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Government of India
केन्द्रीय जल आयोग
Central Water Commission
लागत मूल्यांकन (एच डब्ल्यू एफ) निदेशालय
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F. No: 10/3/2020-CA (HWF)/63

Dated: 04/05/2020

**CIRCULAR**

An addendum No.1 to "Guidelines for Preparation of Project Estimates for River Valley Projects (Second revised edition March, 1997)" is hereby disseminated through the CWC website to all concerned users for clarifying the provisions towards indirect cost of labour to be adopted in analysis of rates for items of works in preparation of Project Estimates.

(Srinivasu Bairy)
Director, CA (HWF)

To,

All concerned through CWC website

# ADDENDUM NO. 1

# TO
# GUIDELINES FOR PREPARATION OF PROJECT ESTIMATES FOR RIVER VALLEY PROJECTS

**(Second revised edition March, 1997)**

## INDIRECT COST OF LABOUR

The following note for clarification is inserted in the Guideline under

**Chapter 3.0: Analysis of Unit Rates**

**Paragraph 3.3 : Labour cost**

**At Page -7**, after the first paragraph:

"Provisions that are expressly governed by law namely, Workmen's Compensation, Gratuity, Employee's Provident Fund etc., shall be adopted as per the statutory provision applicable at the place of project construction for arriving the indirect wages benefits. Indirect cost of labour as 55% (semiskilled/unskilled) and 80 % (skilled) of the basic wage rate shall be commensurately modified (increased/ decreased) vis-à-vis specific provisions governing Employee's provident Fund, Gratuity etc. under law/regulations prevalent at the place of Project.

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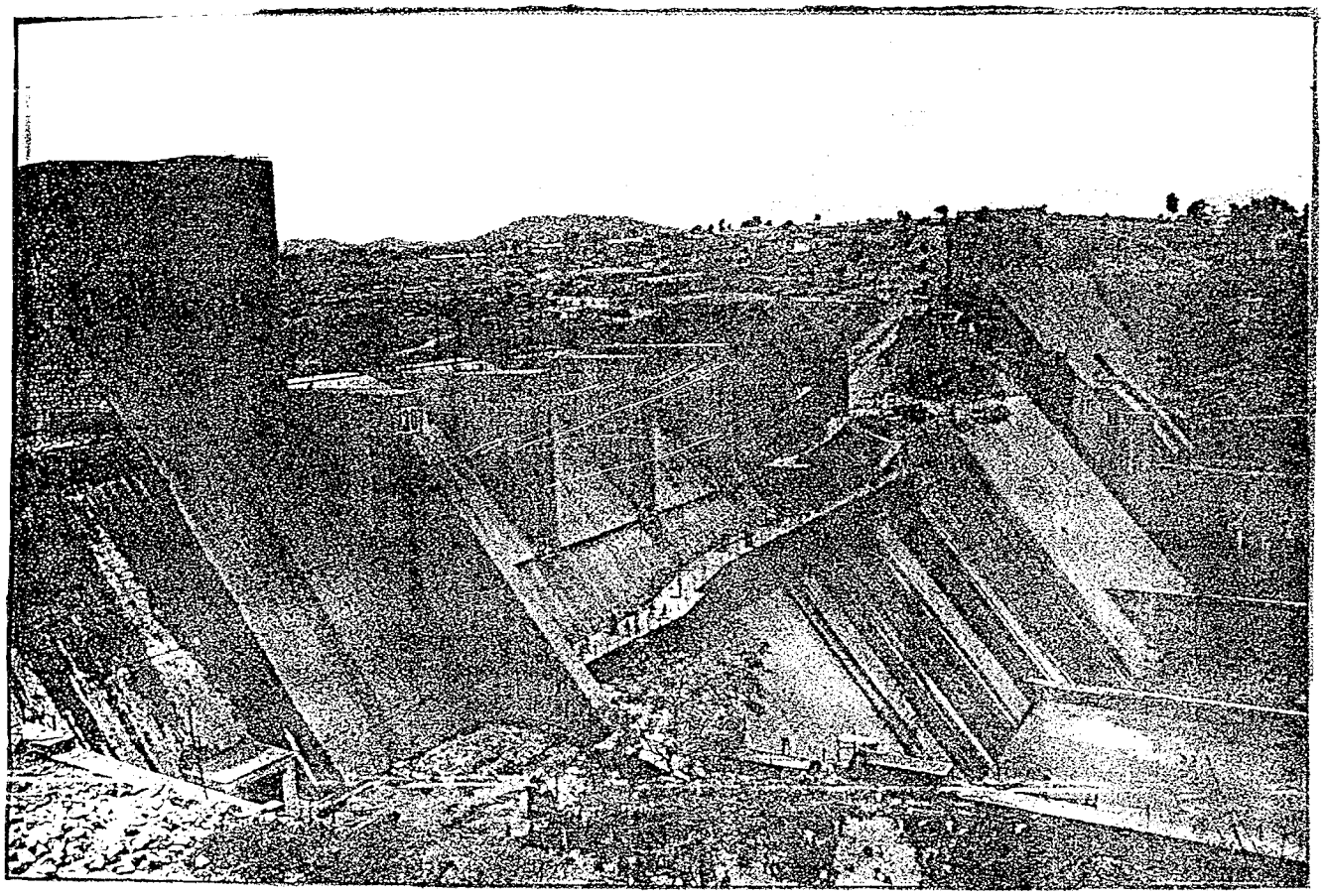
# GUIDELINES FOR PREPARATION OF PROJECT ESTIMATES FOR RIVER VALLEY PROJECTS

(SECOND REVISED EDITION)



ASDEO BANGO DAM

GOVERNMENT OF INDIA
CENTRAL WATER COMMISSION
NEW DELHI
MARCH, 1997

# GUIDELINES FOR PREPARATION OF PROJECT ESTIMATES FOR RIVER VALLEY PROJECTS

( SECOND REVISED EDITION )

## FOREWORD TO THE SECOND REVISED EDITION

The cost estimate of a project is an important document and forms the basis for its economic appraisal, techno-economic acceptance by the Technical Advisory Committee and last but not the least investment clearance of the Government.

Cost estimates of the projects are drawn up on the basis of prices prevailing at the time of preparation of the project reports while the projects get executed over a period of time as per funds made available based upon envisaged implementation schedule to the extent possible. The project report/cost at the time of appraisal is based upon the data/information collected by carrying out minimum/adequate investigations necessary for preparation of the project report. The actual layout/designs do get subjected to change as per actual site conditions at the time of execution of individual components of the project. The above factors also become instrumental in increasing the cost of projects besides other factors such as price rise, inadequate or lumpsum provisions in the initial estimate, public resistance at the time of land acquisition and compensation etc. The rise in project cost is inevitable particularly in projects which have a long gestation period.

Water Planning and Project Wing of C.W.C. has brought out the second revised edition of "Guidelines for Preparation of Project Estimates for River Valley Projects(1997)". An effort has also been made to make the guidelines more comprehensive by incorporating a Chapter on "Preparation of Cost Estimates for Private Sector Power Projects", as private sector participation is likely to increase in the near future.

The C.W.C. would welcome all suggestions for improvement of the edition.

Ramesh Chandra

(RAMESH CHANDRA)
CHAIRMAN
CENTRAL WATER COMMISSION

## PREFACE TO THE SECOND REVISED EDITION

C.W.C. Guidelines for preparation of the project estimates for major irrigation and multipurpose projects were issued in July 1976 and revised for the first time in July, 1983. These are being followed by the State Governments/other concerned agencies for formulation of river valley project estimates. Since these guidelines were prepared more than 10 years back, it was felt that the same need to be reviewed and modified in view of the various changes that have taken place in the methodology of project formulation, funding and execution.

Whereas the quantities of various items of work in headworks, power house, major canal structures and so on can be fairly estimated on the basis of field investigations, surveys & designs, there is considerable scope for improvement in arriving at unit rates of items of work which would require a fairly accurate visualisation and analysis of the sequence of operations involved and cost of material labour and machine hour rates. Typical illustrations have been incorporated to help analyse the rates of items of works involving plant and machinery to arrive at a realistic estimate.

A chapter on cost estimates of Private Sector Power Projects has been added to help frame the estimate on a uniform basis as private sector participation particularly in power projects is likely to increase in the near future.

Separate provision under sub-head W-Drainage has been dispensed with and provision of drainage in command area has been placed under the sub-head X-Environment and Ecology as the same is intrinsic to environmental and ecological protection/safeguards. These are presently examined in the Ministry of Environment and Forest as a whole including command area drainage. This will help in better appreciation of environmental repercussions due to the water resources projects.

The publication has been rightly titled "Guidelines for preparation of project estimates for River Valley Projects" considering its wide applicability in all Irrigation, Flood Control and Hydro-electric projects etc.

The present edition is the result of deliberations of the Review Committee headed by Shri S.C.Chitkara, Chief Engineer(PAO) as Chairman and four Directors, two each from Central Water Commission and Central Electricity Authority, who deserve appreciation for their efforts and hard work in bringing out this edition.

Any comments or suggestions on the contents of these guidelines for improvement will be welcome.

(Z.HASAN)
MEMBER(WP&P)

## PREFACE TO THE FIRST REVISED EDITION

CWC broad guidelines for preparation of the project estimate for Major Irrigation and Multipurpose Projects were first issued in July 1976. The response of the State Governments to the adoption of these guidelines has been very encouraging. Since the printed copies of the guidelines have been exhausted, and since the demand from various quarters still persist, the CWC has decided to bring out a new edition. No doubt considerable experience has been gained in the formulation of project estimates still certain deficiencies are observed in the estimates. The deficiencies noticed are broadly of the following types:-

1. The estimates generally lack detailed rate analysis based on the prevailing wages of labour, prices of construction materials, fuel and machinery, the output of labour & machine relevant to the job.

2. Adequate investigation for the distribution system is found wanting.

3. The estimates in respect of canal structures, distributaries and minors, water courses and drainage are not based on typical estimates of representative structures/areas.

4. Provision for land acquisition & rehabilitation measures are generally inadequate. The land rates adopted are old, land classification done arbitrarily and compensation for properties provided was lumpsum and provision is not supported by certificates from the revenue authority.

5. Provision are made on lumpsum basis even for items for which the cost can be worked out by proper analysis.

6. There is a tendency to underestimate the costs in the first instance. These are attributed to the following:-

(a) The designs are not done in details and therefore quantities are not correct and do not include all the items in the schedule of quantities.

(b) The construction programme is not realistic. Less period is take into account for completion for charging overheads and establishment charges.

7. Adequate provision is not kept for water courses and field channels.

8. The cost of instrumentation is generally not incl in the estimates of dams.

9. The provision for soil conservation is generally included in the estimates.

All the above factors lead to under estimation of t cost.

With the experience gained in the use of th guidelines and scrutiny of project estimates in CWC du the past five years the contents of this book have bee reviewed and revised and additional material include wherever necessary. Opportunity has also been taken bring the instructions contained in various paras upto based on the latest circulars issued by the Plannin Commission, Ministry of Irrigation as well a recommendations made in the Working Group Report preparation of detailed project reports, on Irrigation an Multipurpose projects (1980).

The Standards laid down for the preparation estimates in these guidelines should be followed carefully so that delays which occur in obtaining the missing esssential informations and in processing of the estimat is avoided.

Any comments or suggestions on the contents of the guidelines by way of improving its utility will welcome.

The present edition is the result of efforts and ha work put in by Shri K.C.Kathuria, Director, Rates a Costs and his staff inspite of their busy schedule of work.

Sd/-

(GOKHUL PRASAD)
MEMBER (P&P)

# FOREWORD

Since independence a large number of irrigation and multipurpose projects have been taken up for construction. While the benefits accruing from these projects have been immense, the mounting costs, and the frequent revision of the project estimates have been causing great concern to the Government. In addition, delays in sanctioning the estimates at various levels and consequent delays in completion of the projects and accrual of benefits from them have also been a matter of concern to engineers and planners alike.

The project is cleared for execution only when the criteria laid down for evaluating the benefits vis-a-vis costs are satisfied. The estimates contained in the project report form the basis of the project appraisal and the reliability of these estimates determines the value of said appraisal. It is, therefore, evident that formulation of reliable estimates is of paramount importance.

There is a general expectation that the estimated cost of works concerning irrigation and multipurpose projects should be as good as those of buildings and roads for other public works. The fact, generally, lost sight of, is that river valley projects are much more complex and their estimates embrace a very wide variety of items ranging from surveys and common items of brick masonry, concrete etc. to complex items of tunnelling etc. For the convenience of engineers entrusted with the framing of the estimates of irrigation & multipurpose projects, broad guidelines for preparation of such estimates are presented herewith. As adequate investigations play an important role in correct estimating the guidelines issued earlier by the Central Water Commission for investigations of major irrigation and hydroelectric projects have also been included in this publication for ready reference.

The Central Water Commission would appreciate any suggestions for improvement of this publication.

Sd/
( Y.K.MURTHY )
CHAIRMAN, C.W.C.

New Delhi,
the 5th July 1976.

CONTENTS

## ANNEXURES

# I N T R O D U C T I O N

C.W.C. Guidelines for preparation of the project estimates for Major Irrigation and Multipurpose Projects, issued in July, 1976, were first revised in July,1983. The second revision of the above guidelines was felt necessary in view of the various changes that took place in project formulation, funding and execution during the period between 1983 to 1995.

With the experience gained in the use of these guidelines and scrutiny of project estimates in C.W.C. for the last twenty years, the contents of the guidelines have been reviewed and revised and additional material included wherever necessary. Opportunity has also been availed to bring the instructions contained in various paras upto date, based on the latest circulars issued by Planning Commission, Ministry of Water Resources, Ministry of Labour, Ministry of Welfare etc. The Committee also felt it necessary to have the valued views of the State Irrigation Departments/State Electricity Boards and several other Organisations such as National Hydro Power Corporation, Bihar State H.E. Power Corporation, Karnataka Power Corporation Ltd., North Eastern Electric Power Corporation etc. Accordingly a questionaire was prepared and sent to them on (i) problems if any, being faced by them in preparing estimates of river valley projects in accordance with the existing Guidelines of C.W.C.;(ii) Need to revise percentage provisions in different sub-heads in the guidelines and asking for relevent data on completed/partially completed projects; (iii) methods to accelerate the process of revising project estimates etc. The suggestions received from them were considered/incorporated while reviewing the guidelines.

One of the important aspects is to update the percentage provisions for various sub heads given in the earlier guidelines which has now been done by analysing the data on actual costs incurred on some of the recently completed/partially completed Irrigation/H.E.Projects. The present edition of the guidelines have been made more comprehensive by including references such as typical hourly use rate of some of the commonly used equipments and machineries, analysis of rates for some important items of works. The other important aspect kept in view is that extracts of the relevant paras, tables etc. have been included alongwith reference to relevant text books, I.S.codes or manual to facilitate the users to have them readily available in the pressent guidelines. Separate Chapter for Power Projects with private sector investment/participation has also been included. A para

on preparation of completion report has also been included in the guidelines so that the comparison of initial project cost vis-a-vis the actual cost of construction, sub-headwise, would be made available in the project estimate itself to serve as a vital information in future to have a check in variation of cost for new projects. The suggestions of different specialised Directorates of C.W.C. have also been incorporated in the guidelines for sub-heads like C-Works, Q-Special T&P, X-Environment & Ecology and Instrumentation.

While analysing the items of unit rates of works, a component of indirect cost of labour on account of amenities to labour such as paid holidays, different kind of leave, accommodation, medical and canteen facilities and workmen compensations, retrenchment compensation etc. are required to be included as per the statutory provisions. The component due to these social factors has been categorised into two parts as applicable for skilled and semi-skilled/un-skilled Labourers. These factors shall be carefully adopted for arriving at the unit rates of relevant items.

The present edition is the result of the deliberations of the Review Committee set up in Nov.1994 by the then Member (D&R), Central Water Commission, to review the guidelines and the Committee comprised of the following Officers of CWC & CEA.

| | | |
|---|---|---|
| 1. | Sh. S.C.Chitkara,<br>Chief Engineer(CPM), CWC. | Chairman |
| 2. | Sh. S.C.Mahajan,<br>Director,HTD II, CEA | Member |
| 3. | Sh. R.S.Chadha,<br>Director, HPA I, CEA | Member |
| 4. | Sh. S.C.Chadha,<br>Director, Cost Engg.(H),CWC | Member |
| 5. | Sh. M.K.Sharma,<br>Director,Cost Engg.(Irr.),CWC | Member-<br>Secretary |

The Committee held 17 meetings (Jan.95 to July,96) in all to finalise the draft guidelines. The same were

circulated among the States Irrigation Departments/Electricity Boards and the concerned Public Sector Undertakings and their response/suggestions have been incorporated/considered while bringing out this edition.

The Committee would place on record its appreciations of the efforts and hard works put in by S/Shri L.D.Jangde (Now Director & Member Secretary), Narendra Kumar, C.N.Subramanian, Atul Jain, P.Das Deputy Directors, S/Shri Shiv Charan, Gulzari Lal, H.C.Yadav, Assistant Directors and Shri S.C.Chaudhuri Extra Asstt.Direc tor, in organising meetings, collection and processing of data and completion/finalisation of the Guidelines. Thanks of the Committee are also due to Shri M.L.Roopwani, P.A. and other staff of Cost Engg.(Irr.)Dte.for rendering stenographic / typing and other assistance in bringing out the present edition.

(S.C.Chitkara)
Chairman, Review Committee
&
Chief Engineer(PAO),CWC

## 1.0 EXAMINATION OF PROJECT ESTIMATES IN C.W.C.

Under the procedure laid down by the Planning Commission all major irrigation & multipurpose project reports including cost estimates received from the State Govts./Union Territories have to be examined in detail by CWC and put up to the Advisory Committee of the Ministry of Water Resources for acceptance. After these schemes are accepted by the Advisory Committtee, the investment clearance is issued by the Planning Commission. Thereafter, during implementation of the projects, if the revised cost exceeds 15% of the original approved cost excluding escalation due to price rise or where there is change in scope i.e. change in project parameters resulting in changes in nature and benefits such as CCA, installed capacity, energy generation etc., then a revised estimate for the project has to be submitted by the State & the estimate examined afresh for necessary clearance by CWC/Advisory Committee etc.

Feasibility estimates generally known as project estimates provide the basis for authorisation of the project for construction and for the appropriation of construction funds. These estimates should be in enough detail to show the quantity, unit cost and total costs of various works and supply items.

Engineering surveys, geological explorations and similar works accomplished during the feasibility investigations are usually carried out to the extent needed to enable at least, a tentative layout to be prepared for the purpose of sound cost estimate and to prove the feasibility of the project. CWC has laid down guidelines for the minimum investigations to be done for formulation and submission of Irrigation and H.E.projects. It is necessary that these guidelines are followed and the prescribed investigations are done to arrive at realistic estimates.

In the feasibility estimates, cost of major items is best worked out in detail on the basis of preliminary layouts and designs and unit rates which should be analysed for the project in question. Smaller items may be computed from cost graphs and parametric rates.

## 2.0 NATURE OF PROJECT COSTS

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

2.2 Investigation costs include cost of collection of necessary physical, hydrological, geological, topographical and structural data to give the engineers the basis for design and estimation.

2.3 Design costs include the cost of all necessary analysis of data and studies(geological, structural and economic) to support the layout and dimensions of structures, the layout of construction plant and facilities, the specification of materials and the method of construction.

2.4 Construction costs are the costs of bringing the project into being. These costs should include all the work and supply items required for the supervision and the construction of permanent project along with engineering supervision and administrative services and costs of all service facilities which are used for the construction activities such as colonies, roads, water supply and sanitary systems, camps etc.

### 2.5 CONTINGENCIES & WORK CHARGED ESTABLISHMENT

Contingencies are percentage allowances shown as a separate item to cover minor differences in actual and estimated quantities, omission of minor items of works, difficulties unforeseeable at site, possible minor changes in plans and other uncertainties. In no case should contingencies be allowed for by increasing estimated quantities or unit prices. The percentage to be used is based on consideration of major pay items in the estimate, availability of data, adequacy of the quantity computations and the general knowledge of the conditons at the site.

The cost of labour employed on work relates only to that form of labour which does the physical work. Such work may be done by skilled labourers, carpenters, masons, operators and others.

Work charged establishment comprises of supervisory staff and foremen who do not work with their own hands but exercise immediate control over the quality and output of workers.

Provision for contingencies and W.C. Establishment is generally considered up to 3% and 2% respectively of the works' cost and provided in the detailed works estimates prepared on the basis of item rates & quantities of works to be executed. These percentage provisions should not be considered on lumpsum items. No allowance should be made for contingencies in contract estimates as these estimates are prepared from final design studies and represent the estimated cost of a specific contract based on detailed computations of quantities and detailed analysis of unit costs.

2.6 Except for reconnaissance estimates, the quantities for major items should be computed from actual layouts or preliminary/feasibility drawings. In preparing quantity estimates allowance must be made for wasted and unsuitable materials, for shrinkage of excavation in compacted fills and for over breaks in tunnel excavation, concrete tunnel lining and back fill etc. The allowance should be conservative and reasonable.

2.7 One of the most difficult tasks in connection with the preparation of cost estimates is the determination of the unit costs of labour, materials and equipment necessary to perform the work designated in the various pay items for the proposed construction. A current unit cost should be used in all estimates except in those cases where actual contract bid prices are available. Unit cost may be based on local schedule of rates for items covered by the schedule and for others, analysis of rates may be prepared as per para 3.0. In the case of any doubt on the viability of rates a certificate of the State / Project Chief Engineer on the reasonability of rates shall be taken as final and acceptable. The unit cost should not be increased to cover contingencies.

2.8 The same considerations are required in estimating unit costs for all construction to be performed either by Government Department or by the contractors except that contractor's overheads, profit, insuransce, and taxes are subplanted by Government supervision of construction, Govt. insurance and allowances for annual and sick leave etc.

2.9 In estimating unit rates enough field data should be collected on the duration of the working season, climatic conditions, danger from flood and other hazards, topographic conditions, geology of site, records of foundation explorations, nature and location of aggregate deposits and sources of other construction materials, kind of terrain over which material must be hauled, labour market, housing accommodation and problems of public relation.

## 3.0 ANALYSIS OF UNIT RATES.

### 3.1 GENERAL CRITERIA FOR ANALYSIS OF RATES.

3.1.1 Preparation of project estimates for any river valley project requires calculation of the quantities of various items involved, working out their analysis of rates and computation of their cost. While the quantities depend upon the layout and type of work to be executed, the cost would depend upon the unit rate of items of works involved in the construction of the project. The analysis of rates for various items is 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.

3.1.2 As the project cost estimates are made before the work is done, the estimated cost is only an indication of the order of the actual cost. The agreement between the estimated and actual cost would depend substantially upon the accuracy with which this analysis is done, which implies the use of precise estimating methods and correct visualisation of the manner in which the work would be executed and the sequence of operation. A complete analysis of rate, therefore, requires the determination of costs for various operations developing the cost from basic rates of labour, material and machines for the operation.

### 3.2 MATERIAL COST:

The quantitative assessment of material requirement may 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 States/region. The appropriate cost for freight, unloading, cartage, storage, inspection and testing should also be included.

Over and above the theoretical quantities of materials computed by existing norms and practices there should be adequate provision for wastage allowance and incidentals to the work in the analysis of rates on all accounts including handling, short weight, losss in storage etc. This allowance of wastage and incidental to works may be taken upto 5% of quantities in case of cement when handled in bags and 2% when handled in bulk, while for steel this provision may be made upto 2 1/2% only as there will be some salvage value of the steel scrap.

3.3 LABOUR COST:

The time which a labourer takes in performing a unit of work would vary with personal factors such as climatic conditions, job supervision and complexities of operation etc. The assessment of output of labour may be made as per the relevant IS Code or the norms prevalent in the State/Regions/River Valley Project of similar nature.

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

Apart from the basic wage of a worker there are other liabilities accruing due to benefits and amenities which are given to workers on river valley projects. These benefits and amenities may be on account of the following factors:

i) Hill compensatory allowance.

ii) Hazard allowance.

iii) Travelling allowance.

iv) Medical expenses or benefits.(first aid)

v) Workman compensation.

vi) Free accommodation,water supply and power.

vii) Canteen facilities.

viii) Employee's Provident Fund.

ix) Other amenities like free dresses, gumboots, helmets and woollens.

Besides the above; work in the River Valley Projects cannot continue throughout the year as it may have to be stopped during the flood season. In some projects casual worker system is not accepted and continuity of service is given to many workers depending upon the situation at the project and prevailing practices. The effect of this has also to be considered in the wage rates.

The judicious provision of the above indirect cost of labour has, therefore, to be made over and above the basic wage rate of the labour for each individual project depending on the statutory provisions applicable and practices prevalent for benefits and amentics of workers in the project. This labour welfare or indirect cost of labour may be taken as 55% and 80% of the direct cost for semiskilled /unskilled and skilled labour respectively as per the break-up given in Annexure-2.

3.4 PLANT COST

For working out the use rates of machinery, the norms for life, depreciation, repair provision etc. may be adopted as recommended by the CWC Guide Book on use rate,Hire charges and transfer value of Equipment and spare parts,Dec.1988. Extracts from the guide book giving the norms of life & repair provision of major equipments alongwith typical proformae for calculating the use rate of some of the important equipments are given as Annexure

Prices of various equipment should be taken on the basis of recent quotations/price list of such equipment or information available in CMC Directorate of CWC. All taxes and freight charges should be taken into consideration while arriving at the cost of equipment at site.

3.5 CONTRACTOR'S OVERHEADS AND PROFIT:

The contractor's overhead costs include (i) Office expenses(ii) share of head office expenses (iii) Legal charges (iv) General Establishment, Watch and Ward (v) Local conveyance (vi) Travelling expenses (vii) Social welfare (viii) Salaries of Managerial and clerical staff etc. (ix) Publicity etc.

In addition to the overhead expenses, the contractor has to be allowed certain amount towards his profits. This is usually expressed as a percentage of the total estimated cost of the job. This percentagde varies from job to job but usually a 15% profit is anticipated by the contractors. On large jobs a lesser percentage of profit may be adequate.

Since it is difficult to identify overheads and profits precisely, both these together may be provided at 20% of the prime cost/or as per State Govt. norms in the analysis of rates.

In the case of departmental works it is expected that additional departmental charges would also be about 20%.

It has not been found practicable due to wide variety of works performed in River Valley Projects to present analysis of rate for all items of work. Analysis of rates of some of the general items universally applicable in river valley projects are given in annexure 6.

## 4.0 INFORMATION TO BE GIVEN IN THE REPORT OF THE ESTIMATE:

The following point should generally be covered in the report of each estimate:

### 4.1 SCOPE:

An explicit statement of the work which is and the work which is not covered by the estimate and an indication of the arrangements being made for the portions not included in the estimate should be given.

### 4.2 METHOD OF CONSTRUCTION.

The method proposed for carrying out the work, whether departmentally or through contractors or a combination of these, should be mentioned. The position regarding labour and the source from which obtainable should be explained. The extent to which mechanised construction is contemplated should be fully explained. Separate analysis of rates for manual labour and mechanised construction should be included in the report.

### 4.3 CONSTRUCTION PLANT:

Detailed specifications and working cost of any special plant which is proposed to be employed for construction should be given.

### 4.4 ESTABLISHMENT.

The staff of various grades required for construction, should be shown.

### 4.5 LAND AND RESETTLEMENT OF OUSTEES.

Special arrangements, if any, proposed for the acquisition of land and resettlement of oustees who would be displaced from the area that would be submerged by the reservoir should be discussed and cost worked out in consultation with local Revenue authorities and Administrative departments.

### 4.6 TIME

The phased programme of construction alongwith PERT/CPM Network and expenditure should be indicated as far as possible.

4.7 CONSTRUCTION MATERIALS.

Results of experiments, if any, bearing upon the suitability of construction materials proposed, types of materials, locations from which obtainable, borrow areas, quantity available, facilities for manufacture, distance of work from the source of manufacture,nature of haul roads (whether in plains or hilly areas) should all be specified. Basic rates of steel and cement and other materials should also be given. A write up should be added indicating the quantities of key materials required for the project.

4.8 COMMUNICATIONS:

Average distance of carriage of heavy machinery, cement and steel etc. from the nearest rail head and communication facilities available for carriage of materials and suitability of existing roads and bridges for carriage of heavy plant and machinery should be described. Construction needs for new rail or road links should also be discussed.

4.9 OTHER PUBLIC FACILITIES:

Mention should be made for such public facilities as water supply and electric power for construction etc.

4.10 LABOUR:

Labour requirements for construction of project and their availability should be discussed under this item.

4.11 DIVERSION ARRANGEMENT:

Diversion arragement proposed during construction including information regarding average monthly river flows.

4.12 DOCUMENTS TO ACCOMPANY THE ESTIMATE.

The estimate should be accompanied by the following documents.

1. Index map of the project, general layout and preliminary Drawings of important structures.

2. Single line diagram and layout drawings of Power House and Switchyard (applicable for Power Project only).

3. Brief specifications of works.

4. Details of micro planning for distributries,minors, water courses and drainage for 10% of the total area of the command in the case of Irrigation scheme.

5. A schedule of prevailing basic labour wages.

6. A schedule of prevailing basic cost of materials supported by analysis wherever necessary.

7. A schedule of prevailing transport rates supported by analysis wherever necessary.

8. Basic out-puts of men and machines assumed for estimating the cost.

9. Use rates of equipment supported by their analysis.

10. Analysis of unit rates of various works.

11. Copy of the latest schedule of rates of the district in which the projecct is located.

12. Relevant certificates from concerned Authorities/Departments.

13. Information as per the proformae enclosed at Annex.1

For excavated materials to be used in the body of the structure, separate item rate excluding the cost of excavation shall be worked out and provided.

## 5.0 CLASSIFICATION OF ESTIMATES INTO UNITS AND ACCOUNT HEADS:

5.1 The Bureau of Indian Standards has published a standard numbered IS:4877-1968 entitled "Guide for preparation of estimate for river valley projects" on this subject. According to this standard the project works have to be grouped into the following units:

a) Unit-I Headworks including main dam and auxiliary dam, dykes, spillway, outlet works, energy dissipation devices, barrages, weirs, regulators including intake structures and diversion works.

b) Unit II-Main canals, branches, and distribution system inclusive of all pucca works.

c) Unit III-Hydro-electric installation

1) Power Plant and appurtenant works:

i) Civil works, and

ii) Power equipment.

2) Transmission lines.

3) Sub-stations.

d) Unit IV - Navigation works.

e) Unit V - Water supply works.

5.2 ACCOUNTS HEADS

Minor Heads.

5.2.1 Each unit and if necessary each sub-unit, should be covered under the following minor heads classified as direct and indirect charges.

Direct Charges.

These shall include the following:

I. Works.

II. Establishment.

III. Tools and Plant.

IV. Suspense.

V. Receipts and recoveries on capital account.

Indirect charges:

These shall include the following:

a) Capitalized value of abatement of land revenue, and

b) Audit and account charges.

5.2.2 Detailed Heads under I-Works:

The provisins under the Minor head I-Works will be sub-divided under the following detailed sub-heads:

A- Preliminary.

B- Land.

i) Acquisition & Compensation.

ii) Rehabilitation and resettlement.

C- Works.

D- Regulators and measuring devices(for canals only).

E- Falls (for canals only)

F- Cross drainage works(for canals only).

G- Bridges(for canals only)

H- Escapes(for canals only)

I- Navigation works.

J- Power Plant Civil Works.

K- Buildings.

L- (for canals only)

i) Earthwork;
ii) Lining and
iii) Service Road.

M- Plantation.

N- Tanks and reservoirs.

O- Miscellaneous.

P- Maintenance.

Q- Special T & P.

R- Communications.

S- Power Plant and electrical Mechanical System.

T- Water Supply Works.

U- Distributaries minors and subminors.

V- Water courses.

W- Drainage(to be clubbed with Environment & Ecology)

X- Environment and ecology.

Y- Losses on stock.

5.3 ABSTRACT OF COST:

5.3.1 Detailed Abstract of cost:

To work out the total cost of the project in detail the cost of various units mentioned in para 5.1 should be compiled in a tabular form according to the various accounts heads indicated in para 5.2.

5.3.2 General Abstract of Cost.

On the basis of the detailed abstract of cost as in 5.3.1, a general abstract of cost for the whole project tabulating all the units together may be compiled by minor and detailed heads.

## 6.0 DETAILED ESTIMATES OF COSTS:

The various items under minor and detailed sub heads for which estimates should be prepared are indicated in paras 6.1 to 6.21. Explanatory note regarding the basis of provisions should be given for each item.

### 6.1 A-PRELIMINARY:

The important items to be considered are:

a) Expenditure incurred on previous investigations.

b) Detailed surveys for final location.

c) Aerial survey,contour survey for reservoir basin (including establishment of permanent bench marks).

d) Geological surveys and geophysical surveys.

e) Hydrological and Meteorological surveys including establishment of rain gauges/ and river gauge and discharge, sedimentation stations and their running charges.

f) Investigations for foundations and rock testing.

g) Investigations for availability of construction materials.

h) Construction of access roads to facilitate investigations.

i) Model experiments.

j) Computer & telecommunication facilities.

k) Preparation and printing of project reports.

l) Vehicles for inspecting officers for site investigations.

m) Camp equipment.

n) Preliminary soil tests, establihsing soil testing laboratory.

o) Consultants fees (including charges for preliminary design work or advice).

p) Training of engineers during investigation & preparation of project reports.

q) Ground water studies.

r) Environmental and Ecological Studies.

For Canal Works:

i) Command survey (contouring).

ii) Detailed alignment survey(cross sectional survey)

iii) Establishing and fixing bench marks.

iv) Taking trial pits or trenches and trial bores for foundation investigation of structures.

v) Taking auger holes for soil survey of command area.

vi) Field tests for soil classification.

**6.1.1** The amounts required against each of the above items will vary from project to project, and no general yardsticks can be laid down. It has, however, been the experience that the overall provision under 'A-Preliminary' in a project estimate should be limited to 1 to 2% of the total cost of I-Works.

6.2 B-LAND

This sub head covers the following items:

a) Acquisition of land (Private and Government) for works and that coming under submergence;

b) Compensation for other properties like houses, wells, trees etc;

c) Compensation for standing crops;

d) Compensation for prospective mineral deposits, if any;

e) Rent for use of land.

f) Interest charges on the amount of award for the period between taking over possession of the land and the date of award.

g) Solatium charges for compulsory acquisition.

h) Legal charges.

i) Relocation of communications like roads, railways, telegraph lines etc.

j) Staff for Demarcation/Measurement of Land; and

k) Establishment charges for land acquisition and compensation.

6.2.1 The probable rate for acquisition of different types of lands should be enquired from and got certified by the district revenue, forest or other competant authorities and their certificate appended with the project estimate. Only such cost that will actually be paid for Government land shall be included in the estimates. However, quantities for Government land taken on transfer shall be indicated.

The cost of wells should be based on the evaluation of their numbers and present day costs; but the cost of structures such as buildings, temples etc. should be based on plinth area rates at present day cost less value of usable materials.

The norms for crop compensation and interest charges are not uniform. The provision of crop compensation is normally made at a suitable rate per hectare on a percentage of cultivated land being acquired. It is seen that this percentage generally ranges between 25% to 50% of the agricultural land being acquired.

The interest charges on compensation may also be necessary in view of the likely time lag in taking possession of the land and properties and actual payment of compensation. For estimating purpose this provision may be considered on about 25% of the total compensation for a period of about 2 years @ 12% per annum.

Solatium charges may be provided @ 30% of the cost of permanent acquisition of private land. Establishment charges are provided @ 6.25% of the cost of total compensation.

In addition to L.A. establishment charges, provision is also required for labour and materials for demarcation and measurements for land and properties. This is generally provided @ 1% of the cost of land acquisition. Provision for legal charges may also be considered as requirements on this account have been on the increase. For the purpose of estimation, this may also be considered as 1% of the total compensation.

Following information/statements should be furnished in the estimate for B-Land.

1. Level upto which land is to be acquired for submergence and construction works.

2. Statement showing villages submerged along with total area of the villages and the area to be acquired and also the percentage of the total area of the village.

3. Statement of village-wise structures such as buildings, Stables, Temples, other Religious Buildings and wells.

4. Statement of persons displaced and their occupation villagewise.

5. Alternative means of employment for the oustees.

6. No. of trees, girth at 3' above GL, fruit bearing etc. and their usefulness.

6.2.2 ii) Rehabilitation & Resettlement:

The provision for rehabilitation would depend on the number of persons displaced and the rehabilitation

measures proposed to be adopted which should be clearly indicated in the project report. Broadly, the following provisions need to be considered.

a) Acquisition of lands for new village sites and allotment of plots for housing to the villagers at suitable rates.

b) Making the acquired land fit for habitation and providing facilities such as village roads, wells, school buildings, post offices, dispensaries, panchyat ghars etc.

c) Providing free transport for conveyance of dismantled materials and household articles from old place to new sites.

d) Development of lands(including reclamation if needed )to be allotted to agriculturist displaced persons.

e) Cost towards implementation of Rehabilitation & resettlement plan.

6.2.3 In 1975 a committee was appointed by the Central Board of Irrigation and Power to consider the desirability of fixing norms for acquisition of land and structures on the projects throughout the country The relevent extract from the recommendations of this Committee concerning the extent of land to be acquired is given below:

"Generally acquisition may be done upto FRL only. The area between FRL & MWL may be acquired only if the submerged land is fertile and the duration of submergence beyond FRL upto MWL is long enough to cause damage to crops i.e. over 15 days duration. (for acquisition of land the effect of back water need not be taken into consideration).

All structures coming under submersion between FRL and MWL should be acquired. If the structures coming under submersion are of religious or archaeological interest, provision must be made for re-establishing these structures above MWL".

The provision for acquisition of land and structures should be made accordingly.

Provision should also be made for establishmesnt charges towards implementation of R&R @ 6.25% of its total cost.

6.3 C-Works:

This head is intended to cover the provisions for various components of which the Head works are composed of viz. Dam, spillway, energy dissipation works, outlets(irrigation, power, water supply and scour sluices), pick up, barrage, head regulator etc. The list of pay items to be considered for different works are given below:

Details of C-Works:

6.3.1 Embankment Dam (earth and rock fill):

This includes the following important components:

a) River management during construction including such items such as coffer dams and diversion tunnels.

b) Foundations - These shall include the following:

1) Site Clearance.

2) Excavations:

i) Stripping for dam seat.

ii) Stripping for horizontal blanket (outside dam)

iii) Stripping if any for upstream blanket.

iv) Longitudinal, cross and toe drains.

v) Key for upstream riprap and

vi) Cut off trench.

3) Dewatering arrangements (with details)

4) Foundation treatment

i) Guniting/shotcreting.

ii) Drilling in rock or in soil with casing.

iii) Foundation/grouting tunnel.

iv) Filling cut off trench with selected impervious materials:

- from excavated materials.

- from borrow areas.

v) Grouting(cement, bentonite, chemicals)

vi) Constructing Diaphragm wall(concrete, plastic).

vii) Relief wells.

viii) Upstream horizontal impervious blanket.

ix) Sheet pile.

x) Pile driving.

xi) Other treatments.

5) Foundation drainage -

This shall consist of;

i) Drilling drainage holes, and

ii) Making drainage and grouting tunnels.

6) Filling cut-off trench with selected impervious material;

i) from excavated material, and

ii) from borrow area.

c) Dam

1) Earthwork ( in core, shell, random zones and upstream blanket).

i) Impervious, :
ii) Semi-pervious, :Quantity to be indicated
iii) Pervious, : separately for excavated
iv) Random fill : materials and borrow areas.

2) Rock fill including rock toe;

i) from excavated materials.
ii) from quarries.

3) Filters(at downstream toe or hearting).

i) Fine filter(sand)- sloping, vertical or horizontal.

ii) Coarse filter(gravel or crusted stone) sloping, vertical or horizontal.

4) Upstream sealing:

i) R.C.C.membrane

ii) Blanket of special materials like Geomembrane or non dispersive soil layer.

5) Upstream slope protection

i) Rip rap (dumped or hand placed)

6) Downstream slope protection:

i) Turfing.

ii) Rip rap

iii) Geo-textile etc.(woven fibres)

iv) Surface Drainage System (cross drains, longitudinal drains/pipes collecting and toe drain).

7) Instrumentation.

8) Laying of open jointed pipes for drainage.

9) Manholes.

10) Parapet wall:

i) Masonry or concrete with coping.
ii) Railing, and
iii) Wheel guard stones.

11) Road over the dam.

12) Gauge posts.

6.3.2 Masonry Dam:

This will include the following items:

a) Diversion works during construction, such as coffer dams, diversion tunnels/channels

b) Foundations;

1) Clearing site.

2) Dewatering in foundations.

3) Excavation for main dam, energy dissipation arrangements, approach and tail channels, training/divide/retaining walls in:

i) Overburden of soft strata,
ii) Overburden of hard strata, and
iii) Hard rock.

4) Preparation of dam seat.

5) All works relating to shear zones/faults/ weak zones, treatment, wherever applicable.

6) Cement grouting including curtain and consolidation grouting.

7) Drilling holes:

i) for grouting.
ii) for drainage, and
iii) for anchor rods.

8) Anchor rods.

c) Dam:

1) Masonry for:

i) hearting.
ii) upstream face.
iii) downstream face(non overflow section and overflow sections).
iv) training/divide/retaining walls.
v) parapets and
vi) gallaries, adits and other openings.

2) Cement concrete in:

i) filling crevices and levelling course, overfoundations.
ii) training/divide/retaining walls.
iii) parapets.
iv) gallaries, adits and other openings.
v) upstream concrete/sandwiched concrete membrane.

3) Form-work(if not included in rate for concrete) for items mentioned in 2.

4) Steel for reinforcement.

5) Guniting for the upstream face of masonry

6) Drilling for Anchors.

7) Anchor rods.

8) Instrumentation.

9) Joints and seals.

10) Drilling and grouting of masonry.

11) Porous pipe for drainage.

6.3.3 Concrete Dam:

The various items of works in the construction of concrete dams are:

a) Diversion works during construction, such as coffer dams, diversion tunnels/channels etc.

b) Foundations (items same as under masonry dam(b).

c) Dams:

1) Cement concrete in:

i) hearting(with or without plums),

ii) upstream facing,

iii) downstream facing which shall include the overflow section and non-overflow section,

iv) training/divide/retaining walls,

v) parapet,

vi) galleries, adits and other openings, and

vii) any other structures.

2) Form-work(if not already included in rate for concrete) for items mentioned in (1) above.

3) Reinforcement steel.

4) Joints and seals.

5) Drilling for anchors.

6) Anchor rods.

7) Instrumentation

6.3.4 Spillway:

The spillway structures may generally be of masonry or of concrete and the items, therefore, are respectively the same as for masonry or concrete dam. Following additional items need to be estimated:

a) Cement concrete for:

1) spillway piers,
2) bridge beams and slabs,
3) tunnel lining wherever applicable,
4) spillway crest, downstream glacis, chute etc.

b) Miscellaneous items of bridge like bearings.

c) Tunnel excavation wherever applicable.

d) Crest gates with hoisting equipment and hoist bridge.

e) Stop logs for crest gates and lifting arrangement.

6.3.5 Energy Dissipation Works:

Same items as for concrete dam with the addition of cement concrete for:

a) Stilling basin/bucket/Apron,

b) floor blocks and

c) end sills and chute blocks.

6.3.6 Outlets:

This will include the following:

a) Excavation in soil and rock.

b) Foundation treatment:

i) lean concrete in foundation;
ii) drilling and grouting;
iii) shot-creting/guniting.

c) Structural concrete for:

i) foundation, piers and abutments;
ii) conduit, cut off collars
iii) gate control structure, beams, floor slabs etc.
iv) block outs;
v) stilling basin including chute bocks, baffle blocks and end sills;
vi) guide walls;
vii) lining in approach channels.

d) Masonry in guide walls of approach channels or stilling basin.

e) Steel for reinforcement.

f) Rubber/PVC seals at joints.

g) Gates.

h) Hoisting equipment and auxiliary items.

i) Filters around conduit.

j) Trash rack.

k) Steel lining.

l) Stop logs.

6.4 I-NAVIGATION WORKS:

Important items to be considered under this sub-head are:

(a) Excavation of inter-connecting bye-pass channels etc.

(b) Construction of structures:

i) Wharfs

ii) Quays

iii) Jetties

iv) Navigation locks.

v) Any other.

c) Dredging Operations.

i) Equipment for maintenance dredging.

ii) Other operations involved in dredging.

The provision for (a) channels etc., (b) structures shall be made in line with the procedure discussed under D-Regulator etc. and L-Earthwork. The provision for (c) dredging operations shall be made in consultation with the State Inland Water Authorities.

6.5 J-POWER PLANT CIVIL WORKS

This shall include intake structures, gates, silt exclusion arrangement, tunnels, power canal, and tail race channel/tunnel, surge shaft,forebay, penstocks, power house, switch yard etc.

6.6 K-BUILDING:

Requirement of buildings for execution of the project depends upon whether the works are to be carried out departmentally or on contracts.

This sub-head would include buildings for civil as well as electrical/mechanical works.

The buildings may be classified into residential buildings and non-residential buildings.

Residential buildings should be provided for all officers and staff(regular as well as workcharged) engaged on site of work as necessary.

Non-residential buildings shall include:-

a) Office buildings.

b) Testing laboratory.

c) Rest houses and field hostels.

d) Workshops including site workshops.

e) Stores including site stores.

f) Sheds and

g) Other service buildings such as:

1) hospitals or dispensaries or both;
2) welfare centre;
3) police station;
4) schools;
5) post offices, telegraph and telephone offices;
6) community centre;
7) diesel generating station and sub-station.
8) canteens;
9) co-operative stores & markets;
10) bus stop;
11) public utility;
12) bank and treasuries;
13) pump house and fire station etc.

6.6.1 The buildings, both residential and non-residential shall be further divided in two categories - permanent and semi-permanent or temporary. Permanent buildings may be considered only if these are required in the post construction period also.

6.6.2 The usual practice is to make the provision under this sub head on the basis of plinth area and prevailing market rates per unit area for different types of buildings. The type of construction proposed should be clearly described.

It is observed that the total cost of buildings in a project generally amounts to 5% to 7%in plain region and 6% to 8% in hilly region of the cost of I-Works. Provision less than 5% is likely to be adequate only in cases where the project is located near urban areas or some existing project, where other buildings could be obtained for use.

6.6.3 Other items chargeable to buildings:

In addition to the cost of buildings, provision for following items is also required under this sub-head;

a) Land development(Levelling and filling)

b) Colony roads

c) Fencing/Boundary Walls,security/observation booths.

d) Service connection such as water suply, sanitation drainage and electrification.

e) Lawns,Gardens and plantation(other than plantation under the head M- Plantation and Environment & Ecology)

f) Retaining walls, terracing etc.

The provision for the above items may be made as per norms fixed by the State Governments. However, where

such norms are not available, following table may be taken as a guide:

TABLE SHOWING PERCENTAGE PROVISION AS COST OF BUILDINGS FOR VARIOUS SERVICES UNDER K-BUILDING.

| Item | Permanent | | Temporary | |
|---|---|---|---|---|
| | Residential* | Non residential* | Residential* | Non-residential* |
| Land development | 1 to 2% | 1 to 2% | 1 to 2% | 1 to 2% |
| Colony Roads | 2% | 2% | 2% | 2% |
| Fencing, boundary walls & security/ observation booths. | 1% | 1% | 1% | 1% |
| Lawns, Gardens and Plantation. | 1% | 1% | 1% | 1% |
| Internal Water Supply | 5% | 2.5% | 4% | 2% |
| Internal Sanitation | 5% | 2.5% | 4% | 2% |
| Internal electrification | 7% | 3.5% | 5% | 2.5% |
| Retaining Walls & terracing | 8% | 8% | 8% | 8% |

*Depending upon the topography of the area to be developed.

6.6.4 While planning buildings, the scope for their use after the project construction should also be considered in consultation with the State Industries Department and the extra cost, if any, on this account clearly spelt out.

It is essential that labour employed on works is appropriately accommodated near the work site. Since the provision under buildings does not cover labour huts, provision for labour huts should be made under the individual works estimates.

6.7 L-EARTH WORK.

Important items to be considered under this sub head are:

a) Excavation.

b) Embankment from

i) Excavated material.

ii) Borrow areas.

c) Lining.

d) Pitching.

e) Miscellaneous items, such as construction of drains, inspection and service road/path etc.

The provision under this sub-head shall cover main/branch canal(s). The provision shall be based on detailed surveys of main/branch canal(s). The analysis of rates for major items of work shall be furnished indicating lead/lift involved and shall be in line with the procedure indicated under C-Works.

6.8 M-PLANTATION:

This item provides for establishing of avenue trees and arboriculture etc. The cost depends upon the plantation programme including gardens etc. required for beautification as considered necessary downstream of Dam and appurtenances around power house and other important structures as well as plantation of trees along main and branch canals. The provision made under this sub-head should not be included in X-Environment & Ecology.

For main/branch canal(s), the provision shall be made on the basis of per km. rate of plantation for the total length of the canal(s) etc. The basis for adopting certain km. rate should be indicated. The provision shall include maintenance and protection for 2/3 years.

6.9 N-TANKS AND RESERVOIRS:

This sub-head is intended to cover remodelling of the Tank(s)/Reservoir(s) in the project area considered beneficial/economical for augmentation of the irrigation supplies. All items of work considered necessary for remodelling shall be provided.

Important items to be considered under this sub head are:

a) Earth work in

i) Excavation.

ii) Filling.

b) Repair of the spillway portion.

c) Repair of outlets.

d) Repair of the channels.

e) Any other work.

6.10 O- MISCELLANEOUS:

The main items to be considered under this sub-head are:

1. Capital cost of

i) Electrification.

ii) Water supply, purification and distribution.

iii) Sewage disposal and storm water drainage works.

iv) Fire fighting equipment.

v) Telephone, Telegragh,Post Office and Wireless.

vi) Medical equipment for hospital/dispensary(s) etc.

vii) Any other item such as fountains, recreation facilities, special lighting arrangements for beautification of areas in the project.

2. Maintenance and Service of:

i) Electrification.
ii) Water supply, purification and distribution works.
iii) Sewage disposal and storm water drainage works.
iv) Recreation.
v) Medical Assistance.
vi) Post Office, telephone and telegraph office.
vii) Security Arrangements.
viii) Fire fighting equipment.
ix) Inspection Vehicles.
x) Transport for labour and staff.
xi) School bus.
xii) School.
xiii) Pay Van.
xiv) Ambulance.

3. Other Items.

i) Visits of dignitaries.
ii) Technical record, photographic record, completion report & history of the project.
iii) Inaugural ceremonies.
iv) Compensation to workmen.(for workcharged staff only)
v) Boundary pillars and stones, distance marks and bench marks.
vi) Power supply.
vii) Model and exhibits.
viii) Testing laboratory and exhibits.
ix) Publicity, information centres.
x) Subsidy for school bus.
xi) Publications,Pamphlets.
xii) Running of transit camps/rest sheds/guest house/rest house/inspection bunglow.
xiii) Training of Engineers.
xiv) Canteen facilities.
xv) Co-operative Stores.
xvi) Library facilities.
xvii) Time keeping cabin.
xviii) Wireless communication system.
xix) Inflow forecasting and flood warning system.
xx) Retrenchment compensation(for work-charged staff only).
xxi) Police Station.

xxii) Community Centre.
xxiii) Photographic and Cinematographic equipments, establishment and R/M charges.
xiv) Creches.
xxv) Maintenance of office equipment such as computer & reprographic facilities, fax,telex etc.

The above list is illustrative and not exhaustive. Provision should be made for all the items, which are relevant to the project. The provision are meant for regular and workcharged staff and not for casual/contract labour.

6.10.1 The total provision under this sub head is generally of the order of 4% of I-Works.

## 6.11 P-MAINTENANCE.

This sub head is intended to cover the cost of maintenance of buildings, roads, and other structures during the period of construction.

The usual norm for provision under this sub-head is 1% of the cost of I-Works less A-Preliminary, B-Land, O-Miscellaneous, M-Plantation, Q-Special T & P and X-Environment & Ecology and covers maintenance of all works during the construction period.

## 6.12 Q-SPECIAL T&P

The capital outlay on construction equipment on a project varies from 10 to 30 percent of the total cost of civil structure. This percentage is likely to go up with the increase in the mechanisation of construction methods. It is imperative that extreme care should be exercised in the selection of various machinery and equipment and as far as possible accurate provision for their depreciation and salvage value should be made.

Important items of equipment considered under this sub head are given in Annexure-7.

The capital cost of the construction equipment will depend upon type and quantity of machinery(worked out on the basis of quantum of work contemplated to be carried out by machinery). For an economically planned project, the construction machinery should generally be so planned that it spends 75 percent of its life at project i.e. 75 percent of its cost is recovered from the works as hourly use rates. The provision under the sub-head Q.Special T&P therefore, should be 25 percent of the capital cost of the production oriented special T&P and 75 percent of this provision should be shown under head V-Receipt and Recoveries towards resale/transfer value.

For highly specialised Capital Intensive Equipment like aerial cableways, tunnel boring machines etc. which cannot be planned on the criteria mentioned under para above, the anticipated cost chargeable to the sub-head C-Works should be calculated and the residual value should be shown under the sub head Q.Special T&P as well as the head V-Receipt and Recoveries.

For inspection and transport vehicles(other than those required for construction material transportation) 100 percent of the capital cost should be provided under this sub-head. 20 percent of this value should be considered as resale/transfer value of the vehicles and shown under the head V-Receipts and Recoveries.

All the equipment required inclusive of capital intensive equipment should be provided on the basis of the latest rates including their transport cost upto the project site (insurance, taxes etc. included) and initial requirement of funds worked out. However, the provision for this sub-head should be worked out as under :-

| | |
|---|---|
| Capital cost of production oriented Construction Plant & Machinery(Other than specialised capital intensive equipment and inspection/transport vehicles) | P |
| Cost recoverable as hourly use rate (debited to works) | 0.75 P |
| Capital cost of inspection/transport vehicles | Q |
| Capital cost of specialised capital intensive equipment | R |

| | |
|---|---|
| Cost of specialised capital intensive Equipment recoverable as hourly use rate (debitable to works) | Ra |
| provision to be made under the sub-head Q Special T&P | 0.25 P +Q +R -RA |
| Recoveries to be shown under head V-Receipt and Recoveries | 0.75(0.25P)+ (R-Ra)+0.2Q |

In case of old machinery received on transfer, only 50 percent of its transfer value shall be charged to the works and balance 50 percent to the sub-head Q-special T&P. Further, 25 percent of the provision under special T&P shall be shown under V-Receipts and Recoveries towards resale and transfer value.

Similarly in case of projects where 75 percent of scheduled life of equipment is not expected to be recovered during the execution of project (or in other words less than 75 percent of the cost of equipment shall be recovered through cost of works), the cost proportional to their unused life shall be booked under this sub-head and the same amount shall be shown under V-Receipt and Recoveries. This method is to be adopted to provide for funds for procuring the equipment. Same method shall also be followed in case where specialised Capital Intensive Equipment is procured by the Govt. Department(owner of the project) and given to the contractors on hire. It may be mentioned here that practice of procurement of equipment by Govt. department for hiring out to contractors should be discouraged as far as possible, since this practice has been found to be neither economical nor conducive to efficient working. Therefore, no provision of job specific construction equipment should be kept under the sub head Q.Spl.T&P, when the works are proposed to be carried out through contracting agencies. In such cases, provision of general purpose equipment capable of taking up emergency works such as road clearance, earth work, hill cutting and inspection and transport vehicles etc. should be made under sub head Q-Special T & P.

For privately owned and executed projects, however, no provision for production oriented and specialised capital intensive construction equipment is to be made under the sub-head Q-Special T&P. The cost incurred on account of deployment of such equipment on the project shall be directly recovered through the cost of works as hourly use rates. For inspection and transport vehicles on privately owned projects, only the cost equivalent to its life in years as would be spent on the project should be booked under this sub-head.

No provision should be made under this sub-head for spares as they are directly covered under the hourly rate chargeable to items of work.

6.13 CANAL STRUCTURES:

The provision for canal structures is split up under the following sub-heads:

D-Regulators.

E-Falls

F-Cross Drainage Works.

G-Bridges

H-Escapes

It is seen that provision for canal structures is generally made on lumpsum basis. This practice is not only irrational but is one of the principal causes for steep rise in the costs of revised estimates. It is necessary that preliminary designs are made for all important structures after proper survey and for framing the estimates, typical structures of different capacity (three or more in number) should be analysed to work out unit cost for each type of structrure in each sub-head as follows. (refer illustration at Annexure- 8)

D-Regulators: Cost per unit product of discharges of parent and offtaking canals.

E-Falls: Cost per unit product of discharge and height of fall.

F-Cross Drainage works: Cost per unit product of discharges of drainage and canal.

G-Bridges: Cost per metre span of bridge.

H-Escapes: Cost of structures may be worked out as mentioned above and for escape channel procedure may be same as for canals.

Where the actual cost of similar structures constructed on other project(s) is known, the data could with advantage be used in the estimate. It should however, be ensured and justified that the structures considered are similar in nature. The differences in leads of materials in the two structures are accounted and escalations wherever necessary are taken into account. The basis for premium applied as well as the reference to the project where such costs were realised and the year of work should be mentioned in the estimate.

6.14 R-COMMUNICATIONS:

Important items to be considered are:

a) Construction of the main approach road to dam site.

b) Construction of quarry roads.

c) Construction of temporary roads in the works area.

d) Construction of temporary or permanent river crossings.

e) Railways including sidings, bridges, connecting roads, water-ways and air strips/helipad.

The cost for each type of road should be provided on the basis of calculated road length and rate per km. Major items on this account should be supported by sub-estimates or rates certified by local State PWD.

For road bridges the provision should be made in line with canal structures.

For railway siding and railway bridges the provision should be made in consultation with the Railway Authorities.

For provision of airstrip/helipad, civil aviation authorities should be consulted.

For provision of water-ways State Inland Water Authority should be consulted.

6.15 S-POWER PLANT AND ELECTRICAL SYSTEM:

This sub-head is intended to cover the provision required for the equipment for power plant, switchyard etc. and other items connected with the installation.

The provision to be realistic should be based on budgetary offers or the latest market rates. The price level stating month/year for which the rates are applicable should be indicated.

The estimate for S-Power Plant and electrical system should cover the following items as provided in the guidelines of CEA:

1. Preliminary expenses including Design and consultancy charges.

2. Telephone, lights and power system including illumination of power house, switchyard and construction power.

3. Generating plant and equipment.

a) Supply of Generator, turbine and accessories (Annex. 9(i) )

b) Aux. Eelectrical equipment for power station(Annex.9(ii) )

c) Aux. Equipment and services for power station(Annex.9 (iii) )

d) Central Sales Tax, Transportation, Handling and insurance charges on 3(a),(b) and (c)

e) Erection and Commissioning charges on 3(a),(b),(c) and (d)

Total Generating Plant and Equipment. ----------

4. a) Supply of Transformers, Circuit Breakers & Isolators etc.(sub-station equipment) (Annex- 9(iv) )

b) Aux. Equipment and Services for Switchgear (Annex-9 (v) )

c) Miscellaneous Equipment and Services (Annex.-9(vi) )

d) Central Sales Tax, Transportation, Handling and Insurance charges on 4(a),(b) and (c)

e) Erection and Commissioning of the above equipment on 4(a),(b),(c)&(d).

(Except on items of Fork lift trucks, Tractor Trailors etc. under item no. 4(c)

---

Total

---

5. Losses on stock @ 0.25% on 3(a),(b),(c),(d),4(a),(b),(c) and (d) (If not provided earlier).

6. Maintenance during construction @ 1% on 3(a),(b),(c),(d),4(a),(b),(c) and (d).(if not provided earlier).

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GRAND TOTAL: ---

6.16 T-WATER SUPPLY WORKS:

This sub-head is intended to cover works required for delivering water to a point beyond which the supply system will be taken over by the Pubic Health Department. This should normally consist of water conductor system and pucca structures on open channels. The provision for various items of work should be made in line with that of canal structures.

6.17 U-DISTRIBUTARIES AND SUB-MINORS.

The cost is generally indicated on the basis of rate per ha. of CCA. There is a very wide variation in the rates from project to project depending upon the local conditions. It is, therefore, necessary that for a realistic estimate the rate should be arrived at from a detailed estimate for a typical block of command area of the size of about 10% of CCA after detailed contour surveys and micro planning. The relevant drawings showing therein the alignment of channels, location of structures, outlets, provision of lining etc. should be enclosed with the estimate.

6.18 V-WATER COURSES

The provision for water courses should be made for serving upto 5 to 8 ha. block. The cost may be assessed on the basis of rate per hectare of CCA. The rates per hectare should be arrived at on the basis of a sub estimate of a representative sample area surveyed to cover about 10 percent of the culturable command area in a similar way as adopted for distributories and minors.

6.19 W-DRAINAGE

Provision should be made under X-Environment & Ecology - Para 6.20 (h).

6.20 X-ENVIRONMENT AND ECOLOGY:

This sub head is intended to cover the provisions for the following important items concerning environment and ecological impact due to coming of the project into being.

a) Compensatory afforestation including cost of acquisition of forest/revenue land, payment to be made to forest Deptt. for compensatory afforestation. Provision made under M-Plantation should not be included under this sub head.

b) Catchment area treatment: Cost of treatment of directly draining water sheds (which is to be borne as part of project cost), soil conservation measures etc. as Environment & Ecology damage/mitigation works. However, to avoid undue burdening of the project with general land improvement activities, only direct draining sub-water sheds upto 2500 ha. in extent need to be considered for treatment at project cost. The treatment would generally be for improving land to prevent movement of soil.

c) Establishment of fuel depots etc. to meet fuel requirement of labour force to prevent indiscriminate felling of trees.

d) Measures to salvage/rehabilitate any rare or endangered species of flora and fauna found in the affected area and relocation of archaeological monuments.

e) Control of aquatic weeds in submerged areas to provide improved habitat for aquatic life.

f) Public health measures to control spread of water and soil borne diseases, anti-malaria measures, studies relating to monitoring of water qualities and effect of pesticides, weedicides etc. on effluent water from irrigation system.

g) Restoration of land in construction areas by filling, grading etc. to prevent further erosion and to provide healthy surroundings.

h) Drainage in command area, conjuctive use, ground water monitoring etc.

i) Seismological measurements and disaster management measures.

j) Provision of fish ladder if necessary( to be considered under sub head C-Works)

Provision of the items should be made in consultation with the concerned deptts. as under:

| | | | |
|---|---|---|---|
| 1. | Items a,b,c,d | - | Forest Deptt., Archaeology deptt. |
| 2. | Items e & j | - | Fisheries deptt. |
| 3. | Item f | - | Health deptt. |
| 4. | Item h | - | Central/State Ground Water Board(See para below) |
| 5. | Item i | - | Meteorological Deptt. |

Provision for drainage should be made for improvement of existing drains and construction of new drains carrying a discharge of 50 litres/sec. and above in the command area. The other drains should form a part of the Command Area Development Programme. Provision for drainage in the command area is indicated on the basis of rate per hectare of CCA. The rates per hectare should be arrived at on the basis of sub-estimates for sample area in line with U-Distributaries and Minors etc.taking into account land use mapping, soil surveys and ground water investigations. Further where apparently no drainage arrangements are considered necessary due to existing natural ground slope conditions, a minimum provision may kept on a suitable percentage basis.

## 6.21 Y-LOSSES ON STOCK

The provision under this sub-head is generally made at 0.25% of the cost of I-Works less A-Preliminary, B-Land O-Miscellaneous,M-Plantation,P-Maintenance,Q-Special T& P and X-Environment and Ecology.

## 7.0 II-ESTABLISHMENT:

In case of works let out on contract, the provision for establishment including leave and pensionary charges is generally of the order of 8 to 10 percent for concentrated works and 10 to 12 percent for scattered works like canals.

For works to be executed departmentally the provisions could be higher than those given above say 12 to 15 percent.

The above provision is inclusive of costs towards setting up of Cost Control Cell at the project and Head Quarter level to excercise proper control over construction costs.

Since land aquisition 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, less B-Land.

## 8.0 III-TOOLS & PLANTS.

The provision here as distinct from that under Q-Special T&P is meant to cover survey instruments, camp equipment, office equipment and other small tools. Expenses for small tools and plant are generally not charged directly to units of work but added as a percentage charge to the cost of the project. This percentage would depend on the class and value of the work. The general practice is to charge 1 percent of the cost of I-Works including cost of land.

9.0 **IV-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.

## 10.0 V-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 percent of the cost unless a higher recovery is anticipated due to some special reason (such as tubular construction, vicinity to an 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.

## 11.0 INDIRECT CHARGES:

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 and Accounts Estt.

The provision for Audit and Account charges is generally made at one per cent of the cost of I-works.

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

## 12.0 FUTURE ESCALATION:

Project estimates are to be prepared on the basis of current costs without making any provision for future increase in price during the period of execution of the project. No allowance on future price escalation is to be considered as per government policy. However, in the case of private sector power projects, total completed project cost, including interest during construction (IDC) and financing costs, has to be arrived at as detailed in Chapter 15.0 before considering the project for execution.

## 13.0 REVISED ESTIMATES & PROJECT COMPLETION REPORTS:

In the case of major and multipurpose projects which have been approved by the Planning Commission and where the revised estimates of the project have increased by more than 15% of the original estimates, excluding escalation due to price rise or where there is change in scope, will be required to be furnished to CWC for examination in the same way as new major and multipurpose schemes irrespective of the fact whether the revision is due to change in scope or not. The procedure for scrutiny for such revised project estimates shall be same as outlined in the preceding chapters.

13.2 In respect of revised project estimates where there is no change in the scope and where the cost excluding escalation due to price rise has not changed by more than 15%, the State Government need not forward a detailed estimate for examination at Centre. For such projects the State Government should send to CWC an excess note after obtaining the concurrence of the State Finance Department giving the abstract of cost under major sub head indicating the excess cost over the sanctioned cost and giving reasons thereof. The note will include the salient feaures of the project as originally proposed and as being executed at site. The CWC will examine such estimates broadly and send its views to the Advisory Committee for consideration and recommendation of the Planning Commission.

13.3 In the case of projects which undergo modification and revision subsequent to their approval, the information required to be submitted to CWC/Planning Commission under the following paragraphs of these guidelines should be submitted in good time so that approval for the revised scheme is received from the Planning Commission before any additional commitments over and above the sanctioned project estimate are made in respect of them.

The revised estimate should also include variation statement showing the variation in cost of different sub heads. Quantities and rates of important items should be furnished as per sample proformae at Annex.-1(ii)&1(iii). Other items should be included as miscellaneous items in

the same proforma indicating therein the total cost. The revised estimate should also include an analysis of the reasons for the increase in cost of different sub heads as detailed below:

1. rise in prices including variation due to exchange rate.

2. rise due to change in scope.

3. rise due to inadequate provisions in earlier estimate.

4. rise due to change in design

5. additional requirements/new items.

6. rise due to other causes such as inadequate plan allocation, arbitration, legal cases,poor performance of equipment, procurement problems etc.

13.4 When revised estimates are prepared during construction, the quantities of items completed should be indicated separately and the cost thereof assessed on the basis of actual expenditdure. Any liability arising out of the contract for the completed work and effecting the cost should also be considered in the estimate.

For works in progress the estimates should be based on contract rates. If the contract document contains any clause for escalation on the prices of materials and labour wages subsequent to the award of contract, the amount involved should be assessed and included in the estimate.

For the balance work to be done, the cost should be estimated on the basis of rates prevalent at the time of the preparation of the revised estimates.

13.5 PROJECT COMPLETION REPORT:

Project completion report should be prepared in accordance with IS :10336-1982, and a copy of the same be sent to the Project Appraisal Organisation of C.W.C.

14.0 GENERAL:

An integrated project report has to be prepared after making investigations for ayacut development works, such as field channels below 5 to 8 ha., land shaping field drainage(less than 50 litre/sec.) and ayacut roads. The estimates for these should be separately indicated for arranging funds from the respective departments such as CADA and institutional finanacial sources. These works are not chargeable to irrigation projects and hence no provision may, therefore, be made for these in the estimates for engineering works of the project.

14.2 Provision for tourist facilities and fishery development etc. should not be made part of engineering estimates.

14.3 Programme Evaluation and Review Technique (PERT) and Critical Path Method (CPM) net work should be attempted from the project formulation stage and the programme so drawn should form part of the Project report.

14.4 In some project estimates, the rates are taken from the current schedule of rates of the Irrigation Department. Where such a procedure is adopted it should be seen that appropriate charges for extra leads of various materials etc. are added to the schedule rates to arrive at the rate to be adopted for the project.

14.5 In some project estimates, actual rates obtained on construction works in nearby areas are adopted. Where such a procedure is adopted it should be seen that working conditions in the two projects are similar, the differences in leads of materials in the two projects should be accounted and escalations wherever necessary are taken into account. The project from where the actual rate is taken and the year in which such rate was realised should be specified. A brief description should be given indicating how similarity of the two projects has been established.

14.6 Estimates should be prepared on the basis of the detailed drawings of the project so as to work out correct quantities. Lumpsum provisions should , as far as possible, be minimised and efforts made to assess them by

working out details to the maximum extent practicable. When it is not possible to avoid making lumpsum provisions the cost should be based on experience obtained on works of similar magnitude elsewhere. The name of the project from which experience is drawn should be specified.

14.7 For excavated materials to be used in the body of the structure, separate item rate excluding the cost of excavation should be worked out and provided.

14.8 The Ministry of Water Resources and the Irrigation Ministers' Conference have been stressing the State Govts. the need to set up cost Control Cells on major projects who would keep continuous track on actual costs and suggest measures for effective savings. It has also been indicated that such unit can be assigned the task of updating the cost estimates at regular intervals. To enable the State to discharge the functioins of Cost Control Cells effectively, the Ministry of Irrigation and Agriculture ( Department of Irrigation) have recommended in their letter no. 10/10/77-DV-II dated 16.11.78 that Chief Engineers/Additional Chief Engineers in charge of river valley projects costing Rs.30 crores or more should have independent cost control cells having the following structure:

| | | |
|---|---|---|
| Executive Engineer | - | one |
| Asstt. Engineer | - | one for each Circle. |
| Costing Engineer | - | one. |

Supporting Technical, Ministrial staff i.e. Junior Engineer, Stenographers, Typists etc.

The above provision should form part of II-Establishment.

## 14.9 INSTRUMENTATION:

14.9.1 Gathering of instrumentation data is an important part of overall programme of assessing the safety and proper functioning of the dams and other hydraulic structures in river valley projects. Instrumentation is also required for verifying the design assumptions during the construction period and also for long term monitoring of the structures.

14.9.2 Planning and design of instrumentation for any structure requires skill and knowledge of instruments, their construction and working. A meticulously planned instrumentation will yield more specific and useful instrumentation data that could be interpreted into performance reports which provide much needed feedback to designers and maintenance engineers to assess the status/health of the structure and for planning timely remedial measures where required.

14.9.3 The cost of instrumentation is made up of instruments including junction boxes, cables, data acquisition system, readout sets, personal computers and their installation, reading and interpretation. It is therefore essential that a realistic estimate for instrumentation is implemented in right earnest and is not allowed to suffer due to paucity of funds or insufficient provisions in the estimate. State Dam Safety Organisations can provide the necessary budgetary estimates for instrumentation or alternatively the budgetary rates for various instruments. List of typical instruments used in Dams, Power Houses and tunnels is enclosed in annex-10. Siesmograph and any other instruments provided under X-Environment and A-Preliminary need not be included. Junction boxes, cables, data loggers, personal computers etc. could be obtained from the agencies marketing these instruments. The process of reading of instruments and interpretation of data has to be initiated almost immediately after these instruments are installed and continued throughout the construction period. It is therefore essential that sufficient provision exists in the estimate for trained engineers and staff during the construction period also. An abstract of instruments should also be given as an Annexure.

14.9.4 For mega hydro-electric projects and dams in remote locations, automation in instrumentation is desirable. The cost of instrumentation system with intelligent data acquisition and centralised monitoring will be considedrably higher as compared to projects where the instruments are read manually at terminals provided deploying readout sets.

14.9.5 The cost of instrumentation should preferably be based on prevailing rates. After assessing the requirements of instrumentation the cost may be worked out realistically covering all aspects of reading and interpretation. The overall cost may work out a maximum of 1% and 3% of the cost of relevent structure for manual reading and automation respectively.

## 14.10 ENVIRONMENT & ECOLOGY DAMAGE MITIGATION WORKS:

The question of catchment area treatment as an integral part of the river valley project was considered by the Committee of Central Secretaries and it was decided to draw the attention of the State Governments for immediate necessary action on this important aspect of adopting a holistic approach in formulation of river valley projecct by simultaneously taking up preparation of the project reports for catchment area treatment, soil conservation, command area development, afforestation, etc. Agricultural production and rural development are the ultimate goals under the Command Area projects and several departmental activities are sought to be harmonised under command area development projects which should synchronise with the progress on engineering head-works. Simultaneously, soil conservation and treatment, afforestaton, other antierosion measures, measures for reducing siltation, maintenance of ecological balance (vegetation, animal life and water storage) should also be viewed as an integrated whole at the stage of undertaking large river valley projects. However, while framing the cost estimate of river valley projects, only costs of the direct damage mitigation works should be included in the estimate. In this regard refer Planning Commission's circular dated Oct. 28th,1985 of Annexure-11.

## 14.11 DEWATERING:

In order to drain water out of site of work and maintain the site of work in a normally dry condition where further activities of work can be taken up during the entire period of execution of the work, adequate measures are required to be taken. Cost of all pumping, bailing out or any other works to dewater the foundation area during the entire period of execution of work including cost of all materials, labour, cost of machinery and equipment should be included in the provision for dewatering.

The provision for dewatering should be made on the basis of energy likely to be consumed for dewatering quantity of which can be worked out from the field permeability tests.

The unit of measurement may be in mandays if the nature of work is small. Dewatering by means of pumps may be by any one of the methods given below:

Electrical pumps

Diesel pumps.

Pneumatic Pumps.

The unit of measurement in case of dewatering by electrical pumps shall be killowatt hours(KWH). The unit of measurement in case of dewatering by Diesel pumps shall be horse-power hours. The unit of measurement in case of dewatering by pneumatic pumps shall be cubic metre of air per hour (m3/h).

It is for guidance that the total outlay for dewatering may be about 3 to 5 percent of the cost of the structure for which dewatering is to be carried out.

The cost of dewatering may be added to the concerned item of work (Excavation under water & placing concrete etc.) or they may be shown separately. However, it will be desirable to put binding clauses & upper limit for payment in staggered fashion to keep control over the payment on this item which if unfructuous, will lead to disproportionate extra cost.

## 15.0 PRIVATE SECTOR POWER PROJECTS.

15.1 Cost Estimates for private sector power projects shall be formulated in accordance with the CWC guidelines. Although cost estimates for various components shall be within the percentage limits (wherever applicable) specified in the guidelines, full justification for cost provisions for each component supported with relevant details shall be included in the proposal. Project proposal shall contain the following details to enable quicker processing:

15.2 Total completed cost in Indian Rupees indicating cost in Rupees and foreign currency components, if any, separately. The name of the foreign currency(ies) and the rate of exchange adopted for conversion and the date of exchange rate shall also be indicated.

15.3 Anticipated amount and currency of annual foreign exchange outgo, if any.

15.4 Arrangement for sharing the fixed cost with SEB or any other person/Agency fixed cost to be calculated on the basis of notification.

15.5 The basis of the cost estimates, firm or tentative, such as year of pricing, source of equippment(foreign or domestic), assumptions regarding customs/excise duty, sales tax, escalation, exchange rate (date of exchange rate) etc. are to be given in detail. An abstract of cost estimates as per formats at Annex-12(i)and 12(ii) as pertaining to the proposed project should also be given.

The above abstracts should be supported with detailed estimates of various systems/works wherever necessary.

15.6 Details of the financial package indicating the funding pattern, source of funding, rate of interest, period of repayment etc. The calculations for the following are to be given:

- Interest during construction.
- Depreciation calculations.
- Sale rate calculations as per GOI notification.

The formats in which information on financial package is to be furnished are given at Annex.12(iii) and Annex-12(iv).

15.7 The following details of estimated cost of energy sent out and deviations from relevant GOI notification, if any yearwise for the plant life/ PPA period alongwith cash flow statements is required to be given.

Fixed charges, variable charges and equivalent tariff in Rs. per Kwh for annual energy assessed on 90% availability.

Computations (with detail of calculations) of incentive at different levels of generation.

Spread sheet of yearwise tariff calculations for the period of the PPA.

The fixed charge without taxes over the entire life/ PPA period of the project should also be given.

Annexure-1(i)

## CHECK FOR PERCENTAGE PROVISION

Name of the Project:

Month and year of estimate: At price level:

| Sl. No. | Head/ Sub-head | provision as per guidelines and percentage if any | Percentage of provision in the project estimate. | Variation | Justification of variation. |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| A- | Preliminary | 1% to 2% of the total cost of I-Works. | | | |
| B- | Land | a) Crop compensation: 25% to 50% of Agricultural land to be acquired.<br>b) Interest charges on compensation: 25% of compensation for 2 years considering interest rate @ 12% per annum.<br>c) Solatium & land acquisition establishment charges @ 30% and 6.25% of the cost of land respectively.<br>d) Land and material for demarcation and measurement charges: 1% of cost of land acquisition. | | | |
| K- | Building | Cost of buildings in a project: 5% to 7% in plains and 6% to 8% in hilly regions. | | | |

O- Miscellaneous: 4% of I-Works.

P- Maintenance: 1% of the cost of I-Works minus A-Preliminary, B-Land, O-Misc., M-Plantation, Q-Special T & P and X-Environment & Ecology to cover maintenance during construction period

Y- Losses on Stock: 0.25% of the cost of I-Works minus A-Preliminary, B-Land O-Misc., M-Plantation, P-Maintenance, Q-Special T & P and X-Environment & Ecology.

II- Establishment:

a) Contract works: 8 to 10% for concentrated works.

ii) 10 to 12% for scattered works (cost of I-Works minus B-Land)

b) Departmental Works: 15% of (cost of I-Works minus b-Land)

III-Tools & Plants:

1% of cost of I-Works including cost of land.

Annexure-I(iii)

## REVISED PROJECT ESTIMATE-VARIATION STATEMENT

Name of Project:.....

Name of Work:.....

| Sl. No. | Description of items | Provision in Original estimate at Price Level | | | Provision in Revised Estimate at Price Level | | | | | | | | | | | Variation in | | Variation due to | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Completed work upto | | Work in progress | | | Balance work to be executed | | | Total | | | | | Price escalation | Change in Scope | Inadeq. prov. | Change in Design | Additional requirements. | Other Causes |
| | | Qty. | Rate | Amt. | Qty. | Amt. | Qty. | Agmt. rate | Amt. | Qty. | Rate | Amt. | Qty. | Amt. | Qty. | Amt. | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | | 18 | 19 | 20 | 21 | 22 | 23 |

Annexure-1(iii)

## REVISED PROJECT ESTIMATE-VARIATION STATEMENT COMPARISION, ANALYSIS AND EXPLANATORY NOTES OF VARIATIONS.

Name of the Project:----------

Name of Work----------

| Sl. No. | Description variation | Explanatory Notes |
|---|---|---|
| 1 | 2 | 3 |
| 1. | Price Escalation | |
| 2. | Change in Scope | |
| 3. | Inadequate provisions. | |
| 4. | Change in Design | |
| 5. | Additional/New Items | |
| 6. | Other Causes. | |

Annex.II

## BREAK UP OF INDIRECT WAGES BENEFITS PAYABLE TO WORKMEN ON RIVER VALLEY PROJECTS.

| Sl. No. | Item | CATEGORY | | Remarks |
|---|---|---|---|---|
| | | Skilled | Semi skilled and unskilled | |
| 1. | Paid Holidays | 5 National Holidays | 5 National Holidays. | |
| 2. | Weekly day of rest. | 52 days (included in the wage) | 52 days (included in the wage) | |
| 3. | Earned Leave | 30 days/year | NIL | |
| 4. | Sick Leave | 10 days/year | NIL | |
| | | 45 days | 5 days. | |
| | %of Direct wages | $\frac{45}{268} \times 100 = 16.79\%$ | $\frac{5}{308@@} \times 100 = 1.62\%$ | |
| 5. | Retrenchment compensation. | 15 days. $\frac{15}{268} \times 100 = 5.59\%$ | 15 days. $\frac{15}{308} \times 100 = 4.87\%$ | |
| 6. | Accommodation, water supply, sanitation power etc. | 23% | 18% | |
| 7. | Medical expenses | 4% | 4% | |

| | | | |
|---|---|---|---|
| 8. | Workmen's compensation | 5% | 5% |
| 9. | Canteen facilities | 2% | 2% |
| 10. | Free dress,gumboot etc. | 3% | 3% |
| 11. | Travelling expenses | 6% | 6% |
| 12. | Gratuity | 15 days(5.60%) | NIL |
| 13. | Employee's provident fund | 8.33% | 8.33% |
| | | 79.31% | 52.82% |
| | say | 80% | say 55% |

Annexure-3

## LIFE & REPAIR PROVISION OF EQUIPMENT.

| Sl. No. | EQUIPMENT | | life of Equipment | | repair provision (% of cost of equipment) | Remarks |
|---|---|---|---|---|---|---|
| | Category | Capacity | Years | Hours | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1. | Excavators | | | | | |
| | Shovels & Draglines | Below 1.5 cuyds | 10 | 12,000 | 150 | |
| | | 1.5 to 3.0 cuyds (Diesel) | 12 | 15,000 | 150 | |
| | | Above 3.0 cuyds (Diesel) | 15 | 25,000 | 150 | |
| | | 2.5 to 4.0 cuyds (electric) | 15 | 25,000 | 150 | |
| | | Above 4.0 cuyds (electric) | 20 | 40,000 | 150 | |
| | Walking Dragline | | 20 | 30,000 | 150 | |
| | Hydraulic Excavators | a) Below 1 cum.capacity (Diesel) | | | | |
| | | i) Wheeled | 10 | 15,000 | 100 | |
| | | ii) Crawler | 10 | 12,000 | 100 | |
| | | b) 1 to 3 cum.capacity (Diesel) | | | | |
| | | i) Wheeled | 12 | 17,500 | 125 | |
| | | ii) Crawler | 12 | 15,000 | 125 | |
| | | c) Over 3 cum.capacity | | | | |
| | | i) Diesel | 12 | 20,000 | 150 | |
| | | ii) Electric | 15 | 25,000 | 125 | |

| | | | | |
|---|---|---|---|---|
| Bucket wheeled excavators | | 20 | 40,000 | 150 |
| Dredger in Fresh water | Hull | 25 | - | 60 |
| | Machine | 10 | - | 60 |
| Barges | Hull | 16 | - | 60 |
| | Machine | 10 | - | 60 |
| Tugs | Hull | 16 | - | 60 |
| | Machine | 10 | - | 60 |
| | Machine | 10 | - | 60 |
| 2. Dumpers | | | | |
| Bottom | Below 20 T | 8 | 10,000 | 175 |
| Dumpers | 20 T to 50 T | 10 | 16,000 | 175 |
| | Above 50 T | 12 | 20,000 | 175 |
| Rear Dumpers | Below 15 T | 8 | 10,000 | 175 |
| | 15 to 35 T | 10 | 12,000 | 175 |
| | Above 35 T & Below 50 T | 12 | 15,000 | 175 |
| | 50 T & above. | 15 | 20,000 | 175 |
| 3. Scrapers | | | | |
| A. Motorised push Loaded | Upto 10 cuyds. | 8 | 9,000 | 200 |
| | Above 10 cuyds. | 10 | 10,000 | 200 |
| Elevating & self loading | | 10 | 10,000 | 200 |
| B. Towed | | 12 | 15,000 | 100 |
| 4. Tractors | | | | |
| Crawler | Upto 100 H.P. | 8 | 9,000 | 200 |
| | Above 100 to 300 HP | 10 | 12,000 | 240 |
| | Above 300 H.P. | 12 | 16,000 | 240 |
| Wheeled | Upto 75 H.P. | 8 | 12,000 | 200 |
| | Above 75 H.P. | 10 | 15,000 | 200 |

| | | | |
|---|---|---|---|
| 5. Graders | 10 | 12,000 | 200 |
| 6. Loaders | | | |
| Crawler | 10 | 12,000 | 200 |
| JCB Wheeled — Loader | 10 | 15,000 | 200 |
| Belt Loaders | 16 | 20,000 | 100 |
| Reclaimers & Stackers | 20 | 30,000 | 100 |
| 7. Compactors | | | |
| a) Self propelled Sheepsfoot rollers. | 10 | 12,000 | 100 |
| b) Drawn sheepsfoot rollers | 8 | 10,000 | 70 |
| c) Vibratory rollers | 8 | 8,000 | 200 |
| d) Smooth drum rollers | 8 | 10,000 | 80 |
| e) Smooth drum vibratory rollers | 8 | 8,000 | 200 |
| f) Pneumatic tyred rollers | 8 | 10,000 | 100 |
| g) High speed Compactors | 10 | 16,000 | 100 |
| 8. Water Sprinklers All sizes. | 10 | 16,000 | 120 |
| 9. Canal trimmer and lining equipment. Above 200 cuyds/Hr. | 16 | 20,000 | 100 |
| 10. Drilling Equipment: | | | |
| (i) Drilling Jumbo | | | |
| a) Pneumatic | 8 | 12,000 | 100 |
| b) Hydraulic | 10 | 15,000 | 120 |

| | | | | |
|---|---|---|---|---|
| (ii) | Rock Bolting Jumbo | | | |
| | a) Pneumatic | 8 | 12,000 | 100 |
| | b) Hydraulic | 10 | 15,000 | 120 |
| (iii) | Air Tracks/Drilling equipment | 8 | 8,000 | 80 |
| (iv) | Drills | | | |
| | a) Blast hole drills | 10 | 8,000 | 80 |
| | b) Core Drills | 8 | 8,000 | 80 |
| | c) Wagon Drills | 8 | 8,000 | 80 |
| | d) Tricone rotary drills | 10 | 10,000 | 80 |
| **11.** | Air Compresors: | | | |
| | A. Diesel compressors: | | | |
| | i) Portable upto 300 cfm. | 8 | 10,000 | 100 |
| | ii) Portable above 300 cfm. | 10 | 12,000 | 100 |
| | B. Electric compressors: | | | |
| | i) Portable upto 300 cfm. | 10 | 16,000 | 80 |
| | ii) Portable above 300 cfm. | 12 | 20,000 | 80 |
| | iii) Stationery | 20 | 30,000 | 80 |
| **12.** | Blowers: | 12 | - | 80 |
| 13. | Cooling Plants: | | | |
| | i) Aggregate Cooling Plant | 20 | 40,000 | 75 |
| | ii) Ice Plant | 20 | 40,000 | 75 |
| 14. | Batching and Mixing Plant: | | | |
| | i) Cement Handling Batching and Mixing Plant | 18 | 30,000 | 75 |
| | ii) Transit Mixers/Agricating cars. | 10 | 10,000 | 120 |
| | iii) Portable concrete mixers | 5 | 6,000 | 80 |
| 15. | Aggregate Processing Plant: | | | |
| | a) Upto 100 T capacity | 10 | 20,000 | 100 |
| | b) Above 100 T capacity | 15 | 30,000 | 100 |

| | | | | |
|---|---|---|---|---|
| 16. | Stone crusher (Elect.) | 15 | 20,000 | 200 |
| 17. | Shot-crete Machines. | 5 | 6,000 | 100 |
| 18. | Concrete Pumps | 5 | 8,000 | 100 |
| 19. | Pneumatic concrete placer | 8 | - | 100 |
| 20. | Raise climbers | 15 | 18,000 | 120 |
| 21. | Pumps: | | | |
| | i) Diesel Engine driven above 10 HP | 8 | 10,000 | 100 |
| | ii) Electrical upto 40 HP | 12 | 20,000 | 70 |
| | iii) Electrical above 40 HP | 15 | - | 100 |
| 22. | Lift Irrigation pumps (electrical) | | | |
| | 0.70-1.40 cumecs (25-50 cusecs cap.) | 12 | - | 75 |
| | 1.40-2.80 cumecs(50-100 cusecs cap.) | 15 | - | 75 |
| | above 2.80 cumecs (above 100 cusecs) | 20 | - | 75 |
| 23. | Grout pumps | 10 | - | 100 |
| 24. | Well Points | 12 | 20,000 | 100 |
| 25. | Cranes | | | |
| | i) Mobile (Pneumatic wheeled) Upto 15 T | 10 | 12,000 | 150 |
| | Above 15 T | 12 | 15,000 | 150 |
| | ii) Crawler Mounted Upto 10 T | 10 | 12,000 | 120 |
| | Over 10 T | 12 | 15,000 | 120 |
| | iii) Tower cranes | 20 | 30,000 | 120 |
| | iv) Truck mounted crane | 10 | 16,000 | 175 |
| 26. | Transport Equipment: | | | |
| | A. Heavy Transport Vehicles | | | |
| | a) Trucks & Highway Dumpers | 10 | 2,00,00Km | 175 |
| | b) Tractor Trailers Upto 10 T | 10 | 2,50,000Km. | 175 |
| | Above 10 T | 12 | 20,000hrs | 175 |

| | | | | |
|---|---|---|---|---|
| B. Light Transport Vehicles | | | | |
| i) Jeeps | : | | | |
| ii) Station Wagons | : | | 1,60,000 Km. | 175 |
| iii) Cars. | : | | | |
| iv) Ambulance Cars. | : | | | |
| C. Aerial Transport | | | | |
| i) Ropeways | : | | | |
| ii) Cableways | : | 20 | 40,000 | 70 |
| D Rail Transport | | | | |
| Locomotives: | | | | |
| Diesel | | 10 | 16,000 | 120 |
| Electrical | | 22 | 40,000 | 100 |
| Wagons | | 20 | 30,000 | 70 |
| Rail Cars | | 20 | 30,000 | 70 |
| 27. Diesel Generating Sets: | | | | |
| Upto 50 KVA | | 10 | 20,000 | 100 |
| Above 50 KVA | | 15 | 30,000 | 120 |
| 28. Machine Tools | | 15 | - | 50 |
| 29. Welding sests | | | | |
| (a) Diesel Engine Driver | | 10 | - | 100 |
| (b) M.G.sets | | 12 | - | 70 |
| (c) Transfer type | | 5 | - | 50 |
| 30. Mobile Workshop Van | | 15 | - | 70 |
| 31. Mobile Service Van. | | 15 | - | 70 |

(Source: C.W.C. Guide book on use rate, hire charges and transfer value of equipments and spare parts, Dec.1988)

TABULATION OF OPERATING & MAINTENANCE CREW ADOPTED IN THE HOURLY USE RATE OF EQUIPMENT

| Sl. No. | Name of Equipment | Operation & Maintenance crew required for the operational of the M/C | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Foreman | Operator | Mechanic | Helper | Watchman | Electrician | Supervisor | Driver | Cableman | Beldar |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. | Drill Jumb | 1/8 | 2 | 1/4 | 4 | 1/4 | - | - | - | - | - |
| 2. | Jack Hammer (52 Lbs) | - | 1 | 1/8 | 1/2 | 1/8 | - | 1/5 | - | - | - |
| 3. | Wagon Drill | 1/8 | 1 | 1/8 | 1 | 1/4 | - | | - | - | - |
| 4. | Scaling Hammer | - | 1 | - | 1/2 | 1/10 | - | 1/8 | - | - | - |
| 5. | Drill Steel | - | - | - | - | - | - | - | - | - | - |
| 6. | Locomotive Diesel | 1/8 | 1 | 1/4 | 1 | 1/4 | - | - | - | - | - |
| 7. | Locomotive Battery (for 12 Cu.yd) | 1/8 | 1 | 1/4 | 1 | 1/4 | - | - | - | - | - |
| 8. | Muck/car) (12 cu. yd.) | - | - | - | - | - | - | - | - | - | - |
| 9. | Shortcrete M/C | 1/8 | 1 | 1/2 | 1 | 1/4 | - | - | - | - | - |
| 10. | Drilling Machine | 1/8 | 2 | 1/4 | 3 | 1/4 | - | - | - | - | - |
| 11. | Convey mucker (1.5 cu.yd. 42 wide conveyer) | 1/8 | 1 | 1/6 | 1 | 1/4 | - | - | - | - | - |
| 12. | Overhead Loader (1 cu.yd.) | 1/8 | 1 | 1/4 | 1 | 1/2 | - | - | - | - | - |
| 13. | Front end Loader (2 cu.yd.) | 1/8 | 1 | 1/4 | 1 | 1/6 | - | - | - | - | - |
| 14. | Pusher leg | - | - | - | - | - | - | - | - | - | - |
| 15. | Auto feed | - | - | - | - | - | - | - | - | - | - |
| 16. | Pneumatic concrete placer | 1/8 | 1 | 1/6 | 1 | 1/6 | - | - | - | - | - |
| 17. | Grouting Machine | 1/8 | 1 | 1/6 | 1 | 1/6 | - | - | - | - | - |
| 18. | Ventilation Blower (2000 c.f.m.) | - | 1/4 | 1/4 | 1/2 | - | - | - | - | - | - |
| 19. | Agitating car (4 cu.yd.) | 1/8 | 1/2 | 1/4 | 1/2 | 1/6 | - | - | - | - | - |
| 20. | Diesel Shovel 2 cum, 262 HP | 1/4 | 1 | 1/2 | 1 | 1/4 | - | 1 | - | - | - |
| 21. | Electric Shovel 5 cum, 350 HP | 1/4 | 1 | 1/2 | 1 | 1/4 | 1/2 | 1 | - | 2 | - |
| 22. | Air Compressor (Diesel) 210 c.f.m., HP 61.5 | 1/8 | 1 | 1/4 | 1 | 1/4 | - | - | - | - | - |
| 23. | Air Compressor (Diesel 300 cfm HP 94.3) | 1/8 | 1 | 1/4 | 1 | 1/4 | - | - | - | - | - |
| 24. | Air Compressor (Diesel) 500 cfm 148 HP | 1/8 | 1 | 1/4 | 1 | 1/4 | - | - | - | - | - |
| 25. | Air Compressor (Electric, 500 cfm 90 KWH) | 1/8 | 1 | 1/4 | 1 | 1/4 | 1/2 | - | - | - | - |
| 26. | Air Compressor (Electric, 1500 cfm 240 KWH) | 1/8 | 1 | 1/3 | 1 | 1/4 | 1/2 | - | - | - | - |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Foreman | Operator | Mechanic | Helper | Watchman | Electrician | Supervisor | Driver | Cableman | Beldar |
| 27. | D-8 class Tractor Dozer (HP270) | 1/4 | - | 1/4 | 1 | 1/4 | - | - | 1 | - | - |
| 28. | D-9 class Tractor Dozer (385 HP) | 1/4 | - | 1/4 | 1 | 1/4 | - | - | 1 | - | - |
| 29. | Rear Dumper (35 Tonne) | 1/4 | - | 1/4 | 1 | 1/4 | - | - | 1 | - | - |
| 30. | Hydraulic Excavater (1.25 cu.yd. HP 103.50) | 1/4 | 1 | 1/4 | 1 | 1/4 | - | - | - | - | - |
| 31. | Dumper (15 T) | 1/8 | 1 | 1/6 | 1 | 1/6 | - | - | - | - | - |
| 32. | Tipper Truck (7.0 T) | - | - | 1/8 | 1 (Cleaner) | 1/6 | - | - | 1 | - | - |
| 33. | Crushing & Processing Plant (220 T) | 1 | 2 | 1/4 | - | 1 | - | - | - | - | 20 |
| 34. | Batching & Mixing Plant (35 cu. yd./hr.) | 1/2 | 2 | 1/2 | - | 1 | - | - | - | - | 6 |
| 35. | Mobile Crane (10 T) | 1/4 | 1 | 1/4 | 2 (1 helper + 1 chargeman) | 1/4 | 1/4 | - | - | - | - |
| 36. | Electrical Pump (50 HP) | - | 1 | 1/4 | 1 | - | 1/6 | - | - | - | - |
| 37. | Electrical Pump (15 HP) | - | 1 | 1/4 | - | - | 1/8 | - | - | - | - |
| 38. | Shutter 6 m long | 1/4 | 2 | - | 4 | 1/4 | - | - | - | - | - |
| 39. | D-4 Tractor with Turind Sheep Feet Roller. | 1/8 | 1/6 | - | 1/2 | - | - | - | 1 | - | - |
| 40. | Ropeway | 1 | - | 8 (Fitter) | 2 (Greaser) | 1 | 3 | - | - | - | 24 |
| 41. | Vibratory Roller (62 HP) | 1/8 | 1 | 1/4 | 1 | 1/8 | - | - | - | - | - |
| 42. | Pneumatic Tyred Roller | 1/8 | 1 | 1/4 | 1 | 1/8 | - | - | - | - | - |

Annexure-5

## HOURLY USE RATE OF MACHINERY/EQUIPMENT.

Before proceeding for analysis of rate for a unit item by machine working, it is essential to work out the hourly use rate of Machine/Equipment intended to be deployed in completion of the particular item. For analysis of hourly use rate Nos. of machines and equipments have been identified for illustrative examples from amongst the many which are normally deployed for river valley projects. The list is only illustrative and definitely cannot be exhaustive, however,these machines include the latest type of equipments which are in use now a days. For working out the hourly use rate the general criteria as laid down in the CWC Guide Book on "USE RATE HIRE CHARGES AND TRANSFER VALUE OF EQUIPMENT AND SPARE PARTS"(Third Edition) Dec.1988 have been adopted.

The hourly use rate of the equipment comprises of the following elements:

a) Ownership cost:

i) Depreciation.

ii) Interest on capital investment.

b) Operational cost:

i) Repair charges.

ii) Operators & maintenance crew charges.

iii) POL and energy charges.

iv) Miscellaneous supplies.

The various elements as mentioned above should be evaluated as below:

a) OWNERSHIP COST:

i) Depreciation:

Depreciation of equipment ranges from book value to scrap value. Depreciation shall be calculated based on total hours worked with reference to life in hours and also with reference to life in years based on years lapsed since purchase and the actual depreciation shall be taken as the average of depreciation based on hours and years.

Depreciation shall be calculated based on straight line method of depreciation.

ii) Interest on capital investment is an integral part of the ownership cost of an equipment. The interest charges are to be related to the average annual cost of equipment based on the life of equipment in number of years. The annual cost of equipment is determined as follows:

$$\text{Average annual cost} = c\left(\frac{n+1}{2n}\right)$$

Where 'c' is the book value and 'n' is the number of years of life of a machine. The rate of interest per annum may be taken at the prevalent Govt. rate.

However while calculating the hourly use rate for the purpose of project cost estimation, the interest on capital has not been included to avoid duplication as in some cases, elaborated in the following paragraphs, interest on the total investment is accounted for:

i) In the case of departmental execution of a project, partly or wholly, interest on the total capital investment is accounted for while arriving at the annual cost of the project.

ii) While awarding contracts for big jobs wherein the use of machinery is warranted, interest free machinery advance is sometimes paid to the contractors.

iii) For projects wholly owned by private companies, interest on the total investment during construction is accounted for while arriving at the completed cost which in turn form the basis for tarrif.

b) <u>OPERATIONAL COST:</u>

i) <u>Repair charges:</u>

The repair charges should be taken as percentage of total cost of machine as mentioned in Annexure-3.

ii) Operators & maintenance crew charges.

Operators and maintenance crew required to handle a particular machine/equipment, as mentioned in Annex. have been adopted in the analysis of hourly use rate. The crew charges have been worked out as per actual annual cost over the the operational hours during the year. The hourly cost of the entire crew deployed on the operation of a particular machine would thus be the sum total of the

$$\text{Hourly cost of O \& M Crew.} = \frac{\text{Monthly Salary X 12}}{\text{Annual operational construction hours of the machines.}}$$

The hourly cost of the entire crew deployed on the operation of a particular machine would thus be the sum total of the hourly cost of each labour.

The monthly rate of the various persons in the crew shall be taken as those prevalent in the States at the time of framing the project estimates. The annual operational hour of the machine shall be based on the no. of operational shifts and working season.

As regards the indirect cost of the labour, though the data on actual cost is not available, however on the basis of statutory provisions and discussions with the labour department and organisations undertaking such jobs, a provision of 55% and 80% in respect of semi-skilled/unskilled labour and skilled labour respectively has been made. This covers the cost on account of amenities to labour such as paid holidays, retrenchment benefits, accommodation water supply and power, medical expenses, workmen's compensation, canteen facilities etc.

iii) POL & Energy charges:

For estimating the fuel/energy charges following method may be adopted:

Electrically Powered Equipment:

In case of electrically operated equipment the energy charges can be obtained by estimating energy consumed in Kilowatt Hour per hour and multiplying by the energy rate.

$$\text{Energy consumed} = \frac{\text{BHP X 746}}{1000} \times C_1 \times C_2$$

Where $C_1$ is Type factor.

$C_2$ is duty factor.

Diesel Engine Powered Equipment:

Fuel consumed per hour can be estimated from the following relationship.

Fuel consumption in litres per hour $= 0.22 \times F.H.P. \times C_1 \times C_2$

Where $C_1$ is type factor.

$C_2$ is duty factor.

Values of $C_1$ & $C_2$ are tabulated below:

| Sl. No. | Category of equipment. | $C_1$ | $C_2$ | | |
|---|---|---|---|---|---|
| | | (type factor) | Light duty | Med. duty | Heavy duty |
| 1 | 2 | 3 | 4 | 5 | 6 |
| 1. | Dump Truck | 0.30 | 0.70 | 1.00 | 1.40 |
| 2. | Motor Grader | 0.40 | 0.67 | 1.00 | 1.33 |
| 3. | Excavator | 0.50 | 0.80 | 1.00 | 1.20 |

| | | | | | |
|---|---|---|---|---|---|
| 4. | Wheel Loader | 0.58 | 0.70 | 1.00 | 1.30 |
| 5. | Motorised scraper | | | | |
| | a) Twin engine | 0.57 | 0.70 | 1.00 | 1.30 |
| | b) Single Engine | 0.62 | 0.70 | 1.00 | 1.30 |
| 6. | Bulldozer | 0.57 | 0.75 | 1.00 | 1.25 |
| 7. | Dozer shovel | 0.61 | 0.75 | 1.00 | 1.25 |
| 8. | Diesel Generating sets & Air Compressors. | 1.00 | 0.75 | 1.00 | 1.00 |

Pneumatically Operated Equipment:

The cost of compressed air in Rupees per cubicmeter per minute can first be estimated by analysing use rate of Air Compressor which can then be used for the equipment. Rated capacity of equipment may be used for obtaining energy charges.

Lubricants:

The cost of lubricants can be taken as 25 to 30% of the cost of fuel/energy depending upon type of equipment.

iv) Miscellaneous Supplies:

The hourly miscellaneous provision may be kept at 10% of the hourly repair provision. This could be suitably increased for machines using wire ropes, cutting edges, etc.and in adverse job conditions..

ANNEXURE- 5

## HOURLY USE RATE CALCULATION

### HYDRAULIC DRILL JUMBO (3 BOOM)

Annual Scheduled Production Hours = 1200 hrs.
(12 months x 25 days/month x 1 cycle/day x 4 hours/cycle)

| | | |
|---|---|---|
| Cost of Equipment (in Rs.) (as prevailing on date) | : | 25000000 |
| Scheduled life in years | : | 10 |
| Scheduled life in hours | : | 15000 |
| Life time repair provision (as percentage of cost of equipment) | : | 120 |

(I) OWNERSHIP COST :

Yearly Depreciation (considering straight line method and 10% salvage value) :

(a) With reference to life in years (in Rs.)
= 0.9 x 25000000 / 10
= 2250000.00

(b) With reference to life in hours (in Rs.)
= (0.9 x 25000000 / 15000) x 1200
= 1800000.00

Average yearly depreciation (in Rs.) = 2025000.00

Average hourly depreciation (in Rs.)
= 2025000.00 / 1200
= 1687.50

(II) OPERATIONAL COST :

(1) Hourly Repair Charges (in Rs.)
= 1.20 x 25000000 / 15000
= 2000.00

(2) Operators & Maintenance Crew Charges (for 1 shift /day operation) : (monthly wages as applicable)

| | No. | Rate/month (in Rs.) | Wages |
|---|---|---|---|
| Regular | | | |
| (1) Operator | 2.00 | 3000.00 | 6000.00 |
| (2) Driver | 0.00 | 0.00 | 0.00 |

| | | | |
|---|---|---|---|
| (3) Mechanic | 0.25 | 3500.00 | 875.00 |
| (4) Foreman | 0.125 | 4000.00 | 500.00 |
| (5) Electrician | 0.00 | 0.00 | 0.00 |
| (6) Supervisor | 0.00 | 0.00 | 0.00 |
| | | Sub-total | 7375.00 |
| Casual | | | |
| (7) Helper | 4.00 | 1200.00 | 4800.00 |
| (8) Cableman | 0.00 | 0.00 | 0.00 |
| (9) Beldar | 0.00 | 0.00 | 0.00 |
| (10) Chowkidar | 0.25 | 1500.00 | 375.00 |
| | | Sub-total | 5175.00 |

Total direct crew charges/month (in Rs.) = 12550.00

Add for indirect crew cost (in Rs.)
(@80% of direct crew charges for regular worker and 55% of direct crew charges for casual worker )

= (0.80 x 7375.00) + (0.55 x 5175.00)
= 8746.25

Total crew charges/month (in Rs.) = 21296.25

Total crew charges/year (in Rs.) = 255555.00

Hourly crew charges (in Rs.)
= 255555.00 / 1200
= 213.00

(3) P.O.L. & Energy charges :

(a) Energy charges for hauling of Carrier:

F.H.P. of Engine = 157
Hourly fuel consumption (in litre)
= 0.22 x bhp
= 34.54
Effective fuel consumption per hour (in litre)
= 0.25 x 34.54 (considering hauling time to be 25% of drilling time)
= 8.635
Rate of diesel/litre (in Rs.) = 7.50
Cost of diesel (in Rs.) = 64.80

Lubricants (in Rs.)
@25% of fuel charges = 16.20
Sub-total = 81.00

(b) Energy Charges for Drilling:

Electric Energy consumption per hour
= Power x C1 x C2 (as per CWC guide book)

= 3 Boom x 45 KW x 0.8 x 1.0
where, C1 = type factor = 0.8
C2 = duty factor = 1.0
(factors to be adjusted as per job conditions)

= 108 KW

Rate of electricity = Rs.2.50/KWH

Electric Energy charges(in Rs.)= 270.00

Lubricants (in Rs.)
@30% of energy charges = 81.00
Sub-total = 351.00

| | | |
|---|---|---|
| Total for POL and Energy charges | = | 432.00 |
| (4) Miscellaneous Charges (in Rs.) : = 10% of hourly repair charges | = | 200.00 |
| Total hourly operational cost (in Rs.) | = | 2845.00 |
| **HOURLY USE RATE OF THE EQUIPMENT (in Rs.)** | **=** | **4532.50** |

## BATCHING AND MIXING PLANT ( 90 cum./hr capacity)

Annual Scheduled Production Hours= 1800 hrs.
(for three shift working)
(8 months x15 days/month x 15 hours/day )

| | | |
|---|---|---|
| Cost of Equipment (in Rs.) (as prevailing on date) | : | 12500000 |
| Scheduled Life in Years | : | 18 |
| Scheduled life in hours | : | 30000 |
| Life time repair provision (as percentage of Cost of Equipment) | : | 75 |

(I) OWNERSHIP COST :

Yearly Depreciation (considering straight line method and 10% salvage value) :

(a) With reference to life in years (in Rs.)
= 0.9 x 12500000 / 18
= 625000.00

(b) With reference to life in hours (in Rs.)
= (0.9 x 12500000 / 30000) x 1800
= 675000.00

Average yearly depreciation (in Rs.) = 650000.00

Average hourly depreciation (in Rs.)
= 650000.00 / 1800
= 361.15

(II) OPERATIONAL COST :

(1) Hourly Repair Charges (in Rs.)
= 0.75 x 12500000 / 30000
= 312.50

(2) Operators & Maintenance Crew Charges (for 3 shift /day operation) : (monthly wages as applicable)

| | No. | Rate/month (in Rs.) | Wages |
|---|---|---|---|
| Regular | | | |
| (1) Operator | 6.00 | 3000.00 | 18000.00 |
| (2) Driver | 0.00 | 0.00 | 0.00 |

| | | | |
|---|---|---|---|
| (3) Mechanic | 1.50 | 3500.00 | 5250.00 |
| (4) Foreman | 1.50 | 4000.00 | 6000.00 |
| (5) Electrician | 1.50 | 3500.00 | 5250.00 |
| (6) Supervisor | 0.00 | 0.00 | 0.00 |
| | | Sub-total | 34500.00 |
| Casual | | | |
| (7) Helper | 4.00 | 1200.00 | 4800.00 |
| (8) Cableman | 0.00 | 0.00 | 0.00 |
| (9) Beldar | 18.00 | 1200.00 | 21600.00 |
| (10) Chowkidar | 3.00 | 1500.00 | 4500.00 |
| | | Sub-total | 30900.00 |

Total direct crew charges/month (in Rs.) = 65400.00

Add for indirect crew cost (in Rs.)
(@80% of direct crew charges for regular worker and
55% of direct crew charges for casual worker )

= (0.80 x 34500.00) + (0.55 x 30900.00)
= 44595.00

Total crew charges/month (in Rs.) = 109995.00

Total crew charges/year (in Rs.) =1319940.00

Hourly crew charges (in Rs.)
= 1319940.00 / 1800
= 733.30

(3) P.O.L. & Energy charges :

B.H.P. of Motors = 120

Hourly electricity consumption( as per CWC guide book)
(in KWH) = 0.746 x bhp x C1 x C2

= 0.746 x 120 x 0.8 x 1.0
where, C1 = type factor = 0.8
C2 = duty factor = 1.0
(factors to be adjusted as
per job conditions)
= 71.62

Rate of electricity/KWH (in Rs.) = 2.50

Electric Energy charges(in Rs.) = 179.05

| | | | |
|---|---|---|---|
| Lubricants (in Rs.) @30% of energy charges | = 53.75 | | |
| Total for POL and Energy charges | | = | 232.80 |
| (4) Miscellaneous Charges (in Rs.) : = 10% of hourly repair charges | | = | 31.25 |
| Total hourly operational cost (in Rs.) | | = | 1309.85 |
| **HOURLY USE RATE OF THE EQUIPMENT (in Rs.)** | | = | 1671.00 |

Annexure-6

## ANALYSIS OF RATES.

1.0 **MASS CONCRETE IN DAMS (M-10)**

Rate per cum. Average lead = 1 km.

(A) Materials:

| Sl. No. | Item | Quantities | Unit | Rate | Per | Amount |
|---|---|---|---|---|---|---|
| 1. | Cement | 230 x 1.02 | Kg. | Rs. | Kg. | Rs. |
| 2. | Sand | 0.45 | Cum. | Rs. | cum. | Rs. |
| 3. | Coarse Aggregates | 0.90 | Cum. | Rs. | cum. | Rs. |
| 4. | Water | - | - | L.S. | - | Rs. |
| 5. | Admixtures | - | - | L.S. | - | Rs. |
| | | | | Total: | | |

2% wastage and incidentals to work (bulk supply)

(B) Batching,mixing & Laying of Concrete:

(i) Batching & mixing charges use rate of 90 cum./hr.= Rs.
Batching & mixing plant

Rate per cum. = $\frac{\text{use rate}}{90 \times 0.80 \times 0.75}$

Taking job management factor as 0.75 and plant efficiency factor as 0.80.

(ii) Transport of concrete by 4.5 $m^3$ (2 No.) buckets hauled by 5 T Diesel Locomotive from bathcing and mixing plant to pick up point.

Average lead = 1.00 km.

Hauling cycle Time:

Actual production at Batching plant = 54 $m^3$
(90x0.80x0.75)

Loading time of a train = $\frac{4.5 \times 2 \times 60}{54}$ =10.00 min.

Spotting & waiting time = 1.50 min.

Loaded haul @ 6.0 K.M.P.H.= $\frac{1 \times 60}{6}$ = 10.00 min.

Turning and unloading time = 5.00 min.

Empty haul @ 8.00 K.M.P.H.= $\frac{1 \times 60}{8}$ = 7.50 min.

Total cycle time = 34 min.

No. of trips in a 50 min. working hour= $\frac{50}{34}$

= 1.47 trips.

Output of one train with 2 Buckets
per hour = 2 x4.5 x 1.47 = 13.23 cum.

Use rate of Diesel Locomotive ...Rs.

Use rate of 2 concrete Buckets. ...Rs.

Total use rate = Rs.

Trasnport Rate per cum. = $\frac{\text{Total use rate}}{13.23}$ = Rs.

(iii) Placement of concrete by Tower Crane.

Use rate of crane = Rs.

Output of crane/hour using 4.5 cum.Buckets=54 cum./hr.

Rate per cum = $\frac{\text{Use rate of crane.}}{54}$ = Rs.

Labour for placement L.S. = Rs.

Total(iii)= Rs.

(iv) Vibrating the concrete:

| | | | |
|---|---|---|---|
| (i) Vibrators | L.S. | = | Rs. |
| (ii) Labour | L.S. | = | Rs. |
| | Total(iv) | | |

(v) Cleaning,slurry, curing and finishing:

| | | | |
|---|---|---|---|
| (i) Sand blasting | L.S. | = | Rs. |
| (ii) Cement for slurry mortar: | L.S. | = | Rs. |
| (iii) Cleaning and washing | L.S. | = | Rs. |
| (iv) Curing and finishing | L.S. | = | Rs. |
| | Total(v) | = | Rs. |

(vi) Catwalks and other aids for concreting: = Rs.

(vii) Other charges.

| | | | |
|---|---|---|---|
| Track charges | L.S. | = | Rs. |
| Electricity charges for Lighting | L.S. | = | Rs. |

Total charges for item (B) - item (i)to (vii) = Rs.

(C) Shuttering charges @ Rs. per cum. = Rs.

Abstract of charges Rate in Rs. per cum.

| | | | |
|---|---|---|---|
| (A) | Materials | = | Rs. |
| (B) | Batching, mixing and laying | = | Rs. |
| (C) | Shuttering @ Rs. per cum. charges | = | Rs. |
| | Prime cost | = | Rs. |
| | Add overhead charges and contractor's profit @ 20% of Prime cost. | = | Rs. |
| | Grand Total | = | Rs. |

Say Rs.....

Hence Rate per cum. = Rs.

2.0 **ROCK EXCAVATION IN TUNNELS:**

Format for tunnel of diameter = 7.00 mtr.

Thickness of lining = 0.5 mtr.

Shotcrete = 0.15 mtr.

Length of Tunnel = As per requirement

Minimum excavated diameter of tunnel = Finished dia of tunnel + 2 (Thickness of Lining + Shotcreting)

= 7.00 + 2 x (0.5+0.15)

= 8.3 meter

Add for pay line = 8.3 + 2 x 0.2

Excavated Tunnel Dia = 8.7 meter.

Gross sectional area of Tunnel = $3.14 \times \frac{d2}{4}$

$= \frac{3.14}{4} (8.7)^2$

= 59.41 SQM

Quantity of excavation per meter length of tunnel = 59.41 x 1.00

= 59.41 cum.

Say = 60 cum.

Assumed progress per face This includes drilling blasting, mucking, ribbing and packing etc. = 3 m per cycle.

Hence Quantity of Excavation per cycle = 60 x 3

= 180 cum.(Borrow measure)

and Quantity of Excavation per day(1 cycle per day) = 180 cum.

cycle of operations:

| Sl.No. | Item of operation | No. of working hours. |
|---|---|---|
| 1. | Drilling and shifting of Drill/ Jumbo | 4.00 hrs. |
| 2. | Charging and blasting | 1.00 hrs. |
| 3. | Defuming | 1.00 hr. |
| 4. | Scaling | 1.00 hr. |
| 5. | Mucking | 4.00 hrs. |
| 6. | Mapping | 1.00 hr. |
| 7. | Average time for shotcreting, rock bolting/rib erection and backfill concreting. (Assuming 30% of tunnel requires rib support) | 12.00 hrs. (including setting time) |
| | Cycle time | 24.00 hrs. |

1. Direct Labour:

(i) 1.5 No.Foreman @ Rs. per day = Rs.

(ii) 1 No. Explosive Inspector Rs. = Rs.

(iii) 1.5 No. Electrician/explosive Expert @ Rs. = Rs.

(iv) 1.5 No. Helper to Electrician/ Explosive Expert @ Rs. per day = Rs.

(v) 12 Nos. Beldars @ Rs. per day = Rs.

Add for indirect cost of labour @ 80% on (i) ,(ii) and (iii) and 55% on (iv) &(v).

charges.

Total direct labour: = Rs.

Rate of labour per cum=

$$\frac{\text{Total direct labour}}{180} = \text{Rs.}$$

2. Machinery charges:

| Sl. No. | Equipments | Nos. | Working hrs. per day | Total working hours per day | Use rate per hour in Rs. | Amount in Rs. |
|---|---|---|---|---|---|---|
| 1. | Hydraulic drill jumbo | 1 | 4.00 | 4.00 | | Rs. |
| 2. | Wagon (4.5 m3) | 12 | 5.00 | 60.00 | | Rs. |
| 3. | Convey Muckers(0.75 m3) | 1 | 5.00 | 5.00 | | Rs. |
| 4. | Battery Loco (10 T) | 3 | 5.00 | 15.00 | | Rs. |
| 5. | 180 HP Tractor Dozer | 1 | 2.00 | 2.00 | | Rs. |
| | | | | Total Machinery Charges: | | Rs. |

Total machinery charges Rs.

Quantity of Rock Excavated = 180 cum. Rs.

Rate per cum. = $\frac{\text{Total machinery charges}}{180}$ Rs.

3. Material charges

(A) Drilling and Blasting:

a) It is proposed that to attain 3 m progress per cycle per face 3.3 m deep holes will be drilled.

Cross-sectional area of Tunnel - 60.00 SQM

Assuming average spacing of holes = 0.85 m c/c

Area of rock cross section per hole $= (0.85)^2$

$= 0.723$ SQM

No. of holes required per face $= \frac{60.00}{0.723} = 83$ Nos.

Total depth of drilling = 83 x 3.3 = 273.9 m
say 274 m
Cost of drill steel = 274.0 x cost of drill steel per meter.

Quantity of rock excavatesd = 180 cum.

Rate for drill steel per cum. = $\frac{\text{Total cost of drill steel}}{180}$

(b) Explosives:

i) Gelatine required per cum. = 1.00 kg.
Cost of gelatine per kg. = Rs.
(to be taken equal to issue rate of the gelatine)

Rate per cum. = 1 x cost of gelatine per kg. = Rs.

ii) Detonators and fuse coils

No. of detonators and fuse coils @ one per hole per face = 83 Nos.

Cost of 83 Nos. detonators and fuse coil @ Rs. each (issue rate) = Rs. *

Quantity of rock excavated = 180 cum.

Hence rate per cum. = $\frac{*}{180}$ = Rs.

iii) Other consumable petty stores such as blasting batteries, galvanometers and blasting wires etc. @ 50% of item (i) = Rs.

Total explosive charges per cum ( i + ii + iii ) = Rs.

Total drilling and blasting charges = ( a + b ) = Rs.

(B) Timber for supports packing etc.
Rate per cum L.S. = Rs.

(C) Miscellaneous supplies such as wire ropes, manila ropes, v-clamps, rubber gloves, shackles and artificial respirators etc.

Rate per cum. L.S. = Rs.

Total material charges per cum.

= ( A + B + C )

= Rs....+ Rs.....+ Rs.... = Rs.

4. Charges for ventilation blowers:

Use rate of Blower
Per working hour = Rs.

No. of working hours of blowers per cycle = 24

Total charges of blower per cycle
= 24 x total blower charges/hr.= Rs.

Rock excavated per cycle = 180 cum.

Hence Rate per cum.= $\frac{\text{Total blower charges/hr.}}{180}$ = Rs.

5. Shop charges.

| | | | |
|---|---|---|---|
| i) | Machine shop including foundary and smithy | L.S. | = Rs. |
| ii) | Structural shop | L.S. | = Rs. |
| iii) | Steel metal shop | L.S. | = Rs. |
| iv) | Air and water pipe shop | L.S. | = Rs. |
| v) | Carpentary shop | L.S. | = Rs. |

Total shop charges per cum. = Rs.

| | | | |
|---|---|---|---|
| 6. | Electrical material charges per cum. | L.S. | = Rs. |
| 7. | Track charges per cum . | L.S. | = Rs. |
| 8. | Water charges per cum. | L.S. | = Rs. |

ABSTRACT OF CHARGES:

| | | |
|---|---|---|
| 1. | Direct Labour charges | = Rs. |
| 2. | Machinery charges | = Rs. |
| 3. | Material charges | = Rs. |
| 4. | Ventilation blower charges | = Rs. |
| 5. | Shop charges. | = Rs. |
| 6. | Electric materials | = Rs. |
| 7. | Track | = Rs. |
| 8. | Water charges | = Rs. |
| | Total charges | = Rs. |
| | Add for Electric Energy charges @ 2% of total charges | = Rs. |
| | Prime cost | = Rs. |
| | Add overhead charges and contractor's profit @ 20% of Prime Cost | = Rs. |
| | Grand total: | = Rs. |

Say Rs.....

Hence Rate per cum. = Rs.

NOTE: The above rate is applicable for the theoritical quantity computed on the basis of pay-line. For the over-breaks extending beyond pay-line, two-third of the above rate will be applicable.

## Annexure- 7

## IMPORTANT ITEMS OF EQUIPMENT CONSIDERED UNDER THE SUB-HEAD Q-SPECIAL T&P

### Drilling & grouting equipment

i) Compressed air distribution system
ii) Core drilling machine
iii) Crawler drills
iV) Wagon drills
V) Jack hammers
Vi) Pavement breakers
Vii) Grouting equipment like grout, mixers pumps, etc.

### Earth Moving Equipment

i) Hydraulic Excavators
ii) Cable Shovels and draglines
iii) Scrapers (motorized and tractor drawn)
iV) Front-end loaders( Wheeled / Crawler )
V) Tractors,dozers and rippers( Wheeled / Crawler )
Vi) Motor graders
Vii) Dumper (Rear/Bottom/Side)
Viii) Belt loaders , elevating grader
iX) Trippers trucks
X) Trenchers
Xi) Wheel excavators
Xii) Dredging equipment

### Compaction Equipment

i) Road rollers ( 8 to 12 tonne )
ii) Sheep foot rollers
iii) Pneumatic tyred rollers (20 to 50 tonne )
iV) Vibratory rollers

### Construction Plant

i) Crushers, classifiers
ii) Washing and cleaning plants for aggregates
iii) Batching / Mixing plants
iV) Refrigerating plants
V) Screening plants
Vi) Reclaiming plants
Vii) Belt conveyor
Viii) Cranes, Wagons, cement soils and cement pumping plant
iX) Cable ways
x) Sand mills
xi) Concrete mixers
xii) Transit mixers/ agitators
xiii) Concrete pumps
xiv) Concrete vibrators (pneumatic, electric, diesel, etc)
xv) Tram lines and related equipment

e) Tunnelling Equipment

i) Tunnel boring machine
ii) Road header
iii) Raise climbers
iV) Raise borers
V) Drilling jumbos ( 1/2/3 Booms )
Vi) Rocker shovel / Mucker
Vii) Shotcreting equipment
viii) Rock bolting jumbos

f) Transport Equipment

i) Trucks of 3 to 20 tonne capacity
ii) Motorized tanker (3000 to 10000 litre capacity)
iii) Trailers
iV) Pneumatic tyred tractors
V) Railway locomotive and rolling stock
Vi) Jeeps, cars
Vii) Station wagons and pickups
Viii) Ambulances
iX) Buses

g) Water Supply Works and Dewatering arrangements

h) Electrical Equipment

i) Generators
ii) Motors
iii) Flood Lights

i) Miscellaneous Equipment

i) Hoists
ii) Pulley block, lifting tackle, gantries
iii) Winches
iV) Mobile cranes
V) Welding machines

j) Workshop and ancillary equipment

i) Foundry shop
ii) Smithy shop
iii) Machine shop
iV) Structural shop
V) Welding shop
Vi) Fitting and assembling shop
Vii) Tyre retreading shop
Viii) Carpentry shop
iX) Paint shop
x) Galvanizing shop
Xi) Field repair shops such as carrier repair shop, tractor repair shop, auto shop, pipes and pumping shop and drill and bit repair shop.

Annexure-8

## CALCULATION FOR UNIT COST OF CANAL STRUCTURES

1. Head Regulator:

$$\text{Average rate per product} = \frac{\text{Estimated cost}}{Q_p \times Q_t}$$

$Q_p$ = Discharge of parent channel in cumec.

$Q_t$ = Discharge of offtaking channel in cumec.

Illustrative example : (Assuming values of $Q_p$, $Q_t$ and estimated cost )

| Sl. No. | Particulars | $Q_p$ | $Q_t$ | Product of Discharge $Q_p \times Q_t$ | Estimated cost (Rs. in Lakh ) |
|---|---|---|---|---|---|
| 1. | Head Regulator(HR) at RD 'A' | 40 | 2.0 | 80 | 5.0 |
| 2. | Head Regulator at RD 'B' | 20 | 1.5 | 30 | 3.5 |
| 3. | Head Regulator at RD 'C' | 15 | 1.0 | 15 | 2.0 |

| | | | | | |
|---|---|---|---|---|---|
| 4. | Head Regulator at RD 'D' | 10 | 0.5 | 5 | 1.5 |
| 5. | Head Regulator at RD 'E' | 5 | 0.2 | 1 | 1.1 |
| | | Total: | | 131 | 13.1 |

*Average Rate per product: $\frac{\text{Estimated cost}}{Q_p \times Q_t}$

$$= \frac{13.1 \times 10}{131}$$

$$= \frac{5}{}$$

=Rs.0.10 lakh/cumecs.

Cost of Head Regulator at RD F

whose $Q_p$ = 9 cumecs

$Q_t$ = 0.3 cumecs

Cost = $Q_p \times Q_t$ x Average rate per Product*

= 9 x 0.3 x0.10= Rs.0.27 lakhs.

Similarly the cost of other Head Regulators are to be as mentioned above.

2. Cross Regulator:

Where $W_p$ = water way width in metre.

Illustrative example :(Assuming values of water way width and estimated cost)

| Sl.No. | Particulars | Width of W p | Estimated cost (Rs. in Lakhs) |
|---|---|---|---|
| 1. | Cross Regulator at RD 'A' | 15.0 | 20.0 |
| 2. | Cross Regulator at RD 'B' | 10.0 | 15.0 |
| 3. | Cross Regulator at RD 'C' | 5.0 | 10.0 |
| | Total: | 30.0 | 45.0 |

*Average Rate $= \frac{\text{Estimated cost}}{W_p}$

$= \frac{45.0}{30.0}$

= Rs. 1.5 Lakh/metre.

Cost of cross regulator at RD 'D'

(whose water way width is say 7.5 m)= Width of water way x Avg.rate

= 7.5 x 1.5 = Rs. 11.25 Lakhs.

Similarly the cost of other Cross Regulators are to be worked out as mentioned above.

3. Falls:

Average rate per metre fall per unit discharge =

$$= \frac{\text{Estimated cost}}{Q_f \times h}$$

Where $Q_f$ = Discharge at fall in cumec

$h$ = Height of fall in metre.

Illustrative example: (Assuming values of $Q_f$, h and Estimated cost)

| Sl. No. | Particulars | $Q_f$ | h | $Q_f \times h$ | Estimated cost (Rs. in Lakhs) |
|---|---|---|---|---|---|
| 1. | Fall at RD 'A' | 2.0 | 3.25 | 6.5 | 1.0 |
| 2. | Fall at RD 'B' | 1.5 | 2.0 | 3.0 | 0.65 |
| 3. | Fall at RD 'C' | 1.0 | 2.0 | 2.0 | 0.50 |
| 4. | Fall at RD 'D' | 0.5 | 1.0 | 0.5 | 0.25 |
| | | Total: | | 12.0 | 2.40 |

Average rate per metre fall $= \frac{\text{Estimated cost}}{Q_f \times h}$

$$= \frac{2.40 \times 10^5}{12}$$

= Rs.0.20 lakh/cum.m.

Cost of fall at RD 'E'

Whose $Q_f$ = 2.5 cumec

h = 1.2 m.

Cost = $Q_f$ x h x Average rate *

= 2.5 x 1.2 x 0.20

= Rs 0.60 lakhs.

Similarly the cost of other falls are to be calculated

4. Bridges:

Average rate per metre width = $\frac{\text{Estimated cost}}{W_p}$

Where $W_p$ = water surface width in metre.

Illustrative example : (Assuming value of Estimated cost and water width (wp)

| Sl. No. | Particulars | $W_p$ | Estimated cost (Rs. in Lakhs) |
|---|---|---|---|
| 1. | Bridge at RD 'A' | 32.0 | 52.0 |
| 2. | Bridge at RD 'B' | 20.0 | 46.0 |
| 3. | Bridge at RD 'C' | 16.0 | 34.0 |
| 4. | Bridge at RD 'D' | 10.0 | 24.0 |
| | Total: | 78.0 | 156.0 |

* Average Rate = $\frac{\text{Estimated cost}}{W_p} = \frac{156.0}{78.0}$ = Rs.2.0 lakh/mtr.

Cost of bridge at RD 'E' whose water surface width(WSB) is 15 metre = Width of water surface x Average rate*

= 15x2.00 =Rs. 30 Lakh.

Similarly the cost of other bridges are to be worked out as mentioned above.

Annexure -9(i)

Important items of electrical equipment to be included in Power Plant Project, Generator Turbine and Accessories.

| Item | particulars | Qty. | Rate | Amt. |
|---|---|---|---|---|
| 1. | Generating Units KW r.p.m. P.F. shaft---------- ---------- Turbine complete with allied equipment such as inlet valve, Governors, Lubricating oil system, high pressure compressed air system and Generator with PMG, Excitation system, AVR System, Space Heaters, Coolers, Carbon-Di-oxide Equipment,Neutral Earthing, Surge Protection Equipment and other accessories. | | | |
| 2. | Lubricating oil & Governor oil for first filling. | | | |
| 3. | Unit control Boards. | | | |
| 4. | Bus Ducts for G.T. connections, Cables, CT's,PT's, Surge and neutral grounding cubicles, with support structures and other accessories. | | | |
| 5. | Miscellaneous equipment and Devices required for completion of erection, testing and commissioning, if any. | | | |
| 6. | Spares for 5 years for Generating Unit and accesories listesd under Item-I. | | | |
| 7. | Non-conventional Accessories(if any) | | | |
| | i) Pressure Relief valve. | | | |
| | ii) Draft tube water level depression system and other miscellaneous equipments for synchronous condenser operation. | | | |
| | iii) Additional accessories required for pump-turbine operation. | | | |
| | iv) Other miscellaneous equipments. | | | |

Annexure-9(ii)

## AUXILIARY ELECTRICAL EQUIPMENTS FOR POWER STATION.

| Item | Particulars | (Rs. Lakhs) Qty. | Rate | Amt. |
|---|---|---|---|---|
| 1. | Unit Aux. Transformer | | | |
| 2. | Station Transformers | | | |
| 3. | Switchyard Transformer | | | |
| 4. | 11 KV(HV) Switchgear | | | |
| 5. | L.T.Ac. Switchgear for Aux. power supply to power house and outdoor yard. | | | |
| 6. | Batteries, battery charging equipment, D.C. Distribution Board with D.C. Switchgear. | | | |
| 7. | Relay, Control equipment with Sychronising equipment, annunciation and alarm equipment etc. | | | |
| 8. | Measuring, Recording, Automation and protective system. | | | |
| 9. | Telemetering equipment. | | | |
| 10. | Transformer tract rails in the power house(if any) | | | |
| 11. | Misc. Equipment and devices required for completion of erection, testing and commissioning, if any. | | | |

Annexure-9(iii)

## AUXILIARY EQUIPMENT AND SERVICES FOR POWER STATION.

( Rs.Lakhs)

| Item | Particulars | Qty. | Rate | Amount |
|---|---|---|---|---|
| 1. | Cooling Water System | | | |
| 2. | Drainage & Dewatering system. | | | |
| 3. | Station Grounding. | | | |
| 4. | Hatchways. | | | |
| 5. | Centralised Greasing System. | | | |
| 6. | Centralised Lubricating/Governor oil purification system. | | | |
| 7. | Electric overhead travelling cranes (need not be provided if included under Power House Civil Works.) | | | |
| 8. | L.P. Air Compressor system with accessories. | | | |
| 9. | Electric Lifts and Elevators. | | | |
| 10. | Gantry cranes. | | | |
| 11. | Mobile Jib cranes. | | | |
| 12. | Station Water Supply System(need not be provided if included under Power House Civil Works.) | | | |
| 13. | Cable Racks & Accessories. | | | |
| 14. | Control cables, power cables and D.C.cables etc. | | | |
| 15. | Miscellaneous equipment & devices required for completion of erection, testing and commissioning. | | | |

Annexure-9(iv)

## SUB STATION EQUIPMENTS

| Item | Particulars | (Rs.Lakhs) Qty. | Rate | Amt. |
|---|---|---|---|---|
| I. | Step-up Power Transformers including oil for first filling, transformer cooling equipment and spares. | | | |
| II. | Circuit Breakers with Isolators, structures, control Boards and CTs. | | | |
| | i) Circuit Breakers. | | | |
| | ii) Isolators with & without earthing blades. | | | |
| | iii) Multicore CT's | | | |
| | iv) Control & Relay Boards. | | | |
| | v) Switchyard structure, bus conductor, insulators and Hardware etc. | | | |
| | vi) Spares for switchgear. | | | |
| III. | Lightning arrestors. | | | |
| IV. | Potential Transformers. | | | |
| V. | Musifyre/Fire Protection System for Power/Station Transformers. | | | |
| VI. | Misc. Equipments and devices required for completion of erection, testing and commissioning. | | | |

Annexure-9(y)

**AUXILIARY EQUIPMENT AND SERVICE FOR SWITCHYARD.**

| Item | Particulars | Qty. | (Rs.Lakhs) Rate | Amt. |
|---|---|---|---|---|
| 1. | Fencing and Security. | | | |
| 2. | Drainage system. | | | |
| 3. | Service and amenities. | | | |
| 4. | Grounding & Shielding. | | | |
| 5. | Cable ducts and accessories. | | | |
| 6. | Foundation for structures and Miscellaneous Civil works for other equipment. | | | |
| 7. | P.L.C.C. Equipment. | | | |
| 8. | Water supply works. | | | |
| 9. | Grounding & Levelling charges. | | | |
| 10. | Switchyard compressor plant and piping. | | | |
| 11. | Insulating oil Handling, Storage and purification system including piping (if any). | | | |
| 12. | H.T. Link lines between transformer yard and switchyard (if any). | | | |
| 13. | Miscellaneous equipment and devices required for completion of above. | | | |

Annexure-9(vi)

## MISCELLANEOUS EQUIPMENTS AND SERVICES.

(Rs.Lakhs)

| Item | Particulars | Qty. | Rate | Amt. |
|---|---|---|---|---|
| 1. | Fire fighting system. | | | |
| 2. | Air conditioning & Ventilation. | | | |
| 3. | Fork lift Trucks. | : | | |
| 4. | Tractor Trailors | : (As required for post commissioning) | | |
| 5. | Workshop equipment. | : | | |
| 6. | Standby Diesel Power Station. | : | | |
| 7. | Construction Power Equipment. | | | |
| 8. | Miscellaneous equipment & Devices required for completion. | | | |

Annexure-10

## INSTRUMENTS COMMONLY USED IN RIVER VALLEY PROJECTS FOR GEOTECHNICAL MEASUREMENTS.

A. CONCRETE AND MASONRY DAMS.

(a) Stress Strain Measurements:

1. Stress Meter@@

2. Strain Meter.@@

3. No Stress Strain Meters.@@

(b) Uplift Measurements:

1. Uplift Pressure Pipes.@@

2. Pore Pressure Cells.@@

(c) Joint Movements:

1. Joint Meters.@@

(d) Crack Measurement:

1. Crack Meters.@@

(e) Temperature Measurements:

1. Thermo Meter.@@

(f) Pore Pressure Measurement:

1. Pore Pressure Cells.@@

(g) Deflection Measurements:

1. Plumb Line
2. Tilt Meter.

(h) Rock Displacement Measurement:

1. Inverted Plumb Line.
2. Inclinometer.
3. RCD Meters.

(i) Seepage Measurements:

1. Weirs.
2. Water Level Recorders.

(j) Settlement Measurements:

1. Precision Level
2. Theodolite.
3. EDM

(k) Seismic Measurements:

1. Micro Earthquake Recorders.
2. Seismograph.

(l) Readout System.

1. Manual.
2. Digital
3. Data Loggers.
4. Telemetric.

**EARTH AND ROCKFILL DAMS.**

a) Earth Pressure Measurements:

1. Earth Pressure Cells.

b) Uplift Pressure Measurements:

1. Foundation Piezometers
2. Pore Pressure Cells.

c) Pore Pressure Measurements:

1. Embankment Piezometers
2. Pore Pressure Cells.

d) Settlement Measurements:

1. Cross Arms (Horz)
2. Cross Arms(Vert)
3. Inclinometers
4. Double Fluid Settlement Gauge.
5. Precision Level.
6. Theodolite.
7. EDM

(e) Seepage Measurements:

1. Weirs
2. Automatic Water Level Recorders.

(f) Seismic Measurements:

1. Micro Earthquake Recorders.
2. Seismographs.

(g) Readout System.

1. Manual
2. Digital
3. Data Loggers.
4. Telemetric.

C. **TUNNELS AND POWER HOUSES:**

(a) Stress Strain Measurements:

1. Load Cells.
2. Earth Pressure Cells.
3. Strain Meters.

(b) Pore Pressure Measurements:

1. Pore Pressure Cells

(c) Deformation Measurements:

1. Bore Hole Extensometers

(d) Convergence Measurements:

1. Tape Extensometers

(e) Seismic Measurements:

1. Micro Earthquake Recorders
2. Seismograph

(f) Readout System:

1. Digital
2. Manual
3. Data Loggers
4. Telemetric

Annexure-11

No. 16(12)/85-I&CAD

C.G.Somiah,
Secretary,
Tele. 382847

Government of India,
Planning Commission,
Yojana Bhavan,

New Delhi - 110001

October 28th, 1985.

The Chief Secretaries of

Sub: Irrigation and multipurpose, flood control, drainage,CAD, anti water logging and anti-sea erosion projects - preparation of project reports etc.

Sir,

In Planning Commission letter no. 16(12)/81-I&CAD dated 27.2.1982, a list of items and references ( as revised in 1982) was forwarded to the State Irrigation Departments requesting that the project reports on multipurpose, irrigation and flood control projects, sent to the Planning Commission for inclusion in the Plan, should be formulated with reference to the items and references shown in that list. The list is an exhaustive one attempting to cover various other aspects of the river valley projects such as soil conservation, catchment areas treatment, command area development, afforestation etc. so as to have an integrated view of the project before it is cleared. It is however, observed that adequate attention is not paid and necessary action not taken to have proper perspective of all these anciliary aspects at the stage of the formulation, clearance and implementaton of the projects. The necessity of having an integrated approach in the formulation of the river valley projects has been accepted since long. It may be recalled that the National Commission on Agriculture in its report in January, 1980 had recommended simultaneous preparation of a report on the Command Area Development and other aspects along with the engineering aspects of the project so that the funds for the respective anciliary programmes are ensured from the respective development sector at the stage of formulation of the entire plan of the State.

2. The question of catchment area treatment as an integral part of the river valley project was considered by the Committee of Central Secretaries recently and it was decided to draw the attention of the State Governments for immediate necessary action of this important aspect of adopting a holistic approach in formulation of the river valley project by simultaneously taking up preparation of the project reports for catchment area treatment, soil conservation, command area development, afforestation etc. Agricultural production and rural development are the ultimate goals under the Command Area Projects and several departmental activities are sought to be harmonised under command area development projects which should synchronise with the progress on engineering head-works. Simultaneously, soil conservation and treatment, afforestation, other anti-erosion measures, measures for reducing siltation, maintenance of ecological balance(vegetation, animal life and water storage) should also be viewed as an integrated whole at the stage of undertaking large river valley projects.

3. Different Departments may be involved but multi-disciplinary units should be created at the State level to jointly conceive the various elements of the project and to ensure their simultaneous formulation and implementation in a harmonised manner. The cost of the anciliary items should be provided for by the concerned Departments but direct damage to the environment and ecology at the project site arising out of the irrigation project should be set right at the cost of the main project and the required funds for it should form part and parcel of the project. It would therefore be preferable to prepare a project report in three parts, namely, part I-Main works, Part-II Command Area Development and Part-III Catchment Treatment works. Only costs of the direct damage mitigation works will be included in the estimates for Part-I Main works. The multi-disciplinary teams envisaged for the integrated river valley development should work together and associate themselves at the stage of project formulation with the agencies responsible for preparation of project feasibility reports. In the case of inter-State basins, representatives from the concerned basin States may be associated while formulating the catchment treatment plan. When project approvals have been given, it would be

necessary to ensure properly orchestrated execution of not only the works directly relating to the project but also the ancilliary items of work relating to catchment area treatment, command area development and other such identified works simultaneously. The implementation of various components such as catchmesnt area treatment works should be responsibility of the Departments concerned but coordinated by a suitable agency as decided by the State Government.

4. It has been decided that in future sanction and clearance of projects by the Planning Commission will be accorded only if the projecct report is composite in nature as indicated above. For the projects which are already in the pipeline for clearance and for which necessary plans for catchment area treatment works, afforestation, etc. has not been drawn up on the above lines, the position would be reviewed on a project to project basis by the Technical Advisory Committee of the Planning Commission. The review is intended to ensure that there is no delay in the clearance of the projects despite any lacunae in composite project preparation.

The receipt of this letter may please be acknowledged.

Yours faithfully,

Sd/
(C.G.Somiah)
Secretary to the Govt. of India.

Annexure-12(i)

## GENERAL BREAKDOWN OF PROJECT COST.

| Sl. No. | Description | Foreign component (Currency as applicable) | Domestic component Rs.Million | Completion Cost Year of completion Total | |
|---|---|---|---|---|---|
| | | | | Rs. Million | Foreign Currency |
| 1. | Land and site development. | | | | |
| 2. | Turbine-Generator Island | | | | |
| 3. | Balance of Plant: | | | | |
| | i) Mechanical | | | | |
| | ii) Electrical & C&I | | | | |
| 4. | Civil Works. | | | | |
| 5. | Erection testing and Commissioning | | | | |
| 6. | Turn Key Fee | | | | |
| 7. | Initial/Spares. | | | | |
| 8. | Duties and Taxes. | | | | |
| 9. | Establishment/ Construction Supervision | | | | |
| 10. | i) Operator's training. | | | | |
| | ii) Development expense. | | | | |
| | iii) Legal expense. | | | | |
| 11. | Contingencies on non-turn key works. | | | | |
| 12. | Project cost excluding IDC and financing costs. | | | | |

13. IDC & Financing Cost

    i) Financing expenses.

    ii) Construction Insurance.

    iii) Interest during construction.

    iv) Capital Cost

N.B.:

1. Exchange Rate assumed.
2. Price is firm upto completion except for taxes and duties.

Annexure-12(ii)

## GENERAL BREAKDOWN OF TAXES AND DUTIES.

ALL IN RS. MILLION.

| Sl. | Description | Import Duty | Excise Duty | CST | ST | Works Taxes. | Others | Total |
|---|---|---|---|---|---|---|---|---|
| | | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| 1. | Turbine Generator Island. | | | | | | | |
| 2. | Balance of Plant | | | | | | | |
| | i) Mechancial | | | | | | | |
| | ii) Electrical & C&I | | | | | | | |
| 3. | Civil Works. | | | | | | | |
| 4. | Initial spares. | | | | | | | |
| 5. | Others(specify) | | | | | | | |
| 6. | Total Taxes and duties. | | | | | | | |

Annexure-12(iii)

## FINANCIAL PACKAGE SUMMARY

1. Name of the Project :

2. Capacity(MW)

3. Capital cost of Project:

| | Foreign Currency Component | | | Indian Rs. Component | Total |
|---|---|---|---|---|---|
| | Name of Currency | Amount | Exchange rate and date. Equiv. Indian | | (4)+(5) |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| i) Cost excluding IDC and financing fees/charges | | | | | | |
| ii) Interest during construction | | | | | | |
| iii) Financing fees/charges | | | | | | |
| TOTAL | | | | | | |

Annexure-12(iv)

## FINANCIAL PACKAGE ABSTRACT.

1. Name of the Project:

2. Capacity (MW)

3. Financial Structure:

| Name/ Source of Debt Financing. | Foreign Currency Component | | | | Indian Rs. Component | Total |
|---|---|---|---|---|---|---|
| | Name of Currency | Amount | Exchange rate and date. | Equiv. Indian | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Debt financing | | | | | | |
| Package I | | | | | | |
| Package II | | | | | | |
| Package III | | | | | | |
| Package IV | | | | | | |
| Package V | | | | | | |
| Total Debt | | | | | | |
| Equity financing | | | | | | |
| Promoters Equity | | | | | | |
| Other Equity | | | | | | |
| (Please give details) | | | | | | |
| Total Equity | | | | | | |
| TOTAL DEBT + EQUITY | | | | | | |

Annex.-13

No:16/27/93-PA(N)/1279-1308
Government of India
Central Water Commission
Project Apraisal (North)Dte.

407,Sewa Bhawan,
R.K.Puram,

New Delhi,the 13th Sept.,1993.

To

The Secretary,

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Sub: Revised Estimate for major projects.

Sir,

A number of major projects have been approved by the Planning Commission in the past. It is observed that the cost of many of such projects as also the expenditure has increased much beyond the original approved cost but the revised estimates for these projects have not been submitted to the Central Water Commission for processing. It has now been decided, in consultation with the Planning Commission, that processing of revised estimates for such major projects, which fulfil following conditions, will be done in the CWC as a medium project on a proforma basis with only abstract of cost:

(i) The expenditure and/or physical progress level of the project should be above 90%;

(ii) The project authorities should give an undertaking that they will complete the project at the cost indicated in the revised estimate submitted for clearance;

(iii) There should be no change in scope of the project; and

(iv) The project should still be viable meeting the required B.C.Ratio criterion.

It is accordingly requested that the proforma report of revised estimates for such projects may be submitted to CWC for processing for clearance. The proforma report should include, alongwith the abstract of cost, a comparative statement showing the headwise increase in cost together with the reasons thereof.

(A.Sekhar)
DIRECTOR(PA-N)

Copy for information to:

1. Sh. S.K.Agrawal, Jt. Commissioner, Projects, MOWR.
2. Sh. A.S.Gupta,Dy.Adviser-I&CAD, Planning Commission.
3. The Director, Irrigation Planning, CWC.
4. The Director, Cost Engg.(Irr.)Dt.,CWC.
5. The Director, Cost Engg.(Hydro),CWC.
6. The Director, CMC,CWC.
7. The Director, Project Appraisal(Central),CWC.
8. The Director, Project Appraisal(South),CWC.
9. Under Secretary, B&T,Ministry of Water Resources.
10. Director,PPO-North, CWC
11. Director, PPO-South, CWC.

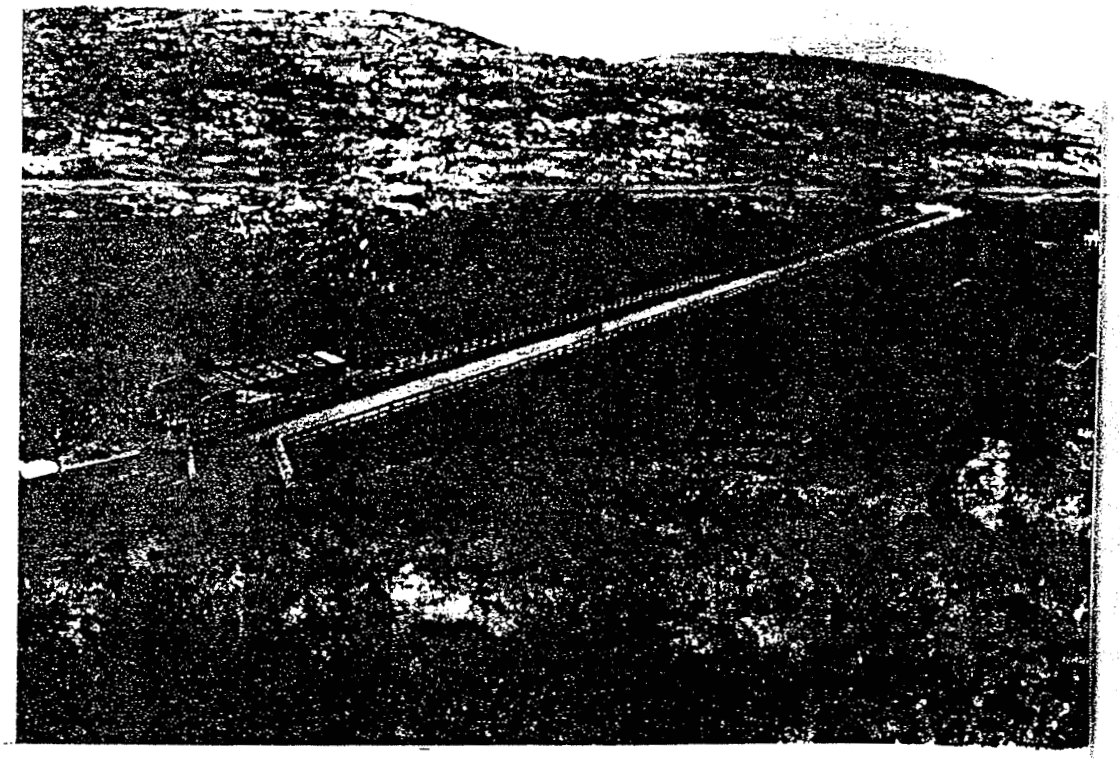
EXTRACT FROM REVISED GUIDELINES FOR TREATMENT OF LANDS LIKELY TO BE AFFECTED DUE TO CONSTRUCTION OF RIVER VALLEY PROJECTS(1993)- PARA 4 & 5.

## 4. CATCHMENT AREA TO BE TREATED:

If sub-watershed in the Direct Draining Areas along the rim of the reservoir has very high and high category erodable areas, such areas need to be treated to reduce direct silt inflow into the reservoir and to improve the environment in the vicinity of the reservoir. Geographical diversity precludes precise definition of such watersheds and standardised package for their treatment. Such areas and their treatment will necessarily be project specific. However, to avoid undue burdening of the project with general land improvement activities, only direct draining sub-watersheds upto 2500 ha. in extent need be considered for treatment at project cost. (Map of Lower Terna Watershed (back page) shows typical direct draining sub-watersheds and erodable areas therein which need to be treated)

## 5. TREATMENT OF DIRECT DRAINING AREAS:

High and very high categories of erodable areas in direct draining sub-watersheds as explained in para 4, along the reservoir rim, should be treated as per soil conservation norms and guidelines already available in Ministry of Agriculture as well as in Bureau of Indian Standard (BIS)like IS:6748 B(Part-I)-1973 Code for Recommended practice for "Watershed Management Relating to Soil Conservation" and IS:6518-1992 Code for Practice for "Control of Sediment in Reservoir". The treatment would generally be for improving land to prevent movement of soil. It would also improve its hydrogeological behaviour. In general it would prevent degradation of land, increase productivity and also improve ecological balance between land, water and the plant and animal life in the watershed directly draining into the reservoir. This improvement of direct draining areas should be carried out alongwith the construction programme of the project.



GHATA PRABHA HIDKAL DAM

DESIGNED & PRINTED AT PUBLICATION DIVISION
CENTRAL WATER COMMISSION
R.K.PURAM, NEW DELHI-110 066
PUBLICATION NO.5/97 NO.OF COPIES 200
PRICE RS.100/-