PROJECT DESIGN DOCUMENT FORM
FOR CDM PROJECT ACTIVITIES (F-CDM-PDD)
Version 04.1

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Qaliwana Hydropower Project
Version number of the PDD	02
Completion date of the PDD	11/12/2012
Project participant(s)	Fiji Electricity Authority
Host Party(ies)	Fiji
Sectoral scope and selected methodology(ies)	Sectoral scope: 1 Energy industries (renewable - / non-renewable sources) Methodology: ACM0002 (Version 13.0.0) Consolidated baseline methodology for grid-connected electricity generation from renewable sources
Estimated amount of annual average GHG emission reductions	17,580 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The purpose of Qaliwana Hydropower Project (hereinafter referred to as the proposed project) is to utilize water resources for electricity generation through the construction and operation of a hydropower project with a total capacity of 18.6MW through river water diversion. The proposed project is to be constructed and operated by Fiji Electricity Authority (FEA).

The purpose of the proposed project is to generate renewable power and deliver it to FEA Grid. For the proposed project,

(a) Prior to the start of implementation of the project activity, the location of the proposed project is covered by the FEA Grid who has an extensive grid system on Viti Levu, and three smaller grids on Vanua Levu and Ovalau. Over the past 10 years, the electricity demand in Fiji has seen a significant increase and the FEA has consistently built and run new diesel power stations to meet the increases in demand.

(b) The project scenario: The proposed project activity aims to construct and operate a diversion type hydropower project with a 62m high, concrete gravity dam on the Qaliwana River at its junction with the Nadala River. A 2.3km tunnel will link the dam to the point on the Nukunuku Creek approximately 250m upstream from the Korolevu Weir. Water will be conveyed across the Nukunuku Creek in a 2.25m diameter penstock supported on a bridge, which also provides access to the tunnel portal. A penstock of 225m long conveys the water to a power station located at the side of the Korolevu Reservoir. The proposed project will have a design flow of $15m^3/s$ and a design turbine installed capacity of 18.6MW, at a net head of 137.8m. The expected annual electricity supplied to the FEA Grid is 38,680 MWh. The proposed project will increase the percentage of renewable energy generation in FEA Grid, further reduce Fiji's dependence on diesel-fired electricity generation, and reduce the need for building new diesel power stations. According to the ACM0002 applied, the proposed project is a renewable electricity generating activity.

(c) The baseline scenario of the proposed project activity is that the electricity delivered to the FEA Grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources. The baseline scenario of the proposed project is the same as the scenario prior to the start of the implementation of the project activity.

The proposed 18.6MW hydropower project will have an annual energy supply of approximately 38,680 MWh, which will generate estimated emissions reductions in the order of 17,580 tonnes of CO_2e annually during the first seven-year crediting period. The proposed project activity is expected to achieve 123,060 tCO_2e of net emission reductions during the first 7-year crediting period.

The proposed project makes contribution to the sustainable development as follows:

1. GHG emission reduction

The proposed project will help reduce the greenhouse gas GHG emissions through avoiding fossil fuel use and lowering greenhouse gas emissions. The project will generate green power through zero-emission hydro technology and therefore reduce CO_2 emissions as compared to the business-as-usual scenario.

2. Employment opportunities

The proposed project will create employment opportunities during the construction phase and operational period to the surrounding villages.

3. Economic Improvement

For the local economy, the road built as part of the proposed project will assist in better access to markets for the agricultural produce from the nearby villages. Technologically the project contributes through training to Fijian power utility professional working for FEA who will gain experience in hydro power installation, commissioning, operation and maintenance and technology transfer to Fiji. Finally, for the national economy it satisfies growing energy demands without increasing dependence on expensive fossil fuels, allowing the country to continue its economic development and contributing to poverty alleviation.

A.2. Location of project activity

A.2.1. Host Party(ies)

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The Republic of the Fiji Islands

A.2.2. Region/State/Province etc.

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Ba Province

A.2.3. City/Town/Community etc.

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Tavua

A.2.4. Physical/Geographical location

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The proposed project is located in Tavua, Ba Province, Western Division, the Republic of the Fiji. The Qaliwana dam will be constructed on the Qaliwana River at its junction with the Nadala River in the upper reaches of the Sigatoka River catchment. The dam of the proposed project has geographical coordinates with east longitude 17°39'12.96", and north latitude 177°57'28.80". The figure A1 and A2 shows the geographical location of the proposed project.

Figure A1. The proposed project on the map of Fiji

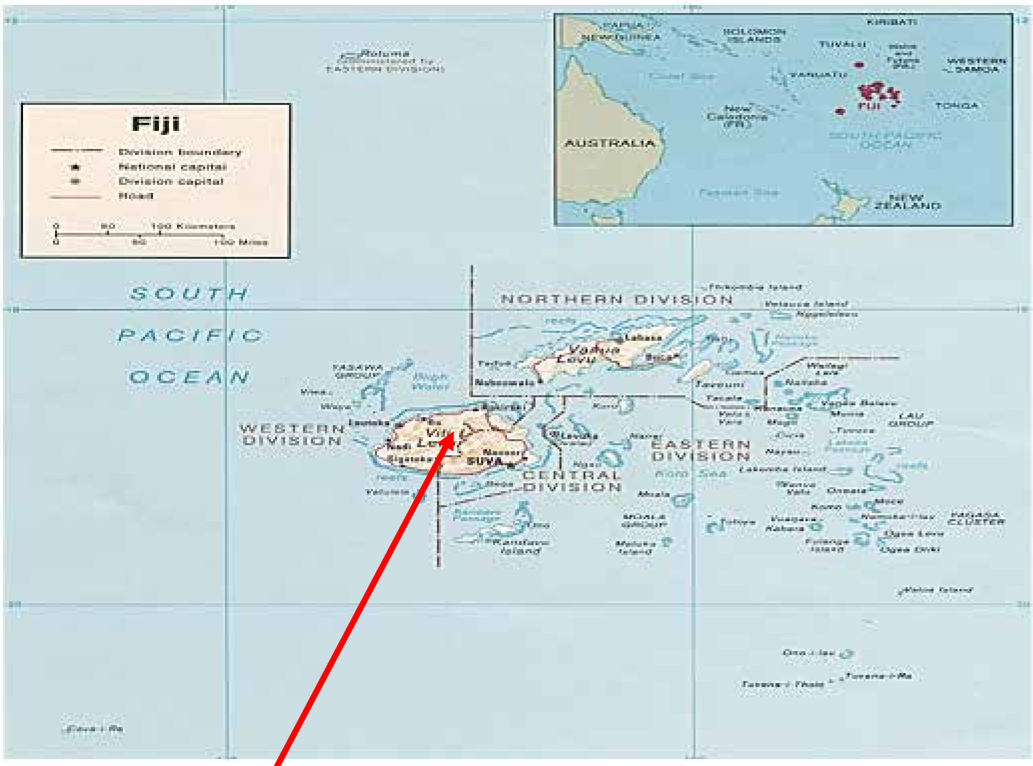
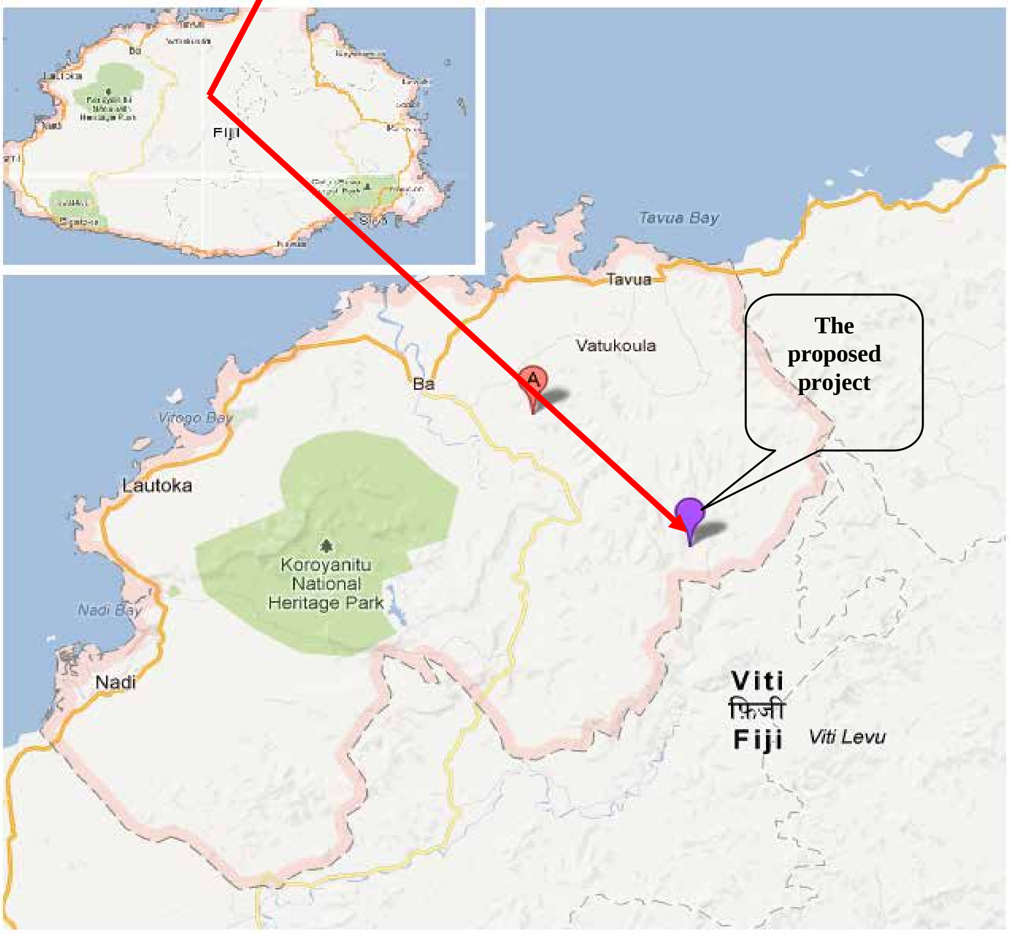


Figure A2. The proposed project on the map of Tavua, Ba Province, Western Division, Fiji



A.3. Technologies and/or measures

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The proposed project is to utilize water resources for electricity generation. The proposed project is a grid-connected renewable energy project. The proposed project will achieve greenhouse gas (GHG) emission reductions.

Prior to the start of implementation of the project activity, there is no power generation unit at the site of the proposed project. The scenario is FEA Grid providing the same electricity service as the proposed project. FEA has consistently used construction of new diesel power stations to meet demand[1].

The baseline scenario of the proposed project is the same as the scenario prior to the start of the implementation of the project activity.

The proposed project involves the installation of a hydro turbine with a capacity of 18.6MW. The expected effective operating hours amount to 2,080 h per year and the plant load factor is 0.2374, which was determined by a third party, MWH Global，Inc., who has developed the Feasibility Study Report (FSR) and is also professional hydro power engineering designing entity. It is consistent with the requirement of EB48, Appendix 11 “Guidelines for the Reporting and Validation of Plant Load Factors”. The estimated net annual power supplied to the grid is 38,680 MWh.

The main technical specifications of the turbine and generator are provided in the following table.

	Parameter	**Unit**	**Data[2]**
Turbine	Set	—	1
	Rated output	MW	18.6
	Turbine discharge	m^3/s	15
Generator	Set	—	1
	Rated voltage	kV	11
	Capacity	kVA	22,800
	Rotational speed	rpm	500

Qaliwana power station will be newly built on the project site. Power generated by the proposed project will be delivered to the Qaliwana power station and sent at 33kV to the Nadarivatu switching station where it will be stepped up to 132kV, and then transmitted to the FEA Grid finally.

The electricity supplied by the proposed project will be monitored through the multifunction electricity meter(s) (the main meter M1 and the backup meter M2) installed at the project site. Both the electricity exported to the grid by the project activity and the electricity imported from the grid to the project site will be monitored with meter(s). The electricity supplied to the grid and the electricity imported from the grid will be cross-checked with the records of electricity sold and purchased. The maximum allowable error of the meters will not exceed ±0.25% of full scale.

The purchase of mechanical and electrical equipment may be from China and the other country according to the FSR of the proposed project. Hence, it will involve technology transferred to the host parties.

[1] Refer to: http://www.reegle.info/policy-and-regulatory-overviews/FJ

[2] Values of the parameters in the table are based on the FSR of the proposed project.

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of the Fiji Islands (host)	Fiji Electricity Authority	No

Further contact information of project participant(s) is provided in Appendix 1.

A.5. Public funding of project activity
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There is no public funding from Annex I Parties for the proposed project.

SECTION B. Application of selected approved baseline and monitoring methodology
B.1. Reference of methodology
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The approved methodology applied in the proposed project activity is ACM0002 (Version 13.0.0) – “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”.
Reference:
http://cdm.unfccc.int/UserManagement/FileStorage/4W1SCKX3EMPO6AYGRJUTD7BQ8IVN0H

“Tool for the Demonstration and Assessment of Additionality (version 07.0.0)”
Reference:
http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf

“Tool to calculate the emission factor for an electricity system (version 03.0.0)”
Reference:
http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v3.0.0.pdf

B.2. Applicability of methodology
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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 was operated prior to the implementation of the project activity (Greenfield plant). It meets all applicability conditions of methodology ACM0002 (Version 13.0.0) which is listed as follows:

1) *The project activity is the installation, capacity addition, retrofit or replacement of a power plant/unit of one of the following types: hydro power 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 activity is the installation of a new hydro power plant (an accumulation reservoir). Hence satisfies the applicability criteria

2) *In the case of capacity additions, retrofits or replacements: the existing plant started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity;*

The Project doesn't belong to these types, so it doesn't need to consider this applicability condition.

3) *In case of hydro power plants, at least one of the following conditions must apply: The project activity is implemented in an existing single or multiple reservoirs, with no change in the volume of any of reservoirs; or The project activity is implemented in an existing single or multiple reservoirs, where the volume of any of reservoirs is increased and the power density of each reservoir, as per the definitions given in the project emissions section, is greater than 4 W/m^2; or The project activity results in new single or multiple reservoirs and the power density of each reservoir, as per the definitions given in the project emissions section, is greater than 4 W/m^2.*

The proposed project results in a single new reservoir and the power density of the reservoir, as per definitions given in the Project Emissions section, is 465 W/m^2, greater than 4W/m^2, so the proposed satisfies this application condition.

4) *In case of hydro power plants using multiple reservoirs where the power density of any of the reservoirs is lower than 4 W/m^2 all the following conditions must apply: The power density calculated for the entire project activity using equation 5 is greater than 4 W/m^2; Multiple reservoirs and hydro power plants located at the same river and where are designed together to function as an integrated project that collectively constitute the generation capacity of the combined power plant; Water flow between multiple reservoirs is not used by any other hydropower unit which is not a part of the project activity; Total installed capacity of the power units, which are driven using water from the reservoirs with power density lower than 4 W/m^2, is lower than 15 MW; Total installed capacity of the power units, which are driven using water from reservoirs with power density lower than 4 W/m^2, is less than 10% of the total installed capacity of the project activity from multiple reservoirs.*

The proposed project results in a single new reservoir, and the power density of the proposed project is 465 W/m^2, greater than 4W/m^2, so it doesn't need to consider this applicability condition.

5) *The methodology is not applicable to the following: Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site; Biomass fired power plants; Hydro power plants that result in new reservoirs or in the increase in existing reservoirs where the power density of the power plant is less than 4W/m^2.*

The proposed project is a new grid-connected hydro power plant, resulting in a new reservoir with the power density of 465 W/m^2, greater than 4W/m^2. Therefore, the proposed project doesn't involve switching from fossil fuels to renewable energy sources at the site of the project activity; the proposed project isn't a biomass-fired power plant.

6) *In the case of retrofits, replacements, or capacity additions, this methodology is only applicable if the most plausible baseline scenario, as a result of the identification of baseline scenario, is "the continuation of the current situation, i.e. to use the power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance".*

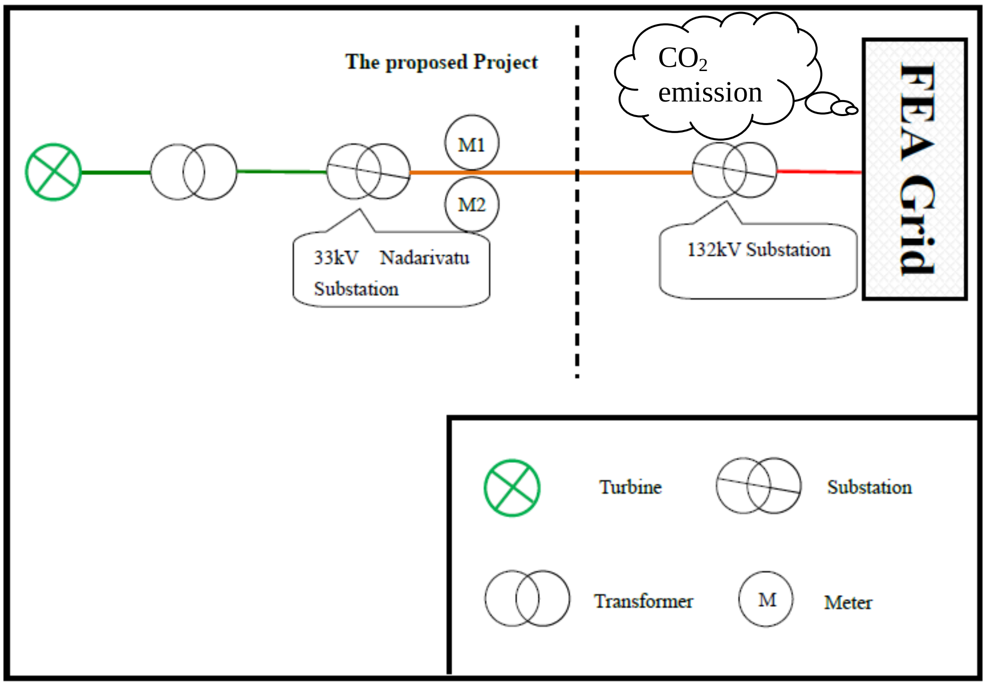
The proposed project is a new installation of a new hydro power plant and the applicability condition is out of consideration.

B.3. Project boundary

As per guidance set out in ACM0002 (Version 13.0.0), "*the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the proposed CDM project power plant is connected to*". In the proposed project activity, the generated electricity from the project will be delivered to the FEA Grid on Viti Levu, the spatial extent of the project boundary includes the Qaliwana Hydropower Project (the project activity) and all power plants connected physically to the FEA Grid on Viti Levu, to which the proposed project is connected to. The FEA Grid on Viti Levu is defined as the project electricity system, which is mainly comprised of eleven diesel plants, plus three hydropower plants and one wind power plant.

	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 emission source.
		N_2O	No	Minor emission source.
Project Activity	The proposed hydro power project	CO_2	No	According to methodology, the proposed project is a hydro power project, so it does not involve project emission.
		CH_4	No	According to methodology, the proposed project is a hydro power project, and the power density of the proposed project is higher than $10w/m^2$, so it does not involve CH_4 emission.
		N_2O	No	According to methodology, the proposed project is a hydro power project, so it does not involve project emission.

The flow diagram of the project boundary is illustrated as follow:



B.4. Establishment and description of baseline scenario

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According to ACM0002 (Version 13.0.0), if the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline is the following:

Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system" (version 03.0.0).

Therefore, supply of equivalent annual power output by operation of power plants connected to FEA grid and by the addition of new generation sources to which the proposed project is connected is the baseline scenario for the proposed project activity.

B.5. Demonstration of additionality

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Based on the FSR finished in August 2010, the proposed project is thus financially unattractive to investors. Then the project owner, Fiji Electricity Authority, held the board meeting on 06/01/2012 and decided to seek additional financial support from CDM to make the proposed project feasible.

Prior consideration of the CDM

Time	Project action
22/10/2008	Nadarivatu Hydropower Scheme Consolidated EIA approved by the Department of Environment (DoE)
August 2010	Feasibility Study Report (FSR) developed
06/01/2012	FEA Board gave serious consideration to CDM
01/06/2013	The estimated starting date of the proposed project

The additionality of the proposed project is demonstrated and assessed by the approved "Tool for the Demonstration and Assessment of Additionality" (Version 07.0.0). Following steps include:

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

Realistic and credible alternatives to the project activity that can be part of the baseline scenario are defined through the following sub-steps:

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

According to the “Tool for the Demonstration and Assessment of Additionality” (Version 07.0.0), 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.

The alternatives available to the proposed project that provide outputs or services comparable with the proposed project activity include:

Alternative 1: The project activity not implemented as a CDM project;
Alternative 2: Provision of equivalent amount of annual power output by the FEA Grid (existing power plants connected to grid and addition of new generation sources) where the proposed project is connected to.

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

The realistic and credible alternative scenarios to the project activity are **Alternative 1** and **Alternative 2**. **Alternative 1** and **Alternative 2** are both in compliance with relevant Fiji laws and regulations, and remain as two alternatives.

Step 2. Investment analysis
The purpose of this step is to determine whether the proposed project activity is economically or financially less attractive than other alternatives without an additional funding that may be derived from the CDM project activities. The investment analysis is conducted in the following steps:

Sub-step 2a. Determine appropriate analysis method
The three analysis methods suggested by *Tool for the demonstration and assessment of additionality* (version 07.0.0) are simple cost analysis (Option I), investment comparison analysis (Option II) and benchmark analysis (Option III). Since the proposed project will earn revenues from not only the CDM but also the electricity output, the simple cost analysis method is not applicable. Investment comparative analysis method is only applicable to the case that alternative baseline scenario is similar to the proposed projects. The alternative baseline scenario of the proposed project is to supply electricity from the FEA Grid rather than a new investment project. Therefore, Option II is not an appropriate method either. The proposed project will use benchmark analysis method based on Project IRR.

Sub-step 2b. Apply benchmark analysis (Option III)
“Tool for the Demonstration and assessment of additionality” (version 07.0.0) stipulates that the project developer should identify the financial/ economic indicator, such as IRR, most suitable for the project type and decision context. As prescribed by the Additionality Tool itself, the project developer has chosen Project IRR to demonstrate the additionality.

The Project IRR needs to be compared with a benchmark to prove the financial unattractiveness of the project. According to the “Tool for the Demonstration and assessment of additionality” (version 07.0.0) and the “*Guidance on the Assessment of Investment Analysis*” (version 05), internal company benchmarks can be applied in cases where there is only one possible project developer. This is the case for the proposed activity, as FEA is the only possible developer of the proposed project due to the poor investment environment in Fiji caused by political instability after the 2006 coup and downturn in the economy - as demonstrated by the withdrawal from the project of the World Bank, the European Investment Bank and the original Joint-Venture partner of the project, Pacific Hydro.

The applicable IRR benchmark for the proposed project is therefore derived from the FEA standard procedure to use 8% IRR (Project IRR, after Tax) as a benchmark for assessing all investment projects. The FEA IRR benchmark (based on the internal Weighted Average Capital Cost) is used as standard by FEA to evaluate its investment decisions. The FEA Board stipulates that investment decisions are dependent on a project achieving a minimum 8% IRR according to standard FEA project discounted cost analysis over 40 years. Therefore the IRR benchmark for the proposed project is 8% (Project IRR, after Tax), a value less than this means that the project is financially unattractive. Information regarding the FEA IRR benchmark is available on request from FEA and can be validated by the DOE.

The application of this Board decision to all FEA investment projects after 2005 can be demonstrated, for example, by the SEL joint venture project (2005) and the Heavy Fuel Oil project at Kinoya (2007), both evaluated against the IRR benchmark of 8%. The IRR calculation and comparative analysis for these two examples, as well as for the proposed project, is the standard method used for evaluation of all FEA projects. Therefore the 8% IRR benchmark proposed in this analysis has been used for similar projects with similar risks, developed by the same company as stated in the *"Guidance on the Assessment of Investment Analysis"*.

Sub-step 2c. Calculation and comparison of financial indicators
Based on the above-mentioned benchmark analysis, the calculation and comparative analysis of financial indicators for the proposed project are carried out in sub-step 2c.

(1) Basic parameters for calculation of financial indicators
Based on the FSR of the proposed project, basic parameters for calculation of financial indicators are as follows:

NO.	Parameters	Value	Unit
1	**Installed capacity**	18.6	MW
2	**Annual power supply**	38,680.00	MWh/yr
3	**Project lifetime**	40 (3 year for construction)	years
4	**Tariff**	25.48 for year 2014 and 2015, and increasing by 4% every fifth year thereafter	FJD cents / kWh
5	**Total static investment**	188,655.64	1000 FJD
6	**Fixed O&M/MW/year**	5,000	FJD / MW / yr
7	**Variable O&M**	10	% of gross revenue
8	**Diesel savings**	1,800	FJD / tonne
9	**Residual Value Factor**	12	times
10	**Tax**	28	%
11	**inflation**	3	%
12	**CER administration costs**	5	%
13	**CER price**	15	Euro
14	**Exchange rate FJD / EUR**	0.40409	
15	**Discount rate / WACC**	8	%

(2) Comparison of IRR for the proposed project and the financial benchmark

In accordance with the benchmark analysis (Option III), the proposed project will not be considered as financially attractive if its financial indicators (such as IRR) are lower than the benchmark.

Table B1 shows the Project IRR of the proposed project, with and without CDM-related income. Without CDM-related income, the Project IRR is lower than the benchmark and the proposed project is not financially acceptable.

Table B1. Financial indicators of the proposed project

	Project IRR (after tax benchmark = 8%)
Without CDM-related income	6.05%
With CDM-related income	6.48%

Sub-step 2d. Sensitivity analysis (only applicable to options II and III):

The purpose of the sensitivity analysis is to assess the impact of uncertainties in the input values of the financial model on the calculated IRR. According to "Guideline on the Assessment of Investment Analysis" (version 05), *only variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation. As a general point of departure variations in the sensitivity analysis should at least cover a range of +10% and -10%.*

Because total static investment and O&M cost are more than 20% of the total investment. And the tariff and annual power supply are selected as the factors for the reason that these two parameters decide the total project revenues. Therefore, four financial parameters including: total static investment, annual O&M cost, tariff and annual power supply were identified as the main variable factors for sensitive analysis of financial attractiveness. The sensitive analysis will be conducted with the fluctuation of the four parameters with the range from -10% to +10%.

Their impacts on Project IRR of the proposed project with the fluctuation range from -10% to +10% were presented in Table B2 and Figure B1.

Table B2. Sensitivity of Project IRR to different financial parameters

Parameter	Range				
	-10%	**-5%**	**0**	**5%**	**10%**
Total static investment	6.93%	6.49%	6.09%	5.71%	5.37%
Annual O&M cost	6.16%	6.12%	6.09%	6.05%	6.01%
Tariff	6.04%	6.06%	6.09%	6.11%	6.13%
Annual power supply	5.29%	5.69%	6.09%	6.47%	6.85%

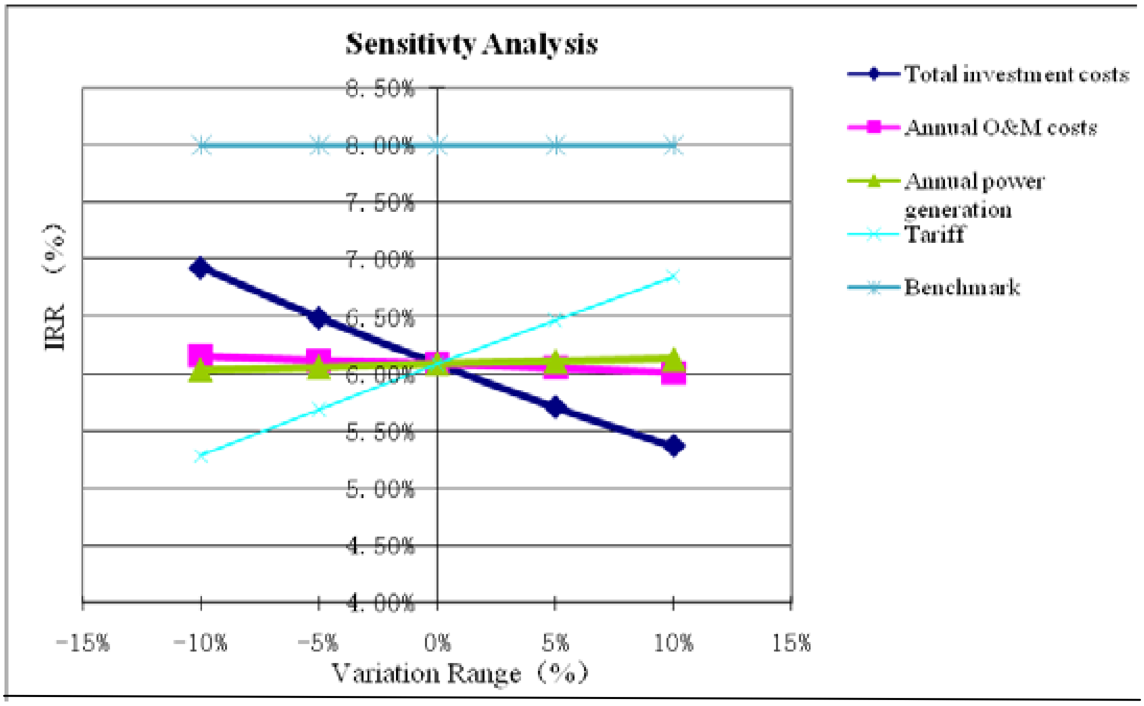

Figure B1. Sensitivity of total investment IRR to different financial parameters

As shown in Table B2 and Figure B1, the Project IRR of the proposed project varies to different extents, when the above four financial indicators fluctuated within the reasonable range from -10% to +10% and the Project IRR does not exceed the benchmark of 8%.

Total static investment

The total static investment needs to decrease by 20.57% when the Project IRR meets the benchmark of 8%. For the proposed project, the total static investment was estimated by a qualified Design Institute, MWH Global, Inc. and the Building Materials Price Index is increase fast these years. According to the information issued by Fiji Bureau of Statistics in 2012[3], the Building Materials Price Index from the year 2006 to 2011 was 104.3, 108.9, 116.6, 128.9, 130.90 and 129.30 respectively, which indicated that the investment cost is always increasing. As a result, the total investment of the proposed project is unlikely to be decreased by over 20.57% to exceed the benchmark.

Annual O&M cost

When the annual O&M cost decreases to zero, the Project IRR is 6.82% which is lower than the benchmark. According to the information issued by Fiji Bureau of Statistics in 2012[4], the national Consumer Price Index from the year 2006 to 2011 was 102.5, 107.4, 115.8, 120.0, 126.7 and 137.7 respectively which indicated the annual O&M cost is always increasing. Hence, the Project IRR is unlikely to exceed the benchmark of 8%.

Tariff

The tariff needs to increase by 65.66% when the Project IRR meets the benchmark of 8%. With regard to the statistic for FEA by the year of 2009, the electricity tariff for the past 15 years had increased at a rate of only 3.4% every 5 years. The analysis for the proposed project used a 4% increase every five years. Therefore it is unrealistic to assume that the tariff would vary by a further increase. There are also a number of barriers to the assumed steady increase in tariffs: 1) Electricity tariffs have also historically recorded decreases as well as increases (e.g. the decrease between 1991 and 1996 and between 1998 and

[3] http://www.statsfiji.gov.fj/Economic/BMPI.htm

[4] http://www.statsfiji.gov.fj/Economic/Prices.htm

1999); 2) Tariff increases are not automatic. Each tariff increase has to be applied for separately and individually approved by the Commerce Commission of Fiji and the Government of the day, following a consultation process. This can be a time consuming process with no guarantee of increase of tariff each time this is applied for; 3) The Government of Fiji is pursuing a policy of poverty reduction and is trying to relieve pressure on the poorer sectors of the population. As such there is an incentive as the owner of FEA to refuse tariff increases and keep electricity tariffs low and 4) FEA is a Government owned utility, and as such it is subject to the political pressures which can arise to lower tariffs or to keep tariffs constant during times when political advantage can be sought from such action. Therefore, it is unlikely that the tariff of the proposed project could increase by 65.66% making the Project IRR meet the benchmark of 8%.

Annual power supply
The annual power supply needs to increase by 25.63% when the Project IRR meets the benchmark of 8%. For the proposed project, the annual electricity generation in the FSR is estimated based on long term rainfall data (year 1980-year 2004) and flow data (year 1981-year 1992). Therefore, the annual electricity generation represents a long-term average power supply through the lifetime of the plant, where the yearly-variations have already been taken into account. Thus, the power generation of the proposed project is unlikely to increase by 25.63% making the Project IRR meet the benchmark of 8%.

In conclusion of the sensitive analysis, as the financial indicators vary within reasonable range, the proposed project remains financially unattractive without CDM support and the proposed project is additional. Hence, the Alternative 1 is not a realistic alternative.

Step 3. Barrier analysis

The barrier analysis is not employed for the proposed project.

Step 4. Common practice analysis

According to the "Tool for the Demonstration and Assessment of Additionality" (version 07.0.0), the measure of the proposed project belongs to "Switch of technology with or without change of energy source (including energy efficiency improvement as well as use of renewable energies)". Thus, the latest version of the "Guidelines on common practice" available on the UNFCCC website shall be applied.
According to the "Guidelines on common practice" (version 02.0), the following steps are analyzed:

Sub-step 1. Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity.

The design capacity of the project activity is 18.6MW. Therefore, the applicable output range is from 9.3 MW to 27.9MW

Sub-step 2. Identify similar projects (both CDM and non-CDM) which fulfil all of the following conditions:

a) The projects are located in the applicable geographical area;
b) The projects apply the same measure as the proposed project activity;
c) The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity;
d) The plants in which the projects are implemented produce goods or services with comparable quality, properties and applications areas (e.g. clinker) as the proposed project plant;
e) The capacity or output of the projects is within the applicable capacity or output range calculated in Sub-step 1;

f) The projects started commercial operation before the project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the proposed project activity.

According to the "Guidelines on common practice" (version 02.0), applicable geographical area should be the entire host country. However, in Fiji, which is divided administratively into four divisions and further subdivided into fourteen provinces, each province has a provincial council which may make bylaws and impose rates (local taxes). As a result, the natural environment, development policies and the investment climate are quite different among provinces. According to Guidelines on common practice (version 02.0), the similar project activities should take place in a comparable environment with respect to regulatory framework and investment climate. The proposed project is located in Ba Province, thus Ba Province has been chosen as the similar region. The common practice analysis of the proposed project activity, therefore, covers projects in Ba Province.

The proposed project belongs to "Switch of technology with or without change of energy source (including energy efficiency improvement as well as use of renewable energies)" and is designed to utilize local water resources to generate electricity which will be exported to the FEA grid. Therefore, the common practice analysis includes projects which belong to "Switch of technology with or without change of energy source (including energy efficiency improvement as well as use of renewable energies)" and generate electricity with water resources.

The project hasn't been published for global stakeholder consultation and the start date of the proposed project is expected on 01/06/2013. Therefore, the common practice includes projects starting commercial operation before 01/06/2013.

As stated above, the similar projects include all the projects generating electricity with water resources, delivering the same capacity within the range of 9.3 MW-27.9MW and starting commercial date before 01/06/2013 in Ba Province.

With reference to FEA data and UNFCCC[5], there is no hydropower project with capacity in the range of 9.3 MW-27.9MW and starting commercial date before 01/06/2013 in Ba Province.

Sub-step 3: Within the projects identified in Sub-step 2, identify those that are neither registered CDM project activities, project activities submitted for registration, nor project activities undergoing validation. Note their number N_{all}.

Based on the analysis of sub-step 2, $N_{all} = 0$

Sub-step 4: Within similar projects identified in Sub-step 3, identify those that apply technologies that are different to the technology applied in the proposed project activity. Note their number N_{diff}

According to the "Guidelines on common practice" (version 02.0), different technologies are technologies that deliver the same output and differ by at least one of the following (as appropriate in the context of the measure applied in the proposed CDM project and applicable geographical area):

(a) Energy source/fuel;

(b) Feed stock;

(c) Size of installation (power capacity):

- (i) Micro;
- (ii) Small;
- (iii) Large;

(d) Investment climate in the date of the investment decision, inter alia:

- (i) Access to technology;
- (ii) Subsidies or other financial flows;
- (iii) Promotional policies;

[5] Data source: http://cdm.unfccc.int

(iv) Legal regulations;

(a) Other features, inter alia:

(i) Unit cost of output (unit costs are considered different if they differ by at least 20%);

Based on the analysis of sub-step 3, $N_{diff} = 0$

Sub-step 5: Calculate factor $F=1-N_{diff}/N_{all}$ representing the share of similar projects (penetration rate of the measure/technology) using a measure/technology similar to the measure/technology used in the proposed project activity that deliver the same output or capacity as the proposed project activity.

Based on the above analysis,
$N_{all}= N_{diff} =0$

According to the "Guidelines on common practice" (version 02.0), if the factor F is greater than 0.2 and N_{all}-N_{diff} is greater than 3, then the proposed project activity is a "common practice". Therefore, the proposed project is not common practice.

Outcome of Step 4:
The proposed project is not a "common practice".

In conclusion, the proposed project is additional and the CDM revenue plays the key role to make the proposed project financially feasible. The CDM was considered in the decision to implement the project activity.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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The key methodological steps are as follows:

1. Calculating the Baseline Emission (BE_y)
2. Calculating the Project Emission (PE_y)
3. Calculating the Leakage Emission (LE_y)
4. Calculating the Emission Reduction (ER_y)

1. Calculating the Baseline emissions

The baseline emissions (BE_y) is the product of the baseline emissions factor ($EF_{grid,CM,y}$ in tCO_2e/MWh) calculated, times the electricity supplied by the project activity to the grid ($EG_{PJ,y}$ in MWh), as follows:

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y}$$

1.1 Calculation of the baseline emissions factor

Following ACM0002, the baseline emission factor is calculated as a combined margin ($EF_{grid,CM,y}$), consisting of the combination of operating margin ($EF_{grid,OM,y}$) and build margin ($EF_{grid,BM,y}$) factors according to the following six steps defined in the "Tool to calculate the emission factor for an electricity system" (version 03.0.0)..

Step 1. Identify the relevant electricity system

As per section B.4., the identified business as usual scenario is the continued generation of power by the FEA grid on Viti Levu, and the baseline emissions are those produced as a result of this. Thus, the FEA grid on Viti Levu is identified as the relevant electric power system.

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

The proposed project does not include off-grid power plants in the project electricity system; only grid power plants are included in the calculation apply to "Tool to calculate the emission factor for an electricity system".

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

The operating margin emission factor is calculated based on one of the following four methods:

1) Simple OM, or
2) Simple adjusted OM, or
3) Dispatch data analysis OM, or
4) Average OM.

Detailed information to carry out a dispatch data analysis is not publicly available; therefore, method 2) and method 3) is not suitable for the proposed project.

The Simple OM method can only be used where low cost/must run power plants[6] constitute less than 50% of total grid generation. According to the historical generating capacity data of FEA in the last 5 years, power generation from hydropower plants accounted for a 50%[7] or more of the total generation capacity (see Table B. 6).

Table B. 1. Contribution of low cost/must run source to overall power generation in Fiji

Year	2007	2008	2009	2010	2011	Average
Percentage share of low cost/must run power station, namely predominantly hydropower plants and wind plants	70.8%	69.9%	64.2%	54.6%	62.5%	64.4%

On the basis of the information provided in Table B. 6, option 1) Simple OM is not applicable for calculating the project's operating margin emission factor. Therefore, the project will use option 4) Average OM to calculate the OM emission factor.

According to the "Tool to calculate the emission factor for an electricity system", the average OM can be calculated using either of the two following data vintages:

(1) Ex ante option: A 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emission factor during the crediting period, or;

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

[6] As defined in the "*Tool to calculate the emission factor for an electricity system*" (Version 2.2.1), Low-cost/must-run resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid. They typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. If coal is obviously used as must-run, it should also be included in this list, i.e. excluded from the set of plants.

[7] Fiji Electricity Authority electricity generation data by source

previous year (y-2) may be used. The same data vintage (*y*, *y-1* or *y-2*) should be used throughout all crediting periods.

Based on the most recent statistics available at the time of PDD completed, the first data vintage (option 1 – Ex-ante) for the calculation of OM emission factor is chosen for this project. The years used are therefore 2009 to 2011 (3 year period).

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

The average OM emission factor is calculated as the average emission rate of all power plants serving the grid, using the methodological guidance as described for the simple OM, but including in all equations also low-cost/must-run power plants.
Thus the Average OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit of net electricity generation (tCO_2/MWh) of all generating power plants serving the system, including low-cost/must-run power plants/units. It may be calculated by using either:

- Option A: Based on net electricity generation and a CO_2 emission factor of each power unit[8]; or
- Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system (Option B only to be used if data for Option A is not available).

In Fiji, the Fiji Electricity Authority has provided the data for the calculation using Option A, thus this is the Option used in this PDD.

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

$$EF_{grid,OM-ave,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where:

$EF_{grid,OM-ave,y}$	=	Average operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* 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)
m	=	All power units serving the grid in year y, including low-cost/ must-run power units;
y	=	The relevant year as per the vintage chosen in Step 3.

The calculation of the CO_2 emission factor of each power unit *m* in year *y* can be calculated using Option A1, A2 or A3. These options should be used according to the following:

- Option A1 – if for a power unit m data on fuel consumption and electricity generation is available;

[8] Power units should be considered if some of the power units at the site of the power plant are low-cost/must-run units and some are not. Power plants can be considered if all power units at the site of the power plant belong to the group of low-cost/must-run units or if all power units at the site of the power plant do not belong to the group of low-cost/must-run units.

- Option A2 – If for a power unit m only data on electricity generation and the fuel types used is available; and
- Option A3 – if for a power unit m only data on electricity generation is available.

In this PDD both option A1 and A3 were used. In these two cases $FE_{EL,m,y}$ was calculates as follows:

Option A1:

$$EF_{EL,m,y} = \frac{\sum_i EG_{m,y} \times NCV_{i,y} \times EF_{CO_2,i,y}}{EG_{m,y}}$$

Where:

$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in 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)
$NCV_{i,y}$	=	Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ / mass or volume unit)
$EF_{CO_2,i,y}$	=	CO_2 emission factor of fossil fuel type *i* in 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)
I	=	All fossil fuel types combusted in power unit *m* in year *y*;
Y	=	The relevant year as per the vintage chosen in Step 3.

Option A3: in case only generation data is available for a power unit *m*, $FE_{EL,m,y}$ = 0 tCO_2/MWh can be assumed as a simple and conservative approach.

$EF_{grid,\ OM\text{-}ave,\ y}$ = **<u>0.2706 tCO_2/MWh</u>**

Appendix 4 presents the detailed datasheets and calculations.

Step 5. Calculate the build margin emission factor

In terms of vintage of data, project participants can choose between one of the following two options:

Option 1: 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. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, ex post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated ex ante, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

In this PDD, Option1 is chosen to calculate the build margin emission factor.

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

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

Where:

$EF_{grid,BM,y}$	=	Build 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* in (MWh);
$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m	=	Power units included in the build margin
y	=	Most recent historical year for which power generation data is available

The CO_2 emission factor of each power unit *m* should be determined as per the guidance in step 4 (a) for the average OM, using Options A1, A2 or A3, using for *y* the most recent historical year for which power generation data is available, and using *m* for the power *units* included in the build margin.

In this PDD, the A1 Option of the average OM method was chosen for this calculation.

$EF_{grid,BM,y}$= **0.6384 tCO_2/MWh**

Step 6. Calculate the combined margin emission factor

The combined margin emission factor is calculated as follows:

$$EF_{grid,CM,y} = w_{OM} \times EF_{grid,OM\text{-}ave,y} + w_{BM} \times EF_{grid,BM,y}$$

Where:

w_{OM}	=	Weighting of operating margin emission factor (%)
w_{BM}	=	Weighting of build margin emission factor (%)

The default values used for ω_{OM} and ω_{BM} for this PDD are 0.5 and 0.5.
Based on $EF_{grid,OM\text{-}ave,y}$ and $EF_{grid,BM,y}$ calculated in the previous steps, the combined margin emission factor is:
$EF_{grid,CM,y}$= 0.5×0.2706 + 0.5×0.6384 = **0.4545 tCO_2/MWh**

Table B. 2. Summary of the OM, BM and CM

Parameter	Value
Operating margin emission factor ($EF_{grid,OM\text{-}ave,y}$, in tCO_2/MWh)	0.2706
Build margin emission factor ($EF_{grid,BM,y}$, in tCO_2/MWh)	0.6384
Baseline emission factor ($EF_{grid,CM,y}$, in tCO_2/MWh)	0.4545

Appendix 3 presents the detailed datasheets and calculations.

The OM and BM emission factors fixed for the duration of the first crediting period yield a baseline emissions factor fixed for the first crediting period. These parameters will be re-calculated at any renewal of the crediting period using the above steps and the latest data available then.

Baseline emissions (BE_y) now can be calculated as the combined margin CO_2 emission factor ($EF_{grid,CM,y}$) multiplied by the annual net generation of the proposed project ($EG_{PJ,y}$).

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y}$$

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 the project electricity system in year *y* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system"

Calculation of $EG_{PJ,y}$

The proposed project is the installation of a new grid-connected renewable power plant/unit at a site where no renewable power plant was operated prior to the implementation of the project activity, then:

$$EG_{PJ,y} = EG_{facility,y}$$

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)

2. Calculating the Project Emission (PE_y)

As per the guidance in the consolidated approved methodology ACM0002 (Version 13.0.0), there are no expected project emissions for hydropower plants which have a run-of-river weir (reservoir) with a power density larger than $10W/m^2$.

The project activity has a total installed capacity of 18.6 MW (or 18,600,000 W). Its surface area of the reservoir is 40,000 m[29]. The power density of the project activity is given by:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$

Where:

PD	=	Power density of the project activity, in W/m^2;
Cap_{PJ}	=	Installed capacity of the hydropower plant after the implementation of the project activity (W);
Cap_{BL}	=	Installed capacity of the hydropower plant before the implementation of the project activity (W). For new hydropower 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 the new

[9] The value was estimated by the project owner and will be updated when there is other authentic data source.

reservoir, this value is zero;

The power density of the project activity PD > 10 W/m^2, therefore
PE_y **=** 18,600,000 (W) /40,000 (m^2) = **465 W/m^2**

Since PD = 465 W/m^2 > 10 W/m^2, therefore $PE_y = 0$

3. Calculating the Leakage Emission (*LEy*)

According to the ACM0002 (Version 13.0.0), no leakage is considered for the proposed project activity. Therefore: $LE_y=0$

4. Calculating the Emission Reduction (*ERy*)

Emission reductions are calculated as follows:

$ER_y = BE_y - PE_y$

Where:

ER_y	= Emission reductions in year y (tCO_2e/yr)
BE_y	= Baseline emissions in year y (tCO_2/yr)
PE_y	= Project emissions in year y (tCO_2e/yr)

B.6.2. Data and parameters fixed ex ante

Data / Parameter	$FC_{i,m,y}$
Unit	tonnes or m^3
Description	Amount of fossil fuel type *i* consumed by power plant / unit *m* in year *y*
Source of data	Fiji Electricity Authority
Value(s) applied	See Appendix 4 for details
Choice of data or Measurement methods and procedures	Data are used from the Fiji Electricity Authority (FEA), the only source for this information.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$NCV_{i,y}$
Unit	GJ / mass or volume unit
Description	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	See Appendix4 for details
Choice of data or Measurement methods and procedures	IPCC default value
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	***EF**$_{CO2,i,y}$*
Unit	tCO_2e/GJ
Description	CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	See Appendix 4 for details
Choice of data or Measurement methods and procedures	IPCC default value
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	**Installed Capacity**
Unit	MW
Description	The Installed Capacity of the power plants in the FEA grid in the year y
Source of data	Fiji Electricity Authority
Value(s) applied	See Appendix 4 for details
Choice of data or Measurement methods and procedures	Data are used from the Fiji Electricity Authority (FEA), the only source for this information.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	**$EG_{m,y}$**
Unit	MWh
Description	Net electricity generated and delivered to the grid by power unit *m* in year *y*, including low-cost/must-run power plants/units, in year y
Source of data	Fiji Electricity Authority
Value(s) applied	See Appendix 4 for details
Choice of data or Measurement methods and procedures	Data are used from the Fiji Electricity Authority (FEA), the only source for this information.
Purpose of data	Calculation of baseline emissions
Additional comment	-

B.6.3. Ex ante calculation of emission reductions
>>
As described in B.6.1., the emission reductions of the proposed project are calculated as follows:

Baseline emissions

Annual generation is estimated as 38,680 MWh.

$EF_{grid,OM,y}$ =0.2706 tCO_2/ MWh
$EF_{grid,BM,y}$ =0.6384 tCO_2/ MWh

$EF_{grid,CM,y}$ =0.2706 × 0.5 + 0.6384 × 0.5 =0.4545 tCO_2/MWh
BE_y = 38,680× 0.4545 =17,580 tCO_2e

The ex-ante baseline emission factor: **0.4545 tCO_2/MWh**
Annual baseline emissions: **17,580 tCO_2e** (details in Appendix 3)

Project emissions

The power density of the proposed project is greater than 10 W/m^2. Therefore, according to ACM0002 (version 13.0.0), PEy = 0.

Leakage

According to ACM0002 (Version 13.0.0), no leakage is considered. The main emissions potentially giving rise to leakage are neglected.

Project Emission Reductions

$ER_y = BE_y - PE_y$

The total annual baseline emissions are 17,580 tCO_2e.
The total annual project emissions are 0 tCO_2e.
$ER_y = BE_y - PE_y$ = 17,580 – 0 = 17,580 tCO_2e

The annual emission reductions are estimated to be: 17,580 tCO_2e. The proposed project activity is expected to achieve 123,060 tCO_2e of net emission reductions during the first 7-year crediting period.

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
01/01/2016-31/12/2016	17,580	0	0	17,580
01/01/2017-31/12/2017	17,580	0	0	17,580
01/01/2018-31/12/2018	17,580	0	0	17,580
01/01/2019-31/12/2019	17,580	0	0	17,580
01/01/2020-31/12/2020	17,580	0	0	17,580
01/01/2021-31/12/2021	17,580	0	0	17,580
01/01/2022-31/12/2022	17,580	0	0	17,580
Total	**123,060**	**0**	0	**123,060**
Total number of crediting years	7			
Annual average over the crediting period	17,580	0	0	17,580

B.7. Monitoring plan
B.7.1. Data and parameters to be monitored

Data / Parameter	$EG_{facility, y}$
Unit	MWh
Description	Quantity of net electricity generation supplied to the Grid by the project activity in year y.
Source of data	On-site measurement by project participant

Value(s) applied	38,680
Measurement methods and procedures	Quantity of net electricity generation supplied by the proposed project activity will be monitored continuously by two multifunction meters (a main meter and a back-up meter) at the substation. The quantity of electricity supplied by the project plant/unit to the grid; and The quantity of electricity delivered to the project plant/unit from the grid Multifunction meters will be suitable for accurately measuring 3-phase, 50-Hz quantities. The maximum allowable error shall not exceed ±0.25% of full scale at 25°C. The meter modules will have electrical isolation between input, output, power supply, and the case ground connection. The meter module will have a minimum dielectric test voltage rating of 1500-V AC rms for 1 minute. This equipment complies with International Electrotechnical Commission (IEC) or ANSI/IEEE standards.
Monitoring frequency	Monthly recorded
QA/QC procedures	· Continuous measurement and monthly recording will take place · The second meter (backup metering system) will be installed which can be used in the event of failure of the first (main metering system). · The data from electricity sales receipts will be cross checked against meter readings taken at the project site. · All data collected as part of monitoring should be archived electronically and be kept for at least 2 years after the end of the last crediting period. · Monthly net generation data will be approved and signed off by the Project Director prior to being accepted and stored. · Testing as per manufacturer's recommendation (every year or at least once every three years)
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	A_{PJ}
Unit	m^2
Description	Determine the 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	On-site measurement by project participant
Value(s) applied	40,000
Measurement methods and procedures	Measured from topographical surveys, maps, satellite pictures, etc.
Monitoring frequency	Measured and recorded annually
QA/QC procedures	-
Purpose of data	Calculation of project emission
Additional comment	-

Data / Parameter	Cap_{PJ}
Unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity
Source of data	Monitored on-site

Value(s) applied	18,600,000
Measurement methods and procedures	Determine the installed capacity based on recognized standards
Monitoring frequency	Measured and recorded annually
QA/QC procedures	-
Purpose of data	Calculation of project emission
Additional comment	-

B.7.2. Sampling plan

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B.7.3. Other elements of monitoring plan

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The proposed project adopts the approved consolidated baseline and monitoring methodology ACM0002 “Consolidated baseline monitoring methodology for grid-connected electricity generation from renewable sources” (Version 13.0.0) to determine the emission reductions from the net electricity generation from the hydropower plant. This plan describes in more detail the process.

1. Monitoring Object

The monitoring is to justify the realistic amount of emission reduction from the CDM project. The monitoring plan will provide credible, accurate, transparent and conservative monitoring data and ensure the real, measurable, long-term GHG emission reduction from this project.

2. Management Structure

Fiji Electricity Authority, the owner of the proposed project, will use this document as guideline in monitoring of the project emission reduction performance and will adhere to the guidelines set out in this monitoring plan to ensure that the monitoring is credible, transparent and conservative.

The responsibilities of the project staff are as follow:

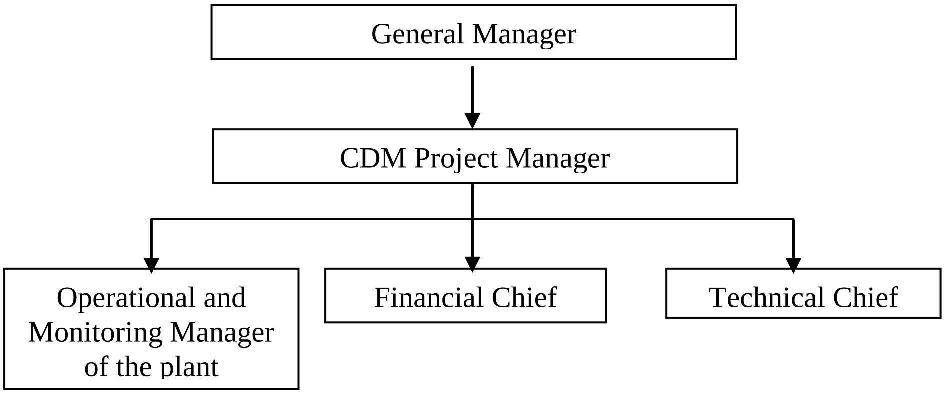
General Manager: To be responsible for supervising the whole monitoring procedure.

CDM Project Manager: To be responsible for data management and compiling monitoring report.

Operational and monitoring manager: To be responsible for collecting data and do internal audit.

Financial chief: To be responsible for collection of sales receipts.

Technical chief: To be responsible for preparing operational reports of the project activity, recording the daily operation of the plant, including operating periods, equipment defects, etc.

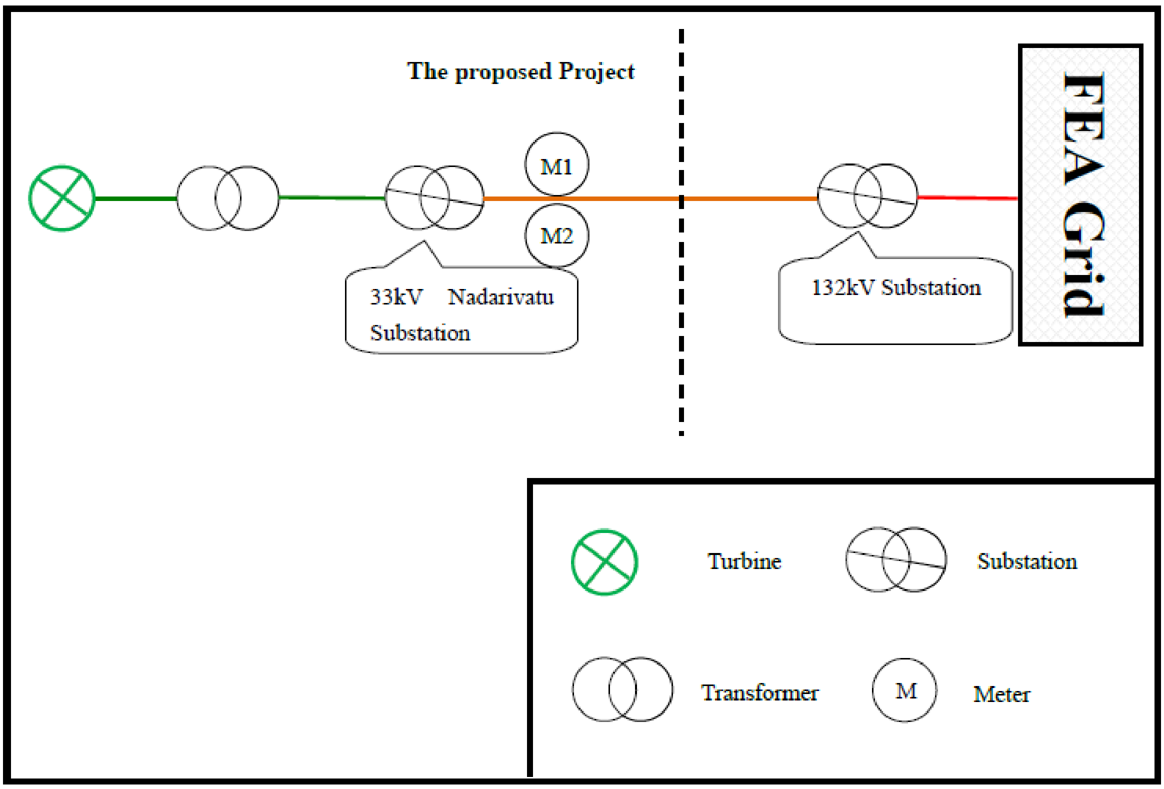


3. Monitoring Equipment

Electricity generated by the proposed project will be delivered to the Qaliwana power station and sent at 33kV to the Nadarivatu switching station where it will be stepped up to 132kV, and then transmitted to the FEA Grid finally.

Electricity supplied by the proposed project will be monitored through the multifunction electricity meter(s) (the main meter M1 and the backup meter M2). Both the electricity exported to the grid by the project activity and the electricity imported from the grid to the project site will be monitored by the meter(s). The maximum allowable error of the meters will not exceed ±0.25% of full scale at 25°C. The meter modules will have electrical isolation between input, output, power supply, and the case ground connection. The modules will have a minimum dielectric test voltage rating of 1500-V AC rms for 1 minute.

A diagram shows how parameters are monitored is presented as follows:



4. Monitoring procedure

The electricity exported to the grid and the electricity imported from the grid will be monitored base on the meter. The net electricity generation supplied to the grid ($EG_{facility, y}$) is calculated through electricity supplied to the grid ($EG_{export,y}$) minus electricity imported from the grid ($EG_{import,y}$). The electricity exchanged between the proposed project and FEA Grid is both checked by the project owner and the grid company.

Monthly net on-grid supplied electricity for the purpose of emission reduction calculations will be cross-checked against sales receipts issued by Fiji Electricity Network Authority, approved and signed off by the Project Manager prior to being accepted and stored.

5. Quality Assurance and Quality Control

The workers are trained to be competent and the metering equipment are calibrated and sealed as per the manufacturer's recommendation at regular intervals, with the purpose to provide credible, accurate, transparent and conservative monitoring data and ensure the real, measurable, long-term GHG emission reduction from this project.

Monthly net on-grid electricity supplied data will be approved and signed off by the Project Manager before it is accepted and stored. This audit will check compliance with monitoring procedures in this monitoring plan. This internal audit will also identify potential improvements to procedures to improve monitoring and reporting in future years. The purpose of training is to assure those staffs are competent to conduct the monitoring plan, thus to make the monitored data accurate.

Emergency Procedure:

(1) When the main meter (M1) is in normal operation state, the reading of it will be measured continuous and recorded monthly. The net electricity supplied to the grid will be calculated based on the readings of the main meter.

(2) If the readings of the main meter in a certain month is so inaccurate as to be out of the error range or the meter does not work normally, the net electricity supplied to the grid will be calculated based on the readings of the backup meter (M2).

(3) If the readings of the main meter and the backup meter are both beyond allowable error, the emission reduction occurred in the period will be abandoned.

6. Calibration of Meters & Metering

The metering equipment are calibrated and checked for accuracy so that the metering equipment shall have sufficient accuracy within the agreed limits. The metering equipment are calibrated and checked annually according to the manufacturer's recommendation for accuracy. The records will be supplied to the plant operator, and maintained by the operator.

If any error is detected, the party owning the meter shall repair, recalibrate or replace the meter giving the other party sufficient notice to allow a representative to attend during any corrective activity.

7. Data Management System

To keep safely the record of the data collected during monitoring, this project will set up a complete data management system. The project owner will perfect the whole monitoring procedure by developing the CDM manual, tracking information from the primary source to the end-data calculations. It is the responsibility of the proposed project owner to provide additional necessary data and information for validation and verification requirements of respective DOE. Physical documentation such as paper-based maps, diagrams and environmental assessment will be collated in a central place, together with this monitoring plan.

Furthermore, the project owner collects the records of electricity sold and purchased as a cross-check, and compiled the monitoring report including the monitoring data and relevant evidence at the end of each crediting year.

All the data will be kept for two years following the end of the last crediting period.

8. Monitoring Report

After the CDM project manager collects and sorts the monitored data, the monitoring report is prepared by the project owner. The project owner has to make sure that the format and content of the monitoring report are consistent with the monitoring methodology in the registered PDD.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>

01/06/2013[10]

C.1.2. Expected operational lifetime of project activity

>>

40 years (3 year for construction)

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>

Renewable crediting period (7×3), and this is the first crediting period.

C.2.2. Start date of crediting period

>>

01/01/2016 (or the date of the registration which is later)

C.2.3. Length of crediting period

7 years 0 month

[10] Recently, there is no implementation or construction or real action of the proposed activity beginning. Therefore, 01/06/2013 is a predictive project starting date.

SECTION D. Environmental impacts
D.1. Analysis of environmental impacts

>>

As a part of Nadarivatu Hydropower Scheme, environmental impact assessment of the proposed project was consolidated in that of Nadarivatu Hydropower Scheme. Different effects on the environment could occur during construction and operation phases of the project. These effects were identified as follows in the Environmental Impact Report (EIA) carried out for this project.

- There will be no inundation of houses, settlements, farms or other productive land uses. There is no requirement to relocate families or communities.
- The habitats of the giant honeyeater, masked shining parrot and Samoan flying fox will not be affected by construction or inundation.
- Discharges of sediment will affect water quality and stream bed habitat immediately downstream of the Ba and Sigatoka Rivers during construction. This will be for the duration of the construction period, and may result in sedimentation but will not have long term effects.
- The diversion of water from the Qaliwana River will create uniformly low river flows downstream in the Sigatoka River. This will affect river flow for at least 12 kilometres, until further flow from other catchments reduces the impact.
- Changes to ecosystems and fish populations will be experienced immediately downstream in the Sigatoka River as a result of the low flow periods. This includes more sedimentation and more algae growths, and potentially less fish.
- Pulses of water from the power station may affect fording and other river uses downstream in the Ba River. This is minor given that there is low population for several kilometres downstream and low river use.
- Changes to erosion and deposition patterns are also expected in the Ba River, but to a minor extent given that the river bed is mainly boulders and bedrock for several kilometres.
- Disturbance to traditional village life, and in particular to Lewa Village, during construction as a result of the works and influx of workers to the district

The following list is proposed mitigation and abatement measures:

1. A comprehensive Environmental Management Plan is proposed as a tool for ongoing control and review of mitigation measures.
Description: A comprehensive Environmental Management Plan (EMP) has been proposed to control activities associated with the project, which could have adverse effects. The EMP sets out the environmental and social principles to be applied to the project, based on the impact assessment carried out the EIA and the proposed mitigation measures. The plan is designed to cover the construction and operational impacts. The EMP encompasses: *<u>1) Construction and Workers Camp Management Plan, that contains:</u>* · Construction Management Plan: This plan will control the adverse impacts associated with erosion and sediment discharges from all earthworks activities. · Camp Management Plan: This plan will outline the operational controls on various aspects of the project including traffic management, noise and vibration management and operation of the workers camps. · Social Management Plan: This plan will address on-site and off-site site social issues especially regarding health and social issues arising from the influx of workers and camp followers. *<u>2) Environmental Supervision during Construction</u>*

Supervision of compliance with the EMP by contractors will be the responsibility of the Supervision Engineer. The Environmental Unit in FEA will have overseen the performance of the Supervision Engineer, review supervision reports on environment and make recommendations as needed during the construction process. The Environmental Unit will provide the necessary information and reports to DoE. Regardless of the above scheme, DoE will carry out its own monitoring and inspection of the project.

3) Socioeconomic Management Plan: This plan identified all necessary activities, institutional arrangements and budget to maximize benefits for the local communities, including:

- Communication and Environmental Education and Awareness Programme (responsibility of the Supervising Engineer)
- Infrastructure programme for local communities, including rural electrification (FEA)
- Health programme (Contractor)
- Traffic safety and regulations (Contractor)
- Grievance mechanism (FEA)

4) Environmental Monitoring Plan

Detailed water quality, ecology and hydrological monitoring programs are included in the EMP to assess the impacts on water quality and ecology from construction and operation. It covers:

- Water quality, fish and in-stream habitat monitoring during construction;
- Water quality, fish and in-stream habitat monitoring during operation.
- Flow monitoring in the Sigatoka and Ba Rivers.
- Cross-section surveys of the Ba River.

Monitoring locations are based on baseline monitoring sites. Environmental monitoring during construction will be implemented by the Supervision Engineer. During operation, FEA will carry out the monitoring plan.

5)Ecological Flows and Management of Water Releases

During operation the EMP shall provide for control of catchments hydrology and sediment management at the weir and discharges from the weir and power station. The EMP includes the recommendations in the EIA to mitigate environmental impacts and comply with the conditions of Environmental Approvals.

2. Optimised scheme design.

Description: Social impacts should be mitigated through ongoing communications with the villagers, including:

- Feedback to the community regarding the issues and concerns raised.
- Developing village protocol that could serve as a guideline for outside workers.
- Education and orientation of outside workers to Fijian culture and social norms before the start of work.
- Awareness and education of hazards and nuisances (such as noise and dust) during construction.
- Awareness and education of villagers regarding the operational regime and the consequential changes in the Ba River.

3. Management of workers and work camp effects.

Description: The following mitigation is proposed to control the adverse issues arising from the operation of the workers camps:

- The take of water from streams for water supplies should leave residual flows in the watercourses.
- Any water supply sources in the Ba catchment should be located so that it does not adversely affect the Buyabuya village supply.
- Sewerage disposal methods should be designed to the standards outlined in the Australia / New Zealand Standard for the Management of on Site Sewage Systems AS/NZ1547: 2000.

· All solid wastes shall be removed from site and disposed of at a municipal landfill. · Water takes should leave a residual flow in the creek. Abstraction should be to holding tanks to buffer peak demands.
4. Erosion and sediment control measures.
Description: Erosion and sediment discharges will be managed through the Construction Environmental Management Plan. Key mitigation measures are: · Phasing of work, a key erosion control and earthworks principle, to reduce the amount of area that is disturbed at any one time should be undertaken. The potential effects from erosion and sedimentation should therefore be restricted to the areas exposed. · There should be no earthworks in the bed of watercourses other than that required for the intake construction and the construction of the power station. Culverts should be placed in the initial stages of the development to minimize vehicle movements through watercourses during the earthworks. All earthworks in or adjacent to watercourses should utilize sediment and erosion control measures as prescribed in the Construction Environmental Management Plan of the EMP. Emphasis should be placed on reducing flow velocities and retaining sediment on site, particularly at locations where the surface water discharges to the drainage network and on steeper slopes.

D.2. Environmental impact assessment
>>
Environmental impact assessment of the proposed project was conducted in 2007 and 2008 consolidated in that of Nadarivatu Hydropower Scheme and the Environmental Impact Assessment Report (EIA) was found to be satisfactory and was approved by the Ministry of Local Government, Urban Development, Housing and Environment, Department of Environment on the 22nd October 2008.

The proposed project use clean renewable energy to generate electricity whose environmental impact comply with relevant environmental laws and regulations in the host country. The environmental impacts of the proposed project are not considered significant.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>

The proposed project is viewed as an essential development opportunity for Fiji to reduce its reliance on imported fossil fuels and develop a more sustainable long term power generation strategy. The proposed project has the potential to replenish the electricity requirements of the Viti Levu. This will in turn aid industry and development in Fiji; by ensuring power supplies are more consistent. Power costs in the long term should be more predictable as Fiji would not be so dependent on the variable global price of oil. The implement of the project activity is in line with the Government's objectives of replacing imported diesel with indigenous renewable resources.

The development of the project has a number of benefits for Fiji, which were summarized as:

- The project represents an opportunity for Fiji to reduce its reliance on imported fossil fuels and develop a more sustainable long-term power generation strategy.
- The power generation provided by the project would be equivalent to replacing an average of 17,580 tCO_2 emissions annually.
- Industry and development in Fiji will benefit by ensuring power supplies are more consistent.
- Temporary employment will be created in the project area with local workers being employed for suitable positions.

The project participants planned to carry out a public survey on the project in the format of questionnaires. The survey was conducted through distributing and collecting responses to a questionnaire which was blocked out by Easy Carbon Consultancy Co. Ltd.. The questions regarding the proposed project were mainly as follows:

Does the project have negative influences on your daily life?
Do you think the project will provide more working opportunities to local people?
Does the project have noise pollution?
Does the land expropriation for the project have any negative influence on you?
Does the project have negative influences on ecosystem and environment?
Do you think the project will improve the energy supply to your country?
Do you think the project is favorable for clean energy technology transfer to your country?
Do you support the proposed project?

E.2. Summary of comments received

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The summary of the comments will be represented when available.

E.3. Report on consideration of comments received

>>

All comments received will be considered based on the survey and the information relevant will be provided when available.

SECTION F. Approval and authorization

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The letter (s) of approval from Party (ies) for the project activity is not available at the time of submitting the PDD to the validating DOE.

- - - - -

Appendix 1: Contact information of project participants

Organization name	Fiji Electricity Authority
Street/P.O. Box	2 Marlows Street
Building	FEA Building
City	Suva
State/Region	
Postcode	
Country	Fiji
Telephone	+679 3313333
Fax	+679 3313064
E-mail	
Website	http://www.fea.com.fj
Contact person	
Title	Project Director
Salutation	Mr
Last name	Gibson
Middle name	
First name	Fatiaki
Department	Major Projects
Mobile	
Direct fax	
Direct tel.	+678 3313333 ext 6605
Personal e-mail	Fate@fea.com.fj

Appendix 2: Affirmation regarding public funding

There is no public funding for Qaliwana Hydropower Project.

Appendix 3: Applicability of selected methodology

Please refer to B.2. in the PDD.

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

All the tables related to the calculation of baseline emission reduction are presented below:

Calculation of Operating Margin (OM)

Table A1 Thermal Power Plants: data supplied by FEA (2009-2011)

Plant	Technology	Installed Capacity (MW)	Electricity Generated (MWh)			Fuel Type	Fuel Consumption (l)			Year Plant Online
			2009	2010	2011		2009	2010	2011	
Kinoya 1	Internal Combustion	28	85929	130737	124141	Diesel	21243564	33078313	31409639	2001
Kinoya 2	Internal Combustion	20	113918	126237	83540	HFO	24103656	33460241	22143373	2007
Vuda	Internal Combustion	22.4	53818	79723	67311	Diesel	13379843	20171084	17030120	76 to 2001
Nadi	Internal Combustion	2	106	4902	3587	Diesel	85684	1239759	885542	68 to 2009
Sigatoka	Internal Combustion	4	8016	14167	9500	Diesel	2145350	3584337	2403614	2003
Deuba	Internal Combustion	4.2	2195	3256	3277	Diesel	603274	824096	828916	2007
Rakiraki	Internal Combustion	2	2239	3559	3774	Diesel	660500	900000	955422	2008
Korovou	Internal Combustion	0.87	33	14	26	Diesel	10711	3614	7229	2007
Rokobili	Internal Combustion	8	0	0	0	Diesel	0	0	0	2003
Monasavu	Internal Combustion	0	0	0	0	Diesel	0	0	0	2003
Vatuwaqa	Internal Combustion	0	0	0	0	Diesel	0	0	0	2003
Total		**91.47**	**266254**	**362595**	**295156**		**62232582**	**93261444**	**75663855**	

Table A2 Renewable Power Plants: data supplied by FEA (2009-2011)

Plant	Technology	Installed Capacity (MW)	Electricity Generated (MWh)			Fuel Type	Fuel Consumption (tons)			Year Plant Online
			2009	2010	2011		2009	2010	2011	
Wailoa	Hydro	80	436081	382963	424818	Water	0	0	0	1983
Wainikasou & Nagado	Hydro	9.2	24048	29758	29683	Water	0	0	0	2004 & 2006
Buttoni	Wind	10	7210	6420	5491	Wind	0	0	0	2007
FSC Lautoka	Biomass	6	7068	10806	13545	Sugarcane fibre	87011	0	0	2007
Tropik Drasa	Biomass	9	3665	5401	17587	Wood Chip	No data available			2003
Total		**114.2**	**478072**	**435348**	**491124**					

Table A3 Total Installed capacity and energy generation: data supplied by FEA (2009-2011)

	Installed Capacity (MW)	Electricity generated (MWh)		
		2009	2010	2011
Thermal Power Plants	91.47	266254	362595	295156
RE Power Plants	114.2	478072	435348	491124
Total	**205.67**	**744326**	**797943**	**786280**

Calculation of the Operation Margin Emission Factor for the Fiji Electricity Authority grid: EF_{OM}

Table A4 Average OM Emission of FEA Grid in 2009

Power Plants (m)	Fuel Consumption (l)	NCV (TJ/Gg)[1]	CO_2 emission factor of the fossil fuel type ($kgCO_2/TJ$) [2]	Density (kg/l)	Fuel used (kg)	Carbon emission (tCO_2)
	A	**B**	**C**	**D**	**E=A*D**	**F=(B*C*E)*10^{-9}**
Kinoya 1	21243564	41.4	72600	0.83	17,632,158	52995.92
Kinoya	24103656	41.4	72600	0.83	20,006,034	60130.94
Vuda	13379843	41.4	72600	0.83	11,105,270	33378.44
Nadi	85684	41.4	72600	0.83	71,118	213.75
Sigatoka	2145350	41.4	72600	0.83	1,780,641	5351.96
Deuba	603274	41.4	72600	0.83	500,717	1504.98
Rakiraki	660500	41.4	72600	0.83	548,215	1647.74
Korovou	10711	41.4	72600	0.83	8,890	26.72
Rokobili	0	41.4	72600	0.83	0	0.00
Monasavu	0	41.4	72600	0.83	0	0.00
Vatuwaqa	0	41.4	72600	0.83	0	0.00
Wailoa	0	0	0		0	0.00
Wainikasou & Nagado	0	0	0		0	0.00
Buttoni	0	0	0		0	0.00
FSC Lautoka (kg)	87011	5.9[3]	84700	1000	87,011,000	43482.01
Total						**198732.46**

Source:

[1] IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories

[2]IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories

[3]IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories for "other solid biomass"

Table A5 Average OM Emission of FEA Grid in 2010

Power Plants (m)	Fuel Consumption (l)	NCV (TJ/Gg)[1]	CO_2 emission factor of the fossil fuel type ($kgCO_2/TJ$)[2]	Density (kg/l)	Fuel used (kg)	Carbon emission (tCO_2)
	A	B	C	D	E=A*D	F=(B*C*E)*10^{-9}
Kinoya	33078313	41.4	72600	0.83	27,455,000	82519.85
Kinoya	33460241	41.4	72600	0.83	27,772,000	83472.63
Vuda	20171084	41.4	72600	0.83	16,742,000	50320.42
Nadi	1239759	41.4	72600	0.83	1,029,000	3092.80
Sigatoka	3584337	41.4	72600	0.83	2,975,000	8941.78
Deuba	824096	41.4	72600	0.83	684,000	2055.86
Rakiraki	900000	41.4	72600	0.83	747,000	2245.21
Korovou	3614	41.4	72600	0.83	3,000	9.02
Rokobili	0	41.4	72600	0.83	0	0.00
Monasavu	0	41.4	72600	0.83	0	0.00
Vatuwaqa	0	41.4	72600	0.83	0	0.00
Hydro – Wailoa	0	0	72600		0	0.00
Hydro - Wainikasou & Nagado)	0	0	72600		0	0.00
Buttoni	0	0	72600		0	0.00
FSC Lautoka (kg)	0	5.9[3]	84700	1000	0	0.00
					Total	**232657.57**

Source:

[1] IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories

[2]IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories

[3]IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories for “other solid biomass”

Table A6 Average OM Emission of FEA Grid in 2011

Power Plants (m)	Fuel Consumption (l)	NCV (TJ/Gg)[1]	CO_2 emission factor of the fossil fuel type ($kgCO_2/TJ$)[2]	Density (kg/l)	Fuel used (kg)	Carbon emission (tCO_2)
	A	**B**	**C**	**D**	**E=A*D**	**F=(B*C*E)*10^{-9}**
Kinoya	31409639	41.4	72600	0.83	26,070,000	78357.04
Kinoya	22143373	41.4	72600	0.83	18,379,000	55240.66
Vuda	17030120	41.4	72600	0.83	14,135,000	42484.72
Nadi	885542	41.4	72600	0.83	735,000	2209.14
Sigatoka	2403614	41.4	72600	0.83	1,995,000	5996.25
Deuba	828916	41.4	72600	0.83	688,000	2067.88
Rakiraki	955422	41.4	72600	0.83	793,000	2383.47
Korovou	7229	41.4	72600	0.83	6,000	18.03
Rokobili	0	41.4	72600	0.83	0	0.00
Monasavu	0	41.4	72600	0.83	0	0.00
Vatuwaqa	0	41.4	72600	0.83	0	0.00
Hydro – Wailoa	0	0	0		0	0.00
Hydro - Wainikasou & Nagado)	0	0	0		0	0.00
Buttoni	0	0	0		0	0.00
FSC Lautoka (kg)	0	5.9	84700	1000	0	0.00
					Total	**198732.46**

Source:

[1] IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories

[2]IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories

[3]IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories for "other solid biomass"

Table A7 Operating Margin Emission Factor of FEA Grid

	2009	2010	2011	Average
Total OM (tCO_2)	0.2670	0.2916	0.2528	
Total Net generation (MWh)	744326	797943	786280	
OM (tCO_2/MWh)				**0.2706**

Calculation of the Build Margin Emission Factor for the Fiji Electricity Authority grid: EF_{BM}

Table B1 Build Margin Emission of FEA Grid in 2009

Power Plants (m) [4]	Fuel Consumption (l)	NCV (TJ/Gg)[1]	CO_2 emission factor of the fossil fuel type ($kgCO_2$/TJ) [2]	Density (kg/l)	Fuel used (kg)	Carbon emission (tCO_2)	Electricity Generated (MWh)
	A	B	C	D	E=A*D	$F=(B*C*E)*10^{-9}$	
Kinoya 1	21243564	41.4	72600	0.83	17,632,158	52995.92	85929
Sigatoka	2145350	41.4	72600	0.83	1780640.5	5351.96	8016
Rokobili	0	41.4	72600	0.83	0	0.00	0
Monasavu	0	41.4	72600	0.83	0	0.00	0
Vatuwaqa	0	41.4	72600	0.83	0	0.00	0
Korovou	10711	41.4	72600	0.83	8890.13	26.72	33
Kinoya 2	24103656	41.4	72600	0.83	20006034.48	60130.94	113918
Deuba	603274	41.4	72600	0.83	500717.42	1504.98	2195
Buttoni	0	0	0	0.83	0	0.00	7210
FSC Lautoka	87011	5.9[3]	84700	1000	87011000	43482.01	7068
Rakiraki	660500	41.4	72600	0.83	548215	1647.74	2239
					Total	**165140.26**	**226608.00**

Source:

1 *IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories*

2 *IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories*

[3]IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories for "other solid biomass"
[4] Plants correspondent to 20% of generation capacity built most recently

Table B2 Build Margin Emission of FEA Grid in 2010

Power Plants (m) [4]	Fuel Consumption (l)	NCV (TJ/Gg)[1]	CO_2 emission factor of the fossil fuel type ($kgCO_2/TJ$) [2]	Density (kg/l)	Fuel used (kg)	Carbon emission (tCO_2)	Electricity Generated (MWh)
	A	B	C	D	E=A*D	F=(B*C*E)*10^-9	
Kinoya 1	33078313	41.4	72600	0.83	27,455,000	82519.85	130737
Sigatoka	3584337	41.4	72600	0.83	2,975,000	8941.78	14167
Rokobili	0	41.4	72600	0.83	0	0.00	0
Monasavu	0	41.4	72600	0.83	0	0.00	0
Vatuwaqa	0	41.4	72600	0.83	0	0.00	0
Korovou	3614	41.4	72600	0.83	3,000	9.02	14
Kinoya 2	33460241	41.4	72600	0.83	27,772,000	83472.63	126237
Deuba	824096	41.4	72600	0.83	684,000	2055.86	3256
Buttoni	0	0	0	0	0	0.00	6420
FSC Lautoka	0	5.9[3]	84700	1000	0	0.00	10806
Rakiraki	900000	41.4	72600	0.83	747,000	2245.21	3559
					Total	**179244.34**	**295196.00**

Source:
[1] IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
[2]IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
[3]IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories for "other solid biomass"
[4] Plants correspondent to 20% of generation capacity built most recently

Table B3 Build Margin Emission of FEA Grid in 2011

Power Plants (m)[4]	Fuel Consumption (l)	NCV (TJ/Gg)[1]	CO_2 emission factor of the fossil fuel type ($kgCO_2/TJ$)[2]	Density (kg/l)	Fuel used (kg)	Carbon emission (tCO_2)	Electricity Generated (MWh)
	A	**B**	**C**	**D**	**E=A*D**	**F=(B*C*E)*10^{-9}**	
Kinoya 1	31409639	41.4	72600	0.83	26,070,000	78357.04	124141
Sigatoka	2403614	41.4	72600	0.83	1,995,000	5996.25	9500
Rokobili	0	41.4	72600	0.83	0	0.00	0
Monasavu	0	41.4	72600	0.83	0	0.00	0
Vatuwaqa	0	41.4	72600	0.83	0	0.00	0
Korovou	7229	41.4	72600	0.83	6,000	18.03	26
Kinoya 2	22143373	41.4	72600	0.83	18,379,000	55240.66	83540
Deuba	828916	41.4	72600	0.83	688,000	2067.88	3277
Buttoni	0	0	0	0.83	0	0.00	5491
FSC Lautoka	0	5.9[3]	84700	1000	0	0.00	13545
Rakiraki	955422	41.4	72600	0.83	793,000	2383.47	3774
					Total	**144063.33**	**243294.00**

Source:

[1] IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories

[2]IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories

[3]IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories for "other solid biomass"

[4] Plants correspondent to 20% of generation capacity built most recently

Table B4 Build Margin Emission Factor of FEA Grid

	2009	2010	2011	Average
Total BM (tCO_2)	0.7287	0.6072	0.5921	
Total Net generation (MWh)	226608.00	295196.00	243294.00	
BM (tCO_2/MWh)				**0.6384**

1) Calculation of the Combined Margin Emission Factor for the Fiji Electricity Authority grid: EF_{CM}

EF_{CM}= 0.5 x OM + 0.5 x BM = 0.5×0.2706+0.5×0.6384=**<u>0.4545 tCO_2/MWh</u>**

Appendix 5: Further background information on monitoring plan

Please refer to B.7.3. in the PDD.

Appendix 6: Summary of post registration changes

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History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03	EB 25, Annex 15 26 July 2006	
02	EB 14, Annex 06b 14 June 2004	
01	EB 05, Paragraph 12 03 August 2002	Initial adoption.
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