STANDARDS/MANUALS/GUIDELINES FOR SMALL HYDRO DEVELOPMENT

1.4

GENERAL:

Reports Preparation:
Reconnaissance, Pre-feasibility, Feasibility/ Detailed Project Report and As Built Report

Sponsor:
Ministry of New and Renewable Energy
Govt. of India

Lead Organization:
Alternate Hydro Energy Centre
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August 2013

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PREAMBLE

There are series of standards, guidelines and manuals available on electrical, electromechanical aspect of moving machines and hydro power related issues from Bureau of Indian Standards (BIS), Rural Electrification Corporation Ltd (REC), Central Electricity Authority (CEA), Central Board of Irrigation & Power (CBIP), International Electromechanical Commission (IEC), International Electrical and Electronics Engineers (IEEE), American Society of Mechanical Engineers (ASME) and others. But most of these are developed keeping in view the large water resources/ hydropower projects. Use of the standards/guidelines/manuals is voluntary at the moment. Small scale hydropower projects are to be developed in a cost effective manner with quality and reliability. Therefore a need to develop and make available the standards and guidelines specifically developed for small scale projects was felt.

Alternate Hydro Energy Centre, Indian Institute of Technology, Roorkee initiated the exercise of developing standards/guidelines/manuals specifically for small scale hydropower projects under the sponsorship of Ministry of New and Renewable Energy, Government of India, in 2006. The available relevant standards / guidelines / manuals were revisited to suitably adopt them for small scale hydro projects. These have been prepared by experts in their respective fields. Wide consultations were held with all stake holders covering government agencies, government and private developers, equipment manufacturers, consultants, financial institutions, regulators and others through web, post and meetings. After taking into consideration the comments received and discussions held with the lead experts the standards/guidelines/manuals are now prepared and presented in this publication.

The experts have drawn some text and figures from existing standards, manuals, publications and reports. Attempts have been made to give suitable reference and credit. However, the possibility of some omission due to oversight cannot be ruled out. These can be incorporated in our subsequent editions.

These standards / manuals / guidelines are the first edition. We request users of these to send their views / comments on the contents and utilization to enable us to review these after about one year of its publication.

Standards/ Manuals/Guidelines series for Small Hydropower Development

General	
1.1	Small hydropower definitions and glossary of terms, list and scope of different Indian and international standards/guidelines/manuals
1.2 Part I	Planning of the projects on existing dams, Barrages, Weirs
1.2 Part II	Planning of the Projects on Canal falls and Lock Structures.
1.2 Part III	Planning of the Run-of-River Projects
1.3	Project hydrology and installed capacity
1.4	Reports preparation: reconnaissance, pre-feasibility, feasibility, detailed project report, as built report
1.5	Project cost estimation
1.6	Economic & Financial Analysis and Tariff Determination
1.7	Model Contract for Execution and Supplies of Civil and E&M Works
1.8	Project Management of Small Hydroelectric Projects
1.9	Environment Impact Assessment
1.10	Performance evaluation of Small Hydro Power plants
1.11	Renovation, modernization and uprating
1.12	Site Investigations
Civil works	
2.1	Layouts of SHP projects
2.2	Hydraulic design
2.3	Structural design
2.4	Maintenance of civil works (including hydro-mechanical)
2.5	Technical specifications for Hydro Mechanical Works
Electro Mechanical works	
3.1	Selection of Turbine and Governing System
3.2	Selection of Generator
3.3	Selection of Switchyard
3.4	Monitoring, control, protection and automation
3.5	Design of Auxiliary Systems and Selection of Equipments
3.6	Technical Specifications for Procurement of Generating Equipment
3.7	Technical Specifications for Procurement of Auxiliaries
3.8	Technical Specifications for Procurement and Installation of Switchyard Equipment
3.9	Technical Specifications for monitoring, control and protection
3.10	Power Evacuation and Inter connection with Grid
3.11	Operation and maintenance of power plant
3.12	Erection Testing and Commissioning

PERSONS INVOLVED

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LIST OF ANNEXURE

REPORTS PREPARATION: RECONNAISSANCE, PRE-FEASIBILITY, FEASIBILITY/ DETAILED PROJECT REPORT AND AS BUILT REPORT

1.0 GENERAL

Small hydro project (SHP) projects harness energy from flowing or falling water from rivers, rivulets artificially created storage dams or canal drops. SHPs have the potential to provide energy to remote and hilly areas where extension of grid as well as transportation of diesel is uneconomical.

Similarly in plains large irrigation networks, diversion structures and small dams are either existing or under development. These existing structures are also used for generation of electricity.

For development of a SHP project, studies and field investigations at various levels are carried out involving following phases:

- Reconnaissance visit of proposed project site
- Pre Feasibility report
- Feasibility reports/DPR (Detailed Project Report)
- Pre construction investigations
- Detailed design, planning, award of civil contracts, selection and procurement of electro-mechanical equipment, execution of civil works, installation of E&M equipment, testing, commissioning and commercial operation
- After execution and commissioning of Project preparation of "As built Report"

1.1 Scope

This document covers the guide lines for report preparation at following stages:

- Reconnaissance Report
- Pre Feasibility Report
- Feasibility / Detailed Project Report
- As Built Report

1.2 References

R1.	Govt. of India, Ministry of Water Resources-2010	Guide lines for preparation of detailed project reports of Irrigation and multipurpose Projects
R2.	CEA, New Delhi-2002	Guide lines for preparation of project reports for Power Projects
R3.	CEA, New Delhi-1982	Guide lines for development of Small Hydroelectric Schemes
R4.	CEA, New Delhi-2012(Rev 3.0)	Guide lines for formulation of detailed project reports for Hydroelectric schemes, their acceptance and examination for concurrence

1.3 Description of Different Types of Reports

1.3.1 Reconnaissance report

The purpose of a site reconnaissance report is to gain an understanding of site characteristics, potential issues as well as solutions, and inputs to site selection of the main project structures.

Prior to undertaking a site reconnaissance visit, available data should be reviewed and preliminary conceptual layout prepared and laid out on available mapping for guidance during the field visit. It is further recommended that an outline of the preliminary studies report with a check list be prepared before going to the field. This will help to identify important information that is required during the site visit for firming the site selection.

The site visit provides an opportunity to obtain an appreciation of site topography, flow regime, geology, socio and economic condition, access for roads and transmission lines. From these on-site observations it is often possible to identify practical locations for temporary facilities, head-works, desilting tank and powerhouse and to decide the side (left or right bank) of the river best suited for routing of the waterways, preliminary access roads and transmission line (T.L.) routes. These locations, their elevations and co-ordinates can be determined with portable GPS equipment. GPS equipment capable of giving elevation and spatial measurement with accuracies of +/- 0.3m and 1.0 m respectively (or better) should be used. It is also recommended that the visiting team include at least three professionals: a hydrologist, an engineering geologist/geotechnical engineer and a hydropower engineer. It is also recommended that the team includes local representatives whose practical knowledge of the area and people would be invaluable. This initial contact could also be an opportunity for developing the interest and support of local residents for the project. Typically, a field visit will require 1-3 days depending on the remoteness, size and complexity of the site.

1.3.2 Pre feasibility report

A Pre-feasibility report is a document that provides preliminary details on the technical and economic feasibility of a project. Before conducting detailed technical and economic studies, pre-feasibility research does a first level evaluation of a project, using the most important evaluation parameters of technical feasibility, economic evaluation and identification of critical issues with possible solution. Pre-feasibility reports are useful because they provide a first-level inference at low cost and within a short duration. On the other hand, detailed feasibility studies take much longer and take many months for completion.

1.3.3 Feasibility / detailed project report

Feasibility Report (FR)/ Detailed Project Report (DPR) is a key document for obtaining different clearances/ approvals and taking investment decision to develop a small hydro power project. Feasibility report is known as detailed project report in India and covers all aspects of development of a projects including justification for the project, site specifications based on survey and investigation of the location, hydrology for the project, reservoir requirements, design for civil structures, electrical and mechanical designs, details

of the transmission system for evacuating the power from the project, infrastructure facilities, environmental and ecological aspects, cost estimates, financial analysis and implementation schedule of the project.

1.3.4 As built report

As Built Report of any SHP should be prepared after commissioning of the Project. The Report should include all the details of the actual executed project components, specifications, drawings, testing reports including technical, financial and other aspects.

2.0 RECONNAISSANCE REPORT

Reconnaissance report is required (a) to obtain an appreciation of site topography, general hydrology, geology and access for roads, (b) to gain an understanding of site characteristics, potential problems as well as solutions, and (c) input for the site selection for the main project structures. From these on-site observations it is often possible to identify practical locations for temporary facilities, head-works, desilting tank and powerhouse and to decide the side of the river best suited for routing of the water conductor system, preliminary access roads and transmission line (T.L.) routes. The report may content following:

- **Table of contents**

- **Relevant photographs**

- **CHAPTER-1 INTRODUCTION**

  Location, climatic conditions and reference of the development etc.

- **CHAPTER-2 TOPOGRAPHY**

  General information, catchment area with elevations, proposal for topographical surveys

- **CHAPTER-3 HYDROLOGY**

  Precipitation, snowfall and other available hydrological data.

- **CHAPTER-4 INFRASTRUCTURE**

  Infrastructural facilities available and required facilities suggested for implementation

- **CHAPTER-5 LOCATION OF CIVIL STRUCTURES**

  Diversion works, desilting chamber, water conductor system, fore bay, penstock, Power house building and switchyard area.

- **CHAPTER-6 INSTALLED CAPACITY**

  Determination of head and discharge. Estimated installed capacity and number of units.

- **CHAPTER-7 ENVIRONMENTAL IMPACT ASSESSMENT – PRELIMINARY**

General comments, resettlement and agricultural activities, deforestation required, effect on flora and fauna, social and health impact of project construction if any and post project commissioning impact.

- **CHAPTER-8 COST ESTIMATE – PRELIMINARY**

  Broad Estimated cost and cost of generation.

- **CHAPTER-9 DRAWINGS**

  Location Map, Catchment area plan, Schematic Layout,

3.0 PRE FEASIBILITY REPORTS (FORMAT)

Pre feasibility report should be prepared before taking up detailed investigations of the project to establish that the scheme conceived is worth going ahead for further investigations and that is technically and economically feasible. The report may content:

Table of Contents

Relevant photographs

- **CHAPTER-1 EXECUTIVE SUMMARY**

- **CHAPTER-2 GENERAL INFORMATION**

2.1 Electricity Sector of India
2.2 Policy Towards SHPs either for Government Owned Entity or Private Owned entity
2.3 Related organization and their role
2.4 State Government Organization roles
2.5 Central Government Organization roles
2.6 Renewable Energy Programs by Government
2.7 Regulatory bodies role
2.8 CDM Applicability
2.9 Reference and context of the project

- **CHAPTER-3 INVESTMENT FOR SMALL HYDRO PROJECTS IN INDIA**

3.1 Investment potential and opportunities
3.2 Power Purchasing and regulations

- **CHAPTER-4 SITE INFORMATION**

4.1 Location
4.2 Access
4.3 Stream

- **CHAPTER-5 TECHNICAL ANALYSIS**

5.1 Site Selection (study of the available options of project layout)
5.2 Hydrology (Get the discharge by direct measurement, from the nearby streams. See the locations of meteorological stations from the project and data availability.)
5.3 Power Potential
5.4 General Geology
5.5 Availability of construction material
5.6 Basic Environmental Study on the basis of availability of secondary data

- **CHAPTER-6 PRELIMINARY DESIGN OF THE PROJECT**

6.1 Civil Construction
6.2 Electromechanical Equipment
6.3 Grid Interconnection
6.4 Cost Estimation

- **CHAPTER-7 PRELIMINARY FINANCIAL ANALYSIS**

7.1 Capital Cost
7.2 Income Generation
7.3 Economics of the Project considering the IRR, NPV, DSCR aspects
7.4 Tariff in respect of Regulatory norms or captive use, if any

- **CHAPTER-8 CONCLUSION AND RECOMMENDATION**

Recommendations for the suitability of the project, whether the developer should go for execution of the project or drop the project.

4.0 FEASIBILITY/DETAILED PROJECT REPORT (FORMAT)

The Detailed Project Report **(**DPR) should be presented in a format such that it can be easily reviewed at various technical and administrative levels and should be written in lucid and straight forward manner so that decision for clearances and investment can be taken. It may also be called for investment decision. The report should start with

Table of contents

Check list (Format for check list given as Annex I)

Salient feature (Formats for Dam based, diversion and canal fall schemes are as Annex II, Annex III and Annex IV respectively)

Relevant photographs

Covering the catchment, location of all major components, nearby locality and nearby major land marks.

CHAPTER – 1 INTRODUCTION

1.1 General
1.2 Project Sponsor
1.3 Power Sector Development in India and policy
1.4 Incentives and support available from various organisations
1.5 Policy of concerned state
1.6 Project Objectives
1.7 Ownership and prepared development plan

CHAPTER – 2 BASIC DATA

2.1 Location
2.2 Topography
2.3 Access
2.4 Climate and Temperature
2.5 Climate and Temperature
2.6 River Basin
2.7 Catchment Area
2.8 Geology and Seismicity

CHAPTER – 3 SURVEY AND INVESTIGATIONS

3.1 Topographical Surveys
3.2 Hydrological Surveys
3.3 Meteorological Surveys
3.4 Water Quality
3.5 Sediment details
3.6 Construction materials investigation
3.7 Muck disposal surveys
3.8 Geological Investigations
3.9 Survey of Transmission Line for Power Evacuation to the Nearest Grid Substation

CHAPTER – 4 GEOLOGICAL AND GEOTECHNICAL INVESTIGATIONS

4.1 Introduction
4.2 Geomorphology and Physiography
4.3 Regional Geology

4.4 Geology of the Project Area
4.5 Geotechnical Appraisal of Project Components
4.6 Geotechnics
4.7 Concluding Remarks

CHAPTER – 5 HYDROLOGY

5.1 Basin Characteristics
5.2 Catchment Area
5.3 Rainfall
5.4 Temperature and Humidity
5.5 Run-Off
5.6 Water Availability
5.7 Design Flood, Design Flood Levels etc.
5.8 Gauge-Discharge Curve
5.9 Sediment characteristics and quality of sediment

CHAPTER – 6 POWER POTENTIAL & INSTALLED CAPACITY

6.1 Type of Power Plant i.e. run of river (with or without diurnal storage) or storage type
6.2 Assessment of Power Potential.
6.3 Optimisation of storage, FRL, MDDL lean period capabilities etc. in case of storage schemes.
6.4 Month wise, 10-daily availability of power and energy peaking capabilities
6.5 Optimisation of installed capacity and unit size studies

CHAPTER – 7 CIVIL WORKS

7.1 General
7.2 Dam, Diversion Barrage, Weir and Intake
7.3 Feeder Channel
7.4 Desilting Tank
7.5 Power Channel
7.6 Head Race Tunnel
7.7 Surge Tank
7.8 Penstock
7.9 Power House
7.10 Tail Race Channel
7.11 Approach Road
7.12 Construction material
7.13 Details of instrumentation of various structures
7.14 Muck Disposal
7.15 Explosives

CHAPTER – 8 ELECTRO MECHANICAL WORKS

8.1 General
8.2 Selection of Turbine and number of units

12.3 Renewable Purchase Obligation and Renewable Energy Certificate

CHAPTER –13 COST ESTIMATES

13.1 General
13.2 Abstract of Cost

CHAPTER – 14 FINANCIAL AND ECONOMIC STUDIES

14.1 Estimates of Cost and Phasing
14.2 Generation Cost
14.3 Project Financing
14.4 Working Capital
14.5 Repayment of Loan
14.6 Sales Price/ Tariff
14.7 Internal Rate of Return

CHAPTER 15–CONCLUSIONS AND RECOMMENDATIONS

15.1 Conclusions
15.2 Reduction of Carbon Emission by the Present Scheme
15.3 Recommendations

LIST OF PERSONNEL INVOLVED

ANNEXURES

Following annexures are required to be appended

Annex I : Detail design of different civil works components
Annex II : Schedule of rates for civil works items
Annex III : Estimation of quantities and cost of Civil works
Annex IV : Drawings

List of drawings
Drawings as per list to be enclosed

5.0 AS BUILT PROJECT REPORT (FORMAT)

During process of execution of Project many alterations are done as per site conditions and system requirements. These alterations are required to be documented in the form of a report containing details of alterations and 'as executed drawings' with technical justifications for the same. This type of 'as built report' is essential for future guidance for effective operation and maintenance of plant. The report should briefly cover all technical, financial and other relevant aspects which can be summarized as follows:

CONTENTS

This part of the report shall give the insight about the efforts made during the appraisal of the Project and changes made in the DPR including the experts' recommendations, if any.

3.3 Implementation

This part should include the following:

a. Details about financial closure
b. Brief of the Progress of the Project including the problems encountered during various phases of the project & the remedial measures
c. Completion of the Project
d. Final Payment details
e. Contract Closure details (if achieved before the report preparation)

CHAPTER-4 EVALUATION OF IMPLEMENTATION

4.1 Project Components

Details about Project Components:

a. Construction of Small Hydro Power Plant : Capacity & Location;
b. Construction of Sub-station / Switchyard of various voltage levels;
c. Construction of transmission line (if any);
d. Provision of distribution network equipment (if required);
e. Provision of offices etc.

As-built salient features to be annexed.

Alterations, deviations made in various erection drawings during process of erection, testing and commissioning should be marked in the 'as executed drawings' and kept in records for future reference after completion of the project

4.2 Project Costs

a. Comparison of the estimated cost as per DPR and actual cost incurred on the Project;
b. Comparison of taxes and duties of estimate and actual shall also be analysed;
c. Effect of delay in Project (if any) i.e. cost overrun or early completion of the Project shall be analysed in the overall Project cost (details to be annexed);
d. Effect of actual cost on the tariff shall also be analysed with the estimated tariff (detail calculation to be annexed with reference to the latest tariff regulations);
e. Economic and financial evaluation of the Project should once again be performed (calculation of NPV, IRR, B/C ratio to be annexed).

4.3 Project Schedule

a. Reviewing the factors envisaged in the DPR for delay in the critical activities considered during the formulation of Project Schedule;

b. Studying the effect of any activity which has diverted the critical path of the Project Schedule;
c. Comparison of Projected Schedule and Actual Schedule should be done considering major activities;
d. All delays either in finalization of loan, consultants, procurement, implementation etc should be specifically covered under this head;
e. Delay in construction either in Civil, HM or E&M shall also be covered with details;
f. Transportation delays shall also be included in analysis of the Project Schedule;
g. Any 'force majeure' conditions shall be covered specifically.

4.4 Procurement of Goods and Services

4.4.1 Engagement of consultant

a. Reasons for engagement of Consultants
b. Scope of work
c. Procedural details and approvals

4.4.2 Procurement of goods & services

a. Route for invitation of the bids (ICB, NCB, LCB)
b. Details of lots for procurement of equipment
c. Procedural details and approvals
d. Any deletion / addition of equipment during the execution

4.5 Performance of Consultants / Contractors / Suppliers

4.5.1 Performance of consultants

a. Total man-months envisaged for consultancy job in the estimate;
b. Actual man-months contracted with the consultant for the execution of the Project as per the scope of consultancy services;
c. Final man-months details after commissioning of the Project;
d. Comparison of the all the above details;
e. Analysis of delays in the consultancy jobs

4.5.2 Performance of contractors and suppliers

a. Details about the contractors engaged for the implementation of the Project;
b. Co-ordination between the Contractor & Sub-Contractors/Vendors and role of the Contractors in resolving the issues;
c. Credits to the Contractors for completion of the Project (if before time);

4.5.3 Performance of borrower /executing agency

This section shall provide details about the performance of the Borrower /Executing Agency.

4.5.4 Performance of bank

a. Time taken by the bank in the financial closure;
b. Disbursement of the requisitions;
c. Monitoring by the bank during execution of the Project;
d. Co-operation in the sanctioning the additional loans in the interest of the Project due to cost overrun or any other reason.

4.6 Conditions and Covenants for Loan Agreement

4.6.1 Details about the conditions and covenants (a formal binding agreement / contract) for loan agreement not adhered to and deviated;
4.6.2 Details about the conditions and covenants for various contracts signed for execution of the Project not adhered to and deviated;
4.6.3 Any other issue;
4.6.4 Status of the above should be annexed.
4.6.5 Disbursement of loan
4.6.5.1 Comparison of phasing of loan with the actual disbursement of loan.
4.6.5.2 The manner in which loan proceeds were allocated and the actual utilization under various categories were made should be annexed with the report.

CHAPTER-5 ENVIRONMENTAL IMPACT

Actual impact of construction and operation of SHP along with Switchyard on the environment;

Comparison and status of the following:

a. Land use/erosion/sedimentation due to encroachment on watershed forests;
b. Fisheries development and reduction of downstream fisheries;
c. Difficulties of resettlement of farmers displaced from the Project area (including power station, dam and other structures);
d. Soil salinization or water logging;
e. Measures taken to augment environment against the development of the Project;
f. Any other issue related to environment.

CHAPTER- 6 PROJECT BENEFITS

i. Commercial Date of Operation the Units & Power Station along with the performance of the units as per contract;
ii. Total energy generation from the project till the drafting of the as-built report;
iii. Benefits from the Project to the nearby area and families;
iv. Effect of the Project on the local grid;
v. Employment generation from the Project (direct or indirect);

CHAPTER-7 CONCLUSION AND RECOMMENDATIONS

7.1 Conclusion

Satisfaction of the authorities regarding the execution and overall progress of the Project. Overall rating of the Project in terms of technical and financial details. Development of the society and environment.

7.2 Recommendations

7.2.1 Project Related

i. Future Monitoring
ii. Covenants
iii. Further Actions or Follow-up and Additional Assistance
iv. Any other as specific to the Project

7.2.2 General

i. Project Appraisal (DPR)
ii. Project Implementation

7.3 List of Documents to be Annexed

7.3.1 Chronology of Events
7.3.2 Salient Technical Features of the Project
7.3.3 General Layout of Dam and Appurtenances
7.3.4 Cross Section of the Power House
7.3.5 Project Cost – Estimated vs Actual
7.3.8 Implementation Schedule – Projected vs Actual
7.3.9 Design Changes on Dam & Power Station
7.3.9 Design change in Electro-mechanical systems
7.3.10 Major Contract Packages
7.3.11 Compliance with the Covenants
7.3.12 Disbursement – Projected vs Actual
7.3.13 Loan Proceeds Allocation vs Utilization
7.3.14 Plant Operational Record
7.3.15 Financial Analysis
7.3.16 Tariff Calculation
7.3.17 Economic Analysis
7.3.18 'As-built drawings' of Civil, HM and E&M

All the reports may be prepared in standard A4 size documents alongwith the drawings in A4/A3/A2/A1 size (as per need and readability) in print copy as well as doc., dwg, jpeg and pdf formats etc. stored in CD/server.

ANNEXURE-I

FORMAT OF CHECK LIST

1. NAME OF THE PROJECT :

(i) State :
(ii) District :
(iii) Taluka /Tehsil :
(iv) Sub Tehsil :
(v) Nearest Village :

2. PLANNING

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

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

(i) Stream surveys :
(ii) Head work surveys (Weir or diversion structure) :
(iii) Plant site and camp site :
(iv) Water conductor system :
(v) Powerhouse, switchyard, tailrace :
(vi) Penstock, Surge shaft :
(vii) Communication etc.

3. GEOLOGY

Have the geological surveys for head works, powerhouse, tailrace etc. been carried out and report on general geology of the area and on geology of the sites of principal structures appended? :

4. FOUNDATION INVESTIGATION

Have the foundation investigation for the major civil structures and of the schemes etc been carried out? :

5. MATERIAL SURVEYS

Have the surveys and laboratory test for construction material like previous and Impervious soil sand aggregate etc and carried out? :

6. HYDROLOGICAL & METEOROLOGICAL INVESTIGATIONS

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

(i) Rainfall in the catchment :
(ii) Gauge and discharge data of the stream :

7. HYDROLOGY

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

8. LAND ACQUISITION & RE-SETTLEMENT (wherever applicable)

Have the provisions for land acquisition been considered? :
Have the socio-economic problems involved in re-settlement been investigated and discussed? :

9. DESIGN

Has the layout of the project area viz. location of diversion, structures, water conductor system, :

Powerhouse and tailrace been finalized? :

Have the preliminary designs been prepared for the following components

(a) Diversion weir :
(b) Penstock and water conductor system :
(c) Power house and switchyard :
(d) Powerhouse equipment, LT Ht switching equipment and control and protection equipment :

10. POWER BENEFITS

Have the following points 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? :
(iii) Energy generated from the project, firm power, seasonal power and total power. :
(iv) Proposal of transmission and or connecting the existing system :
(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 scheme

11. CONSTRUCTION PROGRAMME

Are the major components of work projects 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 (Total quantity)

(i) Excavation – soft and hard strata :
(ii) Earth work in filling :
(iii) Stone for masonry :
(iv) Coarse aggregate for concrete :
(v) Steel of various size and type of reinforcement :
(vi) Cement :
(vii) Controlled items – steel, special steel for penstock :
(viii) Other material – POL(Petroleum, oil and lubricants), electricity, explosives etc :

12. COST ESTIMATES

(a) Is the estimate prepared? :
(b) Have the analysis of rates for: items / various major items and the components of the project been furnished with analysis and the price index at which estimate is based? :

13. ECOLOGICAL AND ENVIRONMENTAL ASPECTS:

Is the area likely to have any environmental and Ecological problems due to the alternate surface water pattern and preventive / corrective measures discussed? :

14. CAMPS AND BUILDINGS

Has the provisions for camps / building made? :

15. SOIL CONSERVATION

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

ANNEXURE-II

SALIENT FEATURES FOR POWER PROJECTS (STORAGE BASED)

I. GENERAL

1. Name of Project

2. Location

(a)	State	:	
(b)	District	:	
(c)	Village	:	
(d)	Access	:	
	Nearest Rail Head	:	
	Nearest Airport		

3. Geographical Coordinates

(a)	Longitude	:	
(b)	Latitude	:	
(d)	Reference toposheets (Survey of India)	:	

4. Hydrology

(a)	Name of tributary	:	
(b)	Main river		
(c)	Catchments area	:	------ sq.km
(d)	Average rain fall	:	------ mm
(e)	Maximum flood discharge	:	------ cumecs
(f)	Annual 90% dependable discharge	:	------ cumecs
(g)	Design flood for	:	

(i) Spillway, (ii) Safe free board, (iii) Diversion

II. PROJECT FEATURES

1. Type of Dam

(a)	Height of dam above river bed, above deepest foundation level		
(b)	Live Storage	:	-----MMC
(c)	Dead storage	:	-----MMC
(d)	Evaporation losses	:	-----MMC
(e)	Top of Road	:	------RL (m)
(f)	River bed	:	------RL (m)
(g)	Pond level	:	------RL (m)
(h)	HFL	:	------RL (m)
(i)	Dead storage level	:	------RL (m)

2. Spill Way

(a) Type
(b) Clear water way length
(C) Gates- number, type and size
(d) Crest level : -----RL (m)
(e) Energy dissipation device- type

3. Submerged area in hectares

(a) Forest
(b) Cultivated
(c) Waste
(d) Habitation-submerged number of villages, buildings and families affected

4. Total land to be acquired in hectares

(a) Permanent total (for head works, power house and power channel/tunnel)
(b) Temporary total (for head works, power house and power channel/tunnel)

5. Intake works

Head Regulator (overall length, number and size of spans, number and size of gates, crest level)

6. Sedimentation tank

Size of silt settling tank, size of hoppers, bottom level of conduits, design discharge for flushing, full supply in tanks, particle size to be removed

7. Power tunnel

Shape, length and diameter, thickness of lining, design discharge, invert elevation (at inlet, at surge tank), Grade.

8. Surge Tank

Type, size, top level of surge tank, bottom level of surge tank, height of riser.

9. Penstock

Main penstock length and diameter, thickness of lining, design discharge, unit penstock number, length, diameter and thickness of lining.

10. Power House

Location, type, size, head (gross head, net head, design head and discharge), installed capacity, number and type of turbine & generators

11. Tail race channel

Size, type and length of tail race channel, crown elevation at outlet.

12. (a) Firm power,
(b) Peaking capacity and
(c) Annual Energy Generation (in MU): at--% load factor

13. Estimates of Cost

(a)	Total Cost		:	Rs. --------million
	(i)	Cost of Civil works	:	Rs. ------- million
	(ii)	Cost of E & M equipment	:	Rs. -------- million
	(iii)	Other expenses	:	Rs. -------- million
	(iv)	Transmission system	:	Rs. -------- million
	(v)	Cost of installation per kW	:	Rs. -------- million

14. Generation Cost Rs. /kWh

Without Subsidy/incentive	:
With Subsidy/ incentive	:
With CDM / RPO/REC benefits	:
With Subsidy/incentive and CDM benefits	:

ANNEXURE-III

SALIENT FEATURES FOR POWER PROJECTS
(RUN OF RIVER DIVERSION SCHEME)

I. GENERAL

1. Name of the Project

2. Location of Dam

(a)	State	:	
(b)	District	:	
(c)	Village	:	
(d)	Access	:	
	Nearest Rail Head	:	
	Nearest Airport	:	

3. Geographical Coordinates

(a)	Longitude	:	
(b)	Latitude	:	
(c)	Altitutde	:	
(e)	Reference toposheets (Survey of India)	:	

4. Hydrology

(a)	Name of stream	:	
(b)	Catchments area	:	-----sq.km
(c)	Main river	:	
(d)	Maximum flood discharge	:	-----cumecs
(e)	Type of stream	:	
(f)	100% dependability flow	:	-----cumecs
(g)	75% dependability flow	:	-----cumecs
(h)	50% dependability flow	:	-----cumecs
(i)	25% dependability flow	:	-----cumecs

II. PROJECT FEATURES

1. Weir and Intake

(a)	Type	:	
(b)	Shape	:	
(c)	Crest Level	:	El. ----- m
(d)	MWL/FRL	:	El. ----- m
(e)	Number of Bays	:	
(f)	Intake Channel	:	

2. Feeder Channel

(a)	Shape	:	
(b)	Material	:	
(c)	Bed slope	:	
(d)	Bed width	:	---- m
(e)	Water depth	:	-----m
(f)	Length	:	---- m
(g)	Design discharge	:	----m^3/s
(h)	Free board	:	---- m

3. Desilting Tank

(a)	Size of tank	:	Length ---- m, width ----m
(b)	Transition length (upstream)	:	---- m
(c)	Transition length (downstream)	:	-----m
(d)	Material	:	
(e)	Particle size to be removed	:	----mm
(f)	Silt disposal outlet	:	----mm dia pipes
(g)	Design discharge	:	----- cumecs
(h)	Free board	:	----- m

4. Power Channel

(a)	Shape	:	
(b)	Material	:	
(c)	Bed slope	:	
(d)	Bed width	:	m
(e)	Water depth	:	m
(f)	Length	:	m
(g)	Design discharge	:	m^3/s
(h)	Free board	:	m

5. Head Race Tunnel (If Applicable)

(a)	Length	:	m
(b)	Diameter / shape	:	
(c)	Type & thickness of lining	:	

6. Surge Tank (If Applicable)

(a)	Type	:	
(b)	Diameter	:	m
(c)	Height above orifice	:	m
(d)	Orifice dia	:	m

7. Penstock

(a)	Type / Material		:	Steel grade E 250 (Fe 410 W)
(b)	Main Penstock			
	(i)	No. of pipe	:	
	(ii)	Length	:	m
	(iii)	Diameter	:	m
	(iv)	Thickness	:	
	(v)	Design discharge	:	cumec
(c)	Branching near power house			
	(i)	No. of Pipe	:	nos.
	(ii)	Length	:	m
	(iii)	Diameter	:	m
	(iv)	Thickness	:	mm

8. Power House

(a)	Type	:	Surface power house
(b)	Gross Head	:	m
(c)	Net Head	:	m
(d)	Design Head	:	m
(e)	Installed Capacity	:	kW
(f)	Size	:	--- m x ---- m x--- m
(g)	Machine Hall Floor Level	:	
(h)	Erection Bay Floor Level	:	

9. Turbine

(a)	Type	:	
(b)	Number	:	
(c)	Capacity	:	-----kW each at generator terminal

10. Type of Generator

(a)	Type	:	Synchronous
(b)	Nos.	:	
(c)	Capacity	:	----- kW each

11. Tailrace Channel

(a)	Length	:	---- m
(b)	Size	:	--- m x ---m rectangular

12. Annual Energy Generation (in MU) : --- MU at--% load factor

13. Estimates of Cost

(a)	Total Cost		:	Rs. -------- million
	(i)	Cost of Civil works	:	Rs. ------- million
	(ii)	Cost of E & M equipment	:	Rs. -------- million
	(iii)	Other expenses	:	Rs. -------- million
	(iv)	Transmission system	:	Rs. -------- million
(b)	Cost of installation per kW		:	Rs.

14. Generation Cost Rs. /kWh

Without Subsidy/incentive	:
With Subsidy/ incentive	:
With CDM / RPO/REC benefits	:
With Subsidy/incentive and CDM benefits	:

ANNEXURE-IV

SALIENT FEATURES FOR POWER PROJECTS (CANAL FALL/SEWAGE /WATER SUPPLY OUTFALL SCHEME)

I. GENERAL

1. Name of the Project :

2. Location of Dam

(a)	State	:
(b)	District	:
(c)	Village	:
(d)	Access	:
	Nearest Rail Head	:
	Nearest Airport	:

3. Geographical Coordinates

(a)	Longitude	:
(b)	Latitude	:
(c)	Altitutde	:
(e)	Reference toposheets (Survey of India)	:

4. Hydrological Parameters

a)	Gross Head	:	m
b)	Net Head	:	m
c)	Maximum discharge	:	m^3/sec
d)	Rated Discharge for both units	:	m^3/sec
e)	Installed Capacity	:	kW
f)	Average Annual Generation	:	MU

5. Technical Particulars of Different Hydraulic and Mechanical Components

5.1 Main Canal

Length	:	m
Width	:	m
Bottom elevation upstream	:	m
Bottom elevation downstream	:	m
Rated flow	:	5 m^3/s

5.2 Main Canal Upstream

Highest water elevation	:	m
Lowest water elevation	:	m

Minimum upstream water depth	:	m
Upstream level with fully closed main canal gates	:	m
Width	:	m
Bottom elevation	:	m

5.3 Main Canal Downstream

Width	:	m
Bottom elevation	:	m
Highest water elevation	:	m
Lowest water elevation	:	m
Downstream level with fully closed main canal gates	:	m

5.4 Main Canal Gate

No. of Main Canal Gates	:	---
Width	:	m
Height	:	m
Bottom elevation	:	m
Displacement height	:	m
Time to open	:	min
Time to close	:	min

5.5 Bye Pass/Diversion Channel

Channel length	:	m
Canal width	:	m
Bottom elevation	:	m

5.6 Head Race Channel

Channel length	:	m
Channel width	:	m
Bottom elevation	:	m
Maximum discharge	:	m^3/s

5.7 Tailrace Channel

Length	:	m
Width	:	m
Bottom elevation	:	m

6. Power House

(a)	Type	:	Surface power house
(b)	Gross Head	:	m

(c)	Net Head	:	m
(d)	Design Head	:	m
(e)	Installed Capacity	:	kW
(f)	Size	:	--- m x ---- m x--- m
(g)	Machine Hall Floor Level	:	
(h)	Erection Bay Floor Level	:	

7. Turbine

(a)	Type	:	
(b)	Number	:	
(c)	Capacity	:	-----kW

8. Type of Generator

(a)	Type	:	Synchronous
(b)	Nos.	:	
(c)	Capacity	:	----- kW each

9. Tailrace Channel

(a)	Length	:	---- m
(b)	Size	:	---- m x ---m rectangular

10. Annual Energy Generation (in MU) : ---- MU at--% load factor

11. Estimates of Cost

(a)	Total Cost		:	Rs. -------- million
	(i)	Cost of Civil works	:	Rs. -------- million
	(ii)	Cost of E & M equipment	:	Rs. -------- million
	(iii)	Other expenses	:	Rs. -------- million
	(iv)	Transmission system	:	Rs. -------- million
(b)	Cost of installation per kW		:	Rs.

12. Generation Cost Rs. /kWh

Without Subsidy/incentive	:
With Subsidy/ incentive	:
With CDM / RPO/REC benefits	:
With Subsidy/incentive and CDM benefits	: