MOEJ/GEC CDM Feasibility Study (FS) 2013
Final Report

「Small-scale conduit type hydropower plant」
（Study Entity : Nippon Koei Co., Ltd）

FS Partner(s)	NEO Energy Oasis Development Co., Ltd. (NEO)
Location of Project Activity	Myanmar, Shan State
Category of Project Activity	Renewable Energy
Targeted GHG	Carbon Dioxide (CO_2)
Description of Project Activity	The Upper Baluchaung No.2 Hydropower Project ("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. ("NEO"). The installed capacity of the project is 10.0 MW, which is estimated to supply 43.8 GWh per year to the national electricity grid. UB-2 is planned to start operating in December 2015.
Methodology to be applied	AMS-I.D. Grid connected renewable electricity generation (ver17.0)
Baseline Scenario	According to AMS-ID (ver 17.0), in the baseline scenario 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 planned new generation sources into the grid. The baseline emissions are the electrical energy baseline produced by the renewable generating unit multiplied by an emission factor. So for the project, the baseline scenario is equivalent to the annual electricity supplied by Myanmar National Power Grid (MNPG).
Monitoring Plan	Monitoring Plan is prepared based on AMS-ID (ver.17.0). Main items for monitoring are amount of power being supplied and imported to MNPG.
Estimation of GHG Emission Reductions	Estimation of GHG Emission Reductions is 16,275 tCO_2/year.
Duration of Project Activity/ Crediting Period	Operation of UB-2 will start in December 2015 (subject to the procurement and construction schedule) Proposed crediting period for the project is 21 years.
Environmental Impact Analysis	NEO conducted Environmental Study in June 2010 as a part of feasibility study and basic design of the project. Results showed that for the implementation of the project, there are no particular problems.
Demonstration of Additionality	To demonstrate additionality, investment barriers to the project and a sensitivity analysis were carried out for the financial parameters (total investment cost, annual generation of electricity, construction cost, rehabilitation cost). The analyses show that the Project is not additional.
Project Feasibility	The project plans to complete the construction in the end of December and starts the CDM project after its completion.
Contribution to Sustainable Development in Host Country	In Myanmar, 2,644 MW hydropower plants will be installed by 2020 to contribute to sustainable development for underdeveloped areas. If the emission factor is registered officially, it can contribute to the spread of CDM in Myanmar.

FS Title: CDM Feasibility Study

"Small-scale conduit type hydropower plant"

(Host country: Myanmar)

FS Entity:

1. FS Implementation Scheme

Country	Implement body for the study (Study team)	Task
Japan	Nippon Koei Co., Ltd. (Environmental Science & Engineering Dept.)	Implement the study, Preparing PDD
	Japan Quality Assurance Organization	Implement validation
Host Country	NEO Energy Oasis Development Co., Ltd.	Provide necessary data of the study
	Nippon Koei Co., Ltd. (Yangon office)	Collecting data and supporting study activities in Myanmar

2. Outline of CDM Project

(1) Description of Project:

The Upper Baluchaung No.2 Hydropower Project ("UB-2" or "the Project") is proposed as a 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. ("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 projects. 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 ("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 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 ("MNPG").

(2) CDM Methodology to be applied to the Project:

"AMS-ID Grid connected renewable electricity generation (ver17.0)" is the applicable methodology to be used for small-scale projects.

3. Study Results

(1) Baseline & Monitoring methodologies

AMS-ID (ver17.0) is the applicable methodology to apply to renewable energy generation units that supply 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 methodology. The technology of hydropower applies for run-off-river hydro plants. The proposed project qualifies as a small-scale project activity and its capacity will remain within the limits of small-scale project activity types during every year of the crediting period. Therefore, the methodology AMS-ID (ver17.0) is applicable to the project.

The following table summarizes, the eligibility of UB-2 to the methodology AMS-ID (ver17.0).

Technology/measure in AMS-ID (ver17.0)	Eligibility of UB-2
This category comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable	As a new hydropower project, UB-2 supply power to the MNPG, which mainly composed of fossil-fuel power

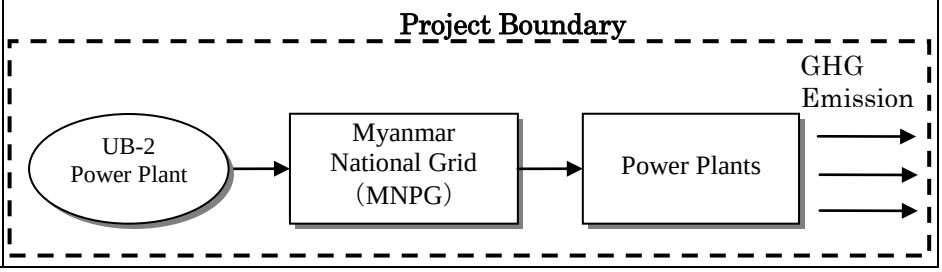
biomass that supply electricity to a national or a regional grid. (a) Supplying electricity to a national or a regional grid; or (b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.	plants. So UB-2 is applicable for this category.
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)	UB-2 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 4 W/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 4 W/m2.	UB-2 does not create any reservoir and have any existing reservoir, so this item is not applicable.
If the new units has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW 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 15 MW.	UB-2 only involves renewable components, so this item is not applicable.
Combined heat and power (co-generation) system are not eligible under this category.	UB-2 only produces electricity, so this item is applicable.
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.	UB-2 is a new hydropower project, so this item is not applicable.
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 15 MW.	UB-2 is a new hydropower project, so this item is not applicable.

Source : Prepared by Nippon Koei Co., Ltd.

(2) Baseline Scenario and Project Boundary:

The following table shows the setting for baseline scenario and project boundary

Item	Outline
Baseline Scenario	According to AMS-ID (ver17.0), in the baseline scenario electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by planned new generation sources into the grid. The baseline emissions are the electrical energy baseline

	produced by the renewable generating unit multiplied by an emission factor. Grid emission factor is calculated based on "Tool to calculate the emission factor for and electricity system (ver04.0)". Combined Margin (CM) is calculated from Operating Margin (OM) and Build Margin (BM) which is based on the data of 2010 -2012.
Project Boundary	The electricity generated by the proposed project will be supplied to the regional electricity system of MNPG. Based on the methodology AMS-ID (ver17.0), 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 follows. 

Source : Prepared by Nippon Koei Co., Ltd.

(3) Monitoring Plan:

Monitoring Plan is prepared based on AMS-ID (ver.17.0). Main items for monitoring are amount of the power being supplied and imported to MNPG. Using these data, amount of net power supply is calculated for the amount of emission reduction.

	Summary
Monitoring Item	Net electricity generated in the plant in a year (MWh)
Monitoring method	Electricity exported to grid will be monitored continuously using a monitoring meter, which will be recorded daily and aggregated monthly.
Monitoring frequency	Continuous measurement and at least monthly recording.

Source : Prepared by Nippon Koei Co., Ltd.

For implementing proper monitoring and reporting based on the methodology, the monitoring duties are to be performed by three staff positions that are shown below.

Staff Position	**Duties**
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 check the invoice against the main meter record on a monthly basis

Source : Prepared by Nippon Koei Co., Ltd.

(4) GHG Emission Reductions:

Study result for the task of grid emission factor is summarized following table.

Option	Summary	Result of the study
a. Emission factor of Dapein 1 Hydropower Project*	Emission Factor : 0.39459 [tCO_2/MWh] Data source : Power generation data of 2006-2008 from MOEP(1) and MOEP (2) Calculation method: "Tool to calculate the emission factor for and electricity system (Version 02.2.1)" is used for the calculation.	Grid emission factor (0.39459 tCO_2/MWh) which is used for Dapein1 Hydropower Project was confirmed applicable for UB-2 project. However the emission factor evidence could not be confirmed by the study team; hence it difficult to use it for UB-2.
b. Emission factor Calculated by MOEP power generation data from 2010 – 2012	Emission Factor : 0.371 [tCO_2/MWh] Data source : Power generation data of 2010-2012 from MOEP Calculation method: "Tool to calculate the emission factor for and electricity system (Version 04.0)" is used for the calculation.	Emission factor (0.371 tCO_2/MWh) that is calculated by the study team based on the data from 2010 – 2012 is chosen for UB-2 project.

*Note : Dapain 1 Hydropower Project is currently the only registered CDM project in Myanmar.
Source : Prepared by Nippon Koei Co., Ltd.

Based on the study, Emission Factor is calculated as 0.371 tCO_2 / MWh as current emission factor. Calculation method of baseline emission and project emission (and Leakage Emission) is shown below.

Baseline Emissions (BE_y) = $EG_{BL,y}$ * $EF_{MNPG,y}$

Where

BE_y = Baseline Emissions in the year *y* (tCO_2)

$EG_{Bl,y}$ = Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in a year y(MWh)

$EF_{MNPG,y}$ = CO_2 emission factor of the grid in year *y* (tCO_2/MWh)

Leakage Emissions (LE_y)=0.

Project Emissions (PE_y) =0.

Emission Reductions (ER_y) = BE_y - PE_y - LE_y

(tCO_2)

	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year
Baseline emission	16,275	16,275	16,275	16,275	16,275	16,275	16,275
Project emission	0	0	0	0	0	0	0
Leakage emission	0	0	0	0	0	0	0
Total	16,275	16,275	16,275	16,275	16,275	16,275	16,275

Source : Prepared by Nippon Koei Co., Ltd.

(5) Duration of Project and Crediting Period:

The crediting period of the project is 21 years (renewal 2 times at least). Average lifetime of hydropower plant is usually over 30 years, therefore the crediting period will be set as 7 years so that it will be renewed 2 times, and it will be possible to make additional income by selling CER during UB-2 operation.

UB-2 plan will start operation on 1st December 2015. The schedule of CDM registration is shown in the following table.

CMD Registration Event	Scheduled Date
Submission of Prior consideration to UNFCCC	22 October 2012
Submission of PDD	October 2013
Approval of host country	January 2013
Implement the validation	Desk review : November 2013 Site review: 24-29 November 2013
Project concept note	March 2014
CDM registration	June 2014 (planning)

Source : Prepared by Nippon Koei Co., Ltd.

(6) Environmental Impact Analysis:

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.

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 in negative perception of 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 equipment 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, negative perception of the Project might occur. In addition, concrete works would cause water pollution with high alkali content.
4	Impacts of construction and operation of quarry and/or crushing and batching plants on the same environmental elements as (above)	Construction and operation of quarry and/or crushing, batching plant would cause almost the same impacts as those of construction of headrace 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,	Utilization of spoil bank would cause air pollution especially dust generation while dumping earth collapsed from dumped rock/gravel materials. It would also bring about water pollution (turbidity) if the collapsed materials got into the river, noise and vibration due to dumping, residual rock waste scattering, and soil contamination if

	soil contamination and social unrest.	excavated rocks contains heavy metal components. In addition, if these negative impacts are not appropriately mitigated, social unrest and negative perception of the Project would occur.

Source : Prepared by Nippon Koei Co., Ltd.

(7) Stakeholder Consultation:

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

#	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 environment
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

Source : Prepared by Nippon Koei Co.,.Ltd.

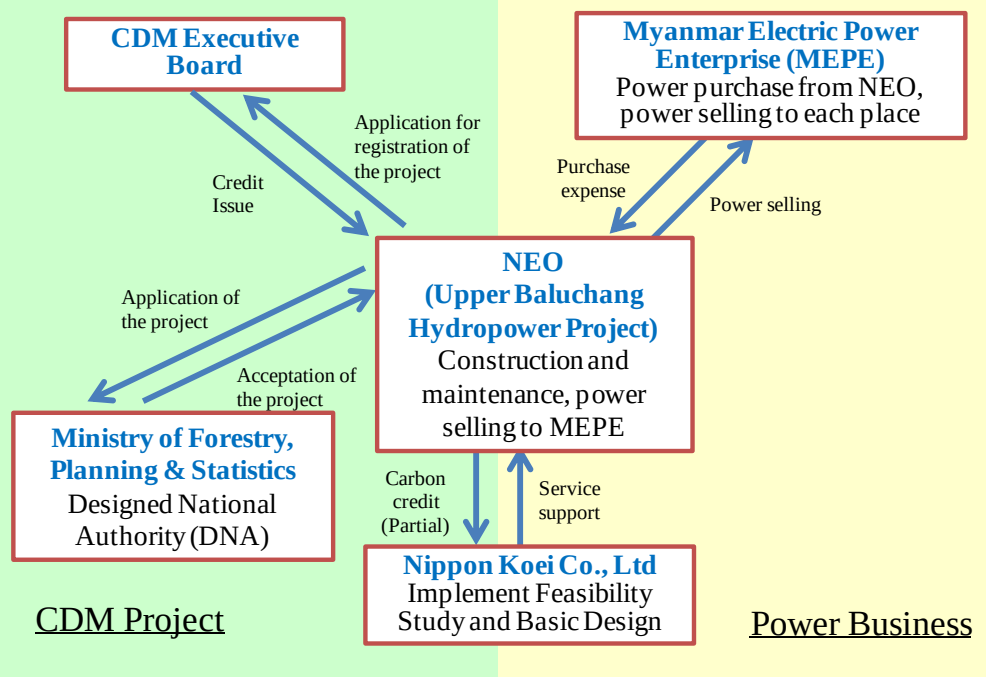
(8) CDM Project Implementation Scheme:

NEO is the Developer of Upper Baluchaung Hydropower Project (including this project). NEO plans to sell power as IPP by own funding.

Implementing body of this project is Nippon Koei Co., Ltd (NK) who is in charge of preparing PDD, calculating emission factor, and prepare a variety of studies to support registration of CDM.

As a power producer, NEO is in charge of construction power plant, maintenance the plant, selling power to Myanmar Electric Power Enterprise (MEPE). For emission reduction of GHG occurring from power generation, NEO will register and do procedure crediting to CDM Executive Board. NK will support these procedures of CDM project.

Project Implementation Scheme is shown in the following figure.



Source : Prepared by Nippon Koei Co., Ltd.

(9) Financial Plan:

UB-2 is planning the construction period as three years. The construction cost is USD 18,000,000. After starting the power generation, operation cost is estimated USD 191,300 (where Fixed cost = USD 191,005, Variable cost = USD 1,869). Annual income from selling electricity is estimated at USD 1,966,000. Cash flow plan for UB-2 is shown in the following table.

Construction will be financed by NEO, which is developer of the project, and they do not plan borrowing funds.

Investment	Item	Cost (USD)
1. Initial investment	Construction cost (1st year)	7,052,042
	Construction cost (2nd year)	7,949,603
	Construction cost (3rd year)	2,867,654
2. Yearly investment cost	Operating & Maintenance cost (Yearly)	192,874
3. Yearly income cost	Yearly power sales price (income)	1,965,984
Yearly income (3-2)		1,773,110
4. income for 60 years		100,122,493
Project income		82,253,194

Source : Prepared by Nippon Koei Co., Ltd.

(10) Analysis of Project Profitability:

The analysis of project profitability is in "Appendix A of the simplified modalities and procedures for small scale CDM project activities". Benchmark in FIRR uses commercial lending rate in Myanmar 2010 (17.0%). All the parameters used for the analysis are from 2010 when it was decided to implement the project.

The FIRRs with and without the income from CERs sale are listed in the following table. The FIRR of the project both with and without CDM revenue are less than 17.0%, the benchmark by the project participant.

	Without income from CERs	With income from CER	Benchmark
FIRR (September 2010)	8.67%	9.45%	17.0%

Source : Prepared by Nippon Koei Co., Ltd.

(11) Demonstration of Additionality:

For this small-scale project "Guidelines on the demonstration of additionality of small-scale project activities (ver 09.0)" are applied. Among the options in the Guidelines, investment analysis is selected for the assessment of additionality. If the project is not implemented, following scenario is considered.

Scenario : Power supply from MNPG (continuing)

Scenario has no barrier because additional investment from NEO is not required. Scenario is only feasible when the project does not implement CDM.

To demonstrate barriers to investment, benchmark analysis is used in this project. Equity IRR of pre-tax is calculated during 20 years such as project lifetime. Benchmark used commercial lending rate in Myanmar (17.0%) to compare to IRR.

IRR is 8.7% without CER income and that is lower the benchmark. Therefore, the project is not attractive as an investment project and additionality is demonstrated for Scenario which has high amount of CO_2 emission.

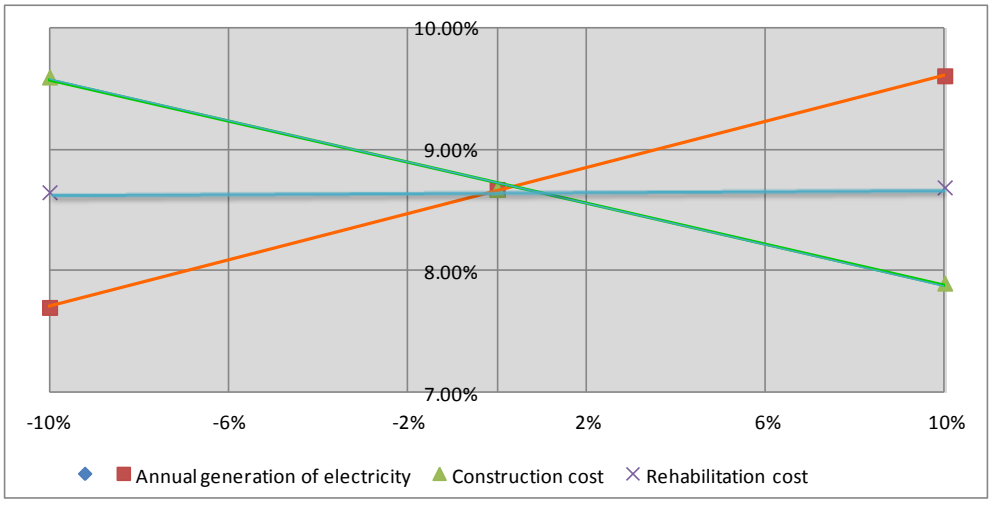
In order to demonstrate the investment sensitivity of the proposed project to external factors, a sensitivity analysis was also carried out for the following financial parameters (Case 1 to 3).

Case 1 : Annual generation of electricity
Case 2 : Construction Cost
Case 3 : Rehabilitation Cost

The following table and figure show that each case does not reach the benchmark and thus the Project is not attractive as an investment target.

Sensitive Parameter		-10%	+10%
Case 1	Annual generation of electricity	7.70%	9.61%
Case 2	Construction Cost	9.60%	7.90%
Case 3	Rehabilitation Cost	8.69%	8.65%

Source : Prepared by Nippon Koei Co., Ltd.



Source : Prepared by Nippon Koei Co., Ltd.

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.

(12) Project Feasibility:

NEO plan to start UB-2 operations in December 2015. Project feasibility and validation schedule are shown in below.

Feasibility of the project	PDD was submitted to DOE in October 2013. DOE implemented desk review in November 2013 and Site review on 24 – 29 November. Currently, PDD has been modified, and aims to be finalized and registered by June 2014
Prior consideration	Submission in October 2012
Project Concept Note	March 2014
Consultation with relevant organizations	Nippon Koei and NEO have meeting of progress of the project and submit the information. Feasibility and CDM registration schedule has not changed significantly, and it is expected to progress as planned.
Designated Operational Entity	Japan Quality Assurance Organization
Validation	November, 2013 : Implemented Desk review 24 – 29 November 2013: Implemented Site review Middle of February 2014 :Submission of Draft Validation report

Source : Prepared by Nippon Koei Co., Ltd.

5. Contribution to Sustainable Development in Host Country

In Myanmar, 44,568 MW (236,780 GWh) hydropower plants will be installed to contribute to sustainable development for underdeveloped areas.

If the project registers CDM, the emission factor can use for other projects. If the emission factor is registered officially, than it can contribute to the spread of CDM in Myanmar.

【Attachment】

(1) Financial Analysis