Lao People's Democratic Republic
Ministry of Energy and Mines
Phongsaly Provincial Department of Energy and Mines
Electricite du Laos

THE PREPARATORY SURVEY FOR MINI-HYDROPOWER DEVELOPMENT PROJECT IN LAO PEOPLE'S DEMOCRATIC REPUBLIC

FINAL REPORT

MARCH 2013

JAPAN INTERNATIONAL COOPERATION AGENCY

TOKYO ELECTRIC POWER SERVICES CO., LTD.
TOKYO ELECTRIC POWER CO., INC.

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【 Preface 】

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to consist of Tokyo Electric Power Services Co., Ltd. (TEPSCO) and Tokyo Electric power Co., Inc. (TEPCO).
The survey team held a series of discussions with the officials concerned of the Government of Lao People's Democratic Republic (Laos), and conducted a field investigation. As a result of further studies in Japan, the present report was finalized.
I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.
Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Laos for their close cooperation extended to the survey team.

March 2013

Hidetoshi Irigaki
Director General,
Industrial Development and Public Policy Department
Japan International Cooperation Agency

【 Summary 】

1 Country Profile

1-1 National Land and Natural Conditions

Lao People's Democratic Republic (Lao PDR or Laos), which is located in the northeast of Indochina Peninsula, is an inland country surrounded by Vietnam to the east, China to the north, Myanmar to the northwest, Thailand to the west, and Cambodia to the south. Its national land area is about 240,000 km^2 almost equal to the main island of Japan. Its population is 6.26 million according to 2010 census.

Laos belongs to the tropical monsoon climate zone, and its weather is divided into the rainy season from May to October and the dry season from November to April. Temperatures reach a peak in April and May, and hit a low in December and January.

The Project site is located in Phongsaly Province in the northern end of Laos, and the elevation of the surrounding area is from 700m to 1,800m. The climate in the area is relatively cool in comparison with other areas in Laos. Particularly, minimum temperatures in December and January in the area sometimes become lower than 10℃.

1-2 Socioeconomic Conditions

Laos is a communist single-party socialist republic led by the Lao People's Revolutionary Party (LPRP) since its establishment in 1975. Since Government of Laos (GOL) was faced with an impasse in its planned economy, it has launched the economic reform, so-called as "New Economy Mechanism", in 1986. GOL has been promoting introduction of market-oriented economy and open economy policy through wide range of reforms such as reforms of banking system and taxation system, establishment of foreign investment law, and privatization of state-owned companies.

In order to accelerate socio-economic development of the country by introducing investment from foreign countries, GOL set a long term target of economic development until 2020 during the Party's 8th Congress in 2006. Following the policy, GOL executed a bilateral investment agreement with Japan in August 2008.

According to Lao Statistics Bureau in 2010, composition rate of the GDP is 39% from services, 28% from agriculture and 26% from industry while agriculture still provides about 70% of employment. The GDP of Lao PDR is assumed as 7.891 billion USD, and the GDP per capital is 1,203 USD according to IMF.

2 Background to the Project

2-1 Overall Goals of Power Sector

In the "Socio-Economic Development Policy", which was published in March 2001, GOL set a target to improve household electrification ratio from 36% in 2000 to 90% by 2020. The electrification ratio reached 73% nationwide in 2010, and 80.1% in the first half of 2012. However, there is bias of electrification ratio by region. Since rural areas are particularly behind in electrification, GOL is focusing on rural electrification.

Focusing on Phongsaly Province where the Project is located in, its electrification ratio is still 23% in 2012, the lowest Province in the country. The Provincial Government has electrification targets to achieve 60% by 2015, and 70-80% by 2020. In addition, Electricite du Laos (EdL) in Phongsaly is importing power from China at the relatively high tariff of 9.2US cent/kWh. Therefore, reduction of

power import is one of issues of the power sector.
In such circumstances, this project is to construct a mini-hydropower plant and to extend distribution lines to the surrounding un-electrified villages in Gnod ou District, phongsaly Province. The Project aims to contribute to reducing power import by about 3GWh/year and improve electrification ratio of Gnod Ou District from the current 32% to 60% by 2015 in association with other electrification program of Phongsaly Province.

2-2 Current Conditions and Issues of Power Sector

GOL is promoting electrification with the following two options:

1) On-grid electrification by EdL and private participation,
2) Off-grid electrification on local basis.

In order to improve electrification ratio from 73% in 2010 to 90% by 2020, it is necessary to expand electrification areas to villages located near boundaries of other countries. At present, GOL is relying on power import from neighboring countries to supply electricity to such areas. However, it is required to accelerate the promotion of the abovementioned options in consideration both of technical and financial aspects.

Issues on the future rural electrification are as follows:

a) Financial Issues:
Power import tariff is relatively expensive, and it is more expensive than electricity tariff to consumers in Lao in many cases. It is one of causes to put pressure on EdL's finances. In Phngsaly Province, power is imported from China at the tariff of 730 kip/kWh (about 9.2 US cent/kWh) while the national average electricity tariff of EdL is 559 kip/kWh.
Therefore, reduction of power import is one of issues of the power sector.

b) Technical Issues:
The local areas where are isolated from the National Power Grid are normally supplied electricity though long distance 22kV distribution line without any substations in the middle of the route. It causes voltage drop and power loss as well as decreasing supply reliability.
As for human resources for off-grid electrification, there are limited resources that have enough capability to operate facilities and manage projects in local government and local communities.

3 Outline of Survey Results and Project Components

3-1 Survey Period and Records of Filed Survey

The Preparatory Survey was implemented from August 2012 to March 2013, and the survey team was dispatched to Lao PDR four times for site survey and discussion with related agencies. The field survey period and each purpose are as follows:

Table-1 Records of Field Survey in Lao PDR

	Period	Purpose
1 st	August 23, 2012 – September 22, 2012	Data Collection for Planning and Designing
2 nd	October 15, 2012 – October 23,2012	Geological Survey and Supplemental Survey
3 rd	December 10, 2012 – December23, 2012	Explanation of the Draft Final Report
4 th	February 12, 2013 – February 20, 2013	Discussion on Organizational Structure for Management the Mini-hydropower Plant

3-2 Project Components

Base on the request from GOL, results of site survey, and discussion with related agencies, the Project was planned to construct Gnod Ou mini-hydropower plant and distribution lines (124km of 22kV lines and 16km of 400V lines) in Gnot Ou District, Phongsaly Province. In addition, provision of technical assistance to ensure sustainable operation of the power plant is also planned as a soft component of the Project.
Outline of each component is described as follows:

3-2-1 Construction of Mini-hydropower Plant

1) Mini-hydropower Plant

Table-2 Featires of Facilities of Mini-hydropower Plant

	Items	Profiles	Remarks
Generation Plan	Type	Run-of-River Type	
	Maximum Discharge	7.02 m^3/s	
	Effective Head	8.8m	
	Installed Capacity	450 kW	
Structure Profile	Intake weir	H 4.5m, L 41.1m	Overflow Crest 31.8m
	Intake	B 4.2m, H 3.3m, L 16.8m	
	Settling Basin	B 10.7m, H 3.5m, L 31.2m	Max./Inner Dimension
	Headrace	B 2.0m, H 2.5m, L 680.5m	Inner Dimension
	Headtank	B 5.0m, H 6.2m, L 32.7m	Max./Inner Dimension
	Penstock	ϕ 1.2m, L 5.2m, 3 units	
	Powerhouse	B 8.9m, H 6.7m, L 14.0m	

2) Equipment for Mini-hydropower Plant

Table-3 Features of Equipment for Mini-hydropower Plant

Equipment	Specification	Remarks
Water Turbine and Generator	Submerged Turbine Generator 3 units Turbine: Vertical Shaft Propeller Turbine 173.5 kW, 600 rpm Generator: Vertical Shaft Three Phase Synchronous Generator 166.7 kVA, 600 rpm	Purchased from Japan
Controller	Start and stop Operation of the Plant Protection Stop Control Voltage, Current, Output Observation Automatic Synchronizer Protection Relay Isolated Operation Detecting Device	Purchased from Japan
Main Transformer	Type: Oil Self Cooling Three Phase Transformer Rated Capacity: 500kVA Voltage: 22kV/440V	Technical Standard of EdL
Switch Gear	Three Phase Switchgear with Fuse Transformer for Instrument Current Transformer for Instrument Arrester	Purchased from Japan

3-2-2 Distribution Lines

Table-4 Features of Distribution Lines

Items	Specifications	Quantity	
Target Area		Northeast	West
22kV Distribution Lines	3 phase Bare ACSR 12m Reinforced Concrete Pole	76.3km	47.5km
400V Distribution Lines	3 phase 4 lines Insulated ACSR 8m Reinforced Concrete Pole	10.0km	6.1 km
Transformers	22kV / 400V	13 units	10 units

3-2-3 Soft Component

Provincial Department of Energy and Mines (PDEM) of Phongsaly as an asset owner of the power plant will be responsible for sustainable utilization of the mini-hydropower plant. PDEM will provide O&M license to the Special Purpose Organization (SPO), and the SPO will operate and maintain the mini-hydropower plant as a plant operator.
For financial management, Provincial Rural Electrification Fund (P-REF) will be established to manage the fund related to the Project for the future overall as well as rehabilitation activities of the power plant.

In order to ensure sustainable operation of the power plant, technical assistance as soft components of the Project will be provided to support 1) establishment of P-REF, 2) Selection and procurement of SPO, and 3) Strengthening capability of PDEM staff who are supposed to monitor and supervise SPO's O&M activities and P-REF's financial management.

4 Project Implementation Schedule and Project Cost

4-1 Project Implementation Schedule

The project implementation schedule is shown in Table-5.

Table-5 Project Implementation Schedule

Stages	Implementation Period	Implementation Months
Detailed Design	April – June 2013	3 months
Tendering Procedures	June – September 2013	4 months
Construction and Equipment Procurement	October 2013 – January 2015	16 months

4-2 Rough Estimate of Project Cost

The burden of GOL out of the total project cost is approximately 2.4 million Japanese Yen.

5 Project Evaluation

5-1 Relevance

The mini-hydropower of the Project is one of renewable energy power sources, and it has a characteristic of relatively small environmental and social impacts. And also, the other component of the project is to extend distribution lines to rural un-electrified villages. Therefore, the Project is consistent not only with Japan's aid policy on assistance in power sector but also with Lao government's development policy to promote rural electrification as well as renewable energy development.

5-2 Effectiveness

5-2-1 Quantitative effects

Indicators	Baseline in 2012	Targets in 2018 3 years after Project Completion
1) Output of Mini-hydropower Plant	0 kW	450 kW
2) Plant Factor of Mini-hydropower Plant	0%	79.6%
3) Electrification Ratio of Gnod Ou District	32 %	60 %
4) Annual Generation/Power Import Reduction	0 MWh/year	3,141 MWh/year

5-2-2 Qualitative Effects

In addition to the contribution to the rural electrification promotion and power import reduction as mentioned above, the following effects by the Project are expected:

a) Strengthening stable power supply to the Project surrounding areas,
b) Contribution to the local economic development and livelihood improvement,
c) Promotion of renewable energy development/utilization.

Lao People's Democratic Republic

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4. Minutes of Discussion
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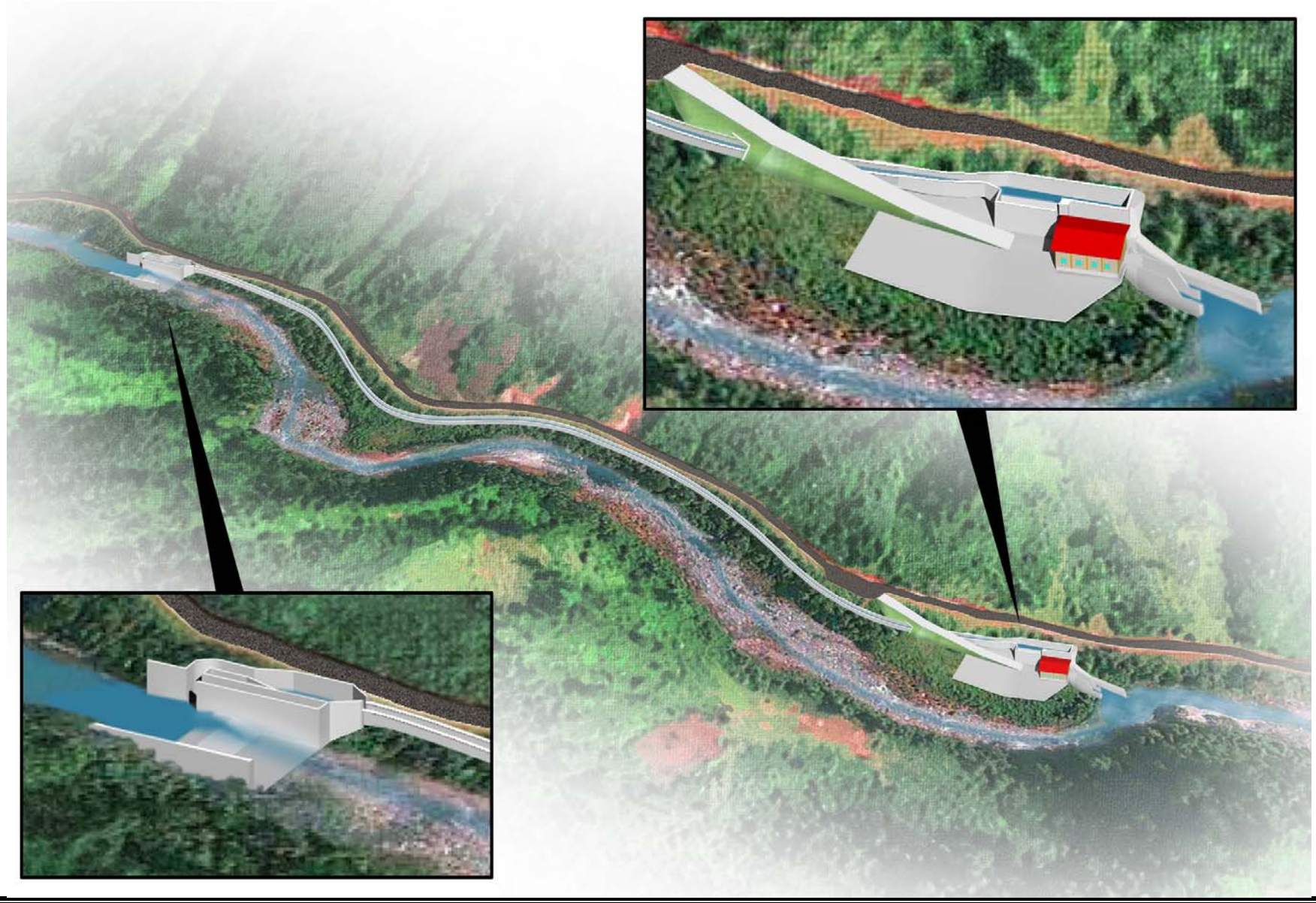

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【 Abbreviations 】

ADB	Asian Development Bank
DEB	Department of Energy Business
DEM	Department of Energy Management
DEPP	Department of Energy Policy and Planning
DESIA	Department of Environmental and Social Impact Assessment
DMH	Department of Meteorology and Hydrology
DOE	Department of Energy
EA	Environment Assessment
EdL	Electricite du Laos
EGAT	Electricity Generating Authority of Thailand
EIA	Environment Impact Assessment
EMMP	Environmental Management Plan and Environmental Monitoring Plan
F/S	Feasibility Study
GDP	Gross Domestic Product
GMS	Greater Mekong Sub-region
GOJ	Government of Japan
GOL	Government of Laos
GRC	Grievance Resolution Committee
IEE	Initial Environmental Examination
IMF	International Monetary Fund
IPP	Independent Power Producer
IREP	Institute of Renewable Energy Promotion
IUCN	International Union for Conservation of Nature and Natural Resources
LACP	Land Acquisition and Compensation Plan
LPRP	Lao People's Revolutionary Party
M/D	Minutes of Discussion
MEM	Ministry of Energy and Mines
MOF	Ministry of Finance
MONRE	Ministry of Natural Resources and Environment
NARPD	Northern Area Rural Power Distribution
NEDO	New Energy and Industrial Technology Development Organization
NEF	New Energy Foundation
NLMA	National Land management Authority
OJT	On the Job Training
PEA	Provincial Electricity Authority
PDEM	Provincial Department of Energy and Mines
PDOF	Provincial Department of Finance
PNRE	Provincial Department of Natural Resources and Environment
PPA	Power Purchase Agreement
P-REF	Provincial Rural Electrification Fund
RAP	Resettlement Action Plan
REF	Rural Electrification Fund
REP	Rural Electrification Plan
ROW	Right of Way
SPRE	Southern Provinces Rural Electrification
WB	World Bank
WREA	Water Resources and Environment Administration

Chapter 1 Background of the Project

1-1 Policy on the Power Sector

1-1-1 Electrification Policy

Owing to the recent economic growth, power demand in Lao PDR has been increasing three times in the past ten years. At the same time, the national electrification ratio of Lao PDR has rapidly been increasing from 36% in 2000 to 48% in 2005, and to 73% in 2010. By region, the electrification ratio becomes 59% in the northern part, 96% in the central part, and 70% in the southern part. Particularly, the electrification ratio of Vientiane, which is the capital city of Lao PDR and is located in the central part of Lao PDR, becomes 99%; it shows that urbane areas have achieved high electrification ratio. However the electrification in the remote area has not been developed yet in comparison with urbane areas.

The Government of Lao PDR (GOL) shows a policy to actively promote rural electrification from the viewpoint of reducing the internal disparities between urban and rural areas and poverty reduction in the remote areas, and has targets to improve the national electrification ratio to 80% by 2015 and to 90% by 2020.
Focusing on Phongsaly Province where the Project site is located in, its electrification ratio is still 23%, the lowest Province in the country. The Provincial Government has electrification targets to achieve 60% by 2015, and 70-80% by 2020.

1-1-2 Issues on Electrification Promotion

GOL is promoting electrification with the following two options:

1) On-grid electrification by EdL and private participation,
2) Off-grid electrification on local basis.

In order to improve electrification ratio from 73% in 2010 to 90% by 2020, it is necessary to expand electrification areas to villages located near boundaries of other countries. At present, GOL is relying on power import from neighboring countries to supply electricity to such areas. However, it is required to accelerate the promotion of the abovementioned options in consideration both of technical and financial aspects.

Issues on the future rural electrification are as follows:

a) Financial Issues:
Power import tariff is relatively expensive, and it is more expensive than electricity tariff to consumers in Lao in many cases. It is one of causes to put pressure on EdL's finances. In Phngsaly Province, power is imported from China at the tariff of 730 kip/kWh (about 9.2 US cent/kWh) while the national average electricity tariff of EdL is 559 kip/kWh.
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b) Technical Issues:
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As for human resources for off-grid electrification, there are limited resources that have enough capability to operate facilities and manage projects in local government and local communities.

1-2 Request for Japan's Grant Aid

In such circumstances mentioned above, GOL requested Government of Japan (GOJ) for Japan's Grand Aid in November, 2012 to construct a mini-hydropower plant and to extend distribution lines to the surrounding un-electrified villages in Gnod ou District, phongsaly Province.

The Project aims to contribute to reduction of power import from China and improvement of electrification ratio of Gnod Ou District. In addition, the following contributions are expected:

- Promotion of renewable energy utilization;
- Improvement of reliability in electricity supply;
- Improvement of energy quality; and

1-3 Targeted Project and Site Location

The targeted mini-hydropower project site is located in Gnod Ou Dostrict, Phongsaly Province that is the northern end of Lao PDR as shown in Figure 1-1 and Figure 1-2.
The project site was initially identified in "The Master Plan Study on Small Hydropower in Northern Laos" which conducted by JICA in 2005, and then its preliminary design was carried out in "Feasibility Study and Detailed Design of Micro Hydropower Project in Lao PDR" in 2006, which is a technical assistance provided by the Government of Thailand.
During the Preparatory Survey, the project layout was reviewed, and finally, the project site was selected.
The result of site selection was discussed with MEM after site survey, and made agreement on it.

For the extension of 22kV and 400V distribution line expansion, two target areas were selected among the planning areas in the rural electrification plan as shown in Figure 1-2.

Figure 1-1 Location Map of the Project Site (1)

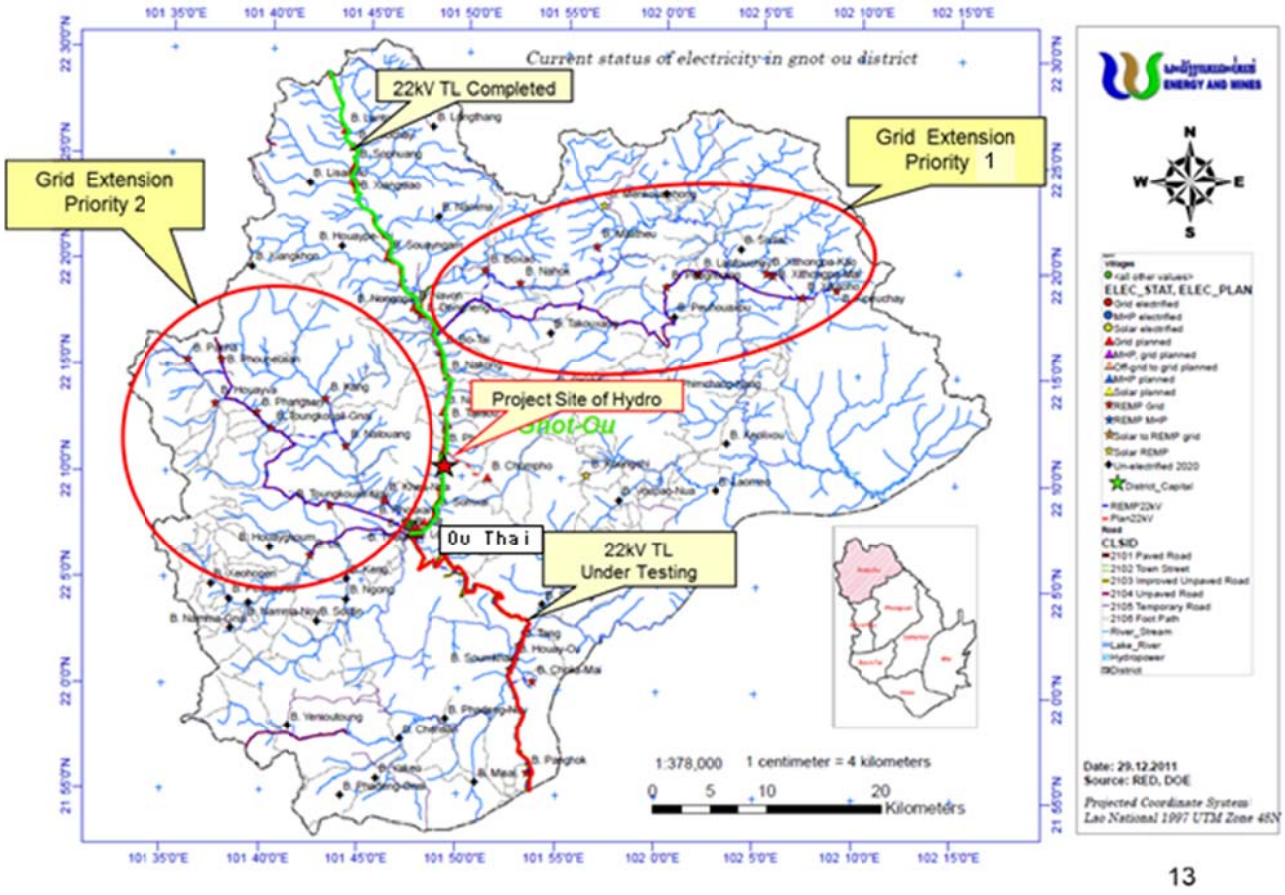


Figure 1-2 Location Map of the Project Site (2)

1-4 Conditions of the Project Site

1-4-1 Natural Conditions

1-4-1-1 Hydro-meteorological Feature

The characteristic of climate in Lao PDR is a high temperature with a rich precipitation through the year affected by the tropical monsoon influenced by warm wet air from the Bengal Bay where southwestern direction and the South China Sea where southeastern direction. There are two seasons which are the rainy season from middle of May to middle of October and dry season from middle of October to middle of May, and about 85% of annual rainfall is in the rainy season.
There is no meteorological observing station near the Project location in Gnod Ou District. Table 1-1 shows meteorological data in Phongsaly meteorological observing station for reference.

Table 1-1 Meteorological Data in Phongsaly Meteorological Observing Station

Items		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Rain Fall	Max.	113.0	52.2	110.8	184.1	420.1	406.5	683.9	438.4	298.7	208.8	109.4	91.4	
	Min.	0.0	0.0	0.0	20.4	0.0	74.8	193.1	134.6	54.2	32.4	0.0	0.0	
	Ave.	21.9	22.3	58.0	80.5	202.7	230.5	355.2	293.1	139.4	98.2	35.6	28.8	1,566.2
Temperature	Max.	29.4	31.0	33.7	34.0	34.8	32.0	32.0	31.3	30.7	29.7	27.8	26.0	
	Min.	3.0	0.4	3.5	6.0	10.7	10.0	10.0	12.4	12.0	10.0	6.5	0.5	
Humidity	Max.	89.0	83.0	79.0	81.0	90.0	97.0	96.0	95.0	94.0	95.0	91.0	91.0	
	Min.	64.0	52.0	49.0	53.0	66.0	77.0	81.0	79.0	74.0	74.0	68.0	67.0	

Normally in the planning of hydropower plant, at least few years of river flow data is gathered and flow duration is assumed. However, there is no river observation data in the Project Site. Therefore the river flow of the Gnod Ou River was assumed only from existing neighboring observation data in the Preparatory Survey.
Following points[1] are considered to select existing flow observation data to assume the river flow:

a) The same water system and its drainage area is neighboring or comprehended;
b) A ratio of drainage area of referred data and target point should be between 0.5 to 1.5; and
c) More than 10 years data in a row.

The flow duration of the Project Site was studied in the Thai F/S report in 2006 based on the four neighboring observation data. However, the study method was not satisfied above a) and b), while the drainage area of referred data are from 3 to 30 times of the target site. Therefore, it was judged unreliable.
In the Preparatory Survey, flow observation data of existing gauging station were newly obtained from DMH consideration of above points of view. The three gauging station named Ngoy, Vangvieng, and Kasi has series of flow and rainfall data from 1998 to 2011. Ngoy station is suited with a) the same water system with project site, and Vangvieng, and Kasi stations are fitted to b) a ratio of drainage area.

First, river flow data of above mentioned gauging stations converted to the Project Site using a conversion factor which is drainage ratio multiplies rainfall ratio. Figure 1-3 shows the flow duration curves of three existing gauging stations which converted to the Project Site. The Ngoy station is not used to study the flow duration of the Project Site to avoid over estimation because the flow data of Ngoy station is extremely big compared with other two as shown the Figure. Therefore, the average of other two data of gauging station (Vangvien and Kasi) is adopted for the Project.

Figure 1-4 shows flow duration curve and water utilization ratio, and Table 1-2 shows the summary of flow duration of the Project Site.

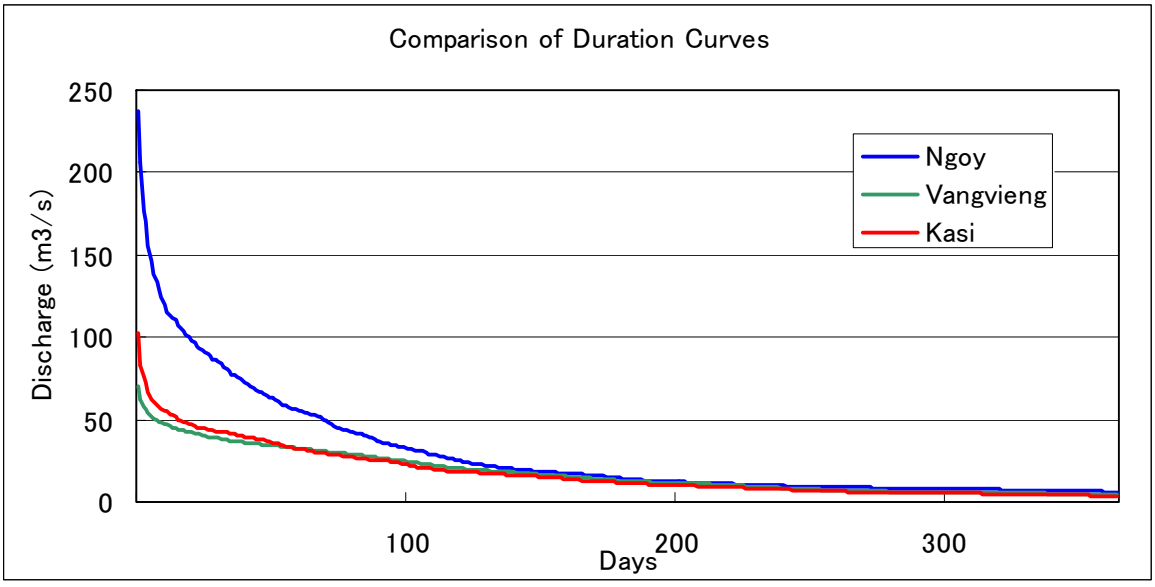


Figure 1-3 Flow Duration Curves of Existing Gauging Station converted to the Project Site

[1] "Guidebook on Medium and small hydropower development" New Energy Foundation, Japan

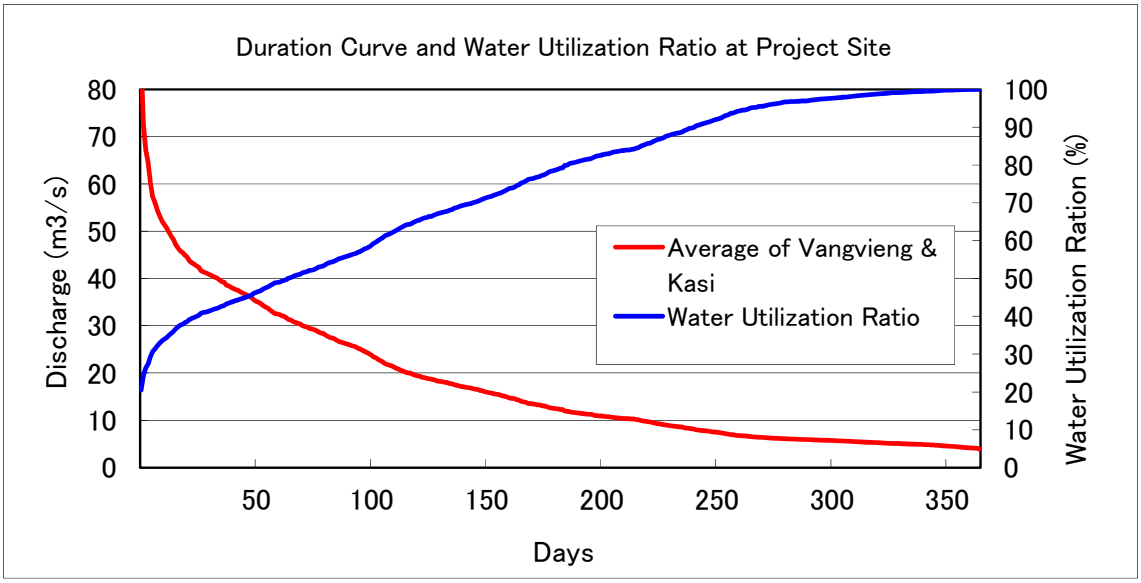


Figure 1-4 Flow Duration Curve and Water Utilization Ratio of the Project Site

Table 1-2 Summary of Flow Duration of the Project Site

(m^3/s)

Catchment Area of Project Site=645km^2	Max. Discharge	35 days Discharge	95 days Discharge	185 days Discharge	275 days Discharge	355 days Discharge	Min. Discharge	Annual Average
Average of Vangvieng and Kasi	86.5	39.7	25.3	12.0	6.3	4.4	3.9	17.0

1-4-1-2 Topographic Survey

The topographic survey was conducted initially during the 1st field survey by the study team for quick start of the basic design work, at the same time the detail topographic survey was conducted by the local consultant to make a detail topographic map.
The contents of the topographic survey work of the re-entrust to local consultant were as follows:

- Setting control points: 3 Points;
- Topographic survey: 7.5 ha (original), plus 19.5 ha (additional)
- River profile survey: 2.5 km
- River cross sectional survey: 13sections
- Mappings: Topographic map 1/200 scale, river profile, and river cross section

The detail field survey was conducted 7.5 ha of survey area in the beginning of the field survey by the local consultant, after that 19.5 ha was added to assume possible flood area upstream of intake weir in the future.

1-4-1-3 Geological Feature

1-4-1-3-1 General view of the Project site

The project site is located in Gnod Ou District, which is in the most northern part of Lao PDR, and the project area is shown in Figure 1-5. The area is on a stable block which called “Indosinian platform” from the geotectonic view point. The geology of the project area is T3-K on the figure means “post-Triassic to Cretaceous age”.

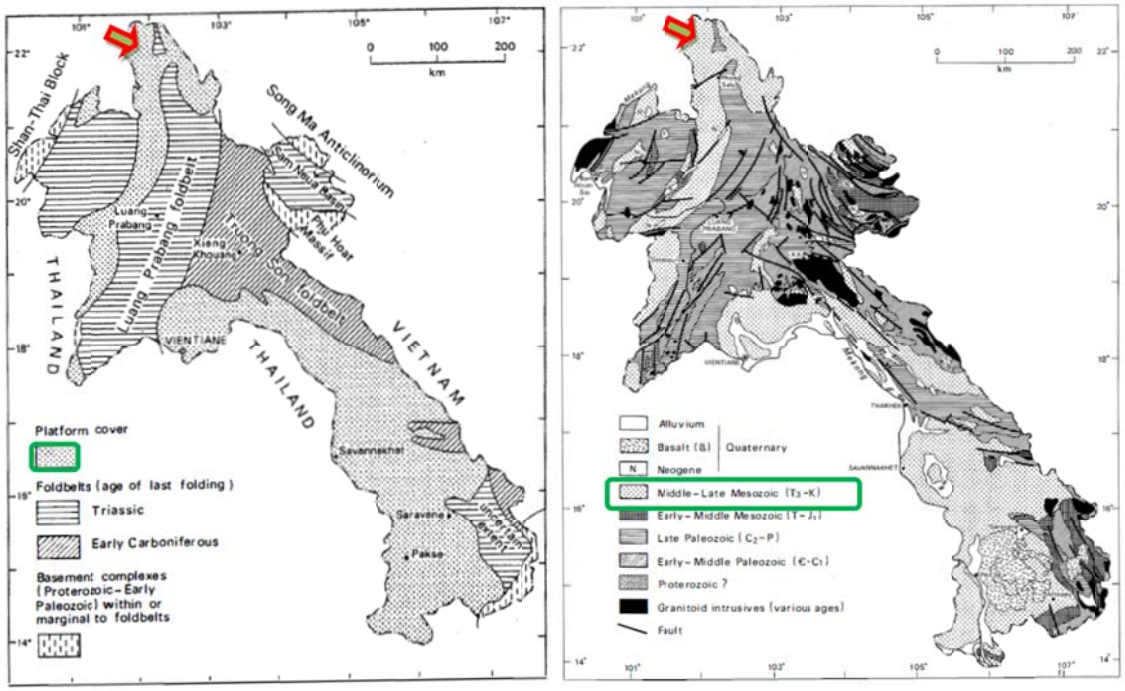
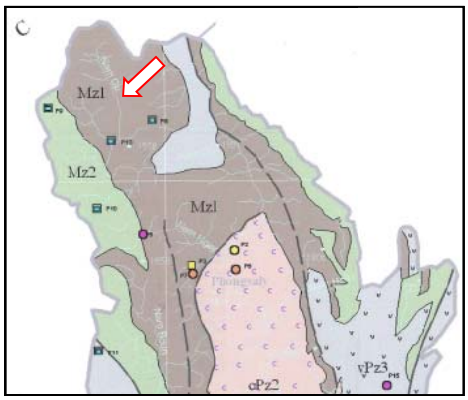


Figure 1-5 Tectonic map (left) and Outline Geological map (right) of Laos
Source: “Laos in Encyclopedia of European and Asian Regional Geology, 1997, p.493-498,Chapman & Hall”

On the other hand, more detail descriptions are seen on ”Geological and Mineral Occurrence Map (Scale 1:1,000,000)” which shown in Figure 1-6, though that is older than the above mentioned one.

“Mz1”- on the Figure 1-6 is ”During mid-Triassic time, shallow shelf sea conditions prevailed in the south, in the Troungson belt and in the Muong Xai belt, with the deposition of limestones and a gradual increase in the proportion of clay and sand as emergence took place over most areas up to mid –Jurassic time. Red continental clays and sands (the indosinias inferieures, Moyennes and the basal indosinias Superieures) were deposited during this interval, with some marine limestone intercalations of Liassic age being laid down in the south. Conglomerates and coal seams developed locally within paralic environments, and megacrystic ganitoid plutons were intruded between late Triassic and late Jurassic time. Recent work by Russian and Laotian geologists suggests that in parts Troungson belt and in the Louangphabang zone, collision events which took place by mid-Triassic time may have caused Permo-Carboniferous limestone unit to slide across Triassic and older rocks with the formation of complex recumbent fold and nappe structures. These structures appear to have been buried by Upper Triassic to Low Jurassic sedimentary units. - R.N.Annels and J.S.Coats (1990) - “- mostly continental sequence with local shallow water marine facies persisting from Upper Palaeozoic. Continental red clayey arenites with occasional thin coal units occur at the base of this interval interbedded with clays –(all are diplomatic copy).

In any case, the rocks of the project area are consisting mainly of continental or neritic sea sedimentary rocks, and rarely reddish argillaceous arenite containing clay and thin coal seam at some places.



Mz1 During mid-Triassic time, shallow shelf sea conditions prevailed in the south, in the Truongson belt and in the Mucng Xai belt, with the deposition of limestones and a gradual increase in the proportion of clay and sand as emergence took place over most areas up to mid-Jurassic time. Red continental clays and sands (the indosinias inferieures, Moyennes and the basal indosinias Superieures) were deposited during this interval, with some marine limestone intercalations of Liassic age being laid down in the south. Conglomerates and coal seams developed locally within paralic environments, and megacrystic granitoid plutons were intruded between late Triassic and late Jurassic time. Recent work by Russian and Laotian geologists suggests that in parts Truongson belt and in the Louangphabeng zone, collision events which took place by mid-Triassic time may have caused Permo-Carboniferous limestone units to slide across Triassic and older rocks with the formation of complex recumbent fold and nappe structures. These structures appear to have been buried by Upper Triassic to Low Jurassic sedimentary units.

Source: "Geological and Mineral Occurrence Map"

1-4-1-3-2 Topographic and Geological condition surrounding the project area

The major structures of this project are pointed in blue on the bird's- eye view on the Google Earth map. They are intake, powerhouse, and quarry candidate sites (see Figure 1-7).
Topographically, the area forms a Cuesta[2] because the Nam Ou river near the project site flows linearly and the hillside slope of left bank goes together with monotonous plain, and a similar geomorphologic feature is formed on the right bank mountain side distant about 1.5km from the site. Arrows indicated in Figure 1-7 mean monotonous slopes which are eroded surface of Cuesta. The monotonous topography of the project site must have been formed by erosion of the old Nam Ou River, as a consequence, fresh and hard arenite bedding plain appeared on the surface ().

Figure 1-7 Bird's-Eye View of the Whole Project Site from the South (Google Earth)

[2] A "Cuesta" (from Spanish: "long slope") is a ridge formed by gently tilted sedimentary rock strata in a homoclinal structure. Usually an erosion-resistant rock layer's slope is more gentle than the other side on the steep ridge. The gentle slope of a homoclinal ridge dips in the same direction is the resistant sedimentary strata.

Photo 1-1 Monotonous Mountain Slope formed by Cuesta on the Left Bank of Nam Ou River

Photo 1-2 Soft and Rusty Color Mudstone near Ban Chompho

1-4-1-3-3 Geotechnical Feature of the Scheme

The waterway runs through a steep and narrow mountain slope between Nam Ou River and the road, and is composed of excavated materials for constructing the road at most part. The river meanders with 'W' shape, and sand and gravels cover both the peak.

(1) Geotechnical assessment for the Intake Weir Site

The left abutment of the intake weir is composed of arenite, which bedding plain's strike and dip is N10W/40W. Arenite exposes for about 20m along the left bank of the river (Photo 1-3, Photo 1-4), accordingly this location is suitable for the intake weir from the geotechnical view point.

On the other hand, right abutment of the weir is composed of gravelly cohesive soil (Photo 1-5). The sediments are mud flow and might have been made by extraordinary floods such as typhoon.

The river bed of the weir site is fully covered by sand and gravel layer (Photo 1-6). It is presumed that this sediment will infill the gap of huge boulders expected lie around 2m beneath the surface gravel layer. The boulders layer is expected for the bearing stratum.

Right abutment of the weir should be excavated to sufficient depth and construct a revetment on the upstream side to protect from scouring by erosion during flood.

Photo 1-3 Arenite Outcrop and Sand and Gravel Sediments in the Left Abutment of Intake Site

Photo 1-4 Arenite Outcrop Exposed at the Downstream of Intake along Lleft Bank

Photo 1-5 Gravelly Cohesive Layer in the Right Abutment of Intake

Photo 1-6 Gravel Layer Covers the River Bed Which Consists of Sand and Some Cohesive Soil

(2) Geotechnical assessment along the headrace

(a) Inlet, Settling Basin, and most upper reach of the Headrace

Sound massive arenite exposes except the settling basin site (Photo 1-4, Photo 1-7). It is suited for the basement of the headrace but hard to excavate by mortal power and necessary to use dynamite and /or heavy duty machine.

(b) Headrace Route of the Upstream Half

Overburden covers bedrock along the headrace at most parts. There are debris (Photo 1-8), disposed material occurred by road construction (Photo 1-9) which might be dumped on the river terrace (Photo 1-10). Dumped materials are loose and have no bearing capacity for the basement of the structure. Furthermore, the dumped part is weak for the river erosion because it becomes cutting slope during flood. Accordingly bank protection works is indispensable along the river of this part.

(c) Headrace Route of the Downstream Half

Arenite exposes on the cutting slope along the road, but no outcrops of rocks are seen and forms monotonous mountain slope covered by dumped boulders which would have been occurred through the road construction (Photo 1-12). The headrace surrounding this area has no selection without present route, because it must be set between road and river. A revetment

should be constructed along the left bank riverside to protect the headrace from flood erosion. Construction of basement of the revetment might be done in the water but the basement should be set at least 1.5m from river bottom suffering damage by flood erosion. As same as the upstream half, dumped part is seen along the headrace, therefore, bank protection works is indispensable along the river of this part also.

(3) Geotechnical assessment for the Powerhouse

It is expected huge boulder layer (Photo 1-13) wears the adequate bearing capacity for the base of the powerhouse (Photo 1-14). From the viewpoint of slope stability, ground water behind the powerhouse is required to release carefully (Photo 1-15).

Photo 1-7 Arenite Exposure Along the Headrace

Photo 1-8 Huge Arenite Boulder and Debris on the Headrace Route

Photo 1-9 Dumped Materials Composed of Gravelly Soil Caused by the Road Construction

Photo 1-10 Huge Arenite Blocks Scattered on the Flood Plain

Photo 1-11 Sand and Gravel Deposits on the Riverside

Photo 1-12 Monotonous Mountain Slope Covered by Dumped Boulders Occurred during Road Construction

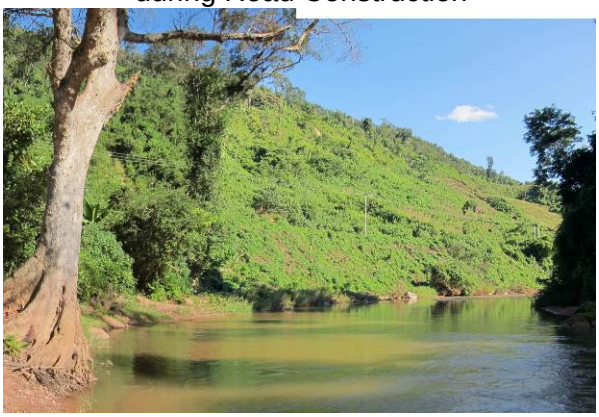


Photo 1-13 Panoramic View Surrounding the Powerhouse Site

Photo 1-14 Huge Boulders Cover the Terrace Surface Beside the Powerhouse

Photo 1-15 Collapse on the Upper Slope of the Powerhouse, which Occurred in a Highly Water- contained Loosen Cohesive Soil

(4) Quarry Site

Sand and gravel for concrete aggregate are found on the riverside (Photo 1-11), but it is hardly found enough amount of concrete aggregate surrounding the site. Sufficient amount of sand and gravel is seen near Ban Chompho village (Photo 1-16), which is about 2.5km downstream from the site, however, the quality of it seems not suitable because it contains much quantity of unsuitable minute particles such as weathered feldspar and mudstone. Finally we gave up getting material from the river and changed to find a quarry. Then we examined an abandoned quarry close to the project site, and we judged the quality of the quarry seems suitable for concrete aggregate though it is costly than riverbed deposit (Photo 1-17).

Photo 1-16 Gravel Pit of the Road Construction

Photo 1-17 Whole View of the Candidate Quarry

1-4-2 Environmental and Social Considerations

1-4-2-1 Environment Assessment

1-4-2-1-1 Outline of Project component

This project are composed of two project constructing Mini-Hydro Power Plant and Distribution Line, of which main component is as follows.

(1) Mini-Hydro Power Plant
The type of planned Mini-Hydro Power Plant is "Run-of River" with no sizable reservoir, no displacing people and then reducing impacts of terrestrial ecosystem and downstream.

(2) Distribution Line
Extension and installation of 22kv distribution lines, and 22kv/400V transformers and 400V distribution lines have no construction of steel towers, big civil works and large loggings.

1-4-2-1-2 Environmental and Social Condition in the Project sites

(1) Mini-Hydro Power Plant

a) Natural Environment
Mostly a mix of farm land and degraded forest surrounds the Project site, with most crops located right along Nam Ou. The forest cover is predominantly dry evergreen and semi-evergreen with a mosaic of swidden land and forest at various stages of regeneration. Large tracts of contiguous old-growth forest survive towards the Vietnamese border and along the Nam Ou, upstream from the Nam Khang confluence.

b) Social Environment
There are no villages near the Project site, but there are some rice fields near the river side of upstream which will be anticipated to be inundated by "occasional" flooding at a frequency ranging from 1/10 to 1/50 years.
In addition to flooding of the rice fields mentioned above, a villager's garden will also be affected, not by flooding but by the construction of penstock along the left bank which starts from the proposed weir to the powerhouse. The garden has approximate total area of 0.8 ha, where crops such as corn and peanuts were cultivated.

(2) Distribution Line

a) Natural Environment
Like most of Laos, the Gnod Ou District is quite mountainous with deep valleys and rolling plains. With an average elevation of around 1300m Ou Thai sits surrounded by a vast array of steep and rolling terrain. The project area has retained the large area of undisturbed forests and other natural vegetation and very deep valley and highland relief with elevation rising to 1950m in mountain range near the Vietnamese border.
However, land use along distribution line alignment will follow an existing road, impacting mainly re-growth vegetation. Some small rubber and bamboo plantations were also recorded along the proposed route, but will not be significantly affected by the distribution line.

b) Social Environment
There are two priority targets for construction of Distribution Line of Priority 1 which covers an approximate distance of 42km and will follow the existing road to B. Xipeuchay and Priority 2 which covers an approximately 34km in distance and will also follow existing road to Kheu Nua. The number of households and population in each village are as bellows.

ine

Priority 1 (North East)				Priority 2 (West)			
No	Name	HH	Population	No	Name	HH	Population
I-1	Bosao	72	475	II-1	Kang	57	311
I-2	Nahok	109	712	II-2	Nalouang	167	876
I-3	Malitheu	82	521	II-3	Toungkouali Gnai	33	210
I-4	Menkuaphong	37	227	II-4	Phargsan	55	278
I-5	Thouchangfang	47	296	II-5	Houayva	28	157
I-6	Phugnixe	31	223	II-6	Phoureusan	50	296
I-7	Peuhouaxou	24	140	II-7	Pacha	47	248
I-8	Sivilai	41	267	III-1	La	100	514
I-9	Laofouchay	37	249	IV-1	Kheu Nua	44	206
I-10	Xithongpa Gao	31	225				
I-11	Xikaoho	57	389				
I-12	Xithongpa Mai	36	266				
I-13	Xipeuchay	37	246				
	Total	641	4,236		Tctal	581	3,096

(Source: Hearing from the villagers)

1-4-2-1-3 Institutional and Legal/regulatory framework

(1) Institutional and Legal/regulatory framework

The following legislation are mainly now in force and supporting regulations in Lao PDR relevant to ensuring environmental and social issues.

a) Constitution of the Lao People's Democratic Republic 1991
b) Environmental Protection Law 1999
   - Decree on Environmental Impact Assessment 2010
   - Regulation for the Agreement on Lao National Environmental Standards 2010
c) Forest Law 1999
d) Wildlife and Aquatic Law 2007
e) The Lao Land Law 1997
   - Decree on Compensation and Resettlement No.192/PM 2005
   - Regulations for Compensation and Resettlement of Persons Affected by Development Projects 2010
f) Decree on the Preservation of the Cultural, Historical and Natural Heritage 1997
g) Water and Water Resource Law 1996

According to Law, Decree and Regulations above mentioned, development project is categorized into two types of "Category 1" which is mandatory to implement Initial Environmental Examination (IEE) and "Category 2" which is mandatory to implement Environmental Impact Assessment (EIA).

Table 1-4 Category for IEE/EIA Project

Project \ Category		Category 1 (IEE)	Category 2 (EIA)
Power House	Hydro	<15MW or reservoir Capacity<1.500ha	≥15MW or reservoir Capacity>1.500ha
Transmission Line	X>230Kv	≤ 50Km	>50Km
	X<230Kv	All	In protected area designated by Gov. In or through the city
Sub station	HV /SS	<10ha	>10ha

(Source: Decree on Environmental Impact Assessment 2010)

(2) Project Category on Mini-Hydro Project

Based on the Environmental Impact Assessment Guideline, November 2011, the Project falls under Category 1; considered small scale and producing approximately 500kW with no storage reservoir. According to these Guidelines, for any project with generation capacity of less than 15MW, only an Initial Environmental Examination (IEE) is necessary.

(Project Category on Distribution Line Project)

Based on the Environmental Impact Assessment Guideline, November 2011, the Project falls under Category 1; considered small scale and less than 230kV, only an Initial Environmental Examination (IEE) is necessary. However, when D-L passes through a National Protected Area (NPA) or exceed 230kV then, an Environmental Impact Assessment (EIA) would be required. But there is no possibility of passing through the National Protected Area (NPA) of 22kv of this Project.

(3) Enforcement structure in Government

A new Ministry of Natural Resource and Environment (MONRE) was created in July 2011 with responsibility over environmental, natural resource and land management issues. This Ministry was created by merging the Water Resource and Environment Administration (WREA) with some departments of the National Land Management Authority (NLMA) and Geology Department, and the Forest Conservation and Protection divisions from MAF.

And evaluation of IEE has done by the flow as bellows;

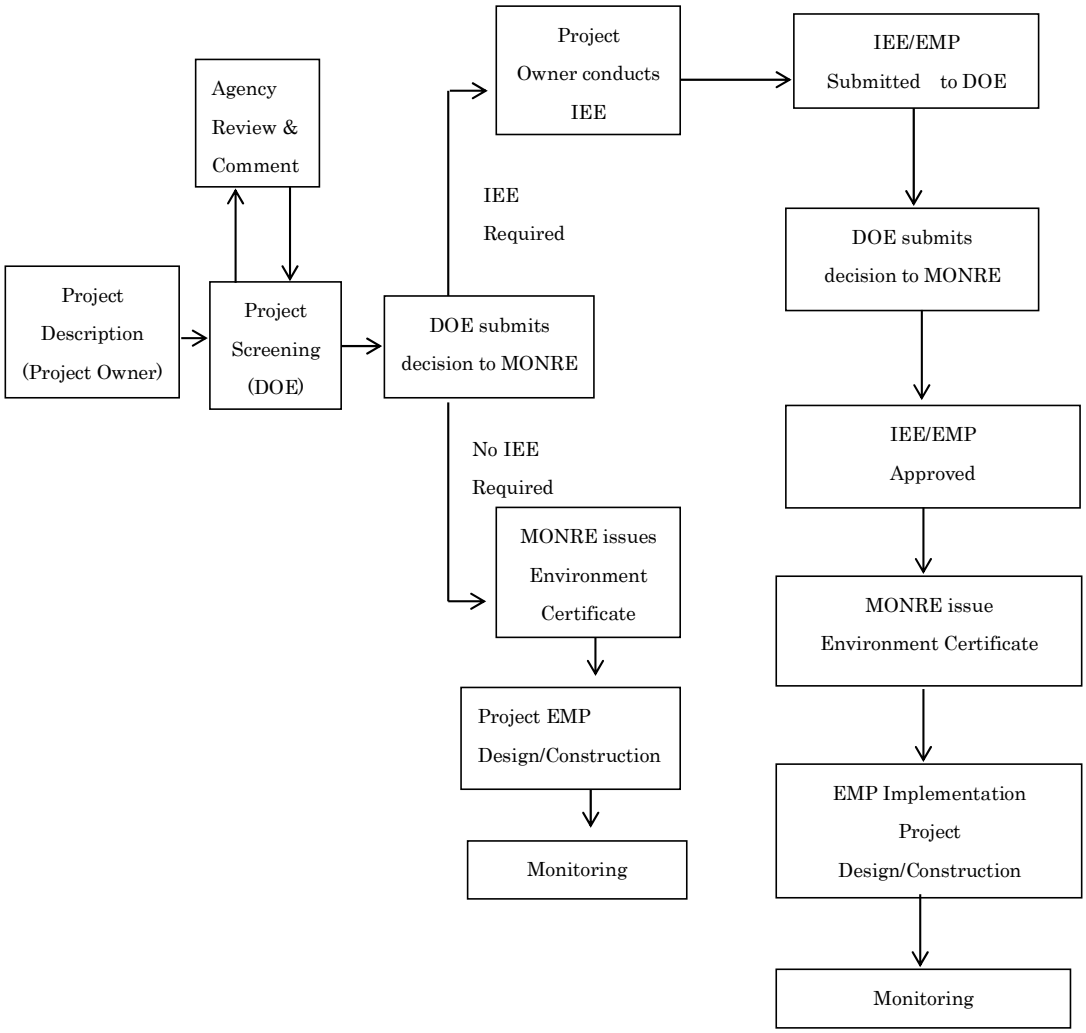


Figure 1-8 Flow for Environmental procedure to getting approval of IEE

1-4-2-1-4 Comparison of Alternatives

Table 1-5 summarizes the characteristics of the alternatives from the view of Environmental and social Conditions. Three alternative plans are discussed and the best plan which has little adverse impacts to rice fields, land modification is being proposed as a "C (Proposed Plan) Plan".

(Mini-Hydro Power Plant)

Table 1-5 Summarizes characteristics of the alternatives studied

Alternatives	Outlines	Possible/Negative impacts
A(No-go option)	No construction and depending on import from China	-0.3million US$/y will be needed to import electrical energy -unstable electrical energy supply and high frequency of power cut -No impacts to environment
B(Original Plan)	Weir: 2.5km upstream with 3m height, beside rice field Headrace: 3.250m with length : flow gradient with 1/6.000 Capacity: 454kw	-adverse impacts to rice field beside or near weir and intake -adverse impacts to corn field and sugar cane field along intake -adverse impacts caused by large digging for construction of headrace with length of 3.25km
C(Proposed Plan)	Weir: no obstacle : with 5m height Headrace: 680m with length : flow gradient with 1/700 Capacity: 450kw	- rice fields near the river side of upstream which will be anticipated to be inundated by "occasional" flooding at a frequency ranging from 1/10 to 1/50 years. -adverse impacts to small corn garden along river

1-4-2-1-5 Scoping on Natural and Social Environment

Table 1-6 shows the scoping result prepared based on the 1st field survey and the generally expected impacts by constructing Mini-Hydro- power plant.

Table 1-6 Result of Scoping for Power Plant

Item	No.	Impact	Ev.	Rating		Result
				Design / construction Phase	Operation Phase	
Pollution mitigation measure		Air pollution	(-1)	B-	D	**Construction phase:** Generation of dust by land preparation and other construction work is expected, but the impact will be temporary. Generation of air pollutant (SOx, NOx, and others) from operation of heavy machines and trucks is predicted, but the impact will be limited only within the surrounding area. **Operation phase:** SOx, NOx and dust will be generated by the operation of the power plant.
	2	Water pollution	(-1)	A-	D	**Construction phase:** Water turbidity is anticipated by excavation work, but the impact will be temporary. The impact of concrete waste water and oil-containing wastewater is anticipated. **Operation phase: the impact of plant** Wastewater, oil-containing wastewater, domestic wastewater, are not expected by the plant operation.
	3	Soil pollution	(-1)	B-	D	**Construction phase:** Possibility of soil pollution caused by leakage of lubricant and fuel oil from construction vehicles and machines. **Operation phase:** No Possibility of soil pollution caused by leakage of lubricant and fuel oil used for the unit operation.
	4	Sediment pollution	(-1)	B-	C-	**Construction phase:** Possibility of sediment pollution in case construction wastewater flows into the river. **Operation phase:** Possibility of sediment pollution in case plant wastewater and domestic wastewater which are not appropriately treated flow into river.
	5	Noise and Vibration	(-1)	B-	D	**Construction phase:** Impact of noise and vibration is predicted caused by operation of heavy machines and trucks, but will be limited to the surrounding area. **Operation phase:** Impact of noise and vibration is not predicted caused by plant operation.
	6	Odor	(-1)	B-	D	**Construction phase:** In case domestic waste from the workers' room was not appropriately treated, bad smell of rotten waste may occur. **Operation phase:** The potential leakage of ammonia from de-nitration process may cause bad smell. Also, in case domestic waste from the room of workers in charge of repair work was not appropriately treated, bad smell of rotten waste may occur.
	7	Waste	(-1)	B-	D	**Construction phase:** general waste and hazardous waste is generated by the construction work. **Operation phase:** general waste and hazardous waste are not generated
Natural environment	8	Natural reserve	-	D	D	**Construction phase and Operation phase:** There are no natural reserve areas near the proposed project site.

Item	No.	Impact	Ev.	Rating		Result
				Design / construction Phase	Operation Phase	
	9	Ecosystem	(-1)	D	B-	**Construction phase:** The impact of construction on the precious species and ecosystem is not predicted. **Operation phase:** Impact to the fresh fish is predicted at water-decreased area during dry season.
Social environment	10	Resettlement	(-1)	D	B-	**Design phase:** Resettlement is not caused by the construction but acquisition of land is needed.
	11	Disturbance to Poor People	(+1)	D	B+	**Design phase:** Impacts to households near the project site are not anticipated. **Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	12	Disturbance to Ethnic Minority Groups and Indigenous People	(+1)	D	B+	**Design phase:** Impacts to households near the project site are not anticipated. **Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	13	Deterioration of Local Economy such as Losses of Employment and Livelihood Means	(+)1	B^+	D	**Design phase:** Employment of local people is not anticipated to be hired. **Construction phase:** Local people will be employed for construction works. **Operation phase:** Employment opportunities will not be offered at the power station for the local people.
	14	Land Use and Utilization of Local Resources	(-1)	D	B-	The implementation of this project will not change the traditional land use pattern and utilization of local resources, which may trigger a large impact on the existing local economy. Impact by flooding to rice fields at upstream will be occurred.
	15	Disturbance to Water Usage, Water Rights etc	(-1)	D	D	**Construction phase:** Impact to landscape of river is anticipated but Local people may not be affected by the turbid water discharged from the construction site because there are no houses or rice fields using water of river at downstream. **Operation phase:** Shortage of water during dry season and impacts to the adjacent road of flooding will anticipated.
	16	Disturbance to the Existing Social Infrastructure and Services	(-1)	B-	D	**Construction phase:** Traffic volume will increase during construction. **Operation phase:** Traffic volume will not increase after construction.
	17	Social Institutions such as Social Infrastructure and Local Decision-mak	(-1)	B-	D	**Design phase:** Detailed measurement surveys for land acquisition and which will cause certain impact to the decision-making institutions.

Item	No.	Impact	Ev.	Rating		Result
				Design / construction Phase	Operation Phase	
		ing Institutions				
	18	Misdistribution of Benefits and Damages	(+1)	B-	$A^{+/-}$	**Construction phase and Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	19	Local Conflicts of Interest	(+1)	C^{-}	$B^{+/-}$	People living around the project site will be improved their social infrastructure and services. Local conflicts of interest may occur between people who get its benefits and not them.
	20	Cultural Heritage	-	D	D	There is no historical, cultural and archaeological property and heritage existing on and around the site.
	21	Landscape	-	D	D	There is no such picturesque scenery existing on and around the site.
	22	Gender	(+)1	C+	B+	**Design phase and Construction phase:** There is no specific negative impact anticipated. **Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	23	Children's Rights	(+1)	C+	B+	**Design phase and Construction phase:** There is no specific negative impact anticipated. **Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	24	Infectious Diseases such as HIV/AIDS	(-1)	C^{-}	D	**Construction phase:** A temporary influx of migrant labor during construction period may increase the risk of sexual transmitted diseases and others.
	25	Working environment (including working safety)	(-1)	B^{-}	D	**Construction phase:** High risk of accident is predicted in construction work. **Operation phase:** Work accident of workers may not happen.
Others	26	Accidents	(-1)	B^{-}	D	**Construction phase:** Accident during construction work may happen. **Operation phase:** Traffic accidents due to increased traffic may happen.
	27	Cross-boundary impact and climate change	-	C^{-}	A+	**Construction phase:** CO_2 will be generated by construction work, but no impact on climate change is predicted. **Operation phase:** CO_2 will not be generated by construction work and desirable impact on climate change is predicted.

A+/-: Significant positive/negative impact is expected.

B+/-: Positive/negative impact is expected to some extent.

C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)

D: No impact is expected.

(-1): Minor impacts but not serious

(+1: Positive impact but not large

Table 1-7 shows the result of scoping for distribution line. This scoping result is prepared based on the results of the first survey on some candidate areas and the generally expected impacts by constructing distribution line, since the route of the distribution line is not always determined at this moment.

Table 1-7 Result of Scoping for Distribution Line

Item	No.	Impact	Ev.	Rating		Result
				Design / construction Phase	Operation Phase	
Pollution mitigation measure	1	Air pollution	(-1)	B-	D	**Construction phase:** Generation of dust by land preparation and other construction work is expected, but the impact will be temporary. Generation of air pollutant (SOx, NOx, and others) from operation of heavy machines and trucks is predicted, but the impact will be limited only within the surrounding area. **Operation phase:** No specific air pollution is anticipated.
	2	Water pollution	-	D	D	**Construction and Operation phase:** No specific Water pollution is predicted.
	3	Soil pollution	(-1)	B-	D	**Construction phase:** Possibility of soil pollution caused by leakage of lubricant and fuel oil from construction vehicles and machines. **Operation phase:** Possibility of soil pollution caused by leakage of lubricant and fuel oil used for the unit operation.
	4	Pollution to rice field	-	D	D	No specific pollution to surrounding rice fields are predicted.
	5	Noise and Vibration	(-1)	B-	D	**Construction phase:** Impact of noise and vibration is predicted caused by operation of heavy machines and trucks, but will be limited to the surrounding area. **Operation phase:** No specific noise and vibration is anticipated.
	6	Odor	(-1)	B-	D	**Construction phase:** In case domestic waste from the workers' room was not appropriately treated, bad smell of rotten waste may occur. **Operation phase:** Domestic waste was not anticipated and then bad smell may not occur.
	7	Waste	(-1)	B-	D	**Construction phase:** general waste and hazardous waste is generated by the construction work. **Operation phase:** general waste and hazardous waste is not generated.
Natural environment	8	Natural reserve	-	D	D	**Construction phase and Operation phase:** There is no specific impact on the protected forest as no logging.
	9	Ecosystem	(-1)	D	C-	**Construction phase:** There is no possibility that the transmission line passes over forest and then the impact to the ecosystem of these forest areas are not anticipated. **Operation phase:** The case of Bird-strike and other impact is little anticipated.
Social environment	10	Resettlement	-	D	D	**Design phase:** No Resettlement
	11	Disturbance to Poor People	(+1)	D	B+	**Design phase:** No impacts to surrounding people of project are anticipated. **Operation phase:** They will have better lives and access

Item	No.	Impact	Ev.	Rating		Result
				Design / construction Phase	Operation Phase	
						to social services throughout a year if electricity conditions are improved.
	12	Disturbance to Ethnic Minority Groups and Indigenous People	(+1)	D	B+	**Design phase:** No impacts to surrounding people of project are anticipated. **Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	13	Deterioration of Local Economy such as Losses of Employment and Livelihood Means	(+1)	B+	D	**Design phase:** N/A **Construction phase:** Local people are employed for construction works.
	14	Land Use and Utilization of Local Resources	-	D	D	No change of land use type of area caused by project.
	15	Disturbance to the Existing Social Infrastructure and Services	(+1)	B-	D	**Construction phase:** Increased traffic is predicted. **Operation phase:** No specific adverse effect is predicted on the existing social infrastructure.
	16	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	(+1)	B-	D	**Design phase:** Detailed measurement surveys for land acquisition and which will cause certain impact to thel decision-making institutions.
	17	Misdistribution of Benefits and Damages	(+1)	B-	A	**Construction phase and Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	18	Local Conflicts of Interest	(-1)	C-	$B^{+/-}$	People living around the project site will be improved their social infrastructure and services. Local conflicts of interest may occur between people who get its benefits and not them.
	19	Cultural Heritage	-	D	D	There is no historical, cultural and archaeological property and heritage existing on and around the site.
	20	Landscape	-	D	D	There is no such picturesque scenery existing on and around the site.
	21	Gender	(+1)	C	B+	**Design phase and Construction phase:** There is no specific negative impact anticipated. **Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved..
	22	Children's Rights	(+1)	C+	B+	**Design phase and Construction phase:** There is no specific negative impact anticipated to Children's Rights. **Operation phase:** They will have better lives and access to social services throughout a year if electricity

Item	No.	Impact	Ev.	Rating		Result
				Design / construction Phase	Operation Phase	
						conditions are improved.
	23	Infectious Diseases such as HIV/AIDS	(-1)	C-	D	**Construction phase:** A temporary influx of migrant labor during construction period may increase the risk of sexual transmitted diseases and others.
	24	Working Conditions(including working safety)	(-1)	B-	D	**Construction phase:** High risk of accident is predicted in construction work during rainy season. **Operation phase:** There is a risk of accident.
Others	25	Accidents	(-1)	B-	D	**Construction phase:** Accidents may occur including soil runoff caused by heavy rain during rainy season.
	26	Cross-boundary impact and climate change	(-1)	C-	C-	Cross boundary and CO_2 emission are not anticipated concerning the distribution line.

A+/-: Significant positive/negative impact is expected.

B+/-: Positive/negative impact is expected to some extent.

C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)

D: No impact is expected.

(-1): Minor impacts but not serious

(+1: Positive impact but not large

1-4-2-1-6 TOR for Survey on Environmental and Social Conditions

IEE and simplified RAP are subject to be compiled and contents of its survey are as bellows;

Table 1-8 Contents of survey and methodology of IEE (Mini-Hydro Power Plant)

Category	NO	items	contents（plan）
Pollution Mitigation measure	1	（Air Pollution） -Environmental standard -State of Air Condition	−National ambient Air Quality Standards, Emission Standards -Meteorological record（Temperature, General weather condition） -Data of SO2,NO2,PM10
	2	（Water Pollution） - Environmental standard - State of Water Condition	- National ambient Water Quality Standards, Discharge Standards -Data of river（Temperature, BOD, SS）
	3	（Soil Pollution ） - Environmental standard	Monitoring of leakage –oil from vehicles and machines, and countermeasures
	4	（Sediment Pollution） - State of river Condition	Monitoring of Sediment and countermeasures
	5	（Noise, Vibration） - Environmental standard -State of Noise ,Vibration Condition	- National Standards on Noise, Vibration -Data of Noise, Vibration
	6	（Odor） - Environmental standard	Monitoring of Odor and countermeasures
	7	（Waste） − Environmental standard	Guideline for Waste Treatment
Natural environment	8	（Protected Ares） -State of habitat on Fauna, Flora	Distribution of Fauna and Flora
	9	（Ecosystem） -State of important habitat	Confirmation of distribution of rare species
Social environment	10	（Resettlement） -Acquisition of land -Assets of affected people -livelihood of afps	-Data of Legal/regulatory framework -census of affected people -data of assets of affected people -social condition of affected people
	11	（Poor people） -livelihood of affected people	- Concerned Data - Interview to affected people
	12	（Ethnic Minority）	- Concerned Data - Interview to affected people
	13	（Loses of /livelihood）	Concerned Data
	14	（Land use） - State of usage of land	Concerned Data
	15	（Water usage） State of usage of river	-confirmation of irrigation - Interview to affected people

Category	NO	items	contents（plan）
	16	（Social infrastructure） - State of infrastructure	-Concerned Data
	17	(Local decision making)	-No
	18	（Benefits/ damages） No	census survey -Concerned Data
	19	（Conflicts） No	- census survey -Concerned Data
	20	（Cultural heritage） - State of Cultural heritage	-Concerned data
	21	（Landscape） -State of Landscape	-Concerned data
	22	（Gender）	- census survey -Concerned data
	23	（Children's Right） -Access to hospital /treatment houses	-census survey -Concerned Data -Interview to affected people
	24	(Infectious diseases such as HIV/AIDS)	No
	25	Working environment -No	No
others	26	（Accident） -No	-No

Table 1-9　Contents of survey and methodology of IEE (Distribution Line)

Category	No	Items	contents（plan）
Pollution Mitigation measure	1	（Air Pollution） No	-No
	2	（Water Pollution） No	-No
	3	（Soil Pollution） No	-No
	4	(Sediment Pollution） - State of river Condition	Monitoring of Sediment and countermeasures
	5	（Noise, Vibration） - Environmental standard -State of Noise ,Vibration Condition	- National Standards on Noise, Vibration -Data of Noise, Vibration
	6	（Odor） - Environmental standard	Monitoring of Odor and countermeasures
	7	（Waste） − Environmental standard	Guideline for Waste Treatment
Natural environment	8	(Protected Ares） -State of habitat on Fauna, Flora	Distribution of Fauna and Flora
	9	（Ecosystem） -State of important habitat	Confirmation of distribution of rare species
Social environme	10	（Resettlement） -Acquisition of land	-Data of Legal/regulatory framework -census of affected people

Category	No	Items	contents（plan）
nt		-Assets of affected people -livelihood of afps	-data of assets of affected people -social condition of affected people
	11	（Poor people） -livelihood of affected people	- Concerned Data - Interview to affected people
	12	（Ethnic Minority）	- Concerned Data - Interview to affected people
	13	（Loses of /livelihood）	Concerned Data
	14	(Land use） - State of usage of land	Concerned Data
	15	（Water usage） State of usage of river	-confirmation of irrigation - Interview to affected people
	16	（Social infrastructure） - State of infrastructure	-Concerned Data
	17	（Local decision making） No	−No
	18	（Benefits/ damages） No	−census survey -Concerned Data
	19	（Conflicts） No	- census survey -Concerned Data
	20	Cultural heritage） - State of Cultural heritage	−-Concerned data
	21	（Landscape） -State of Landscape	-Concerned data
	22	（Gender）	- census survey -Concerned data
	23	（Children’s Right） -Access to hospital /treatment houses	-census survey -Concerned Data -Interview to affected people
	24	（Infectious diseases such as HIV/AIDS）	No
	25	Working environment -No	No
others	26	（Accident） -No	-No

1-4-2-1-7 Results of Survey on Environmental and Social Considerations

(1) Mini-Hydro Power Plant

a） Natural Environment

There are no protection areas in and near the project site which are designated by the country’s laws or international treaties and conventions, and impacts to terrestrial ecosystems in and near the project site are negligible level.

b） Social Environment

There is no resettlement caused by project implementation but some adverse impact as bellows will be caused:

- Corn garden located at the power site is lost, though total is small, resulting in loss of means of livelihood; and
- Rice paddy fields near the river side of upstream which will be anticipated to be

inundated by “occasional” flooding at a frequency ranging of 1/100 years.

(2) Distribution Line

a) Natural Environment

Some construction areas of D/L are included in the protection forest designated by Forest Law, but the construction of poles will not give adverse damages to these areas because of no exposition of soil embankment and cutting of slop.

There are no losses of wildlife habitats, fragmentation, and potential for mortality of large birds striking by cross flyways.

b) Social Environment

There are no losses of accommodation, social inequities, and disruption of community cohesion.

c) Overall aspect of Natural Environment in or Surroundings of Project Sites

Some parts of Mountain of North-east of Project Site are designated as National Biodiversity Conservation Areas (NBCAs) and in which rare, threatened or vulnerable species as listed in Table 1-10 and Table 1-11 are recorded.

Table 1-10 Rare, threatened or vulnerable species in NBCAs（Mammal）

	Scientic name	English name	Criteria		
			N.P.	G.T.C	L.R.S
1	*Macaca mulatta*	Rhesus macaque	-	GNT	PARL
2	*Semnopithecus phayrei*	Black-footed gray langur	INP	DD	ARL
3	*Species not identified*	Bear SP.	-	-	-
4	*Elephas maximus*	Asian Elephant	HNP	EN	ARL
5	*Species not identified*	Pig SP.	-	-	-
6	*Callosciurus inomatus*	Inornate Squirrel	-	VU	LKL
7	*Hystrix brachyura*	Malayan Porcupine	-	VU	0

(Source：Wildlife in Lao PDR, 1999 Status Report)

Table 1-11 Rare, threatened or vulnerable species in NBCAs（Birds）

	Scientic name	English name	Criteria		
			N.P.	G.T.C	L.R.S
1	*Buceros bicornis*	Great Hornbill	HNP	0	ARL
2	*Anorrhinus tickelii*	Brown Hornbill	-	GNT	PARL
3	*Aceros nipalensis*	Rufous-necked Hornbill	HNP	VU	ARL
4	*Aceros undulates*	Wreathed Hornbill	-	0	ARL
5	*Alcedo Hercules*	Blyth’s Kingfisher	-	VU	PARL
6	*Vanellus duvaucelii*	River Lapwing	INP	0	ARL
7	*Ichtyyophaga humilis*	Lesser Fish Eagle	INP	GNT	ARL
8	*Cinclus pallasii*	Brown Dipper	-	0	PARL
9	*Cochoa viridis*	Green Cochoa	-	GNT	0
10	*Phylloscopus cantator*	Yellow-vented Warbler	-	GNT	0
11	*Alcippe rufogularis*	Rufous-throated Fulvetta	-	GNT	0

(Source：Wildlife in Lao PDR, 1999 Status Report)

For fresh water fish, a big fish comes upstream from Mekong River during rainy season when water level becomes high. The big fishes identified at the adjacent river are shown in Table 1-12. But, recent years, there are few big fishes due to over fishing or new fishing style using electricity, high fishing net and explosive compound (hearing results from local people).
Almost all of cough-fishes are consumed by themselves and not bring to market to sell.

Table 1-12 Fresh water fish identified adjacent river

No.	Scientic name	English name	IUCN
1	*Mystus microphthalmus*	Atrifasciatus Fowler	-
2	*Tor sp.*	Minnows	-
3	*Bagarius yarrelli*	Giant Devil Catfish	NT
4	*Notopterus notopterus*	Asiatic Knife-fish	-
5	*Poropuntis sp.*	Yellow-tail Brook Bard	-
6	*Hermibagrus wycki*	Asian Red-tail Catfish	-

(Source：Phongsaly Province office)

1-4-2-1-8 Environmental Evaluation

The scoping results which had been done by collecting the opinions or secondary data at the earlier stage of the project have been reevaluated through the site surveys of two times, and its result is shown table bellows.

Table 1-13 Evaluation of scoping before and after survey（Mini-Hydro Power Plant）

Item	No.	Impact	Ev.	Scoping		After survey		Result
				Design / construction	Operation	Design / construction	Operation	
Pollution mitigation measure	1	Air pollution	(-1)	B-	D	B-	D	**Construction phase:** Generation of dust by land preparation and other construction work is expected, but the impact will be temporary. Generation of air pollutant (SOx, NOx, and others) from operation of heavy machines and trucks is predicted, but the impact will be limited only within the surrounding area. **Operation phase:** SOx, NOx and dust will not be caused
	2	Water pollution	(-1)	B^-	D	B^-	D	**Construction phase:** Water turbidity is anticipated by excavation work, but the impact will be temporary. The impact of concrete waste water and oil-containing wastewater is anticipated. **Operation phase:** the impact of plant Waste water, oil-containing wastewater, domestic wastewater, are not expected by the plant operation.

Item	No.	Impact	Ev.	Scoping		After survey		Result
				Design / construction	Operation	Design / construction	Operation	
	3	Soil pollution	(-1)	B-	D	B-	D	**Construction phase:** Possibility of soil pollution caused by leakage of lubricant and fuel oil from construction vehicles and machines. **Operation phase:** No Possibility of soil pollution caused by leakage of lubricant and fuel oil used for the unit operation.
	4	Sediment pollution	(-1)	B-	C-	B-	D	**Construction phase:** Possibility of sediment pollution in case construction wastewater flows into the river. **Operation phase:** Possibility of sediment pollution in case plant wastewater and domestic wastewater which are not appropriately treated flow into river.
	5	Noise and Vibration	(-1)	B-	D	B-	C-	**Construction phase:** Impact of noise and vibration is predicted caused by operation of heavy machines and trucks, but will be limited to the surrounding area. **Operation phase:** Impact of noise is predicted caused by plant operation.
	6	Odor	(-1)	B-	D	B-	D	**Construction phase:** In case domestic waste from the workers' room was not appropriately treated, bad smell of rotten waste may occur. **Operation phase:** The potential leakage of odor is not predicted.
	7	Waste	(-1)	B-	D	B-	D	**Construction phase:** general waste and hazardous waste is generated by the construction work. **Operation phase:** general waste and hazardous waste are not generated
Natural environment	8	Natural reserve	-	D	D	N/A	N/A	
	9	Ecosystem	(-1)	D	B-	D	C-	**Construction phase:** The impact of construction on the precious species and ecosystem is not predicted. **Operation phase:** Impact to the fresh fish is predicted at water-decreased area during dry season.
Social environment	10	Resettlement	(-1)	D	B-	A-	D	**Design phase:** Resettlement is not caused by the construction but acquisition of land is needed.
	11	Disturbance to Poor People	(+1)	D	B+	D	B+	**Design phase:** Impacts to households near the project site are not anticipated. **Operation phase:** They will have better lives and access to social services throughout a year if electricity

Item	No.	Impact	Ev.	Scoping		After survey		Result
				Design / construction	Operation	Design / construction	Operation	
								conditions are improved.
	12	Disturbance to Ethnic Minority Groups and Indigenous People	(+1)	D	B+	D	B+	**Design phase:** Impacts to households near the project site are not anticipated. **Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	13	Deterioration of Local Economy such as Losses of Employment and Livelihood Means	(+)1	B^{+}	D	B+	D	**Design phase:** Employment of local people is not anticipated to be hired. **Construction phase:** Local people will be employed for construction works. **Operation phase:** Employment opportunities will not be offered at the power station for the local people.
	14	Land Use and Utilization of Local Resources	(-1)	D	B-	D	C-	The implementation of this project will not change the traditional land use pattern and utilization of local resources, which may trigger a large impact on the existing local economy. The decree of water level will be anticipated at diverted river of 700M in dry season.
	15	Disturbance to Water Usage, Water Rights etc	(-1)	D	D	N/A	N/A	
	16	Disturbance to the Existing Social Infrastructure and Services	(-1)	B-	D	C-	A+	**Construction phase:** Traffic volume will increase during construction. **Operation phase:** Traffic volume will not increase after construction.
	17	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	(-1)	B-	D	D	D	**Design phase:** Detailed measurement surveys for land acquisition will not cause certain impact to the decision-making institutions.
	18	Misdistribution of Benefits and Damages	(+1)	B-	$A^{+/-}$	C-	A+	**Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	19	Local Conflicts of Interest	(+1)	C^{-}	C-	D	$B^{+/-}$	People living around the project site will be improved their social infrastructure and services. Local conflicts of interest may occur between

Item	No.	Impact	Ev.	Scoping		After survey		Result
				Design / construction	Operation	Design / construction	Operation	
								people who get its benefits and not them.
	20	Cultural Heritage	-	D	D	N/A	N/A	
	21	Landscape	-	D	D	N/A	N/A	
	22	Gender	(+)1	D	B+	D	B+	**Design phase and Construction phase:** There is no specific negative impact anticipated. **Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	23	Children's Rights	(+1)	D	B+	D	B+	**Design phase and Construction phase:** There is no specific negative impact anticipated. **Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	24	Infectious Diseases such as HIV/AIDS	(-1)	C$^-$	D	C-	D	**Construction phase:** A temporary influx of migrant labor during construction period may increase the risk of sexual transmitted diseases and others.
	25	Working environment (including working safety)	(-1)	B$^-$	D	B-	D	**Construction phase:** Risk of accident is predicted in construction work. **Operation phase:** Work accident of workers may not happen.
Others	26	Accidents	(-1)	B$^-$	D	B-	D	**Construction phase:** Accident during construction work may happen. **Operation phase:** Traffic accidents due to increased traffic may not happen.
	27	Cross-boundary impact and climate change	-	C$^-$	C+	C-	**C+**	**Construction phase:** CO_2 will be generated by construction work, but no impact on climate change is predicted. **Operation phase:** CO_2 will not be generated by operation work and desirable impact on climate change is predicted.

Note: (-1): Minor impacts but not serious

Table 1-14 Evaluation of scoping before and after survey （Distribution Line）

Item	No.	Impact	Ev.	Scoping		After survey		Result
				Design / construction	Operation	Design / construction	Operation	
Pollution mitigation measure	1	Air pollution	(-1)	B-	D	B-	D	**Construction phase:** Generation of dust by land preparation and other construction work is expected, but the impact will be temporary. Generation of air pollutant (SOx, NOx, and others) from operation of heavy machines and trucks is predicted, but the impact will be limited only within the surrounding area. **Operation phase:** SOx, NOx and dust will not be caused
	2	Water pollution	-	D	D	N/A	N/A	
	3	Soil pollution	(-1)	B-	D	B-	D	**Construction phase:** Possibility of soil pollution caused by leakage of lubricant and fuel oil from construction vehicles and machines. **Operation phase:** No Possibility of soil pollution caused by leakage of lubricant and fuel oil used for the unit operation.
	4	Impacts to rice field	-	D	D	N/A	N/A	
	5	Noise and Vibration	(-1)	B-	D	B-	D	**Construction phase:** Impact of noise and vibration is predicted caused by operation of heavy machines and trucks, but will be limited to the surrounding area. **Operation phase:** Impact of noise is not predicted at operation unit.
	6	Odor	(-1)	B-	D	B-	D	**Construction phase:** In case domestic waste from the workers' room was not appropriately treated, bad smell of rotten waste may occur. **Operation phase:** The potential leakage of odor is not predicted.
	7	Waste	(-1)	B-	D	B-	D	**Construction phase:** General waste and hazardous waste is generated by the construction work. **Operation phase:** General waste and hazardous waste are not generated
Natural environment	8	Natural reserve	-	D	D	N/A	N/A	
	9	Ecosystem	(-1)	D	C-	D	C-	**Construction phase:** The impact of construction on the precious species and ecosystem is not predicted. **Operation phase:** Impact to the fauna and flora near the construction site is predicted .

Item	No.	Impact	Ev.	Scoping		After survey		Result
				Design / construction	Operation	Design / construction	Operation	
Social environment	10	Resettlement	-	D	D	N/A	N/A	
	11	Disturbance to Poor People	(+1)	D	B+	D	B+	**Design phase:** Impacts to households near the project site are not anticipated. **Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	12	Disturbance to Ethnic Minority Groups and Indigenous People	(+1)	D	B+	D	B+	**Design phase:** Impacts to households near the project site are not anticipated. **Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	13	Deterioration of Local Economy such as Losses of Employment and Livelihood Means	(+)1	B^+	D	B+	D	**Design phase:** Employment of local people is not anticipated to be hired. **Construction phase:** Local people will be employed for construction works. **Operation phase:** Employment opportunities will not be offered at operation unit for the local people.
	14	Land Use and Utilization of Local Resources	-	D	B-	N/A	N/A	
	15	Disturbance to the Existing Social Infrastructure and Services	(-1)	B-	D	C-	A+	**Construction phase:** Traffic volume will increase during construction. **Operation phase:** Traffic volume will not increase after construction. The condition of road will be improved.
	16	Social Institutions such as Social Infrastructure and Local Decision-making Institutions	(-1)	B-	D	D	D	**Design phase:** Detailed measurement surveys for construction will not cause certain impact to the decision-making institutions.
	17	Misdistribution of Benefits and Damages	(+1)	B-	A^+	C-	A+	**Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	18	Local Conflicts of Interest	(+1)	C^-	B	D	D	People living around the project site will be improved their social infrastructure and services.
	19	Cultural Heritage	-	D	D	N/A	N/A	

Item	No.	Impact	Ev.	Scoping		After survey		Result
				Design / construction	Operation	Design / construction	Operation	
	20	Landscape	-	D	D	N/A	N/A	
	21	Gender	(+)1	C	B+	D	B+	**Design phase and Construction phase:** There is no specific negative impact anticipated. **Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	22	Children's Rights	(+1)	D	B+	D	B+	**Design phase and Construction phase:** There is no specific negative impact anticipated. **Operation phase:** They will have better lives and access to social services throughout a year if electricity conditions are improved.
	23	Infectious Diseases such as HIV/AIDS	(-1)	C-	D	C-	D	**Construction phase:** A temporary influx of migrant labor during construction period may increase the risk of sexual transmitted diseases and others.
	24	Working environment (including working safety)	(-1)	A-	D	C-	D	**Construction phase:** Risk of accident is predicted in construction work. **Operation phase:** Work accident of workers may not happen.
Others	25	Accidents	(-1)	B-	D	B-	D	**Construction phase:** Accident during construction work may happen. **Operation phase:** Traffic accidents due to increased traffic may not happen.
	26	Cross-boundary impact and climate change	-	C-	C+	D	D	**Construction phase:** CO_2 will be generated by construction work, but no impact on climate change is predicted. **Operation phase:** CO_2 will not be generated by operation work and desirable impact on climate change is predicted.

Note: (-1): Minor impacts but not serious

1-4-2-1-9 Mitigation measures and their implementation costs

The estimated cost to implement each item which describes in Environmental Management Plan are showed below Table 1-15. Mitigation measures are described in next item "*Environmental Management Plan and Environmental Monitoring Plan (EMMP)*".

Table 1-15 Environmental Management Plan Budget estimated for each Project

Project Name / Budget (Kip)	Mini-Hydro Power Plant	Distribution Lines
Implementation Cost for EMP	62,000,000	22,000,000
Total	**84,000,000**	

1-4-2-1-10 Environmental Management Plan and Environmental Monitoring Plan

The Project Owner and Environmental Monitoring Unit will be required to prepare a project EMMP for construction of the Mini-Hydro-Project and Distribution Lines, which indicates how the Contractor will implement the mitigation measures and monitoring. The Project Owner and Environmental Monitoring Unit will also be required to prepare and submit a monthly environmental management report and other occasion's reports to the Environmental and Social Monitoring Unit (ESMU) which will be established by Project Owner for the Gnod Ou Mini-Hydro Project and Distribution Lines, as required under the Concession Agreement. This report will identify the work undertaken and document any environmental problems encountered during the reporting period, the environmental protection or mitigation measures adopted to resolve such problems, and any follow-up actions required to correct such problems showed at Table 1-13.
Upon approval, the Project Owner, along with the ESMU and local government authorities, will arrange a dissemination workshop on how the environmental work can be implemented for the Mini-Hydro-Power and Distribution Lines project. The purpose of this workshop should be to make clear to all parties the type and scope of work to be carried out, time schedule and where funds can be accessed when needed for mitigation and compensation.

(1) Environmental Management Plan

The Project Owner is required to prepare an Environmental Management Plan for construction, which indicates how it will implement the project. The Project Owner also required to prepare an environmental management report which identifies the work undertaken over this period and documents the environmental protection measures that have been conducted, problems encountered, and follow-up actions that were taken or will be taken to correct the problems.

The items to be managed, its duration on management and needed budget to carry out Environmental Management Plan are shown at Table 1-16.

Table 1-16 Environmental Management Plan (Mini-Hydro Power Plant)

Item	Potential Impact	Countermeasure to be taken	Responsibility	Duration	Budget (Countermeasure Cost)
Environmental					
Water Quality	Contamination to local waterways from construction sites	Not to discharge domestic waste water directly into waterways. Heavy machinery should not be washed near waterways.	Developer/ Contractor	During construction and operation phases.	
Dust	Increased Dust from construction vehicles	Use water trucks during dry season on access or public roads where construction vehicles will travel.	Developer	Twice daily during construction phase.	15,000,000
Noise	Increased Noise from construction vehicles	Ensure loud vehicles or any earthmoving is conducted during the daytime at acceptable hours, eg. 9am-5pm.	Developer	During construction phase	-
Aquatic Life	Loss or deterioration of aquatic life	Ensure no contaminants or toxic waste is disposed of in or near waterways.	Developer	Pre-Construction Construction 3years/Operation	-
Wildlife	Loss or deterioration of local wildlife	Ensure no hunting of wildlife by employing ranger.	Developer	Construction 2years/Operation	-
Flora	Loss or deterioration of local flora species	Avoid removal of any unnecessary vegetation.	Developer	Construction 2years/Operation	-
Hazardous Waste	Disposal of hazardous waste into waterways or surrounding environment	Ensure hazardous waste is stored and disposed of by qualified contractors.	Developer/ Contractor	During construction and operation phases.	1,000,000
Solid and Domestic Waste	Disposal of solid or domestic waste into waterways or surrounding environment	The use of septic tanks for toilets and bathrooms. Employ certified garbage persons and recycle paper and plastics. Solid waste should be taken to appropriate land fill sites	Developer/ Contractor	During construction and operation phases.	1,000,000
Soil Erosion	Erosion of riverbanks or road sides	Ensure major construction is undertaken during the dry season. Conduct Bank stability and re-vegetation and silt trap.	Developer	Construction 2years/Operation	15,000,000

Social					
Road Safety	Road accidents due to increased traffic	Correct signage including speed limits around project site.	Developer	During construction phase	15,000,000
Worker Health & Safety	Risk of worker health and safety from poor sanitation and disease.	Regular health checks for all workers, and education programs.	Developer	During construction and operation phases.	5,000,000
Village Health & Safety	Risk of village health & safety due to project.	Ensure adequate education about the project and construction of fencing around high risk areas, such as the powerhouse to	Developer	During construction and operation phases.	10,000,000

Table 1-17 Environmental Management Plan (Distribution Lines)

Item	Potential Impact	Countermeasure to be taken	Responsibility	Duration	Budget (Countermeasure Cost)
Environmental					
Dust	Increased Dust from construction vehicles	Use water trucks during dry season on access or public roads where construction vehicles will travel.	Developer	Twice daily during construction phase.	5,000,000
Noise	Increased Noise from construction vehicles	Ensure loud vehicles or any earthmoving is conducted during the daytime at acceptable hours, eg 9am-5pm.	Developer	During construction phase	-
Wildlife	Loss or deterioration of local wildlife	Ensure no hunting of wildlife by employing ranger.	Developer	Construction 2years/Operation	-
Flora	Loss or deterioration of local flora species	Avoid removal of any unnecessary vegetation.	Developer	Construction 2years/Operation	-
Hazardous Waste	Disposal of hazardous waste into waterways or surrounding environment	Ensure hazardous waste is stored and disposed of by qualified contractors.	Developer/ Contractor	During construction and operation phases.	1,000,000
Solid and Domestic Waste	Disposal of solid or domestic waste into waterways or surrounding environment	The use of septic tanks for toilets and bathrooms. Employ certified garbage persons and recycle paper and plastics. Solid waste should be taken to appropriate land fill sites	Developer/ Contractor	During construction and operation phases.	1,000,000
Social					
Worker Health & Safety	Risk of worker health and safety from poor sanitation and disease.	Regular health checks for all workers, and education programs.	Developer	During construction and operation phases.	5,000,000
Village Health & Safety	Risk of village health & safety due to project.	Ensure adequate education about the project and construction of fencing around high risk areas	Developer	During construction and operation phases.	10,000,000

(2) Environmental Monitoring Plan

Project owner is responsible to implement the proposed mitigation measures and show commitment in its report to ensure a good environment and to minimize any adverse impacts which occur during the development.

Project owner also be responsible for ensuring that the monitoring activities identified in the IEE is implemented.

The monitoring plan which should be implemented during construction and its operation phase by project owner is shown in Table 1-18 and Table 1-19, and Monitoring Form which will be used to report its result to concerned authorities including JICA, is shown in Table 1-27 and Table 1-28.

Table 1-18 Environmental Monitoring Plan (Mini-Hydro Power Plant)

Ev.	Item	Detailed	Area	Method	Times	Authority in Charge
-Construction-						
Environment (Pollution, Natural)						
-1	**Air Quality**	Dust	Near Project site Near Villages	Sampling	1/0.5M	Contractor
-1	**Air Quality**	Noise	Near Project site Near Villages	Measuring at site	1/0.5M	Contractor
-2	**Water Quality**	Ph,SS,DO	Downstream	Sampling	1/0.5M	Contractor
-1	**Aquatic**	Fish	Downstream, Upstream	Visual inspection	1/1M	Contractor
-1	**Wild Life**	Valuable species	Near Project site	Hearing	1/6M	Contractor
-1	**Wild Plant**	Valuable species	Near Project site	Visual inspection	1/6M	Contractor
-2	**Hazardous Waste**	Heavy metal	Project site	Hearing	1/0.5M	Contractor
-1	**Domestic Waste**	Domestic Waste	Near Project site	Hearing	1/0.5M	Contractor
-2	**Erosion**	Soil Erosion	Slope of nearby river	Visual inspection	1/0.5M	Contractor
Social						
-2	**Road Condition**	Road facilities	Near Villages(2)	Hearing	1/0.5M	Contractor
-2	**Worker's Condition**	Worker' working Condition	Project site	Hearing	1/1M	Contractor
-2	**Public Health**	Public Health	Near Villages(2)	Hearing	1/0.5M	Contractor
-Operation-						
Environment (Pollution, Natural)						

Ev.	Item	Detailed	Area	Method	Times	Authority in Charge
-1	**Water Quality**	Ph,SS,DO	Downstream	Sampling	1/0.5M 4-years	ESMU
-1	**Aquatic**	Fish	Downstream, Upstream	Hearing	1/1M 3-years	ESMU
-1	**Wild Life**	Valuable species	Near Project site	Hearing	1/6M 2-years	ESMU
-1	**Wild Plant**	Valuable species	Near Project site	Visual inspection	1/6M 2-years	ESMU
-1	**Hazardous Waste**	Heavy metal	Near Project site	Hearing	1/0.5M 4-years	ESMU
-1	**Domestic Waste**	Domestic Waste	Near Project site	Hearing	1/0.5M 4-years	ESMU
-2	**Erosion**	Soil Erosion	Slope of nearby river	Visual inspection	1/0.5M 2-years	ESMU
Social						
-1	**Worker's Condition**	Worker' working Condition	Near Project site	Hearing	1/1D 4-years	ESMU
-1	**Public Health**	Public Health	Near Villages(2)	Hearing	1/0.5M	ESMU
-2	**Grievance**	Grievance redress	Concerned people	Hearing	5 times (all)	ESMU

Table 1-19 Environmental Monitoring Plan (Distribution Lines)

Ev.	Item	Detailed	Area	Method	Times	Authority in Charge
-Construction-						
Environment (Pollution, Natural)						
-1	**Air Quality**	Dust	Near Project site	Sampling	1/0.5M	Contractor
-1	**Air Quality**	Noise	Near Project site Near Villages (2V)	Measuring at site	1/0.5M	Contractor
-2	**Wild Life**	Valuable species	Near Project site	Hearing	1/3M	Contractor
-1	**Wild Plant**	Valuable species	Near Project site	Visual inspection	1/6M	Contractor

Ev.	Item	Detailed	Area	Method	Times	Authority in Charge
-1	**Hazardous Waste**	Heavy metal	Near Project site	Hearing	1/0.5M	Contractor
-1	**Domestic Waste**	Domestic Waste	Near Project site	Hearing	1/0.5M	Contractor
-Operation-						
Environment (Natural)						
-2	**Wild Life**	Valuable species	Near Project site	Hearing	1/6M 2-years	ESMU
Social						
-1	**Public Health**	Public Health	Near Village	Hearing	1/6M 2-years	ESMU
-2	**Grievance**	Grievance redress	Concerned people	Hearing	5 times (all)	ESMU

(Estimated Budget for implementation of Environmental Management Plan ant Environmental Monitoring Plan)
(Monitoring Budget Estimate)
Monitoring budgets were estimated based on the project degree of complexity which intern determines the frequency of monitoring activities.
Number of sectors or authorities responsible for the monitoring, is also related to such complexity of the project. Table 1-20 shows the total monitoring budget and mitigation measures budget to implement such items shown in Table 1-18 and Table 1-19.

Table 1-20 Budget for monitoring and mitigation measures estimated for each Project

Project Name / Budget	Mini-Hydro Power Plant	Distribution Lines	(total)
Implementation Cost for MP	240,000,000 kip	88,000,000 kip	328,000,000 kip
Implementation Cost for MM	62,000,000 kip	22,000,000 kip	84,000,000 kip
Sub total	302,000,000 kip	110,000,000 kip	
Total	**412,000,000 Kip**		

1-4-2-1-11 Stakeholder Meeting

(1) First Stakeholder Meeting

The first stake holders meeting was held at Gnod Ou District Administration office on the 11th of September, 2012. Below are the comments made by all parties involved.

This meeting was chaired by Deputy District Party Secretary and Deputy District Governor, Mr. Khongkheo Khantaphom. He raised the following issues and concerns throughout the meeting.

a) There will be high volume water during wet season, with large boulders and debris flowing down the river.
b) Due to geology of the surrounding mountains, landslides occur during the wet season, along both road and river banks. This also contributes to the river sedimentation in Nam Ou and high turbidity.
c) Possible flooding of upstream towns that are along the river. This could impact rice and corn fields as well.
d) With the end of the Sugar Cane Concession in 2013, the district objective is to change crop production to Tea and Coffee, to assist in the increase of the local economy and reducing the influences to erosion.

Comments made by other parties during the meeting were:

a) The proposed watershed conservation of Gnod Ou District (CaA);
b) Compensation should be carried out fairly (Ban Loum, Head of Village);
c) During construction phase of the project, turbidity of water will increase, mitigation measured should be followed (Communications Department);
d) At present, EdL is importing electricity from China at .58 Yuan per kW h or roughly 7000kip kWh. On average, EdL buys power annually for 50million Kip per year, selling to the district at 20million kip per year, to a loss of 30million Kip per year. EdL said they would be very happy to incorporate electricity from this project into the grid to reduce expenditure (EdL);

Upon meeting with the District Environmental Officer, the following topics were discussed.

a) The largest flood that had occurred in Ou Thai was in 2001, which inundated most of the rice crops downstream and covered the bridge coming into Ou Thai. The last major flood before 2001 was in 1970 which saw similar devastation to the township and agricultural land.
b) Prior to 1975 fish stocks were high; reportedly, villagers could even catch fish by hand. 1997-98 fish stocks began to decline. With the increase of more sophisticated fishing techniques and equipment, such as electro-fishing and dynamite.
c) A Mekong River Cat-Fish has been known to move up into the higher parts of Nam Ou, during periods of increased water flow.
d) Population increase since 1975 has seen an increase in the clearing of land for agriculture purposes.

Table 1-21 Members of Participants to the 1st SHM

	Background	Numbers
Local People	Representative of Village (3Villages) -B.Phouxang (Village of upstream) -B.Chompho (Village near Power House) -B.Somxai (Village of downstream)	3 Persons (1 person each Vil.)
Administration	-(PDEM)、EdL	5 Persons
	-Gnod Ou District (Deputy District Governor, Concerned Department)	8 Persons
	-IREP	2 Persons
EdL	-EdL in District	2 Persons
JICA	-Study Team	8 Persons
	-Local Consultant	2 Persons

The pictures below were taken during the District Meeting.


Photo 1-18 1st Stakeholder Meeting at Gnod Ou District Office

(2) Second Stakeholder Meeting

The second stake holders meeting was held at Gnod Ou District Administration office on the 18th of December, 2012. Below are the comments made by all parties involved.
This meeting was chaired by Deputy District Party Secretary and Deputy District Governor, Mr. Khongkheo Khantaphom.
He raised the following issues and concerns throughout the meeting.

[Objective of this meeting]

A explanation on the outline of the results of IEE from the JICA study Team

[Questions from different Departments and organizations]

a) Institute of Renewable Energy Promotion proposed that the Department of Public Work needs to consult with the Project Manager before any construction should take place.
b) The Department of Public Work proposed to consult with contractors first in order to reduce any environmental impact in the Project area.
c) Owner of corn at planed Power house construction site asked for compensation for his 0.3 ha of his land area
d) The Department of Energy and Mine will consult with the concerned organizations to establish a Management Body to deal with any compensation that will occur. They proposed that separate housing should be built for the Dam site workers.
e) The District Head asked for one year compensation during the construction period. After the completion of the Project, there will be some more detail calculation on the actual affected area for compensation.
f) Department of Environmental Conservation will send technical officials to assess the actual corn field, to protect and conserve water resources and to stop the sugar cane plantation in order to promote reforestation.
g) Department of Agriculture and Forestry proposed that after the completion of the Project, there should be budget funding to look after the catchment areas and to provide covers for open channels on order to prevent accidents.
h) Proposed that JICA Project, according to their ability, should build access roads for some of the 3 villages that have no access roads.

According to the discussions, everyone in the meeting had come to the agreement and the meeting was concluded.

Table 1-22 Members of Participants to the 2nd SHM

	Background	Numbers
Local People	Representative of Village（2Villages） -B.Phouxang（Village of upstream） -B.Chompho（Village near Power House）[3] -B.Somxai（Village of downstream）	2 Persons （1 Person each Vil.）
	-Affected people (cultivation of corn at MHP site)	1 Person
Administration	-phongsaly Province (PDEM)、	7 Persons
	-Gnod Ou District(Deputy District Governor, Concerned Department)	11 Persons
	-IREP	1 Persons
EdL	-EdL in District	1 Persons
JICA	-Headquarters (2), Laos Office(2), Expert(1)	5 Persons
	-Study Team	3 Persons
	-Local Consultant	1 Person

1-4-2-2 Land Acquisition and Compensation Plan

1-4-2-2-1 Necessity of Land acquisition or resettlement

Land acquisition is required to enable placement of project facilities with 0.8 ha which belongs to Government as riverside area but this land has been used for corn garden by a local people with getting permission from its owner.
As such acquisition of this land, compensation for loss of livelihood (loss of crop production/income) should be observed and applied, in accordance to Decree 192/PM.
Entitle matrix shown in the table below is based on estimate of total area of corn garden.

Table 1-23 Entitlement Matrix

No	Type of Loss	Application	Definition of Entitled person	Compensation Policy	Entitlement Amount(Kip)
1	Corn	Construction	Mr.X	Land Law Group 4	24,000,000
Total					**24,000,000**

The corn garden's owner Mr. X and his wife will also be compensated in cash, because his income derive from the corn garden is about 12%*[4].

Table 1-24 Income proportion of affected corn garden

No.	Names of owners	Village of residence	Areas (Ha)	Estimate annual income from affected rice fields	Average total annual incomes	Percentage rice field income against annual total income
1	Mr .X	Phouxang	0.80	3,000,000	25,000,000*[5]	12%*[6]

[3] Not fully attend the meeting, but belatedly attend
[4] Presumption by JICA Study Team
[5] ditto
[6] ditto

1-4-2-2-2 Institutional Background of Compensation

(1) Gap between JICA Guidelines and Laws of Lao

There are no gaps between JICA Guidelines and Lao' policy on way of thinking for compensation Table 1-25 shows the Gap between JICA Guidelines and Laws of Lao.

Table 1-25 Gap between JICA Guidelines and Laws of Lao on Compensation Policy

No.	JICA Guidelines	Laws of Lao	Gap between JICA Guidelines and Laws of Lao
1.	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.	Impact assessment method (under Decree 112) required developer to explore viable options (starting at design stage) in order to avoid impact	No Gap
2.	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken.	Decree 192, "Technical Guidelines On Compensation & Resettlement" deals with Involuntary resettlement, compensation & mitigation measures to ensure that affected persons are not worse off and adequately compensated	No Gap
3.	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.	Decree 192, "Technical Guidelines On Compensation & Resettlement" (TGCR) also required, that affected persons are sufficiently supported, during transitional period as well as ensuring they have viable mean and access to sustainable income, and preferably have a better livelihood than pre project period	No Gap
4.	Compensation must be based on the full replacement cost as much as possible.	Decree 192, & "TGCR"	No Gap
5.	Compensation and other kinds of assistance must be provided prior to displacement.	Decree 192, "TGCR"	No Gap
6.	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public.	Decree 192, "TGCR". Required to set up information offices, at provincial capital and on affected villages	No Gap
7.	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance.	Decree 192, "TGCR)	No Gap
8.	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.	Decree 192, "TGCR- chapter 11)	No Gap
9.	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.	Decree 192, "TGCR- chapter 20) e	No Gap
10.	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.	Decree 192, & "TGCR- chapter 12)	No gap
11.	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits. (WB OP4.12 Para.6)	Decree 192, & "TGCR-chapter 7.2.1)	No gap
12.	Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal	Decree 192, & "TGCR chapter 8.3.1- "entitlement to AP without tenure security"	No gap

No.	JICA Guidelines	Laws of Lao	Gap between JICA Guidelines and Laws of Lao
	right to the land they are occupying. (WB OP4.12 Para.15)		
13.	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WB OP4.12 Para.11)	Decree 192, & "TGCR chapter 8.3.1)	No gap
14.	Provide support for the transition period (between displacement and livelihood restoration). (WB OP4.12 Para.6)	Decree 192, & "TGCR)	No gap
15.	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc. (WB OP4.12 Para.8)	Decree 192,& "TGCR chapter 20) Specific groups- eg women (gender), ethnic as well as "vulnerable group" are given special attention & encourage to participant	No gap
16.	For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared. (WB OP4.12 Para.25)	Decree 192, & "TGCR)	No gap

1-4-2-3 Others

1-4-2-3-1 Other compensation or support without Land acquisition / Resettlement

Compensation to crops of paddy-field is needed by the implementation of construction of Mini-Hydro Power. Acquisition such paddy-field is not necessary, because the impact is considered minor (occasional flooding) however compensation for loss of livelihood should be observed and effected, in accordance to Decree 192/PM.
Compensation for loss mentioned above is to be implemented according to relevant laws and decrees of Lao which having no Gaps with JICA Guideline as shown in Table 1-25. Table 1-26 shows the object of compensation and its needed budged.

Table 1-26 Object of compensation and its needed budget（Kip）

Type of Project	Area (ha)	Production Capacity (kg/ha)	Price Kip/kg	Term of compensation	Total (Kip)
Mini-Hydropower	2.66	2,500	3,000	3	59,850,000
Total					**59,850,000**

Note) The compensation cost calculation was based on "Technical Guideline on Compensation and Resettlement of People Affected by Development Projects"

1-4-2-3-2 Effects to climate change

This projects are planned to provide electricity to the areas where are now being supplied with electricity from china through the 35kv/22kv distribution lines, so that, after completion of these projects, it is predicted that a total amount of **3,367 ton of CO^2** will be reduced in china.

(Note: estimation basis based on Chinese data)
0.9873(tCO2/MHh) X 3,100 MHh X 1.1(distribution loss rate) = ***3,367tCO2***

1-4-2-3-3 Monitoring Form

Monitoring forms of the Project which will be used to submit to concerned authorities and JICA are shown in Table 1-27 and Table 1-28.

Table 1-27 MONITORING FORM (mini-hydropower plant)

<Construction Phase>

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
ex.) Responses/Actions to Comments and Guidance from Government Authorities	

2. Mitigation Measures

- Air Quality（Ambient Air Quality）

Item	Unit	Measured Value（Mean）	Measured Value（Max.）	Country's Standards	Referred International Standards (WHO)	Remarks (Measurement Point, Frequency, Method, Term of investigation, etc.)
Dust	mg/m^3				**0.02(year) 0.05(day)**	

- Water Quality（Effluent/Wastewater/Ambient Water Quality）

Item	Unit	Measured Value（Mean）	Measured Value（Max.）	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
pH					6.5-9.5（EU[7]）	pH
SS (Suspended Solid)	mg/l				100（Japan's Standard）	SS (Suspended Solid)
DO (Dissolved Oxygen)	mg/l				＞5（Japan's Standard	DO (Dissolved Oxygen)

- Waste

Monitoring Item	Monitoring Results during Report Period
Domestic Waste	
Industrial Waste	

- Noise / Vibration

Item	Unit	Measured Value（Mean）	Measured Value（Max.）	Country's Standards	Referred International Standards (WHO)	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level	dB				70dB	

[7] EU: EU Directives

3. Natural Environment
- Ecosystem

Monitoring Item	Monitoring Results during Report Period (Method of survey)
Impacts to Valuable species (Big mammals)	
Impacts to Wild Valuable Plants	
Impact to Aquatic Valuable Plants	
Impact to Slope (Erosion)	

4. Social Environment
- Land Acquisition and Compensation

Monitoring Item	Monitoring Results during Report Period (Method of survey)
Land Acquisition for Power plant of 0.8Ha	
Compensation for corn crops at Power plant site	

5. Social Environment
- Living / Livelihood

Monitoring Item	Monitoring Results during Report Period (Method of survey)
Level of livelihood of former corn field owner at Power plant site	

- Accidents, Working environment, HIV/AIDS

Monitoring Item	Monitoring Results during Report Period (Method of survey)
Accidents	
Working environment	
Infectious Diseases such as HIV/AIDS	

6. Others
- Compensation to rice field which anticipated of floods

Monitoring Item	Monitoring Results during Report Period (Method of survey)
Compensation to rice field owner at anticipated floods	

<Operation Phase>

1. **Response/Action to Comments and Guidance from Government Authorities and the Public**

Monitoring Item	Monitoring Results during Report Period	Frequency
Number and contents of formal comments made by the public		
Number and contents of responses from Government agencies		

2. Countermeasures to Pollution
- Water Quality

Monitoring Item	Monitoring Results during Report Period	Frequency
pH		
SS (Suspended Solids)		
DD (Dissolved Oxygen)		

3. Natural Environment

Monitoring Item	Monitoring Results during Report Period	Frequency
Aquatic Valuable Plants		
Wild Life Animals		
Wild life Plants		
Erosion		

- Waste

Monitoring Item	Monitoring Results during Report Period	Frequency
Domestic Waste		
Industrial Waste		

4. Social Environment
- Accidents, Working environment, HIV/AIDS

Monitoring Item	Monitoring Results during Report Period	Frequency
Working environment		
Infectious Diseases such as HIV/AIDS		
Livelihood/ Grievance		

Table 1-28 MONITORING FORM (Distribution Lines)

<Construction Phase>

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Responses/Actions to Comments and Guidance from Government Authorities	

2. Mitigation Measures

- Air Quality（Ambient Air Quality）

Item	Unit	Measured Value（Mean）	Measured Value（Max.）	Country's Standards	Referred International Standards (WHO)	Remarks (Measurement Point, Frequency, Method, Term of investigation, etc.)
Dust	mg/m^3				0.02(year) 0.05(day)	

- Waste

Monitoring Item	Monitoring Results during Report Period
Domestic Waste	
Industrial Waste	

- Noise / Vibration

Item	Unit	Measured Value（Mean）	Measured Value（Max.）	Country's Standards	Referred International Standards (WHO)	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level	dB				70dB	

3. Natural Environment

- Ecosystem

Monitoring Item	Monitoring Results during Report Period (Method of survey)
Impacts to Valuable species (Big mammals)	
Impacts to Wild Valuable Plants	

4. Social Environment

- Living / Livelihood

Monitoring Item	Monitoring Results during Report Period (Method of survey)
Level of livelihood	

<Operation Phase>

1. Response/Action to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period	Frequency
Number and contents of formal comments made by the public		
Number and contents of responses from Government agencies		

2. Natural Environment

Monitoring Item	Monitoring Results during Report Period	Frequency
Wild Life Animals		

3. Social Environment
- Accidents, Working environment, HIV/AIDS

Monitoring Item	Monitoring Results during Report Period	Frequency
Infectious Diseases such as HIV/AIDS		
Livelihood/ Grievance		

1-4-2-3-4 Environmental Checklist

Table 1-29 Checklist on Mini-Hydro Power

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) N (b) Y (c) N (d) N	(a) IEE report is mandatory. Under carrying out. (b) Approved on “20 February 2013”. (c) No conditions. (d) Not required.
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) Y	(a) Outlines of the Project have been disclosed to concerned people at SHM. (b) Comments are reflected to design of Project (Fish way , reduced weir.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Three alternatives are discussed with No option.
2 Pollution Control	(1) Water Quality	(a) Does the water quality of dam pond/reservoir comply with the country’s ambient water quality standards? Is there a possibility that proliferation of phytoplankton and zooplankton will occur? (b) Does the quality of water discharged from the dam pond/reservoir comply with the country’s ambient water quality standards? (c) Are adequate measures, such as clearance of woody vegetation from the inundation zone prior to flooding planned to prevent water quality degradation in the dam pond/reservoir? (d) Is there a possibility that reduced the river flow downstream will cause water quality degradation resulting in areas that do not comply with the country’s ambient water quality standards? (e) Is the discharge of water from the lower portion of the dam pond/reservoir (the water temperature of the lower portion is	(a) N (b) - (c) - (d) N (e) N	(a) No reservoir, No dam pond. (b) No discharged water. (c) No reservoir, no dam pond. (d) No change. (e) No reservoir, no dam pond.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		generally lower than the water temperature of the upper portion) planned by considering the impacts to downstream areas?		
	(2) Wastes	(a) Are earth and sand generated by excavation properly treated and disposed of in accordance with the country's regulations?	(a) Y	(a) Excavated earth is used for construction materials, rest of earth is carried to other and greened.
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) No.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) Is there a possibility that the project will adversely affect downstream aquatic organisms, animals, plants, and ecosystems? Are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that installation of structures, such as dams will block the movement of the migratory fish species (such as salmon, trout and eel those move between rivers and sea for spawning)? Are adequate measures taken to reduce the impacts on these species?	(a) N (b) N (c) N (d) Y	(a) No. (b) No. (c) No impacts to downstream as maintenance flow is being kept. (d) No big migratory fish. Fish path is constructed to help small fish to come upstream, thus no impacts to fish.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(3) Hydrology	(a) Is there a possibility that hydrologic changes due to the installation of structures, such as weirs will adversely affect the surface and groundwater flows (especially in "run of the river generation" projects)?	(a) N	(a) No impacts to hydrologic changes as weir is small and no water diversion.
	(4) Topography and Geology	(a) Is there a possibility that reductions in sediment loads downstream due to settling of suspended particles in the reservoir will cause impacts, such as scouring of the downstream riverbeds and soil erosion? Is there a possibility that sedimentation of the reservoir will cause loss of the storage capacity, water logging upstream, and formation of sediment deposits at the reservoir entrance? Are the possibilities of the impacts studied, and adequate prevention measures taken? (b) Is there a possibility that the project will cause a large-scale alteration of the topographic features and geologic structures in the surrounding areas (especially in run of the river generation projects and geothermal power generation projects)?	(a) N (b) N	(a) No reservoir No dam pond. (b) No impacts as small weir and no water diversion.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement?	(a) N (b) Y (c) Y (d) Y (e) Y (f) N (g) N (h) N (i) N (j) Y	(a) No Resettlement. (b) Rice crops in anticipated paddy field is compensated. (c) RAP is under complying and compensation and after care is to be done. (d) Based on Law and Guideline, it is to be done appropriately (e) Prepared in document. (f) No Resettlement. (g) No Resettlement. (h) No Resettlement. (i) No Resettlement. (j) Grievance redress mechanism is to be set by Law and Guideline.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?		
	(2) Living and Livelihood	(a) Is there any possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there any possibility that the project causes the change of land uses in the neighboring areas to affect adversely livelihood of local people? (c) Is there any possibility that the project facilities adversely affect the traffic systems? (d) Is there any possibility that diseases, including infectious diseases, such as HIV, will be brought due to the immigration of workers associated with the project? Are adequate considerations given to public health, if necessary? (e) Is the minimum flow required for maintaining downstream water uses secured? (f) Is there any possibility that reductions in water flow downstream or seawater intrusion will have impacts on downstream water and land uses? (g) Is there any possibility that water-borne or water-related diseases (e.g., schistosomiasis, malaria, filariasis) will be introduced? (h) Is there any possibility that fishery rights, water usage rights, and common usage rights, etc. would be restricted?	(a) Y (b) N (c)N (d) Y (e) Y (f) N (g) N (h) N	(a) Air pollution and water contamination is anticipated during construction stage, but watering on road or setting sedimentation pond will decrease its impacts. (b) Electricity supply will benefits to local people. (c) No river use for transportation. (d) Public health education is given construction works. (e) Maintenance water flow is planned. (f) No water use at downstream, project area is far from sea. (g) No possibility as project has not created detention basin. (h) No fishery rights, water usage rights at river.
4 Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) There are no places such as religious heritages.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) There are no places such as landscapes designated by laws.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources to be respected?	(a) N (b) N	(a) Not anticipated adverse impacts to ethnic minorities. (b) Not anticipated adverse impacts to ethnic minorities.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) Y (b) Y (c) Y (d) Y	(a) Adequate measures are written in IEE and to be implemented. (b) Adequate measures are written in IEE and to be implemented. (c) Adequate measures are written in IEE and to be implemented. (d) At local office level (EMU) , adequate measures is to be planned.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce the impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce the impacts?	(a) Y (b) N (c) N	(a) Air pollution and water contamination is anticipated during construction stage, but watering on road or setting sedimentation pond will decrease its impacts. (b) No impacts to surrounding natures as project not needs big civil works. (c) No counter measures as no impacts to social environment.
	(2) Accident Prevention Measures	(a) Is a warning system established to alert the inhabitants to water discharge from the dam?	(a) N	(a) No dam.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
5 Others	(3) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b)Y- (c) Y (d)Y	(a) Compiling monitoring plan and its implementation is mandatory, items having possibility of adverse impact will be monitored. (b) Adequate items are written in IEE and to be implemented (c) At local office level (EMU) , adequate measures is to be planned. (d) These items is being identified by Law and Guideline.
6 Note	(1) Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Forestry Projects checklist should also be checked (e.g., projects in the mountains including large areas of deforestation). (b) In the case of dams and reservoirs, such as irrigation, water supply, and industrial water purposes, where necessary, pertinent items described in the Agriculture and Water Supply checklists should also be checked. (c) Where necessary, pertinent items described in the Power Distribution Lines checklist should also be checked (e.g., projects including installation of electric transmission lines and/or electric distribution facilities).	(a) N (b) N (c) Y	(a) No logging as there are no forest near project site. (b) No reservoir or dam pond. (c) Checklist for D/L is being complying.
	(2) Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as trans boundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	(a) No impacts to global issues as a small project with no impacts to environment.

1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are requested to be made.
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which it is located.

Table 1-30 Check List on Distribution Lines

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) Y (b) Y (c) N- (d) Y	(a) IEE report is mandatory. Under carrying out. (b) Approved on “20 February 2013”. (c) No conditions. (d) Under carrying out. (e) Permission for forest usage is required.
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) N	(a) Outlines of Project have been disclosed to concerned people at SHM. (b) No comments from local people but requested early construction.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) N	(a) No discussion as distribution line is small scale project and not anticipated impacts to environment.
2 Pollution Control	(1) Water Quality	(a) Is there any possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? If the water quality degradation is anticipated, are adequate measures considered?	(a) N	(a) No cutting or filling of earth.
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country’s laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) Y	(a) Site is designated as protected forest, but no impacts to these forest as project works is done only road side from far forest.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife and livestock? (e) Is there any possibility that the project will cause the negative impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystem due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered? (f) In cases where the project site is located in undeveloped areas, is there any possibility that the new development will result in extensive loss of natural environments?	(a) N (b) N (c) N (d) N (e) N (f) N	(a) Surrounding of project site is mainly swidden agriculture and mountain. (b) Not included. (c) No impacts to ecosystem. (d) Not obstruct to animals behavior, habitats. (e) Not anticipated adverse impact to ecosystem. (f) Project site is in development area.
3 Natural Environment	(3) Topography and Geology	(a) Is there any soft ground on the route of power transmission and distribution lines that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed? (b) Is there any possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	(a) N (b) N (c) N	(a) No possibility of erosion as project site is flat and stable slope area. (b) No cutting or filling earth. (c) No cutting or filling earth.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, and people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N (b) Y (c) N (d) N (e) Y (f) N (g) N (h) N (i) N (j) Y	(a) No resettlement. (b) Compensation on crops is to be done. (c) No resettlement. (d) No resettlement. (e) Based laws and guideline , done by document. (f) No resettlement. (g) No resettlement. (h) No resettlement. (i) No resettlement. (j) Grievance redress mechanism is to be set by Las and Guideline.
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary? (c) Is there any possibility that installation of structures, such as power line towers will cause a radio interference? If any significant radio interference is anticipated, are adequate measures considered? (d) Are the compensations for distribution wires given in accordance	(a) N (b) N (c) N (d) Y	(a) Electricity supply not gives adverse impacts. (b) Safety and public health education will be done. (c) No power line towers. (d) Compensation will be done based on laws and guideline.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		with the domestic law?		
4 Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) There are no places such as religious heritages.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) There are no places such as landscapes designated by laws.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N (b) N	(a) Not anticipated adverse impacts to ethnic minorities. (b) Not anticipated adverse impacts to ethnic minorities.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) Y (b) Y (c) Y (d) Y	(a) Adequate measures are written in IEE and to be implemented. (b) Adequate measures are written in IEE and to be implemented. (c) Adequate measures are written in IEE and to be implemented. (d) At local office level (EMU) , adequate measures is to be planned.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce	(a) Y (b) N (c) N	(a) Air pollution and water contamination is anticipated during construction stage, but watering on road or setting sedimentation pond will decrease its impacts. (b) No impacts to surrounding natures as project not needs big civil works.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?		(c) No counter measures as no impacts to social environment.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b)Y - (c) Y (d)Y	(a) Compiling monitoring plan and its implementation is mandatory, items having possibility of adverse impact will be monitored. (b) Adequate items are described in IEE. (c) At local office level (EMU) , adequate measures is to be planned. (d) These items is being identified by Law and Guideline.
6 Note	(1) Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Road checklist should also be checked (e.g., projects including installation of electric transmission lines and/or electric distribution facilities).	(a) N	(a) Impacts to existing road is not anticipated.
	(2) Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed, (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	(a) No impacts to global issues as a small project with no impacts to environment.

1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made.
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the
country and locality in which it is located.

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Overall Goal and Project Goal

The government of Lao PDR (GOL) has a target to improve a national electrification ratio from only 36% in 2000 to 90% in 2020 in the National Scio-economic Development Plan announced in March 2001. The electrification ratio of Lao PDR reached 73% in 2010 and 80.1% in the first half of 2012, however, there is a big regional gap among provinces. Since the electrification in the rural area has been delayed, GOL is focusing on promotion of rural electrification.

Focusing on Phongsaly Province where the project site is located in, the electrification ratio, which is 23% in the first half of 2012, is the lowest among all provinces in Lao PDR. The Province aims to promote its electrification targeting to achieve 60% in 2015, and 70 to 80% in 2020 in terms of household electrification ratio. On the other hand, a part of electric power in Phongsaly Province is imported from China with high tariff of about 9.2 US cents per kWh. Therefore, reduction of power import is one of the key issues of the power sector.

Under such background mentioned above, a mini-hydropower plant will be construct and 22kV distribution line will be extend to un-electrified villages in the Project. The Project is expected to reduce electric power import by approximately 3.1GWh per year, and to contribute in improvement of electrification ratio in Gnod Ou District from the current 32% to 60% after completion of the Project.

2-1-2 Outline of the Project

In order to achieve the above mentioned targets, the Project consists of construction of 450kW mini-hydropower plant, extension of 22kV and 400V distribution lines to un-electrified villages, and technical assistance in establishment of operation and maintenance (O&M) organization and capacity enhancement of its operators. It is expected that the Project will contribute to the reduction of electric power import and the improvement of electrification ratio in Gnod Ou District and Phongsaly Province. In the Project, civil structures will be constructed; turbines and generators will be procured and installed for the mini-hydropower plant. For the distribution extension, 22kV and 400V distribution lines and 22kV/400V transformers will be installed.

2-2 Outline Design of the Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Concept

The Project is to construct a mini-hydropower plant and to extend distribution lines to un-electrified villages in Gnod Ou District, Phongsaly Province, which is the most behind in development in Lao PDR in order to contribute to achievement of the GOL's electrification targets and reduction targets of electric power import.
The capacity of the mini-hydropower plant is planned as 450kW, which is to cover the District's electricity demand after 3years from commissioning of the Project. In accordance with the "Green Growth" policy of Government of Japan, the major equipment such as water turbines and generators will be procured from Japan's small and medium enterprises.
The target areas of the distribution line extension in the Project are selected based on the grid expansion plan in the GOL's rural electrification and in consideration of achievement of 60% of electrification ratio in Gnod Ou District in line with electrification target of Phongsaly Province which accomplishes 60% of electrification ratio by 2015. The specifications of distribution lines are followed

by technical standard of Lao PDR in consideration of easier maintenance by EdL in the future.

2-2-1-2 Meteorological and Hydrological Conditions

(1) Meteorological Data

The characteristic of climate in Lao PDR is a high temperature with a rich precipitation through the year affected by the tropical monsoon influenced by warm wet air from the Bengal Bay where southwestern direction and the South China Sea where southeastern direction. There are two seasons which are the rainy season from middle of May to middle of October and dry season from middle of October to middle of May, and about 85% of annual rainfall is in the rainy season. There is no meteorological observing station near the Project location in Gnod Ou District. Table 2-1 shows meteorological data in Phongsaly meteorological observing station for reference.

Table 2-1 Meteorological Data in Phongsaly Meteorological Observing Station

Items		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Rain Fall	Max.	113.0	52.2	110.8	184.1	420.1	406.5	683.9	438.4	298.7	208.8	109.4	91.4	
	Min.	0.0	0.0	0.0	20.4	0.0	74.8	193.1	134.6	54.2	32.4	0.0	0.0	
	Ave.	21.9	22.3	58.0	80.5	202.7	230.5	355.2	293.1	139.4	98.2	35.6	28.8	1,566.2
Temperature	Max.	29.4	31.0	33.7	34.0	34.8	32.0	32.0	31.3	30.7	29.7	27.8	26.0	
	Min.	3.0	0.4	3.5	6.0	10.7	10.0	10.0	12.4	12.0	10.0	6.5	0.5	
Humidity	Max.	89.0	83.0	79.0	81.0	90.0	97.0	96.0	95.0	94.0	95.0	91.0	91.0	
	Min.	64.0	52.0	49.0	53.0	66.0	77.0	81.0	79.0	74.0	74.0	68.0	67.0	

Source: “Nam Ou Hydropower Project, Feasibility Study, Volume-I Technical Report”, May 2010

The data from three meteorological observing stations in northern Laos, which are M. Ngoy, Vangvieng, and Kasi, is applied to make construction plan because sufficient data for construction plan was not available from Phongsaly meteorological observing station. The number of working available days for the construction was assumed based on the average value of daily rainfall of those three meteorological observing stations.

(2) Hydrological Data

In general, hydrological observation data for 10 years near project site is required for a hydropower generation plan. However, the observation data does not exist near the Project site. The data from the three hydrological observing stations in northern Laos, which are M. Ngoy, Vangvieng, and Kasi, is applied to assume the river flow duration in the Project site.
The assumed river flow duration is shown in Table 2-2.

Table 2-2 River Flow Duration for Power Generating Plan

(m^3/s)

Catchment Area of Project Site=645km^2	Max. Discharge	35 days Discharge	95 days Discharge	185 days Discharge	275 days Discharge	355 days Discharge	Min. Discharge	Annual Average
Average of Vangvieng and Kasi	86.5	39.7	25.3	12.0	6.3	4.4	3.9	17.0

2-2-1-3 Socio-economic Conditions

People in the target area of the Project lives in villages with several dozen to one hundred houses spread deep in the mountains. They earn their living from farming rice, corn, or sugar cane, and growing pigs or chickens. However, their cash income is very small and limited. Average household income of a village is around several million kip per year as self-sufficient livelihoods.
On the other hand, in spite of a limited income, they are using pico-hydro systems whose capacity is around 300W to 1kW in most villages. However, they cannot obtain stable power from pico-hydro

systems, which can be used only for 3 – 4 months a year. They cannot be used in the dry season and also in the flood season. Their life time is normally one to two years. Since the systems are just dipped in the river flow for use, output of the system outputs assumed less than half of its rated capacity. So, it seems that the villagers are paying respectively cost for electricity.

The project area is economically and culturally influenced from China because the China border is near the Project site. Daily commodities are mainly supplied from China and most people understand Chinese language.
Minority tribes called “Akha” and “Kor” live in Phongsaly Province and the tribes are divided into many groups. More other many minority groups live such as “Yao”, “Lolo”, and “Lao Ho”, and they speak their own words. They mainly live in mountainous areas, and they sell vegetables and wild animals in the market in towns to travelers, and get cash income. They can purchase living goods in the market.

2-2-1-4 Conditions on Construction and Procurement

The power development in Lao PDR should be followed Lao Electric Power Technical Standards (LEPTS) in the design and construction. The distribution line should be designed and constructed following not only LEPTS but also the Distribution Line Design Manual of EdL.

Basically, the procurement of labor, construction materials and equipment near the site is difficult. For the work force, even though it is possible to employ temporally unskilled labors from the villages near the site for cash income, it is difficult to secure sufficient quantity and stably employment. Therefore, the procurement of labor force from Vientiane is to be considered. Also for the construction materials and equipment, it is necessary to procure from Vientiane from the viewpoint of securing quality and stability of procurement. As for cements and steel bars, Chinese or Laotian cements and steel bars are used for local construction, however, they cannot be adopted in the Project because the quality of those products is uneven. It is recommended to use Thai and Vietnamese products which are generally used in Laos.

2-2-1-5 Conditions on Local Contractors

Recently, the demand of local contractors increases because many construction projects are pushed forward rapidly in Laos. Therefore, there are some local contractors, which have construction experience and capability to participate in the Project. However, the site management by Japanese and/or third country engineers is still required from the viewpoint of quality and schedule control.

2-2-1-6 Concept of Operation and Maintenance

The operation and maintenance of the distribution lines will be carried out by EdL. EdL has a lot of experience of operation and maintenance of transmission and distribution lines throughout Laos. Therefore, EdL has enough capability and reliance to properly maintain the distribution lines constructed under the Project.

As for O&M of the mini-hydropower plant, PDEM as an asset owner of the power plant will be responsible for sustainable utilization of the mini-hydropower plant. PDEM will provide O&M license to the Special Purpose Organization (SPO), and the SPO will operate and maintain the mini-hydropower plant as a plant operator. PDEM will monitor the SPO’s O&M activities, and provide necessary instruction to the SPO.
For financial management, Provincial Rural Electrification Fund (P-REF) will be established to manage the fund related to the Project for the future overall as well as rehabilitation activities of the plant.

2-2-1-7 Concept on Facilities and Equipment

The scale of the mini-hydropower plant was planned as 450kW consisting of three units of turbines and generators in consideration of power demand of Gnod Ou District three years after the Project completion.
In accordance with the “Green Growth” policy of Government of Japan, the major equipment such as turbines and generators will be procured from Japanese small and medium enterprises. The procurement condition was taken into account for the Project design. The Project site has characteristics of relatively low head but high flood water level. From economical viewpoints, it is preferable to get higher head as much as possible. In consideration of the conditions, a type of turbines and generators were selected to apply to relatively low head and large discharge conditions, and also to get higher head.
As for distribution line extension, the target areas were selected among the rural electrification planning areas, which are planned to be electrified by grid extension in the national electrification plan of GOL. Once the targeted areas are electrified, it will contribute to achieving the electrification target of 60% by 2015 of Phongsaly Province. The distribution lines were designed with the Lao standards in consideration of future maintenance to be done by EdL Meanwhile, service wires and house wiring were not considered under the Project.

2-2-1-8 Concept on Construction and Procurement Method, and Schedule

The weather of Laos is divided into the rainy season and the dry season. The rainy season starts from middle of May, and finishes up to middle of October. The other period is defined as the dry season. In the rainy season, construction works cannot be done, and even transportation of construction materials is difficult. Therefore, most of civil works and distribution works should be done in the dry season, and works in rainy season are limited. In consideration of the weather conditions, overall construction period is assumed for 16 months from October 2013 to January 2015.

Construction of the diversion weir, the intake and the settling basin will be done dividing into left bank and right bank with temporary coffering. Parts of the headrace and the tailrace will be constructed also with temporary coffering.
Most of the works will be done during the first dry season, and the remaining will be done in the second dry season.
Construction of distribution lines will be done also in the first and the second dry seasons in consideration of conditions of access roads.

2-2-2 Basic Plan (Construction Plan / Equipment Plan)

2-2-2-1 Overall Project Plan

As results of the preparatory survey, the Project was planned to construct a 450kW Mini-Hydropower Plant and to extend 22kW and 400kV distribution lines to un-electrified areas in Gnod Ou District in Phongsaly Province.
The overall Project plan is shown in Table 2-3.

Table 2-3 Overall Project Plan

Plan	Items	Profiles	
Mini-Hydropower Development Plan	Type	Run-of-River Type	
	Gross Head	10.8m	
	Effective Head	8.8m	
	Maximum Discharge	7.02m^3/s	
	Installed Capacity	450kW (150kW × 3 units)	
	Annual Generation	3.1GWh	
Distribution Line Extension Plan	Target Area	Northeast	West
	22kV Distribution Lines	76.3km	47.5km
	400V Distribution Lines	10.0km	6.1 km
	22kV/400V Transformers	13 units	10 units

2-2-2-2 Construction Plan

(1) Mini-Hydropower Development Plan

a) Diversion Weir

The diversion weir is designed to minimize its height in order to avoid impacts to upstream as much as possible. As a result, its height became 3m higher than the current water level. Although out crops of sand stone are observed on the left bank abutment, there is possibility that excavation of riverbed becomes huge volume. Therefore, the weir was designed as a floating type dam, which does not require base rock foundation. In this regard, umbonal structure (key) was added at the bottom of the weir in order to lengthen the penetration pass, and an apron was also designed for protection against erosion of toe of the weir.
In addition, fish path was also considered not to disturb fish migration.

b) Intake and Settling Basin

The intake and the settling basin were designed on the left bank in consideration of the function of separation of sand and soil from intake water. Safety of the structure during floods was also taken into account.

c) Headrace

The headrace is basically open channel made of concrete. The portion between +600m to +640m, which is crossing part with the access road to the powerhouse, was designed as a box culvert. The access road will pass above the headrace. The two portions where it is close to the river will be protected with gravity retaining wall to prevent from erosion. The opening area of the headrace will be covered by wire mesh for safety reason and for prevention from trash and garbage entering.

d) Head Tank

The head tank will be installed to secure required regulation capacity for fluctuation of output of the power plant. It will be furnished with the spillway to safely release water when operation of the power plant suddenly stops. In addition, since the head tank is the last structure to remove sand and soil from water, a flushing gate will also be installed.

e) Powerhouse

The powerhouse will be built to obtain spaces for controller and operators' office. I-beam and chain blocks will be installed in the powerhouse to hoist turbines, generators, and inlet valves without heavy equipment.

The flood water level was carefully taken into account when the installation elevation of the powerhouse was decided.

f) Features of Mini-Hydropower Development

The main features of the mini-hydropower development are shown in Table 2-4.

Table 2-4 Main Features of Mini-Hydropower Development

Items			Descriptions							
Site Information	River Name		Num Ou River, Mekong River System, Lao PDR							
	Catchment Area		645km^2							
	River Discharge (m3/s) after extraction of maintenance flow		Max. flow	35th day flow	95th day flow	185th day flow	275th day flow	355th day flow	Min. flow	Annual mean
			86.5	39.7	25.3	12.0	6.3	4.4	3.9	17.8
	Location		Northern part of Gnod Ou District, Phonsary Province, Lao PDR (Approx. 45km downstream from the northern border of China)							
	Restrict Area		Non							
Generation Plan	Name of Power Station		Gnod Ou Hydropower Station (tentative name)							
	Generation Type		Run-Off-River Type							
	Intake Level		E.L. 748.70 m at Intake weir (= Elevation of overflow section at Intake weir)							
	Intake Level		E.L. 747.30 m at Head tank (= Elevation of overflow section at Head tank)							
	Outlet Level		E.L. 737.90 m (using max. intake discharge)							
	Total Head		10.8 m							
	Effective Head		8.8 m							
	Max. Intake Discharge		7.02 m^3/s							
	Installed Capacity		450 kW							
	Continuous Capacity		150 kW							
	Capable Annual Generation		3,490 MWh							
	Annual Generation		3,141 MWh							
	Non-operation ratio		10 %							
Design Outline	Intake Weir	Type	Concrete gravity type (floating type)							
		Height	4.5 m (FWL=754.20m)							
		Length	41.1 m (inclusive of overflow section 31.8m)							
	Intake		On grand surface B4.2m×16.8m×H3.3m							
	Settling basin		On grand surface W10.7m × H3.5m × L31.2m (Max, Inside)							
	Waterway	Headrace	H×W : 2.5×2.0 m Length : 680.5 m Non-pressure type							
		Penstock	D : 1.2 m Length : 5.2 m ×3 Steel pile on ground surface							
		Discharge waterway	W : 3 m Length : 37.5 m Non-pressure type							
	Settling basin		On grand surface W10.7m × H3.5m × L31.2m (Max, Inside)							
	Head tank		On grand surface W5.0m × H6.2m × L32.7m (Max, Inside)							
	Powerhouse		On grand surface W8.9m × H6.7m × L14.0m							
	Turbine		Submersible Pump Turbine 3 set							
	Generator		Synchronous generator-motor 3 set							
Utilization Ratio	Maintenance flow		0.0 m^3/s							
	Water Utilization Ratio		93.5 %							
	Plant Factor		79.6 %							

(2) Distribution Line Extension Plan

The distribution line extension plan was made in accordance with the Lao Electric Power Technical Standards (LEPTS) and Distribution Line Design Manual of EdL. The Design conditions are as follows:

- Types of conductors were selected in consideration of the followings:
  - Voltage drop of 22kV distribution lines will not exceed the allowable range of voltage of transformers,
  - Maximum current will not exceed the allowable current capacity even when reaching the assumed maximum power demand.
- Each pole design was selected from the standard pole design list according to span length and bending angle.

Specifications of the Distribution facilities are as follows:

Table 2-5 Specification of Distribution Facilities

Facilities	Items	Specification
22kV Distribution Lines	Conductor	3 phase Bare ACSR
	Pole	12m Reinforced Concrete Pole
	Others	Cross arm, Insulator, Bolts, etc.
400V Distribution Lines	Conductor	3 phase 4 lines Insulated ACSR
	Pole	8m Reinforced Concrete Pole
	Others	Cross arm, Insulator, Bolts, etc.
Transformers (22kV/400V)	Voltage	Higher side: 22kV (3 phase 3 lines), Lower side: 0.4kV (3 phase 4 lines)
	Capacity	Estimated based on assumed load of each village
	Grounding	With grounding
	Protection Equipment	Higher side: drop out fuse Lower side: fuse in switch box

2-2-2-3 Equipment Procurement Plan

(1) Selection of Main Equipment

1) Unit Output and Unit Number

As mentioned above, the plant output was decided as 450kW in consideration of the future power demand of Gnod Ou District. The unit output is 150kW, and it has three units of turbines and generators. Its reasons are as follows:

- The current minimum demand of Gnod Ou District is about 150kW in day time. In order to avoid reverse current to Chinese power system when at least one unit of the power plant is operated, the unit capacity should be less than the minimum power demand.
- The minimum river discharge is assumed as 3.9 m^3/s on average based on the limited hydrological data. However, in case of the driest year, the river flow may become much less than the assumed minimum discharge. So, the unit discharge was set as 2.34 m^3/s.

In consideration of convenience of maintenance such as common use of spare parts, specification of each unit is the same as others.

2) Water Turbine

The characteristics of the Project is relatively low head (Gross head: 10.8m) and high discharge (7.02 m^3/s) for mini-hydropower project. And also, the flood water level becomes about 5m higher than the normal water level. In order to effectively utilize the head for generation, it is required to install the turbines and generators at lower elevation as much as possible. For the purpose, it is preferable to select water turbines and generators, which can be submerged when flooding, In consideration of the conditions, “submergible pump turbine combined with

generator" is selected.

3) Generator

As mentioned above, "submergible pump turbine combined with generator" was selected. As for types of generator is divided into two; the one is a synchronous type and the other is an induction type. For small power system, an induction type, which has no own power source, is not used because it may cause instability of the power system by its fluctuation of voltage in nature. Therefore, a synchronous type was selected for the Project.

4) Controller

Control of the main equipment is mainly divided into two; the one is start and stop control, the other is output control.

The starting operation of the main equipment will be done as the following steps:

- Operators control the switch manually,
- The Inlet valves are opened automatically,
- Synchronizing control is done to adjust rotating speed and voltage,
- Circuit Breaker is closed.

For the stopping operation, operators manually control the switch to stop, and equipment is stopped through the reverse steps of starting operation automatically.

The output control will be done manually by operators according to instruction and order from the Lanthouy substation at the China border.

(2) Specifications of Equipment

Specifications of the equipment are shown in Table 2-6.

Table 2-6 Specifications of Equipment

Equipment	Specification	No.	Application to
Water Turbine	Submerged Turbine Generator Type: Vertical Shaft Propeller Turbine Effective Head: 8.8m Maximum Discharge: 2.34 m^3/s/unit Maximum Output: 173.5 kW/unit or more Rotation Speed: 600 min^{-1}	3 units	
Generator	Submerged Turbine Generator Type: Vertical Shaft Three Phase Synchronous Generator Rated Output: 166.7kVA or more Rated Rotation Speed: 600min^{-1} Rated Voltage: 440V Rated Frequency: 50Hz Type of Insulation: F	3 Units	
Inlet Valve	Type: Butterfly Valve Driving Type: Electric Drive	3 Units	
Controller	Start and stop Operation of the Plant Protection Stop Control Voltage, Current, Output Observation Automatic Synchronizer Protection Relay Isolated Operation Detecting Device	1 Ls	
Main Transformer	Type: Oil Self Cooling Three Phase Transformer Rated Capacity: 500kVA Voltage: 22kV/440V	1 Ls	For Step-up
Transformer for Powerhouse	Type: Dry Three Phase Transformer Rated Capacity: 30kVA Voltage: 440V/200V	1 Ls	For power source in the powerhouse
Main Circuit System	Circuit Breaker Transformer for Instrument Current Transformer for Instrument	1 Ls	
DC Power Source System	Battery Battery Charger DC Panel board	1 Ls	Power source for Controller and protection equipment
Switch Gear	Three Phase Switchgear with Fuse Transformer for Instrument Current Transformer for Instrument Arrester	1 Ls	

2-2-3 Outline Design Drawings

The drawings of the outline design for the Project are listed below. Those drawings are attached as appendices.

No-1 : General Plan
No-2 : Diversion Weir, Intake, Settling Basin Plan
No-3 : Diversion Weir, Intake, Settling Basin Cross Section 1
No-4 : Diversion Weir, Intake, Settling Basin Cross Section 2
No-5 : Diversion Weir, Intake, Settling Basin Cross Section 3
No-6 : Diversion Weir, Intake, Settling Basin Cross Section 4
No-7 : Diversion Weir Cross Section
No-8 : Intake and Settling Basin Front View, Longitudinal Profile
No-9 : Headrace Plan 1
No-10 : Headrace Plan 2
No-11 : Headrace Channel Typical Section
No-12 : Headrace Longitudinal Profile
No-13 : Head Tank and Powerhouse Plan
No-14 : Head Tank and Powerhouse Cross Section 1
No-15 : Head Tank and Powerhouse Cross Section 2
No-16 : Head Tank and Powerhouse Cross Section 3
No-17 : Head Tank and Powerhouse Cross Section 4
No-18 : Head Tank and Powerhouse Cross Section 5
No-19 : Powerhouse Plan and Sections 1
No-20 : Powerhouse Plan and Sections 2
No.21 : General Section
No.22 : Submergible Turbine Generator
No-23 : Single Diagram
No-24 : Distribution Design Priority 1
No-25 : Distribution Design Priority 2
No.26 : Standard MV Single Pole Design
No.27 : Standard MV Double Pole Design
No.28 : Standard MV Transformer Mounted Pole Design
No.29 : Standard MV Pole Foundation Design
No-30 : LV Distribution Design, Boxao
No-31 : Standard LV Pole Design
No-32 : Standard LV Pole Foundation Design

2-2-4 Implementation Plan

2-2-4-1 Policy on Construction Plan

(1) Basic Policy on Construction

The basic policy on construction of the Project is as follows:

- The construction plan and its schedule should be prepared in consideration of the physical conditions of the Project site such as hydrology, meteorology, geography, geology as well as characteristics of the river flow.
- Common construction technology, which does not require special equipment and materials, should be used for the construction as much as possible.
- Appropriate technical specification and standards for construction supervision should be set in advance, and construction supervision and construction plan should be prepared based on the specification and standards.
- Efforts to avoid water pollution by the construction should be made as much as possible, and construction yards such as quarry site and spoil bank should be selected near the Project site in considerations of environmental and social considerations.

(2) Basic Policy on Procurement

The basic policy on procurement for the Project is as follows:

- In accordance with the "Green Growth" policy of Government of Japan, the major equipment such as turbines and generators will be procured from Japan's small and medium enterprises.
- Other construction materials, equipment and labors will be procured in Lao PDR as much as possible. For construction materials, equipment and engineers, which are not available in Lao PDR, will be procured from the third countries or Japan as long as quality and reliability are secured.

(3) Basic Policy on Construction Management and Supervision

The basic policy on construction supervision is as follows:

- Minimum but essential number of engineers will be assigned for quality and schedule control of the construction for responsibility of the contractor.
- Since the Project site is located in the remotest part of Lao PDR, smooth procurement of construction materials, equipment, labors will be a key issue for schedule control of the Project. In this regard, an office manager will be assigned for the Project.
- Basically, local contractors will be hired for the construction works as much as possible. Instead, experienced engineers will be dispatched from Japan or the third countries to secure quality as necessary.

As for construction supervision, minimum but essential number of engineers will be assigned. Basically, a resident engineer (civil engineer) will supervise the overall construction works. In addition, specific technical engineers will be dispatched for short time when required to secure the function of the structures and facilities.

(4) Responsible and Implementing Organizations of the Laotian Side

Responsible and implementing organizations of the Laotian side for the Project are shown in Table 2-7.

Table 2-7 Responsible and Implementing Organizations of the Laotian Side

Project Components	Responsible Organization	Implementing Organizations	
		Construction Stage	Operation and Maintenance Stage
Mini-Hydropower	IREP / MEM	IREP / MEM, and PDEM (EdL: Technical Support)	PDEM
Distribution Line			EdL

2-2-4-2 Construction Conditions

(1) Natural Conditions

Rainy season at the Project site is from middle of May to middle of October. Though there is some time difference between rainy season and high flow season, Construction works such as intake weir in the river must be done during dry season when water level of the river is relatively low.

(2) Local Procurement Conditions

In general, it is relatively difficult to locally procure construction materials, equipment and labor around the Project site.

Since cash income of the local people is quite limited, they are living a self-sufficient life. In such circumstances, it may be possible to employ local people as a simple labor just in short period and in small scale, but it is difficult to stably secure labor force during the construction period. Therefore, it is necessary to arrange to procure not only technical engineers but also simple labor from Vientiane.

As for materials and equipment, imported items from China can be locally available. However, from viewpoints of securing quality and stable supply, those should also be procured and transported from Vientiane and the third countries.

For transportation of materials from Vientiane to the Project site, it takes about 26 hours. It is required to consider the following measures for securing construction materials:

- Transportation during dry season,
- Keeping sufficient stock at the site,
- Preparing alternative route to the Project site, etc.

(3) Conditions related to Renovation Plan of the Existing Road

The Department of Public Works and Transportation of Phongsaly Province has a plan to renovate the existing road from Boun Nuea to the China border via Ou Thai from 2013. The road runs beside the Project site, and it will be used as an access route and transportation route. Therefore, it is required to closely coordinate the Department in order to avoid any conflict to the implementation of the Project.

2-2-4-3 Scope of Works

Scope of works of the Project is shown in Table 2-8.

Table 2-8 Scope of Works

Category	Items	Major Facility/ Equipment
Facility	Civil Works for Mini-Hydropower Plant	・Diversion Weir ・Intake, Settling Basin ・Headrace ・Head Tank, Powerhouse, Tailrace
	Distribution Extension Works	・22kV Distribution Line ・400V Distribution Line ・22kV/400V Transformer
Equipment	Procurement for Mini-Hydropower Plant	・Water Turbine, Generator ・Controller ・Inlet Valve, Penstock ・Main Transformer, Switch Gear

2-2-4-4 Consultant Supervision

(1) Basic Policy

The roles of Japanese consultant engineers are to supervise and instruct contractors in order to keep quality, schedule and safety of the construction. Considerations for quality, schedule and safety control to be taken are as follows:

a) Quality Control

- Request the contractors for construction drawings, and check them whether major structure and facilities comply with original design and specifications,
- Check structures at the site whether those meet original design and drawings,
- Participate in quality management test and factory test, and check quality of the materials and equipment,
- Participate in and conduct commissioning test of the facilities, and confirm those quality and functions.

b) Schedule Control

- Confirm progress of construction works, and compare with original schedule,
- Confirm process of procurement of construction materials and equipment, and analyze delaying factors in case,
- Periodically hold and participate in schedule coordination meeting.

c) Safety Control

- Assist the contractors in safety education for engineers and workers to avoid electrocution and any other accidents, and confirm each work procedure in advance,
- Assign traffic assistants to avoid public accidents because the construction will be done along the main public road,
- Take anti-scattering measures and restrict traffic when doing blustering work,
- Carry out safety patrol to avoid accidents,
- Prepare an emergency information network for immediate communication among concerned just for in case.

(2) Consultant Arrangement for Construction Supervision

In order to smoothly and appropriately carry out construction supervision, an experienced engineer as Project Manager who is familiar with the Project will be assigned.

Responsibility for quality, schedule and safety control basically lay to the contractors, essential but minimum consultant engineers will be assigned for construction supervision. As a resident supervising engineer, a civil engineer will be assigned. In accordance with the construction schedule, additional engineers such as a civil, metal, electrical/mechanical, and distribution engineers will tentatively be assigned to the Project site as necessary.

The consultant engineers and staff for construction supervision to be assigned and those roles are shown in Table 2-9.

Table 2-9 Consultant Arrangement for Construction Supervision

Engineers and Staff	M/M	No. of Visit	Roles and Responsibility
Project Manager (Experience more than 18 years)	1.00	2	・ Coordination and necessary arrangement at construction commencement ・ Predication in commissioning test
Resident Supervisor (Civil) (Experience more than 13 years)	16.00	1	・ Overall supervision of construction from the start to the end ・ Coordination with related organizations
Civil Engineer (Experience more than 13 years)	4.00	4	・ Supervision during the diversion work ・ Supervision before Rainy season starts ・ Supervision just after Rainy season ・ Commissioning test for civil works
Metal Engineer (Experience more than 13 years)	2.00	2	・ Supervision of metal works for gates and screens
Electrical/Mechanical Engineer (Experience more than 13 years)	2.00	1	・ Supervision of installation of equipment, ・ Participation in commissioning test
Distribution Engineer (Experience more than 13 years)	3.00	3	・ Supervision during start of distribution works, ・ Supervision during commissioning of 22kV distribution lines, ・ Supervision during commissioning of 400V distribution lines,
Electrical/Mechanical Engineer (Experience more than 13 years)	0.1	―	・ Participating in factory test of equipment
Total	4.23		
【Local Staff】			
Driver	16.00	―	・ Driving a car for the Resident Engineer
Office boy	16.00	―	・ Assisting in preparation of reports, ・ Communication with related organizations, ・ Miscellaneous tasks

2-2-4-5 Quality Control Plan

(1) Civil Structures

Required quality control for civil works is for concrete. The contractor shall carry out sample tests such as compression test of concrete specimen to confirm compliance with the contract specifications.

(2) Equipment

Quality control of equipment will be done as follows:

- The equipment supplier shall submit design drawings for confirmation of compliance with the specifications,
- The consultant engineer will participate in factory test,
- When equipment is delivered at the Project site, contents of equipment and damages during transportation will be checked.

2-2-4-6 Procurement Plan

(1) Construction Materials and Equipment

In accordance with the "Green Growth" policy of Government of Japan, the major equipment such as water turbines and generators will be procured from Japan's small and medium enterprises while other equipment such as distribution panels will be procured from the third countries such as Southeastern countries. That equipment will be transported from Japan and the third countries to Bangkok in Thailand by sea, and transported to the Project site via Vientiane by land.

Most of other construction materials, equipment and labors will be procured in Lao PDR as much as possible. For construction materials such as parts of reinforcement bars and concrete admixture, which are not available in Lao PDR, will be procured from the third countries.

(2) Policy on Spare Parts Supply

Spare parts and tools, which are required for continuous operation and maintenance, will be supplied in the Project. Spare parts are categorized as supplies and substitute parts. Under this Project, supplies such as lamps, fuses and recording papers required for normal operations, will be supplied. And also, substitute parts, which are needed to be urgently replaced in case of a failure of parts, will be supplied under this Project.

(3) Concept of Defects Liability

The defects liability will be requested to all the equipment rehabilitated in the Project for one year after taking over. Even if the defects arise on the part out of scope of the Project, it shall be included in the part to be liable in case of such defects caused by Project execution.

2-2-4-7 Operational Guidance Plan

The basic knowledge for the operation and maintenance of power generation facilities will be instructed to nominated operators in the Soft Component mentioned hereinafter, while initial operation manner of installed equipment in the Project will be instructed directly by the technical advisor of the manufacturer while commissioning test. The commissioning test is planned about one month before start operation, and the nominated operators will join the test.

2-2-4-8 Soft Component (Technical Assistance) Plan

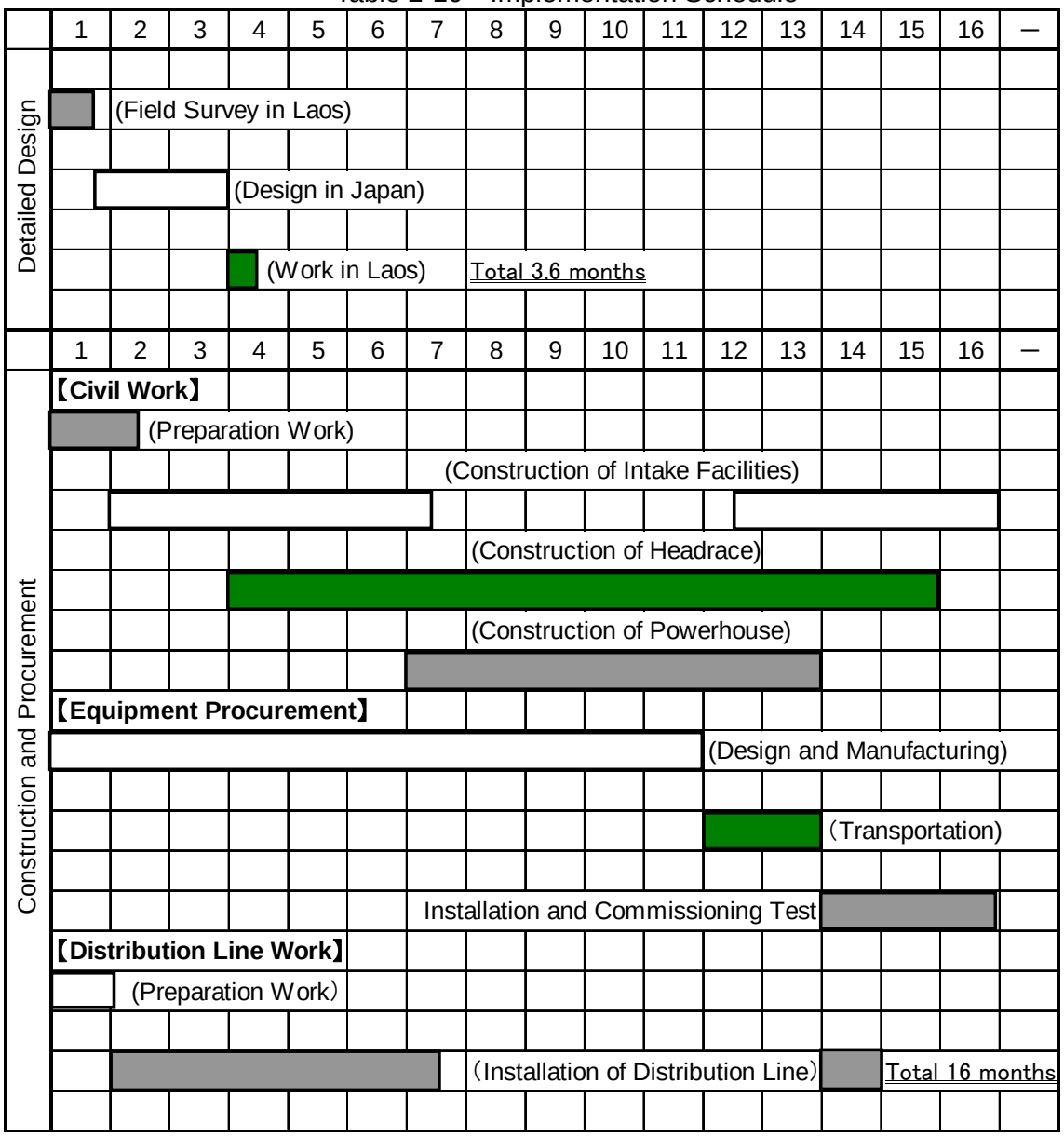
PDEM as an asset owner of the power plant is responsible for sustainable utilization of the mini-hydropower plant. PDEM will provide O&M license to the Special Purpose Organization (SPO), and the SPO will operate and maintain the mini-hydropower plant as a plant operator. For financial management, Provincial Rural Electrification Fund (P-REF) will be established to manage the fund related to the Project for the future overall as well as rehabilitation activities of the plant.

In order to ensure sustainable operation of the power plant, technical assistance as soft components of the Project will be provided to support 1) establishment of P-REF, 2) Selection and procurement of SPO, and 3) Strengthening capability of PDEM staff who are supposed to monitor and supervise SPO's O&M activities and P-REF's financial management.

Details of the soft component plan are shown in Appendix-5.

2-2-4-9 Implementation Schedule

Table 2-10 Implementation Schedule



2-3 Obligation of Recipient Country

For implementation of the Project, the Laotian Side shall take responsibility for the followings:

(1) Permitting and Licensing Procedures for Construction of Mini-hydropower Project
The Laotian side shall take permission and licensing procedures required for mini-hydropower development in compliance with the Lao Electric Power Technical Standards (LEPTS).
In addition, the Laotian side shall also take procedures for permission on aggregate production at the Project site.

(2) Environmental and Social Considerations
Initial Environmental Examination (IEE) was submitted to Provincial Department of Natural Resources and Environment (PNRE) in December 2012, and it was approved on February 20, 2013.

Further, land acquisition and compensation to Project Affected People will be negotiated and settled by the compensation committee, which will be formulated at the Gnod Ou District Office, organized by three (3) parties, i.e., chief of villages, chief of district and PDEM.
In addition, the Laotian side shall conduct environmental and social monitoring during and after the construction, based on the environmental monitoring plan as mentioned above.

(3) Establishment of O&M Organization
The Laotian side shall establish an O&M Organization for the mini-hydropower plant by commencement of the Project implementation.
Since training of PDEM officials and operators is scheduled from right after the commencement of the Project, it is required to prepare hiring process when the construction starts.

(4) Exemption of Tax and Customs Duty
The Laotian side will take procedures to exempt customs duties, internal taxes and other fiscal levies, which may be imposed in Laos with respect to the purchase of the products and services. And also, the Laotian side shall ensure tax exemption and customs clearance of products of disembarkation in Laos and assist internal transportation of the products.

(5) Banking Arrangement and Authorization to Pay
The Laotian side should open an account under the name of the Government of Laos in a bank in Japan, and bear an advising commission of an Authorization to Pay and payment commissions paid to the bank.

(6) Others
a) Coordination with related organizations for implementation of the Project.
b) Proper management of fund to be transferred from the Project to Rural Electrification Fund (REF)

2-4 Project Operation Plan

2-4-1 Basic Policy

After completion of the distribution lines under the Project will be operated and maintained by EdL which is operating nationwide power system including distribution lines. There is no concern about its capability to maintain the constructed distribution lines. Therefore, O&M management plan is described in this section.

After completion of the mini-hydropower plant, PDEM as an asset owner of the power plant will be responsible for sustainable utilization of the mini-hydropower plant. PDEM will provide O&M license to the Special Purpose Organization (SPO), and the SPO will operate and maintain the mini-hydropower plant as a plant operator. For financial management, Provincial Rural Electrification Fund (P-REF) will be established to manage the fund related to the Project for the future overall as well as rehabilitation activities of the plant.

The management plan of the mini-hydropower plant and related assistance for establishment of organizational structure and capacity building is described as follows.

2-4-2 Management Framework and O&M Structure

The management structure for the mini-hydropower plant, which is agreed upon with GOL is shown in Figure 2-1.
The roles of the main parties are as follows:

1） Provincial Department of Energy and Mines (PDEM) of Phongsaly
PDEM will have a key role of technical monitoring of the plant operation and fund supervision/management for sustainable operation of the mini-hydropower plant as an asset owner.

2） Special Purpose Organization (SPO)
SPO will operate and maintain the mini-hydropower plant as a plant operator in compliance with the conditions of PPA and licensing, which will be set during the preparation stage of the SPO selection.
Selection of the SPO will be done by open bidding from private companies and governmental enterprises whoever has sufficient technical and financial capability complying with the selection criteria, which will be set during preparation stage. In case that no entity is eligible as the SPO, a community-based organization will be set up.

3） Provincial Rural Electrification Fund (P-REF)
P-REF and its account will be newly created in Phongsaly in order to manage fund generated from the operation of the mini-hydropower plant.
In order to facilitate the payment/fund-release and administration of P-REF, an operation manual for P-REF needs to be prepared in reference to the national REF's manual.
In accordance with the prepared manual, P-REF will receive monthly payment from EdL, and make monthly payment to the SPO. P-REF will keep and accumulate fund for the future overhaul and replacement, and release the fund for the specific purpose when required. P-REF will save and release additional fund for electrification-related projects in the Province.

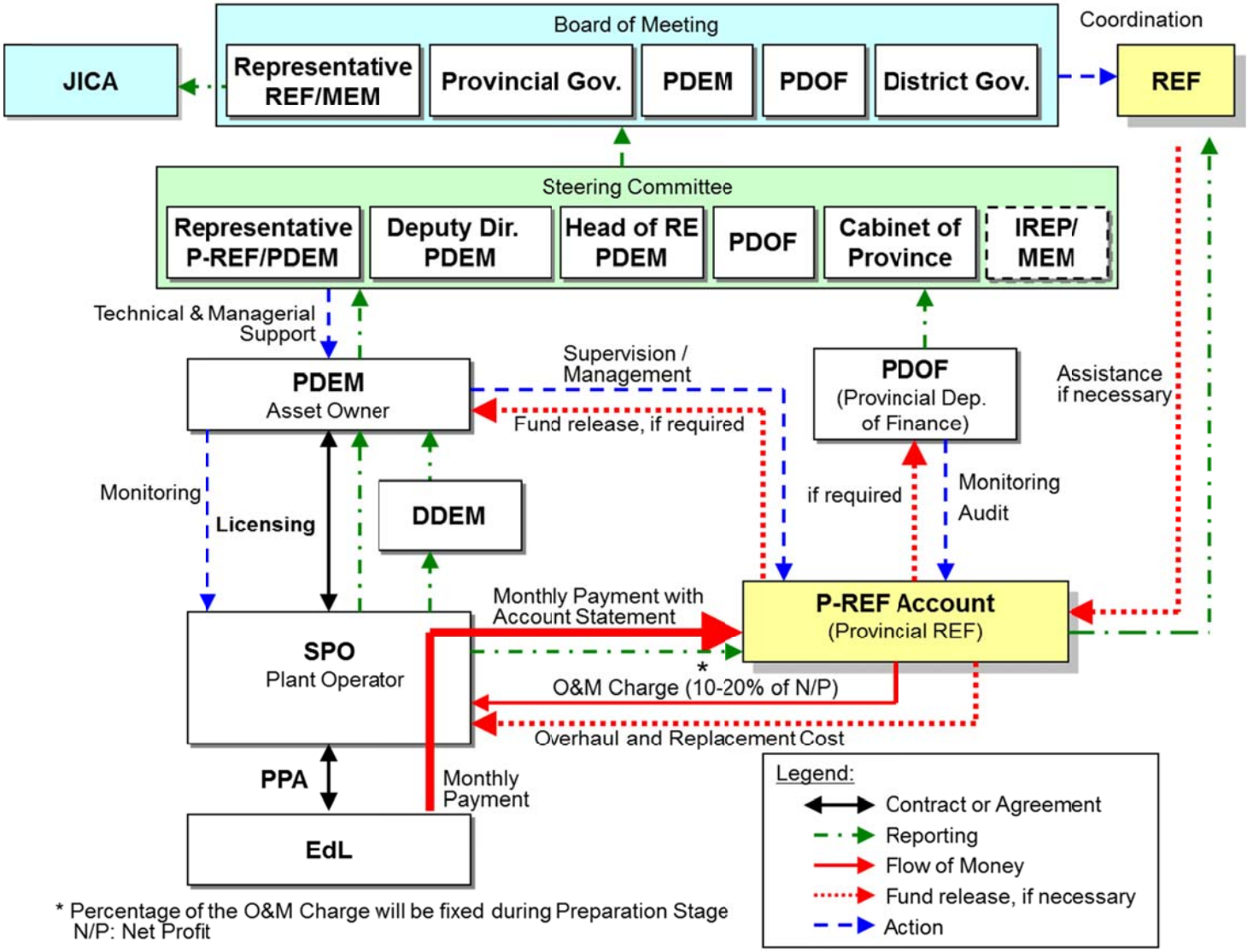


Figure 2-1 Project Management Structure (Draft)

2-4-3 Operation and Maintenance Method

Method of operation and maintenance of the mini-hydropower plant is shown in the table below.

Table 2-11 Operation and Maintenance Method

Entities	Items	Tasks
PDEM	・ Monitoring of the power plant, ・ Reporting to Steering Committee	1) Monitoring/supervising SPO's O&M through report from DDEM or direct plant visit; 2) Periodic reporting to steering committee.
DDEM	・ Monitoring of the power plant, ・ Reporting to PDEM	1) Monitoring/supervising SPO's O&M; 2) Periodic reporting to PDEM
SPO	・ Plant Operation	1) Daily Operation: - Operate the gates of intake and settling basin; - Communicate with EdL's sub-station, and; - According to instruction and order from the substation, control output of the power plant. 2) Flood Response: - Control the flushing gate and intake gate when river flow become flood level, and stop plant operation, and; - After water level become normal level, resume plant operation. 3) Operation Record: - Keep hourly operation record.
	・ Inspection and maintenance	1) Daily Patrol: - Conduct daily patrol to observe and check operation conditions of facilities; - In case that abnormal conditions are found, response to take measures. - Remove trash and garbage from intake and head tank screens. 2) Periodic Inspection - Conduct periodic inspection to confirm conditions and to maintain functions of equipment. 3) Detailed Inspection - Once in several years, operation of the power plant is suspended for detailed inspection. Spare parts are replaced as necessary. 4) Maintenance and Inspection Record - All maintenance and inspection is recorded.
	・ Replacement of Spare Parts	1) Replacement of supplies and substitute parts - Supplies and substitute parts are replaced periodically or when is required.
	・ Business Management	1) Billing Procedures - Read an electric meter of selling power, and send invoice to EdL. - Forward monthly income from EdL to P-REF; - Send invoice with account statement to P-REF for Monthly payment.

2-4-4 Set-up Plan of Plant Management Structure

PDEM, SPO and P-REF will take important roles to function the plant management structure As shown in Figure 2-1.

PDEM as an asset owner of the power plant will conduct technical monitoring of SPO's O&M activities, and provide necessary instruction to SPO. In this regard, PDEM staff should enhance their capability to have sufficient knowledge of the plant facilities and those O&M. Therefore, technical assistance to improve their capability is required.

On the other hand, since SPO will be selected from technically and financially capable entities, it seems that direct assistance to improve its capability is not necessary. For smooth procurement of SPO, assistance in preparation of criteria for SPO selection and the procurement procedures seems necessary.
In addition, P-REF will be established to manage the fund related to the Project for the future overall as well as rehabilitation activities of the plant. For establishment of P-REF, its management manual should be prepared.

The establishment of P-REF and SPO procurement should be completed before start of the construction, and the capacity improvement of PDEM staff should be done by commencement of the plant operation. Technical assistance to those activities will be provided by Japanese consultant under the soft components of the Project.

Details of the technical assistance are shown in the attached soft component plan.

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

Project cost for implementation of the Project is estimated as follows under the conditions mentioned below.

(1) Project Cost born by Japanese Government
Project cost born by Japanese side is confidential until approval of contract agreement for construction and procurement.

(2) Project Cost born by Laotian Government
Project cost born by Laotian side is approximately 2.4 million Yen for land acquisition and/or compensation and bank charges for A/P, etc.

(3) Conditions of Cost Estimation
a) Cost Estimation Point : October 2012
b) Exchange Rate : 1 US$ = 80.41 JPY
1,000 Kip = 9.891 JPY (Average rate in the past 6 months)
c) Escalation Rate : 1.054 (from cost estimation point to bidding month (August 2013)
d) Construction Period : 16 months as shown in the implementation schedule
e) Others : Cost estimation was done in compliance with the manuals for Japan's Grant Aid Project

2-5-2 Operation and maintenance Cost

After completion of the construction, EdL will take over the distribution lines and operate and maintain them together with other existing distribution lines. So, O&M plan only for the mini-hydropower plant is described in this section.

(1) Operation and Maintenance Cost
Operation and maintenance cost of the mini0hydropower plant is estimated as follows:
In general, water turbines and generators are replaced 25 years after those commissioning. But those replacement cost is not included in this estimation.

Table 2-12 Operation and Maintenance Cost of Mini-Hydropower Plant

Items	Annual Cost (million Kip)
1. SPO O&M Cost	
1) Labor Cost	180
2) Repair Expenses	24
3) Other Costs	100
4) O&M Charge	75
2. Overhaul Inspection Cost in 10 years	132
Total	511

Since annual power generation of the power plant is about 3.1 GWh, annual sales income of power to EdL will be assumed as about 1,590 million Kip. Therefore, the income can cover not only expenses for plant operation and maintenance but also contribution to P-REF. Through P-REF, it is expected that not only for the mini-hydropower plant but also for rural electrification activities in Phongsaly Province.

(2) Spare Parts

After start of plant operation, supplies and spare parts required at periodic and overhaul inspection should be procured under the responsibility of the implementing organization (PDEM). As spare parts, there are supplies, which are required at annual inspection, and spare parts, which is required at overhaul inspection 10 years after commissioning. The list of supplies and spare parts is shown in Table 2-13.

Table 2-13 Spare Parts List

Yearly Supplies			Spare Parts for Overhaul Inspection		
Items	No.	Remarks	Items	No.	Remarks
Turbine Seal Oil	60L		Turbine Seal Oil	60L	
Bearing Grease	1can		Bearing Grease	1can	
packing	1Set		Generator Bearing (upper)	1 set	
			Generator Bearing (lower)	1 set	
			Generator Roller Bearing	1 set	
			Mechanical Seal	1 set	
			Censor for generator installation	1 set	
			Warning System	1 set	
			Seal water system of Generator cable	1 set	
			Packing	1 set	

Chapter 3 Project Evaluation

3-1 Preconditions

For implementation of the Project, the Laotian Side shall take responsibility upon the following matters:

3-1-1 Permitting and Licensing Procedures for Mini-hydropower Project

The Laotian side shall take responsibility for permitting and licensing procedures required for mini-hydropower development in compliance with the Lao Electric Power Technical Standards (LEPTS). Also, the Laotian side shall take procedures for permission on aggregate production at the Project site.

According to the LEPTS, Responsible Agencies for Electric Power Development (RAEPD) of the project are;

- PDEM for Hydropower Development (450kW)
- MEM and/or PDEM for Distribution extension (123.8km/22kV)

RAEPD shall issue all the permissions and licenses to those planning, design, construction and operation, based upon requests from the project implementation entities.

In the mini-hydropower project under the Project, both of MEM and PDEM are the RAEPD as well as the project implementation agencies and therefore there should be no difficulty in the procedures for issuing any permissions and licenses upon the project.

3-1-2 Environmental and Social Considerations

Initial Environmental Examination (IEE) was submitted to Provincial Department of Natural Resources and Environment (PNRE) in December 2012, and it was approved on February 20, 2013.

Further, land acquisition and compensation to Project Affected People will be negotiated and settled by the compensation committee, which will be formulated at the Gnod Ou District Office, organized by three (3) parties, i.e., chief of villages, chief of district and PDEM.
In addition, the Laotian side shall conduct environmental and social monitoring during and after the construction, based on the environmental monitoring plan as mentioned above.

3-1-3 Establishment of Project Management Structure

The Laotian side shall take prompt actions for:

- Training of PDEM staffs for monitoring of SPO's O&M activities
- Governmental approval of establishment of P-REF and its management manual
- Selection and procurement of SPO

Since the procurement of a capable SPO is extremely important for the sustainable and appropriate O&M activities of the mini-hydropower plant, its procedures should smoothly be done .

3-2 Necessary Inputs by Recipient Country

3-2-1 Necessary Inputs by MEM/IREP

1) Approval of Detailed Design
2) Approval of Bidding Documents
3) Contract Agreement with the Contractor
4) Assistance for Land Acquisitions and Compensations, initiated by PDEM
5) Assistance for permissions and licenses issued by PDEM
6) Approval of P-REF management manual
7) Procurement of SPO
8) Exemption of Tax and Customs Duty
9) Arrangement of Bank Account in Japan for payment to the Contractor and the Engineer inclusive of any payment for advise and payment commissions to a bank
10) Report of the project monitoring results to JICA
11) Any other assistance for project executions

3-2-2 Necessary Inputs by PDEM

1) Land Acquisitions and Compensations
2) Approval of permissions and licenses in accordance with LEPTS
3) Participation to the training, conducted by Japanese Consultants for O&M supervising activities upon the project
4) Monitoring and Supervising of SPO's O&M activities on the project
5) Establishment and management of P-REF

3-2-3 Necessary Inputs by EDL

1) Installation of house wirings to newly connected consumers
2) O&M of the distribution facilities for the project

3-3 Important Assumptions

(1) Influence by Weather Conditions

Weather conditions of the project site are roughly sorted into the rainy season from the middle of May to the middle of October and the dry season in the remaining period. In the rainy season, the constructions in the river are not possible due to high river water levels, and also transportation of equipment and materials are restricted due to wet road conditions. Therefore, the main part of construction works shall be carried out in the dry season, while the partial works can be done even in the rainy season restrictively. The whole schedule of construction can be assumed as 16 months from October 2013 to January 2015 so as to complete most of constructions in the dry season. For keeping construction time schedule, it is extremely important to start construction works in October, 2013 when the dry season of the first year begins.

(2) Influence by the other projects

As for equipment and materials, imported items from China can be locally available. However, from the viewpoints of securing quality and stable supply, those should be procured and transported from Vientiane and the third countries, while it takes about 26 hours for transportation of materials from Vientiane to the Project site.

The Department of Public Works and Transportation of Phongsaly Province has a plan to renovate the existing road from Boun Nuea to the China border via Ou Thai from 2013. The road runs beside the Project site, and it will be used as an access route and transportation route. Therefore, it is required to closely coordinate with the Department in order to avoid any conflict to the implementation of the Project.

3-4 Project Evaluation

It is evaluated that the Project has sufficient relevance and also high effectiveness as mentioned below.

3-4-1 Relevance

The mini-hydropower of the Project is one of renewable energy power sources, and it has a characteristic of relatively small environmental and social impacts. And also, the other component of the project is to extend distribution lines to rural un-electrified villages. Therefore, the Project is consistent not only with Japan's aid policy on assistance in power sector but also with Lao government's development policy to promote rural electrification as well as renewable energy development.

The details are summarized as follows:

(1) Beneficiaries of the poor peoples

Gnod Ou District in Phongsaly Province where the Project will be constructed is located in the northern end of Laos, and it is one of the poorest districts in Laos. It is expected that approximately 1,200HH (8,000persons) will be able to newly access the electricity by the extension of distribution lines of the Project. Also, the mini-hydropower development of the Project can contribute to local electricity supply to approximately 8,700HH of the neighboring villages as well as to stabilization of the power supply systems. It is also expected to promote the further rural electrifications in Phonsaly Province by utilizing the fund from the Project through the newly established P-REF.

Furthermore, this project can contribute to spending cut of EdL because of reduction of costly power imports from China. It leads to benefits of Lao people of the whole country through the reduction of the electricity tariff, which meets the Japanese ODA policy.

(2) Contribution to realization of Lao's mid-long term development plan

GOL has a target to improve a national electrification ratio from only 36% in 2000 to 90% by 2020 in the National Scio-economic Development Plan announced in March 2001. The electrification ratio of Laos reached 73% in 2010 and 80.1% in the first half of 2012, however, there is a big regional gap among provinces. Since the electrification in the rural area has been delayed, GOL is focusing on promotion of rural electrification in rural areas.

Focusing on Phongsaly Province where the project site is located in, the electrification ratio, which is 23% in the first half of 2012, is the lowest among all provinces in Laos. The Province aims to promote its electrification targeting to achieve 60% in 2015, and 70 to 80% in 2020 in terms of household electrification ratio. On the other hand, a part of electric power for Phongsaly Province is imported from China with high tariff of about 9.2 US cents per kWh. Therefore, reduction of power import is one of the key issues of the power sector.

Under the background mentioned above, a mini-hydropower plant will be constructed and 22kV distribution line will be extended to un-electrified villages in the project areas. The Project is expected to reduce electric power import by approximately 3.1GWh per year, and to contribute to improvement of electrification ratio in Gnod Ou District from the current 32% to 60% after completion of the project.

Therefore, the Project is expected to contribute to achieving the Lao's mid-long term development plan, particularly in rural electrification promotion as part of the poverty reduction.

(3) Consistency with the Japan's ODA Policy

Assistance to the power sector of Laos is one of the pillars of the important points of Japan's ODA

policies, i.e., "promotion of economic growth through infrastructure development", such as 1) enhancement of sustainable, stable and effective power supplies, 2) strengthen of management abilities of power entities, 3) development of power plants, distribution and transmission lines including rural electrification.
Also, GOJ has a policy to support realization of the green growth of developing countries by utilizing Japan's superior techniques in the field of renewable energy.
Therefore, this project is consistent with "Japan's ODA policy" for Laos as well as "Green Growth policy" of GOJ.

3-4-2 Effectiveness

(1) Quantitative Effect

Indicators	Base (2012)	Target (2018) [3 Years after the completion]
1) Installed capacity of HPP	0 kW	450 kW
2) Plant factor	0%	79.6%
3) Electrification ratio (HH) in Gnod Ou district	32 %	60 %
4) Generation of HPP and reduction of power import from China	0 MWh/year	3,141 MWh/year

(2) Qualitative Effect
In addition to the above-mentioned "promotion of the rural electrification" and "reduction of costly power import from China", the following qualitative effects are expected by the Project.

1) Strengthen of Stable Power Supply
Gnod Ou District, which has a northern border with China, is located at an ending point of Lao national power grid, and also there is no power generation plant therein. Therefore, it can be understood that the power generation project at the ending point of system grid will contribute to transmission and distribution loss reductions as well as strengthen of stable power supplies to the adjacent areas.

2) Contribution to improvement of rural economics
Owing to the promotion of rural electrification and stable power supplies by the Project, improvement of local industries and local life conditions can be expected.

3) Promotion of Renewable Energy Developments
Since the min-hydropower project is one of renewable energy projects, it will contribute to promotion of renewable energy development in Phongsaly Province.
In addition, it is expected that renewable energy development in Phonsaly province will be accelerated by utilizing fund from the Project through the newly established P-REF.

4) Use of goods procured from Japan's small and medium enterprises
In accordance with the "Green Growth" policy of Government of Japan, the major equipment such as water turbines and generators will be procured from Japan's small and medium enterprises.