to 2200 hrs while night-time refers to the hours from 2200 hrs to 0700 hrs.
- (c) Background noise levels are not available for NSR5 and NSR6.

## 10.7

### DETERMINATION OF CRITERIA

#### 10.7.1

#### Construction Noise Criteria for Assessment

Since there is no national noise standard in Myanmar to control the noise arising from construction of the Project, IFC Guidelines have been adopted as the construction noise criteria for the assessment in this study. The maximum increase in background levels should not be more than 3 dB(A) at the identified representative NSRs.

### 10.7.2 *Operational Noise Criteria for Assessment*

Since there is no national noise standard in Myanmar to control the noise arising from operation of the Project, IFC Guidelines have been adopted as the operational noise criteria for the assessment in this study. The maximum increase in background levels (See **Table 10.3**) should not be more than 3 dB(A) at the identified representative NSRs.

## 10.8 *ASSESSMENT METHODOLOGY*

### 10.8.1 *Construction Noise*

The methodology adopted for the noise impact assessment is based on standard acoustics principles. The procedures of the assessment are summarised as follows:

- locate representative NSRs that may be affected by the works;
- assign Sound Power Level (SWL) to each plant item proposed and calculate the overall SWL associated with the proposed plant inventory;
- determine the national noise source positions of Project work sites, which was assumed to be midway between the approximate geographical centre of the sites and its boundary closest to the NSR;
- apply the correction factors based on the distance between the representative NSRs and the notional noise source position, and façade correction, in accordance with BS5228: Part 1: 2009<sup>(1)</sup>; and
- predict the construction noise levels at NSRs on the basis of the plant activity and an in built design controls.

It was assumed that the noise generated from the plant items would propagate to NSRs in the form of hemispherical waves. As a conservative approach to the assessment, the atmospheric absorption during sound transmission was not included in the assessment.

### 10.8.2 *Operational Noise*

Noise model SoundPLAN was used for the operational noise impact assessment, in accordance with the *Acoustics -- Attenuation of sound during propagation outdoors -- Part 1: Calculation of the absorption of sound by the atmosphere* (ISO 9613-1:1993) and *Acoustics -- Attenuation of sound during propagation outdoors -- Part 2: General method of calculation* (ISO 9613-2:1996).

The assessment results are presented in noise contours to provide an overall view of the predicted noise levels around the Project Site.

### 10.8.3 *Magnitude of the construction and operational noise impacts*

Based on the effects of noise on health in consideration of annoyance, speech intelligibility, communication interference, disturbance of information extraction, sleep disturbance, and hearing impairment, the sensitivity of the NSRs are determined as follows:

(1) *Noise and Vibration Control on Construction and Open Sites, Part 1. Code of Practice for Basic Information and Procedures for Noise and Vibration control.* British Standard, BS5228: Part 1: 2009

- High Sensitivity - hospitals and theatres;
- Medium Sensitivity - residential, educational and religious; and
- Low Sensitivity - industrials and commercials.

The magnitude of the construction and operational noise impacts are determined based on the criteria given in **Table 10.4** below:

**Table 10.4 Predicted Construction and Operational Phase Noise Impacts**

Impact Classification	Magnitude <sup>1</sup>	Negligible	Small	Medium	Large
<b>Construction Noise:</b>					
Noise Level, in dB(A) $L_{eq, 1 hr}$		$\leq$ background + 3	> background + 3 to background + 8	> background + 8 to background + 13	> background + 13
<b>Operational Noise:</b>					
Daytime Noise Level, in dB(A) $L_{eq, 1hr}$		$\leq$ background + 3	> background + 3 to background + 8	> background + 8 to background + 13	> background + 13
Night-time Noise Level, in dB(A) $L_{eq, 1hr}$		$\leq$ background + 3	> background + 3 to background + 8	> background + 8 to background + 13	> background + 13

## 10.9 IDENTIFICATION OF IMPACTS

### 10.9.1 Construction Phase

The construction activities of particular importance for potential noise impacts are noted below:

- Site preparation, pile driving and foundation works;
- Installation of equipment; and
- Construction of the infrastructure such as internal access roads, storm water drains and security fence.

Operation of the powered mechanical equipment (PME) will be the major sources of noise impact to the NSRs.

An indicative construction plant inventory for the construction activities during daytime period of the Project is summarised in **Table 10.5**. Construction works will be carried out during daytime period from 0730 to 1830 hours.

<sup>1</sup> Institute of Environmental Management and Assessment Institute of Acoustics Guidelines for Noise Impact Assessment (2007)

**Table 10.5 Indicative Construction Plant Inventory (Daytime)**

Plant Item	Reference (a)	Quantity during Peak hour	On-time %	Unit SWL, dB(A)	Sub- Total SWL, dB(A)	Overall SWL, dB(A) (b) (c)
<b>Site formation</b>						
Excavator	BS D3 35	3	100%	106	111	125
Bulldozer	BS D3 27	3	100%	109	114	
Dump truck	BS D3 52	3	100%	109	114	
<b>Piling</b>						
Piling rig	BS C3 1	4	100%	117	123	
<b>Substructure &amp; superstructure</b>						
Batching plant	BS D5 11	1	100%	108	108	
Vibrating compactor	BS D3 116	5	100%	106	113	
Concrete truck	BS D6 23	3	100%	100	105	
Concrete pump	BS D6 34	2	100%	107	110	
Compressor	BS D7 44	1	100%	103	103	
Genset 120kVA	BS D7 56	1	100%	110	110	
<b>Steel structure</b>						
Crawler crane 100t – diesel	BS C4 41	1	100%	99	99	
Crawler crane 50t – diesel	BS C4 46	1	100%	95	95	
Hydraulic crane 50t – diesel	BS C4 46	2	100%	95	98	
Hydraulic crane 75t – diesel	BS C4 41	2	100%	99	102	

**Notes:**

- (a) *Noise and Vibration Control on Construction and Open Sites, Part 1. Code of Practice for Basic Information and Procedures for Noise and Vibration control.* British Standard, BS5228: Part 1: 2009.
- (b) The figures are rounded-up to a whole number.
- (c) The overall SWL represents the maximum potential noise impact during construction phase.

**10.9.2 Operational Phase**

Testing and commissioning (T&C) will predominantly done during daytime, but sometimes it may be extended into night-time. The activities during night-time are listed as follows:

- Steam blowing activity will be carried out to cool down the pipes for maintaining the cyclic reaction during night-time;
- Load rejection activities will be performed during night-time if restricted to be performed during daytime;
- 24-hours transformer Soak Test, Withstand test for the transformer and substation, and Transmission lines will be carried out during night-time;
- Reliability Run test will be operated 24-hours continuously; and
- Boiler chemistry will be operated continuously in order to carry out the steam turbine commissioning.

During all the above events, following by the “continuous steam blow” procedure which is generally quieter than the Pack and Blow operation and the sound pressure levels (SPLs) will be intended to maintain at 70 dB(A) at 1m from the plant items. No adverse noise impact is anticipated during T&C.

The sources of noise associated with the operation of the power plant are expected to include the heat recovery steam generators (HRSG), gas turbines, steam turbine and cooling tower. The key assumption for the noise assessment is that the power plant will be generally operated for 24 hours per day throughout the year, unless dispatched off-line by the grid control centre or shut down for maintenance. An operational plant inventory for the power plant as provided by the Client (excluding downtime for maintenance or an offline instruction) is presented in **Table 10.6**. SPLs are assumed to be 85 dB(A) at 1 m from each of the plant items.

It is anticipated that there will only be 2 trips of company bus/mini-van and 12 trips of trucks per day during the operational phases for fetching employees and plant works transportation respectively. As the traffic generation is insignificant, it is expected that the increase in road traffic noise level would be less than 3 dB(A) during the Project operation. No adverse noise impact due to traffic generation is anticipated during operation.

**Table 10.6 Indicative Operation Plant Inventory List**

Plant Item	Quantity during peak hour	On-time during peak hour	Sound Pressure Level (SPL) at 1m, dB(A)
Heat Recovery Steam Generator (HRSG)	2	100%	85
Heat Recovery Steam Generator (HRSG) Main Stack	2	100%	85
Heat Recovery Steam Generator (HRSG) Main Bypass Stack	2	100%	85
Gas Turbine (GT) Air Inlet	2	100%	85
Gas Turbine (GT) Generator	2	100%	85
Gas Turbine (GT) Transformer	2	100%	85
Steam Turbine (ST) Hall	1	100%	85
Steam Turbine (ST) Transformer	1	100%	85
Cooling Tower	1	100%	85

## 10.10 ASSESSMENT OF NOISE IMPACT

### 10.10.1 Assessment of General Construction Noise

#### **Potential Impacts**

The results of the predicted construction noise levels at the representative NSRs are presented in **Table 10.7**.

**Table 10.7 Predicted Construction Noise Levels at Representative NSRs during Daytime Period**

NSR	Overall SWL from Construction Activities <sup>(a)</sup> , dB(A)	Distance between notional noise source positions of the construction work sites and NSR (D), m	Predicted Noise Level <sup>(b) (c)</sup> , dB(A)
NSR1	125	1920	54
NSR2	125	2670	52
NSR3	125	1810	55
NSR4	125	1060	60
NSR6	125	1560	56

NSR	Overall SWL from Construction Activities <sup>(a)</sup> , dB(A)	Distance between notional noise source positions of the construction work sites and NSR (D), m	Predicted Noise Level <sup>(b) (c)</sup> , dB(A)
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**Notes:**

(a) Overall SWL from *Table 10-5*.

(b) Predicted noise level = overall SWL + distance correction + façade reflection  
 $= 125 - (20 \times \log D + 8) + 3$

(c) The figures are rounded-up to a whole number.

**Potential Consequence**

With the indicative plant inventory presented in *Table 10.5*, the predicted construction noise levels at the representative NSRs are in the range of 53 - 60 dB(A). Cumulative noise impact is presented in *Table 10.8*.

**Table 10.8 Cumulative Construction Noise Levels at Representative NSRs during Daytime Period**

NSR	Predicted Noise Level (A), dB(A)	Daytime Averaged Background Noise Level (B), dB(A)	Cumulative noise level, dB(A) <sup>(a)</sup>	Increase in background noise <sup>(b)</sup> , dB(A)	Compliance <sup>(a)</sup>
NSR1	54	54	57	3	Yes
NSR2	52	56	58	2	Yes
NSR3	55	59	61	2	Yes
NSR4	60	55	61	6	No
NSR6	56	- <sup>(c)</sup>	- <sup>(c)</sup>	- <sup>(c)</sup>	No <sup>(c)</sup>

**Notes:**

(a) Cumulative Noise Level (C) =  $10 \times \log (10^{(A/10)} + 10^{(B/10)})$

(b) With reference to assessment noise criterion of a maximum increase in background levels of not more than 3 dB(A).

(c) Background noise level at NSR6 is not available. The predicted noise level is 1 dB(A) above the IFC General EHS Guidelines during daytime period.

The construction noise level at NSR4 during daytime is predicted with 6 dB(A) increase in background noise level, which exceeds the IFC General EHS Guidelines during daytime period. While that for NSR6 is 1 dB(A) above the IFC General EHS Guidelines during daytime period. The noise exceedance are mainly due to the use of the piling rigs, and equipments for site formation, substructure and superstructure. Noise mitigation measures are considered necessary to mitigate the construction noise impact.

**Proposed Noise Mitigation Measures**

In view of the predicted noise exceedances during the construction of the Project at NSR4 and NSR6, noise mitigation measures with the use of temporary noise barriers have been proposed to screen noise.

The use of temporary noise barriers will be an effective means to mitigate the noise impact arising from the construction works. Noise barriers shall be high enough to screen the direct line of sight between the construction plant and the NSR. It is anticipated that the major noise source of all PMEs, including movable and large PMEs, will be located at a level lower than the top of the proposed noise barriers, and therefore these barriers could reduce noise level by at least a 5 dB(A) n for

mobile plant such as excavator as well as large scale plant such as a crane. The noise barrier material should have a superficial surface density of at least  $7\text{kg m}^{-2}$  and have no openings or gaps.

Proposed noise mitigation measures and the reduced SWLs are shown in **Table 10.9**.

**Table 10.9 Proposed Noise Mitigation Measures**

Plant Item	Noise Mitigation Measures	Noise Reduction, dB(A)	Reduced SWL, dB(A)
<b>Site formation</b>			
Excavator	Noise barrier	-5	106
Bulldozer	Noise barrier	-5	109
Dump truck	Noise barrier	-5	109
<b>Piling</b>			
Piling rig	Noise barrier	-5	118
<b>Substructure &amp; superstructure</b>			
Batching plant	Noise barrier	-5	103
Vibrating compactor	Noise barrier	-5	108
Concrete truck	Noise barrier	-5	100
Concrete pump	Noise barrier	-5	105
Compressor	Noise barrier	-5	98
Genset 120kVA	Noise barrier	-5	105
<b>Steel structure</b>			
Crawler crane 100t – diesel	-	-	99
Crawler crane 50t – diesel	-	-	95
Hydraulic crane 50t – diesel	-	-	98
Hydraulic crane 75t – diesel	-	-	102
<b>Overall SWL</b>			<b>120</b>

With the implementation of the noise barriers, the mitigated noise levels due to the construction of the Project were calculated at the representative NSRs with results summarised in **Table 10.10**.

**Table 10.10 Predicted Construction Noise Levels at NSR4 with Noise Mitigation Measures**

NSR	Overall SWL from Construction Activities <sup>(a)</sup> , dB(A)	Distance between notional noise source positions of the construction work sites and NSR (D), m	Predicted Noise Level <sup>(b) (c)</sup> (A), dB(A)	Daytime Averaged Background Noise Level (B), dB(A)	Cumulative noise level (C), dB(A) <sup>(d)</sup>	Increase in background noise, dB(A)	Compliance
NSR4	120	1060	55	55	58	3	Yes <sup>(e)</sup>
NSR6	120	1560	52	- <sup>(f)</sup>	- <sup>(f)</sup>	- <sup>(f)</sup>	Yes <sup>(f)</sup>

**Notes:**

(a) Overall SWL from *Table 10.9*.

(b) Predicted noise level = overall SWL + distance correction + façade reflection  
 $= 120 - (20 \times \log D + 8) + 3$

(c) The figures are rounded-up to a whole number.

(d) Cumulative Noise Level (C) =  $10 \times \log (10^{(A/10)} + 10^{(B/10)})$

(e) With reference to assessment noise criterion of a maximum increase in background level of not more than 3 dB(A).

(f) Background noise level at NSR6 is not available. The predicted noise level of 52 dB(A) complies with the IFC General EHS Guidelines during daytime period.

With the adoption of the recommended mitigation measures, the mitigated noise levels comply with the IFC EHS Guidelines during the construction phase at all NSRs.

### Significance of Impacts

As presented in **Table 10.10**, the mitigated noise levels comply with the assessment noise criteria. The construction noise impact is considered to be of **negligible** significance at the nearest receptor. A construction noise impact assessment summary is given in **Table 10.11**.

**Table 10.11 Noise Impact Assessment - General Construction Phase**

Impact	Noise impact from the construction works during construction phase				
Impact Nature	<b>Negative</b>	Positive	Neutral		
	Noise impact from the construction activities is <b>negative</b> .				
Impact Type	<b>Direct</b>	Indirect	Induced		
	Noise impact from the construction activities is <b>direct</b> .				
Impact Duration	<b>Temporary</b>	Short-term	Long-term	Permanent	
	Noise impact from the construction activities is <b>temporary</b> .				
Impact Extent	<b>Local</b>	Regional	International		
	Noise impact from the construction equipment and activities is <b>local</b> .				
Impact Scale	Project area				
Frequency	Throughout the construction period.				
Impact Magnitude	Positive	<b>Negligible</b>	Small	Medium	Large
	Considering the predicted noise levels comply with both the noise criteria. The magnitude of the noise impact is <b>negligible</b> as per <i>Table 10-4</i> .				
Receptor Sensitivity	Low	<b>Medium</b>	High		
	The identified NSR are residential, the sensitivity of the receptor is considered as <b>medium</b> .				
Impact Significance	<b>Negligible</b>	Minor	Moderate	Major	
	As the impact magnitude is negligible and the receptor sensitivity is medium, the impact significance is considered as <b>negligible</b> .				

### Mitigation and Management Measures

The use of noise barriers and good site practices are recommended and will be implemented to minimise potential noise impacts during the construction phase, including:

- Install noise barriers as described in **Section 10.10.1** and **Table 10.9**. In accordance with BS 5228-1:2009, the barrier material shall have a mass per unit of surface area in excess of about 7 kg/m<sup>2</sup> and no gaps at the joints. The minimum height of barriers is typically such that no part of the noise source will be visible from the noise sensitive receiver;
- Well-maintained equipment to be operated on-site;
- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components;
- Shut down or throttled down between work periods for machines and construction plant items (e.g. trucks) that may be in intermittent use;

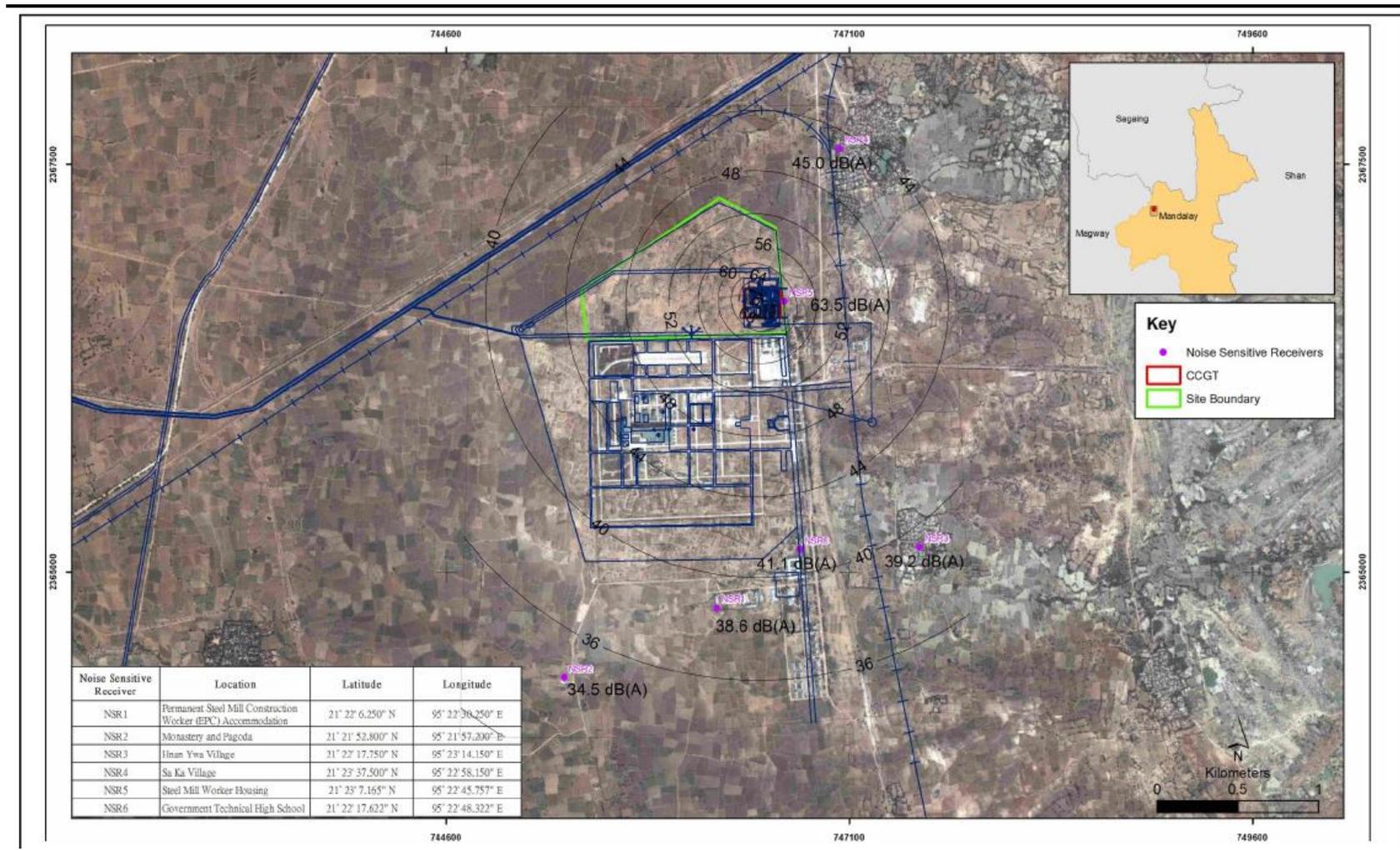
- Reduce the number of equipment operating simultaneously as far as practicable;
- Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable;
- Locate noisy plant as far away from receptors as practicable;
- Avoid transportation of materials on- and off-site through existing community areas;
- Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site construction activities;
- Vehicles should be regularly maintained; and
- Avoid transportation of materials on and off-site through existing community areas.

### 10.10.2 *Assessment of General Operational Noise*

#### **Potential Impacts**

The operational noise levels at the representative NSRs were predicted based on the plant inventory presented in **Table 10.6**. The output noise contour is illustrated in **Figure 10.2**. The predicted operation noise levels are summarized in **Table 10.12**.

Figure 10.2 Fixed Plant Noise Contour



**Table 10.12 Predicted Operation Noise Levels at Representative NSRs**

NSR	Predicted Noise Level (A), dB(A)	Averaged Background Noise Level (B), dB(A)		Cumulative noise level (C), dB(A) <sup>(a)</sup>		Increase in background noise <sup>(b)</sup> (Day/Night), dB(A)		Compliance	
		Daytime	Night-time	Daytime	Night-time	Daytime	Night-time	Daytime	Night-time
NSR1	39	54	50	54	50	0	0	Yes	Yes
NSR2	35	56	53	56	53	0	0	Yes	Yes
NSR3	39	59	55	59	55	0	0	Yes	Yes
NSR4	45	55	51	55	52	0	1	Yes	Yes
NSR6	41	- <sup>(c)</sup>	- <sup>(c)</sup>	- <sup>(c)</sup>	- <sup>(c)</sup>	- <sup>(c)</sup>	- <sup>(c)</sup>	Yes <sup>(c)</sup>	Yes <sup>(c)</sup>

**Notes:**

- (a) Cumulative Noise Level (C) =  $10 \times \log (10^{(A/10)} + 10^{(B/10)})$
- (b) With reference to assessment noise criterion of a maximum increase in background levels of not more than 3 dB(A).
- (c) Background noise level at NSR6 is not available. The predicted noise level of 41 dB(A) complies with the IFC General EHS Guidelines during both daytime and night-time periods.

**Potential Consequence**

The predicted noise levels in the range of 35 to 45 dB(A) comply with the IFC General EHS Guidelines during both daytime and night-time periods. The increase in background levels is not more than 1 dB(A) at all NSRs. The increase in background noise level at NSR4 is mainly due to the operation of the two sets of Heat Recovery Steam Generators. Noise mitigation measures are considered not necessary for the operation of the Project.

**Existing/In-Place Controls**

There are currently no existing or in-place controls for noise impacts associated with the operation of the Project.

**Significance of Impacts**

As presented in **Table 10.11**, the predicted noise levels comply with the assessment noise criteria. The operational noise impact is considered to be of **negligible** significance at the nearest receptor. An operational noise impact assessment summary is given in **Table 10.82**.

**Table 10.82 Noise Impact Assessment - General Operational Phase**

Impact	Noise impact from the operation of fixed plant and machinery during operational phase				
Impact Nature	Negative	Positive	Neutral		
	Noise impact from the operational activities is <b>negative</b> .				
Impact Type	Direct	Indirect	Induced		
	Noise impact from the operational activities is <b>direct</b> .				
Impact Duration	Temporary	Short-term	Long-term	Permanent	
	Noise impact from the operational activities is <b>long-term</b> .				
Impact Extent	Local	Regional	International		
	Noise impact from the operation activities is <b>local</b> .				
Impact Scale	Project area				
Frequency	Throughout the operation period.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
	Considering the predicted noise levels comply with both the noise criteria. The magnitude of the noise impact is <b>negligible</b> as per <i>Table 10-9</i> .				
Receptor Sensitivity	Low	Medium	High		
	The identified NSR are residential, the sensitivity of the receptor is considered as <b>medium</b> .				
Impact Significance	Negligible	Minor	Moderate	Major	
	As the impact magnitude is negligible and the receptor sensitivity is medium, the impact significance is considered as <b>negligible</b> .				

### Mitigation and Management Measures

Good site practices to minimise potential noise impacts during operational phase that should be considered include:

- Selecting quieter equipment;
- Installing silencers, mufflers or acoustic enclosures to reduce sound power level of noisy equipment at all times;
- Installing acoustic enclosures or other applicable control measures to ensure a maximum of 85 dB(A) at 1m away from the noise emitting equipment;
- Re-locating noise sources to less sensitive areas to take advantage of distance and shielding;
- Siting permanent facilities away from community areas if possible; and
- Taking advantage of the natural topography as a noise buffer during facility design.

### 10.10.3 *Residual Impact Assessment Conclusions*

With the adoption of the recommended mitigation measures, the predicted construction noise levels comply with the IFC EHS Guidelines during the construction phase at all NSRs. It is not anticipated that adverse noise impacts will occur during the construction phase of the Project.

With the proposed plant inventory and its corresponding source level (i.e. 85 dB(A) at 1 m from the plant items) to be used during operational phase, results of the assessment indicate that the noise associated with the operation of the Project complies with the IFC EHS Guideline during operation. It is not anticipated that adverse noise impacts will occur during the operational phase of the Project.

In the case of significant changes to the construction and operation plant inventories and respective operating parameters from the current assumptions, re-assessment may be required to be conducted to identify compliance with noise criteria.

### 10.11 *VIBRATION IMPACT*

Vibration will be generated from machinery during construction and operation, such as piling, drilling, and operation of compressors and generators, etc. In view of the nearest NSR is located at more than 900m from the Project Site, no vibration impact is anticipated.