EXECUTIVE SUMMARY

0.1 INTRODUCTION

This Environmental and Social Impact Assessment (ESIA) report presents an assessment of the potential environmental and social impacts associated with the proposed 225MW Combined Cycle Gas Turbine (CCGT) power plant and Project facilities in Myingyan Township, Mandalay Region, Myanmar ('the Project').

This report has been prepared for **Sembcorp Utilities Pte. Ltd.** (hereinafter referred to as **'the Sponsor'** or **'Sembcorp'**) by **Environmental Resources Management** (hereinafter referred to as **'ERM'**) and presents the objectives, methodology and outcomes of the ESIA study.

0.2 PROJECT BACKGROUND AND OVERVIEW

The Sponsor has been selected by the Ministry of Electric Power (MOEP) of the Government of Myanmar (GOM) as a private sector Independent Power Producer (IPP) to develop the Project on a Build, Operate and Transfer (BOT) basis in Myingyan Township, in the Mandalay region in Myanmar. The Project comprises of the following Project facilities:

- 225MW CCGT Power Plant;
- Gas Supply Pipeline;
- 230kV Overhead Transmission Line; and
- Water Supply Pipeline, Wastewater Discharge Pipeline and Water Intake Pumping Station.

The Project will proceed to invest and establish a CCGT power plant with international financing provided by Asian Development Bank (ADB), International Finance Corporation (IFC), and other banks which have adopted the Equator Principles (EPs) as syndicates.

The technology of the Project is an efficient form of CCGT power generation which was designed for high reliability and efficiency operation with lower environmental impact. The Project will operate on natural gas as its only fuel.

The electrical capacity and electricity generated will be sold under a 22 year Power Purchase Agreement ("PPA"), as agreed with MEPE.

0.3 PROJECT NEED

Parallel to growth in GDP, electricity demand in Myanmar has increased dramatically in recent years. ADB released a report on Myanmar's energy sector in October 2012 in which the future power demand was estimated to be doubling from 12,459 million kWh in 2012-2013 to 25,683 million kWh in 2018-2019 (ADB, 2012).

As of July 2013, Myanmar's power is predominantly generated from hydropower, gas and coal, representing over 70%, 22% and 3% of the total power generation

respectively. [1] Out of the 3,735 MW of total installed capacity, approximately 835 MW is of gas-fired power generation. Due to the lack of water during dry season, hydropower generation has not been able to operate at full capacity and therefore electricity supply has been unstable during that time.

To reduce the country's reliance on hydropower, MOEP in its five year plan (2011/2012 to 2015-2016) has set an ambitious target to add 1,740MW of gas-fired generation capacity by 2015-2016, which will increase the gas-fired capacity to over 50% of the total generation mix. [2]

In addition, given that the new gas supply will become available from the Shwe Gas Supply pipeline, the proposed development of a combined cycle gas turbine power plant in Myingyan Township, Myanmar will contribute towards a power source for adding capacity required to cover the shortfall in Myanmar.

0.4 THE PROJECT

The Project Sponsor is planning to develop a 225MW Combined Cycle Gas Turbine (CCGT) power plant in Myingyan Township, Mandalay region in the Union Republic of Myanmar.

0.4.1 Project Location

The Project site is located approximately 8km, south of Myingyan Township, Mandalay region in Myanmar.

The Power Plant will be located on a predominately green field site. The Project site is located adjacent to an existing steel mill (Myingyan Steel Mill No.4), owned by Ministry of Industry (MOI).

The following 5 villages are located in close proximity (3km radius from the Project site boundary):

- Sa Khar village;
- Hnan Ywa village;
- Hpet Taw village;
- Nyaung Kan village; and
- Gyoke Pin village.

The Ayeyarwady River is located approximately 14km west of the Project site boundary, where the water intake pumping station will be installed. In addition, there is 1 village located in close proximity to the proposed water intake pumping station: Tha Pyay Thar village.

0.4.2 Land

The Project site was acquired by the GOM, up to 18 years ago, and the registered land owner is MOI. The majority of this MOI-owned land is occupied by the existing

[1] MEPE (2013). http://www.ubifrance.com/medias/press/mepe_9_7_2013_29_31.pdf Accessed 8 June 2015.

[2] Sharma, Vikas (2013). An Overview of Electricity Market in Myanmar. http://www.slideshare.net/VikasSharma128/myanmar-electricity-industrydec2013 Accessed 8 June 2015.

steel mill infrastructure which was commissioned in 2007. The northern part was allocated for the Power Plant. The Project site was cultivated farmland prior to acquisition of the land by the GOM and is currently dominated by sparse shrubby vegetation.

A total area of approximately 16 hectares (ha) is allocated for the core Project Facilities.

0.4.3 Project Facilities

The Project Facilities and Associated Facilities are described below.

- ***225MW Combined Cycle Gas Turbine Power Plant*** (approx. 9 ha) comprising of the following main components:
  - 2 sets of Gas Turbine (GT) units;
  - 2 sets of Heat Recovery System Generator (HRSG);
  - 1 steam turbine generating unit with associated auxiliary equipment;
  - Switchyard area;
  - Cooling Water System;
  - Demineralised Water System; and
  - Wastewater Treatment Facility.

- ***Gas Supply Pipeline*** (approx. 0.2 ha) connecting the new MOGE gas receiving station to the Power Plant (approximately 1km in length). MEPE/MOGE will build the new MOGE gas receiving station and the Sponsor will build new gas supply pipeline from delivery point at the outlet of the MOGE gas skid to the Power Plant.

- ***230kV Overhead Transmission Line*** (approx. 5 ha) connecting the Power Plant to the upgraded Myingyan Steel Mill sub-station located within the steel mill complex (approximately 2.5km in length).

- ***Water Supply Pipeline and Wastewater Discharge Pipeline*** (approx. 2 ha) connecting the Power Plant to the water intake point and new Pumping Station at the Ayeyarwady River. The water supply pipeline will be approximately 14km in length. The wastewater discharge pipeline will connect the Power Plant to the existing irrigation canal (approximately 3km in length). The wastewater pipeline will be run in parallel with the water supply pipeline. Both pipelines will share the 2m easement.

The key Project components including the proposed emission embedded controls are described in the below sections.

<u>225MW CCGT Power Plant</u>

The main power block of the Plant consists of 2 sets of gas turbine (GT), 1 set of steam turbine (ST), 2 sets of heat recovery steam generator (HRSG) and bypass and exhaust stacks. The Power Plant is designed to operate continuously, either in simple cycle mode or in combined cycle mode. During simple cycle operation, the flue gas from the gas turbine will exit via the bypass stack to the atmosphere. During normal combined cycle operation, the heat of exhaust gas will be admitted to the HRSG

where superheated steam will be produced which will drive the steam turbine to generate electrical power. The exhaust gas from the HRSG will be released from the main stack of the HRSG to the atmosphere.

Cooling Water System

The mechanical draft cooling tower cooling water systems is selected for this Project. The cooling water from the cooling tower will be mainly supplied to the steam turbine condenser and other auxiliary cooling requirements.

Raw Water System

The raw water system includes the make-up water system, raw water storage pond and the pre-treatment system.

The raw water will be taken from Ayeyarwady River, using the water intake pumping station at the flow rate of approximately 405 m^3/hour, via a 14km water pipeline and will be stored in the raw water storage pond.

The capacity of raw water storage pond is approximately 20,000 m^3, which can satisfy the water consumption of the plant for 2 days.

Emission Controls

The Project will be equipped with the following equipment:

- Dry Low NOx burners will be installed to achieve low NOx emissions; and
- Continuous Emissions Monitoring Systems (CEMS) will be installed with a CEMS which shall monitor the concentrations of SO_2, NOx, CO, O_2 and dust as well as temperature and flow.

0.4.4 Associated Facilities

The new MOGE gas receiving station will be installed by MEPE/MOEP for connection of the gas supply pipeline to the Power Plant is regarded as an associated facility.

In addition, the transmission connection beyond the upgraded Myingyan Steel Mill sub-station will be GOM's responsibility and therefore is classified as associated facility. The connection beyond the Myingyan Steel Mill sub-station transmission line is not known at this stage.

0.4.5 Project Life Cycle Overview

For the purposes of this report, the Project is divided into 3 phases: Construction Phase, Operation Phase and Decommissioning Phase.

Construction Phase

Construction is expected to start in the first quarter of 2016 and be completed in approximately 22.5 months, with commercial operation targeted at the first quarter of 2018.

Construction activities of the Project will include: mobilisation, site clearance, onshore construction of all Project components, Nyaung Hla jetty reinforcement and commissioning. Heavy equipment such as bulldozers, excavators, dump trucks, compactors, etc. will be used at the Project site.

The EPC Contractor will be appointed to undertake the engineering, procurement and construction activities of the Project. The EPC Contractor will be responsible for implementation of the mitigation, management measures and monitoring programme defined in this report under the Sponsor's supervision.

Operation Phase

The Project will be owned and operated by the Sponsor. The Operation and Maintenance (O&M) of the Project will be undertaken by the Sponsor with the support of a long term service agreement (LTSA) for the GT with the manufacturer. The LTSA will cover the supply of spare parts, supervision and specialized labour for inspections, major and minor overhauls.

O&M staff with relevant experience of operating similar plants and with adequate knowledge of comparable technology will be deployed prior to Simple Cycle commercial operation date (COD) to commission and take over the Project from the EPC Contractor.

Decommissioning Phase

The design life of the power plant is estimated to be 25 years. If the Power Purchase Agreement, Land Lease Agreement, Gas Supply Agreement and the other relevant agreements are not extended or renewed and an alternative economical fuel is available, the power plant may be retrofitted to support alternative power generation. This option would be possible, provided the required retrofits and new emission rates meet the applicable standards and guidelines.

If retrofitting is not feasible and the operational life of the Power Plant expires, the Power Plant will be decommissioned according to the requirements of the authorities at that time according to best industry practices.

0.5 ALTERNATIVE ANALYSIS

The main design criteria and project type were determined by MOEP to develop the competitive tender process and are therefore beyond the remit of this report.

However, the alternative analysis was conducted for the following aspects:

- Alternatives of the Project Location;
- Alternatives of Configuration on Site;
- Alternatives of Technological Options; and
- Alternatives of Temporary Landing for Heavy Cargo.

0.6 ADMINISTRATIVE FRAMEWORK

The Project will conform to the legal and administrative requirements of the Union Republic of Myanmar. The Project will also conform to international treaties to which

Myanmar is signatory, and to standards and safeguard policies of the Asian Development Bank (ADB) (2009), the International Finance Corporation (IFC) Performance Standards (IFC PS) (2012) and other associated guidelines.

0.6.1 Overview of Myanmar Legislation

The latest enacted Constitution (May 2008) provides information on governing laws and regulations in Myanmar. The Constitution takes precedence over any other national legislation or international agreements.

Myanmar is divided into twenty-one (21) main administrative subdivisions, which include:

- Seven states;
- Seven regions (Note that regions were previously referred to as “divisions”, prior to August 2010);
- Five self-administered zones;
- One self-administered division; and
- One union territory

States and regions are divided into districts. Districts consist of townships, which are composed of towns, wards and village-tracts. Village-tracts are groups of adjacent villages. The administrative structure of the states, regions and self-administering bodies is defined in the Constitution.

Each region and state has a Regional/State Government, consisting of a Chief Minister, Ministers and an Advocate General. Legislative authority resides with the State/Regional “Hluttaw” (a parliament or legislative body), which are made up of elected civilian members and representatives of the military.

0.6.2 ESHIA Requirements in Myanmar

Myanmar currently does not have effectively implemented regulatory requirements for environmental, social and health impact assessments (ESHIA). However, a number of environmental laws are either pending or in the final stages of government approval, and the situation with respect to ESHIA requirements in Myanmar is expected to undergo significant imminent changes. As such, this section will highlight both the current and pending legislation with respect to ESHIAs.

The Myanmar Government has had plans to install new laws on ESHIA requirements since at least 2009. Laws related to ESHIA requirements (including those that are currently pending) are as follows:

- Environmental Policy, 1994, Myanmar Agenda 21, 1997, and National Sustainable Development Strategy, 2009;
- The Environmental Conservation Law, 2012;
- Environmental Conservation Rules (2013);
- Foreign Investment Law, 2012, Foreign Investment Rules, 2013, and Notifications for Investment, 2013; and
- Draft – Environmental Impact Assessment Procedure (Pending, currently on 8th Draft as of January 2015).

0.6.3 *International Standards and Applicable Guidelines*

In addition to national legislation, the Project will be undertaken to comply with a range of international standards, including the Asian Development Bank Safeguard Policy Statement, IFC Performance Standards (IFC PS), and the World Bank Guidelines. These standards are set to complement and reinforce national legislation and ensure the Project is conducted under best practices in a way that minimizes risks, impacts and ensures compliance and fair practices. The international performance standards and guidelines provide guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities.

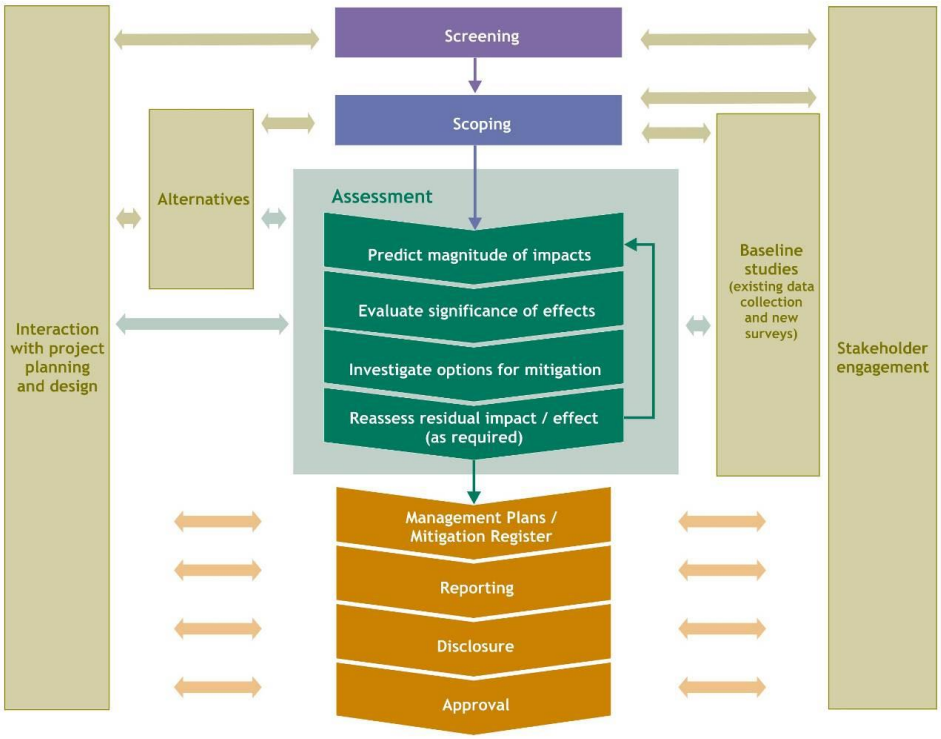
The applicable guidelines and standards for the Project are as follows:

- Asian Development Bank (ADB) Safeguard Policy Statement (2010);
- ADB's Social Protection Strategy (2001), ADB's Gender and Development Policy (2003) and ADB's Public Communication Policy (2003);
- The IFC's Performance Standards (IFC's PSs) (2012);
- IFC/World Bank Group (WBG) EHS Guidelines and WBG EHS Guidelines for Thermal Power (2007 and 2008);
- IFC's Stakeholder engagement handbook and other relevant Good Practice Notes;
- IFC's Handbook for Preparing a Resettlement Action Plan (if applicable)
- Kyoto Protocol to the UNFCC on Climate Change (1997);
- United Nations Convention on Biological Diversity (1992);
- Basel Convention (1989);
- Ramsar Convention on Wetland (1971); and
- International Union for Conservation of Nature and Natural Resources, Red List of Threatened Species (1964).

0.7 *IMPACT ASSESSMENT METHODOLOGY*

The ESIA methodology follows the overall approach illustrated in ***Figure 0.1***. The ESIA has been undertaken following a systematic process that evaluates the potential impacts the Project could have on aspects of the physical, biological, social/ socio-economic and cultural environment; identifies preliminary measures that the Project will take to avoid, minimise/reduce, mitigate, offset or compensate for potential adverse impacts; and identifies measures to enhance potential positive impacts where practicable.

Figure 0.1 Overall Impact Assessment Process



The stages of the ESHIA process are described below.

Screening

At the initial stage of the ESIA, preliminary information was provided to aid in the determination of what legal and other requirements apply to the Project. This step was conducted utilising a high level description of the Project and its associated facilities.

Scoping

It is to be noted that the IFC, with their role in providing MOEP with technical, legal, environmental and financial due diligence advisory services, has undertaken the scoping exercise and the Scoping Study was issued in May 2015.

During the scoping study, potential interactions between the Project, environmental and human resources/receptors were identified, and prioritised in terms of their potential to cause impacts of concern.

Project Description

In order to set out the scope of the Project features and activities, with particular reference to the aspects which have the potential to impact the environment, a Project Description has been prepared.

Baseline Conditions

To provide a context within which the impacts of the Project can be assessed, a description of physical, biological, social / socio-economic and cultural conditions that would be expected to prevail in the absence of the Project is presented. The

baseline includes information on all receptors and resources that were identified as having the potential to be significantly affected by the proposed Project.

It is to be noted that the IFC has undertaken the baseline study including the primary data collection for ambient air quality, noise level and surface water quality during July to December 2014.

Stakeholder Engagement

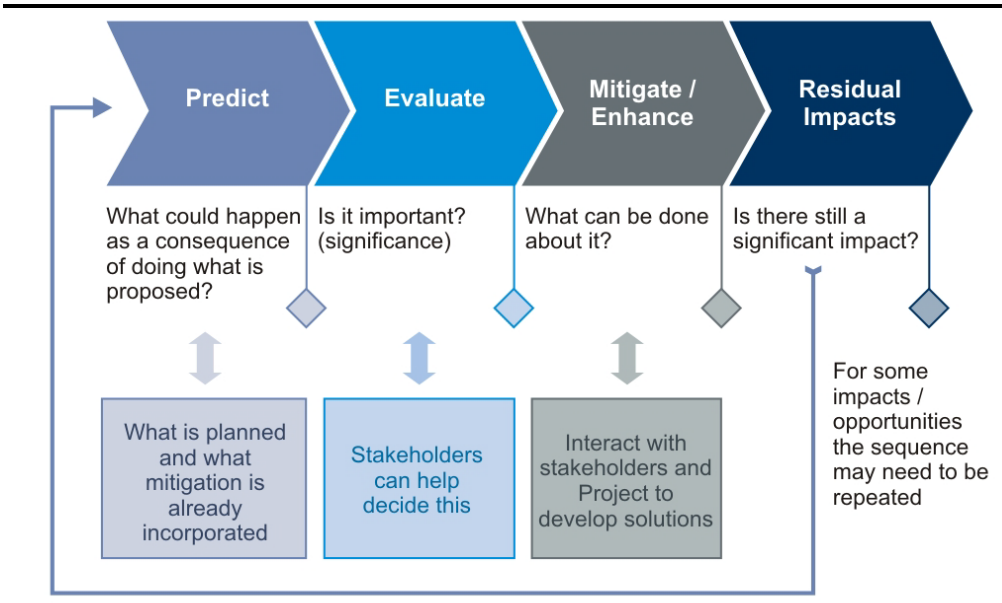
An effective ESIA Process requires engagement with relevant stakeholders throughout the key stages. This assists in understanding stakeholder views on the Project and in identifying issues that should be taken into account in the prediction and evaluation of impacts.

Impact Assessment

Impact identification and assessment starts with scoping and continues through the remainder of the ESIA Process. The principal ESIA steps are summarized in ***Figure 0.2*** and comprise:

- **Impact prediction:** to determine what could potentially happen to resources/receptors as a consequence of the Project and its associated activities;
- **Impact evaluation:** to evaluate the significance of the predicted impacts by considering their magnitude and likelihood of occurrence, and the sensitivity, value and/or importance of the affected resource/receptor;
- **Mitigation and enhancement:** to identify appropriate and justified measures to mitigate negative impacts and enhance positive impacts; and
- **Residual impact evaluation:** to evaluate the significance of impacts assuming effective implementation of mitigation and enhancement measures.

Figure 0.2 ***Impact Assessment Process***



Identification of Mitigation and Enhancement Measures

Once the significance of a potential impact has been characterised, the next step is to evaluate what mitigation and enhancement measures are warranted. For the purposes of this ESIA, ERM has adopted the following Mitigation Hierarchy:

- Avoid at Source, Reduce at Source;
- Abate on Site;
- Abate at Receptor;
- Repair or Remedy; and
- Compensate in Kind, Compensate Through Other Means.

Management, Monitoring and Audit

The final stage in the ESHIA Process is definition of the basic management and monitoring measures that are needed to identify whether: a) impacts or their associated Project components remain in conformance with applicable standards; and b) mitigation measures are effectively addressing impacts and compensatory measures and offsets are reducing effects to the extent predicted.

The Environmental and Social Management Plan (ESMP) has been developed as part of the ESIA report. The ESMP generally refers to the Project specific plan which will set out how the requirements, management and mitigation measures, and any other commitments will be implemented, managed and monitored. It will lay out information such as the responsible parties for implementing the Project commitment, any monitoring requirements and associated standards or thresholds, the timing of monitoring, check methods and corrective actions, and any training requirements.

0.8 DESCRIPTION OF THE ENVIRONMENT

The biophysical environmental baseline conditions within the Project Study Area are based on secondary data from published sources as well as primary data collected to fill data gaps.

The Project Study Area refers to the area that needs to be studied in order to adequately understand and describe the baseline conditions likely to be affected by the Project. The Project Area of Influence (AoI) varies according to the potential impacts on a resource or receptor (influenced by spatial and temporal dimensions). The AoI with respect to the biophysical baseline covers the Project Study Area. However, for air quality the AoI was extended to 10km from the Complex to consider stack emissions.

The baseline studies were carried out as part of the IFC Scoping Study (July to December 2014) and also as part of this report (January to June 2015).

0.8.1 *Climate and Meteorology*

Most of Myanmar belongs to the tropical region. The climate of Myanmar is roughly divided into three (3) seasons: Summer, Rainy Season, and Winter Season. Summer months are from March to Mid-May; the rain falls from Mid-May to the end of October and the Winter Season starts in November up to the end of February.

The Project Site is located in the central plain of Myanmar, and is primarily located in the Dry Zone of Myanmar, which includes the western and middle part of the Mandalay region; this region is the most susceptible to drought in Myanmar [(1)]. The region is characterised by low annual rainfall, with mean temperature of 27°C.

Dominant wind patterns in the Project Study Area are driven primarily by regular southwest (SW) monsoon wind in the rainy season and northeast (NE) monsoon wind in the winter or cold-dry season. These wind patterns are mediated by more mountainous terrain to the west and east. Localized meteorological conditions are also influenced by diurnal thermal cycles and cloud cover.

0.8.2 Ambient Air Quality

Ambient air quality monitoring was undertaken at 5 selected baseline air sampling locations, located in the vicinity of the Project Site. NO_2, SO_2, PM_{10} and $PM_{2.5}$ were measured at the selected baseline air sampling locations for 7 consecutive days each month from July 2014 to June 2015.

The baseline results show that SO_2 levels at Myingyan Project site were considered low (typical of rural area with low emission sources) whilst NO_2 levels were above the WHO annual ambient air quality standard. Tailpipe emissions on the adjacent roads (in particular motorcycle), the operation of the steel mill and the general background are the potential sources of the relatively high measured NO_2 concentration. Background PM levels also showed higher concentrations during winter months (October to March) compared to summer months (July to September). Higher PM_{10} and $PM_{2.5}$ concentrations measured is likely due to local activities, especially burning of wood for cooking by nearby residents and unpaved road dust.

0.8.3 Noise

Baseline noise monitoring was conducted at 4 existing noise sensitive receivers (NSRs) located near the Project Site from July to September 2014 and from February to June 2015. Hourly A-weighted equivalent continuous sound pressure levels (LAeq, 1 hour) were recorded continuously over 24 hours at each location during both weekday and weekend. At each location, daytime and night-time LAeq were calculated by averaging the hourly sound pressure levels measured between 0700 and 2200 hours and between 2200 to 0700 hours, respectively.

Daytime background noise levels at 2 NSRs exceeded the IFC guideline values; while night-time background noise levels at all NSRs exceeded the IFC guideline values.

0.8.4 Surface Water Quality

The Project Study Area is characterised by a flat terrain, with gentle undulating slopes towards the inlands. The Project Site is located approximately 14km from the Ayeyarwady River bank. During the low water season (December through May), riverine morphology alternates between single and multiple channel reaches, the latter created by sand island deposits that emerge near the mouths of convergent tributaries and above and below channel constrictions.

(1) http://lift-fund.net/downloads/Component%203%20Final_19Aug13.pdf

Flow measurements in the southern channel of the Ayeyarwady River were conducted at the surface, mid-depth and bottom of the water column twice a month from July to December 2014 during preparation of the Scoping Report and during February to April 2015, as part of this ESIA study. Flow rates at the sampling location have been estimated to be in the range of 64 m^3 /s (measured on March 28, 2015) to 660 m^3 /s (measured on August 8, 2014).

Water quality monitoring was conducted near the Project's planned cooling water intake in the Ayeyarwady River between July 2014 and December 2014 and February 2015 and April 2015 and also in June 2015. Parameters that were sampled and analyzed include pH, DO, COD, BOD5, Oil and Grease, TN, TP, TSS, Total Coliform, water temperature, channel depth and flow velocity. With the exception of TSS, total coliform bacteria, and iron, all other monitored parameters were found to be below the WBG/IFC guideline values.

0.8.5 Soils

Soils in the Project Study Area are classified as Vertisol Soils. The soils are deep and mostly composed of clayey materials. Their low fertility and declining organic matter level make them difficult for farming, especially under excessively dry or wet conditions.

Soil samples were taken using the standard agricultural sampler (Soil Auger), at 8 locations within the Project Site. Top soil was collected from 10 - 30 cm in depth and sub soil from 2.7 - 3.0 m in depth.

The results show that heavy metals and hydrocarbons were found to be well below the relevant WBG/IFC/WHO guideline values.

0.8.6 Groundwater

Groundwater in the Myingyan region is dependent upon natural recharge from Ayeyarwady River and the upper watershed. Declining groundwater levels in the region have occurred due to associated environmental degradation of water sources, as well as uncontrolled excessive pumping of wells. Siltation, accumulation of waste, and encroachment on the channel areas contribute to reduced drainage capacity.

Groundwater samples were taken at 8 locations around the Project Site, from 16th to 20th June, 2015. For a range of commonly measured and reported parameters including (but not limited to) BOD, TSS, Total Hardness, metals, arsenic, cyanide and fluoride, all were noted to be within the appropriate WBG/IFC/WHO guidelines for drinking water. However, Chemical Oxygen Demand (COD), Total Coliform and Sulfates exceeded the established guidelines.

0.8.7 Landscape and Visual

The Project AOI is characterized by flat terrain, with gentle undulating slopes towards the inlands. The Project AOI is also regarded as predominately rural comprising of agricultural land and scattered village settlements.

The Project site also comprises the Aggreko 95 MW temporary gas-fired power plant which began operation in April 2015. The temporary gas-fired power plant will be decommissioned once the Power Plant is in operation. The existing steel mill, transmission lines and transmission towers are the most dominant features in the landscape. The construction activities associated with Phase 2 of the steel mill are also dominant features.

0.8.8 Waste

The Mandalay City Development Committee is the responsible agency for waste management in the Mandalay region. Currently, there are existing problems in the Municipal Waste Management system due to a lack of equipment (e.g. vehicles) and personnel, improper collection and management of disposal sites, which are mostly run as semi-landfill systems, lack of awareness and cooperation from the public, and lack of awareness in solid waste management. There are currently no recycling facilities in Myanmar.

The feature of solid waste collection in Myanmar is essentially labour-intensive work and mainly relies on manual labour and non-specialized vehicles. Waste collection systems include block collection, communal depot collection, house-to-house collection, limited collection, and street sweeping. Currently, recycling of municipal waste is not fully and systematically developed as the budget allocation covers only routine works. Also, a framework for hazardous waste management has yet to be developed in Myanmar.

0.8.9 Terrestrial and Marine Biodiversity

The Project area resides within the dry zone of central Myanmar. According to the World Wide Fund for Nature (WWF) Wildfinder database, it is located in the Ecoregion known as the Irrawaddy Dry Forests, which have been under intensive conversion pressure to agriculture. In recent years the larger mammal fauna have been hunted to the brink of extinction. The conversion of forests to agricultural land and illegal cutting of timber causes loss and fragmentation of the habitat, while intense poaching of protected animals and the lack of political will to conserve this and other ecoregions in Myanmar leaves the remaining forests devoid of wildlife.

In Myanmar, Key Biodiversity Areas (KBAs) fall in different land management categories including protected areas, public protected forests, community-conserved forests, community forests, reserve forests and other resource and land use areas. The KBAs closest to the Project Site include the Ayeyarwady River (Bagan Section), Minsontaung Wildlife Sanctuary (W.S.), and Popa Mountain Park (Critical Ecosystem Partnership Fund, 2012). The Ayeyarwady River is the country's largest river and home to a large diversity of animals, including about 43 fish species. The Bagan Section of the river is recognized as a high priority KBA and is about 60 km away from the Project Site.

Flora Survey was conducted in June 2015. A Global Positioning System was used to navigate and mark coordinates between sample plots around the proposed Project area.

A total of 10 sample plots (3mx3m in size) were set up and observed during the study period. Care has been taken to cover overall spectrum of species diversity.

In order to obtain essential ecological data for flora, habitat types were classified. Three habitat types were identified in the project area: cultivated land; developed area; and the area of vegetation with grass, shrubs and small trees. All are considered as modified habitat as defined by IFC PS6.

Fauna Survey was also conducted during the same period as Flora Survey on birds, mammal, reptile and amphibian, butterfly, fish and plankton. No threatened species were found in the Project area.

0.9 DESCRIPTION OF THE SOCIO-ECONOMIC BASELINE

Myanmar is divided into a number of States and Regions (sometimes also referred to as Divisions), which are further divided into Townships for governance purposes. The Project site is located in the Myingyan Township in the Mandalay region.

Receptors that may be impacted or influenced by the Project due to their proximity to the Project site and/ or Project associated facilities includes:

- Sa Khar village;
- Hnan Ywa village;
- Hpet Taw village;
- Nyaung Kan village;
- Gyoke Pin village;
- Thien Ywa;
- Tha Pyay Thar village; and
- The temporary accommodation located adjacent to the Project site, which is home to approximately 30 people.

A desktop review of publicly available information was conducted, and primary data was collected through a visit to the Project site. Primary data were collected through a variety of methods so that the data could be triangulated. This included:

- Key informant interviews with village leaders.
- Focus groups with key sectors within each of the villages.
- Household surveys (total of 300 household surveys).

0.9.1 *Demographic Profile*

As of 2013, it was estimated that the population of Myanmar was approximately 53 million, with an annual growth rate of approximately 1% (CIA 2015). The population in the Mandalay region is approximately 6.2 million, making it the second largest region in the country in terms of population, behind Yangon, which has a population of approximately 7.3 million.

Much of the population in Myanmar lives in rural areas. As of 2014, it was estimated that approximately 65.7% of the population lives in rural areas, while 34.3% of the population resides in urban areas. Myingyan township has a population of

approximately 1 million people, most of whom (approximately 888,006 people) live in rural areas.

The largest ethnic group in Myanmar is the Burmans, which make up more than half of the population (68%). This is followed by Shan (9%), Karen (7%), Rakhine (4%), Chinese (3%), Indian (2%), Mon (2%) and other (5%).

0.9.2 Community Health

The life expectancy in Myanmar is 64 years of age for men and 68 years of age for women. The leading causes of morbidity are largely associated with communicable diseases and pregnancy/ child birth. In terms of mortality, again the leading causes are largely associated with communicable diseases i.e. human immunodeficiency virus (HIV)/ acquired immune deficiency syndrome (AIDS).

The prevalence of communicable diseases can be exacerbated by availability of and access to clean drinking water and sanitation facilities. For the Mandalay region, there is better access to sanitary latrines when compared to the broader population, with coverage of 96.7% for urban areas and 78.9% for rural areas. Access to improved drinking water in the Mandalay region was available to 87.7% of the population (Public Health Statistics 2012; Ministry of Health 2014).

According to the Ministry of Health, in 2012, Myanmar had 987 public hospitals with a total of 54,503 beds. In addition to existing health facilities, the use of traditional medicine is widespread and forms an integral part of the country's health services.

0.9.3 Economy and Livelihood

In 2013/2014, Myanmar's gross domestic product (GDP) was estimated to be $56.8 billion. This means that the per capita GDP is approximately $1,505 - one of the lowest in Southeast Asia (World Bank 2015). In fact, nearly one-third of the country's population lives in poverty.

The key sectors of the economy include agriculture, forestry and fishing.

Agriculture

Traditionally, Myanmar has been reliant on the agriculture sector (and to a lesser extent forestry and fishing). Approximately half of all agricultural land in Myanmar is devoted to cereal crops, such as rice. Other agricultural products include beans, sesame, groundnuts, sugarcane, and hardwood. Cereals appear to be the most prominent crop in the Project area.

Forestry

The Myanmar Timber Enterprise (MTE), a government-owned company, manages the timber within the country. The focus is largely on teak and other hardwoods.

The dragging of logs is done mainly by elephants and, to a lesser extent, water buffalo. This process is referred to as skidding. The use of animals in log extraction is considered to have a lower impact on the environment than other methods.

Fisheries

The fishing industry contributes approximately 8% to GDP. The industry is separated into three components – inland fisheries, marine fisheries and aquaculture. The marine sector makes up approximately 52% of the industry, followed by inland fisheries (27%) and aquaculture (20%).

0.9.4 Community Infrastructure and Public Services

The limited access to and the poor state of existing infrastructure and services have been identified as impediments to development in Myanmar. This includes the provision of basic health and education services, as well as other infrastructure such as roads, telecommunications, drinking water and waste management (World Bank 2015).

Access to Electricity

In terms of lighting, a range of sources are available. The most commonly used are electricity, candle, and batteries.

The access to electricity is likely to change in the future given the investment that the Myanmar government is making in the power sector. A number of new power plants are being developed in order to provide an increasing number of people with electricity.

Transportation

A variety of transport methods are used in Myanmar, including roads, rail, air and water. In some areas the various modes of transport are well developed, while in other areas they are quite limited.

Central Myanmar, where the Project is located, has a relatively well developed transport system compared to other parts of Myanmar, including road, air, rail, and water. Due to its geography, central Myanmar, particularly Mandalay acts as the central hub for transport of people and goods with destinations further north, east and west in the country, as well as to China and India.

0.9.5 Cultural Heritage

Desktop study supplemented by field survey conducted between 7 and 16 July 2015 identified no known archaeological resources; three items of ancient above ground resources and 20 items of living heritage sites within the cultural heritage study area. All the identified items are pagoda complexes and monasteries. Most of these items are located within or in close proximity to human settlements. The villages located within the cultural heritage study area include Tha Pyay Thar, Nyaung Kan, Hpet Taw, Hnan Ywa, Thein Ywa and Gyoke Pin. No tangible cultural heritage resources were identified within the project's footprint (i.e. the CCGT plant site boundary and proposed water intake pipeline).

No significant intangible cultural heritage (e.g. tradition, ritual and religious practice, ceremonies) was identified through interview with villagers and stakeholder's meeting.

0.10 STAKEHOLDER ENGAGEMENT

Project stakeholders have been engaged at a number of points during development of the ESIA. The focus of the engagement activities has been to:

- Introduce the Project and provide ongoing updates as the design of the Project is further refined;
- Provide an overview of the likely impacts and proposed management measures and corresponding monitoring activities;
- Gather stakeholder insights and input, including feedback on the identified impacts, proposed management measures and monitoring activities; and
- Respond to key issues raised by stakeholders.

Stakeholders were encouraged to ask questions and raise concerns throughout the engagement process. A range of issues and concerns were raised by stakeholders. Key issues included:

- Employment. Most of the villages indicated that they would like to benefit from the employment opportunities that will be created by the Project;
- Availability and quality of surface and ground water. Stakeholders expressed concern that Project activities (e.g. discharge of waste water, use of water from the Ayeyarwady River) may impact the quality of water and/ or reduce the amount of water available for use by local villagers;
- Access to electricity. Many of the Project area villages do not have access to reliable electricity. There is a keen interest from villagers to be address this issue through the Project;
- Health implications. Stakeholders indicated that they were concerned about the health implications associated with air emissions that will be generated by the Project during construction and operation, and the potential for an increase in the transmission of communicable diseases; and
- Noise. Stakeholders expressed concern about the noise that will be generated by the Project, as it may disrupt local village activities.

The issues and concerns captured during the stakeholder engagement activities have been incorporated into development of the ESIA. The information has been used to inform the impact identification and assessment process as well as the identification of management measures and monitoring activities.

Engagement will continue to occur throughout construction and operation of the Project, in line with Sembcorp's Stakeholder and Community Engagement Policy, the IFC performance standards and ABD safeguards.

0.11 KEY ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

All construction and operation activities that were likely to cause environmental and social impacts were identified, and evaluated to assess their magnitude, duration, and potential receptors.

0.11.1 Construction Phase

The activities which have the potential to cause impacts on surrounding environment and receptors during the construction phase are identified as:

- Site preparation;
- Transportation of construction material and machinery for the power plant by road/ rail and heavy machinery/ equipment by barges up to temporary jetty location;
- Dredging of water channel up to the temporary jetty depending on available water depth during the heavy lift transportation;
- Construction of a temporary jetty, water pipeline, gas pipeline and transmission line;
- Excavation of equipment foundations and installation of power plant components;
- Laydown areas for temporary use during construction phase;
- Storage and handling of hazardous materials, waste and wastewater; and
- Accommodation and transportation for the construction workforce and the Sponsor personnel.

Air Quality

The construction activities of the Project that may potentially generate air quality impacts involves site clearance, site formation and levelling, as well as construction of substructure and superstructure of the power plant facilities. It is anticipated that the dust arising from the dust generating activities and air emissions from construction vehicles and non-road machinery within the construction site boundary are the key concerns during construction of the Project.

With the implementation of the recommended control measures (namely, the dust suppression measures and good site practices at the construction worksites), the magnitude of the air quality impact is considered to be minor.

Greenhouse Gas

During construction, the Project will involve Scope 1 and Scope 2 emissions as follows;

- Scope 1 direct emission mainly from construction site equipment and site vehicles and vessel transportation; and
- Scope 2 indirect emission from purchased electricity from external provider in Myanmar.

Based on the calculated GHG emissions, the emissions from the construction phase (22.5 months) are estimated to be 9,126.94 tonnes CO_2e (Scope 1 and Scope 2). This is considered insignificant emissions according to IFC. GHG emissions are global pollutants. The concentration of GHG in the atmosphere beyond the level of naturally occurring concentrations could result in more heat being held within the atmosphere. Although overall the atmosphere is sensitive to impacts from GHG emissions, the local atmosphere is not expected to be any more or less sensitive to potential impacts to GHG.

Surface Water Quality

During the construction phase, potential water quality impacts may arise from domestic wastewater discharge, inappropriate waste storage and disposal, contaminated surface water runoff, and sedimentation.

Potential impacts to surface water quality are expected to be short-term and localised in nature, and can be controlled with the implementation of good construction practices and adequate wastewater treatment systems on-site. Therefore, the residual impact is considered to be minor.

Noise

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

The construction contractor will ensure that construction noise is adequately controlled to avoid nuisance and not normally exceed the applicable Guidelines. Work will not be carried out at night without notification to the local communities and the local authorities. Further mitigation measures as regular maintenance of construction equipment, noise barriers/enclosures etc. are proposed to further reduce noise level. With the implementation of these measures, the residual noise impact from construction is expected to be minor.

Landscape and Visual

Construction of the Project will result in a change to the visual character of the landscape. However, the Project is located within Industrial Complex (with existing steel mill) which has a low sensitivity. The initial construction will directly impact the character of this area and resulting in a significant contrast with the existing nature of the site. In order to reduce all impacts, the proposed mitigation measures (refer to Chapter 17) will be implemented, together with specific consultation with people from the surrounding villages to obtain their suggestion in terms of additional mitigation measures (if required). The residual impact is considered to be minor.

Soil and Groundwater

During construction phase, the following impacts to soil and groundwater may occur:

- Loss of soil structure, quantity and quality due to improper management during site clearance activities;
- Changes to groundwater levels during development due to abstraction/dewatering (if necessary);
- Soil and groundwater contamination due to potential leaks, spills and contaminated fill materials during all phases of Project construction;
- Soil and groundwater contamination due to improper construction waste storage and disposal; and
- Soil and groundwater contamination due to improper discharge of waste water discharges and runoff.

Construction of the Project will be carried out by the EPC Contractor appointed by the Sponsor. The EPC Contractor will handle, store and dispose of all waste in accordance with applicable guidelines to prevent soil and ground water contamination. With other mitigation measures such as proper storage of chemicals and fuel, drip or spill trays for spills and leaks, site specific emergency response plan for soil clean –up and training by contractors, demarcating routes for heavy vehicle movement, retaining top soil for reuse, the impact to soil and groundwater would be mostly negligible or minor.

Waste

During the construction phase, a range of waste materials will be generated either due to the daily activities of the construction workforce (e.g. generation of putrescible waste) as well as a range of general construction waste such as concrete, steel pipes, plastic pipes, steel plates, structural steel and wooden crates during the civil works phase of construction. Whilst most of these are likely to be non-hazardous, some of these may be hazardous include used paint, engine oils, hydraulic fluids, spent solvents, spent batteries etc. Improper waste management may result in indirect impacts to community and work health and safety due to contamination of drinking water or food; accidental leaks or spills of oil, fuel or other hazardous materials could potentially pollute surface waters; and soil may be contaminated by pollution from spills or leaks of fuel, oil and other hazardous liquid wastes which are incorrectly stored. Implementation of proper mitigation measures including waste management plan (both non-hazardous and hazardous) will minimise the impacts. With implementation of the mitigation measures, the residual impact is expected to be minor.

Terrestrial and Marine Biodiversity

Construction activities such as clearance of vegetation at the Project site, jetty location, transportation route near jetty and excavation of gas pipeline laying will create disturbance to habitat in modified and natural habitat areas, which has the potential to impact the local and downstream biodiversity as well as impacts to priority biodiversity values.

Mitigation measures can be implemented to manage the disturbance during construction such that biodiversity values are not significantly impacted or impacts are reduced by the application of the mitigation hierarchy.

Community Health and Safety

The community health and safety impacts, as those associated with changes in environmental conditions, increased prevalence of diseases and heavy traffic movement are assessed as minor. Impacts due to construction workers camp, laydown areas and logistics on the community health and safety will be temporary and can be considered as minor to moderate.

Social Impacts

In terms of overall social impact, the construction phase in one hand will generate employment, benefit local enterprises, while on the flipside will cause labour influx,

cause some displacement/disruption of communities, and will have noise and dust impacts to some extent. The Project benefits will either reduce or disappear at the end of construction phase. Mitigation measures include maximising local procurement and employment to reduce and manage influx, labour management measures, ensuring no local resources are indiscriminately used by the Project, developing resettlement and livelihood restoration plan, developing compensation plan, consultation with stakeholders, review of land acquisition/procurement, health interventions etc. The residual impact is expected to remain, however, it is considered to be minor.

Cultural Heritage

There are no potential ancient above ground resources. There is also no indication that a large, complex archaeological site is located within the Project site. However, Pagoda complexes were identified in close proximity to the site. Also, based on the number and diversity of known archaeological sites in northern Mandalay state there is the potential for subsurface archaeological resources to be present within the Project area. A cultural heritage baseline survey was conducted and found no archaeological resources within the Project footprint, and no significant intangible cultural heritage. A Chance Find Procedure will be developed for the Project.

0.11.2 Operation Phase

Air Quality

The key emission source associated with the operation of the Project is stack emissions from the combustion of natural gas during combined cycle and simple cycle operation.

With the built-in dry low NOx burners to reduce NOx emission at stack to below 25ppm at all times, the impacts from the stack emissions at identified ASRs, during normal combined cycle operation or simple cycle operation, the impact is considered small as the maximum Project contribution is between 10% and 15% of relevant air quality standards for degraded airshed.

Greenhouse Gas

During operation phase, electricity for the Power Plant will be supplied by the Plant itself, so there would be no Scope 2 emissions to consider. Scope 1 emissions of GHG from the plant operation will mainly come from the gas turbine generators.

The estimated GHG emissions from the Power Plant during operation will exceed the threshold that defines significant emitters of GHGs by the ADB SPS and EP III (100,000 tonnes CO_2e per year) and IFC PS3 (25,000 tonnes CO_2e per year). Therefore, the Project is required to implement measures for GHG reduction, and report annual GHG emissions as per the applicable reference framework.

Surface Water Quality

During the operation phase, potential surface water impacts may arise from domestic wastewater discharge, inappropriate waste storage and disposal,

contaminated surface water runoff, cooling water withdrawal and discharge, impacts to surface water hydrology, erosion, and sedimentation.

As the wastewater generated at various areas of the plant will be collected and treated at the wastewater treatment plant, meeting the discharge standards of the World Bank/ EHS guidelines, the impact is considered to be minor.

Noise

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.

With the proposed plant inventory and its corresponding source level (i.e. 85 dB(A) at 1m from the plant items) to be used during operational phase, results of the assessment indicate the noise associated with the operation of the Project will comply with the IFC guideline with no more than 3 dB(A) increase in background noise during operation. It is therefore not anticipated that adverse noise impacts will occur during the operational phase of the Project.

Landscape and Visual

The long term presence of the Project is anticipated to have impacts upon both the landscape and visual amenity. However, the presence of the Project will add another industrial component into the Industrial Complex area, which already contains an existing steel mill (undergoing expansion). The effect of introducing this into the area will likely have minimal impacts.

Soil and Groundwater

During the operation phase, potential soil and groundwater impacts may arise from:

- Loss of soil due to increased erosion potential during operations;
- Soil and groundwater contamination due to potential leaks, spills and leaks;
- Soil and groundwater contamination due to improper construction waste storage and disposal; and
- Soil and groundwater contamination due to improper discharge of waste water discharges and run-off.

It is noted that soil and groundwater contamination due to improper waste storage and disposal would be the result of contaminated surface water run-off being discharged from waste storage and disposal areas. Therefore, the impacts and mitigation measures are also discussed in surface water quality and waste management sections. With the implementation of good site practices and controls, the residual impacts are considered to be minor.

Waste

The impacts on surface water, soil and groundwater contamination from generation of hazardous and non-hazardous wastes are assessed as minor. The operations of the proposed Project would result in generation of various types of non-hazardous and

hazardous wastes from office and canteens; gas turbine; laboratories; compressors; lube oil systems; DG sets; and power house and workshop area.

The solid and non-hazardous wastes generated from the various areas during operations will be collected and segregated at the point of generation and stored in proper designated areas and disposed of through waste disposal contractors. It is planned that hazardous wastes generated from the proposed Project will be collected and stored in designated roofed-areas and/or barrels with concrete flooring and secondary containment and disposed of/ sold through contractors or treated prior to discharge. Further mitigation measures as proper labelling of hazardous wastes, periodic audits, spill response and emergency plans and manifest records will be maintained. With implementation of the recommended mitigation measures, residual impact significance would be negligible.

Terrestrial and Marine Biodiversity

Operational activities that have potential to disturb native fauna include the use of night lighting at infrastructure and facility locations. Lighting required for operation and safety at the facilities can influence nocturnal foraging behaviours as well as disrupt sleep patterns of crepuscular species. In addition, mortality of individual fauna species as a result of vehicle or machinery strike or falling debris during transmission line maintenance vegetation clearing activities. However, the impact significance is considered to be negligible. There are also no residual impacts to biodiversity values identified that require be offsetting or compensating.

Community Health and Safety

During the operation phase of the Project, Community health and safety issues as hazardous material handling and storage and traffic movement was considered for impact. Impact on traffic in the operational phase of the Project is assessed as negligible as the total manpower will be limited to 80, their transportation will not lead to any impact on road safety of the nearby communities using the access road.

A Quantitative Risk Assessment (QRA) for gas leakage from the Fuel Gas Pipeline from the MOGE Gas Station was conducted. It was concluded that the Individual Risk and the Societal Risk associated with the Fuel Gas Pipeline is compliant with the risk criteria determined in UK HSE Risk Guidelines and BS PD 8010 Part 3 respectively.

Social Impacts

Some of the social impacts predicted due to the operations of the Project are Employment Generation and In-Migration of Skilled workforce, Demand for lodging, housing and civic services, Increments in cost of living, Opportunity for local transporters and Risks of industrial accidents and fatalities to workers. The impacts as employment generation, demand lodging, housing and opportunity for local transporters would be positive where as other would be creating negligible impacts.

Cultural Heritage

There are no potential ancient above ground resources. There is also no indication that a large, complex archaeological site is located within the Project site. However, Pagoda complexes were identified in close proximity to the site. Also, based on the

number and diversity of known archaeological sites in northern Mandalay state there is the potential for subsurface archaeological resources to be present within the Project area. A cultural heritage baseline survey was conducted and found no archaeological resources within the Project footprint, and no significant intangible cultural heritage. A Chance Find Procedure will be developed for the Project.

0.12 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

0.12.1 Mitigation Measures

Many of the mitigation measures suggested during the construction phase of the Project associated with good construction and housekeeping practices and are included in the Environmental and Social Management Plan (ESMP).

Mitigation measures for the operation phase (such as those for air emissions and noise generation) of the Project are part of the design and will be incorporated into the Project design specifications.

The construction phase of the Project is anticipated to be 22.5 months, whereas the operation phase of the Project is 22 years, as per the Power Purchase Agreement.

A summary of mitigation measures identified for the construction and operation phases of the Project is presented in the ESMP. This also identifies lead responsibility for implementing of the mitigation measures and its verification along with reporting requirements and sources of funds for such implementation.

The Sponsor will ensure that the mitigation measures stated in the ESMP are implemented throughout the life span of the Project.

0.12.2 Monitoring Programme

Key roles and responsibilities of the Sponsor and the appointed EPC contractor have been defined for implementation and monitoring of environmental and social impacts. For environmental monitoring, physical, biological and social environmental management components of particular significance have been identified as performance indicators. A comprehensive monitoring plan for each performance indicator will be prepared for all phases of the Project which gives parameters to be measured, methods to be used, sampling locations, frequency of measurements, detection limits, cost and responsibilities for implementation and supervision.

0.12.3 TRAINING PROGRAMME

Prior to commencement of construction activities at site, a suitably qualified in-house/ external expert will be appointed by the EPC contractor in consultation with the Sponsor to develop and deliver a training programme on implementation of the ESMP. Environmental and social monitoring programme and reporting will be implemented in line with the applicable reference framework for the Project.

Prior to the commencement of the Plant operation, a suitably qualified in-house/ external environmental expert will be engaged by the Sponsor to develop and deliver a training programme on operation phase environmental monitoring and reporting. The topics will be mostly same as that during the construction phase. The reporting

and verification will be semi-annual during construction phase and annual during operation phase and the reports will be submitted to the relevant authorities (i.e. MOEP) and the Lenders.

0.13 CONCLUSIONS

The environmental assessment of the Project ascertains that the Project is unlikely to cause any major environmental impacts. Many of the impacts are localised and short-term or temporary in nature and can be readily addressed based on the built-in mitigation measures in the engineering design of the Project.

It is to be noted that the results from baseline air quality monitoring shows that the existing conditions are considered as degraded airshed, this is possibly due to the operation of the existing Steel Mill. However, the built-in dry low NOx burners will be installed in order to reduce NOx emission at stack to below 25ppm at all times. Therefore, the impacts from the stack emissions at identified ASRs, during normal combined cycle operation or simple cycle operation, is considered small as the maximum Project contribution is between 10% and 15% of relevant air quality standards for degraded airshed.

In terms of social aspect, the results from stakeholder engagement indicate that the Project has received favourable support from local people and other stakeholders. Stakeholders appreciated that in addition to providing a reliable power supply to the region, the Project will have several other benefits such as supporting economic growth in the region, potential employment (direct and indirect) and improving local infrastructure.

In addition, the Environmental and Social Management Plan (ESMP) has been prepared as part of this report to manage and mitigate such impacts, a range of measures have been developed to reduce the overall impacts to acceptable levels and as low as reasonably practicable.

The effective implementation of the ESMP and adherence with the ADB SPS and IFC guidelines will assist in minimising the environmental impacts to acceptable levels..