Environmental Impact Assessment

Initial Environmental Examination
Project Number: LN2875

Proposed Loan and Administration of Loan
Provincial Solar Power Project
(Thailand)

Prepared by ERM-Siam Co Ltd (for Bangchak Solar Energy Company Limited)

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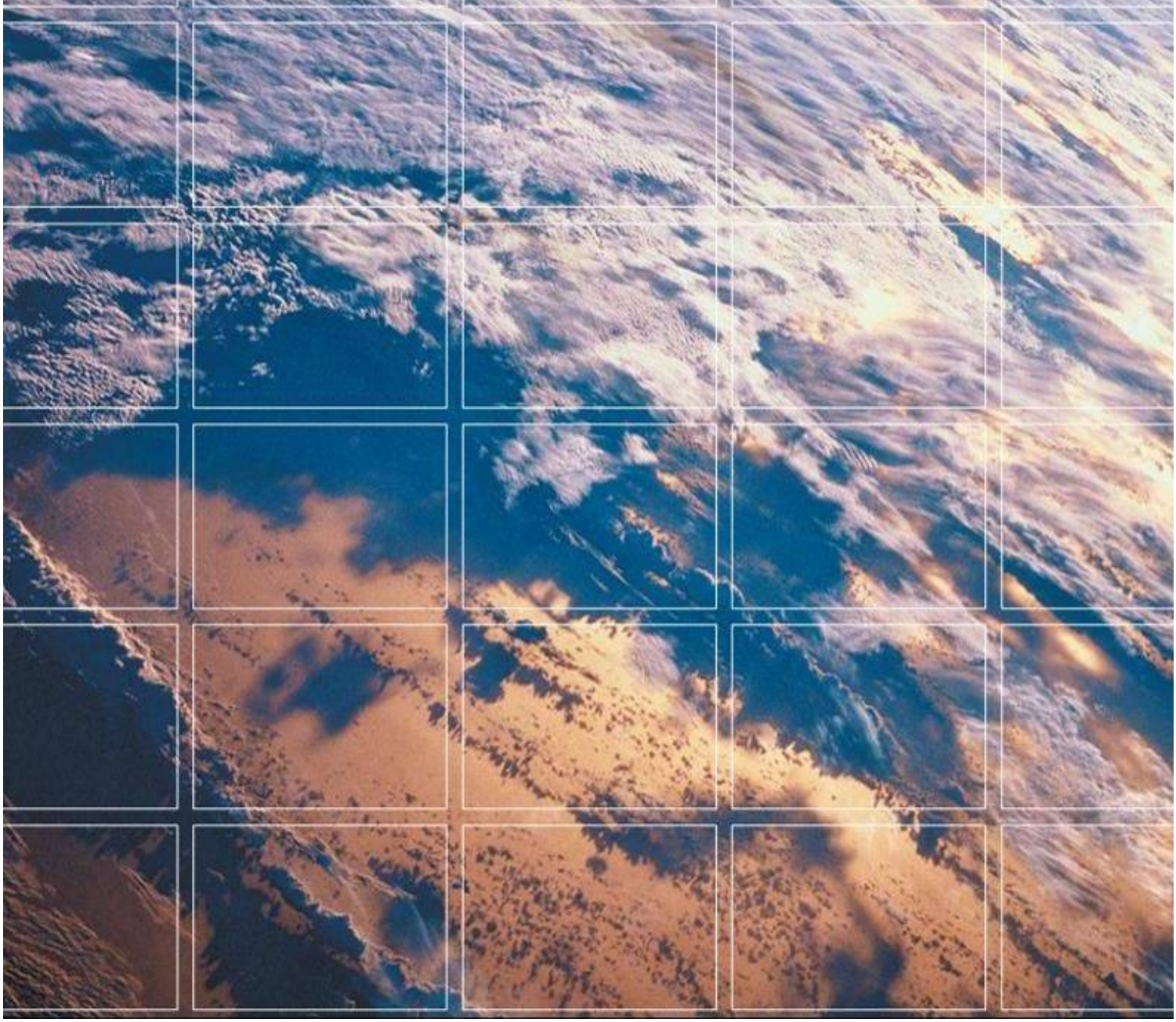
Asian Development Bank



BSE Solar Power Plant at Ayutthaya, Thailand

Final IEE Report

April 2012

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Bangchak Solar Energy Co., Ltd.

BSE Solar Power Plant at Ayutthaya, Thailand

April 2012

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CONTENTS

1 Introduction

1.1 Project Background

Electricity security is the important topic in Thailand thus the government tries to implement policies to reduce the imported crude oil from other countries then utilizing the renewable energy instead. This renewable energy is the main resources to generate domestic electricity. This can promote the energy-efficient alternatives to energy security and sustainability of country and also reduced the Green House Gases Emission which leading to the Climate Change issue.

Consequently, Bangchak Solar Enegy or "BSE" which is one company in the Bangchak Public Company Limited (BCP) Group realizes the benefit of utilizing renewable energy. Therefore, the BSE Solar Power Project (the Project) is initiated by BSE to enhance its green energy business and fulfill its vision of Greenergy Excellence. The Project will consist of two adjacent solar power plants operating as single complex, one with a net alternating current (AC) output of 8 megawatt (MWac). The two plants will sell their outputs to PEA. The project's 16MWac (8 MWac x 2) solar generation project would generate renewable energy under the VSPP program (<10MW). The site that has been identified by Bangchak is approximately 259 rais (41.44 hectares).

1.2 Financial Requirement

BSE on behalf of BCP has requested the Asian Development Bank (ADB) to finance the Project on a corporate basis. ADB classified the Project as environmental category B and BSE with assistance from an environmental consultant prepared this Initial Environmental Examination (IEE) to meet the Project's environmental assessment requirements following ADB's Safeguards Policy Statement (2009). This IEE covers the assessment of the solar power plants' significant environmental impacts and identification of the most appropriate mitigation measures based on the environmental aspects in the plants consultant's site visit in March 2012. The scope of the IEE also includes a

review of BCP's corporate policies and operational framework for environmental and social management. The IEE concludes that the proposed project will not have significant environmental and social impacts. BSE is fully committed to its environmental and social responsibility and discharges this responsibility in adherence to principles of good corporate governance.

1.3 Policy, Legal and Administrative Framework

Environmental Impact Assessment or EIA is not required for solar power projects in Thailand. However, environmental aspect was reviewed in the project feasibility study report and BSE held a public consultation meeting on 18 April 2011 as required by the Thai constitution.

1.4 Project Benefit Expectation

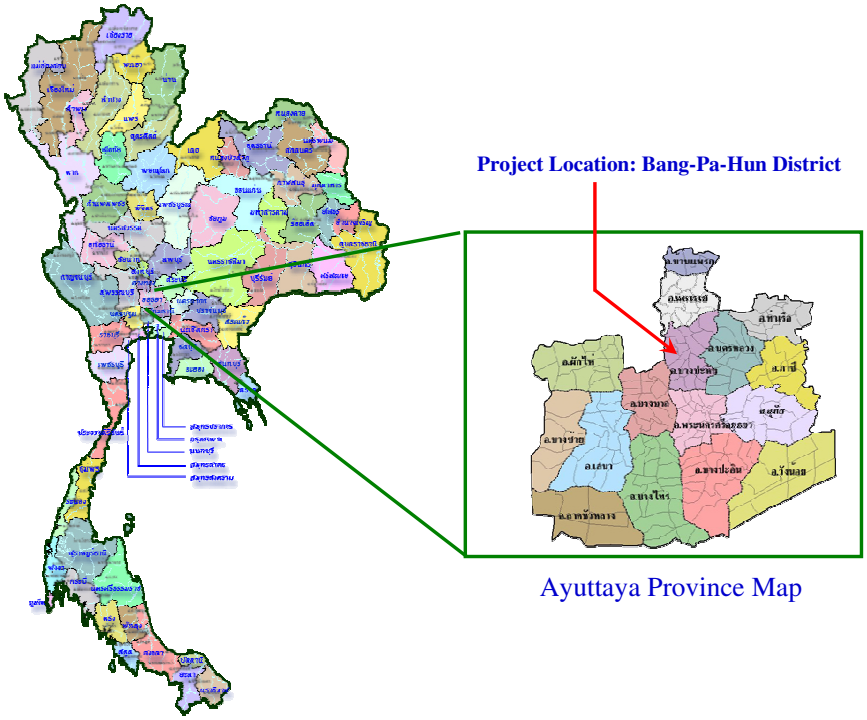
- To increase the energy supply security in Thailand
- To reduce imported energy fuel for power plant
- To increase and contribute the fund of community development and local taxes to develop the different activities in the community
- To reduce CO_2 emissions around 15,000 tCO_2/year from the overall power plants in Thailand.
- To be solar energy learning for youths and community
- To create jobs for community in long and short terms.

2 Project Description

2.1 Project Location

The Project will be located approximately 14.504' N and 100.508' E covering Hun Sang and Baan Mar Sub-district, Bang Pa Hun District, Ayutthaya Province in Central Thailand. The project location is shown in the *figure 2.1*

Figure **2.1 Project Location**



2.2 Scope and Layout

The project will construct and operate solar power plant, control building and other supporting area approximately 414,400 m^2 (259 rais). This project site locates on highway number 32 and was the paddy field in the time. The currently project site and its boundary as shown in *Figure 2.2 and 2.3*

Figure 2.2 Project Layout

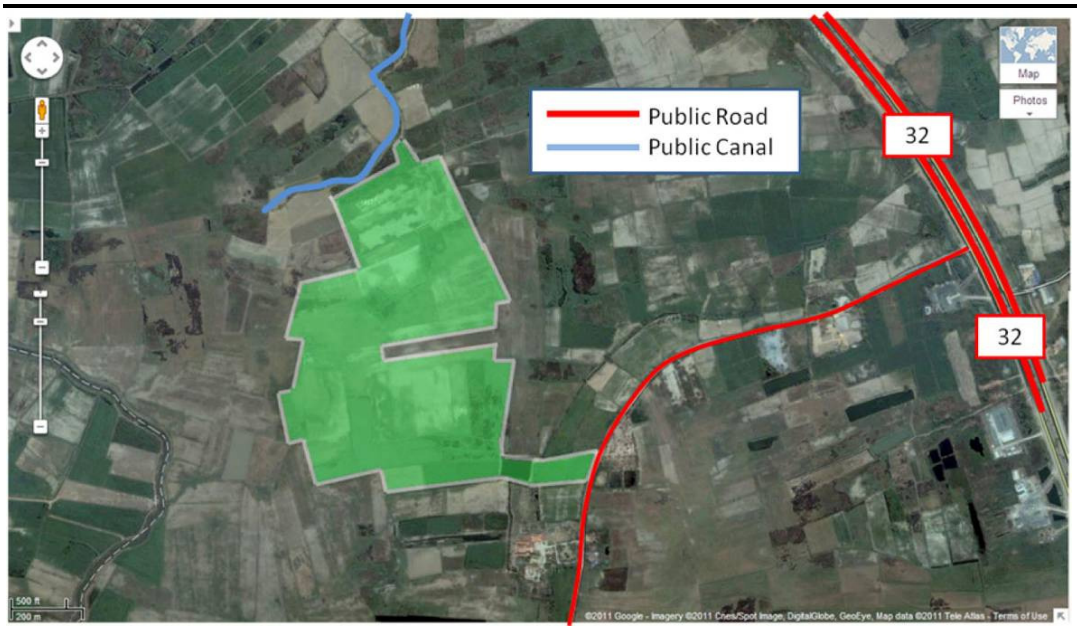


Figure 2.3 Project site (Construction Phase)

The nearby area of the project site shown as *Figure 2.4*

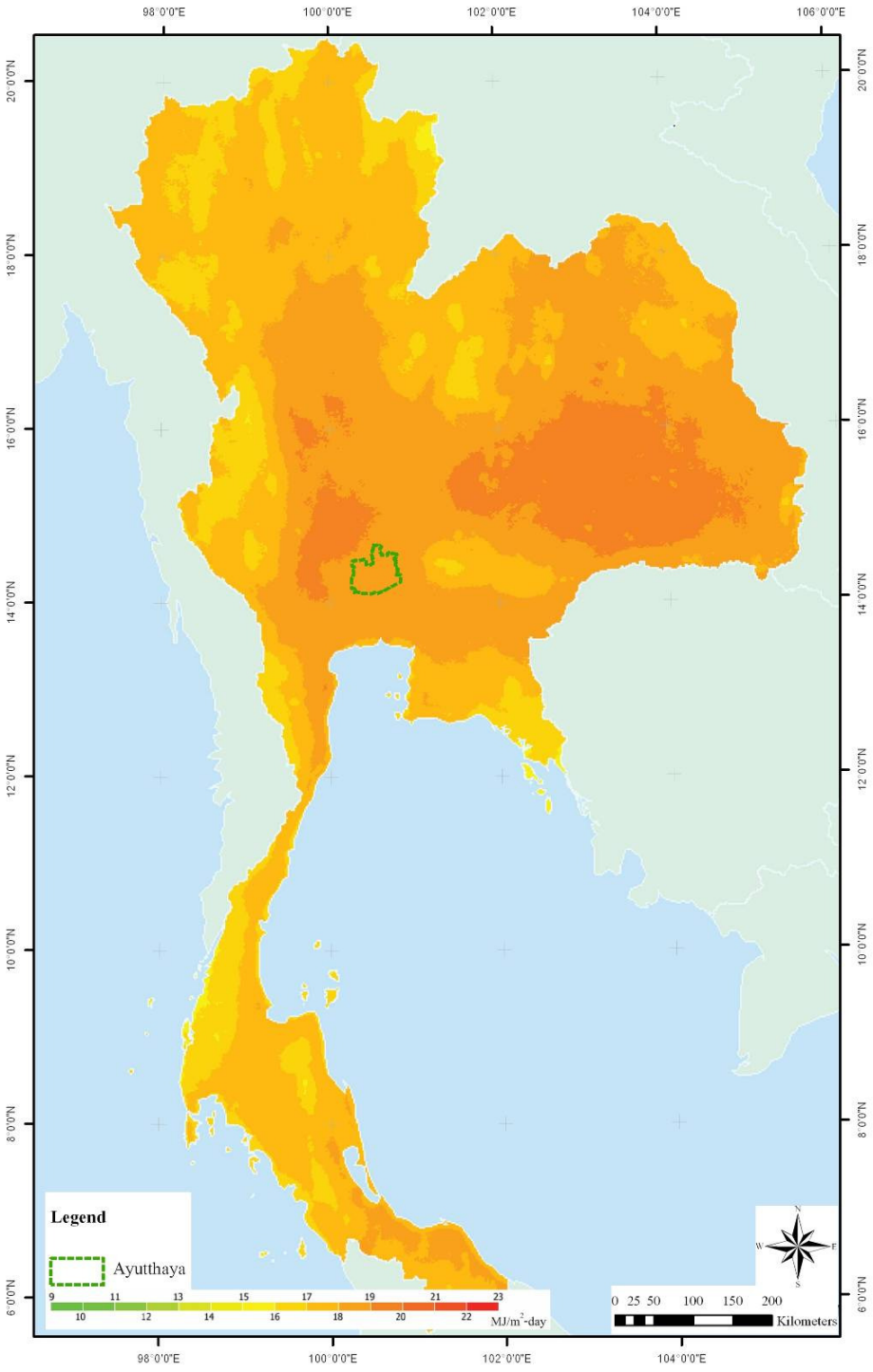
North	Nearby the irrigation canal
South	Nearby Phothong temple (Wat Phothong)
East	Nearby the local road (asphalt road)
West	Nearby the paddy

Figure 2.4 Physical environment of the project site

2.3 *Project site consideration*

BSE considered the location of the BSE Solar Power Plant project at Ayutthaya, Thailand due to the solar energy potential area refer from Department of Alternative Energy Development and Efficiency shown as *Figure 2.5* Ayutthaya locates in the Central of Thailand and also has high solar radiation which is normally over 18 MJ/m^2-day. This global radiation in this province is around 20 - 21 MJ/m^2-day as a result this area meet the qualification of BSE Solar Power Plant and can generate the electricity with the high potential.

Figure 2.5 Average annual solar energy potential map



2.4 Construction

This project site area is approximately 414,400 m^2 or 101.58 Acre (259 rais) and can be classified the land use as *Table 2.1*

Table 2.1 The Land use in project area

		Area	
	Type of land use	**M^2**	**Rais**
1	Solae cells installation	103	164,437
2	Spaces between rows of solar panels	40	64,377
3	Water pond	18	29,388
4	Other	98	156,198
	Total	**414,400**	**259**

2.5 Installed equipments at site construction

The BSE Solar Power Plant at Ayutthaya, Thailand consists of 2 adjacent solar power plants generating 25 MW of the electricity capacity (12.5 MW each). The number of Poly Crystallines is approximately 42,380 panels in each solar power plant which will be installed in this site construction (total 2 plants around 84,760 panels). All of facilities and equipments will be deployed in this site construction which can be concluded as below.

- Solar Panel

The type of solar panel is Poly Crystalline which has 25 years of the life cycle. The qualification of this project has shown as below.

Table 2.2 The qualification of Solar Panels using in the project

List	Qualification
Power Output (Pmax)	295 W
Optimum Operating Voltage (Vmp)	36.5 V
Optimum Operating Current (Imp)	8.09 A
Open Circuit Voltage (Voc)	45.3 V
Short Circuit Current (Isc)	8.57 A
Module Efficiency	15.2%
Operating Module Temperature	-40 to 85 ˚C
Maximum System Voltage	1000 V DC (IEC)/ 600 V DC (UL)
Maximum Series Fuse Rating	20 A

The main rationale to choose Poly Crystalline shows as following

- This technology life cycle is over 25 years thus it can be ensured that this can generate electricity as long as the economic life of the project.
- This technology is more suitable than Solar Thermal Technology for climate in Thailand
- The using space of this technology is less than Thin Film

- Inverter

The specification of central inverter in this project is 500 kW -800 kW. The inverters shall conform to IEEE 929 and / or IEC 62103 2003-07 standards. The inverter shall at a minimum the protection function as per PEA's synchronizing code (year 2551)

- The supporting solar panel structure

The Galvanize Steel is the main material of the solar panel supporting structure and its inclination is 15^{O}.

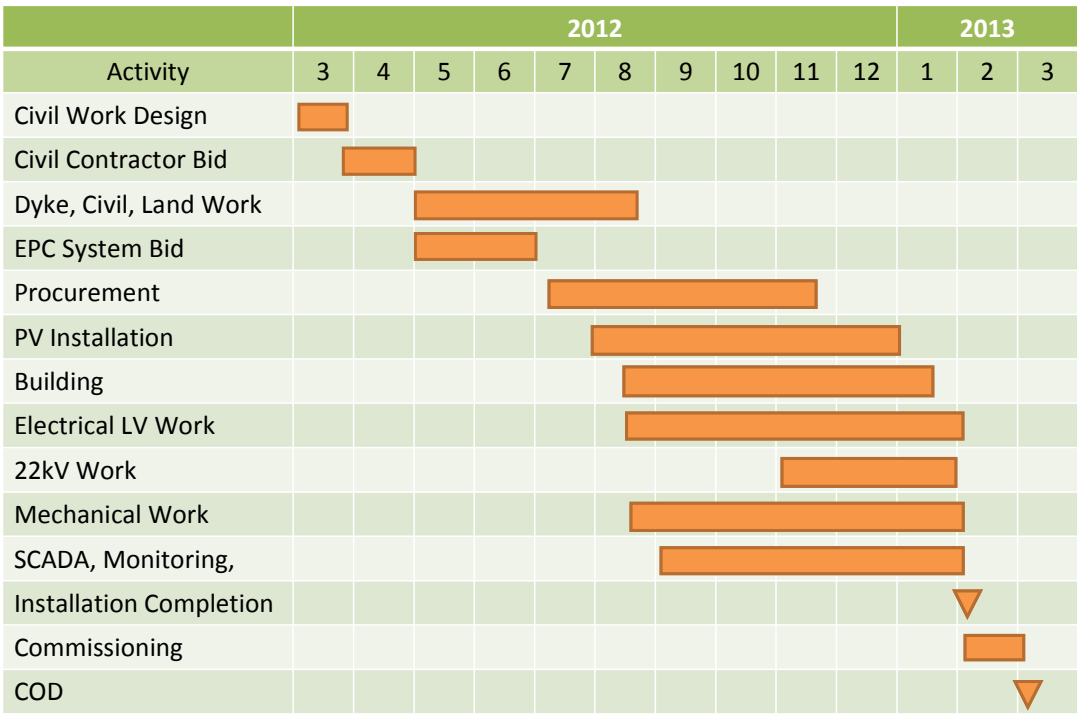
- Electrical equipments

- The specification of ONAN transformer is 22kV and the transformer type is oil type. The number of transformers is also half of inverters.
- The specification of switchgear is 22 kV as PEA standard.

- *Control building*

There is one control building in the project site to control the operation in this project.

2.6 PROJECT SCHEDULE



3 Description of Environment

3.1 Physical Environment

This project site is at Ayutthaya which has a humid and tropical climate characterized by 2 seasons including winter season affecting from north-east monsoon and raining season affecting from south-west monsoon. In addition, the meteorological department said that the average Ayutthaya rainfall in period of 2006-2011 is approximately 100.2 milliliter per year and the average temperature is 28 Celsius.

3.2 Biological Environment

The project site is not located in or near a sensitive ecosystem. An ecological survey of the project site on 14 March 2012 confirmed the absence of unique or ecologically significant flora and fauna. Some part of project area and surrounding area are farming but the project site area was bought legally.

In addition, there is Phokratoop Canal (Figure 3.1) which passes through the entrance of project site and then go through Phothong Temple where locates in the South of project site. However, BSE project will improve and maintain the ditch to keep the water flow normally through the canal. This will not be affected to the community. Moreover, there is the irrigation canal in the north of project site (Figure 3.2) which is the main canal for farming. The width of ridge nearby irrigation canal is approximately 4-5 meter which is the barrier between project site and irrigation canal.

Figure 3.1 Phokratoop Canal

Figure 3.2 Irrigation canal nearby North of the project area

3.3 Socioeconomic Environment

The almost project area site is located in the jurisdiction of Hun Sang Tambon Administrative Office (TAO). Hun Sang has a total population of 3,617 people (1,747 of male and 1,870 of female) and 976 households in 7 villages (As of September 2011). Also, this community located close to the project site as shown in *Figure 3.2*.

Figure 3.3 Hung Sang Community

3.4 Historical and Cultural Value

The project site and the surrounding areas have no extraordinary important historical and cultural sites. There is only Phothong temple located nearby in the south of the project area with around 150 metres distance

4 Anticipated Impacts and Mitigation Measures

4.1 Impact During construction phase

The civil, mechanical and electrical works will be minor and will spread over the large project site. Considering the nature and magnitude of construction works and the ecological insensitivity of the project site, it is certain that the construction would create only minor and manageable environmental disturbances such as noise from trucks and excavation equipment, with insignificant impacts on the nearby communities and the natural environment. No toxic and hazardous materials will be used in the construction apart from diesel oils for vehicles, which will be properly stored. The construction contracts will require the EPC contractors to be responsible for undertaking effective measures for environmental impact mitigation. Environmental performance of the EPC contractors will be monitored by the BSE project manager.

4.2 Impact During Operation phase

The solar power plant does not create noise and gaseous emissions during operation. On the operation phase the project is required water for cleaning the surface of solar panels form the ground water approximately 15 cu.m./day. The deep well for pumping the ground water would be allocated in the project site area near the control building. A volume of wastewater would be daily generated from washing dust from surface of the solar panels. This wastewater is collected and stored in 2 concrete tanks of totally 27,500 cubic meters, first tank plans to place in the south of project site of 15,000 cubic meters and the another one places in the north of 12,500 cubic meters as shown in *Figure 4.1*. This wastewater will not be allowed to pass the canal which is close to project site except the community wants the wastewater to utilize in their farming.

Figure 4.1 Space for 2 concrete tanks of the project

Space for concrete tank places in the south

Space for concrete tank places in the north (nearby irrigation canal)

Not more than 10 staffs for operation and 40 staffs for maintenance such as PV surface cleaning. Domestic wastes generated by this small number of people could be readily handled by a septic tank system.

The potential impacts could be visual and reflection. However, as the project site and the surrounding areas provide no significant aesthetic value, the sights of a large area covered with solar PV panels will have no visual impact. With the old design of solar PV arrays, reflected sunlight may cause problems if the system is close to a road and is facing in a direction which the reflected sunlight may cause problems. This problem will not occur in this Project as its surface of solar PV panels is designed to absorb sunlight and minimize sunlight reflections. Though the reflection problem will not occur because of the panels designed to absorb sunlight.

4.3 Decommissioning

The Project's solar PV panels are expected to have an economic life of 25 years. If the PV panel is breaking down and can not be recycled, it will be removed outside the project by the suppliers. Moreover, the supplier has to request the permission form Ayutthaya Industrial office.

4.4 Social impact

The area of BSE Solar Power Plant is 259 rais and was used to be agricultural area. People in the community sold their areas to BSE with willingness to develop this project. There are no indigenous peoples living near the project site. Therefore, the Project has no resettlement and indigenous people issues. The Project is therefore classified as category C for both involuntary resettlement and indigenous peoples by ADB.

5 *Public Consultation and Grievance Redress Mechanism*

BSE organized Public Participation in 2 times as listed:

- Public Participation Meeting held on 11 September 2011 at Phothong temple (Baan Mar sub-district)
- Public Participation Meeting held on 11 September 2011 at Kai temple (Hun Sang sub-district)

BSE organized the Public participation meeting relating to solar power plant on 11 September 2011 at Phothong temple in Baan Mar community in the morning and at Kai temple in Hun Sang community in the afternoon. BSE also invited representatives from various departments of government. Consequently, the community leaders and people in both of Baan Mar and Hun Sang community attended in both meeting.

The Kyoto protocol and procedure of solar electricity generation were clarified in beneficial term of this project in BSE Public participation meeting. Moreover, environmental impact in nearby community was also explained in this meeting. Then, the attendees can comment and ask questions in this meeting after that BSE will give more explanations.

The objectives of Public participation meeting

1. Project description
2. Describe the impact of global warming and the essence of the Kyoto Protocol.
3. Describe the relationship between the Clean Development Mechanism projects.
4. Describe the environmental impacts arising from the project.
5. Open the opportunity to ask the question relating to project

There were 83 participants in the meeting at Phothong temple and 104 participants in the meeting at Kai temple. There were representatives from government agency, local government agency, Non-Government Organization (NGO), institutions and community leader (*Figure 5.1*). The result of the meeting can be shown no participants disagreed or protested the project.

The summary of consultation issues raised by stakeholders and response by BSE is shown in the table 5.1

Table 5.1 Summary issues raised by stakeholders in the Public Meeting

Issues	**Response**
Do the project have sun glare?	The panels design to absorb most sun light and the reflection will very low.
Do the panels contain Cadmium Telluride?	No, BSE would not choose the panels with contain Cadmium Telluride.
Will it affect the rice and their farms from the light of the solar power plant?	No, the power plant will absorb the incident light on the area.
What the community will receive from the project?	- Project will hire local people to clean panels during operation. - Project will support the surround power plant community fund.

Figure 5.1 Public participation meeting held on 11 September 2011

Public Participation held on 11 September 2011 in the morning

at Phothong temple, Baan Mar community

Public Participation held on 11 September 2011 in the afternoon

at Kai temple, Hun Sang community

5.1 Grievance Redress Mechanism

There are at least 3 channels for environmental complaints i.e. website, call center and telephone. The most effective channel for response is by telephone because the contact can be made anytime and is two-way communication. No matter which channel is, the responders from the environment and community relation division (ECD) firstly obtain the information from the complainer as much as possible to identify source of the problem and inform operation division. When the operation receives the information from ECD, they will find out if the complaint is caused from their operation. In case “yes”, they will fix the problem or stop their operation. After that, the operation will call back the ECD staff for the situation so that ECD staff can communicate to the complainer as soon as possible. Moreover, ECD staff will also meet the complainer at site for better understanding and curing his/their feelings and inform them the progress of mitigation measures from time to time until the problem has been solved.

6 Environmental Management Plan

6.1 Environmental management System

6.1.1 Policy and Scope of Management

BSE on behalf of BCP could be considered as a Green corporate since its Board, Management and employees are firmly and fully committed to "working towards sustainable business development in harmony with the environment and society". This commitment covers safety, health, environment and energy saving (SHEE) and is adopted as SHEE policy for guiding BCP's business operations and SHEE management. BCP's environmental commitment extends to global warming. The current environmental stance of BCP is clearly reflected in its vision "Greeneregy Excellence" and its long term goal to become a "Zero Global Warming Impact Company" or "Carbon Neutral Company".

The SHEE policy commitment drives BCP to strive to achieve its business objectives and targets with no compromise on its responsibility toward society and the environment with strict adherence to the principles of good corporate governance. To implement the SHEE policy, BCP institutionalizes SHEE management to ensure that its business decisions and operations will not compromise: (i) safety and health of its employees, contractors and the public; (ii) environmental quality; (iii) its reputation; and (iv) transparency for public audit and participation. To achieve and maintain the SHEE policy, the SHEE management focuses on three major areas that direct to the outcome: (i) Operation Excellence Work processes, (ii) Standard and quality of Equipment & Instrument, and (iii) Establish SHEE policy in Employees' behavior.

During the project construction phase, the SHEE Management will be monitoring and control the construction to ensure that the SHEE policy will be performed. After the project commissioning, the project's SHEE person will be required to present and perform at least, as a member of SOT (Safe Operation Team), OTM

(Operation Team Meeting) in the SHEE management Structure. Consequently, the SHEE policy will be aligned and deployed to the project seamlessly.

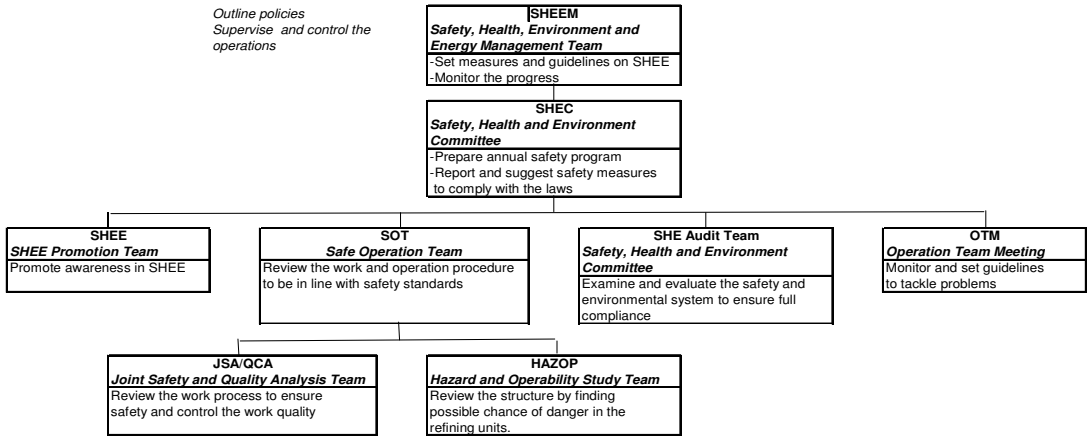
6.1.2 Safety, Health Environment and Energy (SHEE) Management Structure

BCP implements its SHEE policy through a SHEE management system that assigns direct responsibility to all executives and employees, as well as contractors working on behalf of BCP, to ensure that they will:

- work safely, creating no undue impact on themselves, related parties, the community and the environment;
- observe all occupational safety, health, environmental and energy-related laws;
- prevent oil pollution, spills and losses; (Incase Refinery plant of BCP) This item will not take in to solar power plant of BSE because there are not any source of oil pollution for solar power plant technology
- prevent all accidents and illnesses; and
- Use production resources to their best value in the most efficient and effective manners.

BCP has prepared SHEE Management Structure due to successful in SHEE Management. The SHEE management structure involves all executives and organizational units, and consists of policy and operation control teams as shown in a diagram in *Figure 6.1*

Figure 6.1 SHEE Management Structure



SHEE Management Structure's responsibilities are:

- Safety, Health, Environment and Energy Management Team - SHEEM

  SHEEM consists of senior executives from all business units. It formulates corporate policies and guidelines for safety, health, environment, and energy. It also revises safety, health, and environmental management systems, continually provides supports to develop SHEE operations, and appoints task forces to ease the efficiency and effectiveness of safety, health, environmental, and energy-related management.

- Safety Health and Environment Committee-SHEC

  This committee consists of representatives of employees. It delivers performance required by law. This team works jointly with the subcommittee on safety at the operational level to make operations safer.

- Safe Operation Team - SOT

  The SOT consists of all line operation managers. It revises designs, procedures and operation as endorsed by the Job Safety Analysis (JSA) & Quality Control Analysis (QCA), Hazard and Operability (HAZOP), and Engineering Quality Team (EQT) taskforces to ensure compliance with safety standards.

- Safety, Health, Environment and Energy Promotion Team - SHEE P

  This team is responsible for promoting safety, health, environment, and energy awareness amongst employees, through various participatory activities.

- JSA & QCA Task Force

  This task force is responsible for scrutinizing work procedures for safety and quality control.

- HAZOP Task Force

  Relying on HAZOP techniques for safe applications, this task force scrutinizes designs of refinery piping systems, equipment, and tools so as to comply with technical principles and the Company's engineering standards.

- EQT Task Force

  It is responsible for building and controlling the quality of designs to comply with design standards.

6.2 Occupational Health and Safety Performance and Risk Management

BCP's occupational health and safety system is certified TIS 18001 No. OHS00007/007 and OHSAS 18001 standards.

BCP runs its business operations with the utmost concerns on environmental risks and safety. In this regard, BCP strictly complies with all related laws and regulations, undertake risk assessment for all stages of work, implement

appropriate risk management measures, regularly carries out equipment maintenance, establish emergency plans and periodically conduct emergency drills among related parties to ensure their ability to handle emergencies with minimum impacts. Such high standards of operational risk management and preparedness for emergencies have earned for BCP several awards for operation and safety standards.

BCP accords high priority to the management of the following risks:

- Risk from refinery location, its environment and safety conditions:-As the BCP refinery complex is located in the suburb of Bangkok Metropolitan area, BCP therefore gives utmost importance to environmental and safety controls of the refinery operations to ensure insignificant environmental impacts and minimum risks to the surrounding communities.
- Risk from sabotage or accidents during transportation of crude from sources to the refinery
- Risk from accidents during transportation of refined products to customers
- Risk from accidents involving the oil pipeline belonging to Fuel Pipeline Transportation Company Limited (FPT)

6.3 Training

BCP institutionalizes regular training in of its personnel in various subjects to support its SHEE management and operations. In addition to on-site safety training for employees. The center conducts regular training on safety, including elementary and advanced fire-fighting techniques, emergency command, and fire evacuation drills for employees and external parties. In 2011, BCP held a total of 34 courses for 1,360 persons but BSE have 1-2 training course on 2011 from some importance electrical equipment technology and operation training course from EPC contractor.

6.4 EMS Audit

BCP is accredited ISO14001 for its environmental management system (EMS). The EMS is annually audited. The last audit was made in July 2011 by Anglo Japanese American (AJA) Registrars Co.Ltd., a certified auditor for ISO standards. The Auditor found the EMS fully met the requirements and no corrective action requests were made. Of note are the recommended area that can be more improvement such as ensure the condition of chemical spill, MSDS on work place to cover necessary environmental data and pollution control of tank repairing.

6.5 Emergency Response Processes

BCP has emergency plans for fires accident and chemical spill, radiation leak, gas leak and earthquake. The plans are tested annually. For example, the fire plan was tasted on December 12, 2011; acid gas leak plan on November 21, 2011; oil spill plan on May 6, 2011; and ammonia leak test on May 5, 2010 and NaOH leak test on March 20, 2011. All plans cover environmental recovery and all supporting equipment were checked and found to fully comply with required laws and regulations. In the other hand BSE is owner and operator of solar power plant that is supreme friendly environmental technology by the way BSE design to install electrical equipment protection such as switch gear, main board switch or other to cut off operation when there are any force majeure such as earthquake, flooding or short circuit in system (un-plan).

6.6 Social management

6.6.1 Policy and Scope of Management

BCP has no explicit policy statement on social management. However, its social commitment is integrated with its SHEE policy of “working towards sustainable business development in harmony with the environment and society”. The BCP Board ensures that the principles of good corporate governance are strictly adhered to in BCP’s business operations. The commitment to social responsibility is one of the principles and practices of good corporate

governance. BCP's social commitment is clearly reflected in its corporate social responsibility (CSR) activities and its dealing with communities around its refinery complex. BSE will survey community around solar power plant then will select some CSR activity from BCP experience that match with community requirement to do in CSR program in the future

6.6.2 Involuntary Resettlement

Involuntary resettlement is not an issue in BCP's operations and the Solar Power project in Ayutthaya Province. BCP has no authority to appropriate land. If BCP requires land for its business, such as service stations and production facilities, BCP will have to purchase land from owners on a willing buyer-willing seller basis. Selling prices will be based on prevailing market prices satisfactory to the sellers. Land procurement will follow normal procurement procedures of BCP. For example, BCP would advertise an advertisement for land requirement in a specific area. Interested land owners would propose their land to BCP for consideration. BCP would then negotiate with the owner of land that meets BCP's requirements to reach an agreed price. Alternatively, if a small land plot is required, BCP may not advertise to invite land proposals, but opts to directly negotiate with the owners of identified land plots.

6.6.3 Indigenous Peoples

Indigenous peoples in Thailand live in remote provincial areas, particularly along the border areas. This issue is not relevant to BCE as its businesses are not in remote areas.

6.6.4 Social Protection compliance

The BSE, including its contractors, will comply with applicable national labor laws in relation to the Project, and take the following measures to comply with the core labor standards [(1)] for the ADB financed portion of the Project:

(a) carry out its activities consistent with the intent of ensuring legally permissible equal opportunity, fair treatment and non discrimination in relation to recruitment and hiring, compensation, working conditions and terms of employment for its workers (including prohibiting any form of discrimination against women during hiring and providing equal work for equal pay for men and women engaged by the BSE);

(b) not restrict its workers from developing a legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment;

(c) engage contractors and other providers of goods and services:

(i) who do not employ child labor (child labor means the employment of children whose age is below the statutory minimum age of employment in the relevant country, or employment of children in contravention of International Labor Organization Convention No. 138 'Minimum Age Convention" (www.ilo.org)) or forced labor; (forced labor means all work or services not voluntarily performed, that is, extracted from individuals under threat of force or penalty)

(ii) who have appropriate management systems that will allow them to operate in a manner which is consistent with the intent of (A) ensuring legally permissible equal opportunity and fair treatment and non discrimination for their workers, and (B) not restricting their workers from developing a legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment; and

[(1)] the core labor standards are the elimination of all forms of forced or compulsory labor; the abolition of child labor; elimination of discrimination in respect of employment and occupation; and freedom of association and the effective recognition of the right to collective bargaining, as per the relevant conventions of the International Labor Organization;

(iii) whose subcontracts contain provisions which are consistent with paragraphs (i) and (ii) above.

6.7 Labor Practices

In Thailand, labor practices and welfare are governed by the Labor Protection Act, B.E. 2541, latest amendment in 2009, the Social Security Act, B.E. 2533, latest amendment in 1989, and regulations related to the two Acts. The Labor Protection Act covers all labor issues such as child labor, use of woman labor, welfare and benefits of labor, wages and compensation, grievance redress, e.t.c. The Social Welfare Act covers obligations of employers to contribute to the social welfare fund.

6.7.1 Employment

BCP strictly complies with all relevant laws and regulations. All of its 1,032 employees and employees of its contractors are older than 25 years old. There is no discrimination concerning privileges and rights against either gender. Receiving due pays, all employees are eligible to become members of “Bangchak Petroleum Plc Provident Fund” by choosing to contribute either 5% or 10% of each month’s salary, to be matched by the Company.

As for employees of the contractors, BCP requires each contractor to treat their workers properly as required by all relevant laws and regulations. This condition is stipulated in the contracts. Failure of the contractors to comply with this contractual obligation could result in contract termination.

For the employment issue, BSE will hire labor for developing the project. The number of workers that BSE will be employed during construction as the detail in the table 6.1

Table 6.1 Number of workers employed on the Project in Ayutthaya Province.

Item	Amount
Site Development	50
Building Construction	70
EE and ME Work	60
MV Work	20
Mounting Structure and Module Installation	100
Total Workers	**300**

From the detail in the table above, estimated local workers 50% of total workers

6.7.2 Employee Relations

To ensure a happy workplace where satisfaction and synergistic cooperation prevail, BCP continually promotes cordial relations among its employees, as well as between employees and the Management, through assorted activities embedded with virtue and awareness among employees, the Company, and society in general.

6.7.3 Bangchak Petroleum Labor Union

BCP has a labor union with about 20% of the workforce joining the union. BCP's good labor practices and welfare result in satisfied personnel. The staff turnover rate of BCP in 2011 was 3.58% compared with 3.83% in 2010.

6.8 Community Participation and Social Development

BCP is active in community participation and social development undertaken under its corporate social responsibility (CSR) program. Its CSR projects focuses on involving and supporting communities and schools around its refinery complex in sport events, informal education, strengthening the family institution, energy conservation, environmental management, cultural conservation, and community safety. Examples of BCP's community supports include: provision of scholarships to students; renovation of temples, community library and children playground; mangrove plantation in Samutprakarn Province, and optometric services. In

addition, BCP supports community development in some provinces through helping to sell community products in its service stations countrywide.

6.9 Environmental Impacts Mitigation Plan

BSE is responsible for the implementation of the Project, including all environmental management and monitoring activities during project design, construction and operation. BSE's duties and responsibilities will include acquiring all necessary approvals and permits and compliance with permit conditions and other statutory and/or legal requirements, and supervising and monitoring the implementation of environmental measures by the EPC contractors.

The EMP including an environmental measurement and monitoring plan has been prepared and presented in *Tables 6.1 and 6.2* The EMP will ensure that the environmental impacts of the Project will be avoided or minimized through the proposed mitigation measures.

The supervision, evaluation, and reporting of activities implemented as per the EMP will be carried out strictly and punctually to provide feedback to the ADB Project management team.

Table 6.2 Environmental Management Plan on BSE Solar Power Plant, Ayutthaya Province

Aspects/Impact	Mitigation Measure	Time Frame	Responsibility	
			Implementation	Supervision
Construction Phase				
Air and Noise Pollution				
- Dust from truck to be area	The material covered on / off the truck into the project area.	During operation	contractor	BSE
- Noise from Truck and Crane noises	- Not required due to working in remote area - Machines noise level not more than 85 dB(A) at avg. 8 hr	During operation	contractor	BSE
- Velocity of transportation	- Limit speed of trucks transportation not over 60 km/hr in logistic - Limit speed of trucks not over 30 km/hr in project area	During operation	contractor	BSE
Waste and Wastewater				
- Domestic waste from workers	- Provide the container from job adequately - Coordinate with Baan Mar or Hun SangTambon Administrative Office to collect and transport waste	During operation	contractor	BSE

			Responsibility	
Hazardous waste such as lubricant and grease.	- Provide container and space to collect - Coordinate with Baan Mar or Hun Sang Tambon Administrative Office to collect and transport waste or recycle waste	During operation	contractor	BSE
- Wastewater from workers	Provide treatment system of Domestic wastewater adequately.	During operation	contractor	BSE
Occupational Health and Safety: - Working with trucks and piling cranes - Building Construction maximum 2 storey - High voltage work	- Provide Safety Manual - Provide Safety Plan - Provide Safety Equipments - Supervision and Inspection - Protection gears - Provide a basic sanitary system in construction site adequately and comprehensively, such as clean water for drinking, water for washing and toilets	- Land filling and Civil work 5 months - Building construction 3 months - Commissioning 0.5 month	contractor	BSE
Transportation of equipment and construction Materials: Falling earths from land filling truck	- Truck wheels cleaning - Road cleaning	During operation		
Operation Phase				
Air and Noise Pollution				
- No dust and Noise	-	-	-	-
- Velocity of transportation	- Limit speed of transportation	During operation	BSE	BSE
Waste and Wastewater				

			Responsibility	
- Domestic waste from specialist and project's officers	- Provide the container adequately - Coordinate with Baan Mar or Hun Sang Tambon Administrative Office to collect and transport waste (no waste left)	During operation	BSE	BSE
Hazardous waste such as engine oil, lighting, grease and PV panel waste	- Provide the container clearly - Coordinate with Ayutthaya Industrial officer to get a permission to transport hazardous waste to outside project site - Coordination with agencies / companies that are licensed transportation and disposal of the Department of Industrial Works.	During operation	BSE	BSE
- Wastewater from office/control room	Provide sufficient treatment system of Domestic wastewater effective.	During operation	BSE	BSE
Wastewater from cleaning PV	- Construction of the 60,000 cubic meters of concrete tanks for water storage, collection and clean up PV panels without releasing it outside the project area.	During operation	BSE	BSE

			Responsibility	
Drainage and flood protection.	- Construct the ridge height approximately 5.5 meters from the project area around that place. (Project area height 3 meters from MSL). - Develop a system to collect rain water within the project area. - Dredging the drainage system regularly to prevent blockage and shallow.			
Occupational Health and Safety	- Provide Safety Manual - Provide Safety Plan - Provide Safety Equipments - Supervision and Inspection - Provide Annual health check up for all specialist and project's officers	During operation	BSE	BSE

Table 6.3 Environmental Monitoring Plan on BSE Solar Power Plant, Ayutthaya Province

Monitoring parameters	venue	Frequency	Responsibility
Monitoring Parameters of wash water PV panel - pH - Temperature - Total Suspended Solid - BOD - COD	Concrete tank for water storage	Monthly	BSE
Surface water quality - pH - Temperature - Total Suspended Solid - BOD - COD - DO	Canal (Nearby South of project area)	Monthly	BSE
Transportation Record the car in project area for use in planning and traffic safety.	Project area	Daily	BSE
Medical check up	New staff	Before working on the project	BSE coordinate with local care unit in the community
Annually medical checkup	All staffs	Annually	BSE coordinate with local care unit in the community
Record the accidents clearly such as cause, effect, loss and corrective action.	Project area	Every time an accident	BSE

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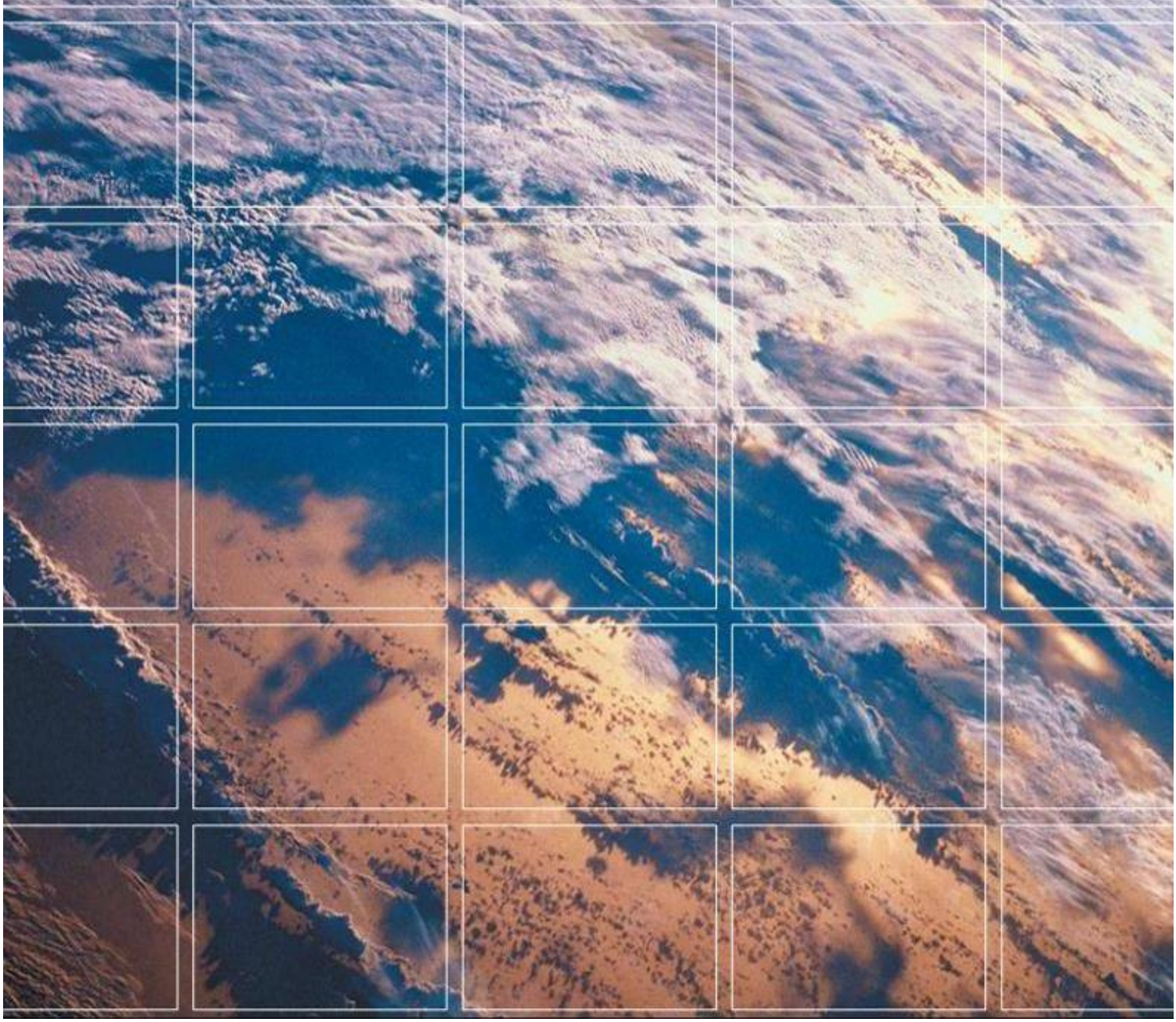

BSE Solar Power Plant at Chaiyaphum, Thailand

Final IEE Report

April 2012

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FINAL IEE REPORT

Bangchak Solar Energy Co., Ltd.

BSE Solar Power Plant at Chaiyaphum, Thailand

April 2012

Prepared by: ERM-Siam Co Ltd

0153522

For and on behalf of
ERM-Siam Co Ltd

Approved by: Amornwan Resanond

Signed: 

Position: Partner

Date: 12 April 2012

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

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CONTENTS

1 Introduction

1.1 Project Background

Electricity security is the important topic in Thailand thus the government tries to implement policies to reduce the imported crude oil from other countries then utilizing the renewable energy instead. This renewable energy is the main resources to generate domestic electricity. This can promote the energy-efficient alternatives to energy security and sustainability of country and also reduced the Green House Gases Emission which leading to the Climate Change issue.

Consequently, Bangchak Solar Enegy or "BSE" which is one company in the Bangchak Public Company Limited (BCP) Group realizes the benefit of utilizing renewable energy. Therefore, the BSE Solar Power Project (the Project) is initiated by BSE to enhance its green energy business and fulfill its vision of Greenergy Excellence. The Project will consist of two adjacent solar power plants operating as single complex, one with a net alternating current (AC) output of 8 megawatt (MWac). The two plants will sell their outputs to PEA. The project's 16MWac (8 MWac x 2) solar generation project would generate renewable energy under the VSPP program (<10MW). The site that has been identified by Bangchak is approximately 257 rais (41.12 hectares).

1.2 Financial Requirement

BSE on behalf of BCP has requested the Asian Development Bank (ADB) to finance the Project on a corporate basis. ADB classified the Project as environmental category B and BSE with assistance from an environmental consultant prepared this Initial Environmental Examination (IEE) to meet the Project's environmental assessment requirements following ADB's Safeguards Policy Statement (2009). This IEE covers the assessment of the solar power plants' significant environmental impacts and identification of the most appropriate mitigation measures based on the environmental aspects in the plants consultant's site visit in February 2012. The scope of the IEE also

includes a review of BCP's corporate policies and operational framework for environmental and social management. The IEE concludes that the proposed project will not have significant environmental and social impacts. BSE is fully committed to its environmental and social responsibility and discharges this responsibility in adherence to principles of good corporate governance.

1.3 Policy, Legal and Administrative Framework

Environmental Impact Assessment or EIA is not required for solar power projects in Thailand. However, environmental aspect was reviewed in the project feasibility study report and BSE held a public consultation meeting on 18 April 2011 as required by the Thai constitution.

1.4 Project Benefit Expectation

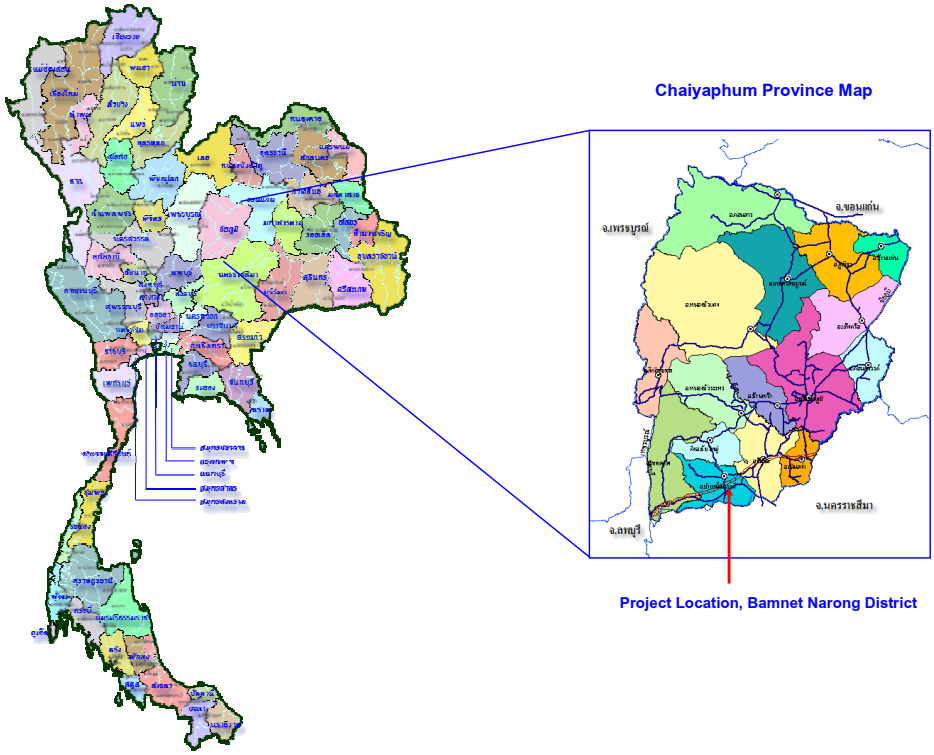
- To increase the energy supply security in Thailand
- To reduce imported energy fuel for power plant
- To increase and contribute the fund of community development and local taxes to develop the different activities in the community
- To reduce CO_2 emissions around 15,000 tCO_2/year from the overall power plants in Thailand.
- To be solar energy learning for youths and community
- To create jobs for community in long and short terms.

2 Project Description

2.1 Project Location

The Project will be located approximately 15.421' N and 101.698' E at Moo 15, 23, Khumping – Nongkok Rd., Baan Phet Sub-district, Bumnet Narong District, Chaiyaphum Province in Northeast Thailand. The project location is shown in the *figure 2.1*

Figure **2.1** **Project Location**



2.2 Scope and Layout

The project will construct and operate solar power plant, control building and other supporting area approximately 411,200 m^2 (257 rais). This project site locates on highway number 205 and was the paddy and cassava farm in the

previous time. Nowadays, this site is also clear and be a pasture for the cattle as shown in *Figure 2.2 and 2.3*

Figure 2.2 Project Layout

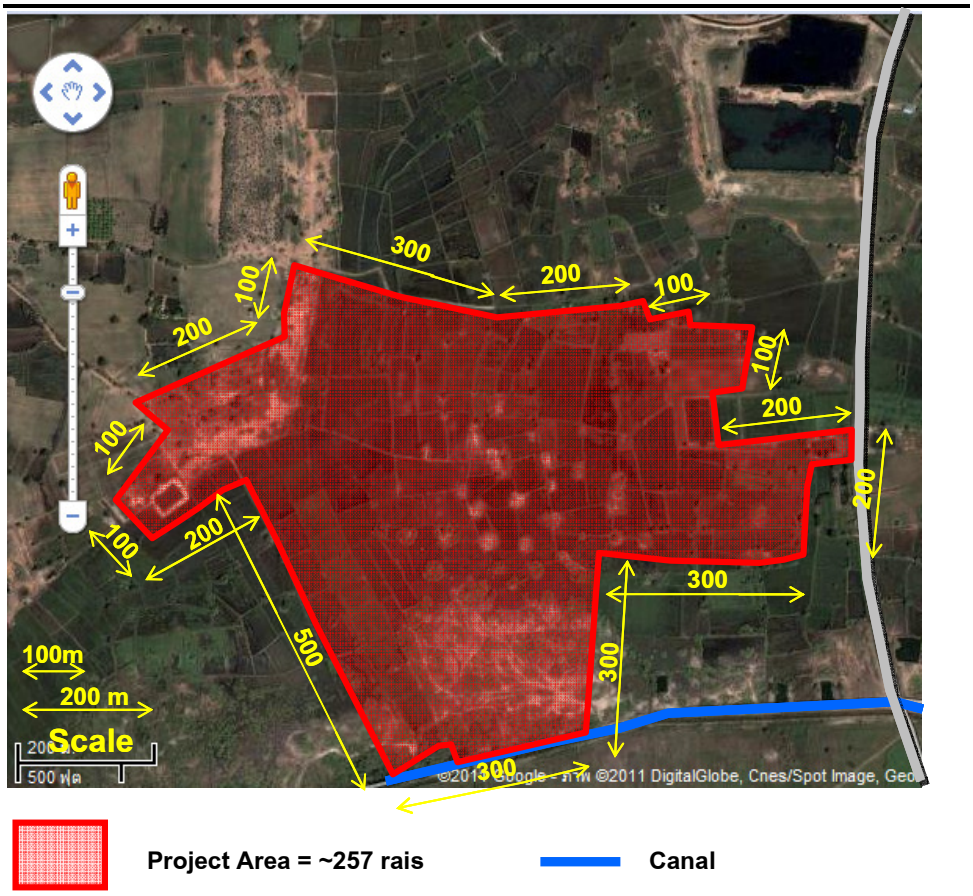
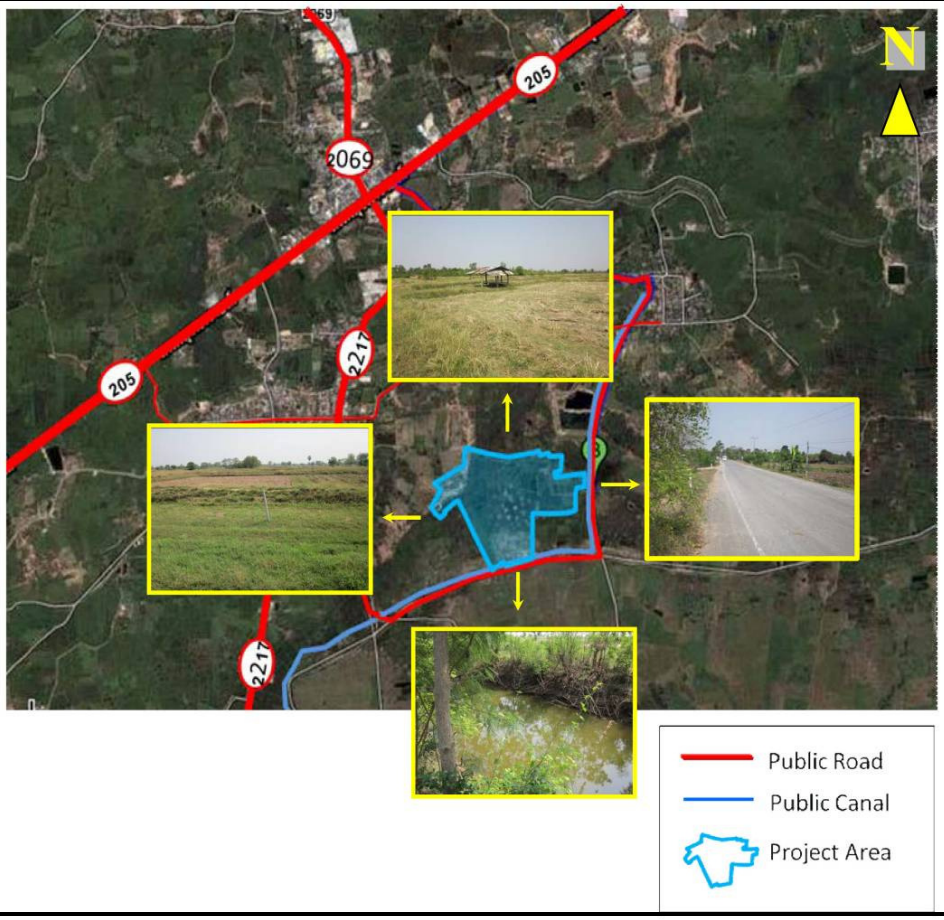


Figure 2.3 Project site (Construction Phase)

The nearby area of the project site shown as *Figure 2.4*

North	Nearby the old paddy
South	Nearby small canal (called “Mueng Naam”)
East	Nearby the concrete road in the community
West	Nearby the old paddy

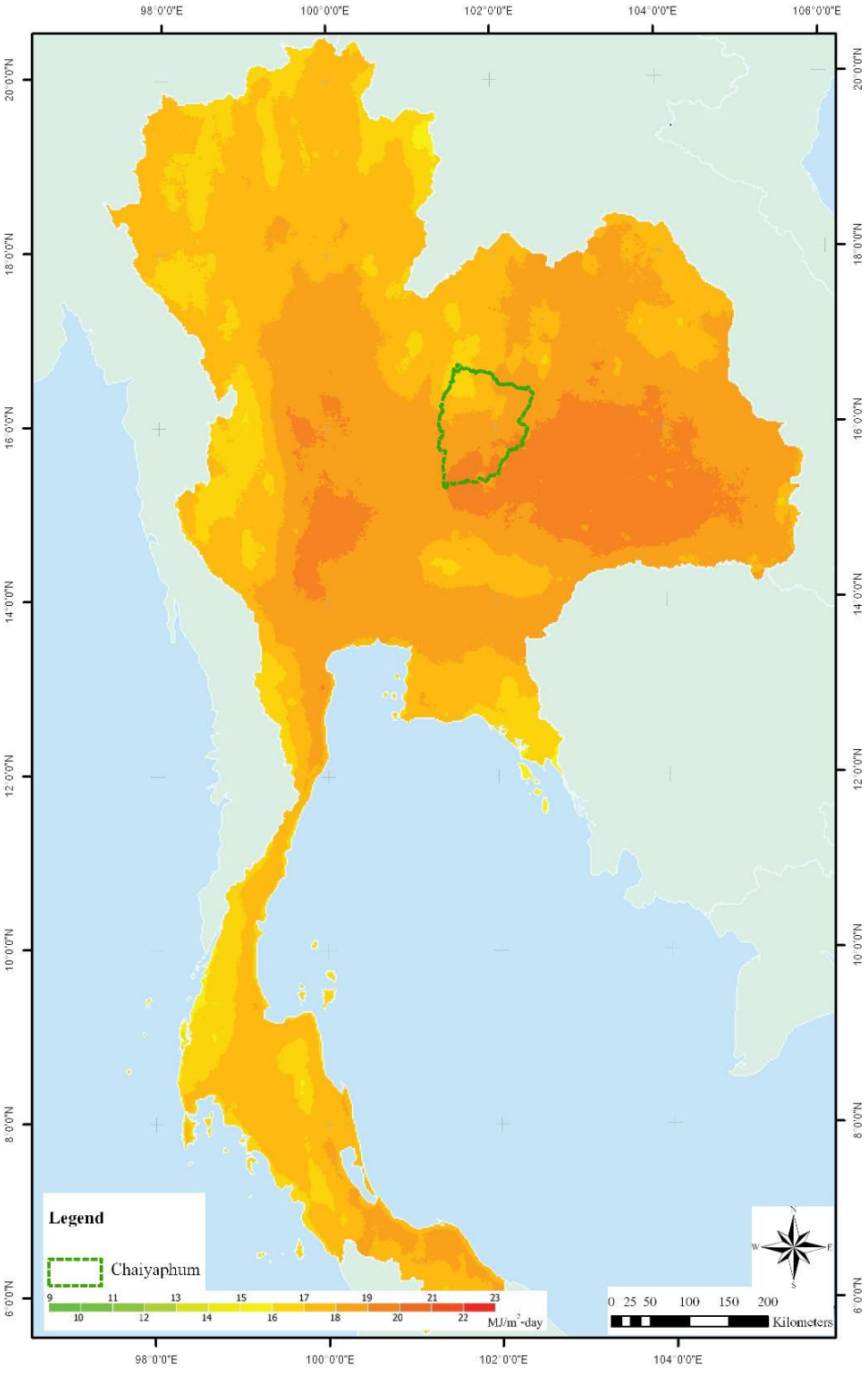
Figure 2.4 Physical environment of the project site



2.3 Project site consideration

BSE considered the location of the BSE Solar Power Plant project at Chaiyaphum, Thailand due to the solar energy potential in North-East area refer from Department of Alternative Energy Development and Efficiency shown as *Figure 2.5*. Chaiyaphum locates in the North-East of Thailand and also has high solar radiation which is normally over 18 MJ/m^2-day especially the Bamnetnarong province located in the South of Chaiyaphum. This global radiation in this province is also over 21 MJ/m^2-day as a result this area meet the qualification of BSE Solar Power Plant and can generate the electricity with the high potential.

Figure 2.5 Average annual solar energy potential map



2.4 Construction

This project site area is approximately 411,200 m^2 or 101.58 Acre (257 rais) and can be classified the land use as *Table 2.1*

Table 2.1 The Land use in project area

		Area		
	Type of land use	**M^2**	**Rais**	**Acre**
1	Solae cells installation	164,437	103	40.71
2	Spaces between rows of solar panels	64,377	40	15.81
3	Water pond	12,800	8	3.16
4	Other	169,586	106	41.89
	Total	**411,200**	**257**	**101.58**

2.5 Installed equipments at site construction

The BSE Solar Power Plant at Chaiyaphum, Thailand consists of 2 adjacent solar power plants generating 25 MW of the electricity capacity (12.5 MW each). The number of Poly Crystallines is approximately 42,380 panels in each solar power plant which will be installed in this site construction (total 2 plants around 84,760 panels). All of facilities and equipments will be deployed in this site construction which can be concluded as below.

- Solar Panel

The type of solar panel is Poly Crystalline which has 25 years of the life cycle. The qualification of this project has shown as below.

Table 2.2 The qualification of Solar Panels using in the project

List	Qualification
Power Output (Pmax)	295 W
Optimum Operating Voltage (Vmp)	36.5 V
Optimum Operating Current (Imp)	8.09 A
Open Circuit Voltage (Voc)	45.3 V
Short Circuit Current (Isc)	8.57 A
Module Efficiency	15.2%
Operating Module Temperature	-40 to 85 ˚C
Maximum System Voltage	1000 V DC (IEC)/ 600 V DC (UL)
Maximum Series Fuse Rating	20 A

The main rationale to choose Poly Crystalline shows as following

- This technology life cycle is over 25 years thus it can be ensured that this can generate electricity as long as the economic life of the project.
- This technology is more suitable than Solar Thermal Technology for climate in Thailand
- The using space of this technology is less than Thin Film

- Inverter

The specification of central inverter in this project is 500 kW -800 kW. The inverters shall conform to IEEE 929 and / or IEC 62103 2003-07 standards. The inverter shall at a minimum the protection function as per PEA's synchronizing code (year 2551)

- The supporting solar panel structure

The Galvanize Steel is the main material of the solar panel supporting structure and its inclination is 15^{O}.

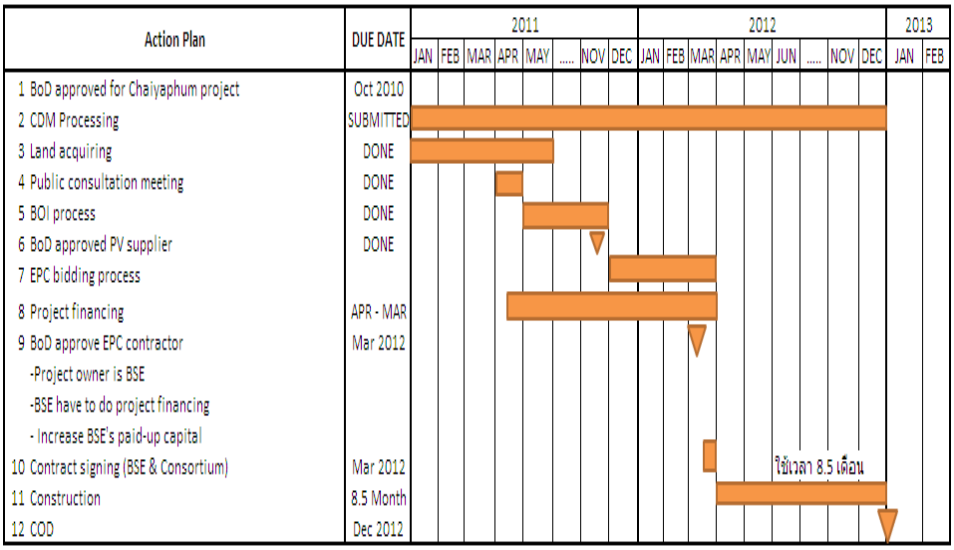
- Electrical equipments

- The specification of ONAN transformer is 22kV and the transformer type is oil type. The number of transformers is also half of inverters.
- The specification of switchgear is 22 kV as PEA standard.

- *Control building*

There is one control building in the project site to control the operation in this project.

2.6 PROJECT SCHEDULE



3 Description of Environment

3.1 Physical Environment

This project site is at Chaiyaphum which has a humid and tropical climate characterized by 3 seasons. There are high temperature in hot season and low temperature in cool season. However, the period in each season is not in the exactly time in every year.

(1) Hot season from November to February

(2) Cool season from March to May

(3) Rainy season from June to October

The terrain is mostly mountainous. Petchaboon range has a long stretch of the east and Dong Phaya Yen range has also stretch of the south-west. This is an obstacle of the wind of south-west monsoon influence thus this leads to the less rainfall in the rainy season. Chaiyaphum located in the rain shadow especially the north-west and west areas reference from Chaiyaphum climatological data for period 1982-2011. In addition, the meteorological department said that the average Chaiyaphum rainfall in period of 1982-2011 is approximately 96.3 milliliter per year and the average temperature is 27.2 Celsius.

3.2 Biological Environment

The project site is not located in or near a sensitive ecosystem. An ecological survey of the project site on 9 February 2012 confirmed the absence of unique or ecologically significant flora and fauna. However, there is no the nearest significant specific protected area to the project site. The previous surrounding area was the agricultural area particularly paddy and cassava farm and the products depend upon the rainfall. Nowadays, this area becomes to a pasture for the cattle.

Moreover, there is the natural canal in the south of this project site as shown in *Figure 3.1*. This canal is also the main water resource for community farming which is around this site project.

Figure 3.1 Natural canal (Mueng Naam) nearby south of the project area

3.3 Socioeconomic Environment

The project site is located in the jurisdiction of Baan Petch Tambon Administrative Office (TAO). Baan Petch has a total population of 9,722 people (4,899 of male and 4,823 of female) and 3,075 households in 23 villages (As of 30 September 2011). Also, this community located close to the project site as shown in *Figure 3.2*.

Figure 3.2 Baan Petch Community

The Chaiyaphum economic depends upon the agriculture, wholesale and retail trade sectors. The Most households earn income from farming and others such as government officer, private officer and trader. The average income per year is roughly 27,869 Baht per person.

3.4 Historical and Cultural Value

The project site and the surrounding areas have no important historical and cultural sites. There are only 9 temples (Wat) in Baan Petch area (The secondary data from Baan Petch Administrative Office), named are: Wat

Ampawan, Wat Petch Don Yang, Wat Cok Sawang, Wat Pa-Nong-Kok, Wat Petch Wisayaram, Wat Thong Kam Ping, Wat Baan Kloi Samakkee, Wat Sarasong and Wat Nong Waeng.

The project site and the surrounding areas have no important historical and cultural sites.

4 Anticipated Impacts and Mitigation Measures

4.1 Impact During construction phase

The civil, mechanical and electrical works will be minor and will spread over the large project site. Considering the nature and magnitude of construction works and the ecological insensitivity of the project site, it is certain that the construction would create only minor and manageable environmental disturbances such as noise from trucks and excavation equipment, with insignificant impacts on the nearby communities and the natural environment. No toxic and hazardous materials will be used in the construction apart from diesel oils for vehicles, which will be properly stored. The construction contracts will require the EPC contractors to be responsible for undertaking effective measures for environmental impact mitigation. Environmental performance of the EPC contractors will be monitored by the BSE project manager.

4.2 Impact During Operation phase

The solar power plant does not create noise and gaseous emissions during operation. On the operation phase the project is required water for cleaning the surface of solar panels form the ground water approximately 15 cu.m./day. The deep well for pumping the ground water would be allocated in the project site area near the control building. A volume of wastewater would be daily generated from washing dust from surface of the solar panels. This wastewater is collected and stored in concrete tank of 60,000 cubic meters and places in the south of project site as shown in *Figure 4.1*. Only after the wastewater is treated, and tested to meet Thai standards for wastewater. It will be diverted to the canal for any use by the community for farming purposes.

Figure 4.1 Space for concrete tank

Not more than 10 staffs for operation and 40 staffs for maintenance such as PV surface cleaning. Domestic wastes generated by this small number of people could be readily handled by a septic tank system.

The potential impacts could be visual and reflection. However, as the project site and the surrounding areas provide no significant aesthetic value, the sights of a large area covered with solar PV panels will have no visual impact. With the old design of solar PV arrays, reflected sunlight may cause problems if the system is close to a road and is facing in a direction which the reflected sunlight may cause problems. This problem will not occur in this Project as its surface of solar PV panels is designed to absorb sunlight and minimize sunlight reflections. Though the reflection problem will not occur because of the panels designed to absorb sunlight.

4.3 Decommissioning

The Project's solar PV panels are expected to have an economic life of 25 years. If the PV panel is breaking down and can not be recycled, it will be removed outside the project by the suppliers. Moreover, the supplier has to request the permission form Chaiyaphum industrial office.

4.4 Social impact

The area of BSE Solar Power Plant is 257 rais and was used to be agricultural area. The type of soil in project site is sandy soil thus the hygroscopic property is not good which leads to a small number of agricultural products. Consequently, people in the community sold their areas to BSE with willingness to develop this project. There are no indigenous peoples living near the project site. Therefore, the Project has no resettlement and indigenous people issues. The Project is therefore classified as category C for both involuntary resettlement and indigenous peoples by ADB.

5 *Public Consultation and Grievance Redress Mechanism*

BSE organized Public Participation in 2 levels

- Public Participation Engagement held on 4 and 11 April 2011
- Public Participation Meeting held on 18 April 2011

Public Participation in this project can be concluded as below

5.1 *Public engagement*

Public Engagement of BSE project was occurred 2 times on 4 and 11 April 2011 at Baan Petch Tambon Administrative Office, Bumnet Narong district, Chaiyaphum. The objectives of Public Engagement can be shown as following.

- Identified the stakeholder in this project
- Preliminary survey on the implementation of the project to improve the fit of the meeting to receive comments from stakeholders.
- Preparation of the project to the attendees Public. Participation Meeting held on April 18, 2554.

The Public Engagement attendees totaled approximately 48 people including 18 of Baan Petch Tambon Administrative Officer (37.5%) and 30 of Baan Petch village committees (62.5%) as shown *in Figure 5.1*.

Figure 5.1 Public Engagement held on 4 and 11 April 2011

This meeting can be concluded that people in this community knew about the operation of this project However, the solar power plant is new technology in this community and no more information was published thus the information of environmental impact was not clear. Therefore, the community leaders and

community agents will pay an attention to participate in the Public participation meeting which held on 18 April 2011. Then, the community leaders and community agents will communicate to people in community later.

The final comment after BSE Public Engagement can be concluded that the details of this project should be explained more as following.

- The impact of project construction to the nearby community
- The waste water from cleaning PV panels and equipments or chemicals used to clean PV panels.
- Other environmental issues

5.2 Public participation meeting

BSE organized the Public participation meeting relating to solar power plant on 18 April 2011 at Thong Kom Ping temple in Baan Petch community. BSE also invited representatives from various departments of government. Consequently, the community leaders and people in Baan Petch community attended in this meeting.

The Kyoto protocol and procedure of solar electricity generation were clarified in beneficial term of this project in BSE Public participation meeting. Moreover, environmental impact in nearby community was also explained in this meeting. Then, the attendees can comment and ask questions in this meeting after that BSE will give more explanations.

The objectives of Public participation meeting

1. Project description
2. Describe the impact of global warming and the essence of the Kyoto Protocol.
3. Describe the relationship between the Clean Development Mechanism projects.

4. Describe the environmental impacts arising from the project.
5. Open the opportunity to ask the question relating to project

There are 200 participants in this meeting including representatives from government agency, local government agency, Non-Government Organization (NGO), institutions and community leader (*Figure 5.2*).

The result of meeting can be concluded as following

- 92 percentage of attendees agree with this project
- 68 percentage of attendees understood solar power plant project after meeting

The summary of consultation issues raised by stakeholders and response by BSE is shown in the table 5.1

Table 5.1 Summary issues raised by stakeholders in the Public Meeting

Issues	**Response**
Do the project have sun glare?	The panels design to absorb most sun light and the reflection will very low.
Do the panels contain Cadmium Telluride?	No, BSE would not choose the panels with contain Cadmium Telluride.
Will it affect the rice and their farms from the light of the solar power plant?	No, the power plant will absorb the incident light on the area.
What the community will receive from the project?	- Project will hire local people to clean panels during operation. - Project will support the surround power plant community fund.

Figure 5.2 Public participation meeting held on 18 April 2011

5.3 Grievance Redress Mechanism

There are at least 3 channels for environmental complaints i.e. website, call center and telephone. The most effective channel for response is by telephone because the contact can be made anytime and is two-way communication. No matter which channel is, the responders from the environment and community relation division (ECD) firstly obtain the information from the complainer as much as possible to identify source of the problem and inform operation division. When the operation receives the information from ECD, they will find out if the complaint is caused from their operation. In case “yes”, they will fix the problem or stop their operation. After that, the operation will call back the ECD staff for the situation so that ECD staff can communicate to the complainer as soon as possible. Moreover, ECD staff will also meet the complainer at site for better understanding and curing his/their feelings and inform them the progress of mitigation measures from time to time until the problem has been solved.

6 Environmental Management Plan

6.1 Environmental management System

6.1.1 Policy and Scope of Management

BSE on behalf of BCP could be considered as a Green corporate since its Board, Management and employees are firmly and fully committed to "working towards sustainable business development in harmony with the environment and society". This commitment covers safety, health, environment and energy saving (SHEE) and is adopted as SHEE policy for guiding BCP's business operations and SHEE management. BCP's environmental commitment extends to global warming. The current environmental stance of BCP is clearly reflected in its vision "Greeneregy Excellence" and its long term goal to become a "Zero Global Warming Impact Company" or "Carbon Neutral Company".

The SHEE policy commitment drives BCP to strive to achieve its business objectives and targets with no compromise on its responsibility toward society and the environment with strict adherence to the principles of good corporate governance. To implement the SHEE policy, BCP institutionalizes SHEE management to ensure that its business decisions and operations will not compromise: (i) safety and health of its employees, contractors and the public; (ii) environmental quality; (iii) its reputation; and (iv) transparency for public audit and participation. To achieve and maintain the SHEE policy, the SHEE management focuses on three major areas that direct to the outcome: (i) Operation Excellence Work processes, (ii) Standard and quality of Equipment & Instrument, and (iii) Establish SHEE policy in Employees' behavior.

During the project construction phase, the SHEE Management will be monitoring and control the construction to ensure that the SHEE policy will be performed. After the project commissioning, the project's SHEE person will be required to present and perform at least, as a member of SOT (Safe Operation Team), OTM

(Operation Team Meeting) in the SHEE management Structure. Consequently, the SHEE policy will be aligned and deployed to the project seamlessly.

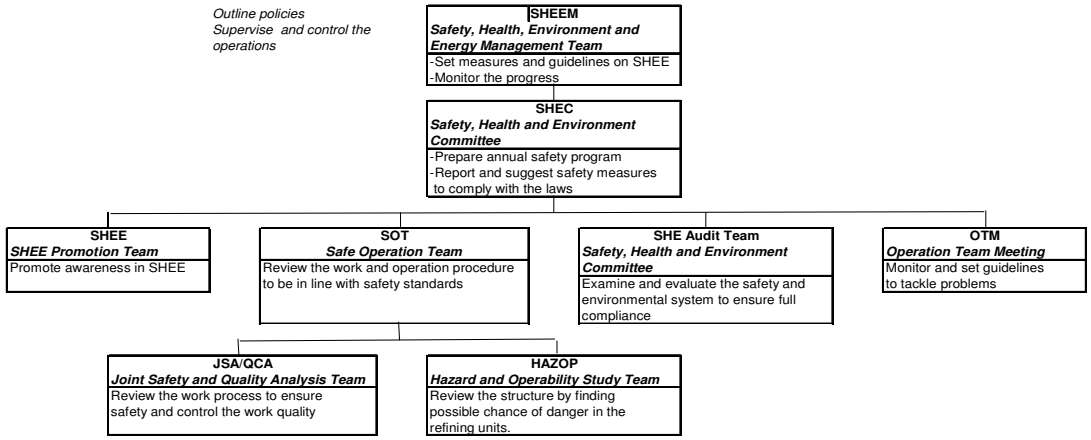
6.1.2 Safety, Health Environment and Energy (SHEE) Management Structure

BCP implements its SHEE policy through a SHEE management system that assigns direct responsibility to all executives and employees, as well as contractors working on behalf of BCP, to ensure that they will:

- work safely, creating no undue impact on themselves, related parties, the community and the environment;
- observe all occupational safety, health, environmental and energy-related laws;
- prevent oil pollution, spills and losses; (Incase Refinery plant of BCP) This item will not take in to solar power plant of BSE because there are not any source of oil pollution for solar power plant technology
- prevent all accidents and illnesses; and
- use production resources to their best value in the most efficient and effective manners.

BCP have prepared SHEE Management Structure due to successful in SHEE Management. The SHEE management structure involves all executives and organizational units, and consists of policy and operation control teams as shown in a diagram in *Figure 6.1*

Figure 6.1 SHEE Management Structure



SHEE Management Structure's responsibilities are:

- Safety, Health, Environment and Energy Management Team - SHEEM

  SHEEM consists of senior executives from all business units. It formulates corporate policies and guidelines for safety, health, environment, and energy. It also revises safety, health, and environmental management systems, continually provides supports to develop SHEE operations, and appoints task forces to ease the efficiency and effectiveness of safety, health, environmental, and energy-related management.

- Safety Health and Environment Committee-SHEC

  This committee consists of representatives of employees. It delivers performance required by law. This team works jointly with the subcommittee on safety at the operational level to make operations safer.

- Safe Operation Team - SOT

  The SOT consists of all line operation managers. It revises designs, procedures and operation as endorsed by the Job Safety Analysis (JSA) & Quality Control Analysis (QCA), Hazard and Operability (HAZOP), and Engineering Quality Team (EQT) taskforces to ensure compliance with safety standards.

- Safety, Health, Environment and Energy Promotion Team - SHEE P

  This team is responsible for promoting safety, health, environment, and energy awareness amongst employees, through various participatory activities.

- JSA & QCA Task Force

  This task force is responsible for scrutinizing work procedures for safety and quality control.

- HAZOP Task Force

  Relying on HAZOP techniques for safe applications, this task force scrutinizes designs of refinery piping systems, equipment, and tools so as to comply with technical principles and the Company's engineering standards.

- EQT Task Force

  It is responsible for building and controlling the quality of designs to comply with design standards.

6.2 Occupational Health and Safety Performance and Risk Management

BCP's occupational health and safety system is certified TIS 18001 No. OHS00007/007 and OHSAS 18001 standards.

BCP runs its business operations with the utmost concerns on environmental risks and safety. In this regard, BCP strictly complies with all related laws and regulations, undertake risk assessment for all stages of work, implement

appropriate risk management measures, regularly carries out equipment maintenance, establish emergency plans and periodically conduct emergency drills among related parties to ensure their ability to handle emergencies with minimum impacts. Such high standards of operational risk management and preparedness for emergencies have earned for BCP several awards for operation and safety standards.

BCP accords high priority to the management of the following risks:

- Risk from refinery location, its environment and safety conditions:-As the BCP refinery complex is located in the suburb of Bangkok Metropolitan area, BCP therefore gives utmost importance to environmental and safety controls of the refinery operations to ensure insignificant environmental impacts and minimum risks to the surrounding communities.
- Risk from sabotage or accidents during transportation of crude from sources to the refinery
- Risk from accidents during transportation of refined products to customers
- Risk from accidents involving the oil pipeline belonging to Fuel Pipeline Transportation Company Limited (FPT)

6.3 Training

BCP institutionalizes regular training in of its personnel in various subjects to support its SHEE management and operations. In addition to on-site safety training for employees. The center conducts regular training on safety, including elementary and advanced fire-fighting techniques, emergency command, and fire evacuation drills for employees and external parties. In 2011, BCP held a total of 34 courses for 1,360 persons but BSE have 1-2 training course on 2011 from some importance electrical equipment technology and operation training course from EPC contractor.

6.4 EMS Audit

BCP is accredited ISO14001 for its environmental management system (EMS). The EMS is annually audited. The last audit was made in July 2011 by Anglo Japanese American (AJA) Registrars Co.Ltd.,- a certified auditor for ISO standards. The Auditor found the EMS fully met the requirements and no corrective action requests were made. Of note are the recommended area that can be more improvement such as ensure the condition of chemical spill, MSDS on work place to cover necessary environmental data and pollution control of tank repairing.

6.5 Emergency Response Processes

BCP has emergency plans for fires accident and chemical spill, radiation leak, gas leak and earthquake. The plans are tested annually. For example, the fire plan was tasted on December 12, 2011; acid gas leak plan on November 21, 2011; oil spill plan on May 6, 2011; and ammonia leak test on May 5, 2010 and NaOH leak test on March 20, 2011. All plans cover environmental recovery and all supporting equipment were checked and found to fully comply with required laws and regulations. In the other hand BSE is owner and operator of solar power plant that is supreme friendly environmental technology by the way BSE design to install electrical equipment protection such as switch gear, main board switch or other to cut off operation when there are any force majeure such as earthquake, flooding or short circuit in system (un-plan).

6.6 Social management

6.6.1 Policy and Scope of Management

BCP has no explicit policy statement on social management. However, its social commitment is integrated with its SHEE policy of “working towards sustainable business development in harmony with the environment and society”. The BCP Board ensures that the principles of good corporate governance are strictly adhered to in BCP’s business operations. The commitment to social responsibility is one of the principles and practices of good corporate

governance. BCP's social commitment is clearly reflected in its corporate social responsibility (CSR) activities and its dealing with communities around its refinery complex. BSE will survey community around solar power plant then will select some CSR activity from BCP experience that match with community requirement to do in CSR program in the future

6.6.2 Involuntary Resettlement

Involuntary resettlement is not an issue in BCP's operations and the Solar Power project in Chaiyaphum Province. BCP has no authority to appropriate land. If BCP requires land for its business, such as service stations and production facilities, BCP will have to purchase land from owners on a willing buyer-willing seller basis. Selling prices will be based on prevailing market prices satisfactory to the sellers. Land procurement will follow normal procurement procedures of BCP. For example, BCP would advertise an advertisement for land requirement in a specific area. Interested land owners would propose their land to BCP for consideration. BCP would then negotiate with the owner of land that meets BCP's requirements to reach an agreed price. Alternatively, if a small land plot is required, BCP may not advertise to invite land proposals, but opts to directly negotiate with the owners of identified land plots.

6.6.3 Indigenous Peoples

Indigenous peoples in Thailand live in remote provincial areas, particularly along the border areas. This issue is not relevant to BCE as its businesses are not in remote areas.

6.6.4 Social Protection compliance

The BSE, including its contractors, will comply with applicable national labor laws in relation to the Project, and take the following measures to comply with the core labor standards [(1)] for the ADB financed portion of the Project:

(a) carry out its activities consistent with the intent of ensuring legally permissible equal opportunity, fair treatment and non discrimination in relation to recruitment and hiring, compensation, working conditions and terms of employment for its workers (including prohibiting any form of discrimination against women during hiring and providing equal work for equal pay for men and women engaged by the BSE);

(b) not restrict its workers from developing a legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment;

(c) engage contractors and other providers of goods and services:

(i) who do not employ child labor (child labor means the employment of children whose age is below the statutory minimum age of employment in the relevant country, or employment of children in contravention of International Labor Organization Convention No. 138 'Minimum Age Convention" (www.ilo.org)) or forced labor; (forced labor means all work or services not voluntarily performed, that is, extracted from individuals under threat of force or penalty)

(ii) who have appropriate management systems that will allow them to operate in a manner which is consistent with the intent of (A) ensuring legally permissible equal opportunity and fair treatment and non discrimination for their workers, and (B) not restricting their workers from developing a legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment; and

[(1)] the core labor standards are the elimination of all forms of forced or compulsory labor; the abolition of child labor; elimination of discrimination in respect of employment and occupation; and freedom of association and the effective recognition of the right to collective bargaining, as per the relevant conventions of the International Labor Organization;

(iii) whose subcontracts contain provisions which are consistent with paragraphs (i) and (ii) above.

6.7 Labor Practices

In Thailand, labor practices and welfare are governed by the Labor Protection Act, B.E. 2541, latest amendment in 2009, the Social Security Act, B.E. 2533, latest amendment in 1989, and regulations related to the two Acts. The Labor Protection Act covers all labor issues such as child labor, use of woman labor, welfare and benefits of labor, wages and compensation, grievance redress, e.t.c. The Social Welfare Act covers obligations of employers to contribute to the social welfare fund.

6.7.1 Employment

BCP strictly complies with all relevant laws and regulations. All of its 1,032 employees and employees of its contractors are older than 25 years old. There is no discrimination concerning privileges and rights against either gender. Receiving due pays, all employees are eligible to become members of “Bangchak Petroleum Plc Provident Fund” by choosing to contribute either 5% or 10% of each month’s salary, to be matched by the Company.

As for employees of the contractors, BCP requires each contractor to treat their workers properly as required by all relevant laws and regulations. This condition is stipulated in the contracts. Failure of the contractors to comply with this contractual obligation could result in contract termination.

For the employment issue, BSE will hire labor for developing the project. The number of workers that BSE will be employed during construction as the detail in the table 6.1

Table 6.1 Number of workers employed on the Project in Chaiyaphum Province.

Item	Amount
Site Development	50
Building Construction	70
EE and ME Work	60
MV Work	20
Mounting Structure and Module Installation	100
Total Workers	**300**

From the detail in the table above, estimated local workers 50% of total workers

6.7.2 Employee Relations

To ensure a happy workplace where satisfaction and synergistic cooperation prevail, BCP continually promotes cordial relations among its employees, as well as between employees and the Management, through assorted activities embedded with virtue and awareness among employees, the Company, and society in general.

6.7.3 Bangchak Petroleum Labor Union

BCP has a labor union with about 20% of the workforce joining the union. BCP's good labor practices and welfare result in satisfied personnel. The staff turnover rate of BCP in 2011 was 3.58% compared with 3.83% in 2010.

6.8 Community Participation and Social Development

BCP is active in community participation and social development undertaken under its corporate social responsibility (CSR) program. Its CSR projects focuses on involving and supporting communities and schools around its refinery complex in sport events, informal education, strengthening the family institution, energy conservation, environmental management, cultural conservation, and community safety. Examples of BCP's community supports include: provision of scholarships to students; renovation of temples, community library and children playground; mangrove plantation in Samutprakarn Province, and optometric services. In

addition, BCP supports community development in some provinces through helping to sell community products in its service stations countrywide.

6.9 Environmental Impacts Mitigation Plan

BSE is responsible for the implementation of the Project, including all environmental management and monitoring activities during project design, construction and operation. BSE's duties and responsibilities will include acquiring all necessary approvals and permits and compliance with permit conditions and other statutory and/or legal requirements, and supervising and monitoring the implementation of environmental measures by the EPC contractors.

The EMP including an environmental measurement and monitoring plan has been prepared and presented in *Tables 6.1 and 6.2* The EMP will ensure that the environmental impacts of the Project will be avoided or minimized through the proposed mitigation measures.

The supervision, evaluation, and reporting of activities implemented as per the EMP will be carried out strictly and punctually to provide feedback to the ADB Project management team.

Table 6.2 Environmental Management Plan on BSE Solar Power Plant, Chaiyaphum Province

Aspects/Impact	Mitigation Measure	Time Frame	Responsibility	
			Implementation	Supervision
Construction Phase				
Air and Noise Pollution				
- Dust from truck to be area	The material covered on / off the truck into the project area.	During operation	contractor	BSE
- Noise from Truck and Crane noises	- Not required due to working in remote area - Machines noise level not more than 85 dB(A) at avg. 8 hr	During operation	contractor	BSE
- Velocity of transportation	- Limit speed of trucks transportation not over 60 km/hr in logistic - Limit speed of trucks not over 30 km/hr in project area	During operation	contractor	BSE
Waste and Wastewater				
- Domestic waste from workers	- Provide the container from job adequately - Coordinate with Baan Petch Tambon Administrative Office to collect and transport waste	During operation	contractor	BSE

			Responsibility	
Hazardous waste such as lubricant and grease.	- Provide container and space to collect - Coordinate with Baan Petch Tambon Administrative Office to collect and transport waste or recycle waste	During operation	contractor	BSE
- Wastewater from workers	Provide treatment system of Domestic wastewater adequately.	During operation	contractor	BSE
Occupational Health and Safety: - Working with trucks and piling cranes - Building Construction maximum 2 storey - High voltage work	- Provide Safety Manual - Provide Safety Plan - Provide Safety Equipments - Supervision and Inspection - Protection gears - Provide a basic sanitary system in construction site adequately and comprehensively, such as clean water for drinking, water for washing and toilets	- Land filling and Civil work 5 months - Building construction 3 months - Commissioning 0.5 month	contractor	BSE
Transportation of equipment and construction Materials: Falling earths from land filling truck	- Truck wheels cleaning - Road cleaning	During operation		
Operation Phase				
Air and Noise Pollution				
- No dust and Noise	-	-	-	-
- Velocity of transportation	- Limit speed of transportation	During operation	BSE	BSE
Waste and Wastewater				

			Responsibility	
- Domestic waste from specialist and project's officers	- Provide the container adequately - Coordinate with Baan Petch Tambon Administrative Office to collect and transport waste (no waste left)	During operation	BSE	BSE
Hazardous waste such as engine oil, lighting, grease and PV panel waste	- Provide the container clearly - Coordinate with Chaiyaphum Industrial officer to get a permission to transport hazardous waste to outside project site - Coordination with agencies / companies that are licensed transportation and disposal of the Department of Industrial Works.	During operation	BSE	BSE
- Wastewater from office/control room	Provide sufficient treatment system of Domestic wastewater effective.	During operation	BSE	BSE
Wastewater from cleaning PV	- Construction of the 60,000 cubic meters of concrete tanks for water storage, collection and clean up PV panels without releasing it outside the project area.	During operation	BSE	BSE

			Responsibility	
Drainage and flood protection.	- Construct the ridge height approximately 2 meters from the project area around that place. (Project area height 207 meters from MSL). - Develop a system to collect rain water within the project area. - Dredging the drainage system regularly to prevent blockage and shallow.			
Occupational Health and Safety	- Provide Safety Manual - Provide Safety Plan - Provide Safety Equipments - Supervision and Inspection - Provide Annual health check up for all specialist and project's officers	During operation	BSE	BSE

Table 6.3 Environmental Monitoring Plan on BSE Solar Power Plant, Chaiyaphum Province

Monitoring parameters	venue	Frequency	Responsibility
Monitoring Parameters of wash water PV panel - pH - Temperature - Total Suspended Solid - BOD - COD	Concrete tank for water storage	Monthly	BSE
Surface water quality - pH - Temperature - Total Suspended Solid - BOD - COD - DO	Canal (Nearby South of project area)	Monthly	BSE
Transportation Record the car in project area for use in planning and traffic safety.	Project area	Daily	BSE
Medical check up	New staff	Before working on the project	BSE coordinate with local care unit in the community
Annually medical checkup	All staffs	Annually	BSE coordinate with local care unit in the community
Record the accidents clearly such as cause, effect, loss and corrective action.	Project area	Every time an accident	BSE

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