



Sembcorp Utilities Pte. Ltd.

# **Environmental and Social Impact Assessment (ESIA) Report for Myingyan IPP Project – 225 MW Gas-fired Combined Cycle Power Station, Myanmar**

September 2015

Prepared by: ERM-Siam Co Ltd

For and on behalf of ERM-Siam Co Ltd

Approved by: Cristina Pellegrino

Signed:



Position: IAP Partner

Date: 15 September 2015

This report has been prepared by ERM-Siam Co Ltd with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.

We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.

This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at their own risk.

## CONTENTS

### ABBREVIATIONS

<b>EXECUTIVE SUMMARY</b>		<b>0-1</b>
<b>0.1</b>	<b>INTRODUCTION</b>	<b>0-1</b>
<b>0.2</b>	<b>PROJECT BACKGROUND AND OVERVIEW</b>	<b>0-1</b>
<b>0.3</b>	<b>PROJECT NEED</b>	<b>0-1</b>
<b>0.4</b>	<b>THE PROJECT</b>	<b>0-2</b>
<b>0.4.1</b>	<i>Project Location</i>	<b>0-2</b>
<b>0.4.2</b>	<i>Land</i>	<b>0-2</b>
<b>0.4.3</b>	<i>Project Facilities</i>	<b>0-3</b>
<b>0.4.4</b>	<i>Associated Facilities</i>	<b>0-4</b>
<b>0.4.5</b>	<i>Project Life Cycle Overview</i>	<b>0-4</b>
<b>0.5</b>	<b>ALTERNATIVE ANALYSIS</b>	<b>0-5</b>
<b>0.6</b>	<b>ADMINISTRATIVE FRAMEWORK</b>	<b>0-5</b>
<b>0.6.1</b>	<i>Overview of Myanmar Legislation</i>	<b>0-6</b>
<b>0.6.2</b>	<i>ESHIA Requirements in Myanmar</i>	<b>0-6</b>
<b>0.6.3</b>	<i>International Standards and Applicable Guidelines</i>	<b>0-7</b>
<b>0.7</b>	<b>IMPACT ASSESSMENT METHODOLOGY</b>	<b>0-7</b>
<b>0.8</b>	<b>DESCRIPTION OF THE ENVIRONMENT</b>	<b>0-10</b>
<b>0.8.1</b>	<i>Climate and Meteorology</i>	<b>0-10</b>
<b>0.8.2</b>	<i>Ambient Air Quality</i>	<b>0-11</b>
<b>0.8.3</b>	<i>Noise</i>	<b>0-11</b>
<b>0.8.4</b>	<i>Surface Water Quality</i>	<b>0-11</b>
<b>0.8.5</b>	<i>Soils</i>	<b>0-12</b>
<b>0.8.6</b>	<i>Groundwater</i>	<b>0-12</b>
<b>0.8.7</b>	<i>Landscape and Visual</i>	<b>0-12</b>
<b>0.8.8</b>	<i>Waste</i>	<b>0-13</b>
<b>0.8.9</b>	<i>Terrestrial and Marine Biodiversity</i>	<b>0-13</b>
<b>0.9</b>	<b>DESCRIPTION OF THE SOCIO-ECONOMIC BASELINE</b>	<b>0-14</b>
<b>0.9.1</b>	<i>Demographic Profile</i>	<b>0-14</b>
<b>0.9.2</b>	<i>Community Health</i>	<b>0-15</b>
<b>0.9.3</b>	<i>Economy and Livelihood</i>	<b>0-15</b>
<b>0.9.4</b>	<i>Community Infrastructure and Public Services</i>	<b>0-16</b>
<b>0.9.5</b>	<i>Cultural Heritage</i>	<b>0-16</b>
<b>0.10</b>	<b>STAKEHOLDER ENGAGEMENT</b>	<b>0-17</b>
<b>0.11</b>	<b>KEY ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT</b>	<b>0-17</b>
<b>0.11.1</b>	<i>Construction Phase</i>	<b>0-18</b>
<b>0.11.2</b>	<i>Operation Phase</i>	<b>0-21</b>
<b>0.12</b>	<b>ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN</b>	<b>0-24</b>
<b>0.12.1</b>	<i>Mitigation Measures</i>	<b>0-24</b>
<b>0.12.2</b>	<i>Monitoring Programme</i>	<b>0-24</b>
<b>0.12.3</b>	<b>TRAINING PROGRAMME</b>	<b>0-24</b>
<b>0.13</b>	<b>CONCLUSIONS</b>	<b>0-25</b>
<b>1</b>	<b>INTRODUCTION</b>	<b>1-1</b>
<b>1.1</b>	<b>PURPOSE OF THIS REPORT</b>	<b>1-1</b>

<b>1.2</b>	<b>PROJECT BACKGROUND AND OVERVIEW</b>	<b>1-1</b>
<b>1.3</b>	<b>PROJECT NEED</b>	<b>1-2</b>
<b>1.4</b>	<b>PROJECT SPONSOR / PROJECT DEVELOPER</b>	<b>1-2</b>
<b>1.5</b>	<b>ENVIRONMENTAL, SOCIAL AND HEALTH EXPERTS</b>	<b>1-3</b>
<b>1.6</b>	<b>ENVIRONMENT AND SOCIAL IMPACT ASSESSMENT OBJECTIVES</b>	<b>1-4</b>
<b>1.7</b>	<b>IMPACT ASSESSMENT SCOPE</b>	<b>1-4</b>
<b>1.8</b>	<b>STRUCTURE OF THIS REPORT</b>	<b>1-5</b>
<b>2</b>	<b>PROJECT DESCRIPTION AND ALTERNATIVES</b>	<b>2-1</b>
<b>2.1</b>	<b>INTRODUCTION</b>	<b>2-1</b>
<b>2.2</b>	<b>NAME OF PROJECT</b>	<b>2-1</b>
<b>2.3</b>	<b>PROJECT SPONSOR</b>	<b>2-1</b>
<b>2.4</b>	<b>PROJECT LOCATION</b>	<b>2-2</b>
<b>2.4.1</b>	<b>Existing Steel Mill Facilities</b>	<b>2-2</b>
<b>2.4.2</b>	<b>Aggreko Temporary Gas-Fired Power Plant</b>	<b>2-3</b>
<b>2.5</b>	<b>PROJECT FACILITIES</b>	<b>2-6</b>
<b>2.5.1</b>	<b>Project Facilities</b>	<b>2-6</b>
<b>2.5.2</b>	<b>Associated Facilities</b>	<b>2-6</b>
<b>2.5.3</b>	<b>225 MW CCGT Power Plant</b>	<b>2-7</b>
<b>2.5.4</b>	<b>Gas Supply Pipeline</b>	<b>2-18</b>
<b>2.5.5</b>	<b>230kV Overhead Transmission Line</b>	<b>2-19</b>
<b>2.5.6</b>	<b>Water Supply Pipeline and Wastewater Discharge Pipeline</b>	<b>2-19</b>
<b>2.6</b>	<b>PROJECT LIFE CYCLE OVERVIEW</b>	<b>2-24</b>
<b>2.6.1</b>	<b>Construction Phase</b>	<b>2-24</b>
<b>2.6.2</b>	<b>Operational Phase</b>	<b>2-34</b>
<b>2.6.3</b>	<b>Decommissioning Phase</b>	<b>2-38</b>
<b>2.7</b>	<b>PROJECT ALTERNATIVES</b>	<b>2-39</b>
<b>2.7.1</b>	<b>Project Need</b>	<b>2-39</b>
<b>2.7.2</b>	<b>Alternatives of Different Power Generation Options</b>	<b>2-41</b>
<b>2.7.3</b>	<b>Alternatives of the Project Location</b>	<b>2-46</b>
<b>2.7.4</b>	<b>Alternatives of Configuration on Site</b>	<b>2-50</b>
<b>2.7.5</b>	<b>Alternatives of Technological Options</b>	<b>2-50</b>
<b>2.7.6</b>	<b>Alternatives of Temporary Landing for Heavy Cargo</b>	<b>2-51</b>
<b>3</b>	<b>ADMINISTRATIVE FRAMEWORK</b>	<b>3-1</b>
<b>3.1</b>	<b>INTRODUCTION</b>	<b>3-1</b>
<b>3.2</b>	<b>NATIONAL ADMINISTRATIVE REQUIREMENTS</b>	<b>3-1</b>
<b>3.2.1</b>	<b>Overview of Myanmar Legislation</b>	<b>3-1</b>
<b>3.2.2</b>	<b>Summary of Applicable Standards</b>	<b>3-22</b>
<b>3.3</b>	<b>INTERNATIONAL STANDARDS AND GUIDELINES</b>	<b>3-25</b>
<b>3.3.1</b>	<b>International Finance Corporation (IFC) and World Bank Performance Standards</b>	<b>3-25</b>
<b>3.3.2</b>	<b>Gap Analysis between Myanmar Legislation and IFC Performance Standards</b>	<b>3-28</b>
<b>3.3.3</b>	<b>International Finance Corporation (IFC)/World Bank Environmental, Health, and Safety (EHS) Guidelines</b>	<b>3-34</b>
<b>3.3.4</b>	<b>Projects Located in Degraded Airsheds</b>	<b>3-36</b>
<b>3.3.5</b>	<b>Asian Development Bank Safeguard Policy Statement (2010)</b>	<b>3-37</b>
<b>3.3.6</b>	<b>ADB's Social Protection Strategy (2001)</b>	<b>3-44</b>
<b>3.3.7</b>	<b>ADB Gender and Development Policy (2003)</b>	<b>3-44</b>
<b>3.3.8</b>	<b>ADB's Public Communications Policy (2011)</b>	<b>3-45</b>
<b>3.4</b>	<b>INTERNATIONAL CONVENTIONS</b>	<b>3-45</b>

3.4.1	<i>The Kyoto Protocol on Climate Change (UNFCC)</i>	3-45
3.4.2	<i>The United Nations Convention on Biodiversity 1992</i>	3-46
3.4.3	<i>The Basel Convention 1989</i>	3-46
<b>4</b>	<b>IMPACT ASSESSMENT METHODOLOGY</b>	<b>4-1</b>
4.1	<i>INTRODUCTION</i>	4-1
4.2	<i>SCREENING</i>	4-1
4.3	<i>SCOPING</i>	4-2
4.4	<i>PROJECT DESCRIPTION</i>	4-3
4.5	<i>BASELINE CONDITIONS</i>	4-3
4.6	<i>STAKEHOLDER ENGAGEMENT</i>	4-3
4.7	<i>IMPACT ASSESSMENT</i>	4-4
4.7.1	<i>Prediction of Impacts</i>	4-4
4.7.2	<i>Evaluation of Impacts</i>	4-5
4.7.3	<i>Identification of Mitigation and Enhancement Measures</i>	4-8
4.7.4	<i>Residual Impact Evaluation</i>	4-9
4.8	<i>MANAGEMENT, MONITORING AND AUDIT</i>	4-9
<b>5</b>	<b>DESCRIPTION OF THE ENVIRONMENT – BIOPHYSICAL BASELINE</b>	<b>5-1</b>
5.1	<i>INTRODUCTION</i>	5-1
5.1.1	<i>Project Study Area</i>	5-1
5.1.2	<i>Project Area of Influence (Aoi)</i>	5-1
5.2	<i>CLIMATE AND METEOROLOGY</i>	5-3
5.2.1	<i>Myanmar Climatic Conditions</i>	5-3
5.2.2	<i>Mandalay Region Climatic Conditions</i>	5-3
5.2.3	<i>Project Site Climatic Conditions</i>	5-4
5.3	<i>AMBIENT AIR QUALITY</i>	5-20
5.3.1	<i>Nitrogen Dioxide (NO<sub>2</sub>)</i>	5-24
5.3.2	<i>Sulphur Dioxide (SO<sub>2</sub>)</i>	5-25
5.3.3	<i>Particulates Matters (PM<sub>10</sub> and PM<sub>2.5</sub>)</i>	5-25
5.4	<i>NOISE</i>	5-30
5.4.1	<i>Baseline Noise Monitoring Locations and Sampling Methodology</i>	5-30
5.4.2	<i>Results of Baseline Noise Monitoring</i>	5-32
5.5	<i>SURFACE WATER</i>	5-33
5.5.1	<i>Hydrology</i>	5-33
5.5.2	<i>Water Use</i>	5-37
5.5.3	<i>Surface Water Quality</i>	5-37
5.6	<i>SOILS</i>	5-43
5.6.1	<i>Soil Landscape</i>	5-43
5.6.2	<i>Soil Quality</i>	5-43
5.7	<i>GROUNDWATER</i>	5-51
5.7.1	<i>Hydrogeology</i>	5-51
5.7.2	<i>Groundwater Use</i>	5-53
5.7.3	<i>Groundwater Quality</i>	5-53
5.8	<i>LANDSCAPE AND VISUAL</i>	5-59
5.9	<i>WASTE</i>	5-60
5.10	<i>TERRESTRIAL AND MARINE BIODIVERSITY</i>	5-60
5.10.1	<i>EcoRegion Description</i>	5-60
5.10.2	<i>Key Biodiversity Areas</i>	5-61
5.10.3	<i>Protected Areas</i>	5-62

<b>5.10.4</b>	<b><i>Species of Conservation Significance</i></b>	<b>5-62</b>
<b>5.10.5</b>	<b><i>Invasive Species</i></b>	<b>5-63</b>
<b>5.10.6</b>	<b><i>Flora</i></b>	<b>5-63</b>
<b>5.10.7</b>	<b><i>Data Analysis</i></b>	<b>5-65</b>
<b>5.10.8</b>	<b><i>Results</i></b>	<b>5-66</b>
<b>5.10.9</b>	<b><i>Habitats</i></b>	<b>5-76</b>
<b>5.10.10</b>	<b><i>Fauna</i></b>	<b>5-76</b>
<b>6</b>	<b><i>DESCRIPTION OF THE SOCIO-ECONOMIC BASELINE</i></b>	<b>6-1</b>
<b>6.1</b>	<b><i>DATA COLLECTION</i></b>	<b>6-1</b>
<b>6.2</b>	<b><i>SOCIAL RECEPTORS</i></b>	<b>6-1</b>
<b>6.3</b>	<b><i>INTRODUCTION</i></b>	<b>6-4</b>
<b>6.4</b>	<b><i>DEMOGRAPHIC PROFILE</i></b>	<b>6-6</b>
<b>6.5</b>	<b><i>COMMUNITY HEALTH</i></b>	<b>6-8</b>
<b>6.5.1</b>	<b><i>Morbidity</i></b>	<b>6-8</b>
<b>6.5.2</b>	<b><i>Mortality</i></b>	<b>6-10</b>
<b>6.5.3</b>	<b><i>Access to Water and Sanitation</i></b>	<b>6-12</b>
<b>6.5.4</b>	<b><i>Behavioural Factors</i></b>	<b>6-14</b>
<b>6.5.5</b>	<b><i>Healthcare Facilities</i></b>	<b>6-15</b>
<b>6.6</b>	<b><i>ECONOMY AND LIVELIHOODS</i></b>	<b>6-17</b>
<b>6.6.1</b>	<b><i>Agriculture</i></b>	<b>6-18</b>
<b>6.6.2</b>	<b><i>Livestock</i></b>	<b>6-23</b>
<b>6.6.3</b>	<b><i>Forestry</i></b>	<b>6-26</b>
<b>6.6.4</b>	<b><i>Fisheries</i></b>	<b>6-27</b>
<b>6.6.5</b>	<b><i>Industry</i></b>	<b>6-30</b>
<b>6.7</b>	<b><i>COMMUNITY INFRASTRUCTURE AND PUBLIC SERVICES</i></b>	<b>6-31</b>
<b>6.7.1</b>	<b><i>Education and Schools</i></b>	<b>6-31</b>
<b>6.7.2</b>	<b><i>Waste Management</i></b>	<b>6-33</b>
<b>6.7.3</b>	<b><i>Electricity and Energy</i></b>	<b>6-34</b>
<b>6.7.4</b>	<b><i>Transportation</i></b>	<b>6-36</b>
<b>6.8</b>	<b><i>CULTURAL HERITAGE</i></b>	<b>6-39</b>
<b>7</b>	<b><i>AIR QUALITY</i></b>	<b>7-1</b>
<b>7.1</b>	<b><i>INTRODUCTION</i></b>	<b>7-1</b>
<b>7.2</b>	<b><i>ASSUMPTIONS AND LIMITATIONS</i></b>	<b>7-1</b>
<b>7.3</b>	<b><i>SCOPE OF THE ASSESSMENT</i></b>	<b>7-1</b>
<b>7.4</b>	<b><i>LEGISLATION REQUIREMENTS AND IFC GUIDELINES</i></b>	<b>7-2</b>
<b>7.5</b>	<b><i>SUMMARY OF RELEVANT BASELINE CONDITIONS</i></b>	<b>7-4</b>
<b>7.6</b>	<b><i>IDENTIFICATION OF AIR SENSITIVE RECEPTORS</i></b>	<b>7-4</b>
<b>7.7</b>	<b><i>IDENTIFICATION OF IMPACTS</i></b>	<b>7-7</b>
<b>7.7.1</b>	<b><i>Construction Phase</i></b>	<b>7-7</b>
<b>7.7.2</b>	<b><i>Operational Phase</i></b>	<b>7-7</b>
<b>7.8</b>	<b><i>ASSESSMENT METHODOLOGY</i></b>	<b>7-7</b>
<b>7.8.1</b>	<b><i>Construction Phase</i></b>	<b>7-7</b>
<b>7.8.2</b>	<b><i>Operational Phase</i></b>	<b>7-7</b>
<b>7.8.3</b>	<b><i>Assessment Criteria for Quantitative Assessment</i></b>	<b>7-14</b>
<b>7.9</b>	<b><i>ASSESSMENT OF IMPACTS</i></b>	<b>7-15</b>
<b>7.9.1</b>	<b><i>Construction Phase</i></b>	<b>7-15</b>
<b>7.9.2</b>	<b><i>Operation Phase</i></b>	<b>7-19</b>
<b>7.9.3</b>	<b><i>Cumulative Impacts</i></b>	<b>7-38</b>
<b>7.10</b>	<b><i>RESIDUAL IMPACT ASSESSMENT CONCLUSIONS</i></b>	<b>7-42</b>

<b>8</b>	<b>GREENHOUSE GAS</b>	<b>8-1</b>
<b>8.1</b>	<b>INTRODUCTION</b>	<b>8-1</b>
<b>8.2</b>	<b>ASSUMPTIONS AND LIMITATIONS</b>	<b>8-1</b>
<b>8.3</b>	<b>SCOPE OF ASSESSMENT</b>	<b>8-2</b>
<b>8.3.1</b>	<b>Project Activities</b>	<b>8-2</b>
<b>8.4</b>	<b>LEGISLATION REQUIREMENTS</b>	<b>8-2</b>
<b>8.5</b>	<b>SUMMARY OF RELEVANT BASELINE CONDITIONS</b>	<b>8-2</b>
<b>8.6</b>	<b>ASSESSMENT METHODOLOGY</b>	<b>8-3</b>
<b>8.7</b>	<b>ASSESSMENT OF IMPACTS</b>	<b>8-3</b>
<b>8.7.1</b>	<b>Construction Phase</b>	<b>8-3</b>
<b>8.7.2</b>	<b>Operation Phase</b>	<b>8-9</b>
<b>9</b>	<b>SURFACE WATER QUALITY</b>	<b>9-1</b>
<b>9.1</b>	<b>INTRODUCTION</b>	<b>9-1</b>
<b>9.2</b>	<b>ASSUMPTIONS AND LIMITATIONS</b>	<b>9-1</b>
<b>9.3</b>	<b>SCOPE OF ASSESSMENT</b>	<b>9-2</b>
<b>9.4</b>	<b>LEGISLATION REQUIREMENTS</b>	<b>9-2</b>
<b>9.5</b>	<b>SUMMARY OF BASELINE CONDITIONS</b>	<b>9-2</b>
<b>9.5.1</b>	<b>Hydrology</b>	<b>9-2</b>
<b>9.5.2</b>	<b>Water Use</b>	<b>9-3</b>
<b>9.5.3</b>	<b>Water Quality</b>	<b>9-3</b>
<b>9.6</b>	<b>ASSESSMENT METHODOLOGY</b>	<b>9-3</b>
<b>9.6.1</b>	<b>Impact Identification</b>	<b>9-4</b>
<b>9.7</b>	<b>ASSESSMENT OF IMPACTS</b>	<b>9-4</b>
<b>9.7.1</b>	<b>Construction Phase</b>	<b>9-4</b>
<b>9.7.2</b>	<b>Operation and Maintenance Phase</b>	<b>9-12</b>
<b>10</b>	<b>NOISE AND VIBRATION</b>	<b>10-1</b>
<b>10.1</b>	<b>INTRODUCTION</b>	<b>10-1</b>
<b>10.2</b>	<b>ASSUMPTIONS AND LIMITATIONS</b>	<b>10-1</b>
<b>10.3</b>	<b>SCOPE OF THE ASSESSMENT</b>	<b>10-1</b>
<b>10.4</b>	<b>LEGISLATION REQUIREMENTS</b>	<b>10-1</b>
<b>10.4.1</b>	<b>Myanmar Legislation</b>	<b>10-1</b>
<b>10.4.2</b>	<b>IFC Guidelines</b>	<b>10-2</b>
<b>10.5</b>	<b>NOISE SENSITIVE RECEIVERS</b>	<b>10-2</b>
<b>10.6</b>	<b>BASELINE CONDITIONS</b>	<b>10-5</b>
<b>10.7</b>	<b>DETERMINATION OF CRITERIA</b>	<b>10-5</b>
<b>10.7.1</b>	<b>Construction Noise Criteria for Assessment</b>	<b>10-5</b>
<b>10.7.2</b>	<b>Operational Noise Criteria for Assessment</b>	<b>10-6</b>
<b>10.8</b>	<b>ASSESSMENT METHODOLOGY</b>	<b>10-6</b>
<b>10.8.1</b>	<b>Construction Noise</b>	<b>10-6</b>
<b>10.8.2</b>	<b>Operational Noise</b>	<b>10-6</b>
<b>10.8.3</b>	<b>Magnitude of the construction and operational noise impacts</b>	<b>10-6</b>
<b>10.9</b>	<b>IDENTIFICATION OF IMPACTS</b>	<b>10-7</b>
<b>10.9.1</b>	<b>Construction Phase</b>	<b>10-7</b>
<b>10.9.2</b>	<b>Operational Phase</b>	<b>10-8</b>
<b>10.10</b>	<b>ASSESSMENT OF NOISE IMPACT</b>	<b>10-9</b>
<b>10.10.1</b>	<b>Assessment of General Construction Noise</b>	<b>10-9</b>
<b>10.10.2</b>	<b>Assessment of General Operational Noise</b>	<b>10-13</b>

<b>10.10.3</b>	<b><i>Residual Impact Assessment Conclusions</i></b>	<b>10-17</b>
<b>10.11</b>	<b><i>VIBRATION IMPACT</i></b>	<b>10-17</b>
<b>11</b>	<b><i>LANDSCAPE AND VISUAL</i></b>	<b>11-1</b>
<b>11.1</b>	<b><i>INTRODUCTION</i></b>	<b>11-1</b>
<b>11.2</b>	<b><i>ASSUMPTIONS AND LIMITATIONS</i></b>	<b>11-1</b>
<b>11.3</b>	<b><i>SCOPE OF ASSESSMENT</i></b>	<b>11-1</b>
<b>11.4</b>	<b><i>LEGISLATION REQUIREMENTS</i></b>	<b>11-2</b>
<b>11.5</b>	<b><i>SUMMARY OF BASELINE CONDITIONS</i></b>	<b>11-2</b>
<b>11.5.1</b>	<b><i>Landscape Baseline</i></b>	<b>11-2</b>
<b>11.5.2</b>	<b><i>Visual Baseline</i></b>	<b>11-5</b>
<b>11.6</b>	<b><i>ASSESSMENT METHODOLOGY</i></b>	<b>11-6</b>
<b>11.7</b>	<b><i>ASSESSMENT OF IMPACTS</i></b>	<b>11-6</b>
<b>11.7.1</b>	<b><i>Construction Phase</i></b>	<b>11-6</b>
<b>11.7.2</b>	<b><i>Operation Phase</i></b>	<b>11-10</b>
<b>12</b>	<b><i>SOIL AND GROUNDWATER</i></b>	<b>12-1</b>
<b>12.1</b>	<b><i>INTRODUCTION</i></b>	<b>12-1</b>
<b>12.2</b>	<b><i>ASSUMPTIONS AND LIMITATIONS</i></b>	<b>12-1</b>
<b>12.3</b>	<b><i>SCOPE OF ASSESSMENT</i></b>	<b>12-2</b>
<b>12.4</b>	<b><i>LEGISLATION REQUIREMENTS</i></b>	<b>12-3</b>
<b>12.5</b>	<b><i>SUMMARY OF BASELINE CONDITIONS</i></b>	<b>12-3</b>
<b>12.6</b>	<b><i>ASSESSMENT METHODOLOGY</i></b>	<b>12-3</b>
<b>12.7</b>	<b><i>RECEPTOR IDENTIFICATION AND SENSITIVITY</i></b>	<b>12-4</b>
<b>12.8</b>	<b><i>ASSESSMENT OF IMPACTS</i></b>	<b>12-4</b>
<b>12.9</b>	<b><i>CONSTRUCTION PHASE</i></b>	<b>12-4</b>
<b>12.10</b>	<b><i>OPERATION AND MAINTENANCE PHASE</i></b>	<b>12-12</b>
<b>13</b>	<b><i>WASTE</i></b>	<b>13-1</b>
<b>13.1</b>	<b><i>INTRODUCTION</i></b>	<b>13-1</b>
<b>13.2</b>	<b><i>ASSUMPTIONS AND LIMITATIONS</i></b>	<b>13-1</b>
<b>13.3</b>	<b><i>SCOPE OF ASSESSMENT</i></b>	<b>13-2</b>
<b>13.4</b>	<b><i>LEGISLATION REQUIREMENTS</i></b>	<b>13-3</b>
<b>13.5</b>	<b><i>SUMMARY OF BASELINE CONDITIONS</i></b>	<b>13-3</b>
<b>13.5.1</b>	<b><i>Existing Waste Generators</i></b>	<b>13-3</b>
<b>13.6</b>	<b><i>ASSESSMENT METHODOLOGY</i></b>	<b>13-4</b>
<b>13.7</b>	<b><i>RESOURCES AND RECEPTORS</i></b>	<b>13-4</b>
<b>13.8</b>	<b><i>ASSESSMENT OF IMPACTS</i></b>	<b>13-4</b>
<b>13.8.1</b>	<b><i>Construction Phase</i></b>	<b>13-4</b>
<b>13.9</b>	<b><i>OPERATION AND MAINTENANCE PHASE</i></b>	<b>13-8</b>
<b>14</b>	<b><i>TERRESTRIAL &amp; MARINE BIODIVERSITY</i></b>	<b>14-1</b>
<b>14.1</b>	<b><i>INTRODUCTION</i></b>	<b>14-1</b>
<b>14.2</b>	<b><i>ASSUMPTIONS AND LIMITATIONS</i></b>	<b>14-1</b>
<b>14.3</b>	<b><i>SCOPE OF ASSESSMENT</i></b>	<b>14-1</b>
<b>14.3.1</b>	<b><i>Project and Associated Activities</i></b>	<b>14-1</b>
<b>14.3.2</b>	<b><i>Resources and Receptors</i></b>	<b>14-2</b>
<b>14.3.3</b>	<b><i>Project Study Area</i></b>	<b>14-2</b>

<b>14.4</b>	<b>LEGISLATION REQUIREMENTS</b>	<b>14-3</b>
<b>14.5</b>	<b>SUMMARY OF RELEVANT BASELINE CONDITIONS</b>	<b>14-3</b>
<b>14.6</b>	<b>ASSESSMENT METHODOLOGY</b>	<b>14-3</b>
<b>14.6.1</b>	<b>Sensitivities of Terrestrial and Aquatic Biodiversity Resources/ Receptors</b>	<b>14-4</b>
<b>14.6.2</b>	<b>Assessment Criteria</b>	<b>14-4</b>
<b>14.7</b>	<b>ASSESSMENT OF IMPACTS</b>	<b>14-7</b>
<b>14.7.1</b>	<b>Avoidance/ Minimisation of Impacts</b>	<b>14-11</b>
<b>14.7.2</b>	<b>Construction Phase</b>	<b>14-11</b>
<b>14.7.3</b>	<b>Operation Phase</b>	<b>14-13</b>
<b>14.7.4</b>	<b>Residual Impacts on Biodiversity Values</b>	<b>14-15</b>
<b>15</b>	<b>SOCIAL IMPACT ASSESSMENT</b>	<b>15-1</b>
<b>15.1</b>	<b>ASSESSMENT METHODOLOGY</b>	<b>15-1</b>
<b>15.1.1</b>	<b>Socio-economic Receptors</b>	<b>15-1</b>
<b>15.1.2</b>	<b>Assumption and Limitations</b>	<b>15-4</b>
<b>15.2</b>	<b>ASSESSMENT OF IMPACTS</b>	<b>15-4</b>
<b>15.2.1</b>	<b>Impacts on Employment and the Economy</b>	<b>15-4</b>
<b>15.2.2</b>	<b>Impacts on Community Health</b>	<b>15-6</b>
<b>15.2.3</b>	<b>Impacts on Community Safety and Security</b>	<b>15-10</b>
<b>15.2.4</b>	<b>Impacts from Environmental Emissions</b>	<b>15-14</b>
<b>15.2.5</b>	<b>Impacts on Community Infrastructure and Services</b>	<b>15-15</b>
<b>15.2.6</b>	<b>Impacts on Social Networks</b>	<b>15-18</b>
<b>15.2.7</b>	<b>Impacts from Land Acquisition and Involuntary Resettlement</b>	<b>15-21</b>
<b>15.2.8</b>	<b>Impacts on Cultural Heritage</b>	<b>15-24</b>
<b>15.3</b>	<b>SUMMARY</b>	<b>15-25</b>
<b>16</b>	<b>STAKEHOLDER ENGAGEMENT</b>	<b>16-1</b>
<b>16.1</b>	<b>INTRODUCTION</b>	<b>16-1</b>
<b>16.2</b>	<b>STAKEHOLDER IDENTIFICATION</b>	<b>16-1</b>
<b>16.3</b>	<b>SUMMARY OF STAKEHOLDER ENGAGEMENT ACTIVITIES</b>	<b>16-2</b>
<b>16.3.1</b>	<b>Engagement materials</b>	<b>16-5</b>
<b>16.4</b>	<b>SUMMARY OF KEY STAKEHOLDER FEEDBACK</b>	<b>16-5</b>
<b>16.4.1</b>	<b>Incorporation in ESIA</b>	<b>16-11</b>
<b>16.5</b>	<b>FUTURE STAKEHOLDER ENGAGEMENT ACTIVITIES</b>	<b>16-11</b>
<b>16.5.1</b>	<b>Action Plan</b>	<b>16-12</b>
<b>16.5.2</b>	<b>Stakeholder Committee</b>	<b>16-13</b>
<b>16.5.3</b>	<b>Stakeholder Database</b>	<b>16-14</b>
<b>16.5.4</b>	<b>Grievance Mechanism</b>	<b>16-14</b>
<b>16.5.5</b>	<b>Monitoring and Evaluation</b>	<b>16-16</b>
<b>17</b>	<b>CUMULATIVE IMPACT ASSESSMENT</b>	<b>17-1</b>
<b>17.1</b>	<b>INTRODUCTION</b>	<b>17-1</b>
<b>17.2</b>	<b>METHODOLOGY</b>	<b>17-2</b>
<b>17.2.1</b>	<b>Overview</b>	<b>17-2</b>
<b>17.2.2</b>	<b>Determine Spatial and Temporal Boundaries and VECs</b>	<b>17-3</b>
<b>17.2.3</b>	<b>Identify VEC's and their Present Conditions</b>	<b>17-3</b>
<b>17.2.4</b>	<b>Identify all Developments and External Natural and Social Stressors Affecting the VECs</b>	<b>17-3</b>
<b>17.2.5</b>	<b>Identification and Assessment of Impacts</b>	<b>17-4</b>

17.2.6	<i>Development of Management, Mitigation and Monitoring Measures</i>	17-5
17.3	<i>IDENTIFICATION OF VEC'S AND THEIR PRESENT CONDITIONS</i>	17-5
17.4	<i>IDENTIFICATION OF ALL DEVELOPMENTS AND EXTERNAL NATURAL AND SOCIAL STRESSORS</i>	17-6
17.4.1	<i>Associated Facilities</i>	17-6
17.4.2	<i>Projects External to the Sponsor</i>	17-6
17.5	<i>SUMMARY OF TRENDS, VEC'S AND SCOPE REFINEMENT</i>	17-9
17.5.1	<i>Summary of Trends</i>	17-9
17.5.2	<i>Scope Finalisation</i>	17-9
17.6	<i>AIR QUALITY CUMULATIVE IMPACT ASSESSMENT</i>	17-12
17.6.1	<i>Project Impacts</i>	17-12
17.6.2	<i>Relevant Cumulative Impacts with Other Projects</i>	17-12
17.6.3	<i>Specific Mitigation Measures for Cumulative Impacts</i>	17-12
17.7	<i>NOISE CUMULATIVE IMPACT ASSESSMENT</i>	17-14
17.7.1	<i>Project Impacts</i>	17-14
17.7.2	<i>Relevant Cumulative Impacts with Other Projects</i>	17-14
17.7.3	<i>Specific Mitigation Measures for Cumulative Impacts</i>	17-14
17.8	<i>SURFACE WATER CUMULATIVE IMPACT ASSESSMENT</i>	17-14
17.8.1	<i>Project Impacts</i>	17-14
17.8.2	<i>Relevant Cumulative Impacts with Other Projects</i>	17-14
17.8.3	<i>Specific Mitigation Measures for Cumulative Impacts</i>	17-15
17.9	<i>SOIL AND GROUNDWATER CUMULATIVE IMPACT ASSESSMENT</i>	17-15
17.9.1	<i>Project Impacts</i>	17-15
17.9.2	<i>Relevant Cumulative Impacts with Other Projects</i>	17-16
17.9.3	<i>Specific Mitigation Measures for Cumulative Impacts</i>	17-16
17.10	<i>SOCIO-ECONOMIC CUMULATIVE IMPACT ASSESSMENT – COMMUNITY HEALTH AND SAFETY</i>	17-16
17.10.1	<i>Project Impacts</i>	17-16
17.10.2	<i>Relevant Cumulative Impacts with other Projects</i>	17-17
17.10.3	<i>Specific Mitigation Measures for Cumulative Impacts</i>	17-17
17.11	<i>SOCIO-ECONOMIC CUMULATIVE IMPACT ASSESSMENT – EMPLOYMENT AND BUSINESS OPPORTUNITIES</i>	17-17
17.11.1	<i>Project Impacts</i>	17-17
17.11.2	<i>Relevant Cumulative Impacts with other Projects</i>	17-18
17.11.3	<i>Specific Mitigation Measures for Cumulative Impacts</i>	17-18
17.12	<i>CONCLUSION AND RECOMMENDATIONS</i>	17-18
18	<i>ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN</i>	18-1
18.1	<i>OBJECTIVES</i>	18-1
18.2	<i>SCOPE OF THIS ESMP</i>	18-1
18.3	<i>SUMMARY OF IMPACTS AND MITIGATION/ MANAGEMENT MEASURES</i>	18-3
18.4	<i>DETAILED MANAGEMENT PLAN</i>	18-3
18.5	<i>ENVIRONMENTAL AND SOCIAL MONITORING PROGRAMME</i>	18-4
18.5.1	<i>Performance Indicators and Monitoring Schedule</i>	18-5
18.5.2	<i>Reporting Mechanism for Environmental and Social Monitoring Programme</i>	18-5
18.6	<i>INSTITUTIONAL SETTING AND IMPLEMENTATION ARRANGEMENTS</i>	18-30
18.6.1	<i>Construction Phase</i>	18-30
18.6.2	<i>Operation Phase</i>	18-31
18.7	<i>TRAINING</i>	18-31
18.7.1	<i>Construction Phase</i>	18-31
18.7.2	<i>Operation Phase</i>	18-32
18.8	<i>PLANS FOR CONSTRUCTION AND OPERATION PHASE OF THE PROJECT</i>	18-32
18.8.1	<i>Construction Phase</i>	18-32
18.8.2	<i>Operation Phase</i>	18-33

<b>18.8.3</b>	<b>Budget</b>	<b>18-34</b>
<b>18.9</b>	<b>UPDATING OF ESMP</b>	<b>18-34</b>
<b>19</b>	<b>DISASTER RISK PLAN</b>	<b>19-1</b>
<b>19.1</b>	<b>INTRODUCTION</b>	<b>19-1</b>
<b>19.2</b>	<b>FINDINGS AND RECOMMENDATIONS</b>	<b>19-1</b>
<b>20</b>	<b>CONCLUSION AND RECOMMENDATION</b>	<b>20-1</b>
<b>21</b>	<b>REFERENCES</b>	<b>21-1</b>

## **ANNEXES**

<i>Annex A</i>	<i>Quantitative Risk Assessment</i>
<i>Annex B</i>	<i>Laboratory Reports</i>
<i>Annex C</i>	<i>Checklist of Invasive Species</i>
<i>Annex D</i>	<i>Household Survey Questionnaire</i>
<i>Annex E</i>	<i>Air Quality Results Summary</i>
<i>Annex F</i>	<i>Stakeholder Engagement Presentations</i>
<i>Annex G</i>	<i>Photographs from Stakeholder Engagement</i>
<i>Annex H</i>	<i>Stakeholder Suggestion Box Comments</i>
<i>Annex I</i>	<i>Stakeholder Engagement Questionnaire</i>
<i>Annex J</i>	<i>Grievance Log Template</i>
<i>Annex K</i>	<i>Relevant Criteria and Standards</i>
<i>Annex L</i>	<i>Standard Analytical Methods</i>
<i>Annex M</i>	<i>Risk and Disaster Management Plan</i>

## List of Tables

Table 1.1	Key Facts of SCI	1-3
Table 1.2	ESIA Report Structure	1-5
Table 2.1	Gas Turbine Generator Specification	2-11
Table 2.2	HRSG Specification (at design condition)	2-12
Table 2.3	Steam Turbine Generator Specifications	2-13
Table 2.4	Shwe Gas (natural gas) Composition	2-19
Table 2.5	Power Plant Key Structures	2-26
Table 2.6	Heavy Cargo to be transported from Thilawa Port in Yangon to Nyaung Hla Jetty	2-30
Table 2.7	Anticipated Workforce during Construction	2-34
Table 2.8	Water Requirements during Operation	2-35
Table 2.9	Wastewater during Operation	2-35
Table 2.10	Solid Waste during Operation	2-36
Table 2.11	Hazardous Materials during Operation	2-37
Table 2.12	Anticipated Workforce during Operation	2-37
Table 2.13	Existing Hydroelectric Power Plant in Myanmar (> 50 MW)	2-41
Table 2.14	Expected Hydroelectric Power Plant Projects to be completed during 2013-2016	2-42
Table 2.15	Existing Gas-fired Power Plants in Myanmar	2-43
Table 2.16	Expected Gas-fired Power Plant Projects to be completed during 2013 to 2016	2-44
Table 3.1	Administrative Regions of Myanmar	3-2
Table 3.2	Protected Areas in Myanmar	3-14
Table 3.3	Project-Relevant Legislation in Myanmar	3-20
Table 3.4	Indicative Guideline for Treated Sanitary Sewage Discharges	3-23
Table 3.5	General Noise Level Standards	3-23
Table 3.6	Effluent Standards for Thermal Power	3-24
Table 3.7	Air Emission Standards for Thermal Power (applicable to non-degraded airsheds)	3-24
Table 3.8	IFC Performance Standards	3-26
Table 3.9	Gap Analysis International Standards and Myanmar Legislation Relevant to the Project	3-29
Table 3.10	Applicable IFC General EHS Guidelines	3-35
Table 3.11	IFC/World Bank EHS Guidelines for Thermal Power Plants	3-37
Table 3.12	Safeguard Policy Statement (Safeguards Requirements 1-3)	3-39
Table 3.13	International Conventions Ratified by Myanmar	3-47
Table 4.1	Resources/Receptors and Potential Impacts Considered in Scoping	4-2
Table 4.2	Impact Characteristic Terminology	4-5
Table 4.3	Impact Type Definitions	4-5
Table 4.4	Definitions for Likelihood Designations	4-6
Table 4.5	Impact Significance	4-7
Table 5.1	Climatic Data of Myingyan, Mandalay State, Myanmar 2013	5-5
Table 5.2	Average Ambient Temperature (°C) between July to December 2014 and January to June 2015	5-7
Table 5.3	Average Relative Humidity (%) between July to December 2014 and January to June 2015	5-7
Table 5.4	Averaged Wind Speed and Direction at SRs	5-9
Table 5.5	Details of Baseline Air Sampling Locations	5-20

Table 5.6	Air Sampling Parameters, Equipment and Methodology / Standard for Baseline Monitoring	5-23
Table 5.7	Sampling Date and Number of Samples / Measurements	5-23
Table 5.8	Measurement Results of NO <sub>2</sub> in Ambient Air at All Monitoring Locations	5-26
Table 5.9	Measurement Results of SO <sub>2</sub> in Ambient Air at All Monitoring Locations	5-27
Table 5.10	Measurement Results of PM <sub>10</sub> in Ambient Air at All Monitoring Locations	5-28
Table 5.11	Measurement Results of PM <sub>2.5</sub> in Ambient Air at All Monitoring Locations	5-29
Table 5.12	Background Concentrations of Pollutants	5-30
Table 5.13	Locations of Baseline Noise Monitoring Locations	5-31
Table 5.14	Equipment Used for Baseline Noise Monitoring and Measurement Parameters	5-31
Table 5.15	Monitoring Schedule	5-31
Table 5.16	Results of Baseline Noise Monitoring	5-32
Table 5.17	Operational Noise Criteria	5-33
Table 5.18	Surface Water Flow Rate Monitoring Locations	5-34
Table 5.18	Estimated Flow Rates in Southern Channel Ayeyarwady River	5-36
Table 5.19	Surface Water Quality Monitoring Locations	5-38
Table 5.20	Monitoring Results of Baseline Surface Water Quality	5-42
Table 5.21	Location of Soil Samples	5-45
Table 5.22	Soil Quality Results	5-49
Table 5.23	Estimated Groundwater Potential across Myanmar	5-51
Table 5.24	Water Use by Different Sectors	5-53
Table 5.25	Description of Groundwater Sampling Locations	5-54
Table 5.26	Groundwater Quality Analysis	5-56
Table 5.27	Species of Conservation Significance found in the Project Ecoregion	5-62
Table 5.28	Location of sample plots	5-64
Table 5.29	Relative Frequency, Relative Density and IVI value of the study area	5-66
Table 5.30	Species distribution by frequency classes	5-68
Table 5.31	Plant species diversity index values	5-69
Table 5.32	Plant species recorded in the area of vegetation with grass, shrubs, and small trees	5-70
Table 5.33	Plant species recorded in the developed areas	5-71
Table 5.34	Plant species recorded in the cultivated land	5-73
Table 5.35	Plant species composition in the proposed area	5-74
Table 5.36	Bird species recorded during the survey period	5-78
Table 5.37	Species diversity index values of birds in the Project Study Area	5-79
Table 5.38	Mammal species recorded during the survey period	5-80
Table 5.39	Reptile and amphibian species recorded during the survey period	5-80
Table 5.40	Butterfly species recorded during the survey period	5-81
Table 5.41	Species diversity index values of butterflies in the Project Study Area	5-81
Table 5.42	Fish species recorded during the survey period	5-81
Table 5.43	Sampling points of plankton and benthos	5-82
Table 5.44	Zooplankton species recorded during the survey period	5-82
Table 5.45	Phytoplankton species recorded during the survey period	5-83
Table 5.46	Benthos species recorded during the survey period	5-83
Table 6.1	Village Overview	6-7
Table 6.2	Key Health Indicators	6-8
Table 6.3	Leading Causes of Morbidity in Myanmar (2012)	6-8
Table 6.4	Diseases under Myanmar National Surveillance (2012)	6-9
Table 6.5	Village Health - Morbidity	6-10
Table 6.6	Leading Causes of Mortality in Myanmar (2012)	6-10
Table 6.7	Village Health - Mortality	6-11
Table 6.8	Village Water Sources	6-13
Table 6.9	Alcohol Use	6-14

Table 6.10	Health Facilities in Myanmar	6-15
Table 6.11	Health Personnel in Myanmar	6-15
Table 6.12	Village Healthcare Facilities	6-16
Table 6.11	Village Agricultural Practices	6-13
Table 6.13	Government Irrigation Projects	6-18
Table 6.14	Income from Agriculture	6-19
Table 6.14	Village Livestock Practices	6-15
Table 6.15	Household Income	6-20
Table 6.16	Crops – Dry Season	6-21
Table 6.17	Crops – Wet Season	6-21
Table 6.18	Livestock Population by State and Region (2013-2014)	6-23
Table 6.19	Village Livestock Practices	6-24
Table 6.20	Village Fisheries Practices	6-29
Table 6.21	Village Educational Facilities	6-32
Table 6.22	Access to Energy	6-35
Table 6.23	Village Energy Sources	6-35
Table 6.24	Road Traffic Accidents by States and Regions in Myanmar (2013-2014)	6-38
Table 6.25	Vehicle Ownership	6-38
Table 6.26	Village Vehicle Ownership	6-39
Table 6.27	List of Tangible Cultural Heritage Resources Identified within the Cultural Heritage Study Area	6-40
Table 7.1	Air Pollutants of Concern during Construction and Operational Phase of the Project	7-2
Table 7.2	WHO Ambient Air Quality Guidelines (2005) (a)	7-3
Table 7.3	Emission Guidelines for Combustion Turbine (in mg/Nm <sup>3</sup> or as indicated) (a)	7-3
Table 7.4	Summary of the Average Background Air Pollutant Concentrations in the Project Site Area	7-4
Table 7.5	Representative Air Sensitive Receptors (ASRs)	7-4
Table 7.6	Summary of Modelling Input Data for Stack Emissions of the Project	7-9
Table 7.7	Modelling Scenarios	7-10
Table 7.8	Summary of Assumed Parameter Values for Meteorological Data Processing	7-11
Table 7.9	Determination of Impact Magnitude based upon IFC Method	7-15
Table 7.10	Relevant WHO Guidelines Adopted as Air Quality Standards for this Project	7-15
Table 7.11	Assessment of Air Quality Impact during Construction of Project	7-18
Table 7.12	Predicted Maximum Ground Level Concentrations at Representative Air Sensitive Receptors during Combined Cycle Operation (Project Only)	7-19
Table 7.13	Predicted Maximum Ground Level Concentrations at Representative Air Sensitive Receptors during Simple Cycle Operation (Project Only)	7-20
Table 7.14	Assessment of Air Quality Impacts from Stack Emission at Identified Air Sensitive Receptors	7-38
Table 7.15	Cumulative Maximum Ground Level Concentrations at Representative Air Sensitive Receivers during Combined Cycle Operation	7-39
Table 7.16	Cumulative Maximum Ground Level Concentrations at Representative Air Sensitive Receivers during Simple Cycle Operation	7-39
Table 7.17	Assessment of Cumulative Air Quality Impacts from the Operation of the Project and General Background Air Quality	7-41
Table 7.18	Environmental Monitoring Program for Stack Emissions and Ambient Air Quality at Air Sensitive Receptors during the Operation of the Project	7-42
Table 8.1	Greenhouse Gas and Global Warming Potentials	8-3
Table 8.2	Default Emission Factors (kg of greenhouse gas per TJ on a Net Calorific Basis)	8-4
Table 8.3	Scope 1 Emission during Construction Phase	8-6
Table 8.4	Scope 2 Emissions during Construction Phase	8-7

Table 8.5	Assessment of GHG Emissions during Construction Phase	8-7
Table 8.6	Assessment of GHG Emissions during Construction Phase	8-8
Table 8.7	Estimated GHG Emissions during Operation Phase	8-10
Table 8.8	Assessment of GHG Emissions during Operation Phase	8-11
Table 9.1	FAO Guidelines for Interpretations of Water Quality for Irrigation	9-13
Table 10.1	Noise Level Guidelines (2007)	10-2
Table 10.2	Representative Noise Sensitive Receivers	10-3
Table 10.3	Results of Background Noise Measurement	10-5
Table 10.4	Predicted Construction and Operational Phase Noise Impacts	10-7
Table 10.5	Indicative Construction Plant Inventory (Daytime)	10-8
Table 10.6	Indicative Operation Plant Inventory List	10-9
Table 10.7	Predicted Construction Noise Levels at Representative NSRs	10-9
Table 10.8	Predicted Construction Noise Levels at Representative NSRs during Daytime Period	10-10
Table 10.9	Proposed Noise Mitigation Measures	10-11
Table 10.10	Predicted Construction Noise Levels at NSR4 with noise mitigation measures	10-11
Table 10.11	Noise Impact Assessment - General Construction Phase	10-12
Table 10.12	Predicted Operation Noise Levels at Representative NSRs	10-15
Table 10.13	Noise Impact Assessment - General Operational Phase	10-16
Table 11.1	Religious and Sacred Sites within LCU 3	11-5
Table 11.2	Landscape Impacts during Construction Phase	11-8
Table 11.3	Visual Impacts during Construction Phase	11-10
Table 11.4	Landscape Impacts during Operation Phase	11-12
Table 11.5	Visual Impacts during Operations Phase	11-13
Table 12.1	Assessment of Topsoil Loss during Construction	12-6
Table 12.2	Impacts to groundwater due to groundwater abstraction during construction phase	12-8
Table 12.3	Soil and Groundwater Contamination due to Potential Leaks, Spills and Importation of Contaminated Fill Material during Project Construction	12-9
Table 12.4	Loss of soil due to increased erosion potential during operations	12-12
Table 12.5	Soil and groundwater contamination due to potential leaks and spills	12-13
Table 13.1	Resources and Receptors for Waste Management	13-4
Table 13.2	Potential Impacts Due to Improper Disposal of Removed Biomass	13-5
Table 13.3	Potential Impacts Due to Solid Waste Generation, Storage and Disposal upon the Existing Waste Management Network	13-7
Table 13.4	Potential Impacts of Solid Waste Generation, Storage and Disposal during Operations	13-9
Table 14.1	Nature of impacts on biodiversity values	14-2
Table 14.2	Area of Habitats found in the Study Area	14-3
Table 14.3	Threats to biodiversity values during Construction	14-7
Table 14.4	Assessment of Impacts to Habitats during Construction	14-8
Table 14.5	Mitigation and Management Measures, Construction Phase	14-11
Table 14.6	Summary of the Significance of Site Development Activities	14-13
Table 14.7	Assessment of Impacts to Habitats during Operation	14-14
Table 14.8	Mitigation and Management Measures, Operation Phase	14-15
Table 14.9	Summary of the Significance of Site Development Activities	14-15
Table 15.1	Impacts and Receptors	15-3

Table 15.2	Assessment of Impacts to Employment and Economy – Construction	15-5
Table 15.3	Assessment of Impacts to Employment and Economy - Operation	15-6
Table 15.4	Assessment of Impacts on Community Health	15-9
Table 15.5	Assessment of Impacts on Community Safety and Security - Construction	15-12
Table 15.6	Assessment of Impacts on Community Safety and Security – Operation	15-13
Table 15.7	Assessment of Impacts from Environmental Emissions	15-15
Table 15.8	Assessment of Impacts on Community Infrastructure and Services - Construction	15-17
Table 15.9	Assessment of Impacts on Community Infrastructure and Services - Operation	15-17
Table 15.10	Assessment of Impacts on Social Networks – Construction	15-20
Table 15.11	Assessment of Impacts on Social Networks – Operation	15-20
Table 15.12	Summary of Impact Significance Before and After Mitigation	15-23
Table 16.1	List of Project Stakeholders	16-2
Table 16.2	Summary of Engagement Activities	16-3
Table 16.3	Summary of Stakeholder Feedback	16-6
Table 16.4	Stakeholder Action Plan for Construction	16-13
Table 16.5	Draft Stakeholder Action Plan	16-16
Table 17.1	Assessment of Impacts	17-7
Table 17.2	Scoping for RCIA	17-10
Table 18.1	Environmental and Social Management Plan of the Project	18-6
Table 18.2	Environmental and Social Monitoring Programme (Construction and Operation Phase)	18-25
Table 18.3	Roles and Responsibilities of Sponsor and EPC Contractor	18-30

## List of Figures

Figure 0.1	Overall Impact Assessment Process	0-7
Figure 0.2	Impact Assessment Process	0-9
Figure 2.1	Location of the Project Site within Myanmar	2-4
Figure 2.2	Project Site Location	2-5
Figure 2.3	Project Facilities	2-8
Figure 2.4	CCGT Power Plant Layout Plan	2-9
Figure 2.5	Process Flow Diagram of the CCGT Power Plant	2-10
Figure 2.6	Power Plant Water Balance	2-16
Figure 2.7	Proposed Alignment of Gas Supply Pipeline from New MOGE Gas Receiving Station to the Power Plant	2-21
Figure 2.8	Proposed Alignment 230kV Overhead Transmission Line Route from Power Plant to Upgraded Myingyan Steel Mill sub-station	2-22
Figure 2.9	Proposed Alignment of Water Supply Pipeline from the Power Plant to the Ayeyarwady River Water Intake Point and Wastewater Discharge Pipeline	2-23
Figure 2.10	Power Plant Construction Area	2-27
Figure 2.11	Proposed Transportation Route of Heavy Cargo from Nyanung Hla Jetty to the Project Site	2-31
Figure 2.12	Proposed Transportation Route of Construction Materials to the Project Site	2-32
Figure 2.13	Estimate of Electricity Demand and Supply in Myanmar, million kWh	2-40
Figure 2.14	Alternatives of the Project Location	2-49
Figure 3.1	Myanmar States/Regions and Townships	3-3
Figure 3.2	EIA Review and Approval Process (According to Draft EIA Procedure, 2014)	3-12
Figure 3.3	Protected Areas in Myanmar and Project Location	3-15
Figure 3.4	Ministry of Electric Power Organizational Chart	3-17
Figure 4.1	Overall Impact Assessment Process	4-1
Figure 4.2	Impact Assessment Process	4-4
Figure 5.1	Project Study Area	5-2
Figure 5.2	Myingyan, Myanmar Climate Graph 2013	5-6
Figure 5.3	Myingyan, Myanmar Precipitation (in mm) 2013	5-6
Figure 5.4	Wind Rose for ASR 1	5-10
Figure 5.5	Wind Rose for ASR 2	5-12
Figure 5.6	Wind Rose for ASR 3	5-14
Figure 5.7	Wind Rose for ASR 4	5-16
Figure 5.8	Wind Rose for ASR 5	5-18
Figure 5.9	Location of Sensitive Receivers	5-22
Figure 5.10	Monitoring Locations for Surface Water Quality and Flow Rate (1 of 2)	5-39
Figure 5.11	Monitoring Locations for Surface Water Quality and Flow Rate (2 of 2)	5-40
Figure 5.12	Myanmar Dominant Soils	5-44
Figure 5.13	Soil Sampling Locations	5-46
Figure 5.14	Major Aquifers of Myanmar Relative to Project Study Area	5-52
Figure 5.15	Groundwater Sampling Locations	5-55
Figure 5.16	Sampling and Habitat Types within the Project Study Area	5-64
Figure 5.17	Top ten relative frequencies of plant species	5-67
Figure 5.18	Top ten relative densities of plant species	5-68

Figure 5.19	Plant species distribution by frequency classes	5-69
Figure 6.1	Project Area	6-5
Figure 6.2	Map of Myanmar	6-7
Figure 6.3	Buddha Statue and Monk	6-9
Figure 6.4	Local Population	6-9
Figure 6.5	Proportional Mortality (2014)	6-13
Figure 6.6	Drinking Water	6-15
Figure 6.7	Water Sources	6-15
Figure 6.8	Wastewater Discharge	6-16
Figure 6.9	Village Agricultural Practices	6-25
Figure 6.10	Village Livestock Practices	6-28
Figure 6.11	Thaung Thar Mountain Reserve	6-28
Figure 6.12	Rivers of Myanmar	6-30
Figure 6.13	Inland Fisheries Production in Myanmar	6-31
Figure 6.14	Local Businesses	6-32
Figure 6.15	Household Education Attainment Levels in Myanmar	6-34
Figure 6.16	Village Schools	6-35
Figure 6.17	Wastewater Discharge	6-36
Figure 6.18	Solid Waste Disposal	6-36
Figure 6.19	Village Energy Sources	6-38
Figure 6.20	Myanmar Transportation Network	6-39
Figure 6.21	Village Vehicle Ownership	6-41
Figure 6.22	Key Tangible Cultural Heritage Resources Identified within the Cultural Heritage Study Area	6-45
Figure 6.23	Cultural and Social Heritage Resources Identified at/ near Tha Pyay Tha	6-46
Figure 6.24	Cultural and Social Heritage Resources Identified at/ near Nyaung Kan	6-47
Figure 6.25	Cultural and Social Heritage Resources Identified at/ near Hpet Taw	6-48
Figure 6.26	Cultural and Social Heritage Resources Identified at/ near Hnan Ywar	6-49
Figure 6.27	Cultural and Social Heritage Resources Identified at/ near Sa Khar	6-50
Figure 6.28	Cultural and Social Heritage Resources Identified at/ near Thein Ywa	6-51
Figure 6.29	Cultural and Social Heritage Resources Identified at/ near Gyoke Pin	6-52
Figure 7.1	Location of Representative Air Sensitive Receivers	7-6
Figure 7.2	Stack Location with Project Site	7-8
Figure 7.3	Wind roses of MM5 Meteorological Data for Year 2010 – 2014	7-11
Figure 7.4	Predicted Maximum Ground Level 1-hour Average NO <sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2010	7-22
Figure 7.5	Predicted Maximum Ground Level 1-hour Average NO <sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2011	7-23
Figure 7.6	Predicted Maximum Ground Level 1-hour Average NO <sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2012	7-24
Figure 7.7	Predicted Maximum Ground Level 1-hour Average NO <sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2013	7-25
Figure 7.8	Predicted Maximum Ground Level 1-hour Average NO <sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2014	7-26
Figure 7.9	Predicted Maximum Ground Level Annual Average NO <sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2010	7-27
Figure 7.10	Predicted Maximum Ground Level Annual Average NO <sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2011	7-28
Figure 7.11	Predicted Maximum Ground Level Annual Average NO <sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2012	7-29

Figure 7.12	Predicted Maximum Ground Level Annual Average NO <sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2013	7-30
Figure 7.13	Predicted Maximum Ground Level Annual Average NO <sub>2</sub> Concentrations during Combined Cycle Operation (Project Only) in 2014	7-31
Figure 7.14	Predicted Maximum Ground Level 1-hour Average NO <sub>2</sub> Concentrations during Simple Cycle Operation (Project Only) in 2010	7-33
Figure 7.15	Predicted Maximum Ground Level 1-hour Average NO <sub>2</sub> Concentrations during Simple Cycle Operation (Project Only) in 2011	7-34
Figure 7.16	Predicted Maximum Ground Level 1-hour Average NO <sub>2</sub> Concentrations during Simple Cycle Operation (Project Only) in 2012	7-35
Figure 7.17	Predicted Maximum Ground Level 1-hour Average NO <sub>2</sub> Concentrations during Simple Cycle Operation (Project Only) in 2013	7-36
Figure 7.18	Predicted Maximum Ground Level 1-hour Average NO <sub>2</sub> Concentrations during Simple Cycle Operation (Project Only) in 2014	7-37
Figure 9.1	Water Balance Diagram	9-19
Figure 10.1	Locations of Representative Noise Sensitive Receivers	10-4
Figure 10.2	Fixed Plant Noise Contour	10-14
Figure 12.1	Location of Tube Well during Construction	12-7
Figure 14.1	Magnitude Criteria for Effect on Baseline Habitats	14-5
Figure 14.2	Magnitude Criteria for Effect on Baseline Species	14-6
Figure 16.1	Overview of the Grievance Management Process	16-16

## ABBREVIATIONS

ADB	Asian Development Bank
AIDS	Acquired Immune Deficiency Syndrome
ALARP	As Low As Reasonably Practicable
AoI	Area of Influence
API	American Petroleum Institute
ASEAN	Association of Southeast Asian Nations
ASRs	Air sensitive Receivers
AZE	Alliance for Zero Extinction
BOD	Biochemical Oxygen Demand
BOT	Build, Operate and Transfer
CBP	Concrete Batching Plant
CCCW	Closed Cycle Cooling Water system
CCGT	Combined Cycle Gas Turbine
CCW	Closed Circuit Water system
CDP	Community Development Plan
CEDAW	Convention on Elimination of All Forms of Discrimination against Women
CEO	Chief Executive Officer
CEMS	Continuous Emission Monitoring System
CH	Critical Habitat
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLO	Community Liaison Officer
CO <sub>2</sub> e	Carbon dioxide equivalent
COC	Cycles of Concentration
COD	Commercial Operation Date
COD	Chemical Oxygen Demand
CR	Critically Endangered
DC	Direct Current
DD	Data Deficient
DICA	Directorate of Investment and Company Administration
DLN	Dry Low NOx burners
ECC	Environmental Compliance Certificate
EHS Guidelines	Environmental Health and Safety (EHS) Guidelines
EIA	Environmental Impact Assessments
EM&A	Environmental Monitoring and Audit
EPC contractor	Engineering, Procurement and Construction contractor
EPs	Equator Principles
EQS	Environmental Quality Standards
ERM	Environmental Resources Management
ESHIA	Environmental Social and Health Impact Assessments
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FAO	Food and Agriculture Organization
FDS	Fire Detection System
FID	Foreign Investment Department

## **ABBREVIATIONS**

GAD	General Administration Department
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIIP	Good International Industry Practice
GISD	Global Invasive Species Database
GLCs	Ground Level Concentrations
GOM	Government of Myanmar
GT	Gas Turbine
GTG	Gas Turbine Generator
GWh	Gigawatt-hours
GWP	Global Warming Potential
Ha	Hectares
HAZID	Hazard Identification
HAZOP	Hazard and Operability
HEMP	Hazard and Effects Management Process
HIV	Human Immunodeficiency Virus
HP	High Pressure
HPGE	Hydropower Generation Enterprise
HRSG	Heat Recovery System Generator
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IP	Intermediate Pressure
IPIECA	International Petroleum Industry Environment Conservation Association
IPP	Independent Power Producer
ITTA	International Tropical Timber Agreement
IWTS	Industrial Wastewater Treatment System
KBAs	Key Biodiversity Areas
Km	Kilometer
kWh	Kilowatt-hours
LC	Least Concern
LCU	Landscape Character Unit
LNG	Liquefied Natural Gas
LP	Low Pressure
LPG	Liquefied Petroleum Gas
LSD	Low Sulphur Diesel
LTSA	Long Term Service Agreement
MEPE	Myanmar Electric Power Enterprise
MIC	Myanmar Investment Commission
MMIP	Mandalay Myotha Industrial Park
MNPED	Ministry of National Planning and Economic Development
MOAI	Ministry of Agriculture and Irrigation
MOECAF	Ministry of Environmental Conservation and Forestry
MOEP	Ministry of Electric Power
MOGE	Myanmar Oil and Gas Enterprise
MOI	Ministry of Industry
MSDS	Material Safety Data Sheet
MSL	Mean Sea Level

## ABBREVIATIONS

MtCO <sub>2</sub> e	million tons of CO <sub>2</sub> equivalent
MTE	Myanmar Timber Enterprise
MW	Megawatt
NCEA	National Commission for Environmental Affairs
NEMC	National Energy Management Committee
NEP	National Environment Policy
NGOs	Non-Government Organizations
NO <sub>2</sub>	Nitrogen dioxide
NSDS	National Sustainable Development Strategy
NSRs	Noise Sensitive Receivers
NT	Near Threatened
O&M	Operation and Maintenance
OECD	Organization for Economic Cooperation and Development
OH&S	Occupational Health and Safety
PAs	Protected Areas
PCP	Public Communications Policy
PEECC	Packaged Electrical and Electronic Control Compartment
PM	Particulate Matters
PM <sub>10</sub>	Particles less than 10 micrometers in diameter (or respirable suspended particulates)
PM <sub>2.5</sub>	Particles less than 2.5 micrometers in diameter (or fine suspended particulates)
PME	Powered Mechanical Equipment
PPA	Power Purchase Agreement
PPE	Personal Protective Equipment
PS	Performance Standard
QRA	Quantitative Risk Assessment
RDMP	Risk and Disaster Management Plan
REM	Resource and Environment Myanmar Ltd
RH	Reheat
RoW	Right of Way
SEP	Stakeholder Engagement Plan
SEZ	Special Economic Zone
SIA	Social Impact Assessment
SO <sub>2</sub>	Sulphur dioxide
SPLs	Sound pressure levels
SS	Suspended Solids
STG	Steam Turbine Generator
STP	Sewage Treatment Plant
SWL	Sound Power Level
TAR	Third Assessment Report
TB	Tuberculosis
TCB	Total Coliform Bacteria
TDS	Total Dissolved Solids
TJ	Terajoules
TSS	Total Suspended Solids
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development

## ***ABBREVIATIONS***

UNDHR	Universal Declaration of Human Rights
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
VSR	Visually Sensitive Receptors
VU	Vulnerable
WBCSD	World Business Council for Sustainable Development
WBG	World Bank Group
WHO	World Health Organization
WRI	World Resources Institute
WWF	World Wide Fund for Nature
YESB	Yangon City Electricity Supply Board

**ERM has 145 offices  
across the following  
countries worldwide**

Argentina	The Netherlands
Australia	New Zealand
Belgium	Panama
Brazil	Peru
Canada	Poland
Chile	Portugal
China	Puerto Rico
Colombia	Romania
France	Russia
Germany	Singapore
Hong Kong	South Africa
Hungary	Spain
India	Sweden
Indonesia	Taiwan
Ireland	Thailand
Italy	United Arab Emirates
Japan	UK
Kazakhstan	US
Korea	Venezuela
Malaysia	Vietnam
Mexico	

**ERM-Siam Co.,Ltd.**

179 Bangkok City Tower  
24<sup>th</sup> Floor, South Sathorn Road  
Thungmahamek, Sathorn  
Bangkok, 10120, Thailand  
T: (66+ 2) 655 1390  
F: (66+ 2) 655 1399

[www.erm.com](http://www.erm.com)