CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

SECTION A. General description of project activity

A.1. Title of the project activity:

Xekaman 3 Hydropower Project, Lao PDR
Version 1.3
16/10/2011

A.2. Description of the project activity:

The project activity is to build and operate a hydropower plant with an accumulation reservoir located along the Nam Pagnou River (tributary of the Xekaman River) in the South of Laos being around 10km from the Vietnam border (beeline). The project, which is expected to meet the future growing demand for power supply in Vietnam is part of the Vietnam-Lao partnership for energy development.

The project is owned and built by the Xekaman 3 Power Company Limited[1].

The hydropower plant will produce 977.5 GWh per year, with an installed capacity of 250 MW[2]. The Xekaman 3 hydropower plant is a diversion plant. Water from a storage reservoir is directed through tunnel and penstock to the powerhouse. The power scheme has a reservoir area at maximum water level of 5.251km^2. The energy density is thus around 47.6 W/m^2. The electricity produced will be transmitted to Vietnam by a 92 km long 230 kV dual circuit line. The project started construction in April 2006 and expects to enter into operations April 2012.

The project will reduce GHG emissions by annually 499,481 tCO_2 by producing electricity with a renewable source thus substituting electricity produced in Vietnam to a large extent by fossil means. Only electricity sold to Vietnam is accounted for. The electricity produced in Laos is as of today only renewable. Electricity supplied to Laos will thus not be included in any calculations. The combined grid factor of Laos and Vietnam is taken to determine the Combined Margin.

For Laos this project is of big importance for CDM development. As of Global Stakeholder Consultation starting date Laos had only 1 registered CDM project and no renewable energy project registered[3].

The contribution to sustainable development is:

- Reduced GHG emissions in Vietnam through producing energy with a renewable source.
- Reduced local air pollution, especially particle matter and sulfur dioxide caused by thermal power plants, especially coal plants as used by Vietnam.
- Renewable energy sources and technology is promoted thus diversifying energy sources and securing energy supply for a sustained economic growth of Vietnam.

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[1] The Company was granted the Foreign Investment License 002-06/KHDT by the Laotian Committee for Planning and Investment and the Business License 0003/TD-DN (files 7 and 8).

[2] Total production; production to the grid is 1.5% less; see for details and source table 1

[3] The registered project is #930 (energy efficiency at beer brewery); One HPP project was under validation (Xeset 2)

- Creation of 3,800 additional jobs during construction and 122 permanent jobs during hydropower plant operations[4].

57 households with a around 342 people were affected due to the project[5]. No people were dislocated. Compensation and support have been given to affected people. The project is also being evaluated for WCD (World Commission on Dams) compliance and has realized all respective documentations.

A.3. Project participants:

Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Lao People's Democratic Republic (host)	Xekaman 3 Power Company Limited (private entity)	No
Socialist Republic of Vietnam (host)	Viet Lao Power Joint Stock Company (private entity)	No
Switzerland	ecotawa AG (private entity)	No

The project is located in Lao People's Democratic Republic and is connected to the grid of the Socialist Republic of Vietnam via the power grid of Lao People's Democratic Republic. Therefore both countries are listed as host Parties.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

The location of the project is in Lao People's Democratic Republic. Therefore under A.4.1.1 only this host is listed

A.4.1.1. Host Party(ies):

Lao People's Democratic Republic

A.4.1.2. Region/State/Province etc.:

Sekong Province

A.4.1.3. City/Town/Community etc.:

Dak Chung District

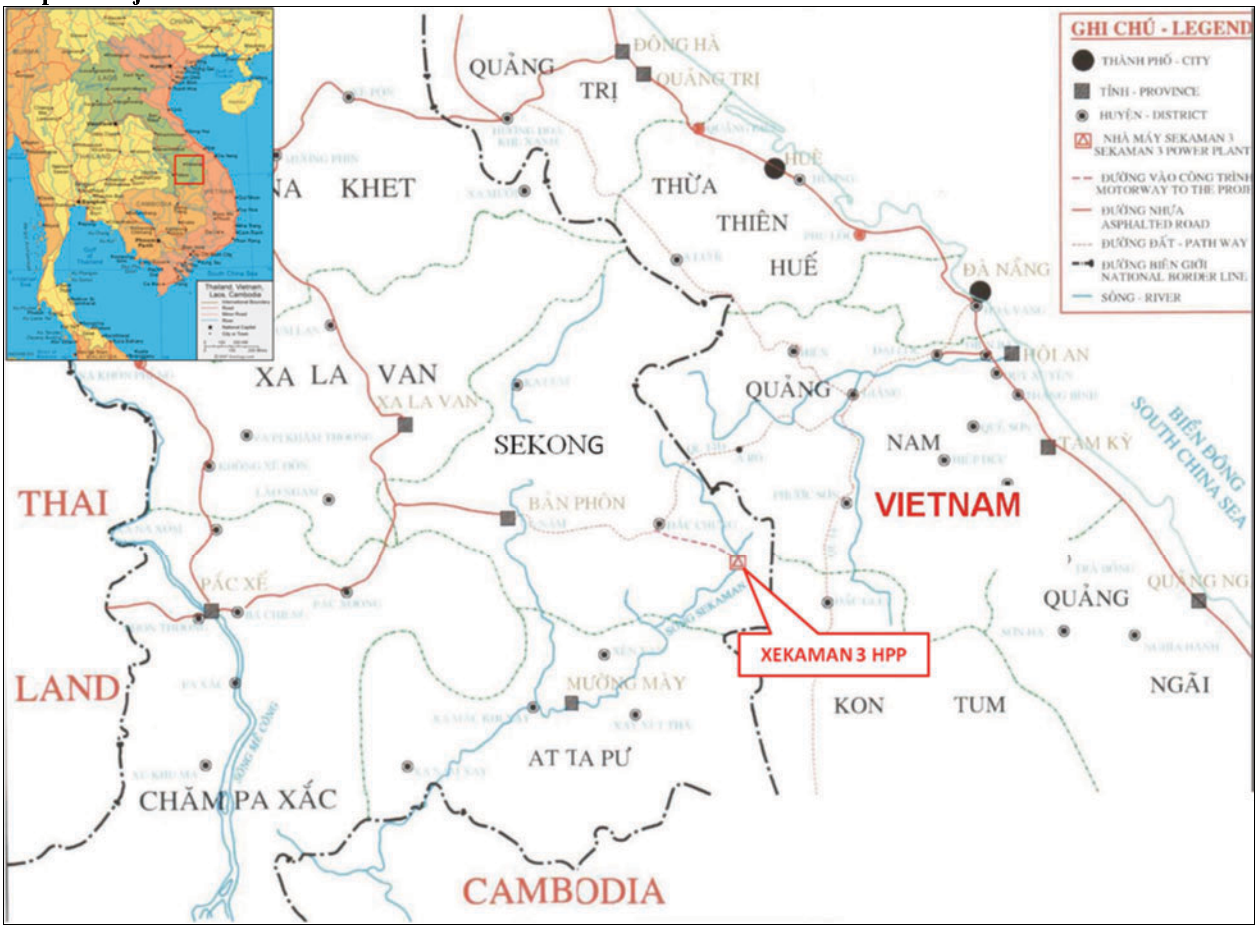
[4] File 17 p.11

[5] File 9, p.24 for relocation ; Affected people with compensation agreements see File 10 p. 17, File 11 p.3, File 12 p.3, File 13 p.3, File 14 p.2, Files 15 and 16

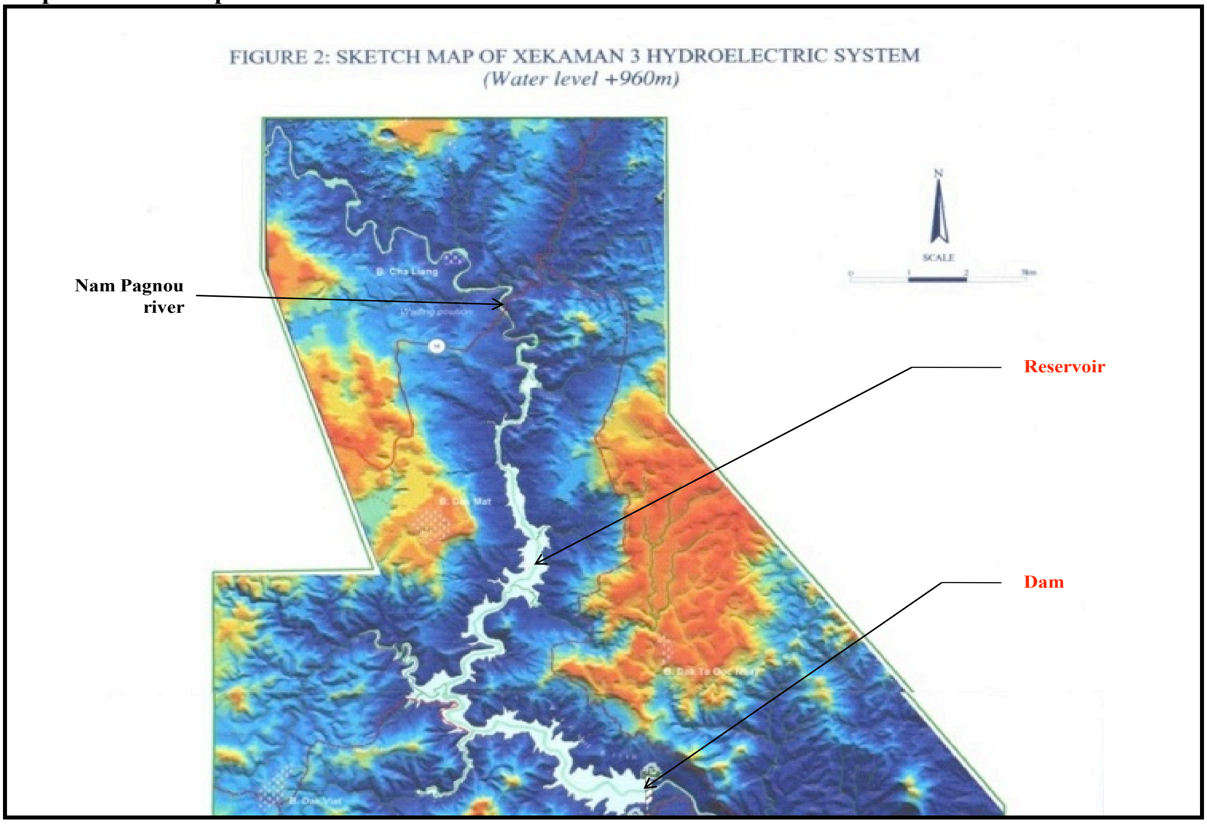
A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

Power house: Latitude: 15.3756 and Longitude: 107.4064
(equivalent to 15°22’32” N, 107°24’23” E)

Map 1: Project Site



Map 2: Sketch Map



A.4.2. Category(ies) of project activity:

Sectoral scope / Category 01: Energy industries (renewable sources)
Grid-connected electricity generation from renewable sources

A.4.3. Technology to be employed by the project activity:

The hydropower plant has two synchronous hydraulic vertical shaft Francis turbines. The total generation capacity is 250 MW. The hydropower plant is based on an accumulation reservoir.

Table 1: Characteristics of the Hydropower Plant

Parameter	Unit	Value	Source
Generation capacity	MW	250	File 6, p.V-12
Maximum rated flow rate	m^3/s	62.3	File 6, p.V-12
Operating hours per year	Hours	3,910	File 6, p.V-12
Average annual power production	MWh	977,500	Calculated
Internal usage of electricity	Percentage	1.5%	File 6, p.V-28
Electricity production for the grid per annum	MWh	962,838	Calculated

The hydropower plant has one reservoir with a concrete faced rock-filled dam. Characteristics of the reservoir are listed in the following table.

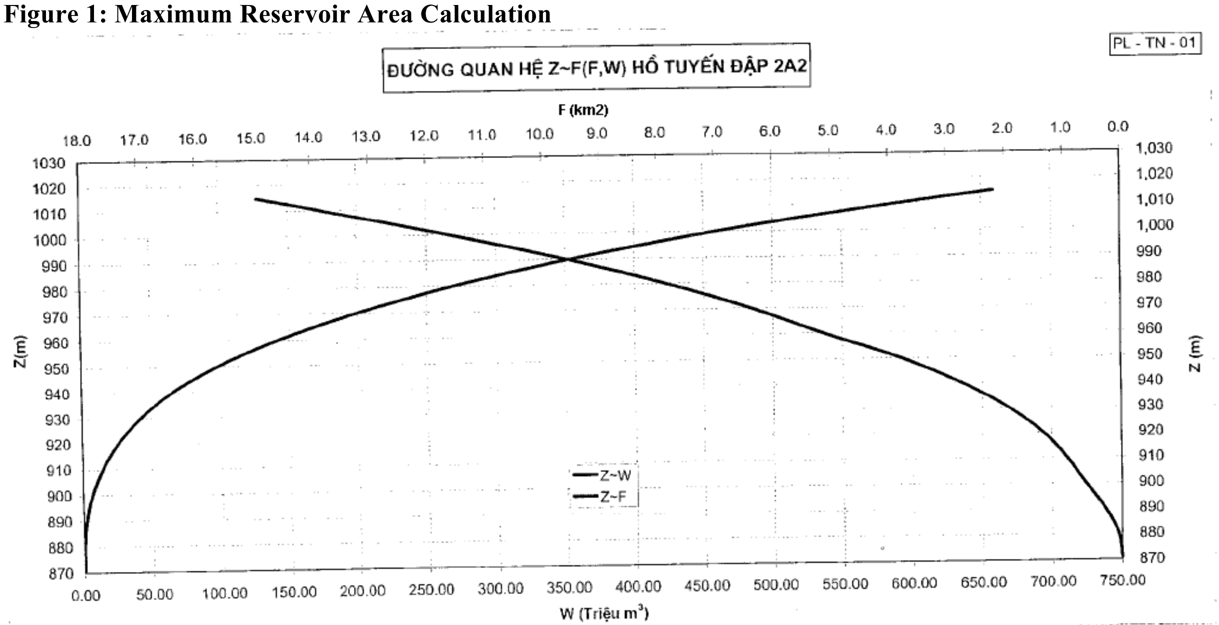
Table 2: Characteristics of the Reservoir

Parameter	Unit	Value
Reservoir level at normal water level	meter	960
Reservoir level at dead water level	meter	925
Reservoir level at surcharge water level (check flood)	meter	964
Reservoir area at normal water level	km^2	5.13
Reservoir area at maximum water level	km^2	5.251
Power density	W/m^2	47.6
Total volume of reservoir	million m^3	141.5
Useful volume of reservoir	million m^3	108.5
Length of dam crest	meter	540
Maximum height of dam	meter	101.5

Source: Reservoir data except reservoir area at maximum water level File 18, p.1; reservoir area at maximum water level File 19, p.I; dam data File 19, p.II

The reservoir area was calculated basing on the function F=F(Z) which is showed in following figure based on topographical survey map[6].

Figure 1: Maximum Reservoir Area Calculation



Z (m)	871	875	880	885	890	895	900	905	910	915	920	925	930	935	940
F(km2)	0.00	0.01	0.06	0.18	0.29	0.43	0.62	0.77	0.94	1.14	1.35	1.59	1.94	2.30	2.75
W (Triệu m3)	0.00	0.02	0.21	0.80	1.97	3.77	6.40	9.87	14.14	19.35	25.58	32.95	41.77	52.38	65.00
Z (m)	945	950	955	960	965	970	975	980	985	990	995	1000	1005	1010	1015
F(km2)	3.21	3.78	4.37	5.13	5.61	6.36	6.81	7.77	8.58	9.58	10.58	11.62	12.67	13.81	14.93
W (Triệu m3)	79.90	97.39	117.75	141.49	168.34	198.27	231.21	267.67	308.55	353.96	404.37	459.87	520.58	586.77	658.62

[6] File 20, Hydraulic annex, PL – TN – 01

Table 3: Turbine Specifications

Parameter	Specification
Producer	Va Tech Hydro GmbH, Austria; Manufacturing in Austria and China
Type	Synchronous hydraulic turbine of Francis type, vertical shaft (set)
Number of units	2
Characteristics	Power rating: 127.551 MW each Qmax: 31.1 m^3/s Guaranteed turbine efficiency: ηaverage 94.95%

Source: File 21, p.3

Table 4: Generator Specifications

Parameter	Specification
Producer	Va Tech Hydro GmbH, Austria; Manufacturing in Austria, China and India
Type	Synchronous generator of vertical shaft, bracket type, three-phase (set) Three-phase dry-type excitation transformer, natural cooling of air convection
Number of units	2
Characteristics	Power rating: 125 MW each 15.75kV

Source: File 21, p.4

Various power transformers fabricated by Huapeng, China including 7 units of single-phased two-winding power transformers with no-load voltage regulators of 51.5 MVA, 50 Hz each[7].

The transmission line connects to the Vietnam national grid through a 230 kV dual circuit line with a length of 92 km. The voltage supplied for the Vietnamese national grid is 230 kV, and for Laos the charge is 115 kV[8].

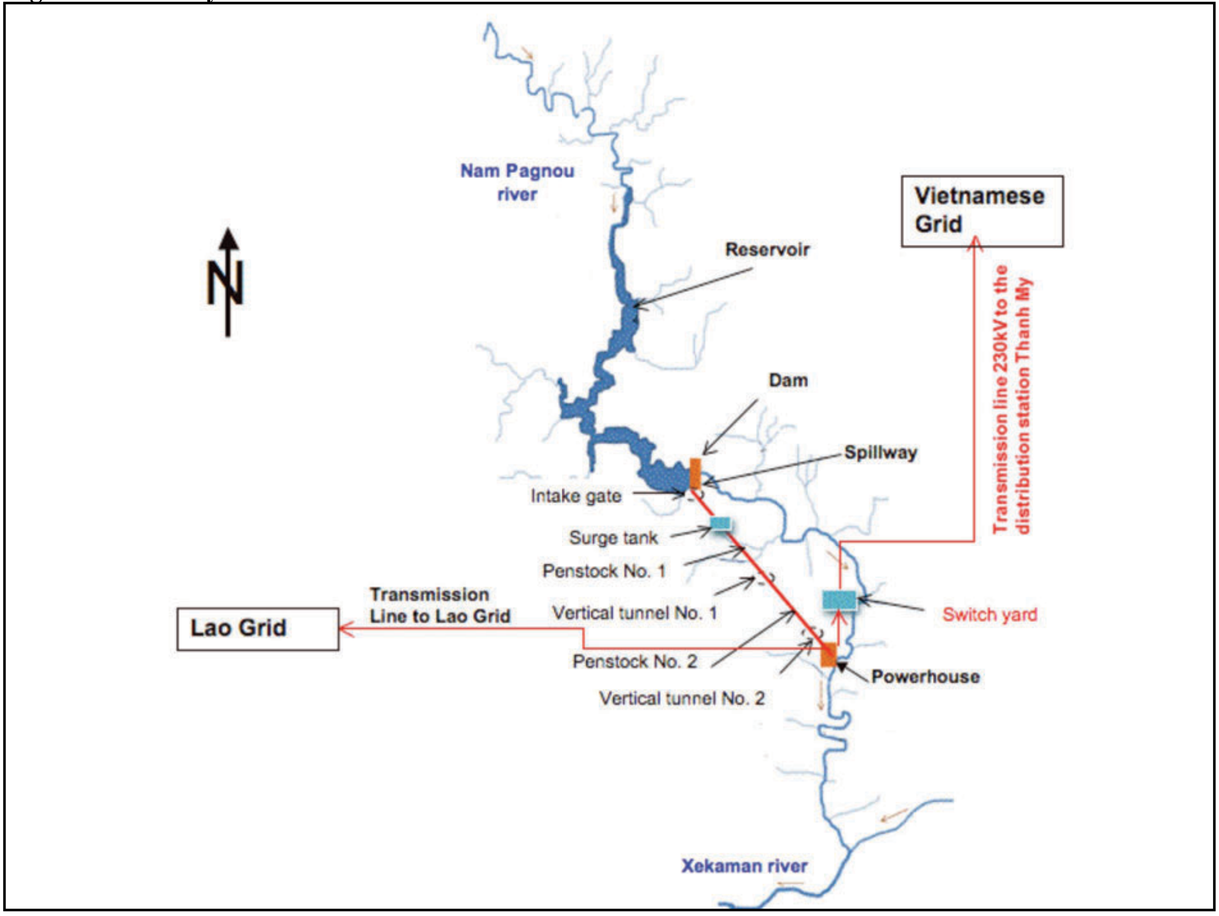
Generators and turbines are imported from Austria, India and China. They therefore contribute to the sustainable development aspect of the project via technology transfer.

Figure 2 shows a general plant layout.

[7] File 21, p.5

[8] File 22 p.8

Figure 2 Plant Layout



A.4.4. Estimated amount of emission reductions over the chosen crediting period:

Years	Estimation of annual emission reductions in tCO_{2eq}
2012 (8 months)	332,987
2013	499,481
2014	499,481
2015	499,481
2016	499,481
2017	499,481
2018	499,481
2019 (4 months)	166,493
Total estimated reductions (tonnes of CO_{2eq})	**3,496,366**
Total number of crediting years	7
Annual average of the estimated reductions over the crediting period (tCO_{2eq})	**499,481**

A.4.5. Public funding of the project activity:

There is no Official Development Assistance in this project and the project will not receive any public funding from Parties included in Annex I[9].

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

Applied methodology

ACM0002 Version 12.1.0: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources".

Related tools

- "Tool to calculate the emission factor for an electricity system" Version 02.2.0
- "Tool for the demonstration and assessment of additionality" Version 05.2

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

The proposed project is a grid-connected renewable power generation project activity that installs a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (green-field plant) applicable to ACM0002. The applicability conditions of the methodology are related with the project in table 5.

Table 5: Applicability Conditions and Project Situation

Applicability condition	Project situation
The project activity is the installation, capacity addition, retrofit or replacement of a power plant/unit of one of the following types: hydropower plant/unit (either with a run-of-river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit.	The project is the installation of a new hydropower plant with an accumulation reservoir.
In case of hydropower plants, one of the following conditions must apply: - The project activity is implemented in an existing reservoir, with no change in the volume of reservoir; or - 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/m^2; or - 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/m^2.	The project activity results in a new reservoir with a power density of 47.6 W/m^2.

All applicability criteria are thus met.

[9] File 23

B.3. Description of the sources and gases included in the project boundary:

The greenhouse gases and emission sources included in or excluded from the project boundary are shown in Table 6.

Table 6: Emissions Sources Included in or Excluded from the Project Boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that is displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emissions source
		N_2O	No	Minor emissions source
Project activity	For hydro power plants, emissions of CH_4 from the reservoir	CO_2	No	Minor emissions source
		CH_4	Yes	Main emission source
		N_2O	No	Minor emissions source

The spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to. ACM0002 refers to the “Tool to calculate the emission factor for an electricity system”. This tool defines the grid/project electricity system by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without significant transmission constraints.

In its 28th meeting in December 2006, the CDM Executive Board clarified that the word “regional”, in the context of “regional electricity system” used in ACM0002 can also be interpreted as extending across several countries. The Board further clarified that trans-national electricity systems are eligible under ACM0002. Furthermore, the Board clarified that the grid emission factor in this context shall be estimated for the “regional electricity system” (EB28, paragraph 14).

Delineation by DNA of project electricity system

There is no published delineation of the DNAs of the host countries Vietnam and Laos regarding the project electricity system, but both DNAs have issued a Letter of Approval to the project activity, hence agreeing with the chosen definition of the project electricity system.

The concept of trans-national electricity between Laos and Vietnam can also be verified from the Agreement on Cooperation in the Electric Power Sector dated July 6th 1998 between the Government of Laos and the Government of the Socialist Republic of Vietnam in which the Vietnamese Government agreed to support the development and supply of up to 2,000MW of electricity[10]. January 9th 2003 the Government of Laos and the Government of the Socialist Republic of Vietnam entered a Protocol on the Co-operation in Economic, Cultural and Technical science under which Vietnam will encourage investment in hydropower projects in Lao and then buy the electricity thereof[11].

[10] File 27, Art. B, p.7

[11] File 38

Based on the Tool to calculate the emission factor for an electricity system" the following criteria can be used to determine the existence of significant transmission constraints:

- Constraint criterion 1: In case of electricity systems with spot markets for electricity: there are differences in electricity prices (without transmission and distribution costs) of more than 5 percent between the systems during 60 percent or more of the hours of the year.
- Constraint criterion 2: The transmission line is operated at 90% or more of its rated capacity during 90% percent or more of the hours of the year.

Constraint criterion 1 as given above is not applicable for the proposed activity, as there is no spot market in the both countries which could be compared. The power purchasing agreement indicate a similar price for both markets with Laos paying 95% of the primary price of Vietnam, which amounts to virtually the same price as the average price paid for exports to Vietnam[12]. The price difference between Laos domestic paid price and Vietnam exports based on the average price is calculated at 4%[13] which is lower than benchmark established by the Tool under constraint number 1. It can also be stated that the achievable tariff for power delivery from Laos to Vietnam is the most important economic key data for the project participant to invest in the project or not as this represents 90% of all revenue[14].

Constraint criterion 2 is not fulfilled for the proposed project activity as the Ministry of Industry of Vietnam has approved the improvement of the network connection line between Vietnam and Laos[15]. The same holds true for the Government of Lao which has decided to improve its transmission network to take advantage of hydroelectric energy exports to neighboring countries[16].

The existence of the direct transmission lines between Laos and Vietnam (see following figure) substantiates the fact that a) the two grid are not independent but fully integrated, and hence "trans-national grid" and b) that, there is no transmission constraint.

[12] Price paid by Laos 0.045 USD/kWh; average export price 0.043 USD/kWh; see File 25b based on Files 25a and 26 (PP agreements Laos and Vietnam); the power purchase price has 3.7% difference on average. The ifference is smaller in case not the full expected output is produced as the Vietnam export price is divided in a primary and a secondary price(see File 25b)

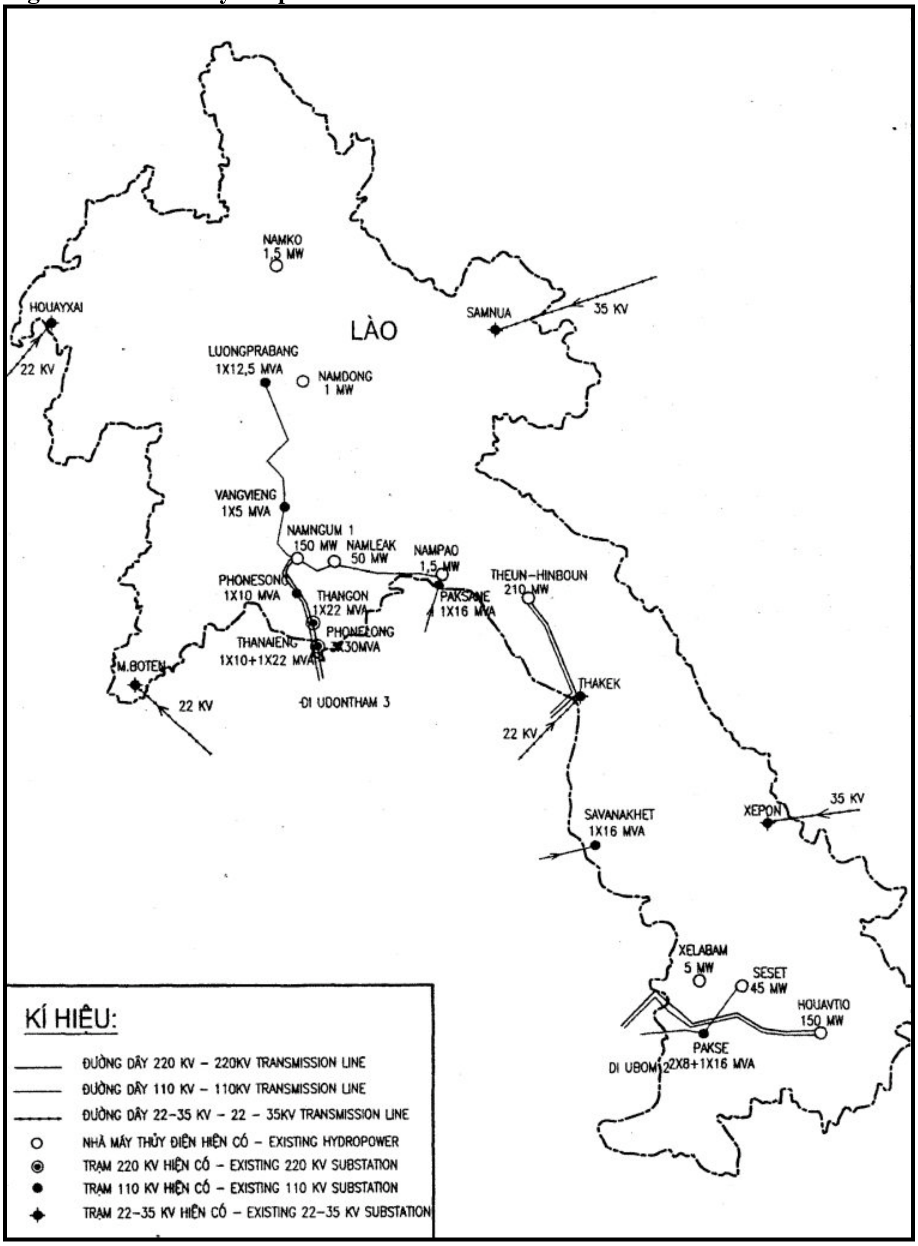
[13] See file finance 1

[14] Based on File 26 where Laos takes as maximum 10% of production (File 26 Art. 6.2. and Art. 10)

[15] File 6, p.I-2

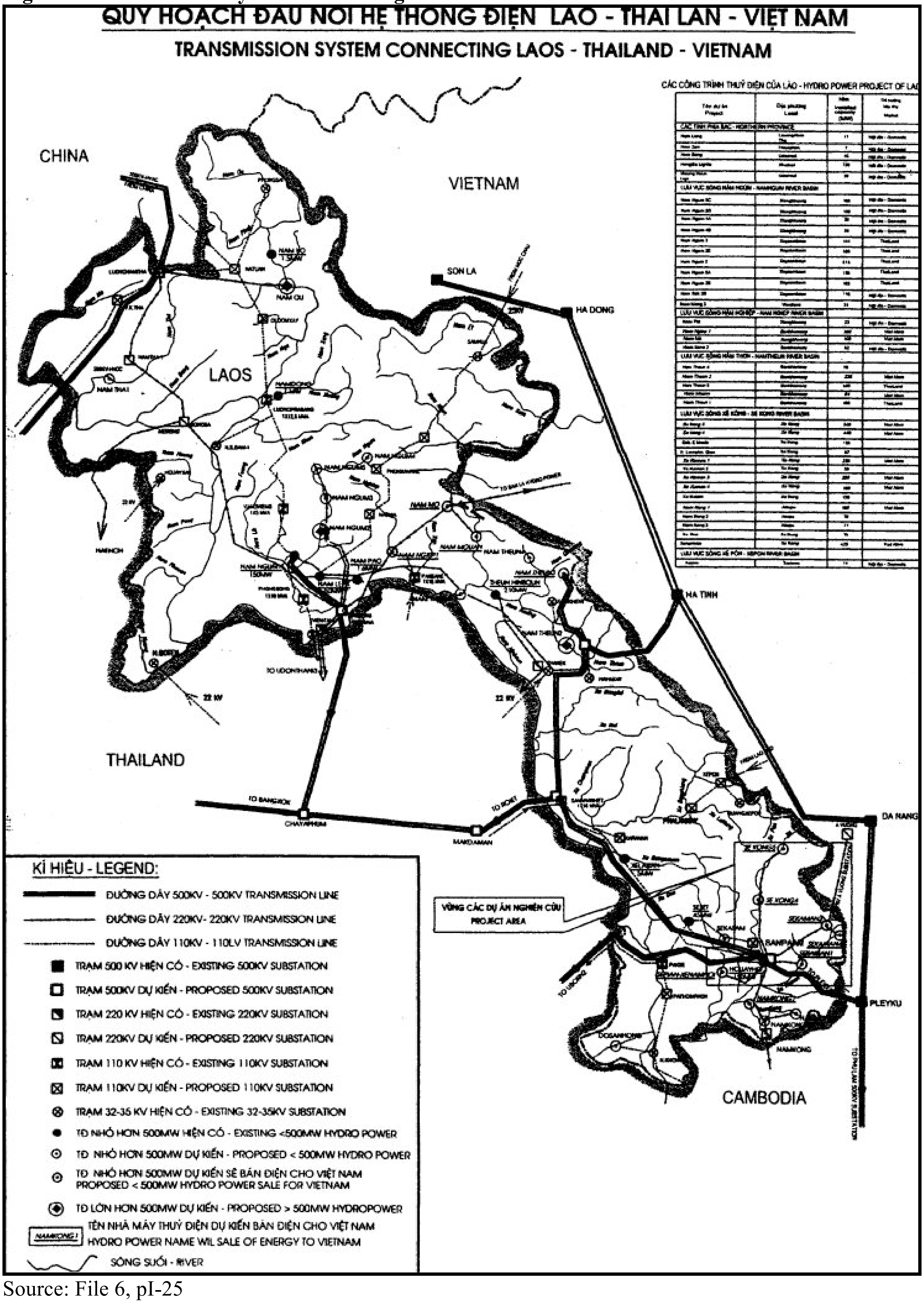
[16] File 6, p. I-17 and chapter 1.11 page I-19ff

Figure 3: Electricity Map Laos



Source: File 6, pI-24

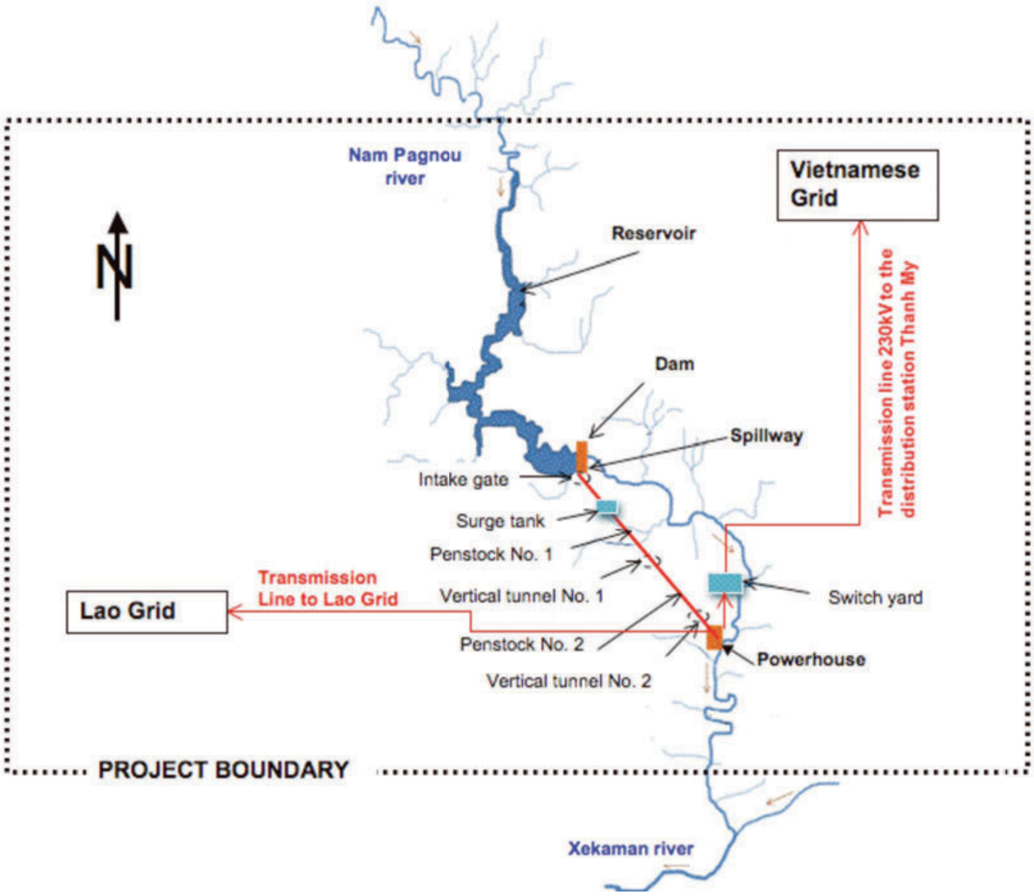
Figure 4: Transmission System Connecting Laos – Thailand - Vietnam



Source: File 6, pI-25

Both constraints are thus not given and hence the project boundary is defined as a regional grid consisting of the Vietnamese and the Laotian grid. In line with the requirement of the EB28, paragraph 14, Laos and Vietnam are the Host Parties in the project activity.

Figure 5: Project Boundary



B.4. **Description of how the baseline scenario is identified and description of the identified baseline scenario:**

Based on ACM0002 the baseline scenario is the electricity delivered to the grid by the project activity which would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system".

Chapter B.6. includes the calculation of the CM. For formulas see chapter B.6.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

The additionality of the project is determined using the latest Version of the "Tool for the demonstration and assessment of additionality" (Version 05.2).

The project starting date is defined as the date on which the construction contract was signed being 04.04.2006. The project activity thus started prior validation and prior 2.8.2008 and is thus considered an existing project activity in line with EB 49 Annex 22 (section C of guidelines).

Based on section C part a) of EB 49 Annex 22 the following table shows awareness of the CDM of the project participant prior to the project activity start date, and that the benefits of the CDM were a decisive factor in the decision to proceed with the project.

Table 7: Prior Consideration Part A

Date	Milestone	Documentary Proof
11/10/2005	Offer CDM consultant	Letter (File 28)
15/11/2005	Instruction general director to realize CDM	Directive (File 29)
04/01/2006	BOT agreement with Government of Lao	Contract (File 27)
1/2006	Power purchase agreement with EDL Laos	Contract (File 26)
24/03/2006	Power purchase agreement with EVN Vietnam	Contract (File 25)
04/04/2006	Project starting date: Signature of construction contract	Contract (File 24)

The project was knowledgeable about CDM prior investment decision and took a decision to include CDM based on an instruction of the general director to ensure financial sustainability and feasibility of the project as of 11/2005 i.e. prior signature BOT agreement with the Government of Lao and prior project starting date defined in accordance with EB regulations.

Based on section C part b) of EB 49 Annex 22 the following table shows by means of reliable evidence, that continuing and real actions were taken to secure CDM status for the project in parallel with its implementation.

Table 8: Prior Consideration Part B

Date	Milestone	Documentary Proof
04/04/2006	Project starting date: Signature of construction contract	Contract (File 24)
18/07/2006	CDM development contract	Contract (File 30)
27/12/2007	Contract termination with original CDM developer	Termination (File 31)
18/01/2008	MoU Carbotech for CDM development	MoU (File 32)
17/04/2008	Purchasing of equipment	Contract (File 21)
03/06/2008	MoU Ecotawa for CDM development	MoU (File 33)
01/10/2008	Approval of amendment of total investment	Approval (File 35)
10/06/2009	Carbon finance agreement	Contract (File 64)
28/10/2009	Approval of revised technical design	Board of Director decision (File 34)
08/12/2010	Request for validation offer	Mail (File 5)
03/2011	GSC of project UNFCCC	UNFCCC website
April 2012	Expected operational start of project	

July 2006 the project owner signed a CDM project development contract with a first service provider. This contract was terminated December 2007 and substituted with a MOU with Carbotech which transferred the MoU mid 2008 to ecotawa. Ecotawa thereafter established a carbon finance agreement with the project owner signed June 2009.

Prior to 2010 it was unclear if the project required a new methodology or not. A comparable project for exporting electricity from a 0-grid country to a neighbouring country with a positive Combined Margin using a different approach had been submitted to the UNFCCC October 2007[17]. A 2nd comparable project from Laos had been submitted in July 2009[18]. Ecotawa decided to await a decision of the EB on these projects also in light of operational start of the project being only mid 2012 and thus sufficient time being available. The project from Bhutan received a request for review by the EB and finally got registered as project number 2746 as of 26/02/2010. As of mid 2010 the project of Laos was still stuck in validation. Based on this decision ecotawa started collection the relevant grid information of Laos (data on Vietnam was already available) and prepared the project for validation using the procedure as in the successfully registered project of Bhutan.

The project owner has thus shown clear steps of continuous action with less than 2 years between actions in line with point 6b of EB 49 Annex 22 which states: "Evidence to support this should include, *inter alia*, contracts with consultants for CDM/PDD/methodology services, Emission Reduction Purchase Agreements or other documentation related to the sale of the potential CERs (including correspondence with multilateral financial institutions or carbon funds)».

STEP 1. IDENTIFICATION OF ALTERNATIVES TO THE PROJECT ACTIVITY CONSISTENT WITH CURRENT LAWS AND REGULATIONS

Sub-step 1a: Define alternatives to the project activity

Paragraph 4 of version 05.2 of the additionality tool states: "Project activities that apply this tool in context of approved consolidated methodology ACM0002, only need to identify that there is *at least one credible and feasible alternative* that would be more attractive than the proposed project activity."

Therefore following two scenarios are considered:

- Alternative 1: The proposed project undertaken without the CDM;
- Alternative 2: Continuation of the current situation with power from the Laos and the Vietnamese grid.

Sub-step 1b: Consistency with mandatory laws and regulations

Alternative 1 is theoretically technically feasible and complies with Vietnamese and Laotian current laws and Regulations. Alternative 2 does not face with any barrier from the current law and regulation because the project owner has no obligation to build or invest in the power plant to supply electricity for the local area.

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[17] Dagachhu Hydropower Project in Bhutan, GSM 23.10.2007

[18] Xeset 2 Hydropower Project

Step 2. Investment analysis

The steps used and the procedures follow the Guidance on the Assessment of Investment Analysis as included as Annex in the methodological tool "Tool for the Demonstration and Assessment of Additionality" Version 5.2.

Sub-step 2a: Determine appropriate analysis method

Options include:

1. Simple cost analysis
2. Investment comparison analysis
3. Benchmark analysis

The project activity generates income other than CER revenues. Thus option 1 is not appropriate. The 2 options included are the project with or without revenue of CER. The baseline case has no investment. Thus the investment comparison analysis is not appropriate. Therefore the option 3 benchmark analysis is chosen as appropriate analysis method.

Sub-step 2b – Option III: Apply benchmark analysis

Determine Suitable Indicator

The financial/economic indicator chosen is the IRR as it is considered as the most suitable indicator for the project type. The IRR is taken as it can be easily compared to a financial benchmark. The IRR is capable of comparing the investment decision of the project with a financial benchmark and thus gives an indication of the financial profitability of the investment.

The financial analysis is based on a standard market parameter as benchmark. As benchmark the commercial lending rate used in Vietnam is used. The rate of Vietnam is used as the investor is a Vietnamese company with 100% funding from Vietnam of the project[19] and the investor has alternative investment possibilities in Vietnam. The State Bank of Vietnam (SBV) fixes the maximum loan interest rate. All commercial banks applied this same maximum commercial interest rate. This rate was 12.4% in VND at the time of financial analysis[20]. The benchmark is lower than the IMF commercial lending rate for the same period being 13.6%[21]. The benchmark is thus clearly justified and conservative.

[19] File 36

[20] Base rate of State Bank of Vietnam is 8.25% plus 50%; Base rate source: State Bank of Vietnam, Spread according to Directive of SBV; File 2

[21] IMF, 2007; interest rate for the year 2005; Table 21, p. 24 (fixed capital, medium term), File 3

Sub-step 2c: Calculation and comparison of financial indicators

The principles used for all calculations and their compliance with EB guidance is shown in the following table.

Table 9: Investment Principles and EB Guidelines[22]

EB Guideline[23]	**Project**
Points1 and 2: General introduction of Guidance	
Point 3: Period of assessment	The period of assessment taken is 25 years of operation (total 29 years including 4 years of construction). According to the guidance "In general a minimum period of 10 years and a maximum of 20 years will be appropriate." After 25 years the plant is turned over to the Lao Government based on the BOT agreement; see FSR File 6 p. V.27 and BOT, File 27, p.23
Point 4: Salvage value	The salvage value after 25 years of operation is 0 as the HPP is turned over to the Laos government after 25 years based on the signed BOT agreement (see BOT, File 27, p.23). This was also considered in the FSR, File 6 p.V.27
Point 5: Depreciation and other non-cash items	Depreciation and other non-cash items such as amortization are not included when calculating the IRR. Taxes have not been included. This is in line point 11 as the IRR is calculated pre-tax as recommended in this point.
Point 6: Time of assessment	All input values are based on data available as of December 2005. The decision taking was after availability of the feasibility report (File 6, 11.2003), prior signature of BOT agreement (File 27, 1.2006), prior signature of purchasing power agreements with Laos and Vietnam (Files 25/26 dated 1.2006) and prior signature of first construction contract (File 24, 4.2006)
Point 7: Cesation of implementation	Not relevant for project
Point 8: Provision of spreadsheet	Spreadsheet is provided as File 1
Point 9: Finance expenditures	Financing expenditures are not included when calculating the IRR (see point 5).
Point 10: Equity IRR	Project IRR and not equity IRR is calculated.
Point 11: Taxation	Taxation is not included and a pre-tax benchmark is applied.
Point 12-18: Selection of benchmark	The applied benchmark is the local commercial lending rate as a project IRR is used. The benchmark is based on publicly available data sources of the State Bank of Vietnam.
Point 19: If the alternative to the project activity is the supply of electricity from a grid this is not to be considered an investment and a benchmark approach is considered appropriate.	A benchmark approach is used.
Point 20: Only variables, including the initial investment cost, that constitute	Sensitivity analysis is made assuming following changes: • 10% lower investment costs

[22] Tool for the demonstration and assessment of additionality, Version 5.2. Annex: Guidance on the Assessment of Investment Analysis Version 04

[23] Tool for the demonstration and assessment of additionality, Version 5.2. Annex: Guidance on the Assessment of Investment Analysis Version 02

more than 20% of either total project costs or total project revenues should be subjected to reasonable variation.	• 10% lower operational costs • 10% higher income from electricity sale equivalent to a 10% higher plant load factor These are all important cost/revenue variables.
Point 21: The DOE should assess in detail whether the range of variations is reasonable in the project context. Past trends may be a guide to determine the reasonable range. As a general point of departure variations in the sensitivity analysis should at least cover a range of +10% and -10%.	The sensitivity analysis covers a range of ±10%. Additionally an ex-post assessment is made and a cross comparison if data ranges and their variations are plausible

The following table shows the core data used for the financial assessment.

Table 10: Core Data Used for Financial Assessment (Investment decision 12/2005)

Item	Unit	Value	Data Source
Local commercial lending rate	Percentage	12.4%	Base rate of State Bank of Vietnam is 8.25% plus 50%[24] Date of document: 1746/QĐ-NHNN dated 01/12/2005
Period of assessment	Years	29	See former table Based on FSR File 6 dated 11/2003 and confirmed by BOT signed after investment decision (File 27)
Salvage value	Million VND	0	See former table Based on FSR File 6 dated 11/2003 and confirmed by BOT signed after investment decision (File 27)
Total electricity generated per annum	MWh	977,500	Calculated based on 250 MW installed capacity (FSR, File 6, p. V.12) and 3,910 operating hours (FSR, File 6, p.V.12) Date of document: 11/2003
Operating hours	hours	3,910	FSR, File 6, p.V.12; In accordance with EB 48 Annex 11 "Guidelines for the reporting and validation of plant load factors" Version 01 point II.3.b) the PLF was determined by a 3rd Party contracted by the project proponent. The FSR was realized by Song Da Construction Consulting Company SDCCC i.e. an independent 3rd Party in compliance with the referred guidance. Date of document: 11/2003
Internal usage of electricity	Percentage	1.5%	FSR, File 6, p.V.28 Date of document: 11/2003
Electricity sold to the grid per annum	MWh	962,838	Calculated based on total produced minus internal usage
Electricity sale price	tsd VND / MWh	624	FSR, File 6, p.V.28 fixes the price of 0.04 USD/kWh and the exchange rate of 15,600 (FSR, File 6, p.V.29) Based on FSR economics File 6 p.1.

24 Base rate source: State Bank of Vietnam; Spread according to Directive of SBV. See File 2. The IMF published for 2005 a nominal interest rate in Vietnam of 13.6% which is higher than the base-rate used therefore showing the . conservativeness of the base rate (see file 3)

			Date of document: 11/2003
Annual operational cost	Percentage	1.5%	FSR, File 6, p.V.31 Date of document: 11/2003
Annual insurance fee	Percentage	0.1%	FSR, File 6, p.V.31 Date of document: 11/2003
Investment	Million VND	3,863,429	FSR, File 6, p.V.29/30 (see details following table) Date of document: 11/2003
Natural resources tariff Laos	Million VND per annum	9,013	FSR, File 6, p.V.28 annual tariff for resource usage of 577,748 USD at 15,600 VND exchange rate as in FSR, File 6 , pV.29 (this corresponds to a charge of 1.5% of revenue see also FSR File 6 p.V31) Date of document: 11/2003
Turnover tariff Laos	Percentage of electricity income	5%	FSR File 6, p. V.31 This is not the income tax which is 20% (FSR, File 6, p.V.31) Date of document: 11/2003
Price of CERs	tsd VND /tCER	172	File 4 IETA/PCF, 2004, p. i, has projected a price of 11 USD; exchange rate VND to USD FSR File 6, p.V.29 Date of document: 06/2004
Quantity of CERs	tCERs	variable	Based on PDD

Table 11 shows the investment detail of the project.

Table 11: Investment Detail (million VND)

Item	Investment
Construction cost	2,259,076
Equipment cost	848,049
Transmission line to grid	105,000
Construction work preparation, consulting, compensation etc. excl. interest during construction	311,882
Contingencies	339,421
Total	**3,863,429**

Source: FSR, File 6 p.V.29/30, 11/2003

The IRR baseline is 10.5% and thus significantly lower than the benchmark of 12.4%.

Sub-step 2d: Sensitivity analysis

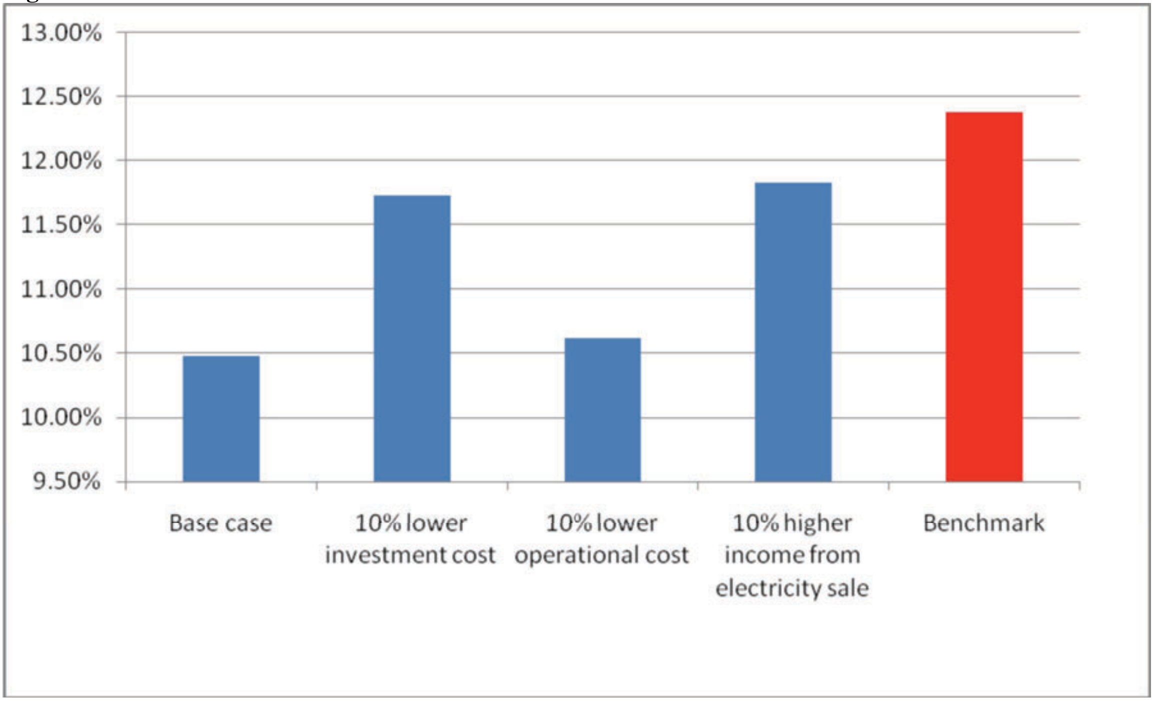
Table 12 and figure 6 show the financial profitability of the investment in absence of the CER including the sensitivity analysis and comparing the values with the benchmark. In all cases the IRR is below the benchmark.

Table 12: IRR Base Case and Sensitivity to Parameter Changes Excluding CER Revenues

Case	IRR
Base case	10.5%
10% lower investment cost	11.7%
10% lower operational cost	10.6%
10% higher income from electricity sale (either higher tariff or higher PLF)	11.8%
Benchmark	**12.4%**

Source: Finance File 1

Figure 6: IRR in Absence of CER Revenues



In all cases the IRR is clearly lower than the benchmark i.e. the project in absence of CDM is financially non-feasible.

Calculations done are conservative and the probability of 10% or even lower investment costs, 10% higher energy prices, 10% higher plant load factor or more than 10% lower operational costs are marginal. This conclusion is based on the following arguments listed below.

Probability of lower investment costs: This probability is considered as marginal. Often FSR underestimate the actual investment cost. The investment cost increased between 12.2005 (investment decision) and 5/2008 in USD from 277 million[25] USD to 312 million USD[26] i.e. an increase of 13%. The probability of lower investment costs is thus clearly not given. In practice the project will have significantly higher investment costs reducing the IRR.

Probability of lower operational costs: The incidence of this parameter on IRR is marginal. Even assuming 0 operational costs the IRR would remain significantly below the benchmark[27].

Probability of higher revenues: This can be caused either due to a higher plant load factor or due to higher income from sales of electricity. The incidence of revenues on the IRR is also significantly affected by the completion date of the project i.e. if the project is completed behind schedule the IRR will

[25] FSR File 6 p.V30 of VND 4,312,322 million (total investment including interest) with an exchange rate VND to USD 15,600 see FSR, File 6, p.V.29

[26] File 37, p.14 approved by the Government (see File 35)

[27] With 0 operational costs the IRR would be 11.8%

change less than if the project is completed early due to the discount factor embedded in the IRR. Large hydropower plants run a considerable risk of running behind schedule. This is also true of Xekaman. According to the FSR the construction timer period would have been 4 years while this time-period has been adjusted to 6.5 years. Based on the actual construction time the IRR has been recalculated (all other parameters no change). The IRR under this scenario would drop from 10.5% to 8.9%[28]. To achieve the benchmark the revenues would need to increase by 33% i.e. either a 33% higher price or a 33% increase in the PLF. Both changes are highly improbable. It can thus be shown that the incidence of higher revenues is highly improbable not least due to the fact that the risk of longer construction times is prevalent and this will have a significant impact on reducing the IRR.

Based on the signed Purchase Power Agreements with Laos[29] signed January 2006 and the purchase power agreement with Vietnam signed 3.2006[30] the IRR was re-calculated based on the contractually agreed purchase power price which includes also an annual escalation[31]. The resulting IRR is 11.0% which is still significantly below the benchmark value thus showing the robustness of the result[32].

With the CDM the project is however profitable and financially feasible as can be seen in the following table. The access to CDM finance is thus decisive for project success and implementation.

Table 13: IRR with and without CER Revenues

	IRR
IRR base case without CER revenues	10.5%
IRR with CER revenues	12.5%
Benchmark	12.4%

With CDM the project is above the benchmark. To check the plausibility of this statement an ex-post calculation is made with the actual electricity prices as in the Purchasing Power agreements[33], receiving only 90% of the CERs (based on Purchasing power agreement with Laos where 10% is sold in Laos[34]) and ER prices of 5/2011. The IRR with CDM is thereafter 14.5% (under the same assumptions without CDM the IRR is 11.0%)[35]. This information was not available as of time of decision taking. However this scenario is calculated to test the plausibility of the above calculations realized at the time of decision taking. They clearly show that the conclusion of the project being financially non-feasible without CDM and being feasible with CDM are robust and consistent and can be confirmed with current available data.

Step 3 (Barrier analysis) is not performed.

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28 See Finance File 1

29 File 26

30 File 25

31 For operational and other costs no such annual escalation has been included thus the IRR in this case would be overstated.

32 File 1

33 Files 25 and 26

34 File 26

35 File 1

Step 4: Common practice analysis

The above additionality test is complemented with an analysis of the extent to which the proposed project type has already diffused in the relevant sector and region.

Sub-step 4a: Analyze other activities similar to the proposed project activity

According to the additionality tool projects which are operational and which are in the same country/region, relying on a similar technology, of a similar scale and which take place in a comparable environment including inter alia investment climate and access to finance are considered as similar. Similar projects are thus:

- Operational large scale hydropower plants (over 15 MW using the differentiation made by UNFCCC between large and small-scale power plants). This condition refers to “similar scale” and “similar technology”.
- Plants operating in Laos. This condition refers to “same country/region”.
- Hydropower plants operating in Laos and exporting their electricity to Vietnam with a Vietnamese investor. This condition relates to a comparable regulatory and financial surrounding which is given by the Laos-Vietnam accord dated 1998 on cooperation in the electric power sector[36].

Sub-step 4b: Discuss any similar Options that are occurring

No other similar projects are operational in Laos[37]. Thus the project can be considered as not being common practice.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

PROJECT ACTIVITY EMISSIONS

Project activity emissions are 0.

The power density of the project is greater than 10 W/m^2 and therefore

$$PE_{HP,y} = 0 \tag{1}$$

Where

$PE_{HP,y}$ Project emissions from water reservoirs (tCO_{2e}/yr)

The power density of the project activity (*PD*) is calculated as follows:

[36] File 27, articles B and C, page 7

[37] File 63

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \quad (2)$$

Where:

PD	Power density of the project activity (W/m^2)
Cap_{PJ}	Installed capacity of the hydro power plant after the implementation of the project activity (W)
Cap_{BL}	Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero
A_{PJ}	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2)
A_{BL}	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero

The hydropower project is new and thus the baseline parameters included are 0.

BASELINE EMISSIONS

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y} \quad (3)$$

Where:

BE_y	Baseline emissions in year *y* (tCO_2/yr)
$EG_{PJ,y}$	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)
$EF_{grid,CM,y}$	Combined margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of the “Tool to calculate the emission factor for an electricity system” (tCO_2/MWh)

The project is a greenfield plant and thus:

$$EG_{PJ,y} = EG_{facility,y} \quad (4)$$

Where:

$EG_{PJ,y}$	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)
$EG_{facility,y}$	Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* (MWh/yr)

Step 1: Identify the relevant electricity systems

The spatial extent of the project boundary includes the project power plant and all power plants physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints. In its 28th meeting in December 2006, the CDM Executive Board clarified that the word “regional”, in the context of “regional electricity system” used in ACM0002 can also be interpreted as extending across several countries. The Board further clarified that trans-national electricity systems are eligible under ACM0002. Furthermore, the Board clarified that the grid emission factor in this context shall be estimated for the "regional electricity system" (EB28, paragraph 14). Chapter 3 has detailed the determination of the relevant electricity grid as being the regional grid consisting of the Vietnamese and the Laotian grid. Vietnam has one national grid. The relevant electricity system for Vietnam is based on the official combined margin of the DNA. For Laos the DNA has not delineated such a system, therefore the entire national grid of Laos is taken. The grid emission factor is thereafter calculated for the regional electricity system including Vietnam and Laos. In Laos all electricity is distributed through EDL which thus controls the grid[38].

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)

Option I is chosen and only grid power plants are included in the calculation.

Step 3: Select a method to determine the operating margin (OM)

The simple OM is used (method a). According to the Tool any of the four methods can be used, however, the simple OM method can only be used if low-cost/must-run resource constitute less than 50% of total grid generation in the average of the five most recent years. No geothermal, wind, nuclear and solar generation facilities connected to the regional grid are operating.

Table 14: Low-Cost/Must-Run Power Plants in Laos and Vietnam (2004-2008)

	2004	2005	2006	2007	2008
Hydro low-cost/must run Vietnam MWh	17,858,651	16,365,438	19,508,244	22,385,232	25,933,762
Hydro low-cost/must run Laos MWh	3,345,459	3,499,620	3,608,884	3,369,657	3,678,365
Hydro low-cost/must run Vietnam + Laos MWh	**21,204,110**	**19,865,058**	**23,117,128**	**25,754,889**	**29,612,127**
Total generation Vietnam MWh	44,974,169	50,330,468	57,160,493	66,348,589	74,689,636
Total generation Laos MWh	3,345,459	3,499,620	3,608,884	3,369,657	3,678,365
Total generation Vietnam + Laos MWh	**48,319,628**	**53,830,088**	**60,769,377**	**69,718,246**	**78,368,001**
Percentage low-cost/must run Vietnam + Laos	**43.9%**	**36.9%**	**38.0%**	**36.9%**	**37.8%**

Source: Vietnam: MONRE, official CM, table 2 (File 39); Laos: EDL Statistic Yearbook 2009, p.8 (File 42[39])

Low-cost/must-run facilities had on average over the last 5 years 38.7% of total electricity generation and thus clearly less than 50% of total grid generation.

The ex-ante option is taken based on a 3-year generation-weighted average, based on the most recent data available at the time of submission of the PDD to the DOE for validation. Only the electricity exported to Vietnam is taking into consideration when calculating the CERs. Based on the contract this is assumed to be 90% of total generation[40]. The EB had in it request for review of the comparable project Dagachhu Hydropower project, Bhutan" (CDM Reference No. 2746) raised the issue of "the suitability of ex-ante

[38] See Prospectus Dated December 15, 2010; http://www.bol.gov.la/stockmarket/Prospectus%20Eng.pdf (access 11/02/2011, page 22)

[39] EDL owned plants and EDL joint venture plants

[40] File 26, Art. 6.2, p.16

grid emission factor as it is not clear how the ex-ante grid emission factor will address the scenario of less electricity export to eastern regional grid of India than the planned, if any, during the crediting period". This issue was raised as, comparable to the proposed project, the country of production has a 0-emission grid and the country of export has a positive CM. The proposed project resolves this problem by ONLY including exports to the Vietnamese grid for calculating the CERs. Thus if less electricity than planned will be exported to Vietnam then the project receives less CERs. Electricity used domestically in Laos from the project is not taken into consideration. This approach allows for using the ex-ante option of the CM.

Step 4: Calculate the operating margin emission factor according to the selected method

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants. The ex-ante option is taken based on a 3-year generation-weighted average, based on the most recent data available at the time of submission of the PDD to the DOE for validation. The data vintage taken is 2006-2008. The data is based on the official data for the Combined Margin in Vietnam. All plants in Laos are hydro-electric power plants and low-cost / must run power plants[41].

Data per power plant on fuel consumption is available based on fuel usage per kWh (plant efficiency). Therefore Option A is employed.

$$EF_{grid,OMsimple,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}} \tag{5}$$

Where:

$EF_{grid,OMsimple,y}$	Simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in the year *y* (tCO_2/MWh)
m	All power units serving the grid in year *y* except low-cost/must run power plants / units
y	Last 3 years available

The emission factor is determined as follows for plants where the fuel consumption is known (Option A1):

$$EF_{EL,m,y} = \frac{\sum_{i,m} FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}} \tag{6}$$

Where:

$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in the year *y* (tCO_2/MWh)
$FC_{i,m,y}$	Amount of fossil fuel type *i* consumed by power unit *m* in year *y* (mass or volume unit)

[41] See File 40, p.46

$NCV_{i,y}$	Net calorific value of fossil fuel type *i* in the year *y* (GJ / mass or volume unit)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* in the year *y* (tCO_2/GJ)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
m	All power units serving the grid in year *y* except low-cost/must run power plants / units
i	All fossil fuels combusted in power unit *m* in year *y*
y	Last 3 years available

If for a power unit *m* only data on electricity generation and the fuel types used is available, the emission factor is determined based on the CO_2 emission factor of the fuel type used and the efficiency of the power unit, as follows:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}} \tag{7}$$

Where:

$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$EF_{CO2,m,i,y}$	Average CO_2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO_2/GJ)
$\eta_{m,y}$	Average net energy conversion efficiency of power unit *m* in year *y* (ratio)
m	All power units serving the grid in year *y* except low-cost/must-run power units
y	Last 3 years available

Step 5: Calculate the build margin emission factor

Option 1 is chosen: For the first crediting period, calculate the build margin emission factor ex ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. This option does not require monitoring the emission factor during the crediting period.

Capacity additions from retrofits of power plants are not be included in the calculation of the build margin emission factor.

The sample group of power units *m* used to calculate the build margin is determined as per the following procedure, consistent with the data vintage selected above:

a). Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently (SET5-units) and determine their annual electricity generation (AEGSET-5-units, in MWh);
b). Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEGtotal, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEGtotal (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) (SET ≥ 20%) and determine their annual electricity generation (AEGSET ≥ 20%, in MWh);
c). From SET5-units and SET ≥ 20% select the set of power units that comprises the larger annual electricity generation (SETsample);

Identify the date when the power units in SETsample started to supply electricity to the grid. None of the power units in SETsample started to supply electricity to the grid more than 10 years ago[42]. Therefore SETsample is used to calculate the build margin and steps (d), (e) and (f) of the tool are ignored.

Table 15: 5 Most Recent Power Plants in Laos and Vietnam

Name of Power Plant	Commissioning Date	Production in MWh 2008
A. Vuong	2008	168,103.5
Tuyen Quang	2008	1,136,112.2
Dai Ninh	2008	1,145,108.5
Nonh Trach	2008	544,808.6
Ca Mau 1&2	2007	4,835,679.2
Total		**7,829,812**

Source: Vietnam: MONRE, official CM, table 2 (File 39); Laos: last commissioned power plant year 2005 (File 47)

20% of system generation in the year 2008 was: 15,673,600 MWh[43]. Clearly the set of 5 most recent power plants is less than 20% of power generation in the year 2008. Therefore the set of power capacity additions that comprise 20% of the system is used, as this comprises the larger annual generation.

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \tag{8}$$

Where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in the year *y* (tCO_2/MWh)
$EG_{m,y}$	Net electricity generated and delivered to the grid by power unit *m* in the year *y* (MWh)
$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in the year *y* (tCO_2/MWh)
m	Power units included in the build margin
y	Most recent year for which data is available (2008)

The CO_2 emission factor for each power unit is determined per guidance step 4(a) using Option A1.

Step 6: Calculate the combined margin emission factor

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \tag{9}$$

Where:

$EF_{grid,CM,y}$	Combined margin CO_2 emission factor in the year *y* (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in the year *y* (tCO_2/MWh)
$EF_{grid,BM,y}$	Build margin CO_2 emission factor in the year *y* (tCO_2/MWh)
w_{OM}	Weighting of operating margin emission factor (%)
w_{BM}	Weighting of build margin emission factor (%)

[42] File 5b table 7

[43] Total MWh 78,368,001 (see Table 14)

The default values for weighting w_{OM} and w_{BM} of 0.5 are used as the project is a hydropower plant in the 1st crediting period.

LEAKAGE EMISSIONS

No leakage emissions are included according to ACM0002. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport). These emissions sources are neglected in accordance with ACM0002.

EMISSION REDUCTIONS

$$ER_y = BE_y - PE_y \quad (10)$$

Where:

ER_y Emission reductions in the year *y* (tCO_2)

BE_y Baseline emissions in year *y* (tCO_2)

PE_y Project emissions in year *y* (tCO_2)

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	**$FC_{i,m,y}$**
Data unit:	Mass or volume unit
Description:	Amount of fossil fuel type *i* consumed by power plant *m* in the year *y*
Source of data used:	MONRE, 2010 (File 39)
Value applied:	See B.6.3.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data years 2006/7/8 used i.e. 3 most recent years prior validation. Once for 1st crediting period determined ex-ante.
Any comment:	Data based on fuel efficiency factor per power plant (fuel usage in relation to net electricity generation) as reported by EVN For Laos (data used for BM) all power plants are hydro-electric.

Data / Parameter:	**$EG_{m,y}$**
Data unit:	MWh
Description:	Net electricity generated by power plant *m* in the project electricity system in the year *y*
Source of data used:	MONRE, 2010 (File 39) EDL, 2009 (File 42)
Value applied:	See B.6.3.
Justification of the choice of data or	Data years 2006/7/8 used i.e. 3 most recent years prior validation. Once for 1st crediting period determined ex-ante.

description of measurement methods and procedures actually applied :	
Any comment:	Gross electricity generated minus internal power consumption as reported by EVN

Data / Parameter:	**NCV_i**
Data unit:	TJ/Gg
Description:	Net calorific value of fossil fuel type *i*
Source of data used:	MONRE, 2010 (File 39)
Value applied:	Per power plant
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	For Laos (data used for BM) all power plants are hydro-electric.

Data / Parameter:	**$EF_{CO2,i}$**
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor of fossil fuel type *i*
Source of data used:	IPCC 2006 guidelines, Chapter 1 Vol. 2 table 1.4, lower limit of the uncertainty at a 95% confidence interval
Value applied:	Anthracite Coal: 94.6 Other Bituminous coal: 89.5 Natural gas: 54.3 Fuel Oil: 75.5 Diesel oil: 72.6
Justification of the choice of data or description of measurement methods and procedures actually applied :	Once for 1st crediting period
Any comment:	

Data / Parameter:	**$EF_{grid,CM}$**
Data unit:	tCO_2/MWh
Description:	Combined Margin CO_2 emission factor for grid connected power generation
Source of data used:	See B.6.3. and above sources
Value applied:	0.5764
Justification of the choice of data or description of measurement methods	Once for 1st crediting period As per Tool "Tool to calculate the emission factor for an electricity system" OM: 0.6465 BM: 0.5064

and procedures actually applied :	
Any comment:	

B.6.3. Ex-ante calculation of emission reductions:

Project Emissions

The Power Density PD is calculated based on formula 2.

Data required[44]:
Cap_{PJ}: 250 MW
A_{PJ}: 5.251 km^2

The energy intensity is thus 47.6 W/m^2. According to ACM0002 if the power density is >10 W/m^2 the project emissions are 0.

Baseline Emissions

Annex 3 details all calculations. Table 16 resumes all data for the calculation of emission reductions.

Table 16: Calculation of Baseline Emissions

Parameter	Value
Operating margin (weighted average years 2006-2008)	0.6465 tCO_2/MWh
Build margin (year 2008)	0.5064 tCO_2/MWh
Combined margin	0.5764 tCO_2/MWh
Annual energy generation to the grid	962,838 MWh
Annual projected energy exported to Vietnam (90% of total grid generation[45])	866,554
Annual baseline emissions	499,481 tCO_2

B.6.4 Summary of the ex-ante estimation of emission reductions:

Year	Estimation of project activity emissions (tCO_{2e})	Estimation of baseline emissions (tCO_{2e})	Estimation of leakage (tCO_{2e})	Estimation of overall emission reductions (tCO_{2e})
2012 (8 months)	0	332,987	0	332,987
2013	0	499,481	0	499,481
2014	0	499,481	0	499,481
2015	0	499,481	0	499,481
2016	0	499,481	0	499,481
2017	0	499,481	0	499,481
2018	0	499,481	0	499,481
2019 (4 months)	0	166,493	0	166,493
Total (tCO_{2e})	**0**	**3,496,366**	**0**	**3,496,366**

[44] File 6, p. V.12 and File 19, p.I

[45] File 26 Art. 6.2, p.16

B.7. Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**EG_y**
Data unit:	MWh
Description:	Quantity of net electricity generation supplied by the project plant to the Vietnamese grid in year y
Source of data to be used:	Energy meters
Value of data applied for the purpose of calculating expected emission reductions in section B.5	866,554
Description of measurement methods and procedures to be applied:	The electricity supplied to the Vietnamese grid will be measured with two main meters and two backup meters at Thanh My station of EVN. The electricity consumed by the project from the grid will also be measured by the mentioned meters. All electricity consumed for internal use will be purchased from Vietnam - no electricity will be bought from the Lao grid. The net electricity is calculated (total supplied electricity to the grid minus the consumption of electricity coming from the grid). For more details see chapter B.7.2.
Monitoring frequency	Continuous measurement and monthly recording
QA/QC procedures to be applied:	Measuring equipment will be certified and calibrated according to Vietnamese standards (see File 69). Measurement results are checked with records for sold/purchased electricity (e.g., invoices/receipts). The net electricity export/supplied to the Vietnamese grid is the difference between the measured quantities of the grid electricity export and the import. Total electricity produced and total electricity supplied to Laos grid will also be monitored for cross check.
Any comment:	Main meters and backup meters are multi-functional meters (details see file 65) which can measure both exported and imported power.

Data / Parameter:	**CAP_{PJ}**
Data unit:	W
Description:	Installed capacity of the hydro power plant after the implementation of the project activity
Source of data to be used:	Project site
Value of data applied for the purpose of calculating expected	250,000,000

emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Determine the installed capacity based on recognized standards
Monitoring frequency	Yearly
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$\mathbf{A_{PJ}}$
Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full
Source of data to be used:	Project site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	5,251,000
Description of measurement methods and procedures to be applied:	The reservoir level will be controlled regularly when the water overflows the dam in order to assess the highest level of the reservoir. Based on the water level and on the topographical survey which was carried out during the feasibility study the largest reservoir area can be calculated.
Monitoring frequency	Yearly
QA/QC procedures to be applied:	
Any comment:	

TEG is not monitored as according to ACM002 this parameter is only required for power plants with a power density of the project activity (PD) greater than 4 W/m^2 and less than or equal to 10 W/m^2 which is not the case in the project activity.

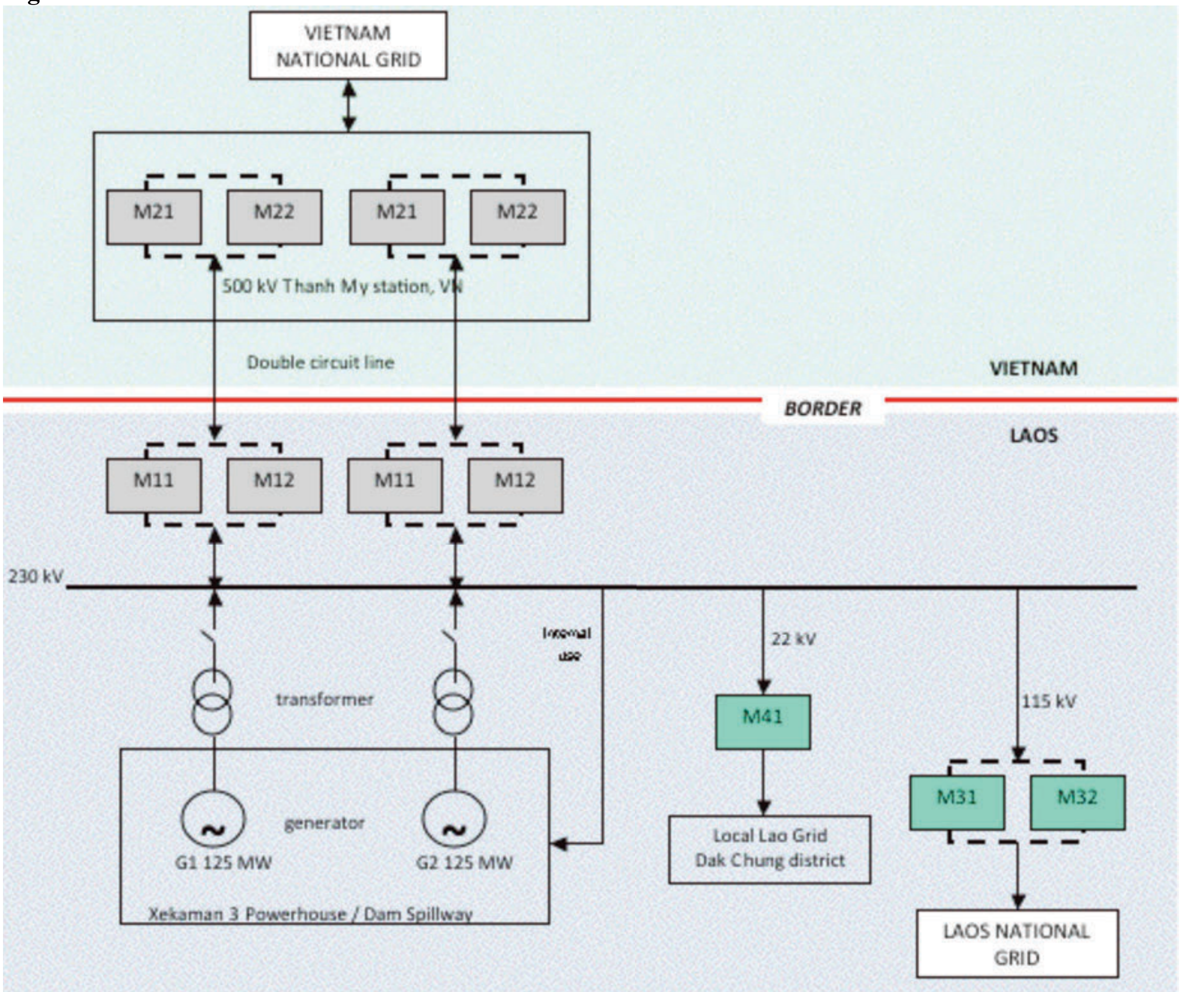
All the above monitored data will be stored for 2 years after the end of the crediting period.

B.7.2. Description of the monitoring plan:

Description of the metering system

Total electricity produced and sold to be grid is measured by electric measuring equipment. The meters shall achieve the accuracy class 0.2s and comply fully with the requirements of the Vietnamese standard TCVN 6571:1999 which is equivalent with the international standard IEC-60687.The backup meters shall be the same technical parameters as the main meters.

Figure 7: Electric Scheme of Xekaman 3



Xekaman 3 hydropower plant will export mainly to Vietnam. According to the agreement with Laos Xekaman 3 hydropower plant will sell maximum 10 % of the electricity production to Laos if it is needed. If there is no need this part of the electricity will also be sold to Vietnam.

Laos will construct two connection lines to the power plant: a 22 kV and a 115 kV line. At the plant site, there are metering systems for measuring the outgoing electricity to Laos. For the 115 kV line there is one main meter (M31) and one backup meter (M32). The electricity supply will be measured through the main meter. If the main meter is out of operation the measurement of the backup meter is used for billing. For the local electricity consumption a 22kV line will be built. The main meter (M41) will measure the supplied electricity to Dak Chung district (details see file 26).

The Xekaman 3 hydropower plant will not use any electricity from Laos (no contractual agreement for it). All the electricity consumed by the hydropower plant for internal use will be exclusively purchased from Vietnam through the double circuit line.

The electricity production for Lao PR will not be included in the emission reduction calculation. Only the electricity supplied to Vietnam will be accounted for. In any case, if Xekaman 3 hydropower plant would use electricity from Laos (this is not foreseen and there is no contractual agreement) this consumption would be integrated in the net electricity calculation.

For the electricity export to Vietnam a double circuit line between Xekaman 3 hydropower plant (seller) and the Thanh My station of EVN (buyer in Vietnam) will be used. Therefore, two metering systems are installed in each place at Xekaman 3 plant and at Thanh My station (see figure above).

The total amount of electricity in both places are thus the sum of the two main meters (M11 + M11 in Xekaman 3 HPP) and (M21 + M21 in Thanh My station). At both sites there are backup meters if the main meters are out of operation. All the used meters (see figure above) are multi-function meters from elster (see file 65) which can measure in- and outgoing electricity. Xekaman 3 Company will maintain and calibrate their meters at the plant site, while EVN maintain the meters in Thanh My station (details concerning this see file 25, purchase agreement with EVN). According to the Vietnamese standard[46] the main meter must have an accuracy of 0.2% (File 67).

The meters are sealed and maintained through the owners. The owner is also responsible for the calibration of the meters. The calibration process must comply with the Article 33 of Circular No 27/2009/ TT – BCT of Ministry of Industry and Trade dated 25/09/2009 on regulating the metering of electricity in a competitive electricity generation market[47]. The main meters will be calibrated every two years[48].

Calibration is only conducted with the presence of the power generating company and the power trading company[49].

The emission reduction calculation will be based on the main meters in Thanh My station (in - and outgoing electricity). This is conservative because the electricity loss in the grid will be integrated for supplied and for consumed electricity. For billing between the two companies the grid loss will be covered through the suppliers (see §8 of the purchase agreement between the project owner and EVN, file 25).

If the main meters are out of operation at any time, the values of the backup meters will be used for the emission reduction calculation during this time. If both meters are out of service no emission reduction will be claimed during this time.

The backup meters (M22) will be used to cross check the main EVN meters (M21). The net electricity production of the Xekaman 3 hydropower plant will be cross-checked with the invoices for supplied electricity and electricity used from the grid.

Data Collection and Management

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[46] File 66 regulates the devices which must be calibrated; File 66: Regulates the frequency of calibration (2 years for 3-phase electrical meters); File 67: Accuracy of the different meters systems (0.2% main meter)

[47] see File 69

[48] see File 67

[49] see File 25

Following principles are applied:

- The electricity supplied by the project to the Vietnamese as well as the Laotian grid will be automatically monitored by each metering system (see figure above).
- The data is measured continuously and recorded monthly.
- All records of electricity generation output will be archived in paper form for at least two years after finishing the crediting period.
- Paper invoices are collated by the Project Manager and archived for at least two years beyond the end of the crediting period.

In case of any unforeseen event that is not covered under this monitoring plan, staff of the CDM group shall inform the manager and the director. The manager and director are then responsible to ensure that the cause for the unforeseen event is detected, the event is remedied and for the period of time in which the unforeseen event has occurred uncertainty in data gathered is limited as much as possible.

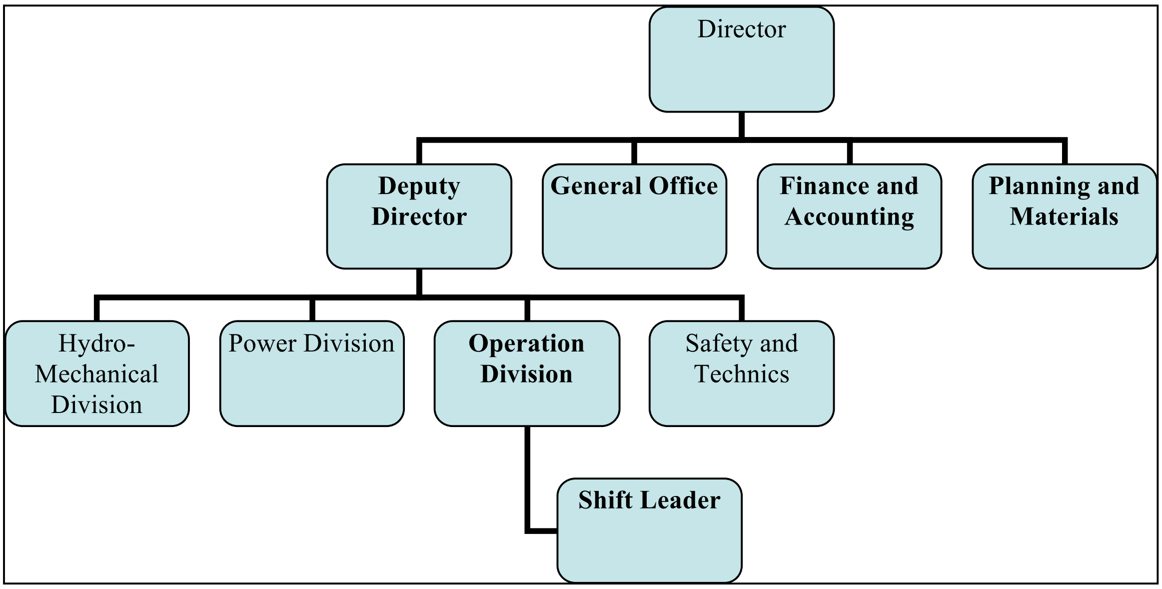
Xekaman 3 Power Co. Ltd established with Decision No 21/XKM3-QD-VP a CDM team for implementing and monitoring the CDM project activities[50]. The CDM Implementation & Monitoring Team (CDM team) consists of following members with their responsibilities:

- Team leader (Deputy Director): Responsible for QA/QC. The team leader is responsible for guiding and managing the overall monitoring process, writing monitoring reports and working with related partners on the quantity of Certified Emission Reductions (CERs) of the project as well as keeping the CDM project on track.
- Financial – Accounting and Economic – Planning Department: They are responsible for providing invoices and documents relevant to power purchase activities of the company and for power generation data for grid (Vietnam and Laos) and self use power generation. They also monitor the annual emission reduction amount, the amount of sold CERs and control the expenses for CDM implementation.
- Operation Division: This Division is responsible of keeping track of the operation diary and the operation booklet and of keeping record of the indicators for power generation, power generation per grid and internal use. They also monitor the adjustment and calibration of equipment and identify and resolve incidents in a timely manner to ensure the accuracy of measured data. They also monitor the reservoir operation and check and supervise daily monitoring data of all shifts.
- Shift leader: This is the person who will be responsible for monitoring and reporting operating results to the Management and Technical Department including electricity output, water volume running into turbines and emission reduction amount of the project in line with the monitoring forms.

Figure 8 shows the management structure and responsibilities for monitoring.

Figure 8: Organizational Structure for the Monitoring of CDM Activities

[50] File 43



Source: Xekaman 3 Power Company Ltd, bold marked are members of the CDM team

The annual monitoring reports and data quality check will be realized by ecotawa AG through its Vietnamese partner.

B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

Completion date: 01/02/2011

The PDD was developed by Dr. Jürg M. Grütter of ecotawa AG. Staff involved in the elaboration of this PDD are also Daniel Wunderlin, ecotawa AG as well as staff of the Vietnamese partner of ecotawa AG.

ecotawa AG is responsible for the baseline determination of the project.

Contact person: Jürg M. Grütter
jgruetter@gmail.com
www.ecotawa.com

ecotawa AG is also project participant as listed in Annex 1.

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

04/04/2006

Signature of construction contract[51].

C.1.2. Expected operational lifetime of the project activity:

Minimum 30 years[52]

C.2. Choice of the crediting period and related information:

C.2.1. Renewable crediting period:

C.2.1.1. Starting date of the first crediting period:

01/05/2012 or date of registration

C.2.1.2. Length of the first crediting period:

7 years 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable

C.2.2.2. Length:

Not applicable

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

Hydropower plants in Laos must meet the following environmental requirements:

- Law on Environmental Protection of Laos approved by the National Assembly on 03/04/1999 and signed for implementation by the President of Laos on 26/04/1999;
- Regulation on Environmental Assessment in Laos, 2000;
- Regulation on the implementation of the environmental assessment for electricity projects in Laos No. 447/ Min issued 20/11/2001by the Ministry of Industry and Handicraft;

[51] File 24

[52] Generators and transformers according to EB 50 Annex 15 30 years; 150,000 hrs for hydro turbines according to EB 50 Annex 15 (equivalent to 38 years at planned operational hours per annum)

- Regulation on environmental assessments in Laos No 1170/ TEA issued on 03/10/2000 by Science/Technology/Environment Department of the Governmental Office;
- Law on Land No 04/ NA passed by the National Assembly of Laos on 21/10/2003;
- The Forestry Law approved in 1996;
- The Land Law approved in 1997;
- The Water and Water Resource Law approved in 1996;
- The Decree to Implement the Law on Water and Water Resources, 2001.

The project made an EIA issued in May 2004[53] and an environmental and social management plan in September 2006[54] (see details chapter D.2).

Certificate No 2385/ UBKHCNMT – VPTTCP issued by the Committee of Science, Technology and Environment Office of the Laotian Government dated 17/11/2004 approved the Environmental Impact Assessment of Xekaman 3 Hydropower Project[55].

Certificate No 2441/UBKCM.VPTT issued by the Science, Technology and Environment Agency of Laos on 23/10/2006 accepted the environmental and social management plan of Xekaman 3[56].

The project is also validating its conformance with WCD requirements.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

An EIA[57] was realized May 2004 and approved by the by the Committee of Science, Technology and Environment Office of the Laotian Government November 2004[58].

The main environmental impacts of the project, recommendations given and actions taken are listed in table 17.

Table 17: Environmental Impacts, Recommendations and Actions Taken

Potential Environmental Impacts	Recommendations Given by EIA	Actions Taken by Project
Construction Period		
Air and noise pollution being basically mud and dust from transportation and construction vehicles, dust from and raw materials exploitation	Compliance with regulations	Usage of modern equipment; watering of road

53 File 44

54 File 17

55 File 45

56 File 46

57 File 44

58 File 45

Solid waste from worker's camp and from earthwork	Storage of materials for other usage in the future; appropriate disposal of camp waste	Landfill for camp waste 
Impacts on land use and ecosystem including tree cutting for reservoir, changing habitat of flora and fauna due to construction of dam, leaking through cavities	Organize rescue of animals; disposal of harmful war toxics; sealing and shutting of caves which might cause leakage;	Decision No 3171/BNL dated 19/08/2010 by the Ministry of Agriculture and Forestry on the establishment of a board for upstream forest management and protection[59]; Official Letter No 0149/BNLM.CXTPTNL dated 05/02/2010 from the Department of Promotion and Energy Development under the Ministry of Energy and Mines sent to Xekaman 3 Power Co., Ltd on afforestation, reforestation and forest protection along with expense table[60].
Water pollution due to waste from maintenance & cleaning such as mechanical oil, lubricants etc and from workers camp	Landfills and appropriate storage	See above (solid waste); periodic testing of water surface quality[61]
Fire/Explosion/Safety	Compliance with regulations; protective equipment; sanitation and health service; ensure transport and telecommunication on-site	Pasport of explosive application[62]; Contract No07/HDKT/XKM3/2004 on unexploded ordnance clearance[63]
Operation Period		
Change of water balance downstream	Ensured that the discharge is 12,89 m^3/s	Comply with discharge value
Erosion and sedimentation in reservoir bed and downstream	Basically forestation measures	Decision No 3171/BNL by the Ministry of Agriculture and Forestry on establishment of a

[59] File 50

[60] File 51

[61] Files 48 and 49

[62] File 52

[63] File 53

		board for upstream forest management and protection of Xekaman 3 HPP[64]
Water pollution due to biomass decay during flooding	Clearance of reservoir bed and periodic controls	Decision 09/CTT by Sekong Province on granting power to the supervising committee of Xekaman 3 hydropower project[65]; Decision No 330/TT by Sekong Province on the establishment of a supervising group for reservoir bed clearance of Xekaman 3 HPP[66]; Contract No 01/2010/HDXD between Xekaman 3 Power Co., Ltd and Department of Agriculture and Forestry of Sekong Province, Laos on reservoir bed clearance before storing water[67].
Improving living standards	Fishery and tourism development	

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

No people were dislocated due to the project as no people were living in the reservoir bed area [68].

Living disorder was experienced by 57 households with about 342 people. As of end 2010 five stages of compensations were completed with 48 households, a border post and a cemetery[69]. The investor plans to complete stage 6 and stage 7 with 9 households[70]. The compensation plan for these two stages was submitted to the authority for approval. TETA consultants worked with the investor and the local authorities to carry out an onsite interview with local residents of Dak Chung district between January 12th and14th 2011 with a stakeholder meeting on January 12th 2011[71]. It was stated that Dak Grang Nhay

[64] File 50

[65] File 54

[66] File 55

[67] File 56

[68] File 9, p.24, 26 and 27

[69] File 10 p.17; File 11 p,3; File 12 p.3; File 13 p.3; File 14 p.2

[70] Files 15 and 16

[71] File 57

Village was relocated due to free migration. There were only two households of this village left and the rest moved to Kontum. These two households moved to Dak Grang Noi Village to form Dak Grang Village.

Compensated land was to build roads 16B, D4, D3, TC17, TC15B, stone mine No 3, auxiliary works and the transmission line. Compensation prices are based on Decision No 298/CT dated 04/07/2006 by Sekong Province[72]. At each stage of compensation, the investor has to ask for permission of the local authority[73].

The involvement of people was through meetings between the investor and affected people:

- A meeting was organized by the Environmental and Social Management Committee of Dak Chung District to discuss about compensation prices on 22/05/2006[74]. At this meeting, representatives of nine villages, officials of the District Departments and representatives of the Investor discussed about compensation prices and alternatives. The meeting reached a mutual agreement on compensation prices or in case residents do not receive monetary compensation, the investor will provide them with land instead.
- A Compensation Team was formed to carry out compensations. The team includes the Deputy head of the Compensation Board of the Dak Chung District and staff of the Investor. When local residents receive compensation, it has seen the participation of Representatives of the Investor, Representatives of the Compensation Board of Xekaman 3 project, Representatives of villages and Representatives of households as can be see in the signatures in the compensation minutes[75].

During the realization of the Feasibility Study, the EIA report and the Relocation and Resettlement report several workshops and meetings were realized and there were several interviews realized with affected people[76]. These workshops were to introduce Xekaman 3 hydropower project and to identify possible environmental and social issues that may happen during the project implementation and the mitigation measures proposed by project owner.

12/01/ 2011 a formal stakeholder meeting with Dak Chung District People's Committee was realized[77]. The meeting focused on clarifying local environmental and economic - social issues. Questions were raised about impacts on lost land, water source, noise problem, air quality … as well as satisfaction of the participants concerning project implementation and its contribution to local economic development. Interviews with stakeholders were conducted during that time including head of villages and affected farmers. People were asked about their opinion on the hydropower project especially but not only

[72] File 58

[73] Stage 1 see File 10, p.15; stage 2 see File 11, p.1; stage 3 see File 12, p.1; stage 4 see File 13, p.1; stage 5 see File 14, p.1.

[74] File 59

[75] See e.g. File 10, p.25-27

[76] See File 44, p.7-2 and 7-3; see also File 9, p.31 point 2

[77] File 57

concerning environmental aspects. The interviews of the stakeholder meeting were carried out according to the following process through an independent person: Identification of stakeholders – selection of stakeholders – make an official interview list – invitation for interviews – interviews – following actions. The identification and determination of the stakeholders was made among individuals and organizations who are directly affected by the project (e.g. land loss, use of affected lands certified under the compensation policy of local authority and the Government), local authorities. Criteria such as age, position, relation to the project, etc. were defined in order to make a representative choice for all the affected groups. Thereafter a list of the selected persons was made and was checked with the project owner and the head of villages. The selected people were informed by the head of villages in order to arrange meetings. Also, interviews were carried out at local resident's houses. Each representative of a household was delivered a questionnaire. The questionnaire consists of two parts. Part 1 details the information about the interviewee, for example, age, gender and occupation. Part 2 emphasizes environmental issues. The households' representative was clearly explained each question through a local translator before answering them. Also, each questionnaire had the confirmation of the head of each village Afterwards the interviewed people could read and sign the minutes[78].

E.2. Summary of the comments received:

The following summary is based on the stakeholder meeting January 12th 2011 and the interviews realized[79].

Major positive comments received include:

- Socioeconomic development including improved road, upgrading of the hospital, building of a school;
- Assistance of project investor in growing crops;
- Power supply to the villages.

The major concerns or recommendations mentioned were:

- Moderate noise during construction;
- Clearing of reservoir bed is important;
- Laotian engineer should be working at the plant when operational;
- Ensure safety of workers during construction;
- Replacement of the broken water supply system of the village through the investor;
- Finish construction as soon as possible.

No impact on agricultural activities or on irrigation and water resource is previewed. The financial compensations received are considered as fair.

The overall conclusion is that the project is beneficial for the community especially in improving their livelihood. All interviewed were in favour of the project and none against it.

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[78] File 60

[79] Files 61 and 62

E.3. Report on how due account was taken of any comments received:

The concerns mentioned have been addressed by the company being basically:

- Noise and dust pollution have been mitigated as far as possible based on the recommendation given by the EIA.
- Socio-economic development and inclusion of local labour force is strived at by the investor. The investor is training local staff to perform this job in the future.
- The investor signed an agreement with the Province for reservoir bed clearance[80].

[80] File 56

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no Official Development Assistance in this project and the project will not receive any public funding from Parties included in Annex I[81].

[81] See File 23

Annex 3

BASELINE INFORMATION

OPERATING MARGIN (OM)

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants. The ex-ante option is taken based on a 3-year generation-weighted average, based on the most recent data available at the time of submission of the PDD to the DOE for validation. The data vintage taken is 2006-2008. The data is based on the official data for the Combined Margin in Vietnam. All plants in Laos are hydro-electric power plants and low-cost / must run power plants[82].

Table A.1 Fuel Consumption, Emissions and Power Generation of Fossil Plants 2006, 2007, 2008

Power plants	**Fuel consumption** Coal, oil: kton Gas: mm^3)	**Power generating to the grid** (GWh)	**Emission** ($t CO_2$)
2006			
Coal thermal power plants	5,645.86	8,989.230	11,823,610
Gas turbines		26,542.978	12,479,578
- Gas turbine using gas	5,743,235.28	18,838.764	12,244,651
- Gas turbine using petroleum oil	70.14	233.582	234,927
- Add-on (steam/heat)	0	7,470.632	0
Diesel thermal power plant	397.65	1,043.991	1,327,593
Diesel power plant using FO	16.60	80.000	51,642
Diesel power plant using DO	6.39	25.000	20,495
Imported power		937.000	0
Total		37,618.119	25,702,918

[82] See File 40, p.46

2007			
Coal thermal power plants	6,386.09	9,836.548	13,272,897
Gas turbines		29,474.918	13,116,063
- Gas turbine using gas	5,910,941.84	20,023.591	12,570,669
- Gas turbine using petroleum oil	163.27	557.880	545,394
- Add-on (steam/heat)	0	8,893.447	0
Diesel thermal power plant	614.06	1,834.409	2,046,368
Diesel power plant using FO	25.15	104.626	79,867
Diesel power plant using DO	9.16	42.000	29,088
Imported power		2,629.000	0
Total		43,921.501	28,544,283
2008			
Coal thermal power plants	6,483.99	10,055.394	13,378,811
Gas turbines		33,857.135	14,716,799
- Gas turbine using gas	6,839,114.84	22,396.231	14,535,266
- Gas turbine using petroleum oil	54.35	183.088	181,533
- Add-on (steam/heat)	0	11,277.816	0
Diesel thermal power plant	534.59	1,481.880	1,784,825
Diesel power plant using FO	22.48	90.465	71,385
Diesel power plant using DO	3.73	15.000	11,879
Imported power		3,220.000	0
Total		48,719.874	29,963,699

Table A.2 Total Emission and Power Generation Fossil Plants 2006/2007/2008

	2006	2007	2008	Total
Total power generation fossil plants (MWh)	37,618,119	43,921,501	48,719,874	**130,259,494**
Total emission (tCO2)	25,702,918	28,544,283	29,963,699	**84,210,900**

Table A.3 Result of OM Emission Factor

Year	**Total power generation fossil plants (MWh)**	**Total emission(tCO_2)**	**OM $_{2008}$ (tCO_2/MWh)**
	A	B	(∑B/∑A)
2006	37,618,119	25,702,918	
2007	43,921,501	28,544,283	
2008	48,719,874	29,963,699	
Total	130,259,494	84,210,900	0.6465

BUILD MARGIN

Table A.4. System Generation 2008 (MWh)

	MWH
System Generation Vietnam	74,689,636
System Generation Laos	3,716,970
Total System Generation	78,406,606
20% of total system generation	**15,681,321**

Source: Vietnam: MONRE, official CM, table 2 (File 39); Laos: EDL, p.17 (File 40)

Table A.5. Most Recent Power Plants in Laos and Vietnam

Name of Power Plant	**Commissioning Date**	**Production in MWh 2008**
A. Vuong	2008	168,103.5
Tuyen Quang	2008	1,136,112.2
Dai Ninh	2008	1,145,108.5
Nonh Trach	2008	544,808.6
Ca Mau 1&2	2007	4,835,679.2
Total		**7,829,812**

Source: Vietnam: MONRE, official CM, table 2 (File 39); Laos: No power plant commissioned prior 2005 (File 47)

Clearly the set of 5 most recent power plants is less than 20% of power generation in the year 2008. Therefore the set of power capacity additions that comprise 20% of the system is used, as this comprises the larger annual generation.

Table A.6 Calculation of the BM Emission Factor for the Year 2008

Power plant	**COD year**	**Fuel consumption** (Coal, oil: kton Gas: mm^3)		**Power generated to the grid** (MWh)	**Emission** (t CO2)
The set of power plants most recently constructed contributes 20% of total power generation					
A Vuong	2008	Hydropower		168,103.50	
SROC Phu Mieng IDICO	2006	Hydropower		241,556.00	
Se San 3A	2006	Hydropower		394,895.70	

Tuyen Quang	2008	Hydropower		1,136,112.18	
Dai Ninh	2008	Hydropower		1,145,108.50	
Se San 3	2006	Hydropower		1,131,614.00	
Quang Tri	2007	Hydropower		250,804.40	
Uong Bi 2	2007	Coal	281,759	532,000.00	581,018
Na Duong	2005	Coal	532	627,930.00	883,846
Cao Ngan	2007	Coal	526	708,693.00	1,081,146
Formosa	2004	Coal	495	560,295.00	1,291,303
Nhon Trach	2008	Gas	166.38	544,808.60	378,023
Ca Mau 1&2	2007	Gas	647.24	2,106,807.24	1,431,048
		Add-on		2,728,872.00	
Phu My 2.2	2004	Gas	1,159.75	4,141,980.00	2,510,751
Phu My Nitrogen	2006	Gas	56.15	4,716.00	133,868
CAI LAN - VINASHIN	2007	FO	22.48	90,465.01	71,385
Total				**16,514,761.12**	**8,362,386**
Result of BM emission calculation (BM)					
Total emission			8,362,386 (tCO_2)		
Total power generation			16,514,761 (MWh)		
BM_{2008}			**0.5064 tCO_2/MWh)**		

Total electricity output for the regional grid in 2008 is 78,368,001 MWh (Table 14) and 20% of this output is 15,673,600 MWh (see table A.4.)

COMBINED MARGIN

Table A.7 Calculation of Combined Margin

A	Estimated operating margin emission rate	tCO_2/MWh	**0.6465**
B	Estimated build margin emission rate	tCO_2/MWh	**0.5064**
C	Estimated baseline emission rate	tCO_2/MWh	**0.5764**

Annex 4

MONITORING INFORMATION

Details see chapter B.7.2.

List of Documents

File 1	ecotawa, Finance File, 2011
File 2	State Bank of Vietnam, Base Interest Rate and Decision No. 16/2008/QD-NHNN dated 16 May 2008 of the Governor of the State Bank, 2009
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File 11	Compensation document stage 2
File 12	Compensation document stage 3
File 13	Compensation document stage 4
File 14	Compensation document stage 5
File 15	Environmental and Social Management Committee of Xekaman 3 Power Co., Ltd, Projected list of projected families receiving compensation of stage 6 in 2010 by the Environmental and Social Management Committee of Xekaman 3 Power Co., Ltd
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File 25/25e	Xekaman 3 Power Company Limited and Electricity of Vietnam, Power purchase agreement 2006/XKM3-EVN/VL between Xekaman 3 Power Company Limited and Electricity of Vietnam for Xekaman 3 Hydropower Plant, 2006

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File 30/30a	Energy and Construction Consultant JSC, Contract, 18/07/2006
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File 32	Carbotech, MoU, 18/01/2008
File 33	ecotawa, MoU, 03/06/2008
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