CLEAN DEVELOPMENT MECHANISM
SIMPLIFIED PROJECT DESIGN DOCUMENT
FOR SMALL-SCALE PROJECT ACTIVITIES (SSC-CDM-PDD)
Version 02

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>.

SECTION A. General description of the small-scale project activity

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

6.6 MW Sheshadri Iyer Mini Hydel Power project of Atria Hydel Power Limited at Malavalli Taluk, Mandya District, Karnataka

Version 04, 28/09/2006

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

The Shivanasamudram Generating Station (SGS) Project was commissioned on the Cauvery river with an installed capacity of 42 MW. From the Shivanasamudram anicut, power channel having a capacity of 62.3 cumecs discharges into Shiva Balancing Reservoir. Two canals emanate from the reservoir, one canal having a capacity of 25.45 cumecs carries water required for Shimsha Power House and Bangalore Water Supply. The second power channel with a capacity of 50.97 cumecs and a length of 1.4 Km feeds SGS.

The project activity – *"Sheshadri Iyer Mini Hydel Power Project"* (SMHP) utilizes the flows from the excess water in the forebay of SGS and the head available in the stream for power generation. The generated electricity is exported to the state owned power utility company Karnataka Power Transmission Corporation Ltd. (KPTCL). The project design comprises an Approach channel, Intake Structure, penstock and anchor blocks, powerhouse, power evacuation system, winch and railway track and tailrace canal. No storage facility such as dam was envisaged in the project design and hence, the power is being generated whenever water flow is available in the canal.

The purpose of the project activity is to generate electricity by using canal water as a renewable energy resource to meet the ever-increasing demand for energy in the region. The development of the project activity reduces the Green House Gas (GHG) emissions produced by burning of fossil fuels in the power plants, supplying electricity to the state grid. SMHP generates about 6.6 MW and sells it to the state grid, through Power Purchase Agreement (PPA) contract.

Project activity's contribution to sustainable development

Government of India has stipulated social, economic, environmental and technological well-being as indicators for sustainable development in the interim approval guidelines[1] for CDM projects. SMHP believes that the project activity has beneficial effect on rural industries and employment in the region and has shaped the economic, environmental and social life of the people in the region.

Social well being

- The project activity has helped to create employment in the area for skilled and unskilled labour during construction and operation of the projects. Also, the plant has resulted in the establishment of shops in the vicinity.
- The project activity has also helped to create business opportunity for local stakeholders such as bankers, consultants, suppliers / manufacturers, contractors and other small shop owners *etc.*

[1] Ministry of Environment and Forest web site: http://envfor.nic.in:80/divisions/ccd/cdm_iac.html

- Due to 24 hour operation of the plants, the area has been lighted which has provided security for the local people in odd hours

Economic well being

- This electricity generation from the project activity substitutes the power generation by thermal power plants, which supply electricity to the state grid. It contributes towards the reduction in (demand) use of finite natural resource like coal, natural gas etc. minimizing depletion or else increasing availability to other important processes
- Project activity helps to reduce transmission losses due to generation of decentralised power close to load points
- Project activity helps to reduce the demand-supply gap in the power deficit state grid
- Project activity helps in preservation of irrigation canals/bridges/roads by up-gradation of these structures
- Project activity also contributes to the state exchequer

Environmental well being

- The project activity, by generating clean power eliminates an equivalent carbon dioxide, sulphur dioxide, nitrogen oxides, SPM *etc.* which would have been otherwise generated to produce electricity.

Technological well being

- The technology selected for the power project during its inception was a modern and efficient, using horizontal Francis turbines
- Project activity serves a small demonstrative project for clean renewable energy project in the state.

In view of the above arguments, SMHP considers that the project activity contributes to the sustainable development.

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)
India	Atria Hydel Power Ltd. .	No

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

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

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A.4.1.1. Host Party(ies):

India

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

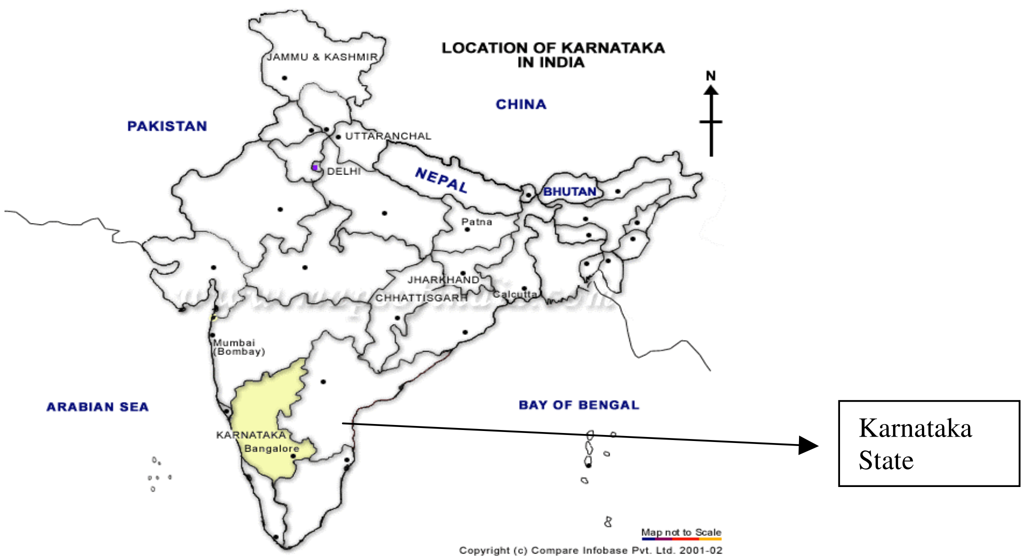
Karnataka

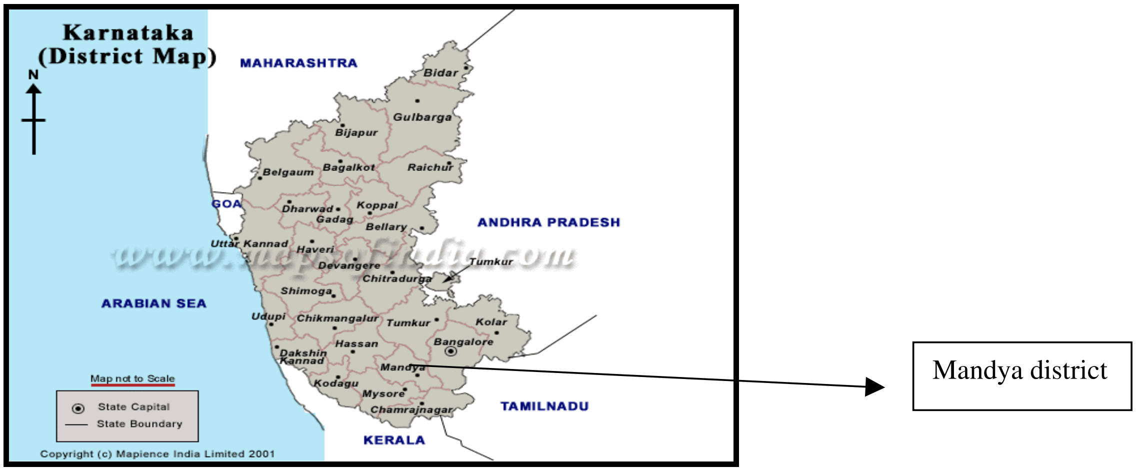
A.4.1.3. City/Town/Community etc:

Malavalli Taluk, Mandya District

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

The project activity is located at Survey No. 371 of Belakavali Village, B.G.Pura Hobli, Malavalli Taluk, Mandya District, Karnataka which is about 100 Km from Bangalore city, the capital of Karnataka state. The geographical location is detailed in the maps below.




Karnataka
(District Map)
N
MAHARASHTRA
Bidar
Gulbarga
Bijapur
Belgaum
Bagalkot
Raichur
GOA
Dharwad
Koppal
Gadag
Bellary
ANDHRA PRADESH
Uttar Kannad
Haveri
Devangere
Tumkur
Chitradurga
Shimoga
ARABIAN SEA
Udupi
Chikmangalur
Tumkur
Kolar
Hassan
Bangalore
Dakshin Kannad
Mandya
Kodagu
Mysore
Chamrajnagar
TAMILNADU
KERALA
Map not to Scale
State Capital
State Boundary
Copyright (c) Mapience India Limited 2001
Mandya district

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

Type I: Renewable Energy Projects
Category-D: Grid Connected renewable electricity generation

The project activity is a Hydel Power plant. The installed/rated capacity of the turbine is only 6.0 MW, which is less than the limit of 15 MW for renewable energy project activities to qualify under Type I project activities.

As per the provisions of Appendix B of Simplified Modalities and Procedures for Small Scale CDM Project Activities, (Version 08: 3rd March 2006) Type ID "comprises renewables, such as photovoltaics, hydro, tidal/wave, wind, geothermal, and biomass, that supply electricity to an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit".

Project activity comprises hydel power plant supplying electricity to the Karnatka state grid which is a part of the Southern Grid, which has an emission factor of 0.830 kg CO_2/kWh. With above considerations, the Type I.D. is the most appropriate category for the project under discussion. The project activity does not comprise any electricity generation from non-renewable energy sources.

Technology of project activity

The technology or power generation process using hydro resources is converting the potential energy available in the water flow into mechanical energy using hydro turbines and then to electrical energy using alternators. The generated power will be transformed to match the nearest grid sub-station for proper interconnection and smooth evacuation of power.

The powerhouse comprises two horizontal shaft francis turbine each of 3300 kW capacity. The generated voltage at the generator terminals is 11 kV, which is stepped-up to 66 kV to match the nearest substation voltage level. The details of the turbine and the generator are given in the table below.

Equipment Technical Details

Sr. No	Parameter	Details
A.	**Hydraulic Turbine**	
1.	Type	Horizontal Francis Turbine
2.	Supplier	V.A.Tech Escherwyss Flovel Ltd., Faridabad
3.	Rating	3475 KW
4.	Design Head	124 m
5.	Discharge at Design point	3.1 m^3/sec
6.	Maximum Discharge	3.4 m^3/sec
7.	Maximum Power	3820 KW
8.	Speed	1000 rpm
9.	Runner Diameter	663 m
10.	No. of wicket gates	16
B.	**Synchronous Generator**	
11.	Manufacturer	Crompton Greaves Ltd.
12.	Type	Salient Pole
13.	Shaft Orientation	Horizontal

14.	Rated Speed	1000 rpm
15.	Normal Voltage	11,000
16.	Frequency	50 Hz
17.	Rated power factor	0.9
18.	Guaranteed rated output	3300 KW
19.	Guaranteed maximum output	3630 KW
20.	Short circuit ratio	0.87

There is no transfer of technology to the host country since the technology is available in India from reputed manufacturers.

A.4.3. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed small-scale project activity, including why the emission reductions would not occur in the absence of the proposed small-scale project activity, taking into account national and/or sectoral policies and circumstances:

The energy supplied by project activity to the state grid would reduce anthropogenic GHG emissions as per the combined margin carbon intensity of the grid, which is mainly dominated by fossil fuel based power plants.

Project activity would supply energy equivalent of approximately 156.2 million kWh to the grid in a period of 7 years thereby resulting in total CO_2 emission reduction of 129,618 tons. In the absence of the project activity equivalent electricity would have to be supplied to the grid customers from a mix of power plants supplying power to grid and consequent CO_2 emissions would occur.

A.4.3.1 Estimated amount of emission reductions over the chosen crediting period:

Years	**Annual estimation of emission reductions in tonnes of CO_2 e**	**Annual estimation of project emissions in tonnes of CO_2 e**
2002-2003	23,575	6
2003-2004	24,819	7
2004-2005	15,851	8
2005-2006	16,346	11
2006-2007	16,342	15
2007-2008	16,342	15
2008-2009	16,342	15
Total Credits	129,618	
Total number of crediting years	7 years	
Annual average over the crediting period of estimated reductions ((tonnes of CO_2 e)	18,517	

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

No public funding as part of project financing from parties included in Annex I of the convention is involved in the project activity.

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

The project activity is not a debundled component of a large project activity as the project proponents have not registered or applied to register any small scale project activity:

- With the same project participants;
- In the same project category and technology/measure;
- 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.

SECTION B. Application of a baseline methodology:

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

Main Category: Type I - Renewable Energy Projects
Sub Category: I.D.- Grid connected renewable electricity generation

The reference has been taken from the list of the small-scale CDM project activity categories contained in 'Appendix B of the simplified M&P for small-scale CDM project activities-Version 08, 3rd March 2006'

B.2 Project category applicable to the small-scale project activity:

Appendix B of the simplified M&P for small-scale CDM project activities (Version 08, 3rd March 2006') provides indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories. As per this document the project activity falls under Category I.D.-Grid connected renewable electricity generation.

Baseline for projects under Type I.D has been detailed in paragraph 9 of Type I.D. described in Annex B of the simplified modalities and procedures for small-scale CDM project activities. It states that the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in $kgCO_2/kWh$) calculated in a transparent and conservative manner as:

a) The average of the "approximate operating margin" and the "build margin", where:
    a. The "approximate operating margin" is the weighted average emissions (in $kgCO_2equ/kWh$) of all generating sources surviving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation;
    b. The "build margin" is the weighted average emissions (in $kgCO_2equ/kWh$) of recent capacity additions to the system, defined as the higher (in MWh) of most recent 20% of plants built or the 5 most recent plants;

OR

b) The weighted average emissions (in $kgCO_2equ/kWh$) of current generation mix.

Considering the available guidelines and the present project scenario, Southern Grid has been chosen for baseline analysis by selecting "The average of the approximate operating margin and the build margin (combined margin)" for baseline calculations. Further details of the baseline are given in section B.5.

The operating margin estimates the effect of the project activity on the operation of existing power plants and the build margin estimates the effect of the project activity on the building of future power plants. There is a gap between demand and supply in the Southern grid so there is likely addition of more power plants in the grid mix. Combined margin is calculated as average of operating and build margin, which takes into account the trend of the types of power plant coming up in the grid, thus the uncertainties get addressed by taking the said approach for baseline calculation

B.3. 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 implementation of the hydel power based project activity is a voluntary step undertaken by SMHP 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 proponent was aware of the various barriers associated to project implementation. But it was felt that the availability of carbon financing against a sale consideration of carbon credits generated due to project activity would help to overcome these barriers.

The barriers faced by the project activity are discussed below:

Barriers

Although it is well known fact that, power generation from renewable energy has various advantages, however, it is still not widely applied, particularly in the developing countries like India. For private parties to venture into such an unexplored area, it is a steep diversification from their core industrial economics to power sector economics, where the project proponents needs to meet requirements and challenges of power policies, delivery/non-delivery of power, techno-commercial, social, environmental problems etc. associated with the power project.

Although there is a good potential for IPP's to implement such power projects in India very few have adopted for the similar project activity. The project overcomes the various barriers by taking up the risk of implementing power project, which is not a core business of the promoter group. Further, as per the Electricity Act 2003, the projects that have the lowest tariff will be the market players in future as it encourages competitive tariffs. In this view, the cost of generation of unit with coal will be lower due generation at higher capacity and with use of advanced technologies. Therefore, as a result of enactment of the Electricity Act 2003, the new power projects that would come up will be of coal based so as to be feasible and be competitive in market. This is a policy related threat to the project activity.

As per the attachment A to Appendix B of the simplified M&P for small-scale CDM project activities of the UNFCCC CDM website, to prove that the project is an additional, explanation regarding the project activity would not have occurred anyway due to at least one of the following barriers is required:

(a) Investment barrier
(b) Barrier due to prevailing practice
(c) Other barriers

In this view, the significant barriers to the project that SMHP has over come and continue to face and operate the power plant are as under:

a) Investment Barrier to project implementation

In order to implement the project, the project proponent was required to Secure Financial Closure

High upfront cost, lack of easy and long-term financing, project cash flows *etc.* are the known investment barriers to the high efficiency renewable energy projects. Due to restrictions like institutional barriers and low penetration in the region, the accumulation of sufficient funds to finance a high investment and capital-intensive project, such as the CDM renewable energy project is a quite difficult proposition.

Financial closure for the project activity has been achieved at high interest costs. In SMHP project too, the restrictions like high upfront cost, technological issues to project implementation, institutional aspects related to project cash flows and no prior experience in power generation and in selling power to the grid are some of the reasons for the delay in financial closure. The various roadblocks to project implementation have been detailed below. Carbon financing over the 7-year crediting period as one of the cash in flows of the project, will add more credibility to SMHP's loan repayment capability.

Prevailing practice barrier:

In the Indian power sector, the common practice is investing in only medium or large scale fossil fuel fired power projects, which is evident from a host of planned projects that comprises mostly large-scale fossil fuel based power generation projects. This is mainly due to the assured return on investment, economies of scale and easy availability of finances. This is also true in the Karnataka state also. The Business As Usual (BAU) situation for power generation in Karnataka can be considered as coal based thermal power generation with dominating share of more than 55% in the total power generation.

The share of electricity from small hydroelectric projects in India's total installed capacity is very small. According to the latest statistics published by the Ministry of Non-conventional Energy Sources (MNES)[2] the total installed capacity of small hydroelectric projects in the year 2001-2002 was only at 1423 MW including projects under construction where as the India's total installed capacity was around 75,218 MW[3] as on 31 March 2001 excluding small hydro, biomass and wind sources. This translates into a very small share of 1.8% from small hydro sector. Further, as against the total generation in the Karnataka state for the year 2001-2002, power generation from the Mini Hydel constituted only about 0.5% of the total generation. This shows that the investing in small hydroelectric sector was not a common practice.

b) Institutional barriers:

SMHP was selling power to KPTCL through a 20 year Power Purchase Agreement (PPA) contract. The initial PPA signed with KPTCL was for a tariff of INR 2.87/kWH with an annual escalation of 5%. However, there has been a revision in the tariff in the year 2003-2004 by KPTCL by reducing the tariff to INR 2.90/kWH with an annual escalation of 2%. Similarly, SMHP has now signed another PPA with the Bangalore Electric Supply Company Limited (BESCOM) with the same tariff and annual escalation. The revised tariff has resulted in financial losses to the company in the tune of INR 15 Million.

It is envisaged that with the changing policies the PPA could be further amended in the future. This indicates inconsistency in government policies and no guarantee that the project receives the same tariff in future for the power fed to grid. This makes a significant barrier for the private sector investments in the

[2] Website of Ministry of Non Conventional Energy Sources. www.mnes.nic.in

[3] Ministry of Power, Annual report 2001-2002, www.powermin.nic.in

power sector in the Karnataka state. Another major barrier which SMHP faces is that the benefits accruing on account of carbon credit shall be shared between SMHP and BESCOM in the ratio of 30:70, as indicated in the PPA.

For their cash in-flows the project proponent depends on the payments from KPTCL against the sale of electricity to the grid. KPTCL need to pay SMHP against the sale of electricity within a period of 15 days. However, since the project has exported power to state electricity board, there has been a delay of about 1-3 months in the payment. This has resulted in delay of payment by SMHP to the financial institutions, for which SMHP is paying additional interest on the interest. It is envisaged that the delay in payment from KSEB would continue which would result in a financial burden to SMHP.

Another critical issue is that the project proponents have to back down the generation whenever required by the utility company, KPTCL. A clear clause is built into the Power Purchase Agreement to this effect. Accordingly, a significant risk is existing for the project activity that demands shut down of the project in situations such as an emergency, surplus power situation, off-peak duration etc. SMHP has already faced this risk when KPTCL issued orders to back down the generation. For seasonally operating small hydroelectric projects, risk associated with this PPA clause makes a significant barrier.

The CDM funds therefore would ensure a financial stability to the project and would also ensure that SMHP do not incur heavy financial losses.

c) Other Barriers

Hydrology Risks

Uncertainty with respect to the availability of water in the canal on which the project is constructed is a major concern. . Two canals emanate from the reservoir; one canal having a capacity of 25.45 cumecs carries water required for Shimsha Power House and Bangalore Water Supply and the second power 0channel with a capacity of 50.97 cumecs and a length of 1.4 Km feeds SGS. The project activity utilizes the excess water flows in the forebay of SGS and the head available in the stream for power generation.

KPCL controls the water flows to meet the requirement of SGS, Bangalore water supply and Shimsha Power house. It is obligatory on KPCL to meet the water requirements of Bangalore city, SGS and the Shimsha Power House in the order. The project activity is purely based on releases from the SGS.

SGS initially was not operating at its full capacity and hence there was abundant water available for SMHP. However, post revamp, the SGS project is operating at its full capacity and the water discharge to SMHP has considerably reduced, which has resulted in less power generation.

The river gauge data was collected from the irrigation department based on which the flow duration curve was established. However, with the increasing demand of the SGS and the Bangalore city, water supply to the project has considerably reduced. Though sufficient head is available for power generation, due to uncertainty in the water availability as explained above, the power projections have not been matched and have resulted in a financial burden.

The Shiva head works initially, out of the total 8 vents was operating with only 4 vents. SMHP invested about INR 15 Million (INR Fifteen Million) and renovated the other 4 vents ensuring that all the 8 vents were in operation. This resulted in more water flow in the reservoir, which further ensured that there would be more water supply for the SGS, Bangalore water supply and Shimsha Power house. SMHP were not sure if this would result in any further water availability to them for power generation, as they are dependent for water availability from the forebay of SGS. However, they had gone ahead and taken the risk of investing in the renovation. The operation of 8 vents has not resulted in any further water for SMHP, which has resulted in huge financial loss.

Though SMHP is capable of generating and exporting more green power, it is not able to, as it is not operating to its full capacity due to the non-availability of water. In order to ensure that there is continuous water supply, SMHP had proposed to install a direct penstock from the headworks to their generating station, which is about 5 KM. However, as the project involved a huge investment of about INR 70 Million (INR Seventy Million), SMHP due to lack of funds could not take it forward. However, with the CDM funds available, SMHP could install a direct penstock, which would reduce the financial burden on SMHP for generating more green power.

Expected policy effects:

The project will have a major effect of The New Electricity Act-2003. This Act consolidates laws relating to electricity generation, transmission, distribution and trading.

As per this Act, bulk purchase of power by SEB's should be routed through tendering process with selection of power supplier offering lowest rate on competitive basis. Since, this Act supports the power generation with lower tariffs, the power generated by the cheaper but carbon emissive fossil fuels like coal and lignite will be purchased by the SEB's and individual bulk consumers with preference. As a result, the power generated using renewable fuels like biomass will get lower priority from these buyers as its generation cost is higher than the generation cost from conventional fuels like coal and lignite.

Due to this new Electricity Act 2003, promoters of SMHP may be required to compromise on the selling price of electricity, which will adversely affect the economics of the project. This is a policy related threat to this project.

In such scenario, where the promoter may get forced to offer much lower tariff than the present PPA, CDM funds will certainly help to reduce the gap between the tariff offered by the project activity and the other power generators/suppliers which generate power with lower cost but high carbon emissive fuels like coal and lignite.

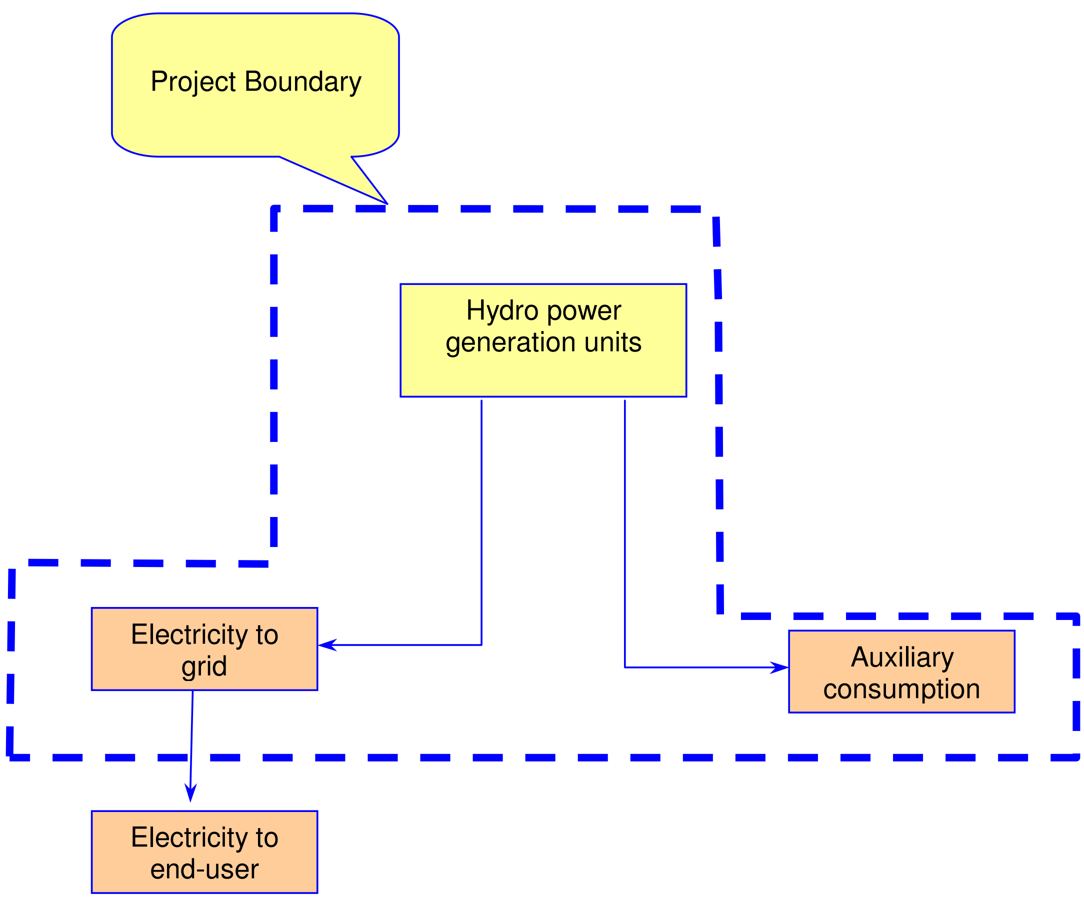
This further justifies the need of CDM funds for the project activity, which will help to improve the project feasibility and financial sustainability if the electricity tariffs reduce in future.

Above barriers are strong enough to affect the decision of project implementation and in case if due to any of the above reason project implementation cancels, the proposed grid to which the project will feed power will alternatively get the power from the project alternatives as discussed above. Since, these alternatives are more GHG emissive, project option only can reduce the GHG emissions. Although there is a good potential for IPP's to implement such power projects in India very few have adopted for the similar project activity due to above strong barriers. Therefore, the proposed renewable energy project is an additional activity as it over comes the above barriers by taking up additional risk of implementation.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the small-scale project activity:

As mentioned under paragraph 4 of Type I.D. of '*Annex-B of the simplified modalities and procedures for small-scale CDM project activities'*, project boundary encompasses the physical, geographical site of the renewable generation source. For the project activity the project boundary is from the point of fuel storage to the point of electricity supply to the grid interconnection point where the project proponent has full control.

For the project activity the project boundary is from the forebay to switchyard where the project proponent has a full control. Thus, boundary covers forebay, trash rack, powerhouse, draft tube on downstream of turbine, tailrace, switchyard and all other accessory equipments. However, for the purpose of calculation of baseline emissions, state grid is included in the system boundary. Flow chart and project boundary is illustrated in the following diagram:



B.5. Details of the baseline and its development:

Using the methodology available in paragraph 9 of Type I.D. described in Annex B of the simplified modalities and procedures for small-scale CDM project activities, **the average of the approximate operating margin and the build margin** (in $kgCO_{2e}$qu/kWh) of current generation mix of Southern grid is used for the calculation of baseline.

Steps in Application of Methodology in the context of the project:

Project will supply power to KPTCL grid which is a part of the Southern Grid. The methodology demands extensive background data for analysis and application. For detailed analysis, data/information was collected from government/non-government organisations and other authentic sources; Above-mentioned methodology of baseline analysis is used as under for baseline emission factor estimation and estimation of resulting CO_2 emission reduction due to the project.

Base line data

Carbon emission factor of grid

Southern regions present generation mix, sector wise installed capacities, thermal efficiency, and emission co-efficient are used to arrive at the net carbon intensity/baseline factor of the chosen grid. As per the provisions of the methodology the emission coefficient for the electricity displaced would be calculated in accordance with provisions of paragraph 9 of Type I.D. mentioned in Appendix B of Simplified Modalities and Procedures for Small Scale CDM Project Activities for grid systems.

The provisions require the emission coefficient (measured in kg CO_2equ/kWh) to be calculated in a transparent and conservative manner as:

(a) The average of the “approximate operating margin” and the “build margin” (or combined margin)
OR
(b) The weighted average emissions (in kg CO_2equ/kWh) of the current generation mix.

Complete analysis of the electricity generation has been carried out for the calculation of the emission coefficient as per paragraph 9 (a) given above.

Combined Margin

The baseline methodology suggests that the project activity will have an effect on both the operating margin (i.e. the present power generation sources of the grid, weighted according to the actual participation in the state grid mix) and the build margin (i.e. weighted average emissions of recent capacity additions) of the selected grid and the baseline emission factor would therefore incorporate an average of both these elements.

Operating Margin

The “approximate operating margin” is defined as the weighted average emissions (in kg CO_2equ/kWh) of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation;

The project activity would have some effect on the operating margin of the Southern Grid. The carbon emission factor as per the operating margin takes into consideration the power generation mix of 2004-2005 excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation of the selected grid, thermal efficiency and the default value of emission factors of the fuel used for power generation. The data collected and used are presented in Tables in Annex 3.

The formulae are presented in Section-E and the calculations are presented in an excel sheet as Enclosure

1. Carbon Emission Factor of grid as per Operating Margin is 0.997 kg CO_2/kWh electricity generation.

Build Margin

The "build margin" emission factor is the weighted average emissions (in kg CO_2equ/kWh) of recent capacity additions to the system, which capacity additions are defined as the greater (in MWh) of most recent 20% of existing plants or the 5 most recent plants. In order to calculate the build margin, most recent 20% of the existing plants is taken into consideration, the details of which are given in Excel sheet in Annex 3.

Carbon Emission Factor of grid as per Build Margin is 0.662kg CO_2/kWh electricity generation.

Net Carbon Emission Factor Grid as per combined margin = (OM + BM)/2 = 0.830 kg of CO_2 / kWh generation respectively. (Refer to Excel Sheet Annex 3).

B.5.2 Date of completing the final draft of this baseline section *(DD/MM/YYYY)*:

10/11/2005

B.5.3 Name of person/entity determining the baseline:

Atria Hydel Power Corporation and associated consultants

SECTION C. Duration of the project activity / Crediting period:

C.1. Duration of the small-scale project activity:

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C.1.1. Starting date of the small-scale project activity:

21/10/2001

C.1.2. Expected operational lifetime of the small-scale project activity:

25y

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

Project activity would use renewable 7 year crediting period

C.2.1. Renewable crediting period:

>>

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

1/1/2002

C.2.1.2. Length of the first crediting period:

7y-0m

C.2.2. Fixed crediting period:

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C.2.2.1. Starting date:

C.2.2.2. Length:

SECTION D. Application of a monitoring methodology and plan:

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D.1. Name and reference of approved monitoring methodology applied to the small-scale project activity:

Title: Monitoring Methodology for the category I D – Grid Connected renewable electricity generation

Reference: 'Paragraph 13' as provided in Type I.D. of 'Appendix B of the simplified M&P for small-scale CDM project activities- Version 08, 3rd March 2006'

D.2. Justification of the choice of the methodology and why it is applicable to the small-scale project activity:

As established in Section A.4.2, the project activity falls under Category I.D and can use the monitoring methodology for type I.D project activities.

The methodology requires the project-monitoring plan to consist of metering the electricity generated by the renewable technology. In order to monitor the mitigation of GHG due to the project activity, the total energy exported needs to be measured. The net energy supplied to grid by the project activity multiplied by emission factor for Southern grid, would form the baseline for the project activity.

GHG SOURCES

Direct on-site emissions

There would be no direct on-site emissions after implementation of the project activity since it is a canal drop based mini hydroelectric project without any storage of water.

Direct off-site emissions

Also there would be no direct off-site emissions after implementation of the project activity since it does not involve any transportation of fuel.

Indirect on-site emissions

The indirect on site GHG source is the consumption of energy and the emission of GHGs involved in the construction of projects. Considering the life of the projects and the emissions to be avoided in the life span of 25 years, emissions from the above-mentioned source is too small and hence neglected. No other indirect on-site emissions are anticipated from the project activity.

Indirect off-site emissions

No indirect off-site emissions are anticipated from the project activity

Key Project Parameters affecting Emission Reductions

Total Power generated by the project: The total power generated by the power project is measured to the best accuracy and is recorded, monitored on a continuous basis. The parameter would substantiate the smooth operation of the power plant.

Net Power exported to the grid: The project revenue is based on the net units exported as measured by Main metering system installed at the interconnection point and/or Check metering system installed at grid sub-station of KSEB. The monitoring and verification system would mainly comprise of these meters as far as power export is concerned.

D.3 Data to be monitored:

a. Parameters affecting the emission reduction potential of the project activity

ID Number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data to be kept?	Comment
1	Power	Total electricity generated	kWh	m	Continuous	Total	Electronic/ Paper	2 years after crediting period	Measured in plant premises.
2	Power	Power export	kWh	m	continuous	Total	Electronic/ Paper	2 years after crediting period	Measured at supply and receiving end. The electronic form of the data is stored at the corporate office.
3	Power	Auxiliary consumption	KWH	M	continuous	Total	Electronic/ Paper	2 years after crediting period	Measured at supply and receiving end and stored at the site.
4	Power	Power Import	KWh	M	Continuous	Total	Electronic/ Paper	2 years after crediting period	Measured at the plant premises

b. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored. (data items in tables contained in section D.3 (a) above, as applicable)

Data	**Uncertainty level of data (High Medium/Low)**	**Are QA/QC procedures planned for these data?**	**Outline explanation why QA/QC procedures are or are not being planned.**
D.3.(a)1	Low	Yes	This data will be used for calculation of emission reductions by project activity.
D.3.(a)2	Low	Yes	This data will be used for calculation of emission reductions by project activity.
D.3.(a)3	Low	Yes	This data will be used for calculation of emission reductions by project activity.
D.3.(a)4	Low	Yes	This data will be used for calculation of emission reductions by project activity.

Key Project Parameters affecting Emission Reductions

Total Power generated by the project: The power exported by SMHP would be monitored to the best accuracy and as per the table given in section D.3.

Auxiliary consumption:

The auxiliary consumption by SMHP would be monitored to the best accuracy.

Net Power exported to the grid:

The project revenue is based on the net units exported by SMHP.

The general principles for monitoring above parameters are based on:

The general monitoring principles are based on:

- Frequency
- Reliability
- Registration and reporting

Frequency

Monthly joint meter reading of main meters installed at interconnection point are taken and signed by authorised officials of SMHP and KSEB on the first day of every month. Hourly data recording by the shift in-charge of SMHP will be there at generation end.

Reliability

The amount of emission reduction is proportional to the net energy generation from the project activity. 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.

The project proponent ensures accuracy of the measurement system as follows:

- The shift incharge is responsible for the hourly data recording and the plant manager would ensure that the data is properly archived.
- The plant manager is a qualified engineer with 5-7 year experience in power industry. All the shift incharges are diploma holders and have undergone an exhaustive training programme, including plant operations, data monitoring, report generation etc.

Accuracy class for energy measured shall be 0.5 as defined in applicable Indian Standards.

SMHP keeps requisite sets of metering equipment, duly tested/calibrated, as spares, for replacement as and when required. Main or Check meter would be replaced by spare set of meter with, mutual consent of the parties when a faulty meter is required to be removed.

The Main and Check meter would be jointly inspected and sealed on behalf of the parties and shall not be interfered with, by either party except in presence of the other party.

The Main and Check meter is test checked for accuracy insitu every six months. If any meter is found to be beyond permissible limits of error, it would be calibrated or replaced with spare tested calibrated meter, as may be necessary. All the tests on the Main and Check meters would be conducted in KSEB's laboratory in presence of the authorised staff of both the parties.

Registration and reporting

KSEB and SMHP jointly read the metering system and keep the complete and accurate records for proper administration.

Hourly data recording by the shift incharge is there. Daily, weekly and monthly reports stating the generation are prepared by the shift incharge and verified by the plant manager. In addition to the records maintained by SMHP, KSEB also monitors the actual power exported to the grid.

Verification

The performance of the project would lead to CO_2 emission reductions. In other words, the higher the electricity exports to the grid the more would be the emission reductions.

There are two aspects of Verification

[A] Verification of the Monitoring System which includes:

- Verification of various measurement and monitoring methods
- Verification of instrument calibration methods
- Verification of measurement accuracy

[B] Verification of Data collected which includes

- Total generation of power and power export to grid.

For measuring the delivery and import of energy by SMHP one main meter is maintained at interconnection point and one check meter is maintained at grid substation of KSEB. Main meter reading would form the basis of billing and emission reduction calculations, so long the meter is found to be within prescribed limits of error during half yearly check.

D.5. Please describe briefly the operational and management structure that the project participant(s) will implement in order to monitor emission reductions and any leakage effects generated by the project activity:

The Chief Engineer and the Plant Incharge are responsible for the operation and maintenance of the power plant. Four mechanical engineers for the operation and maintenance of the power plant assist the chief engineer. Similarly, electrical engineers assist the Plant Incharge for the power generation. The Chief Engineer would be a qualified diploma/degree engineer with 5-7 year experience in power industry. The Director would be overall responsible for the operation and maintenance of the power plant.

The Jr. Engineer is responsible for the hourly data recording of SMHP at generation end. The Daily and monthly reports stating the generation and net power export would be prepared by the Engineer and verified by the Plant Incharge, who would maintain the records. Records of joint meter reading would be maintained at site. The Chief Engineer and Plant Incharge maintains records with regard to the operation and maintenance of the turbine. All the records are kept at the site.

As and when required and identified, people are sent to short term training courses on operation and maintenance of the power plant. Similarly, in house training is also provided on need basis. The chief engineer and the Plant Incharge are responsible for identifying the training needs and maintaining the undergone training records. The records of training undergone are kept at the site and also at the corporate office.

Adequate fire fighting and safety equipment are installed as per the guidelines of the Directorate of Factories. The Chief engineer and Plant Incharge are responsible for the upkeep of the safety and fire fighting and maintain necessary records at the site.

Calibration of the main meters recording the power exported is done by KPTCL every year and necessary records are maintained by both KPTCL and SMHP. The Plant Incharge maintains records of the same at the site.

In order to ensure that the project emissions are being regularly monitored and to ensure the function of the monitoring system, the Chief Engineer would carry out an audit every six months and maintain necessary records of the same. Necessary corrective and preventive action based on the audit findings would be carried out. All the internal audit records would be kept at the corporate office and a copy of the same would be maintained at the site.

D.6. Name of person/entity determining the monitoring methodology:

Atria Hydel Power Limited has determined the monitoring methodology and they are project participant as listed in Annex 1 of this document.

SECTION E.: Estimation of GHG emissions by sources:

E.1. Formulae used:

>>

E.1.1 Selected formulae as provided in appendix B:

Since category I.D. does not indicate a specific formula to calculate the GHG emission reduction by sources, the formula is described below in E.1.2

E.1.2 Description of formulae when not provided in appendix B:

>>

E.1.2.1 Describe the formulae used to estimate anthropogenic emissions by sources of GHGs due to the project activity within the project boundary:

In case of no power generation, SMHP import power for the running of equipment such as computers, lights, etc. The total power imported since inception is given in the table below:

Power Imported (kWh) during plant shutdown

Month	Year 2002	Year 2003	Year 2004	Year 2005
January	0	180	1455	1230
February	0	255	1545	900
March	0	1260	720	1125
April	1440	1395	870	1245
May	585	1245	1095	1140
June	750	1275	975	1635
July	1440	1110	855	1230
August	1290	900	240	2055
September	1215	615	105	915
October	225	225	105	660
November	300	300	855	600
December	240	75	1245	615
Total	**7,485**	**8,835**	**10,065**	**13,350**
Project Emissions (T CO_2)	**6**	**7**	**8**	**11**

As it is evident from the table above, the power imported is minimal. The project emissions of 15 T for the future crediting years has been considered.

E.1.2.2 Describe the formulae used to estimate leakage due to the project activity, where required, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities

As prescribed in Appendix B of the Simplified Modalities and Procedure for small-scale CDM project activities, for Category I.D leakage estimation is only required if there has been any transportation of either any equipment or fuel. As, there is no transport of any fuel or equipment, no leakage is envisaged.

E.1.2.3 The sum of E.1.2.1 and E.1.2.2 represents the small-scale project activity emissions:

The emissions from the project activity are 15 T.

E.1.2.4 Describe the formulae used to estimate the anthropogenic emissions by sources of GHGs in the baseline using the baseline methodology for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities:

Southern grid is considered for baseline analysis and calculation of anthropogenic emissions by fossil fuels during power generation. As mentioned in Chapter B, in the southern grid generation mix, coal and gas based power projects are responsible for GHG emissions. We have considered here the average of the approximate operating margin and the build margin (Combined Margin) for baseline calculations

Formula used for estimation of the anthropogenic emissions by sources of greenhouse gases of the baseline is as under.

Scenario I: The average of the approximate operating margin and the build margin **(Combined Margin Method)**

- **Baseline Power generation**

$$P_{wlc} = P_{tot} - P_{lrc}$$

Where,
P_{wlc} - Power generation by all sources, excluding hydro, biomass and nuclear.
P_{tot} - Power generation by all sources of grid mix.
P_{lrc} - Power generation by hydel, nuclear, biomass projects

- **Sector wise baseline Power generation**

$$P_{fuel} = \frac{P_f}{P_{wlc}} x100$$

Where,
P_{fuel} - Share (in %) of power generation by each fuel used (coal, gas and diesel in present scenario), out of total power generation excluding P_{lrc}

P_f - Power generation by fuel used. (in Million kWh units)

- **Calculation of Operating Margin emission factor**

  $OM_{bef} = \sum P_{fuel}\ x\ E_{fuel}$ for base year for Scenario 1

  Where,

  OM_{bef} - OM Emission factor of baseline for base year (kg/kWh)
  E_{fuel} - Emission factor (actual or IPCC) for each fuel type considered (*e.g.* coal, gas, etc.).

- **Calculation of Build Margin emission factor for each source of baseline generation mix**

  BM_{yr} = weighted average of emissions by recent 20% capacity additions.

  Where

  BM_{yr} = Build Margin for base year.(kg/kWh) = $\left(\frac{\sum P'_f E'_f}{\sum P'_f}\right)$

  Where
  P'_f - Generation capacity from specific fuel in the most recent 20% power plants
  E'_f - Emission factor for the specific fuel in the most recent 20% power plants built

- **Combined Margin Factor**

  CMF for crediting period
  = $(OM_{bef} + BM_{yr}) / 2$ (in Kg/kWh)

  [Refer to Baseline Excel sheet in Annex 3]

- **Power generation and export by project activity**

  $TP_{gen} = TP_{exp} + TP_{loss}$
  Where,
  TP_{gen} - Total power generated
  TP_{exp} - Total clean power export to grid per annum by project activity
  TP_{loss} - T & D Loss
  (all power units are in Million kWh)

The metered value of power export to grid is to be used for further estimations.

- **Emission Reduction by project activity**

  $$ER = TP_{exp} x (NEF_B - NEF_P) - PE - EL$$

  Where,

ER - Emission reduction per annum by project activity (tones/year)
TP_{exp} - Total clean power export to grid per annum
NEF_B - Final Emission Factor of baseline
NEF_P - Net Emission Factor of project activity [= 0]
PE – Project emissions
EL – Emission Leakage (tones/year) [= 0]

- **CO_2 equivalent Emission Reduction by project activity**

$$ER = TP_{exp} x \left(WA_{bef} - NEF_P \right) - PL - EL$$

Where,
ER - Emission reduction per annum by project activity (tonnes of CO2 equ/year)
TP_{exp} - Total clean power export to grid per annum (MU)
WA_{bef} **-** Final Emission Factor of baseline
NEF_P **-** Net Emission Factor of project activity baseline
PL – Project Emission Leakage (tonnes/year)
EL – Emission Leakage (tonnes/year)

Since there is a gap in demand and supply scenario in Southern grid, the export of power to grid will replace or get absorbed to partially fulfill the Karnataka State power requirement. If the same amount of electricity would be generated by a mix of coal and gas based power project it will add to the emissions that is getting reduced by the project activity. Hence, the baseline calculated using above method would represent the anthropogenic emissions by sources (due to use of carbon emissive fuels) that would occur in absence of the proposed project activity.

E.1.2.5 Difference between E.1.2.4 and E.1.2.3 represents the emission reductions due to the project activity during a given period:

Following formula is used to determine Emission reduction

CO_2 emission reduction due to project activity	=	Baseline emission	–	Project Activity emission

E.2 Table providing values obtained when applying formulae above:

Emission reductions by project activity for 7-year crediting period have been calculated and tabulated below:

Table E.2.1: Emission Reductions

Sr. No.	Operating Years	Net Baseline Emission Factor (kg of CO_2 / kWh)	Net Power Exported (Million kWh)	Baseline Emissions (Tons of CO_2)	Project Emissions (Tons of CO_2)	Emission Reductions, (Tons of CO_2)
1.	2002-2003	0.830	28.4	23,581	6	23,575
2.	2003-2004	0.830	29.9	24,826	7	24,819
3.	2004-2005	0.830	19.1	15,859	8	15,851
4.	2005-2006	0.830	19.7	16,357	11	16,346
5.	2006-2007	0.830	19.7	16,357	15	16,342
6.	2007-2008	0.830	19.7	16,357	15	16,342
7.	2008-2009	0.830	19.7	16,357	15	16,342
		Total	**156.2**	**129,695**	**77**	**129,618**

Therefore a conventional energy equivalent of 156.2 million kWh for a period of 7 years would be saved by exporting power from the project activity, which in turn would reduce 129,618 tons of CO_2 emissions considering baseline calculations.

SECTION F.: Environmental impacts:

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

The project does not fall under the purview of the Environmental Impact Assessment (EIA) notification of the Ministry of Environment and Forest, Government of India hence, not required by the host party. However, A detailed Environmental Impact Assessment report highlighting the impacts arising from the project has been prepared and submitted to the Karnataka State Pollution Control Board (KSPCB). On reviewing the EIA report, the KSPCB has accorded the 'Consent to Operate'.

SECTION G. Stakeholders' comments:

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

SMHP organised stakeholder consultation meetings with individual village panchayat (elected body of representatives administering the local area) in the area with the objective to inform the interested stakeholders on the environmental and social impacts of the project activity and discuss their concerns regarding the project activity. Invitation for stakeholder consultation meetings were sent out requesting the members of village panchayat to participate and communicate any suggestions/objections regarding the project activity in writing. On the day of meeting, SMHP representatives presented the salient features of the company and the project activity to the participants and requested their suggestions/objections.

The other stakeholders identified for the project activity are as under:

- Elected body of representatives administering the local area (village *Panchayat*)
- Karnataka Power Transmission Corporation Limited (KPTCL)
- Karnataka Electricity Regulatory Commission (KERC)
- Karnataka Renewable Energy Development Agency Limited (KREDL)
- Karnataka State Pollution Control Board (KSPCB)
- Environment Department, Government of Karnataka
- Ministry of Environment & Forest (MoEF), Government of India
- Ministry of Non Conventional Energy Sources (MNES)
- Ground water / Irrigation department
- Non-Governmental Organisations (NGOs) of the nearby area
- Project Consultants
- Equipment Manufacturers / Suppliers

Stakeholders list includes the government and non-government parties, which were involved in the project activity at various stages. At the appropriate stage of the project development, SMHP consulted them to get the comments.

G.2. Summary of the comments received:

The village Panchayat /local elected body of representatives administering the local area is a true representative of the local population in a democracy like India. Hence, their consent / permission to set up the project is necessary. SMHP has already completed the necessary consultation.

Local population comprises of the local people in and around the project area. The role of the local people are as a beneficiary of the project as it includes local manpower working at the plant site. Since, the project will provide good direct and indirect employment opportunities the local populace is encouraging the project.

The project will not require displacement of any local population. In addition, the local population is also an indirect consumer of the power that is supplied from the power plants. This is essentially because the power sold to the grid is expected to improve the stability in the local electricity network. Since, the distance between the electrical substation for power evacuation and the plant is not very high, installation of transmission lines will not create any inconvenience to the local population.

Thus, the project will not cause any adverse social impacts on local population rather will help in improvising their quality of life.

Karnataka State Pollution Control Board (KPCB) and Environment Department of Government of Karnataka have prescribed standards of environmental compliance and monitor the adherence to the standards

As a buyer of the power, the KPTCL is a major stakeholder in the project. They hold the key to the commercial success of the project. KPTCL has already cleared the project and SMHP has already signed Power Purchase Agreement (PPA) with KPTCL.

The government of India, through Ministry of Non-conventional Energy Sources (MNES), has been promoting energy conservation, demand side management and viable renewable energy projects including wind, small hydro and bagasse cogeneration / bio-mass power.

Project consultants are to be involved in the project to take care of various pre contract and post contract project activities like preparation of Detailed Project Report (DPR), preparation of basic and detailed engineering documents, preparation of tender documents, selection of vendors / suppliers, supervision of project implementation, Successful commissioning and trial runs.

Equipment suppliers will be supplying the equipments as per the specifications finalized for the project and will be responsible for successful erection & commissioning of the same at the site and for performance.

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

JSL in a meeting with the local pollution control board (Karnataka State Pollution Control Board) highlighted the various environmental issues with regard to the project. After evaluating the project, KSPCB granted the ‘Consent to Establish’ and “Consent to Operate”. This detailed and thorough process ensures proper stakeholders consultation.

In view of various direct and indirect benefits (social, economical, environmental), no concerns were raised during the consultation with stakeholders, hence it is not required to take due account of the comments.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding as part of project financing from parties included in Annex I of the convention is involved in the project activity.

Annex 3

BASELINE INFORMATION

2002 – 2003

	AP	KAR	KER	TN+Pond	Total
Thermal Coal Based-State	23032.1	10291.9	0.0	21079.8	54403.8
Thermal Coal Based-Central	4670.0	0.0	0.0	16908.2	21578.2
IPP-Coal Based	0.0	0.0	0.0	472.3	472.3
Lignite based power plant	0.0	0.0	0.0	15375.1	15375.1
IPP-Gas (Naphtha) Based	8139.7	2081.2	2423.2	3538.4	16182.5
IPP-Diesel Based	339.4	1127.0	801.3	2420.3	4688.0
Hydro-State	3394.8	7320.4	4866.1	2724.0	18305.2
Nuclear Based-Central	0.0	3308.4	0.0	1071.0	4379.4
IPP-Co-Generation+BIOMASS	1558.8	370.5	0.0	467.7	2396.9
IPP-Wind	103.1	84.2	2.4	1305.0	1494.7
	41237.9	24583.5	8093.1	65361.6	139276.2

2003-2004	Andhra	Kerala	Karnataka	Tamilnadu	Pondicherry	Total
Thermal Coal Based-State	22229	0	11400	20424		54053
Thermal Coal Based-Central	24054	0	0	0		24054
IPP-Coal Based	0	0	0	0		0
IPP-Gas (Naphtha) Based	8239	3109	1631	2927	277	16949
IPP-Diesel Based	0	657	661	1907		3225
Lignite based power plant	0	0	0	17791		17791
IPP - Coal, blast furnace gas	0	0	766	0	0	0
VVNL-Diesel Based(State)	0	0	0	0		0
Hydro-State	3210	3917	7459	2044		16630
IPP-Mini Hydel	0					0
VVNL-Hydro (State)	0					0
Hydro - TB Dam	0					0
Nuclear Based-Central	0		3123	1577		4700
IPP-Co-Generation + Biomass	0					1910
IPP-Wind	0					3500
Total	**57732**	**7683**	**25040**	**46670**		**142812**

2004-2005	Andhra	Kerala	Karnataka	Tamilnadu	Pondicherry	Total
Thermal Coal Based-State	23356.6	0	10717.93	20002.89	0	54077.42
Thermal Coal Based-Central	25291.93	0	0	0	0	25291.93
IPP-Coal Based	0	0		0	0	0
IPP-Gas (Naphtha) Based	8174.37	732.33	629.55	2466.47	275.69	12794.41
IPP-Diesel Based	0	312.64	549.92	1501.55	0	2364.11
Lignite based power plant	0	0	0	18078.66	0	18078.66
IPP - Coal, Blast furnace gas	0	0	516	0	0	0
VVNL-Diesel Based(State)	0	0	0	0	0	0
Hydro-State	5812.57	6144.02	8910.08	4413.11	0	25279.78
IPP-Mini Hydel	0	0	0	0	0	0
VVNL-Hydro (State)	0	0	0	0	0	0
Hydro - TB Dam	0	0	0	0	0	0
Nuclear Based-Central	0	0	2926.25	1480.18	0	4406.43
IPP-Co-Generation + Biomass	0	0	0	0	0	2080
IPP-Biomass	0	0	0	0	0	0
IPP-Wind	0	0	0	0	0	6000
Total	62635.47	7188.99	24249.73	47942.86	275.69	150372.74

Source: For 2002-03: Southern Regional Electricity Board Annual Report 2002-03

For 2003-04 & 2004-05: CEA Annual Generation data (cea.nic.in)

All units are expressed in **(Million kWh)**

Calculation of Baseline Emission factor for Southern Region

	2002-03		2003-04		2004-05	
Sector	**MU**	**%**	**MU**	**%**	**MU**	**%**
Thermal Coal Based-State	54403.766	39.06	54053	37.85	54077.42	35.96
Thermal Coal Based-Central	21578.237	15.49	24054	16.84	25291.93	16.82
IPP-Coal Based	472.294	0.34	0	0.00	0	0.00
IPP-Gas (Naphtha) Based	16182.487	11.62	16949	11.87	12794.41	8.51
Lignite based power plant	15375.106	11.04	17791	12.46	18078.66	12.02
IPP-Diesel Based	4688.043	3.37	3225	2.26	2364.11	1.57
Hydro-State	18305.244	13.14	16630	11.64	25279.78	16.81
Nuclear Based-Central	4379.39	3.14	4700	3.29	4406.43	2.93
IPP-Co-Generation+BIOMASS	2396.94	1.72	1910	1.34	2080	1.38
IPP-Wind	1494.664	1.07	3500	2.45	6000	3.99
Total	**139276.2**	**100.00**	**142812.0**	**100.00**	**150372.7**	**100.00**
Total generation excluding Low-cost power generation	112699.93	80.92	116072.00	81.28	112606.53	74.88
Generation by Coal out of Total Generation excluding Low-cost power generation	76454.30	54.89	78107.00	54.69	79369.35	52.78
Generation by Gas (Naphtha) out of Total Generation excluding Low-cost power generation	16182.49	11.62	16949.00	11.87	12794.41	8.51
Generation by Diesel out of Total Generation eexcluding Low-cost power generation	4688.04	3.37	3225.00	2.26	2364.11	1.57
Generation by lignite out of total generation excluding low - cost power generation	15375.106	11.04	17791	12.46	18078.66	12.02
Estimation of Baseline Emission Factor (tCO_2/MU)						
Simple Operating Margin						
Fuel 1 : Coal						
Avg. Calorific Value of Coal used (kcal/kg)		3828.6		3979.7		4069.4
Estimated Coal consumption (tons/yr)		47884000		52657000		53164000
Emission Factor for Coal-IPCC standard value (tonne CO2/TJ)		96.1		96.1		96.1
Oxidation Factor of Coal-IPCC standard value		0.98		0.98		0.98
COEF of Coal (tonneCO2/ton of coal)		1.51		1.57		1.60
Fuel 2 : Gas (Naphtha)						
Avg. Efficiency of power generation with gas as a fuel, %		45		45		45

Avg. Calorific Value of Gas used (kcal/kg)		11942		11942		11942	
Estimated Gas consumption (tons/yr)		2589727.91		2712395.09		2047524.63	
Emission Factor for Gas- IPCC standard value(tonne CO2/TJ)		56.1		56.1		56.1	
Oxidation Factor of Gas-IPCC standard value		0.995		0.995		0.995	
COEF of Gas(tonneCO2/ton of gas)		2.791		2.791		2.791	
Fuel 3 : Diesel							
Avg. Efficiency of power generation with diesel as a fuel, %		41.7		41.7		41.7	
Avg. Calorific Value of Diesel used (kcal/kg)		9760		9760		10186	
Estimated Diesel consumption (tons/yr)		990613.324		681463.026		478659.193	
Emission Factor for Diesel-IPCC standard value (tonne CO2/TJ)		74.1		74.1		74.1	
Oxidation Factor of Diesel-IPCC standard value		0.99		0.99		0.99	
COEF of Diesel (tonneCO2/ton of diesel)		3.00		3.00		3.13	
Fuel 4 : Lignite							
Avg. Efficiency of power generation with lignite as a fuel, %		25		25		25	
Avg. Calorific Value of Lignite used (kcal/kg)		2400		2400		2400	
Estimated lignite consumption (tons/yr)		22117730.6		25593094.8		26006905.7	
Emission Factor for Lignite-IPCC standard value (tonne CO2/TJ)		101.1		101.1		101.1	
Oxidation Factor of Lignite-IPCC standard value		0.98		0.98		0.98	
COEF of Lignite (tonneCO2/ton of lignite)		1.00		1.00		1.00	
EF (OM Simple, excluding imports from other grids), tCO2/MU		927.32		1014.26		1051.59	
EF (OM Simple), tCO2/MU		**927.32**		**1014.26**		**1051.59**	
Average EF (OM Simple), tCO2/MU							**997.72**
Considering 20% of Gross Generation							
Sector							
Thermal Coal Based-State						1554.00	5.15
Thermal Coal Based-Central						7296.00	24.20
IPP-Coal Based						0	0.00
Lignite based power plant						4668	15.48
IPP-Gas (Naphtha) Based						8520	28.26
IPP-Diesel Based						422.32	1.40
Hydro-State						2200.70	7.30
Nuclear Based-Central						0.00	0.00
IPP-Co-Generation + biomass						3493.40	11.59
IPP-Wind						2000	6.63

Total						**30154**	**100.00**
Generation by Coal out of Total Generation						8850.00	29.35
Generation by Gas out of Total Generation						8520.06	28.26
Generation by Diesel out of Total Generation						422.32	1.40
Generation by lignite out of Total Generation						4668	15.48
Built Margin							
Fuel 1 : Coal							
Avg. efficiency of power generation with coal as a fuel, %							32.5
Avg. calorific value of coal used, kcal/kg							4069.4
Estimated coal consumption, tons/yr							5752500.0
Emission factor for Coal (IPCC),tonne CO2/TJ							96.1
Oxidation factor of coal (IPCC standard value)							0.98
COEF of coal (tonneCO2/ton of coal)							1.605
Fuel 2 : Gas (Naptha)							
Avg. efficiency of power generation with gas as a fuel, %							45
Avg. calorific value of gas used, kcal/kg							11942
Estimated gas consumption, tons/yr							1363488.64
Emission factor for Gas (as per standard IPCC value)							56.1
Oxidation factor of gas (IPCC standard value)							0.995
COEF of gas(tonneCO2/ton of gas)							2.791
Fuel 3 : Diesel							
Avg. efficiency of power generation with diesel as a fuel, %							41.7
Avg. calorific value of diesel used, kcal/kg							10186
Estimated diesel consumption, tons/yr							85506.7
Emission factor for Diesel (as per standard IPCC value)							74.1
Oxidation factor of Diesel (IPCC standard value)							0.99
COEF of diesel tonneCO2/ton of diesel							3.13
Fuel 4 : Lignite							
Avg. efficiency of power generation with lignite as a fuel, %							25
Avg. calorific value of lignite used, kcal/kg							2400
Estimated lignite consumption, tons/yr							6714652.2
Emission factor for lignite (as per standard IPCC value)							101.1
Oxidation factor of lignite (IPCC standard value)							0.98
COEF of lignite tonneCO2/ton of lignite							1.00

EF (BM , excluding imports) (tCO2/MU)							662.90
EF (BM), tCO2/MU							**662.9**
Combined Margin Factor (Avg of OM & BM)							**830.3**
Baseline Emissions Factor (tCO2/MU)							**830.3**

Build Margin Details

Sr. No	Power Plant	Fuel	MW	MU (2004-05)
1	Raichur Unit VII	Coal	210	1554
2	NLC - 1 Expansion	lignite	210	1413
	NLC - 2 FST Extn	lignite	210	1824.68
3	Neyveli ST-CMS	lignite	250	1430
4	Talcher Stage II	Coal	500	
5	Kuttalam	Gas	100	640.88
6	Samayanallur	Diesel	106	382.02
7	Srisailam LBPH	Hydel	900	1411
8	Simhadri	Coal	500	4066
9	BSES	Gas	220	1141.34
10	Jegurupadu	Gas	235	1419.6
11	Kondapally	Gas	350	2246.34
12	LVS Power	Gas	36.8	0
13	Spectrum	Gas	208	1372.96
14	Ramagundam STPS	Coal	500	3230
15	Gerusoppa	Hydel	60	437.59
16	Alamatti	Hydel	125	138.68
17	Bellary	Diesel	25.2	40.3
18	KEPS	Gas	119	0
19	Valantharvi	Gas	52	0
20	Wind	Wind	1200	2000
21	Cogen+Biomass+ IG Wells		569.7	3493
22	Valuthur	Gas	95	558
23	Peddapuram CCGT	Gas	220	1141
24	Pykara	Hydel	70	213
	Total			**30154**
	20% of the total generation			**30075**
	Coal(State)			1554
	Coal(Central)			7296
	Lignite			4668
	Diesel			422
	Gas			8520
	Hydel(State)			2201
	Wind			2000
	IPP-Cogen+Biomass			3493

Annex 4
ABBREVIATIONS

BAU	Business As Usual
BESCOM	Bangalore Electric Supply Company Limited
BM	Build Margin
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CER	Certified Emission Reduction
CO_2	Carbon dioxide
CPU	Central Power Units
DPR	Detailed Project Report
EIA	Environment Impact Assessment
EPS	Electric Power Supply
GHG	Greenhouse gas
INR	Indian Rupees
IPCC	Inter Governmental Panel On Climate Change
IPP	Independent Power Producer
IREDA	Indian Renewable Energy Development Agency
ISPLAN	Integrated System Plan
Kg	Kilogram
Km	Kilometer
KERC	Karnataka Electricity Regulatory Commission
KPCL	Karnataka Power Corporation Limited
KPTCL	Karnataka Power Transmission Company Limited
KREDL	Karnataka Renewable Energy Development Agency Limited
KSPCB	Karnataka State Pollution Control Board
KSEB	Karnataka State Electricity Board
KW	Kilo watt
KWh	Kilo watt hour
KV	Kilo Volt
MNES	Ministry of Non Conventional Energy Sources
MoEF	Ministry of Environment and Forest
MOU	Memorandum of Understanding
MW	Mega watt
MWh	Megawatt Hour
NGO	Non Government Organization
OM	Operating Margin
PDD	Project design document
PLF	Plant Load Factor
PPA	Power Purchase Agreement
SEB	State Electricity Board
SGS	Shivanasamudram Generation Station
SHR	Station Heat Rate
SMHP	Seshadari Iyer Mini Hydel Power Project
SPM	Suspended Particulate Matter
T&D	Transmission & Distribution
UNFCCC	United Nations Framework Convention on Climate Change
VVNL	Vishweshwrayah Vidhut Nigam Limited

ANNEX 5
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 02
3.	UNFCCC document: Simplified modalities and procedures for small–scale clean development mechanism project activities
4.	UNFCCC document: Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories, Version 08
5.	UNFCCC document: Determining the occurrence of debundling
6.	Ministry of Power (MoP), Govt. of India, www.powermin.nic.in
7.	Central Electricity Authority (CEA), Govt. of India, www.cea.nic.in
8.	Emission Baselines-Estimating the Unknown, International Energy Agency
9.	Ministry of Environment and Forest, http://envfor.nic.in/cdm/host_approval_criteria.htm
10.	Detailed Project Report for Seshadari Iyer Mini Hydel Project