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:

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Title-"6 MW Harangi Phase –II Hydro Power Project in Karnataka, India"

Version - 01
Date – 12th May, 2008

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

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The project activity involves installation of a 6MW small hydropower plant, Harangi Hydro-Electric Project (HEP) Phase-II by Energy Development Company Limited (EDCL), in order to tap the hydro power generation potential due to excess spill water of Harangi dam constructed across Harangi river (in Karnataka, India). The dam was constructed by Government of Karnataka.

In the present scenario, there is an existing 9MW hydro power project [Harangi Hydro-Electric Project (HEP)] constructed across the irrigation canal drop head regulator situated near Hudgar village of Somwarpet taluk (sub-division) of Kodagu (erstwhile Coorg) district of Karnataka, India. The existing 9 MW HEP consists of:

- a dam built across the river Harangi with spillway and head regulator for irrigation canal. The main purpose of canal head regulator is to cater to the irrigation requirements of the command area
- a 9 MW power house situated in the non-overflow section of the dam, bypassing the canal head regulator drop across the main irrigation canal. The tailrace water of the existing powerhouse joins the original irrigation canal and present irrigation canal junction.
- an escape channel originating from the tail race of existing 9 MW power house for the purpose of diverting the excess water of Harangi Dam during the overflow season.

The primary objective of the project activity under consideration, *i.e.* 6MW Harangi Phase – II hydro power project is to generate 6MW from the excess spill water from existing HEP during overflow season. Hence, an approach channel type intake structure at the junction point by the side of and parallel to the present escape channel will be constructed and water will be taken via an intake gate and a penstock to turbine inside the power house. This intake and penstock will be designed for 1900 cubic feet per second (cusec). A 7 m x 47 m approach channel will lead water via penstock up-to intake to drive 1 x 6MW turbo generating set. After power generation, the water will be led to escape channel and thereafter back in to the

river Harangi at downstream of the dam. A cross regulator to maintain fixed flow of irrigation requirement will be constructed across the main irrigation canal (downside of unction point).

Thus the project activity intends to harness the hydropower generation potential of the river Harangi during the excess spill overflow season over and across the main spill way gates of the main dam to supply power to the grid. For this purpose, a power purchase agreement has already been signed with Hubli Electricity Supply Company Limited (HESCOM) which falls under Karnataka Power Transmission Company Limited (KPTCL) grid, *i.e.*, the state grid of Karnataka. This will displace an equivalent amount of electricity in the Southern Regional grid that would have been generated by the thermal-power-plant-dominated grid mix, thereby resulting in GHG emissions. So, the project activity will reduce GHG emissions and contribute to the overall cause of mitigation of global warming.

The contribution of the project activity towards sustainable development can be ascertained on the basis of the following parameters:

a) Social well-being
b) Economic well-being
c) Environmental well-being
d) Technological well-being

Social well-being: The project activity will not involve human displacement, hence no resettlement problem is envisaged. The cross-regulator gates will ensure effective water management and effective supply of irrigation water, for optimum agricultural requirement. Further, the project activity will create direct and indirect employment opportunities for the local people during the construction phases which will also contribute to the improvement in the economic condition of the area.

Economic well-being: The direct and indirect employment opportunities created as a result of the project activity will contribute to improvement of the economic condition of the region.

Technological well-being: The project harnesses hydro-power potential of the river Harangi during rainy season. The success of the project would encourage other new private entrepreneurs of Karnataka to invest in small hydro power plants. This will go a long way towards solution of demand-supply gap in the power sector in India as well as towards increasing the share of renewable energy usage in the country.

Environmental well-being: The project activity will not cause any negative impact on the ecological characteristics of the area. It will displace an equivalent amount of electricity generation in the thermal-power-plant-dominated grid, resulting in reductions in GHG emissions associated with electricity

generation as per the grid mix. Further, by ensuring effective flood control, the project will be effective to lessen soil erosion and other environmental hazards associated with floods.

A.3. Project participants:

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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)
Ministry of Environment and Forests (MoEF), Government of India	Energy Development Company Limited	No

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

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

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A.4.1.1. Host Party(ies):

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India

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

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Karnataka

A.4.1.3. City/Town/Community etc:

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District Kodagu

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

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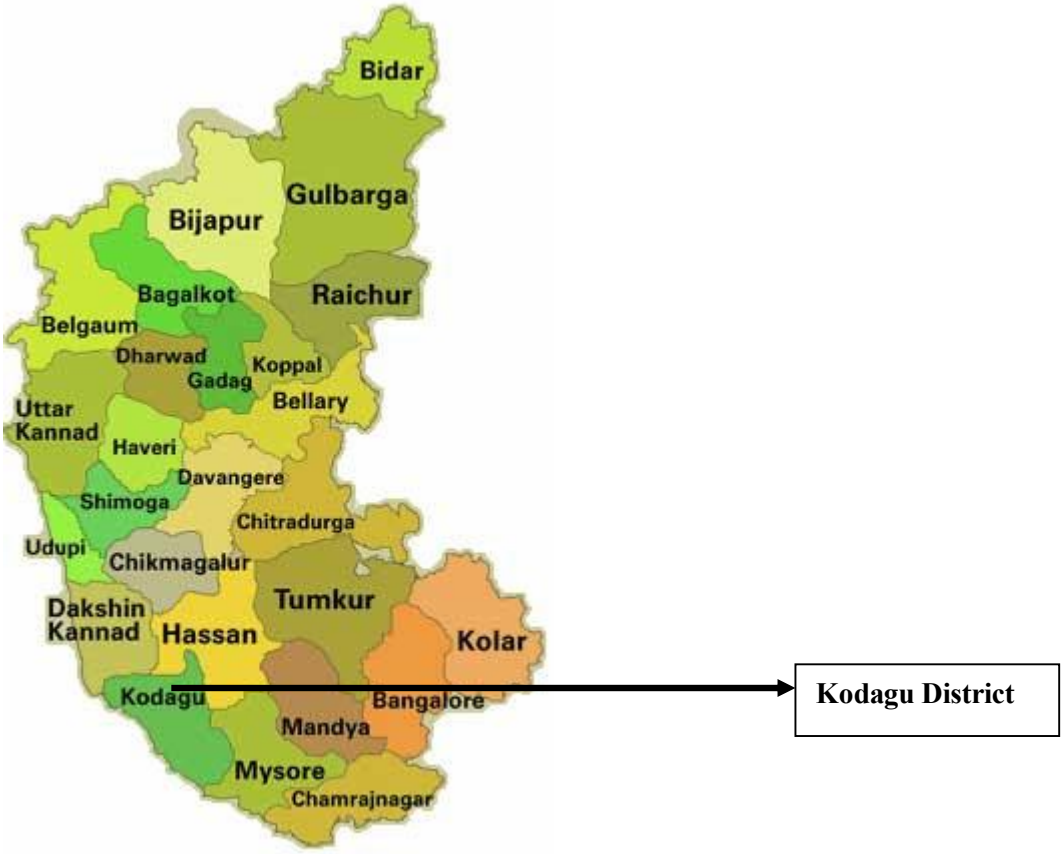
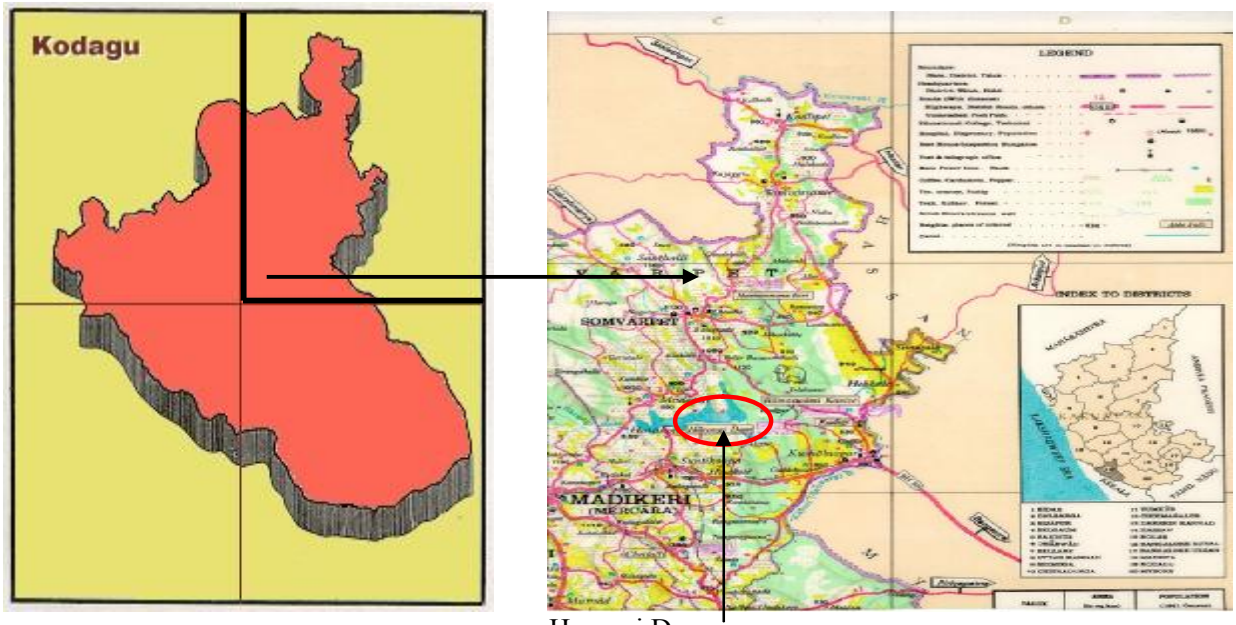
The Harangi Phase-II hydro power plant will be located on the Harangi river near Hudgar Village of Somawarpet Taluk in District Kodagu in Karnataka. EDCL already owns a 9MW hydro power plant at the above location at the non-overflow section of a dam across Harangi river. The existing project is referred to as 9MW existing Harangi hydroelectric project. The Phase-II power plant will be set up in the escape channel of the dam built previously. The geographical co-ordinates of the Harangi Phase-II power plant are 12°29'34'' N and 75° 54'20'' E. The site is 36 km from Madikeri, the nearest town. The nearest railway station is Mysore, which is 156 km by road. Bengaluru, the nearest international airport, is 257 km away. The physical location of the project activity is shown in the figure below:

Karnataka State

District Map of Karnataka State:





Harangi Dam

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

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According to the categorization specified in Appendix B to the simplified modalities and procedures for small scale project activities (http://cdm.unfccc.int/methodologies/SSCmethodologies) the project activity fits the type and category as specified below:

Type: *Type I – Renewable Energy Projects*

Category: *I.D. 'Grid Connected Renewable Energy Generation'*

Reference: AMS-I.D., Version 13, EB 33[1]

Technology:

The key components of the project activity are the water conveying channels (intake, approach channel and penstock), cross regulator gates, turbine-generator assembly and power evacuation arrangement. The technical specifications of these key components are provided in the following table:

SALIENT FEATURES		
S. No.	**Item Description**	**Details**
1.0	**Cross Regulator Gate**	
1.1	Size of Gate	4.205 m x 3.5 m
1.2	No. of Gates	4
1.3	FSL at D/s Cross Regulator	Elevation 848.6
1.4	Bottom level of Cross Regulator	EL 845.6
1.5	Top Level of Cross Regulator Gates	Elevation 851.899
1.6	Hoist Mechanism	Hydraulic hoisting
1.7	Size of pier	1.0 m x 6.299 m
1.8	No. of Pier	4
2.0	**Intake , Approach Channel & Penstock**	
2.1	Length of Intake Channel	21 m
2.2	Size of Approach Channel	7 m x 47 m
2.3	Intake Gate	4.5 m x 4.5 m
2.4	Escape Gate	6 m x 2 m

[1] http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_LPQNF2IC0HM1LAZCQGJPWLSGCP5BB8

2.5	Penstock Dia & Length		4.3 m & 36 m
3.0	**POWER HOUSE**		
3.1	Type of building		Surface
3.2	Location		By the side of Present Escape Channel
3.3	Proposed Capacity of unit		1 x 6000 kW
3.4	Size of Power House	:	27.67 m (length) x 10.69 m (width)
3.5	Centre Line of Runner		Elevation 829.44 m
3.6	Top of the roof		Elevation 846 m
3.7	Crane	:	40 T, Crane
3.8	Service bay dimensions		7 m x 10.69 m
3.9	Control Room Air-conditioned	:	There will be no control room for this power house. It will have local controls at its power house floor, Unit will be generally started and synchronized from the existing Power House using remote conrol.
3.10	Approach Road	:	From bridge to service bay
4.0	**TAIL RACE POOL**		
4.1	Max. Tail Water Level	:	Elevation 836.49 m
4.2	Normal Tail Water Level	:	Elevation 833 m
4.3	Bottom of Tail Pool	:	Elevation 824.09m
4.4	Bed width	:	15 m
4.5	Length Tail Pool	:	25.63
4.6	Length of Tail Race		Approximate 400 m
5.0	**TURBINE / GENERATOR**		
5.1.1	High Flood Level at Head race side.	:	River Level 849.15 m
5.1.2	Full Reservoir Level at Head race side.	:	River Level 848.6 m (Measured from the releases of existing Power House)
5.2.1	High Flood Level at Tail race side.	:	River Level 836.5 m
5.2.2	Full Reservoir Level at Tail race	:	River Level 833 m

	side.		
5.3	Gross Head	:	15.6 m
5.4	Design Net Head	:	13.036 m
5.5	Max. Head Available.	:	17.5 m
5.5	Max. Design Flood Discharge at Head race side.	:	■ 1900 Cusecs (Left Bank Canal Capacity)
5.6	Max. Design Flood Discharge at Tail race side River.	:	■ 63000 Cusecs (without Gate in Service) ■ 33000 Cusecs (After Canal Operation) ■ 95000 Cusecs (Gate in Service)
5.7	Design Discharge		54.32 Cumecs
5.8	Type of turbine	:	Horizontal Kaplan (Propeller)
5.9	Turbine Speed		750 rpm
5.10	Type of Excitation	:	Brushless
5.11	Type of Generator		Synchronous
5.12	Generation voltage, Frequency & speed	:	11V +/- 10%, 50 Hz +/- 5%, 3PH, 4W
5.13	Grid Network Voltage	:	66 kV +/-10%, 3ph, 4 wire, 50 Hz
5.14	Overload	:	110% continuous of max. output of rated head and maximum discharge
5.15	Power Factor	:	0.85 Lag
5.16	DC Control Voltage	:	110 V DC from old PH
6.0	**POWER EVACUATION**		
6.1	Power Evacuation		Stepped up to 66 kV, and transmitted by means of existing 66 kV line from Phase –I Power house to Khushalnagar substation.
6.2	Auxiliary Power Supply		415 V
6.3	Standby Supply		415 V

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

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Years	Estimation of annual emission reductions in tonnes of CO_2 e
2009-2010	6400
2010-2011	6400
2011-2012	6400
2012-2013	6400
2013-2014	6400
2014-2015	6400
2015-2016	6400
2016-2017	6400
2017-2018	6400
2018-2019	6400
Total estimated reduction CO_2 e	**64000**
Total number of crediting years	**10**
Annual average of the estimated reductions over the crediting period (tCO_2 e)	**6400**

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

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

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

As per clause 12(c) of the Simplified Modaliteies and Procedures for small scale clean development mechanism project activities (decision 4/CMP.1, Annex II), "*To use simplified modalities and procedures for small-scale CDM project activities, a proposed project activity shall: Not be a debundled component of a larger project activity, as determined through appendix C to this annex.* "

As per clause 2 of the Appendix C of the Simplified Modalities and Procedure for Small-Scale CDM project activities[2], "*A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:*

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

No similar project activity has been implemented by the project proponent that:

- qualifies as a small scale project activity under Simplified Modalities and Procedures for small scale CDM project activities;
- deals with same technology/measure, with the same project category;
- registered with or has been applied for registration with UNFCCC as a small scale CDM project activity; and
- whose boundary is within 1 km of the project boundary of the proposed small-scale project activity at its closest point.

Hence, it can be concluded that the proposed project activity under consideration is not a debundled component of a large 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:

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Title of Approved Baseline Methodology: 'Grid Connected Renewable Energy Generation'

Reference of the Approved Baseline Methodology: Category I.D – Renewable Energy Projects – Version 13 of AMS –I.D., Sectoral Scope 1, EB 36 of the Appendix B of the Simplified Modalities and Procedures (M&P) of Small Scale CDM Project Activities.

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

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Vide paragraph 12 of the Simplified Modalities and Procedures for small scale CDM project activities, to use simplified modalities and procedures for small scale CDM project activities, a project activity shall:

[2] http://cdm.unfccc.int/Projects/pac/howto/SmallScalePA/sscdebund.pdf

(a) "Meet the eligibility criteria for small-scale CDM project activities set out in paragraph 28 of Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its second session, held at Nairobi from 6 to 17 November 2006 [FCCC/KP/CMP/2006/10/Add.1, English, Page 08][3] ; Point i. [Renewable energy project activities with a maximum output capacity equivalent to up to 15 megawatts (or an appropriate equivalent)]"

The hydrological analysis done for the project activity under consideration suggests that the head available for power generation at the project site requires a 6MW turbine, which is again expected to run only at 15% plant load factor. Owing to the fact this plant will only function during the rainy season. Hence, there is no possibility of expansion of the project activity. Among the provisions of paragraph 6(c) of decision 17/CP.7, the proposed project activity qualifies as a small-scale CDM project activity under clause (i), *i.e.,* "*Renewable energy project activities with a maximum output capacity equivalent of up to 15 megawatts (or an appropriate equivalent)*" as the proposed project activity intends to generate 6MW (hence below the 15MW cap) of renewable energy harnessing the hydro power potential of river Harangi during the rainy season.

(b) *"Conform to one of the project categories in appendix B to this annex;" :*

The conformance of the project activity to the applicability criteria of the methodology has been explained as follows:

1."*This category 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."*

[3] In accordance with decision 17/CP.7 (contained in document FCCC/CP/2001/13/Add.2), paragraph 6 (c), simplified modalities and procedures have been developed for the following types of small-scale CDM project actives the revised definitions of which is provided in paragraph 28 of decision -/CMP.2:
Type I: Renewable energy project activities with a maximum output capacity equivalent to up to 15 megawatts (or an appropriate equivalent);
Type II: Energy efficiency improvement project activities which reduce energy consumption, on the supply and/or demand side, limited to those with a maximum output of 60 GWh per year (or an appropriate equivalent);
Type III: Other project activities limited to those that result in emission reductions of less than or equal to 60 kt CO2 equivalent annually;

The project activity involves setting up of renewable power generation unit that will generate power harnessing the hydropower potential of the excess spill-water of the existing 9 MW Harangi hydro power plant during the rainy season. The power so generated will be exported to the Karnataka Power Transmission Corporation Limited (KPTCL) grid, which is a part of Southern Regional grid of India. The Southern Regional grid is dominated by thermal power plants[4]. Therefore this particular criterion of the methodology is satisfied by the proposed project activity.

2. *"If the unit added has both renewable and non-renewable components (e.g.. a wind/diesel unit), the eligibility limit of 15MW for a small-scale CDM project activity applies only to the renewable component. If the unit added co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15MW."*

The proposed project activity does not have any non-renewable component. Hence, this clause is not relevant for the proposed project activity.

3. "Combined heat and power (co-generation) systems are not eligible under this category".

The proposed project activity does not involve co-generation of heat and power. Hence, the criterion mentioned above does not hold good for the proposed project activity.

4. *"In the case of project activities that involve the 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[5] from the existing units."*

The proposed project activity involves addition of a physically distinct renewable energy generation unit (6MW Harangi Hydroelectric Project Phase-II) at an existing renewable power generation facility (9 MW Harangi Hydrelectric Project). The added unit (6MW Harangi hydro electric project Phase-II) will be physically distinct from the presently existing unit (9 MW Harangi hydroelectric project) in the sense that a new turbine will be installed for the proposed project activity and is the unit will be less in capacity than the specified limit of 15 MW. Clearly, the proposed project activity under consideration satisfies all the conditions of this clause as well.

[4] The list of power plants in the Southern Regional Grid of India can be obtained at www.srldc.org

5. *"Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category. To qualify as a small scale project, the total output of the modified or retrofitted unit shall not exceed the limit of 15 MW."*

The proposed project activity under consideration does not involve retrofitting or modification of an existing renewable power generation facility. Hence, this clause is not relevant for the project activity.

From the above discussion, it may be concluded that the use of simplified baseline methodology for the project category 'AMS-I.D./Version 13' is justified for the proposed project activity.

(c) "*Not be a debundled component of a larger project activity, as determined through appendix C to this annex*" :

That the project activity is not a debundled component of a larger project activity is justified as per provisions of appendix C to the simplified modalities and procedures for small-scale CDM project activities in the Section A.4.5 of this Project Design Document

B.3. Description of the project boundary:

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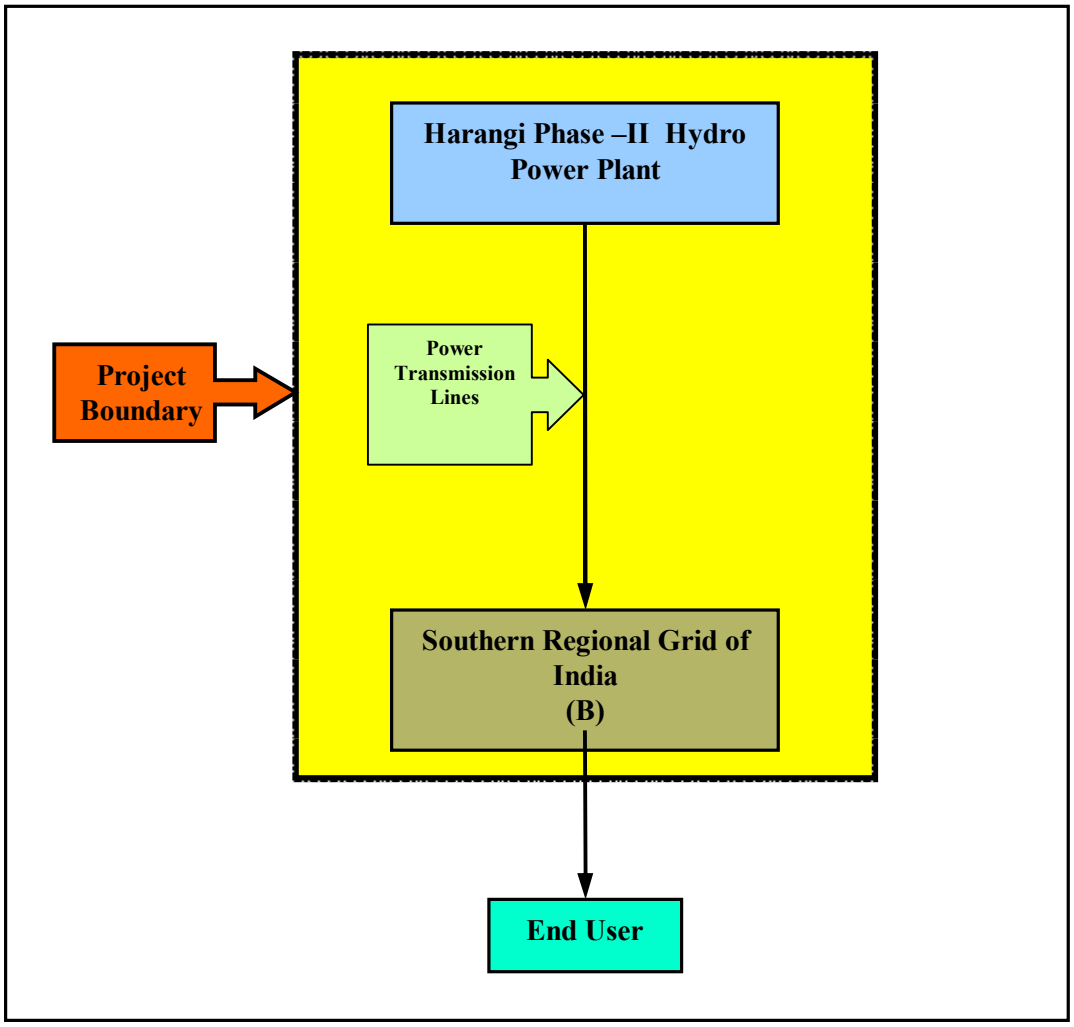
As per paragraph 6 of AMS I.D of Appendix B, *"the project boundary encompasses the physical and geographical site of the renewable generation source"*.

So for the project activity, the project boundary consists of the cross regulator gates, approach channel, intake gate, forebay, penstock, power house with generating equipment, escape gate, tail race canal and the power evacuation system up to the grid substation via existing 9MW Power house switchyard.

[5] Physically distinct units are those that are capable of generating electricity without the operation of existing units, and that do not directly affect the mechanical, thermal, or electrical characteristics of the existing facility. For example, the addition of a steam turbine to an existing combustion turbine to create a combined cycle unit would not be considered "physically distinct".

Further, for the purpose of estimation of baseline emissions, the Southern Regional Grid of India has also been considered within the project boundary. A schematic block diagram of the project boundary is given as below:



B.4. Description of baseline and its development:

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To arrive at the baseline scenario, the project proponent identified realistic and credible alternatives to the proposed project activity. A transparent assessment of all the alternatives has been carried out with respect to prohibitive barriers associated with their implementation and their economic attractiveness. The GHG emissions reductions as a result of the project activity have been calculated with respect to the most plausible baseline scenario (arrived at after analysis of the credible alternatives to the project activity).

Alternative 1- Continuation of present scenario

In absence of the project activity, the 6MW electricity to be generated by the proposed project activity would not be produced and hence, will not be substituted at the grid end. Equivalent amount of electricity in that case will be generated by the thermal power plant dominated grid mix of the Southern Regional electricity grid. This will in turn generate GHG emissions as per carbon intensity of the grid mix. This alternative is in compliance with all applicable legal and regulatory requirements. Moreover, this alternative will not entail any additional investment by EDCL, as is required for the proposed project activity. Hence, this alternative is further considered for arriving at the baseline scenario.

Alternative 2 – Proposed project activity not being undertaken as a CDM activity

This alternative being a renewable energy based power generation will not generate any GHG emission. The electricity generated would substitute an equivalent amount of electrical energy generated as per the grid mix of the Southern Regional electricity grid. This alternative is in compliance with all applicable legal and regulatory requirements. However, this alternative has associated barriers which prevent EDCL from its implementation, as substantiated in the section B.5 of the Project Design Document. The CDM revenue associated with the proposed project activity has played a key role in EDCL's decision to pursue the project activity despite the barriers.

Thus, this alternative is not considered further for arriving at the baseline scenario.

Following the above discussion it can be concluded that the baseline scenario for the proposed project activity is "Alternative 1: Continuation of the present scenario".

As per paragraph 9 of the methodology AMS-I.D. / Version 13, *"the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2e/kWh) calculated in a transparent and conservative manner as:*

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate emission factor of an electricity system'.

OR

(b) The weighted average emissions (in kg CO_2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

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

Since the proposed project activity is likely to affect both present and future carbon intensity of the grid mix, the project proponent chooses to use Option (a), a combined margin emission factor, consisting of a combination of operating margin and build margin, calculated according to the procedures described in the 'Tool to calculate emission factor of an electricity system' by Central Electricity Authority of India and made publicly available[6] through their website. The same has been used to arrive at the baseline emissions of the proposed project activity.

Parameters required for calculation of baseline emissions:

Serial number	Variable	Parameters	Data sources
1	EF_{GRID}	Emission factor for electricity generation by the Southern Regional Electricity grid	The value of emission factor provided in the CO_2 Baseline Database, Version 3, Central Electricity Authority, India which is calculated as per the guidelines of the "Tool to calculate emission factor of an electricity system, Version1, EB35"
2	EG_y	Net electricity substituted in the grid	Plant records

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:

The applicable methodology AMS-I.D. Version 13 states that the project participants shall take into account the general guidance to the methodologies, information on additionality, abbreviations and general guidance on leakage provided at the Attachment A to the Appendix B of the 'Simplified Modalities and Procedures for Small Scale Project Activities[7]'. According to this attachment,

'Project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

[6] http://www.cea.nic.in/planning/c%20and%20e/database_publishing_ver3.zip

(a) Investment barrier: a financially more viable alternative to the project activity would have led to higher emissions;

(b) Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;

(c) Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;

(d) Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.'

The barriers faced by the project activity have been elucidated below:

✓ **Investment Barrier:**

When the project activity was envisaged, the top management of EDCL had to give a nod for an investment of INR 154.77 million for its implementation. This being a substantial investment, the management evaluated the project against the company's internal benchmark for similar projects. An internal benchmark had been fixed at 8-10 years for small hydro projects on the basis of the payback for existing 9 MW Harangi hydroelectric project. The payback period for the project activity under consideration was calculated to be as high as 13 years.

The following table summarizes the key parameters used in the financial analysis of Harangi Phase-II hydro electric project with and without CDM revenue.

Parameters		Value
PLANT CAPACITY & CAPITAL COST		
Capacity (MW)	MW	6.00
Capital Cost (in Rs. Million)	Rs. Million	148.45
IDC+Finance charges	Rs. Million	6.32
Capital Cost with IDC (in Rs. Million)	Rs. Million	154.77
Interest Rate on loan / WC from financial instiurion (%)	%	10.00

[7] http://cdm.unfccc.int/methodologies/SSCmethodologies/AppB_SSC_AttachmentA.pdf

Loan Repayment Period in years (1+6)	Years	7.00
Equity Portion (%)	%	30.00
Debt Portion (%)	%	70.00
Equity Amount	Rs. Million	46.82
Debt Amount	Rs. Million	107.95
Discount rate (%)	%	12.00
ENERGY GENERATION		
Plant Load Factor	%	0.15
Total Energy Generation (Annual) in Mus	Mus	**7.980**
After Outage of 5%		7.581
Auxiliary Consumption (0.5%)	Mus	0.04
Loss due to transmission	Mus	0.00
Loss due to transformation (1.0%)	Mus	0.08
Net energy sent out to the grid	Mus	7.467
Net Saleable Energy	Mus	**7.47**
MNES		30.00
ENERGY SELLING RATE		
Power selling rate per unit in Rs.	Rs.	2.80
Escalation factor for power selling rate per year %		2.00
OPERATION & MAINTENANCE		
O&M Charges inclusive Insurance %	%	1.00
O&M Escalation rate after every years %	%	4.00
DEPRECIATION		
Depreciation rate as per Electricity Act	%	3.60
Capital cost - Civil Works (in Rs. Million)	Rs. Million	71.33
Capital Cost - Electro-Mechanical (in Rs. Million)	Rs. Million	76.43
MAT (Min. Alt. Tax) %	%	8.43
I. Tax Rate %	%	33.66
Interest on working capital	%	11%

This high payback was found to reduce considerably once the CDM revenue likely to follow (provided the project was registered under UNFCCC) was considered. Considering CDM revenue, the payback was found to improve, so as to be acceptable to the EDCL management

Sensitivity analysis;

Possible variations of factors like O&M expenses , tariff had already been considered in arriving at the pay-back period for the Harangi Phase – II hydroelectric project. In addition, the project payback was found to be sensitive to the plant load factor. Analysis of sensitivity of payback with respect to plant load factor was carried out and the financial attractiveness of the project with reasonable variations of plant load factors was evaluated.

The results of the sensitivity analysis confirmed that the payback period of the proposed project activity without CDM revenues was much higher than the payback period as as acceptable to the investors, even under circumstances which could bring about favorable variations in the plant load factor.

EDCL management, on realization that CDM revenue would make the GHG abatement project viable, had decided to pursue the project activity.

✓ **Other Barriers:**

The implementation of the project activity has not been as smooth as contemplated. The project proponent has to acquire additional land for the implementation of the project activity which presently belongs to the state government. Due to political volatility and bureaucratic redtapism prevailing in the state, the Government of Karnataka has still failed to fix up the revenue for the land that is to be procured by EDCL. Even after obtaining all necessary clearances and freezing the power purchase agreement with the appropriate authority, the project proponent has no options but to keep the construction activities on hold, thereby leading to time and cost over-run

Impact of CDM revenue:

.From the above discussion it is clear that it would never have been a financially viable option for the project proponent to go ahead with the proposed project activity without CDM revenue. Potential CDM revenue will ensure a better return for the investors in the project and a reduced payback of the project activity.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

>>

The methodology is applied in the context of the project activity in order to calculate the baseline emissions, project emissions, leakages and emission reductions as follows:

I. Baseline Emissions: According to the simplified baseline methodology AMS-I.D. **Version 13, "***the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient*

measured in kg CO_2 equivalent/kWh". Two methods are provided for category I.D for estimating the emission coefficient in a transparent and conservative manner as follows:

a. A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the "Tool to calculate emission factor of an electricity system". The CM will be calculated as average of the OM and the BM.

b. The weighted average emissions in kg CO_2/kWh of the current generation mix.

Since the project activity affects both current and future generation mix of the grid, the project proponent has opted to use combined margin (CM), consisting of the combination of 'operating margin' and the 'build margin', for estimating the emission coefficient of the electricity distribution system.

Emission Factor of the Grid (EF_{GRID})

Electricity baseline emission factor of Southern regional grid (EF_{GRID}) has been taken from the CO_2 baseline database, version 3, December 2007, Central Electricity Authority, wherein the value has been calculated based on the guidelines provided in the 'Tool to calculate emission factor of an electricity system, Version 01, EB 35'. For further details, please refer to Annex 3 of this project document.

Baseline Emission Calculations

The baseline emission is calculated as,

$$BE_y = EG_y \otimes EF_{GRID} \quad \text{..... (7)}$$

where,

BE_y = Baseline Emissions due to displacement of electricity during the year y (in tCO_2)

EG_y = Net units of electricity substituted in the grid during the year y (in MWh)

EF_{GRID} = Emission Factor of the grid (in tCO_2/ MWh) and

y is any year within the crediting period of the project activity

II. Project Emissions: The project activity is a hydroelectric project. There are no anthropogenic emissions by sources of GHGs in the project boundary as a result of the project activity.

III. Leakage Emissions: As per the selected methodology, "*If the energy generating equipment is transferred from another activity or if the existing equipment is transferred to another activity, leakage is to be considered.*" The project activity does not involve any transfer of equipments to or from other activities as cited in the methodology. Hence, there will be no leakage emissions for the project activity.

IV. Emission Reductions: The emission reductions of the project activity are calculated as the difference between the baseline emissions and the project emissions.

$ER_y = [BE_y – (PE_y + L_y)]$..... **(8)**

where,

ER_y = emission reductions for the project activity in tonnes of CO_2 e

BE_y = Baseline emissions in tonnes of CO_2 e

PE_y = Project emissions in tonnes of CO_2 e = 0

L_y = Leakage emissions in tonnes of CO_2 e = 0

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

(Copy this table for each data and parameter)

Data / Parameter:	EF_{GRID}
Data unit:	tCO_2/MWh
Description:	CO_2 emission factor of the grid
Source of data used:	Central Electricity Authority CO_2 baseline database, version 3, 15th December 2007 calculated as per guidelines of the 'Tool to calculate emission factor of an electricity system, Version 01, EB 35'
Value applied:	0.857
Justification of the choice of data or description of measurement methods and procedures actually applied :	The generation figures and other relevant data have been collected from national agencies like CEA and calculations have been done by CEA as per the guidelines of the "Tool to calculate emission factor of an electricity system."
Any comment:	This emission factor based on the CEA: CO_2 baseline database, version 3, 15th December 2007 will remain fixed for the entire crediting period of the project activity.

B.6.3 Ex-ante calculation of emission reductions:

>>

Parameter	**Unit of Parameter**	**Value**	**Comments/Assumptions**
Power Generation capacity of the project	MW	6	As per specifications by equipment suppliers
Plant Load Factor		0.15	Determined from the hydrological study of the project area; provided in the Detailed Project Report
Energy exported to Southern Regional grid by the project	MkWh	7.47	As projected in Detailed Project Report

activity on an annual basis **EG_y**			
Combined Margin electricity emission factor of Southern Regional grid of India **EF_{GRID}**	kg CO_2e / kWh	0.857	Calculated as per the guidelines of the "Tool to calculate emission factor of an electricity system", Version 1, EB 35.
Annual Baseline Emission **$BE_y = (EG_y * EF_{GRID})$**	t CO_2e / yr	6400	Calculated as per equation (7) of Section B.6.1
Annual Project Emission **PE_y**	t CO_2e / yr	0	The proposed project is a hydro based renewable energy generation activity. Therefore, there will not be any project emissions associated with it.
Leakage due to project activity **L_y**	t CO_2 e/yr	0	There is no transfer of equipments from another project activity and that all the project equipments have been procured new. Thus there is no leakage for the project activity.
Annual Emission Reduction **$ER_y = [BE_y – (PE_y + L_y)]$**	t CO_2e / yr	6400	Calculated as per equation (8) of Section B.6.1

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

>>

Years	Estimation of project activity Emissions (tonnes of CO2 e)	Estimation of baseline Emissions (tonnes of CO2 e)	Estimation of leakage (tonnes of CO2 e)	Estimation of overall emission reductions in tonnes of CO_2 e
June 2009-May 2010	0	6400	0	6400
June 2010-May 2011	0	6400	0	6400
June 2011-May 2012	0	6400	0	6400
June 2012-May 2013	0	6400	0	6400
June 2013-May 2014	0	6400	0	6400
June 2014-May 2015	0	6400	0	6400
June 2015-May 2016	0	6400	0	6400

June 2016-May 2017	0	6400	0	6400
June 2017-May 2018	0	6400	0	6400
June 2018 – May 2019	0	6400	0	6400
Total (tonnes of CO_2 e)	**0**	**64000**	**0**	**64000**

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

B.7.1 Data and parameters monitored:

(Copy this table for each data and parameter)

Data / Parameter:	**EG_y**
Data unit:	kWh
Description:	Net electrical energy exported to grid from the project activity
Source of data to be used:	Plant Log Books
Value of data	7.47×10^6
Description of measurement methods and procedures to be applied:	Measurement of the export of energy by the project activity will be done at the plant premises, where there will be a dual energy metering system – (i) external metering system comprising of the main meter, that will be sealed, maintained and calibrated by Hubli Electricity Supply Company Limited (HESCOM). and (ii) internal metering system comprising of the check meter that will be maintained and calibrated by the project proponent. Net electricity exported to the grid, will be monitored daily by EDCL on the basis of the check meter readings. Monthly joint meter readings of the main meter and check meter at the interconnection point will be taken by the designated officials of HESCOM and EDCL. Monthly power export bills will be generated by EDCL against the main meter readings. Emission reductions will be claimed on the basis of the net electricity exported to grid as per the check meter readings.
QA/QC procedures to be applied:	Net electricity exported to the Southern Regional Grid will be verified against the monthly electricity bills.
Any comment:	Please refer to Annex 4: Monitoring Plan for details

B.7.2 Description of the monitoring plan:

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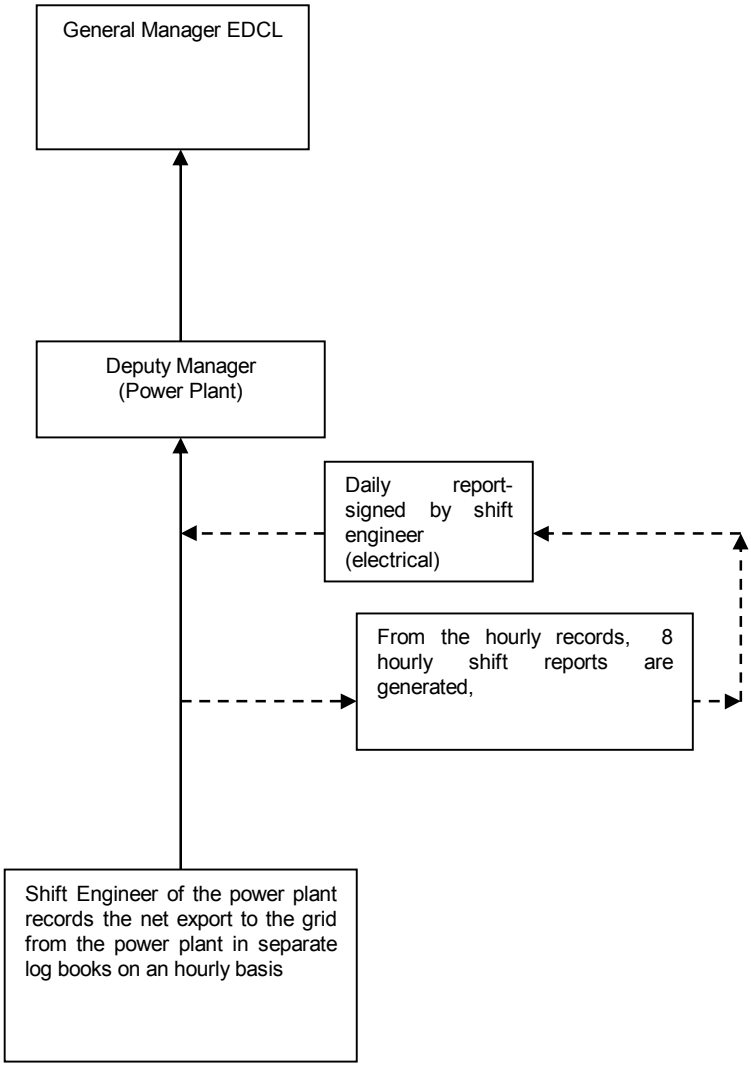
EDCL has decided to put in practice a clear, credible and accurate set of monitoring procedure for the Harangi Phase-II hydroelectric project. The purpose of these procedures would be to direct and support continuous monitoring of project performance/key project indicators to determine greenhouse gas (GHG) emission reductions. The project activity's revenue will be from two sources – from sale of energy to the grid and from the carbon credits generated. Hence both project performance and GHG emission reductions will be monitored following a protocol such that each parameter relevant towards assessing of the project performance.

The net electricity sent out to the grid will be monitored and recorded by the plant personnel using the check meter readings (Ref. Section B.7.1) on a hourly basis wherefrom daily records will be generated. The daily reports will be verified by the shift engineers and submitted to Deputy Manager (Power Plant). Based on the daily reports, the monthly figures of net power exported to the grid will be submitted to the General Manager. When KPTCL personnel will visit the power plant for taking readings/calibration of the main meter, EDCL personnel will simultaneously take down the readings of the main and check meters. Discrepancies in the readings, if any, will be escalated for corrective actions to the General Manager.

Organogram for reporting for Energy Development Company Limited



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

CDM – Executive Board

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Date of completion of the application of the baseline and monitoring methodology: 12/05/08

Name of person responsible: Mr. S Saraf

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:

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29/10/2005

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

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25y 0m

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

C.2.1. Renewable crediting period

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

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Not applicable

C.2.1.2. Length of the first crediting period:

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Not applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

01/06/2009 or the date of registration under UNFCCC, whichever is later.

C.2.2.2. Length:

>>

10y 0m

SECTION D. Environmental impacts

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

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Vide Environmental Impact Assessment (EIA) Notification S.O. 1533, Ministry of Environment and Forests, dated 14th September 2006 (in supersession of the notification number S.O. 60 (E), dated the 27th

January 1994[8]), the river valley projects with power production capacity less than 25 MW, which is the project case, do not require EIA submission. However, the project has obtained the forest clearance for setting up of the project activity. The project being establishment of a power house in the escape channel of the existing 9 MW Harangi project and cross regulator gates at irrigation channel, escape channel and water inflow sections, it will not affect the ecological and environmental balance of the area. No human displacement is involved in the project, hence no resettlement issues are envisaged due to the implementation of the project activity under consideration. Therefore, it can justifiably be concluded that the project activity will have no adverse effects on the environment.

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:

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Not applicable

SECTION E. Stakeholders' comments

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

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EDCL has identified the people, groups and organizations that are interested or have got involved with the Harangi Phase-II project implementation as stakeholder. EDCL sent a communication to all the identified stakeholders about the Harangi Phase-II project activity. They sent a written notification to all the stakeholders requesting them to present their views regarding the project activity.

The stakeholders identified for the project activity are:

- Elected body of representatives administering the local area (village Panchayat)
- Local clubs and Non-Governmental Organisations (NGOs)
- Contractors.

E.2. Summary of the comments received:

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The feedbacks from different stakeholders of the project activity are positive and encouraging. A summary of the same is given below:

[8]Source: http://envfor.nic.in/legis/eia/so1533.pdf

Sl No.	Name of Stakeholders	Mode of Communication	Feedback	Status
1	Elected body of representatives administering the local area (village *Panchayat*)	Written communication	The local people have appreciated in writing the project's potential to ensure better flood control and promote employment opportunities, along with its core objective of clean power generation.	EDCL has already received a written feedback from the elected body of representatives administering the local area.
2	Local clubs and Non Governmental Organizations (NGO)	Written notification	The initiative of EDCL to venture in power generation from renewable resources has been appreciated by the local clubs and NGOs. They have further commended the project activity particularly considering the absence of human displacement issues, better flood control and socio-economic benefits of the project activity.	A written appraisal has already been received from the NGO.

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

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EDCL has received positive comments from the local stakeholders on the project activity. The relevant comments and important clauses mentioned in the project documents/clearances like Detailed Project Report (DPR), environmental clearances, local clearance etc. were considered while preparation of CDM project development document.

As per UNFCCC requirement this Project Design Document (PDD) will be published at the validator's web site for public comments.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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URL:	
Represented by:	
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Salutation:	Mr.
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Middle Name:	
First Name:	Sanjiv
Department:	
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Direct FAX:	
Direct tel:	
Personal E-Mail:	saraf.sanjiv@gmail.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding for the project activity

Annex 3

BASELINE INFORMATION

For the project activity under consideration, the baseline scenario involves equivalent electrical energy generation by the grid mix, which entails GHG emissions since the Southern Regional Grid is a thermal power plant dominated grid. As per the simplified baseline methodology AMS-I.D, Version 13, the baseline emissions for grid connected renewable power generation is based on the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO2e/kWh). Since the proposed project activity is likely to affect both present as well as future carbon intensity of power generation at the grid, the project proponent opts to use a combined margin, calculated as an average of operating and build margins as per the guidelines of 'Tool to calculate emission factor of an electricity system', as the emission coefficient. For calculating the combined margin emission factor, the project proponent adhered to the steps mentioned in the tool as follows:

A) Identification of the relevant power system:

This step is identical to the "*STEP 1: Identify the relevant power system*" as mentioned in the 'Tool to calculate emission factor of an electricity system'. Indian power grid system (or the National Grid) is divided into five regional grids namely Northern, North Eastern, Eastern, Southern and Western Region Grids. These regional grids have independent state Load Dispatch Centres (LDCs) that manage the flow of power in their jurisdiction. Power generated by state owned generation units and private owned generation units is consumed by the respective states. The power generated by central sector generation plants is shared by all states forming part of the grid in a fixed proportion.

The project activity plant Harangi Phase –II is connected to the Karnataka Power Transmission Corporation Limited (KPTCL) which falls under the Southern Regional Grid network of India. The Southern Regional Grid consists of state grids of Andhra Pradesh, Kerala, Tamil Nadu, Karnataka and Pondicherry; central generating stations of National Thermal Power Corporation (NTPC), Neyveli Lignite Corporation Limited (NLC) and Nuclear Power Corporation (NPC); and private sector grids like GMR energy, Tata Power, Reliance Energy and others in the respective states.

Since the baseline involves equivalent power generation by the prevailing grid mix, it is necessary to use the carbon intensity of the entire Southern Regional grid in order to arrive at the baseline emission factor for the proposed project activity.

Furthermore, 'Tool to calculate emission factor of an electricity system' says "*use a regional grid definition in the case of large countries with layered dispatch systems (e.g. provincial / regional / national)*".

Taking into consideration both the points mentioned above (i.e. the relevant grid displaced by the project activity and the guidelines for selection of the appropriate grid in large countries with layered dispatch systems like India as given in the tool), the Southern Regional Grid has been considered as the most representative "relevant electricity system", where an equivalent amount of electricity would be replaced by the implementation of the proposed project activity. The carbon intensity of the Southern Regional Grid would be determined to arrive at the baseline emission factor for baseline emission calculations for the project activity's crediting period.

B) Determination of the Carbon Intensity of the chosen Grid

This step takes care of rest of the steps (other than STEP 1) mentioned in the tool.

Complete analysis of the system boundary's electricity generation mix has been carried out for calculating the emission factor of Southern Regional Grid by Central Electric Authority (CEA) of India in its CO_2 Baseline Database Version 3.0 dated December 2007. The project proponent has used this analysis for computation of the grid emission factor. The combined margin grid emission factor for the Southern Regional Grid calculated by CEA is 0.857 tCO_2/MWh.

Taking 0.857 tCO_2 / MWh as the combined margin grid emission factor of the Southern Grid, the baseline emissions have been calculated as follows:

Total Energy Generation (Annual)	MkWh	**7.980**
After Outage of 5%		7.581
Auxiliary Consumption (0.5%)	MkWh	0.04
Loss due to transmission	MkWh	0.00
Loss due to transformation (1.0%)	MkWh	0.08
Net energy sent out to the grid	MkWh	7.467
Net Saleable Energy	MkWh	**7.47**
Emission Factor	tCO_2/MWh	**0.857**
Emission Reductions	tCO_2	**6400**

Annex 4

MONITORING INFORMATION

Quantification of emission reductions is one of the key requirements of a CDM project. The project activity under consideration will supply energy produced from renewable resources to the grid, thereby reducing an equivalent amount of electricity in the grid. In the absence of project activity would otherwise be produced by the grid mix dominated by thermal power plants; hence the project activity will reduce GHG emission by supplying hydropower to the grid.

The Monitoring and Verification (M&V) procedures define a project-specific standard against which the project's performance (*i.e.* GHG reductions) and conformance with all relevant criteria will be monitored and verified. It includes developing suitable data collection methods and data interpretation techniques for monitoring and verification of GHG emissions with specific focus on technical / efficiency / performance parameters. It also allows scope for review, scrutiny and benchmarking of all these information against reports pertaining to M & V protocols.

The M&V Protocol provides a range of data measurement, estimation and collection options/techniques in each case indicating preferred options consistent with good practices to allow project managers and operational staff, auditors, and verifiers to apply the most practical and cost-effective measurement approaches to the project. The aim is to enable this project have a clear, credible, and accurate set of monitoring, evaluation and verification procedures. The purpose of these procedures would be to direct and support continuous monitoring of project performance/key project indicators to determine project outcomes, greenhouse gas (GHG) emission reductions.

Monitoring:

CDM stands on the quantification of emission reduction and keeping the track of the emissions reduced. The project activity would reduce the carbon dioxide whereas an appropriate monitoring system would ensure this reduction is quantified and helps maintaining the required level.

Also a monitoring system brings about the flaws in the system if any are identified and opens up the opportunities for improvement.

The general monitoring principles are based on:

- Frequency

- Reliability
- Registration and Reporting

Frequency of Monitoring

Since the emission reduction units from the project activity would be determined by the electrical energy exported to the grid sub-station by the project activity, it becomes important for the project activity to monitor the amount of electricity exported. The data will be recorded from a meter, installed and maintained by KPTCL, by the plant personnel on an hourly basis, wherefrom daily and finally monthly reports will be generated, as discussed in Section B.7.2 of this Project Design Document. This data may be cross-checked against the power export bills sent by KPTCL to EDCL. Further, the plant personnel will also take the readings of both main and check meters in a separate log book when KPTCL personnel visit the EDCL plant for taking readings/calibration etc. Discrepancies between the two meters, if any, will be escalated to the management for corrective actions

Reliability

As the reliability of the monitoring system is governed by the accuracy of the measurement system and the quality of the equipment to produce the result, all relevant measuring instruments will be calibrated as per standard procedures on a regular basis for ensuring reliability of the system.

Registration and Reporting:

Registration of data would be in the plant log-books. Monthly reports would be prepared stating the relevant parameters. The parameters to be monitored for the project activity will be archived in the plant's internal recording system (plant log books). The project proponent will also maintain a GHG performance procedure on a regular basis. All the monitored parameters will be recorded for crediting period plus two years.