CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

Title of the small scale project activity	:	Way Ganga hydro power project, Sri Lanka
Version of the document	:	04
Date	:	09/08/2007

A.2. Description of the small-scale project activity:

Purpose of project activity

The main purpose of the project activity is to generate electricity from the potential energy in the water of Way Ganga river and export the net electricity after its auxiliary consumption to the state electric grid.

Project description

The project is a Run-of-river mini hydro project of 8.4 MW output capacity. The project utilizes water of the Way Ganga in the Ratnapura District. A weir of 40 metres length with a maximum height of 4.9 metres has been constructed across the river at Kahawatta to create a head-pond from where, water is taken through an Intake conduit of 4 metres x 3.4m x 2.8 m. Water is then taken through a channel of 3,700 metres and an aqueduct of 319 meters to a Forebay from where water flows through 3 Penstock Intake gates into the power house causing a head of 61 meters. Each penstock leads to a horizontal shaft Francis type turbine in the Power house. Three turbines are employed in the project. Each turbine is connected to a Synchronous Generator of output capacity of 2.8 MW for a total output capacity of 8.4 MW. The electricity is generated at 6.3 KV, which is stepped up to 33 KV through 3 nos. 3150 kVA Transformers. The stepped up electricity is connected to the grid of the state electric utility, Ceylon Electric Board (CEB). The exported energy is transmitted through a 33 KV line for a distance of 6 kilometres to Nivithigala – Ratnapura 33 KV line.

The electricity required for auxiliary requirements is consumed by stepping down the generated electricity through a 150 KVA transformer. The net electricity is exported to the CEB grid.

A standby diesel generator (DG) of 10 KVA is provided to supply electricity for lighting and other domestic uses of the project activity when both the sources of electricity supply namely, electricity from the project activity and the CEB grid are not available. The standby generator would be used quite sparingly because non availability of electricity from both the sources – from the project activity and the grid – would be a rare occurrence.

Contribution of the project activity to sustainable development in view of project participant

Contribution to sustainable development is generally measured through following attributes:

i) Social well being

ii) Economical well being

iii) Environmental well being

iv) Technological well being

i) Social well being

The social well being is assessed by contribution to improvement in living standards of the local community. The proponents of the project activity carried out following developmental works for the local community:

- Road chain was developed between Kahawatte and Poranuwa.
- Assistance was provided for developmental works in the Poranuwa village
- Local manpower was employed in the project activity.
- About 864,000 man hours of employment was provided during implementation of the project activity.

ii) Economic well being

The project activity has created direct and indirect job opportunities to the local community during construction and operation. During implementation of the project activity, several persons were provided with job opportunities continuously for long periods. During operation of the project activity, about 14 persons are employed directly, apart from indirect employment. The project proponent have invested SLRs. 867.64 million (US$ 7.96[1]Million) for the project activity. This investment is quite significant in a rural area. These activities have contributed to the economic well being of the local community.

iii) Environmental well being

The project activity produces electricity without any greenhouse gas (GHG) emissions. Additionally, the project activity generates electricity from "renewable energy source". The renewable energy source is generally defined as a source of energy that gets replenished naturally and does not suffer permanent depletion due to use.

The project activity is an environment friendly electricity generation project with no significant impact on the environment. This is a very important contribution of the project activity for environmental well being. Moreover, the project activity generates electricity from a renewable source of energy where the source gets replenished and is available for use. This is another important contribution of the project activity to the environmental well being.

Therefore, the following environmental benefits are derived from the project activity:

[1] 1US$= SLRs.109

- Produces electricity without GHG emissions.
- Hydro power plant with no increase in volume of reservoir and no land inundation
- Produces electricity from a renewable energy source.

iv) Technological well being

The project activity improves the supply of electricity with clean, renewable hydroelectric power while contributing to the regional/local economic development. Small-scale hydropower run-of-river plants provide

- improved power quality for nearby areas of the grid connection;
- reduced lines losses; and
- increased system capacity with reduced transmission and distribution investment.

A.3. Project participants:

Name of Party involved (host indicates a host Party)	Private and/or public entity (ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Sri Lanka (Host Party)	Didul Private Limited (DPL) – Private Entity	No

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

Sri Lanka

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

Sabaragamuwa province / Ratnapura district

A.4.1.3. City/Town/Community etc:

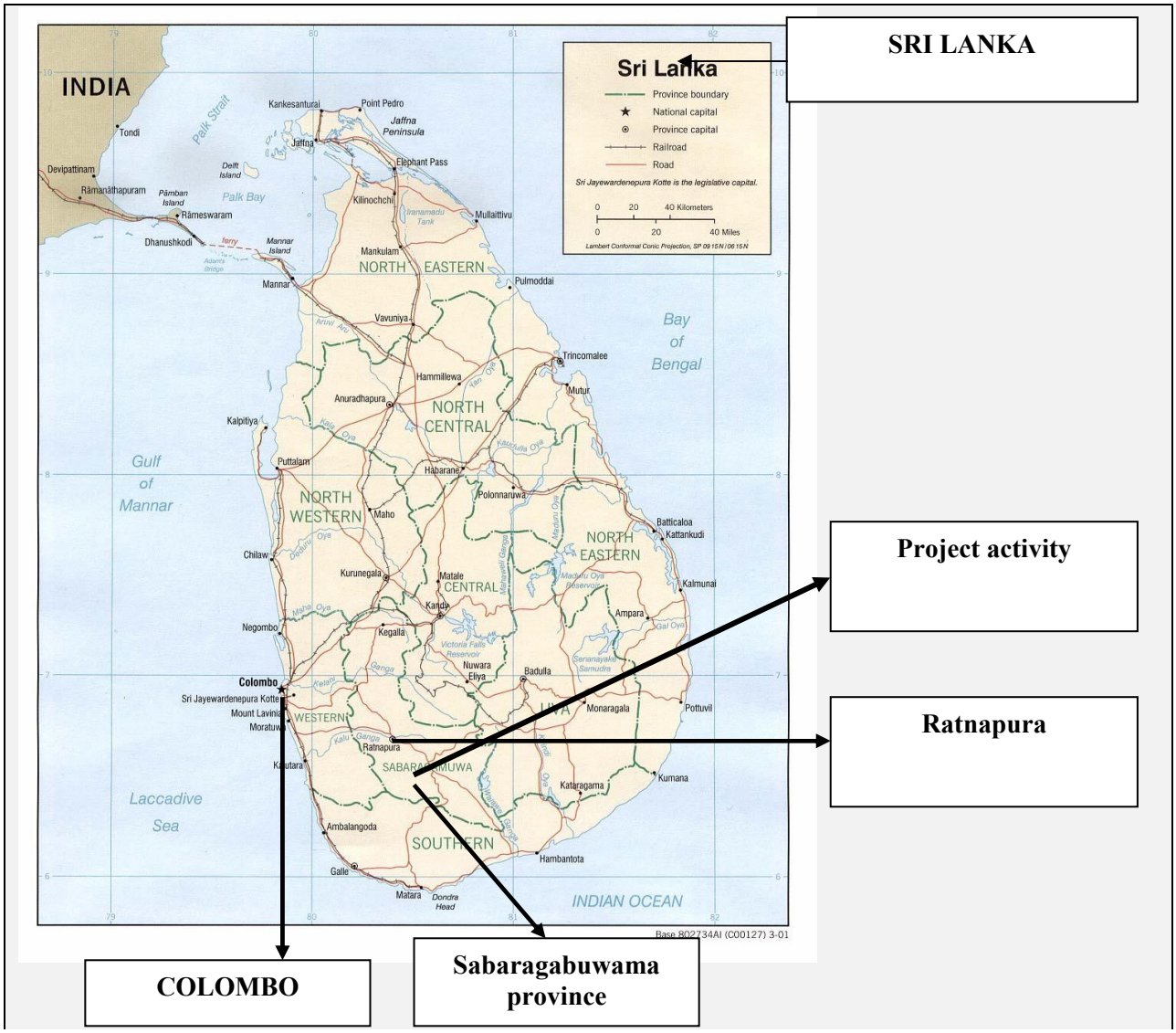
Poronuwa, Kahawatte

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

The project activity is located at a place called Poronuwa near Kahawatte village. Kahawatte is about 166 kms from Colombo, the capital of Sri Lanka and is about 6 kms from a town called Pelmadulla, which is

well connected to Colombo by trunk road No. A3. Colombo has an international airport and is well connected to all parts of the world. .

The coordinates of the small scale project activity are : 06(degrees) 34.50" N and 80(degrees) 31.55"E.
The location of project activity is shown in the following figure.



A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

Since the capacity of the project activity is less than 15 MW, project activity qualifies for a small scale CDM project activity.

Scope : 1

Sectoral Scope : Energy Industries (Renewable -Non renewable sources)

Type : I - Renewable energy projects

Category : I.D - Grid connected renewable electricity generation

The project activity is a hydropower plant and the output capacity is to generate 8.4 MW which is lesser than 15 MW, qualifying for small scale CDM project activity. As per the provisions of Appendix B of Simplified Modalities and Procedures for Small Scale CDM Project Activities AMS I.D, ***Version 10*** dated 23 December, 2006, "comprises renewable energy generation units, such as photovoltaics, **hydro,** tidal/wave, wind, geothermal, and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit". The project activity comprises of hydropower plant supplying electricity to the Ceylon Electricity Board (CEB) grid, which is being supplied by several fossil fuel generating units. With above considerations, the Type I.D. is the most appropriate category for the project activity. The project activity does not comprise any electricity generation from non-renewable energy sources.

Technology

The process is conversion of the potential energy, embodied in the water flowing from a higher point to a lower point, into mechanical energy and then into electrical energy. This flowing water is guided through a head race tunnel and penstock gate and jetted on to a turbine. This action rotates the turbine, which is connected to a synchronous generator. The rotation of turbine causes the rotation of the generator thereby producing electricity which after in-house auxiliary consumption is exported to grid.

The most important technology component of the project activity is the turbine and the generator.

The project activity employs horizontal Francis type turbines and brushless, synchronous generators. Three turbines each coupled to a generator of 2.8 MW are installed in the project activity.

Specification of turbine

No. of units	3
Type	Horizontal shaft , Francis type
Rated net head	58 metres
Operating speed	750 rpm
Runaway speed	1320 rpm
Design flow of one unit	5.33 m^3/ sec
Installed capacity	2.8 MW
Runner	Diameter of 850 mm made of stainless steel 13/4. Cr/Ni
	16 runner blades
Deflectors	Jet deflectors to avoid excessive pressure rise in the penstock and proper speed regulation of the unit
Other accessories	Inlet valve,
	Draft tube
	Turbine oil governor , pressure maintained by dual pumps and pressure tank

Specification of generator

No. of units	3
Type	Brushless, synchronous
Duty	Continuous
Shaft	Continuous
Rated output of each unit	2.8MW
Generating voltage	6300 V
Power factor	0.85
Rated speed	750 rpm
Max speed	1450 rpm
Protection	Over/under voltage protection
	Over/under frequency protection
	Over current protection
	Loss of mains protection
	Neutral voltage displacement protection
	Inter tripping protection

Specification of other components of the project

Weir

Type	Concrete gravity
Length	40 m
Height	4.9 m

Intake

Number of openings	5
Length	1.4 m
Height	0.8 m

Intake Chamber

Size	10.5 m x 6.0 m x 1 m

Forebay tank

Length	25 m
Entry width	3.4m
Maximum width at intake	8 m
Depth at entry	1.74 m
Max depth at Intake	8 m

Penstock

No. of pipes	3
Length	464 m
Thickness	8 mm
Diameter	1500 mm

Power house

Type	RCC and masonry
Size	26 m x 12 m x 10 m

Transformer – Step up for grid connection

No. of units	3
Capacity	6300 V to 33000 V
Rated power	3150 kVA

Transformer – Step down for auxiliary consumption

No. of units	1
Capacity	150 kVA, 400 V

The project activity produces electricity from a renewable source of electricity where there is no loss of source and the source is completely replenished and there is very little negative impact on the environment due to the project activity.

The technology is an established, commercially available and absolutely safe. The project activity does not have any significant impact on air, water and land. Thus, an environmentally safe technology is implemented in the project activity.

The technology would not be substituted by more efficient technology during the crediting period.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

S.No.	Year	Estimation of annual emission reductions in tonnes of CO_2 e
1	2007 – 2008	17,979
2	2008 – 2009	17,979
3	2009 – 2010	17,979
4	2010– 2011	17,979
5	2011– 2012	17,979
6	2012– 2013	17,979
7	2013– 2014	17,979
	Total estimated reductions (tCO_2e)	**125,853**
	Total number of crediting years	7
	Annual average over the crediting period of estimated reductions (tCO_2e)	**17,979**

A.4.4. Public funding of the small-scale project activity:

There is no public funding for the project activity from Annex 1 Parties.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

The project proponents confirm that the proposed project activity is not a debundled component of a larger project activity. The project activity is an independent hydro power plant generating electricity and supplying to the grid.

The project proponents have not registered or applied to register any small scale project activity:

- in the same project category and technology/measure; and
- within the previous 2 years and
- whose project boundary is within 1 km of project boundary of the small scale project activity.

SECTION B. Application of a baseline and monitoring methodology

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

Title of approved baseline methodology	:	Grid connected renewable electricity generation
Reference	:	Approved small scale methodology AMS I. D. / version 10 dated 23 December 2006
Scope number	:	1
Sectoral scope	:	Energy industries (renewable - / non-renewable sources)

B.2 Justification of the choice of the project category:

Appendix B of the simplified M&P for small-scale CDM project activities provides indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories. As per the M&P, the project activity falls under the following approved small scale methodology AMS I.D / version 10 dated 23 December 2006 – Grid connected renewable electricity generation.

Justification of the small scale project activity as per technology/measure of AMS I. D / Version 10 dated 23 December 2006

The applicability conditions of approved baseline methodology in the context of the project activity are given in the following table in Table B.2-1:

Technology /Measure as per AMS I.D/ Version 10	Measure of project activity
This category comprises renewable energy generation units such as photovoltaics, hydro, tidal/wave, wind, geothermal and biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit	The project activity is a renewable energy generation unit based on **hydro** source. The generated energy is supplied to CEB grid, which is being supplied by several fossil fuel fired generating units.
If the unit added has both renewable and non renewable components (e.g. a wind/diesel unit), the eligibility of 15 MW for a small scale CDM project	The unit has only renewable component and the total output capacity of the project activity is 8.4 MW which is less than 15 MW.

activity applies only to the renewable component. If the unit added co-fires fossil fuel, the capacity of the entire unit shall not exceed 15 MW.	
The sum of all forms of energy output shall not exceed 45 MW $_{thermal}$	There is no thermal energy and the total output capacity of the project activity is 8.4 MW.
In case of project activities that involve addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	Not applicable since no addition of renewable energy. However, the total output capacity is less than 15 MW.
To qualify as a small scale project activity, the total output of the modified retrofitted unit shall not exceed the limit of 15 MW.	No retrofitting and hence not applicable. However the total output of the project activity is less than 15 MW.

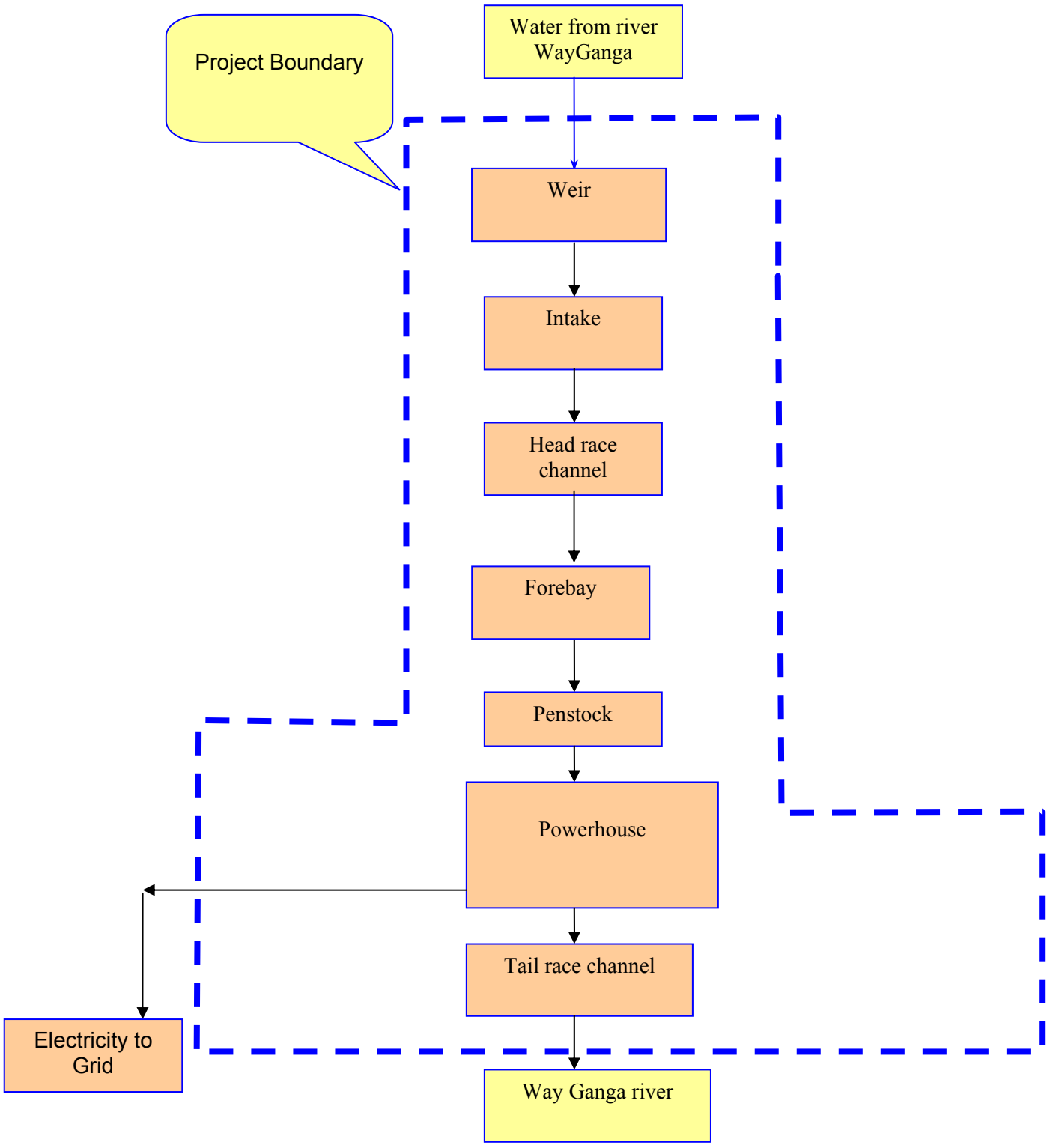
From the above table, it is evident that the project activity meets all the applicability conditions of the approved small scale methodology AMS I.D/ Version 10 dated 23 December 2006 - Grid connected renewable electricity generation as specified in *appendix B of the simplified modalities and procedures for small scale CDM project activities*.

B.3. Description of the project boundary:

Paragraph 6 of AMS I.D, mentions that, the project boundary encompasses the physical, geographical site of the renewable generation source. For the project activity, the project boundary consists of the following :

- Weir
- Intake
- Head race channel
- Forebay
- Penstock
- Powerhouse
- Interconnection point with the grid (within the premises of the generating station)
- Tail race channel

Flow chart for project boundary is illustrated in the following diagram:


Project Boundary
Water from river WayGanga
Weir
Intake
Head race channel
Forebay
Penstock
Powerhouse
Tail race channel
Electricity to Grid
Way Ganga river

B.4. Description of baseline and its development:

The baseline for the project activity is as per paragraph 9 of AMS I.D. described in Annex B of the simplified modalities and procedures for small-scale CDM project activities, which mentions that the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2 eq/ kWh) to be calculated in a transparent and conservative manner as follows :

A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the approved consolidated methodology ACM0002 where:

(a) The Operating Margin emission Factor ($EF_{om,y}$) is based on one of the four following methods :

(i.) Simple OM, or

(ii.) Simple Adjusted OM, or

(iii.) The Dispatch Data Analysis OM,or

(iv.) The average OM

(b) The build margin emission factor ($EF_{bm,y}$) is the generation weighted average emissions (in t CO_2/MWh) of a sample of power plants m. The sample group m consists of either the five power plants that have been built most recently, or the power plant capacity additions in the electricity system that comprise 20 % of the system generation (in MWh) and that have been built most recently. Project participants should use from these two options that sample group comprise the larger annual generation. Power plant capacity additions registered as CDM project activities should be excluded from the sample group m. If 20 % falls on part capacity of a plant, that plant is included in the calculation.

(c) The baseline emission factor (EF_y) is the weighted average of the Operating Margin emission factor ($EF_{om,y}$), and the Build Margin emission factor ($EF_{bm,y}$), where the weights are by default 50 % for each emission factor.

Calculation of the Operating Margin emission factor (EF_{OM})

As per ACM0002, the operating margin emission factor is calculated by one of the following methods :

(a) Simple operating margin

(b) Simple adjusted operating margin

(c) Dispatch data analysis

(d) Average operating margin

Since data required for calculation of OM as per dispatch data analysis and simple adjusted OM are not publicly available, these methods are not adopted.

Hence, the other methods that are available are simple operating margin and average operating margin emission method. The simple OM method has to be used where (a) low –cost / must run resources constitute less than 50 % of total grid generation in (i) average of the five most recent years . or (ii) based on long term normals for hydroelectricity production. The average operating margin emission rate method has to be used only where low cost/must run resources constitute more than 50 % of total grid generation and detailed data to apply options (b) and (c) are not available.

Hence, the share of low cost /must run resources in the grid has to be calculated for the last five years and the average of this value has to be determined to select the method to estimate operating margin. The table B.5-1 gives the power generation mix of low cost and other resources.

Table B.5-1 – Generation mix for the five most recent years

Power generation mix of Sri Lanka Electricity grid for the last five years - GWh					
Generation	**2001**	**2002**	**2003**	**2004**	**2005**
Total Power Generation	6,625	6,946	7,218	7,534	8,769
Total Thermal Power Generation	3,407	4,114	3,904	4,571	5,314
Total Low Cost Power Generation	3,218	2,832	3,314	2,963	3,455
Thermal % of Total grid generation	51.43	59.23	54.09	60.67	60.60
Low Cost % of Total grid generation	**48.57**	**40.77**	**45.91**	**39.33**	**39.40**
Average of the five most recent years of % of Low Cost generation out of Total grid generation					**42.80**

The average of percentage of low-cost /must run resources for the most recent 5 years as per above data is 42.80%

Hence, simple Operating Margin option is chosen for calculation of operating margin emission factor.

The simple OM has been calculated EX-ANTE using the vintage data as the full generation-weighted average for the most recent 3 years for which data are available at the time of PDD submission.

The build margin emission factor has been calculated based on most recent information available on plants already built at the time of PDD submission.

The baseline emission factor is determined as per approved methodology ACM 0002 and is given in Annex 3 – Baseline information of this PDD. An excel sheet is also attached as Appendix 3 giving the complete calculations of determination of baseline emission factor.

The baseline emission factor of the grid as per combined margin is 0.697 kg CO_2 e/ kWh (0.697 ton CO_2e / MWh)

The baseline emission factor shall be updated ex-post monitoring.
Date of completing the final draft of this baseline section *(DD/MM/YYYY)*:

30 /01/2007 (last updated)

Name of person/entity determining the baseline:

Ecoinvest Carbon S.A.
13, Rte de Florissant
PO Box 518
CH-1211 Geneva 12
Switzerland
Tel :+41 22-592-9121
Fax : +41 22-592-9105

The entity determining the baseline is not a project participant.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

Justification for additionality of the project

Simplified modalities and procedures for small scale CDM project activities guides to establish additionality of the project activity as per Attachment A to Appendix B. The Attachment A to appendix B mentions various barriers and requires explanation to show that the project activity would not have occurred due to at least **any one** barrier.

Barrier analysis

Establishing the project activity is a voluntary step undertaken by DPL with no direct or indirect mandate by law. The main driving forces to this 'climate change initiative' have been:

- GHG reduction and subsequent carbon financing against sale consideration of carbon credits.
- Rural development of the region by creating job opportunities for the local people.
- Demonstration of developing such projects to the other entrepreneurs.

However, the project had various barriers associated to project implementation. The barriers faced by the project activity are discussed below:

Investment barriers

(i) Internal Rate of Return from the Project activity

The project activity has a high capital cost. An investment analysis of the project activity was conducted with the Internal Rate of Return as the financial indicator. 'Internal Rate of Return' is one of the known financial indicators used by project developers, banks, and financial institutions for making investment decisions.

The IRR of the project was estimated with the following project specific figures:

Table B. 5.1 - Project Cost

Parameters	Value in US Dollars [2]
Project development costs	0.0033 Million
Engineering, procurement and construction costs	7.86 Million
Other costs	0.1 Million
Total cost of the project	7.9633 Million
Equity investment	2.05 Million
Debt component	5.9133
Revenue from sale of electricity	1.38 Million/year (projected)
Internal rate of return of the project	**8.83 %**

The detailed calculations of the IRR workings are attached as Appendix 4 in an excel spread sheet. It may be seen that IRR for the project is only 8.83 %, which is not attractive for investment in any project.

An IRR of 14 % is the project proponent's desired value for an investment. The Project proponent's lowest expected returns are 14 %. However DPL went ahead with the implementation of the project in its endeavour to establish a hydropower plant and expecting to realize the revenue from the sale of CERs.

(ii) Power Purchase Tariff

The power purchase tariff was fixed as SLRs. 5.85 (US$0.05) per kWh . This tariff would be revised as per "Avoided Cost of generation" principle. Avoided cost of generation is the maximum value of generation avoided by CEB as a result of any purchase of energy from sources outside the CEB system. According to this, the avoided cost of a kWh of electricity comprises fuel and variable O&M costs of generation displaced at the margin by a kWh purchased at a given instant. There is a likely chance of

[2] 1 USD = 109 Sri Lankan Rupees

generation of cost coming down due to cheaper power sources. This would also reduce the power purchase tariff of the project activity greatly reducing the returns of the project activity.

iii) Determination of power purchase tariff

The project proponents of small hydropower plants in Sri Lanka face considerable investment risk barrier as CEB does not revise the tariff transparently and also, does not pay as per agreed SPPA. The power purchase tariff for the electricity sold to the grid is to be revised based on "Avoided Cost of generation" principle as explained above. The method of calculation of "avoided cost of generation" is complicated. Also, the inputs to calculate this tariff are not publicly available and therefore, the tariff is unilaterally calculated by CEB every year. The project proponents do not have any say in working of the tariff, which is a very big barrier for investment in power sector in Sri Lanka.

iv) 15 % reduction in revenue

The Government of Sri Lanka decided to pay additional 15 % over the calculated tariff to small hydro power developers with a view to encourage investment in the sector and to promote renewable energy. The project proponent had also been granted the same incentive as embodied in the SPPA. However CEB does not pay the additional 15 %. CEB was not paying this additional 15 % to other project developers and this practice was known to DPL. However, they went ahead with the implementation of the project with the risk hoping that CEB would change its practice and revise the tariff as per SPPA and Government directive and also considering that the project activity would be eligible for CDM incentives.

This practice of CEB not paying as per SPPA reduces revenues upto 15 %.

(v) Financial closure

The lending institutions in Sri Lanka were apprehensive of the project activity as they were not familiar in financing small hydroelectric projects. The lenders were more used to thermal projects and large hydroelectric projects due to assured returns. Moreover, the lenders in Sri Lanka rely too much on collateral securities rather than the projected cash flows of the project activity. The project proponents were developers of a small hydro electric projects with no big collateral security and it took considerable time to convince the lenders on the projected returns and the environmental benefits of the project activity. Hence, there was delay in achieving financial closure. The lending institutions were approached in January 2001 for financial assistance of the debt component of the project. Since the type of the project activity was fairly new to the lending institute, they took nearly 12 months to execute the loan

agreements and the loan was sanctioned in January 2002. This delay in financial closure delayed the implementation of the project activity. This delay also caused a cost over run as the project proponents spent equity up front pending quick disbursements of loan capital.

(vi) Disbursement Delays

Although the loan agreement was signed in January 2002, the disbursements started only in October 2002. This was due to complying with several pre-disbursement conditions which were more on collateral security with out considering the returns and cash flows from the project activity. This delay in disbursements had escalated the project cost. This was a big barrier for the project activity.

(vii) Increased Exchange Rate

The Way Ganga Hydro Power Project finalized the supply contract with Voith Siemens Hydro of Germany for design, supply, erection and commissioning of electro mechanical equipment in August 2002 and the exchange rate was 1 Euro = SLRs 85. As per the Letter of Credit terms, the payment had to be effected in stages over a period of 21 months. At the time of opening the Letter of Credit in October 2003 with the down payment of 20% of the contract value, the Euro/Sri Lankan Rupees (SLRs) exchange rate was SLRs 105.9 per Euro and within a month rose to SLRs. 124.6 /Euro. This adverse exchange fluctuation between the time of opening the Letter of Credit and final payment resulted in a cost overrun for electro mechanical equipment alone SRs 35 Million (US$0.343 Million)

Other Barriers for the project activity

Extended approval procedure

In Sri Lanka, private sector small hydro power projects need to obtain various approvals from the government agencies after receiving the LOI from the Ceylon Electricity Board (CEB) before commencing the construction of the project activity. Such delays caused additional cost both due to extra expenditure and increasing material costs. The Project Report was prepared in 2001 and the approvals were received in December 2002. During this period the construction cost had increased significantly.

Due to the above barriers for implementation of the project activity which would have led to implementation of the project activity with higher emissions, the project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

As per paragraph 9 of Type I.D. described in Appendix B of the simplified modalities and procedures for small-scale CDM project activities, the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2 eq/ kWh or ton CO_2eq/MWh).

Ceylon Electricity Board grid is considered for estimation of baseline emission factor.

The baseline emission factor is estimated through the average of the "approximate operating margin" and "built margin" of the CEB grid for the most recent three years of 2003, 2004 and 2005.

Formula used for estimation of the anthropogenic emissions by sources of greenhouse gases of the baseline is given below:

Emission Reduction by project activity

The emission reduction by the project activity is given by the following formula:

ER_y = BE_y - PE_y - L_y

(ton CO_2 e/year) (ton CO_2 e/year) (ton CO_2 e/year) (ton CO_2 e/year)

Where,

ER_y - Emission reduction per annum by project activity in ton CO_2 e/year

BE_y - Baseline emissions in ton CO_2 e/year

PE_y - Project emissions in ton CO_2 e/year

L_p - Leakage in ton of ton CO_2 e/year

Baseline emissions (BE_y)

The baseline emissions of the project are calculated as per following formula:

BE_y = El_{exp} * EF_B

(ton CO_2 e/year) (MWh /year) (ton CO_2e /MWh)

Where,

BE_y - Baseline emissions in ton CO_2e /year

El_{exp} - Net electricity exported to grid per annum in MWh/year

EF_B - Baseline emission factor in ton CO_2e /MWh

Project emissions (PE_y)

During non operation of the project activity, the electricity required for lighting and other miscellaneous requirements is consumed from the CEB grid. Also, the electricity required for start up of the plant is imported from the CEB grid. The emissions due to this imported electricity would contribute the anthropogenic emissions by sources of GHGs due to the project activity.

These emissions due to import of electricity is given by the following formula:

PE_y	=	El_{imp}	*	EF_B
(ton CO_2e /yr)		(MWh/year)		(ton CO_2e /MWh)

Where PE_y is the project emissions due to electricity imported from the grid in ton CO_2e/year

El_{imp} is the electricity imported from the grid in MWh/year

EF_B is the baseline emission factor of the grid in ton CO_2e /MWh

Emissions due to operation of standby generator

Since the DG is very sparingly used, the emissions due to the consumption of diesel are very less. The average running time of the standby generator had been 40 hours per year and diesel consumption had been about 0.07 ton per year and therefore, the emissions due to consumption of diesel are negligible. Hence, these emissions are not considered for estimation of project emissions. However, the operation time of the DG and consumption of the diesel would be monitored and emissions due to consumption of diesel would be accounted when these emissions contribute for 1 % of the baseline emissions.

Leakage (PL_y)

As per category AMS I.D/ Version 10 dated 23 December 2006, leakage is to be considered only if the energy generating equipment is transferred from another activity or if the existing equipment is transferred to another activity. Since this does not apply for the project activity, there is no leakage associated with the project activity and therefore, leakage is zero.

Emission Reductions

Therefore, emission reductions by the project activity are given by the following formula:

ER_y	=	BE_y	-	PE_y
(ton CO_2 e/year)		(ton CO_2 e/year)		(ton CO_2 e/year)

Where,

ER_y - Emission reduction per annum by project activity in ton CO_2 e/year

BE_y - Baseline emissions in ton CO_2 e/year

PE_y - Project emissions in ton CO_2 e/year

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

Data / Parameter:	**P_{czp}**
Data unit:	MW
Description:	Capacity of the project activity
Source of data used:	-
Value applied:	8.4 MW
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data is to justify the choice of the project category.
Any comment:	-

Data / Parameter:	**El_{exp}**
Data unit:	MWh/year
Description:	Average net electricity exported to the grid in a year
Source of data used:	Monthly invoice
Value applied:	25,800
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is required to estimate the baseline emissions. The electricity exported by the project activity is recorded jointly by CEB and representative of the project proponents. The monthly invoice is prepared based on the jointly certified reading. Meters would be calibrated as per CEB standards by CEB.
Any comment:	Average value of electricity exported to the grid is applied. Actual values would be used to estimate baseline emissions during monitoring of the project activity.

Data / Parameter:	**El_{imp}**
Data unit:	MWh/year
Description:	Average electricity imported from the grid in a year
Source of data used:	Monthly Bills by CEB
Value applied:	5
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is required to estimate the project emissions. The monthly invoice from CEB would be the basis for estimation of project emissions. Meters would be calibrated as per CEB standards.
Any comment	Average value of electricity imported from the grid is applied. Actual values would be used to estimate project emissions during monitoring of the project activity.

B.6.3 Ex-ante calculation of emission reductions:

Baseline emissions

The ex-ante baseline emissions of the project activity are calculated as per following formula:

BE_y = El_{exp} * EF_B

(ton CO_2 e/year) (MWh /year) (ton CO_2e /MWh)

Where,

BE_y - Baseline emissions in ton CO_2e /year

El_{exp} - Net electricity exported to grid per annum in MWh/year

EF_B - Baseline emission factor in ton CO_2e /MWh

The project activity has been supplying electricity to the grid since July 2004. The estimated net electricity supplied to the grid is estimated based on the average net electricity exported to the grid and design export value. The net electricity exported to the grid would be around **25,800 MWh/year.**

The baseline emission factor has been estimated as described in section B.4 and Annex 3. The baseline emission factor is estimated to be **0.697 t CO_2 /MWh.**

Applying these values in the formula for baseline emissions,

BE_y = 25,800 * 0.697

(ton CO_2 e/year) (MWh /year) (ton CO_2e /MWh)

= **17,982.60 t CO_2 e/year**

Project emissions (PE_y)

The ex-ante project emissions are calculated by the following formula:

PE_y = El_{imp} * EF_B

(ton CO_2e /yr) (MWh/year) (ton CO_2e /MWh)

Where PE_y is the project emissions due to electricity imported from the grid in ton CO_2e/year

El_{imp} is the electricity imported from the grid in MWh/year

EF_B is the baseline emission factor of the grid in ton CO_2e /MWh

On an average, the project has been consuming about 5 MWh of electricity per year. The baseline emission factor has been estimated as described in section B.4 and Annex 3. The baseline emission factor is estimated to be **0.697 t CO_2 /MWh.**

Applying these values in the formula for project emissions,

PE_y = 5 * 0.697

(ton CO_2 e/year) (MWh /year) (ton CO_2e /MWh)

= **3.485 t CO_2e /year**

Emission Reductions

Ex-ante emission reductions by the project activity are estimated by the following formula:

ER_y (ton CO_2 e/year) = BE_y (ton CO_2 e/year) - PE_y (ton CO_2 e/year)

Where,

ER_y - Emission reduction per annum by project activity in ton CO_2 e/year
BE_y - Baseline emissions in ton CO_2 e/year
PE_y - Project emissions in ton CO_2 e/year

Applying the baseline and project emissions, Emission reductions,

ER_y (ton CO_2 e/year) = 17, 982.60 (ton CO_2 e/year) - 3.485 (ton CO_2 e/year)

= 17,979.115 ton CO_2 /year

= **17,979 ton CO_2 /year**

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

The project activity has been supplying electricity to the grid since July 2004. However, the crediting period would start from the date of registration of the project activity which is expected to be 01/06/2007. In the event of change in the date of registration of the project activity, the date of starting of crediting period would start from the actual date of registration. The estimated ex-ante emission reductions of the project activity from 2007 to 2014 are given in the table B-1.

Table B-1. – Ex-ante emission reductions of the project activity

S.No.	Year	Baseline emissions (ton CO_2 e)	Project emissions (tonCO_2e)	Emission reductions (ton CO_2e)
1	2007 – 2008	17,982	3	17,979
2	2008 – 2009	17,982	3	17,979
3	2009 –2010	17,982	3	17,979
4	2010–2011	17,982	3	17,979
5	2011–2012	17,982	3	17,979
6	2012–2013	17,982	3	17,979
7	2013–2014	17,982	3	17,979
Total		**125,874**	**21**	**125,853**

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

B.7.1 Data and parameters monitored:	
Data / Parameter:	**El_{gross}**
Data unit:	MWh
Description:	Gross electricity generated by the project activity
Source of data to be used:	Generation meter in the panel board
Value of data	
Description of measurement methods and procedures to be applied:	Measured in the generation meter in the panel of the project activity. The data would be archived electronically for the entire crediting period and two years thereafter.
QA/QC procedures to be applied:	Meters would be calibrated as per manufacturer standards.
Any comment:	

Data / Parameter:	**El_{exp}**
Data unit:	MWh
Description:	Net electricity exported to the grid
Source of data to be used:	Monthly invoice
Value of data	Value of data would be used to calculate the baseline emissions.
Description of measurement methods and procedures to be applied:	Measured in the CEB energy meter at the project boundary. The electricity exported is recorded by CEB and jointly certified by CEB and DPL. The data would be archived electronically for the entire crediting period and two years thereafter.
QA/QC procedures to be applied:	The meter is calibrated as per CEB standards.
Any comment:	-

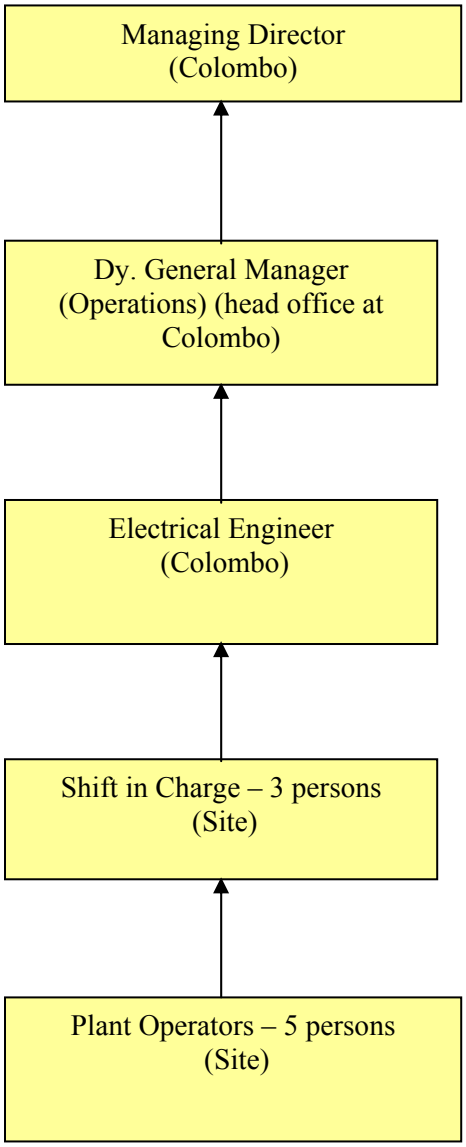
Data / Parameter:	**El_{imp}**
Data unit:	MWh
Description:	Electricity imported from the grid
Source of data to be used:	Monthly bill from CEB
Value of data	Value of data would be used to calculate the project emissions.
Description of measurement methods and procedures to be applied:	Measured in the meter by CEB for billing the project activity for the electricity imported by the project activity. This CEB bill would be used to calculate the project emissions. The data would be archived electronically for the entire crediting period and two years thereafter.
QA/QC procedures to be applied:	The meter is calibrated as per CEB standards.
Any comment:	

Data / Parameter:	EFy
Data unit:	Ton CO_2/MWh
Description:	Electricity baseline emission factor of CEB grid
Source of data to be used:	Publicly available data of generation of electricity from all sources in Sri Lanka
Value of data	Value of data would be used to calculate the baseline emissions, project emissions and therefore emission reductions.
Description of measurement methods and procedures to be applied:	The electricity baseline emission factor of the grid shall be determined as per Combined Margin method as described in ACM0002.
QA/QC procedures to be applied:	-

Data / Parameter:	D_{con}
Data unit:	tons
Description:	Diesel consumed
Source of data to be used:	Record of the project activity
Value of data	Value of data would be used to calculate the project emissions.
Description of measurement methods and procedures to be applied:	Measured by project proponents. The data would be archived electronically for the entire crediting period and two years thereafter.
QA/QC procedures to be applied:	-

B.7.2 Description of the monitoring plan:

The operational and management structure of the project activity is given below:


Managing Director
(Colombo)
Dy. General Manager
(Operations) (head office at
Colombo)
Electrical Engineer
(Colombo)
Shift in Charge – 3 persons
(Site)
Plant Operators – 5 persons
(Site)

The day today operations of the project activity are run by the Shift In charge who is in -charge of the operations in a shift. There are three Shift In charges – one for each shift – to operate the plant. All the Shift In charges are qualified electrical engineers and have undergone related training including plant operations, data monitoring, report generation etc.

There are 5 plant operators to assist the Shift in charge to operate the plant.

The electricity generated by the project activity and exported to the grid would be recorded electronically in the computer in the power plant. Apart from these, other data like Oil temperature, oil level, water level, voltage levels etc., are monitored and recorded. The Shift in charge continuously monitors the operating data and generation data. The computers of the power plant are networked with the computers in the head office at Colombo. These data can be continuously viewed and monitored from the head office at Colombo on a real time basis. The Electrical Engineer at head office at Colombo regularly monitors the operation of the plant from head office on a continuous real time basis.

The electricity exported to the grid would be measured at the export meter within the premises of the project activity by representatives of CEB during the last week of each month. This reading would be the basis for invoicing the CEB by the Project Proponent. These meter readings would be maintained by the Project Proponent in site and in the head office. Monthly invoices are prepared based on the joint certification of meter reading.

Internal Audits

Managing Director visits the plant once in a month and conducts an internal audit periodically. He reviews all the records, safety installations, operating procedures, etc., any corrective action to be taken are recorded and steps are taken to implement the corrective action.

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

Date of completing the final draft of this baseline section *(DD/MM/YYYY)*:

30 /01/2007 (last updated)

DPL and its associates have determined the monitoring methodology.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

16/04/2002.

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

30 y-0m

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

The project activity will use a renewable crediting period.

C.2.1. Renewable crediting period

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

01/09/2007; or date of registration with CDM-EB.

C.2.1.2. Length of the first crediting period:

7y -0m

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not Applicable

C.2.2.2. Length:

Not Applicable

SECTION D. Environmental impacts

>>

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

Central Environmental Authority (CEA) is the regulatory body for environmental compliance in Sri Lanka. CEA prescribes the environmental standards and monitors the compliance by industries. CEA has specified detailed standards for various sources of discharge such as air, water, noise, solid waste etc.

CEA issues the Terms of Reference (TOR) pertaining to each project. The project proponents have to submit an Initial Environmental Examination (IEE) based on the TOR in compliance with TOR. On submission of these documents, CEA gives environmental clearance for the project based on which the construction of the project activity can start.

A brief review of the environmental aspects are presented below :

Land acquisition, compensation and physical and/or economic resettlement

The project required relocation of two families and these two families accepted the compensation and there were no issues on this relocation. There has been no other land acquisition due to the project activity. Since the project activity is a run of river hydroelectric project, there is no land inundation, and therefore, there are no land submerging issues.

Potential impacts on downstream users

Since there is no change in the flow of water, there is no impact on the downstream users of the river.

Impact on Air, water and ecology

There is no impact on the air quality due to the project activity. Only source of air pollution is from the exhausts of standby diesel generator set. The emissions from the DG do not have contaminants at a concentration that would have an impact the environment. Moreover the standby generator is run for very less time. The emissions from the DG are let out in compliance with statutory requirements.

No effluents are produced from the project activity and hence no impact on water. This is a run of river hydropower project where size of the reservoir was not increased and hence there was no inundation of land due to the project activity. There are no known endangered species in the vicinity of the project activity. Hence, there are no significant negative impacts on the ecology due to the project activity.

Impact on Flora and Fauna

CEA gives more importance for impact on flora and fauna of the surroundings of the project activity. The project activity has no significant negative impact on the flora and fauna.

Social and economy issues

The installation of the project activity has given job opportunities to the local community during construction and operation of the project activity. The project activity has contributed for improving the standard of living of the local community.

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

There are no significant negative impacts on the environment, ecology and local community due to the project activity. The project has several positive impacts on the environment.

SECTION E. Stakeholders' comments

>>

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

The residents of the Poranuwa village and representatives of the village development societies are the local stakeholders of the project activity. A meeting was organized on 17th August 2002 with local stakeholders of the project. Letters were sent to the local stakeholders informing about the meeting and were invited to attend the meeting.

Following representatives attended the meeting:

1. Mr. V. P. Premadasa, President, Poranuwa Branch Sri Lanka Freedom Party, & Justice of the Peace
2. Mr. D. Jayasena, President, Grama Sanwardhan Samitiya (Village Development Society)
3. Mr. D. Liyanagunawardane, Former President, Pradeshiya Sabha, Pelmadulla
4. Mr. S.T. Thilakaratne, Secretary, Vilage Death Donating Society
5. Mr. D.R. Upul, Resident Project Area (Poranuwa Village)
6. Mr. P. Paranamanna, Grama Sevaka., Poranuwa
7. Mr. Wijeratne, Poranuwa School
8. Mr. K.V.V. Lal Upul, Resident, Project Area (Poranuwa Village)
9. Mr. Prabodha Sumanasekera , Director Didul Pvt Ltd.
10. Mr. A.K. Dheerasinghe , Project Manager, Vallibel Lanka (Pvt) Ltd.
11. Mr. R.A. Nandasena, Site Manager, Way Ganga Hydro Power Project
12. Mr. P.C.S. Nandasena, Site Officer, Way Ganga Hydro Power Project
13. Mr. Lasantha Dhammika, Site Supervisor, Didul Pvt Ltd.
14. Mr. Upali, Construction Manager, Way Ganga Hydro Power Project
15. Mr. S.W. Karunarathna, Purchasing Officer, Didul Pvt Ltd

E.2. Summary of the comments received:

Mr. Sumanasekara - Director welcomed the attendees to the meeting and explained that the Way Ganga Small Hydro Power Project was being constructed for the purpose of selling hydro power to the Ceylon Electricity Board and the project was being constructed strictly within the guidelines stipulated by the Central Environmental Authority which had granted the approval to commence construction of the

project. After briefly mentioning about the background of the company and its operations, he also explained about the contribution of the project in reduction of global warming by producing electricity without the emissions of carbon dioxide. He stated that the Project was going to help both the economy and the environment significantly. There was no pollution of waterways and the air.
He also informed that the Project was contemplating in obtaining the benefit of selling carbon credits.

The queries raised by the local stakeholders and answers by the project proponent are given below;
Mr. V.P. Premadasa, President Poranuwa Branch SLFP & Justice of the Peace *said that these construction activities should be conducted in such a way that poor villagers would not be inconvenienced and their properties should not be affected due to heavy construction activities. He also stated that once the project is completed the villages should feel that the project would be beneficial to the villagers.*
Director said that project was being constructed with all precautions not to affect the residents and the environment. Any damage to any property would be compensated as per the official estimates He mentioned that local people had been employed to the maximum extent possible and once the project would become operational, the local people would be employed to the maximum extent possible. This was no doubt a boost to the village economy.

Mr. ***D. Liyanagunawardane, Former President, Pradeshiya Sabha, Pelmadulla*** *said that the road connecting the Kahawatta and Poranuwa was in a bad condition and the local government body did not have sufficient funds to effect the necessarry repairs and equested that the road be repaired.*
Mr. V.P. Premadasa thanked the Company for maintaining the road connecting Kahawatta and Poranuwa and requested the Company to carry out repair work.
Director informed that this would be undertaken.

Mr. P. Paranamanna*, Grama Sevaka, Poranuwa asked whether the water stream would get polluted because of the power plant.*
Director said that the water stream would not get polluted at all and no waste water would be discharged to stream as well. He further mentioned that the Central Environmental Authority (CEA) would carry out inspection periodically to ensure the compliance of conditions stipulated by the CEA.

Mr. H. Wijeratne, Principal, Poranuwa School requested some assistance to carry out repair work of the few buildings of the school and for school development work.

Director said that such assistance would be extended to the school as part of the Proponent's social responsibility towards the society.

Mr. D.R. Upul requested to build a community center for the village and also requested a public address system to be used for public functions.
Director said that the company is keen to provide such community development projects and assured that all these would be provided.

Mr. K.V.V. Lal Upul, Resident, Project Area (Pornuwa Village) *asked whether heavy blasting of boulders will affect the nearby houses.*
Director informed that that only the controlled blasting would be carried out and the possibility of damaging any residential house was very remote. He also mentioned that such houses will be compensated as per the official valuation or will be repaired by the Company as per the requirement of the house owner.

Mr. D. Jayasena, President, Grama Sanwardhan Samitiya (Village Development Society) *requested the Company to pay adequate compansation for tea bushes not according to the official valuation because such valuation was low.*
Director agreed to the request.

Mr. R. A. Nandasena (Site Manager) thanked all those who attended the meeting.

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

All the concerns of the local stakeholders were addressed and attended. The roads as requested by the local stakeholders were repaired. Assistance was provided to construction of buildings in school and local residents were employed in the project activity.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Didul Private Ltd
Street/P.O.Box:	
Building:	27-02, East Tower, World Trade Centre,
City:	Colombo -1
State/Region:	Colombo
Postfix/ZIP:	
Country:	Sri Lanka
Telephone:	+94 11 2381111/23811112
FAX:	+94 11 238 1115
E-Mail:	
URL:	
Represented by:	
Title:	Managing Director
Salutation:	Mr.
Last Name:	Wickremarachchi
Middle Name:	
First Name:	Leel
Department:	
Mobile:	+94 77348 6666
Direct FAX:	+94 11 238 1115
Direct tel:	
Personal E-Mail:	leel@vallibel.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding of the project activity from Annex 1 Parties.

Annex 3

BASELINE INFORMATION

The baseline for the project activity is as per paragraph 9 of AMS I.D. described in Annex B of the simplified modalities and procedures for small-scale CDM project activities, which mentions that the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2 eq/ kWh) to be calculated in a transparent and conservative manner as follows :

A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the approved consolidated methodology ACM0002 where:

(a) The Operating Margin emission Factor ($EF_{om,y}$) is based on one of the four following methods :

(i.) Simple OM, or

(ii.) Simple Adjusted OM, or

(iii.) The Dispatch Data Analysis OM,or

(iv.) The average OM

(d) The build margin emission factor ($EF_{bm,y}$) is the generation weighted average emissions (in t CO_2/MWh) of a sample of power plants m. The sample group m consists of either the five power plants that have been built most recently, or the power plant capacity additions in the electricity system that comprise 20 % of the system generation (in MWh) and that have been built most recently. Project participants should use from these two options that sample group comprise the larger annual generation. Power plant capacity additions registered as CDM project activities should be excluded from the sample group m. If 20 % falls on part capacity of a plant, that plant is included in the calculation.

(e) The baseline emission factor (EF_y) is the weighted average of the Operating Margin emission factor ($EF_{om,y}$), and the Build Margin emission factor ($EF_{bm,y}$), where the weights are by default 50 % for each emission factor.

Since data required for calculation of OM as per dispatch data analysis and simple adjusted OM are not publicly available, these methods are not adopted.

Hence, the other methods that are available are simple OM and average operating margin method. The simple OM method has to be used where (a) low –cost / must run resources constitute less than 50 % of total grid generation in (i) average of the five most recent years . or (ii) based on long term normals for hydroelectricity production. The average emission rate method has to be used only where low cost/must

run resources constitute more than 50 % of total grid generation and detailed data to apply options (b) and (c) are not available.

Hence, the share of low cost /must run resources in the grid has to be calculated for the last five years and the average of this value has to be determined to select the method to estimate operating margin. The table A.3-1 gives the power generation mix of low cost and other resources.

The latest year for which data is available publicly is 2005. Hence, the 5 year period commences from 2001. Similarly, the estimation of operating margin emission factor and build margin emission factor is estimated for the years 2003, 2004 and 2005 which are the most recent three years for which data is publicly available in Sri Lanka.

The percentage of low-cost/must run resources and thermal generation for the last 5 years is given in the table A.3-1.

Table A.3-1 – Generation mix for the five most recent years [3]

Power generation mix of Sri Lanka Electricity grid for the last five years - GWh					
Generation	**2001**	**2002**	**2003**	**2004**	**2005**
Total Power Generation	6,625	6,946	7,218	7,534	8,769
Total Thermal Power Generation	3,407	4,114	3,904	4,571	5,314
Total Low Cost Power Generation	3,218	2,832	3,314	2,963	3,455
Thermal % of Total grid generation	51.43	59.23	54.09	60.67	60.60
Low Cost % of Total grid generation	**48.57**	**40.77**	**45.91**	**39.33**	**39.40**
Average of the five most recent years of % of Low Cost generation out of Total grid generation					**42.80**

The average of percentage of low-cost /must run resources for the most recent 5 years as per above data is 42.8 %

Hence, simple Operating Margin option is chosen for calculation of operating margin emission factor.

The simple OM has been calculated EX-ANTE using the vintage data as the full generation-weighted average for the most recent 3 years for which data are available at the time of PDD submission.

[3] CEB Report for Long Term Expansion Plan and Systems control and Operations Department

The complete baseline emission factor is determined below. A separate excel sheet giving all calculations to estimate the baseline emission factor is being given to DOE.

The power plants connected to the Ceylon Electricity Board (CEB) grid with installed capacities are given in Table A.3-2 and A.3-3. below :

LIST OF POWER PLANTS IN CEYLON ELECTRICITY BOARDGRID

Table A.3-2 – Details of hydroelectric plants in Sri Lanka

S.No.	Plant name	Capacity (MW)	Annual average electricity generation (GWh)	Date of commissioning
Hydroelectric plants				
	Laxapana hydro generation complex – CEB			
	Canyon	60	160	Unit 1 – May 1983, Unit 2 – May 1989
	Wimalasurendra	50	112	January, 1965
	Old Laxapana	50	286	December, 1950 & Dec, 1958
	New Laxapana	100	552	Unit 1- Feb 1974, Unit 2 – March 1974
	Polpitiya	75	453	
2	**Mahaweli complex**			
	Victoria	210	865	Unit 1- Jan, 1985, Unit 2 - Oct, 1984, Unit 3 - Feb, 1986
	Kotmale	201	498	Unit 1- April 1985, Unit 2&3 - Feb, 1988
	Randenigala	122	454	July, 1986
	Ukuwela	38	154	Unit 1- July, 1976, Unit 2 - August,1976
	Bowatenna	40	48	June, 1981
	Rantambe	49	239	January, 1990
3	Samanalawewa	120	344	October, 1992
4	Kukule	70	300	July, 2003
5	Small Hydro	20		
Total Hydro capacity		**1205**	**4465**	

Table A.3-3 - Details of thermal power plants in Sri Lanka				
S.no.	**Name of the plant**	**Capacity (MW)**	**Annual average generation (GWh)**	**Date of commissioning**
Existing thermal power plants				
CEB Plants				
1	Kelanitissa station - Old gas turbines	80	417	December, 1981 March, 1982, April, 1982
2	Kelanitissa station -New gas turbines	115	707	August, 1997
3	Kelanitissa station- Combined cycle plant	165	1290	August, 2002
4	Sapugaskanda diesel	80	472	May,1984
5	Sapugaskanda diesel extension	80	504	Sept, 1987
6	Chunakkam	8	-	March, 1999
Independent power producers				
6	Lakdhanavi	22.5	156	November, 1997
7	Asia Power Ltd	51	330	June, 1998
8	Colombo Power (Pvt) Ltd	64	420	Mid 2000
9	Diesel Plant Matara	24.8	167	March, 2002
10	Diesel Plant Horana	24.8	167	December, 2002
11	Kelanitissa AES CCY	163	1314	GT- March 2003 ST- October, 2003
12	Heladanavi (Pvt) Ltd	100	698	October, 2004
13	ACE Power Embilipitiya Ltd	100	697	March, 2005
Total Thermal power		**978.5**	**6881**	
WIND BASED GENERATION		**3 MW**		

The latest year for which the generation details are publicly available in Sri Lanka is 2005. Hence, the years considered for estimation of baseline emission factor are 2003, 2004 and 2005.

The electricity generation from all the power sources in Sri Lanka for the latest three years of 2003, 2004 and 2005 is given in Table A.3-4.

Table A.3-4 – Generation from each power source for the years 2003, 2004 and 2005

Hydro generation	Total cap MW	Fuel Type	*2003*	*2004*	*2005*
					All units in GWh
Laxapana hydro generation complex - CEB owned					
Canyon	60	Hydro	134.857	106.461	131.329
Wimalasurendra	50	Hydro	83.106	75.461	87.636
Old Laxapana	50	Hydro	230.890	223.101	245.804
New Laxapana	100	Hydro	465.771	392.458	466.788
Polpitaya	75	Hydro	370.986	333.463	375.802
Mahaweli hydro generation complex - CEB					
Victoria	210	Hydro	496.727	344.074	351.446
Kotmale	201	Hydro	300.280	294.210	341.650
Randenigala	122		288.458	133.232	225.097
Ukuwela	38	Hydro	132.921	132.338	167.527
Bowatenna	40	Hydro	44.683	35.423	42.215
Rantambe	49	Hydro	164.989	105.969	129.134
Other hydro genration - CEB					
Samanalawewa	120	Hydro	318.311	233.203	240.627
Kukule	70	Hydro	118.659	320.339	318.941
Small Hydro	20	Hydro	39.399	25.039	49.258
TOTAL HYDRO GENERATION	**1205**		**3190.037**	**2754.771**	**3173.254**

Thermal Generation- CEB owned	Total cap MW	Fuel Type	*2003*	*2004*	*2005*
					All units are in GWh
Kelanitissa Gas Power station					
Gas turbine (old)s	80	Diesel	37.936	141.418	22.231
Gas turbine (New)	115	Diesel	292.793	438.532	276.909
Combined cycle	165	Naphtha	855.049	1107.441	1006.715
Sapugaskanda Diesel Power station	80	Fuel oil	494.690	303.196	327.948
Sapugaskanda Diesel Ext	80	Fuel oil	512.779	512.558	527.482
Chunakkam small thermal	8	Diesel	0.000	0.000	0.590
CEB small diesel generation		Diesel	0.000	3.715	0.000
Small power producers		Biomass	120.311	205.577	279.739
Thermal Generation – IPP owned – Diesel					
Kool Air (Kankasanturai)		Fuel oil	24.829	36.904	55.556
Aggrego (Chunakkam)		Fuel oil	0	0	55.554
Lakdhanavi	22.5	Fuel oil	146.754	176.075	151.082
Asia Power Ltd	51	Fuel oil	344.874	368.268	353.692
Colombo Power (Pvt) Ltd	64	Fuel oil	435.697	507.023	475.780
ACE Power Matara	24.8	Fuel oil	151.075	198.380	163.308
ACE Power, Horana	24.8	Fuel oil	109.617	167.784	174.017
AES Kelanitissa (Pvt) Ltd	163	Fuel oil	497.729	407.060	475.780
Heladanavi (Pvt) Ltd	100	Fuel oil	0.000	202.726	758.887
Ace Power Embilipitiya Ltd	100	Fuel oil	0.000	0.000	488.219
Total thermal energy generation			**3903.822**	**4571.080**	**5313.750**
Renewable energy	3	Wind	3.388	2.661	2.438

The generation details from various fuel sources for the year 2003, 2004, and 2005 of Sri Lanka are given in Table A.3- 5 below;

Table A.3-5 – Generation data from fuel sources

	2003	2004	2005
Sector wise generation	**GWh**	**GWh**	**GWh**
Diesel oil based generation	330.729	583.665	299.730
Residual fuel oil based generation	2718.044	2879.974	4007.305
Naphtha based generation	855.049	1107.441	1006.715
Hydro electric generation	3190.037	2754.771	3173.254
Small power producers (Biomass)	120.311	205.577	279.739
Non -conventional energy	3.388	2.661	2.438
Total generation	**7217.558**	**7534.089**	**8769.181**
Total generation excluding Low-cost power generation and CDM project	**3903.822**	**4571.080**	**5313.750**

Estimation of Baseline Emission Factor

Estimation of Simple Operating Margin			
Table A.3.-6- Estimation of CO_2 emission factor for diesel consumed			
Description	**2003**	**2004**	**2005**
Avg. efficiency of power generation with diesel as fuel, %	26.00%	27.40%	26.78%
Net Calorific Value of diesel oil used (TJ/ton) – IPCC 2006	0.04330	0.04330	0.04330
Estimated diesel oil consumption (tons/yr)	105758	177104	93054
Carbon content for diesel oil (t C/ TJ) – IPCC 2006 Guidelines	20.2	20.2	20.2
Mass conversion factor (t CO2/TC)	3.67	3.67	3.67
Oxidation Factor of diesel oil	1.00	1.00	1.00
Effective CO2 Emission Factor for diesel oil (tonne CO2/TJ)	74.1	74.1	74.1
CO2 emission factor of diesel oil used (tonneCO2/ton of diesel)	3.21	3.21	3.21
CO2 emissions due to consumption of diesel oil (t CO2)	339175.31	567986.99	298431.69

Table A.3.7- Estimation of CO_2 emission factor for fuel oil consumed			
Description	**2003**	**2004**	**2005**
Avg. efficiency of power generation with residual fuel oil %	39.65%	39.85%	39.85%
Net Calorific Value of fuel oil used (TJ/ton)	0.04040	0.04040	0.04040
Estimated fuel oil consumption (tons/yr)	610850	643993	896077
Carbon content of fuel oil (t C/ TJ)	21.1	21.1	21.1
Mass conversion factor t CO2/TC	3.67	3.67	3.67
Oxidation Factor of fuel oil	1.00	1.00	1.00
Effective CO2 Emission Factor for fuel oil (tonne CO2/TJ)	77.4	77.4	77.4
CO2 emission factor of fuel oil (tonneCO2/ton of fuel oil)	3.13	3.13	3.13
CO2 emissions due to consumption of fuel oil (t CO2)	1909280	2012874	2800789

Table A.3.8- Estimation of CO_2 emission factor for naphtha consumed			
Description	**2003**	**2004**	**2005**
Avg. efficiency of power generation with naphtha, %	47.1%	48.1%	48.0%
Net Calorific Value of naphtha used (TJ/ton)	0.04450	0.04450	0.04450
Estimated Naphtha consumption (tons/yr)	146863	186259	169671
Carbon Content of Naphtha (t C/ TJ)	20	20	20
Mass conversion factor t CO2/TC	3.67	3.67	3.67
Oxidation Factor of Naphtha	1.00	1.00	1.00
Effective CO2 Emission Factor for naphtha (tonne CO2/TJ)	73.3	73.3	73.3
COEF of Naphtha (tonneCO2/ton of diesel)	3.26	3.26	3.26
CO2 emissions due to consumption of Naphtha (t CO2)	479263	607826	553693

Table A.3.9- Estimation of Simple Operating Margin			
Description	**2003**	**2004**	**2005**
CO_2 emissions due to diesel oil (t CO_2/year)	339175.31	567986.99	298431.69
CO_2 emissions due to fuel oil (t CO_2/year)	1909280	2012874	2800789
CO_2 emissions due to naphtha/gas (t CO_2/year)	479263	607826	553693
Total CO_2 emissions (t CO_2/year)	2727719	3188687	3652914
Electricity generation excluding low cost generation GWh	3903.82	4571.08	5313.75
Simple Operating Margin Emission factor ($EF_{OM\ Simple}$), (tCO_2/GWh)	698.730	697.579	687.446
Average EF_{OM} , tCO_2/GWh	**694.585**		
Average EF_{OM}, tCO_2/MWh	**0.694**		

Estimation of Build Margin emission factor

The Build Margin emission factor is the generation weighted average emission factor (tCO_2/MWh) of sample group of power plants . The sample group m should consist of either the five power plants that have been built most recently, or the power plant capacity additions in the electricity system that comprise 20 % of the system generation (in MWh) that have been built most recently considering the sample group that comprises the larger annual generation shall be considered.

The generation of CEB for the most recent year 2005 is 8769.181 GWh and the 20 % of the generation is 1753.84 GWh. The following table A.3.10 gives the list of most recent built plants. It may be seen that generation from 5 most recent built plants is more than 20 % of the generation. Hence, the generation of 5 most recent built units which is same as 20 % generation is considered for estimation of Build Margin.

A. 3- 10 Group of sample power plants for calculation of Build Margin					
Sr. No	**Power Plant**	**Fuel**	**MW**	**Year of commissioning**	**Generation in 2005 in GWh**
1	Ace Power Embilipitiya Ltd	Fuel oil	100	March, 2005	488.219
2	Aggrego - Chunakkam	Fuel oil		2005	55.554
3	Heladanavi (Pvt) Ltd	Fuel oil	100	October, 2004	758.887
4	AES Kelanitissa (Pvt) Ltd	Fuel oil	163	GT- March 2003 ST- October, 2003	475.78
5	Kukule	Hydro	70	July, 2003	318.941
	Total				**2097.38**
	20% of the total generation				**1753.84**
	Fuel oil based generation (Total generation excluding low cost generation0				1778.44
	Hydro				318.94

The Built Margin is estimated in Table A.3.11below.

Table A.3-11 CALCULATION OF BUILD MARGIN	
Residual Oil	
Avg. efficiency of power generation with residual fuel oil %	39.85%
Net Calorific Value of fuel oil used (TJ/ton)	0.04040
Estimated fuel oil consumption (tons/year)	397678
Carbon content of fuel oil (t C/ TJ)	21.1
Mass conversion factor (t CO2/TC)	3.67
Oxidation Factor of fuel oil	1.00
Effective CO2 Emission Factor for fuel oil (ton CO2/TJ)	77.4
CO2 emission factor of fuel oil (tonneCO2/ton of fuel oil)	3.13
CO2 emissions due to consumption of fuel oil (t CO2)	1242989
Total generation excluding Low-cost power generation (GWh)	1778.44
Built Margin (BM), tCO2/GWh	**698.92**
Built Margin (BM), tCO2/MWh	**0.6989**

Estimation of Baseline emission factor

As per ACM 0002 /Version 06, the baseline emission factor (EF) by the combined margin method is the weighted average of operating margin and build margin.

$$EF = W_{OM} * EF_{OM} + W_{BM} * EF_{BM}$$

where W_{OM} and W_{BM} are the weights for operating margin and build margin respectively.

As per ACM 0002, for wind energy project, the default weights W_{OM} = 0.5 and W_{BM}= 0.5

Hence, Emission factor EF (t CO_2/MWh)	=	0.5 *0.694 (t CO_2/MWh)	+	0.5 * 0.699 (t CO_2/MWh)
	=	**0.697 t CO_2 /MWh**		

The baseline emission factor shall be updated ex-post monitoring.

Annex 4

MONITORING INFORMATION

As emission reductions from the project activity are determined by the amount of electricity exported to the grid, it is essential to have a monitoring system in place and ensure that the project activity produces and exports the rated power at the stipulated norms. The sole objective of having monitoring system is to have a constant watch on the emission reductions.

Key project parameters affecting emission reductions

Electricity generated by the project activity: The gross power generated by the project activity would be monitored to the best accuracy and as per the table given in section B.7.1

Net electricity exported to the grid: The project revenue is based on the net electricity exported by the project activity to the grid.

The general principles for monitoring above parameters are based on:

- Frequency
- Data recording
- Reliability
- Experience and training

Frequency

Monthly reading of meters installed for metering the electricity exported shall be taken by authorised officials of CEB during the last week of every month. Daily data recording by the shift in-charge of DPL is there at generation end. Meter reading of the CEB energy (export) meter shall be the basis for monthly invoice of net energy exported to the grid by the project activity.

Data recording

Records of the meter reading of net energy exported to the grid would be maintained by DPL and CEB and archived electronically for the entire crediting period and two years thereafter the crediting period.

Reliability

The meter to measure the electricity export is calibrated and sealed and is not interfered with, by either DPL or CEB.

The calibration of the meter would be performed pursuant to IEC standards, by CEB or by a mutually agreed upon qualified independent third party.

The emission reductions of the project activity would be given by the following formula :

ER	=	BE	-	PE
(tCO_2e)		(tCO_2e)		(tCO_2e)

Where ER is the emission reductions in ton CO_2 eq

BE is the baseline emissions in ton CO_2 eq

PE is the project emissions in ton CO_2 eq

Baseline emissions are calculated by multiplying the net electricity exported to the grid in MWh during the monitoring period by the baseline emission factor in t CO_2/ MWh. The net electricity exported by the project activity would be metered by CEB. The metering equipment is maintained in accordance with CEB standards. The monthly meter readings are taken at the interconnection point at CEB energy meter by CEB during the last week of the each month. The monthly reading is jointly certified by CEB and representative of the project proponent.

Project emissions are calculated by multiplying the electricity imported by the project activity from the grid in MWh during the monitoring period by the baseline emission factor in t CO_2/MWh. The electricity imported from the grid would be obtained from the monthly bills of CEB.

Emissions due to operation of standby generator

Since the DG is very sparingly used, the emissions due to the consumption of diesel are very less at present. However, the consumption of the diesel for operation of standby diesel generator would be monitored and emissions due to consumption of diesel would be accounted as project emissions when these emissions contribute for 1 % of the baseline emissions.

Appendix 1 –Abbreviations

AMS	Approved small scale methodology
BM	Built Margin
CEB	Ceylon Electricity Board
CM	Combined Margin
CDM	Clean Development Mechanism
CEA	Central Environment Authority
CEB	Ceylon Electricity Board
CO_2e or CO_2eq	Carbon di Oxide equivalent
DPL	Didul Private Limited
FO	Fuel oil
GHG	Green House Gases
GWh	Giga watt hour
IPCC	Inter Governmental Panel on Climate Change
IRR	Internal rate of return
$kgCO_2$ eq/kWh	Kilogram carbon di oxide equivalent per kilowatt hour
KV	Kilo Volt
KVA	Kilo Volt Amperes
kW	Kilo watt
kWh	Kilo watt hour
m	Metre or metres
mm	mill metre or millimetres
m^3 /s	Cubic meters per second
M&P	Modalities and Procedures
MW	Megawatt
MWh	Mega watt hour
MWh/year	Mega watt hour per year
MVA	Mega Volt Amperes
OM	Operating margin
rpm	Revolutions Per Minute
RCC	Reinforced Cement Concrete
SLRs	Sri Lankan Rupees – the official currency of Sri Lanka, IUS$= SLRs 109
SPPA	Standard Power Purchase Agreement

t CO_2/MWh	tonnes carbon di oxide per mega watt hour
tCO_2e or tCO_2eq or ton CO_2e	tonnes carbon di oxide equivalent
UNFCCC	United Nations Framework Convention on Climate Change
US$	United States Dollars

Appendix 2- List of References

Sl. No.	Particulars of the references
1.	United Nations Framework Convention on Climate Change (UNFCCC), http://unfccc.int
2.	UNFCCC document: Clean Development Mechanism, Simplified Project Design Document for Small Scale Project Activities (SSC-PDD), Version 03
3.	UNFCCC document: Simplified modalities and procedures for small–scale clean development mechanism project activities
4.	UNFCCC document: Appendix B of the simplified modalities and procedures for small–scale CDM project activities - Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories - Type I.D Grid connected renewable electricity generation Version 10:23 December, 2006
5.	Revised 2006 IPPC guidelines for National Greenhouse Gas Inventories: Workbook and Reference Manual
6.	Long Term Generation Expansion Plan 2003-2017 of Ceylon Electricity Board
7.	Ceylon Electricity Board (CEB), www.ceb.lk
8.	Standard Power Purchase Agreement with Ceylon Electricity Board