HYDRO POWER POLICIES AND GUIDELINES

Prepared by
Water for Welfare Secretariat
IIT Roorkee

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The publication is for creating an awareness and utilising the vast potential of water resources in the state of Uttarakhand

Every possible care has been taken to ensure that the data are correct, consistent and complete as far as possible. Constraints of available time and resources, however do not preclude the possibility of errors, omissions etc. in the data and consequently in their use in the report.

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PREFACE

Uttarakhand, the newly formed 27th state of the Republic of India is endowed with the largest and highest natural dam in the world, the Himalaya. Every year, huge amount of water is transported from the oceans as cloud, precipitates and gets deposited (in the form of snow) in the Himalaya. The snow then melts and feeds our rivers. This makes Uttarakhand an ideal state to harness the potential of water resources for generating hydro power for the energy hungry nation and provide regulated and regular supply of water for the nation.

It is now well recognized that availability of power is an essential requirement for development of a nation. With the fast depleting fossil fuels, the need to increase and shift dependence on hydro power generation for the prosperity of the nation can not be over emphasized. It is well known that as a state, Uttarakhand has not utilized even one tenth of its potential for generating hydro power. However, it is heartening to note that the government has recognized the need of the hour and the challenge has been taken up to convert Uttarakhand as a leading power generating state of India. A large number of hydro power schemes are under different stages of planning/execution and many more are envisaged in the future.

Vide Govt. of Uttarakhand O.M. No.293/I/2004-034(3)/65/03 dated August 5, 2004 and No. 1129/I/2005-04(3)/65/03 dated March 3, 2005, a Virtual Centre of Excellence named as “Water for Welfare : An Uttaranchal Initiative” has been set up with the secretariat at IIT Roorkee. As per decision taken in the meeting held on Nov. 29, 2005 at IITR, some special articles, publications and promotional material on hydropower projects, public perceptions is prepared and pasted on website (http://www.uttara.in/initiatives/wfw/intro.htm). This special publication is a compilation of State and Central Policies, Guidelines, Opportunity with CDM and case study of a typical small hydroproject.

The readers are suggested to upgrade the information from the respective website of Ministries/departments.

We hope to receive the suggestions from readers for the improvement of this document. This special publication is planned to be distributed among users, NGOs, Colleges district libraries etc.
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GOVERNMENT OF UTTARAKHAND

POLICY FOR HARNESSING RENEWABLE ENERGY SOURCES IN UTTARAKHAND WITH PRIVATE SECTOR / COMMUNITY PARTICIPATION

1. PREAMBLE

Uttarakhand is richly endowed with natural renewable resources for generating electricity. Most of this could be harnessed through environmentally clean Medium & Large Hydroelectric Projects (i.e. projects with capacity in excess of 25 MW); it is estimated that a capacity of more than 20,000 MW is yet to be tapped through these sources.

In addition, the State has significant Renewable Energy (RE) Sources that includes sites for developing Micro (up to 100 KW), Mini (100KW-5 MW) & Small (5-25 MW) Hydro power projects) as well as sources for generating electricity through Biomass/Agro residue, Wind power, Solar energy, Cogeneration etc. This policy aims at expeditiously harnessing these sources of energy that are non polluting and are useful for electrification of isolated and remote habitations in Uttarakhand. It is felt that more than 1,000 MW electrical power could be tapped through these sources before 2020.

2. OBJECTIVE

To create conditions conducive to Private Sector/Community participation in power projects based on RE Sources in the State. In particular,

2.1 To harness the environment friendly RE resources and enhance their contribution to the socio-economic development of the State.

2.2 To meet and supplement minimum rural energy needs through sustainable RE projects.

2.3 To provide decentralized energy supply to agriculture, industry, commercial and household sector.

2.4 To improve the quality of grid power through such projects, as a consequence of tail-end generation and feeding.

2.5 To enhance the use of energy sources that assist in mitigating environmental pollution.

2.6 To support efforts for developing, demonstrating and commercializing new and emerging technologies in the RE sector and, to this end, help establish linkages with national and international institutions for active collaboration.

2.7 To create conditions conducive to the involvement of private investors in RE projects.

2.8 To create public awareness and involve users/local community along with their capacity building in establishing, operating and managing RE projects.

2.9 To create direct and indirect employment opportunities in the State.
3. **MEASURES TO BE ADOPTED**
In order to fulfill the above, the following measures are proposed to be adopted:

- Power generation through Hydro projects
- Co-generation in industries such as Sugar, Paper, Fertilizer and Chemical etc.
- Power generation from Biomass / Agricultural residue.
- Power generation from urban, municipal and industrial waste.
- Power generation from solar energy.
- Power generation from wind energy.
- Power generation from geothermal energy.
- Energy conservation in domestic, agriculture, industrial, commercial and transport sectors through induction of administrative/statutory/legislative/ technical solutions and imposing stringent conditions for all categories of consumers.

4. **POTENTIAL PROPOSED TO BE HARNESSED:**
Given the geographical conditions of the State of Uttarakhand, and availability of various sources of energy, the State proposes to harness the resources with active involvement of private/public sector/ community participation in the following manner:

4.1 **Hydroelectric Power:**
By virtue of its topographic location, the State has a number of perennial streams where water is available throughout the year. The untapped potential that could be harnessed before 2020 through Micro/Mini/Small Hydro projects is about 600 MW. The State Government is committed to exploiting this potential.

4.2 **Co-generation:**
Uttarakhand has an established industrial base which is expanding. The Sugar, paper, fertilizer, chemical, textile and other industries have an estimated potential of about 220 MW that could be tapped by co-generation. This would not only augment the State's grid but would also help captive generation. This potential would also be exploited by the year 2020.

4.3 **Biomass/Agro residue and waste :**
It is estimated that about 20 million Metric Tons of agro residues and agro industrial/ processing waste is produced annually in Uttarakhand. It holds promising potential for generating decentralized power of about 300 MW. The State Government would support and facilitate harnessing this potential by 2020.

4.4 **Urban, Municipal and Industrial Liquid /Solid Waste :**
At present about 1000 Metric Tons of Municipal, Urban and Industrial solid/ liquid waste is being produced every day in the State. Introducing scientific processing and treatment of this waste
would lead to power generation along with abatement of environmental pollution. Initially a small number of such projects would be supported.

4.5 **Solar Energy:**

The State is endowed with vast potential of solar energy and the Government of Uttarakhand (GOU) is keen to tap this resource; the State would support efforts for setting up Solar based power projects.

4.6 **Wind Power:**

Sufficient untapped wind power potential is available in the State. There is immediate necessity for wind mapping in the State to assess and exploit the available potential. The State would support such programmes.

4.7 **Geothermal Power:**

Sufficient untapped geothermal power potential is available in the State. There is necessity for assessment of geothermal energy in the State to exploit the available potential. The State would support programmes for exploiting the available potential optimally.

4.8 **Energy conservation:**

Measures related to conservation of energy in domestic, commercial, agriculture and industrial sector could lead to 20% savings in energy consumption. The State Government is committed to introducing effective energy conservation measures in all sectors of economy. Energy auditing would be made mandatory in the State especially for industrial units where the load exceeds 25 kW. Appropriate mechanisms would be evolved for effective implementation of energy conservation measures.

5. **INCENTIVES:**

5.1 **Sale of electricity:** On the electricity generated by the RE projects, UPCL will have the first right of purchase; such purchases may be made in whole or part as per the requirement of UPCL. The price of electricity to be purchased by the UPCL will be determined by the UERC; the price so determined will be announced in advance and will be uniformly applicable to all producers. The GOU will provide guarantee for the payments to be made by the UPCL for such purchases.

5.2 **Wheeling of electricity:** UPCL/PTCUL will undertake to transmit through its grid the power generated and make it available to the producer for captive use or third party sale within/outside the State for which wheeling charges uniformly applicable to all producers would be announced in advance.

5.3 **Banking:** UPCL would extend the facility of Banking to the Developers at mutually agreed terms.

5.4 For evacuating energy from the generation site, requisite network of transmission/ distribution lines would be provided by UPCL/PTCUL.

5.5 In case of power generation from Municipal Solid Waste, if Government land (belonging to Urban Local Bodies/Panchayats) is available, the required land for setting up RE projects would
be provided on nominal lease rent of one rupee per square meter per year for a period of 33 years subject to further renewal on mutually agreed terms and conditions.

6. SINGLE WINDOW CLEARANCE FOR RE PROJECTS:
Setting up of RE projects involves sanctions/clearances from a number of Government Agencies/Departments. The State Government would provide requisite clearances in a time bound manner through a single window mechanism. For this purpose a high level empowered committee (composition at Appendix) is constituted to accord necessary approvals/clearances.

7. CLASSIFICATION OF PROJECTS:
Broadly, RE projects would be classified as
(A) Hydro Projects (up to 25 MW)
(B) Other RE Projects i.e. projects involving generation of power from co-generation, Biomass/Agro-residue, urban, municipal and industrial liquid/solid waste, wind, solar energy and including projects for energy conservation.

7(A) HYDRO PROJECTS :

(I.) Based on the generating capacity, Projects will be grouped into the following three categories:
   a) Micro Projects with capacity upto 100 kW,
   b) Mini Projects with capacity above 100 kW and upto 5 MW,
   c) Small Projects with capacity above 5 MW and upto 25 MW.

(II.) On the basis of the mode for identification, projects may be grouped into the following two categories:
   a) Self Identified Projects: Developers may identify projects, prepare the DPR and ask for allotment;
   b) State Identified Projects: The State or State Sponsored Agencies may identify projects of any size, prepare the DPR and allot it in the manner prescribed below.

Allotment of Hydro Projects :

Self Identified Projects:

Eligibility criteria

For Micro projects
(i) Individuals who are domiciles of Uttarakhand,
(ii) Gram Panchayats of Uttarakhand in the vicinity of the site,
(iii) Societies of Uttarakhand registered under the Society Registration Act, 1860/UP Cooperative Society Act 1965

would be eligible for allotment.

For Mini projects
(i) Individuals who are domiciles of Uttarakhand,
(ii) Gram Panchayats of Uttarakhand in the vicinity of the site,
(iii) Societies of Uttarakhand registered under the Society Registration Act, 1860/UP Cooperative Society Act 1965,
Firms registered under the Company Act 1956 and having their manufacturing units located in Uttarakhand would be given preference for allotment of project.

For Small Projects

These would be open to all; there would be no reservations. For this premium will be decided later.

Evaluation criteria

For evaluating suitability of a prospective Developer, the following would be considered:

a) Technical capability including past experience in developing, constructing or operating Energy Projects – this aspect would be evaluated based on a maximum of 60 marks;

b) Financial capability, including the capacity to invest in the equity of the project and the ability to arrange for institutional finance. The minimum financial capability (Solvency Certificate to be provided) would be Rs.10.00 Lakhs and for Micro projects and Rs.50.00 Lakhs for Mini projects. Financial capability would be evaluated based on a maximum of 40 marks.

Payments to be made:

All payments would be made in the form of a Bank draft of any Nationalized Bank.

 Application fee (Non-refundable): Rs.5000/-

 Processing fee (Non-refundable): At the time of signing the Development Agreement
    ♦ For Micro projects: Rs. 10,000/-.
    ♦ For Mini projects : Rs. 25,000/-.
    ♦ For Small projects: Rs. 50,000/-

 Security payment: At the time of signing the Implementation Agreement
    ♦ For Micro projects:: Rs.20,000/-.
    ♦ For Mini projects: Rs.50,000/-.
    ♦ For Small projects: Rs. 1,00,000/-

State Identified Projects:

Small Hydro projects would be allotted on the basis of open competitive bidding (without any reservation).

Eligibility and evaluation criteria;
Eligibility and Evaluation parameters shall be provided in the Request For Qualification (RFQ)/Request For Proposal (RFP)/ bidding documents.
Allotment Procedure:
The identified projects would be advertised in order to seek bids. Selection of Developers would follow a two-stage process.

i Prequalification: Firstly, the applicants would be evaluated on the basis of pre-qualification criteria laid down in the RFQ document which will be made available on payment of a prescribed fee. Broadly, prequalification criteria would be based on balance sheet, annual report, technical and financial capacity etc. After evaluations, a short list of successful applicants would be prepared.

ii Financial bid: Applicants short-listed on the basis of prequalification criteria would be invited to submit their financial bids based on premium payable to the Government of Uttarakhand. For this purpose the following threshold premium is prescribed (bids quoting premium below the threshold would be rejected outright):

- Above 2 MW & upto 5MW: Rs.100,000/- per MW
- Above 5MW & Up to 25 MW: Rs.5,00,000/- per MW

iii A project will be allotted to the short-listed bidder who has offered the highest bid. The successful bidder shall be required to deposit the premium and other amount due within the time specified in the bid document.

iv Complete transparency in allotment of the projects shall be ensured. Comprehensive RFQ/RFP/bidding documents would be prescribed for inviting bids clearly enumerating technical and financial parameters.

7(B) OTHER RE PROJECTS:

Other RE Projects would be kept open for all categories of developers and these would be allotted on self identification basis or, wherever possible, on tariff based bidding.

The procedure for tariff based bidding would be prescribed separately. The Self Identified Projects would be allotted on the basis of the following:

Evaluation Criteria:
For evaluating suitability of a prospective Developer of a Self Identified Projects, the following would be considered:

a) Technical capability including past experience in developing, constructing or operating Energy Projects – this aspect would be evaluated based on a maximum of 60 marks;

b) Financial capability, including the capacity to invest in the equity of the project and the ability to arrange for institutional finance. Financial capability would be evaluated based on a maximum of 40 marks.

Payments to be made:
All payments would be made in the form of a Bank draft of any Nationalized Bank.

Application fee (Non-refundable): Rs.5000/-

Processing fee (Non-refundable): At the time of signing the Development Agreement
- For projects upto 1MW: Rs.10,000/-.
- For projects more than 1MW : Rs.25,000/-.
**Security payment:** At the time of signing the Implementation Agreement
- For projects upto 1MW: Rs.20,000/-.  
- For projects more than 1MW: Rs.50,000/-.  

8. **Benefits Under Clean Development Mechanism (CDM)**

Projects covered under this policy may not involve cheapest form of generating energy. However, keeping their environment friendly nature, the State would encourage projects to obtain the benefits available under the Clean Development Mechanism (CDM).

9. **MISCELLANEOUS**

9.1 Not more than three Projects in each category enumerated in paragraphs 4.1 to 4.8 will be allotted to a Developer.

9.2 Industrial units located in Uttarakhand and willing to participate in the open competitive bid for the purpose of establishing RE projects for their captive use, would be given preference by accepting their bids provided these are not less than 80% of the highest bid.

9.3 The Government of Uttarakhand reserves its rights to allot a project to a State owned enterprise.

9.4 If a feasible Micro/Mini Hydro project remains un-allotted on the basis of the procedure prescribed in this Policy, the same would be allotted to any developer through open competitive bidding, the procedure for which would be laid down separately.

9.5 In the event a Developer fails to achieve the various stages of completion of the allotted project as per the prescribed time schedule without valid reasons, the premium deposited shall be forfeited and the allotment would be cancelled.

9.6 Projects allotted before the date of publication of this Policy in the Official Gazette shall continue to be governed by the Policy under which they were allotted; these would not be eligible for incentives under this Policy.

9.7 In case of augmentation of capacity of Self Identified Projects due to any reason, the developer would be required to pay additional premium of Rs.1 Lakh per MW or fraction thereof for enhancement upto 5 MW and Rs.5 Lakh per MW or fraction thereof in case of enhancement beyond 5 MW along with requisite amount to take into effect the inflation from the date the premium was paid. For State Identified Projects allotted on the basis of open competitive bidding, the extra premium to be paid would be calculated on the basis of a formulation to be specified separately.

9.8 In case any developer, for any reason (before a project is commissioned), sells his project to some other developer, the developer selling the project shall be required to deposit an additional amount equal to the bid premium.

9.9 Projects would be offered for a period of 40 years from the date of award at the end of which they shall revert to the GOU or extended further on mutually agreed terms.

9.10 **Royalty:**

(i) On Micro, Mini and Other RE projects governed by this policy, no royalty payment would be charged.

(ii) On Small Hydro projects governed by this policy, royalty payment for the first 15 years of operation would be exempted. From 16th year of operation, a royalty @ 18% of energy generated would be charged.

10. **AMENDMENTS/ RELAXATION/ INTERPRETATION OF PROVISIONS OF THE POLICIES:**

GOU shall have all powers to amend/ relax/ interpret provisions under the policy.
11. **APPLICABILITY:**

This Policy would become effective from the date of its notification in the Official Gazette of GOU.

**Appendix**

**CONSTITUTION OF EMPOWERED COMMITTEE**

**Composition of Empowered Committee:**

The Empowered Committee of Administrative Secretaries for according approvals/ clearances is constituted as under:

1. Chief Secretary, Government of Uttarakhand - Chairman
2. Additional Chief Secretary, GOU - Vice Chairman
3. Principal Secretary/ Secretary, Dept. of Energy, GOU - Member
4. Principal Secretary/ Secretary, Dept. of Finance, GOU - Member
5. Principal Secretary/ Secretary, Dept. of Irrigation, GOU - Member
6. Principal Secretary/ Secretary, Dept. of Forest, GOU - Member
7. Principal Secretary/ Secretary, Dept. of Industry, GOU - Member
8. CMD/ MD, Uttarakhand Power Corporation Limited. - Member
9. CMD/ MD, Uttarakhand Jal Vidhyut Nigam Limited. - Member
10. CMD/ MD, PTCUL - Member
11. Vice President, UIPC - Member
12. Director, UREDA - Convener

The Committee may co-opt other Secretaries/State Government officials and experts as and when required.
POLICY FOR THE DEVELOPMENT OF HYDROPOWER IN UTTARANCHAL THROUGH PROJECTS OF CAPACITY OF 25 MW AND LARGER

1. SCOPE AND OBJECTIVES OF HYDROPOWER DEVELOPMENT IN UTTARANCHAL

Uttaranchal has a hydropower potential of the order of 15,000 MW against which only 1124 MW has been harnessed so far. Keeping in mind the national objective of increasing power generation through environmentally appropriate means, and the target of 3000 MW for the hydropower sector in the 10th Plan period, the Government of Uttaranchal (GoU) has framed a hydropower policy as below. The objectives of this policy are to attract investors for the development of the State’s water resources in an environment-friendly manner, and to generate revenues for the State from development of its hydel resources while ensuring project viability.

2. PARTICIPATION & OPERATIVE PERIOD

This policy shall be in operation from the date of its publication as notified by Government Order. All projects awarded within this period under this policy will be governed by this policy for their entire duration.

All Hydropower projects/stations estimated to have an installed capacity of 25 MW and larger shall be eligible under this policy. The identified potential for further hydropower projects of a capacity larger than 25 MW, which is being offered under this policy is about 509 MW at 13 identified locations as at Annexure A. As and when further sites are identified/investigated, they will be brought within the purview of this policy.

Uttaranchal invites any qualified, non-Uttaranchal State government agency to bid for identified projects for the development of this sector. These will be termed as Independent Power Producers (IPP). This would include any Private sector entities, Central power utilities, State Governments or any other Government entities and their Joint Ventures.

3. PREQUALIFICATION

There shall be a pre-qualification by the GoU of the bidders for the projects in the state based on a) past experience with development, construction and operations of hydro projects or other power sector experience and b) financial capacity to mobilise required resources and bring in or raise their equity contribution. The applicants will have to qualify on both these counts to be pre-qualified for the competitive bidding process for project allotment. The weightage to be given to the sub-categories of these attributes to be evaluated, the guidelines for evaluation and the passing score on attributes/in aggregate required for pre-qualification shall be specified in the bid documents inviting bids for pre-qualification.

4. PROJECTS

4.1 The list at Annexure A identifies projects available for development with indications of estimated capacities, and for which development of pre-feasibility studies is in progress. The Uttaranchal Jal Vidyut Nigam Ltd. (UJVNL) will undertake to prepare the pre-feasibility studies in a time bound manner. The evacuation requirements including details of nearest sub-station will be specified in the pre-feasibility studies.
4.2 The GoU shall stipulate for each project, as part of the bid conditions, a maximum number of years for completion of the project implementation i.e. outer limit for project completion, which would be binding on all bidders.

4.3 The projects shall be offered for a period of forty five (45) years from the date of the award at the end of which they shall revert to the Government of Uttaranchal or extended further on mutually agreed terms, as per the decision of the Government of Uttaranchal.

4.4 The project assets would be maintained by the successful concessionaire in a condition that would ensure a residual life of the project at the rated capacity for at least 30 years at any point of time. During the 10th, 20th, 30th and 40th years of operations, as well as during the last year of concession, the GoU or one of its appointed agencies would carry out a mandatory inspection of the project site to ensure that the project assets are maintained to the required standards to ensure the specified generation capability and residual life of the plant.

4.5 If such inspections find that the plant capacity and/or life are being undermined by inadequate maintenance, the GoU would be entitled to seek remedial measures from the concessionaire. If the concessionaire fails to comply with the requirements, the GoU would have the right to terminate the concession by payment of compensation to be computed as follows. The termination compensation value would be based on estimated net cash flows to equity shareholders for the next ten years or residual period of concession, whichever is lesser, discounted at a suitable rate. Both the estimate of cash flows as well as the discount rate would be approved by the Electricity Regulatory Commission of Uttaranchal (ERCU) which will also factor the costs of refurbishment, renovation, repairs, etc. required to bring the project assets to the standards specified.

4.6 All projects would need to conform to the R&R policy of the GoU, which would be made available prior to the bidding process.

5. PROCESS OF ALLOTMENT

5.1 The sites shall be advertised in order to seek potential bidders. Applications should be accompanied by a non-refundable draft of Rs. 5 lakhs, payable to the Uttaranchal Jal Vidyut Nigam (UJVNL).

5.2 All interested parties will be subject to pre-qualification as provided in Paragraph 3.

5.3 All pre-qualified bidders will be provided with the pre-feasibility studies prepared by the UJVNL.

5.4 Bids shall be invited for premium payable upfront to the Government of Uttaranchal per MW in the case of each project/site, subject to a minimum threshold premium of Rs. 5 lakhs per MW. Bids received beneath the threshold premium will be rejected.

5.5 Projects will be allotted to the bidders making the highest bids. The successful bidder shall be required to deposit the premium /other amount due within a reasonable period of receiving intimation regarding his bid being successful. The exact time period shall be specified in the bid documents for invitation of bids. The successful bidder, however, may be permitted to provide 50% of the bid amount in excess of the threshold as a bank guarantee encahsed at the time of actual or scheduled financial closure, whichever is earlier. The proportion of bank guarantee may be modified by the GoU prior to bidding, if required.

5.6 If there is more than one identical bid which emerges as the best bid for any site/station, a gradation list based on a simple average of the technical and financial scores in the pre-qualification criteria shall be the basis for allotment.
5.7 In case of any project failing to attract any acceptable bids despite being bid out the GoU may consider allotting the site to a GoU agency.

6. **SALE OF POWER**

The IPP can contract to sell power to any consumer/s outside Uttaranchal, to the Uttaranchal Power Corporation Ltd. (UPCL), or for the captive use of new industrial consumers in Uttaranchal. The UPCL will specify the conditions under which any consumer or group of consumers is deemed to be a captive user. Sales to the UPCL will be mutually negotiated and approved by the ERCU.

7. **WHEELING CHARGES**

The infrastructure and facilities of UPCL will be made available to all IPPs for wheeling the generated energy. Wheeling charges for wheeling the generated energy outside the State and to captive users within the State will be as determined by the ERCU. However, for those projects which are bid out prior to the determination of this rate by the ERCU, the wheeling charge (for the entire concession period) would be 10% of net energy supplied at the interconnection point. The wheeling charges will be payable to the UPCL, and will include compensation for all costs, infrastructure charges and losses that may be incurred by the UPCL. The UPCL will prepare a standard wheeling agreement draft consistent with this policy statement. This will be made available prior to any bidding for projects. No wheeling charges are applicable in cases of sales to the UPCL.

8. **GRID INTERFACING/TRANSMISSION LINE**

8.1 The IPP shall be responsible for laying lines for connectivity to the nearest grid sub-station at the appropriate voltage, which will be 132 kV or higher depending on the capacity of the power station and distance from the power station to the Grid. UPCL will determine the specifications for the evacuation facilities required. This would be specified for each project prior to the bidding for the project.

8.2 For certain projects where the evacuation costs are very high, the GoU may agree to finance a part of the costs, the quantum and terms of which shall be made available as part of the pre-bid information.

8.3 For certain projects where the infrastructure costs like access roads, bridges, etc. are very high, the GoU may decide to share such costs with the IPP. The likely extent of GoU sharing of infrastructure costs would be indicated as part of the pre-bid information.

8.4 IPPs would be free to structure the evacuation facilities in a different company if they so desire.

9. **BANKING**

No banking of power will be permitted.

10. **TAXES, & ROYALTY & OTHER CHARGES**

10.1 On all projects governed by this policy, for the first 15 years, royalty at the rates of 12% of net energy wheeled (after deducting wheeling charges) or supplied directly without wheeling would be charged. Beyond the 15th year of operation, a royalty of 18% of net energy wheeled or supplied directly without wheeling will be made available to the GOU free of charge by all IPPs.
10.2 No further levies, taxes, charges other than those stipulated in this policy would be levied by the State Government and its agencies or the Regulator on the IPPs governed by this policy, for a period of ten years from the date of this policy.

11. INCENTIVES BY STATE GOVERNMENT

11.1 No entry tax will be levied by the State Government on power generation, transmission equipment and building material for projects.

11.2 As part of bid conditions, GoU could offer select projects an option to defer royalty payments of the first 8 years of project operation with the condition that the deferred royalty shall be valued at the weighted average sales realisation of UPCL per unit of input power fed into UPCL's grid system at 132 KV and below. The deferred royalty would be recovered from the project company by GoU from the 9th to the 15th year and will attract interest at the rate of 12.5 % per annum applicable at six monthly intervals on the total outstanding amounts. The project company would have the option to avail of such deferment or have the flexibility to structure partial royalty deferment or for shorter periods with quicker repayment, if it so desires, within six months of achieving financial close. The deferred royalty dues to GoU would be secured by a charge on the assets and cash flows of the IPP, which would however be subordinated to the charge of senior lenders and working capital bankers to the IPP.

12. TRANSFER OF ALLOTMENT

Free transfer of shares will be permitted in the companies allotted projects as per the procedure laid down in this document.

13. TIME LIMIT FOR EXECUTING THE PROJECT

13.1 IPP shall prepare and submit the detailed project reports and all other information and make the necessary applications for obtaining the statutory clearances and approvals of the state and central governments and the regulator (as applicable) after carrying out the required confirmatory surveys and investigations as per prevailing regulations/norms within 3 years from the date of allotment. The IPP shall be responsible for ensuring completeness of all submissions to concerned authorities. Failure to do so within the stipulated time frame shall be treated as non-compliance with the requirement stipulated in this paragraph.

13.2 The IPP shall achieve the financial closure within 1 year from the date of receipt of all statutory approvals and clearances given by the State and Central governments. Financial closure would imply firm commitments for financing the entire project, with all pre-disbursement conditions having been fulfilled.

13.3 The GoU shall stipulate for each project, as part of the bid condition, a maximum number of years for completion of the project implementation. The project shall be made operational within this time-frame.

13.4 The failure to reach any of the milestones mentioned in 13.1 or 13.2 above will result in automatic cancellation of the allotment of the site, and forfeiture of any up front premium amounts paid. No compensation would be payable to the IPPs in such instance.

13.5 Failure to reach the milestone as in 13.3 above, after project has commenced construction, would result in a liability to pay a penalty by the IPP to the GoU, computed at the equivalent royalty revenue that would have been payable to the GoU had the project met the milestone.
If the project has failed to start construction even after lapse of the timeframe in 13.3 above, it would result in automatic cancellation of the allotment of the site, and forfeiture of any up front premium amounts paid. No compensation would be payable to the IPPs in such instance.

13.6 The IPP may surrender the allotment back to GoU if on completion of the DPR, within the stipulated time-frame, it has grounds to establish that the project is not technoeconomically viable. On such surrender, the bank guarantees provided by the IPP in lieu of upfront premium would be released and any premium amount paid in excess of the threshold premium of Rs. 5 lakhs / MW, would be refunded to the IPPs by the GoU.

14. ROLE OF UJVNL

The GoU would facilitate projects through UJVNL, which will be responsible for the following, with regard to project facilitation:
(i) Carrying out data collection and preparation of preliminary techno-economic study to obtain reliable basic data on the project required to attract bidders,
(ii) Carrying out preliminary survey to, prima facie, identify the extent of environmental and social issues likely to be involved in a project prior to bidding
(iii) Obtaining through the PTC an assessment of market situation and potential buyers for each project,
(iv) Marketing the project sites to attract bidders,
(v) Assisting projects in obtaining the necessary project clearances from the State Government agencies in a time-bound manner,
(vi) Monitoring the development of allotted projects/ and of delivery as per time schedules.
(vii) UJVNL may also facilitate projects and participate in their equity (as a minority holder) or provide other assistance to any of the bid projects to facilitate financial closure or implementation. However, such assistance by UJVNL would be mutually negotiated between the allottee and UJVNL after the allotment is made and would not be mandatory on UJVNL. UJVNL participation as a joint venture partner would be subject to Board and Shareholders approval, and no pre-conditions relating to UJVNL joint venture participation can be attached to bids received.

15. ROLE OF UPCL

The UPCL will be responsible for the preparation of wheeling agreements (Para 7) and assessment of evacuation requirements (Para 8).

16. REGULATORY OVERSIGHT

Aspects of this policy that require Regulatory approvals from the concerned regulator, would be subject to such approvals being given and would apply in the manner approved by the Regulator.

17. DUE DILIGENCE

The applicant/IPP shall be responsible for carrying out due diligence with regard to his compliance responsibilities under various applicable Central/State/other laws, rules and regulations, and ensure compliance with the same.
18. POWER TO RESOLVE DIFFICULTIES

In the event of a dispute, the interpretation of these guidelines made by the Government of Uttarakhand shall be final. In all such matters, to the extent practicable, an opportunity shall be given to affected stakeholders to be heard, before the Government takes any decision.

Annexure A

List of Hydro Power Projects 25-100 MW

<table>
<thead>
<tr>
<th>No.</th>
<th>Project</th>
<th>Valley</th>
<th>River</th>
<th>Type</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Barkotkuwa</td>
<td>Yamuna</td>
<td>Yamuna</td>
<td>ROR</td>
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<tr>
<td>2</td>
<td>Hanuman Chatti</td>
<td>Yamuna</td>
<td>Yamuna</td>
<td>ROR</td>
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<tr>
<td></td>
<td>Siana Chatti</td>
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</tr>
<tr>
<td>3</td>
<td>Devramori</td>
<td>Yamuna</td>
<td>Tons</td>
<td>ROR</td>
<td>27MW</td>
</tr>
<tr>
<td>4</td>
<td>Mori Hanol</td>
<td>Yamuna</td>
<td>Tons</td>
<td>ROR</td>
<td>27MW</td>
</tr>
<tr>
<td>5</td>
<td>Markura Lata</td>
<td>Ganga</td>
<td>Dhauliganga</td>
<td>ROR</td>
<td>45MW</td>
</tr>
<tr>
<td>6</td>
<td>Sianachatti</td>
<td>Yamuna</td>
<td>Yamuna</td>
<td>ROR</td>
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</tr>
<tr>
<td></td>
<td>Gangani</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Chunni Semi</td>
<td>Ganga</td>
<td>Pinder</td>
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<td>8</td>
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<td>Ganga</td>
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<td>9</td>
<td>Bagoli Dam</td>
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<td>Saryu</td>
<td>Saryu</td>
<td>Reservoir</td>
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<tr>
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<td>Eastern Ram</td>
<td>Ramganga</td>
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<td></td>
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<td>13</td>
<td>Hanol Tiuni</td>
<td>Yamuna</td>
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<td>ROR</td>
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POLICY FOR THE DEVELOPMENT OF HYDROPOWER IN
UTTARANCHAL THROUGH PROJECTS OF CAPACITY OF 100MW
AND LARGER

PROJECT ABOVE 100 MW CAPACITY.

1. SCOPE AND OBJECTIVES:

The State of Uttaranchal has an identified Hydro power potential of about 15000 MW. Out of this generating capacities of about 1100 MW have already been established. Projects totaling to a capacity of about 7900 MW are in the pipeline. The Government of Uttaranchal (GOU), recognising the fact that the hydro power potential of the state needs to be harnessed to the maximum in the shortest possible time for the economic development of the state and for meeting the energy demand of the country, has accorded top priority to this sector. As a result thereof, a number of Projects in Central sector, State sector and Private sector are being set up in the State. A policy for private sector investment in the Hydropower projects ranging for 0 to 100 MW has already been announced on 19-10-2002. There are a number of sites where hydropower project of the capacities larger than 100 MWs can be established. To attract private investment for the development of such projects and as a sequel to the policy of 19-10-2002, the Government of Uttaranchal has decided to announce this policy.

2. PARTICIPATION AND OPERATIVE PERIOD:

2.1 This policy shall be in operation from the date of its publication as notified by Government order. Projects, above the capacity of more than 100 MW offered by GOU for private investment will be eligible under this policy and will be governed by this policy for their entire duration.

2.2 The GOU will invite proposals from private sector investors for development of identified sites. The preliminary project profiles of the identified sites will be made available to the investors before the process of competitive bidding.

3. PRE-QUALIFICATION:

For each identified site, which will be notified by the GOU from time to time, there shall be a pre-qualification selection of the bidders based on their past experience and financial and technical capacity. The applicants qualifying in the pre-qualification selection will be eligible for competitive bidding. Each attribute set for pre-qualification will be evaluated. Guidelines for evaluation and the passing score on attribute required for pre-qualification shall be specified at the time of inviting proposal for pre qualification.

4. PROCESS OF ALLOTMENT

4.1 Project identified by the Government of Uttaranchal shall be advertised for inviting international bids. All interested parties will be subject to pre qualification as provided in Para-3, above.

4.2 Application should be accompanied by a non-refundable draft of Rs.5.00 lacs, payable to GOU or its designated agency.

4.3 Bids shall be invited over a minimum premium, payable upfront to the Government of Uttaranchal, at the rate of Rs. 5 (Five) Crores per project. Project will be allotted to bidders
making the highest bid over and above the upfront minimum premium. Bids below the minimum premium shall not be considered.

4.4 Project will be allotted to the highest bidders. The successful bidder shall be required to deposit the minimum premium and 50% of the bid amount in excess of the minimum premium within the period fixed by the Government in this behalf. For the remaining fifty percent (50%) of the bid amount in excess of the minimum premium, the bidder may be permitted to provide a bank guarantee encashable at the time of actual or scheduled financial closure, whichever is earlier.

4.5 If there are two or more identical bids which emerge as the best bids for any project, allotment will be made on the basis of the average score obtained in valuation of the pre qualification among the identical bidders.

4.6 After the allotment the allottee/developer shall have to sign a project development agreement with GOU within the period fixed by GOU (Three month) for preparation of detailed project report (DPR) within a prescribed time frame. After the DPR is accepted/approved by GOU, the allottee/developer shall have to sign an implementation agreement with GOU which shall interalia include time schedule for getting necessary legal/administrative/technical approvals, financial closure, construction/commissioning etc. of the project.

4.7 In the events of inability of preparing a viable DPR or getting legal/administrative/technical approvals after the completion of the above mentioned fixed period the project will revert back to GOU and the allotment shall be treated cancelled automatically. In such a case no compensation will be payable to the allottee and the amount paid by allottee shall vest in the GOU.

5. TERMS OF ALLOTMENT OF THE PROJECT

5.1 Project will be allotted for an initial period of 45 years. Extension for further period (s) can be given on the terms & conditions to be decided mutually. After the expiry of the initial period or the extended period, as the case may be, the project will revert back to the Government of Uttarakhand.

5.2 The project assets would be maintained by the developer in a condition that would ensure a residual life of the project at the rated capacity for at least 30 years at any point of time. During the 10th, 20th, 30th, and 40th years of operations as well as during the last year of allotment, Govt. of Uttarakhand or one of its appointed agencies would carry out a mandatory inspection of the project to ensure that the project assets are maintained to the required standards to ensure the specified generation capability and residual life of the plants.

5.3 If such inspections find that the plant capacity and/or life are being undermined by inadequate maintenance, the GOUA would be entitled to seek remedial measures from the concessionaire. If the concessionaire fails to comply with the requirements, the GOUA would have the right to terminate the concession by payment of compensation to be computed as follows. The termination compensation value would be based on estimated net cash flows to equity shareholders for the next ten years or residual period of concession, whichever is lesser, discounted at a suitable rate. Both the estimate of cash flows as well as the discount rate would be approved by the Uttarakhand Electricity Regulatory Commission (UERC) which will also factor the costs of refurbishment, renovation, repairs, etc. required to bring the project assets to the standards specified.

5.4 All projects would need to conform to the R&R policy of the GOUA.
6. **SALE OF POWER**

The developer of the project will have the right to sell the power outside the State. No agency of the State will guarantee purchase of power. If anytime the state requires additional power, the concerned organisation of the State, may purchase electricity from the project on terms and conditions to be decided mutually by the developer and the concerned agency.

7. **ROYALTY**

7.1 Twelve percent (12%) of electricity generated shall be made available free of cost to the State during the entire life of the Project. This free power will be in addition to the amounts received at the time of allotment.

7.2 Completion of the project prior to the scheduled date as contained in the implementation agreement will attract incentive to the developer. This incentive will be decided on the basis of a rebate of one percent (1%) per year on the 12% free power for each year of earlier completion. Likewise delay in completion will also entail penalty of one percent (1%) for one year over and above the 12% free power for each year of delay. However, in case the delay in completion is for more than three years the allotment of the Project may be cancelled.

7.3 Electricity duty shall be applicable as per law.

8. **POWER EVACUATION:**

The developer may build his own evacuation system or get the same constructed through the Transmission/Distribution Corporation of the State/Power Grid Corporation of India. If the evacuation system is constructed by the undertaking of the State, the same will be developed as a commercial venture. In this case or in the case of utilization of existing evacuation system, wheeling charges, as determined by the Central Electricity Regulatory Commission or Uttarakhand Electricity Regulatory Commission, will be payable by the developer to the State Corporations/Central utility.

9. **DISPLACEMENT/REHABILITATION:**

The developer of the project shall be liable for the rehabilitation of the displaced persons from the project area and the cost of the same shall be included in the project cost. The State Government will provide necessary assistance to the developer in implementation of R&R Plan.

10. **INFRASTRUCTURE:**

The necessary infrastructure for the construction/development of the project will be part of the project cost and will be developed by the developer.

11. **INCENTIVE FROM STATE GOVERNMENT:**

No entry tax will be levied by the State Govt. on building material, power generation/transmission equipment during construction of the project.
12. OTHERS:

12.1 State Govt. will provide necessary assistance for required approvals/clearances and other related matters. For clearances/approvals from the State Government and its concerned agencies, an empowered committee or a nodal agency will be nominated.

12.2 If any report/data etc. relating to the project are made available to the developer by the State Government Department/Corporations, the cost incurred in preparation of such documents will be paid by the developer.
GOVERNMENT OF INDIA
POLICY ON HYDRO POWER DEVELOPMENT

1. Need for a Hydel Policy

Hydro power is a renewable economic, non polluting and environmentally benign source of energy. Hydro power stations have inherent ability for instantaneous starting, stopping, load variations etc. and help in improving reliability of power system. Hydro stations are the best choice for meeting the peak demand. The generation cost is not only inflation free but reduces with time. Hydroelectric projects have long useful life extending over 50 years and help in conserving scarce fossil fuels. They also help in opening of avenues for development of remote and backward areas.

Our country is endowed with enormous economically exploitable and viable hydro potential assessed to be about 84,000 MW at 60% load factor (1,48,700 MW installed capacity). In addition, 6781.81 MW in terms of installed capacity from small, mini and micro hydel schemes have been assessed. Also, 56 sites for pumped storage schemes with an aggregate installed capacity of 94,000 MW have been identified. However, only 15% of the hydroelectric potential has been harnessed so far and 7% is under various stages of development. Thus, 78% of the potential remains without any plan for exploitation.

Despite hydroelectric projects being recognised as the most economic and preferred source of electricity, share of hydro power has been declining steadily since 1963. The share of hydro power has been continuously declining during the last three decades. The hydro share has declined from 44 percent in 1970 to 25.75:23:2 percent in 1998. The ideal hydro thermal mix should be in the ratio of 40:60. Because of an imbalance in the hydel thermal mix especially in the Eastern and Western regions, many thermal power stations are required to back down during off peak hours. The capacity of the thermal plants cannot be fully utilised resulting in a loss of about 4 to 5 percent in the plant load factor. Even if the share of hydro power is to be maintained at the existing level of 25 percent, the capacity addition during the 9th and 10th Plan would work out to 23,000 MW. If the share were to be enhanced to 30 percent, it would require a further addition of 10,000 MW of hydro capacity.

The constraints which have affected hydro development are technical (difficult investigation, inadequacies in tunnelling methods), financial (deficiencies in providing long term financing), tariff related issues and managerial weaknesses (poor contract management). The hydro projects are also affected by geological surprises especially in the Himalayan region where underground tunnelling is required), inaccessibility of the area, problems due to delay in land acquisition, and resettlement of project affected families, law & order problem in militant infested areas.

2. Objectives

The programmed capacity addition from hydel projects during the 9th Plan is 9815 MW, of which Central Sector and State Sector will contribute 3455 MW and 5810 MW respectively and the balance 550 MW will be contributed by the Private Sector. Sanctioned and ongoing schemes under implementation will enable a capacity addition of 6537 MW during the 10th Plan, of which 990 MW, 4498 MW and 1050 MW will be the contribution of Central, State and Private Sectors respectively. In addition, 12 projects (5615 MW) have been identified for advance action in the 9th Plan for benefits in the 10th Plan.

The Government of India has set the following objectives for accelerating the pace of hydro power development:

-
(i) **Ensuring Targeted capacity addition during 9th Plant:**

The 9th Plan programme envisages capacity addition of 9815 MW from hydel projects in the total capacity addition of 40245 MW. The Central Sector hydel projects would contribute 3455 MW, State Sector would add 5810 MW and Private Sector 550 MW. Keeping in view that the achievement in 8th Plan had been dismal, the Government is determined to ensure that no slippage is allowed to occur and the targeted capacity addition in the 9th Plant is achieved in full.

(ii) **Exploitation of vast hydroelectric potential at a faster pace:**

The Government would initiate advance action for taking up new hydro projects since the ongoing projects will contribute a very small percentage of the desired capacity addition envisioned for 10th Plan and beyond. Towards this end, Government would take up for execution all the CEA cleared projects, and take steps to update and obtain clearances for pending DPRs. Measures for vigorously starting survey and investigations for new green field sites would also be implemented shortly. In addition, Government is keen to restart and activate the hydro projects which are either languishing for want of funds or are remaining dormant due to unresolved inter-State issues.

(iii) **Promoting small and mini hydel projects**

Small and mini hydel potential can provide a solution for the energy problems in remote and hilly areas where extension of grid system is comparatively uneconomical and also along the canal systems having sufficient drops. The small hydro potential could be developed economically by simple design of turbines, generators and the civil works. Small and mini hydel capacity aggregating to about 340 MW is in operation, and Government is determined to provide thrust for developing the assessed small hydel potential at a faster pace henceforth.

(iv) **Strengthening the role of PSUs/SEBs for taking up new hydel projects**

In view of the poor response of the private sector so far in hydro development which may persist for some more years, the involvement of public sector in hydel projects would not only have to continue but will also have to be enlarged. There are categories of projects such as multi-purpose, projects involving inter-State issues, projects for peaking power and those involving rehabilitation and resettlement which may be taken up and implemented more easily in public sector. Similarly, mega hydro projects in the North and North Eastern region would also have to be executed by CPSUs in case the State or the private sector is not in position to implement these projects.

(v) **Increasing private investment:**

Even though public sector organisations would play a greater role in the development of new schemes, this alone would not be adequate to develop the vast remaining hydro potential since it will require huge investments which are difficult to be supported from the budget/plan assistance in view of competing demands from the various sectors. A greater private investment through IPPs and joint ventures would be encouraged in the coming years and required atmosphere, incentives and reliefs would be provided to stimulate and maintain a trend in this direction.

3. **Policy Instruments**

To achieve the above stated objectives for faster development of hydro potential, the Government proposes to take the following steps and measures:
3.1 Funding

All the ongoing Central Sector hydroelectric projects namely Nathpa Jhakri (1500 MW), Tehri Stage I (1000 MW), Ranganadi State I (405 MW), Dulhasti (390 MW), Dhauliganga (280 MW), Doyang (75 MW) and Rangit (60 MW) would be provided with full budgetary support till completion. Government of India will also provide budgetary support for the new projects to be taken up by the CPSUs during the 9th Plan. The actual utilisation of the funds on the ongoing Central Sector hydel projects has been Rs. 1616.87 crores in 1997-98 and the budget provision for 1998-99 has been increased to Rs. 2070 crores. Therefore the remaining three years of the 9th Plan would require about Rs. 5896 crores on the ongoing Central Sector projects (excluding NEC projects). Having regard to the large capacity addition envisaged in the State Sector (5810 MW) it is necessary to (a) provide a mechanism for funding hydro projects by earmarking funds in the plan allocation of the State Governments by the Planning Commission; and (b) organising supplementary funding of hydel projects where more than 50 percent of the expenditure has already been incurred.

The monitoring of all the ongoing projects will be intensified and a task force would be constituted for this purpose. The progress of important projects in the State and Central Sector would be reviewed at the level of Minister/Secretary (Power) and all measures will be taken so that there is no slippage in the schedule for completion of the ongoing projects.

3.2 Power Development Fund

The survey and investigation of hydro projects have been discontinued since long in the States due to paucity of funds. As a result, there are not enough projects right now that could be taken up in the next 2 to 3 years and get completed in the 10th Plan or early 11th Plan. It is necessary to carry out survey and investigations continuously and prepare a shelf of projects of execution over a decade and more.

In case fully investigated projects with Detailed Project Reports are offered to private developers, their response could be more favourable. If pre-construction activities and enabling works could be completed and these sites offered to IPPs the chances of IPPs opting to invest in these projects would further improve. Further this would reduce the gestation period which would make investment in hydro projects more attractive.

The above approach is possible and successful only if a dedicated fund is available for this purpose.

It is proposed to levy a Power Development Cess at 10 paise per kWh of electricity consumed in the country. The levy of cess was recommended by the Sub Committee of the NDC Committee on power which gave its report in January, 1994. The cess would be levied on the electricity billed by SEBs/Electricity Departments/Bulk licensees/Distribution licensees. The State/UT Governments would be responsible for the collection of the cess. The amount would thereafter be credited to a "National Power Development Fund. It is expected that about Rs. 3000 crores per annum can be realised by levying a cess of 10 paise per kWh.

It would be necessary to establish a legal and organisational frame work for levy of a cess. Electricity being a Concurrent Subject, the Central Government is empowered to legislate on all aspects of electricity including the levy of cess, the proceeds of which is to be utilised for power development. In order to levy a power development cess, it would be necessary for parliament to enact a legislation on the subject. The cess will be imposed on the consumption of electricity throughout the country. The State Electricity Boards will be the responsible agencies for the collection of cess. The proceeds of the cess will be shared with the State/UT governments and the Central Government. Two-thirds of the amount realised from the State/UT Government will be allocated to the respective government to be utilised for power development. This amount would be released from the National Power Development Fund for financing schemes/projects recommended by the State Government. The remaining one-third will be utilised by the Central Government.
for promoting hydel projects in the Central Sector and for investment in transmission lines for evacuation of power from mega hydel projects which will benefit more than one State.

3.3 Basin-wise Development of Hydro Potential

The assessment of hydro potential in 845 identified conventional hydropower projects and 56 pumped storage projects is on the basis of desk studies using toposheets and discharge data. Further, detailed studies to firm up the parameters of the projects as identified by CEA would be taken up on the basis of development of hydro potential in a basin as a whole for maximising benefits and prioritising execution of projects. These studies will be done in close co-ordination with CWC and in harmony with Planning Commission and development for other uses of water like irrigation, drinking water etc. While CEA would carry out these studies, CPSUs/other Central Government Organisations and State authorities would do the investigations and prepare the detailed project reports, by adopting an integrated approach towards planning and development of the various projects, evacuation arrangement and environmental impact assessment. This would enable an optimal harnessing of hydro potential in each river basin.

3.4 Advance Action for Capacity addition in the 10th Plan and beyond

Government will take immediate steps to tie up funding, execution agencies and convey investment decision for schemes already accorded techno economic clearance of CEA, as far as Central Sector is concerned, NHPC would take up Chamera Stage II (300 MW), Parbati Stage-II (800 MW), HP and Kol Dam (800 MW) in HP; Teesta Stage V (510 MW) in Sikkim, Luktak Downstream (90 MW) in Manipur and NEEPCO will take up Tuivai (210 MW) in Mizoram, Lower Kupili (150 MW) in Assam, Kameng (600 MW) and Rangadi Stage II (160 MW) in Arunachal Pradesh (after the consent of the State Govt. has been obtained). In addition THDC would take action to start activities on Tehri Stage II (1000 MW) and Koteswar (400 MW) in UP. Similarly NJPC would also take up Rampur Project (535 MW) in HP. These projects would require budgetary support of about Rs. 2000 crores in the 9th Plan.

3.5 Survey & Investigations

As a long term strategy efforts will be made to ensure that DPRs which are under various stages of processing for accord to TEC by CEA are finalised and cleared so that a start could be made on these projects in the next one or two years. Survey and investigation of the potential hydro sites on an advanced scientific basis would be essential requirement for the future. The progress on this front has been dismal given the funds constraint and outdated technology. The funding agencies like World Bank and ADB have shown their interest towards funding the survey and investigation activities for hydroelectric projects. Concerted efforts would be made towards availing the funds quickly. This would not only help in preparation of the bankable DPRs for large hydroelectric projects but would also bring in advanced technology by involving reputed international consultants. The central organisations like CWC, Brahmaputra Board, NEEPCO and NHPC, besides SEBs would be provided with funding support from the proposed power development fund for the purpose of carrying out survey and investigations and preparation of bankable DPRs.

Since the private sector has so far been hesitant and cautious to invest in hydro projects, it is proposed that new projects will initially be taken up by CPSUs/SEBs for investigations, updation of DPRs, obtaining the necessary clearances and pre-construction activities. After these stages, the projects could be offered to the private sector for execution either on 'stand alone' basis or for joint venture participation with the CPSU/SEB. The expenditure incurred by CPSUs/SEBs on these activities would be adjusted in the project cost to be recovered from the executing agency to be decided at a later stage. The Government expects that more private investment would be possible with this approach. In case for a particular project no such private investment is forthcoming, it will be executed entirely by the concerned CPSU/SEB which initiated its development.
3.6  Inter-State Projects

A substantial hydel power potential has remained locked up and many mega hydel projects could not be taken up for implementation, even though these projects are well recognised as attractive and viable, because of unresolved Inter-State issues. Govt. of India recognises the need for evolving an approach to ensure that the available hydro-electric potential is fully utilised without prejudice to the rights of the riparian States as determined by the awards of the Tribunals/Agreements arrived at among the party States for a given river basin with regard to water sharing. The selection and design of project would be based on integrated basin wise studies, so as to arrive at an optimal decision and care will be taken that such projects do not in any way prejudice the claims of basin states or affect benefits from the existing projects. A consensus would be evolved amongst the basin states regarding the location of such project, basic parameters involved and mechanism through which each project would be constructed and operated. As far as possible, there would be preference to take up simple run-of-the-river schemes that do not involve any major storage or consumptive uses.

3.7  Renovation, Modernisation & Uprating

Renovation, Modernisation & Uprating of old hydro power plants is being accorded priority as it is a faster and cheaper way of capacity addition that installing new capacity. As per recommendations of National Committee set up in 1987 and based on the subsequent reviews, 55 hydro schemes with an aggregate capacity of 9653 MW were identified for RM&U. Out of these, 20 hydro schemes have been completed providing a benefit of 971.5 MW and work on 27 schemes is in progress. In order to provide a greater thrust for RM&U, Government would set up a Standing Committee, to identify the new schemes and for tying up technology, funding and executing agencies.

3.8  Promoting Small and Mini Hydel Projects

The Ministry of Non-Conventional Energy Sources (MNES) deals with all matters related to Small Hydel projects (upto 3 MW Capacity). These projects are being provided with the following incentives.

(i)  Incentives for detailed survey & investigation and preparation of DPR.
(ii) Incentives during the execution of the project in the form of capital/interest subsidy.
(iii) Special incentives for execution of small hydro projects in the North Eastern Region by the Government departments/SEBs/State agencies.
(iv) Financial support for renovation, modernisation and uprating of old small hydro power stations.

The small hydel projects are site specific and depending on the hydrology, typically the plant load factor varies from 40 to 60%. The Small Hydel Projects upto 25 MW will also be transferred to MNES in order to provide greater thrust for its development. Government of India proposes to provide soft loans to these projects (upto 25 MW) through IREDA/PFC/REC and other financial institutions and Ministry of Non-Conventional Energy Sources would announce a suitable package of financial incentives for the accelerated development of Small Hydel Projects upto 25 MW station capacity. The State Government and Central and State Hydro Corporations like NHPC/NEEPCO etc. would be encouraged to take up a cluster of small/mini hydel schemes on Build, Operate and Transfer basis, and other suitable arrangements.
3.9 Simplified Procedures for Transfer of Clearances

As stated in the foregoing, the CPSUs and the private sector would need to play a greater role in hydro development. The immediate requirement would be to transfer the clearances already accorded to non-starting hydro projects in the State Sector in favour of CPSU/IPP/Joint Venture of IPP and CPSU. Government would evolve a simple procedure so that the transfer of CEA's techno economic clearance would be facile as only updatation of project estimate would be examined by CEA. In the case of Environment and Forest clearances these could be transferred to CPSU/IPP etc. within a prescribed time limit on acceptance of conditionalities stipulated in the MOEF clearance accorded for execution in the State sector by the above executing agencies. Another inhibiting factor discouraging IPPs is the need for notification of the scheme as per Section 29 of ES Act in newspaper and Gazette afresh even if this was done earlier for execution by SEBs. Government intends to do away with this requirement. The simplified procedure as proposed would be an encouraging factor of IPP to evince greater interest in hydro development. Government would initiate action right away towards this end.

3.10 Rationalisation of Hydro Tariff

The tariff formulation and norms for hydro projects as per existing Government Notification are viewed by CPSUs and IPPs as unfavourable compared to those for thermal projects and the IPPs tend to prefer thermal projects for investment. There is a need to reformulate the principles on the basis of which tariff is determined for hydel generation. The objective is to fix a rate which will be reasonable to the consumer, to ensure adequate internal resources to repay the loan and also to provide a reasonable rate of return on investment. Recognising the difficulties in execution of hydro projects, the Government has decided to rationalise the existing hydro tariff norms, improve the incentives for better operation and evolve a solution to the contentious issue of computing the completion cost in the face of geological uncertainties and surprises and natural incidents of rock slide etc.

In January 1995, the Government issued a notification providing for a two part tariff for hydel generation stations. The first part of the tariff, denominated as capacity charges covers (a) interest on loan capital; and (b) depreciation reckoned at an annual amount not exceeding 1/12 of the loan amount and limited to the actual loan liability of the year as per approved financial package. The second part of the tariff denominated as energy charges covers (a) return on equity calculated at 16% (b) O&M charges; (c) tax on income; and (d) any other variable charge.

Hydro projects provide valuable peak power and have inherent capability for instaneous starting and stoppage based on variation of load. The peaking power stations generally operate at a very low load level. Recognising the value of peak power to the system and resultant improvement in operation of thermal stations, it is proposed to allow a premium on the sale rate for hydro generation during peak period. The formulation of peak tariff and the premium to be allowed would be decided by the Central Electricity Regulatory Commission and the State Electricity Regulatory Commissions. Under the present notification, the rate for incentive for secondary energy has to be fixed at a rate mutually agreed between the State Electricity Board and the generating company. However, the maximum payment on this account is restricted to an amount not exceeding 10% return on equity. In order to provide an additional incentive for attracting investment in hydel projects, it is proposed to allow the sale rate for secondary energy at the same rate which is applicable for a primary energy.

Recognising the problems in operation of hydro power stations in the initial years especially in project with silt laden water, the normative availability factor is proposed to be reduced from 90% to 85%.
3.11 Estimates on Completion Cost (Geological Risks)

During the implementation of hydro power projects specially underground power stations, there is a likelihood of coming across geological surprises which are not anticipated at the time of preparation of Detailed Project Report. This results in increase in capital cost. The developer would need to be compensated for this kind of eventualities.

In the existing tariff notification for hydro projects there is no provision for increase in project cost arising due to geological risks. A realistic estimate of completion cost has to take into account the geological and hydrological risks, cost escalation and natural occurrences of land slides, rock falls etc. In such cases, the developer will be allowed to submit his proposal for the enhanced cost to the Government. Expert committee would be constituted at the State and Central level who would evaluate the recommend the cost increases for acceptance by the Government. The expert committee at the State Government level would recommend the cost increase proposal upto certain percentage and beyond that the cost increase would be recommended by the expert committee at the Central Government level.

3.12 Promoting Hydel Projects with Joint Ventures

With a view to bring in additional private investment in the hydel sector there would be a greater emphasis to take up schemes through the joint ventures between the PSUs/SEBs and the domestic and foreign private enterprises. The joint venture company will be an independent legal entity to be registered under the Companies Act and would act as an independent developer. The joint venture agreement between the two partners will bring clearly the extent of participation by each pattern and sharing of risks relating to implementation and operation of the project. It will also provide for arrangement in such cases where the joint venture pattern would not be associated with the operation and maintenance of the project. While the selection of a joint venture partner would be in accordance with the policy of the Government, there would be an option for the PSU to either select the joint venture partner together with their financial and equipment package or to select a joint venture partner wherein the EPC contract is decided by both the partners after they have formed the joint venture company. The associated transmission lien connected with the scheme will be constructed by the Power grid Corporation of India. The power from joint venture hydel projects will be purchased by the Power Trading Corporation (PTC) proposed to be formed with equity participation from Government/CPSUs/Financial Institution. The security for payment of power purchased from the joint venture projects would be through a LC to be provided by the SEBs and recourse to the State's share of Central Plan Allocation and other revolution. This security package would enable to raise finances for these projects. as far as the new schemes to be developed under the joint venture route are concerned, the power sharing formula as applicable to the Central Sector Projects shall not apply and joint venture company would be totally guided by the Commercial interest. The State Government (home State/States) will be compensated by way of 12% free power as per the present policy applicable for Central Sector hydel projects.

3.13 Selection of Developer and Techno Economic Clearance of CEA

As per Government notification of September, 1996, all the schemes estimated to involve a capital expenditure above Rs. 100 crores are to be submitted to CEA for techno economic clearance and in respect of schemes prepared by a generating company and selected through a process of competitive bidding by the competent Government or governments, the exemption from CEA's techno-economic clearance is applicable if the capital cost is Rs. 1000 crores or less.

Considering the capital intensive nature of hydel projects especially those of medium size being executed in the State Sector, it is proposed to increase the limit for exemption of CEA clearance from the present Rs. 100 crores to Rs. 250 crores if the projects are taken in the MOU route. In case of projects through competitive bidding the existing limit of Rs. 1000 crores for CEA techno economic clearance will
continue. However, irrespective of the capital cost or capacity, all hydel projects having inter-State aspect will require a mandatory clearance from the CEA. Keeping in view the need for transparency and cost assessment by an accepted mechanism as well as the uncertainties that are inevitable in the development and execution of hydel projects, the Government proposes to allow the selection of developer through MOU route for the hydel projects upto 100 MW instead of the existing limit of Rs. 100 crores. However, these projects would require CEA techno economic clearance if their capital cost exceeds Rs. 250 crores. This would enable more developers to evince interest in medium size hydro projects due to ease of execution and resource raising and due to exemption in obtaining clearances.

3.14 Govt. Support for Land Acquisition, Resettlement & Rehabilitation, Catchment Area Development

The acquisition of requisite Government, forest and private land involves cumbersome procedure and difficult negotiations with land owners to part with the land. Demands for employment in lieu of the land cost, land for land at places of land owners choice etc. has resulted in contractual problems for several projects. There is, therefore, a need that project authorities are insulated from the problems arising out of land acquisition and R&R. It will be the responsibility of the State Govt. to acquire the land (Government/Private/Forest) for the project and also negotiate at its own terms with land owners as per the policy adopted by respective State Governments. Similarly, all the issues of resettlement and rehabilitation associated with projects have to be addressed by the State Govt. The State Governments may consider to form Authorities to address the problems of land acquisition and R&R for all infrastructure projects. In case of mega projects the project specific Authorities may be created not only for land acquisition and RR but for comprehensive development of the area including catchment area. The project developer may not be involved in execution and implementation of works by these Authorities, but will be required to contribute for funding their plans. All such costs incurred by the developer shall be considered as cost to the project and allowed to be passed through tariff.
CENTRAL ELECTRICITY AUTHORITY

GUIDELINES FOR FORMULATION OF
DETAILED PROJECT REPORTS FOR
HYDRO ELECTRIC SCHEMES, THEIR
ACCEPTANCE AND EXAMINATION
FOR CONCURRENCE

NEW DELHI
January 2007
If you have any suggestions on the following guidelines, kindly mail to us latest by 31st January, 2007 at:

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CHAPTER-1

REQUIREMENT FOR COCURRENCE OF HYDRO ELECTRIC SCHEMES

1.1 Provisions under the Electricity Act, 2003

1.1.1 As per Section 8 (1) of the Electricity Act, 2003, any generating company intending to set up a hydro generating station shall prepare and submit to the Authority for its concurrence, a scheme estimated to involve a capital expenditure exceeding such sum, as may be fixed by the Central Government, from time to time, by notification.

11.2 As per Section 8(2) of the Electricity Act, 2003, the Authority shall before concurring to any scheme submitted to it, have particular regard to, whether or not in its opinion, -

a) the proposed river-works will prejudice the prospects for the best ultimate development of the river or its tributaries for power generation, consistent with the requirements of drinking water, irrigation, navigation, flood control, or other public purposes, and for this purpose the Authority shall satisfy itself, after consultation with the State Government, the Central Government, or such other agencies as it may deem appropriate, that an adequate study has been made of the optimum location of dams and other river-works.

b) The proposed scheme meets the norms regarding dam design and safety.

1.1.3 As per Section 8 (3), where a multi-purpose scheme for the development of any river in any region is in operation, the State Government and the generating company shall co-ordinate their activities with the activities of the persons responsible for such scheme in so far as they are inter-related.

1.2. Capital Expenditure exceeding which Concurrence required

1.2.1 In compliance with Section 8(1) of the Electricity Act, 2003, the Central Government vide Notification No. SO 550(E) dated 18.04.2006 has fixed the following limits of capital expenditure for various categories of hydroelectric schemes exceeding which the scheme is to be submitted to the Authority for concurrence:

i) Rs. 2500 crores, provided that –
   a) the scheme is included in National Electric Plan (NEP) as notified by Central Electricity Authority (CEA) and conforms to the capacity and type
   b) the site for setting up the generating station has been allocated through the transparent process of bidding in accordance with the guidelines issued by Central Govt.

ii) Rs. 500 crores for any other scheme not covered by para (a) and (b) of clause.
CHAPTER-2
PREPARATION OF DETAILED PROJECT REPORT

2.1 General

2.1.1 The Detailed Project Report (DPRs) of hydro Electric Schemes required to be submitted to the Authority for concurrence in compliance with the requirement of Section 8 of the Electricity Act, 2003 shall be formulated by Generating Company/ Project Developer as per the guidelines laid down by the Authority considering the following:-

(a) the Hydro Electric Scheme aims at best ultimate development of the river basin,

(b) the Scheme is designed for optimum benefits and does not adversely affect the operation of the upstream and downstream Hydro Electric Schemes and takes into consideration the impact of the future upstream and downstream developments in the river basin identified at the Central and State levels.

(c) the Hydro Electric Scheme is consistent with water requirement for drinking water, irrigation, navigation, flood control or other public purposes.

(d) the Hydro Electric Scheme takes into account the progressive development of consumptive use of water and new water resources development schemes in the river basin due to which the water availability may undergo change over the period,

(e) the Hydro Electric Scheme meets the requirement of optimum location of dams and other river works.

(f) the Hydro Electric Scheme meets the norms regarding dam design and dam safety.

(g) the Hydro Electric Scheme is either included in National Electricity Plan drawn by the Authority under section 3(4) of the Act or results in generation of power at reasonable tariff.

(h) the DPR is prepared after essential site surveys and investigations are completed.

(i) the Generating Company shall refer to the latest edition of the “Guidelines for preparation of Detailed Project Report of Irrigation & Multipurpose Schemes” published by the Central Water Commission for civil works and shall consult the relevant documents listed in Annex - 2(a) wherever applicable.

2.1.2 The DPR prepared by the Generating Company shall be structured in the format as described in the succeeding paragraphs.
2.2 Structure of the Detailed Project Report

2.2.1 The details to be included in the respective chapters of the DPR is given below. The sections of “Guidelines for preparation of Detailed Project Report of Irrigation and Multipurpose Projects” issued by CWC to be referred are indicated in bracket against the respective components of work.

2.2.2 The DPR should include the following chapters:

- Chapter –I Introduction
- Chapter –II Justification of project from power supply angle
- Chapter -III Basin Development
- Chapter -IV Inter-State / Inter-National Aspects
- Chapter -V Survey & Investigation (Section 3.4)
- Chapter -VI Hydrology (Section 3.5)
- Chapter –VII Reservoir (Section 3.7)
- Chapter –VIII Power Potential & Installed Capacity (Refer Appendix-1 of these Guidelines)
- Chapter –IX Design Of Civil Structures (Section 3.6)
- Chapter –X Electrical And Mechanical Designs
- Chapter –XI Transmission of Power and Communication facilities
- Chapter –XII Construction Programme & Plant Planning (Section 3.13)
- Chapter –XIII Project Organisation
- Chapter –XIV Infrastructural Facilities
- Chapter –XV Environmental & Ecological Aspects
- Chapter –XVI Cost Estimates
- Chapter –XVII Allocation Of Cost
- Chapter –XVIII Economic Evaluation
- Chapter –XIX Future Utilisation Of Buildings (Section 3.20)
- Chapter –XX Recommendations
- Chapter –XXI Clearances / Inputs
Chapter -I  INTRODUCTION

1.1 Type of the project (run of river, storage, pumped storage, multipurpose)
1.2 Location of the project area including longitude and latitude and district(s) and tehsil/ village etc.
1.3 Access by air/rail/road/ferry, sea port & other communication facilities available in area.
1.4 General climatic conditions in the project area.
1.5 General description of topography, physiography and geology of the project area.
1.6 Historical background of the project:
   a) Earlier proposal, if any
   b) Present proposal
1.7 Need for the project, possible options and justification for selected option.
1.8 Alternative studies carried out for various major components of the project and final choice of the project parameters.
1.9 Natural resources of the State/Region.
1.10 Socio-economic aspects including tribal, backward and drought areas.
1.11 Land required for the project construction – forest land, village land and agricultural land, total area of the land being submerged.
1.12 Population affected by the project and occupation of the people affected.
1.13 Environmental aspects.
1.14 Inter State / Inter-national aspects
1.15 Defence angle, if any.
1.16 Cost and benefits of the scheme.
1.17 Construction Programme

Chapter -II  JUSTIFICATION OF THE PROJECT FROM POWER SUPPLY ANGLE

2.1 Justification of project from power supply-demand considerations on all India / regional basis
2.2 Details of scheme for wheeling evacuating power
2.3 Resources for power development in the region/state.
   (i) Coal resources
   (ii) Hydro resources
2.4 Available generating capacity in the state/region from different sources
2.5 Peak load and energy requirement in future in all India/region/state up to the likely date of project completion.
2.6 Likely addition to generating capacity in future in the all India/region/state indicating power supply position with & without the project under consideration and improvement in the hydro-thermal mix.
Chapter -III  BASIN DEVELOPMENT

3.1 The course of the river
3.2 Power potential of the river basin and stages of development
3.3 Whether trans-basin diversion of waters involved
3.4 Fitment of the scheme in the overall basin development
3.5 Fitment of the scheme in the power potential assessment studies carried out by CEA
3.6 Effect of future upstream/downstream developments on the potential of proposed scheme

Chapter -IV  INTER-STATE / INTER-NATIONAL ASPECTS

4.1 States/countries traversed by the river
4.2 Distribution of catchment in states/countries and yields from the catchment of state/country concerned.
4.3 Effect of the following on the project:
   a) Inter-state agreement on sharing of waters, sharing of benefits and costs, acceptance of submergence in the upstream state(s), if any.
   b) Inter-state adjudication, if any
   c) Interstate aspects of territory, property etc. coming under submergence, oustees rehabilitation, compensation etc.
   d) Any other aspect of the project involving inter-state problems
   e) Inter-national aspects, if any
4.4 Existing riparian use, quantum of water presently utilized, commitments for ongoing projects, plans for future development, balance share of the state/country and proposed utilization by this project. (Discuss relevant items both for upstream and downstream usages)

Chapter -V  SURVEY & INVESTIGATION (Section 3.4)

5.1 Topographical survey of river, reservoir, head works, colony layout, head race tunnel/channel, power house, switchyard, surge shaft, tail race tunnel/channel, adits, penstock etc. considering different water levels
5.2 Archaeological surveys in the reservoir area.
5.3 Mineral surveys in the catchment areas.
5.4 Right of way surveys for the reservoirs. These shall cover survey for right of approach roads, which may be claimed by owners to various structures above FRL.
5.5 Communication surveys
5.6 Geology & geo-technical features
5.7 Seismicity
5.8 Foundation investigations of different structures/components of the project indicating boreholes details, soil/rock strata etc.
5.9 Construction materials investigations
5.10 Hydrological and meteorological investigations.
Chapter -VI HYDROLOGY (Section 3.5)

6.1 Hydrological inputs for the project planning
6.2 Effect of project development on hydrologic regime.
6.3 Hydrologic studies for water availability, design flood, design flood levels, sedimentation etc.

Chapter -VII RESERVOIR (Section 3.7)

7.1 Catchment area, annual run-off, submergence, suitability of soil/rock, dead storage level
7.2 Sedimentation data and studies
7.3 Fixation of storage and reservoir levels, { maximum water level (MWL), full reservoir level (FRL), minimum draw down level (MDDL) }, flood cushion etc.
7.4 Life of reservoir in years with basis
7.5 Capacities at MWL, FRL, MDDL, Dead Storage level etc. at project planning stage and after 25, 50, 75 and 100 years or more of operation
7.6 Water tightness of the reservoir
7.7 Annual losses (month-wise) (evaporation, seepage etc.)
7.8 Flood absorption on regular/flash flood
7.9 Effect on subsoil water tables in the adjoining areas upstream and downstream of the dam
7.10 Seismic characteristics and effects due to construction of dam
7.11 Reservoir rim stability
7.12 Area of submergence
7.13 Land acquisition
7.14 Recreation facilities
7.15 Pisci-culture
7.16 Other facilities, if any
7.17 Need and recommendations for soil conservation measures in the catchment.

Chapter -VIII POWER POTENTIAL & INSTALLED CAPACITY
(Refer Appendix-1 of these guidelines)

Conventional H.E. Schemes

8.1 Type of power plant i.e. run-of-river (with or without diurnal storage) or storage type.
8.2 Assessment of power potential (firm power and 90% dependable energy, secondary energy) of the scheme.
8.3 Studies for optimisation of storage, FRL, MDDL, lean period capabilities etc.
8.4 Monthwise, 10 daily availability of power and energy, peaking capabilities etc.
8.5 Optimisation of installed capacity and unit-size studies carried out may be discussed.

**Pumped Storage Schemes.**

8.6 Type of scheme – daily or weekly regulated
8.7 Optimisation of storage capacity, FRL, MDDL etc. of upper and lower reservoirs – Studies carried out may be discussed
8.8 Optimisation of installed capacity and number of units – Studies carried out may be discussed
8.9 Operating criteria of the project in generating and pumping mode, availability of pumping energy for pumping operations over the years.
8.1 Cycle efficiency of the scheme.

**Chapter - IX  DESIGN OF CIVIL STRUCTURES (Section 3.6)**

9.1 Structures & layout
9.2 General
   (i) Head works - site and vicinity
   (ii) Reasons for choice of the layout of the project adopted.
   (iii) Type of structure – dam (earth / rock-fill / masonry etc.)
   (iv) Layout of dam and spillway / barrage / weir / appurtenants / auxiliary works and power house, reasons for choice of site.
9.3 Geology, seismicity and foundations
9.4 Alternative studies carried out for selection of site and type of structures / dam / barrage / weir, regulators, water conductor system, power house etc.
9.5 Choice of final layout of all the major components of the project and reasons – with details
9.6 Design flood and sedimentation studies
9.7 Free board
9.8 River diversion arrangements – choice of design flood with hydro-graphs
9.9 Construction materials
9.10 Details of Model of studies
9.11 Design of dam / barrage / weir
9.12 Design of intake, power channel/tunnel, balancing reservoir / fore-bay, surge shaft, penstocks, power house, tailrace, switchyard
9.13 Details of instrumentation for various structures

The chapter shall include structural and hydraulic design calculations for dam, spillway gates and energy dissipation arrangements, outlets – regulators, river sluices, intake structures, surge shafts, power house etc. Essential structural calculations shall be furnished. For stability analysis, loading diagrams considering various conditions of water level, earthquake and other forces/stresses considered shall be included.

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   (ii) Operating heads & outputs
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   (iv) Setting of turbine/pump turbine
   (v) Speed & pressure rises

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   (ii) Outputs, power factor, Generation Voltage
   (iii) Class of insulation
   (iv) Type of Cooling
   (v) Generator inertia
   (vi) Starting method (Pumped storage schemes)

10.3 Generator – transformer connections

10.4 Main step-up transformer

10.5 Switchyard equipment

10.6 Single line scheme

10.7 Control & protection equipment

10.8 Auxiliary Mechanical services
   (i) EOT Crane
   (ii) Electrical lifts and elevators
   (iii) Workshop equipment
   (iv) Test Laboratory
   (v) Telemetry
   (vi) Ventilation & air conditioning
   (vii) Fire protection
   (viii) Cooling water

10.9 Auxiliary Electrical services
(i) A.C. auxiliary services  
(ii) D.C. auxiliary service.  
(iii) Cables  

10.10 Transport limitations  
(i) Maximum limiting dimensions (L x W x H) of packages for transport  
(ii) Maximum limiting weight of the package which can be transported  

*The design calculations wherever required shall be included.*

**Chapter -XI** **TRANSMISSION OF POWER AND COMMUNICATION FACILITIES**

11.1 Transmission of power  
i) Consent / Agreement signed between the Generating company and the purchaser(s) (State utility or other buyers)  
ii) Letter of Consent from the appropriate Transmission utility to provide evacuation system,  
iii) Details of the existing and proposed system  
iv) Target date of completion of the proposed system  
v) Letter of Comfort from the Transmission Company to enter into a back to back agreement with the promoter covering risk in case of default/ delay in commissioning by either of the parties.

11.2 Telecommunication aspects

**Chapter -XII - CONSTRUCTION PROGRAMME & PLANT PLANNING**  

*(Section 3.13)*

12.1 PERT chart giving details of activity-wise construction programme for each of the major components of the civil, electrical and mechanical equipment  

12.2 Bar charts showing the construction programme quantity-wise, item-wise and year-wise target of construction  

12.3 Key materials planning  

12.4 Executing agencies for major works – departmental/contractor  

12.5 Various alternatives for construction programme and proper justification of adopted programme  

12.6 Plant/equipment planning  

12.7 Programme for construction of tunnel / channel shall include:
(i) Excavation of tunnel/channel – cycle time to be given
(ii) Lining of tunnel
   (a) Overt
   (b) Invert

Chapter XIII  PROJECT ORGANISATION

13.1 Proposed set up for the project

13.2 Details of the proposed organization, No. of staff and expenditure (year-wise)
   (i) For civil works
   (ii) For electric and mechanical works
   (iii) Administrative & financial set up
   (iv) Others

13.2.1 Pre-construction organization

13.2.2 Consultants

Chapter XIV  INFRASTRUCTURAL FACILITIES

14.1 Access roads
   (i) Roads to the project
   (ii) Roads in the project area

14.2 Rail head

14.3 Port facilities, As applicable

14.4 Construction power requirement

14.5 Power supply facilities

14.6 Telecommunication facilities required during construction and after completion of the project

14.7 Project colonies / buildings

14.8 Workshops

14.9 Drinking water facilities

14.10 Others

Chapter XV  ENVIRONMENTAL & ECOLOGICAL ASPECTS

15.1 Status of Environmental clearance

   All Hydro Electric Schemes require environmental clearance from MOEF before being taken up for construction. Various information and environmental action plans to be
incorporated in the DPR should be as per the latest “Guidelines for Environmental Impact Assessment of River Valley Projects” issued by MOEF. Environmental aspects such as status of site clearance, EIA/EMP studies, public hearing, environmental clearance etc. shall be included on the DPR.

15.1 Status of Forest clearance

In case, construction of hydro-electric project involves diversion of forest land, forest clearance would also be required under Forest (Conservation) Act. The case for forest clearance should be submitted to MOEF through State Forest Authorities as per Forest (Conservation) Rules and Guidelines issued by MOEF in this regard from time to time. Details of forest land involved and status of its clearance shall be included in the DPR.

15.3 Cost of proposed remedial & mitigative measures

The cost of the proposed remedial and mitigative measures, if any, to protect the environment must be included in the cost estimates of the project. Mitigative measures may include:

- Rehabilitation measures
- Compensatory afforestation
- Disaster management plan
- Restoration of land in construction areas by filling, grading etc. to prevent further erosion
- Control of aquatic weeds in submerged areas to provide improved habitat for aquatic life
- Measures to salvage/rehabilitation of any rare or endangered species of flora and fauna found in the affected areas
- Enforcement of anti poaching laws
- Measures to prevent forest fires, over grazing of areas etc
- Establishment of fuel depots etc
- Public health measures
- Catchment Area Treatment
- Environmental and ecological studies
- Details about Net Present Value of forest land
Chapter XVI  COST ESTIMATES

16.1 The Civil Cost Estimates of the project shall be prepared as per “Guidelines for preparation of estimates for the river valley projects” issued by CWC and Indian Standard IS: 4877 “Guide for Preparation of Estimate for River Valley Projects”. Wherever any specific stipulation is made in these guidelines, these shall take precedence over what is stipulated in CWC guidelines.

16.2 The estimates of a Hydro Electric Scheme shall be divided under the following heads indicated at Annex-2(b).

A. Direct Cost

I. Works
   A - Preliminary
   B - Land
   C - Works
   J - Power Plant Civil Works
   K - Buildings
   M - Plantation
   O - Miscellaneous
   P – Maintenance during construction
   Q - Special T&P
   R - Communications
   S - Power Plant and Electro- Mechanical system
   X - Environment and ecology
   Y - Losses on stock

Total I - Works
   1. Establishment
   2. Tools and Plants
   3. Suspense
   4. Receipt And Recoveries

Total (A) - Direct Cost

B. Indirect Cost

i. Capitalisation of Abatement of Land Revenue
ii. Audit and Account Charges

Total (B) - Indirect Cost

Total Cost (A +B)
16.3 Preparation of estimates

16.3.1 The capital cost of a project includes all cost associated with investigations, design, construction and maintenance during construction period of the project.

16.3.2 For preparation of cost estimates of civil works, the unit costs of labour, materials and equipment necessary to perform the work designated in the various pay-items for the proposed construction shall be determined. Current unit cost shall be used in all estimates and price level of the project estimate shall be mentioned.

16.3.3 The analysis of rates for various items shall be worked out taking into consideration the cost of materials, carriage-handling-storing, labour and share of machines involved in executing various items of the work and overhead charges.

16.3.4 The quantitative assessment of material requirement shall be adopted from authoritative books/publications or through independent calculations based on the data available at site or other projects. The unit cost of various materials may be taken as those prevalent in the State/region. The appropriate cost for freight, unloading, cartage, storage, inspection and testing should also be included.

16.3.5 The wages of workers are periodically revised by the State under the statutory labour laws. Daily wage rates, therefore, shall be taken as those prevalent in the State at the time of formulation of the project.

16.3.6 For working out the use rates of machinery, the norms for life, depreciation, repair provision etc. shall be adopted as recommended by the latest CWC Guide Book on use rate, hire charges and transfer value of equipment and spare parts. Price of various equipment should be taken on the basis of recent quotations/price list of such equipment. All taxes and freight charges should be taken into consideration while arriving at the cost of equipment at site.

16.3.7 Provision for contingencies and work-charged establishment is generally considered up to 3% and 2% respectively of the works’ cost and provided in the detailed works estimates prepared on the heads of items rates and quantities of works to be executed. These percentage provisions should not be considered on lump-sum items.
16.3.8 Mention shall also be made regarding communication facilities available, terrain through which the roads are passing (hilly, plain etc.), type of road (Black top, water bound macadam, murum, kacha etc.).

16.4 Preparation of detailed Estimates of Cost (I-Works)

16.4.1 A- Preliminary

The provision under this head covers the works relating to various investigations, Surveys, Model tests, ecological studies etc. This should be based on the actual cost likely to be incurred and should not exceed 2% of the total cost of I-Works.

16.4.2 B- Land

The provisions under this head covers Acquisition of land, rehabilitation & resettlement including compensation for property, Interest charges, Solatium charges, demarcation & measurement charges, etc. The provision should be made as per actual.

16.4.3 C- Works

The provisions under this head is intended to cover the costs of the Head works viz. Dam, spillway, energy dissipation works, outlets (irrigation, power, water supply and scour sluices), pick up weir, barrage, head regulators, etc.

16.4.4 J- Power plant civil works

Important items to be considered under this head are

(a) Intake structures

i) Excavation
ii) Foundation treatment
iii) Cement concrete for foundation, piers and abutments
iv) Masonry/concrete for guide walls of approach channel
v) Concrete for trash racks including raking arrangement
vi) Gates with auxiliary equipment
vii) Reinforcement steel
viii) Instrumentation etc.

(b) Head Race / Tail Race Tunnels (including cut and cover section)

i) Excavation
   Open cut
   Tunnel including temporary supports
ii) Rock bolts
iii) Permanent support, ventilation
iv) Drainage
v) Cement concrete for lining
vi) Steel lining
vii) Drilling and grouting  
viii) Gates and ancillaries, where required  
ix) Reinforcement steel  
x) Instrumentation  

(c) Head Race channel and Tail race channel  
i) Excavation  
ii) Embankment  
iii) Lining with cement concrete in bed and sides with drainage pipes and valves  
iv) Pucca works  
- Cross Drainage(s)  
- Escape(s)  
- Bridge(s)  
- Meter flume  
- Balancing tank  
v) Instrumentation  

(d) Surge shaft  
i) Excavation  
ii) Cement concrete lining  
iii) Drilling and grouting  
iv) Miscellaneous items such as masonry, guiniting, steel lining, ladder, bolts etc.  
v) Reinforcement steel  
vi) Instrumentation  

(e) Penstock  
i) Excavation  
ii) Cement concrete for  
- Bed  
- Anchor blocks  
- Intermediate supports  
iii) Steel pipes for  
- Stiffner  
- Reducers  
- Bends  
- Wye pieces  
- Penstock valves  
v) Instrumentation  

(f) Power House  
i) Excavation  
ii) Concrete for foundation, sub-structure, super structure and supports for turbines and generators  
iii) Masonry/concrete for super-structure and other necessary items for building work  
iv) Scroll casing / Generator barrel  
v) Draft tube  
vi) Bulkhead gates, crane and hoisting equipment  
vii) Power-house crane  
viii) Miscellaneous items such as anchor bolts, grouting etc.  
ix) Instrumentation
16.4.5 K – Buildings
The provisions under this head covers the Residential / Non-residential buildings, Office buildings, Testing laboratories, Workshops, Other Service Buildings, Community Centre etc. The provision shall be made as per the actual requirement.

16.4.6 M – Plantation
The provisions under this head covers the plantation programme including Gardens etc. required for beautification as considered necessary downstream of Dam and appurtenances around Power House and other important structure.
The provision should be made on lump sum basis keeping in view the experience of other projects.

16.4.7 O – Miscellaneous
The provisions under this head covers the capital cost & maintenance of Electrification, Water supply, Sewage disposal and drainage works, Recreation, Medical, Fire fighting equipments, Inspection vehicles, School bus, Pay van, Visit of dignitaries, welfare works etc. The provision, however, should not exceed.
   i) @3% of the cost of I-Works upto Rs.1000 crores limited to Rs. 20 crores
   ii) @ 2% of the cost of I-Works upto Rs.2000 crores limited to Rs. 30 crores
   iii) @1.5% of the cost of I-Works greater than Rs.2000 crores limited to Rs. 40 crores)

16.4.8 P - Maintenance during Construction
The provisions under this head covers the cost of maintenance of all works during the construction period. The provision should be 1% of the total cost under the heads of C-Works, J-Power House Civil Works and K-Buildings.

16.4.9 Q – Special T&P
The provisions under this head covers the Drilling & Grouting equipments, Transport, Compaction, Electrical equipments, Construction Plant & Earth Moving equipments and other Miscellaneous equipments. Since the projects are presently being executed through limited contracts package and is the responsibility of the contractor to arrange for such equipment. A token provision of Rs. 1-2 crores under this head may be adequate to provide for essential equipment not covered under contract package.
16.4.10 R - Communication

The provisions under this head covers the construction of main approach roads, quarry roads, temporary or permanent river crossing, Railways, Bridges, connecting roads, water ways and airstrip/helipad.

The major items on this account shall be supported by sub estimates. The provisions shall be made in consultation with the concerned authorities.

16.4.11 S - Power Plant and Electro – Mechanical System

The provisions under this head cover the Electro-mechanical equipment for the power plant, and associated substation under the sub-heads indicated in Annex-S “Abstract of Cost Estimates of Electro-Mechanical Equipments”.

The provision should be realistic and be based on the current orders and latest market rates. The price levels stating month/year for which the rates are applicable should be indicated.

The cost may be indicated in foreign currency (ies) (FC) applicable for the imported equipment and in Indian rupees (INR) for indigenous Equipment. The total cost may be given as sum of (FC+INR)

The central sales tax, transportation & insurance, erection & commissioning, contingencies, establishment, T&P and Audit & Account charges may be taken as per ‘Abstract of cost estimates’. However, care may be taken that overheads like establishment, contingencies, Audit & Accounts, etc. may not be repeated in cost of civil works.

The rate of central sales tax, custom duty, freight & insurance and service tax may be taken as per prevailing rates at the time of submission of DPR/Documents.

In case of mega hydro electric projects, benefits available as per the policy may be considered.

16.4.12 X- Environment and Ecology

This sub-head generally covers the provisions for items like, compensatory afforestation, catchment area treatment, establishment of fuel depot, salvage / rehabilitation of any rare or endangered spicies of flora and fauna, control of aquatic weeds, public health measures to control water or soil borne diseases, Restoration of land, seismological measures etc. The provisions shall be as per actual requirement.
16.4.13 Y- Losses on stock

The provision under this sub-head is generally made at 0.25% of the total cost of C-Works, J-Power Plant Civil Works and K-Buildings only.

16.5 Establishment

The projects presently are being executed through 3 or 4 major contract packages in case of civil works and a single EPC contract for Electro-mechanical works. Therefore, the establishment necessary at site would be limited to posting of limited supervisory staff and thus the norm of 8% for civil works and 6% for Electro-mechanical works is not necessary. The provision under this head therefore should be based on the manpower actually proposed to be deployed. However this should in any case not exceed the following:

For Civil works Estimated to cost

1. Up to Rs. 1000 crores @ 8% with a ceiling of Rs. 60 crores
2. Rs. 1000 to Rs. 2000 crores @ 6% with a ceiling of Rs. 80 crores.
3. > Rs. 2 000 crores @ 4% with a ceiling of Rs. 100 crores.

For Electro-mechanical works
(The ceilings shall be ¾ of the above)

A detailed chart showing the Manpower proposed to be deployed, their salary structure and other expenses likely to incurred shall be enclosed in the report.

Since land acquisition staff is separately provided under the sub-head B-Land, the percentage provision for II-Establishment should be considered on the cost of I-Works minus less B-Land.

16.6 Tools & Plants

The provisions under this head covers survey instruments, camp equipments, office equipments and other small tools. A token provision of Rs. 1-2 crores under this head may be adequate.

16.7 Suspense

The net provision under this minor head will be “NIL” as all the outstanding suspense accounts are expected to be cleared by adjustment to appropriate heads on completion of the project.
16.8 Receipts & recoveries on capital account

This head is meant to account for estimated recoveries by way of resale or transfer of temporary buildings and special T&P. Miscellaneous receipts like rent charges of buildings, electricity charges etc., should also be accounted for under this head.

The recoveries on account of temporary buildings may generally be taken at 15% of the cost unless a higher recovery is anticipated due to some special reason such as tubular construction, vicinity to city/village/town industrial undertaking etc. Such special reasons should be indicated in the report. The recoveries on account of special T&P should be indicated as explained in the sub-head Q-Special T&P. Credit on account of resale of electrical installations, water supply fittings etc., after execution of the project, if anticipated, should also be shown under the head.

16.9 Indirect charges

16.9.1 The complete estimate for a project besides including all anticipated direct charges should further include as indirect charges, the amount required to cover the capitalisation of abatement of land revenue on the area occupied by the works and allowance for the cost of Audit & Accounts and Establishment.

16.9.2 The provision for Audit and Account charges may be made.
@ 0.5% of I-Work cost upto Rs. 1000 crores
@ 0.25% of I-Work more than Rs. 1000 crores subject to minimum of Rs. 5 crores.

16.9.3 Charges for capitalisation of abatement of cost of land revenue are generally calculated at either 5% of the culturable land cost or 20 times of the annual revenue lost.

Chapter -XVII ALLOCATION OF COST

The details in respect of allocation of cost for each component of the Multipurpose Project shall be based on the cost cleared by Technical Advisory Committee of MOWR. The details in this regard may be clearly spelt out under this Chapter.

In case of projects involving flood moderation, it may clearly be indicated whether the cost of flood moderation as cleared by CWC shall be borne by the concerned beneficiary State.
Chapter - XVIII ECONOMIC EVALUATION

18.1 Phasing of expenditure half yearly as per Annex-2(c).
18.2 Interest during construction (IDC)
18.3 Cost of generation at power house bus bars (with IDC)
18.4 Sale rate of energy (with IDC) (with and without free power to home State)
18.5 Levelised tariff (with and without free power to home State)
18.6 Comparison of cost of generation with alternate source of generation in the State/Region
18.7 Project estimated cost and financial package summary shall be submitted as per Annex-2(d).

Calculations Shall be carried out as per the tariff order of the Appropriate Regulatory Commission.

Chapter - XIX FUTURE UTILISATION OF BUILDINGS (Section 3.20)

19.1 Details of buildings to be constructed to meet peak requirements of the project
19.2 Departmental requirement of buildings after completion of the project
19.3 Requirement of the buildings by other agencies
19.4 Utilisation of surplus buildings

Chapter - XX RECOMMENDATIONS

20.1 Economic justification of the project
20.2 Socio-economic and other benefits

Chapter - XXI CLEARANCES / INPUTS

21.1 Authenticated Copies of the following Documents/Certificates/Clearances are required to be submitted to CEA for concurrence.
   - Letter from the Registrar of Companies indicating that the company has been registered as a Generating Company under Indian Companies Act, 1956
   - Article of Association indicating that generation is one of the objectives of the Company
   - Letter from Competent Government authorizing the company to establish, own and operate generating power plant. The letter must contain the following
     - Location of Project-State, District, Taluka, Tehsil, Village, longitude and latitude.
➢ Capacity of the power plant
   ▪ Land availability certificate from State Revenue Authorities
   ▪ Water availability certificate from State Irrigation Department/ concerned agency
   ▪ Clearance of Ministry of Water Resources/ Central Water Commission as the case may be. In case of inter-state/country aspects, necessary clearance from concerned authority
   ▪ Status of Environmental and Forest clearance from Ministry of Environment & Forests, Government of India
   ▪ Defence clearance (if applicable)
   ▪ Consent / Agreement signed between the Generating company and the purchaser(s) (State utility or other buyers). In case of CPSU project, the willingness for absorption of power by the beneficiary States/ UTs
   ▪ Recommendation of the State Govt. on the project cost in case of private projects.
   ▪ Any other Statutory clearance from Ministries / Departments / Organisations for the specific aspects of the project, wherever required in the proposed project
   ▪ Letter of Comfort from the Transmission Company to provide evacuation system, details of the proposed system and completion schedule.
   ▪ Letter of Comfort from the Transmission Company to enter into a back to back agreement with the promoter covering risk in case of default/ delay in commissioning by either of the parties.

2.2.4 The DPR shall contain checklists in the beginning of the DPR as given at Appendix-2(a) and Appendix-2(b).
List of relevant Documents/ References

1. The Electricity Act, 2003
2. Indian Companies Act, 1956
3. Forest Conservation Act, 1980 and Notifications/Resolutions by MOE&F
4. “Guidelines for preparation of DPRs of Irrigation and Multipurpose Projects” issued by CWC.
5. “Guidelines for preparation of project estimates for major irrigation and multipurpose project” issued by CWC.
6. National Electricity Plan notified by CEA
8. Policy on Hydro Power Development issued by Ministry of Power
9. Guidelines for “Investigation of major irrigation and hydro-electric projects” issued by CWC.
11. IS 5497 : Guide for topographical surveys for river valley projects
12. IS 4890 : Method for measurement of suspended sediment in open rivers
16. IS 5477 : Methods for fixing the capacities of reservoirs.
   (Part 1-4)
17. IS 7323 : Method for determining evaporation from reservoirs.
18. IS 7323 : Guidelines for operation of reservoirs.
19. IS 13028 : Guidelines for overall planning of river basin.
20. IS 7560 : Guidelines for allocation of cost among different purposes of river valley projects.
22. IS 12837 : Guidelines for selection of hydraulic turbines for medium and large hydro-electric power houses.
23. IS 12800 : Guidelines for selection of turbines preliminary dimensioning & layout of surface hydro electric power houses.

Note: The above listed documents are available either free or as priced documents from the concerned Govt. Department / Agencies/ Govt. publishers. Latest versions of the above references may be referred.
## Abstract of Cost Estimates

### i) State:

### ii) Name of Project:

<table>
<thead>
<tr>
<th>Item</th>
<th>Civil Works</th>
<th>E &amp; M Works</th>
<th>Total</th>
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<tbody>
<tr>
<td><strong>Direct Cost</strong></td>
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<td>I- Works</td>
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<td>A- Preliminary</td>
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<td>B- Land</td>
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<td>C-Civil Works</td>
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<td>J- Power Plant Civil Works</td>
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<td>K-Building</td>
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<td>M-Plantation</td>
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<td>O-Miscellaneous</td>
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<td>P-Maintenance during Construction</td>
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<td>Q-Special T &amp; P</td>
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<td>R-Communication</td>
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<td>S- Power Plant (Details as per Annex-S)</td>
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<td>X-Environment &amp; Ecology</td>
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<td>Y-Losses on stock</td>
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<td><strong>Total (I- Works)</strong></td>
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<td>II. Establishment</td>
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<td>III. Tools And Plants</td>
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<td>IV. Suspense</td>
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<td>V. Receipt And Recoveries</td>
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<td><strong>Total (Direct Cost)</strong></td>
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<td>Capitalisation of Abatement of Land Revenue</td>
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<td>Audit and Account Charges</td>
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<td><strong>Total (Indirect Cost)</strong></td>
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<td><strong>Total Cost (Direct &amp; Indirect Cost)</strong></td>
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<td>IDC &amp; FC</td>
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<td><strong>Total with IDC &amp; FC</strong></td>
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Note: 1. Head-wise cost of civil works to be furnished in annex forms as per “Guidelines for preparation for project estimates for River Valley Projects” issued by CWC.

2. The details of civil works under sub-heads shall be given in Annex and numbered in similar way of main head. For example, Annex giving details of works under sub-heads of main head “C-Works” shall be numbered as Annex-C(1), Annex-C(2), etc.
**Annex-S**  
**H.E. Project (______ MW)**  
*(Abstract of Cost Estimates of Electro Mechanical Works)*

**Price level:**
FE Rate: _______

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Item</th>
<th>Indian Component</th>
<th>Foreign Component</th>
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<tbody>
<tr>
<td>1.</td>
<td>Preliminary (Only cost of model tests)</td>
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<td>2.</td>
<td><strong>Generating Plant and Equipment</strong></td>
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<tr>
<td></td>
<td>a) Generator, turbine and accessories – <em>Annex -S(1)</em></td>
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<td>b) Auxiliary Electrical equipment for power station – <em>Annex -S(2)</em></td>
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<td>c) Auxiliary mechanical equipment and services for power station-</td>
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<td><em>Annex -S(3)</em></td>
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<td>d) Central Sales Tax (as applicable) on 2(a) (b) and (c)</td>
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<td>e) Transportation, handling and Insurance charges @ 6% of 2 (a),</td>
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<td>(b) &amp; (c)</td>
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<td>f) Erection and commissioning charges @ 8% of 2(a), (b) &amp; (c)</td>
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<td>excluding spares</td>
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<td><strong>Sub-Total (Generating Plant and Equipment)</strong></td>
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<td>3.</td>
<td><strong>Substation Equipment, Auxiliary Equipment and Service of Switchyard</strong></td>
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<td>a) Substation equipment, auxiliary equipment and service of switchyard - <em>Annex -S(4)</em></td>
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<tr>
<td></td>
<td>b) Central Sales Tax (as applicable) on 3 (a)</td>
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<tr>
<td></td>
<td>c) Transportation, handling and insurance charges @ 6% of 3 (a)</td>
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<tr>
<td></td>
<td>d) Erection and commissioning charges @ 8% of 3(a) excluding spares.</td>
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<tr>
<td></td>
<td><strong>Sub-Total (Substation Equipment, Auxiliary Equipment and Service of Switchyard)</strong></td>
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<tr>
<td>4.</td>
<td><strong>GIS &amp; XLPE Cable</strong></td>
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<tr>
<td></td>
<td>a) GIS &amp; XLPE Cable – <em>Annex - S(5)</em></td>
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<td></td>
<td>b) Custom Duty</td>
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<tr>
<td></td>
<td>c) Freight &amp; Insurance @3% (Marine) of item 4(a)</td>
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<tr>
<td></td>
<td>d) Freight &amp; Insurance @6% (Inland) of item 4(a), 4(b) &amp; 4(c)</td>
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<tr>
<td></td>
<td>e) Erection and commissioning charges @ 8% of 4(a) &amp; 4(b) excluding spares.</td>
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<tr>
<td></td>
<td><strong>Sub-Total (GIS &amp; XLPE Cable)</strong></td>
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<td>5.</td>
<td>Contingencies @ 1% on items 2,3 &amp; 4</td>
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<td>6.</td>
<td>Tools and Plants @0.5% of item 2,3 &amp; 4</td>
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<td>7.</td>
<td><strong>Sub-Total (Item 1 to 6)</strong></td>
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<td>8.</td>
<td>Establishment</td>
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<td>9.</td>
<td><strong>Sub-Total (Item 7 &amp; 8)</strong></td>
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<td>10.</td>
<td>Audit &amp; Account Charges *</td>
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<td>11.</td>
<td>Service Tax (as applicable) on erection and commissioning</td>
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<td></td>
<td><strong>GRAND TOTAL</strong></td>
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*: Charges would be same as provided for civil works.
### Cost Estimates of Electro Mechanical Works
(Generator, Turbine and Accessories)

**Price level:**

**FE Rate:**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Item Particulars</th>
<th>Quantity</th>
<th>Rate (Rs. Lakhs)</th>
<th>Amount (Rs. Lakhs)</th>
<th>Excise Duty Rate</th>
<th>Amount (Rs. Lakhs)</th>
<th>Total (Rs. Lakhs)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>a) Turbine-Generator units ___ MW, ___ RPM, ___ m head, 0.9 p.f. ___ kV complete with allied equipment such as MIV, Governor, LP compressed air system, AVR, excitation system etc.</td>
<td>1</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>5+7</td>
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<tr>
<td></td>
<td>b) Unit Control Boards</td>
<td>1</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>5+7</td>
</tr>
<tr>
<td></td>
<td>c) Cooling water system comprising pump sets, valves, piping, etc.</td>
<td>1</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>5+7</td>
</tr>
<tr>
<td></td>
<td>d) Drainage and Dewatering systems</td>
<td>1</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>5+7</td>
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<tr>
<td></td>
<td>e) Compressed air system including pipes and valves</td>
<td>1</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>5+7</td>
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<tr>
<td></td>
<td>f) Spares @ 5% on item 1(a) to 1(e) (including one spare runner)</td>
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<td>___</td>
<td>___</td>
<td>___</td>
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<td>___ kV Phase Bus Ducts for Generator- Transformer Connection</td>
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<td>___</td>
<td>___</td>
<td>___</td>
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<td>3</td>
<td>Surge Protection &amp; Neutral Earthing system</td>
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<td>___</td>
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<td>4</td>
<td>Supervisory Control and Data Acquisition System</td>
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<td>___</td>
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<td>5+7</td>
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<td>5</td>
<td>Control &amp; Protection Panels</td>
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<td>___</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>5+7</td>
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<td>6</td>
<td>Lubricating oil &amp; Governor oil for first filling</td>
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<td>___</td>
<td>___</td>
<td>___</td>
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<td>7</td>
<td>Penstock Valve (___ m dia)</td>
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<td>5+7</td>
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<tr>
<td>8</td>
<td>Spares @ 3% on items 2 to 7</td>
<td>1</td>
<td>___</td>
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<td>___</td>
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<td>5+7</td>
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26
## Cost Estimates of Electro Mechanical Works

(Auxiliary Electrical Equipment for power station)

### Price level:

#### H.E. Project (______ MW)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Item Particulars</th>
<th>Quantity</th>
<th>Rate (Rs. Lakhs)</th>
<th>Amount (Rs. Lakhs)</th>
<th>Excise Duty Rate %</th>
<th>Amount (Rs. Lakhs)</th>
<th>Total (Rs. Lakhs)</th>
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<tr>
<td>1</td>
<td>Step up Transformer (Rating ____kV, ____MVA, ____Type)</td>
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<td>5+7</td>
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<td>2</td>
<td>Unit Auxiliary Transformer (Rating ____kV, ____MVA, ____Type)</td>
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<tr>
<td>3</td>
<td>Station Service Transformer (Rating ____kV, ____MVA, ____Type)</td>
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<tr>
<td>4</td>
<td>HT/LT AC Switchgear for power supply to PH and outdoor switchyard complete</td>
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<tr>
<td>5</td>
<td>DC Batteries, Battery charging equipment, D.C. Distribution Board with D.C. switchgear (Rating ____V, ____AH &amp; ____V &amp; ____AH)</td>
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<td>6</td>
<td>Diesel generating set (Rating ____kVA) (In addition to construction power)</td>
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<td>7</td>
<td>Control &amp; Power cables</td>
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<tr>
<td>8</td>
<td>Cable racks and accessories</td>
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<td>9</td>
<td>Ground mat and earthing for P.H. &amp; Transformer Cavern</td>
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<td>10</td>
<td>Illumination of Power House &amp; Switchyard</td>
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<td>11</td>
<td>Electrical Test Lab and Generator testing Equipments</td>
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<td>12</td>
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<td>13</td>
<td>Spares @ 3% on items 12</td>
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<td>Sl. No.</td>
<td>Item Particulars</td>
<td>Quantity</td>
<td>Rate (Rs. Lakhs)</td>
<td>Amount (Rs. Lakhs)</td>
<td>Excise Duty Rate %</td>
<td>Amount (Rs. Lakhs)</td>
<td>Total (Rs. Lakhs)</td>
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<tr>
<td>1</td>
<td>Electrical Overhead Traveling crane for PH (Capacity ___ T)</td>
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<td>2</td>
<td>Electrical Overhead Traveling crane for GIS (Capacity ___ T)</td>
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<td>3</td>
<td>Electric lifts and elevators</td>
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<tr>
<td>4</td>
<td>Fire fighting equipment with storage tanks, pipes, pumps, valves etc.</td>
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<tr>
<td>5</td>
<td>Air conditioning, ventilation and heating equipment</td>
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<td>6</td>
<td>Filtered water supply for power house</td>
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<td>7</td>
<td>Oil handling equipment with pipes, valves, tanks, purifiers</td>
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<td>8</td>
<td>Workshop machines and equipment</td>
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<td>9</td>
<td><strong>Sub-Total (Item 1 to 7)</strong></td>
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<tr>
<td>10</td>
<td>Spares @ 3% for item No.9</td>
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</table>
# Cost Estimates of Electro Mechanical Works

**Substation Equipment & Aux. Equipment & Services for Switchyard**

**Price level:**

**FE Rate:**

## Indian Equipment:

<table>
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<tr>
<th>Sl. No.</th>
<th>Item Particulars</th>
<th>Quantity</th>
<th>Rate</th>
<th>Amount (%</th>
<th>Amount (Rs. Lakhs)</th>
<th>Total (Rs. Lakhs)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>__ kV potheat yard equipment including coupling capacitors, wave traps, LAs etc.</td>
<td></td>
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<tr>
<td></td>
<td>(a) Circuit breaker</td>
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<tr>
<td></td>
<td>(b) Isolator/Pantograph with/without earthing blade (Rating ___kV)</td>
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<td></td>
<td>(c) Current transformers (Rating ___kV)</td>
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<td></td>
<td>(d) Potential transformers /CVT (Rating ___kV)</td>
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<td></td>
<td>(e) Lightning arrestors (Rating ___kV)</td>
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<td></td>
<td>(f) Wave traps (Rating ___kV)</td>
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<td>2</td>
<td>Shunt Reactor</td>
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<td>3</td>
<td>Bus conductors, hardware and isolators</td>
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<td>4</td>
<td>D.C. battery, charger and associated equipment</td>
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<td>5</td>
<td>Fire protection System</td>
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<td>6</td>
<td>PLCC Equipment</td>
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<td>Gantry, Foundation for structures &amp; miscellaneous civil works for other equipment</td>
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<td>8</td>
<td>Fencing and security</td>
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</table>
Annex - S(5)

H.E. Project (______ MW)
Cost Estimates of Electro Mechanical Works
(Substation Equipment & Aux. Equipment & Services for Switchyard)

Price level:
FE Rate: __________

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Item Particulars</th>
<th>Quantity</th>
<th>Rate (M US$)</th>
<th>Amount (M US$)</th>
<th>Amount (Rs Lakhs)</th>
<th>Custom Duty Rate</th>
<th>Amount (Rs Lakhs)</th>
<th>Total (Rs. Lakhs)</th>
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<tr>
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<td>a) __ kV GIS</td>
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<td>XLPE Cable</td>
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<tr>
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<td>a) __ kV XLPE Cable</td>
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<td>3</td>
<td>Spares @ 3%</td>
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### PRESENT DAY AND COMPLETED COST

*(Phasing of Expenditure On Item of Hard Cost of Civil Works)*

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<tr>
<th>Sl. No.</th>
<th>Item</th>
<th>Present day Cost</th>
<th>No. Of Months</th>
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<td>I- WORKS</td>
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<td>A- Preliminary</td>
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<td>B- Land</td>
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<td>C-Civil Works</td>
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<td>J- Power Plant Civil</td>
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<td>K-Building</td>
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<td>O-Miscellaneous</td>
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<td>P-Maintenance</td>
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<td>Q-Special T &amp; P</td>
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<td>R-Communication</td>
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<td>X-Environment &amp; Ecology</td>
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<td>Y-Losses on stock</td>
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<td>TOTAL (I- WORKS)</td>
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<td>II- Establishment</td>
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<td>III- Tools and Plants</td>
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<td>IV- Suspense</td>
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<td>V- Receipt and recoveries</td>
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<td>TOTAL (DIRECT COST)</td>
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<td>INDIRECT COST:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Capitalised value of abatement of land revenue</td>
<td></td>
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<tr>
<td></td>
<td>b) Audit and Account charges</td>
<td></td>
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<tr>
<td></td>
<td>TOTAL (INDIRECT COST)</td>
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<tr>
<td></td>
<td>TOTAL (CIVIL COST)</td>
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<tr>
<td>2. E&amp;M COST</td>
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<tr>
<td>E&amp;M EQUIPMENT</td>
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</tr>
<tr>
<td>i) Generator, Turbine and Accessories</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii) Auxiliary Electrical Equipment for Power Station</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>iii) Auxiliary Mechanical Equipment and Services for Power Station</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iv) Substation Equipment &amp; Aux. Equipment &amp; Services for Switchyard (Indian Equipment)</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>v) GIS &amp; XLPE Cable (Foreign Equipment)</td>
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<td>TOTAL (E&amp;M EQUIPMENT)</td>
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<td>TAXES &amp; DUTIES</td>
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</tr>
<tr>
<td>I. Custom Duty</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
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</tr>
<tr>
<td>II. Excise Duty</td>
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<tr>
<td>III. Central Sales Tax</td>
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<tr>
<td>IV. Service Tax</td>
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**TOTAL (TAX & DUTIES)**

**OVERHEADS**

<table>
<thead>
<tr>
<th>I. Establishment</th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>II. Contingencies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III. Audit &amp; Account</td>
<td></td>
<td></td>
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</tbody>
</table>

**TOTAL (OVER HEADS)**

**TOTAL (E & M COST)**

**GRAND TOTAL (CIVIL AND E&M COSTS)**

Note: For Private Power Projects, present cost will be phased on half yearly basis and escalated at a rate indicated by CEA/ prevailing indices to arrive at completed cost.
# Annex-2(d)

## PROJECT ESTIMATED COST

### FINANCIAL PACKAGE SUMMARY

#### A. PROJECT ESTIMATED COST

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Item</th>
<th>Currency</th>
<th>Foreign Currency Amount</th>
<th>Exchange Rate @</th>
<th>Component Equivalent Indian Rs. Crores</th>
<th>Indian Component Rs. Crores</th>
<th>Total Cost Rs. crores</th>
<th>% of total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Hard Cost</td>
<td>(excluding IDC &amp; Financing Charges)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)=(4)x(5)</td>
<td>(7)</td>
</tr>
<tr>
<td>1</td>
<td>i)…</td>
<td>(i)…</td>
<td>(ii)…..</td>
<td>(iii)…</td>
<td>(iv)…</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sub-Total (1) =

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<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Item</th>
<th>Currency</th>
<th>Foreign Currency Amount</th>
<th>Exchange Rate @</th>
<th>Component Equivalent Indian Rs. Crores</th>
<th>Indian Component Rs. Crores</th>
<th>Total Cost Rs. crores</th>
<th>% of total cost</th>
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<tr>
<td>(2)</td>
<td>IDC</td>
<td>@@</td>
<td>(i)…</td>
<td>(ii)</td>
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<tr>
<td></td>
<td>Debt Package-I</td>
<td>(i)…</td>
<td>(ii)</td>
<td>(iii)…</td>
<td>(iv)…</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Debt Package-II</td>
<td>(i)…</td>
<td>(ii)</td>
<td>(iii)…</td>
<td>(iv)…</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Debt Package-III</td>
<td>(i)…</td>
<td>(ii)</td>
<td>(iii)…</td>
<td>(iv)…</td>
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Sub-Total (2) =

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<table>
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<th>Item</th>
<th>Currency</th>
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<th>Exchange Rate @</th>
<th>Component Equivalent Indian Rs. Crores</th>
<th>Indian Component Rs. Crores</th>
<th>Total Cost Rs. crores</th>
<th>% of total cost</th>
</tr>
</thead>
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<tr>
<td>(3)</td>
<td>Financing Charges</td>
<td></td>
<td>(i)…</td>
<td>(ii)</td>
<td>(iii)…</td>
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<tr>
<td></td>
<td>Debt Package-I</td>
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<td>(ii)</td>
<td>(iii)…</td>
<td>(iv)…</td>
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</tr>
<tr>
<td></td>
<td>Debt Package-II</td>
<td>(i)…</td>
<td>(ii)</td>
<td>(iii)…</td>
<td>(iv)…</td>
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</tr>
<tr>
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<td>Debt Package-III</td>
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<td>(iii)…</td>
<td>(iv)…</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Others (if any)</td>
<td>(i)…</td>
<td>(ii)</td>
<td>(iii)…</td>
<td>(iv)…</td>
<td></td>
<td></td>
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</table>

Sub-Total (3) =

**GRAND TOTAL (1+2+3)**

**NOTES:**

(i) @ - Exchange Rate prevailing at the time of submission of DPR/Documents.

(ii) @@ - Detailed calculation for interest during construction (IDC) shall be attached separately for each Debt Package (in respective currencies) clearly indicating Drawl of funds, phasing of expenditure & Gestation Period etc.

(iii) If the currencies or Debt Packages are more, the additional Columns / Rows may be suitably inserted.
### B. FINANCIAL PACKAGE SUMMARY

#### B1. DEBT FINANCING

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Source/ Name of Agency</th>
<th>Currency</th>
<th>Amount</th>
<th>Exchange rate @</th>
<th>Equivalent Indian Rs. Cr</th>
<th>Interest rate % (Fixed)</th>
<th>Repayment period (Years)</th>
<th>Moratorium period (if any) (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Foreign Debt</td>
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<td></td>
<td></td>
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<td>Source I</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Source II</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(a) Sub-Total =</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Source/ Name of Agency</th>
<th>Currency</th>
<th>Amount</th>
<th>Exchange rate @</th>
<th>Equivalent Indian Rs. Cr</th>
<th>Interest rate % (Fixed)</th>
<th>Repayment period (Years)</th>
<th>Moratorium period (if any) (Years)</th>
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<tr>
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<tr>
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<td>Source I</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Source II</td>
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<td></td>
</tr>
<tr>
<td>(b) Sub-Total =</td>
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TOTAL DEBT (a) + (b)

#### B2. EQUITY FINANCING

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Source/ Name of Equity Partners</th>
<th>Currency</th>
<th>Amount</th>
<th>Exchange rate @</th>
<th>Equivalent Indian Rs. Cr</th>
<th>Remarks</th>
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<tbody>
<tr>
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<td>Others</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Sub-Total =</td>
<td></td>
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<td></td>
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</table>

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Source/ Name of Equity Partners</th>
<th>Currency</th>
<th>Amount</th>
<th>Exchange rate @</th>
<th>Equivalent Indian Rs. Cr</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>1</td>
<td>Domestic Equity</td>
<td>Rs.</td>
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<tr>
<td>1</td>
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<td>Rs.</td>
<td>.......</td>
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</tr>
<tr>
<td>2</td>
<td>Others</td>
<td>Rs</td>
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<tr>
<td>3</td>
<td>Public Issue (If any)</td>
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<tr>
<td>(b) Sub-Total =</td>
<td></td>
<td></td>
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TOTAL EQUITY (a) + (b)

DEBT + EQUITY (B1 + B2) = DEBT : EQUITY RATIO =

#### FINANCING CHARGES #

<table>
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<tr>
<th>Sl. No</th>
<th>Item</th>
<th>Upfront charges Rs. Cr.</th>
<th>Commitment charges Rs. Cr.</th>
<th>Guaranté Fees Rs. Cr. @</th>
<th>Others (if any) Rs. Cr.</th>
<th>Total Financing Charges (Rs. Cr)</th>
<th>Remarks</th>
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<td></td>
<td>(1)+(2)+(3)+(4)+(5)+(6) (7) (8)</td>
<td></td>
</tr>
<tr>
<td>2</td>
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<td>Source II</td>
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<td></td>
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</tr>
<tr>
<td>3</td>
<td></td>
<td>Source III</td>
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<tr>
<td>1</td>
<td>EQUITY</td>
<td>Public Issue Charges</td>
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<td>TOTAL</td>
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</tbody>
</table>

# - Financing Charges as applicable for the Project may be indicated.
@
- Exchange Rate prevailing at the time of submission of DPR/Documents.
CHAPTER-3
SUBMISSION AND ACCEPTANCE OF DPR

3.1  Power projects

3.1.1 The Generating Company / Project Developer intending to set up a hydro generating station shall submit the DPR to the Authority for its concurrence as required under Section 8 of the Electricity Act, 2003.

3.1.2 In the first instance three sets of the DPR shall be submitted to Secretary, CEA. The Authority in first instance checks whether all the information, data, certificates essentially required for appraisal of DPR have been included as per the Checklists (Checklist-1 and Checklist-2 appended with these guidelines). This scrutiny shall be completed within 2 weeks. In case the DPR is found does not contain essential inputs or found to be incomplete in certain respects, the same shall be returned to the Generating Company / Project Developer for resubmission after completing the requisite details. If prima facie the DPR is found to be in order, the Generating Company / Project Developer shall be asked to submit 21 copies of DPR along with one soft copy on compact disks to Secretary, CEA for detailed examination.

The Generating Company / Project Developer shall give a detailed presentation on all aspects of DPR after 2 weeks of submission of 21 sets of DPR. CEA/CWC/GSI shall decide in another 2 weeks whether the details furnished in the DPR are adequate for further examination of DPR or DPR to be returned for carrying out further studies/investigations.

3.2  Multi-purpose Projects

3.2.1 DPRs of multipurpose projects involving drinking water, irrigation, power, flood control, navigation etc shall be submitted to CWC for clearance of Technical Advisory Committee (TAC) of Ministry of Water resources (MOWR). In case DPRs of these schemes are submitted to the Authority, the Authority shall not accept the same and redirect these to CWC/ MOWR for examination/appraisal.

The views of the Authority on power portion of the scheme viz. power planning and cost estimates shall be submitted to CWC for accord of clearance by Technical Advisory Committee of MOWR. Detailed examination of Hydro Electric Scheme shall be undertaken by the Authority after DPR of the power portion is submitted to it for accord of concurrence under Section 8 of the Electricity Act, 2003.

3.2.2 DPRs of power projects, involving flood moderation aspects only in addition to power generation shall be accepted in CEA and referred to CWC for examination of the flood moderation aspects. Detailed examination of such schemes could be continued by CEA along with appraisal of scheme by CWC/ MOWR for flood moderation aspects. However, the date of acceptance of such scheme in CEA for appraisal would be reckoned from the date of clearance of flood moderation aspects by CWC/ MOWR.
CHAPTER-4
EXAMINATION AND CONCURRENCE OF DPR

4.1 Examination Procedure

4.1.1 Techno-economic examination of a Hydro Electric Scheme is an interactive process and involves appraisal of various aspects like Hydrology, Design and safety of the dam, Hydel civil design, Electro-mechanical design, Geology, Cost, project financing etc.

4.1.2 To discharge its obligation under Section 8 of the Electricity Act, 2003, the Authority may take the assistance of Central Water Commission, Ministry of Water Resources, Geological Survey of India (GSI) etc. The Authority may also consult the State Government or Central Government or such other Government agencies as it may deem appropriate.

4.1.3 The comments / queries raised by the Authority shall be promptly replied by the Generating Company / Project Developer preferably within a period of 7 working days and not more than 15 working days, failing which the DPR shall stand returned to the generating company.

4.1.4 Appraisal of DPR:

The Authority acts as a single agency in so far as concurrence of the Hydro Electric Schemes is concerned. However, as per the demarcation of responsibility in Govt. of India, the following aspects related to Hydro Electric Schemes are assigned to MOWR:

- Hydraulic Structures for hydropower
- Water Management
- Flood Control
- Dam Safety
- Regulation and development of inter-state rivers and river basins
- Water laws legislation
- International water laws
- The matter regarding rivers common to India and neighboring countries: Joint River Commission for Bangladesh and India, Indus Water Treaty, Indus Commission etc.

CEA therefore consults CWC/ MOWR on issues related to Inter-State/ International clearance, Hydrology, Hydraulic Structures, Dam design & Safety, Construction Material and Machinery, Cost of civil works, etc.

4.1.5 Aspects to be appraised:

i. Hydrology: An accurate assessment of the hydrology at the project site is crucial as this plays a vital role in the planning of Hydro Electric Schemes and the design of various hydrological structures. An over estimate of water availability may lead to higher installation and larger investment whereas a lower estimate may result in non-utilization of potential optimally. Appraisal of the project hydrology includes water availability studies, design flood estimation and sedimentation studies for estimating the life of the project.

ii. Hydro Power Planning: Power potential studies carried out for all the hydrological years for which data is available including the installed capacity, number and size of units are examined. General layout of the Scheme whether it fits into the overall basin development plan or not is also examined.
iii. **Dam and Head Works**: Design and safety of the dam and appurtenant works are examined.

iv. **Hydraulic Structures/ Hydel Civil Design**: Techno-economic evaluation of water conductor system and power house comprising of intake, de-silting arrangement, head race tunnel, surge shaft, pressure shaft/penstock, tailrace tunnel/channel and the type/layout and dimensions of the power house is made to ensure that the surveys and investigations carried to finalize the layout & designs are adequate, layout is optimum & is evolved after evaluation of various alternatives; project components are safe, planning & design has been carried out utilizing state of the art technology and relevant standards.

v. **Geology**: Geology of the project components is appraised to ensure that detailed geological mapping & geophysical surveys have been done, drilling/drifting carried out and structural features viz. thrusts, folds/faults have been studied in detail to delineate problems during construction.

vi. **Electro-Mechanical Design**: Design & layout of turbine-generator sets, main step-up transformer, auxiliary equipment in the power house and switchyard/gas insulated switchgear room etc. are appraised.

vii. **Justification of the Project**: The Authority examines the need/ justification of the project from anticipated power demand (both energy and peak) and reasonability of tariff of energy generation.

viii. **Construction Material and Machinery**: Appraisal of the construction methodology and equipment used in the project and the quality and quantity of the local construction material available at project site and the properties of rock/soil for foundation of the structures is carried out.

ix. **Inter-State/ International aspects**: The inter-State/international aspects are examined in consultation with Ministry of Water Resources, which provide necessary suggestions to the Authority.

x. **Cost Estimates**

   a) **Cost Estimates of Civil Works**: After the designs of various works are frozen, the quantities of various components of civil works are checked for correctness. Analysis of rate of main works like excavation, concreting, RCC works, stripping, filling, grouting etc. based on hourly use rates of equipment is done and the estimated cost of civil works proposed in the DPR is finalized.

   b) **Cost of Electro-Mechanical Works**: For appraisal of cost estimates of E & M Works, estimated cost is assessed based on cost data of other projects for which orders have been placed recently.

xi. **Evacuation of Power**: Adequacy of power evacuation arrangements proposed in the DPR is examined.

xii. **Construction Schedule**: Activity-wise, item-wise and year-wise targets/schedule of construction for each of the major components of works as per detailed PERT Chart are examined.
xiii. **Financial and Commercial Aspects:** Financing and financial analysis of the project including financial package, interest during construction, financial charges and tariff are examined.

xiv. **Clearance from Defence Angle:** If a hydro electric scheme involves defence aspects, clearance of the project from Ministry of Defence is required.

xv. **Clearance from MOEF:** Development of Hydro Electric Schemes may have adverse impact on environment and ecology viz. deforestation, loss of bio-diversity including disappearance of rare species of animals and plants, soil erosion, faster rate of reservoir sedimentation, socio-economic implications, relocation and rehabilitation of people, increased seismic risk, change in aquatic system, climatic change, change in flow regimes downstream of the dam and outbreak of disease etc.

The Environment Impact Assessment and Environment Management Plans are to be prepared by the Generating Company / Project developer and submitted to MOEF. The same are examined by MOEF and cleared if found satisfactory. In case the project involves diversion of forest land, clearance is also required from forest angle from MOEF under the Forest Conservation Act. For the schemes involving wild life sanctuary/ national park, recommendations/ approval of Indian Board of Wild Life is necessary.

Information on rehabilitation and resettlement aspects of the project viz. villages / families / persons affected, details of R&R Plan and its approval by MOEF is also required.

Information on tribal population affected and status of clearance from Ministry of Social Justice and Empowerment / Tribal Affairs is also necessary, if tribal population is affected.

4.1.6 For hydro electric schemes selected through tariff based competitive bidding, the Authority shall examine the technical viability consistent with the provisions of the Act.

**4.2 Concurrence to the Scheme**

4.2.1 In case the Hydro Electric Scheme is found technically and economically viable with necessary inputs and clearances having been tied-up, the Authority may accord concurrence for implementation of the Hydro Electric Scheme, under Section 8 (2) of the Electricity Act, 2003.

4.2.2 The intimation regarding accord of concurrence to hydro electric schemes is conveyed to the Generating Company / Project Developer, Ministry of Power, Planning Commission, other concerned Government Departments, State Govt. and appropriate Regulatory Commission.

**4.3 Submission of updated DPR**

4.3.1 During the appraisal process, a number of changes are suggested by CEA/CWC/GSI which have an impact on the design and cost of the scheme. The Generating Company / Project Developer is required to update the DPR incorporating all the suggested modifications as agreed by them during the deliberations and submit the same on compact disk along with 5 (five) nos. of hard copies for record of the Authority.

4.3.2 The Generating Company / Project Developer is also required to submit the updated DPR to concerned State Government, the Regulatory Commission and the Transmission Utility under intimation to the Authority.
4.4 **Information regarding Financial Closure**

After the finance for the project is tied up, the Generating Company / Project Developer shall inform the details of the financial package to the Authority.

4.5 **Time Frame for accord of Concurrence**

In case the Hydro Electric Scheme is found technically and economically viable with necessary inputs/ clearances having been tied up, the Authority may accord concurrence for implementation of the hydro electric scheme, as far as practicable, within a period of 90 (ninety) working days from the date of submission of 21 sets of DPR complete in all respects.

4.6 **Validity of Concurrence**

4.6.1 In case the time gap between the concurrence to the scheme by the Authority and the actual start of the work of the project by the generating company is three years or more, a fresh concurrence of the Authority shall be obtained by the Generating Company / Project Developer.

4.6.2 The Authority reserves the right to revoke the concurrence, if the conditions stipulated in the Office Memorandum conveying the Concurrence are not complied with to the satisfaction of the Authority.

4.7 **Transfer of Concurrence**

Concurrence to the Hydro Electric Scheme given by the Authority in the name of a generating company can be transferred to another generating company in accordance with the procedure laid down by the Authority (under revision). The new Generating Company / Project Developer shall submit the request for such a transfer for the consideration of the Authority.

4.8 **Subsequent changes in the Project parameters**

In case, there are major changes in the parameters of the project viz. type of development (storage/ ROR), type & height of dam, live storage, design head, installed capacity, number of units, type of turbine, type of power house, transmission voltage etc, from those concurred by the Authority necessitated on account of site conditions, the same need to be brought to the notice of the Authority with appropriate justification for its approval prior to implementation of such changes in the project.

*Note: Central Electricity Authority “Guidelines for formulation of DPRs of Hydro Electric Projects and Processing for Concurrence” are available on the Authority’s website ([www.cea.nic.in](http://www.cea.nic.in)).*
Appendix-1

Power Potential Studies and Installed Capacity

After finalization of hydrology, the next step is to determine installed capacity and unit size of the project.

For determination of installed capacity ensure that the-

i) Efficiencies of T-G sets are taken correctly.
ii) Rated head assessments are accurate.
iii) Minimum discharges as per requirement of MOEF during non-monsoon season for aquatic life is taken.
iv) Provision has been made for discharges during monsoon season for silt flushing.
v) Other requirements of water are met.

1 FOR ROR SCHEMES

1.1 The first step is to compute 90% dependable year:

i) Obtain 10-daily hydrological inflow series in m$^3$/sec for all hydrological years, year-wise.
ii) Calculate unrestricted energy generation in MUs.
iii) Arrange unrestricted annual energy generation in descending order.
iv) 0.9(n+1)th year is the 90% dependable year, where n is the number of years for which hydrological inflows data is available.

1.2 Fixating the installed capacity:

i) Calculate firm power available based on average power generation during the lean months flows in a 90% dependable year.
ii) Consider a number of alternatives of installed capacities in suitable steps say 5%, for load factors say about 40% down to about 15%.
iii) Compute incremental energy generation ($\Delta$ KWH) for every incremental MW ($\Delta$ MW) and plot result on a graph.
iv) Installed capacity is fixed at a value where the fall in the graph is sharp.
v) B/C ratio and incremental benefit cost ratio ($\Delta$B/$\Delta$C) is also considered for fixing the installed capacity. An alternative for installed capacities which provides maximum net benefit (B-C) and ensures incremental ($\Delta$B/$\Delta$C) higher than unity is considered optimum

1.3 Selecting unit-size & Number of Units:

i) Number of generating units should be kept minimum because the cost of generating units and related equipment increases with the increase in number of units
ii) Unit-size is decided based on the transport limitations i.e. maximum size (LxWxH) of package of generating units/transformer which can be transported to site.
iii) Where more than one units are to be installed in a power house, these should be of the same capacity to facilitate interchangeability of powerhouses of generating and other equipment in the station.
iv) The unit size should be verified for system stability and loss of generation probability criteria.
v) In case of run-of-river schemes without pondage, number of units are decided keeping in view the varying discharge during lean period and turbine operating characteristics.

1.4 Computing Design energy:
i) 10-daily unrestricted energy generation in 90% dependable year is restricted to 95% of the installed capacity of the power house. The total of these 10-daily restricted energies for the year gives the annual design energy generation.

2 FOR STORAGE BASED SCHEMES

2.1 A reservoir is created to store the excess water during the high inflow period and release it as and when required.

The storage provided can be for -
1) annual operation i.e. every year the reservoir is depleted to its minimum draw-down level
2) carry over operation i.e. waters from good hydrological year is carried over to the bad hydrological years that may follow.

2.2 Multipurpose reservoirs are planned to serve more than one purpose. In Indian conditions the multi-purpose reservoirs are planned for drinking water, irrigation, hydro electric power and flood control etc. Planning of such a reservoir requires detailed analysis of past run off records and other hydrological data.

2.3 In case of power projects involving flood moderation only, in addition to power generation, the reservoirs are planned to have cushion for flood moderation during flood periods.

2.4 Fixing the storage capacity, FRL and MDDL of Reservoir:

The capacity of the reservoir shall be fixed based on the guidelines given in IS: 5477 (Part-1, 2, 3 and 4) “Fixing the capacity of Reservoirs”.

After fixing the reservoir capacity is determined, the next step would be to fix the FRL/ MDDL. Area / Elevation Curves of the proposed site are used to determine these levels. While fixing the FRL/ MWL, the factors like submergence in reservoir area, tail water level of upstream development, geological constraints in raising dam height etc. are fully taken in to account.

For determining the MDDL, the considerations like siltation of reservoir during the life of the project, safe limit of operating heads of the turbines etc. are considered.

The reservoirs are operated in order to achieve the maximum benefits consistent with their physical characteristics and functions for which they are planned and constructed. For actual operation of reservoir or a system of reservoirs, individual regulation schedules are required to be formulated, after considering all critical factors involved.

Reservoir operation studies are carried out in accordance with IS: 7323 – 1994 “Operation of Reservoirs Guidelines”. Levels computed in the above studies are refined considering the optimum benefits/ cost analysis.
Appendix-2(a)

Checklist - 1 (To be examined in the office of Secretary, CEA)

<table>
<thead>
<tr>
<th>S. No</th>
<th>ITEM</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Name of the project</td>
<td></td>
</tr>
</tbody>
</table>
| 2.    | Location  
|       | a) State(s)  
|       | b) District(s)  
|       | c) Taluka(s)/Tehsil(s)  
|       | d) Basin  
|       | e) River  
|       | f) Longitude/Latitude  
|       | g) Survey of India Topographical Map reference No.(s)  
|       | h) Earthquake Zone number  
|       | i) Complete address for correspondence along with pin code/ e-mail, FAX, Telephone number. | |
| 3.    | Whether the scheme is included in the National Electricity Plan. If so, whether the capacity and type of the scheme are same as given in the NEP. | * Yes / No |
| 4.    | Category of the project  
|       | a) Power Project  
|       | b) Power Project having reservoir for flood moderation.  
|       | c) Multipurpose Project | * |
| 5.    | In case of category 4c) above, whether the clearance of Technical Advisory Committee of Ministry of Water Resources is available. | * Yes / No |
| 7.    | Whether the Generating Company is Registered with the Registrar of the Company. Whether Article of Association has Generation as one of the objectives of the Company | * Yes / No |
| 8.    | What is the mode of allocation of the scheme whether through  
|       | i) MOU route upto 100 MW  
|       | ii) Tariff based bidding  
|       | iii) MOU route with equity participation of State Govt. If so %age of State Govt. equity.  
|       | iv) Any other mode. | * |
| 9.    | Whether authorization of the Competent Government in favour of the company to establish, operate and maintain specific Power Station available | * Yes / No |
| 10.   | Whether land availability Certificate from State Government available | Yes/No |
| 11.   | Whether State Govt. authorised the company to utilize water of that stretch of river. | Yes/No |
| 12.   | Whether power/energy benefits have been estimated on the updated hydrological series. | *Yes /No |
| 13.   | Whether Cost Estimates enclosed  
|       | a) Completed Cost - For private generating companies  
|       | b) Present Day Cost - For SEBs & State power Utilities  
<p>|       | c) Present &amp; Completed Cost -For Generating Companies in Public Sector | *Yes/No |
| 14.   | How the project is going to be financed. |         |</p>
<table>
<thead>
<tr>
<th></th>
<th>Question</th>
<th>Yes/ No</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Whether arrangement for absorption/despatch of power made</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Whether arrangements for wheeling/ evacuation of Power made</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Whether any agreement with the transmission company to provide evacuation system made. If so details of the agreement.</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Whether Consent of STU/ State Govt. for availability of off peak power/energy (for pumped storage scheme) is obtained.</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Whether salient features of the Project filled up in the prescribed format.</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Status of CWC /other affected states clearance from inter-state angle, if applicable</td>
<td>*</td>
</tr>
<tr>
<td>21</td>
<td>Status of Defence clearance, if required</td>
<td>*</td>
</tr>
<tr>
<td>22</td>
<td>Whether the area is likely to have any Environmental and Ecological problems due to the altered surface water pattern. If yes, whether preventive measures have been discussed</td>
<td>Yes/No</td>
</tr>
<tr>
<td>23</td>
<td>Status of MOEF Clearance from Environment/Forest angle</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Status of Clearance from Indian Board of Wild-Life</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Status of Clearance from Ministry of Social Justice &amp; Enforcement/ Tribal Affairs (In case Scheduled Tribe population is affected)</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Whether Rehabilitation and Resettlement Plan from State Revenue Department enclosed.</td>
<td>Yes/No</td>
</tr>
</tbody>
</table>

Note: In case marked ‘Yes’ in the Check List, attach the supporting document.

* : Must for examination of DPR
Appendix-2(b)

Checklist - 2 (To be examined in HPA /TCD Divisions)

A. Following chapters/documents should be available in the DPR

i) Basin Planning.
ii) Hydrology
iii) Power Potential Studies.
iv) Power evacuation aspect.
v) Design of civil structures.
vi) Design of Electrical & Mechanical equipment
vii) Geology
viii) Environment and ecology
ix) Estimated cost along with basis of preparation of cost, documentary support.
x) Financial analysis.
xi) Project layout map and drawing
xii) Power supply position in the State and justification of the scheme from power demand-supply considerations.

B. Completeness and relevance of material given in the above chapters needs to be checked.
GUIDELINES FOR ACCORD OF CONCURRENCE TO HYDRO GENERATING SCHEMES SUBMITTED TO THE AUTHORITY UNDER SECTION 8 OF ELECTRICITY ACT, 2003

1. General

1.1 These guidelines have been framed to describe the procedure to be followed by Central Electricity Authority for accord of concurrence to Hydro Electric Schemes submitted to it under Section 8 of the Electricity Act, 2003.

1.2 In these guidelines unless the context otherwise requires –
   (b) ‘Authority’ means the Central Electricity Authority constituted under sub-section (2) of Section 70 of the Act.
   (c) ‘Installed Capacity’ means the summation of the capacities of all the generating units to be installed in the Hydro Electric Generating Station.
   (d) ‘Hydro Electric Scheme’ means a scheme aimed at setting up the complete Hydro Electric Generating Station which will provide facility including penstocks, head and tail works, main and regulating reservoirs, dams and other hydraulic works, building and plant with step up transformer, switchgear, switchyard, cables and other appurtenant equipment including building used for housing the operating staff of the generating station.

1.3 Other words and expressions used and not defined in these guidelines but defined in the Electricity Act, 2003 shall have the meaning assigned to them in the said Act.

2. Applicability of the Guidelines

These guidelines are applicable to any Generating Company intending to set up a Hydro Electric Generating Station estimated to involve a capital expenditure exceeding such sum as may be fixed by the Central Government from time to time, by Notification (1) under Section 8(1) of the Act.

3. Objectives and Scope

(i) Hydro Electric Schemes constitute an integral part of the overall development of the water resources of the river basins for multipurpose use and often are a part of a series of single or multipurpose schemes. In the overall river basin context, the impact of the operation of the upstream Hydro Electric Schemes, water availability undergoing changes over the life of the Hydro Electric Scheme on account of progressive development in the river basin, constraints imposed by the downstream Hydro Electric Schemes, requirements of drinking water, irrigation diversions downstream, flood moderation, navigation and other related matters are to be considered.

(ii) Hydro Electric Scheme shall be designed for optimum benefits and shall not adversely affect the operation of the upstream and downstream Hydro Electric Schemes and shall take into consideration the impact of the future upstream and downstream developments in the river basin as identified by the concerned State and the Authority.
(iii) To meet the objectives at 3(i) and 3(ii), the following should be ensured:

(a) the Hydro Electric Scheme meets the requirement of the best ultimate development of the river basin as provided in the National Electricity Policy and National Electricity Plan.
(b) the Hydro Electric Scheme is consistent with water requirement for irrigation, navigation, flood control, drinking water or other public purposes.
(c) the Hydro Electric Scheme takes into account the progressive development of consumptive use of water and new water resources development schemes in the river basin due to which the water availability may undergo change over the period,
(d) the Hydro Electric Scheme meets the requirement of optimum location of dams and other river works.
(e) the Hydro Electric Scheme meets the norms regarding dam design and dam safety.
(f) the Hydro Electric Scheme is either included in National Electricity Plan drawn by the Authority under section 3(4) of the Act or results in generation of power at reasonable tariff.

4. Inputs and Procedures for concurrence of Hydro Electric Schemes
(a) The generating company after completing essential site survey and investigations shall prepare detailed project report (DPR) of the Hydro Electric Scheme in accordance with the latest editions of “Guidelines for Formulation of Detailed Project Reports for Hydro Electric Schemes, their Acceptance and Examination for Concurrence” published by the Authority and “Guidelines for preparation of Detailed Project Report of Irrigation & Multipurpose Schemes” published by the Central Water Commission and submit the same to the Authority.
(b) The DPR shall include a checklist incorporating tie-up of essential inputs and statutory clearances, salient features of the Hydro Electric Scheme, executive summary, geological aspects, defence aspects, hydrology, justification for the best ultimate development of the river basin, power potential studies, optimization of location of dam and other civil works detailing various alternatives considered, studies for optimization of dam height, detailed design calculations for checking dam design & safety, civil design aspects, inter-state and international aspects, environmental & forest aspects, rehabilitation & resettlement aspects, cost estimates for civil works and electro-mechanical works and source of funding, fund flow and tariff calculations as per the regulations of the appropriate Commission.
(c) The electrical & mechanical cost estimates shall be based on the latest edition of “Guidelines for Formulation of Detailed Project Reports for Hydro Electric Schemes, their Acceptance and Examination for Concurrence” published by the Authority and as modified from time to time and civil cost estimates shall be based on the latest edition of “Guidelines for preparation of Estimates for River Valley Schemes” published by the Central Water Commission and as modified from time to time.
(d) The DPR shall also include the following:
   (i) Authorization of the concerned State Government(s) for the development of the Hydro Electric Scheme.
   (ii) Confirmation from State Government(s) in respect of water availability and land availability.
   (iii) Information on environmental and forest aspects and status of clearance from the Ministry of Environment & Forest.
   (iv) Information on tribal population affected and status of clearance from the Ministry of Social Justice and Empowerment/Tribal Affairs, if tribal population is affected.
(v) Clearance from the Ministry of Defence if required.

e) Twenty one numbers of hard copies of the DPR along with one soft copy on compact disk shall be submitted to the Authority.

(f) The generating company shall also submit the DPR to the appropriate Regulatory Commission and the appropriate Transmission Utility for information.

(g) The Authority shall send a copy of DPR to the State Govt. seeking its views on development of the scheme. Also, the State Government representative shall be invited to participate in the meetings held for consultations and resolving various issues.

(h) In case of DPR not being complete in all respects, the Authority shall return the same to the generating company within the time period stipulated in the “Guidelines for Formulation of Project Reports for Power Projects” for its revision or modification and resubmission thereafter.

(i) DPR complete in all respects will be taken up for detailed examination by the Authority. The queries raised by the Authority, if any, shall be promptly replied by the generating company within the stipulated time schedule as prescribed by the Authority failing which the DPR shall stand returned to the generating company.

(j) In case the Hydro Electric Scheme is found technically and economically viable with necessary inputs and clearances having been tied-up as stipulated in the “Guidelines for Formulation of Detailed Project Reports for Hydro Electric Schemes, their Acceptance and Examination for Concurrence”, the Authority may accord concurrence for implementation of the Hydro Electric Scheme, as far as practicable, within a period of 90 (ninety) days from the date of submission of the DPR complete in all respects.

(k) For Hydro Electric Scheme selected through tariff based competitive bidding, the Authority shall examine the technical viability consistent with the provisions of the Act.

(l) On tying up of all essential inputs and statutory clearances, the generating company shall update the DPR incorporating all the modifications as agreed during the deliberations and in accordance with the conditions of concurrence and submit the same on compact disk in the software format prescribed by the Authority along with 5 (five) nos. of hard copies for record of the Authority.

(m) The Generating Company shall submit the updated DPR to the concerned State Government under intimation to the Authority.

5. Consultation with Other Agencies

(i) The Authority may take the assistance of any institution like the Central Water Commission, the Ministry of Water Resources, the Geological Survey of India etc. for examination of the DPR as it may consider necessary.

(ii) The Authority shall consult the State Government or Central Government or such Government agencies as it may deem appropriate as per Section 8(2) of the Act.

6. Availability of the Guidelines

Central Electricity Authority “Guidelines for Formulation of Detailed Project Reports for Hydro Electric Schemes, their Acceptance and Examination for Concurrence” shall be available on the Authority’s web site (www.cea.nic.in).

7. Validity of Concurrence

In case the time gap between the concurrence to the scheme by the Authority and the actual start of the work of the project by the generating company is more than three years, the
generating company may apply for revalidation of the concurrence giving justification after getting due authorization of the appropriate Government. The Authority will consider the request for extension of the validity based on the merit.

8. **Transfer of Concurrence**

Concurrence to the Hydro Electric Scheme given by the Authority in the name of a generating company can be transferred to another generating company in accordance with the procedure laid down by the Authority. The new generating company shall submit the request for transfer of concurrence for consideration of the Authority.

9. **Subsequent Changes in the Project Parameters**

In case, there are major changes in the parameters of the project viz. type of development (storage/ ROR), type & height of dam, live storage, design head, installed capacity, number of units, type of turbine, type of power house, transmission voltage etc, from those concurred by the Authority necessitated on account of site conditions, the same need to be brought to the notice of the Authority with appropriate justification for its approval prior to implementation of such changes in the project.
PREFACE

India has a large potential for development of hydro energy. Unlike some other countries, a major portion of this potential remains to be harnessed even in major and medium projects. Small hydro development has been taking place steadily since a very long time, where encouraging factors existed. This development has mostly taken place in remote mountainous areas to meet the local energy demand and in the plains, through development of canal drops wherever found attractive. To cope up with the increasing energy demand in the country, exploitation of all possible sources, including the hydro resources, is getting concerted attention. In the recent past, development of micro/mini/small schemes has been gaining ground. No doubt, hydro schemes – small or large – are somewhat capital intensive relative to some other types of generation, but have the significant advantage of in-built protection against inflation.

Small (micro/mini included) hydro power development, which was earlier considered economically less viable, is receiving greater attention now as its relative economics is improving vis-à-vis other sources of energy.

Small hydro projects are rather distinct from the conventional major and medium hydro electric projects. Small gestation period and simplicity in project layouts can be their attractive features but call for careful project preparation.

Small hydro schemes – high head and low head – either in the remote areas or in the plains on canal drops have been set up in quite large numbers in the past and a number of such schemes are also, presently, under construction. However, the development in this field has been rather slow and in the current context of energy resources there has evolved a general consciousness that its acceleration would be useful.

Taking up of small hydro-electric schemes has been attracting the attention of the CEA for quite some time. CEA, with the active participation of the Min of Energy, has been bringing this aspect of the hydro energy development to the various state authorities on different occasions and in various forums. Requests have been made to states for instance to assess the potential available, particularly on canal falls, also to submit viable projects for clearance etc. At our request, the Ministry of Irrigation has also issued instructions that provision for generation of power must be visualised in construction of irrigation structures, such as small dams etc.

In a meeting held on 7th July, 1981 by the Secretary, Min of energy, Department of power, a decision was taken to set up a committee under the chairmanship of Shri A.N. Singh, Member (H.E.), CEA, to prepare guidelines for the development of small hydro schemes with a view to help in correct and quick formulation of viable projects. Initially, the committee functioned with Shri R. Ramaswamy, Chief Engineer (P & I), Central water commission, Prof. O.D. Thapar, Roorkee University, and a representative of M/s Jyoti Ltd. Subsequently, other members were added to the Committee to pool all available knowledge in preparation of the guidelines. These were, representatives of M/s Elovel, M/s Bharat Pumps and Compressors, and Shri K. Madhavan, Chief Engineer, Central Water Commission, and Shri P.K. Behl and Shri T.A. Deodas, Directors CEA. Over the period of 8-9 months the committee made exhaustive studies and held five formal meetings and finalised the guidelines.

The finalisation of the guidelines has been possible with full co-operation of all the Committee members and the valuable suggestions contributed by them. I would also like to express my appreciation for the suggestions and work put in by the various officers of CEA and CWC. We all hope that these guidelines would be very useful in identification and preparation of project reports for small hydro-electric schemes by the various connected Electricity authorities and organisations.

(A.N. Singh)
Member (H.E.)
Central Electricity Authority
GUIDELINES FOR DEVELOPMENT OF SMALL HYDRO POWER PROJECTS

1. INTRODUCTION

1.1 In the wake of uncertainty about availability of fossil fuels in future, new and renewable sources of energy are gaining in importance day by day. Hydro power is one of the most attractive sources of renewable energy. Hydro schemes – small or large – are capital intensive relative to the operational costs, however, they have in – built inflationary protection, i.e. once built, the water is essentially free. Small (mini/micro included) hydro power development which was earlier considered economically less viable in developed countries is receiving greater attention now as its relative economics is improving vis-à-vis other small sources of energy. Interest generated the world over in small hydro development has also given a fillip to small hydro technology and suitable and more efficient generating plant and equipment is becoming available.

1.2 In India small hydro development has been taking place steadily since very long time, wherever encouraging factors existed. Thus a number of small hydro projects have been in operation in Arunachal Pradesh, Sikkim, Himachal Pradesh, Uttar Pradesh and Jammu & Kashmir. Also a number of projects are presently under construction in a large number of states. Unlike some other countries India still has a large potential of hydro energy which remains to be harnessed in major and medium projects. While this large resource of renewable hydro energy has to continue to be developed as an important source of energy, the small hydro development has simultaneously its own role to play and has to be exploited side by side wherever feasible in view of over-increasing energy requirement in the country and evolving position of energy resources. Thus in remote areas small hydro may be the only or the most economical sources of energy making its development imperative. Similarly, in the plains, large irrigation canal net-works, diversion structures, small dams are either existing or under development. These sources can be very well tapped for production of energy, even if the quantum may be relatively small.

1.3 Small hydro can be broadly categorised in two types in Indian conditions as

(i) Small independent hydro electric projects in the hills, mainly Himalayan where small streams are available. These are mostly of medium/high head utilising small dis-charge, and

(ii) Small installations in the plains and other regions which utilise water regulated for other purposes e.g. irrigation canals, small dams, etc. These are usually of low head utilising larger discharges.

Both the above categories have certain limitations. Flows in small rivers/rivulets/streams in the hilly areas are not perennial and the few perennial streams also have very wide flow variations in the monsoon season. Substantial storages cannot be easily developed as a result of which these schemes tend to be run-of-the river schemes. Power availability in the lean months may be relatively very small or even nil. In the second category also discharges are governed mainly by the pattern of irrigation releases. Also canal discharges may not occur in the monsoon months and during periods of canal closure for maintenance. In the plains, however, grid lines might be available which can normalise to some extent small power requirements of a particular area.
SMALL HYDRO-ELECTRIC SCHEMES

TAKE OFF
FROM WEIR ON THE RIVULET
1.4 Central Electricity Authority and Ministry of Energy have already taken steps towards making the various state authorities in the country aware of potential in small hydro and needs for its development. Some of the states have identified a large number of such schemes for taking up further investigations. It has been observed that the methodology of development work of small-hydro projects differs from state to state owing to many factors including site conditions and priorities. Though this development is termed as small-hydro, systematic studies in respect of investigations, hydrology, installation etc. need to be carried out, may be to a lesser extent. Keeping in view above mentioned factors, a need was felt for making the efforts in development and installation of small hydro as uniform as practicable. Thus an attempt has been made to bring out comprehensive guidelines in this regard in the following paras which are recommendatory in nature for development of small/mini/micro hydroelectric schemes of all categories. It is intended that these guidelines would be able to reduce the gestation period of small-hydro, in relation to major schemes, which is one of the attractive points of the small hydro development and also improve their relative overall economics.

1.5 The work of the formulation of the project reports for small/mini/micro hydel projects may be undertaken by the state authorities if they have a competent team consisting of a geologist, engineer with experience in hydrology, civil and electrical/mechanical design engineers. Incidentally, private organisations are coming up in the country who seem to be capable of doing the necessary investigation and project formulation work. The small hydro developmental work may be entrusted to such agencies if the State Authorities so chose. Central organisations like CEA and CWC would also assist the state authorities if they are specifically approached in this regard.

1.6 There does not exist any consensus about the definition or capacities of micro/mini/small hydroelectric schemes. The definition also varies from country to country depending upon its resources. This has led to certain amount of confusion and it is proposed that following definitions would be adopted in respect of these schemes in future.

(a) Micro Hydro-Electric Schemes:
Hydro-electric schemes with a total installed capacity of 100 KW having individual generating units with capacities from a few KW to 100 KW.

(b) Mini Hydro-electric Schemes:
Hydro-electric schemes with a total installed capacity upto 2000 KW or near around with capacities of individual units from 100 to 1000 KW.

(c) Small Hydro – Electric Schemes:
Hydro-electric schemes with a total installed capacity upto 15 MW with individual units having capacities from 1 MW to 5 MW.

1.7 The cost of low head/small hydel schemes depends largely on the civil engineering works, like dam, water conductor system and power house, etc. To minimise the cost of such schemes, it is imperative to effect the reduction in cost of such structures. The siting of low head hydrl schemes on large irrigation canal offer a good scope to utilise the falls on the canal for generation of electricity more economically.

2. IDENTIFICATION

Some of the essential points which need to be taken into consideration for choosing the potential for mini/micro/small hydel schemes, are enumerated below:
2.1 Location

Such sites may be located within reasonable distance from the users so that transformation equipment and long transmission lines can be avoided. This is particularly applicable to the independent schemes in isolated hilly areas. Neartness to the existing grid or proposed grid may be kept in view especially for low head schemes in plains.

The site should be amenable for development without elaborate civil works, long water conductor system, etc. and adaptable to simple structures. Existing structures wherever available should also be considered for utilisation.

2.2 Reliability

The flows in the rivers/rivulets / canals should be available for major portion of the year to make the project of value to the users, as in such cases, the average availability of power would be for longer periods. It is particularly true for independent schemes.

2.3 Head and Flows

The head and flows should be optimised as far as possible. Schemes should also be amenable to choice of relatively simple and less costly equipment.

2.4 End-Use

Potential for use of electric power should either exist or can be developed within a reasonable period of time. This may be in addition to the normal power requirements like lighting, heating, domestic, commercial and community services which readily exist in most of the habitations. In case the power generated can be fed into the existing grids, this consideration may have less importance.

2.5 Technical Services

Especially in isolated independent schemes, equipment very simple in installation and maintenance should be chosen. Also services for operation and maintenance of the equipment as well as supply of the power should be created from amongst the local population, as it would be difficult and also uneconomical to get technical services from outside.

3. PROCEDURE FOR PREPARATION OF FEASIBILITY REPORT

3.1 Once a scheme has been identified and the site for development of small hydro has been located, the following procedure should be followed for preparation of the pre-feasibility/feasibility reports project formulation etc.

3.2 Planning

The stream on which the development is envisaged may have existing development or may have potential for attractive development on the upstream or downstream of the site. Thus it should be examined whether any over all development of the stream has been considered or is required to be considered.

Further, consideration has to be given to whether the proposed scheme is to be connected to an inter-connected system or would be feeding an isolated area having no power supply facilities and/or is
having small diesel installation operating in isolation. Most of the small hydro schemes are energy productive as balancing facilities are generally not available. The aspects which need to be considered for two types of categories are given below.

3.3 Run-of-the-river type development in isolated area

Generally these schemes are conceived to meet the requirement of isolated population centres in hilly areas. Power grid lines usually do not exist at such locations. Thus these schemes tend to have low load factors and for power utilisation of the available potential, provision of a poundage for meeting the evening peak would be of great help. It would be necessary to consider this aspect while planning such projects. The evaluation of the benefits and the economics of such schemes depend, to a great extent, on this aspect. The poundage requirement would be relatively less for high head development.

3.4 Low head schemes in plains

The possibilities of small hydro schemes in the plains usually occur at small dams and regulating structures constructed for irrigation as well as on the canal falls that would be existing in the entire planned, consideration might be given while planning that concentrated drops are available at certain locations for power utilisation. In the case of existing canals, certain extent of re-alignment might be necessary to avail of the fall in the canal system. Such schemes may also be very much amenable for connection to nearby grid. Thus in planning of these schemes exploitation of maximum potential consistent with the economics of energy generation has to be considered.

The low head schemes usually have to handle large quantities of water. Thus size of the civil structures as well as that of generating plant is usually very large. These schemes may, therefore, tend to be comparatively costly. Consideration, therefore, has to be given to make the civil structures as simple as possible.

3.5 In considering both the types of schemes as brought out above, criterion of utilisation of flow available for about 75% to 50% of the time may be considered with particular attention in case of isolated scheme. The determination of the installed capacity and a number of units should be governed as described in the subsequent paragraphs.

4. SURVEYS

4.1 Reconnaissance Survey

Reconnaissance survey shall be carried out after preliminary topographical studies by a team comprising of experienced engineers, geologist and hydrologist for selecting optimum
location for hydro-electric schemes. Alternative lay-out should be studied with a view to utilise the best combination of head and discharge at minimum cost.

4.1.1 The reconnaissance survey for low head canal schemes should be carried out for selecting the location of such schemes for optimum utilisation of head created by a fall structure in canal, taking into consideration the topographical consideration of canal alignment. The points to be kept in view before finalisation of the site are:

i) Proximity to the load centre and an existing grid

ii) Availability of sufficient space to accommodate switchyard, by pass channel, residential houses for the staff responsible for operation and maintenance of the power house or set of power house in the vicinity.

iii) Capacity of the canal and likely fluctuations in the discharge in the canal and variation in the head of water.

iv) If the scheme is considered on a proposed canal, the possibility of combining two or more falls for achieving a higher head. Heads less than 3 m are not likely to be attractive.

v) Possibility of stage development of the entire length for power generation.

vi) The type of strata likely to be encountered at the foundation level of the proposed structure.

4.1.2 For run-of-river schemes, especially for micro-mini projects, there might be only merge data available for assessing dependable flow. In such cases, discharge observations should be commenced immediately at approximately located site. The data collected on this basis should be analysed for deriving a long term run-off series based on rainfall to obtain as best a reliable correlation as possible. The rain gauges considered should preferably be located in the catchment in the vicinity of a particular scheme or in the absence of such location, the rain gauge stations of neighboring catchment should be considered for arriving at proper correlation between rainfall and run-off.

4.1.3 Discharge measurement in the vicinity of the site chosen for hydro-electric scheme should be taken in as accurate a manner as possible. Any one of the following methods may be employed for discharge measurements, as considered appropriate for the particular location.

1. Notches, weirs and flumes (Ref. IS : 1193-1959)
2. Velocity area method (Ref: IS: 1192-1959)
3. Slope area method (Ref: IS 2912-1964)
4. Stream gauging (Ref: Manual issued by CWPRS, Min. of Irrigation).

The discharge measurements should preferably cover a minimum period of two lean seasons.
4.1.3.1 Criteria for selection of site for discharge measurements of streams

The general criteria for selecting a suitable site for measurements of discharge of streams as described in the “Stream Gauging Manual” published by central water & power research station, Ministry of Irrigation and power are:

i) The river banks and bed should be reasonably stable and river reach sufficiently straight, both upstream and downstream of the cross-section for a distance of atleast four times the width of the river during floods or 0.8 Km., whichever is less.

ii) The reach of the river, as described in (I) should be fairly uniform in cross-section at and below the high flood level and the water surface and bed slopes should not be subject to sudden changes. The river bed should also not have a reverse slope in this reach.

iii) When a discharge site is located upstream of a confluence, whether on the main or tributary streams, its distance from the confluence should not be less than three times the maximum width of the channel or 0.8 km, whichever is more. In case the site is located downstream of the confluence, the minimum distance should not be less than three times the width of the channel or 0.8 km, whichever is more.

iv) If gauge sites already exist within the reach where discharge measurements are required, it is advantageous to consider the possibility of establishing a discharge site at the gauge station itself. This would enable the gauge discharge relation to be established and made use of. If however, gauge and discharge sites cannot, for any reason, be at the same location, the alternative is to keep them as close as possible. Care should be taken to see that no inflow or outflow takes place between these two sites.

v) The site should not be unduly exposed to wind. Direction of the flow should be as divergent as possible from wind direction, specially during the period when stream gauging is required to most accurate.

vi) The site chosen should be easily accessible at all times of the year. It is also desirable that the river reach upstream and downstream be clearly visible from the discharge site. This is essential when floats used for the measurement of velocity.

vii) At the selected discharge site, the water should flow in a single channel. If such channel is not available, two or more channels satisfying all conditions should be adopted and individual measurements taken.

4.1.3.2 Method for Measurement of discharge:

A. Measurement of discharge by notches:

The notches of all types are suitable for measuring small discharge in a stream or canal system. The accuracy of this method will largely depend on the fulfilment of the following conditions:

i) A uniform, stable and straight reach of the stream. The length of such a reach shall not be less than 15 times the maximum head over the notch and the cross-section of the stream in this reach shall not be less than six times the head over the crest. The gauge observation shall be made a minimum distance of four times the depth of flow from the notice.

ii) Notch plates shall be vertical and have a sharp right angled edge on the upstream edge and downstream edge bevelled at 45°. The crest width may be 3 mm.
iii) The crest shall be perfectly horizontal in case of rectangular and Cipolletti notches, and 45° to the horizontal for 90° notch.

iv) Distance between top of crest and bed of the stream, and between the sides of the notch and sides of stream shall not be less than twice the depth of water above the crest and shall not be in any case less than 30 cms.

v) A minimum head of 6 cm, over the crest is necessary.

vi) There shall be no leakage around the structure.

The common formula as per stream gauging Manual of OWPRS, Pune for various types of notches are:

a) For contracted rectangular notches;

This formula is applicable for free overfall condition without submergence and applicable only in case depth of flow is less than 1/3 the length.

\[ Q = 3.33 \left( (H+h)^{3/2} - h^{3/2} \right) \times (L - 0.2H), \]

where

- \( Q \) = Discharge in cusecs
- \( H \) = Depth of flow in ft
- \( h \) = Velocity head ---- \( V^2/2g \) ft
- \( L \) = Length of notch

b) Suppressed rectangular notches:

\[ Q = (3.223 + 0.435 h_e/Z) BH_e^{3/2}, \]

where

- \( Q \) = Discharge in cusecs
- \( h_e \) = \( h + .0036 \) ft
- \( h \) = Depth of flow in ft
- \( Z \) = Height of crest above channel bottom in ft
- \( B \) = Length of crest in ft
CONTRACTED RECTANGULAR NOTCH

\[ Q = 3.83 \left( H + \frac{b}{2} - H \right)^{\frac{3}{2}} \left( L - 0.2H \right) \]

TRIANGULAR \(90^\circ\) V NOTCH

\[ Q = 2.48H \text{ CUSECS} \]

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MEASUREMENT OF DISCHARGE

BY NOTCHES
c) Cipolletti Notches:

These are contracted trapezoidal notches with sides inclined outward at 1 to 4. The formula for discharge is:

\[ Q = 3.367 \times L \times (H + 1.5 \times h)^{2/3} \]

d) 90°V notches:

The formula for measurement of discharge is:

\[ Q = 2.49 \times H^{2.98} \text{ cusecs} \]

V notches are most suitable for the measurement of small discharge in the range of 30 litres/sec. To 300 litres/sec.

The formula for the measurement of discharge by notches as per IS: 1193-1959 are:

1. Rectangular notches:

   a) Without end contractions:

\[ Q = \frac{2}{3} \times C_d \times \sqrt{2 \times g \times L \times H^{3/2}}, \quad \text{where} \]

\[ Q = \text{Total discharge in m}^3/\text{sec} \]

\[ C_d = \text{Co-efficient of discharge to be determined experimentally.} \]

\[ g = \text{Acceleration due to gravity m/sec}^2 \]

\[ L = \text{Breadth of notch in m} \]

\[ H = \text{Head of water over the sill in m} \]

b) With end contractions

\[ Q = \frac{2}{3} \times C_d \times \sqrt{2 \times g \times (L - 0.1 \times n) \times H^{3/2}}, \quad \text{where} \]

\[ n = \text{Number of end contractions} \]

c) Where velocity of approach is to be taken into consideration:

\[ Q = \frac{2}{3} \times C_d \times \sqrt{2 \times g \times (L - 0.1 \times n) \times X} \]

\[ X = \left( \frac{V_1^2}{2g} - \left\{ \frac{\alpha \times V_1^2}{2g} \right\}^{3/2} \right)^{3/2} \]

Where:

\[ \alpha = \text{Average velocity connection, generally its value is taken unity.} \]

\[ V_1 = \text{Velocity of approach.} \]
2) Triangular notches:

\[ Q = \frac{8}{15} C_d \sqrt{2g \tan \left(\frac{\theta}{2}\right)} / (H^{3/2}), \]  
where:

\[ \theta = \text{angle of notch} \]

For 90° notch:

\[ Q = \frac{8}{15} C_d \sqrt{2g} x H^{5/2} \]

B. Measurement of discharge by Area – Velocity Method

The measurement of discharge by this method involves the measurement of area of cross section of channel at the site of discharge measurement and velocity of current at that section. The area of the cross section can be measured by the method of segmentation and velocities by a current meter.

Theoretically, the area velocity method using a current meter is capable of giving substantially correct results. There are, however, certain limitations affecting the accuracy of this method in field conditions, slight inaccuracy in the rating of current meter, small fluctuations in discharge, turbulent flows, wold-effect, personal errors in the measurement of depth and velocity are some of the factors which introduce errors. IN natural streams, bed is not uniform and velocity distribution is irregular. Discharge and water level rarely remain constant during gauging operations. In order to complete the discharge measurement within a limited period, during which the gauge remains stable. The number of observation points and the verticals have to be restricted. An error of 3% to 4% may be expected. The efficiency of current meter may further go down because of extremely turbulent flow, carrying heavy load of suspended material. The measurement of velocity made by floats is far too inferior to current meter observations and should, therefore, be adopted only when employment of current meter is not feasible or the current meter is not available.

The measurement of depth during the lean season on small channel can be made by wading rods, but during floods, the measurement of depth of water at various segments may be made from a single span wooden bridge or a suspension bridge at the site of observation. If the width of width of river is excessive, a cable way along with cradle may be provided.

C. Measurement of Discharge by Area Slope Method

Selection of sites, besides general criteria mentioned before the following additional points should also be kept in view before finalizing the selection of site for measurement of discharge by area slope method (IS: 2912 – 1964):

i) The length of the reach should not be less than five times the width of the channel, with reasonably stable banks and uniform in section.

ii) The slope should be such that the surface drop should not be less than 150 mm in the length of reach selected.

iii) The flow in the channel shall be contained within its banks for all stages in which this method of measurement may be employed, when:

(a) Equipment required for making measurement with current meter is not available.
(b) High flood might have passed and its estimate is required subsequently.

In this method, discharge is worked out by multiplying the average cross-sectional area with the average velocity of the channel, which is indirectly found by using one of the open channel formulae. The method lacks accuracy, since both area and velocity can at best be determined only approximately. Very
often the area measured during dry weather is employed for computations of flood discharges. Evaluation of accurate value of rugosity co-efficient in an open channel is another limitation of this method.

Besides rugosity co-efficient, accurate data of river slope may not, many times, be available. This is because high water level may have been determined from flood marks, gauge positions may be defective, and slope may not be uniform.

Due to these limitations, discharge estimates by area slope method can at best be approximate.

D. A number of methods are available for measurement of cross-sectional area and current velocity depending upon the depth and width of the channel and current velocity. Only the methods in respect of these measurements for small streams are suggested here.

E. During the lean seasons, when the discharge is less than 1 cumec/m, the depth of the river can be measured by stretching a steel tape across the cross-section and dividing the width into a number of segments approximately 1 to 1.5 m and measuring the depth at these points by sounding rod or wading rod having attachment for fixing the current-meter at the bottom or any desired height for measuring the current velocities. The measurements during high floods can be made by demarcating the segments on a steel wire rope and taking the depth of river at each segment by a sounding rod from a boat and velocity of current can be measured by suspending the current meter from the boat. But due to swift currents, it may not be feasible to employ a boat. In such cases, the measurement of depth and velocity can be made from the deck of a single span wooden bridge. Wherever feasible, near the discharge site, if construction of bridge is not feasible, a cable – way may be provided across the channel and the measurements may be taken from the cradle.

4.2 Detailed Field Surveys

Detailed field surveys should be conducted to fix the location of particular structures, viz. diversion structure, water conductor system, desilting tank, forebay/balancing reservoir, power house, tail race channel, and cross drainage works. The surveys should be connected to a GTS bench mark. In the absence of a GTS bench mark at a reasonable distance from the project site, a suitably – located permanent point within the project area may be chosen with a suitable value assigned to it to serve as datum for reference.

4.2.1 Survey plan for medium and high head schemes

Preliminary cross-section of the survey plans of the project shall be prepared and exhibited to cater to requirement as indicated below:

i) The survey for the general layout of the scheme should extend from the river course about 2 kms. Upstream of the weir to 1 km downstream of the confluence of the tailrace channel with the river and also cover the layout of the water conductor system and other structures. Cross section of the river should cover the banks of the river well above the high flood marks. The contour plan should preferably be drawn to a scale of 1: 1000 with 5 m contour interval. In cases where canal alignment does not follow the river course and tailrace discharges into another river, the survey of the river course may be limited to about 2 km d/s of the weir.

ii) Diversion Structure:

The topographical survey for the diversion structure should cover an area sufficient to accommodate all possible arrangement of diversion structures, intake structures, etc. a distance of
50 m u/s and 50 m d/s of the proposal weir site is normally considered adequate. The bed level of the river and the water levels shall also be included. The plan may be drawn to a scale of 1:200 with 2 m contour interval.

iii) Water conductor (Power Channel/Conduit)

The survey should extend on the sides of the power channel/conduit sufficient to provide a clear idea of the hill slopes. A width of 10 meters towards hill slopes in the case of micro/min hydro electric schemes is generally adequate for this purpose. Cross-sections along the power channel/conduit alignment at 100 meters interval shall be taken as also at locations where the topography changes abruptly. The cross-section should extend sufficiently to indicate the hill slopes where the power channel/conduit is adjacent to the river. The cross-section should extend to include the river banks.

iv) Cross Drainage Works

The survey shall include the L-section of the drain and at least four cross-sections near the cross drainage work with high flood levels marked on it. The nature and extent of catchment area should also be included in the survey to arrive at discharge capacity of the drain. The contour plan may be drawn to 1:200 scale with 2 m contour interval.

v) Penstock Intake & Penstocks

The survey should include the forebay, penstock intake, penstock alignment and spilling arrangement at the intake. The surveys should include L-section along penstock alignment and cross-sections to an extent of at least 20 m on either side of the penstock alignment. The contour plan may be drawn to a scale of 1:500 with 2 m contour interval. The L-section should clearly show the abrupt changes, if any, in the scale.

vi) Power Station

For the location of power house and switchyard, surveys should include sufficient area to include alternative layouts of the station and switchyard. The plan may be drawn to 1:200 scale with 2 m contour interval.

The section of the river at its confluences with the tailrace indicating bed levels, water levels known HEL, shall also be included. While carrying out the topographical surveys the deposits of coarse aggregate and sand in the vicinity of the project area should also be located. In the absence of these deposits in the project area, other location near the site may be indicated.

vii) Tailrace Channel

If the length of the tailrace channel is short, the area may be included in the power house area survey, otherwise the survey may be done on the lines of the surveys of power channel.

4.2.2 Survey Plan for low head schemes

Surveys required for low head schemes are relatively much less. In the case of existing small dams, diversion structures, where penstock pipes are already embedded, no survey would be required. In case penstock embodiment does not exist, water would be required to be led though suitable channel to the power house site and from there back to the power house site and from there back to the existing canal.
system. If a power house is to be located on an existing canal at a point where suitable fall is available, then by-pass with similar arrangement, as above, would be necessary. Surveys would be over a short stretch to fix the suitable channels by-pass, etc,

However, if a suitable fall is to be created in the existing run of a canal, re-modelling of the existing canal would be necessary. As this might involve considerable length in realignment of the canal which would make the scheme rather costly, this should be done as far as possible to avail a minimum fall (but not less than 3m.), compatible with the discharges.

Field surveys should include preparation of contour plans of the proposed arrangement conversing sufficient area to a scale of 1: 500 with a contour interval of 2m. the I-section and Cross section of the canal should also be obtained.

4.3 Geological investigations

A reconnaissance report, based on a geological traverse of the area, shall be prepared. In addition, the following minimum geological investigations shall be carried out:

(i) Diversion structure

It is desirable to ascertain the type of strata underlying the proposed structure by means of at least one bore-hole trial pit at a suitable location, as advised by the geologist, with geological logging. The report should also include the type of strata of the abutments.

(ii) Power Channel

As the power channel in micro/mini hydel scheme has comparatively small cross-section, detailed geological investigation by drill holes/ test pits may not be required. However, the geological mapping of the hill slopes along the alignment is essential for assessing the stability of hill slopes, particularly the reaches where falling of the loose material in the canal is apprehended, should be identified in order to enable the designer to consider the remedial measures, like providing covered conduit or duct in these reaches.
SMALL HYDRO-ELECTRIC SCHEMES

DROP TYPE (TRENCH) WEIR
(iii) **Cross Drainage works**

A geological assessment of the strata, particularly of the abutments and bed of the drain at the proposed site of structure is required. Such a report would assist the designer to take care of the geological factors for the foundation of the abutment of the structure.

(iv) **Penstock Intake and penstocks**

Geological mapping of the penstock slopes should be carried out. Particular attention should be given for geological sections at saddle and anchor block locations with indication of strata at the foundation level of the structure. One test pit at the location of intake and two or more test pits on the penstock slope with geological logging may suffice.

(iv) **Power House**

One test pit at power house site with geological logging should be carried out. In particular, geological mapping of the slopes of the power house excavation should be prepared indicating the satiability of the construction slopes and any adverse geological feature, so that this could be taken care of in the design for stability of slopes.

4.3.2 The geological investigation for small schemes on canal falls may include the geological assessment of the site, indicating the type of rock, if available or type of soil likely to be met at the foundation level of the power station by test pits. In case rock is not available at foundation grade, permeability test should be carried out.

**PROJECT FORMULATION**

5.1 After the necessary data, as mentioned in the preceding paras, has been collected, formulation of the project report can be done and this should, broadly cover the following

(i) **Study of power Availability**

It is considered that the potential at site might be taken on the basis of 75% availability criteria. The total installation at the site would depend on the pattern of load consumption and likely future development. Roughly, it may be worthwhile to take load factor of 50 to 60%.

(ii) **Number of Units**

Depending upon the load pattern, it may be possible to install a single unit of a certain capacity or more than one unit. However, in case of independent schemes, it is always advisable to have at least two units, so that the reliability of power supply is better. Generally, it is recommended that for different capacities, the number of units considered for installation may be adopted as given below:

(a) For total capacity
   - Upto 100 kW . 2 Units –maximum
(b) For total capacity
   - above 100 kW . 4 Units –maximum

5.2 **Preparation of Preliminary Designs For Works**

The exact layout of the project area, viz. location of weir/diversion structure, conductor system, power house switchyard area, should be prepared.
Designs for diversion structure or weir, penstocks and water conductor system etc., power house structure and switchyard structure, electrical single line diagram, general layout of the equipment, details of the instrumentation, protection and other connected items, should be done as detailed below,

5.3 **Design Aspects of Micro-Hydel Schemes**

5.3.1 Micro-hydel schemes generally comprise of the following structures: these structures should be designed to utilize the locally available construction materials to the maximum extent possible and simple enough to avoid deployment of heavy construction equipment and highly skilled labourers.

(a) Diversion weir & Intake  
(b) Water Conductor  
(c) Desilting tank  
(d) Forebay  
(e) Penstock intake & Penstocks  
(f) Spilling arrangements  
(g) Power house building  
(h) Tailrace channel

5.3.2 Before design of micro/mini hydel schemes in the Himalayan region are taken up, due consideration should be given to the large boulders, gravel and heavy silt load carried by the stream during floods. The flows during flood season bear a high ratio as compare to lean season flows, and flash floods of high intensity cannot be ruled out. These factors require special consideration and study.

5.3.2.1 **Diversion structure & Intake**

The hill streams generally carry big boulders during flood season, which destroy the over-ground structure constructed across the river and thus restrict the choices of adoption of different alternatives. The development of trendi-type weir for deviation structure has solved this problem to a significant extent. The trench-type (or drop type) weir consists of a trapezoidal trough located below the bed of the river with top kept at the bed level of the river. The intake structure located at the end of the weir is an integral part of the weir. The intake structure should preferably be at such location as to clear the width of the stream at minimum water level conditions. The top width of the trough is kept between 1.5 m to 2.5 m and is covered by a horizontal trash rack of simple but robust design to withstand the impact of rolling boulders. The trough may be provided with a slope at the top along the flow to facilitate the crossing of boulders and other coarse material. The trough bed is also provided with a longitudinal slope of the order of 1:10 to 1:20 for easy collection of coarser material in the desilting chamber, which may enter the trough through the openings in the trash-rack and subsequent clearance through a desilting pipe by flushing.

5.3.2.2 The intake structure is provided with two gate openings, one for flushing of desilting pipe and the other for the power channel. The opening of the flushing off pipe is kept about 60-75 cm. Lower than the opening for the water conductor to provide the necessary head for flushing the silt and coarser material though the desilting pipe.

5.3.2.3 The intake with may be constructed of stone masonry or reinforced cement concrete. The desilting pipe should be aligned in such a way that it negotiates the flood height in the shortest possible length and attains a minimum flushing velocity of 2 to 2.5 m/sec. The desilting pipe is
discharged into the river. The water conductor in the initial reach could be in the form of a concrete hume pipe upto a distance where it is above the high flood level and embedded in the concrete to provide protection form scouring.

5.3.2.4 The gates may be of a simple design consisting of a steel skin plate with metallic strips welded to it, to minimize the leakage around the opening. An angle iron frame may be fixed on the opening, to serve as guide for the gate-leaf. The gate-leaf is connected to a manually-operated hoist through a hoisting stem.

5.3.2.5 Besides a horizontal trash-rack, additional opening with trash bars is provided on the side wall of intake were allow some flow to the intake in flood season if the horizontal trash rack is choked.

5.3.2.6 It may be possible in some locations to have a conventional weir for stream where the problem of rolling boulders and flash floods is not severs. In flash boards or wooden stop-logs with suitable supporting structure. They should be of simplest design for easy erection and removal.

5.3.2.7 In very small streams, the diversion of water into the canal may be of effected by constructing (i) boulder barrier across the stream. This requires frequent rebuilding after floods (ii) provision of stop-los, and (iii) in very small streams, temporary diversion during lean period to divert practically all the flow could be effected by temporary blockage of the river with available boulders.

Other designs, like intake and siphons, vertex chambers and vertical shafts, may be worked out to suit the local conditions.

5.3.3 Water conductor system

The current trend in the design of water conductor system is to provide an R.C.C. duct in the initial reaches followed by any or the combination of conventional type of channels. The channel may be unlined or lined using stone or bricks or concrete for the lining depending upon the local availability of material. The use of pipes equivalent for the channel is preferred where the channel is to be covered to from the slopes generally encountered along the course of water conductor.

The longitudinal slope could be 1:500 to 1:1000 with appropriate design section for the water conductor.
5.3.4 Desilting tank:

To trap the pebbles and suspended matter, a desalting tank is generally provided in the initial reaches of the water conductor. The velocity of flow is reduced to 0.3 m/sec. In the chamber to allow suspended material to settle down in the drawn provided in the bottom of the chamber. The sediment is flushed out in the valley occasionally through a gated orifice.

5.3.5 Forebay

The forebay in a micro–hydel scheme is provided mainly to ensure the minimum head over the penstock intake to prevent the air entry into penstock. Generally, two minutes storage to a depth of 3 metres is considered sufficient.

If storage is required to meet the peak load demand, a balancing reservoir of suitable capacity may be considered after establishing the economic feasibility for such a prevision.

5.3.6 Penstock Intake & Penstocks

The invert of the penstock intake is generally kept about 0.6 m, from the bed of the forebay to allow suspended matter to settle and flushed out occasionally through a pipe controlled by a sluice valve. Penstock entry should be a bell-mouth and provides with a 100 mm air vent pipe with its top above the maximum water level in the forebay.

Generally, one penstock pipe is provided from the intake to a suitable point upstream of the power house where manifold is provided to feed individual turbines where more than one turbine is provided. The pipes may be honed by welding or by providing dresser couplings. The pipe should be supported by anchor blocks at the bends. If the pipe is buried, expansion joints may not be provided. Victual couplings may be provided to take care of the expansion, if pipe is laid over ground. These couplings, beside permitting the expansion, introduce some flexibility which helps greatly in laying the pipes.

In case of penstock length more than 5 times the head, expert opinion will be necessary for design of water conductor system.

In case manufacturing pipes are not readily available, mild steel plates of requisite thickness may be used for rolling the pipes.

A sluice valve could be provided for each penstock in the initial reaches to isolate it from the turbines during an emergency.

5.3.7 Spilling Arrangement

Spilling arrangement is provided at the penstock intakes to become operative in case of sudden load rejection or at partial load. An opening with its bottom at the maximum water level may be provided at a suitable location on the forebay and connected to a natural drain. In case tail waters are required for irrigation or domestic purposes, the spilled water may be diverted to the tailrace channel through a chute or a cascade.
5.3.8 Power House

The power house building, housing the generating units and also the control panels should be as simple as possible. Space should also be provided for repair bay, if considered necessary.

Centre-to-centre distance between units depends upon the physical dimensions of the machines. Medium and high head machines upto 100 KW capacity with smaller runner diameters could have centre-to-centre distance, even 2.5 meters or lower. In case the medium and high head machines having larger runner diameters, the centre -to-centre distance could be as much as 5 to 7 metres or more. The high of the power house side walls form the floor may be 3-5 metres.

Where weight of the heaviest part of the machine does not exceed 2-3 tonnes, a chain pulley block of 3-5 tones capacity with a tripod may suffice for erection and subsequent maintenance of the machine. For machines involving heavier weights manual. Electrically operated traveling crane would have to be provided. For low head turbines of higher capacity, regular EOT crane of suitable capacity may be necessary and units centre line spacing would be as dictated by civil design, unit design and electrical design requirements.

In case of medium and high head machines upto 100 kW capacity, the power house buildings may be constructed of stone or brick masonry and the of any be constructed of tubular trusses and GI sheets. The trusses can be so arranged that these abridge each generally unit, this could ensure a high clearance availability over the units for handling the equipment during operation and maintenance. Typical drawings showing general arrangements of different turbines are enclosed (3 Drawings).

In case of high capacity machines, low head or high head, power house building design would again be dictated by the type of unit and weights required to be handled by the electric overhead traveling crane, installation of which would be necessary at such power stations.

In case of micro and mini schemes,m transformers wherever lower voltages, say upto 11kV are involved, and switching equipment could be housed in an annexe to the power house building or in one corner of the service may and connection to the transmission lines could be made through cables. However, in case of small generating units scheme involving higher sizes of units and higher transmission voltages, transformation and switching equipment could be housed in an outdoor switchyard adjacent to the power house.

5.3.9 Tailrace Channel

The tailrace channel deserves care in the design of adequate capacity and sufficient slope to clean the discharges form the machines swiftly. The undivided tailrace channels of each unit are connected to a common channel outside the power house building and may be constructed of stone masonry or RCC upto a pint where the turbulence subsides. Beyond this, the tailrace channel may be constructed as an unlined channel discharging into a drain.

A typical arrangement of principal features of a micro–hydel scheme is shown in the enclosed drawing.
SMALL HYDRO-ELECTRIC SCHEMES

GENERAL ARRANGEMENT OF

130 kw PELTON TURBINE

PLATE - 6
SMALL HYDRO-ELECTRIC SCHEMES

CANAL DROP DEVELOPMENT (ON THE CANAL)
5.3.10 Low Head Scheme

The principal structures of low head schemes located on the canal include the intake with the provision of trash-rack, structure housing the machine, tailrace and a by-pass channel.

The power house may preferably be located on the canal alignment with intake on the u/s and tailrace on the d/s of the fall. In most of the running canals, it may not be possible to locate the power house on the canal alignment itself, which may require the closure of canal for considerable period during the construction. In such a condition, the power house may be located on a by-pass channel by leaving a edge in the bank of canal at the u/s end of the by-pas channel. This ledge may be remove after the completion of the construction after closing the canal, which would be only of short duration. The main canal in such alternatives would serve to bypass the discharge, when generating units are not in operation.

5.4 Electrical Design Aspects

The main items which go in a micro/mini/small hydel power station generally are: (i) water conductor control by providing inlet valves (ii) turbine generating sets, (iii) governing and excitation system, (iv) electrical protection equipment, (v) step-up transformers, (vi) HT switching equipment, (vii) D.C. supply equipment, (viii) grounding system, (ix) handling equipment for erection, like crane, etc., and (x) fire protection system.

The various design aspects in regard to these equipments are discussed in the following paras.

5.4.1 Water Conductor Control

It is recommended that at least two valves may be provided in the power station for each generating set, one as a cut off, and the other to stop the machine in case of emergency shut-down of the unit due to operation of various protections. Obviously, these valves would be provided in case of medium and high head generating units. In case of low head, particularly canal falls power stations, a quick acting gate, backed by some kind of stop log gates at the beginning of the water conductor system would be provided. The timings for automatic classing of the inlet valves in case of medium and high head machines and quick-acting gates in case of low head machines should be taken as the safe timings prescribed by the generating set supplier, which is normally dependent on the safe time the generating unit can stand on runaway speed, usually 3 minutes.

5.4.2 Turbines

Various types of turbines to suit the combination of head and output have been developed in the world. In India, poltroon, turgo-impulse, Francis, Kaplan and propeller type of turbines have been developed, to cover head ranges between small and high heads. For very small heads also, the know-how is available in the country with the already established firms. Other firms, both in private as well as public sector, have also shown interest in starting the manufacture of turbines for micro/mini/small hydro installations.

In the interest of standardization, it is recommended that overall capacities of the unit may be chosen from the followings:-
SMALL HYDRO-ELECTRIC SCHEMES

LOW HEAD DEVELOPMENT

PLATE - 9
10 kW, 25 kW, 50kW, 100kW, 200kW

250 kW, 350 kW, 750 kW, 1000 kW

1500 kW, 2000 kW, 2500kW, 3000kW, 4000kW, 4500kW and 5000kW.

However, while inviting the tenders for the generating units, option should be left to the tenderer to offer the nearest to the required size, if the design for the same is available with the tenders, and should be considered if the same can meet the requirements. It may be mentioned here that in view of the various requirements of heads and water flow conditions, the turbine has to be tail or –made for every particular site. However, if the capacity of the unit, as mentioned above, is acceptable, this may help in standardization of the unit according to the runner diameter in each case of turbine type, i.e. pelton, francis, kaplan, propeller. Also, if the head available can give speed in ranges of 300, 375, 500, 600, 750, 1000 and 1500 rpm, the generator frames of the various capacities would also, possibly, be standardized to make them economical.

It is also felt that alternative types of turbines offered by the tenderer should be considered on technical and economical merits. However, where water to be exploited contains heavy silt contents, various parts like runner, wicket gates, labyrinth, etc., could be specified to be of stainless steel. While tendering, nature of the load which the unit has to cater for, must be clearly stated so that various bearings, particularly thrust bearing, are of appropriate size and capacity.

In the medium and high head range, manufacturer can offer horizontal or vertical sets. However, horizontal sets will give simpler and economical civil structure for small generating units. For low head and small capacity generating units, the horizontal tubular turbines offer an economical and simpler solution; while tubular/bulb turbines would be more appropriate for longer capacities.

In India, bulb type turbines have not been developed so far and units which have already been installed or are under installation, have been installed or are under installation, have been imported, but the tubular turbines are being offered by the indigenous manufacturers.

5.4.3 Generator

In most of the micro/mini/small H.E. projects, hydro generators, which may be located in remote areas to feed independent load, or are to operate in parallel with other similar units, will be synchronous type, i.e. with its own excitation system. However, in case these generating units have to feed into a nearby strong grid, induction type generators could also be considered. As already mentioned, the rating of the generators could be chosen from any of the capacities mentioned in para 5.4.2. As the generators would have synchronous speed, the turbine speeds have to match the same for a particular set and wherever sufficient head is available to give required speed, direct coupling between turbine and generator is to be provided. However, in case of very low head generators, which may be more economical, gears having good quality and good maintenance facilities, will need to be available. In case of very small machines, say of a few kW capacity, ‘V’ belt derive is also possible.
SMALL HYDRO-ELECTRIC SCHEMES

SCHEMATIC LAYOUT

OF

TUBULAR TURBINE POWER PLANT
5.4.4. **Governing & Excitation System**

Micro/unit/small hydro-electric installations built to serve loads independently either singly or in parallel with other sets at the same location or at the nearby stations, will need to be provided with suitable speed governing equipment of regulated frequency and output.

For very small isolated installations, thyristers based apparatus on the principle of keeping load, and thereby speed constant, have been developed and could be utilized.

For small sets to be connected to large grids, use of induction generators could eliminate the need of governors. Some special systems, which partially perform functions of governors, which partially perform functions of governors, have been developed abroad, though not yet developed in the country. Such devices, if proposed, will have to be considered on merits.

For synchronous generators, voltage regulation is also required. However, in case of units connected with nearby strong grid, induction generators can also be chosen. In such a case, no voltage regulation would be required, as the unit can be started directly connected with the system dry and later on load taken up, depending on the water available.

In case of installations, where synchronous generators are to be installed, to supply load independently or in conjunction with another similar installation, manual synchronizing equipment also will have to be provided to synchronise the units with each other in the same installation and/or with other similar installations.

5.4.5. **Electrical Control & Protection Equipment**

A control-board should be provided, where from all functions of the plant can be monitored. Indicating meters, control switches, position indicating lamps, protective relays and annunciation should be provided on this board. Adequate safeguards should be provided to protect personal from electric shock and equipment from damage due to short-circuit, etc.

In micro/mini/s will hydro plants with generation voltage of 4.15 V and rating below 1000 kW, the generator neutral may be earthed directly to ground through an isolating switch. At power stations with more than one unit, only one generator may be earthed at a time. Generating units with higher generation voltage and higher rating may be earthed through resistance or distribution transformers. For small sets, say upto 1000kW, restricted earth-fault protection may be adequate. In canes of generating units connected with grid, reverse power relay may also be provide, if considered necessary. For bigger sized sets, elaborate protection may be necessary. To protect the generator from voltage surges, surge protection may also be provided.

The generating units in a micro/mini/small hydro stations may preferably be bussed at the generation voltage. The stepping up of the voltage, wherever necessary, may be done by minimum two and maximum three transformers in parallel.

For 415V, air –circuit breakers with instantaneous short-circuit and thermal over-load trip facilities may be preferred.
LEGEND

1. VOLTMETER SELECTOR SWITCH............ V
2. AMMETER SELECTOR SWITCH.......... A
3. AMMETER.......................... A
4. VOLTMETER.................................. V
5. FREQUENCY METER.......................... F
6. KILOWATT HOUR METER................. KWH
7. KILOWATT METER........................... KW
8. POWER FACTOR METER .................. PF
9. CIRCUIT BREAKER WITH THERMAL
   OVERLOAD AND INSTANTANEOUS MAGNETIC
   SHORT CIRCUIT RELEASE............
10. LIGHTNING ARRESTER......................... 
11. OVER VOLTAGE RELAY....................... O/V
12. RESTRICTED EARTH FAULT RELAY....... E/R
13. FUSE......................................
14. THREE CB'S OF DESCRIPTION 'A' ... A(B)
15. SWITCH FUSE UNIT (THREE PHASE, 4 WIRE) [O O O O]
16. ISOLATOR................................

SMALL HYDRO ELECTRIC SCHEMES

TYPICAL ELECTRICAL LAYOUT

SINGLE LINE DIAGRAM-1
SMALL HYDRO ELECTRIC SCHEMES

TYPICAL ELECTRICAL LAY-OUT

SINGLE LINE DIAGRAM - II

PLATE - 12
5.4.6 D.C. Equipment

For micro and mini installations upto 200 kW installed capacity, D.C. supply is necessary for continuous load of indicating lamps, other control purposes, and may be for giving initial impulse to the self-excitation system by means of a field flashing switch. A 24-volt, 50 ampere hour capacity load acid battery with charger is usually found adequate for this purpose. For bigger installations, the battery voltage and its capacity would have to be decided, taking into consideration various d.c. requirements in the power station.

5.4.7 Step-up Transformers

Step-up transformers, wherever necessary, may preferably be on ONAN type. Rating of the transformer chosen, should be standard rating as per the Indian Standards. The transformers upto 500 kVA should be provided with Buchholz protection with alarm and trip facilities, and over-current and earth-fault relay on the primary side. For bigger transformers, normal protection, such as restricted earth-fault, differential, etc., as per CBIP Manual along with the lightning arresters may be necessary.

5.4.8 HT Switching Equipment:

In the case of voltages upto 33 kV and stations supplying loads radically and not connected with any other source of generation, switching may be possible by means of drop-out fuses and isolators only, and circuit-breakers may not be necessary. In such cases, pole-mounted structures can be provided. Single bus-bar arrangement is usually adequate. Lightning arresters may be provided to protect the line and switching equipment from surges.

In the case of important stations connected to the grid or other sources of generation and transmission voltage above 33 kV, use of circuit-breakers with usual switching equipment would be necessary. Sketches showing the typical single line switching diagrams are enclosed.

5.4.9 Grounding System

In order to protect the personnel and the equipment, the power house and switchyard areas should be provided with grounding system. The non-current carrying parts of all the equipment should be connected to this earth system. In the case of small stations, grounding may be done by driving rods. In the case of bigger stations connected with the grid, where earth-fault currents are likely to be of high order, suitably designed grounding mat using M.S. flat may have to be laid in power house and switchyard areas. All equipment bodies and metal parts should be earthed to the mat. I.S. Code No. 3043 may be referred for design of earthing system.

5.4.10 Fire Protection System

For small generating schemes, say upto 2000 kW, elaborate fire protection system may not be provided as it would be rather expensive. Portable CO₂ extinguishers for general fire, portable foam type for oil fires and fire buckets filled with clean dry sand, ready for immediate use, may serve the purpose adequately. Wherever sufficient water pressure is available, fire hoses may also be provided at strategic locations in the power house.
SMALL HYDRO ELECTRIC
SCHEMES
SINGLE LINE RELAYING
AND METERING DIAGRAM

DEVICE FUNCTION NUMBER

UNDER VOLTAGE RELAY ........................................ 27
LOSS OF EXCITATION RELAY ..................................... 40
NEGATIVE PHASE SEQUENCE RELAY ................................ 46
OVERCURRENT RELAY ............................................... 51
VOLTAGE RESTRAINT OVER CURRENT RELAY ..................... 51VR
OVER VOLTAGE RELAY ............................................... 50
MOTOR EARTH FAULT RELAY ....................................... 64R
STATION EARTH FAULT RELAY ..................................... 64FB
BUS BAR DIFFERENTIAL RELAY ................................... 8760
GEN DIFFERENTIAL RELAY ......................................... 8765
PILOT WIRE PROTECTION RELAY .................................. 87W
NEW TRANSF. RESTRICTED EARTH FAULT RELAY ................ 646TR
NEW ALL ARC FAULT DIFFERENTIAL RELAY ...................... 676T
5.4.11 Handling Equipment in the Power House

For power stations having individual generating unit sizes up to 1000 kW, where the weights to be handled are likely to be under 5 tonnes, a simple arrangement with a chain pulley block and tripod would meet the requirement of erection and subsequent handling. For generating units of bigger capacities and or involving higher weights, an electrically-operated over-head traveling crane would be necessary.

6. COST ESTIMATES

Cost estimates with sufficient itemization for individual civil structures and electrical/mechanical equipments should be prepared. The estimate should be based on latest rates for various materials, works, equipment and labour, prevailing or estimated for works to be carried out at the location of the site. Provision for transportation of material, handling, insurance, erection charges contingencies should be made and based on realistic basis. Brief itemisation of cost component to be taken care of while preparation of estimate for power station for electrical/mechanical equipment for a station with capacity less than 2000 kW and for small schemes above this capacity are separately given in Annexures.

7. LOAD DATA COLLECTION

Detailed data may be collected for the number of users, type of load, i.e. domestic/commercial/common community loads, industrial and irrigation loads, like water pumps, furniture making, flour mills, etc. The demand pattern would require to be worked out and the total energy which would be consumed on account of each load, should be worked out. This, in turn, would also help to finally decide the size of units and number of units, etc.

8.1 Evaluation of The Schemes

8.1 After working out the estimates of cost and phasing of expenditure, it would be necessary to work out the energy benefits from the schemes for the proposed installed capacity. In the case of schemes connected to the grids, it very often happens that the capacity of the schemes under consideration forms very small protection of the total grid installed capacity. It could, therefore, be safely assured that all the available energy could be absorbed in the system. As these schemes tend to have seasonal character in regard to energy availability, the evaluation would have to be in terms of the coal saving at the existing thermal stations. In considering coal saving, the plant having the highest fuels component cost would have to be considered.

8.2 In the case of schemes in isolated areas, the energy absorption from the schemes would have to be worked out, keeping in view the availability of pondage and the ability of the schemes to cater the demands as per the system load curve. For this purpose, it would be necessary to work out a typical daily load curve, preferably for two or three seasons and calculate the likely energy absorbed from the hydro schemes. The economics of the scheme could be worked out considering the total system cost in meeting a demand sequence with the existing diesel capacity and the hydro stations and alternatively with the existing diesel capacity and a diesel alternative. The cost streams in both the cases could be compared to work out the benefit cost ratio of the proposed hydro schemes.
9. **SECONDARY ENERGY**

Special mention should be made if any secondary energy is available from the scheme and if this can be economically absorbed, particularly in case of independent schemes.

10. **COST BENEFITS & ECONOMIC CONSIDERATIONS**

10.1 Finally, detailed cost benefits of the scheme should be worked out. The specific cost (cost/kW) of a small hydro project generally, tends to be comparatively higher because of the intrinsic reasons associated with their comparatively small power outputs even though there are a few instances where due to exceptionally favourable circumstances, the cost has been comparable. The items of civil works for a given topography remain almost the same. The requirement of the generating plant and equipment may also be of a specialized nature, especially in the case of very small heads. The cost of generation is, therefore, comparatively higher. The guidelines contained in this document are intended to bring down the total cost of the small project as much as possible. Thus, unless the criteria for economic evaluation of small hydro is viewed in a broader context, the development may not take place at appropriate rate.

10.2 Small hydro project is a class in itself and has its own role to play as brought out earlier. Their development is rather distinct from the conventional and major hydro projects. They have many attractive features such as frequently small gestation period, simplicity in project layouts and their operation and maintenance. They are also almost devoid of environmental disturbances which now-a-days is a very important consideration. Many of these schemes would contribute to the uplift of the rural masses, especially projects located in remote areas. Taking these factors into considerations, a different approach to the criterion for economic evaluation of small projects is needed than that considered for major H.E. Projects.

10.3 Normally, economic viability of small H.E. projects would have to be determined by comparison with the cost for making power available at the same place by alternative means, including therein all elements such as proportionate transmission/distribution cost for such alternatives. In isolated hilly areas for instance, such alternative may be small diesel generation where comparison should be made with this source. In areas where the small hydro may be feeding into a local grid, it may offer the advantage of short gestation period in which case a comparison with other short terms methods of coping up with shortages, e.g. diesel or gas turbine generation could be partially taken into consideration.

10.4 In the present day conditions of changing economy, it is difficult to specify any figures of specific cost. From survey of the cost of small hydro projects all over the world, it is seen that at present day cost levels, the specific cost for recent projects ranges between U.S. $1000 to 2000 (and more for installations of smaller than 100 kW or very small head). In India, the specific cost of a medium sized hydro project presently comes to about Rs. 6000 to Rs. 8000.

10.5 The projects having higher specific cost also need to be considered on their merits. In the case of far off places in hilly regions, where even transport of diesel on time is likely to pose problems, installation of small hydro might be the only source of generation and may not be compared with any alternate source of energy. In the case of small irrigation dams where waters are being let into canals through regulators without utilization of power potential, generation at such points can become viable if civil costs of the dam etc. are not charged to power. There can be other special situations which may not have been brought out in the space of this limited document which could call for favourable consideration.
In order to achieve the due benefits from small hydro power stations, it is considered worthwhile that exploitation of small hydro potential should be entrusted to a separate special set up in the States. There are many disadvantages of clubbing small hydro together with conventional generation in the same organization. It can easily be appreciated that small projects are likely to suffer from inattention if clubbed in this manner. Technique of implementation of small hydro can also be developed effectively when a special unit remains engaged on it. Special unit in the Central organizations is also needed for purposes of overall planning as well as providing technological help to small States/Territories, etc.

Generally an attempt for completion of a small hydro where basic civil works are ready and land is available in about three years period, has to be made and four to five years in other cases, otherwise one of the major aims of such projects would be lost.

A format for preparation of detailed project report for mini/micro/small hydro-electric schemes is enclosed. This format covers, generally, schemes with an installed capacities of 100 kW to 15 MW.
# MICRO HYDRO POWER STATION
**INSTALLED CAPACITY UPTO 2000 kW**

Estimate of Electrical & Mechanical Equipment for the Power House and Switchyard

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Item</th>
<th>Quantity</th>
<th>Rate in Rs.</th>
<th>Amount (in Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Generating units each rated for 3 phase, 415 V, 0.9 P.F. &amp; … kW, complete with inlet valves, turbine, governor, generator with excitation and regulation systems, neutral earthing and surge protection equipment, synchronizing equipment, etc., including spares for 5 years trouble-free operation.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>415 volts control panels for generator incoming &amp; outgoing feeders complete with air circuit breakers, current transformers, instrumentation &amp; protection.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>24 volts, 50 Ampere hours, lead-acid battery, charging equipment, L.G. distribution board, complete in all respects.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Station ground materials.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Fire protection equipment.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Lifting tools &amp; tackles, including chain pulley block/hand-operated mobile crane.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Power &amp; control cables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Step-up transformers rated for ….., including buchholz protection with alarm &amp; trip facilities, oil for first filling &amp; spares for 5 years trouble-free operation.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Isolators with/without earthing blades.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Drop out fuse sets, complete with fuse elements.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Lightning arresters.</td>
<td></td>
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</tr>
<tr>
<td>12.</td>
<td>Bus-bar materials, including ACSR conductor, insulators, clamps &amp; connectors, and switchyard structures for busbars, isolators, dropout fuses, lightning arresters, etc.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Description</td>
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<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Power house &amp; switchyard illuminating materials fixtures, complete with luminaries.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Miscellaneous</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Total generating plant &amp; equipment.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Contingencies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Transportation, handling &amp; transmit insurance.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Erection &amp; commissioning of the above equipment.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Losses on stock @ 0.25%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Maintenance during construction @1%.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Procurement &amp; Inspection charges @2%.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Tools &amp; Plant including office equipment, camp equipment @1%.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Establishment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Audit &amp; Accounts @1%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Grand Total</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Rs.
## SMALL HYDRO POWER STATION
### INSTALLED CAPACITY UPTO 15 MW

Estimate of Generating Plant & Equipment

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Item</th>
<th>Quantity</th>
<th>Rate in Rs.</th>
<th>Amount (in Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Preliminary expenses, including design &amp; consultancy.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Turbines rated for …….. complete with governing &amp; lubricating oil systems, high pressure compressed air system, dewatering system, etc., including spares for 5 years trouble-free operation.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Generators rated or ……. complete with PMG, AVR, excitation system, cooling system, CO₂ equipment, neutral earthing &amp; surge protection equipment etc., including spares for 5 years trouble-free operation.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Generator-Transformers connection, bus-ducts/cables, current transformers, potential transformers, instrumentation &amp; protection complete.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>L.T. &amp; H.T. switchgear for auxiliary power supply to power house and switchyard.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Unit Auxiliary transformers.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Station service transformers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Control &amp; Relay panels for incoming &amp; outgoing feeders, complete with synchronizing equipment, annunciating &amp; alarming equipment, etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Lead-acid batteries, charging equipment, D.C. distribution board complete.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Fire protection equipment.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Power &amp; Control cables, with cable racks, supports, etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Illumination of power house &amp; switchyard</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Electric over-head traveling crane complete.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Step-up transformers rated for</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td></td>
<td></td>
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<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Station grounding equipment materials.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Air/Oil circuit breakers.</td>
<td></td>
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<tr>
<td>17</td>
<td>Isolators with/without earthing blades.</td>
<td></td>
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<tr>
<td>18</td>
<td>Current transformers.</td>
<td></td>
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<tr>
<td>19</td>
<td>Potential transformers</td>
<td></td>
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<td>20</td>
<td>Lightning arresters.</td>
<td></td>
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<tr>
<td>21</td>
<td>Bus-bar materials, including ACSR conductors, insulators, connectors, etc.</td>
<td></td>
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<tr>
<td>22</td>
<td>Switchyard structures.</td>
<td></td>
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<tr>
<td>23</td>
<td>Miscellaneous</td>
<td></td>
<td></td>
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<td></td>
<td>Total Generating Plant &amp; Equipment (Items 2 to 23)</td>
<td></td>
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<tr>
<td>24</td>
<td>Contingencies.</td>
<td></td>
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<tr>
<td>25</td>
<td>Transportation, handling &amp; Transit insurance.</td>
<td></td>
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<tr>
<td>26</td>
<td>Erection &amp; commissioning of the above equipment.</td>
<td></td>
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</tr>
<tr>
<td>27</td>
<td>Losses on stock @0.25%.</td>
<td></td>
<td></td>
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<tr>
<td>28</td>
<td>Maintenance during construction @1%.</td>
<td></td>
<td></td>
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<tr>
<td>29</td>
<td>Procurement &amp; inspection charges @2%.</td>
<td></td>
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<td>30</td>
<td>Tools &amp; Plant, including office equipment, camp equipment @1%.</td>
<td></td>
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<tr>
<td>31</td>
<td>Establishment</td>
<td></td>
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<tr>
<td>32</td>
<td>Audit &amp; Accounts @1%</td>
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<td></td>
<td>Grand Total : Rs.</td>
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GENERAL ELECTRICITY AUTHORITY

FORMAT FOR PREPARATION

OF

DETAILED PROJECT REPORTS

FOR

SMALL HYDRO-ELECTRIC PROJECTS

NEW DELHI
1982
FORMAT FOR PREPARATION OF DETAILED PROJECT REPORTS FOR MICRO/MINI/SMALL HYDEL PROJECTS

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SECTION-VI DRAWING
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SECTION-I – CHECK LIST

NAME OF THE PROJECT

LOCATION

i) State
ii) District
iii) Taluka

CATEGORY OF THE PROJECT

i) Micro Hydel – Hydro-Electric Schemes with a total installed capacity of 100 kW having individual units with capacities of a few kW to 100 kW.
ii) Mini-Hydel – Hydro-Electric Schemes with a total installed capacity of 2000 kW with capacities of individual units from 100 kW to 1000 kW.
iii) Small Hydel – Hydro-Electric Schemes with a total installed capacity upto 15 MW with individual units having capacities from 1 MW to 5 MW.

Planning

Has the overall development of the stream canal been prepared and stages of development discussed briefly?

Have the alternative proposals been studied and their merits and demerits discussed?

Have the detailed topographical surveys been carried out for the following items and drawings prepared as per prescribed scales?

i) Stream/canal surveys
ii) Head works surveys (weir or diversion structure).
iii) Plant site and camp site
iv) Water conductor system
v) Power Houses, switchyard, tailrace
vi) Penstock, surge shaft, if necessary
vii) Communication etc.

3. GEOLOGY

Have the geological surveys for Head works, Power House and tail-race, etc., been carried out and report on general geology of the area and on geology of the sites of principal structures appended?

FOUNDATION INVESTIGATIONS

Have the foundation investigations for the major civil structures and of the schemes, etc., been carried out?
MATERIAL SURVEYS

Have the surveys and laboratory tests for construction material, like previous and impervious soils, sand, aggregate etc., been carried out? (wherever necessary).

HYDROLOGICAL & METEOROLOGICAL INVESTIGATIONS

Have the hydrological and meteorological investigations been carried out and status of data discussed in report?

i) Rail-fall in the catchment
ii) Gauge and discharge data of the stream/canal.

HYDROLOGY

Have hydrological studies been carried out to establish the availability of water for the benefits envisaged; and what is the dependability of the potential?

LAND ACQUISITION & RESETTLEMENT (Wherever applicable)

Have the provision for land acquisition and resettlement been considered?

Have the socio-economic problems involved in resettlement been investigated and discussed?

DESIGN

Has the layout of the project area, viz. location of diversion structure, workshop sheds, offices, camps, etc., been finalized?

Have the preliminary designs prepared for the following components?

i) Diversion structure or weir etc.
ii) Penstocks and water conductor system, etc.
iii) Power house & switchyard.
iv) Power house equipment, LT/HT switching equipment and control & protection equipment.

POWER BENEFITS

Have the following points been discussed?

i) Total energy production and installed capacity of the grid system.
ii) How does the scheme fit into overall development of power of the region? (if applicable).
iii) Energy generated from the project, firm power, seasonal power and total power.
iv) Proposals for transmission and or connecting the existing system, etc. (wherever applicable).
v) Cost of generation per kW installed/as per kWh generated, as compared to the various micro-hydel projects and various services in the region to justify the economic variability of the scheme.

CONSTRUCTION PROGRAMME

Are the major components of work proposed to be done departmentally or through contractor?
Have the year/month-wise quantities of the following items been worked out for various components of the project?

i) Excavation – soft and hard strata
ii) Earth-work in filling (wherever applicable).
iii) Stone for masonry
iv) Coarse aggregate for concrete
v) Steel of various sizes and type of reinforcement
vi) Cement
vii) Controlled items – special steel for penstocks.
viii) Other material – P.O.L., Electricity, explosives, etc.

ESTIMATE

Is the estimate prepared?

Have the analysis of rates for various major items of works for the major components of the project been furnished, with the basis of analysis and the price index at which the estimate is based?

ECOLOGICAL & ENVIRONMENTAL ASPECTS

Is the area likely to have any environmental and ecological problems due to the altered surface water pattern and preventive/corrective measures discussed? (wherever applicable).

CAMPS AND BUILDINGS

Has the planning of the camps/buildings been done?

SOIL CONSERVATION

Is the need for soil conservation measures in the project discussed?

SECTION – II – SALIENT FEATURES

1. LOCATION

i) State
ii) District
iii) Taluka
iv) Village
v) Access – Road
   Rail
   Foot track
vi) Geographical co-ordinates
   Latitude
   Longitude

2. RIVER CATCHMENT

i) Catchment
ii) River
iii) Tributary
iv) Sub-tributary

3. HYDROLOGY

i) Catchment area of the stream/nallah
ii) Catchment area at the diversion site
   - Gross
   - Intercepted in the upstream, if any.
   - Free catchment
iii) Precipitations:

<table>
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<tr>
<th></th>
<th>Annual</th>
<th>Monsoon (June – October)</th>
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<tbody>
<tr>
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<tr>
<td>Average rainfall</td>
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<tr>
<td>Maximum rainfall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum rainfall</td>
<td></td>
<td></td>
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<tr>
<td>Co-efficient of variation</td>
<td></td>
<td></td>
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<tr>
<td>Snow-fall</td>
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iv) Dependable yield (where applicable)

<table>
<thead>
<tr>
<th>Percent</th>
<th>Annual</th>
<th>Monsoon (June – October)</th>
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<tbody>
<tr>
<td>50%</td>
<td></td>
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<tr>
<td>75%</td>
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<tr>
<td>90%</td>
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<tr>
<td>95%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>98%</td>
<td></td>
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</table>
v) Climate data

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Maximum</th>
<th>Minimum</th>
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<tbody>
<tr>
<td>Atmospheric temperature (°C)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Humidity (percent)</td>
<td></td>
<td></td>
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<tr>
<td>Wind (Km/hr)</td>
<td></td>
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</tbody>
</table>

vi) Floods

Historical  Location & Elevation

- Maximum water level
- Maximum discharge estimated (cumecs)
- Date of occurrence

Observed  Location & Elevation

- Maximum water level
- Maximum discharge estimated (cumecs)
- Date of occurrence
- Standard projected flood (cumecs)
- Maximum probable floods (cumecs)
- Design Flood (cumecs)

Head works/Diversion site
- Maximum designed flood (cumecs)
- Stream/nallah flows (Minimum observed)

- Water level (El. M)
- Discharge (Cumecs)
- Months of ‘NIL’ flow

4. Medium/High Head projects:

a) **DIVERSION STRUCTURE (HEAD WORKS)**

i) Type of structure
- Weir/barrage
- Concrete
- Masonry
- Any other type

ii) Length (m)
- Over-flow section (wherever applicable).
- Non-over flow section.

iii) Tail water level (El m)
iv) Maximum discharging capacity (cumecs)

v) Gates

   Number of gates
   Type of gates
   Size of gates

b) WATER CONDUCTOR SYSTEM

i) Length (m)

ii) Shape

iii) Size (m)

iv) Full supply depth (m)

v) Thickness of lining (mm)

vi) Design discharge (cumecs)

vii) Free flow/under pressure (m)

c) FOREBAY

i) Size of forebay (m)

ii) Sill level of forebay (El. M)

iii) Full forebay level (El. M)

iv) Maximum forebay level (El. M)

v) Number of off-takes

   - Size (m)
   - Invert level (El. M)
   - Capacity

vi) Maximum discharging capacity (cumecs)

d) PENSTOCKS

i) Number

ii) Diameter (m) and thickness (mm)

iii) Length (m)

iv) Size of gate/valve (m)

v) Bifurcations, if any, at lower end

vi) Invert level (m)

vii) Design discharge (cumecs)

5. POWER HOUSE

i) Type

ii) Head (m)

   - Maximum
   - Minimum
   - Average
   - Design
iii) Size of Power House:

(a) Length (m)
(b) Width (m)
(c) Height (m)
(d) Machine Hall floor level (El. M)

iv) Installed capacity (kW)

v) Turbine(s)
   - Type
   - Number
   - Capacity (kW/HP)

vi) Type of generator –
   (a) Excitation system
   (b) Regulation system

vii) Power House Crane/Lifting tackle capacity

6. TAIL RACE

i) Shape

ii) Size

iii) Length (m)

iv) Water level (El. M)
   - Maximum
   - Minimum

v) Number and size of draft-tube gates.

7. POWER

i) Installed capacity

ii) Firm power (kW) – Load factor – in percent

iii) Seasonal (max.) Power (kW).

iv) Annual energy (kWh).
   - Firm
   - Seasonal
   - Total

8. SWITCHYARD

i) Voltage level/Basic Insulation level

ii) No. of bays.

iii) Size:
   (a) Length
   (b) Width

9. ESTIMATES OF COSTS

i) Total Cost (Rs. lakhs)

ii) Cost per kW installed (Rs. )

iii) Cost of generation per kWh (paisa)
SECTION –III – GENERAL REPORT

CHAPTER –1 SCOPE OF THE PROJECT
CHAPTER –2 INTRODUCTION

2.1 Geographical Disposition
2.2 Topography and physiography of the Basin/sub-Basin
2.3 Geology
2.4 Hydrology
2.5 River system/Canal System
2.6 Location of Project area
2.7 Communication facilities
2.8 Climatic conditions
2.9 Population
2.10 Natural Resources
2.11 Socio-Economic Aspects
2.12 History
2.13 Necessity – Needs and Opportunities for development.
2.14 Choice of Scheme – Alternative Studies.
2.15 Scheme proposals
2.16 Plan of Development

Note: Only relevant information need be given in case of canal fall schemes.

CHAPTER –3 SURVEYS AND INVESTIGATIONS

3.1 Topographical Surveys
- Establishment of G.T. s. bench marks
- River Course/Canal
- Head works/Diversion Site/Fall/By-pass system.
- Water Conductor system
- Penstock, Forebay,
- Power House, Switchyard, Tailrace
- Camp/Buildings
- Communication and approach roads.
3.2 Hydrological Surveys
(a) For high head/medium head schemes
- River/stream cross sections
- Gauge and Discharge stations
- Tail water curves
(b) Canal fall schemes
- Canal discharge data
3.3 Meteorological Surveys
- Rain gauge stations
- Meteorological Observatories

CHAPTER-4 WATER RESOURCES (HYDROLOGY)

4.1 Surface water
- Catchment area
- Existing uses
- Rain fall data
- Climatological parameters like temperature – humidity – wind, sun-shine, etc.
- Gauge and discharge data
- Sediment (suspended and bed-load) in flow and grain size composition.
- Flood estimation

4.2 Water Quality
- Dissolved and suspended materials
- Suitability of water

4.3 Design Flood (Wherever applicable)

CHAPTER-5 GEOLOGY

a) For high / medium head schemes
   - Regional Geology
   - Geology of diversion site/ Power house site
   - Geological explorations -
   - Drill holes - pits, etc.
   - Seismicity

b) Canal fall schemes
   - Soil bearing capacity under structures proposed.

CHAPTER - 6 CONSTRUCTION MATERIALS

6.1 Sources and tests carried out
6.2 Requirements - quantities of principal construction materials
6.3 Concrete Materials
   - Coarse aggregate
   - Fine aggregate

6.4 Masonry materials
   - Stone
   - Bricks
   - Tiles
   - Fine Aggregate

6.5 Cement, possolane, lime & kankar
6.6 Steel
   - Structural steel
   - Reinforcement steel
   - Plate steel
   - Special steel, etc.

6.7 Scarce materials
   - P.O.L.
   - Explosives
   - C.G.I. sheets etc.
   - Gas
CHAPTER - 7 PROJECT PURPOSES

7.1 Present development
- Existing power facilities
- Generating capacity
- Transmission system
- System loads
- Load factors

7.2 Proposed development
- Existing markets
- Growth trends
- Load forecast
- Firm power
- Secondary power
- Installed capacity

7.3 Transmission System
7.4 Rural Electrification

CHAPTER - 8 CONSTRUCTION PROGRAMME

8.1 Bar Chart showing quantity - wise & item wise target of construction
8.2 Material planning
8.3 Plant and equipment planning
8.4 Man power planning
8.5 Dewatering
8.6 Workshop and transport equipment
8.7 Model of construction
- Departmental
- Contractor / Agencies
8.8 Organisational set up
8.9 Services and utilities (wherever applicable)
- Colony
- Water supply
- Power supply / Construction Power
- Sanitation
- Telephones
8.10 Procurement of materials
8.11 Work programme - season - wise

CHAPTER - 9 COSTS

9.1 Abstract of cost
9.2 Quarter-wise / Year-wise phasing of expenditure
CHAPTER – 10 BENEFITS AND FINANCIAL ASPECTS

10.1 Direct benefits
   - Firm power
   - Secondary power

10.2 Indirect benefits

10.3 Financial aspects
   - Expenditure
   - Annual Operating
   - Maintenance
   - Replacement costs

10.4 Cost Benefit Ratios & Annual Returns
10.5 Financing (cash flow studies) & schedule of repayment of loans

CHAPTER 11 ENVIRONMENTAL & ECOLOGICAL ASPECTS

- Site selection
- Physical aspects
- Resource linkage aspects
- Socio-cultural aspects
- Public health aspects
- Preventive / corrective measures
- Estimation for measures

SECTION - IV - DESIGN REPORT

CHAPTER 12 WATER & POWER STUDIES

12.1 Data available
12.2 Parameters of diversion structure
12.3 Capacity of water conductor System
12.4 Power Potential
   - Installed capacity
   - Load factors
   - Firm power
   - Secondary power

12.5 River Diversion during construction

CHAPTER - 13 DESIGN CRITERIA OF MAJOR COMPONENTS OF SCHEME

13.1 Barrage / Weir / Intake
   - Axis
   - Section (Sluices, over-flow section, head-regulator, road bridge)
   - Design criteria (as applicable)
   - Gates & operating bridge (as applicable)
   - Spillway (as applicable)
13.2 a) High head / medium head schemes
   - Water Conductor System
     - Alignment
     - L-section
     - Typical cross-section
     - Hydraulic design
     - Lining
     - Sub-surface drainage
     - Cross drainage works
     - Desilting chamber

b) Canal fall Schemes
   - Automatic by-pass arrangement for canal power house

13.3 Forebay with sill escape
   - Design criteria
   - Typical section
   - Diurnal storage

13.4 Penstock
   - Layout
   - Hydraulic & structural design
   - Economic diameter

13.5 Power Plant & Power House
   - Layout (installed capacity, stages of construction)
   - Structural design criteria
   - Generating equipment (Turbines, Generators, Governors, Switch panels)
   - Mechanical equipment & auxiliaries -
     (Water supply, compressed air, oil & dewatering system, generator hall, draft-tube & gantry crane, pressure relief and butterfly valves, air-conditioning & ventilations systems, fire-fighting equipment, etc.) (whatever and wherever applicable).

13.6 Auxiliary Power Supply
13.7 Swithcyard
13.8 Grounding System
13.9 Transmission Lines
13.10 Power Circuits & lighting circuits
13.11 Telephone system
13.12 Tail-Race Channel
   - Draft tube gates
   - Tail-race rafting curve
SECTION V - COSTS & ESTIMATES REPORTS

CHAPTER - 14 ESTIMATES OF COSTS

14.1 Major items of works & explanatory notes
   - Outlines of the schemes
   - Brief description of main components & structures

14.2 Abstract of Cost
   - General abstract of cost
   - Detailed abstract of cost

14.3 Detailed Estimates costs
   - Explanatory notes
   - Details of provisions made under various sub-heads
   - Brief explanation for the basis of provisions

14.4 Composition of units
   Unit - I  Head works including diversion weir/barrage regulator etc.
   Unit - II  Water Conductor System
   Unit-III Hydro-electrical installations
   - Power plant & appurtenant works
   i)  Civil works
   ii)  Power equipment
   - Transmission lines
   - Sub-stations

14.5 Accounts classification
   - Direct charges
     I - works
     II - Establishment
     III - Tools & plant
     IV - Suspense
     V - Receipt & recoveries on capital account
     - Indirect charges
       a) Capitalized value of abatement of land revenue
       b) Audit and account charges

14.6 Provision under 1 - works
   A - Preliminary
   B - Land
   C - Works
   J - Power plant appurtenances (civil works)
   K - Buildings
   M - Plantations
   D - Miscellaneous
   P - Maintenance
   Q - Special T&P
   R - Communications
   S - Power plant & electrical system
     Losses on stock
     Unforeseen items

14.7 Analysis of rates for working of machinery

14.8 Analysis of rates for principal items of work
SECTION VI - DRAWINGS

- Index map of the scheme showing the location of major components.
- Catchment area plan showing location of Hydro-meteorological stations
- L-sections of the river showing maximum flood level, minimum water level etc.
- X-Section of river at head works
- Stage discharge curve of the site at Head works and Power House and tail water rating curve.
- Plan showing location of the bore-holes drilled and pits excavated, site geology and bed rock contours, etc.
- Section along the axis of the head works showing MWL, FRL, DWL, LWL, log of bore holes drilled pits excavated along the axis upstream & downstream.
- Cross-section through spillway (if applicable).
- X-section of the power house generating system from inlet to outlet.
- Layout plan of power house and appurtenant works with contours
- L-Section of the power house
- Plans of the power house at different elevations.
- Map showing the general layout, including the head works, water conductor system, power house, step-up substation, out-going transmission lines etc.
- Penstock alignment showing the ground profile and position of anchor blocks.
- Single line diagram showing switching scheme, Instrumentation & Protection scheme.
- Switchyard layout plan with contours
- Penstock steel liner and bend details
- Plan and Sections of anchor blocks
- Colony layout plan
- Typical plan and sections for residential and non-residential buildings.
- Organisation Chart
- Master control network for construction programme of the scheme.
- Bar Chart, showing the construction programme and programme of development of benefits.
- Details of typical cross drainage work
- Layout plan, L-Section & Typical X-Section of tailrace channel.
- Layout plan sections of forebay/balancing reservoir with contours.
- Layout plan of head works and section with contours
- Layout, L-Section and typical X-Section of water conductor system with contours.

SECTION VII - SCHEDULE OF ITEMS

1. GENERAL
   - Statement of work
   - Description of masonry
   - Description of power plant
   - Records of test-pits and borings
   - Hydraulic records and data
   - Diversion and dewatering

2. EXCAVATION
   - Clearing of site
   - Stripping bluffs of loose rock
   - Classification
- Blasting
- Excavation for head works and appurtenant works
- Backfill
- Disposal of materials
- Drilling and tests
- Measurements

3. CONCRETE

- Composition
- Classification
- Cement
- Sand
- Coarse aggregate
- Admixtures
- Water
- Batching
- Mixing
- Test
- Temperature of concrete
- Forms of concrete
- Preparation for placing concrete
- Placement of concrete
- Weather conditions
- Finishes & finishing
- Protection, curing & repairs of concrete
- Reinforcement bars, fabric, Anchros

4. BARRAGE / WEIR / HEAD REGULATOR (as applicable)

- Preparation of work areas
- Stripping
- Excavation of cut-off trench
- Preparation of foundation
- Concrete in foundation
- Concrete in main structure
- Concrete in Spillway
- Chipping and roughening of concrete surface
- Measurement of concrete
- Furnishing, Installing gates, Mechanical equipment and hoists, etc.

5. MECHANICAL AND ELECTRICAL INSTALLATIONS

- Hydraulic turbines
- Generator and appurtenances
- Over-head travelling crane
- Grounding system
- High voltage buses
- Control room panels and boards
- Switchyard structure
- Carrier current communication system
- Penstock gates / valves & hoists
- Draft tube gates and stop-logs & hoists
- Track rails
- Drainage pumps
- Water supply intakes
- Trash racks

6. POWER HOUSE

- Excavation for foundation
- Concrete in power plant structure
- Contraction and expansion joints
- Installation of reinforcement bars & electrical metal conduit
- Walls, ceiling & floors
- Damp proofing
- Terrazzo flooring
- Bonded concrete finish
- Glass block panels
- Metal folding doors
- Metal swing doors/rolling shutters
- Metal sash windows and window operator
- Painting

7. MATERIAL FOR CONSTRUCTION

(i) Stone
   - Stone for coarse aggregate for concrete work
   - Crushing & grading
   - Storage

(ii) Sand
    - Natural sand
    - Manufactured sand

(iii) Tests
(iv) Water
    - for mixing
    - for curing

(v) Cement
(vi) Steel reinforcement
(vii) Structural steel
(viii) Miscellaneous steel work
## SECTION - VIII

### LOCATION AND DEPTH OF EXPLORATORY / HOLES / PITS ETC.

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<th>S. No.</th>
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<th>Minimum pattern of drilling</th>
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<td></td>
<td>Spacing of drill holes / Pits etc.</td>
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<tr>
<td>1.</td>
<td>Barrage and Weirs</td>
<td>One drill hole at the middle and one drill hole each on either abutment.</td>
</tr>
<tr>
<td>2.</td>
<td>Power House</td>
<td>Two drill holes covering the area</td>
</tr>
<tr>
<td>3.</td>
<td>Water Conductor</td>
<td>Pits 500 m apart will suffice.</td>
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### SECTION - VIII STANDARD NORMS AND SURVEYS

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<th>S. No.</th>
<th>Site</th>
<th>Area to be surveyed/ Extent of surveys</th>
<th>Scale</th>
<th>Contour interval</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>General layout</td>
<td>The survey should extend from 2 km u/s of diversion structure to 1 km d/s of the junction of tailrace channel with the river and should cover all the components of the project</td>
<td>1:10000</td>
<td>5 m</td>
<td>If the terrain is hilly, spot levels should be taken by tacheometer. If the area is reasonably plan, block-levelling on a suitable grid should be done.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>River cross-sections @ 200 m intervals to cover both the banks well above the highest flood marks and include power channel if the channel alignment is close to river course.</td>
<td>1:1000</td>
<td>-</td>
<td>On the river X-section at the axis of the diversion structure, following information should be indicated. (i) Date of survey and water level on that date. (ii) Maximum observed HFL (iii) Minimum water level</td>
</tr>
<tr>
<td>2.</td>
<td>Diversion structure</td>
<td>All area covering 50 m u/s and 50 m d/s of the structure and 10 m above highest flood level.</td>
<td>1:200</td>
<td>2 m</td>
<td>--</td>
</tr>
<tr>
<td>3.</td>
<td>Water conductor system</td>
<td>Contour plan of an area covering 20 m towards the hill side and 10 m towards the valley side. L-section X-sections at 100 m interval and at locations where topography changes abruptly.</td>
<td>1:1000</td>
<td>5 m</td>
<td>On the river X-section at the junction of tail-race channel and the race channel and the river, maximum and minimum water levels in the river should be indicated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1:1000</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1:1000</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Penstocks</td>
<td>The area for contour plan should include intake, forebay, length of penstocks and a width of 20 m on either side of penstock alignment L-section</td>
<td>1:500</td>
<td>2 m</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1:500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Power House</td>
<td>Contour plan should cover sufficient area to include different alternative layouts of power house and switchyard, and tailrace channel, if its length is short</td>
<td>1:500</td>
<td>2 m</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Tailrace Channel</td>
<td>If the length of the tailrace channel is large, the area to be surveyed should be governed by the norms described in (3).</td>
<td>1:1000</td>
<td>2 m</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Colony</td>
<td>Contour plan of the required plan</td>
<td>1:1000</td>
<td>2 m</td>
<td></td>
</tr>
</tbody>
</table>
MINISTRY OF ENVIRONMENT AND FORESTS

New Delhi 14th September, 2006

Notification

S.O. 1533  Whereas, a draft notification under sub-rule (3) of Rule 5 of the Environment (Protection) Rules, 1986 for imposing certain restrictions and prohibitions on new projects or activities, or on the expansion or modernization of existing projects or activities based on their potential environmental impacts as indicated in the Schedule to the notification, being undertaken in any part of India\(^1\), unless prior environmental clearance has been accorded in accordance with the objectives of National Environment Policy as approved by the Union Cabinet on 18th May, 2006 and the procedure specified in the notification, by the Central Government or the State or Union territory Level Environment Impact Assessment Authority (SEIAA), to be constituted by the Central Government in consultation with the State Government or the Union territory Administration concerned under sub-section (3) of section 3 of the Environment (Protection) Act, 1986 for the purpose of this notification, was published in the Gazette of India, Extraordinary, Part II, section 3, sub-section (ii) vide number S.O. 1324 (E) dated the 15th September, 2005 inviting objections and suggestions from all persons likely to be affected thereby within a period of sixty days from the date on which copies of Gazette containing the said notification were made available to the public;

And whereas, copies of the said notification were made available to the public on 15th September, 2005;

And whereas, all objections and suggestions received in response to the above mentioned draft notification have been duly considered by the Central Government;

Now, therefore, in exercise of the powers conferred by sub-section (1) and clause (v) of sub-section (2) of section 3 of the Environment (Protection) Act, 1986, read with clause (d) of sub-rule (3) of rule 5 of the Environment (Protection) Rules, 1986 and in supersession of the notification number S.O. 60 (E) dated the 27th January, 1994, except in respect of things done or omitted to be done before such supersession, the Central Government hereby directs that on and from the date of its publication the required construction of new projects or activities or the expansion or modernization of existing projects or activities listed in the Schedule to this notification entailing capacity addition with change in process and or technology shall be undertaken in any part of India only after the prior environmental clearance from the Central Government or as the case may be, by the State Level Environment Impact Assessment Authority, duly constituted by the Central Government under sub-section (3) of section 3 of the said Act, in accordance with the procedure specified hereinafter in this notification.

2. Requirements of prior Environmental Clearance (EC):- The following projects or activities shall require prior environmental clearance from the concerned regulatory authority, which shall hereinafter referred to be as the Central Government in the Ministry of Environment and Forests for matters falling under Category ‘A’ in the Schedule and at State level the State Environment Impact Assessment Authority (SEIAA) for matters falling under Category ‘B’ in the said Schedule, before any construction work, or preparation of land by the project management except for securing the land, is started on the project or activity:

\(^1\)Includes the territorial waters
(i) All new projects or activities listed in the Schedule to this notification;

(ii) Expansion and modernization of existing projects or activities listed in the Schedule to this notification with addition of capacity beyond the limits specified for the concerned sector, that is, projects or activities which cross the threshold limits given in the Schedule, after expansion or modernization;

(iii) Any change in product - mix in an existing manufacturing unit included in Schedule beyond the specified range.

3. State Level Environment Impact Assessment Authority:-

   (1) A State Level Environment Impact Assessment Authority hereinafter referred to as the SEIAA shall be constituted by the Central Government under sub-section (3) of section 3 of the Environment (Protection) Act, 1986 comprising of three Members including a Chairman and a Member – Secretary to be nominated by the State Government or the Union territory Administration concerned.

   (2) The Member-Secretary shall be a serving officer of the concerned State Government or Union territory administration familiar with environmental laws.

   (3) The other two Members shall be either a professional or expert fulfilling the eligibility criteria given in Appendix VI to this notification.

   (4) One of the specified Members in sub-paragraph (3) above who is an expert in the Environmental Impact Assessment process shall be the Chairman of the SEIAA.

   (5) The State Government or Union territory Administration shall forward the names of the Members and the Chairman referred in sub-paragraph 3 to 4 above to the Central Government and the Central Government shall constitute the SEIAA as an authority for the purposes of this notification within thirty days of the date of receipt of the names.

   (6) The non-official Member and the Chairman shall have a fixed term of three years (from the date of the publication of the notification by the Central Government constituting the authority).

   (7) All decisions of the SEIAA shall be unanimous and taken in a meeting.

4. Categorization of projects and activities:-

   (i) All projects and activities are broadly categorized in to two categories - Category A and Category B, based on the spatial extent of potential impacts and potential impacts on human health and natural and man made resources.

   (ii) All projects or activities included as Category ‘A’ in the Schedule, including expansion and modernization of existing projects or activities and change in product mix, shall require prior environmental clearance from the Central Government in the Ministry of Environment and Forests (MoEF) on the recommendations of an Expert Appraisal Committee (EAC) to be constituted by the Central Government for the purposes of this notification;

   (iii) All projects or activities included as Category ‘B’ in the Schedule, including expansion and modernization of existing projects or activities as specified in sub paragraph (ii) of paragraph 2, or change
in product mix as specified in sub paragraph (iii) of paragraph 2, but excluding those which fulfill the General Conditions (GC) stipulated in the Schedule, will require prior environmental clearance from the State/Union territory Environment Impact Assessment Authority (SEIAA). The SEIAA shall base its decision on the recommendations of a State or Union territory level Expert Appraisal Committee (SEAC) as to be constituted for in this notification. In the absence of a duly constituted SEIAA or SEAC, a Category ‘B’ project shall be treated as a Category ‘A’ project;

5. Screening, Scoping and Appraisal Committees:-

The same Expert Appraisal Committees (EACs) at the Central Government and SEACs (hereinafter referred to as the (EAC) and (SEAC) at the State or the Union territory level shall screen, scope and appraise projects or activities in Category ‘A’ and Category ‘B’ respectively. EAC and SEAC’s shall meet at least once every month.

(a) The composition of the EAC shall be as given in Appendix VI. The SEAC at the State or the Union territory level shall be constituted by the Central Government in consultation with the concerned State Government or the Union territory Administration with identical composition;

(b) The Central Government may, with the prior concurrence of the concerned State Governments or the Union territory Administrations, constitutes one SEAC for more than one State or Union territory for reasons of administrative convenience and cost;

(c) The EAC and SEAC shall be reconstituted after every three years;

(d) The authorised members of the EAC and SEAC, concerned, may inspect any site(s) connected with the project or activity in respect of which the prior environmental clearance is sought, for the purposes of screening or scoping or appraisal, with prior notice of at least seven days to the applicant, who shall provide necessary facilities for the inspection;

(e) The EAC and SEACs shall function on the principle of collective responsibility. The Chairperson shall endeavour to reach a consensus in each case, and if consensus cannot be reached, the view of the majority shall prevail.

6. Application for Prior Environmental Clearance (EC):-

An application seeking prior environmental clearance in all cases shall be made in the prescribed Form 1 annexed herewith and Supplementary Form 1A, if applicable, as given in Appendix II, after the identification of prospective site(s) for the project and/or activities to which the application relates, before commencing any construction activity, or preparation of land, at the site by the applicant. The applicant shall furnish, along with the application, a copy of the pre-feasibility project report except that, in case of construction projects or activities (item 8 of the Schedule) in addition to Form 1 and the Supplementary Form 1A, a copy of the conceptual plan shall be provided, instead of the pre-feasibility report.

7. Stages in the Prior Environmental Clearance (EC) Process for New Projects:-

7(i) The environmental clearance process for new projects will comprise of a maximum of four stages, all of which may not apply to particular cases as set forth below in this notification. These four stages in sequential order are:-
• Stage (1) Screening (Only for Category ‘B’ projects and activities)
• Stage (2) Scoping
• Stage (3) Public Consultation
• Stage (4) Appraisal

I. Stage (1) - Screening:

In case of Category ‘B’ projects or activities, this stage will entail the scrutiny of an application seeking prior environmental clearance made in Form 1 by the concerned State level Expert Appraisal Committee (SEAC) for determining whether or not the project or activity requires further environmental studies for preparation of an Environmental Impact Assessment (EIA) for its appraisal prior to the grant of environmental clearance depending up on the nature and location specificity of the project. The projects requiring an Environmental Impact Assessment report shall be termed Category ‘B1’ and remaining projects shall be termed Category ‘B2’ and will not require an Environmental Impact Assessment report. For categorization of projects into B1 or B2 except item 8 (b), the Ministry of Environment and Forests shall issue appropriate guidelines from time to time.

II. Stage (2) - Scoping:

(i) “Scoping”: refers to the process by which the Expert Appraisal Committee in the case of Category ‘A’ projects or activities, and State level Expert Appraisal Committee in the case of Category ‘B1’ projects or activities, including applications for expansion and/or modernization and/or change in product mix of existing projects or activities, determine detailed and comprehensive Terms Of Reference (TOR) addressing all relevant environmental concerns for the preparation of an Environment Impact Assessment (EIA) Report in respect of the project or activity for which prior environmental clearance is sought. The Expert Appraisal Committee or State level Expert Appraisal Committee concerned shall determine the Terms of Reference on the basis of the information furnished in the prescribed application Form 1/Form 1A including Terms of Reference proposed by the applicant, a site visit by a sub-group of Expert Appraisal Committee or State level Expert Appraisal Committee concerned only if considered necessary by the Expert Appraisal Committee or State Level Expert Appraisal Committee concerned, Terms of Reference suggested by the applicant if furnished and other information that may be available with the Expert Appraisal Committee or State Level Expert Appraisal Committee concerned. All projects and activities listed as Category ‘B’ in Item 8 of the Schedule (Construction/Township/Commercial Complexes/Housing) shall not require Scoping and will be appraised on the basis of Form 1/ Form 1A and the conceptual plan.

(ii) The Terms of Reference (TOR) shall be conveyed to the applicant by the Expert Appraisal Committee or State Level Expert Appraisal Committee as concerned within sixty days of the receipt of Form 1. In the case of Category A Hydroelectric projects Item 1(e) (i) of the Schedule the Terms of Reference shall be conveyed along with the clearance for pre-construction activities. If the Terms of Reference are not finalized and conveyed to the applicant within sixty days of the receipt of Form 1, the Terms of Reference suggested by the applicant shall be deemed as the final Terms of Reference approved for the EIA studies. The approved Terms of Reference shall be displayed on the website of the Ministry of Environment and Forests and the concerned State Level Environment Impact Assessment Authority.

(iii) Applications for prior environmental clearance may be rejected by the regulatory authority concerned on the recommendation of the EAC or SEAC concerned at this stage itself. In case of such rejection, the decision together with reasons for the same shall be communicated to the applicant in writing within sixty days of the receipt of the application.
III. Stage (3) - Public Consultation:

(i) “Public Consultation” refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impacts of the project or activity are ascertained with a view to taking into account all the material concerns in the project or activity design as appropriate. All Category ‘A’ and Category B1 projects or activities shall undertake Public Consultation, except the following:-

(a) modernization of irrigation projects (item 1(c) (ii) of the Schedule).

(b) all projects or activities located within industrial estates or parks (item 7(c) of the Schedule) approved by the concerned authorities, and which are not disallowed in such approvals.

(c) expansion of Roads and Highways (item 7 (f) of the Schedule) which do not involve any further acquisition of land.

(d) all Building /Construction projects/Area Development projects and Townships (item 8).

(e) all Category ‘B2’ projects and activities.

(f) all projects or activities concerning national defence and security or involving other strategic considerations as determined by the Central Government.

(ii) The Public Consultation shall ordinarily have two components comprising of:-

(a) a public hearing at the site or in its close proximity- district wise, to be carried out in the manner prescribed in Appendix IV, for ascertaining concerns of local affected persons;

(b) obtain responses in writing from other concerned persons having a plausible stake in the environmental aspects of the project or activity.

(iii) the public hearing at, or in close proximity to, the site(s) in all cases shall be conducted by the State Pollution Control Board (SPCB) or the Union territory Pollution Control Committee (UTPCC) concerned in the specified manner and forward the proceedings to the regulatory authority concerned within 45(forty five ) of a request to the effect from the applicant.

(iv) in case the State Pollution Control Board or the Union territory Pollution Control Committee concerned does not undertake and complete the public hearing within the specified period, and/or does not convey the proceedings of the public hearing within the prescribed period directly to the regulatory authority concerned as above, the regulatory authority shall engage another public agency or authority which is not subordinate to the regulatory authority, to complete the process within a further period of forty five days,

(v) If the public agency or authority nominated under the sub paragraph (iii) above reports to the regulatory authority concerned that owing to the local situation, it is not possible to conduct the public hearing in a manner which will enable the views of the concerned local persons to be freely expressed, it shall report the facts in detail to the concerned regulatory authority, which may, after due consideration of
the report and other reliable information that it may have, decide that the public consultation in the case need not include the public hearing.

(vi) For obtaining responses in writing from other concerned persons having a plausible stake in the environmental aspects of the project or activity, the concerned regulatory authority and the State Pollution Control Board (SPCB) or the Union territory Pollution Control Committee (UTPCC) shall invite responses from such concerned persons by placing on their website the Summary EIA report prepared in the format given in Appendix IIIA by the applicant along with a copy of the application in the prescribed form, within seven days of the receipt of a written request for arranging the public hearing. Confidential information including non-disclosable or legally privileged information involving Intellectual Property Right, source specified in the application shall not be placed on the web site. The regulatory authority concerned may also use other appropriate media for ensuring wide publicity about the project or activity. The regulatory authority shall, however, make available on a written request from any concerned person the Draft EIA report for inspection at a notified place during normal office hours till the date of the public hearing. All the responses received as part of this public consultation process shall be forwarded to the applicant through the quickest available means.

(vii) After completion of the public consultation, the applicant shall address all the material environmental concerns expressed during this process, and make appropriate changes in the draft EIA and EMP. The final EIA report, so prepared, shall be submitted by the applicant to the concerned regulatory authority for appraisal. The applicant may alternatively submit a supplementary report to draft EIA and EMP addressing all the concerns expressed during the public consultation.

IV. Stage (4) - Appraisal:

(i) Appraisal means the detailed scrutiny by the Expert Appraisal Committee or State Level Expert Appraisal Committee of the application and other documents like the Final EIA report, outcome of the public consultations including public hearing proceedings, submitted by the applicant to the regulatory authority concerned for grant of environmental clearance. This appraisal shall be made by Expert Appraisal Committee or State Level Expert Appraisal Committee concerned in a transparent manner in a proceeding to which the applicant shall be invited for furnishing necessary clarifications in person or through an authorized representative. On conclusion of this proceeding, the Expert Appraisal Committee or State Level Expert Appraisal Committee concerned shall make categorical recommendations to the regulatory authority concerned either for grant of prior environmental clearance on stipulated terms and conditions, or rejection of the application for prior environmental clearance, together with reasons for the same.

(ii) The appraisal of all projects or activities which are not required to undergo public consultation, or submit an Environment Impact Assessment report, shall be carried out on the basis of the prescribed application Form 1 and Form 1A as applicable, any other relevant validated information available and the site visit wherever the same is considered as necessary by the Expert Appraisal Committee or State Level Expert Appraisal Committee concerned.

(iii) The appraisal of an application be shall be completed by the Expert Appraisal Committee or State Level Expert Appraisal Committee concerned within sixty days of the receipt of the final Environment Impact Assessment report and other documents or the receipt of Form 1 and Form 1A, where public consultation is not necessary and the recommendations of the Expert Appraisal Committee or State Level Expert Appraisal Committee shall be placed before the competent authority for a final decision within the next fifteen days. The prescribed procedure for appraisal is given in Appendix V;
7(ii). Prior Environmental Clearance (EC) process for Expansion or Modernization or Change of product mix in existing projects:

All applications seeking prior environmental clearance for expansion with increase in the production capacity beyond the capacity for which prior environmental clearance has been granted under this notification or with increase in either lease area or production capacity in the case of mining projects or for the modernization of an existing unit with increase in the total production capacity beyond the threshold limit prescribed in the Schedule to this notification through change in process and or technology or involving a change in the product mix shall be made in Form I and they shall be considered by the concerned Expert Appraisal Committee or State Level Expert Appraisal Committee within sixty days, who will decide on the due diligence necessary including preparation of EIA and public consultations and the application shall be appraised accordingly for grant of environmental clearance.

8. Grant or Rejection of Prior Environmental Clearance (EC):

(i) The regulatory authority shall consider the recommendations of the EAC or SEAC concerned and convey its decision to the applicant within forty five days of the receipt of the recommendations of the Expert Appraisal Committee or State Level Expert Appraisal Committee concerned or in other words within one hundred and five days of the receipt of the final Environment Impact Assessment Report, and where Environment Impact Assessment is not required, within one hundred and five days of the receipt of the complete application with requisite documents, except as provided below.

(ii) The regulatory authority shall normally accept the recommendations of the Expert Appraisal Committee or State Level Expert Appraisal Committee concerned. In cases where it disagrees with the recommendations of the Expert Appraisal Committee or State Level Expert Appraisal Committee concerned, the regulatory authority shall request reconsideration by the Expert Appraisal Committee or State Level Expert Appraisal Committee concerned within forty five days of the receipt of the recommendations of the Expert Appraisal Committee or State Level Expert Appraisal Committee concerned while stating the reasons for the disagreement. An intimation of this decision shall be simultaneously conveyed to the applicant. The Expert Appraisal Committee or State Level Expert Appraisal Committee concerned, in turn, shall consider the observations of the regulatory authority and furnish its views on the same within a further period of sixty days. The decision of the regulatory authority after considering the views of the Expert Appraisal Committee or State Level Expert Appraisal Committee concerned shall be final and conveyed to the applicant by the regulatory authority concerned within the next thirty days.

(iii) In the event that the decision of the regulatory authority is not communicated to the applicant within the period specified in sub-paragraphs (i) or (ii) above, as applicable, the applicant may proceed as if the environment clearance sought for has been granted or denied by the regulatory authority in terms of the final recommendations of the Expert Appraisal Committee or State Level Expert Appraisal Committee concerned.

(iv) On expiry of the period specified for decision by the regulatory authority under paragraph (i) and (ii) above, as applicable, the decision of the regulatory authority, and the final recommendations of the Expert Appraisal Committee or State Level Expert Appraisal Committee concerned shall be public documents.

(v) Clearances from other regulatory bodies or authorities shall not be required prior to receipt of applications for prior environmental clearance of projects or activities, or screening, or scoping, or
appraisal, or decision by the regulatory authority concerned, unless any of these is sequentially dependent on such clearance either due to a requirement of law, or for necessary technical reasons.

(vi) Deliberate concealment and/or submission of false or misleading information or data which is material to screening or scoping or appraisal or decision on the application shall make the application liable for rejection, and cancellation of prior environmental clearance granted on that basis. Rejection of an application or cancellation of a prior environmental clearance already granted, on such ground, shall be decided by the regulatory authority, after giving a personal hearing to the applicant, and following the principles of natural justice.

9. Validity of Environmental Clearance (EC):

The “Validity of Environmental Clearance” is meant the period from which a prior environmental clearance is granted by the regulatory authority, or may be presumed by the applicant to have been granted under sub paragraph (iv) of paragraph 7 above, to the start of production operations by the project or activity, or completion of all construction operations in case of construction projects (item 8 of the Schedule), to which the application for prior environmental clearance refers. The prior environmental clearance granted for a project or activity shall be valid for a period of ten years in the case of River Valley projects (item 1(c) of the Schedule), project life as estimated by Expert Appraisal Committee or State Level Expert Appraisal Committee subject to a maximum of thirty years for mining projects and five years in the case of all other projects and activities. However, in the case of Area Development projects and Townships [item 8(b)], the validity period shall be limited only to such activities as may be the responsibility of the applicant as a developer. This period of validity may be extended by the regulatory authority concerned by a maximum period of five years provided an application is made to the regulatory authority by the applicant within the validity period, together with an updated Form 1, and Supplementary Form 1A, for Construction projects or activities (item 8 of the Schedule). In this regard the regulatory authority may also consult the Expert Appraisal Committee or State Level Expert Appraisal Committee as the case may be.

10. Post Environmental Clearance Monitoring:

(i) It shall be mandatory for the project management to submit half-yearly compliance reports in respect of the stipulated prior environmental clearance terms and conditions in hard and soft copies to the regulatory authority concerned, on 1st June and 1st December of each calendar year.

(ii) All such compliance reports submitted by the project management shall be public documents. Copies of the same shall be given to any person on application to the concerned regulatory authority. The latest such compliance report shall also be displayed on the web site of the concerned regulatory authority.

11. Transferability of Environmental Clearance (EC):

A prior environmental clearance granted for a specific project or activity to an applicant may be transferred during its validity to another legal person entitled to undertake the project or activity on application by the transferor, or by the transferee with a written “no objection” by the transferor, to, and by the regulatory authority concerned, on the same terms and conditions under which the prior environmental clearance was initially granted, and for the same validity period. No reference to the Expert Appraisal Committee or State Level Expert Appraisal Committee concerned is necessary in such cases.

12. Operation of EIA Notification, 1994, till disposal of pending cases:
From the date of final publication of this notification the Environment Impact Assessment (EIA) notification number S.O.60 (E) dated 27th January, 1994 is hereby superseded, except in suppression of the things done or omitted to be done before such suppression to the extent that in case of all or some types of applications made for prior environmental clearance and pending on the date of final publication of this notification, the Central Government may relax any one or all provisions of this notification except the list of the projects or activities requiring prior environmental clearance in Schedule I, or continue operation of some or all provisions of the said notification, for a period not exceeding one year from the date of issue of this notification.


(R.CHANDRAMOHAN)
JOINT SECRETARY TO THE GOVERNMENT OF INDIA
### LIST OF PROJECTS OR ACTIVITIES REQUIRING PRIOR ENVIRONMENTAL CLEARANCE

<table>
<thead>
<tr>
<th>Project or Activity</th>
<th>Category with threshold limit</th>
<th>Conditions if any</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>1</td>
<td>Mining, extraction of natural resources and power generation (for a specified production capacity)</td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1(a)</td>
<td>Mining of minerals</td>
<td>≥ 50 ha. of mining lease area</td>
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<tr>
<td></td>
<td></td>
<td>Asbestos mining irrespective of mining area</td>
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<tr>
<td></td>
<td></td>
<td>&lt;50 ha ≥ 5 ha of mining lease area.</td>
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<tr>
<td>1(b)</td>
<td>Offshore and onshore oil and gas exploration, development &amp; production</td>
<td>All projects</td>
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<td></td>
<td>Note</td>
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<td>Mineral prospecting (not involving drilling) are exempted provided the concession areas have got previous clearance for physical survey</td>
</tr>
<tr>
<td>1(c)</td>
<td>River Valley projects</td>
<td>(i) ≥ 50 MW hydroelectric power generation; (ii) ≥ 10,000 ha. of culturable command area</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(i) &lt; 50 MW ≥ 25 MW hydroelectric power generation; (ii) &lt; 10,000 ha. of culturable command area</td>
</tr>
<tr>
<td>1(d)</td>
<td>Thermal Power Plants</td>
<td>≥ 500 MW (coal/lignite/naptha &amp; gas based); ≥ 50 MW (Pet coke diesel and all other fuels -)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt; 500 MW (coal/lignite/naptha &amp; gas based); &lt;50 MW ≥ 5MW (Pet coke ,diesel and all other fuels )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>General Condition shall apply</td>
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<td>Note</td>
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<tr>
<td></td>
<td></td>
<td>Exploration Surveys (not involving drilling) are exempted provided the concession areas have got previous clearance for physical survey</td>
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<tr>
<td>(1)</td>
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<td>(3)</td>
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</tr>
<tr>
<td>1(e)</td>
<td>Nuclear power projects and processing of nuclear fuel</td>
<td>All projects</td>
</tr>
</tbody>
</table>

2

<table>
<thead>
<tr>
<th>Primary Processing</th>
</tr>
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<tbody>
<tr>
<td>2(a) Coal washeries</td>
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<td></td>
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</tbody>
</table>

2(b) Mineral beneficiation | ≥ 0.1 million ton/annum mineral throughput | < 0.1 million ton/annum mineral throughput | General Condition shall apply |
|                           | (Mining proposal with Mineral beneficiation shall be appraised together for grant of clearance) |
### 3. Materials Production

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
</table>
| 3(a) | Metallurgical industries (ferrous & non ferrous) | a) Primary metallurgical industry  
All projects  
b) Sponge iron manufacturing ≥ 200TPD | Sponge iron manufacturing <200TPD | General Condition shall apply for Sponge iron manufacturing |
|      |                          | c) Secondary metallurgical processing industry  
All toxic and heavy metal producing units ≥ 20,000 tonnes/annum | Secondary metallurgical processing industry  
i.) All toxic and heavy metal producing units <20,000 tonnes/annum  
ii.) All other non-toxic secondary metallurgical processing industries >5000 tonnes/annum  |
<p>| 3(b) | Cement plants           | ≥ 1.0 million tonnes/annum production capacity | &lt;1.0 million tonnes/annum production capacity. All Stand alone grinding units | General Condition shall apply |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Materials Processing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>4</td>
<td>Petroleum refining industry</td>
<td>All projects</td>
</tr>
<tr>
<td>4(b)</td>
<td>Coke oven plants</td>
<td>≥2,50,000 tonnes/annum -</td>
</tr>
<tr>
<td>4(c)</td>
<td>Asbestos milling and asbestos based products</td>
<td>All projects</td>
</tr>
<tr>
<td>4(d)</td>
<td>Chlor-alkali industry</td>
<td>≥300 TPD production capacity or a unit located outside the notified industrial area/ estate</td>
</tr>
<tr>
<td>4(e)</td>
<td>Soda ash Industry</td>
<td>All projects</td>
</tr>
<tr>
<td>4(f)</td>
<td>Leather/skin/hide processing industry</td>
<td>New projects outside the industrial area or expansion of existing units outside the industrial area</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Manufacturing/Fabrication</td>
</tr>
<tr>
<td>5(a)</td>
<td>Chemical fertilizers</td>
<td>All projects</td>
</tr>
<tr>
<td>5(b)</td>
<td>Pesticides industry and specific intermediates (excluding formulations)</td>
<td>All units producing technical grade pesticides</td>
</tr>
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</tr>
<tr>
<td>5(c)</td>
<td>Petro-chemical complexes (industries based on processing of petroleum fractions &amp; natural gas and/or reforming to aromatics)</td>
<td>All projects</td>
</tr>
<tr>
<td>5(d)</td>
<td>Manmade fibres manufacturing</td>
<td>Rayon</td>
</tr>
<tr>
<td>5(e)</td>
<td>Petrochemical based processing (processes other than cracking &amp; reformation and not covered under the complexes)</td>
<td>Located out side the notified industrial area/estate</td>
</tr>
<tr>
<td>5(f)</td>
<td>Synthetic organic chemicals industry (dyes &amp; dye intermediates; bulk drugs and intermediates excluding drug formulations; synthetic rubbers; basic organic chemicals, other synthetic organic chemicals and chemical intermediates)</td>
<td>Located out side the notified industrial area/estate</td>
</tr>
<tr>
<td>5(g)</td>
<td>Distilleries</td>
<td>(i) All Molasses based distilleries</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(ii) All Cane juice/ non-molasses based distilleries ≥30 KLD</td>
</tr>
<tr>
<td>5(h)</td>
<td>Integrated paint industry</td>
<td>-</td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
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<tr>
<td>------</td>
<td>---------------------------------------------------------------------</td>
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</tr>
<tr>
<td>5(i)</td>
<td>Pulp &amp; paper industry excluding manufacturing of paper from waste paper and manufacture of paper from ready pulp with out bleaching</td>
<td>Pulp manufacturing and Pulp &amp; Paper manufacturing industry</td>
</tr>
<tr>
<td>5(j)</td>
<td>Sugar Industry</td>
<td>-</td>
</tr>
<tr>
<td>5(k)</td>
<td>Induction/arc furnaces/cupola furnaces 5TPH or more</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Service Sectors</td>
<td></td>
</tr>
<tr>
<td>6(i)</td>
<td>Oil &amp; gas transportation pipeline (crude and refinery/petrochemical products), passing through national parks/sanctuaries/coral reefs/technologically sensitive areas including LNG Terminal</td>
<td>All projects</td>
</tr>
<tr>
<td>6(b)</td>
<td>Isolated storage &amp; handling of hazardous chemicals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(As per threshold planning quantity indicated in column 3 of schedule 2 &amp; 3 of MSIHC Rules 1989 amended 2000)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Physical Infrastructure including Environmental Services</td>
<td></td>
</tr>
<tr>
<td>7(a)</td>
<td>Air ports</td>
<td>All projects</td>
</tr>
<tr>
<td>7(b)</td>
<td>All ship breaking yards including ship breaking units</td>
<td>All projects</td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>7(c)</td>
<td>Industrial estates/ parks/ complexes/ areas, export processing Zones (EPZs), Special Economic Zones (SEZs), Biotech Parks, Leather Complexes.</td>
<td>If at least one industry in the proposed industrial estate falls under the Category A, entire industrial area shall be treated as Category A, irrespective of the area. Industrial estates with area greater than 500 ha. and housing at least one Category B industry.</td>
</tr>
<tr>
<td>7(d)</td>
<td>Common hazardous waste treatment, storage and disposal facilities (TSDFs)</td>
<td>All integrated facilities having incineration &amp; landfill or incineration alone</td>
</tr>
<tr>
<td>7(e)</td>
<td>Ports, Harbours</td>
<td>≥ 5 million TPA of cargo handling capacity (excluding fishing harbours)</td>
</tr>
<tr>
<td>7(f)</td>
<td>Highways</td>
<td>i) New National High ways; and</td>
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<tr>
<td>7(g)</td>
<td>Aerial ropeways</td>
<td>All projects</td>
</tr>
<tr>
<td>7(h)</td>
<td>Common Effluent Treatment Plants (CETPs)</td>
<td>All projects</td>
</tr>
<tr>
<td>7(i)</td>
<td>Common Municipal Solid Waste Management Facility (CMSWMF)</td>
<td>All projects</td>
</tr>
</tbody>
</table>

### Building /Construction projects/Area Development projects and Townships

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>8(a)</td>
<td>Building and Construction projects</td>
<td>≥20000 sq.mtrs and &lt;1,50,000 sq.mtrs. of built-up area</td>
<td>#(built up area for covered construction; in the case of facilities open to the sky, it will be the activity area)</td>
</tr>
<tr>
<td>8(b)</td>
<td>Townships and Area Development projects.</td>
<td>Covering an area ≥ 50 ha and or built up area ≥1,50,000 sq.mtrs</td>
<td>++All projects under Item 8(b) shall be appraised as Category B1</td>
</tr>
</tbody>
</table>

**Note:**

**General Condition (GC):**

Any project or activity specified in Category ‘B’ will be treated as Category A, if located in whole or in part within 10 km from the boundary of: (i) Protected Areas notified under the Wild Life (Protection) Act, 1972, (ii) Critically Polluted areas as notified by the Central Pollution Control Board from time to time, (iii) Notified Eco-sensitive areas, (iv) inter-State boundaries and international boundaries.

**Specific Condition (SC):**

If any Industrial Estate/Complex / Export processing Zones /Special Economic Zones/Biotech Parks / Leather Complex with homogeneous type of industries such as Items 4(d), 4(f), 5(e), 5(f), or those Industrial estates with pre-defined set of activities (not necessarily homogeneous, obtains prior environmental clearance, individual industries including proposed industrial housing within such estates/complexes will not be required to take prior environmental clearance, so long as the Terms and Conditions for the industrial estate/complex are complied with (Such estates/complexes must have a clearly identified management with the legal responsibility of ensuring adherence to the Terms and Conditions of prior environmental clearance, who may be held responsible for violation of the same throughout the life of the complex/estate).
APPENDIX I
(See paragraph – 6)
FORM 1

(I) Basic Information

Name of the Project:

Location / site alternatives under consideration:

Size of the Project: *

Expected cost of the project:

Contact Information:

Screening Category:

• Capacity corresponding to sectoral activity (such as production capacity for manufacturing, mining lease area and production capacity for mineral production, area for mineral exploration, length for linear transport infrastructure, generation capacity for power generation etc.).

(II) Activity

1. Construction, operation or decommissioning of the Project involving actions, which will cause physical changes in the locality (topography, land use, changes in water bodies, etc.)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Information/Checklist confirmation</th>
<th>Yes/No</th>
<th>Details thereof (with approximate quantities /rates, wherever possible) with source of information data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Permanent or temporary change in land use, land cover or topography including increase in intensity of land use (with respect to local land use plan)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td>Clearance of existing land, vegetation and buildings?</td>
<td></td>
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<tr>
<td>1.3</td>
<td>Creation of new land uses?</td>
<td></td>
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<tr>
<td>1.4</td>
<td>Pre-construction investigations e.g. bore houses, soil testing?</td>
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<tr>
<td>1.5</td>
<td>Construction works?</td>
<td></td>
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<tr>
<td>1.6</td>
<td>Demolition works?</td>
<td></td>
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<tr>
<td></td>
<td>Description</td>
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<tr>
<td>1.7</td>
<td>Temporary sites used for construction works or housing of construction workers?</td>
<td></td>
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<tr>
<td>1.8</td>
<td>Above ground buildings, structures or arthworks including linear structures, cut and fill or excavations</td>
<td></td>
<td></td>
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<tr>
<td>1.9</td>
<td>Underground works including mining or tunneling?</td>
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<tr>
<td>1.10</td>
<td>Reclamation works?</td>
<td></td>
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<tr>
<td>1.11</td>
<td>Dredging?</td>
<td></td>
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<tr>
<td>1.12</td>
<td>Offshore structures?</td>
<td></td>
<td></td>
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<tr>
<td>1.13</td>
<td>Production and manufacturing processes?</td>
<td></td>
<td></td>
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<tr>
<td>1.14</td>
<td>Facilities for storage of goods or materials?</td>
<td></td>
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<tr>
<td>1.15</td>
<td>Facilities for treatment or disposal of solid waste or liquid effluents?</td>
<td></td>
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<tr>
<td>1.16</td>
<td>Facilities for long term housing of operational workers?</td>
<td></td>
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<tr>
<td>1.17</td>
<td>New road, rail or sea traffic during construction or operation?</td>
<td></td>
<td></td>
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<tr>
<td>1.18</td>
<td>New road, rail, air waterborne or other transport infrastructure including new or altered routes and stations, ports, airports etc?</td>
<td></td>
<td></td>
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<tr>
<td>1.19</td>
<td>Closure or diversion of existing transport routes or infrastructure leading to changes in traffic ovements?</td>
<td></td>
<td></td>
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<tr>
<td>1.20</td>
<td>New or diverted transmission lines or pipelines?</td>
<td></td>
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<tr>
<td>1.21</td>
<td>Impoundment, damming, culverting, realignment or other changes to the hydrology of watercourses or aquifers?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.22</td>
<td>Stream crossings?</td>
<td></td>
<td></td>
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<tr>
<td>1.23</td>
<td>Abstraction or transfers of water form ground or surface waters?</td>
<td></td>
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<tr>
<td>1.24</td>
<td>Changes in water bodies or the land surface affecting drainage or run-off?</td>
<td></td>
<td></td>
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<tr>
<td>1.25</td>
<td>Transport of personnel or materials for construction, operation or decommissioning?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.26</td>
<td>Long-term dismantling or decommissioning or restoration works?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S.No.</td>
<td>Information/checklist confirmation</td>
<td>Yes/No</td>
<td>Details thereof (with approximate quantities /rates, wherever possible) with source of information data</td>
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<tr>
<td>-------</td>
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<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1.27</td>
<td>Ongoing activity during decommissioning which could have an impact on the environment?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.28</td>
<td>Influx of people to an area in either temporarily or permanently?</td>
<td></td>
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<tr>
<td>1.29</td>
<td>Introduction of alien species?</td>
<td></td>
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<tr>
<td>1.30</td>
<td>Loss of native species or genetic diversity?</td>
<td></td>
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<tr>
<td>1.31</td>
<td>Any other actions?</td>
<td></td>
<td></td>
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</tbody>
</table>

2. Use of Natural resources for construction or operation of the Project (such as land, water, materials or energy, especially any resources which are non-renewable or in short supply):

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Information/checklist confirmation</th>
<th>Yes/No</th>
<th>Details thereof (with approximate quantities /rates, wherever possible) with source of information data</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Land especially undeveloped or agricultural land (ha)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>Water (expected source &amp; competing users) unit: KLD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3</td>
<td>Minerals (MT)</td>
<td></td>
<td></td>
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<tr>
<td>2.4</td>
<td>Construction material – stone, aggregates, sand / soil (expected source – MT)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>Forests and timber (source – MT)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.6</td>
<td>Energy including electricity and fuels (source, competing users) Unit: fuel (MT), energy (MW)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.7</td>
<td>Any other natural resources (use appropriate standard units)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. Use, storage, transport, handling or production of substances or materials, which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Information/Checklist confirmation</th>
<th>Yes/No</th>
<th>Details thereof (with approximate quantities/rates, wherever possible) with source of information data</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Use of substances or materials, which are hazardous (as per MSIHC rules) to human health or the environment (flora, fauna, and water supplies)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>Changes in occurrence of disease or affect disease vectors (e.g. insect or water borne diseases)</td>
<td></td>
<td></td>
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<tr>
<td>3.3</td>
<td>Affect the welfare of people e.g. by changing living conditions?</td>
<td></td>
<td></td>
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<tr>
<td>3.4</td>
<td>Vulnerable groups of people who could be affected by the project e.g. hospital patients, children, the elderly etc.,</td>
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<tr>
<td>3.5</td>
<td>Any other causes</td>
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</tr>
</tbody>
</table>

4. Production of solid wastes during construction or operation or decommissioning (MT/month)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Information/Checklist confirmation</th>
<th>Yes/No</th>
<th>Details thereof (with approximate quantities/rates, wherever possible) with source of information data</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Spoil, overburden or mine wastes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.2</td>
<td>Municipal waste (domestic and or commercial wastes)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.3</td>
<td>Hazardous wastes (as per Hazardous Waste Management Rules)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Information/Checklist confirmation</td>
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<tr>
<td>4.4</td>
<td>Other industrial process wastes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td>Surplus product</td>
<td></td>
<td></td>
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<tr>
<td>4.6</td>
<td>Sewage sludge or other sludge from effluent treatment</td>
<td></td>
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</tr>
<tr>
<td>4.7</td>
<td>Construction or demolition wastes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.8</td>
<td>Redundant machinery or equipment</td>
<td></td>
<td></td>
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<tr>
<td>4.9</td>
<td>Contaminated soils or other materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.10</td>
<td>Agricultural wastes</td>
<td></td>
<td></td>
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<tr>
<td>4.11</td>
<td>Other solid wastes</td>
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<td></td>
</tr>
</tbody>
</table>

5. **Release of pollutants or any hazardous, toxic or noxious substances to air (Kg/hr)**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Information/Checklist confirmation</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>Emissions from combustion of fossil fuels from stationary or mobile sources</td>
</tr>
<tr>
<td>5.2</td>
<td>Emissions from production processes</td>
</tr>
<tr>
<td>5.3</td>
<td>Emissions from materials handling including storage or transport</td>
</tr>
<tr>
<td>5.4</td>
<td>Emissions from construction activities including plant and equipment</td>
</tr>
<tr>
<td>5.5</td>
<td>Dust or odours from handling of materials including construction materials, sewage and waste</td>
</tr>
</tbody>
</table>

Details thereof (with approximate quantities/rates, wherever possible) with source of information data
5.6 Emissions from incineration of waste

5.7 Emissions from burning of waste in open air (e.g. slash materials, construction debris)

5.8 Emissions from any other sources

6. Generation of Noise and Vibration, and Emissions of Light and Heat:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Information/Checklist confirmation</th>
<th>Yes/No</th>
<th>Details thereof (with approximate quantities/rates, wherever possible) with source of information data with source of information data</th>
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</thead>
<tbody>
<tr>
<td>6.1</td>
<td>From operation of equipment e.g. engines, ventilation plant, crushers</td>
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<tr>
<td>6.2</td>
<td>From industrial or similar processes</td>
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</tr>
<tr>
<td>6.3</td>
<td>From construction or demolition</td>
<td></td>
<td></td>
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<tr>
<td>6.4</td>
<td>From blasting or piling</td>
<td></td>
<td></td>
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<tr>
<td>6.5</td>
<td>From construction or operational traffic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.6</td>
<td>From lighting or cooling systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.7</td>
<td>From any other sources</td>
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<td></td>
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</tbody>
</table>
7. Risks of contamination of land or water from releases of pollutants into the ground or into sewers, surface waters, groundwater, coastal waters or the sea:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Information/Checklist confirmation</th>
<th>Yes/No</th>
<th>Details thereof (with approximate quantities/rates, wherever possible) with source of information data</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1</td>
<td>From handling, storage, use or spillage of hazardous materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.2</td>
<td>From discharge of sewage or other effluents to water or the land (expected mode and place of discharge)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.3</td>
<td>By deposition of pollutants emitted to air into the land or into water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.4</td>
<td>From any other sources</td>
<td></td>
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</tr>
<tr>
<td>7.5</td>
<td>Is there a risk of long term build up of pollutants in the environment from these sources?</td>
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</tbody>
</table>

8. Risk of accidents during construction or operation of the Project, which could affect human health or the environment

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Information/Checklist confirmation</th>
<th>Yes/No</th>
<th>Details thereof (with approximate quantities/rates, wherever possible) with source of information data</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1</td>
<td>From explosions, spillages, fires etc from storage, handling, use or production of hazardous substances</td>
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<td></td>
</tr>
<tr>
<td>8.2</td>
<td>From any other causes</td>
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<tr>
<td>8.3</td>
<td>Could the project be affected by natural disasters causing environmental damage (e.g. floods, earthquakes, landslides, cloudburst etc)?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9. Factors which should be considered (such as consequential development) which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Information/Checklist confirmation</th>
<th>Yes/No</th>
<th>Details thereof (with approximate quantities/rates, wherever possible) with source of information data</th>
</tr>
</thead>
</table>
| 9.1    | Lead to development of supporting activities, ancillary development or development stimulated by the project which could have impact on the environment e.g.:  
  - Supporting infrastructure (roads, power supply, waste or waste water treatment, etc.)  
  - housing development  
  - extractive industries  
  - supply industries  
  - other |        |                                                                                                   |
| 9.2    | Lead to after-use of the site, which could have an impact on the environment |        |                                                                                                   |
| 9.3    | Set a precedent for later developments |        |                                                                                                   |
| 9.4    | Have cumulative effects due to proximity to other existing or planned projects with similar effects |        |                                                                                                   |

(III) Environmental Sensitivity

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Areas</th>
<th>Name/Identity</th>
<th>Aerial distance (within 15 km.) Proposed project location boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Areas which are important or sensitive for ecological reasons - Wetlands, watercourses or other water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td></td>
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<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Inland, coastal, marine or underground waters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>State, National boundaries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Defence installations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Densely populated or built-up area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Areas occupied by sensitive man-made land uses (hospitals, schools, places of worship, community facilities)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Areas containing important, high quality or scarce resources (ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Areas already subjected to pollution or environmental damage. (those where existing legal environmental standards are exceeded)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Areas susceptible to natural hazard which could cause the project to present environmental problems (earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(IV). Proposed Terms of Reference for EIA studies
APPENDIX II

(See paragraph 6)

FORM-1 A (only for construction projects listed under item 8 of the Schedule)
CHECK LIST OF ENVIRONMENTAL IMPACTS
(Project proponents are required to provide full information and wherever necessary attach explanatory notes with the Form and submit along with proposed environmental management plan & monitoring programme)

1. LAND ENVIRONMENT

(Attach panoramic view of the project site and the vicinity)

1.1. Will the existing landuse get significantly altered from the project that is not consistent with the surroundings? (Proposed landuse must conform to the approved Master Plan / Development Plan of the area. Change of landuse if any and the statutory approval from the competent authority be submitted). Attach Maps of (i) site location, (ii) surrounding features of the proposed site (within 500 meters) and (iii)the site (indicating levels & contours) to appropriate scales. If not available attach only conceptual plans.

1.2. List out all the major project requirements in terms of the land area, built up area, water consumption, power requirement, connectivity, community facilities, parking needs etc.

1.3. What are the likely impacts of the proposed activity on the existing facilities adjacent to the proposed site? (Such as open spaces, community facilities, details of the existing landuse, disturbance to the local ecology).

1.4. Will there be any significant land disturbance resulting in erosion, subsidence & instability? (Details of soil type, slope analysis, vulnerability to subsidence, seismicity etc may be given).

1.5. Will the proposal involve alteration of natural drainage systems? (Give details on a contour map showing the natural drainage near the proposed project site)

1.6. What are the quantities of earthwork involved in the construction activity-cutting, filling, reclamation etc. (Give details of the quantities of earthwork involved, transport of fill materials from outside the site etc.)

1.7. Give details regarding water supply, waste handling etc during the construction period.

1.8. Will the low lying areas & wetlands get altered? (Provide details of how low lying and wetlands are getting modified from the proposed activity)

1.9. Whether construction debris & waste during construction cause health hazard? (Give quantities of various types of wastes generated during construction including the construction labour and the means of disposal)

2. WATER ENVIRONMENT

2.1. Give the total quantity of water requirement for the proposed project with the breakup of requirements for various uses. How will the water requirement met? State the sources & quantities and furnish a water balance statement.

2.2. What is the capacity (dependable flow or yield) of the proposed source of water?
2.3. What is the quality of water required, in case, the supply is not from a municipal source? (Provide physical, chemical, biological characteristics with class of water quality)

2.4. How much of the water requirement can be met from the recycling of treated wastewater? (Give the details of quantities, sources and usage)

2.5. Will there be diversion of water from other users? (Please assess the impacts of the project on other existing uses and quantities of consumption)

2.6. What is the incremental pollution load from wastewater generated from the proposed activity? (Give details of the quantities and composition of wastewater generated from the proposed activity)

2.7. Give details of the water requirements met from water harvesting? Furnish details of the facilities created.

2.8. What would be the impact of the land use changes occurring due to the proposed project on the runoff characteristics (quantitative as well as qualitative) of the area in the post construction phase on a long term basis? Would it aggravate the problems of flooding or water logging in any way?

2.9. What are the impacts of the proposal on the ground water? (Will there be tapping of ground water; give the details of ground water table, recharging capacity, and approvals obtained from competent authority, if any)

2.10. What precautions/measures are taken to prevent the run-off from construction activities polluting land & aquifers? (Give details of quantities and the measures taken to avoid the adverse impacts)

2.11. How is the storm water from within the site managed? (State the provisions made to avoid flooding of the area, details of the drainage facilities provided along with a site layout indication contour levels)

2.12. Will the deployment of construction labourers particularly in the peak period lead to unsanitary conditions around the project site (Justify with proper explanation)

2.13. What on-site facilities are provided for the collection, treatment & safe disposal of sewage? (Give details of the quantities of wastewater generation, treatment capacities with technology & facilities for recycling and disposal)

2.14. Give details of dual plumbing system if treated waste used is used for flushing of toilets or any other use.

3. **VEGETATION**

3.1. Is there any threat of the project to the biodiversity? (Give a description of the local ecosystem with it’s unique features, if any)

3.2. Will the construction involve extensive clearing or modification of vegetation? (Provide a detailed account of the trees & vegetation affected by the project)
3.3. What are the measures proposed to be taken to minimize the likely impacts on important site features (Give details of proposal for tree plantation, landscaping, creation of water bodies etc along with a layout plan to an appropriate scale)

4. FAUNA

4.1. Is there likely to be any displacement of fauna- both terrestrial and aquatic or creation of barriers for their movement? Provide the details.

4.2. Any direct or indirect impacts on the avifauna of the area? Provide details.

4.3. Prescribe measures such as corridors, fish ladders etc to mitigate adverse impacts on fauna

5. AIR ENVIRONMENT

5.1. Will the project increase atmospheric concentration of gases & result in heat islands? (Give details of background air quality levels with predicted values based on dispersion models taking into account the increased traffic generation as a result of the proposed constructions)

5.2. What are the impacts on generation of dust, smoke, odorous fumes or other hazardous gases? Give details in relation to all the meteorological parameters.

5.3. Will the proposal create shortage of parking space for vehicles? Furnish details of the present level of transport infrastructure and measures proposed for improvement including the traffic management at the entry & exit to the project site.

5.4. Provide details of the movement patterns with internal roads, bicycle tracks, pedestrian pathways, footpaths etc., with areas under each category.

5.5. Will there be significant increase in traffic noise & vibrations? Give details of the sources and the measures proposed for mitigation of the above.

5.6. What will be the impact of DG sets & other equipment on noise levels & vibration in & ambient air quality around the project site? Provide details.

6. AESTHETICS

6.1. Will the proposed constructions in any way result in the obstruction of a view, scenic amenity or landscapes? Are these considerations taken into account by the proponents?

6.2. Will there be any adverse impacts from new constructions on the existing structures? What are the considerations taken into account?

6.3. Whether there are any local considerations of urban form & urban design influencing the design criteria? They may be explicitly spelt out.

6.4. Are there any anthropological or archaeological sites or artefacts nearby? State if any other significant features in the vicinity of the proposed site have been considered.

7. SOCIO-ECONOMIC ASPECTS

7.1. Will the proposal result in any changes to the demographic structure of the local population? Provide the details.

7.2. Give details of the existing social infrastructure around the proposed project.
7.3. Will the project cause adverse effects on local communities, disturbance to sacred sites or other cultural values? What are the safeguards proposed?

8. BUILDING MATERIALS

8.1. May involve the use of building materials with high-embodied energy. Are the construction materials produced with energy efficient processes? (Give details of energy conservation measures in the selection of building materials and their energy efficiency)

8.2. Transport and handling of materials during construction may result in pollution, noise & public nuisance. What measures are taken to minimize the impacts?

8.3. Are recycled materials used in roads and structures? State the extent of savings achieved?

8.4. Give details of the methods of collection, segregation & disposal of the garbage generated during the operation phases of the project.

9. ENERGY CONSERVATION

9.1. Give details of the power requirements, source of supply, backup source etc. What is the energy consumption assumed per square foot of built-up area? How have you tried to minimize energy consumption?

9.2. What type of, and capacity of, power back-up to you plan to provide?

9.3. What are the characteristics of the glass you plan to use? Provide specifications of its characteristics related to both short wave and long wave radiation?

9.4. What passive solar architectural features are being used in the building? Illustrate the applications made in the proposed project.

9.5. Does the layout of streets & buildings maximise the potential for solar energy devices? Have you considered the use of street lighting, emergency lighting and solar hot water systems for use in the building complex? Substantiate with details.

9.6. Is shading effectively used to reduce cooling/heating loads? What principles have been used to maximize the shading of Walls on the East and the West and the Roof? How much energy saving has been effected?


9.8. What are the likely effects of the building activity in altering the micro-climates? Provide a self assessment on the likely impacts of the proposed construction on creation of heat island & inversion effects?
9.9. What are the thermal characteristics of the building envelope? (a) roof; (b) external walls; and (c) fenestration? Give details of the material used and the U-values or the R values of the individual components.

9.10. What precautions & safety measures are proposed against fire hazards? Furnish details of emergency plans.

9.11. If you are using glass as wall material provides details and specifications including emissivity and thermal characteristics.

9.12. What is the rate of air infiltration into the building? Provide details of how you are mitigating the effects of infiltration.

9.13. To what extent the non-conventional energy technologies are utilised in the overall energy consumption? Provide details of the renewable energy technologies used.

10. Environment Management Plan

The Environment Management Plan would consist of all mitigation measures for each item wise activity to be undertaken during the construction, operation and the entire life cycle to minimize adverse environmental impacts as a result of the activities of the project. It would also delineate the environmental monitoring plan for compliance of various environmental regulations. It will state the steps to be taken in case of emergency such as accidents at the site including fire.
APPENDIX III

(See paragraph 7)

GENERIC STRUCTURE OF ENVIRONMENTAL IMPACT ASSESSMENT DOCUMENT

<table>
<thead>
<tr>
<th>S.NO</th>
<th>EIA STRUCTURE</th>
<th>CONTENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction</td>
<td>• Purpose of the report</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Identification of project &amp; project proponent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Brief description of nature, size, location of the project and its importance to the country, region</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Scope of the study – details of regulatory scoping carried out (As per Terms of Reference)</td>
</tr>
<tr>
<td>2.</td>
<td>Project Description</td>
<td>• Condensed description of those aspects of the project (based on project feasibility study), likely to cause environmental effects. Details should be provided to give clear picture of the following:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Type of project</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Need for the project</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Location (maps showing general location, specific location, project boundary &amp; project site layout)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Size or magnitude of operation (incl. Associated activities required by or for the project)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Proposed schedule for approval and implementation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Technology and process description</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Project description. Including drawings showing project layout, components of project etc. Schematic representations of the feasibility drawings which give information important for EIA purpose</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Description of mitigation measures incorporated into the project to meet environmental standards, environmental operating conditions, or other EIA requirements (as required by the scope)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Assessment of New &amp; untested technology for the risk of technological failure</td>
</tr>
</tbody>
</table>
| 3. | Description of the Environment | • Study area, period, components & methodology  
| | | • Establishment of baseline for valued environmental components, as identified in the scope  
| | | • Base maps of all environmental components  
| 4. | Anticipated Environmental Impacts & Mitigation Measures | • Details of Investigated Environmental impacts due to project location, possible accidents, project design, project construction, regular operations, final decommissioning or rehabilitation of a completed project  
| | | • Measures for minimizing and / or offsetting adverse impacts identified  
| | | • Irreversible and Irretrievable commitments of environmental components  
| | | • Assessment of significance of impacts (Criteria for determining significance, Assigning significance)  
| | | • Mitigation measures  
| 5. | Analysis of Alternatives (Technology & Site) | • In case, the scoping exercise results in need for alternatives:  
| | | • Description of each alternative  
| | | • Summary of adverse impacts of each alternative  
| | | • Mitigation measures proposed for each alternative and  
| | | • Selection of alternative  
| 6. | Environmental Monitoring Program | • Technical aspects of monitoring the effectiveness of mitigation measures (incl. Measurement methodologies, frequency, location, data analysis, reporting schedules, emergency procedures, detailed budget & procurement schedules)  
| 7. | Additional Studies | • Public Consultation  
| | | • Risk assessment  
| | | • Social Impact Assessment. R&R Action Plans  
| 8. | Project Benefits | • Improvements in the physical infrastructure  
| | | • Improvements in the social infrastructure  
| | | • Employment potential –skilled; semi-skilled and unskilled  
| | | • Other tangible benefits  
<p>| 9. | Environmental Benefit Analysis Cost | If recommended at the Scoping stage |</p>
<table>
<thead>
<tr>
<th></th>
<th>EMP</th>
<th>Description of the administrative aspects of ensuring that mitigative measures are implemented and their effectiveness monitored, after approval of the EIA</th>
</tr>
</thead>
</table>
|11| Summary & Conclusion (This will constitute the summary of the EIA Report) | • Overall justification for implementation of the project  
• Explanation of how, adverse effects have been mitigated |
|12| Disclosure of Consultants engaged                                 | • The names of the Consultants engaged with their brief resume and nature of Consultancy rendered |
APPENDIX III A
(See paragraph 7)

CONTENTS OF SUMMARY ENVIRONMENTAL IMPACT ASSESSMENT

The Summary EIA shall be a summary of the full EIA Report condensed to ten A-4 size pages at the maximum. It should necessarily cover in brief the following Chapters of the full EIA Report:

1. Project Description
2. Description of the Environment
3. Anticipated Environmental impacts and mitigation measures
4. Environmental Monitoring Programme
5. Additional Studies
6. Project Benefits
7. Environment Management Plan
APPENDIX IV  
(See paragraph 7)  

PROCEDURE FOR CONDUCT OF PUBLIC HEARING  

1.0 The Public Hearing shall be arranged in a systematic, time bound and transparent manner ensuring widest possible public participation at the project site(s) or in its close proximity District -wise, by the concerned State Pollution Control Board (SPCB) or the Union Territory Pollution Control Committee (UTPCC).  

2.0 The Process:  

2.1 The Applicant shall make a request through a simple letter to the Member Secretary of the SPCB or Union Territory Pollution Control Committee, in whose jurisdiction the project is located, to arrange the public hearing within the prescribed statutory period. In case the project site is extending beyond a State or Union Territory, the public hearing is mandated in each State or Union Territory in which the project is sited and the Applicant shall make separate requests to each concerned SPCB or UTPCC for holding the public hearing as per this procedure.  

2.2 The Applicant shall enclose with the letter of request, at least 10 hard copies and an equivalent number of soft (electronic) copies of the draft EIA Report with the generic structure given in Appendix III including the Summary Environment Impact Assessment report in English and in the local language, prepared strictly in accordance with the Terms of Reference communicated after Scoping (Stage-2). Simultaneously the applicant shall arrange to forward copies, one hard and one soft, of the above draft EIA Report along with the Summary EIA report to the Ministry of Environment and Forests and to the following authorities or offices, within whose jurisdiction the project will be located:  

(a) District Magistrate/s  
(b) Zila Parishad or Municipal Corporation  
(c) District Industries Office  
(d) Concerned Regional Office of the Ministry of Environment and Forests  

2.3 On receiving the draft Environmental Impact Assessment report, the above-mentioned authorities except the MoEF, shall arrange to widely publicize it within their respective jurisdictions requesting the interested persons to send their comments to the concerned regulatory authorities. They shall also make available the draft EIA Report for inspection electronically or otherwise to the public during normal office hours till the Public Hearing is over. The Ministry of Environment and Forests shall promptly display the Summary of the draft Environmental Impact Assessment report on its website, and also make the full draft EIA available for reference at a notified place during normal office hours in the Ministry at Delhi.  

2.4 The SPCB or UTPCC concerned shall also make similar arrangements for giving publicity about the project within the State/Union Territory and make available the Summary of the draft Environmental Impact Assessment report (Appendix III A) for inspection in select offices or public libraries or panchayats etc. They shall also additionally make available a copy of the draft Environmental Impact Assessment report to the above five authorities/offices viz, Ministry of Environment and Forests, District Magistrate etc.
3.0 Notice of Public Hearing:

3.1 The Member-Secretary of the concerned SPCB or UTPCC shall finalize the date, time and exact venue for the conduct of public hearing within 7(seven) days of the date of receipt of the draft Environmental Impact Assessment report from the project proponent, and advertise the same in one major National Daily and one Regional vernacular Daily. A minimum notice period of 30(thirty) days shall be provided to the public for furnishing their responses;

3.2 The advertisement shall also inform the public about the places or offices where the public could access the draft Environmental Impact Assessment report and the Summary Environmental Impact Assessment report before the public hearing.

3.3 No postponement of the date, time, venue of the public hearing shall be undertaken, unless some untoward emergency situation occurs and only on the recommendation of the concerned District Magistrate the postponement shall be notified to the public through the same National and Regional vernacular dailies and also prominently displayed at all the identified offices by the concerned SPCB or Union Territory Pollution Control Committee;

3.4 In the above exceptional circumstances fresh date, time and venue for the public consultation shall be decided by the Member –Secretary of the concerned SPCB or UTPCC only in consultation with the District Magistrate and notified afresh as per procedure under 3.1 above.

4.0 The Panel

4.1 The District Magistrate or his or her representative not below the rank of an Additional District Magistrate assisted by a representative of SPCB or UTPCC, shall supervise and preside over the entire public hearing process.

5.0 Videography

5.1 The SPCB or UTPCC shall arrange to video film the entire proceedings. A copy of the videotape or a CD shall be enclosed with the public hearing proceedings while forwarding it to the Regulatory Authority concerned.

6.0 Proceedings

6.1 The attendance of all those who are present at the venue shall be noted and annexed with the final proceedings.

6.2 There shall be no quorum required for attendance for starting the proceedings.

6.3 A representative of the applicant shall initiate the proceedings with a presentation on the project and the Summary EIA report.

6.4 Every person present at the venue shall be granted the opportunity to seek information or clarifications on the project from the Applicant. The summary of the public hearing proceedings accurately reflecting all the views and concerns expressed shall be recorded by the representative of the SPCB or UTPCC and read over to the audience at the end of the proceedings explaining the contents in the vernacular language and the agreed minutes shall be signed by the District Magistrate or his or her representative on the same day and forwarded to the SPCB/UTPCC concerned.
6.5 A Statement of the issues raised by the public and the comments of the Applicant shall also be prepared in the local language and in English and annexed to the proceedings.

6.6 The proceedings of the public hearing shall be conspicuously displayed at the office of the Panchyats within whose jurisdiction the project is located, office of the concerned Zila Parishad, District Magistrate, and the SPCB or UTPCC. The SPCB or UTPCC shall also display the proceedings on its website for general information. Comments, if any, on the proceedings which may be sent directly to the concerned regulatory authorities and the Applicant concerned.

7.0 **Time period for completion of public hearing**

7.1 The public hearing shall be completed within a period of 45 (forty five) days from date of receipt of the request letter from the Applicant. Therefore the SPCB or UTPCC concerned shall send the public hearing proceedings to the concerned regulatory authority within 8(eight) days of the completion of the public hearing. The applicant may also directly forward a copy of the approved public hearing proceedings to the regulatory authority concerned along with the final Environmental Impact Assessment report or supplementary report to the draft EIA report prepared after the public hearing and public consultations.

7.2 If the SPCB or UTPCC fails to hold the public hearing within the stipulated 45(forty five) days, the Central Government in Ministry of Environment and Forests for Category ‘A’ project or activity and the State Government or Union Territory Administration for Category ‘B’ project or activity at the request of the SEIAA, shall engage any other agency or authority to complete the process, as per procedure laid down in this notification.
APPENDIX –V
(See paragraph 7)

PROCEDURE PRESCRIBED FOR APPRAISAL

1. The applicant shall apply to the concerned regulatory authority through a simple communication enclosing the following documents where public consultations are mandatory:

- Final Environment Impact Assessment Report [20(twenty) hard copies and 1 (one) soft copy]
- A copy of the video tape or CD of the public hearing proceedings
- A copy of final layout plan (20 copies)
- A copy of the project feasibility report (1 copy)

2. The Final EIA Report and the other relevant documents submitted by the applicant shall be scrutinized in office within 30 days from the date of its receipt by the concerned Regulatory Authority strictly with reference to the TOR and the inadequacies noted shall be communicated electronically or otherwise in a single set to the Members of the EAC /SEAC enclosing a copy each of the Final EIA Report including the public hearing proceedings and other public responses received along with a copy of Form -1or Form 1A and scheduled date of the EAC /SEAC meeting for considering the proposal.

3. Where a public consultation is not mandatory and therefore a formal EIA study is not required, the appraisal shall be made on the basis of the prescribed application Form 1 and a pre-feasibility report in the case of all projects and activities other than Item 8 of the Schedule. In the case of Item 8 of the Schedule, considering its unique project cycle, the EAC or SEAC concerned shall appraise all Category B projects or activities on the basis of Form 1, Form 1A and the conceptual plan and stipulate the conditions for environmental clearance. As and when the applicant submits the approved scheme/building plans complying with the stipulated environmental clearance conditions with all other necessary statutory approvals, the EAC /SEAC shall recommend the grant of environmental clearance to the competent authority.

4. Every application shall be placed before the EAC /SEAC and its appraisal completed within 60 days of its receipt with requisite documents/details in the prescribed manner.

5. The applicant shall be informed at least 15 (fifteen) days prior to the scheduled date of the EAC /SEAC meeting for considering the project proposal.

6. The minutes of the EAC /SEAC meeting shall be finalised within 5 working days of the meeting and displayed on the website of the concerned regulatory authority. In case the project or activity is recommended for grant of EC, then the minutes shall clearly list out the specific environmental safeguards and conditions. In case the recommendations are for rejection, the reasons for the same shall also be explicitly stated.
APPENDIX VI
(See paragraph 5)
COMPOSITION OF THE SECTOR/PROJECT SPECIFIC EXPERT APPRAISAL COMMITTEE (EAC) FOR CATEGORY A PROJECTS AND THE STATE/UT LEVEL EXPERT APPRAISAL COMMITTEES (SEACs) FOR CATEGORY B PROJECTS TO BE CONSTITUTED BY THE CENTRAL GOVERNMENT

1. The Expert Appraisal Committees (EAC(s) and the State/UT Level Expert Appraisal Committees (SEACs) shall consist of only professionals and experts fulfilling the following eligibility criteria:

Professional: The person should have at least (i) 5 years of formal University training in the concerned discipline leading to a MA/MSc Degree, or (ii) in case of Engineering /Technology/Architecture disciplines, 4 years formal training in a professional training course together with prescribed practical training in the field leading to a B.Tech/B.E./B.Arch. Degree, or (iii) Other professional degree (e.g. Law) involving a total of 5 years of formal University training and prescribed practical training, or (iv) Prescribed apprenticeship/article ship and pass examinations conducted by the concerned professional association (e.g. Chartered Accountancy ) or (v) a University degree, followed by 2 years of formal training in a University or Service Academy (e.g. MBA/IAS/IFS). In selecting the individual professionals, experience gained by them in their respective fields will be taken note of.

Expert: A professional fulfilling the above eligibility criteria with at least 15 years of relevant experience in the field, or with an advanced degree (e.g. Ph.D.) in a concerned field and at least 10 years of relevant experience.

Age: Below 70 years. However, in the event of the non-availability of /paucity of experts in a given field, the maximum age of a member of the Expert Appraisal Committee may be allowed up to 75 years.

2. The Members of the EAC shall be Experts with the requisite expertise and experience in the following fields/disciplines. In the event that persons fulfilling the criteria of “Experts” are not available, Professionals in the same field with sufficient experience may be considered:

- **Environment Quality Experts:** Experts in measurement/monitoring, analysis and interpretation of data in relation to environmental quality

- **Sectoral Experts in Project Management:** Experts in Project Management or Management of Process/Operations/Facilities in the relevant sectors.

- **Environmental Impact Assessment Process Experts:** Experts in conducting and carrying out Environmental Impact Assessments (EIAs) and preparation of Environmental Management Plans (EMPs) and other Management plans and who have wide expertise and knowledge of predictive techniques and tools used in the EIA process

- **Risk Assessment Experts**

- **Life Science Experts in floral and faunal management**

- **Forestry and Wildlife Experts**

- **Environmental Economics Expert with experience in project appraisal**
3. The Membership of the EAC shall not exceed 15 (fifteen) regular Members. However the Chairperson may co-opt an expert as a Member in a relevant field for a particular meeting of the Committee.

4. The Chairperson shall be an outstanding and experienced environmental policy expert or expert in management or public administration with wide experience in the relevant development sector.

5. The Chairperson shall nominate one of the Members as the Vice Chairperson who shall preside over the EAC in the absence of the Chairman/Chairperson.

6. A representative of the Ministry of Environment and Forests shall assist the Committee as its Secretary.

7. The maximum tenure of a Member, including Chairperson, shall be for 2 (two) terms of 3 (three) years each.

8. The Chairman/Members may not be removed prior to expiry of the tenure without cause and proper enquiry.
CO₂ Baseline Database for the Indian Power Sector

User Guide

Version 3.0

December 2007

Government of India
Ministry of Power
Central Electricity Authority
Sewa Bhawan, R.K.Puram,
New Delhi-66
Revision History of the Database

<table>
<thead>
<tr>
<th>Version No.</th>
<th>Date of Publication</th>
<th>Main Revisions Compared to Previous Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 Draft for Stakeholder Consultation</td>
<td>4th October 2006</td>
<td>–</td>
</tr>
</tbody>
</table>
| 1.0 | November 2006 | - Added data on 10 stations which had been in exclusion worksheet of draft database  
- Adjusted values to latest IPCC Guidance (IPCC 2006 Guidelines for National Greenhouse Gas Inventories) where IPCC defaults are used |
| 1.1 | December 2006 | - Adjusted fuel emission factor of lignite to be in line with Initial National Communication figures |
| 2.0 | June 2007 | - Added data for FY 2005-06, including new stations and units commissioned during 2005-06  
Retroactive changes to data for FY 2000-01 to 2004-05:  
- Introduced differentiated default heat rates for open- vs. combined-cycle stations (gas- and diesel-fired; only applicable where fuel consumption was not provided by station)  
- Refined approximation of unit-level generation where not provided by station, by taking into account day of commissioning (for build margin)  
- Revised fuel consumption for some stations where data became available |
| 3.0 | December 2007 | - Added data for FY 2006-07, including new stations and units commissioned during 2006-07  
- Adapted calculations and User Guide to ensure consistency with new CDM methodologies: ACM0002 Version 07, and Tool to Calculate the Emission Factor for an Electricity System (Version 01; EB 35 Annex 12) |

Expert Team Contributing to the Database

Central Electricity Authority

Mr. V. S. Verma, Member(Planning)  
Mr. D.S. Arora, Chief Engineer (C&E)  
Mr. Praveen Gupta, Deputy Director (C&E)  
Mr. Rajesh Kumar, Assistant Director (C&E)

Factor Consulting + Management AG

Mr. Urs Brodmann, Managing Partner  
Mr. Benjamin Stocker, Project Assistant  
Mr. Till Danckwardt, Project Manager
Foreword

The Clean Development Mechanism (CDM) gives an opportunity to developing countries in achieving their sustainable development objective, besides providing opportunity to introduce new and efficient technologies.

India has high potential for CDM projects, particularly in the Power Sector. With large resources of technical power we can develop innovative CDM projects in energy efficiency and conservation including R&M schemes for power generation and adopt new and renewable technologies.

The last version of CO\textsubscript{2} Baseline Database for the Indian Power Sector (Version 2.0) containing data for the year 2005-06 was published in June 2007. The Baseline Database has benefited all prospective CDM project developers to estimate the amount of Certified Emission Reduction (CERs). This publication is the version 3 of the CO\textsubscript{2} Baseline Database for Indian Power Sector containing data for the year 2006-07.

With the efforts taken by Government of India, Ministry of Power, the average CO\textsubscript{2} emission rate has declined from 0.85 t CO\textsubscript{2}/MWh in the year 2002-03 to 0.80 t CO\textsubscript{2}/MWh in the year 2006-07. All efforts are being made to improve the efficiency of power generation, transmission and distribution.

The team of CEA officers headed by Shri D.S. Arora, Chief Engineer (Conservation and Efficiency Division) has done a commendable job under the able guidance of Shri V.S. Verma, Member (Planning), CEA. We are thankful to Dr A. Kaupp, Smt. Pamposh Bhat, Director, GTZ, Climate Change Unit, Mr Urs Brodmann and Dr Axel Michaelowa, GTZ-CDM-India consultants, who provided guidance and gave useful input to the team of CEA engineers.

New Delhi
December 2007

(Rakesh Nath) Chairperson
Preface

Developing countries like India do not fall in the Annex I category of the Kyoto Protocol but India has a strong commitment to reduce its emissions of greenhouse gases and mitigate climate change. Ministry of Power has accorded high priority to the CDM projects in the power sector. The number of Indian CDM projects registered with the CDM Executive Board is a good indication to India’s commitment towards protection of the Global Environment. Till date, 289 Indian projects have been registered with the Executive Board. Host country approval to more than 650 projects has also been accorded by National CDM Authority established under the Ministry of Environment and Forest.

CEA undertook the study relating to the baseline data for the Power sector in the country with a view to obtaining uniformity of approach in the country towards a common objective. Detailed information was collected from all power generating stations. The database has been updated for the year 2006-07 and is proposed to be updated on annual basis. The user guide has been prepared to enable project developers to use these baseline emission data effectively for CDM benefits. The emission factors have been calculated based on the new tool “Tool to calculate the emission factors for an electricity system” published by CDM Executive Board.

The baseline emission database is useful not only to power sector projects but to all the industrial projects which are improving the efficiency of the process thus saving electricity. Indian industries have taken a lead in development of large number of CDM projects though of smaller size. The development of the baseline database would encourage project developers to pose large CDM projects in hydro power generation, Renovation and Modernisation, adoption of super critical technologies in power generation etc. In fact, many CDM projects have been registered based on the emission factors published by Central Electricity Authority.

I appreciate the efforts put in by all the officers of Central Electricity Authority and GTZ-CDM-India in bringing up the updated data for the year 2005-06. This is a unique effort made by our country for the first time in the world.

I am confident, that baseline carbon dioxide emissions, developed by CEA would provide direction to help industry to come up with new CDM project concepts to further consolidate and reinforce our effort to save the global environment.

New Delhi
December 2007

(V.S. Verma)  
Member (Planning)
Acknowledgement

India has the distinction of maximum number of registered CDM projects by the CDM Executive Board and I am confident that more and more CDM projects would be got registered in future. Various CDM projects had been facing the difficulties in establishing the baseline emissions for calculating authentic Carbon Emission Reductions (CERs). Accordingly, Central Electricity Authority took the initiative to publish the Carbon di-oxide baseline database for the Indian Power Sector to assist CDM project developers for speedy approval of their CDM projects.

The present publication is the result of the trust Ministry of Power, Government of India, posed in Central Electricity Authority and entrusting us with the responsibility of establishing the Baseline carbon dioxide emissions from the Indian power sector. I am thankful to Shri Anil Razdan, Secretary (Power) and Shri Anil Kumar, Additional Secretary, Ministry of Power who provided whole hearted support and encouragement in developing of Baseline database.

I am grateful to Shri Rakesh Nath, Chairperson, CEA and Shri V.S. Verma, Member(Planning), CEA for enlightening us with their valuable views and guidance all along in developing the Baseline carbon dioxide emissions.

I sincerely thank Dr A. Kaupp, Manager, IGEN, the CDM-India consultants Mr Urs Brodmann and Mr Benjamin stocker of Factor Consulting, Dr Axel Michaelowa of Perspectives Climate Change and Ms Pamposh Bhat, GTZ- Climate Change Unit for providing their expert views in establishing the baseline emissions.

Central Electricity Authority extends its grateful thanks to all the power sector utilities/organizations and their officers for active co-operation and support rendered by them in timely furnishing the requisite data to bring out this updated document.

I acknowledge with deep appreciation, the hard work and efforts put in by Shri Praveen Gupta, Deputy Director and other officers of Conservation and Efficiency Division, CEA in compilation of data and evolving the Baseline carbon dioxide emissions from the power sector. I also thank officers of Thermal, GO&D and Hydro wings of CEA for their contribution in completing this study and providing necessary data and its validation.

All efforts have been made to project the latest data on energy generation to keep high integrity of the Baseline. Any omission in this could be due to oversight of the undersigned. Suggestion from the project developers and consultants are welcome to avoid such omissions in future.

New Delhi
December 2007

(D.S. Arora)
Chief Engineer (C&E)
Message

The Kyoto Protocol’s Clean Development Mechanism is expected to result in emission reductions equivalent to over 2 billion tonnes of CO2 to the end of 2012. CDM will bring in investments in developing projects that reduce Greenhouse Gases. CDM project implementers earn certified emission reduction units which are bought by countries with emission reduction commitments under the Kyoto protocol. CDM in India can lead the way to a low carbon economy.

The Indo German Energy Programme, a technical cooperation of the Governments of India and Germany jointly implemented by GIZ together with partners Central Electricity Authority and the Bureau of Energy Efficiency under the Ministry of Power has undertaken the task of Carbon market development in India since 2003. We have together achieved many landmarks one among which is “Development of the Baseline Data for CDM Projects in the Power Sector”. This valuable tool for CDM project developers reduces transaction costs and increases accuracy and consistency of emission reduction calculations.

This baseline was presented to the public as an outstanding example of a national effort to support CDM project developers at the UNFCCC 12th Conference of Parties in Nairobi 2006. We congratulate our partner in the initiative Central Electricity Authority Officials and Personnel as well as our international consultants for their tireless efforts and commitment to the cause.

Dr. Albrecht Kaupp Pamposh Bhat
Manager Director
Indo German Energy Programme GTZ- Climate Change Unit

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Summary

Since the emergence of the Kyoto Protocol and its Clean Development Mechanism (CDM), energy projects lowering the carbon intensity of the electricity grid can generate additional revenues from carbon credits. Methodologies approved by the CDM Executive Board have to be applied to determine the resulting emission reductions, using the “baseline” CO$_2$ emission factor of the relevant geographical area.

In order to facilitate adoption of authentic baseline emissions data and also to ensure uniformity in the calculations of CO$_2$ emission reductions by CDM project developers, Central Electricity Authority (CEA), in cooperation with GTZ CDM-India, has compiled a database containing the necessary data on CO$_2$ emissions for all grid-connected power stations in India. The database currently covers the seven fiscal years 2000-01 to 2006-07. CEA intends to update the database at the end of each financial year.

The Indian electricity system is divided into five regional grids, viz. Northern, Eastern, Western, Southern, and North-Eastern. Each grid covers several states. As the regional grids are interconnected, there is inter-state and inter-regional exchange. A small power exchange also takes place with the neighbouring countries Bhutan and Nepal. For each of the five regions, the main emission factors are calculated in accordance with the relevant CDM methodologies.

The prevailing baseline emissions based on the data for the Fiscal Year 2006-07 is shown in Table S-1. The calculations are based on generation, fuel consumption and fuel quality data obtained from the power stations. Typical standard data were used only for a few stations where information was not available from the station. Inter-regional and cross-border electricity transfers were also taken into account for calculating the CO2 emission baseline.

Table S-1: Weighted average emission factor, simple operating margin (OM), build margin (BM) and combined margin (CM) of all Indian regional grids for FY 2006-07 (inter-regional and cross-border electricity transfers included), in tCO$_2$/MWh

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>OM</th>
<th>BM</th>
<th>CM</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>0.74</td>
<td>1.00</td>
<td>0.63</td>
<td>0.81</td>
</tr>
<tr>
<td>East</td>
<td>1.00</td>
<td>1.09</td>
<td>0.93</td>
<td>1.01</td>
</tr>
<tr>
<td>South</td>
<td>0.72</td>
<td>1.00</td>
<td>0.71</td>
<td>0.85</td>
</tr>
<tr>
<td>West</td>
<td>0.86</td>
<td>0.99</td>
<td>0.59</td>
<td>0.79</td>
</tr>
<tr>
<td>North-East</td>
<td>0.40</td>
<td>0.70</td>
<td>0.23</td>
<td>0.46</td>
</tr>
<tr>
<td>India</td>
<td>0.80</td>
<td>1.01</td>
<td>0.68</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Average is the average emission of all stations in the grid, weighted by net generation.
OM is the average emission from all stations excluding the low cost/must run sources.
BM is the average emission of the 20% (by net generation) most recent capacity addition in the grid.
CM is a weighted average of the OM and BM (here weighted 50 : 50).
1 Background and Objective

Purpose of the CO₂ Database

The Clean Development Mechanism (CDM) under the Kyoto Protocol to United Nations Framework Convention on Climate Change (UNFCCC) provides an opportunity for the Indian power sector to earn revenue through the reduction of greenhouse gas emissions (GHG), particularly carbon dioxide (CO₂). India has tremendous potential for CDM projects. Power generation based on higher efficiency technologies such as supercritical technology, integrated gasification combined cycle, and renovation and modernisation of old thermal power plants, co-generation along with renewable energy sources are some of potential candidates for CDM in the power sector. Energy efficiency and conservation projects also present themselves as eligible CDM projects, as these would also result in energy savings and displace associated CO₂ emissions which otherwise would be produced by grid-connected power stations.

CDM appears to be a promising mechanism but many implementation issues are yet to be addressed like fixing of baseline etc. A need was, therefore, felt to work out an acceptable and realistic baseline of CO₂ emissions for the various regions of the country to enable the prospective project developers to pose their projects for approval by the CDM Executive Board. Central Electricity Authority (CEA), accordingly took up in cooperation with GTZ CDM-India, to compile a database for all grid-connected power stations in India. The purpose of the database is to establish authentic and consistent quantification of the CO₂ emission baseline which can be readily used by CDM project developers in the Indian power sector. This would enhance the acceptability of Indian projects and would also expedite the clearance/approval process. India is the first country in the world to have ventured to take up the complex task of developing such an official baseline for the power sector as a whole.

The baseline emissions for all the five regional grids are given in Section 5 (Results) of this User Guide. The complete updated CO₂ Database (Microsoft Excel File) and this User Guide along with all previous versions are available on the website of Central Electricity Authority: www.cea.nic.in.

The purpose of this User Guide is to provide a ready reference to the underlying calculations and assumptions used in the CO₂ database and to summarise the key results.

Official Status of the Database

The database is an official publication of the Government of India for the purpose of CDM baselines. It is based on the most recent data available to the Central Electricity Authority.
Consistency of the Database with CDM Methodologies

Under the CDM, emission reductions must be quantified using an approved methodology. Key examples of such methodologies include AMS-I.D and ACM0002 for grid-connected power generation from renewable sources in small and large-scale projects, respectively. The latest versions of all approved CDM methodologies are available at the official CDM website, http://cdm.unfccc.int.

In October 2007, the CDM Executive Board adopted a methodological tool to facilitate the calculation of baseline emission factors for electricity grids. This Tool is set to become the main reference for CDM methodologies involving baseline emission factors for power grids. In particular, ACM0002 was subsequently revised and in its latest Version 07 refers to the Tool with respect to the methodological details of the baseline emission factor calculation.

The CO₂ Database is designed to be consistent with the Tool and thus Version 07 of ACM0002. In comparison with the previous versions of the database, this required only one minor modification, in the calculation of CO₂ emissions from imported electricity (see Section 4.4). Moreover, the delineation into regional grids was reviewed, but found to be consistent with the respective criteria provided in the Tool (see next section for details).

Indian Power Sector: Installed Capacity and Regional Grids

As a result of the impressive growth attained by the Indian Power Sector, the installed capacity has grown from mere 1,713 MW in 1950 to 138251.63 MW as on 30.11.2007, consisting of 89275.84 MW Thermal, 34680.76 MW Hydro and 4120 MW Nuclear. Region-wise details of installed capacity is shown in Table 1.

<table>
<thead>
<tr>
<th>Region</th>
<th>Hydro</th>
<th>Thermal</th>
<th>Nuclear</th>
<th>Renew.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Coal</td>
<td>Gas</td>
<td>Diesel</td>
<td>Total</td>
</tr>
<tr>
<td>Northern</td>
<td>12671.15</td>
<td>18,327.50</td>
<td>3,433.19</td>
<td>14.99</td>
<td>21,775.68</td>
</tr>
<tr>
<td>Western</td>
<td>7198.50</td>
<td>23502.50</td>
<td>6600.72</td>
<td>17.48</td>
<td>30120.70</td>
</tr>
<tr>
<td>Southern</td>
<td>10646.18</td>
<td>16182.50</td>
<td>3,586.30</td>
<td>939.32</td>
<td>20,708.12</td>
</tr>
<tr>
<td>Eastern</td>
<td>3048.93</td>
<td>15149.88</td>
<td>190.00</td>
<td>17.20</td>
<td>15357.08</td>
</tr>
<tr>
<td>N.Eastern</td>
<td>1,116.00</td>
<td>330.00</td>
<td>771.50</td>
<td>142.74</td>
<td>1,244.24</td>
</tr>
<tr>
<td>Islands</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>70.02</td>
<td>70.02</td>
</tr>
<tr>
<td>All India</td>
<td>34,680.76</td>
<td>73492.38</td>
<td>14581.71</td>
<td>1201.75</td>
<td>89275.84</td>
</tr>
</tbody>
</table>

Note: These capacities are not identical with those listed in the Excel database, because the database currently covers only the years up to 31.3.2007

---

1 Tool to calculate the emission factor for an electricity system (Version 01), adopted by EB 35 (Annex 12). See http://cdm.unfccc.int
It is evident from Table 1 that the installed capacity is predominantly coal based and therefore, is a major source of carbon dioxide emissions in India. Hence, there exists scope for reducing the CO₂ emissions in the country by way of fuel substitution, increased use of renewable energy sources, and also by improving the thermal efficiency of power generation.

The Indian power system is divided into five independent regional grids, namely Northern, Eastern, Western, Southern, and North-Eastern. Each grid covers several states (see Table 2). Power generation and supply within the regional grid is managed by Regional Load Dispatch Centre (RLDC). The Regional Power Committees (RPCs) provide a common platform for discussion and solution to the regional problems relating to the grid.

Each state in a regional grid meets their demand with their own generation facilities and also with allocation from power plants owned by the central sector such as NTPC and NHPC etc. Specific quotas are allocated to each state from the central sector power plants. Depending on the demand and generation, there are electricity exports and imports between states in the regional grid. Moreover, there are also electricity transfers between regional grids, and small exchanges in the form of cross-border imports and exports (e.g. from Bhutan). Recently, the Indian regional grids have started to work in synchronous mode, i.e. at same frequency.

Table 2: Geographical scope of the five regional electricity grids

<table>
<thead>
<tr>
<th>Northern</th>
<th>Western</th>
<th>Southern</th>
<th>Eastern</th>
<th>North-Eastern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chandigarh</td>
<td>Chhattisgarh</td>
<td>Andhra Pradesh</td>
<td>Bihar</td>
<td>Arunachal</td>
</tr>
<tr>
<td>Delhi</td>
<td>Gujarat</td>
<td>Karnataka</td>
<td>Jharkhand</td>
<td>Pradesh</td>
</tr>
<tr>
<td>Haryana</td>
<td>Daman &amp; Diu</td>
<td>Kerala</td>
<td>Orissa</td>
<td>Assam</td>
</tr>
<tr>
<td>Himachal Pradesh</td>
<td>Dadar &amp; Nagar Haveli</td>
<td>Tamil Nadu</td>
<td>West Bengal</td>
<td>Manipur</td>
</tr>
<tr>
<td>Jammu &amp; Kashmir</td>
<td>Madhya Pradesh</td>
<td>Pondicherry</td>
<td>Sikkim</td>
<td>Meghalaya</td>
</tr>
<tr>
<td>Punjab</td>
<td>Maharashtra</td>
<td>Lakshadweep</td>
<td>Andaman-Nicobar</td>
<td>Mizoram</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>Goa</td>
<td></td>
<td></td>
<td>Nagaland</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td></td>
<td></td>
<td></td>
<td>Tripura</td>
</tr>
<tr>
<td>Uttarakhand</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For the purposes of the CDM, the delineation of the electricity grid is a key step in the calculation of a grid emission factor. The current methodological guidance given by the CDM Executive Board implies that a grid is characterized by the absence of significant transmission constraints, and provides the following possible criteria for determining the existence of such constraints:

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2 Tool to calculate the emission factor for an electricity system (Version 01), adopted by EB 35 (Annex 12). See [http://cdm.unfccc.int](http://cdm.unfccc.int)
• In case of electricity systems with spot markets for electricity: there are differences in electricity prices (without transmission and distribution costs) of more than 5% between the systems during 60% or more of the hours of the year.
• The transmission line is operated at 90% or more of its rated capacity during 90% or more of the hours of the year.

Due to the absence of well-established spot markets, the first criterion is currently not applicable in the Indian context. Similarly, a transmission line fulfilling the second criterion would be an exception. Nevertheless, CEA has decided to maintain the division into five regional grids for the purpose of this database. The main reason is that electricity continues to be produced and consumed largely within the same region, as is evidenced by the relatively small volume of net transfers between the regions. Consequently, it is appropriate to assume that also the impacts of CDM projects will be confined to the regional grid in which it is located.
2 How to Use the Database

Structure of the Database

Emission reductions from CDM projects in the power sector are calculated based on the net electricity generated by the project, and the difference between the emission factors (in tCO₂/MWh) of the baseline and the project activity. The baseline emission factor reflects the carbon intensity of the displaced amount of grid electricity. This baseline emission factor can be derived from the data provided in the CO₂ Database.

Specifically, the database contains the following elements:

- Worksheet “Data” provides the net generation and the absolute and specific CO₂ emissions of each grid-connected power station (see Section 3 for exceptions). It also indicates which stations and units have been included in the operating margin and build margin, respectively.

- Worksheet “Results” provides the most commonly used aggregate emission factors. These are calculated from the station data in accordance with the approved consolidated methodology ACM0002 (Version 07). The emission factors are explained in more detail in the next section.

- Worksheet “Abbreviations” explains the abbreviations used in the “Data” worksheet.

- Worksheet “Assumptions” shows the assumptions that were used for the calculation of the CO₂ emissions at station and unit level, to the extent required.

- Worksheet “Electricity Transfers” shows the inter-regional and cross-border power transfers.

Different Types of Emission Factors

The CDM methodologies which have been approved to date by the CDM Executive Board distinguish a range of different emission factors. In the Indian context, the following four are most relevant, and were therefore calculated for each regional grid based on the underlying station data:

- **Weighted average:**
  The weighted average emission factor describes the average CO₂ emitted per unit of electricity generated in the grid. It is calculated by dividing the absolute CO₂ emissions of all power stations in the region by the region’s total net generation. Net generation from so-called low-cost/must-run sources (hydro and nuclear) is included in the denominator.

- **Simple operating margin (OM):**
  The operating margin describes the average CO₂ intensity of the existing stations in the grid which are most likely to reduce their output if a CDM project supplies electricity to the grid (or reduces consumption of grid electricity). “Simple” denotes one out of four possible
variants listed in ACM0002 for calculating the operating margin. The simple operating margin is the weighted average emissions rate of all generation sources in the region except so-called low-cost or must-run sources. In India, hydro and nuclear stations qualify as low-cost / must-run sources and are excluded. The operating margin, therefore, can be calculated by dividing the region’s total CO₂ emissions by the net generation of all thermal stations. In other words, it represents the weighted average emissions rate of all thermal stations in the regional grid.

- **Build margin (BM):**
  The build margin reflects the average CO₂ intensity of newly built power stations that will be (partially) replaced by a CDM project. In accordance with ACM0002, the build margin is calculated in this database as the average emissions intensity of the 20% most recent capacity additions in the grid based on net generation. Depending on the region, the build margin covers units commissioned in the last five to ten years.

- **Combined margin (CM):**
  The combined margin is a weighted average of the simple operating margin and the build margin. By default, both margins have equal weights (50%). However, CDM project developers may choose to argue for different weights. In particular, for intermittent and non-dispatchable generation types such as wind and solar photovoltaic, ACM0002 allows to weigh the operating margin and build margin at 75% and 25%, respectively (see ACM0002, Version 06). However, the combined margins shown in the database are calculated based on equal weights.

In line with the Tool for calculation of the emission factor for an electricity grid, if a station is registered as a CDM activity, it is excluded from the build margin but not from the operating margin.⁴

---

³ The two variants “Simple adjusted operating margin” and “Dispatch data analysis operating margin” cannot currently be applied in India due to lack of necessary data.

⁴ See EB 35 (Annex 12), pp.5 and 13.
3 Scope of Database

The database includes all grid-connected power stations having an installed capacity above 5 MW in case of hydro and above 10 MW for other plant types. The data covers power stations of both public utilities and independent power producers (IPPs).

![Figure 1: Breakdown of generation capacity covered by the database. The total corresponds to 124,486 MW as on 31.03.2007.](image)

The following power stations are currently not accounted for in the database:

- Stations or units installed in Andaman and Nicobar Islands and Lakshadweep.
- Captive power stations:
  As on 31 March 2007, the installed capacity and electricity generation from captive stations were 24,680.70 MW. The generation of these stations in 2006-07 was 76,845.50 GWh, equalling 10.32% of total generation in India.
- Non-conventional renewable energy stations:
  These include power generation from wind, biomass, solar photovoltaic, and hydro below 5 MW capacity. The installed, grid-connected capacity of these sources was approx. 10,175 MW as on 31.12.2007.5
- Small decentralised generation sets.

---

5 Annual Report 2005-2006, Ministry of Non-Conventional Energy Sources
4 Data and Calculation Approach

This section gives an overview on the base data, annual data as well as the approaches used to calculate station-level and unit-level CO₂ emissions.

4.1 Base Data

The following base data parameters were collected for all the stations listed in the CO₂ database:

- SNo:
  The Station Numbers start at 1 in each regional grid. The numbering has been introduced for unambiguous referral to each station and to allow for the insertion of additional station in a region without having to change the numbers of other regions. All units of a station have the same station number. Numbers may change in future database versions.

- Station Name
  Name of the power station

- Unit Number:
  The units of a station are numbered serially starting with 1. Stations are attributed with unit number 0 for the purpose of calculations.

- Commissioning Date:
  The commissioning date is provided for each unit. Commissioning dates are important for the determination of the build margin.

- Capacity:
  Capacity data is based on declared rated capacities in MW for each unit as of 31st March 2007.

- Region:
  Regional grid to which the station is connected to. The table below gives the codes for the different regions used in the database:

<table>
<thead>
<tr>
<th>Name of the Region</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Region</td>
<td>NR</td>
</tr>
<tr>
<td>Eastern Region</td>
<td>ER</td>
</tr>
<tr>
<td>Western Region</td>
<td>WR</td>
</tr>
<tr>
<td>Southern Region</td>
<td>SR</td>
</tr>
<tr>
<td>North-Eastern Region</td>
<td>NER</td>
</tr>
</tbody>
</table>

- State:
  State where the power station is located.
• Sector:
  This denotes whether the station is operated by the central sector, the state authorities, or the private sector.

• System:
  A list of the systems including abbreviations and full names is provided in Appendix A.

• Type:
  Indicates the type of the station, viz. thermal, nuclear, hydro.

• Fuel:
  Fuel 1 and Fuel 2 indicates the main fuels used for power generation at each station. For example, in coal based stations, Coal is indicated as Fuel 1 and Oil as Fuel 2.

4.2 Annual Data

The annual data columns in the database provide the following: net generation in GWh of the station, absolute carbon dioxide emissions in metric tonnes, and specific carbon dioxide emissions in tCO₂/MWh, for the Fiscal Years 2000-01 to 2006-07. In addition, there are columns to indicate whether the station is included in the operating margin in the respective year, and an additional column indicating which units are included in the build margin. If a unit is part of a registered CDM activity, it is excluded from the build margin, and the CDM registration number is indicated in the respective column.

CEA has compiled the CO₂ Database for the Fiscal Years (FY)⁶ 2000-01 to 2006-07 based upon generation, fuel consumption and fuel gross calorific value (GCV) data furnished by each power station. In cases where the station could not provide reliable data for all the relevant parameters, assumptions were made as described below. Further details on the assumptions made are provided in Appendix B.

Assumptions at Station Level

At the station level, the following assumptions were made where the relevant data could not be provided by a station:

Net generation:
For hydro stations, only gross generation was available, but not net generation data. Instead, the CEA standard value for auxiliary power consumption in hydro units (0.5%) was applied to derive the net generation from the gross generation data reported by the stations. Likewise, CEA standard values for auxiliary power consumption had to be applied for some of the gas- and diesel-fired thermal stations.

⁶ FY: 1 April – 31 March
Gross Calorific Value (GCV):
Default values were used for some thermal stations where station-specific GCVs were not available.

Assumptions at Unit Level
At unit level, the following assumptions were made for those units falling into the build margin (i.e. the most recently built units comprising 20% of net generation):

Gross generation:
For some stations, gross generation data were not available at unit level. Instead, the plant load factor of the respective station was used to derive the gross generation of the units. For units commissioned after the start of the relevant fiscal year, the gross generation was further adjusted pro rata the number of days since commissioning.

Net generation:
Net generation data is generally not measured at unit level. Two distinct approaches were applied to estimate net generation.

1. The auxiliary consumption (in % of gross generation) of the unit was assumed to be equal to that of the respective stations in the following cases:
   i. All units of a station fall into the build margin; or
   ii. All units of a station have the same installed capacity; or
   iii. The units in the station have different capacities but do not differ with respect the applicable standard auxiliary consumption.

2. In all other cases, standard values for auxiliary consumption adopted by CEA were applied.

Fuel consumption and GCV:
Fuel consumption and GCV are generally not measured at unit level. Instead, the specific CO₂ emissions of the relevant units were directly calculated based on heat rates. See Section 4.3 for details.
4.3 Calculation of CO₂ Emissions

Calculation Approach – Station Level

CO₂ emissions of thermal stations were calculated using the formula below:

\[
AbsCO₂_{\text{station}}(y) = \sum_{i=1}^{2} \text{FuelCon}_{i,y} \times \text{GCV}_{i,y} \times \text{EF}_i \times \text{Oxid}_i \quad (1)
\]

Where:

- \(AbsCO₂_{\text{station}}(y)\): Absolute CO₂ emission of the station in the given fiscal year ‘\(y\)’
- \(\text{FuelCon}_{i,y}\): Amount of fuel of type \(i\) consumed in the fiscal year ‘\(y\)’
- \(\text{GCV}_{i,y}\): Gross calorific value of the fuel \(i\) in the fiscal year ‘\(y\)’
- \(\text{EF}_i\): CO₂ emission factor of the fuel \(i\) based on GCV
- \(\text{Oxid}_i\): Oxidation factor of the fuel \(i\)

The emission- and oxidation factors used in the CO₂ database are provided in Appendix B.

The emission factors for coal and lignite are based on the values provided in India’s Initial National Communication under the UNFCCC (Ministry of Environment & Forests, 2004). The emission factor for coal is supported by the results of an analysis of approx. 120 coal samples collected from different Indian coal fields. Since the values in the National Communication are based on the NCV (Net Calorific Value), they were converted to GCV basis using a formula also furnished in the National Communication. For other fuels, default emission factors from IPCC 2006 Guidelines, also based on the respective fuel’s NCV, were used and converted to GCV basis using IEA default conversion factors.

The oxidation factor for coal and lignite were derived from an analysis performed with data on the unburnt carbon content in the ash from various Indian coal-fired power stations. The value of 98% is consistent with the default value provided in the IPCC 1996 Guidelines. For all other fuels, default values provided in the more recent IPCC 2006 Guidelines were used.

Specific CO₂ emissions of stations (\(SpecCO₂_{\text{station}}(y)\)) were computed by dividing the absolute emissions (\(AbsCO₂_{\text{station}}(y)\)) estimated above by the station’s net generation (\(NetGen_{\text{station}}(y)\)).

\[
SpecCO₂_{\text{station}}(y) = \frac{AbsCO₂_{\text{station}}(y)}{NetGen_{\text{station}}(y)} \quad (2)
\]

---

7. 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Table 2.2
Calculation Approach – Unit Level

Unit-level CO₂ emissions were only calculated for units falling in the build margin.

The absolute CO₂ emissions of thermal units \((\text{AbsCO}_2(\text{unit}_y))\) were derived by multiplying the specific emissions \((\text{SpecCO}_2(\text{unit}_y))\) with the net generation of each unit \((\text{NetGen}(\text{unit}_y))\), where net generation was obtained as described in section 4.2:

\[
\text{AbsCO}_2(\text{unit}_y) = \text{SpecCO}_2(\text{unit}_y) \times \text{NetGen}(\text{unit}_y), \quad (3)
\]

A unit was assumed to have the same specific emissions as the corresponding station in the following three cases:

i. If all units of a station fall into the build margin;

ii. If all units of a station have the same installed capacity;

iii. If the default specific emissions for the respective station type is higher than the corresponding station’s specific emissions, and the concerned unit is capacity-wise among the largest of the station.

For over 90% of all thermal units in the build margin 2006-07, one of these cases applied. In the remaining cases, the specific emissions of the units were derived from conservative standard heat rate values, defined as the design heat rate plus 5% (see Appendix B).

4.4 Adjustment for Inter-Regional and Cross-Border Electricity Transfers

The weighted average emission factors and operating margins of each region were adjusted for inter-regional and cross-border electricity imports and exports, in line with the methodology ACM0002 and the Tool to calculate the emission factor for an electricity system:

- The relevant amounts of electricity imported and exported are listed in the database worksheet “Transfers”;
- The CO₂ emissions associated with these imports were quantified based on the simple operating margin of the exporting grid.⁹ was used to quantify the CO₂ emissions associated with imports;

---

⁹ This corresponds to Approach c) listed in the Tool to calculate the emission factor of an electricity grid (Version 01, p.4). In the previous versions of the database, the emissions had been calculated based on either the combined margin or the weighted average emission factor of the exporting grid, depending on the share of imports in the importing region’s total electricity supply.
4.5 Conservativeness

The need to ensure conservativeness of calculations in situations of uncertainty is a fundamental principle in the CDM. Assumptions are conservative if they tend to reduce the number of emission reductions being credited to a CDM project activity. The following approaches and assumptions contribute to the conservativeness of the database:

- The quality of station-level data was ensured through extensive plausibility testing and interaction with the station operators.

- In cases of data gaps at station level, standard data from CEA was used. For example, standard auxiliary power consumption was assumed for a number of gas-fired stations. Comparison with monitored values shows that these standard values are rather conservative, i.e. they lead to a somewhat lower heat rate and hence lower emissions than observed in many stations.

- Where required, the emission factors of thermal units were also derived from standard CEA values (design heat rate plus 5%). Again, these values are conservative (i.e. relatively low) compared to the heat rates observed in practice. See Section 4.3 for details on the build margin calculation.

- The fuel emission factors and oxidation factors used are generally consistent with IPCC defaults. For coal, the emission factor provided in India’s Initial National Communication was used (95.8 t CO₂/TJ on NCV basis), being somewhat lower than the IPCC default for sub-bituminous coal (96.1 t CO₂/TJ).\(^\text{10}\)

\(^{10}\) 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Table 2.2
5 Results

Worksheet “Results” in the database provides the net generation and CO₂ emissions data and the resulting emission factors for the five regional grids in FY 2000-01 to FY 2006-07. The emission factors are also reproduced in Appendix C. The values are rounded off at two decimals. See database file for additional decimals.

5.1 Results for Fiscal Year 2006-07

Table 5 indicates the development of total emissions by region over the years covered by the database. The total emissions of India increased on average by 3.8% per year.

Table 4: Total emissions from the power sector by region for the FY 2000-01 to 2006-07

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>97386566</td>
<td>102743113</td>
<td>106808582</td>
<td>109996544</td>
<td>112212597</td>
<td>120102148</td>
<td>129554682</td>
</tr>
<tr>
<td>East</td>
<td>58026488</td>
<td>61427499</td>
<td>65593200</td>
<td>75512010</td>
<td>83506480</td>
<td>92517515</td>
<td>96300317</td>
</tr>
<tr>
<td>South</td>
<td>89019233</td>
<td>92178116</td>
<td>105239700</td>
<td>108123211</td>
<td>105603264</td>
<td>101769966</td>
<td>109251906</td>
</tr>
<tr>
<td>West</td>
<td>135192213</td>
<td>141597621</td>
<td>146557341</td>
<td>144127175</td>
<td>157781065</td>
<td>153303199</td>
<td>157722686</td>
</tr>
<tr>
<td>North-East</td>
<td>22073396</td>
<td>21599669</td>
<td>22867274</td>
<td>24627962</td>
<td>2469463</td>
<td>2532819</td>
<td>2645856</td>
</tr>
<tr>
<td>India</td>
<td>382311134</td>
<td>400106317</td>
<td>429464546</td>
<td>440221731</td>
<td>462022608</td>
<td>470846647</td>
<td>485535347</td>
</tr>
</tbody>
</table>

Table 5 shows the emission factors for FY 2006-07 excluding inter-regional and cross-border power transfers, whereas Table 6 shows the emission factors for the same year including these power transfers.

Table 5: Weighted average emission factor, simple operating margin (OM), build margin (BM) and combined margin (CM) of all regional grids for FY 2006-07 (not adjusted for inter-regional and cross-country electricity transfers), in tCO₂/MWh

<table>
<thead>
<tr>
<th>Average</th>
<th>OM</th>
<th>BM</th>
<th>CM</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>0.72</td>
<td>0.99</td>
<td>0.63</td>
</tr>
<tr>
<td>East</td>
<td>1.03</td>
<td>1.13</td>
<td>0.93</td>
</tr>
<tr>
<td>South</td>
<td>0.72</td>
<td>1.00</td>
<td>0.71</td>
</tr>
<tr>
<td>West</td>
<td>0.85</td>
<td>0.99</td>
<td>0.59</td>
</tr>
<tr>
<td>North-East</td>
<td>0.39</td>
<td>0.69</td>
<td>0.23</td>
</tr>
<tr>
<td>India</td>
<td>0.80</td>
<td>1.01</td>
<td>0.68</td>
</tr>
</tbody>
</table>
Table 6: Weighted average emission factor, simple operating margin (OM), build margin (BM) and combined margin (CM) of all regional grids for FY 2006-07 (adjusted for inter-regional and cross-country electricity transfers), in tCO$_2$/MWh

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>OM</th>
<th>BM</th>
<th>CM</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>0.74</td>
<td>1.00</td>
<td>0.63</td>
<td>0.81</td>
</tr>
<tr>
<td>East</td>
<td>1.00</td>
<td>1.09</td>
<td>0.93</td>
<td>1.01</td>
</tr>
<tr>
<td>South</td>
<td>0.72</td>
<td>1.00</td>
<td>0.71</td>
<td>0.85</td>
</tr>
<tr>
<td>West</td>
<td>0.86</td>
<td>0.99</td>
<td>0.59</td>
<td>0.79</td>
</tr>
<tr>
<td>North-East</td>
<td>0.40</td>
<td>0.70</td>
<td>0.23</td>
<td>0.46</td>
</tr>
<tr>
<td>India</td>
<td>0.80</td>
<td>1.01</td>
<td>0.68</td>
<td>0.84</td>
</tr>
</tbody>
</table>

The observed variations in the emission factors between the different regional grids originate from the differing availability and use of coal, gas and hydro resources. Stations fired with other fossil fuels such as diesel as well as nuclear stations play a less significant role.

A comparison of Table 5 and Table 6 shows that electricity transfers between regions did not have a significant influence on the emission factors in 2006-07.

Table 7 shows the weighted average specific emissions for fossil fuel-fired power stations in the five regional grids. Inter-regional variations arise chiefly from differences in station age and build (installed capacity and conversion technology). The substantially higher emission factor of gas stations in the North-Eastern Region (0.69 tCO$_2$/MWh) compared to other regions (0.44-0.49 tCO$_2$/MWh) can be explained with the dominance of open-cycle gas stations in the North-Eastern grid. However, due to the relatively low absolute generation level in this region, the influence on the country average value is small.

Table 7: Weighted average specific emissions for fossil fuel-fired stations in FY 2006-07, in tCO$_2$/MWh.

<table>
<thead>
<tr>
<th>Weighted average specific emissions fuel wise in 2006-07 (tCO$_2$/MWh)</th>
<th>Coal</th>
<th>Dist</th>
<th>Gas</th>
<th>Lign</th>
<th>Napt</th>
<th>Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>1.09</td>
<td>-</td>
<td>0.44</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>East</td>
<td>1.13</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>South</td>
<td>1.01</td>
<td>0.62</td>
<td>0.49</td>
<td>1.43</td>
<td>0.66</td>
<td>0.61</td>
</tr>
<tr>
<td>West</td>
<td>1.10</td>
<td>-</td>
<td>0.45</td>
<td>1.36</td>
<td>0.61</td>
<td>0.82</td>
</tr>
<tr>
<td>North-East</td>
<td>-</td>
<td>0.64</td>
<td>0.69</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>India</td>
<td>1.09</td>
<td>0.62</td>
<td>0.47</td>
<td>1.42</td>
<td>0.61</td>
<td>0.77</td>
</tr>
</tbody>
</table>

Note:
Stations for which assumptions had to be made are included in this analysis (see Section 4 for details).
5.2 Developments over Time

Figure 2 illustrates the development of the import-adjusted operating margins over the period from FY 2000-01 to FY 2006-07. The variations between the years are generally quite small, and largely driven by variations in annual electricity transfers between the regions (see Appendix C for details).

Figure 2: Development of the operating margin (adjusted for electricity transfers) for India’s regional grids over the period 2000-01 to 2006-07.

Figure 3 shows the build margins for the three Fiscal Years 2004-05 to 2006-07. Significant changes compared to the previous year are observed for some regions. These can be explained by variations in the respective shares of coal, hydro and other generation types among the units falling into the build margin, as shown in Figure 4. It should be noted that due to the definition stipulated by the CDM rules, the build margin can react sensitively to a few large units being added to the grid in a given year. Consequently, the changes observed here need not necessarily point to longer-term trends.

The build margins for the four years prior to 2004-05 (i.e., 2000-01 – 2003-04) could not be calculated for practical reasons. The combined margins for these years were determined based on the respective operating margins for each year and the build margin for 2004-05.
Figure 3: Development of the build margins for India’s regional grids for FY 2004-05 and 2006-07.

Figure 4: Breakdown of the build margin (comparison of FY 2004-05 and 2006-07) by station and fuel type for all regional grids (shares based on net generation)
Figure 5 shows the trends in the import-adjusted combined margins in the period 2000-01 – 2006-07. The most prominent variations are due to the changes in the build margins between 2004-05 and 2006-07. For India as a whole, the combined margin remained nearly constant.

Figure 5: Development of the combined margin (adjusted for electricity transfers) for India’s regional grids over the period 2000-01 to 2006-07.

5.3 Changes compared to Previous Database Versions

In comparison with the previous version of the Database (Version 2.0), this version includes some small changes which affect the emission factors for the past Fiscal Years 2000-01 to 2005-06:

- South: Build margin for 2004-5 has slightly decreased due to revision of commissioning dates of some units;
- All regions: Slight changes of different margins due to adoption of a new calculation approach for import-adjusted emission factors, in line with the latest version of ACM0002 and the new Tool for calculation of the emission factor for an electricity system (see Sections 1 and 4.4).
6 User Examples

This section provides two illustrative examples of how the CO₂ Database can be applied. The examples are based on hypothetical renewable energy projects that differ in size and supply different regional grids.

**Project A** is a grid-connected 5 MW small hydropower station located in the State of Assam (North-Eastern Region). The station will be commissioned in 2009. Annual net generation is projected at approx. 17'500 MWh.

- The project qualifies as a small-scale CDM activity since its capacity is below the 15 MW threshold. Hence it will use the latest version of CDM methodology AMS-I.D for grid-connected power generation from renewable energy sources.

- Methodology AMS-I.D gives two options for determining the baseline emission factor: Either the weighted average emissions, or the combined margin of the regional grid. In this example, it is assumed that the promoters choose the weighted average option. In addition, it is assumed that the promoters choose to adjust the weighted average emission factor for electricity imports, despite the fact that this is not mandatory under AMS-I.D.

- In the PDD, the expected emission reductions achieved by the hydro station are projected based on the expected annual generation, and the import-adjusted weighted average emission factor for the North-Eastern Grid in the most recent year for which data is available (2006-07). The corresponding value is 0.40 t CO₂/MWh. Hence the absolute emission reductions are projected at 0.40 * 17'500 = 7'000 t CO₂/yr. The emission reductions are equal to the baseline emissions, since the project does not result in greenhouse gas emissions of its own.

- In accordance with AMS-I.D, the promoters will determine the actual baseline emission factor *ex post*. The actual emission reductions will then be calculated in each year of the crediting period based on the observed net generation and the weighted average emission factor for the respective year.\(^{11}\) The latter would be published annually by CEA.

**Project B** is a 100 MW grid-connected wind farm located in the State of Tamil Nadu (Southern Region). The project will be commissioned in 2009. Average net supplies to the grid are projected at 312,500 MWh per year.

- The project exceeds the 15 MW threshold and thus qualifies as a large-scale CDM activity. Hence it is eligible to use the latest version of methodology ACM0002 for grid-connected power generation from renewable energy sources.

- Under ACM0002, the combined margin approach is mandatory. In addition, inter-regional power transfers (imports and exports) must be taken into account.

\(^{11}\) The emission factor of the previous year may be used instead. See request for clarification AM_CLA_0038 (http://cdm.unfccc.int/methodologies/PAmethodologies/Clarifications/index.html).
In contrast to the first example, the promoters decide to fix the baseline emission factor \textit{ex ante}. That is, the baseline emission factor is determined based on the most recent data available, and remains fixed for the duration of the crediting period. The actual emission reductions will be calculated in each year based on the observed net generation and the pre-defined baseline emission factor.

For this \textit{ex ante}-option, the methodology ACM0002 requires that the operating margin is calculated as the average of the three most recent years (here 2004-05 – 2006-07). The operating margin to be applied thus works out to 1.00 t CO$_2$/MWh.

Since wind is an intermittent energy source, the promoter is allowed to assign a weight of 75% to the operating margin, and 25% to the build margin. The resulting combined margin is 0.93 t CO$_2$/MWh (75% x 1.00 + 25% x 0.71 for the fiscal year 2006-07. This value is used for projecting the emission reductions in the PDD as well as for calculating the actual emission reductions.

The two CDM project activities are summarised in Table 8 below.
Table 8: Illustration on how to use the CO₂ Database for calculating the emission reductions of CDM projects

<table>
<thead>
<tr>
<th>Project Info</th>
<th>Project A</th>
<th>Project B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type:</td>
<td>Hydro station</td>
<td>Wind park</td>
</tr>
<tr>
<td>Size:</td>
<td>5 MW (small-scale according to CDM criteria)</td>
<td>100 MW (large-scale according to CDM criteria)</td>
</tr>
<tr>
<td>Projected Generation (net):</td>
<td>17'500 MWh /yr</td>
<td>312'500 MWh /yr</td>
</tr>
<tr>
<td>Commissioning year:</td>
<td>2009</td>
<td>2009</td>
</tr>
<tr>
<td>Year of CDM registration:</td>
<td>2008</td>
<td>2008</td>
</tr>
<tr>
<td>Region:</td>
<td>North East</td>
<td>South</td>
</tr>
<tr>
<td>CDM methodology:</td>
<td>AMS-I.D / Version 13</td>
<td>ACM0002 / Version 07</td>
</tr>
</tbody>
</table>

Baseline Emission Factor Calculation

<table>
<thead>
<tr>
<th>Calculation method:</th>
<th>Weighted average</th>
<th>Combined margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data vintage for projection of emission reductions:</td>
<td>2006-07 (most recent available at time of PDD validation)</td>
<td>For OM: 2004-05, 2005-06, 2006-07 (most recent 3 years available at time of PDD validation)</td>
</tr>
<tr>
<td>Data vintage for verification of emission reductions:</td>
<td>Actual year of generation, i.e. 2006-07, 2006-07 etc. (emission factor fixed ex post)</td>
<td>Same as for projection (emission factor fixed ex ante)</td>
</tr>
<tr>
<td>Accounting of imports:</td>
<td>Not mandatory, but done</td>
<td>Mandatory</td>
</tr>
<tr>
<td>Weights for combined margin:</td>
<td>Operating margin: 50%</td>
<td>Operating margin: 75%</td>
</tr>
<tr>
<td>Build margin:</td>
<td>50%</td>
<td>Build margin: 25%</td>
</tr>
<tr>
<td>(default for intermittent sources)</td>
<td></td>
<td>(default for intermittent sources)</td>
</tr>
</tbody>
</table>

Emission Reduction Calculations

<table>
<thead>
<tr>
<th>Values in tCO₂/MWh:</th>
<th>0.40</th>
<th>Weighted average</th>
<th>1.00</th>
<th>Operating margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projected emission reductions:</td>
<td>7000 t CO₂ per year</td>
<td>290,625 t CO₂ per year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual emission reductions:</td>
<td>Monitored net generation x monitored weighted average</td>
<td>Monitored net generation x fixed combined margin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7 Updating Procedure

The CO₂ Database will be updated annually by CEA and made available on its website: [www.cea.nic.in](http://www.cea.nic.in). Previous versions will be archived by CEA and the main changes relative to previous database versions will be documented.

8 Further Information

For any further information, contact by email:

Chief Engineer(C&E)  
Central Electricity Authority  
Sewa Bhawan  
R. K. Puram, New Delhi-110066  
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New Delhi-110017  
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Telefax no.: 91-11-40610030/31/32
Appendix A – Systems in India’s Regional Grids

*In alphabetical order*

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full name</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABAN</td>
<td>ABAN Power Company</td>
</tr>
<tr>
<td>APGCL</td>
<td>Assam Power Generation Corporation Limited</td>
</tr>
<tr>
<td>APGENCO</td>
<td>Andhra Pradesh Power Generation Co Ltd</td>
</tr>
<tr>
<td>ASEB</td>
<td>Assam State Electricity Board</td>
</tr>
<tr>
<td>BBMB</td>
<td>Bhakra Beas Management Board</td>
</tr>
<tr>
<td>BSEB</td>
<td>Bihar State Electricity Board</td>
</tr>
<tr>
<td>CESC</td>
<td>Calcutta Electric Supply Company Limited</td>
</tr>
<tr>
<td>CSEB</td>
<td>Chattisgarh State Electricity Board</td>
</tr>
<tr>
<td>DPL</td>
<td>Durgapur projects Limited</td>
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<tr>
<td>DVC</td>
<td>Damodar Valley Corporation</td>
</tr>
<tr>
<td>GIPCL</td>
<td>Gujarat Industrial Power Corporation Limited</td>
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<tr>
<td>GMDCL</td>
<td>Gujarat Mineral Development Corporation Limited</td>
</tr>
<tr>
<td>GMR Energ</td>
<td>GMR Energy</td>
</tr>
<tr>
<td>GPEC</td>
<td>Gujarat Paguthan Energy Corporation Pvt. Limited</td>
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<tr>
<td>GSECL</td>
<td>Gujarat State Electricity Corporation Limited</td>
</tr>
<tr>
<td>GTE Corp</td>
<td>GTE Corporation</td>
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<tr>
<td>GVK Ind.</td>
<td>GVK Power &amp; Infrastructure Limited</td>
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<tr>
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<td>HEG Limited</td>
</tr>
<tr>
<td>HPGCL</td>
<td>Haryana Power Generation Corporation</td>
</tr>
<tr>
<td>HPSEB</td>
<td>Himachal Pradesh State Electricity Board</td>
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<tr>
<td>INDSIL</td>
<td>Indsil Electrosmelt Ltd</td>
</tr>
<tr>
<td>IPGPCL</td>
<td>Indrapratha Power Generation Co Ltd</td>
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<tr>
<td>JINDAL</td>
<td>JSW Energy Limited</td>
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<tr>
<td>JKEB</td>
<td>Jammu &amp; Kashmir Electricity Board</td>
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## Continuation

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<td>Jai Prakash Hydro Power Limited</td>
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<tr>
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<td>KPCL</td>
<td>Karnataka Power Corporation Limited</td>
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<td>Kerala State Electricity Board</td>
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<td>LVS Power Limited</td>
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<td>MaduraiP</td>
<td>Madurai Power Corporation Limited</td>
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<tr>
<td>MAHAGENCO</td>
<td>Maharashtra State Power Generation Company Ltd</td>
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<tr>
<td>MAPS</td>
<td>Madras Atomic Power Station</td>
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<tr>
<td>MALANA</td>
<td>Malana Power Corporation Ltd</td>
</tr>
<tr>
<td>MPDC</td>
<td>Manipur Power Development Corporation</td>
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<tr>
<td>MEGEB</td>
<td>Meghalaya State Electricity Board</td>
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<tr>
<td>MPGPCL</td>
<td>Madhya Pradesh Power Generating Co. Ltd.</td>
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<tr>
<td>NAPS</td>
<td>Narora Atomic Power Station</td>
</tr>
<tr>
<td>NCTPP</td>
<td>National Capital Thermal Power Plant</td>
</tr>
<tr>
<td>NEEPCO</td>
<td>North Eastern Electric Power Corporation Ltd</td>
</tr>
<tr>
<td>NHDC</td>
<td>Narmada Hydro Electric Development Corporation</td>
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<tr>
<td>NHPC</td>
<td>National Hydro Electric Corporation</td>
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<tr>
<td>NLC</td>
<td>Neyvelli Lignite Corporation Ltd</td>
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<tr>
<td>NPC</td>
<td>Nuclear Power Corporation of India Ltd.</td>
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<tr>
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<td>NTPC Ltd</td>
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<td>OHPC</td>
<td>Orissa Hydro Power Corporation</td>
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<td>OPGC</td>
<td>Orissa Power Generation Corporation</td>
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<td>Pondichery Power Corporation Limited</td>
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### Abbreviation

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<td>Ratnagiri Gas &amp; power Pvt Ltd</td>
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<td>Reliance Energy Ltd</td>
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<td>RPG</td>
<td>RP Goenka Group</td>
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<tr>
<td>RRVUNL</td>
<td>Rajasthan Rajya Vidyut Utpadan Nigam</td>
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<td>Samalpatti</td>
<td>Samalpatti Power Company Limited</td>
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<tr>
<td>SJVNL</td>
<td>Sutluj Jal Vidyut Nigam Ltd</td>
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<tr>
<td>SPECT. IND</td>
<td>Spectrum Power Generation Limited</td>
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<td>SSVNL</td>
<td>Sardar Sarovar Vidyut Nigam Limited</td>
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<tr>
<td>STPS</td>
<td>Super Thermal Power Station</td>
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<td>Tata Power Company Limited</td>
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<td>Tata PCL</td>
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<td>THDC</td>
<td>Tehri Hydroelectric Development Corporation</td>
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<td>TNEB</td>
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<td>UPHPC</td>
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<td>VVNL</td>
<td>Visvesarya Vidyut Nigam Ltd</td>
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<td>WBPDC</td>
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<td>WBSEB</td>
<td>West Bengal State Electricity Board</td>
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### Fuel Emission Factors (EF) (Source: Coal/Lignite - Initial National Communication, Gas/Oil/Diesel/Naphta - IPCC 2006, Corex - own assumption)

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<tr>
<th>Unit</th>
<th>Coal</th>
<th>Lignite</th>
<th>Gas</th>
<th>Oil</th>
<th>Diesel</th>
<th>Naphta</th>
<th>Corex</th>
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<tr>
<td>EF based on NCV (gCO₂/MJ)</td>
<td>95.6</td>
<td>106.2</td>
<td>56.1</td>
<td>77.4</td>
<td>74.1</td>
<td>74.5</td>
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<td>Delta GCV/NCV (%)</td>
<td>3.6%</td>
<td>3.6%</td>
<td>10%</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
<td>n/a</td>
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<tr>
<td>Oxidation Factor</td>
<td>0.98</td>
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<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
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<tr>
<td>Fuel Emission Factor (gCO₂/MJ)</td>
<td>92.5</td>
<td>102.5</td>
<td>51.0</td>
<td>72.7</td>
<td>70.6</td>
<td>69.6</td>
<td>0.0</td>
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</table>

**Assumptions at Station Level** (Only where data was not provided by station)

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<tr>
<th>Unit</th>
<th>Coal</th>
<th>Lignite</th>
<th>Gas-CC</th>
<th>Gas-OC</th>
<th>Oil-Eng</th>
<th>Diesel-OC</th>
<th>Naphta</th>
<th>Hydro</th>
<th>Nuclear</th>
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<tr>
<td>Auxiliary Power Consumption (%)</td>
<td>8.0</td>
<td>10.0</td>
<td>3.0</td>
<td>1.0</td>
<td>3.5</td>
<td>3.5</td>
<td>1.0</td>
<td>3.5</td>
<td>0.5</td>
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<td>Gross Heat Rate kcal/kWh (net)</td>
<td>2'500</td>
<td>2'713</td>
<td>2'013</td>
<td>3'014</td>
<td>2'013</td>
<td>2'013</td>
<td>2'013</td>
<td>2'013</td>
<td>2'013</td>
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<td>Net Heat Rate kcal/kWh (net)</td>
<td>2'117</td>
<td>2'342</td>
<td>1'942</td>
<td>2'802</td>
<td>1'802</td>
<td>1'802</td>
<td>1'802</td>
<td>1'802</td>
<td>1'802</td>
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<tr>
<td>Specific Oil Consumption ml/kWh (net)</td>
<td>2.0</td>
<td>3.0</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
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<tr>
<td>GCV kcal/kg (or m³)</td>
<td>8'000</td>
<td>10'100</td>
<td>10'500</td>
<td>11'300</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
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<tr>
<td>Density t/1,000 lt</td>
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<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
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<tr>
<td>Specific CO₂ emissions tCO₂/MWh</td>
<td>1.04</td>
<td>1.28</td>
<td>0.44</td>
<td>0.68</td>
<td>0.68</td>
<td>0.68</td>
<td>0.68</td>
<td>0.68</td>
<td>0.68</td>
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**Assumptions at Unit Level** (By capacity; only for units in the BM, where data was not provided by station)

<table>
<thead>
<tr>
<th>Unit</th>
<th>Coal 67.5 MW</th>
<th>120 MW</th>
<th>200-250 MW</th>
<th>500 MW</th>
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</thead>
<tbody>
<tr>
<td>Gross Heat Rate kcal/kWh (net)</td>
<td>2'750</td>
<td>2'500</td>
<td>2'500</td>
<td>2'425</td>
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<tr>
<td>Auxiliary Power Consumption (%)</td>
<td>12.0</td>
<td>9.0</td>
<td>9.0</td>
<td>7.5</td>
</tr>
<tr>
<td>Net Heat Rate kcal/kWh (net)</td>
<td>3'125</td>
<td>2'747</td>
<td>2'747</td>
<td>2'622</td>
</tr>
<tr>
<td>Specific Oil Consumption ml/kWh (net)</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Specific CO₂ Emissions tCO₂/MWh</td>
<td>1.19</td>
<td>1.05</td>
<td>1.05</td>
<td>1.00</td>
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<tr>
<td>Lignite 75 MW</td>
<td>125 MW</td>
<td>210/250 MW</td>
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<td></td>
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<tr>
<td>Gross Heat Rate kcal/kWh (net)</td>
<td>2'750</td>
<td>2'500</td>
<td>2'500</td>
<td>2'425</td>
</tr>
<tr>
<td>Auxiliary Power Consumption (%)</td>
<td>12.0</td>
<td>12.0</td>
<td>10.0</td>
<td>8.0</td>
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<tr>
<td>Net Heat Rate kcal/kWh (net)</td>
<td>3'125</td>
<td>2'909</td>
<td>2'914</td>
<td>2'722</td>
</tr>
<tr>
<td>Specific Oil Consumption ml/kWh (net)</td>
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<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
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<tr>
<td>Specific CO₂ Emissions tCO₂/MWh</td>
<td>1.32</td>
<td>1.23</td>
<td>1.28</td>
<td>1.20</td>
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<tr>
<td>Gas 0-49.9 MW</td>
<td>50-99.9 MW</td>
<td>&gt;100 MW</td>
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<tr>
<td>Gross Heat Rate kcal/kWh (net)</td>
<td>2'750</td>
<td>2'500</td>
<td>2'500</td>
<td>2'425</td>
</tr>
<tr>
<td>Auxiliary Power Consumption (%)</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Net Heat Rate kcal/kWh (net)</td>
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<td>1'969</td>
<td>2'031</td>
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<td>Specific CO₂ Emissions tCO₂/MWh</td>
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<td>0.43</td>
<td>0.43</td>
<td>0.43</td>
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<tr>
<td>Diesel 0.1-1 MW</td>
<td>1-3 MW</td>
<td>&gt;3 MW</td>
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<td>Gross Heat Rate kcal/kWh (net)</td>
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<td>2'250</td>
<td>2'250</td>
<td>2'250</td>
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<tr>
<td>Auxiliary Power Consumption (%)</td>
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<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Net Heat Rate kcal/kWh (net)</td>
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<td>2'322</td>
<td>2'176</td>
<td>2'047</td>
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<tr>
<td>Specific CO₂ Emissions tCO₂/MWh</td>
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<td>0.64</td>
<td>0.64</td>
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## Combined Margin

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<tr>
<th>Unit</th>
<th>Weight OM (%)</th>
<th>Weight BM (%)</th>
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<td>Weight OM (%)</td>
<td>50%</td>
<td>50%</td>
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## Conversion Factors

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<tr>
<th>Unit</th>
<th>Energy</th>
<th>Oil</th>
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<tr>
<td>Energy (kcal)</td>
<td>4.186</td>
<td>4.186</td>
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<tr>
<td>Oil (ml/kWh)</td>
<td>3.5</td>
<td>3.5</td>
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**Oil Specific Emission (gCO₂/ml) | 2.96**
Appendix C – Grid Emission Factors

Note: Values are rounded off at two decimals here. See Database (Excel File, Worksheet "Results") for additional decimals.

Table A: Values for all regional grids for FY 2000-01 until FY 2006-07, excluding inter-regional and cross-border electricity transfers.

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<td>North</td>
<td>0.72</td>
<td>0.73</td>
<td>0.74</td>
<td>0.71</td>
<td>0.71</td>
<td>0.71</td>
<td>0.72</td>
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<tr>
<td>East</td>
<td>1.09</td>
<td>1.06</td>
<td>1.11</td>
<td>1.10</td>
<td>1.08</td>
<td>1.08</td>
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<td>0.73</td>
<td>0.75</td>
<td>0.82</td>
<td>0.84</td>
<td>0.78</td>
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<td>West</td>
<td>0.90</td>
<td>0.92</td>
<td>0.90</td>
<td>0.90</td>
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<td>0.87</td>
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<td>North-East</td>
<td>0.42</td>
<td>0.41</td>
<td>0.40</td>
<td>0.43</td>
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<td>0.85</td>
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<td>1.01</td>
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<td>North</td>
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<td>0.71</td>
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Table B: Values for all regional grids for FY 2000-01 until FY 2006-07, including inter-regional and cross-border electricity transfers.

**Weighted Average Emission Rate (tCO2/MWh) (incl. Imports)**

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**Simple Operating Margin (tCO2/MWh) (incl. Imports)**

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**Build Margin (tCO2/MWh) (not adjusted for imports)**

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**Combined Margin in tCO2/MWh (incl. Imports)**

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Appendix D – Summary of Methodology ACM0002 / Version 07

Download ACM0002 at: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

ACM0002 is a consolidated CDM methodology for grid-connected power generation from renewable energy sources. It covers grid-connected renewable power generation project activities that involve electricity capacity additions. Examples of eligible project types include run-of-river hydro power plants, and hydro power projects with existing reservoirs where the volume of the reservoir is not increased; wind energy; geothermal energy; solar energy; and wave and tidal energy.

The methodology requires the calculation of the baseline emission factor following the combined margin (CM) approach. The combined margin consist of a weighted average of:

- Operating margin (OM);
- Build margin (BM).

The relative weights used to determine the combined margin are by default the same, i.e. 50%. Alternative weights can be used for intermittent power sources.

There are four options to calculate the operating margin, depending on local conditions:

- Simple operating margin. This is the preferred approach for India, except potentially in regions with a very high share of hydro power (North-Eastern Region).
- The other three approaches are: (i) simple adjusted operating margin; (ii) dispatch data analysis; and (iii) average operating margin.

The build margin is the generation-weighted average emission factor of the most recent power plants, consisting of the larger of (i) the five power plants that have been built most recently; or (ii) the capacity additions that represent 20% of the system generation that have been built most recently. In India, the latter approach generally yields the larger sample and hence must be followed. CDM projects must be excluded from the build margin, as long as the build margin does not contain generation units older than 10 years.

The operating margin must be adjusted for electricity transfers (imports) from connected electricity systems (other states/regions, other countries) to the project electricity system. Generally, no such adjustments are required for the build margin.

The actual emission reductions achieved by a CDM project are calculated based on the monitored electricity production in each year, and the combined margin (baseline emission factor). The combined margin is initially calculated from the most recent data available at the time of PDD submission. It can then either remain fixed for the duration of the project’s crediting period (ex-ante approach), or be updated annually (ex-post approach). The two approaches have different requirements in terms of data vintage.
### Appendix E – Abbreviations

*In alphabetical order*

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<tr>
<th>Abbreviation</th>
<th>Full Name</th>
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<td>ACM0002</td>
<td>Approved Consolidated Methodology by CDM Executive Board for grid connected large scale renewable project</td>
</tr>
<tr>
<td>AMS-I.D</td>
<td>Approved Methodology for small scale grid connected renewable projects</td>
</tr>
<tr>
<td>BM</td>
<td>Build margin</td>
</tr>
<tr>
<td>CDM</td>
<td>Clean Development Mechanism</td>
</tr>
<tr>
<td>CEA</td>
<td>Central Electricity Authority</td>
</tr>
<tr>
<td>CER</td>
<td>Certified Emission Reduction</td>
</tr>
<tr>
<td>CM</td>
<td>Combined margin</td>
</tr>
<tr>
<td>CO₂</td>
<td>Carbon Dioxide</td>
</tr>
<tr>
<td>FY</td>
<td>Financial Year</td>
</tr>
<tr>
<td>GCV</td>
<td>Gross Calorific Value</td>
</tr>
<tr>
<td>GHG</td>
<td>Greenhouse Gases</td>
</tr>
<tr>
<td>GWH</td>
<td>Gigawatt Hour</td>
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<td>IEA</td>
<td>International Energy Agency</td>
</tr>
<tr>
<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
</tr>
<tr>
<td>IPP</td>
<td>Independent Power Producer</td>
</tr>
<tr>
<td>MW</td>
<td>Megawatt</td>
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<td>OM</td>
<td>Operating margin</td>
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<td>PDD</td>
<td>Project Design Document</td>
</tr>
<tr>
<td>RLDC</td>
<td>Regional Load Dispatch Centre</td>
</tr>
<tr>
<td>RPC</td>
<td>Regional Power Committee</td>
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<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
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</table>
CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004

CONTENTS

A. General description of project activity
B. Application of a baseline methodology
C. Duration of the project activity / Crediting period
D. Application of a monitoring methodology and plan
E. Estimation of GHG emissions by sources
F. Environmental impacts
G. Stakeholders' comments

Annexes

Annex 1: Contact information on participants in the project activity
Annex 2: Information regarding public funding
Annex 3: Baseline information
Annex 4: Monitoring plan
SECTION A. General description of project activity

A.1 Title of the project activity:

22.5 MW Bhilangana Hydro Power Project (BHPP)
Version 02
Date: 12th September 2006

A.2 Description of the project activity:

Swasti Power Engineering Limited (SPEL) is developing the 22.5 MW hydro electric power project on the Bhilangana River. The project is a run-of-the river hydroelectric project, which envisages harnessing the perennial waters of Bhilangana River – a major tributary of the River Bhagirathi. The purpose of the project is to generate environmentally clean electricity and contribute towards meeting the acute regional power requirements. Except for some small flourmills which harness the running water to run the mills, the water potential of the river remains un-utilized. The project will supply electricity to Northern grid.

Contribution of the project activity to Sustainable Development

As per Government of India the following indicators for sustainable development have been stipulated in the interim approval guidelines for CDM projects:

- Social well being
- Economic well being
- Environmental well being
- Technological well being

The performance of the Bhilangana hydro power project across the above indicators is as follows:

Social well being:

The project activity would result in the employment of the local people during the construction and operation phases. The project activity being a run-of the river project does not result in any displacement of local people.

The irrigation facilities tend to dry up in the lean discharge months because of the lack of adequate intake diversion structures. Provision of sacrifice discharge to the tune of 0.25 m³/s has been made in the design of the scheme to guarantee a perennial supply of water needed for the irrigation channel downstream.

Economic well being:

The northern grid is facing shortage of electrical power and thereby stunting the economic growth. The project activity will be a move towards bridging the supply and demand gap. During construction and operation of the project, employment would be generated for the local population.

Environmental well being:

The project will result in generation of clean and green power without any GHG emissions. Also, since it is a run-of-the river project there is no storage and hence no submergence. Though no deforestation is

1 http://www.envfor.nic.in/cc/cdm/criteria.htm
required in the project activity still budget for afforestation has been provided. Fish ladder has been provided for free movement of fish on either side of the diversion weir.

**Technological well being:**

Highly efficient turbines and generators are being used in the project and the power transmission will be at high voltage to ensure low losses.

This demonstrates that the project activity contributes positively towards sustainable development.

### A.3. Project participants:

<table>
<thead>
<tr>
<th>Name of Party involved ([host] indicates a host Party)</th>
<th>Private and/or public entity (ies) project participants (as applicable)</th>
<th>The Party involved wishes to be considered as project participant (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>India (host)</td>
<td>Swasti Power Engineering Limited (SPEL)</td>
<td>No</td>
</tr>
</tbody>
</table>

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

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

#### A.4.1.1. Host Party(ies):

India

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

Uttaranchal

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

Ghansali Village, Tehri Garhwal District

#### A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

The project activity is located a few kilometres North of Ghansali township (Longitude 78°34'30", Latitude 30°25'41"). The project site is about 45 kilometers from the origin of River Bhilangana. The topography of the area is rugged. The project area is within the main Himalayan belt, a tectona-litho stratigraphic belt, with the granite-gneiss of the Central Himalayan Crystallines in the northern part, and the quartzites with associated metabasics of the Garhwal group in the southern part. The access road to the project site is the Tehri-Ghansali-Koti Road.
A.4.2. Category(ies) of project activity:

The project activity falls under Scope Number 1: Energy industries (renewable - / non-renewable sources) as per the Sectoral Scopes of the project activities enlisted in the ‘List of Sectoral Scopes’ (Version 4) for accreditation of operational entities.

A.4.3. Technology to be employed by the project activity:

The scheme comprises of Boulder Weir 44 m long and 5 m high with an intake structure to divert and regulate the waters into the 594.17 m long horse shoe shaped interconnecting tunnel, which leads the water into a 117 m long, 12.6 m wide and 16 m high D-shaped underground desilting tank. The silt free water is led to a surge shaft via a 4.0 m dia horse shoe shaped Head Race Tunnel (HRT), which is in two parts namely HRT-1 and HRT-2 with an aqueduct in between the two tunnels for crossing of the Phelenda Nala. HRT-2 terminates into the circular surge shaft of 12 m dia and 39 m high. Following the surge shaft at the exit portal emerges a single steel penstock of 3.25 m dia and 370 m long, which trifurcates into three branches of 1875 m dia just before entering the powerhouse. The powerhouse is a surface type power house, which houses three Francis type turbo generators – each of 7.5 MW capacity. The tail water emerging out from the three machines is led back to Bhilangana River via a short tailrace channel.

The project activity would be incorporating the latest / state-of-the-art technologies available in the field of hydro electric power generation as given by the Central Electricity Authority of India² i.e.,:

- Use of digital turbine governors for speed regulation of hydro turbines
- Computerised Control System for control of generating unit, station & units, auxiliaries, H. V. Switchgear, Intake Gates etc.
- Gas Insulated Switchgear as it involves minimum maintenance and much lesser space to install.

No import of technology is involved in the project activity.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

As the project is a run-of-the river hydro electric project, there are no GHG emissions from the project. The BHPP will be supplying power to the Northern grid which comprises mainly of coal (61.6%) and gas (11.5%) based power plants (please refer Annex 3). It displaces conventional energy equivalent of 1219.56 GWh thereby resulting in total emission reduction of 1,093,040 tons of CO₂e over ten years crediting period. No appreciable transmission and distribution losses will occur since the power from the project site will be evacuated at a high voltage of 220 kV for a relatively short distance. In the absence of the project activity, equivalent electrical load would have been taken up by the grid mix, which is mainly dominated by fossil fuel based power plants leading to GHG emissions. Thus the BHPP would help in reducing the anthropogenic GHG emissions as per the combined margin carbon intensity of the Northern Grid.

² [http://www.cea.nic.in/hydro/Special_reports/best_practises/index.pdf](http://www.cea.nic.in/hydro/Special_reports/best_practises/index.pdf)
A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

Total estimated emission reductions of 1,093,040 tonnes of CO₂ are expected by the BHPP over the fixed crediting period of ten years.

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<td>2016 - 17</td>
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</table>

Total estimated reductions (tonnes of CO₂e) 1,093,040

Total number of crediting years 10

Annual average over the crediting period of estimated reductions (tonnes of CO₂e) 109,304

A.4.5. Public funding of the project activity:

No public funding from parties included in Annex – I is involved in the project activity.
SECTION B. Application of a baseline methodology

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

Title: “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

The methodology applicable is the approved consolidated baseline methodology ACM0002 because it satisfies the following applicability criteria:

- It is electricity capacity addition to the grid from a run-of-river hydro power plant;
- The project activity does not involve switching from fossil fuels to renewable energy at the site of the project activity;
- The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available.

Grid Selection

The electrical transmission system in India is divided into five regions - Northern, Eastern, Western, Southern and North-Eastern regions. Since the project activity is coming in the northern region so Northern regional electricity grid has been taken as the baseline. The Northern Regional Electricity Board comprises of the following states namely Delhi, Haryana, Himachal Pradesh, Jammu & Kashmir, Punjab, Rajasthan, Uttar Pradesh and Uttarakhand.

B.2. Description of how the methodology is applied in the context of the project activity:

In the selected approved consolidated methodology ACM0002 - version 06, the following approaches have been suggested for the identification of baseline:

- "Existing actual or historical emissions, as applicable"
  Or
- "Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment"

And also it is suggested that the baseline scenario for project activities that do not modify or retrofit existing electricity generation facility is the electricity delivered to the grid which would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources.

The latter approach has been adopted to identify the baseline. The calculation of baseline emission ($BE_y$ in tCO$_2$) is done by multiplying the electricity baseline emission factor ($EF_y$) and the electricity exported to the grid ($EG_y$). The electricity baseline emission factor ($EF_y$) is estimated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors. The steps involved in the estimation of baseline emission factor are discussed in section D 2.1.4 and the key information and data are given in annexure 3.
**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 CDM project activity:**

The project activity is additional compared to baseline scenario, which is discussed by using the “Tool for the demonstration and assessment of additionality - version 02 - 28 November 2005” in the following paragraphs:

**Step 0. Preliminary screening based on the starting date of the project activity**

SPEL wishes to have the crediting period starting after the project gets registered. The expected start of the crediting period is after 31st December 2005, since the project activity would start operating only in the year 2007, so step 0 does not apply to the BHPP activity.

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

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

The alternatives available with SPEL which are realistic, credible and provide outputs comparable with the BHPP activity are:

1. The project activity not undertaken as a CDM project;
2. A diesel based power project with equivalent power output;
3. A gas based power project with equivalent power output;
4. A coal based power project with equivalent power output;
5. Continuation of the current situation in the northern grid with no project activity or alternatives undertaken.

**Sub-step 1b. Enforcement of applicable laws and regulations:**

The alternatives mentioned above are in compliance with the applicable legal and regulatory requirements.

**Alternative 1: The project activity not undertaken as a CDM project**

As the project faces various barriers discussed in step 3, this alternative cannot be undertaken without CDM consideration.

**Alternative 2: A diesel based power project with equivalent power output**

In this scenario, the users will draw electricity from Northern region grid with inclusive of equivalent capacity of diesel based power project. This scenario is not economically viable due to high price of diesel. Hence this option is not available with SPEL for consideration.

**Alternative 3: A gas based power project with equivalent power output**

Since gas availability at the project site is economically not feasible. Hence this option is not available with SPEL for consideration.

**Alternative 4: A coal based power project with equivalent power output.**

In this scenario, the users will draw electricity from Northern region grid with inclusive of equivalent capacity of Coal based power project. But again the feasibility of this project is questionable as the availability of fuel at viable cost at the project site is difficult. Hence this option also cannot be considered by SPEL.

**Alternative 5: Continuation of the current situation in the northern grid with no project activity**

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.
In this scenario, the current grid mix will continue without any inclusion. This option is the most likely alternative in the absence of the project activity.

From the above discussions, it is clear that the realistic and credible alternative option to the project activity is:

Alternative 5 – Continuation of the current situation in the northern grid with no project activity

Step 2. Investment analysis

The addiality of the project has been demonstrated by the following step – Barrier analysis.

Step 3. Barrier analysis

For the BHPP, barrier analysis has been undertaken to indicate that the proposed project activity faces barriers that prevent the baseline scenario from occurring and therefore the project activity is additional. In this step it has been shown that the BHPP activity faces barriers that:

a) Prevent the implementation of this type of project; and
b) Do not prevent the implementation of at least one of the alternatives.

Sub-step 3a. Identify barriers that would prevent the implementation of type of the proposed project activity:

The following barriers have been identified that would prevent the implementation of the BHPP from being carried out if the project activity were not to be registered as a CDM activity:

Investment barriers

SPEL is a family promoted company; the promoters had to liquidate a large portion of their properties and assets to fund the project. The risks that prevent the financial institutions from funding the project are as follows:

(a) Hydrological risks – Bhilangana is a snow-fed as well as rain-fed river and carries discharges all year round but there was absence of long-term hydrological data initially. The BHPP being a run-of-the river project, the generation from the project varies as per the pattern of the river discharges. Therefore, to arrive at the power potential short term discharge data was recorded and long term hydrological database for the Bhilangana basin was extracted from the data of Bhagirathi. Also, the Bhilangana’s catchment area is prone to severe storms occasionally resulting into cloudbursts and associated flash floods which could damage the project.

(b) Geological risks – The BHPP lies in the seismic zone IV of the Seismic Zone Map of India. The Phalenda nala lies along a fault line from where the intake tunnel passes. This plane of fault could act as a zone for the release of earth strain. Displacement of rock on either side of the tunnel is possible and this movement could damage the project activity.

(c) Environmental risks - SPEL had the option of taking water to the powerhouse via a channel or a tunnel. Although the option of channel is economically cheaper to implement as compared to that of a tunnel, but it is environmentally more degrading and results in higher emissions during construction. Therefore, SPEL has opted for the tunnel route in spite of the fact that it requires higher investments but is an environmental friendly option.

(d) Implementation risks – The promoter group is not established in hydro power generation. This could lead to time/cost overruns for the project. The BHPP being in a hilly region with the
associated hydrological and geological risks can result in time/cost over-runs due to lack of proper project management practices.

(e) Transmission risks - The evacuation of power from the BHPP to the grid would require construction of a 39 km transmission line. This transmission line has to be laid in the hilly terrain which is a difficult task and involves significant investments.

Barriers due to prevailing practice

The various small hydro power plants (1 to 25 MW) operating in the state of Uttaranchal are as follows:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of Scheme</th>
<th>Installed Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pathri</td>
<td>20.40</td>
</tr>
<tr>
<td>2</td>
<td>Mohammadpur</td>
<td>9.30</td>
</tr>
<tr>
<td>3</td>
<td>Galogi</td>
<td>3.00</td>
</tr>
<tr>
<td>4</td>
<td>Urgam</td>
<td>3.00</td>
</tr>
<tr>
<td>5</td>
<td>Kanchauti</td>
<td>2.00</td>
</tr>
<tr>
<td>6</td>
<td>Chhirkila</td>
<td>1.50</td>
</tr>
<tr>
<td>7</td>
<td>Kulagad</td>
<td>1.20</td>
</tr>
<tr>
<td>8</td>
<td>Sobla</td>
<td>6.00</td>
</tr>
<tr>
<td>9</td>
<td>Durgapur</td>
<td>1.15</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>47.55</strong></td>
</tr>
</tbody>
</table>

All these plants are operated by the state authority and as per the latest available statistics there is no independent power producer in Uttaranchal. There is no private party producing power in the state of Uttaranchal as per the available statistics on hydro electric plants given by Central Electricity Authority (CEA). The BHPP activity will be the first of its kind independent power producer (IPP) of its size coming up in the state of Uttaranchal. The BHPP activity would thus be setting the precedence and thus would encourage other private investors to come up for the development of the tremendous hydro power potential existent in the state of Uttaranchal.

Other barriers

The other barriers which are associated with the BHPP hindering its implementation are:

- (a) In the downstream of the river Tehri dam has been constructed on the river Bhagirathi resulting in inundation of large area of land and displacement of the local populace. This has resulted in apprehensions in the mind of some of local populace that a hydro project essentially results in land inundation and displacements. So, some of them are against the putting up of this run-of-the river hydropower project although it does not involve any displacement. Since the project is a run-of-the river project and does not require building up a dam for water storage, so land inundation due to the BHPP is minimal which is limited to diversion of agricultural/forest land at diversion dam and also in the path of the tunnel/channel/tail end channel.

- (c) The region falls under seismically sensitive and unsafe zone therefore the apprehensions of destructions caused by the boulder weir and the tunnel can not be ignored. A 2 km long tunnel is to be

---

4 http://www.cea.nic.in/hydro/List%20of%20Hydroelectric%20Stations%20in%20the%20Country.htm
built to take the river water to the turbine using blasting method. Blasting can cause minor to major landslip in the region. Even minor adjustment of rocks can cause relocation of natural water sources to further intensify the woes of the local population.

(e) Since the BHPP is located in a remote area so SPEL is facing problems in getting skilled manpower for the project. The reluctance of skilled people to come and work in a remote location is to be tackled by devising higher compensation structure.

(f) The project is situated in the newly formed state of Uttaranchal, which was carved out from Uttar Pradesh in the year 2001. The project was allotted earlier by Uttar Pradesh and since it lies in Uttaranchal, so SPEL had to negotiate terms with the new state, i.e., Government of Uttaranchal (GoU). GoU took about 2 years to finalize its own power policy which was eventually brought out in December 2002. Owing to unclear policies of GoU, the formation of the new state and the time taken in crystallization of GoU’s power policy, SPEL has faced many problems.

Sub-step 3b. Show that the Identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity):

As discussed in substep 3a, the BHPP has many associated barriers in its successful implementation. The barriers are arising due to the location of the project activity, which is in the hilly terrain. The above mentioned barriers though do not prevent alternatives 2, 3 and 4 from happening. Alternative 5 wherein there is no investment involved and the status quo of the grid is maintained, i.e., Continuation of the current situation in the northern grid with no project activity is the most likely baseline scenario.

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity:

The estimated potential of Small Hydro Power (SHP) i.e., less than 25 MW in India is about 15,000 MW. As of 31st December 2005 only 1,747.98 MW5 has been developed, this corresponds to only 11.65% of the identified potential. The database for SHP projects created by MNES in 2005-2006 includes 4404 potential sites with an aggregate capacity of 10,477 MW. In North India most of the SHP projects and capacity are located in the states of Uttaranchal, Himachal Pradesh and Jammu & Kashmir.

The statistics for these states (as on 31st December 2005) are as follows5:

<table>
<thead>
<tr>
<th>State</th>
<th>Identified no. of sites</th>
<th>Total Capacity (MW)</th>
<th>Project Set-up</th>
<th>Projects ongoing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>No.s</td>
<td>Capacity (MW)</td>
</tr>
<tr>
<td>Uttaranchal</td>
<td>354</td>
<td>1478.24</td>
<td>76</td>
<td>75.45</td>
</tr>
<tr>
<td>Himachal Pradesh</td>
<td>323</td>
<td>1624.78</td>
<td>53</td>
<td>119.08</td>
</tr>
<tr>
<td>Jammu &amp; Kashmir</td>
<td>201</td>
<td>1207.27</td>
<td>30</td>
<td>109.74</td>
</tr>
<tr>
<td>Total</td>
<td>878</td>
<td>4310.29</td>
<td>159</td>
<td>304.27</td>
</tr>
</tbody>
</table>

As can be seen from the above statistics, only 7.06% of the identified SHP potential has been developed in these states and that too the sites are of less than 5 MW size if average is taken. Moreover, the latest list6 (as on 30-04-2006) of hydro-electric stations in India above 3 MW shows that there is no reference of any private party hydroelectric station in the state of Uttaranchal. The existing hydro-electric stations are

5 http://mnes.nic.in/frame.htm?publications.htm

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.
being operated by the state body - Uttaranchal Jal Vidyut Nigam (UJVNL). There clearly indicates that carrying out a project similar to the BHPP as an Independent Power Producer (IPP) is not a common practice as of date.

Also, as per the latest available statistics by the CEA of the total identified hydro-electric potential in the state of Uttaranchal is 18175 MW of which only 1802 MW has been developed representing only 9.9 % of the total potential.

Sub-step 4b. Discuss any similar options that are occurring:

As observed from the statistics given in the sub-step above it is very much clear that similar options as that of the BHPP is not existent as of now. The average capacity of the projects already set-up comes to 1.87 MW and that of ongoing projects is 2.22 MW. Thus it indicates that there are hydro power projects coming up in these regions but the capacity of them is very small and usually in the range of 1-5 MW.

Step 5. Impact of CDM registration

The impact of CDM registration of the BHPP would be very much beneficial and multi-fold. It would help in overcoming the barriers identified as above. SPEL has taken the initiative to develop the BHPP as a CDM project and pave the way for others also to follow suit. The financial incentive due to CDM revenues would attract more parties for the development of the identified SHP existing in the region. As has been seen by the statistics presented in sub-step 4a, there is tremendous potential of generating clean power by the development of SHP potential identified. All these potential sites are usually in the hilly regions and thereby posing similar barriers as mentioned above. Thus CDM registration would give a boost towards the development of these projects and help in the reduction of anthropogenic greenhouse gas.

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

As per definition project boundary shall encompass all anthropogenic emissions by sources of greenhouse gases (GHG) under the control of the project participants that are significant and reasonably attributable to the CDM project activity.

The BHPP activity boundary covers the point of water supply (Penstock entry) to the point of power generation and export to the grid, where SPEL has full control. Thus the project boundary covers the intake water structures, turbine, generator, control systems, auxiliary units, synchroniser and the power evacuation system.

According to the approved consolidated baseline methodology ACM 0002 the spatial extent of the project boundary includes the project site and all power plants connected physically to the electricity system that the CDM project power plant is connected to.

For the purpose of determining the build margin (BM) and operating margin (OM) emission factor, a (regional) project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints.

http://www.cea.nic.in/hydro/Status%20of%20Hydroelectric%20Potential%20Development.pdf

http://www.cea.nic.in/hydro/List%20of%20Hydroelectric%20Stations%20in%20the%20Country.htm
The BHPP evacuates the power to the northern grid therefore all the power plants contributing to the northern regional grid are taken for the calculation of baseline emission.
B.5. Details of baseline information, including the date of completion of the baseline study and the name of person(s)/entity(ies) determining the baseline:

Refer Annex 3, for details of baseline information

Date of completion of the baseline study - 05/09/2006

SPEL has determined the baseline for the project activity. SPEL contact details have been provided in Annex-I.
### SECTION C. Duration of the project activity / Crediting period

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

| C.1.1. Starting date of the project activity: | 16/10/2003 |
| C.1.2. Expected operational lifetime of the project activity: | 35 years |

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

| C.2.1. Renewable crediting period |
| C.2.1.1. Starting date of the first crediting period: | Not Applicable |
| C.2.1.2. Length of the first crediting period: | Not Applicable |

| C.2.2. Fixed crediting period: |
| C.2.2.1. Starting date: | 16/04/2007 |
| C.2.2.2. Length: | 10 years |
SECTION D. Application of a monitoring methodology and plan

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

Title: Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources


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

The applicability criteria of the approved consolidated monitoring methodology ACM 0002 and the explanation of how the project activity will meet the criteria are discussed below:

- Applies to electricity capacity additions from
  - Run-of-river hydro power plants; hydro power projects with existing reservoirs where the volume of the reservoir is not increased.
  - Wind sources;
  - Geothermal sources;
  - Wave and tidal sources.

The project activity is electricity capacity addition to the grid from a run-of-river hydro power plant;

- This methodology is not applicable to project activities that involve switching from fossil fuels to renewable energy at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site;

  There is no fossil fuel switch over to renewable energy at the project site in the project activity

- The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available;

  As explained in section B 1.1, Northern region grid is selected as grid boundary to estimate the baseline emission factor based on the location of the project activity. Information about the power plants located in northern region, electricity generation details are available. The details are given in Annex 3.
D.2.1. **Option 1: Monitoring of the emissions in the project scenario and the baseline scenario**

There are no emissions associated with the BHPP activity. Therefore this section is not applicable.

<table>
<thead>
<tr>
<th>ID number</th>
<th>Data variable</th>
<th>Source of data</th>
<th>Data unit</th>
<th>Measured (m), calculated (c) or estimated (e)</th>
<th>Recording frequency</th>
<th>Proportion of data to be monitored</th>
<th>How will the data be archived? (electronic/paper)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

D.2.1.2. **Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO₂ eq.)**

Not applicable

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.
D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived:

<table>
<thead>
<tr>
<th>ID number</th>
<th>Data variable</th>
<th>Source of data</th>
<th>Data unit</th>
<th>Measured (m), calculated (c), estimated (e)</th>
<th>Recording frequency</th>
<th>Proportion of data to be monitored</th>
<th>How will the data be archived? (electronic/paper)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. EG_y</td>
<td>Electricity supplied to the grid by the BHPP activity</td>
<td>BHPP records / Power Trading Corporation (PTC) records</td>
<td>MWh</td>
<td>m, c, e</td>
<td>hourly measurement and monthly recording</td>
<td>100%</td>
<td>Electronic, The data be kept during the crediting period and two years after</td>
<td>Used for baseline emission calculation</td>
</tr>
</tbody>
</table>

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO₂ equ.)

With reference to ACM 0002 baseline emissions are estimated as under:

**Calculation of electricity baseline emission factor**

The electricity baseline emission factor (EFₘₐₓ) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors according to the following three steps. Calculations for this combined margin must be based on data from an official source (where available) and made publicly available.

**STEP 1. Calculate the Operating Margin emission factor(s)**

Out of the four methods mentioned in ACM 0002, simple OM approach has been chosen for calculations since the low-cost/must run resources constitute less than 50% of the total grid generation in the Northern grid mix. Simple OM factor is calculated as under.

\[ EF_{OM, \text{simple}} = \frac{\text{average of the most recent three years (2003-2004, 2004-2005, and 2005-2006)}}{\text{total grid generation}} \]
\[ EF_{OM, simple, y} = \sum_{i,j} F_{i,j,y} \times COEF_{i,j} I \sum_{j} GEN_{j,y} \]

Where

- \( COEF_{i,j} \) - is the \( CO_2 \) emission coefficient of fuel \( i \) (\( t CO_2 \) / mass or volume unit of the fuel), calculated as given below and

- \( GEN_{j,y} \) - is the electricity (MWh) delivered to the grid by source \( j \)

- \( F_{i,j,y} \) - is the amount of fuel \( i \) (in a mass or volume unit) consumed by relevant power sources \( j \) in year(s) \( y \), calculated as given below

- \( j \) - refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports from the grid

The Fuel Consumption \( F_{i,j,y} \) is obtained as

\[ \sum_{i} F_{i,j,y} = \left( \sum_{j} GEN_{j,y} \times 860 \right) \left/ \left( NCV_{i} \times E_{i,j} \right) \right. \]

Where

- \( GEN_{i,j} \) - is the electricity (MWh) delivered to the grid by source \( j \)

- \( NCV_{i} \) - is the net calorific value (energy content) per mass or volume unit of a fuel \( i \)

- \( E_{i,j} \) - is the efficiency (%) of the power plants by source \( j \)

The \( CO_2 \) emission coefficient \( COEF_{i} \) is obtained as

\[ COEF_{i} = NCV_{i} \times EF_{CO_2,i} \times OXID_{i} \]

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.
Where

\[ NCV_i \] - is the net calorific value (energy content) per mass or volume unit of a fuel \( i \)

\[ EFCO_2,i \] - is the CO₂ emission factor per unit of energy of the fuel \( i \)

\[ OXID_i \] - is the oxidation factor of the fuel

**STEP 2. Calculation of the Build Margin emission factor (EF_{BM,y})**

It is calculated as the generation-weighted average emission factor (t CO₂/MWh) of a sample of power plants \( m \) of grid, as follows:

\[
EF_{BM,y} = \sum_{i,m} F_{i,m,y} \times COEF_{i,m} \times \sum_{m} GEN_{m,y}
\]

Where

\( F_{i,m,y}, COEF_{i,m} \) and \( GEN_{m,y} \) - are analogous to the variables described for the simple OM method above for plants \( m \).

Considered calculations for the Build Margin emission factor \( EF_{BM,y} \) as ex ante based on the most recent information available on plants already built for sample group \( m \) of northern grid at the time of PDD submission. The sample group \( m \) consists of the 20% of power plants supplying electricity to grid that have been built most recently, since it comprises of larger annual power generation. (Refer Annex 3)

Further, none of the power plant capacity additions in the sample group have been registered as CDM project activities.

**STEP 3. Calculate the electricity baseline emission factor (EF_{y})**

It is calculated as the weighted average of the Operating Margin emission factor (EF_{OM_simple,y}) and the Build Margin emission factor (EF_{BM,y}):

\[
EF_y = W_{OM} \times EF_{OM_simple,y} + W_{BM} \times EF_{BM,y}
\]

where the weights \( W_{OM} \) and \( W_{BM} \), by default, are 50% (i.e., \( W_{OM} = W_{BM} = 0.5 \)), and \( EF_{OM\_simple,y} \) and \( EF_{BM,y} \) are calculated as described in Steps 1 and 2 above and are expressed in t CO₂/MWh.

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.
\[ BE_y = EF_y \times EG_y \]

Where

- \( BE_y \) are the baseline emissions due to displacement of electricity during the year \( y \) in tons of \( \text{CO}_2 \)
- \( EG_y \) is the net quantity of electricity generated by the project activity during the year \( y \) in MWh, and
- \( EF_y \) is the \( \text{CO}_2 \) baseline emission factor for the electricity displaced due to the project activity in during the year \( y \) in tons \( \text{CO}_2/\text{MWh} \).

**D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity** (values should be consistent with those in section E).

Not Applicable

**D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:**

<table>
<thead>
<tr>
<th>ID number (Please use numbers to ease cross-referencing to table D.3)</th>
<th>Data variable</th>
<th>Source of data</th>
<th>Data unit</th>
<th>Measured (m), calculated (c), estimated (e),</th>
<th>Recording frequency</th>
<th>Proportion of data to be monitored</th>
<th>How will the data be archived? (electronic/paper)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Not Applicable

**D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of \( \text{CO}_2 \ equ.):**

Not Applicable

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.
### D.2.3. Treatment of leakage in the monitoring plan

#### D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

<table>
<thead>
<tr>
<th>ID number (Please use numbers to ease cross-referencing to table D.3)</th>
<th>Data variable</th>
<th>Source of data</th>
<th>Data unit</th>
<th>Measured (m), calculated (c) or estimated (e)</th>
<th>Recording frequency</th>
<th>Proportion of data to be monitored</th>
<th>How will the data be archived? (electronic/paper)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO₂ equ.)

Not Applicable.

#### D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO₂ equ.)

Formula used for estimation of the total net emission reductions due to the project activity during a given year y is as under:

\[ ER_y = BE_y - PE_y - L_y \]

Where,

- \( ER_y \) - are the emissions reductions of the project activity during the year y in tons of CO₂
- \( BE_y \) - are the baseline emissions due to displacement of electricity during the year y in tons of CO₂
- \( PE_y \) - are the project emissions associated with the project
- \( L_y \) - are the emissions sources as leakage

Since \( PE_y \) and \( L_y \) are zero therefore the equation reduces to

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.
D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

<table>
<thead>
<tr>
<th>Data (Indicate table and ID number e.g. 3.1.; 3.2.)</th>
<th>Uncertainty level of data (High/Medium/Low)</th>
<th>Explain QA/QC procedures planned for these data, or why such procedures are not necessary.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. EGy – Electricity supplied to the grid by the project activity</td>
<td>Low</td>
<td>Electricity meters would be properly maintained with regular testing and calibration schedules developed as per the technical specification requirements to ensure accuracy</td>
</tr>
</tbody>
</table>
D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity.

The BHPP activity contributes towards emission reductions by generation of electricity by harnessing the hydropower. Therefore the emission reductions would be monitored by the net electricity delivered to the grid by the project activity. The BHPP control and monitoring system will be based on programmable logic control (PLC). There are no leakages involved in the project activity. SPEL would implement an operational and management structure to monitor the emission reductions generated by the project activity.

The operational and management structure would be as follows:

Shift In-charge → Project Manager → Management

Shift in-charge would be assigned with the responsibility of monitoring and recording of electricity supplied to the grid as per the monitoring plan. On a weekly basis, the monitoring reports would be checked and discussed with project manager. In case of any irregularity observed, necessary action would be taken immediately. On monthly basis, these reports would be forwarded to the management. The project manager would be a qualified engineer with 15-20 years of experience in power sector and all shift in-charges would also be qualified engineers with 8-10 years of relevant experience. The details of the same are mentioned in Annex 4: Monitoring plan.

D.5 Name of person/entity determining the monitoring methodology:

SPEL the project participant, along with guidance from the project consultants has determined the monitoring plan for the project activity.
SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

There are no GHG emissions arising from the project it being a hydro electric project. i.e., PE$_y$=0

E.2. Estimated leakage:

The main emissions potentially giving rise to leakage in the context of hydro electric sector projects are emissions arising due to activities such as power plant construction. As per the methodology ACM0002, project participants do not need to consider these emission sources as leakage in applying this methodology. Therefore no emissions related to leakage have been considered in this project.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

Total project activity emissions are zero over a 10 year crediting period

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

Baseline emissions (BE$_y$) are calculated using the formula:

$$BE_y = EF_y \times EG_y$$

Where,

$EG_y = 121.956 \text{ GWh/annum}$

$EF_y = 0.89626 \text{ tCO}_2/\text{GWh}$

The net annual baseline emissions are = 109,304 tonnes of CO$_2$

<table>
<thead>
<tr>
<th>Year</th>
<th>Estimation of Net Electricity supplied to the facility, EG$_y$ (GWh/annum)</th>
<th>Estimation of Emission factor, tCO$_2$/GWh</th>
<th>Estimation of baseline emissions (tonnes of CO$_2$e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007 - 08</td>
<td>121.956</td>
<td>896.26</td>
<td>109,304</td>
</tr>
<tr>
<td>2008 - 09</td>
<td>121.956</td>
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</tr>
<tr>
<td>2009 - 10</td>
<td>121.956</td>
<td>896.26</td>
<td>109,304</td>
</tr>
<tr>
<td>2010 - 11</td>
<td>121.956</td>
<td>896.26</td>
<td>109,304</td>
</tr>
<tr>
<td>2011 - 12</td>
<td>121.956</td>
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<td>2012 - 13</td>
<td>121.956</td>
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<tr>
<td>2014 - 15</td>
<td>121.956</td>
<td>896.26</td>
<td>109,304</td>
</tr>
<tr>
<td>2015 - 16</td>
<td>121.956</td>
<td>896.26</td>
<td>109,304</td>
</tr>
<tr>
<td>2016 - 17</td>
<td>121.956</td>
<td>896.26</td>
<td>109,304</td>
</tr>
<tr>
<td>Total</td>
<td><strong>1219.56</strong></td>
<td></td>
<td><strong>1,093,040</strong></td>
</tr>
<tr>
<td></td>
<td>(tonnes of CO$_2$e)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

Emissions reductions (ER_y) are calculated using formula:

\[
ER_y = BE_y - PE_y - L_y
\]

Since project emissions (PE_y) and leakages (L_y) are zero, the emission reductions are equal to baseline emissions as given in table below.

### E.6. Table providing values obtained when applying formulae above:

<table>
<thead>
<tr>
<th>Year</th>
<th>Estimation of project activity emissions (tonnes of CO₂e)</th>
<th>Estimation of baseline emissions (tonnes of CO₂e)</th>
<th>Estimation of leakage (tonnes of CO₂e)</th>
<th>Estimation of emission reductions (tonnes of CO₂e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007 - 08</td>
<td>0</td>
<td>109,304</td>
<td>0</td>
<td>109,304</td>
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<tr>
<td>2008 - 09</td>
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<tr>
<td>2009 - 10</td>
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<td>2010 - 11</td>
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<td>0</td>
<td>109,304</td>
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<tr>
<td>2011 - 12</td>
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<td>0</td>
<td>109,304</td>
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<tr>
<td>2012 - 13</td>
<td>0</td>
<td>109,304</td>
<td>0</td>
<td>109,304</td>
</tr>
<tr>
<td>2013 - 14</td>
<td>0</td>
<td>109,304</td>
<td>0</td>
<td>109,304</td>
</tr>
<tr>
<td>2014 - 15</td>
<td>0</td>
<td>109,304</td>
<td>0</td>
<td>109,304</td>
</tr>
<tr>
<td>2015 - 16</td>
<td>0</td>
<td>109,304</td>
<td>0</td>
<td>109,304</td>
</tr>
<tr>
<td>2016 - 17</td>
<td>0</td>
<td>109,304</td>
<td>0</td>
<td>109,304</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>1,093,040</td>
<td>0</td>
<td>1,093,040</td>
</tr>
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</table>
SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

The environmental impacts associated with the project activity are as follows:

Impact on Flora and Fauna

As there is no storage of water involved in the project so there is no submergence of the forests, cultivable land or of the inhabited areas. The project structures to be constructed are small in size to cause an appreciable disturbance to the eco-system during the construction as well as operational phase. The construction debries are also likely to be small and measures for appropriate disposal of the same have been planned and would be carried out. No deforestation is required at the weir location. Cutting of few trees along the water conductor system is inescapable, but it has been kept to a bare minimum by suitably re-orienting the structures where possible. Fish ladder will also be provided in the project activity. The project has got the final sanction for the forest and Government land for a total of 8.9705 Hectares through 3 different orders of Government of Uttaranchal dated 4th August 2004 and 1st June 2005. Acquisition of private land will be carried out as per mutual agreements.

Socio-Economic Impact

Load survey studies have indicated that the people in the influence area are desirous of having electric power facility. The construction and operational phase of the project will also give rise to employment opportunities for the local population.

Environmental Pollution

Since it is a hydro project, there is no issue regarding air pollution. The dust occurring during construction would be suppressed by sprinkling water. On the other hand power generation from the project will result in air quality improvement and emission reductions caused by burning of fossil fuels and firewood.

Impact on Irrigation

The irrigation facilities currently tend to dry up in the lean discharge months because of the lack of adequate intake diversion structures. Provision of sacrifice discharge to the tune on 0.25 cumecs has been made in the design of the scheme to guarantee a perennial supply of water needed for the irrigation channel through the scheme’s intake structures.

From the above discussion it is clear that there is minimal negative impact on the environment due to the project activity.

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

The BHPP is an environmentally benign ‘clean energy’ and cost effective solution to meet the region’s growing energy demands. Efforts have been made to enhance the existing resources and minimize the

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8 Section 12.3.3, Bhilangana H.E. Project (3x7.5 MW), Detailed Project Report, April 2004
adverse impact on the ecosystem through suitable planning. Environmental impact assessment for the project has been carried out and the environmental clearance for the project has been obtained.
SECTION G. Stakeholders’ comments

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

An initial meeting with the local stakeholders was conducted on 31st August 2003 to obtain the no objection certificate (NOC) and to discuss upon the various issues related to the project. On 19th January 2004, the Sub-District Magistrate (SDM), Tehri Garhwal, held a meeting with the villagers at Ghansali and SPEL representatives explained about the project activity and clarified that BHPP being a run-of-the river project will not have any significant adverse effect; there would not be any submergence due to the project activity. Subsequently a meeting on 12th April 2004 was conducted at Ghansali, chaired by the District Magistrate (DM), Tehri Garhwal, to resolve the issues raised by the local villagers. Agreements and Memorandum of Understanding (MoU) with the local villagers have been signed to address the issues raised by the local villagers.

G.2. Summary of the comments received:

The summary of the comments received from the local stakeholders are as follows:

The local people represented by the head of the village(s) raised the following issues with regards to the planned BHPP:

- Inundation of land that would occur due to the hydroelectric project
- Land acquisition required for the project activity
- Damage to crop occurring due to construction activity
- Water availability for irrigation after the project gets commissioned
- Employment generation of local people for the project activity
- Pollution arising due to the project construction
- Health impacts of the project activity
- Deforestation arising due to civil construction
- Social welfare associated with the project activity
- Criminal activities which would arise due to outsiders coming during construction phase

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

Due account has been taken for all the comments received by the local stakeholders. The issues raised by the local people have been addressed as follows:

- Since the project is a run-of-the river project and does not require building up a dam for water storage, so land inundation due to the BHPP is minimal which is limited to diversion of agricultural/forest land at diversion dam and also in the path of the tunnel/channel/tail end channel.
- Land acquisition for the BHPP would be done at the prevailing market rates or the rates provided by the revenue department or on a mutually agreeable basis.
- If any damage to the crop occurs due to the BHPP then SPEL would pay the damages as decided by the local committee
- SPEL would provide water required for irrigation through sacrificial discharge, construct tanks of requisite size and also put up hand-pumps.
- SPEL would offer employment to the local people depending upon their qualification for carrying out the required work.
- Due care will be taken such that pollution occurring during the construction phase is minimum. Water would be sprayed to suppress the dust arising during the construction.
- A doctor would be visiting for the check up of the local people, to take care of the adverse health impacts (if any) that arise to the coming up of the BHPP.
- Due diligence has been done to ensure that deforestation does not occur due to the project and is kept to a minimum. A substantial sum has been allocated for afforestation of the area.
- To improve the conditions of the local people SPEL would be constructing roads, school etc., and also provide monetary aid for the social welfare works annually.
- SPEL would ensure that no person of criminal background is involved in the project and poses a threat to the local people.

To make these issues binding SPEL has signed a deed with the local people.
**Annex 1**

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

<table>
<thead>
<tr>
<th>Table 1.1: Project Proponent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organization:</strong></td>
</tr>
<tr>
<td><strong>Street/P.O.Box:</strong></td>
</tr>
<tr>
<td><strong>Building:</strong></td>
</tr>
<tr>
<td><strong>City:</strong></td>
</tr>
<tr>
<td><strong>State/Region:</strong></td>
</tr>
<tr>
<td><strong>Postfix/ZIP:</strong></td>
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<tr>
<td><strong>Country:</strong></td>
</tr>
<tr>
<td><strong>Telephone:</strong></td>
</tr>
<tr>
<td><strong>FAX:</strong></td>
</tr>
<tr>
<td><strong>E-Mail:</strong></td>
</tr>
<tr>
<td><strong>URL:</strong></td>
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<tr>
<td><strong>Represented by:</strong></td>
</tr>
<tr>
<td><strong>Title:</strong></td>
</tr>
<tr>
<td><strong>Salutation:</strong></td>
</tr>
<tr>
<td><strong>Last Name:</strong></td>
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<tr>
<td><strong>Middle Name:</strong></td>
</tr>
<tr>
<td><strong>First Name:</strong></td>
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<tr>
<td><strong>Mobile:</strong></td>
</tr>
<tr>
<td><strong>Direct FAX:</strong></td>
</tr>
<tr>
<td><strong>Direct tel:</strong></td>
</tr>
<tr>
<td><strong>Personal E-Mail:</strong></td>
</tr>
</tbody>
</table>

**Annex 2**

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.
INFORMATION REGARDING PUBLIC FUNDING

No public funding from Parties included in Annex I is availed for this project activity.
Annex 3

BASELINE INFORMATION

Selection of Grid boundary

In the approved consolidated methodology ACM0002, the following guideline is given for the selection of grid. “Where DNA guidance is not available, in large countries with layered dispatch systems (e.g. state/provincial/regional /national) the regional grid definition should be used. A state/provincial grid definition may indeed in many cases be too narrow given significant electricity trade among states/provinces that might be affected, directly or indirectly, by a CDM project activity”.

As explained earlier in B.1.1, the electrical transmission system in India, is divided into five regions namely Northern Region, North Eastern Region, Eastern Region, Southern Region and Western Region. Northern region grid comprises of Delhi, Punjab, Haryana, Chandigarh, Rajasthan, Jammu & Kashmir, Uttarakhand, Uttar Pradesh and Himachal Pradesh. The location of project activity is in Uttarakhand state which is coming under northern region. Therefore northern grid region is selected as grid boundary to estimate the baseline emission factor.

Key elements to determine baseline for the project activity

The following key parameters are used to estimate the baseline emission factor of the project activity:

<table>
<thead>
<tr>
<th>S No.</th>
<th>Key Parameters</th>
<th>Data Sources</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Coal consumption of each coal fired power plant for the year 2003-04, 2004-05 and 2005-06</td>
<td>Annual Performance review of Thermal power plant (CEA)</td>
<td><a href="http://www.cea.nic.in">www.cea.nic.in</a></td>
</tr>
<tr>
<td>3</td>
<td>Calorific value of coal</td>
<td>NATCOM Report</td>
<td><a href="http://www.natcomindia.org/natcomreport.htm">http://www.natcomindia.org/natcomreport.htm</a></td>
</tr>
</tbody>
</table>
### Emission factor of non-coking coal

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Emission factor (tC/TJ)</th>
<th>Emission factor (tCO₂/TJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas</td>
<td>15.3</td>
<td>56.1 (15.3 x 44/12)</td>
</tr>
<tr>
<td>Non-coking coal</td>
<td>26.13</td>
<td>95.8 (26.13 x 44/12)</td>
</tr>
</tbody>
</table>

### Power generation Mix of Northern Region for five years

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Power Generation (GWh)</td>
<td>150935</td>
<td>154544</td>
<td>168110</td>
<td>172682</td>
<td>180854</td>
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<tr>
<td>Total Thermal Power Generation</td>
<td>113817</td>
<td>115986</td>
<td>122955</td>
<td>126342</td>
<td>132522</td>
</tr>
<tr>
<td>Total Low Cost Power Generation</td>
<td>37117</td>
<td>38559</td>
<td>45154</td>
<td>46339</td>
<td>48332</td>
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<tr>
<td>Thermal % of Total grid generation</td>
<td>75.41</td>
<td>75.05</td>
<td>73.14</td>
<td>73.16</td>
<td>73.28</td>
</tr>
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<td>Low Cost % of Total grid generation</td>
<td>24.59</td>
<td>24.95</td>
<td>26.86</td>
<td>26.84</td>
<td>26.72</td>
</tr>
</tbody>
</table>

### % of Low Cost generation out of Total grid generation - Average of the five most recent years

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<tr>
<th>Year</th>
<th>Average</th>
<th>2001-02</th>
<th>2002-03</th>
<th>2003-04</th>
<th>2004-05</th>
<th>2005-06</th>
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</thead>
<tbody>
<tr>
<td>%</td>
<td>25.99</td>
<td>24.59</td>
<td>24.95</td>
<td>26.86</td>
<td>26.84</td>
<td>26.72</td>
</tr>
</tbody>
</table>

### Generation details

The power generation of power plants falls under Northern grid region for the past three years is given below:

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Fuel</th>
<th>Generation (2003-04) GWh</th>
<th>Generation (2004-05) GWh</th>
<th>Generation (2005-06) GWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anta GPS</td>
<td>Thermal</td>
<td>Gas</td>
<td>2775.92</td>
<td>2595.77</td>
<td>2806.84</td>
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<td>Auriya GPS</td>
<td>Thermal</td>
<td>Gas</td>
<td>4247.41</td>
<td>4119.47</td>
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<td>Project</td>
<td>Type</td>
<td>Fuel</td>
<td>Year 1</td>
<td>Year 2</td>
<td>Year 3</td>
</tr>
<tr>
<td>------------------</td>
<td>----------</td>
<td>-------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
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<tr>
<td>Badarpur TPS</td>
<td>Thermal</td>
<td>Coal</td>
<td>5428.96</td>
<td>5462.78</td>
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<td>Bairasiul</td>
<td>Hydro</td>
<td>Hydel</td>
<td>687.79</td>
<td>689.67</td>
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<td>Bhakra Complex</td>
<td>Hydro</td>
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<td>6956.9</td>
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<td>-</td>
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<td>Gas</td>
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<td>2792.58</td>
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<td>H.P.</td>
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<td>251.73</td>
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<td>J &amp; K</td>
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<td>851.03</td>
<td>1133.41</td>
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<tr>
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<td>23.51</td>
<td>28.31</td>
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<td>NAPS</td>
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<td>Nuclear</td>
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<td>Hydel</td>
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<td>14118.96</td>
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<td>Nuclear</td>
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<td>3480.87</td>
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<tr>
<td>Singrauli STPS</td>
<td>Thermal</td>
<td>Coal</td>
<td>15643.4</td>
<td>15803.34</td>
<td>15502.80</td>
</tr>
<tr>
<td>SJVNL</td>
<td>Hydro</td>
<td>Hydel</td>
<td>1537.92</td>
<td>1617.45</td>
<td>3867.12</td>
</tr>
<tr>
<td>Tanakpur HPS</td>
<td>Hydro</td>
<td>Hydel</td>
<td>510.99</td>
<td>495.17</td>
<td>483.26</td>
</tr>
<tr>
<td>Tanda TPS</td>
<td>Thermal</td>
<td>Coal</td>
<td>2872.81</td>
<td>3254.67</td>
<td>3329.89</td>
</tr>
<tr>
<td>U.P.</td>
<td>Thermal</td>
<td>Coal</td>
<td>20638.05</td>
<td>19788.21</td>
<td>19326.44</td>
</tr>
<tr>
<td>U.P.</td>
<td>Hydro</td>
<td>Hydel</td>
<td>2063.04</td>
<td>2063.04</td>
<td>1244.92</td>
</tr>
<tr>
<td>Unchahar-I TPS</td>
<td>Thermal</td>
<td>Coal</td>
<td>3252.14</td>
<td>3342.83</td>
<td>3544.89</td>
</tr>
<tr>
<td>Unchahar-II TPS</td>
<td>Thermal</td>
<td>Coal</td>
<td>3187.93</td>
<td>3438.28</td>
<td>3501.21</td>
</tr>
<tr>
<td>Uri HPS</td>
<td>Hydro</td>
<td>Hydel</td>
<td>2873.54</td>
<td>2206.71</td>
<td>2724.81</td>
</tr>
<tr>
<td>Uttarakhand</td>
<td>Hydro</td>
<td>Hydel</td>
<td>3452.96</td>
<td>3452.96</td>
<td>3496.87</td>
</tr>
</tbody>
</table>

**TOTAL**

168109.8 | 172681.6 | 180853.9

*Calculation of Operating Margin Emission Factor*

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.
The following table gives a step by step approach for calculating the Simple Operating Margin emission factor for Northern Regional electricity grid for the most recent 3 years at the time of PDD submission i.e. 2003-2004, 2004-2005 & 2005-2006.

<table>
<thead>
<tr>
<th></th>
<th>2003-04</th>
<th>2004-05</th>
<th>2005-06</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation by Coal out of Total Generation (GWh)</td>
<td>102704.29</td>
<td>106451.00</td>
<td>112572.8</td>
</tr>
<tr>
<td>Generation by Gas out of Total Generation (GWh)</td>
<td>20251.12</td>
<td>19890.00</td>
<td>19949.49</td>
</tr>
</tbody>
</table>

### Imports from others

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Imports from WREB (GWh)</td>
<td>282.02</td>
<td>1602.84</td>
<td>2153.23</td>
</tr>
<tr>
<td>Imports from EREB (GWh)</td>
<td>2334.76</td>
<td>3600.58</td>
<td>4112.67</td>
</tr>
</tbody>
</table>

### Fuel 1: Coal

<table>
<thead>
<tr>
<th></th>
<th>2003-04</th>
<th>2004-05</th>
<th>2005-06</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg. Calorific Value of Coal used (kcal/kg)</td>
<td>4593</td>
<td>4593</td>
<td>4593</td>
</tr>
<tr>
<td>Coal consumption (tons/yr)</td>
<td>70,397,000</td>
<td>73,279,000</td>
<td>73,279,000</td>
</tr>
<tr>
<td>Emission Factor for Coal (tonne CO₂/TJ)</td>
<td>95.8</td>
<td>95.8</td>
<td>95.8</td>
</tr>
<tr>
<td>Oxidation Factor of Coal-IPCC standard value</td>
<td>0.98</td>
<td>0.98</td>
<td>0.98</td>
</tr>
<tr>
<td>COEF of Coal (tonne CO₂/ton of coal)</td>
<td>1.806</td>
<td>1.806</td>
<td>1.806</td>
</tr>
</tbody>
</table>

### Fuel 2: Gas

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg. Efficiency of power generation with gas as a fuel, %</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Avg. Calorific Value of Gas used (kcal/kg)</td>
<td>10349</td>
<td>10349</td>
<td>10349</td>
</tr>
<tr>
<td>Estimated Gas consumption (tons/yr)</td>
<td>3,739,808</td>
<td>3,673,119</td>
<td>3,684,105.1</td>
</tr>
<tr>
<td>Emission Factor for Gas-IPCC standard value(tonne CO₂/TJ)</td>
<td>56.1</td>
<td>56.1</td>
<td>56.1</td>
</tr>
<tr>
<td>Oxidation Factor of Gas-IPCC standard value</td>
<td>0.995</td>
<td>0.995</td>
<td>0.995</td>
</tr>
<tr>
<td>COEF of Gas(tonne CO₂/ton of gas)</td>
<td>2.419</td>
<td>2.419</td>
<td>2.419</td>
</tr>
</tbody>
</table>

EF (WREB), tCO₂/GWh  
910.00  
906.00  
884.00  

EF (EREB), tCO₂/GWh  
1186.00  
1178.00  
1158.00  

EF (OM Simple), tCO₂/GWh  
1108.35  
1116.65  
1115.55  

Average EF (OM Simple), tCO₂/GWh  
1113.51  

### List of power plants considered for calculating build margin

During 2005-06, the total power generation in northern grid region was 180,853.94 GWh. Twenty % of total generation is about 36,170.79 GWh. The recently commissioned power plant whose summation of power generation is about 37,608.63 GWh is considered for the calculation of Build margin. The list is tabulated below:

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Plant</th>
<th>Date of commissioning</th>
<th>MW</th>
<th>Generation of the unit in 2005-2006 (GWh)</th>
<th>Fuel Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dhauliganga unit-I</td>
<td>2005-2006</td>
<td>70</td>
<td>78.61</td>
<td>Hydro</td>
</tr>
<tr>
<td>2</td>
<td>Dhauliganga unit-II</td>
<td>2005-2006</td>
<td>70</td>
<td>78.61</td>
<td>Hydro</td>
</tr>
<tr>
<td>3</td>
<td>Dhauliganga unit-III</td>
<td>2005-2006</td>
<td>70</td>
<td>78.61</td>
<td>Hydro</td>
</tr>
<tr>
<td>4</td>
<td>Dhauliganga unit-IV</td>
<td>2005-2006</td>
<td>70</td>
<td>78.61</td>
<td>Hydro</td>
</tr>
<tr>
<td>5</td>
<td>Rihand Stage - II unit I</td>
<td>2004-2005</td>
<td>500</td>
<td>2593.70</td>
<td>Coal</td>
</tr>
<tr>
<td>6</td>
<td>Panipat #7</td>
<td>2004-2005</td>
<td>250</td>
<td>921.46</td>
<td>Coal</td>
</tr>
<tr>
<td>7</td>
<td>Panipat #8</td>
<td>2004-2005</td>
<td>250</td>
<td>1613.95</td>
<td>Coal</td>
</tr>
<tr>
<td>8</td>
<td>Chamera HEP-II (Unit 1)</td>
<td>2003-2004</td>
<td>100</td>
<td>567.67</td>
<td>Hydro</td>
</tr>
<tr>
<td>9</td>
<td>Chamera HEP-II (Unit 2)</td>
<td>2003-2004</td>
<td>100</td>
<td>567.67</td>
<td>Hydro</td>
</tr>
<tr>
<td>10</td>
<td>Chamera HEP-II (Unit 3)</td>
<td>2002-2003</td>
<td>100</td>
<td>567.67</td>
<td>Hydro</td>
</tr>
<tr>
<td>11</td>
<td>SJ VPNL</td>
<td>2003-2004</td>
<td>1500</td>
<td>4104.25</td>
<td>Hydro</td>
</tr>
<tr>
<td>12</td>
<td>Baspa-II (Unit 3)</td>
<td>2003-2004</td>
<td>100</td>
<td>389.87</td>
<td>Hydro</td>
</tr>
<tr>
<td>13</td>
<td>Suratgarh-III (Unit-5)</td>
<td>2003-2004</td>
<td>250</td>
<td>2033.40</td>
<td>Coal</td>
</tr>
<tr>
<td>14</td>
<td>Kota TPS-IV (Unit-6)</td>
<td>2003-2004</td>
<td>195</td>
<td>1695.70</td>
<td>Coal</td>
</tr>
<tr>
<td>15</td>
<td>Baspa-II (Unit 1 &amp; 2)</td>
<td>2002-2003</td>
<td>200</td>
<td>779.74</td>
<td>Hydro</td>
</tr>
<tr>
<td>16</td>
<td>Pragati CCGT (Unit III)</td>
<td>2002-2003</td>
<td>104.6</td>
<td>728.29</td>
<td>Gas</td>
</tr>
<tr>
<td>17</td>
<td>Pragati CCGT (Unit III)</td>
<td>2002-2003</td>
<td>121.2</td>
<td>843.86</td>
<td>Gas</td>
</tr>
<tr>
<td>18</td>
<td>Rangim CCGT Stage-II (GT-2)</td>
<td>2002-2003</td>
<td>37.5</td>
<td>146.80</td>
<td>Gas</td>
</tr>
<tr>
<td>19</td>
<td>Rangim CCGT Stage-II (GT-2)</td>
<td>2002-2003</td>
<td>37.8</td>
<td>147.97</td>
<td>Gas</td>
</tr>
<tr>
<td>20</td>
<td>Upper Sindh Extn (HPS)(1)</td>
<td>2001-2002</td>
<td>35</td>
<td>68.52</td>
<td>Hydro</td>
</tr>
<tr>
<td>21</td>
<td>Suratgarh stage-II (3 &amp; 4)</td>
<td>2001-2002</td>
<td>500</td>
<td>3844.81</td>
<td>Coal</td>
</tr>
<tr>
<td>22</td>
<td>Upper Sindh Stage II (2)</td>
<td>2001-2002</td>
<td>35</td>
<td>68.52</td>
<td>Hydro</td>
</tr>
<tr>
<td>23</td>
<td>Mulana-1 &amp; 2</td>
<td>2001-2002</td>
<td>86</td>
<td>337.79</td>
<td>Hydro</td>
</tr>
<tr>
<td>24</td>
<td>Panipat TPS Stage 4 (Unit-6)</td>
<td>2000-2001</td>
<td>210</td>
<td>1688.29</td>
<td>Coal</td>
</tr>
<tr>
<td>25</td>
<td>Chenani Stage III (1,2,3)</td>
<td>2000-2001</td>
<td>7.5</td>
<td>3.88</td>
<td>Hydro</td>
</tr>
<tr>
<td>26</td>
<td>Ghanvi HPS (2)</td>
<td>2000-2001</td>
<td>22.5</td>
<td>69.71</td>
<td>Hydro</td>
</tr>
<tr>
<td>27</td>
<td>RAPP (Unit-4)</td>
<td>2000-2001</td>
<td>220</td>
<td>1432.17</td>
<td>Nuclear</td>
</tr>
<tr>
<td>28</td>
<td>Ranjit Sagar (Unit-1,2,3,4)</td>
<td>2000-2001</td>
<td>600</td>
<td>2012.84</td>
<td>Hydro</td>
</tr>
<tr>
<td>29</td>
<td>Gumma HPS</td>
<td>2000-2001</td>
<td>3</td>
<td>6.59</td>
<td>Hydro</td>
</tr>
<tr>
<td>30</td>
<td>Faridabad CCGT (Unit 1)</td>
<td>2000-2001</td>
<td>144</td>
<td>986.70</td>
<td>Gas</td>
</tr>
<tr>
<td>31</td>
<td>Suratgarh TPS 2</td>
<td>1999-2000</td>
<td>250</td>
<td>2112.17</td>
<td>Coal</td>
</tr>
<tr>
<td>32</td>
<td>RAPS-B (2)</td>
<td>1999-2000</td>
<td>220</td>
<td>1432.17</td>
<td>Nuclear</td>
</tr>
<tr>
<td>33</td>
<td>Uppersindh-2 HPS #1</td>
<td>1999-2000</td>
<td>35</td>
<td>68.52</td>
<td>Hydro</td>
</tr>
<tr>
<td>34</td>
<td>Faridabad GPS 1 &amp; 2 (NTPC)</td>
<td>1999-2000</td>
<td>286</td>
<td>1959.71</td>
<td>Gas</td>
</tr>
<tr>
<td>35</td>
<td>Unchahar-II TPS #2</td>
<td>1999-2000</td>
<td>210</td>
<td>1732.60</td>
<td>Coal</td>
</tr>
<tr>
<td>36</td>
<td>Unchahar-II TPS #1</td>
<td>1998-1999</td>
<td>210</td>
<td>1767.20</td>
<td>Coal</td>
</tr>
</tbody>
</table>
Built Margin Emission Factor is calculated as per the following table:

<table>
<thead>
<tr>
<th>Sector</th>
<th>Built Margin</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Coal Based</td>
<td>20003.28</td>
<td></td>
</tr>
<tr>
<td>Thermal Gas Based</td>
<td>4813.33</td>
<td></td>
</tr>
<tr>
<td>Hydro</td>
<td>9927.69</td>
<td></td>
</tr>
<tr>
<td>Nuclear</td>
<td>2864.33</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>37608.63</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Fuel 1: Coal**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg. calorific value of coal used in Northern Grid, kcal/kg</td>
<td>4593</td>
</tr>
<tr>
<td>Coal consumption, tons/yr</td>
<td>12952313</td>
</tr>
<tr>
<td>Emission factor for Coal, tonne CO₂/TJ</td>
<td>95.8</td>
</tr>
<tr>
<td>Oxidation factor of coal (IPCC standard value)</td>
<td>0.98</td>
</tr>
<tr>
<td>COEF of coal (tonneCO₂/ton of coal)</td>
<td>1.806</td>
</tr>
</tbody>
</table>

**Fuel 2: Gas**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg. efficiency of power generation with gas as a fuel, %</td>
<td>45</td>
</tr>
<tr>
<td>Avg. calorific value of gas used, kcal/kg</td>
<td>10349</td>
</tr>
<tr>
<td>Estimated gas consumption, tons/yr</td>
<td>888886</td>
</tr>
<tr>
<td>Emission factor for Gas (as per standard IPCC value)</td>
<td>56.1</td>
</tr>
<tr>
<td>Oxidation factor of gas (IPCC standard value)</td>
<td>0.995</td>
</tr>
<tr>
<td>COEF of gas (tonneCO₂/ton of gas)</td>
<td>2.419</td>
</tr>
</tbody>
</table>

**EF (BM), tCO₂/GWh**

| EF (BM), tCO₂/GWh | 679.00 |

Therefore the **net baseline emission factor** as per combined margin

\[
\frac{(OM + BM)}{2} = 896.26 \text{ tCO₂/GWh}
\]
Annex 4

MONITORING PLAN

Description of monitoring plan
The project activity would have main and backup meters to record the net power supplied to the grid. Meters would be calibrated and marked at regular intervals so that the accuracy of measurement can be ensured all the time.

Key Project Parameters affecting Emission Reductions

Net Power exported to the grid
The project revenues are based on the net units exported as measured by main metering system and/or backup metering system. The monitoring and verification system would mainly comprise of these meters as far as power export is concerned. Power Trading Corporation (PTC) would be billed by SPEL based on joint meter reading promptly following the end of each month for energy supplied.

The general monitoring principles are based on:

- Frequency
- Reliability
- Registration and reporting

Since the emission reduction from the project are determined by the net units exported to the grid (and then multiplying with appropriate emission factor) it becomes important for the project to monitor the net export of power to the grid on real time basis.

Frequency of monitoring
SPEL would carry out the hourly data recording. PTC and SPEL would jointly read the main and backup metering system on the first day of every month.

Reliability
The amount of emission reduction is proportional to the net electricity supplied to grid by 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 would also ensure quality of the equipment used for monitoring.

PTC would own, test and maintain the main metering system. The backup metering system shall be installed, tested, owned and maintained by SPEL. The main and backup metering system shall be sealed in the presence of both parties. All metering instruments would be electronic trivector meters of accuracy class 0.2%. All the main and check meters would be tested for accuracy every calendar quarter with reference to a portable meter which shall be of an accuracy class of 0.1%. When the main metering system and/or backup metering system and/or any component is found to be outside the acceptable limits of accuracy or otherwise not functioning properly, it would be repaired, re-calibrated or replaced, as soon as possible. All instruments would carry tag plates, which indicate the date of calibration and the date of next calibration. Any meter seal shall be broken only by PTC’s representative in the presence of SPEL’s
representative whenever the main or backup metering system is to be inspected, tested, adjusted, repaired or replaced.

Registration and reporting

PTC and SPEL shall jointly read the metering system and shall keep the complete and accurate records for proper administration. Hourly data recording by the Shift Incharge will be there. Weekly reports stating the generation would be prepared by the shift incharge and verified by the Plant Manager. In addition to the records maintained by SPEL, PTC would also monitor the actual power exported to the grid and certify the same.

Verification

The performance of the project would lead to CO₂ 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

- Net export of power.

The project proponent is required to provide the necessary support to enable verification of both the monitoring system and the data archived.
Comments about
Bhilangana Hydro Power Project in Uttaranchal, India

[This comment was sent to the Designated Operating Agency for the CDM validation for Bhilangana SHP on June 14 2006 and the DOA acknowledged the receipt of the comment.]

While (relatively) small hydro projects like the 22.5 MW BHPP are desirable if taken up in proper manner, the project taken up as present should not be validated for the following reasons.

1. The project developer (Swasti Power Engineering Ltd) has not done any satisfactory consultation with the people in the affected villages. The local people have not been given any of the project documents like the detailed project report, have not been given the full environment impact assessment or environment management plan in the language that they can understand. Nor have the people been told in full about the adverse impacts of the project. This is clear violation of the rights of the people and also violation of the CDM norms for consultation of the stakeholders and the local people. The claim made by the proponents in the CDM PDD in this regard (section G.1) is misleading. Till this is corrected, the project should not be validated.

As a matter of fact, an intense agitation by the local people against the project has been going on for over two years, during which the local community people have also faced human right violations. We would be happy to provide material to substantiate this if required.

2. Section G.1 should have given details of the amount of total land to be taken for the project, which has not been given.

3. The PDD repeatedly makes the most shockingly misleading statement (section F.1, page 27 of PDD) “there is no negative impact on the environment due to the project activity”. A project of this nature always causes significant negative impacts on the environment, including due to diversion of agricultural land, due to diversion of forest land, due to diversion of the Bhilangana (thus almost drying up of the stream even if we take into consideration the claim that project would release 0.25 cumeecs discharge all the time, till the water return to the stream after tail end channel), blasting for the tunnels and diversion structure, addition of large number of outsiders to the area and the impacts thereof, the disposal of the muck created in the project activity, the laying of transmission lines & roads, noise and dust pollution during construction, increase of possibilities of soil erosion and land slides and so on. The project document should be honest on such impacts and should include management plan for such impacts.

4. The PDD contradicts itself as on the one hand it says that the power will be connected to the grid and exported to the Northern region (section A.2). In the last para in section B.1.1 (page 7) the PDD says the power will be exported to Punjab as per Power Purchase Agreement with Power Trading Corporation. (The PDD also justifies the need of the project in the name of power demand in the northern region.) On the other hand it claims (section F.1, page 27) that “With the availability of assured cost effective electricity, there is vast potential for the development of agro, horticultural and forest based industries”. Experience from other areas where such projects have been taken up so that such claims are unfounded as the grid connected power (that too mostly exported outside the state) does not benefit the local people.
5. The PDD makes wrong statement in section A.4.3 that “only fossil fuel fired power stations would contribute to major part of the future capacity additions” in the Northern region in future, when in reality, a very large number of big hydro projects are planned and under construction in the Northern Indian region. Moreover, the figure of energy shortage of 10.06% in 2004-5 is wrong, as per the report of the Northern Region Load Dispatch Centre (www.nrldc.org), the shortage was 9.01%. The figure of growth rate in peak power of 11.39% given is also wrong. The correct way would be to look at the compound annual growth rate over the last decade, which figure is 4.7%.

6. Power generation data from small hydro projects in Uttaranchal shows (e.g. in the PDD of the Kaliganga small hydro in Uttaranchal, which was put up for validation during May 5 to June 4, 2006) that the Plant load factor of such projects is 20.7% generally. If that is the case how are the proponents claiming that for the proposed BHPP, the PLF would be 66.26% when it claims in section A.2 that “The project will produce around 130.59 GWh of electricity”?

7. The analysis and the conclusion there from on page 8-13 in section B.3 that project is additional is misleading and incorrect for the following reasons.

- It would not be right to claim that step 0 does not apply to BHPP activity.
- The alternatives listed in step 1a does not include some of the most important viable alternatives: Increase the output from existing plants, reduce transmission and distribution losses, increase end use efficiencies, reduce theft of power, other generation options including smaller hydro, biomass, solar, etc. Due to non-inclusion of these important and viable alternatives, the exercise of proving the project as additional remains suspect.
- Rejection of Alternative on the grounds that the project cannot be taken up without the CDM credits is not correct as the project activities started before the CDM registration process started. As mentioned in point (f) on page 11, the project was allotted to the developer (on developer having expressed interest in the project) by the Uttar Pradesh govt before 2001.
- The claim made (page 11) “The people who were affected by the Tehri dam have been given heavy monetary compensation” leading to “increased expectations and greed” is utterly wrong and misleading. As a matter of fact the struggle of the people affected by the Tehri dam to get just & proper rehabilitation as per the promised policies and provisions have been long and well known, which is not yet over. To say that they have been given “heavy monetary compensation” is totally wrong. To insinuate that people affected by such projects are driven by greed, that too when it comes from the developer of the project, is total travesty of justice and truth. The situation is exactly opposite, most developers in their greed to cut corners and reduce expenses, do injustice to the affected people.
- Moreover, there is a separate ministry for non conventional sources of energy, at whose website (www.mnes.nic.in) one can see the slew of incentives provided for small hydro projects. By not mentioning these, the proponents are trying to mislead the CDM process.
- The figure of existing hydropower capacity in India at 27 000 MW given in step 4 is quite outdated. The existing capacity as on March 31, 2006 is over 32200 MW as per Ministry of Power, Govt of India, see the website: www.powermin.nic.in. Similarly the current figure for small hydro installed capacity as on Dec 31, 2005 is 1747.98 MW and those under implementation is at 585.13 MW (annual report of MNES for 2005-6). Thus the claim on page 13 that “similar options as that of BHPP is not existent as of now” is totally wrong. A number of projects in comparable range are coming up in Northern India.
8. The baseline emission rate of 916 T / million units generated (section E.4) is much higher than what should be the figure. For example, the rate for the emission from the recently commissioned 20% of the existing capacity in the Northern Region comes to 720 T / MU, way below the assumption of 916 T / MU. Similarly, for Kaldigad, Kaliganga and madhyamaheshwar small hydro in Uttaranchal that came up for validation recently, the emission factor assumed is 839.87 T / MU, way below the figure assumed for BHPP. If the project were to consider the project mix in Uttaranchal or Punjab (where the power from the project is expected to go), than the emission rate would be even lower.

9. The statement in section F.1 that “the irrigation facilities currently dry up in the lean discharge months…” gives a wrong picture. In reality the project is going to significantly alter the releases in the Bhilangana stream and impact both the irrigation water availability in the downstream areas and also the fisheries and other biodiversity in the stream. There is no mention of the full assessment of these impacts in the PDDs, and on the contrary an attempt has been made to give a contrary picture.

10. The claim in section G.2 that there is no requirement for NOC (No objection certificate) from the state pollution control board is completely wrong as NOC is required not just from the SPCB, but also from each of the panchayat in the project area.

11. The objectives of “open forum” stated in Section G.1 that the project is for it is to ensure project sustainability and help stakeholders contribute to the project is also incorrect. The objective of the public hearing process is supposed to be to get people’s views about the project’s acceptability, among other aspects and the public hearing process is supposed to be part of the decision making process.

12. The statement on page 30 of the PDD that “land inundation would not occur due to the BHPP” is not correct. Some inundation of the land at the diversion dam and also in the path of the tunnel/ channel / tail race canal.

Under the circumstances, the project in current form should not be validated.

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