

Initial Environmental Examination Report (Final)

Project Number: 49067-001
October 2017

THA: Southern Thailand Waste-to-Energy Project (Part 1 of 5)

Prepared by Chana Green Company Ltd.

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CHAPTER 1

EXECUTIVE SUMMARY

Chana Green Company Limited (the Company) has a plan to develop the project of Chana Green Power Plant at Ku Sub-district, Chana District, Songkhla Province (**Figure 1-1**). It is a biomass power plant. Legal wooden waste from agricultural activities such as rubber wood and acacia wood. It has a capacity of 25 MW located in the area of 161.49 rai. The Company has been approved by the Electricity Generating Authority of Thailand (EGAT) under the project of power purchase from a small power plant in accordance with the Notification of power purchase from renewable small power plant B.E.2550 (revision B.E.2552). This is coherent with the Alternative Energy Development Plan of the government.

The main equipment of the Project is a boiler with a capacity of 98 ton/hour, power generator with a capacity of 25 MW, and supporting system. The designed capacity of the power plant is 25 MW and the operating capacity is 23.003 MW. About 2.381 MW will be used in the Project and the rest of 20.622 MW will be supplied to the grid of Electricity Generating Authority of Thailand in non-firm contract basis.

The study was conducted in order to avoid, minimize and mitigate environmental and social impacts to the lowest possible level to increase potential of the project design and investment. The principal criteria considered were as follows:

- (1) Mainly utilize the areas to mitigate impact on peoples' land use;
- (2) Avoid historic areas or archaeological sites;
- (3) Have feasible engineering design for both construction and maintenance;
- (4) Have enough basic infrastructure to support the need of the project;
- (5) Cause the least impact on sensitive environmental areas such as communities, religious places, government offices and hospitals; and
- (6) Avoid the areas specified in the attachment of the Notification of the Ministry of Natural Resources and Environment on specific conservative areas which have been protected by law.

The Chana Green Power Plant Project is subjected to the requirements on the preparation and submission of the environmental impact assessment (EIA) report to the Office of the Natural Resources and Environmental Policy and Planning (ONEP) for review and approval under the Notification of the Ministry of Natural Resources and Environment on type and size of project or activity that requires to prepare environmental impact assessment report announced on 24 April 2012 on the

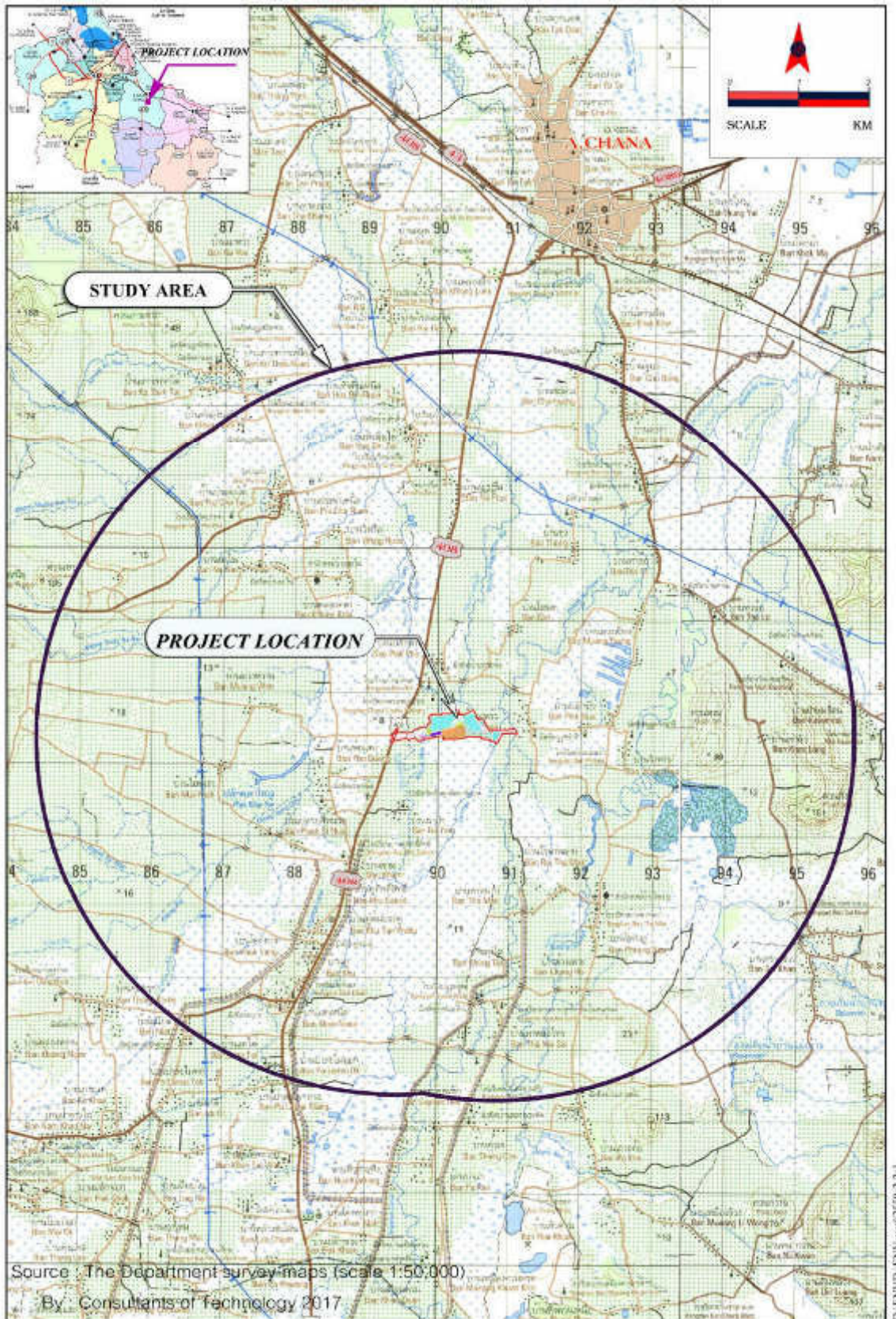


Figure 1-1 Project Site and Study Area

Government Gazette on 16 June 2012.). Therefore, the Consultant of Technology Company Limited was engaged to conduct the required EIA study. The EIA study for Chana Green Power Plant Project complied with applicable Thai laws i.e. ONEP guidelines for EIA report for Power Plant which include environmental standards/regulations of Department of Industrial Works, Ministry of Industry, Ministry of Natural Resource and Environment, Ministry of Interior, Ministry of Transport and Communications, and Ministry of Labor.

As the project shall create temporary and permanent employments for skilled and unskilled labors, the project should fully comply with ADB's Social Protection Strategy (2001) which upholds international recognized labor standards and/or national labor laws, particularly on the following conventions: (1) no harmful or exploitative forms of forced labor, (2) no child labor, (3) no discrimination in respect of employment and occupation, and (4) no restrictions of freedom of association and the effective recognition of the right to collective bargaining. In addition, the Chana Green Power Plant project should fully comply with the relevant requirements of the ADB's Safeguard Policy Statement (SPS) throughout the project operation and maintenance period. Objectives of ADB's environmental and social safeguards are to: (i) avoid adverse impacts of projects on the environment and affected people, where possible; (ii) minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible, and (iii) help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks. Since the project is Category B for environment, Safeguard Requirements 1: Environmental and eleven policy principles have been triggered (referred to page 16 of the SPS, 2009). As this is a thermal power plant it will definitely create negative impact such as emission to air, water, noise, waste and GHG emissions on its local environment but based on the IEE is minimal and in the event of a negative impact, mitigation measures outlined in their Environmental and Social Action Plan (ESAP) will be implemented. Applicable standards in the World Bank Group's Environmental, Health and Safety (EHS) guidelines¹ as required by ADB SPS Safeguards Requirement 1 in relation to pollution prevention and health and safety risks.

The results of the study (including the summary of the key environmental and social baseline data, anticipated impacts and associated mitigation measures) and recommendations in the IEE study are summarized as follows:

1.1 Air quality

¹ WB EHS guidelines to be complied: on general guidelines; on waste management facilities (as ash pond on site); on transmission and distribution lines (for associated facility); and on thermal power (Table 5 - Effluent Guidelines).

Environmental impact assessment for air quality impact from the project over construction, and operation periods were analyzed using AERMOD modeling system by which the construction period has emission source as “Area Source” while the operation period has emission source as “Point Source”.

Air quality impact assessment of the project over the construction period was studied. The total suspended particulates (TSP) dispersion were obtained from construction activities using the data from the US EPA as per the “Compilation of Air Pollution Emission Factors” Publication NO.AP-42 (1995) approximately 1.2 tonne/acre/month, or 9.88 g/sq.m./day (0.000114 g/sq.m./sec), and soil type of the construction area which is clay loam (containing PM-10 around 35-60%, or approximately 0.42 tonne/acre/month, or 0.0000399 g/sq.m./sec). Activity of the project for soil surface removal is done from a small construction area of 200 sq.m. (according to efficiency of machine) which was allowed to operate the construction activities only from 8.00 to 17.00 hrs, and working from Monday to Saturday only. Air quality impact assessment was considered for PM-10 emission loading from construction machine and soil surface removal activity. Then, the predicted ground concentration was compared to ambient air quality standard according to the NEB promulgation issued 21st (B.E. 2544), issued 24th (B.E. 2547), and issued 33rd (B.E. 2552) and compliance with WB IFC EHS General Guidelines on WHO Ambient Air Quality Guidelines. It was found that all predicted results did not exceed ambient air quality national and international standards.

For operation period, the project has emission sources from those boiler stacks of the project. Predicted ambient air quality over studied grid of 13x13 sq.km had 3 assumptions by;

- (1) Case 1: Forecasting air emission source from construction period of the project,
- (2) Case 2: Forecasting air emission source of the project (including downwash), and
- (3) Case 3: Forecasting air emission source of the project (including downwash) by which air quality control equipment of the boiler (capacity 95 tonne/hr) is not working.

Then, the predicted ground concentration for all cases (some case was combined with monitoring background concentration) obtained from the AERMOD modeling system was compared to ambient air quality standard according to the NEB promulgation issued 21st (B.E. 2544), issued 24th (B.E. 2547), and issued 33rd (B.E. 2552) and compliance with WB IFC EHS General Guidelines: Small Combustion Facilities Emissions Guidelines (3MWth – 50MWth). It was found that all predicted results did not exceed ambient air quality national and international standards.

1.2 Noise

Noise impact assessment was assessed by the consultant on two sensitive areas: Chana Chanupatham School located in the north-west direction from the noise sources of the project approximately 318 m; and Moo 6 Baantung or first home project located in the east direction from the noise sources of the project approximately 600 m. The assessment covered both the construction and operation periods in its worst case scenario including machine installation to the project.

Interfering noise level calculation from operation activities to Moo 6 Bangtung (first home project) during 06.00 – 18.00 hrs. revealed that noise level was 6.1-10.8 dB(A) by which calculated noise level still not exceed noise level standard according to the NEB promulgation issued 29 June 2007 (B.E.2550) about interfering (“annoyance”) noise level which was limited to 10 dB(A). However, an exceedance was found on 23 -24 August 2016. While the nighttime during 22.00 – 06.00 hrs, noise level was 0.0-5.6 dB(A) indicating noise level did not exceed noise level standard. Since there is no interfering noise level in the WB IFC EHS General Guidelines, mitigation measures detailed in the EMP will be undertaken to monitor adherence to noise standards. Therefore, noise level impact from operation activities of the project is considered low.

1.3 Water consumption

Water consumption of the project will be supplied from two sources: reserved rain falls in the fresh water reservoir; and irrigation water from the Nathawee Canal. Total water consumption of the project will be 728,354 cu.m./yr. Estimated water consumption of all activities in the study area from the Nathawee Canal watershed over 30 years are the following: tap water production of the Provincial Tap Water Authority Nathawee Branch (approximately 1.63 million cu.m./yr); total water consumption in Nathawee District (approximately 3.35 million cu.m./yr); total water consumption for agriculture (approximately 98.89 million cu.m./yr); total water consumption in Chana District (approximately 4.98 million cu.m./yr); and water consumption for ecological conservation for the Nathawee watershed (approximately 47.28 million cu.m./yr). From the study, it was indicated that water irrigation without any impact to community required fresh water reservoir to maintain water supply for at least 4 months by which water head to supply for the project must be started at +5.35 m. above mean sea level (msl) or water head is higher than bottom stream level around 0.15 m. for maintain water supplying of 15,365 cu.m./day. Therefore, an installation of fresh water reservoir with water irrigation will cause acceptable impact to water consumption.

1.4 Water quality/irrigation and flooding prevention

Water drainage in the construction area will be done by installation of temporary spillways in the same location of permanent spillway to drain rain fall to fresh water reservoir for reuse. According to flooding prevention measures, the project will command subcontractor not to leave any

garbage to spillway and remove sediments every 6 months with checking for water blocking of those spillways. Therefore, impact to water drainage and flooding prevention is low.

The design of rain fall spillway and wastewater spillway will be separated using pipeline with safety factor more than 1.3. It was found that the project will has capacity of captured rain fall to 35,937.57 cu.m./3 hr by which the project will use fresh water reservoir with capacity of 370,000 cu.m. to maintain rain fall sufficiently.

Wastewater discharged from construction period is mainly from water consumption of workers which is approximately 17 cu.m./day (calculated from 80% of water consumption) from 300 workers. The project will provide sufficient sanitary lavatories to those construction workers according to related laws with an installation of septic tank or instant wastewater treatment tank to treat wastewater discharged from worker consumption. Thus, treated wastewater has water quality according to related standards before sending to further treatment by responsible organizations. The septic tank or instant wastewater treatment tank will be maintained to a proper condition for using over the construction period, and treating those wastewater according to the wastewater quality of building type Kor (Thai Alphabet) under the promulgation of the Ministry of Natural Resources and Environment about wastewater quality discharged from some building types, and sizes. Monitoring parameters for wastewater are pH, BOD, Suspended Solid (SS), Sulfide, Total Dissolved Solids (TDS), Sattleable Solids, Oil and Grease, and TKN. Additional equipment for wastewater treatment system is an installation of water quality monitoring pond for wastewater to collect wastewater at least 1 day for quality monitoring before using as water spraying to construction site, and roads over entering and exiting areas of the project for dust dispersion reduction.

For operation period, wastewater is classified to 5 types which are wastewater discharged from daily consumption of staffs, wastewater from manufacturing and auxiliary processes, contaminated rain fall/oil contamination water, wood cleaning water, and leachate from land filling area for ash. Those 5 types wastewater including wastewater from cooling tower and wastewater from oil removal pond are pumped to Wastewater Holding Pond before sending to the water quality monitoring pond for automatically monitoring pH, Temperature, and Conductivity in the pipeline. Treated wastewater will be discharged to the Nathawee Canal, unless water quality of those treated wastewater is not follow the wastewater quality standard. Poor quality wastewater will be pumped to emergency pond will has capacity to collect wastewater for 1 day to find a proper solution such as neutralized pH in the emergency pond, temperature adjustment, or resending those wastewater to fresh water reservoir for sedimentation and maintaining

conductivity before reuse as recycling wastewater. In case of untreated wastewater over 1 day, the project will ask for wastewater treatment from authorized organizations.

Treated wastewater which will follow the wastewater standard quality of the commanding of the Royal Irrigation Department 73rd/2554 about Prevention, and Solution for low quality discharged water to irrigation canals and connection canals is reused and discharged to the Nathawee Canal by which the water quality impact for BOD Mixing, DO Mixing, and DO Sag Curve of the Nathawee Canal is low. Therefore, a using of discharged wastewater to the Nathawee Canal for agricultural purpose gives low impact.

There are no impact to aquatic biological resource during construction period, because wastewater to be discharged to the Nathawee Canal. Thus, an operation of construction period gives low impact to aquatic biological resource. While the operation period is designed to has the Waste Water Holding Pond for Dry Season which is covered the floor with HDPE (Pond capacity is 58,820 cu.m. to maintain wastewater for approximately 4 months or $58,820/464.6 = 126$ days) to reduce impact to the Nathawee Canal during that time. However, treated wastewater is controlled to has water quality according to wastewater standard quality of the commanding of the Royal Irrigation Department 73rd/2554 about Prevention, and Solution for low quality discharged water to irrigation canals and connection canals by which the water quality impact for BOD Mixing, DO Mixing, and DO Sag Curve of the Nathawee Canal is low. Therefore, a using of discharged wastewater to the Nathawee Canal gives low impact.

1.5 Traffic

The consultant had assessed traffic impact for highway no. 43, and highway no. 408 (no data record of daily average traffic condition) which are main transportation routes to the project.

Daily averaging impact (Normal case): The construction period will has traffic loading approximately 40 PCU/day or 5 PCU/ hr (based on 8 hrs operation period). It was found that highway no. 43 has traffic index (V/C) around 0.184-0.193 which was indicating good traffic condition (A level, V/C ratio = 0.00-0.60) by which vehicle flow smoothly without interfering from any factor, and drivers have freely vehicle control. The operation period, the project will operated by B.E. 2561 under the traffic loading approximately 165.97 PCU/day or 6.92 PCU/ hr. It was found that highway no. 43 gonna has (V/C) around 0.202-0.243 which was indicating good traffic condition (A level, V/C ratio = 0.00-0.60). Therefore, traffic impact is considered low.

Impact over urgent period and non urgent period: The construction period will has traffic loading approximately 40 PCU/day or 5 PCU/ hr (based on 8 hrs operation period). It was found that

highway no. 43 has traffic index (V/C) around 0.200-0.428 which was indicating good traffic condition (A level, V/C ratio = 0.00-0.60). For highway no. 408, it has traffic index (V/C) around 0.321-0.628 which is indicating free flow traffic with slightly interfering by some factor, and drivers have low interfering for vehicle control. The operation period, the project will operated by B.E. 2561 under the traffic loading approximately 165.97 PCU/day or 6.92 PCU/ hr. It was found that highway no. 43 gonna has (V/C) around 0.220-0.540 which was indicating good traffic condition (A level, V/C ratio = 0.00-0.60). Therefore, traffic impact is considered low. The highway no. 408 gonna has (V/C) around 0.332-0.794 which is indicating free flow traffic with slightly interfering by some factor, and drivers have low interfering for vehicle control (B level, V/C ratio = 0.61-0.70). Therefore, traffic impact is considered low.

1.6 Waste management

Waste generated from construction period could be classified to 2 types which are general waste generated by construction workers, and waste generated from construction activities. General waste generated from construction workers such as food residual and plastic bags is approximately 300 kg/day (calculated based on averaging waste generation rate of 1 kg/person/day × 300 workers). The project will provide sufficient trash bins with capacity of 200 Liters covered by lids to collect general waste for elimination by the Banna Sub District Municipality. For those construction waste which is steel, wood, and bricks is reused or all to recycling retailer, and unwanted material will be used for elevation adjustment in the project area.

During operation period, general waste is generated from office, and staffs daily activities which are piece of papers, office material, and food residual approximately 65 kg/day or 21 tonne/yr (calculated based on averaging waste generation rate of 1 kg/person/day × 65 staffs). Those waste is an omission from the Ministry of Industry Promulgation about waste management or unused material B.E. 2548, but required to follow the Public Health Act. (issued 2nd) B.E. 2550. The project plan to recycle waste for reuse by separating waste from sources and collected in separated trash bin with capacity of 200 Liters by which the separated trash bins are wet, dry, and hazardous waste. This procedure can sell dry waste before sending unused parts to be eliminated by the Banna Sub District Municipality. Other waste such as used lubricant from maintenance activity, unused chemical packagings, depleted membrane, and unused activated carbon from water supply process will be sent to be eliminated by authorized organization from the Department of Industrial Works.

Ash generated from boiler is classified to 2 types which is Fly Ash, and Bottom Ash. Those ash is sent to land filling area with size of 33,600 sq.m. or 21 Rai. The land filling area has capacity to operate more than 5 years, and an excess ash is distributed to ash users which is permitted by the

Department of Industrial Works before operation. Ashes are being tested before distribution to farmers. Therefore, waste management impact to community is considered low.

1.7 Socio-economic management plan

An installation of the project makes an expansion of local construction business which is increasing provincial gross domestic product. Furthermore, the installation of the power plant can turn business cycle in the province such as material supply, and service business to related business sectors. Therefore, the power plant construction has positive impact to provincial fiscal structure. In addition, the biomass power plant project can increase agricultural product income to local farmers by which an increasing income is support the provincial gross domestic product according to an increasing of buying power in local community. Economic expansion due to buying cycle from product and service buying is considered a positive impact to socio-economic in Songkhla. However, a negative impact from power plant installation is a duration of construction period which is approximately 24 months using 300 construction workers. Those construction workers are provided by subcontractors which is normally employ local or regional workers for operation. Thus, construction workers for power plant installation during the construction period are local workers which is not affect population structure, and indirect impact according to worker migration to the area. Therefore, socio-economic is considered low.

The biomass power plant project can increase provincial income, and make provincial buying cycle to provide sufficient money returns for making basic infrastructure to serve local peoples. Those money returns are posted tax, building and land tax, juristic person tax, and power plant development fund. Furthermore, additional positive impact is an employment of local workers for project operation. Nevertheless, negative impact is about a relocation of occupational system from agricultural sector to industrial sector of adolescents according to higher income stable income from industrial sector for maintaining better living quality.

Unconfident perception to the project and responsible organization from local peoples is related to educational background of family leaders (normally primary level), and occupation which are famers. Thus, those local peoples are not interested in socio-economic news or academic report about the operation of the project which are difficult to understand. The local peoples are easily getting news from T.V. according to brief news or series, communication with neighbors, and community leaders which are normally lack of details and distorting main information of the news. These factors lead to make unconfident to the project operation and responsible organizations. Therefore, information perception is required to distribute project operation data to communities effectively for reducing worrying and unconfident of environmental quality management using suggested channels. Public relation can be made by informing to community leaders or community tower public relation with an

easy to understand information, and using the method as guideline for public relation of project operation. According to previous summary table, community leaders communication for understanding of operation is suggested to make confident to local peoples, and transferred information from community leaders to local peoples.

1.8 Occupational health and safety management, and

Health impact assessment was considered from impact type, emission sources, risk of exposure, and exposure pathway by which scope of the study, and target groups are;

(1) Spatial proximity was considered for project location which was direct or indirect impacts,

Project operation area is operation staffs, and subcontractors to operate in construction, and operation periods.

Surrounding area is neighboring communities by which the consultant had limited study area for a radius of 5 km from the project area to cover all health impact to peoples in the study area. Target groups are those risked person which are baby, children, working age, elderly peoples, and very old person including peoples living or working in the sensitive areas such as schools, hospitals/sud district health promotion hospital, governmental offices, and religion places.

(2) Temporal proximity is divided to the project activities which are construction, and operation periods covering short term and long term impacts.

To support safety confidence to staffs, and property of the project, proper measures and mitigations for operation is required for monitoring the occupational health and safety dimension for quantifying significant changing due to project operation, and used as guideline for problem solving.

1.9 Aesthetics management.

Construction activities are land preparation, building construction, and machine installation by which those activities are unavoidable and causing visual pollution. However, the project area is located far away from communities, and surrounding by rubber trees which could helping for visual impact, and the project does not has any activities affecting to tourism destinations, natural conservation, and ancient areas directly. Therefore, aesthetical impact is considered low.

The project will provide green spaces of 18,000 sq.m. or 11.25 Rai (6.97% of the entire project area) by which the areas are conserved for growing local trees such as neem tree (local tree which is promoted to be Tree of Songkhla province), tall shape trees such as pine tree, and cemetery tree, and small trees by designing a zigzag pattern to reduce wind speed and maintain diversity of trees with making good landscape for using as buffer zone to surrounding communities.

Furthermore, area in a radius of 5 km from the project areas does not contain any tourism destinations, natural conservation, and ancient area by which the project operation will not cause direct impact to significant aesthetical areas. Therefore, aesthetical impact is considered low.

1.10 Grievance redress mechanism

Complaints related to communities' inconvenience caused by the project implementation shall be handled and prioritized for rapid solution. The first stage of complaint procedure is starting with filling of a complaint form by the affected residents.

(1) After the complainant made a complaint via one of the channels to the complaint center or to the power plant, the responsible personnel will investigate the cause. If the issue did not originate from the project, then complainant must be informed within 24 hours.

(2) If the issue is indeed from the project, the complaint officer will forward the complaint to the site manager if it is during construction period or to the power plant manager if it is during operation period. A meeting to rectify the issue will be held and personnel assigned to rectify the issue. Progress must be informed to the complainant every 2 days or as agreed upon with the complainant.

(3) Site manager or the power plant manager is responsible for ordering corrective actions to be taken and report on the progress to the complainant every week or as agreed upon period. The Occupational Health, Safety & Environment Committee must also be informed. The complaint officer and the complainant shall also inspect the rectification together.

1.11 Measures

The Chana Green Co.ltd. has planned to develop Chana Green Power Plant Project at Ku subdistrict, Chana, Songkhla which is a biomass power plant using residual from wood transformation industry or wood piece from rubber tree, and mangium tree. The power plant has capacity of 25 MW cover an area of 161.49 Rai (Thai area unit: 1 Rai = 1,600 sq.m.).

The Chana Green Co.ltd. has concerned about good governance enterprise by which consideration for environmental quality, hygiene, and safety of local peoples and related organizations. Thus, the company had planned for environmental quality mitigations for operation consisting of 10 issues which are;

- (1) General operation,
- (2) Air quality management,
- (3) Noise management,
- (4) Water consumption,
- (5) Water quality/irrigation and flooding prevention,
- (6) Traffic management,
- (7) Waste management plan,
- (8) Socio-economic management plan,
- (9) Occupational health and safety management, and
- (10) Aesthetics management.

1.12 Recommendations

Based on the results of the EIA study, the necessary recommendations can be emphasized as follows:

- (1) The project shall be under all conditions, strictly enforce the implementation of the proposed environmental measures designed for the construction and operation phases in order to avoid or minimize both environmental and social impacts on the surrounding communities and general public,
- (2) The project shall always conduct an environmental study for any modification of the project design and/or the environmental action plan to find out the environmental feasibility before making the decision,
- (3) The public participations are the ongoing activities throughout the project implementation. The comments, concerns and suggestions from concerned stakeholders shall be considered and incorporated into the project environmental management plan as appropriate,

CHAPTER 2

POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

Chana Green Company Limited (the Company) has a plan to develop the project of Chana Green Power Plant at Ku Sub-district, Chana District, Songkhla Province. It is a biomass power plant. Legal wooden waste from agricultural activities such as rubber wood and acacia wood. It has a capacity of 25 MW located in the area of 161.49 rai. The Company has been approved by the Electricity Generating Authority of Thailand (EGAT) under the project of power purchase from a small power plant in accordance with the Notification of power purchase from renewable small power plant B.E.2550 (revision B.E.2552). This is coherent with the Alternative Energy Development Plan of the government.

The Chana Green Power Plant Project with 25 MW capacity is within the scope of the Environmental Impact Assessment (EIA) system in Thailand and is subjected to the requirements on the preparation and submission of the EIA report to the Office of Natural Resources and Environmental Policy and Planning (ONEP) for review and approval (under the EIA system also know as Notification of Ministry of Natural Resources and Environment B.E. 2552). The types and sizes of projects covered under the EIA system is detailed under the Enhancement and Conservation of the National Environmental Quality Act, B.E. 2535 (1992). Therefore, Consultant of Technology Company Limited was engaged to conduct the required EIA study.

2.1 Policy, Legal and Administration Framework

The EIA of Chana Power Plant Project fully complied with applicable Thai laws i.e. ONEP guidelines for EIA report for Power Plant which include environmental standards/ regulations of Department of Industrial Works, Ministry of Industry, Ministry of Natural Resource and Environment, Ministry of Interior, Ministry of Transport and Communications, and Ministry of Labor.

The Project should also conform to other environmental policies and standards mandated by the host country government such as permit to pump and discharge water from and to Nathawee canal, permit disposed ash, and approval of Solid Waste Disposal, etc.

2.1.1 Relevant Thai Regulation

(1) Thai Environmental Standard/Regulations

1) Ambient air quality standard Notification of National Environmental Committee Vol. 10 B.E.2538 (1995) under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992), published in the Royal Government Gazette No. 112 Part 52 dated May 25, B.E.2538 (1995).

Standard of Ambient Air Pollutant Concentration $\mu\text{g}/\text{m}^3$				
TSP average 24 hrs. ($\mu\text{g}/\text{m}^3$)	PM-10 average 24 hrs. ($\mu\text{g}/\text{m}^3$)	NO ₂ average 1 hr. (Mg/m^3)	SO ₂ average 24 hrs. ($\mu\text{g}/\text{m}^3$)	SO ₂ average 1 hr. ($\mu\text{g}/\text{m}^3$)
330	120	320	300	780

The WB IFC EHS General Guidelines for Ambient Air Quality to be met is detailed in Table 1.1.1, i.e., at 24 hour averaging period PM₁₀ (150 $\mu\text{g}/\text{m}^3$) and SO₂ (125 $\mu\text{g}/\text{m}^3$).

2) Noise level standard

Notification of National Environmental Committee Vol.15 B.E.2540 (1997) under the Conservation and Enhancement of National Environmental Quality Act B.E.2535 (1992) dated March 12, B.E.2540 (1997) and Notification of Pollution Control Department ; Subject: Calculation of Noise Level Dated August 11, B.E. 2540 (1997).

Standard of Noise Level, Decible (A)			
Leq (24 hrs.)	Lmax	Ldn	L90
70.0	115.0	-	-

The WB IFC EHS standard to be met which is the WHO guidelines with LAeq 70dB at the site boundary the same as Thai Standard. The Thai standard has no LAeq day/ night at the nearest residential receptor. The WHO guidelines on LA max is 60dB at the nearest residential receptor is more stringent than the Lmax in Thai Standard which is 115 dB(A). The Company will undertake the mitigation measures as stated in the EMP and if exceedance in the more stringent standard additional mitigation measures as appropriate will be applied.

3) Surface Water Quality Standard

- Notification of National Environmental Committee Vol. 8 B.E.2537 (1994) in accordance with the National Environmental conservation and enhancement Act B.E.2535 (1992), subjected to the standard of surface water quality, published in Royal Gazette Vol. III Special Part 16D, dated 24 February 1994.

- The Royal Irrigation Department Order no. 73/2554 re: Amending of Preventive and Solutions on Poor Quality of Discharged Water into Irrigation Canal and Connected Part of the Irrigated Areas, dated 1 April 2011.

The surface water quality standard is shown in **Table 2.1-1**.

Table 2.1-1
Surface water quality standard

Quality	Measurement Index	Unit	Standard Quality of Surface Water ^{1/}				Standard Quality of Water Discharged to Irrigation Canal ^{2/}
			2	3	4	5	
Physical	Depth	m	-	-	-	-	-
	Flow rate	m/s	-	-	-	-	-
	Temperature	°C	n'	n'	n'	n'	-
	pH	-	5.0	5-9	5-9	5-9	-
	Suspended Solids	mg/l	-	-	-	-	-
	Total Dissolved Solids	mg/l	-	-	-	-	-
	Conductivity	µ mol/cm	-	-	-	-	-
Chemical	Dissolved Oxygen	mg/l	>6	>4	>2	-	2.0
	BOD	mg/l	<1.5	<2	<4	-	100
	COD	mg/l	-	-	-	-	5.0
	Oil & Grease	mg/l	-	-	-	-	-
Biological	Total Coliform Bacteria	MPN/100 ml	<5,000	<20,000	-	-	-
	Fecal Coliform Bacteria	MPN/100 ml	<1,000	<4,000	-	-	-

Source: ^{1/} The notification of National Environmental Committee Vol8 BE.2537 (1994) in accordance with the National Environmental conservation and enhancement Act Bf. 2535 (1992). re: Standard Quality of Surface Water, published in Royal Gazette Vol.111 Special Part 16 0, dated 2L February 1994

^{2/} The Royal Irrigation Department Order no. 73/25S4 re: Amending of Preventive and Solutions on Poor Quality of Discharged Water into Irrigation Canal and Connected Part of the Irrigated Areas, dated 1 April 2011

Remark : n' = naturally but changing not more than 3°C

^{1/} Classification of surface water quality

Class 1 Extra clean fresh surface water resources used for:

- (1) Conservation not necessary pass through water treatment process require only ordinary process for pathogenic destruction
- (2) Ecosystem conservation where basic organisms can breed naturally

Class 2 Very dean fresh surface water resources used for:

- (1) Consumption which requires ordinary water treatment process before use
- (2) Aquatic organism of conservation
- (3) Fisheries
- (4) Recreation

Class 3 Medium clean fresh surface water resources used for:

- (1) Consumption, but passing through an ordinary treatment process before using
- (2) Agriculture

Class 4 Fairly dean fresh surface water resources used for :

- (1) Consumption, but requires special water treatment process before using
- (2) Industry

Class 5 The sources which are not classification in class 1-4 and used for navigation

3) Ground Water

The results of groundwater quality measurement were compared with the standards for groundwater quality as prescribed in the Notification of National Environment Board No. 20 B.E. 2543 re: Prescribing Standards for Groundwater Quality. In addition, the measured parameters were compared with the suitable and maximum allowable concentration for consumption water as prescribed in the Notification of Ministry of Natural Resources and Environment re: Prescribing Academic Standards for Protection of Public Health and Environmental Pollution B.E. 2551 as shown in **Table 2.1-2**.

Table 2.1-2
Groundwater quality standard

No.	Parameters	Unit	Standard		
			(1)	(2)	(3)
1.	pH	-	-	7.0-8.5	6.5-9.2
2.	Water Temperature	°C	-	-	-
3.	Conductivity	µS/cm	-	-	-
4.	Turbidity	NTU	-	5	20
5.	Total dissolved solids (TDS)	mg/l	-	600	1,200
6.	Suspended solids (SS)	mg/l	-	-	-
7.	Total Hardness	mg/l as CaCO ₃	-	300	500
8.	Carbonate Hardness	mg/l as CaCO ₃	-	-	-
9.	Sulfate (SO ₄)	mg/l	-	200	250
10.	Manganese (Mn)	mg/l	0.5	0.3	0.5
11.	Iron (Fe)	mg/l	-	0.5	1.0
12.	Copper (Cu)	mg/l	1.0	1.0	1.5
13.	Zinc (Zn)	mg/l	5.0	5.0	15
14.	Magnesium (Mg)	mg/l	-	-	-
15.	Calcium (Ca)	mg/l	-	-	-
16.	<i>E.Coli</i>	MPN/100 ml	-	None	-
17.	Total Conform Bacteria	MPN/100 ml	-	<2.2	-
18.	Fecal Coliform Bacteria	MPN/100 ml	-	<2.2	-

(2) Power Plant Standard/Regulations

Environmental standards in Thailand for thermal power plants.

1) Air emission standard

- Notification of MNRE on emission standard for a new power plant. 20 December B.E.2552 (2009).
- Notification of Ministry of industry B.E.2547 (2004) on regulation of air pollutant quantity released from power plants and power distributors.
- Pollutant quantity released from power plants and power distributors

Emission Standard for a New Power Plant			
Fuel	TSP (mg/Nm ³)	SO ₂ (ppm)	NO _x as NO ₂ (ppm)
Biomass	Not more than 120	Not more than 60	Not more than 200

The WB IFC EHS standard that will be complied is under General Guidelines for Small Combustion Facilities Emissions Guidelines (3MWth – 50MWth) (Table 1.1.2), i.e., PM (50 or up to 150 mg/m³); SO₂ (2000 mg/m³); and NO_x (650 mg/m³).

2) Water Discharge Standard

The discharge water from the project will meet applicable government standards such as the Notification of Ministry of Industry No. 2, B E. 2560 (2017) re: Prescribing Factory Wastewater Standards as shown in **Table 2.1-4**

Table 2.1-4

Industrial Effluent Standard

No.	Parameter	Standard Values
1.	pH	5.5-9.0
2.	Total Dissolved Solids (TDS)	Not more than 3,000 mg/l
3.	Temperature	Not more than 40 °C
4.	Suspended Solids (SS)	Not more than 50 mg/l
5.	Color and Odor	Not more than 300 ADMI
6.	Biochemical Oxygen Demand	Not more than 20 mg/l
7.	Chemical Oxygen Demand	Not more than 120 mg/l
8.	Sulphide	Not more than 1.0 mg/l.
9.	Cyanide (CN)	Not more than 0.2 mg/l.
10.	Oil & Grease	Not more than 5.0 mg/l

11.	Formaldehyde	Not more than 1.0 mg/l.
12.	Phenols	Not more than 1.0 mg/l.
13.	Free Chlorine	Not more than 1.0 mg/l.
14.	Pesticides	None
15.	Total Kjeldahl Nitrogen (TKN)	Not more than 100 mg/l
16.	Heavy metals	
16.1	Zinc (Zn)	Not more than 5.0 mg/l.
16.2	Chromium (Hexavalent)	Not more than 0.25 mg/l.
16.3	Chromium (Trivalent)	Not more than 0.75 mg/l.
16.4	Arsenic (As)	Not more than 0.25 mg/l.
16.5	Copper (Cu)	Not more than 2.0 mg/l.
16.6	Mercury (Hg)	Not more than 0.005 mg/l
16.7	Cadmium (Cd)	Not more than 0.03 mg/l.
16.8	Barium (Br)	Not more than 1.0 mg/l.
16.9	Selenium (Se)	Not more than 0.02 mg/l
16.10	Lead (Pb)	Not more than 0.2 mg/l.
16.11	Nickel (Ni)	Not more than 1.0 mg/l.
16.12	Manganese (Mn)	Not more than 5.0 mg/l.

The effluent quality of the project will meet standard of Irrigation Department. Mitigation measures will be followed as detailed in the EMP to comply with the WB IFC EHS standard.

Moreover, the discharge water from the project will meet applicable government standards such as the Notification of Ministry of Industry (B.E. 2560) re: Prescribing Factory Wastewater Standards. Total Dissolved Solids (TDS) will meet the requirement of the Royal Irrigation Department of no more than 1,300 mg/l with temperature of no more than 34 degree Celsius.

(3) EIA Regulations

Notification of Natural Resources and Environmental Ministry B.E.2555 (2012) on regulation of types and specifications of projects or businesses that requires an environment impact assessment (EIA) including the principles, procedures, practices and guidelines of EIA preparation.

2.1.2 Concerned ADB Regulations

(1) Social Protection Strategies (2001)

As the project shall create temporary and permanent employments for skilled and unskilled labors, the project will fully comply with ADB's Social Protection Strategy (2001) which upholds international recognized labor standards and/or national labor laws, particularly on the following conventions: (1) no harmful or exploitative forms of forced labor, (2) no child labor, (3) no discrimination in respect of employment and occupation, and (4) no restrictions of freedom of association and the effective recognition of the right to collective bargaining.

(2) Safeguard Policy Statement (2009)

ADB's safeguard policy statement (SPS) was issued in 2009 and applies to all projects funded by ADB since 20 January 2010. This operational policy revision resulted in a consolidated policy outlining common objectives of ADB's safeguards, policy principles, and delivery process for the SPS, It also outlines a set of specific safeguard requirements when addressing social and environmental impacts and risks. The Chana Power Plant project will fully comply with the relevant ADB's safeguard policy throughout the project operation period- ADB's safeguard policy statement consists of three operational policies on the Environment, Indigenous Peoples, and Involuntary Resettlement. Objectives of ADB's environmental and social safeguards are to: (i) avoid adverse impacts of projects on the environment and affected people, where possible; (ii) minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible, and (iii) help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks. Since the project is Category A for environment, Safeguard Requirements 1: Environmental and eleven policy principles have been triggered (referred to page 16 of the SPS, 2009).

2.2 Scope of EIA study

The study of the project's environmental resources is mainly relied on the methods of environmental impact assessment defined by the Office of Natural Resources and Environmental Policy and Planning. The methods are composed of reviewing secondary data from related governmental agencies, compiling relevant reports and conducting field survey. In addition, the study of the project is chiefly emphasized on potential impact associated to the project which is expected to be affected by the project and/or generated impact to the project during construction and operation periods.

Environmental resources are studied as follow :

- (1) Physical Resources consisting of
 - Topography
 - Climate and Air Quality
 - Noise
 - Surface Water Quality

- (2) Biological Resources consisting of
 - Aquatic Ecology
 - Terrestrial Ecology

- (3) Human Use Values consisting of
 - Land Use
 - Water Use
 - Electricity Use
 - Drainage and Flood Control
 - Solid Waste Management

- (4) Quality of Life Values consisting of
 - Socio-Economics
 - Public health/Occupational health and safety

The study of environmental aspects are based on compilation of related data, documents and reports such as mitigation measure and impact relief report, monitoring program and other related reports. Besides, activity of public participation has been implemented by coordinating with beat government agencies and local dwellers in order to continuously disseminate information of the project. Meanwhile, the study of health impact assessment has been based on compiled public health implementation reports from relevant government agencies,

2.3 Methodology

The information used in this study comprises both primary and secondary data as shown in **Table 2.3-1.**

Table 2.3-1

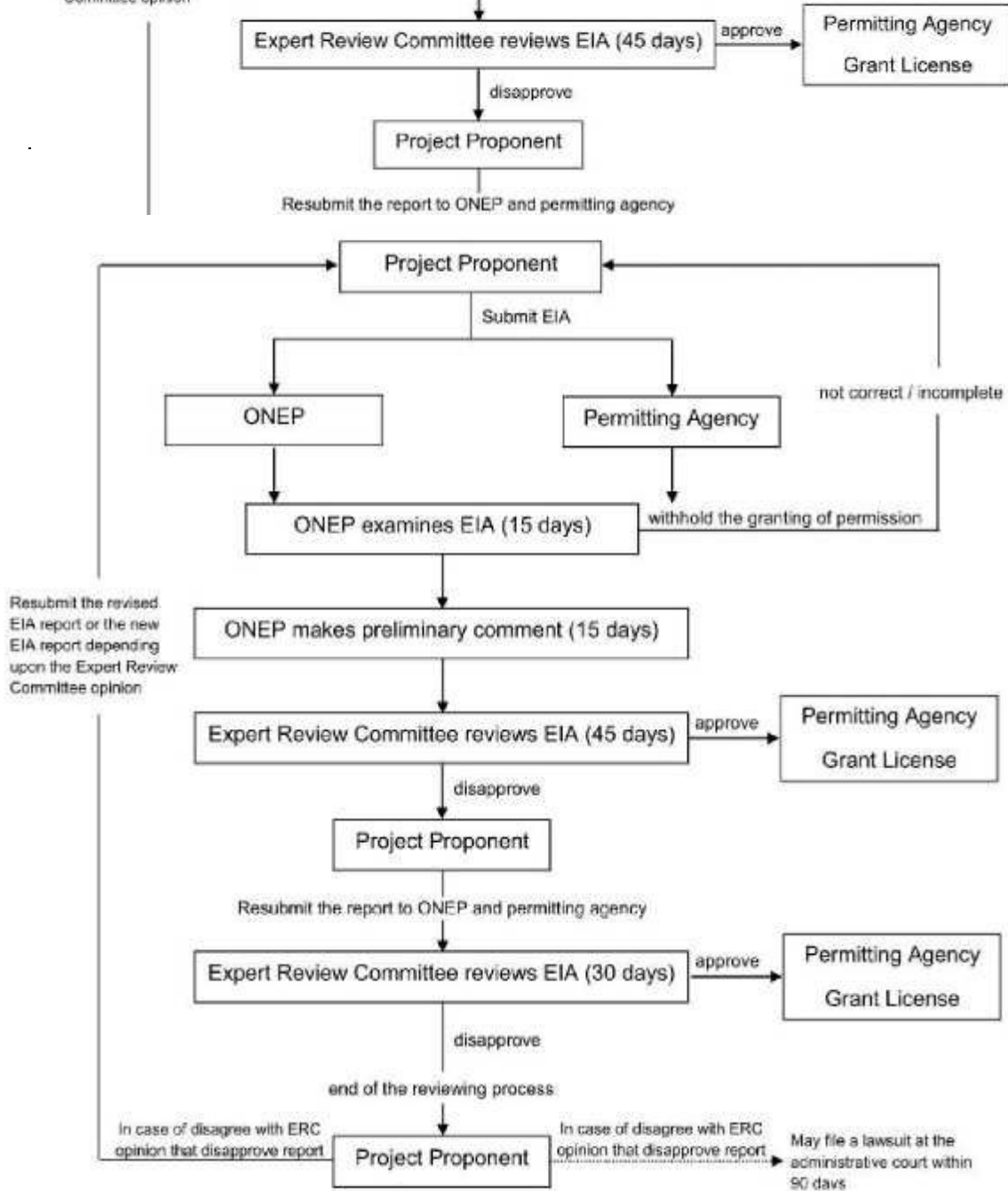
Method of The Study and Data Compilation for The Chana Power Plant

Potential Impact	Studied Areas	Source of data
1. Topography	5-km radius from the project location and project location	Collected data from topographic map at scale 1:50,000 and conducted field survey.
2. Climate and air quality	Climate of southern specially at the project location. The data was from the nearest meteorological station.	- Collected secondary data from meteorological station near the project area - Measured air quality for 4 stations
3. Noise	5-km radius from the project location	- Collected secondary data from relevant documents and Reports - Measured noise level for 3 stations for 7 consecutive days
4. Surface water quality	Collected water samples from surface water sources within 5-km radius from the project location	- Collected secondary data from relevant documents and Reports - Collected water samples from Khong Nathawee covering 2 seasons : dry season and wet season
5. Aquatic ecology	Collected plankton and benthos	Collected plankton and benthos from Khlong Nathawee covering 2 seasons : dry season and wet season
6. Terrestrial ecology	5-km radius from the project location	Collected data from relevant documents and reports
7. Land use	5-km radius from the project location	- Collected relevant secondary data. - Conducted field survey during February 2016.
8. Water use	5-km radius from the project location	Collected water use data from the project and relevant agencies.
9. Electricity use	5-km radius from the project location	Collected data from the Provincial Electricity Authority.
10. Drainage and flood control	5-km radius from the project location	Collected relevant secondary data. Conducted field survey
11. Solid waste	5-km radius from the project	Collected solid waste management from

Potential Impact	Studied Areas	Source of data
management	location	the project and relevant local agencies
12. Socio-economics	Communities within 5-km radius from the project Location	<ul style="list-style-type: none"> - Collected socio-economics data of communities within 5-km radius from the project location as well as from all Sub-district Administrative Organization within tile study area - Interviewed relevant agencies, community headmen and community within the nearby area to obtain socio-economics data and opinions toward the oroject development.
13. Public health/ Occupational health and safety	Communities within 5-km radius from the project Location	<ul style="list-style-type: none"> - Collect secondary data from hospitals, District Public Health Office as well as Tambon Health Promoting Hospitals. - Interviewed local public health officers within the study area, and obtain health status data of local people from household interview.
14. Public participation	5-km radius from the project location	Consulted with governmental agencies, educational institutions, religious institutions and community headmen.

2.4 ONEP EIA Review and Approval Process

The EIA report of Chana Power Plant Project must be submitted to ONEP for review and approval according to the following procedural scheme;



2.5 EIA Approval

EIA report of the project has been submitted to ONEP since April 2017 and expected to get approval within this year.
