**Appendix A[1] to the simplified modalities and procedures for small-scale CDM project activities**

# CLEAN DEVELOPMENT MECHANISM
# SIMPLIFIED PROJECT DESIGN DOCUMENT
# FOR SMALL–SCALE PROJECT ACTIVITIES (SSC-PDD)
# Version 01 (21 January, 2003)

## Introductory Note

1. This document contains the clean development mechanism project design document for small-scale project activities (SSC-PDD). It elaborates on the outline of information in appendix B 'Project Design Document' to the CDM modalities and procedures (annex to decision 17/CP.7 contained in document FCCC/CP/2001/13/Add.2) and reflects the simplified modalities and procedures (herewith referred as simplified M&P) for small-scale CDM project activities (annex II to decision 21/CP.8 contained in document FCCC/CP/2002/7/Add.3).

2. The SSC-PDD can be obtained electronically through the UNFCCC CDM web site (http://unfccc.int/cdm/ssc.htm), by e-mail (cdm-info@unfccc.int) or in print from the UNFCCC secretariat (Fax: +49-228-8151999).

3. Explanations for project participants are in italicized font *(e.g. explanation)*.

4. The Executive Board may revise the SSC-PDD if necessary. Revisions shall not affect small-scale CDM project activities validated prior to the date at which a revised version of the SSC-PDD enters into effect. Versions of the SSC-PDD shall be consecutively numbered and dated. The SSC-PDD will be available on the UNFCCC CDM web site in all six official languages of the United Nations.

5. In accordance with the CDM modalities and procedures, the working language of the Board is English. The completed SSC-PDD shall therefore be submitted to the Executive Board in English.

6. Small-scale activities submitted as a bundle, in accordance with paragraphs 9 (a) and 19 of the simplified M&P for small-scale CDM project activities, may complete a single SSC-PDD provided that information regarding A.3 (*Project participants*) and A.4.1 *(Location of the project activity)* is completed for each project activity and that an overall monitoring plan is provided in section D.

7. A small-scale project activity with different components eligible to be proposed[2] as a small-scale CDM project activity may submit one SSC-PDD, provided that information

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[1] This appendix has been developed in accordance with the simplified modalities and procedures for small-scale CDM project activities (contained in annex II to decision 21/CP.8, see document FCCC/CP/2002/7/Add.3) and it constitutes appendix A to that document. For the full text of the annex II to decision 21/CP.8 please see http://unfccc.int/cdm/ssc.htm).

[2] In paragraph 7 of simplified M&P for small-scale CDM project activities, on clarifications by the Executive Board on small-scale CDM project activities, the Board agreed that in a project activity with more than one component that will benefit from simplified CDM modalities and procedures, each component shall meet the threshold criterion of each applicable type, e.g. for a project with both a renewable energy and an energy efficiency component, the renewable energy component shall meet the criterion for 'renewable energy' and the energy efficiency component that for 'energy efficiency'.

regarding subsections A.4.2 (*Type and category(ies) and technology of project activity*), and A.4.3 (*brief statement on how anthropogenic emissions of greenhouse gases (GHGs) by sources are to be reduced by the proposed CDM project activity)* and sections B *(Baseline methodology)*, D *(Monitoring methodology and plan)* and E *(Calculation of GHG emission reductions by sources)* is provided separately for each of the components of the project activity.

8. If the project activity does not fit any of the project categories in appendix B of the simplified M&P for small-scale CDM project activities, project proponents may propose additional project categories for consideration by the Executive Board, in accordance to paragraphs 15 and 16 of the simplified M&P for small-scale CDM project activities. The project design document should, however, only be submitted to the Executive Board for consideration after it has amended appendix B as necessary.

9. A glossary of terms may be found on the UNFCCC CDM web site or from the UNFCCC secretariat by e-mail (cdm-info@unfccc.int) or in print (Fax: +49-228-8151999).

**CONTENTS**

## A. General description of project activity

### A.1 Title of the project activity:

Palachan Small Hydro Power Project, Himachal Pradesh, INDIA.

### A.2 Description of the project activity:

*(Please include in the description*
*- the purpose of the project activity*
*- the view of the project participants on the contribution of the project activity to sustainable development (max. one page).)*

The main purposes of this project activity are:

1. Electricity generation from three run-of-the-river small hydro projects located in Kullu District, Himachal Pradesh
2. Harnessing of already available natural resource by generating more electricity, exposing the local population to job opportunities and increasing their income level thus leading to livelihood improvement through sustainable development.

- The three hydroelectric projects, with total capacity of 12MW, are planned in cascade on Palachan Khad, a tributary of Tirthan River, in Himachal Pradesh, India.

The proposed projects are run–of–the river type and does not include construction of dam. The reconnaissance survey, detailed survey, investigation of the project site – involving topographical survey, geo-technical investigations on both banks of the river and the hydrological study have been carried out. Based on these surveys various project components have been designed. Breakup of the total capacity in the three different projects is given below:

- Bathad Hydroelectric Project : 4.5 MW
- Banagi Hydroelectric Project :4 MW
- Farari Hydroelectric Project : 3.5 MW

**View of the project participants on the contribution of the project activity to sustainable development**

In India, power generation is mainly from the coal based power plants. Use of coal and other fossil fuels for large scale power generation have negative environmental impact globally, through emissions of greenhouse gases. They even have a negative impact locally. Hydro power generation is in itself clean power generation where in fossil fuels

are not used. Further, the proposed project is run–of–the river which does not involve construction of dam, which in itself is a negative environmental impact.

In addition to augmenting the power generation, the project activity tends to provide around 40 – 45 direct as well as indirect job opportunities to the local population for various activities involved in construction, commissioning, running and O&M of each of the projects. This would improve their income generation and thus would improve their livelihoods. Further due to the project activity in the region the infrastructure will also be developed e.g. building of roads in the area which would result in overall economic development of the area. All these would definitely contribute towards sustainable development of the local population.

### A.3 Project participants:

*(Please list Party(ies) and private and/or public entities involved in the project activity and provide contact information in annex 1 of this document.)*

*(Please designate one of the above as the official contact for the CDM project activity.)*

DCM Shriram Consolidated Ltd(DSCL), is the only party involved in the project activity.

| | |
|---|---|
| Organization: | DCM Shriram Consolidated Ltd.(DSCL) |
| Street/P.O.Box: | 2nd Floor, Kanchenjunga Building, 18, Barakhamba Road |
| Building: | Kanchenjunga Building |
| City: | New Delhi |
| State/Region: | Delhi |
| Postcode/ZIP: | 110001 |
| Country: | India |
| Telephone: | +91-11-23316801 |
| FAX: | +91-11-23319062 |
| E-Mail: | nishamenon@dscl.com |
| Contact Persons Name: | Nisha Mennon |
| Title: | Sr Analyst |

## A.4 Technical description of the project activity:

### A.4.1 Location of the project activity:

**A.4.1.1** Host country Party(ies):

India

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

The project area is in the state of Himachal Pradesh.

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

The hydroelectric projects are located in Kullu district of Himachap Pradesh. The three hydro poweer projects are planned in cascade on Palachan Khad, a tributary of Tirthan river, which in turn is a major tributary of Beas river as shown in the project location map.

**A.4.1.4** Detailed description of the physical location, including information allowing the unique identification of this project activity *(max one page)*:

The Palachan Khad is located about 44 km from National Highway 21 (Chandigarh–Manali). A motorable road connects the project site to NH21.

Palachan Khad originates from the snow–capped mountains at an elevation of 4875 m. The stream flows in the SW direction till its confluence with the Tirthan River. The eco-development zone of the GHNP (Great Himalayan National Park) falls on the right bank of the stream. Most of the project components are located on grassland and exposed rocky surfaces of mid Himalayan range. The location is sparsely populated and there will be no displacement of local inhabitants.

**Project location**

## A.4.2 Type and category(ies) and technology of project activity

*(Please specify the type and category of the project activity using the categorization of appendix B to the simplified M&P for small-scale CDM project activities, hereafter referred to as appendix B. Note that appendix B may be revised over time and that the most recent version will be available on the UNFCCC CDM web site.*

*In this section you shall justify how the proposed project activity conforms with the project type and category selected (for simplicity, the rest of this document refers to 'project category' rather than 'project type and category').*

*If your project activity does not fit any of the project categories in appendix B, you may propose additional project categories for consideration by the Executive Board, in accordance with paragraphs 15 and 16 of the simplified M&P for small-scale CDM project activities. The final SSC-PDD project design document shall, however, only be submitted to the Executive Board for consideration after the Board has amended appendix B as necessary.)*

*(This section should include a description of how environmentally safe and sound technology and know-how is transferred to the host Party, if such a transfer is part of the project.)*

Project Category : Renewable Energy Project - TYPE I

Sub Category : I D Renewable electricity generation for a grid

**Technology of project activity**

The proposed project will have a capacity of 12 MW from three small hydro projects which are bundled to reduce the transaction costs. The electricity generated will be fed into a 33 kV (high tension) northern grid line.

The technology used in these hydro projects is to generate electricity from hydro potential through run–of–river schemes where no dam is built. The scheme envisages minimum civil works with no adverse environmental effect. The natural water is directed to a Forbay tank through a weir and channel arrangement. The water from the fore bay is fed to a turbine by penstock pipe. The turbine is coupled to a generator which produces electricity and then is fed to the grid. The whole operation is maintained by a sophisticated control system.

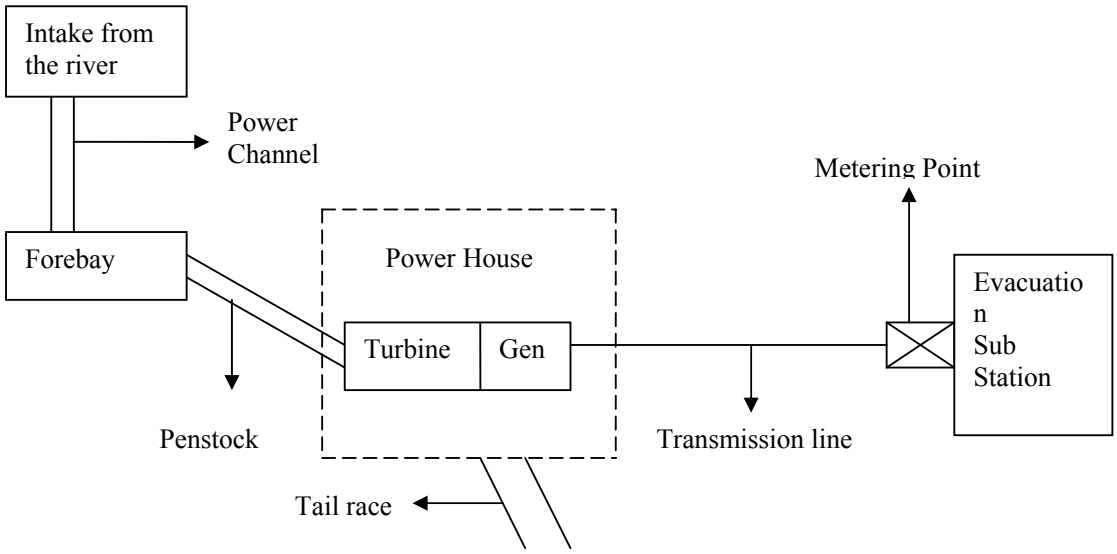
The Bathad Hydro Electric project will use a Pelton Turbine, the Banagi and Farari Hydro Electric Projects will employ Francis Turbines. The turbine is selected according to the head available at various sites. Kaplan is usually used for low head sites and Pelton for high head sites. The generators will be horizontal shaft synchronous type and the generation voltage will be 3.3 kV. Power generated will be evacuated at HPSEB's (Himachal Pradesh State Electricity Board) Sidhwan 33kV sub-station located 16 km from the Bathad power house site and 12 km from the

Farari power house site. The projects will include state-of-the art controls and instrumentation for remote monitoring of operation of power plant.

Electronic PLC based digital governor shall be provided. It shall control the speed as well as load of TG set in grid connection system. It shall detect speed / load from the reference value and convert these into the main servomotor stroke deviation in a characteristic manner. The electronic speed governor shall be linked to the mechanical hydraulic part of the governing system i.e. by servo valve. The governing system shall mainly consist of a) speed transducers b) position transducers c) microprocessor based governor unit e) Oil pumping unit etc., as per the system requirement.

PLC based Unit Control board shall be provided, which shall control all functions of the generating units, transformers and lines etc., both in auto & manual mode. A separate Unit Control Board shall be provided for each unit and shall comprise of ammeter, voltmeter, power factor meter, kWH meter, kVAR meter, frequency meter, recorder, push bottons, indicators etc., as per the system requirement. The energy meter shall be provided of 0.2 accuracy class for measurement of import & export of energy for the system

The Block Diagram given below shows the schematic of a small hydro project.




Block Diagram of a "Run–Of–the–River" Small Hydro Project

The table below gives a brief technical specification of the projects

| | **Bathad HEP** | **Banagi HEP** | **Farari HEP** |
|---|---|---|---|
| Installed Capacity | 4.5 MW | 4.0 MW | 3.5 MW |
| Annual net power generation | 23.45 Million kWh | 20.91 Million kWh | 19.15 Million kWh |
| **STREAM** | | | |
| Name | Palachan Khad | | |
| Source | Snow/ Glacier/ Rain Fed | | |
| Altitude (Power House) | 2024 m | 1855 m | 1728 m |
| Catchment Area at Diversion | 64.86 $km^2$ | 81.06 $km^2$ | 101.89 $km^2$ |
| **TECHNICAL DESCRIPTION** | | | |
| Gross Head, m | 246 | 132 | 106.5 |
| Net Head , m | 236 | 125 | 98 |
| Design Discharge, cumec | 2.25 | 3.76 | 4.20 |
| *Diversion Structure & Intake* | Trench type weir (RCC) | | |
| | Altitude 2267.5 | Altitude 1987 m | Altitude 1831 m |
| *Water Conductor Intake* | Steel Pipe of 1200mm dia, 35 m long | Steel Pipe of 1500mm dia, 138 m long | Steel Pipe of 1500mm dia, 205 m long |
| *De-silting Chamber* | Remove particles of size > 0.2 mm with appropriate flushing arrangement | | |
| *Power Channel* | Rectangular RCC 2500 m length Slope 1 in 735 | Rectangular RCC 1870m length Slope 1 in 2000 | Rectangular RCC 1588 m length Slope 1 in 2000 |
| *Fore bay Tank* | Rectangular RCC, 3 minutes storage 2 gates | | |
| *Penstock* | MS Fabricated anchor and saddle supports | | |
| | 1100 mm dia, 2 bifurcations, 350 m length | 1200 mm dia, 2 bifurcations, 230 m length | 1200 mm dia, 2 bifurcations, 230 m length |
| *Power House* | Surface Type | | |
| *Turbine* | 2 x 2250 kW Horizontal Pelton Turbine | 2 x 2000 kW Horizontal Francis | 2 x 1750 kW Horizontal Francis |
| *Generator* | 2 x 2250 kW | 2 x 2000 kW | 2 x 1750 kW |
| | Horizontal, synchronous, SESR brush less | | |
| *Transformer* | 8 MVA | 6.3 MVA | 5MVA |
| | 3.3/33 kV Delta Star Step Up ONAN | | |
| *Transmission Lines* | 33 kV 16 km | | |
| *Tail Race* | 2 channels – rectangular RCC | | |

**A.4.3 Brief statement on how anthropogenic emissions of GHGs (greenhouse gases) by sources are to be reduced by the proposed CDM project activity:**

*(Please state briefly how anthropogenic GHG (greenhouse gas) emission reductions are to be achieved (detail to be provided in section B.) and provide the estimate of total anticipated reductions in tonnes of $CO_2$ equivalent as determined in section E. below.)*

The proposed project activity of hydro power generation dose not result in any direct GHG emissions. The power generation from the project is supplied to the northern grid. The northern grid, with present generation mix, is dominated by coal based power generation and thus have high emissions intensity. The project will displace the fossil fuel based grid electricity with the hydro based electricity, contributing to GHG emission reductions. The project envisages annual generation of 63.51 million kWhr of energy which will be fed in to the northern grid. With present generation mix of the northern region it is estimated that the $CO_2$ emission reduction will be to the tune of 49537.8t $CO_2e$ (tonnes of carbon dioxide equivalent) per year. With a 10 -year crediting period, the project is expected to reduce approximately **495378 t**$CO_2e$, thereby generating equivalent amount of CERs(Certified Emission Reductions).

**A.4.4 Public funding of the project activity:**

*(Indicate whether public funding from Parties included in Annex I is involved in the proposed project activity. If public funding from one or more Annex I Parties is involved, please provide information on sources of public funding for the project activity in annex 2, including an affirmation that such funding does not result in a diversion of official development assistance and is separate from and is not counted towards the financial obligations of those Parties.)*

The proposed debt equity ratio for the project is 3:2. While the equity( Rs 215 million) would be invested by the promoters, remaining portion of the project cost(Rs 500 million) would come as commercial loans from the banking institutions. No funding/grant from the annex –I countries is involved for the project activity.

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

*(Please refer to appendix C to the simplified M&P for the small-scale CDM project activities for guidance on how to determine whether the proposed project activity is not a debundled component of a larger project activity.)*

The proposed project is not a debundled component of a larger project activity. The proposed hydro projects do not form a part of any larger activity and are independent.

## B. Baseline methodology

### B.1 Title and reference of the project category applicable to the project activity:

*(Please refer to the UNFCCC CDM web site for the most recent list of the small-scale CDM project activity categories contained in appendix B of the simplified M&P for small-scale CDM project activities.)*

Type I Renewable Energy Projects – ID Renewable Electricity Generation for a grid.

### B.2 Project category applicable to the project activity:

*(Justify the choice of the applicable baseline calculation for the project category as provided for in appendix B of the simplified M&P for small-scale CDM project activities.)*

According to article 23 of appendix B of the simplified M&P for small-scale CDM project activities, the category 'renewable generating unit, that supply electricity to an electricity distribution system that is or would have been supplied by at least one fossil fuel or nonrenewable biomass fired generating unit.'
Two methodologies for estimation of baseline, for the above mentioned category of projects, have been approved

1. Average of built margin and approximate operating margin of the grid
2. Grid system average of emissions from present generation mix

The selection of appropriate baseline methodology depends on the existing power sector scenario, grid size, generation mix and operation. The following section describes the selection of baseline methodology for the proposed project.

**Power scenario : India**

The total installed capacity in India, as on January 2004 was about 1 08 315.30 MW, with thermal power plants constituting a major share at 71.50 % of the total capacity, followed by hydro (26 %) and nuclear (2.5%). The total generation for the year 2003-2004 till January 2004 was about 460 712 million units, with nearly 83%, coming from thermal power plants. It is evident that the power generation is heavily dependent on the thermal generation. There are about 143 thermal power stations in India, out of which 90 are coal based and the remaining use other fuels like gas, diesel, naphtha, etc.

*In India, power is a concurrent subject between the state and the central governments*. The perspective planning, monitoring of implementation of power projects is the responsibility of Ministry of Power, Government of India. At the state level the state utilities or SEBs (state electricity boards) are responsible for supply, transmission, and distribution of power. In addition, there are different central / public sector organizations involved in generation like NTPC (National Thermal Power Corporation), NHPC (National Hydro Power Corporation), etc. in transmission e.g. PGCIL (Power Grid Corporation of India Ltd.) and in financing e.g. PFC (Power Finance Corporation Ltd.).

There are five regional grids in India: Northern, Western, Southern, Eastern and North-Eastern. Different states are connected to one of the five regional grids as shown in the Table below.

*States connected to different regional grids*

| *Regional grid* | Northern | Western | Southern | Eastern | North Eastern |
|---|---|---|---|---|---|
| *States* | *Haryana, Himachal Pradesh, Jammu & Kashmir, Punjab, Rajasthan, Uttar Pradesh, Uttaranchal, Delhi* | *Gujarat, Madhya Pradesh, Maharashtra, Goa, Chattisgarh* | *Andhra Pradesh, Karnataka, Kerala, Tamil Nadu,* | *Bihar, Orissa, West Bengal, Zarkhand* | *Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura* |

The management of generation and supply of power within the state and regional grid is undertaken by the SLDC (state load dispatch centres) and RLDC (regional load dispatch centres). Different states within the regional grids meet the demand from their own generation facilities plus generation by power plants owned by the central sector i.e. NTPC and NHPC etc. Depending on the demand and generation there are exports and imports of power within different states in the regional grid. Thus there is an exchange of power among states in the regional grid. Similarly there exists imports and export of power between regional grids.

**Power Scenario: Northern Grid**

The total installed capacity in the northern region is 30 484.5 MW, the present generation generation mix is given in the table below:

| **Region\type** | *Thermal MW* | *Hydro MW* | *Nuclear MW* | *Total MW* |
|---|---|---|---|---|
| Northern | 18 869.7 | 10 434.8 | 1 180 | 30 484.5 |

The details of the generation in the northern region during the year 2003-04 is provided in the annexure 3. It may be seen from this data that the power generation in northern region

is dominated by the thermal power plants. Out of total generation of 166 273 million units in the year 73% generation was from the thermal power plants, followed by hydro (22.4%) and nuclear (4.4%).

Himachal Pradesh is having all installed capacity based on hydro power. However it is net exporter of energy in the states in the northern grid. In the year 2003-04 it has exported 11 753 units to the northern grid. Himachal Pradesh also plans to increase the exports by exploiting the hydro resource in the state.

**Selection of Baseline methodology**

Power scenario in the northern grid

The proposed project would be feeding power in to the northern grid. The power scenario in the northern regional grid is of demand outstripping the supply. During the April to June 2004 period the energy and peak shortage in the northern region was 5.4% & 5.7 % respectively. The energy as well as peak shortage in the northern region are given in table 3, annexure 3. The state of Himachal Pradesh, where the project is located, is meeting its power demand, thus the additional power would be used in the other states of the northern regional grid.

The average of built margin and approximate operating margin:

There is a gap between demand and supply in the northern regional grid and it is expected to remain so in the future. Thus in case of project scenario, the operating margin method for estimating baseline would not be appropriate for the proposed project . In case of built margin approach the assumption is that the CDM project is affecting future planning of capacity additions. In case of India, though the renewable energy technologies for power generation are well developed, the installed capacity of renewable energy projects is still about 3700 MW, which is approximately 3.5% of total generation capacity. In addition to this, the small–scale CDM project of the size 12MW would not have an impact on planned capacity additions which are in terms of hundreds of MW of individual power plant capacity. Thus it is unlikely that run of the river type projects of total capacity 12.5 MW project will alter the decisions regarding new capacity additions in the northern grid.

In case of the project scenario, the power fed in to the grid would simply displace the present generation mix in the northern region. Thus the grid system average method is appropriate for estimation of baseline for the proposed project.

**B.3 Description of how the anthropogenic GHG emissions by sources are reduced below those that would have occurred in the absence of the proposed CDM project activity**

*(Justify that the proposed project activity qualifies to use simplified methodologies and is additional using attachment A to appendix B of the simplified M&P for small-scale CDM project activities.)*

*(National policies and circumstances relevant to the baseline of the proposed project activity shall be summarized here as well.)*

According to article 23 of appendix B of the simplified M&P for small scale CDM project activities, the category 'renewable generating unit, that supply electricity to an electricity distribution system that is or would have been supplied by at least one fossil fuel or nonrenewable biomass fired generating unit'.

The proposed project is to generate power from three run-of-the river hydro power plants having a total capacity of 12 MW. Thus the project is small scale CDM activity having power generation capacity below 15MW.

Project additonality

i. The projected investment in the proposed plants is about Rs 715 million. This comes upto Rs 59.6 million/MW, which is higher than the cost/MW of conventional power plants which is around 30-40 million/MW (*source: CEA*). Further in case of run-of-the river small hydro projects the generation is uncertain, due to the very fact that there is no reservoir, compared with the conventional as well as other small hydro plants involving storage. Thus the uncertainty or the risk in terms of the generation is a barrier for investment, especially in case of Himachal Pradesh where large hydro potential for small hydro plants, with storage dams, is available. Thus the risk in the run-of-the river project vis a vis the other small hydro plants and the conventional power plants is an barrier.

Further the sites identified for the run-of-the river projects are unique where normal small hydro plants with dams can not be constructed. Thus with the investment barrier the potential at these site will remain untapped. Though the state has a estimated run of the river hydro potential of 1624.78 MW, only 93.54 MW of capacity has been utilised.

ii. The evacuation of the power generated by the project to the grid is a major concern. The power generated has to be transmitted through long distances to the available grid/sub

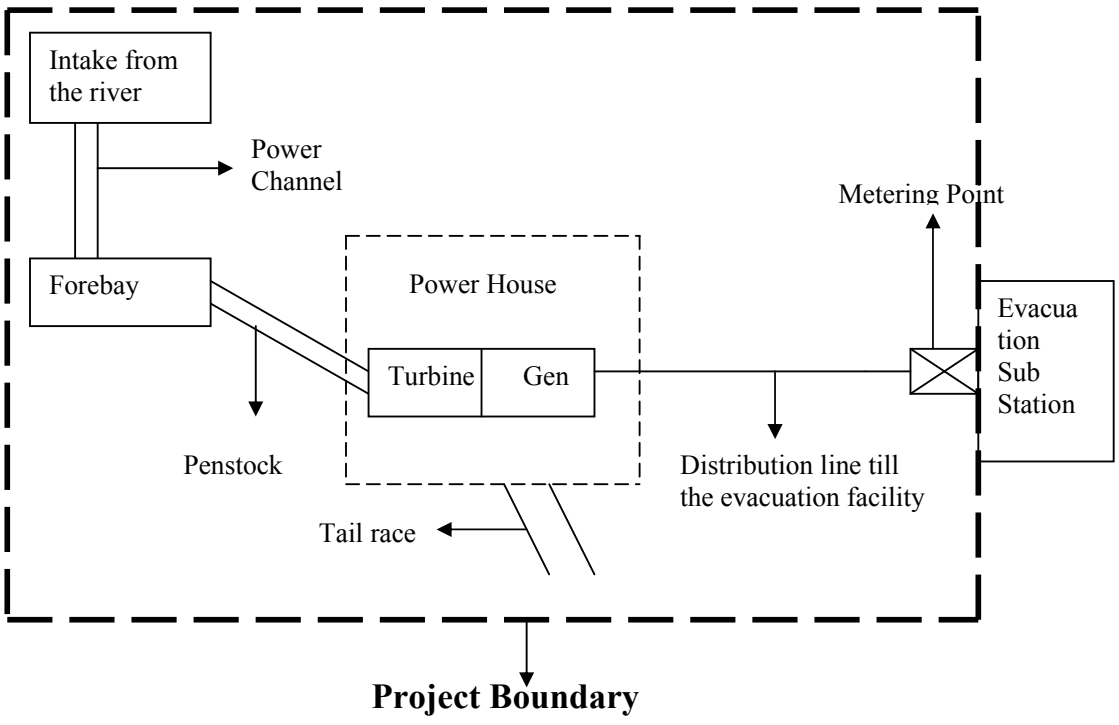
station. This involves technical issues and investment in substation if the grid is far away from the place electricity is generated.

iii. The project requires a number of administrative approvals as well as power purchase agreements with the state electricity boards and environmental clearances. This takes a considerable amount of time for the project to reach the implementation stage. This is a barrier for such small-scale project activity.

## B.4 Description of the project boundary for the project activity:

*(Define the project boundary for the project activity using the guidance specified in the applicable project category for small-scale CDM project activities contained in appendix B of the simplified M&P for small-scale CDM project activities.)*

Project Boundary is the physical boundary around the three individual small hydro projects. This includes the catchment's areas, weirs, intake, feeder pipes, de silting tanks, power channel forebay, power house, tail race and the transmission system till the evacuation point as shown in the block diagram below. The power generated from these projects is metered and accurately quantifiable.



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

**B.5.1** *Specify the baseline for the proposed project activity using a methodology specified in the applicable project category for small-scale CDM project activities contained in appendix B of the simplified M&P for small-scale CDM project activities*:

The proposed project uses the weighted average carbon emission factor of the current generation mix i.e. system average baseline methodology. This is the approved methodology for small-scale renewable energy projects supplying power into grid.

Thus the weighted average of carbon emission factor for all power generation activities in the northern regional grid, to which the proposed project would be supplying the power, would form the baseline for the proposed project.

**B.5.2** Date of completing the final draft of this baseline section *(DD/MM/YYYY)*:
11/07/2004

**B.5.3** Name of person/entity determining the baseline:
*(Please provide contact information and indicate if the person/entity is also a project participant listed in annex 1 of this document.)*

| | **Corresponder's Data** |
|---|---|
| Company name | The Energy and Resources Institute (TERI) |
| Address | Habitat Place |
| Zip code + city address | India Habitat Centre |
| Postal address | Lodhi Road |
| Zip code + city | 110 003 New Delhi |
| Country | India |
| Contact person: | Mr. Mahesh Vipradas |
| Job title | Fellow |
| Telephone number | + 91 - 11 - 24682100 |
| Fax number | + 91 - 11 - 24682144 |
| E-mail | vipradas@teri.res.in |

## C. Duration of the project activity and crediting period

### C.1 Duration of the project activity:

**C.1.1** Starting date of the project activity

*(For a definition of the term 'starting date', please refer to the UNFCCC CDM web site).*

The starting date for the project is May 2006. The construction of project will start by December 2004 and the projects are proposed to be commissioned by May 2006 in the same season.

**C.1.2** Expected operational lifetime of the project activity: *(in years and months, e.g. two years and four months would be shown as: 2y-4m.)*

25y-0m

### C.2 Choice of the crediting period and related information: *(Please underline the selected option (C.2.1 or C.2.2) and provide the necessary information for that option.)*

*(Note that the crediting period may only start after the date of registration of the proposed activity as a CDM project activity. In exceptional cases, the starting date of the crediting period can be prior to the date of registration of the project activity as provided for in paragraphs 12 and 13 of decision 17/CP.7 and in any guidance by the Executive Board, available on the UNFCCC CDM web site.)*

**C.2.1 Renewable crediting period *(at most seven (7) years per crediting period)***

**C.2.1.1** Starting date of the first crediting period *(DD/MM/YYYY)*:

**C.2.1.2** Length of the first crediting period *(in years and months, e.g. two years and four months would be shown as: 2y-4m.)*:

**C.2.2 Fixed crediting period *(at most ten (10) years)*: This crediting period was chosen in consultation with the developer.**

**C.2.2.1** Starting date *(DD/MM/YYYY)*: 01/05/2006

**C.2.2.2** Length (max 10 years) : 10 years

## D. Monitoring methodology and plan

*(The monitoring plan shall incorporate a monitoring methodology specified for the applicable project category for small-scale CDM project activities contained in appendix B of the simplified M&P for small-scale CDM project activities and represent good monitoring practice appropriate to the type of project activity.*

*The monitoring plan shall also provide information on the collection and archiving of the data specified in appendix B of the simplified M&P for small-scale CDM project activities to:*
*- Estimate or measure emissions occurring within the project boundary;*
*- Determine the baseline, as applicable;*
*- Estimate leakage, where this needs to be considered.*

*Project participants shall implement the registered monitoring plan and provide data, in accordance with the plan, through their monitoring reports.*

*Operational entities will verify that the monitoring methodology and plan have been implemented correctly and check the information in accordance with the provisions on verification. This section shall provide a detailed description of the monitoring plan, including an identification of the data to be collected, its quality with regard to accuracy, comparability, completeness and validity, taking into consideration any guidance contained in the methodology, and archiving of the data collected.*

*Please note that monitoring data required for verification and issuance are to be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.*

*An overall monitoring plan that monitors performance of the constituent project activities on a sample basis may be proposed for bundled project activities. If bundled project activities are registered with an overall monitoring plan, this monitoring plan shall be implemented and each verification/certification of the emission reductions achieved shall cover all of the bundled project activities.)*

### D.1 Name and reference of approved methodology applied to the project activity:

*(Please refer to the UNFCCC CDM web site for the most recent version of the indicative list of small-scale CDM project activities contained in appendix B of the simplified M&P for small-scale CDM project activities.)*

*(If a national or international monitoring standard has to be applied to monitor certain aspects of the project activity, please identify this standard and provide a reference to the source where a detailed description of the standard can be found.)*

The proposed project is of Type I Renewable Energy Projects – ID Renewable Electricity Generation for a grid.

The monitoring methodology involves metering of the electricity generated and supplied to the grid by the proposed hydro project.

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

*(Justify the choice of the monitoring methodology applicable to the project category as provided for in appendix B.)*

The proposed project is eligible as a small scale project (see section 2.2.2), category 'Renewable electricity generation for a grid' (1.D.). The monitoring methodology is consistent with the methodology as required in Appendix B (UNFCCC, 2003b).
The proposed methodology thus provides measured data on the amount of electricity generated through energy meters. With this information, a reliable estimate of the amount of emission reduction can be made.

## D.3 Data to be monitored:

*(The table below specifies the minimum information to be provided for monitored data. Please complete the table for the monitoring methodology chosen for the proposed project activity from the simplified monitoring methodologies for the applicable small-scale CDM project activity category contained in appendix B of the simplified M&P for small-scale CDM project activities.*

*Please note that for some project categories it may be necessary to monitor the implementation of the project activity and/or activity levels for the calculation of emission reductions achieved. Please add rows or columns to the table below, as needed)*

The data to be monitored is given in table below

Table: Data to be monitored

| ID No | Data Type | Data Variable | Data Unit | Measured (m), Calculated © 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 |
|---|---|---|---|---|---|---|---|---|---|
| a | Quantitative | Electricity Generated From Bathad Project | kWh | m | monthly | 100% | Electronic and paper | Crediting period | Summing up of total electrical units generated over the month |
| b | Quantitative | Electricity Generated From Banagi Project | kWh | m | monthly | 100% | Electronic and paper | Crediting period | Summing up of total electrical units generated over the month |
| c | Quantitative | Electricity Generated From Farari project | kWh | m | monthly | 100% | Electronic and paper | Crediting period | Summing up of total electrical units generated over the month |

### D.4 Name of person/entity determining the monitoring methodology:

*(Please provide contact information and indicate if the person/entity is also a project participant listed in annex 1 of this document.)*

The Energy and Resources Institute(TERI) is determining the monitoring methodology.

| | |
|---|---|
| Company name | The Energy and Resources Institute (TERI) |
| Address | Habitat Place |
| Zip code + city address | India Habitat Centre |
| Postal address | Lodhi Road |
| Zip code + city | 110 003 New Delhi |
| Country | India |
| Contact person: | Mr. Mahesh Vipradas |
| Job title | Fellow |
| Telephone number | + 91 - 11 - 24682100 |
| Fax number | + 91 - 11 - 24682144 |
| E-mail | vipradas@teri.res.in |

## E. Calculation of GHG emission reductions by sources

### E.1 Formulae used:

*(In E.1.1 please provide the formula used to calculate the GHG emission reductions by sources in accordance with the applicable project category of small-scale CDM project activities contained in appendix B of the simplified M&P for small-scale CDM project activities.*

*In case the applicable project category from appendix B does not indicate a specific formula to calculate the GHG emission reductions by sources, please complete E.1.2 below.)*

#### E.1.1 Selected formulae as provided in appendix B:

*(Describe the calculation of GHG emission reductions in accordance with the formula specified for the applicable project category of small-scale CDM project activities contained in appendix B of the simplified M&P for small-scale CDM project activities.)*

The formulae used for estimation of CO2 emission from individual power plants depending upon the available data about the efficiency of the power plant. Two types of information are available about the performance of power plant:

1. Heat rate (kCal/kWh)
2. Specific fuel consumption (Kg/kWh)

Depending on availability of one of two above performance data, the emission from individual power plant was estimated using following formulae

Estimation of emissions based on heat rate

The plant heat rate gives the amount of heat required to generate one unit of electricity. The amount of $CO_2$ emission is estimated from heat rate using following formula.

Gross Emissions (kg/ kWh) = heat rate (kcal/ kWh) × emission factor (kg/kg)/ Calorific value (kcal/kg)

The emission factor is estimated from the IPCC emission coefficients for different fuels using calorific value for different fuels. The calorific value used for different fuels are given in annexure 4.

*Estimation of emissions based on specific coal consumption*

The emissions from the specific fuel consumption are estimated using following formula

Gross emissions (kg/ kWh) = specific fuel consumption (kg/ kWh) × emission factor (kg/kg)

The generally reported figures are for gross generation from the given power plant thus the emissions are corrected for net generation using following formula.

Net emission (kg/kWh) = Gross emissions (kg/kWh) / {1- auxiliary consumption (%)}

In coal based power plants the coal linkage, thus the coal grade, is identified. Therefore, calorific value and the carbon emissions factor of the respective grade coal is used to estimate the plant emissions. However, in actual practice coal from different sources and hence of different grades is used by individual power plants. Since the IPCC emissions factors were used, which are provided as emissions per unit of energy from a particular type of fuel, the plant emissions would be the same even if different grade coal is used.

Total $CO_2$ emissions from a power plant in a year are estimated from net annual generation

Plant emissions (tonne) = net emissions (kg/kWh) × net generation (kWh)/1000

Total regional emissions (tonne) = Σ plant emissions (tonne)

Baseline emission = total regional emissions / total generation from all sources

The total generation for estimation of baseline includes generation from all power plants in the northern region i.e. thermal, hydro and nuclear. The detailed baseline estimation is given in annexure 5.

### 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: (for each gas, source, formulae/algorithm, emissions in units of $CO_2$ equivalent)*

**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 (for each gas, source, formulae/algorithm, emissions in units of $CO_2$ equivalent)*

**E.1.2.3** The sum of E.1.2.1 and E.1.2.2 represents the project activity emissions:

**E.1.2.4** Describe the formulae used to estimate the anthropogenic emissions by sources of GHG's 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: *(for each gas, source, formulea/algorithm, emissions in units of $CO_2$ equivalent)*

**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:

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

Annual Energy Generated

Bathad Hydro Electric Project = 23.45MU

Banagi Hydro Electric Project = 20.91MU

Farari Hydro Electric Project = 19.15MU

Total Annual Energy Units Generated and fed in to Northern grid = **63.51MU/yr**

Baseline emission factor = **0.781 kg/unit**

Crediting period = 10 yrs

| Year | 2006-07 | 2007-08 | 2008-09 | 2009-10 | 2010-2011 | 2011-2012 | 2012-2013 | 2014-2015 | 2015-2016 | 2016-2017 |
|---|---|---|---|---|---|---|---|---|---|---|
| Units Generated (MkWh) | 63.51 | 63.51 | 63.51 | 63.51 | 63.51 | 63.51 | 63.51 | 63.51 | 63.51 | 63.51 |
| Baseline emission factor | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 | 0.781 |
| CER's | 49537 | 49537 | 49537 | 49537 | 49537 | 49537 | 49537 | 49537 | 49537 | 49537 |

Total amount of emission reduction = **495378t of Co2.**

**Please refer Annexure 3 for tables regarding the northern region electricity generation scenario.**

## F. Environmental impacts

**F.1 If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:** *(if applicable, please provide a short summary and attach documentation)*

Environmental clearances required to set up the hydro projects are required which are being processed by the developer. EIA is not mandatory, but the project developer has made the analysis on

a) Impact due to project location, involving impact on settlements, flora fauna and rehabilitation problems

b) Impact due to project design involving seismicity and climate.

c) Impact due to construction works involving pollution, soil erosion, sanitary and health effect

d) Impact due to project operation involving land inundation, water logging and salinity

The proposed activities by the developer are

a) Compensatory afforestation

Some trees may be felled for project construction works. Compensatory afforestation would be carried out in the vicinity of the project area. This would also deter the soil erosion. A budgetary provision of Rs 0.5 million has been kept for the same.

b) Restoration of construction areas and disposal of muck

The entire construction area shall be properly landscaped when the project is completed so as to merge the project with the natural surroundings. Major portion of the muck generated during excavation of diversion channel, desilting tank, forebay shall be dumped in the properly demarcated sites. The dumping sites shall be identified before project implementation in consultation with the state authorities. These dumping sites shall have proper protection works like wire crates, etc to make the slopes stable. A total provision of Rs 0.4 million has been kept for the same.

c) Provision of fuel and labour force

Fuel wood shall be purchased from depots of the Forest Department and shall be provided free of cost to the labour force to ensure that such requirements do not compel the work force to fell trees during the construction of the project. The project staff shall be provided with electricity connection and LPG cylinders. A provision of Rs 0.1 million has been kept for this purpose.

d) Anti poaching measures

The construction labour and project staff will be educated in terms of environmental concerns and relevant anti poaching laws in consultation with the forest department. Apart from this, suitable information dissemination activities like setting up of notice boards, posters etc. at appropriate places to warn people against poaching in the area would be carried out. It is felt that these measures may benefit the people in general making them more aware and concerned with their natural surroundings.

e) Environment monitoring cell

An environment-monitoring cell would be set up during the construction & operation phases of the project to supervise all the above activities and liaison with state/ central government authorities. A provision of Rs.0.2 million has been earmarked for the same in the project budget.

## G. Stakeholders comments

### G.1 Brief description of the process by which comments by local stakeholders have been invited and compiled:

The developer to provide the official documents regarding the comments received. The procedure which would be applied to collect the comments are

1) Meeting with the villagers on whose land the construction activities would take place and minutes of the meetings would be documented
2) Meeting with state electricity board officials
3) Meetings with the forest officials
4) Meetings with the villagers who are staying in the surrounding environment

## Annex 1: Contact Information For Participants In The Project Activity

*(Please repeat table as needed)*

| | |
|---|---|
| Organization: | DCM Shriram Consolidated Ltd.(DSCL) |
| Street/P.O.Box: | 2nd Floor, Kanchenjunga Building, 18, Barakhamba Road |
| Building: | Kanchenjunga Building |
| City: | New Delhi |
| State/Region: | Delhi |
| Postcode/ZIP: | 110001 |
| Country: | India |
| Telephone: | +91-11-23316801 |
| FAX: | +91-11-23319062 |
| E-Mail: | nishamenon@dscl.com |
| URL: | |
| Represented by: | |
| Title: | Sr Analyst |
| Salutation: | Ms |
| Last Name: | Menon |
| Middle Name: | |
| First Name: | Nisha |
| Department: | |
| Mobile: | |
| Direct FAX: | +91-11-23319062 |
| Direct tel: | +91-11-23316801 |
| Personal E-Mail: | nishamenon@dscl.com |

## Annex 2

## INFORMATION REGARDING PUBLIC FUNDING

No public funding from Annex I countries was sought for the proposed project activity

## Annex 3 : Data for northern regional grid

Table 1: State wise generation mix 2003-04

| | **Thermal Generation in MW** | **Nuclear Generation in MW** | **Hydro Generation in MW** | **Total Generation In MW** |
|---|---|---|---|---|
| Delhi | 10593 | - | - | **10593** |
| Haryana | 9536 | - | 256 | **9792** |
| Himachal Pradesh | - | - | 11753 | **11753** |
| Jammu and Kashmir | 29 | - | 7241 | **7270** |
| Punjab | 14235 | - | 11346 | **25581** |
| Rajasthan | 18079 | 4323 | 643 | **23045** |
| Uttar Pradesh | 69149 | 3041 | 2145 | **74335** |
| Uttaranchal | - | - | 3904 | **3904** |
| **Total** | **121621** | **7364** | **37288** | **166273** |

Table 2: Northern regional grid fuel mix: Installed capacity and generation

| | Installed capacity (MW) | Generation during 2003-04 (GWh) |
|---|---|---|
| Thermal | 18869.7 | 121621 |
| Nuclear | 1180.0 | 7364 |
| Hydro | 10434.8 | 37288 |
| Total | 30484.5 | 166273 |

Source: CEA Website. Annual Energy Generation 2003-04.

Table 3: Energy and peak shortage in Northern Region

| Shortage\ Year | 2003-04 | 2002-03 | 2001-02 |
|---|---|---|---|
| Energy | 4.7% | 8.1% | 5.3% |
| Peak | 6.3% | 9.6% | 11.3% |

## Annex 4: Calorific values for different fuels

Table 1: Calorific values for different fuels

| Coal type | Average calorific Value (kcal/kg) |
|---|---|
| Coal Grade D | 4583 (*) |
| Coal Grade E | 4045 (*) |
| Coal Grade F | 3437 (*) |
| Washed coal | 4100 (*) |
| Imported coal | 6400 (*) |
| Lignite | 2800 (*) |
| Natural Gas | 12428 (**) |
| Diesel | 10316 (**) |
| Heavy Furnace Oil | 9596 (**) |

* - Fourth National Power Plan 1997-2012, CEA (Central Electricity Authority). 1997.

New Delhi: CEA, Ministry of Power, Government of India

** - IPCC Guidelines for national Greenhouse Gas Inventories: Workbook, Module 1: Energy

IPCC (Intergovernmental Panel on Climate Change). 1996, Geneva: IPCC

## Annex 5: Calculation of Baseline emission factor

| Power Plant | Agency | Installed capacity (MW)] | Fuel type | Generation (gross) (GWH ) 03-04 (Ref 1) | Auxiliary Consumption 03-04 (Ref 2) | Heat rate (Ref 3) | Net heat rate | Specific fuel consumption (f1) (96-97) | CO2 emission kg/kwh | Net generation 03-04 | CO2 emissions (tonne) | Baseline emissions 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. NORTHERN REGION** | | | | | | | | | | | | |
| **Delhi** | | | | | | | | | | | | |
| BADARPUR | NTPC | 705 | Coal 1D | 5432 | 597.5 | 3491 | 3922 | | 1.54 | 4834.5 | 7447872.9 | |
| I.P.STN. | DVB | 247.5 | Coal 1D | 771 | 84.8 | 3130 | 3517 | | 1.38 | 686.2 | 947810.2 | |
| RAJGHAT | DVB | 135 | Coal 1D | 775 | 85.3 | 3159 | 3549 | | 1.39 | 689.8 | 961554.7 | |
| D.V.B. GT | DVB | 282 | Gas HBJ | 1210 | 133.1 | | 2929 | | 0.69 | 1076.9 | 744449.0 | |
| PRAGATI GT | DVB | 330.4 | Gas HBJ | 2405 | 264.6 | | 2929 | | 0.69 | 2140.5 | 1479669.3 | |
| | | | | | 199.7 | | | | | -199.7 | | |
| DELHI Thermal | | 1700 | | 10593 | 862.1 | | | | | 9730.9 | 11581356.1 | 1.1902 |
| Delhi Hydro | | 0 | | 0 | 0.0 | | | | | 0.0 | 0.0 | |
| | | 1700 | | 10593 | | | | | | 10593.0 | 11581356.1 | 1.0933 |
| | | | | | | | | | | 0.0 | | |
| **J. & K.** | | | | | | | | | | 0.0 | | |
| PAMPORE GT | J&K | 175 | Diesel | 29 | 0.3 | 1785 | 2929 | | 0.69 | 28.7 | 19856.9 | |
| J & K TH. | | 175 | | 29 | 0.3 | | | | | 28.7 | 0.0 | |
| J&K Hydro | | 1472 | | 7241 | 29.0 | | | | | 7212.0 | 0.0 | |
| J & K TOT. | | 1647 | | 7270 | 29.2 | | | | | 7240.8 | 0.0 | |
| **Himachal Prdesh** | | | | | | | | | | 0.0 | | |
| HP thermal | | 0 | | 0 | 0.0 | | | | 0 | 0.0 | 0.0 | |
| HP hydro | | 4319 | | 11753 | 23.5 | | | | 0 | 11729.5 | 0.0 | |
| HP Total | | 4319 | | 11753 | 23.5 | | | | | 11729.5 | 0.0 | |
| **Haryana** | | | | | | | | | | 0.0 | | |
| F'BAD EXTN | HP | 165 | Coal 4F | 795 | 87.5 | 4372 | 4912 | | 1.86 | 707.6 | 1314652.9 | |
| PANIPAT | HP | 860 | Coal 4F | 5949 | 654.4 | 3248 | 3649 | | 1.38 | 5294.6 | 7308425.3 | |
| F'BAD CCGT | NTPC | 430 | Gas HBJ | 2792 | 55.8 | | 2062 | | 0.49 | 2736.2 | 1331589.5 | |
| HAR. THERMAL | | 1455 | | 9536 | 1049.0 | | | | | 8487.0 | 9954667.6 | 1.1729 |
| Har hydro | | 48 | | 256 | 5.1 | | | | | 250.9 | 0.0 | |
| HAR. TOTAL | | 1503 | | 9792 | 1054.1 | | | | | 8737.9 | 9954667.6 | 1.1392 |

| Power Plant | Agency | Installed capacity (MW)] | Fuel type | Generation (gross) (GWH ) 03-04 (Ref 1) | Auxiliary Consumption 03-04 (Ref 2) | Heat rate (Ref 3) | Net heat rate | Specific fuel consumption (f1) (96-97) | CO2 emission kg/kwh | Net generation 03-04 | CO2 emissions (tonne) | Baseline emissions 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Rajasthan** | | | | | | | | | | **0.0** | | |
| KOTA | RAJ | 1045 | Coal 4F | 6758 | 635.3 | 2650 | 2925 | | 1.11 | 6122.7 | 6773730.0 | |
| SURATGARH | RAJ | 1250 | Coal 2W | 8303 | 780.5 | | 2717 | | 1.06 | 7522.5 | 7976070.8 | |
| RAMGARH GT | RAJ | 76 | Gas HBJ | 241 | 22.7 | | 2929 | | 0.69 | 218.3 | 150940.2 | |
| RAMGARH ST | RAJ | 37.8 | | 0 | 0.0 | | | | | 0.0 | | |
| ANTA | NTPC | 413 | Gas HBJ | 2777 | 261.0 | | 2062 | | 0.49 | 2516.0 | 1224427.1 | |
| RAJ. THERMAL | | 2822 | | 18079 | 1699.4 | | | | | 16379.6 | 16125168.1 | 0.9845 |
| RAJ. HYDRO | | 430 | | 643 | 18.0 | | | | | 625.0 | 0.0 | 0.9483 |
| RAJ. NUCLEAR | | 740 | | 4323 | 429.1 | | | | | 3893.9 | 0.0 | |
| RAJ. TOTAL | | 3992 | | 23045 | 2146.5 | | | | | 20898.5 | 16125168.1 | 0.7716 |
| **Punjab** | | | | | | | | | | **0.0** | | |
| GNDTP(BHATINDA) | PSEB | 440 | Coal 2W | 2553 | 219.6 | 3130 | 3425 | | 1.336 | 2333.4 | 3118396.1 | |
| GHTP(LEH MOH) | PSEB | 420 | Coal 2W | 3379 | 290.6 | 2840 | 3107 | | 1.21 | 3088.4 | 3744921.0 | |
| ROPAR | PSEB | 1260 | Coal 2W | 8303 | 714.1 | 2865 | 3135 | | 1.22 | 7588.9 | 9283159.0 | |
| Pun. Thermal | | 2120 | | 14235 | 1224.2 | | | | | 13010.8 | 16146476.1 | 1.241 |
| Punjab Hydro | | 2546 | | 11346 | 158.4 | | | | | 11187.6 | 0.0 | |
| Pun Total | | 4666 | | 25581 | 1382.7 | | | | | 24198.4 | 16146476.1 | 0.6673 |
| | | | | | | | | | | 0.0 | | |
| **Uttar Pradesh** | | | | | | | | | | **0.0** | | |
| OBRA | UP | 1482 | Coal 3E | 6247 | 624.7 | 3000 | 3333 | | 1.32 | 5622.3 | 7413003.7 | |
| PANKI | UP | 242 | Coal 4F | 1065 | 106.5 | 2628 | 2920 | | 1.10 | 958.5 | 1058616.8 | |
| H'GANJ B&C | UP | 425 | Coal 4F | 733 | 73.3 | 3914 | 4349 | | 1.64 | 659.7 | 1085147.1 | |
| PARICHA | UP | 220 | Coal 4F | 655 | 65.5 | 3934 | 4371 | | 1.65 | 589.5 | 974629.3 | |
| ANPARA | UP | 1630 | Coal 3E | 11982 | 1198.2 | 2628 | 2920 | | 1.10 | 10783.8 | 11910184.7 | |
| SINGRAULI NTPC | NTPC | 2000 | Coal 3E | 15644 | 1564.4 | | 0 | 0.61 | 1.02 | 14079.6 | 14314260.0 | |
| RIHAND NTPC | NTPC | 1000 | Coal 3E | 7958 | 795.8 | | 0 | 0.66 | 1.10 | 7162.2 | 7878420.0 | |
| DADRITH NTPC | NTPC | 840 | Coal 2W | 6185 | 618.5 | | 0 | 0.65 | 1.08 | 5566.5 | 6030375.0 | |

| Power Plant | Agency | Installed capacity (MW)] | Fuel type | Generation (gross) (GWH ) 03-04 (Ref 1) | Auxiliary Consumption 03-04 (Ref 2) | Heat rate (Ref 3) | Net heat rate | Specific fuel consumption (f1) (96-97) | CO2 emission kg/kwh | Net generation 03-04 | CO2 emissions (tonne) | Baseline emissions 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UNCHAHAR NTPC | NTPC | 840 | Coal 3E/4F | 6454 | 645.4 | | 0 | 0.74 | 1.23 | 5808.6 | 7163940.0 | |
| TANDA NTPC | NTPC | 440 | Coal 4F | 2912 | 291.2 | | 0 | 0.96 | 1.60 | 2620.8 | 4193280.0 | |
| AURAIYA GT NTPC | NTPC | 652 | Gas HBJ | 4252 | 85.0 | | 2062 | | 0.49 | 4167.0 | 2027907.8 | |
| DADRI CCGT NTPC | NTPC | 817 | Gas HBJ | 5062 | 101.2 | | 2062 | | 0.49 | 4960.8 | 2414221.3 | |
| Small Thermal | | 10 | | 0 | 0.0 | | | | | 0.0 | 0.0 | |
| U.P. THERMAL | | 10598 | | 69149 | 6169.8 | | | | | 62979.2 | 0.0 | 0 |
| U.P. HYDRO | | 525.8 | | 2145 | 12.9 | | | | | 2132.1 | 0.0 | 0 |
| UP Nuclear (NARORA APS) | | 440 | Nuclear | 3041 | 302.3 | | | | | 2738.7 | 0.0 | |
| U.P. TOTAL | | 11564 | | 74335 | 6182.7 | | | | | 68152.4 | 66463985.7 | 0.9752 |
| **Uttranchal** | | | | | | | | | | **0.0** | | |
| UTT Thermal | | 0 | | 0 | | | | | 0 | 0.0 | | 0 |
| Utt Hydro | | 1095 | | 3904 | 7.8 | | | | 0 | 3896.2 | 66463985.7 | 0 |
| Utt Total | | 1095 | | 3904 | 7.8 | | | | | 3896.2 | 66463985.7 | 0 |
| | | | | | | | | | | | | |
| **Northern region** | | | | | | | | | | | | |
| **Thermal** | | **18870** | **0.619** | **121621** | | | | | | **110616.3** | **120291510.5** | **1.087** |
| **Hydro** | | **10435** | **0.342** | **37288** | | | | | | **37033.3** | **0.0** | **0.815** |
| **Nuclear** | | **1180** | **0.039** | **7364** | | | | | | **6632.7** | **0.0** | |
| | | **30485** | | **166273** | | | | | | **154282.2** | **120291510.5** | **0.78** |

**REFERENCES**


(Ref 1) Generation Report, Central Electricity authority, Ministry of Power, Govt. of India

(Ref 2) General review 2002-03, Central Electricity authority, Ministry of Power, Govt. of India

(Ref 3) Performance review of Thermal Power Plants