**PROJECT DESIGN DOCUMENT FORM
FOR SMALL-SCALE CDM PROJECT ACTIVITIES (F-CDM-SSC-PDD)
Version 04.1**

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Upper Baluchaung No.2 Hydropower Project in Myanmar
Version number of the PDD	Ver.1.0
Completion date of the PDD	23/10/2013
Project participant(s)	Neo Energy Oasis Development Co., Ltd. (host) Nippon Koei Co., Ltd.
Host Party(ies)	Republic of the Union of Myanmar
Sectoral scope(s) and selected methodology(ies)	Renewable Energy AMS-I.D. version17
Estimated amount of annual average GHG emission reductions	16,275tCO_2

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The Upper Baluchaung No.2 Hydropower Project (hereinafter referred to as "UB-2" or "the Project") is a proposed run-of-river hydropower facility on the Upper Baluchaung river in the Southern Shan State, Myanmar. The Project developer is Neo Energy Oasis Development Co., Ltd. (hereafter referred as "Neo"). The installed capacity of the Project is 10.0 MW, which is estimated to supply 43.82 GWh per year to the national electricity grid.

Myanmar has long suffered from lack of electricity, and the Government is encouraging private companies to participate in developing hydropower projects as an Independent Power Producer(IPP), particularly for medium to small scale ones. Neo undertook the feasibility study of UB-2, which was approved by the Government in December 2010.

UB-2 is located downstream of the Upper Baluchaung No.1 hydropower project (hereafter referred as "UB-1") which is under construction by Neo. UB-2 will utilize water released from UB-1 and the remaining catchment basin of the Upper Baluchanung. UB-1 and UB-2 are planned as a cascade type development to harness the rapid flow of the Upper Baluchaung. The electricity generated by UB-2 will be delivered to Myanmar National Power Grid (hereafter referred to as "MNPG").
The annual grid-connected electricity generated by the proposed project is 43.82 GWh per year.

The baseline scenario is the same as the scenario existing prior to the start of the implementation of the proposed project. In the absence of the proposed project, the most viable baseline scenario is "the same amount power provided by MNPG". The electricity generated by proposed project will substitute part of electricity in MNPG.

Emission Reduction

UB-2 will displace a part of electricity which is generated by fossil-fired power plants being connected to Myanmar national grid (hereafter referred to as "MNPG"). Therefore the Project will reduce Greenhouse Gasses (hereafter referred to as "GHG") at an equivalent amount with that would have otherwise been emitted from the national grid generation mix. UB-2 utilizes a renewable resource of hydropower without creating large reservoirs, and accordingly is a zero emission energy project.

The renewable crediting period is chosen by the proposed project. In the first renewable crediting period, the proposed project will have total emission reductions of about 11,380 tCO_2 with annual emission reductions of 16,275tCO_2.

Table1: Estimated amount of emission reductions over the chosen crediting period

	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year
Annual estimateion of emission reductions(tCO2)	16,275	16,275	16,275	16,275	16,275	16,275	16,275

Contribution to Sustainable Development

One of the most outstanding issues for Myanmar is the shortage of electricity supply. The Project will contribute to alleviate the load shedding that is frequently taken place even in Yangon, and also

stimulate sustainable economic development of the country, creating new jobs both directly and indirectly.

UB-2 is expected to have a negligible change of quality and quantity of the river. It is an indigenous renewable energy generation that only utilize a head difference of the river to drive hydraulic turbines for power generation. Negative impact is not foreseen for the eco system around the project site through the project implementation.

The Project will also benefit the residents and the local communities around the project site in terms of employment opportunities, particularly during the construction period and operation of the Project activities.

The annual grid-connected electricity of the proposed project is 43.82 GWh/year.

Myanmar is rich in water resources that can generate hydropower according to the geographical condition. Myanmar has been in suffering from power shortage which has deeply influenced economic development, industrial and agricultural production and living in Myanmar. In December 1987, Myanmar was declared by the United Nations to be a "least developed country (LDC)"[1]. As generating of electricity has been speeded up after 1988, 19 hydropower plants, one coal-fired power plant and 11 gas power plants totalling 30 across the nation were constructed in MNPG, which is now generating 10,837GW in the annual generation electricity composition of MNPG, hydropower accounts for 71% in year 2012[2].

The proposed project will achieve electricity generation by utilizing renewable water resources. It can promote local sustainable development.

A.2. Location of project activity
A.2.1. Host Party(ies)
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Republic of the Union of Myanmar

A.2.2. Region/State/Province etc.
>>
Shan State

A.2.3. City/Town/Community etc.
>>
Nyaunshwe Township

A.2.4. Physical/ Geographical location
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The Project site is located on the Upper Baluchaung, 3km west of Indein village at the south-west shore of the Inle Lake. The geographic coordinates are 20°28′19″N and 96°48′43″E. The project location is shown in Figure 1.

[1] http://www.un.org/en/development/desa/policy/cdp/ldc/profile/country_129.shtml
[2] Data source:From Hydro Power Generation Enterprise, 6th of Feb 2013

Figure 1 Map of Project Location

A.3. Technologies and/or measures

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UB-2 is a small-scale CDM project activity involving electricity generation from a renewable energy source with a total installed capacity of 10 MW, which conforms to the project category I.D. Grid connected renewable electricity generation.

The baseline scenario is that the absence of the CDM project activity, the electricity supplied to MNPG by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources. The electricity supplied to MNPG by the project activity will substitute part of electricity in MNPG.
The project activity is a run-of-river hydropower project which involves the installation of two Francis turbine units with a total capacity of 10 MW. It is estimated to generate annual energy of 43.82 GWh. UB-2 utilizes water released from UB-1 for electricity generation at a design flow rate of 16.0 m^3/s. Water through the turbines will be discharged back to the Upper Baluchaung. The main components of UB-2 comprise intake, waterway, head tank, penstock, powerhouse and tailrace. The hydraulic turbine and generator are planned to install two turbines with 5,200kw which average lifetime is almost 60 years and two generators with 5,000 kVA of capacity. Also, the plant load factor for the designed plant is estimated as0.5.

In the following table, specification of the equipments for UB-2 is indicated.

Table1. Specification of the equipments

NO	Particulars	Type	Qty
TAILRACE:			
	Draft tube gates and monorail hoist	Slide gate type, transferring by a monorail crane	2
TURVINE			
	Horizontal Francis	5200kW, 500rpm	2
GENERATOR			
	3 phase horizontal	5000kW	2

The project does not involve in any technology transfer from other countries.

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Neo Energy Oasis Development Co., Ltd. (host)	Private entity	NO
Nippon Koei Co., Ltd.	Private entity	NO

A.5. Public funding of project activity

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There is no public funding available from any Annex I party for the project activity.

A.6. Debundling for project activity

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As per "*Guidelines on Assessment of Debundling for SSC Project Activities*" (Version- 03, EB- 54, Annex- 13)[3]

Debundling is defined as the fragmentation of a large project activity into smaller parts. A small-

[3] http://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid17.pdf

scale project activity that is part of a large project activity is not eligible to use the simplified modalities and procedures for small-scale CDM project activities. The full project activity or any component of the full project activity shall follow the regular CDM modalities and procedures.
A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants;
- In the same project category and technology/measure; and
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

There is no registered small-scale CDM project activity or an application to register another small-small CDM project activity in Myanmar. So, the project activity of UB-2 is not a debundled component of a large project activity.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

1) "AMS-I.D. Grid connected renewable electricity generation" (version 17)[4].

2) "Tool to calculate the emission factor for an electricity system" (version 04.0). [5]

B.2. Project activity eligibility

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The methodology AMS-I.D. (version 17) is applicable to renewable energy generation units that supple electricity to an electricity grid, which is the case for the project. Moreover, the size of the project is 10 MW, which is well within the limit of 15 MW stipulated by the chosen (small scale) methodology. The technology of hydro power applies run-off-river hydro plant. The proposed project qualifies as a small-scale project activity and the capacity will remain within the limits of small-scale project activity types during every year of the crediting period. Therefore, the methodology AMS-I.D. (version 17) is applicable to the project.

In the following, the eligibility of the proposed project to the methodology AMS-I.D. is summarized.

Table 2. Eligibility of the Proposed Project to the methodology AMS-I.D.

Technology/measure in AMS-I.D.	The proposed project
This category comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass that supply electricity to a national or a regional grid. (a) Supplying electricity to a national or a regional grid; or (b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.	As a new hydropower project, the proposed project supply power to the MNPG, which mainly composed of fossil-fuel power plants. So the proposed project is applicable for this category.

[4] http://cdm.unfccc.int/methodologies/SSCmethodologies/approved
[5] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v4.0.pdf

This methodology is applicable to project activities that (a) install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity(Greenfield plant); (b) involve a capacity addition;(c) involve a replacement of(an) existing plant(s)	The proposed project is a new hydropower project which belongs to (a) install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity(Greenfield plant).
Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: The project activity is implemented in an existing reservoir with no change in the volume of reservoir. The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section, is greater than 4W/m2. The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the project emissions section, is greater than 4W/m2.	The proposed project does not create any reservoir and have any existing reservoir, so this item is not applicable for it.
If the new units has both renewable and non-renewable components(e.g. a wind/diesel unit), the eligibility limit of 15MW for a small scale CDM project activity applies only to the renewable component. If the new units co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15MW.	The proposed project only involves renewable components, so this item is not applicable for it.
Combined heat and power(co-generation) system are not eligible under this category.	The proposed project only produces electricity, so this item is applicable for it.
In the case of project activities that involve the addition of renewable energy generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	The proposed project is a new hydropower project, so this item is not applicable for it.
In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15MW.	The proposed project is a new hydropower project, so this item is not applicable for it.

From the analysis above, the methodology AMS-I.D.(Version 17.0) is applicable to the project activity.

The proposed project activity is categorized as Type I project activity which involve renewable energy project with a maximum output capacity equivalent to 10MW.

B.3. Project boundary

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The electricity generated by the proposed project will be supplied to the regional electricity system, MNPG.

Based on the methodology AMS-I.D. (version 17), the project boundary is: The spatial extent of the project boundary includes the project power plant and all power plants connected physically to the power grid that the CDM project power plant is connected to.

The project boundary is schematically illustrated as following.

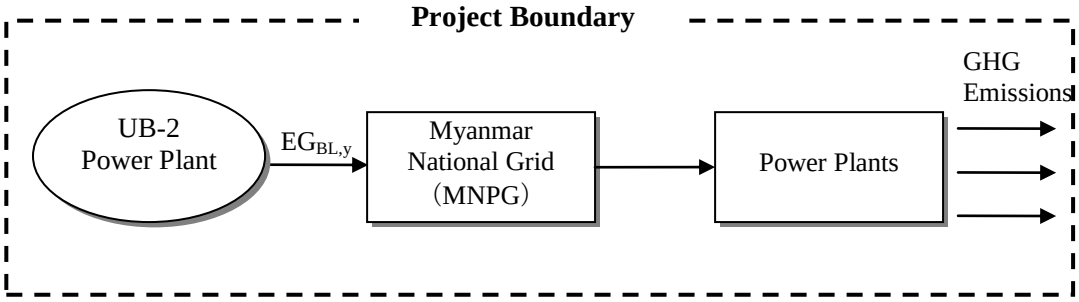

Figure 1: Project Boundary

The table below describes the sources and gases included in the project boundary.

Table 3. Sources and gases included in the project boundary

	Source	Gas	Included ?	Justification
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	YES	Main emission source. Emission due to thermal power plant dispatch.
		CH_4	NO	Minor emission source
		N_2O	NO	Minor emission source
Project	For hydro power plants, emission of CH_4 from water reservoir	CO_2	NO	Minor emission source
		CH_4	NO	Minor emission source
		N_2O	NO	Minor emission source

B.4. Establishment and description of baseline scenario

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According to AMS-I.D.(version17), the baseline scenario is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid. The baseline emissions are the product of electrical energy baseline of electricity produced by the renewable generating unit multiplied by an emission factor.

So for the project, the electricity generated by the project will be finally connected to the MNPG. Therefore, the baseline scenario of the project is:

The baseline scenario is that the absence of the CDM project activity, the electricity supplied to MNPG by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources. The electricity supplied to MNPG by the project activity will substitute part of electricity in MNPG.

B.5. Demonstration of additionality

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Assessment and demonstration of additionality

According to Guidelines on the demonstration of additionality of small-scale project activities (version 09.0)[6], project participants shall provide an explanation to show that the project activity would now have occurred anyway due to at least one of the following barriers.

- Investment barriers
- Technical barriers
- Barrier due to prevailing practices
- Other barriers

The project faces the investment barrier.

Investment Analysis

Among of above options in the Guidelines on the Demonstration of Addtionality of small scale Project activities (version 09.0), investment analysis is selected for the assessment of additionality. Since the approved methodology AMS-I.D. (version 17.0) prescribes the baseline, further discussion on the alternatives is not required for the project activity.

According to financial analysis for Upper Baluchaung Hydropower Project which was conducted in the feasibility study in 2010, the FIRR on total investment for the hydropower project is 8.67%.

According to *Guidance on Assessment of Investment Analysis, version 05*, "Local lending rates or weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR". The local lending rate at the time of decision making was chosen as the benchmark for the proposed project. At the time of decision made in 2010, the commercial lending rate in Myanmar was 17.0[7]%, hence the commercial lending rate of 17% can be chosen as the benchmark for the project. The benchmark is applied as before tax.

Based on the important parameters of the proposed project, the IRR change of the proposed project without CDM is calculated. The main parameters are as follows.

Table4. Main parameters for the calculation of financial indicators

Item	Unit	Value	Data source
Installed capacity	MW	10	FS & Basic Design report
Total static investment	Million USD	17.87	FS & Basic Design report
Annual O&M cost	Million USD	0.19	FS & Basic Design report
Annual grid-connected electricity generation	GWh /year	43.82	FS & Basic Design report
Electric power selling price	Cent USD/kWh	4.5	FS & Basic Design report
Project life time	Year	60	FS & Basic Design report
CERs crediting time	Year	7 x 3	Neo

The O&M cost includes the following items.

items	contents
Fixed operation and maintenance cost	Daily operation, maintenance activities, semi-overhauling The cost is assumed at 0.5% for civil and metal works

[6] http://cdm.unfccc.int/Reference/Guidclarif/meth/methSSC_guid05.pdf
[7] http://data.worldbank.org/indicator/FR.INR.LEND

Variable operation and maintenance cost	Lubricant and other necessary expenditures The cost is assumed at 1.5% for E&M cost.

The FIRRs without the income from CERs sale are listed in the following table. Without the income from CERs, the FIRR of the proposed project is 8.67 %. The FIRR of the project without CDM revenue is well below 17.0%, the benchmark considered by the project participant.

Table5. Comparison of financial indicators with an without income from CERs

Benchmark	17.0%
Item	Without the income from CERs
IRR of total investment	9.4%

Sensitivity Analysis

In order to demonstrate the investment barriers to the proposed project further, a sensitivity analysis also carried out for the relevant variables. The sensitivity analysis of the project activity has been conducted to show whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions.

The '*Guidance on the Assessment of Investment Analysis*' *(Version- 5, EB- 62, Annex- 5)*[8] , states that only variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation.

In accordance to the above guidance, the following financial parameters were taken as factors for sensitive analysis.

- Annual generation of electricity
- Construction Cost
- Rehabilitation Cost

In the sensitivity analysis, variations of plus minus 10% have been considered in the critical assumptions. A summary of the results of the sensitivity analysis are shown in the following.

Table6. Value for Sensitivity Scenario

Sensitive Parameter	**% Variation**	**Project IRR**
Annual generation of electricity	-10%	7.7%
	Standard Case	8.7%
	+10%	9.6%
Construction Cost	-10%	9.6%
	Standard Case	8.7%
	+10%	7.9%
Rehabilitation Cost	-10%	8.7%
	Standard Case	8.7%
	+10%	8.65%

[8] http://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03.pdf

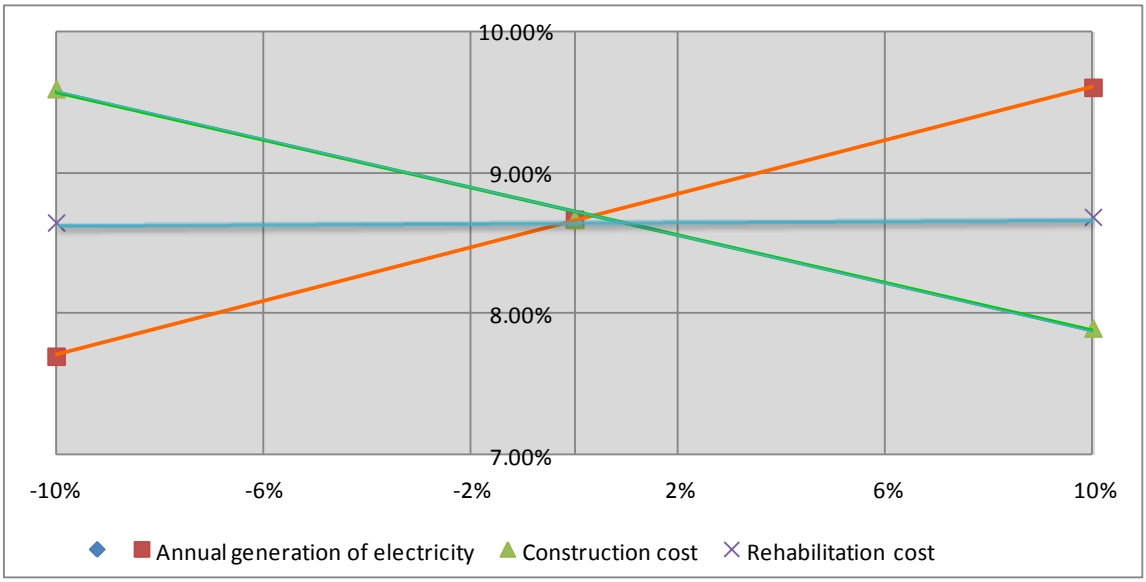

Figure2. Result of Sensitivity Analysis

The sensitivity analysis shows that even with 10% increase and decrease, the benchmark is not achieved. It is unlikely to be financially attractive even under the most optimistic conditions of electricity generation going up by 10% and total investment cost and construction cost going down by 10%. As a result, the project activity is additional.

The following table indicates that when the four parameters fluctuate between the range of -10% and +10%, IRR which is pre-tax of the proposed project can't reach the benchmark of 17%.

Table 7. Variations to reach the benchmark(without CER's revenues)

Item	Variation to reach the benchmark of 17%
Annual generation of electricity	199.1%
Construction Cost	-47.5%
Rehabilitation Cost	-28,000%

Annual generation of electricity

The above analysis shows that when the annual generation of electricity is increased by 99.1%, the IRR which is pre tax would reach 17% of bench mark. However, the size of electricity generation is determined by the pre condition of the project. The possibility of achieving the 199.1% of annual generation of electricity is unreal and thus is ruled out.

Construction cost

The above analysis shows that when the construction cost is decreased by -47.5%, the IRR which is pre tax would reach 17% of bench mark. The construction of UB-2 project has not started yet and the cost of materials tends to be increased in accordance with the recent economic situation in Myanmar. So it is unlikely to be assumed that the construction cost is decreased by -47.5%.

Rehabilitation cost

The above analysis shows that when the rehabilitation cost is decreased by -28,000%, the IRR which is pre tax would reach 17% of bench mark. The project life time is planned to be 60 years and the rehabilitation of the equipment is to be necessary in 33 years after the project's initiation. The

percentage of the crossing the benchmark is more than 28000% and it is not likely to occur considering the cost of replacement of the main equipment of the project.

Also, the chronological events of the project show the project is seriously considered as CDM project.

Table 7. Consideration of CDM prior to Project Implementation

Date	Key event
15 May 2009	Completion of Pre-FS report
5 November 2009	Approval of the project proposal
20 June 2010	Completion of Environment study
August 2010	Completion of Feasibility Study Report and Basic Design
11 November 2010	Approval of the Feasibility Study Report and Basic Design
17 January 2011	Construction permission from MOEP1
More than 20 times between 2011 and 2013	Conducting Stakeholder meeting
22 October 2012	Submission of Prior consideration to UNFCCC
24 September 2013	Contract with DOE for validation
1 December 2014	Project starting date(civil work contract)

The notification of UB-2 which contain the precise geographical location and a brief description of the proposed project activity, using standardized form F-CDM prior consideration has been submitted to the UNFCCC secretariat and host country DNA on 22 October 2012. The submission is done before the project activity start date. It demonstrates that the project is additional.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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1. Baseline Emissions

Based on methodology AMS-I.D (version 17), the baseline emissions are the product of electrical energy baseline $EG_{Bl,y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by an emission factor.

Refer to the approved methodology AMS-I.D (version 17), paragraph12, the emission factor can be calculated in transparent and conservative manner as follows.

a. A combined margin(CM), consisting of the combination of operating margin(OM) and build margin(BM) according to the procedures prescribed in the latest version of ‘ Tool to calculate the Emission factor for an electricity system’.

b. The weighted average emission (in t CO_2/MWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Calculations must be based on data from an official source (where available) and made publicly available.

Option (a) is applied for UB-2, which uses a CM, consisting of the combination of OM and BM according to the procedures prescribed in the "Tool to calculate the emission factor for an electricity system (version 04.0)".

The baseline emissions are calculated in the following equation.

$BEy = EG_{Bl,y} * EF_{CO2, grid,y}$

Where

BE_y	= Baseline Emissions in the year *y* (tCO_2)
$EF_{CO2, grid,y}$	= CO_2 emission factor of the grid in year *y* (tCO_2/MWh)
$EG_{Bl,y}$	= Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y(MWh)

The Emission Factor (EF) for UB-2 which is calculated as 0.371 tCO_2/MW. The calculation method for the EF which is calculated based on "Tool to calculate the emission factor for an electricity system (version 04.0)".

Calculation of EF $_{MNPG, CM, y}$

According to "Tool to calculate the emission factor for an electricity system (version 04.0)", the calculation of the CM emission factor ($EF_{MNPG,CM,y}$,) is based on one of the following methods:

(a) Weighted average CM; or
(b) Simplified CM.

The weighted average CM method (option a) should be used as the preferred option.
The simplified CM method (option b) can only be used if:

- The project activity is located in a Least Developed Country (LDC) or in a country with less than 10 registered projects at the starting date of validation; and

- The data requirements for the application of step 5 above cannot be met.

The proposed project is located in Myanmar which is one of LDC and a country with less than 10 registered projects at the starting date of validation. Also, the data requirements for the application of step 5 above cannot be met.
So the simplified CM method is applicable to the proposed project.

Also, it is required to choose whether to include off-grid power plants in the project electricity system as option. The proposed project chooses option I which is only grid power plants are included in the location to calculate the operating margin and build margin emission factor.

Under the simplified CM, the operating margin emission factor ($EF_{MNPG,OM,y}$) must be calculated using the average OM.
For the simple OM, the simple adjusted OM and the average OM, the emissions factor can be calculated using either of the two following data vintages:

- ***Ex ante*** **option**: If the *ex ante* option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation.

For off-grid power plants, use a single calendar year within the 5 most recent calendar years prior to the time of submission of the CDM-PDD for validation.

- ***Ex post* option**: If the *ex post* option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required to calculate the emission factor for year *y* is usually only available later than six months after the end of year *y*, alternatively the emission factor of the previous year *y-1* may be used. If the data is usually only available 18 months after the end of year *y*, the emission factor of the year proceeding the previous year *y-2* may be used. The same data vintage (*y*, *y-1* or *y-2*) should be used throughout all crediting periods.

The proposed project chooses the "Ex ante option". The average OM is calculated ex-ante using a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the first crediting period.

Calculation Average OM

The average OM emission factor ($EF_{MNPG,OM,y}$) is calculated as the average emission rate of all power plants serving MNPG, using the methodological guidance as described under (a) above for the simple OM, but including in all equations also low-cost/must-run power plants.
The simple OM may be calculated:

Option A: Based on the net electricity generation and a CO_2 emission factor of each power unit; or

Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

Option B can only be used if:
(a) The necessary data for Option A is not available; and PROJECT DESIGN DOCUMENT FORM (CDM PDD) - Version 03 CDM – Executive Board page 28
(b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and
(c) Off-grid power plants are not included in the calculation.

For data of each power station and power unit is not publicly available in Myanmar, it can't adopt option A. Meanwhile, only renewable power generation are considered as low-cost / must-run power sources and the quantity of electricity supplied to the grid by these sources is known[9]. Therefore, option B could be used to calculate OM emission factor.

Option B - Calculation based on total fuel consumption and electricity generation of the system

Under this option, the average OM emission factor is calculated based on the net electricity supplied to MNPG by all power plants serving the system, including low-cost/must-run power plants/units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:

$$EF_{MNPG,OM,y} = \frac{\Sigma FC_{i,,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{MNPG,y}}$$

Where:
$FC_{i,y}$ = Amount of fossil fuel type i consumed in the project electricity system in year *y* (mass or volume

[9] Data source from MOEP.

unit)
$NCV_{coal,y}$ = Net calorific value (energy content) of fuel type i in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$ = CO_2 emission factor of fuel type i in year *y* (tCO_2/GJ)
$EF_{MNPG,OM,y}$ = Average operating margin CO_2 emission factor of MNPG in year *y* (tCO_2/MWh)
$EG_{MNPG,y}$ = Net electricity generated and delivered to MNPG by all power sources serving the system, including low-cost/must-run power plants/units, in year *y* (MWh)
I = all fuel types combusted in power sources in the project electricity system in year y
y = the three most recent years (2010, 2011, and 2012 for which data is available at the time of submission of the CDM –PDD to the DOE for validation)

For this approach (simple OM) to calculate the OM, the subscript *m* refers to the power plants/units delivering electricity to MNPG, including low-cost/must-run power plants/units, and including electricity imports to the grid. Electricity imports should be treated as one power plant *m*.
CM is calculated using following equation with the following conditions:

$W_{BM} = 0$
$W_{OM} = 1$

$$EF_{MNPG,CM,y} = W_{OM} \times EF_{MNPG,OM,y} + W_{BM} \times EF_{MNPG,BM,y}$$
$$= 1 \times EF_{MNPG,OM,y} + 0 \times EF_{MNPG,BM,y}$$
$$= EF_{MNPG,OM,y}$$

2. Project Emissions:
As per AMS-I.D (version 17), project emissions need to be considered for emissions related to the operation of geothermal power plants or from water reservoirs of hydro power plants. The proposed project activity is a run-of-river type hydropower project, hence,
$PE_y = 0$

Where,
PE_y = Project emissions in year *y* (tCO_2/y)
y = a given year

3. Leakage Emissions:
According to AMS I.D. (version 17), a leakage calculation is only needed if the renewable energy technology equipment is transferred from another activity. This is not applied for the proposed project.

Therefore, $LE_y = 0$

4. Emission Reduction:
The emission reductions calculations are as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where:
ER_y = Emission reductions in year y (tCO_2/y)
BE_y = Baseline Emissions in year y (tCO_2/y)

PE_y = Project Emissions in year y (tCO_2/y)

LE_y = Leakage Emissions in year y (tCO_2/y)

$ER_y = BE_y$

Where,
$PE_y = 0$
$LE_y = 0$

B.6.2. Data and parameters fixed ex ante

Data / Parameter	**$FC_{i,y}$**
Unit	Mass or volume unit of fuel i
Description	The amount of fuel type i consumed by power plant/unit in year(s) y
Source of data	An official electricity power data in Myanmar provided by Ministry of Electric Power
Value(s) applied	See Appendix 4 for details
Choice of data or Measurement methods and procedures	According to the "Tool to calculated the emission factor for an electricity system (version 04.0)", values from government records or official publications can be used; Once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation(ex-ante option)
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	**$NCV_{i, y,}$**
Unit	GJ/ton
Description	Net calorific value(energy content) of fossil fuel type i in year y
Source of data	Defaults in table 1.2 of Chapter 1 of Vol.2(Energy) of the 2006IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	See Appendix 4 for details
Choice of data or Measurement methods and procedures	According to the "Tool to calculated the emission factor for an electricity system", 2006 IPCC defaults can be used; Once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation(ex-ante option)
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EF_{CO2,i\ y}$
Unit	tCO_2 /GJ
Description	CO_2 emission factor of fossil fuel type i in year *y*
Source of data	Defaults in table 1.2 of Chapter 1 of Vol.2(Energy) of the 2006IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	See Appendix 4 for details
Choice of data or Measurement methods and procedures	According to the "Tool to calculated the emission factor for an electricity system", 2006 IPCC defaults can be used;
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EG_{MNPG,y}$
Unit	MWh
Description	Net electricity generated and delivered to MNPG by power plant/unit in year y
Source of data	An official electricity power data in Myanmar provided by Ministry of Electric Power.
Value(s) applied	See Appendix 4 for details
Choice of data or Measurement methods and procedures	According to the "Tool to calculated the emission factor for an electricity system", values from government records or official publications can be used; Once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation(ex-ante option)
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EF_{MNPG,OM,\ y}$
Unit	tCO2/MWh
Description	OM emission factor of MNPG
Source of data	Calculated according to related data
Value(s) applied	0.371
Choice of data or Measurement methods and procedures	According to the "Tool to calculated the emission factor for an electricity system", values from government records or official publications can be used; Once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation(ex-ante option)
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EG_{MNPG,CM,y}$
Unit	tCO2/MWh
Description	CM emission factor of MNPG
Source of data	Calculated according to related data
Value(s) applied	0.371
Choice of data or Measurement methods and procedures	According to the "Tool to calculated the emission factor for an electricity system", values from government records or official publications can be used; Once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation(ex-ante option)
Purpose of data	Calculation of baseline emissions
Additional comment	-

B.6.3. Ex-ante calculation of emission reductions

>>

The project activity reduces GHG through displacement of grid electricity generation with fossil fuel based power based power plants by renewable electricity. The emission reduction ER_y due to project activity during given year y is calculated as the difference between baseline emissions (BE_y), project emissions(PE_y) and emissions due to leakage (LE_y) .

The proposed project activity is a run-of- river hydro electric project, which does not generate any anthropogenic GHG emissions within the project boundary. As such, no formulae are applicable. Emissions associated with the construction of the project have been excluded as the construction of a fossil fuel would generate a similar quantity of emissions.

A consideration of the leakage effects generated by the project activity is not required as per the provisions of AMS I.D. (version17) grid connected renewable electricity generation, Appendix B of the simplified modalities and procedures for small-scale CDM project activities, as the energy generating equipment on site. No sources of leakages are expected.

Calculation of Emission Reduction:

1. Project Emissions

According to AMS I.D. (version17), most of renewable energy project activities, $PE_y = 0$. However, as for the following categories of project activities, project emissions have to be considered referring the recent version of ACM 0002.

The proposed project activity is a run-off –river type hydro power plants, hence,

$PE_y = 0$

2. Baseline Emissions

Based on the formula in section B6.1 and data from section B6.2, the figure of emission factors of MNPG is as follows.

$EF_{MNPG,y}$ =0.371 tCO_2 /MWh

The annual average net electricity supplied to the grid as a result of the implementation of the project activity in year *y* (GWh) is estimated to be 43.82 GWh, and ex-ante estimated emission reductions, adopt grid-off electricity of the proposed project is zero, therefore, estimated annual average baseline emission is as follows.

Baseline Emissions (BE_y)
= $EG_{BL,y}$ * $EF_{MNPG,y}$
= 43,820 * 0.371
=16,257 tCO_2 /year

3. Leakage emission
No leakage emissions needed to be considered. So, LE_y=0.

4. Emission reductions
Emission reductions (ER_y) are equal to baseline emissions (BE_y) subtract to project emissions (PE_y) and leakage emission (LE_y), namely:

Emission reductions (ER_y)
= BE_y – PE_y – LE_y
= BE_y – 0 – 0
= 16,257 tCO_2/year

B.6.4. Summary of ex-ante estimates of emission reductions
The summary of the estimated ex-ante emission reduction for the crediting period is provided in the following table.

Table8. Summary of the Estimated Ex-ante Emission Redution

Year	Baseline emissions (tCO_2)	Project emissions (tCO_2)	Leakage (tCO_2)	Emission reductions (tCO_2)
Year1	16,257	0	0	16,257
Year2	16,257	0	0	16,257
Year3	16,257	0	0	16,257
Year4	16,257	0	0	16,257
Year5	16,257	0	0	16,257
Year6	16,257	0	0	16,257
Year7	16,257	0	0	16,257
Total	113,799	0	0	113,799
Total number of crediting years	7 years			
Annual average over the crediting period	16,257	0	0	16,257

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	$EG_{BL,y}$
Unit	MWh
Description	Net electricity generated in the plant in year *y*
Source of data	On-site measurement
Value(s) applied	43,820
Measurement methods and procedures	1) Electricity exported to grid is defined as net electricity supply to the Grid(MNPG) 2) Electricity exported to grid will be monitored continuously using a monitoring meter, which will be recorded daily and aggregated in monthly.
Monitoring frequency	Continuous measurement and at least monthly recording
QA/QC procedures	Measurement results should confirm and sign by the MNPG and the project owner. The measurement results will be cross checked with records for sold/purchased electricity. Calibration will be conducted at least once every two years in accordance with international standard.
Purpose of data	Calculation of baseline emission
Additional comment	-

B.7.2. Sampling plan

The data and parameter monitored does not require any sampling approach.

B.7.3. Other elements of monitoring plan

>>

An overall monitoring plan will be applied to the project in order to guarantee the actual long-term measurement of GHG emission reductions of the proposed project and to have complete, consistent, and precise emission reduction calculation. The details of the monitoring plan are summarized as follows.

1. The organizational structure of the monitoring plan

The authority and responsibility for monitoring, measurement, reporting and reviewing of the data rests with the Neo. The identified person will be in charge of the monitoring activities

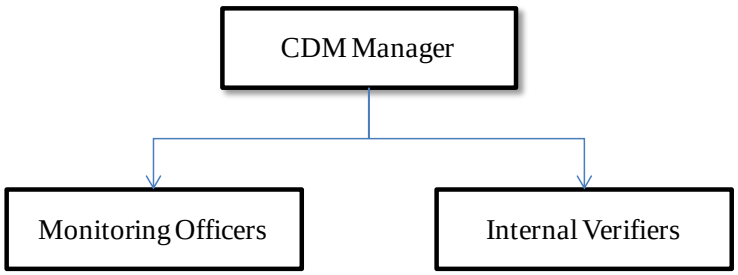

Figure 2. Operation and Management Structure of the Project

Table9. Monitoring Plan

Position	Duty
CDM Manager	• To take the overall responsibility for the project monitoring system • To manage the process of training new staff, ensuring the continuity of monitoring performance, and the integrity of the whole monitoring system • To prepare monitoring report which is submitted to DOE based on the data reported by Monitoring officers
Monitoring Officers	• To take charge of data collection and management such as reading meters, keeping sales receipts, and maintaining the normal operation of QA/QC system • To report the monitoring result to CDM manager monthly
Internal Verifiers	• To check the data and record on a regular basis, and cross check the invoice against the main meter record on a monthly basis

2. Monitoring system

The data requires monitoring for the project is the amount of electricity exported to the grid by the project.

The monitoring equipment is the bidirectional electric energy meter. The meter will be installed in accordance with national or IEC standard. The main meter and backup meter will be installed at the connection point to the grid.

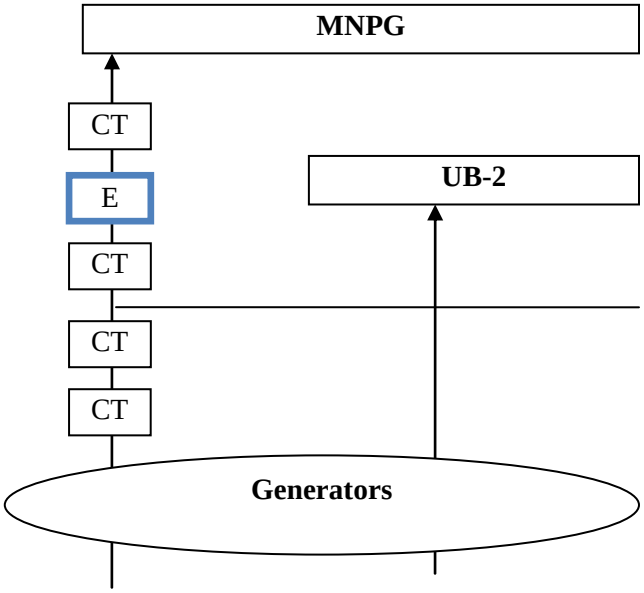

Figure 3. Monitoring system

3. Data collection and management

Monitoring officers will read and check the meters and record the data on a monthly basis. The monitored data will be archived electrically each month and the electric files need back up and archived in a different place. Also, monitoring officers will report the result of monitoring to CDM manager regularly.

A CDM manager also needs to keep the original and copies of electricity sales and purchase receipts provided by the power grid company for cross check. CDM manager will make a monitoring report which is submitted to DOE based on the result of monitoring reported by monitoring officers.

An internal verifier will check all documents such as maps, diagrams, reports. All data should be archived for 2 years after the end of the last crediting period.

4. Quality assurance and quality control

As for quality assurance and quality control, the monitoring shall be conducted in accordance with the following manner.

- The meters should be installed and calibrated in accordance with the relevant national and industrial regulations by a qualified calibration entity.
- The calibration will be conducted at least once a two years.
- Data and records will be checked before being archived and possible errors should be identified before recording
- Training for CDM monitoring will be provided to the relevant staff to guarantee the success of the implementation of the monitoring plan by CDM manager. The training program includes CDM knowledge, operational regulations, quality control, standard flow, data monitoring requirements and data management regulations.

5. Monitoring results and verification

The verification of the monitoring results of the project activity is required for each crediting period. The monitoring results will be combined in a monitoring report that will be served as a basis for project verification.

SECTION C. Duration and crediting period
C.1. Duration of project activity
C.1.1. Start date of project activity

01/12/2014 (the date of contract of construction)

C.1.2. Expected operational lifetime of project activity

60 years

C.2. Crediting period of project activity
C.2.1. Type of crediting period
>>
Renewable (first crediting period)

C.2.2. Start date of crediting period
>>
01/04/2016 or the registered date, which one is later.

C.2.3. Length of crediting period

7years

SECTION D. Environmental impacts
D.1. Analysis of environmental impacts
>>
In Myanmar, the environmental policy was formulated in 1994, which is Myanmar's principle policy document on environmental protection. However, there is no specific guideline established for environmental procedure such as IEE or EIA. As for the proposed project, Neo conducted Environmental Study in June 2010 as a part of feasibility study and basic design of the project. The environmental study was prepared based upon the existing environmental policy and established an environmental management and monitoring plan.

The impact of the proposed project on the environment is summarized as follows.

1) Impact during Construction Phase

Table 10. Summary of potential negative impacts due to construction works

NO	Potential impact	Impact description
1	Impacts on air pollution, soil erosion, waste, noise and vibration	Improvement and new construction works of access roads would cause air pollution including dust, noise and vibration while cutting of slope and embankment, soil erosion and water pollution (turbidity) unless an appropriate measure to prevent erosion over the denuded slope is taken. These

		negative impacts might result bad perception with the Project.
2	Impacts of construction of base camp, construction facility yards, and other temporary facilities	Construction of these temporary facilities would cause air pollution including dust, soil erosion and from the denuded area if no appropriate measures are taken. Water pollution (turbidity), noise and vibration from heavy equipments while embankment and buildings construction, would also occur. Scattering of construction wastes including garbage and effluent might generate, which might also cause water pollution of the river.
3	Impacts of construction of intake weirs, headrace channels, head ponds, powerhouses and other permanent facilities on the same environmental elements as those of temporary facilities (above)	Construction of these permanent facilities would cause almost the same impacts as those of construction of temporary facilities mentioned above. Construction of headrace channel would cause noise and vibration as the excavation of channel is done by blasting. It would also bring about industrial waste (residual rocks) during excavation works, In addition, if these negative impacts are not appropriately mitigated, bad perception with the Project would occur. In addition, concrete works would cause water pollution with high alkali water.
4	Impacts of construction and operation of quarry and/or crushing and batching plantson the same environmental elements as those of (above)	Construction and operation of quarry and/or crushing, batching plant would cause almost the same impacts as those of construction ofheadrace channel mentioned above. In this regard, crushing of rocks at crushing plant would cause intense noise.
5	Impacts of utilization of spoil bank on dust, soil erosion, turbid water discharge, noise and vibration, construction waste, soil contamination and social unrest.	Utilization of spoil bank would cause air pollution especially dust generation while dumping, earth collapse from dumped rock/gravel materials. It would also bring about water pollution (turbidity) if the collapsed materials reaches into the river, noise and vibration due to dumping, residual rock waste scattering, and soil contamination if excavated rocks contains heavy metal components. In addition, if these negative impacts are not appropriately mitigated, social unrest and bad perception with the Project would occur.

2) Impact during Operation Phase

As the projects are of run-off-river type plants the power output in the dry season becomes low at a level of 4-5 MW for the UB-1, and 2.3 MW for the UB-2. In order to maintain the power output as high as possible during the dry season peak power operation of about 4 hours is considered by regulating daily discharge at the Intake Dam of UB-1. Although this option of maintaining the peak power seemed economical viable, the boat transportation along the Indein stream and irrigation downstream of Indein will be affected. Therefore inorder not of have adverse effects on the downstream water requirement the option of maintaining peak power has abandoned.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>

The stakeholder meeting was held from 2011 to 2013. Stakeholders who live in neighbourhood of the project site and government officers were invited to the stakeholder meeting and interviewed by the project owners in order to collect comments on the project. The project participants inform the village's local authority about the local stakeholder meetings. The introduction documents of the project activity are provided to the local authority. The introduction documents of the project activity are provided to the local authority. The local authority hands out the introduction to the villagers. The comments from the villagers are collected and informed to the project participants by the local authority. The villagers who have comments on the project activity is gathered to discuss their comments with the project participants at the local stakeholder meeting.

The meeting were held more than 10 times.

E.2. Summary of comments received

>>

The following table summarizes stakeholders' comments which were collected at stakeholders' meeting.

Table12. Summary of stakeholders' comments

#	Stakeholders	No of Meeting	Discussion
1	- 9 members from MOEP, - 1 member from Police Officer of Nyaung Shwe Township, Special Bureau of Investigation - 1member from Myanmar Economic bank	1time in 2011 7 times in 2012	Site visit and discuss of the project
2	- 1 member from Tanggyi District, - 1 member from Nyaung She Township, - 1 member from Inn Tain-Le Pyin' Village, - 1 member from Tone Le'Village, - 1 member from Kyauk Taw Knoe' Village, - 1 member from Ministry of Forest	1 time in 2011	Negotiation of Project Base Camp Area
3	- 1 member from Myanmar Economic Bank	1 time in 2011	To explain the history & progress of the investment condition of the project
4	- 2 members from Shan State Administrative Authorities, - 2 members from MOEP, - 1 member from Tanggyi District - 1 member from Nyaung Shwe Township	1 time in 2011, 3 times in 2012	Discuss about the surrounding envoronment
5	- 2 members from 'Inn' party, - 1 members from Indein Village Trap, - 1 member from Minlone Village	1 time in 2013	Discuss about the environmental impact

E.3. Report on consideration of comments received

>>

As for the comments of the stakeholders, most stakeholders and local government are very supportive for the proposed project. Toward the considerations and opinions of the stakeholders, the solutions are as follows:

- Regarding environmental impact, there is no significant issues from stakeholders since no stakeholders reside the project area. Therefore, any countermeasures on environmental issues are planned to consider.
- Consequently, since no big counterview is showed in the interview, serious changes in the project design, construction and operation need not be made.
- As for the comments on land occupation for basecamp and land compensation, villagers were compensated for land occupation by the project participant.

Based on the above measures, opinions and views of the public can be basically solved. Therefore it is not necessary to modify design, construction and the run way of this proposed project.

SECTION F. Approval and authorization
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The letters of approval from the DNA of Myanmar and Japan for the project activity is issued when PCN is submitted by the project participants. It is under process.

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Appendix 1: Contact information of project participants

Project Owner

Organization	Neo Energy Oasis Development Co., Ltd
Street/P.O. Box	(1A/11)
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Website	-
Contact person	Khine Oo
Title	Managing Director
Salutation	-
Last name	-
Middle name	-
First name	Khine Oo
Department	-
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Project Participant

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Fax	81-3-5276-3024
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Website	-
Contact person	Masaru Ishikawa/Sachiyo Shimizu
Title	-
Salutation	-
Last name	Masaru/Sachiyo
Middle name	-
First name	Ishikawa/ Shimizu
Department	Environmental Science & Engineering Dept
Mobile	-
Direct fax	81-3-5276-3024
Direct tel.	81-3-5276-7369
Personal e-mail	-

Appendix 2: Affirmation regarding public funding

No public funding is involved in this project activity.

Appendix 3: Applicability of selected methodology

The approved small-scale methodology "AMS-I.D. Grid connected renewable electricity generation (Version17.0)" is used for the project.

Appendix 4: Further background information on ex ante calculation of emission reductions

To calculate average OM, the following default values were used.

Table A-1. Default values of calculation average OM

Item	Unit	Value	Source
CO2 emission factor (natural gas)	tCO_2/TJ	56.1	default value, IPCC 2006
CO2 emission factor (lignite)	tCO_2/TJ	101.0	default value, IPCC 2006

The calculation of the CO_2 emission from fuel type i is shown in the following equation and Table A-3;

$EC_{i,y} = FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}$

Table A-3. Calculation of CO_2 emission of Coal-fired plants in 2010 to 2012

Item	unit	2010	2011	2012
Annual Fuel Consumption[10]	ton	384,226	452,186	454,073
Annual Energy Volume[12]	MWh	351,509	379,040	266,906
Specific Coal Consumption	ton/MWh	1.093	1.193	1.701
CO_2 Emission	tCO_2	609,268	717,031	720,023

The calculation of the CO_2 emission from natural gas power plants is shown in the following equation and Table A-2;

Table A-2. Calculation of CO_2 emission of Natural gas power plants in 2010 to 2012

Item	unit	2010	2011	2012
Annual Fuel Consumption[10]	MCF	35,780	51,134	56,435
Annual Heat Volume[11](Each power plant data is shown in attachment-1)	x 10^9 BTU	24,750	34,080	37,607
Annual Energy Volume[10]	MWh	1,563,845	2,121,582	2,355,869
CO_2 Emission	tCO_2	1,464,942	2,017,175	2,225,910

※

The calculation of the emission factors of MNPG is shown in the following equation and Table A-4.

$$EF_{MNPG,OM,y} = \frac{EC_{GT,y} + EC_{coal,y}}{EG_{MNPG}}$$

Table A-4. Calculation of average OM emission factor of MNPG in 2010 to 2012

Item	unit	2010	2011	2012
Annual Energy Generated[10]	MWh	7,816,800	10,044,457	10,837,335
Emission factor OM(each year)	tCO_2/MWh	0.265	0.272	0.272
Emission Factor OM on 3-year average	tCO_2/MWh			0.270
CO_2 Emission in total	tCO_2	2,074,210	2,734,206	2,945,933

[10] Data from MOEP
[11] Heat Volume (BTU) = Heat rate for offshore or inland gas field (BTU/CF)* Fuel Consumption (MCF) /10^6

Appendix5:Further background information on monitoring plan

No further background information on the monitoring plan.

Appendix6: Summary of post registration changes

Not applicable.

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History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for small-scale CDM project activities" (EB 66, Annex 9).
03	EB 28, Annex 34 15 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.
02	EB 20, Annex 14 08 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
01	EB 07, Annex 05 21 January 2003	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		