

A.3 Project Operation & Maintenance Stage

Reference to the requested contract of the company submitted to the Royal Government of Cambodia for the period of project operation & maintenance is the longer stage with 40 years. The project activity within this period is likely to have very main negative impacts on environment in the followings:

- Can impact on the system irrigation of Cheay Areng river and down stream due to blocking water for increasing to be enough power to generate alternator with 108 Megawatt and not enough draining from Site A dam may effect the water level of Cheay Areng river which is located between the dam and House power. Moreover; to keep water in the deep basin with large surface of water will make much absorbent into the soil. This can increase the level of water in the ground down stream is higher than its usualness and can harm cropping, other plantations and can lead to be irregular water level of Tra Pang Rung because of not enough drainage from the basin; especially, it will make the salty level of Tra Pang Rung water increasing than before and eco-system of this canal can be effected.

- Can effect the water quality on the ground due to keeping water in the basin for generating 3 alternators, total power is 108 megawatts. 9 474 hectares with crop, plantation and forest will be flooded. Underneath plant with chemical and organism element will be rotten. Dam with 36.6 m height can contain water from 15 to 25 m height and may pollute water to be bad smell because of the amount of oxygen melting in water is low. On the other hand, downstream will be effected when water is drained from the dam. Mineral melted in the soil causes to increase the chemical element water under the ground. This is because of keeping water in the basin and its absorbance from the basin water under the ground which consists of rotten smell due to the amount of oxygen in the water is low and makes the water quality under the ground decrease. Water polluted causes by the bed of the basin is washed, silt and sand are drained from the bed of the basin in the rainy season may cause the rotten smell and make the river polluted and effect on the user who are near by the down stream; especially, domestic animals, birds and wildlife animals that are living in and around the project area. Moreover, keeping water with such a huge basin, water plants will be born such as aquatic plants and hazardous insect such as mosquito, bacteria and various communicable diseases may cause from this water source.

- Also it can impact on wildlife's habitat because of the activities of the employees-workers enter the forest for hunting, snaring, and timber-wildlife trading. This can the forest and wildlife animals or lead to extinguish some of species. Meanwhile, land encroachment in or nearby the project area (where forest and habitats are conserved in the cardamom) from employees-workers and outsiders may decrease the natural resources and forest fire may happen nearby the project area because of employees-workers. Keeping water in the basin can harm crocodile's habitats such as in the TrorPangBusThom and TrorPangBusToch and also wildlife's and bird's that used to live there.

- With the lost of number of habitats in the basin area with 9474 hectares of the Hydro project will decline a great deal of wildlife animals in the CCPF. With Such a huge basin, some of the animals cannot navigate across; especially, the navigation of elephants in the project area as well as the dragon fish, Siamese crocodiles and their habitats. Entering the forest for hunting, snaring from the workers who operate and maintain the project can also effect on wildlife in this area such as declining some of the species or extinguish some of the species that are conserved by CI. After the project had been built, there would be various developments around the area and new comers from different places may encroach and live in there. Those kinds of activities will destruct natural resources and effect on biodiversity, irregular changes of breeding, finding food and migration etc.

- Base on interview and many fish picture presentations to the population who has experiences in fishing with their expression to reveal that in Cheay Areng river where the project area, there are about 43 kinds of fish living in that area include Dragonfish and Siamese crocodile which are rare species conserved by CCPF, CI. So, blocking the gate for keeping water in the basin of the Cheay Areng Hydro Project can have bad impact on Dragon fish, Siamese crocodile and other water species. Biology factor which badly impact on Dragon fish and other water species is their navigation across this Hydro Dam and nests of Siamese crocodile. Draining from the basin with lack of oxygen melt in water can impact to the factor biology of water species that are living this water. On the other hand, keeping water in basin of the Hydro project, water plants such as aquatic plants and hazardous insect such as mosquito, bacteria, decrease water species or no longer exist or new water species appear. Whereas water polluted by remaining liquid-hard element from where the staff-workers stay, from warehouse and from the workshops will also impact to water species.

- Project will impact on the culture and habit of the residence who live there. this is because the company hire the project workers from different places or foreign staff whose belief is not the same. This contradict belief cam impact to their belief in forest mountain spirit. They perform Spirit Forest for the place to respect and pray. Moreover, they respect and pray some of wildlife animals such as Siamese crocodile.

- Can impact on water using of people in the area of the downstream because bad quality of water in the basin and rotten smell from rotten plant and not enough oxygen in water. Controlling of remaining liquid and hard element, latrines which are drained from the office, staff-worker dorm, warehouse etc. can harm the water source of the project area. The Cheay Arent Hydro Project in Koh Kong province is the tourism coast of Cambodia. National an international tourists who wish to visit Areng Hydro Dam after completion of the project will be increase due to accessible facilities. The number of tourists increase in Cheay Areng may impact on water polluted the waste of liquid and hard element from those tourists.

- Transportation of the people may get bad impact such as blocking the paths that people used to use. According to narrow condition streets, jam and many cliffs, accidents may occur to tourists, residents and project staff/workers will increase. Keeping water in the basin, water plants may be born such as តើក ចក កំរោង សារាយ and insect, mosquitoes, bacteria or other insects that can cause communicable diseases from animals to human being;

especially, from waterborne diseases. Cardamom Mountain abounded with forest, cliffs; water stream can harm project staff/worker because this area is the area of malaria and feverishness. On the contrary, people in the project area may be speeded by HIV AIDS, sexual diseases, TB and other communicable diseases from staff/workers that are hired by the company from elsewhere. Draining the remaining liquid and littering may harm the people and public health due to the mismanagement.

It may have drug exploitation from the workers of the project which effects to the public health in the area.

- Will be able to increase the visitors and immigrants to the project area which cause waste disposal improperly from the visitors, local people, and the project workers and degrading the area view.
- Risks from the natural disasters such as earthquake, volcanic eruption, affected from the rain or storms caused by Typhoon, and other hurricanes from Thai gulf, may result disasters such as dam destruction, and important infrastructures especially injuring and dying the workers and the local people living in/nearby the project area. The pressure of water in the reservoir carrying 921 million cubic meter=921 million tons may cause earthquake, dam destruction, and mountainous land slide. Forest fire caused by neglecting or terror may result disaster/danger to the important infrastructures of the project, natural recourses in the area, and lives of the local people. Territory encroachment war into Cambodia and civil wars are the obstacle of the process and maintenance of the project; sometimes war may destroy the whole project.

A-4. Project termination

The project termination of Chinese Southern Power Grid Co., Ltd will take place after the contract between the government and the company finished. The royal government will be responsible to continue management, so project termination depends on the government itself, and hopefully during the step of project termination will remain no significantly negative impacts on environment.

B. Positive impacts

- Building dam site-A of the project in Koh Kong across Areng river, would help reduce one part of the big floods resulting from Typhoon storm in the Cardamoms. Trapaing Rong Channel area is always flooded from Areng valley nearly every year. Therefore the flood in the beginning of rainy season can be significantly reduced; the flood at the end of rainy season can only be reduced in small portion.
- Flowing water from Dam site-A to downstream $1.5\text{m}^3/\text{second}$ in the dry season results the segment Areng Valley from the dam to powerhouse carrying enough water to maintain biodiversity. Besides, Trapaing Rong channel has enough fresh water in dry season because of water flowing from the second turbine of about $52\text{m}^3/\text{second}$. The channel consisted about $15.94\text{m}^3/\text{second}$ in March stable

to the environment and also prevents the absorption of sea water from Kbal Chhay area.

- The huge amount of the reservoir could make suitable condition for conservation and increase fish stock in the Areng Valleys.
- Areng Valley hydropower project will produce about 108 MW and provide 610GWh or 81% of the whole electricity produced in 2005 (753 million KWh) including electricity imported from the neighboring countries, Thailand and Vietnam. Because the hydropower project will provide great amount of electricity as describe above, it will be able to effectively respond to the solution of electricity resource for Southwest and Northwest Cambodia in a medium period of time or it will double the amount of electricity compared to the 2005's (this project alone; not included the other projects).
- This hydropower project will provide stability in electricity supply to the factories, industries, households, public places, and developing the national economy to reduce poverty of the local people and the whole country as well as develop all fields in the country.
- The project will construct road infrastructures such as restoring the road from Thmar Bang district to Thmar Daun Pov commune, constructing roads and bridges to the new settlements, road to the power house, and the roads along the channels.etc. Beside the infrastructures for the public, the project constructs buildings for its workers, offices, gardens, and wastewater purification containers for the project's staffs and beauty of the whole project.
- Because of the effects of the project and its infrastructures, it may increase the price of land in the area higher than that today (2007) especially industrial, intensively agricultural lands, and tourism sites. Because of the infrastructures, the project would attract so many national and international visitors to the Areng Valleys and the nearby areas in the future, and this may result the whole Koh Kong becoming a main tourism for Cambodia.
- The project will provide jobs for Cambodians especially the local people in the construction process, and it plans to get 1,200 workers including Chinese technicians.
- The project will employ some Cambodian workers and technicians in the implementation and maintenance process.
- The project will make the income to Cambodian people especially the local community people via getting employed as workers during both construction and maintenance implementation. It will be able to increase the income of the local people due to national and international tourists visiting the Areng Valleys and also this hydro-power dam because of the impacts of its infrastructure and development.

- The Areng Valley hydro-power project will provide stability in electricity supply to all development fields including the use in household, city, agriculture, tourism, especially and small-scale enterprises and industries being a strong basis in developing national economy. This will especially insure the cheap price of electricity use.
- Although the hydro-power dam impacts the forests, wildlife, fish, and some people, but the company plans donate environmental protection and resettlements. Currently, EDC uses the generators powered by diesel to produce electricity. **គិតប្រើប្រេងម៉ាស៊ូត ១៣៧ លាន KWh ត្រូវជា ៨១.៣% នៃប្រេងឥន្ធនៈច្នៃ ៣១ លាន KWh.** By this rate, it will decrease 3.6 times of the fuel use in electricity generation in 2005 by EDC (only this project; the other projects are not included).

5. Consultation and discussion of the local publics

Consultation and discussion of the local publics who is involved with the project is an important point which allows them to provide idea and suggestion to help implement and be smooth.

a. Objectives of consultation

The objectives of the consultation and discussion with the local publics are:

- Disseminate the local publics and stakeholders to be aware about the objectives and steps of project implementation.
- Find out criticizing idea, requests, conflict issues, and decorating methods.
- Solve those conflicts by arranging the discussion meetings with the local people and authorities.

b. Institutions and consultants

Researchers for the primary environmental social impact assessment of SAWAC have consulted and discussed with the local publics concluding:

- Cabinet chief of Koh Kong municipal
- Koh Kong Environmental Department
- Koh Kong Industry, Mine, and Energy Department
- Koh Kong Water Resource and Meteorology Department
- Koh Kong Agriculture Department
- Khan Forestry Administration, Koh Kong
- Koh Kong Land Management, Urban Planning, and Construction Department
- Thmor Bang District department (vice district governor)
- Thmor Daun Pov Commune office (commune chief and commune development committee)
- Chumnoab Commune office (commune chief and commune development committee)

- Bralay Commune office (commune chief and commune development committee) and
- all people in the villages Thmor Daun Pov, Chumnoab, and Bralay commune.

Note: the report of consultation and discussion describe the details in chapter 6 of the report.

6. Environmental Management Plan

In this chapter describes about environmental management (EMP) that will be implemented through the steps of the project especially construction, maintenance, and termination. The main objectives of EMP are to monitor the environmental impact reduction actions stated in Chapter 5. The plan implementation is the obligation of multi-authorities participated by offices, departments, and ministries or involving institutes. The monitoring and witness team will be under controlled of Ministry of Environment. The project owner will determine important measures to prevent and reduce the negative impacts on environment to ensure the efficiency environmental management through the technique environmental standard and also ensure sustainable development. These conclude:

- Arranging sectors or responsible group for work implementation
- Limiting the schedule in environmental protection properly
- Equipping the health, danger protection, and modern standardizing machineries.

- Preventing and vaccinating epidemic diseases
- Managing solid, liquid, and poisonous waste
- Building solid-waste dump site
- Encouraging to grow trees at the public or the areas around the protected areas
- Incorporating with specialized institution in locating technical location and accepting any change if required by specialists.
- Conserving important wildlife species in area
- Disseminating and educating about protected forest and wildlife species
- Spreading out and educating methodologies for health care, hygiene, and safety
- Preparing budget for carrying out environmental management

Note: The company will prepare budget amount 2,556,206.00 USD (two million, five hundred fifty six, and two hundred and six US dollar) to protect environment during project construction step. Moreover, it will prepare 77,000.00 USD (seventy seven thousand US dollar) each year for environmental protection and totally of 3,080,000.00 USD (three million and eighty thousand US dollar) for 40-year project implementation. (See details in chapter 7, at 7.6 of the report)

Monitoring program and environmental protection measurement implementation control program include:

- Observe mountain excavation if inclined ground built properly, growing grass or plants to protect soil erosion, and controlling smoothing ground at the soil extracting places, rock, gravel, soil waste dump site if inclined ground, wall cleaned, and replant at the site.

- Observe soil quality at the equipment and chemical storage, petroleum containers, and workshop if cleaned and well managed. Monitor machinery site, petroleum container, and chemical element (element spill on the ground).
- Observe the change of channel, rivers, and lakes in the whole project area. Monitor water flow under the second reservoir $1.5\text{m}^3/\text{second}$ into the ground in order to protect biodiversity between the dam and powerhouse. Monitor sewage water drainage system flowing into rivers, and streams (water sample at the intersect of the stream to Areng valley will be taken to analyze and observe the result referring to the water quality standard in public water source for biodiversity protection of Ministry of Environment). Establish 4 hydro stations in the downstream reservoir 200m, and under the powerhouse 300m and at Trapaing ROUNG channel.
- Observe the change of the underground water level in the project site. Observe water quality through experiment, water quality of Areng valley referring to the water quality standard at the public water source for biodiversity of the Ministry of Environment.
- Observe hunting activities and log traffic and wildlife of the project's workers. Observe the sound of machineries and work time.
- Observe hunting activities of the workers. Observe and monitor the population and species of wildlife and fishes.
- Observe air quality, smoke disposal of the machineries, and solid and liquid waste management if they smell bad.
- Observe the forest lands that will be flooded if they were cleared before flooding. Observe solid and liquid waste management.
- Observe fuel containers and machinery parking (fuel and chemical element spoil on the ground).
- Observe sound and vibration of tracks and machineries in the project site.
- Observe the resettlement plan of the project, land solution, legal land compensation, and land that will be lost because of the project.
- Observe job employment of the company (prioritizes the local people). Observe the restoration of business program of the affected people (as stated in the resettlement plan).
- Observe and follow up all mistakes and offensives of the workers to the tradition, cultures, and habits of the local people as well as the nation.
- Observe traffic and speed signs along the road and road maintenance and repairing in the project site. Observe road maintenance in the new tourism site in the Areng valleys and the nearby areas (if existing)
- Observe security and health care, health care of the workers, medical kids, and preventing the infective diseases in the project site.
- Observe and follow up all even resulting to dam destruction, mountain land slide, health care and security care of explosive, combustive materials. Observe and prevent local forest fire and terror.

Beside the preventive and observing measurements of the project, training program is also very important in environmental management which it required to pay attention to meet success in implementation. To be sustainable developed, the project must consist of human qualified resources to work progressively, and perfect work in both techniques and environmental work. Thus project owner will hold trainings on technique or

important clues to the workers, agents, or the institutes that will be responsible to monitor security, safety, health, sustainability, natural resources, and social resources.

7. Conclusion and Recommendation

- Conclusion

Environmental and social impact assessment of the project investment for Areng valley hydropower development in Pursat province of the China Southern Power Grid Co., Ltd., which the company provides SAWAC Consultants for Development to conduct research for compiling environmental, social impact assessment report, concludes as the following:

- The project will take over the whole 3,067ha evergreen forests, 3,790ha semi-evergreen forest, 37ha deciduous forest, 10ha bush, 1,133.37ha secondary forest, and 4ha mix bamboo forest (more details in Chapter 4, paragraph 4.2.5.3). The project will impact the wildlife, habitat, but the company will comfort the migration of biodiversity to the linked protect area.
- The project may affect the land use and property right of the local people of 3,624ha which owned by 346 families, and evacuated 189 families from the reservoir to the new location of 2,347ha (see map 2.3 and 2.4).
- The project will make problems with water use and water quality between Dam site-A and powerhouse. This area consists of wildlife such as crocodile, Asian arowana, and the presence of the people at Phum Svav. Though the company plans to flow water to this area $1.5\text{m}^3/\text{second}$ in dry season.

Along with the negative impacts on natural resources and social environment, the project will also provides great deal of profits to the local people and the whole nation such as:

- 1.** Cambodia will have big scale hydropower plants producing 108 Mega Watt (MW) or 617.89 Giga Watt hour (GWh) per year slightly 82% of the electricity produced in 2005 in Cambodia, and this hydropower project will provide main electricity to efficiently response the solution of electricity source in Cambodia for a medium period of time. When the project is working, Cambodia will have double electricity to the whole 2005 electricity. Moreover, the Areng valley hydropower will stabilize electricity supply further uses such as industrial pants, agricultural, commercial, housing, public areas and Cambodia's economic development to save from poverty of people in the project and nationwide areas as well as making society develop in all areas.
- 2.** The project will provide some 1200 people with jobs in the stage of constructing and other jobs while operating and maintaining. Owing to the effects on its development projects and infrastructures, it can boost incomes of people in the local community through national and international tourists coming to Cheay Areng area and visiting Cheay Areng hydroelectricity dam and ecotourism.
- 3.** Cheay Areng hydroelectricity project can narrow a number of heavy inundations in the area of Prek Tompong Rong such as largely preventing the deluges at the beginning of the rainy season, but the flood at the end of rainy season can partly prevent. If the project flows water from the dam Site A high 1.5 m^3 per second regularly, it will make the

portion of the Cheay Areng River from this dam to hydroelectricity site environmentally well stable and in addition, during the dry season it can prevent salt water from the sea coming into Prek Tompong Rong which hugely benefits fresh water usage for irrigating crops and other recreations.

4. The project will have road infrastructures in the area such as improving Cheay Areng exit and entrance better, repairing roads and constructing bridges in and from Thmor Bang district and paved roads from the dam to the hydroelectricity area, entrance to new housing locations of people affected by the dam, etc. On top of the infrastructures serving the public, the project will have worker dorms, offices, gardens, and other infrastructures for the use of project staff and give beauty to the area as a whole.

5. The project will pay directly into national budgets because the company pays tax on importing fuel for constructions, cuts tax, income tax and other taxations in the period of operating and project maintenance in compliance with the contract between the company and Royal Government of Cambodia.

The project has no serious effects on environment and society because measures will be taken by cutting maximum negative effects by many years of experienced company in China and a number of developing nations. For example, brief prevention and deduction measures for waste containing fuel and chemicals or other solid wastes, the company technically stores them with full regard. Moreover, the company equips water purifiers which have enough capacity according to the project disposal. The company not only cooperates with the Ministry of Environment, but also institutions concerned in supervising and giving the recommendations on the activity of regular solid and liquid waste management. Cheay Areng River hydroelectricity project has high risks such as mountain landslides and dam bursts while constructing and operating as mentioned in details in chapter 5 of the report.

RECOMMENDATION

In order to get smoothness in conducting in Cheay Areng hydroelectricity project and strengthening the responsibility for sustainable economic development on the natural resources and social safety through the evaluation of environmental effects and society, first for this hydroelectricity project, SAWAC would like to make recommendations as follows:

- The company has to study the designs of all its project components which guarantee its technically effective and diminish the effects of land, housing, property of people in the project zone.

- The company cooperates with the Royal Government presented by the Ministries concerned and copes with the loss of land, housing, legal property of people and their daily livelihood de jure and de facto without infringement of people who are vulnerable to Cheay Areng hydroelectricity project activity, especially the company has to set the plan for new housing of people whose plan affects 189 households at best (for this plan the company has allowed SBK company to deal with it). The company has to

reserve the forests along the river (150m from the axis totally 300m from the river) at the new area of people affected by the dam and to reserve wild animal corridors (breadth 300m) from the mountain in this area to the reserves (see map 4) and along the preserve areas the company has to hold up the signs which are clearly visual.

- The company has to cooperate fully (both in budget and technique) with forestry administration, CI, FFI organizations, Ministry of Environment and Ministry of Agriculture, Forestry and Fishery in order to carry out reforestation in the nearby areas and dig natural ponds which are home to crocodiles again in the dam, i.e. the project contributes to restoring the loss of forest and lair and make the surrounding of Krovign mountain reserves stable. The project should design and lets water flow out of the second dam to the down stream by guaranteeing the quantity of water at least 1,5m/second nonstop both in dry and rainy seasons (even though the company is short of water and closes the sluice to refill the dam) to make the dam more stable with its surrounding.

- The project should carry out a study up to standard on the leaking from the dam rigorously in the stage of operating and maintaining the project.

- The company has to be careful and is ready to control the high risks such as the study on geology and setting in the project areas thoroughly, the design, quality of constructions and to prevent the dam breaches and mountain slides. The company is ready to settle on time the possible dangers with enough media, rescuers and rescue materials both budget for emergency.

- The company has to comply with the relevant laws of the Royal Government in order to conduct the project smoothly and successfully.